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LSMV Drive

LSMV Series

User's Manual

Safety Precautions

- Please read all safety precautions before using this product.
- After reading this manual, please store it in a location where it can be easily found.

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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 three categories: "Danger", "Warning" and "Caution." The definition of each category is as detailed below.

Precaution		Definition
	**Danger**	May cause immediate serious injury or death if the instruction is not followed.
	**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 symbols displayed on the inverter and in the manual indicate the following.

Symbol	Definition
	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.
  Doing so may result in an 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.
  The LSMV may remain charged for a long time even after the power supply is turned off. 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 (below DC 30 V).
- Do not operate switches with wet hands.
  Doing so may result in an electric shock.
- Change the cable immediately if its coating is damaged.
  Doing so may result in an electric shock.
- Do not put things that excessively stress the cable.
  Placing heavy object on the cable could damage its sheath and may result in an 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 LSMV failure, immediately turn off input power. If you do not turn off input power, fire may result due to a secondary accident. ▪ Do not touch the LSMV while power is on or until 10 minutes after power is off. Contact with the high-temperature LSMV may cause burns. ▪ Do not supply power to an LSMV with damaged exterior or parts. Doing so may result in an electric shock. ▪ Do not allow foreign bodies such as screws, metals, water or oil to enter the LSMV. Introducing foreign substances to the PCU may start a fire.

Directions for Use

■ Transportation 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		Details
Environment	Temperature	0-40℃ (There should be no ice or frost)
	Ambient humidity	85% RH or less (Provided no condensation has formed.)
	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. Excess voltage may damage the inverter.

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 modify the interior workings of the inverter.
- 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 inverter 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 LSMV

1.1 LSMV Series Overview

■ LSMV Models

LSMV is 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 [kVA]	Rated current [A]	Product Model No.	Maximum Applicable Motor Capacity [kW] [1)]	Panel Dimension [mm][2)]			Approximate Weight [kg]
						Width	Depth	Height	
3000	50	180	35	LSMV-030F200-G1	140	1600	1900	2350	2236
		270	53	LSMV-030F300-G1	210	1600	1900	2350	2524
		360	70	LSMV-030F400-G1	290	1600	1900	2350	2788
		450	88	LSMV-030F500-G1	360	1600	1900	2350	2992
		540	105	LSMV-030F600-G1	440	3600	1900	2350	4190
		680	131	LSMV-030F750-G1	550	3600	1900	2350	4526
		900	175	LSMV-030F10H-G1	730	3600	1900	2350	4970
		1100	218	LSMV-030F12H-G1	910	3600	1900	2350	5528
		1360	260	LSMV-030F15H-G1	1120	3600	1900	2350	5972
		1810	350	LSMV-030F20H-G1	1500	4000	1900	2350	7866
		2270	438	LSMV-030F25H-G1	1880	4000	1900	2350	8990
		2720	525	LSMV-030F30H-G1	2250	5000	1900	2350	11544
		3360	657	LSMV-030F37H-G1	2780	5000	1900	2350	13118
3300	60	200	35	LSMV-033S200-G1	160	1600	1900	2350	2072
		300	53	LSMV-033S300-G1	240	1600	1900	2350	2312
		400	70	LSMV-033S400-G1	320	1600	1900	2350	2538
		500	88	LSMV-033S500-G1	400	1600	1900	2350	2708
		600	105	LSMV-033S600-G1	490	3600	1900	2350	3880
		750	131	LSMV-033S750-G1	610	3600	1900	2350	4160
		1000	175	LSMV-033S10H-G1	820	3600	1900	2350	4530
		1200	218	LSMV-033S12H-G1	990	3600	1900	2350	5040
		1500	260	LSMV-033S15H-G1	1240	3600	1900	2350	5410
		2000	350	LSMV-033S20H-G1	1660	4000	1900	2350	7117
		2500	438	LSMV-033S25H-G1	2070	4000	1900	2350	8053
		3000	525	LSMV-033S30H-G1	2490	5000	1900	2350	10420
		3700	657	LSMV-033S37H-G1	3070	5000	1900	2350	11731
4160	50	250	35	LSMV-041F250-G1	200	2000	1900	2350	2598

Voltage [V]	Power frequency [Hz]	Output capacity [kVA]	Rated current [A]	Product Model No.	Maximum Applicable Motor Capacity [kW] 1)	Panel Dimension [mm]2)			Approximate Weight [kg]
						Width	Depth	Height	
		380	53	LSMV-041F380-G1	300	2000	1900	2350	2946
		500	70	LSMV-041F500-G1	400	2000	1900	2350	3234
		630	88	LSMV-041F630-G1	510	2000	1900	2350	3510
		750	105	LSMV-041F750-G1	610	4200	1900	2350	4868
		950	131	LSMV-041F950-G1	770	4200	1900	2350	5276
		1200	175	LSMV-041F12H-G1	980	4200	1900	2350	5804
		1500	218	LSMV-041F15H-G1	1240	4200	1900	2350	6620
		1900	260	LSMV-041F19H-G1	1570	4200	1900	2350	7316
		2500	350	LSMV-041F25H-G1	2070	5000	1900	2350	9755
		3100	438	LSMV-041F31H-G1	2570	5000	1900	2350	11073
		3700	525	LSMV-041F37H-G1	3070	6000	1900	2350	14192
		4700	657	LSMV-041F47H-G1	3900	6000	1900	2350	16390
4160	60	250	35	LSMV-041S250-G1	200	2000	1900	2350	2416
		380	53	LSMV-041S380-G1	300	2000	1900	2350	2706
		500	70	LSMV-041S500-G1	400	2000	1900	2350	2954
		630	88	LSMV-041S630-G1	510	2000	1900	2350	3184
		750	105	LSMV-041S750-G1	610	4200	1900	2350	4520
		950	131	LSMV-041S950-G1	770	4200	1900	2350	4860
		1200	175	LSMV-041S12H-G1	980	4200	1900	2350	5300
		1500	218	LSMV-041S15H-G1	1240	4200	1900	2350	6040
		1900	260	LSMV-041S19H-G1	1570	4200	1900	2350	6620
		2500	350	LSMV-041S25H-G1	2070	5000	1900	2350	8839
		3100	438	LSMV-041S31H-G1	2570	5000	1900	2350	9938
		3700	525	LSMV-041S37H-G1	3070	6000	1900	2350	12837
		4700	657	LSMV-041S47H-G1	3900	6000	1900	2350	14668
6000	50	360	35	LSMV-060F400-G1	280	2400	1900	2350	3424
		540	53	LSMV-060F600-G1	430	2400	1900	2350	3698
		720	70	LSMV-060F800-G1	580	2400	1900	2350	4298
		900	88	LSMV-060F10H-G1	720	2400	1900	2350	4766
		1090	105	LSMV-060F12H-G1	890	4800	1900	2350	6530
		1360	131	LSMV-060F15H-G1	1110	4800	1900	2350	7010
		1800	175	LSMV-060F20H-G1	1470	4800	1900	2350	7694
		2200	218	LSMV-060F25H-G1	1820	4800	1900	2350	9522
		2720	260	LSMV-060F30H-G1	2250	4800	1900	2350	9638
		3630	350	LSMV-060F40H-G1	3010	6000	1900	2350	13204
		4540	438	LSMV-060F50H-G1	3760	6000	1900	2350	15080
		5450	525	LSMV-060F60H-G1	4520	8000	1900	2350	19816

Voltage [V]	Power frequency [Hz]	Output capacity [kVA]	Rated current [A]	Product Model No.	Maximum Applicable Motor Capacity [kW] 1)	Panel Dimension [mm] 2)			Approximate Weight [kg]
						Width	Depth	Height	
		6810	657	LSMV-060F75H-G1	5650	8000	1900	2350	22630
6600	60	400	35	LSMV-066S400-G1	320	2400	1900	2350	3174
		600	53	LSMV-066S600-G1	480	2400	1900	2350	3394
		800	70	LSMV-066S800-G1	640	2400	1900	2350	3906
		1000	88	LSMV-066S10H-G1	810	2400	1900	2350	4296
		1200	105	LSMV-066S12H-G1	980	4800	1900	2350	6020
		1500	131	LSMV-066S15H-G1	1230	4800	1900	2350	6420
		2000	175	LSMV-066S20H-G1	1640	4800	1900	2350	6990
		2500	218	LSMV-066S25H-G1	2070	4800	1900	2350	8690
		3000	260	LSMV-066S30H-G1	2490	4800	1900	2350	8700
		4000	350	LSMV-066S40H-G1	3320	6000	1900	2350	11953
		5000	438	LSMV-066S50H-G1	4150	6000	1900	2350	13517
		6000	525	LSMV-066S60H-G1	4980	8000	1900	2350	17940
		7500	657	LSMV-066S75H-G1	6220	8000	1900	2350	20285
10000	50	600	35	LSMV-100F600-G1	480	3600	1900	2350	4126
		900	53	LSMV-100F900-G1	720	3600	1900	2350	4966
		1200	70	LSMV-100F12H-G1	970	3600	1900	2350	5794
		1500	88	LSMV-100F15H-G1	1210	3600	1900	2350	6184
		1800	105	LSMV-100F18H-G1	1470	6000	1900	2350	8330
		2200	131	LSMV-100F22H-G1	1800	6000	1900	2350	8990
		3000	175	LSMV-100F30H-G1	2460	6000	1900	2350	9900
		3700	218	LSMV-100F37H-G1	3070	6000	1900	2350	11760
		4500	260	LSMV-100F45H-G1	3730	6000	1900	2350	12290
		6000	350	LSMV-100F60H-G1	4980	7500	1900	2350	16460
		7500	438	LSMV-100F75H-G1	6220	7500	1900	2350	17940
		9000	525	LSMV-100F90H-G1	7470	10000	1900	2350	24080
		11000	657	LSMV-100F11M-G1	9130	10000	1900	2350	26773
10000	60	600	35	LSMV-100F600-G1	480	3600	1900	2350	3754
		900	53	LSMV-100F900-G1	720	3600	1900	2350	4500
		1200	70	LSMV-100F12H-G1	970	3600	1900	2350	5184
		1500	88	LSMV-100F15H-G1	1210	3600	1900	2350	5496
		1800	105	LSMV-100F18H-G1	1470	6000	1900	2350	7588
		2200	131	LSMV-100F22H-G1	1800	6000	1900	2350	8116
		3000	175	LSMV-100F30H-G1	2460	6000	1900	2350	8844
		3700	218	LSMV-100F37H-G1	3070	6000	1900	2350	10512
		4500	260	LSMV-100F45H-G1	3730	6000	1900	2350	10918
		6000	350	LSMV-100F60H-G1	4980	7500	1900	2350	14736

Voltage [V]	Power frequency [Hz]	Output capacity [kVA]	Rated current [A]	Product Model No.	Maximum Applicable Motor Capacity [kW] 1)	Panel Dimension [mm]2)			Approximate Weight [kg]
						Width	Depth	Height	
		7500	438	LSMV-100F75H-G1	6220	7500	1900	2350	15920
		9000	525	LSMV-100F90H-G1	7470	10000	1900	2350	21656
		11000	657	LSMV-100F11M-G1	9130	10000	1900	2350	23811

1) The maximum motor capacity is calculated according to a standard type 4-pole induction motor.
2) The actual size of a product may change. Confirm before purchase.

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.

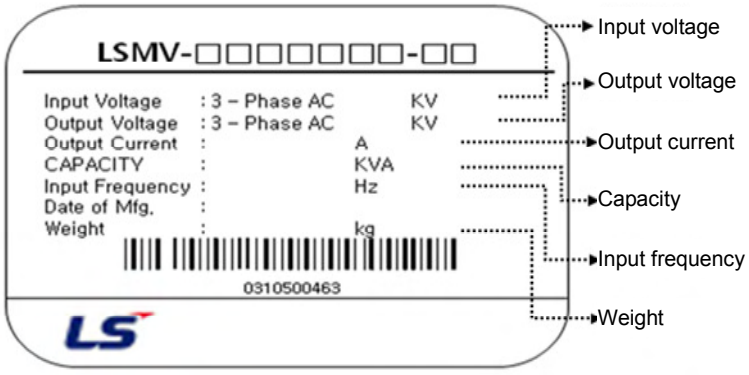


Figure 1-1 Standard Plate Format

■ LSMV Series Product Model Names

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

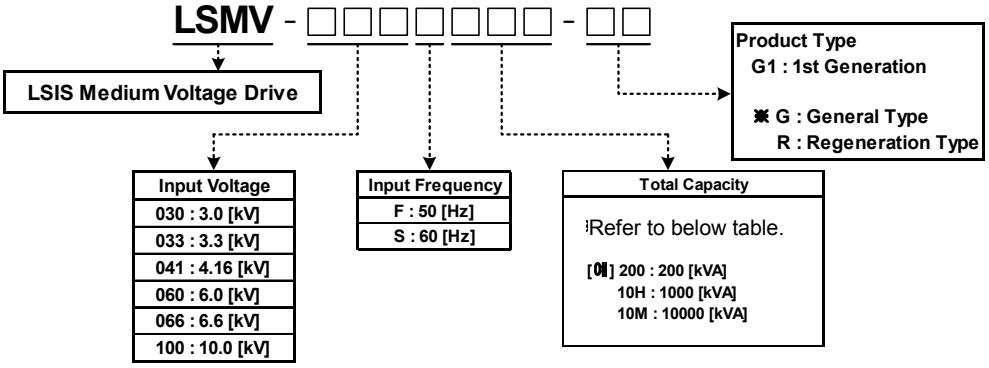


Figure 1-2 LSMV Series Product Model Name

Category	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.

■ CHB (Cascaded H-bridge) 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 a MV Drive. 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 MV Drive. 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 Components

■ Type A

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

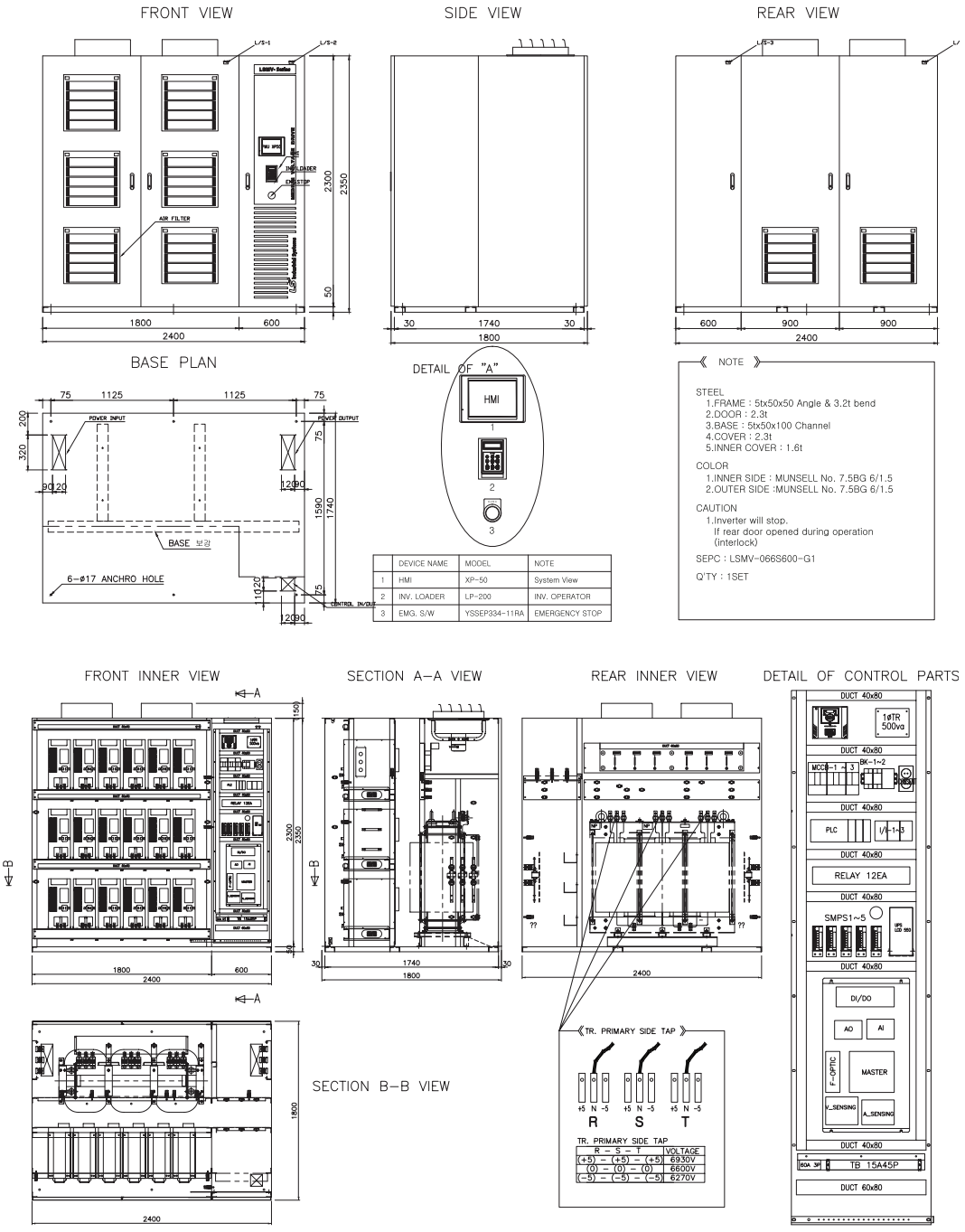
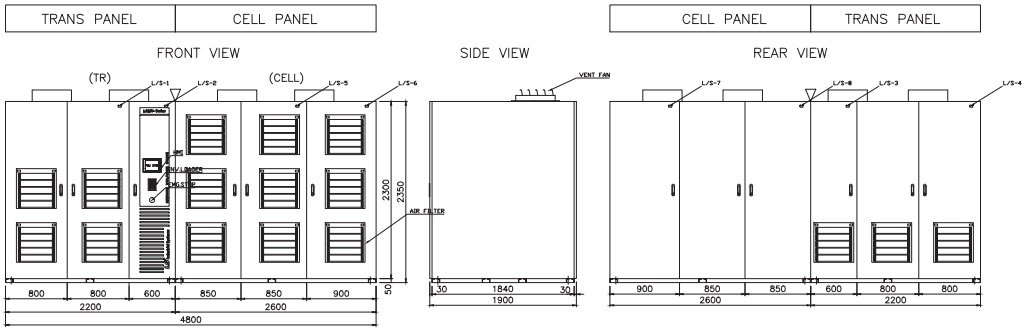
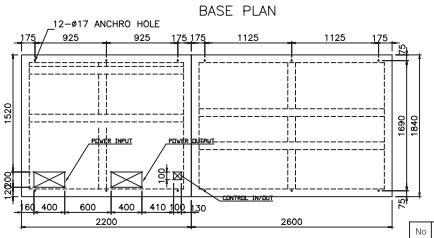


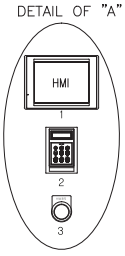
Figure 1-3 LSMV-066F600-G1 Exterior and Interior Block Diagram

■ 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

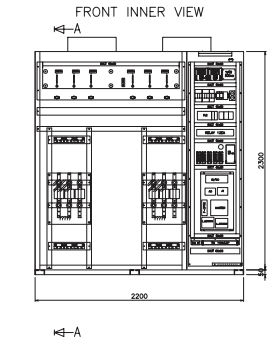
NOTE

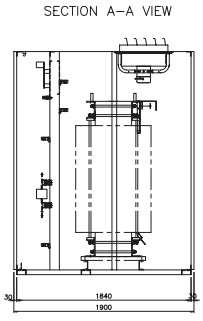
STEEL
1.FRAME : 5tx50x50 Angle & 3.2t bend
2.DOOR : 2.3t
3.BASE : 5tx50x100 Channel
4.COVER : 2.3t
5.INNER COVER : 1.6t

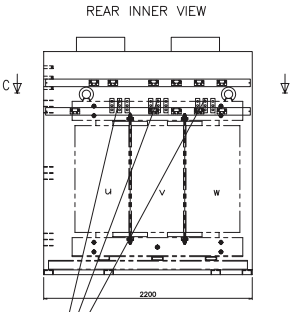
COLOR
1.INNER SIDE : 5Y 7/1 (TEXTURE)
2.OUTER SIDE : 5Y 7/1 (TEXTURE)

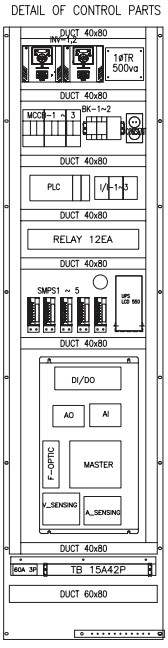
CAUTION
1.Inverter will stop.
If rear door opened during operation
(interlock)

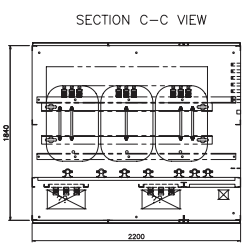
Q'TY : 1SET

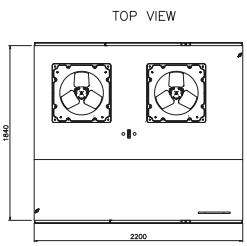


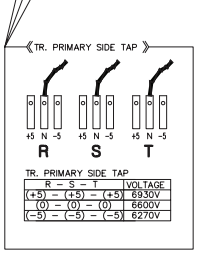












TR. PRIMARY SIDE TAP

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

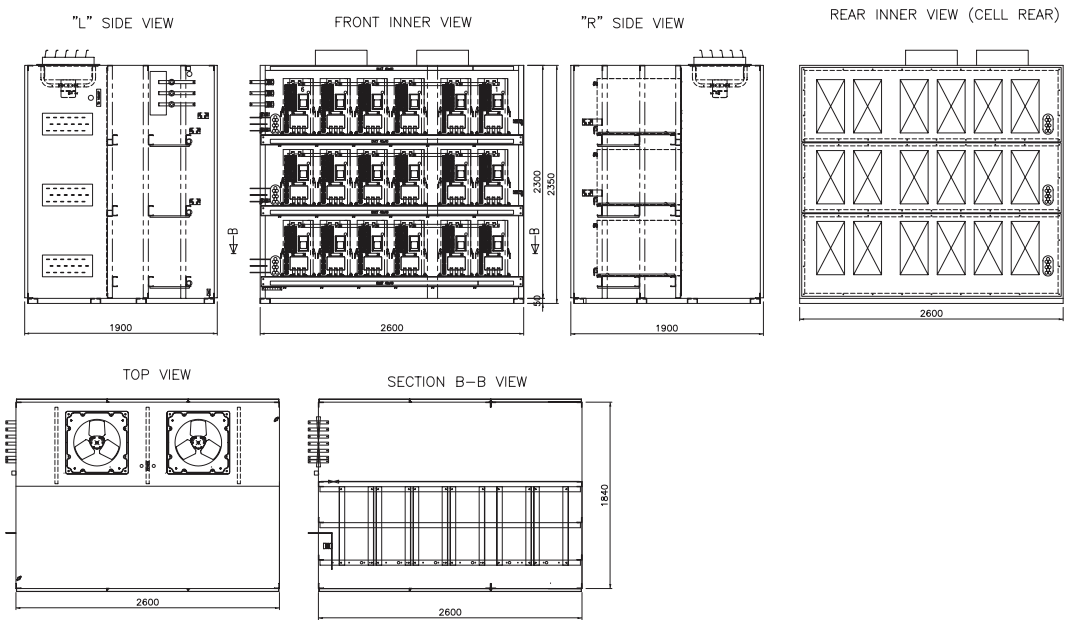


Figure 1-4 LSMV-066S30H Exterior and Interior Block Diagram

1.3.3 Dimension and Weight

Refer to Table 1-1 and Figure 1-5 and 1-6 for the size and weight of the LSMV series products.

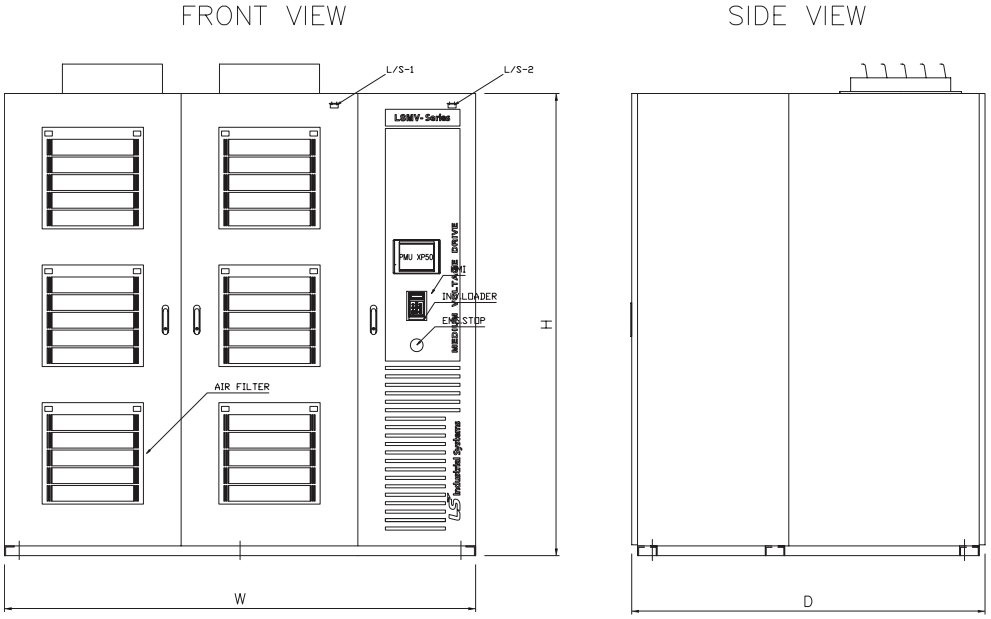


Figure 1-5 LSMV Type A

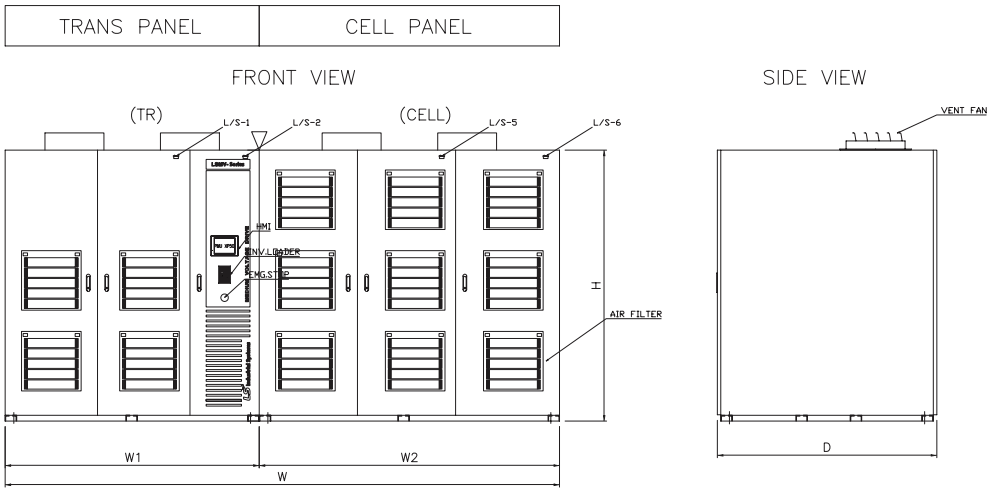


Figure 1-6 LSMV Type B

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.

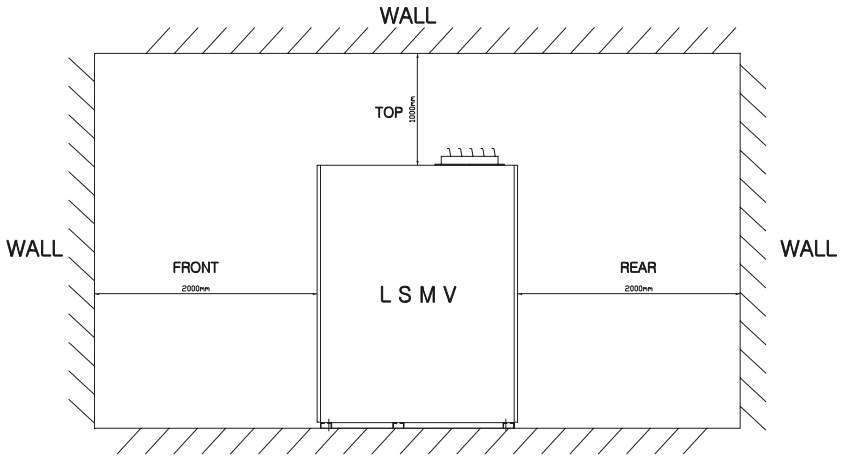


Figure 1-7 Securing Spaces

1.4.3 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 LSMV 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 Transportation 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.)

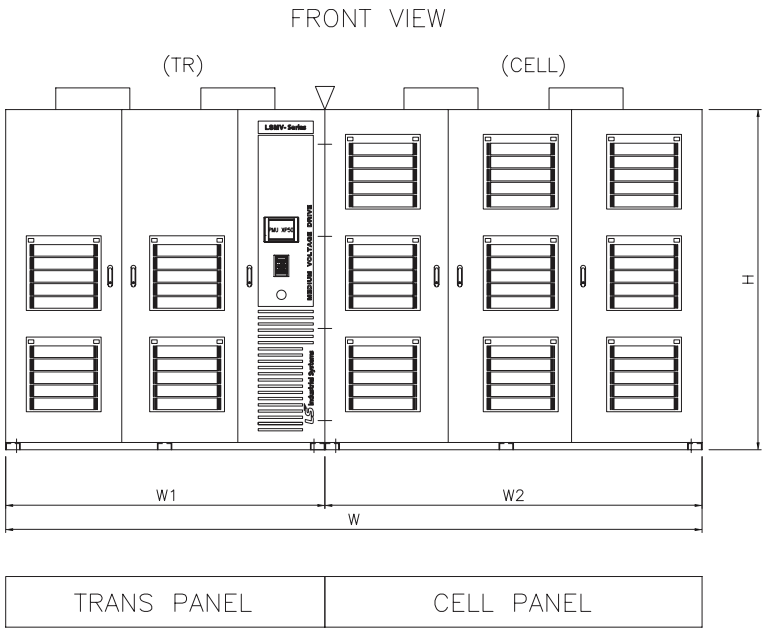


Figure 1-8 LSMV Configuration

■ Base for Product Installation

The following figure shows a base plan and the hole positions for LSMV 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)

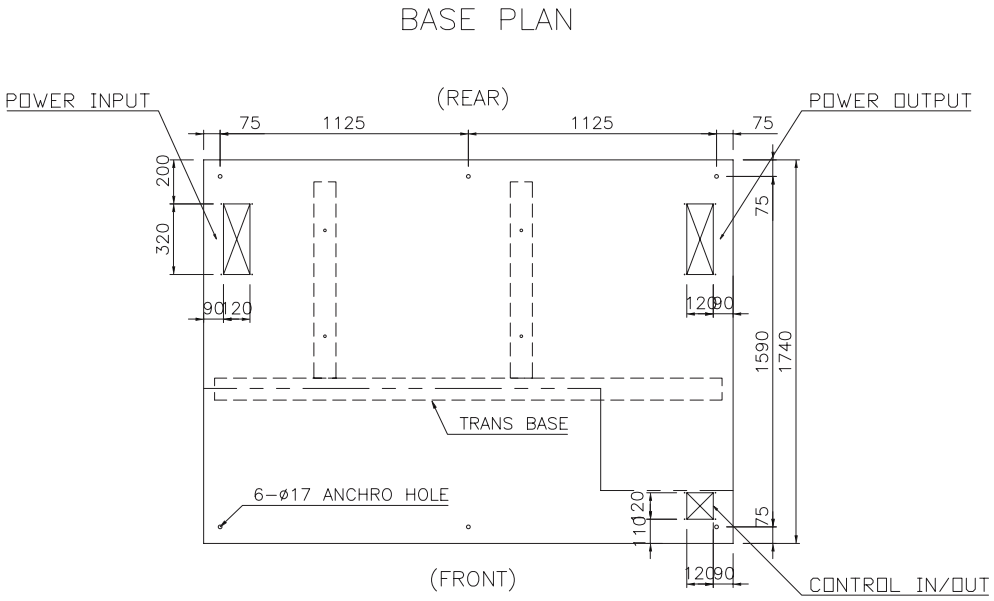


Figure 1-9 LSMV-066S600-G1 (Type A) Base Plan

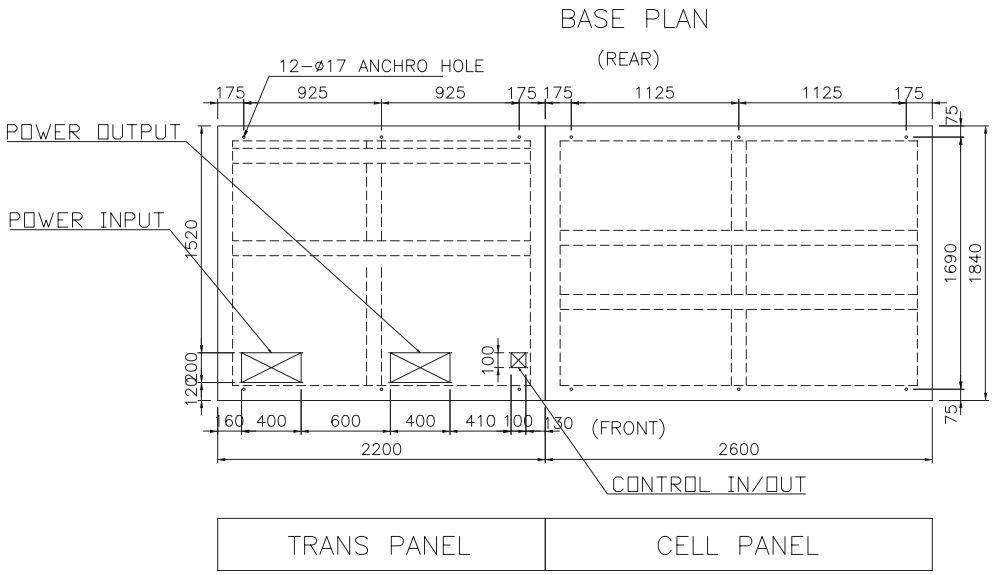


Figure 1-10 LSMV-066S30H-G1 (Type B) Base Plan

2. Wiring

2.1 Standard Wiring

Figure 2.1 is the standard wiring diagram of the LSMV.

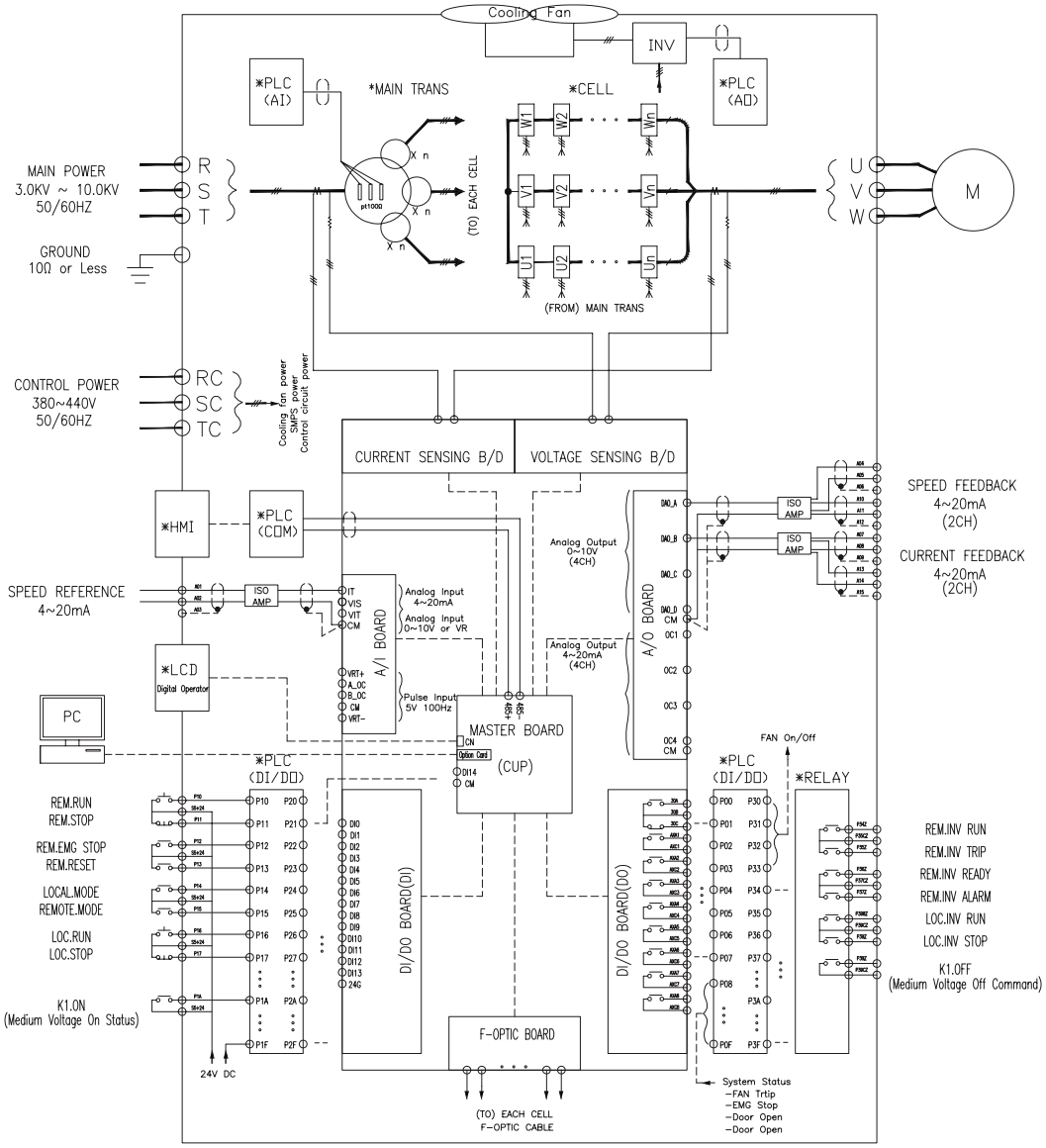


Figure 2-1 Standard Wiring Diagram

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.**
- **Main Power Monitoring Circuit Configuration**
  - **Must receive On Status of the upper circuit breaker (K1).**
  - **Wiring must be configured to turn OFF the upper circuit breaker (K1) in case of loss of control power.**
- **Control power: Input (RC, SC, TC)**
  - **For the required power capacity, refer to the plan of each product.**
- **Analog Input/Output: Input (A01 - A03) / output (A04 - A15)**
  - **Uses DC 4 ~ 20mA signal.**
    Be careful that the signal wires do not shor circuit.
- **Digital Input/Output: Input (P10 ~ P1A), Output (P34 ~ P3A)**
  - **DC 24V power is supplied to DI signal. Make sure no circuit with power supplied is connected.**
  - **The maximum capacity of the DO signal contact is 250V/3A. 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 terminals (type A, type B).

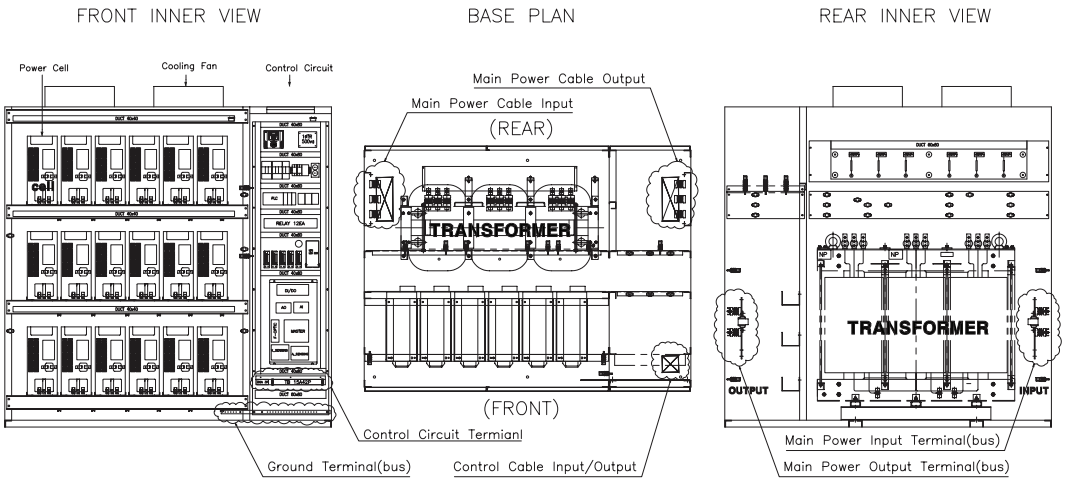


Figure 2-2 Terminal Locations (Type A)

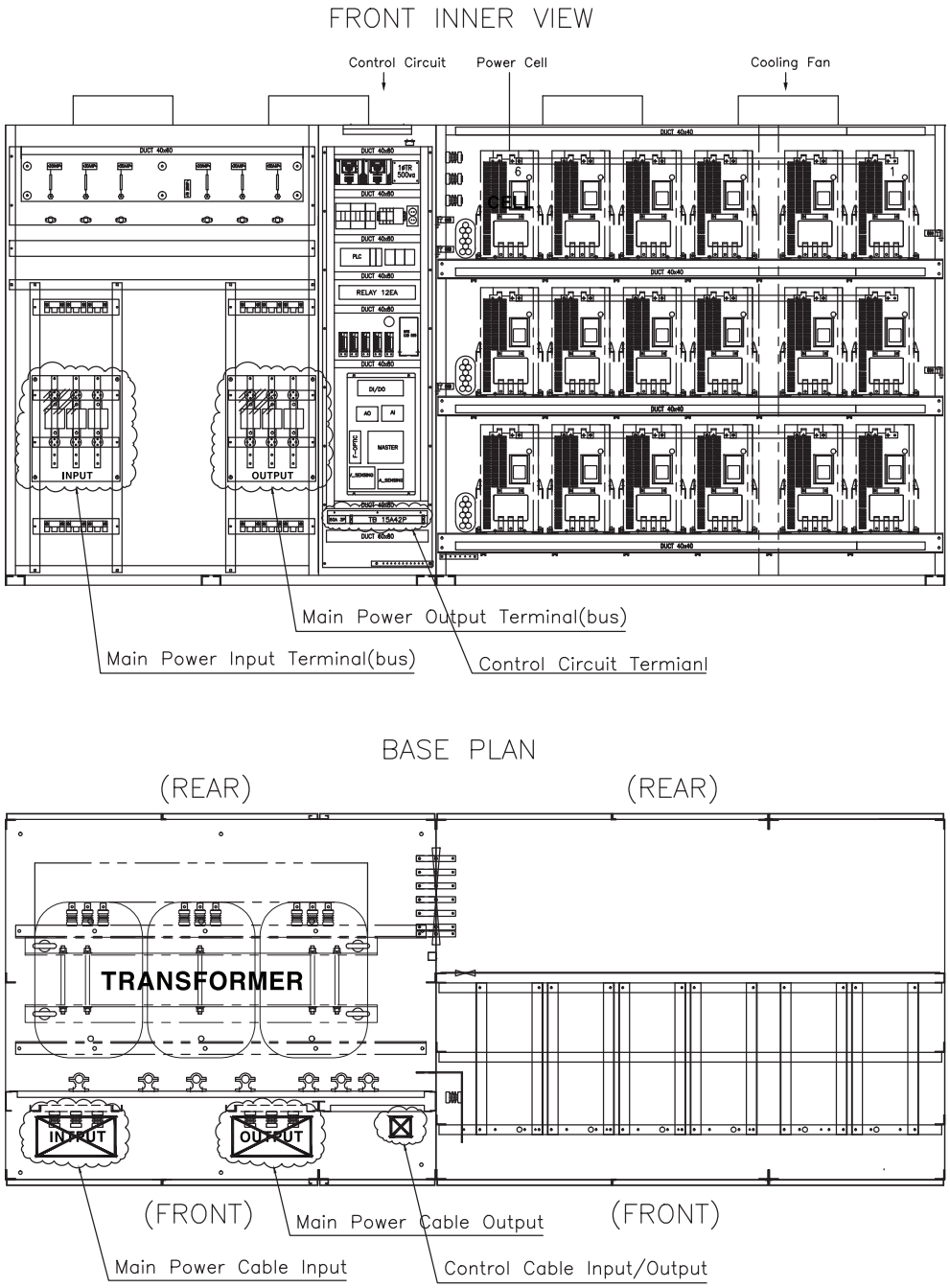


Figure 2-3 Terminal Locations (Type B)

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 Main Circuit Configuration

Tag	Details	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

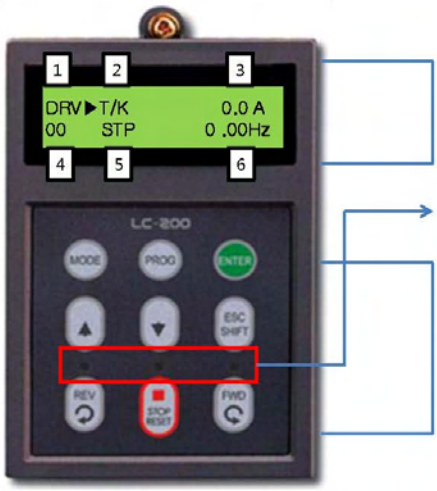
Chapter 3 describes setup, keypad display and functions, and how to change modes.

3.1 Keypad

This section describes keypad display and functions.

■ Keypad Display

The key configuration and functions on the keypad are as follows:



1: Parameter group
2: Operation/frequency command position (T/K represents terminal block operation / keypad frequency command.)
3: Outputs current value while in operation
4: LSMV group number
5: Operation information
6: Sets frequency while out of operation. Sets output frequency while in operation.

REV LED: Blinks during REV, constant ON normal operation
STOP LED: Blink when coming to STOP, constant ON after full stop STOP, and blinks during Trip
FWD LED: Blinks during FWD, constant ON normal operation

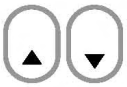
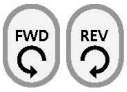
MODE: Moves between groups.
PROG: Changes parameter values.
ENTER: Saves a specified value or moves between groups in the opposite direction.
ESC/SHIFT: Shift to DRV-00, shift by number of set digits.
FWD: Forward direction operation command.
STOP/RESET: Stop command while driving, Trip is disabled

Figure 3-1 Keypad Configuration and Functions

■ Composition of Keypad

Table 3-1 Keypad Configuration

Category	Sign	Function Name	Function description
Key	MODE	Mode key	▪ Moves between groups. ▪ Moves from code within the group to top level code (DRV-00).
	PROG	Program key	▪ Used when changeing parameter settings in the Set Mode.
	ENTER	Enter key	▪ Used to save the settings in teh Set Mode. ▪ Shifts from group to group in reverse direction in none setting mode.

Category	Sign	Function Name	Function 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	▪ Blinks during deceleration in reverse direction. ▪ Comes ON during operation at constant speed in reverse direction.
		Stop/Fault indicator	▪ Blinks when coming to Stop. ▪ Comes ON when in full Stop. ▪ Flashes when a fault occurs.
		Forward indicator	▪ Blinks during deceleration in forward direction. ▪ Comes ON during operation at constant speed in forward direction.

■ Keypad Display Explanation

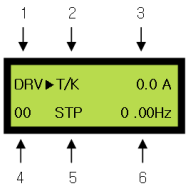


Table 3-2 Keypad Display Description

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. • P: Pulse frequence command (0 ~ 5 V, 0 ~ 100 kHz) • 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) • 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

LSMV 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.

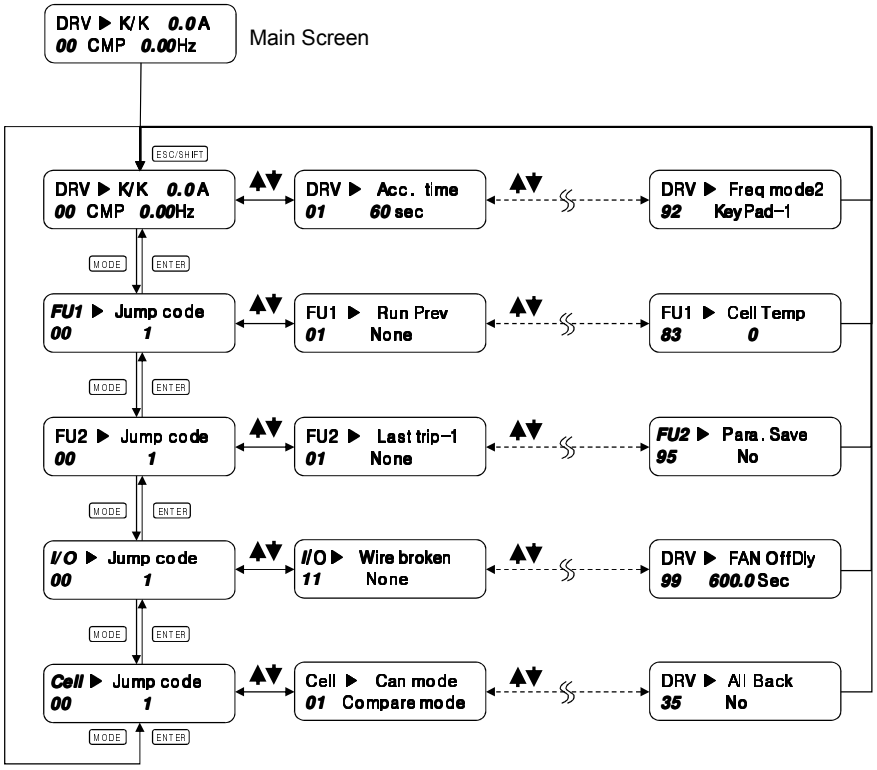


Figure 3-2 Parameter Setting and Changing Group

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. The cursor (■) will blink, if you press PROG.
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 Parameter List.)
- [FU2-94] parameter lock is set and you cannot change the value.

- For example, setting up output frequency.

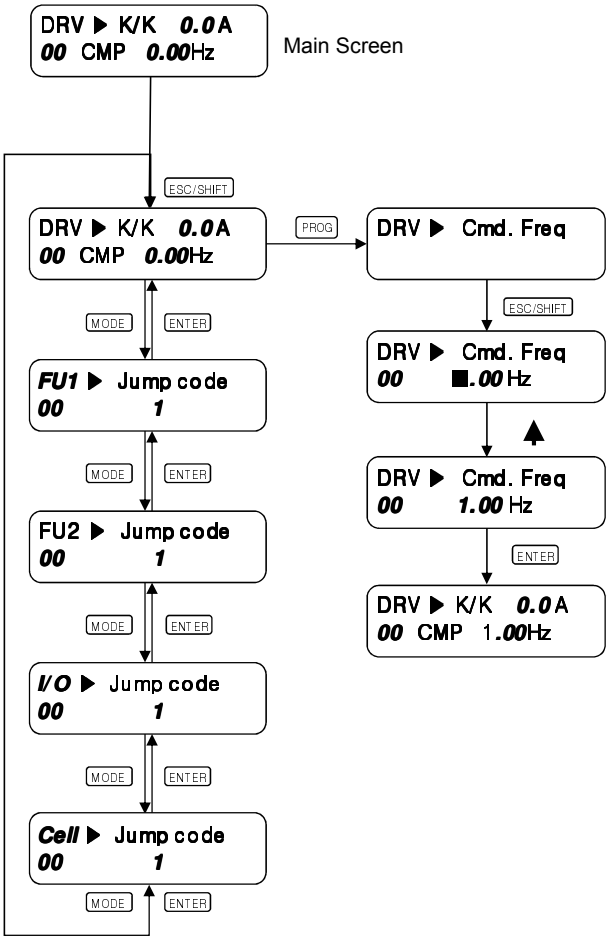


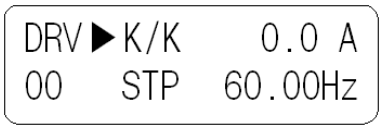
Figure 3-3 Parameter Setting

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.

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.



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

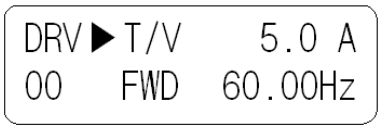
Press the STOP/RESET key. The motor decelerates and then it stops. The frequency at this time is the set frequency.

■ 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.

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

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



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.

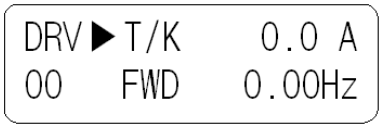
Turn off operation command FX (or RX).

■ 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.

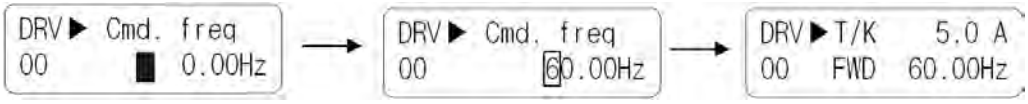
Turn on the power and then make sure the target frequency and frequency command are displayed as follows. If the displayed target frequency and frequency command are not the same as follows, change the settings as shown. Set [DRV-03] operation mode to Fx/Rx-1, and [DRV-04] frequency mode to Keypad.

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

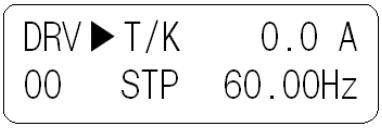


Set the target frequency with the keypad. Set the target frequency to 60.00 Hz with PROG, (UP), SHIFT, and ENT keys.

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



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



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.

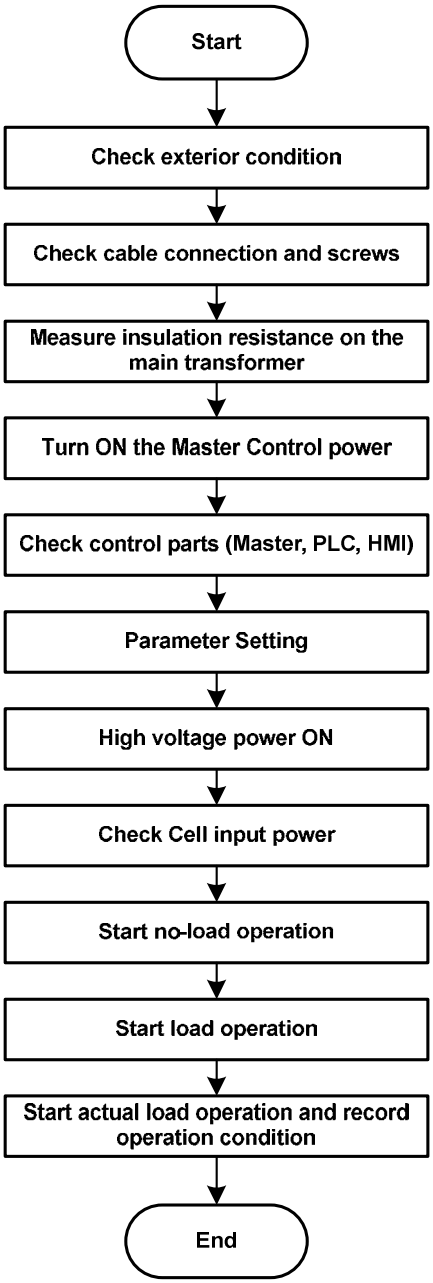


Figure 4-1 LSMV Test Operation Order

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 LSMV input cable. Measure insulation resistance on the 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 LSMV.

■ 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 main power VCB (K1) operation state (VCB is in Test position)
    - Check that the control cable is properly connected.
    - Check the VCB (K1) response to On/Off command.

■ Check Display Status

- Keypad Display

When a fault occurs on the LSMV, the keypad displays detailed information. If a problem with the LSMV 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

- Common Feature Settings

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

Table 4-1 Basic LSMV Settings

Order	Item	Code Number	Function 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	FU1-29	Sets input power frequency of the drive.	40 ~ 120 Hz	60 Hz
5	Max. frequency	FU1-30	Seta maximum output frequency of the drive.	40 ~ 120 Hz	60 Hz

Order	Item	Code Number	Function description	Range	Default Value
6	Base frequency	FU1-31	Sets base frequency of the motor.	30 ~ 120 Hz	60 Hz
7	Starting frequency	FU1-32	Sets starting frequency of the drive.	0.01 ~ 10 Hz	0.5 Hz
8	Motor voltage	FU2-40	Sets rated voltage of the motor.	0 ~ 12000 V	6600 V
9	Number of poles	FU2-41	Sets the number of poles in the motor.	2 ~ 12	4
10	Motor slip	FU2-42	Sets rated slip of the motor.	0 ~ 10 Hz	2 Hz
11	Setting Motor Rated current	FU2-43	Sets rated current of the motor (RMS).	1 ~ 1000 A	100 A
12	No-load current	FU2-44	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	Function description	Range	Default Value
1	Forward torque boost	FU2-47	Set quantity of forward direction torque boost.	0.0 ~ 5.0%	0.0%
2	Reverse torque boost	FU2-48	Set quantity of reverse direction torque boost.	0 .0~ 5.0%	0.0%

  - Slip compensation control mode

    Set to "Slip compen" from control mode setting [FU2-29] 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 [FU2-29] to operate. To operate with sensorless control, perform auto tuning immediately after medium voltage is supplied.

Order	Item	Code Number	Function description	Range	Default Value
1	Auto Tuning	FU2-31	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 LSMV, 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 LSMV 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 LSMV.
  - Check functions for emergency stop and protection.
- Terminal Operation

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

  - When you operate the LSMV, 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 LSMV 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

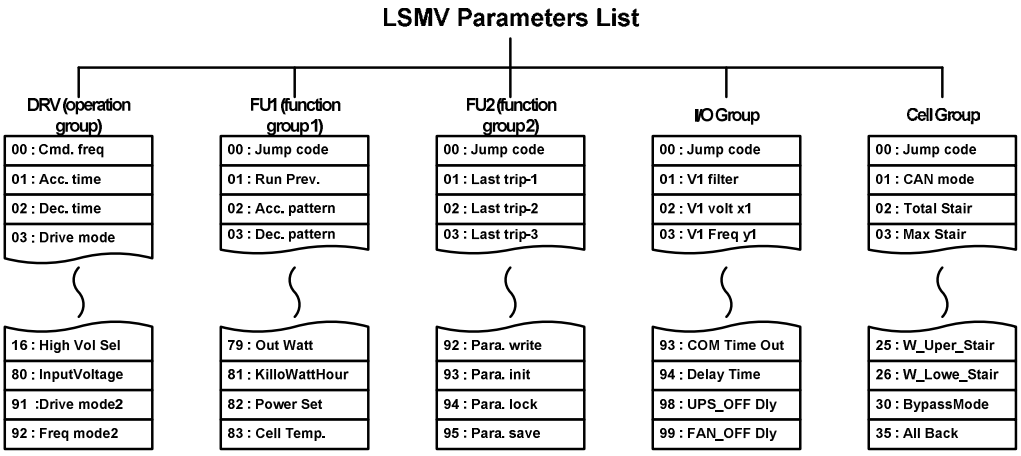


Figure 5-1 Composition of LSMV Parameters

Item	Details
DRV (operation group)	Basic parameters needed for operation, such as target frequency and Accel/Decel time, etc.
FU2 (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

Table 5-1 DRV Group Parameter List

Code DRV	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
00	9100	Command frequency Output frequency	Cmd. freq	While out of operation: Indicates command frequency. During operation: Indicates output frequency.	0 ~ [FU1-30] Max Freq	0 Hz	○	
01	9101	Acceleration time	Acc. time	The time taken to reach the reference frequency from the starting frequency.	0 ~ 6000 s	60 s	○	
02	9102	Deceleration time	Dec. time	The time taken to reach 0 Hz from reference frequency.	0 ~ 6000 s	180 s	○	
03	9103	Operation mode	Drive mode	Sets the method of operation command.	KeyPad Fx/Rx-1 Fx/Rx-2 Int. 485	KeyPad	X	
04	9104	Frequency mode	Freq mode	Sets the method of frequency command.	KeyPad-1 KeyPad-2 V1 Pulse I V1+I Int. 485	KeyPad-1	X	
05[1)]	9105	Multi-step speed frequency 1	Step Freq-1	Sets the frequency for multi-step speed operation. ***. Refer to 6.9 Input Terminal Setup**	[FU1-32] Start Freq ~ [FU1-30] Max Freq	10.00 Hz	○	
06	9106	Multi-step speed frequency 2	Step Freq-2		[FU1-32] Start Freq ~ [FU1-30] Max Freq	20.00 Hz	○	
07	9107	Multi-step speed frequency 3	Step Freq-3		[FU1-32] Start Freq ~ [FU1-30] Max Freq	30.00 Hz	○	
08	9108	Output current	Current	Indicates the RMS value of the LSMV output current while in operation.	*	* A	*	
09	9109	Motor speed	Speed	Indicates motor speed during operation.	*	* rpm	*	

Code DRV	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
10	910A	DC link voltage	DC link Vtg	Indicates DC voltage of a cell.	*	* V	*	
11	910B	User selection display	User disp	Displays the value set from [FU2-81] user selection (output voltage of output power).	[FU2-81]	Output voltage V	*	
12	910C	Current fault information	Fault	Indicates the current fault information of the LSMV.	*	*	*	
80	9150	Input line voltage	InputVoltage	Indicates the RMS value of the input line voltage.	*	* V	*	
91[2)]	915B	Operation mode 2	Drive mode2	It is the LOC/REM terminal input related function among the [IO-14 ~ 28] multifunction terminal input, and sets the drive/frequency mode applied when the ON signal is inputted in the terminal set to LOC/REM.	KeyPad Fx/Rx-1 Fx//Rx-2	Fx/Rx-1	X	
92[2)]	915C	Frequency mode 2	Freq mode2		KeyPad-1 KeyPad-2 V1 Pulse I V1+I	KeyPad-1	X	

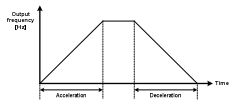
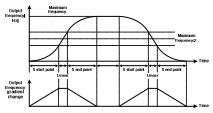
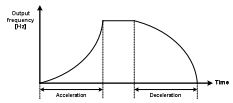
1) Shaded parts are shown when [multi-step speed] is selected in [IO-14 to 28] terminal setting.
2) It is used when the LOC/REM is selected for the [IO-14 ~ 28] terminal settings.

Note

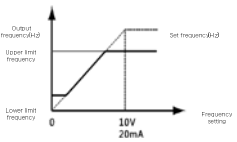
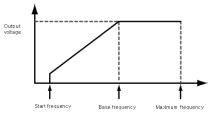
Codes in shaded rows (▭) are hidden codes that are displayed only when setting corresponding codes.

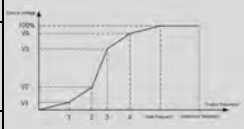
5.2 FU1 Group

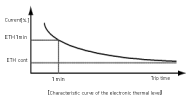
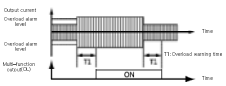
Table 5-2 FU1 Group Parameter List

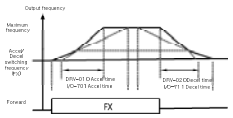
Code FU1	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
00	9200	Jump code	Jump code	Moves directly to the code you want to use.	1 ~ 99	1	○	
01	9201	Forward/reverse rotation prohibition	Run Prev.	Can set to disable forward or reverse rotation of the motor.	None Forward Prev Reverse Prev	None	X	
02	9202	Accelerating pattern	Acc. pattern	Selects appropriate Accel/Decel pattern for the purpose. ***. Refer to 6.6 Frequency Accel/Decel Curve** ▪ Linear: Linear Accel/Decel pattern  ▪ S-curve: An S shape Accel/Decel pattern.  ▪ U-curve: A U shape Accel/Decel pattern. Use this curve when smooth operation is needed for Accel/Decel. 	Linear S-curve U-curve	Linear	X	
03	9203	Decelerating pattern	Dec. pattern		Linear S-curve U-curve	Linear	X	
04	9204	S-curve start point gradient	Start Curve		0 ~ 100%	50%	X	
05	9205	S-curve end point gradient	End Curve		0 ~ 100%	50%	X	
06	9206	Start mode	Start mode	Selects LSMV start method. ▪ Accel: Operates with the time taken from the start frequency to acceleration. ▪ Dc-start: When you start the drive, perform DC excitation first and then accelerate operation.	Accel Dc-start Flying-start	Accel	X	

Code FU1	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
				▪ Flying-start: Start while the motor is rotating. ***. Refer to 6.4 Start Procedure**				
07[1)]	9207	DC excitation time at start	DcSt time	Indicates DC excitation time at the time of start.	1.0 ~ 60.0s	1.0 s	X	
08	9208	DC excitation quantity at start	DcSt value	It is the size of the DC excitation at start, and it is set to % of the rated current.	0 ~ 150%	33%	X	
09	9209	Stop mode	Stop mode	Select the LSMV stop method. ▪ Decel: Drive stops by decelerating. ▪ Dc-brake: From below the braking frequency, drive stops by supplying DC to the motor. ▪ Free-run: Cuts off the LSMV output voltage and the motor comes to stop after free run. ***. Refer to 6.5 Stop Procedure**	Decel Dc-brake Free-run	Free Run	X	
10[2)]	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 LSMV output is blocked before starting DC braking. ▪ DC braking time: Time to supply DC to the motor. ▪ DC braking quantity: It is the amount of DC supplied to the motor, and it is set to % of the rated current.	1.00 ~ 60.00s	5.00 s	X	
11	920B	DC braking frequency	DcBr freq		0.10 ~ 10.00 Hz	0.50 Hz	X	
12	920C	DC braking time	DcBr time		1.0 ~ 60.0s	1.0 s	X	
13	920D	DC braking quantity	DcBr value		0 ~ 200%	50%	X	

Code FU1	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
24	9218	Frequency upper/lower limit selection	Freq limit	It is the function for restricting the target frequency of the LSMV. If the frequency is set out of the upper/lower limit range, it is converted to upper/lower limit value.	No Yes	No	X	
25[3)]	9219	Lower limit frequency	F-limit Lo		0 ~ [FU1-26] F-limit Hi	0.50 Hz	X	
26	921A	Upper limit frequency	F-limit Hi	 ***. Refer to 6.7 Frequency Restrict Feature**	[FU1-25] F-limit Lo ~ [FU1-30] Max Freq	60.00 Hz	X	
29	921D	Power frequency	Line Freq	Set input power frequency.	40.00 ~ 120.00 Hz	60.00 Hz	X	
30	921E	Maximum frequency	Max Freq	Sets the LSMV output frequency parameter. ▪ Max Freq.: The maximum frequency that the motor can operate.	40.00 ~ 120.00 Hz	60.00 Hz	X	
31	921F	Base frequency	Base Freq	▪ Base Freq.: The frequency from where the LSMV rated voltage is outputted. ▪ Start Freq.: The frequency where output voltage of the LSMV output begins.	30.00 ~ 120.00 Hz	60.00 Hz	X	
32	9220	Start frequency	Start Freq	 *** Refer to 6.1 Basic Function Setup**	0.01 ~ 10.00 Hz	0.50 Hz	X	
40	9228	V/F pattern	V/F pattern	Selects the V/F pattern type. ▪ 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.	Linear Square User V/F	Linear	X	

Code FU1	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
				▪ User V/F: You arbitrarily set the ratio in special circumstances.				
41[4)]	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. The user V/F voltage setting is set as % of the output rated voltage. 	0 ~ [FU1-43] User freq 2	15.00 Hz	X	
42	922A	User V/F voltage 1	User volt 1		0 ~ 100%	25%	X	
43	922B	User V/F frequency 2	User freq 2		0 ~ [FU1-45] User freq 3	30.00 Hz	X	
44	922C	User V/F voltage 2	User volt 2		0 ~ 100%	50%	X	
45	922D	User V/F frequency 3	User freq 3		0 ~ [FU1-47] User freq 4	45.00 Hz	X	
46	922E	User V/F Voltage 3	User volt 3		0 ~ 100%	75%	X	
47	922F	User V/F frequency 4	User freq 4		0 ~ [FU1-30] Max Freq	60.00 Hz	X	
48	9230	User V/F voltage 4	User volt 4		0 ~ 100%	100%	X	
50	9232	AC input voltage correction	VAC	It is set to compensate the difference between the input voltage and the keypad displayed value.	73.0 ~ 115.0%	100.0%	X	
53	9235	Select electronic thermal	ETH select	Protects the motor from overheating without adding extra thermal relay to outside. The protective feature is engaged when the electric thermal is activated. ▪ ETH 1 min: It is the current size that determines motor overheat when the current flows continuously for 1 minute, and it is set as % of rated current of the motor.	No Yes	Yes	○	
54	9236	One minute level of electronic thermal	ETH 1min		[FU1-55] ETH cont ~ 200%	150%	○	
55	9237	Continuous operation level of electronic thermal	ETH cont		50 ~ [FU1-54] ETH 1min	120%	○	

Code FU1	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
56	9238	Motor cooling method	Motor type	▪ ETH cont: It is the size of the current that determines that the motor is in thermal equilibrium condition even though load current flows continuously, and it is set as % of rated current of the motor. ▪ Self-cool: It is set when using the cooling fan mounted on the motor shaft. ▪ Forced-cool: Set to drive the motor cooling fan with a separate power supply. ***. Refer to 6.8 Fault Detection Setup** 	Self-cool Forced-cool	Self-cool	○	
57	9239	Overload alarm level	OL level	Issues an alarm signal using the multi-function output terminal if the output current of LSMV stays for overload warning time with a value higher than the overload warning level. Overload warning level is set as % of rated current of the motor. ***. Refer to 6.8 Fault Detection Setup** 	30 ~ 110%	110%	○	
58	923A	Overload warning time	OL time		0.0 ~ 30.0s	10.0 s	○	
59	923B	Select Overload Fault	OLT select	Protective feature engages if the LSMV output current exceeds the overload limit for longer than the overload fault time. ***. Refer to 6.8 Fault Detection Setup**	No Yes	No	○	
60[5)]	923C	Overload fault level	OLT level	Overload fault level is set as % of rated current of the motor.	30 ~ 150%	120%	○	
61	923D	Overload fault time	OLT time	Sets overload fault time.	0.0 ~ 60.0s	60.0 s	○	

Code FU1	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
62	923E	Select input/output open-phase protection	PO Trip Sel	Protective feature engages if input/output open-phase is detected. ***. Refer to 6.8 Fault Detection Setup**	No InputPO Sel OutputPO Sel InOutPO Sel	No	X	
64	9240	Current level for stall prevention	Stall level	If the LSMV output current is greater than the stall prevention current level, the target frequency is reduced to suppress the overcurrent and engage in stall operation. The stall prevention current level is set as % of rated current of the motor. ***. Refer to 6.8 Fault Detection Setup**	30 ~ 150%	100%	X	
65	9241	Select low current protection feature	No Motor Sel	Sets the protective action for low output current. ***. Refer to 6.8 Fault Detection Setup**	No Yes	No	X	
66[6)]	9242	Low current operation prevention detection current level	NoMotorLevel	▪ NoMotorLevel: It is the base current for low current detection, and it is set as % of rated current of the motor. ▪ NoMotorTime: Fault is generated if the output current is maintained at below NoMotorLevel for preset time.	5 ~ 100%	5 %	X	
67	9243	Low current operation prevention detection time	NoMotorTime		1 ~ 3000 s	10s	X	
70	9246	Accel/Decel switching frequency	Acc/Dec ch F	The system can automatically change the Accel/Decel time in certain frequency while LSMV is in operation. If the frequency is lower than the preset Accel/Decel switching frequency, the Accel/Decel time set in [I/O-70,71] is applied, and if the frequency is higher, then the default Accel/Decel time set in [DRV-01,02] is applied. 	0 ~ [FU1-30] Max Freq	0.00 Hz	X	

Code FU1	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
71	9247	Accel/Decel reference frequency	Acc/Dec Freq	Changes Accel/Decel reference frequency of the LSMV. ▪ Max Freq.: The time taken from 0 to Max. frequency. ▪ Delta Freq.: The time taken from random frequency to next target frequency.	Max Freq Delta Freq	Max Freq	X	
73	9249	Continuous operation feature in case of instantaneous power interruption	Ride-Through	This feature allows continuous operation even in case of instantaneous power interruption. ***. Refer to 6.12 Instantaneous Power Interruption Recovery Procedure**	Yes No	No	X	
75[7)]	924B	Applied Slip ratio in case of instantaneous power interruption	Slip Perc	▪ Slip Perc: The output frequency is momentarily decreased if LSMV detects instantaneous power interruption. At this time, the frequency decrease size is set and inputted as % value of the rated slip frequency of the motor. ▪ Short time S: Sets the time for disabling the input low voltage fault (ILVT) protection feature for continuous operation in case of instantaneous power interruption. ▪ Ride Down T: Sets the output frequency decrease gradient during the continuous operation function in case of instantaneous power interruption.	10 ~ 500	100%	O	
76	924C	LV Trip time during instantaneous power interruption	Short time S		0.01~30.00 sec	1.00 sec	X	
77	924D	Output frequency decrease time during instantaneous power interruption	Ride Down T		1.0~100 sec	10.00 sec	O	
79	924F	Output power	Out Watt	Indicates the output power.[8)]	*	* kW	*	
81	9251	Accumulated electric power	KilloWattHour	Indicates the accumulated electric power.[9)]	*	*M *kWh	*	
82	9252	Electric power correction	Power Set	Compensates the output power difference.	10 ~ 300%	100.0%	O	

Code FU1	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
83	9253	Cell temperature	Cell Temp.	Indicates the LSMV internal cell temperature.	*	*	*	

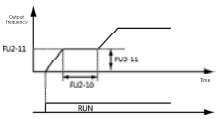
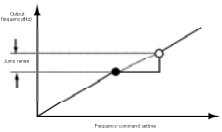
1) [FU1-07 to 08] display area is shown if the Start Mode in [FU1-06] is set to [Dc-start].
2) [FU1-10 to 13] display area is shown if Stop Mode in [FU1-09] is set to [DC-brake].
3) [FU2-25.26] display area is shown if the Freq Limit in [FU1-24] is set to [Yes].
4) [FU1-41 to 48] display area is shown if V/F Pattern in [FU1-40] is set to [User V/F].
5) [FU1-60.61] display area is shown if the OLT Select in [FU1-59] is set to [Yes].
6) [FU1-66.67] display area is shown if the No Motor Sel in [FU1-65] is set to [Yes].
7) [FU1-75,76,77] display area is shown if the instantaneous power interruption Ride-Through in [FU175] is set to [Yes].
8) [FU1-79] output power may result in different output during low-speed operation below 20Hz.
9) The Accumulated electric power in [FU1-81] may differ than the actual amount.

Note

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

5.3 FU2 Group

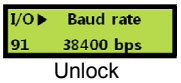
Table 5-3 FU2 Group Parameter List

Code FU2	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
00	9300	Jump code	Jump code	Moves directly to the code you want to use.	1 ~ 99	1	○	
01	9301	Fault history 1	Last trip-1	Fault history saves up to the past 5 trips. A smaller number indicates a more recent fault.	None	None	*	
02	9302	Fault history 2	Last trip-2				*	
03	9303	Fault history 3	Last trip-3				*	
04	9304	Fault history 4	Last trip-4				*	
05	9305	Fault history 5	Last trip-5				*	
06	9306	Fault history deletion	Erase trips	Deletes the fault history.	Yes No	No	○	
10	930A	Dwell time	Dwell time	Temporarily stops and restarts acceleration when driving large load.	0.0 ~ 10.0 s	0.0 s	X	
11	930B	Dwell frequency	Dwell Freq		[FU1-32] Start Freq ~ [FU1-30] Max Freq	5.00 Hz	X	
12	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 Yes	No	X	
13[1)]	930D	Lower limit of first frequency	jump lo 1		[FU1-32] Start Freq ~ [FU2-14] jump Hi 1	10.00 Hz	○	
14	930E	Upper limit of first frequency	jump Hi 1		[FU2-13] jump lo 1 ~ [FU1-30] Max Freq	15.00 Hz	○	
15	930F	Lower limit of second frequency	jump lo 2		[FU1-32] Start Freq ~ [FU2-16] jump Hi 2	20.00 Hz	○	

Code FU2	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
16	9310	Upper limit of second frequency	jump Hi 2		[FU2-15] jump lo 2 ~ [FU1-30] Max Freq	25.00 Hz	○	
17	9311	Lower limit of third frequency	jump lo 3		[FU1-32] Start Freq ~ [FU2-18] jump Hi 3	30.00 Hz	○	
18	9312	Upper limit of third frequency	jump Hi 3		[FU2-17] jump lo 3 ~ [FU1-30] Max Freq	35.00 Hz	○	
21	9315	Flying Start output current limit	Fly-I Perc	It is the speed search section related setting for the Flying Start feature among the drive procedures. ▪ Fly-I Perc: It is the output current limit during speed search, and it is set as % of rated current of the motor. ▪ Fly-Down T: Sets the output frequency deceleration time during speed search. ***. Refer to 6.4 Start Procedure**	50 ~ 160%	100%	O	
22	9316	Flying Start output frequency deceleration time	Fly-Down T		1.0~100.0sec	10.0 sec	X	
25	9319	Restart after fault reset	Reset Start	Automatically restarts after a fault.	No Yes	No	X	
26[2)]	931A	Number of restart	Reset Num	Sets the restart count after a fault. ***. Refer to 6.10 Fault Restart Procedure**	0 ~ 10	1	X	
28	931C	Motor RPM display gain	RPM factor	It is the constant variable for compensation when changing the motor speed indication to RPM. Speed of revolution = 120 * F/P * motor revolution display gain	1 ~ 1000%	100%	○	

Code FU2	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
29	931D	Select control mode	Control mode	Sets the LSMV control procedure. ▪ V/F: It is the control mode for maintaining consistent ratio of output voltage and output frequency. ▪ 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 Slip compen Sensorless	V/F	X	
30[3)]	931E	Sensorless mode	Sensor Mode	Selects sensorless control method.	Sensor_Less	Sensor_Less	X	
31	931F	Auto Tuning	Auto tuning	Automatically measures motor parameters required for control, such as stator resistor and leakage inductance, to ensure that the sensorless control mode operates at full performance.	No Yes	No	X	
32	9320	Stator resistor	%Rs		*	1.90%	X	
33	9321	Leakage inductance	%Lsigma		*	12.00%	X	
40	9328	Motor voltage	Motor Volt	▪ Motor related constants Slip Frequency calculation formula [Hz] = Rated frequency [Hz] - (Rated motor speed [rpm] * P/120) ※ P: Number of motor poles	0 ~ 12000	6600 V	X	
41	9329	Number of poles on the motor	Pole number		2 ~ 30	4	X	
42	9330	Rated slip of the motor	Rated-Slip		0.00 ~ 10.00 Hz	2.00 Hz	O	
43	9331	Rated current of the motor (RPM)	Rated-Curr		1.0 ~ 1000.0 A	100.0 A	X	
44	9332	No-load current of the motor (RMS)	Noload-Curr		1.0 ~ 500.0A	30.0 A	X	
45[3)]	932D	Sensorless current P gain	SL P-gain	Used to adjust sensorless P and I gains.	0 ~ 32767	600	X	

Code FU2	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
46	932E	Sensorless current I gain	SL I-gain	▪ P gain: Proportional Gain of speed controller ▪ I gain: Integral gain of speed controller	0 ~ 32767	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. The size of the boost voltage is set as % of the output rated voltage.	0.0 ~5.0%	0.0%	X	
48	9330	Quantity of reverse torque boost	Rev boost		0.0 ~ 5.0%	0.0%	X	
80	9350	Select display when turned on.	PowerOn disp	The detail that first appears on the keypad when LSMV is powered can be set as any one of the [DRV-00]~[DRV-12] in the DRV Group.	0 ~ 12	0	○	
82	9352	Software version	LS-MV S/W	Indicates the LSMV software version.	*.	Ver 2.0-00	*	
83	9353	Elapsed time from the last fault	LastTripTime	Displays the time elapsed from the last fault to present. Year (Y): Month (M): Date (D): Hour (H): Minute (m)	*	0:00:00:00:00	*	
84	9354	Power supply time	On-time	Displays how long power is supplied so far. Year (Y): Month (M): Date (D): Hour (H): Minute (m)	*	0:00:00:00:00	*	
85	9355	Operation time	Run-time	Displays how long the LSMV is operated so far. Year (Y): Month (M): Date (D): Hour (H): Minute (m)	*	0:00:00:00:00	*	
91	935B	Read parameters	Para. read	Saves controller's parameters in keypad memory.	No Yes	No	X	
92	935C	Write parameters	Para. write	Downloads parameters from keypad memory to controller.	No Yes	No	X	
93	935D	Parameter initialization	Para. init	Initializes parameters to default values.	No All Groups DRV FU1 FU2 I/O CEL	No	X	

Code FU2	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change 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. LOCK NUMBER: 12  Unlock  Lock	0 ~ 9999	0	○	
95	935F	Save parameters	Para. save	Used to save the parameters.	No Yes	No	X	

1) [FU2-13, 17] display area is shown when the Jump Freq in [FU2-12] is set to [YES].
2) [FU2-26] display area is shown when the Reset Start in [FU2-25] is set to [YES].
3) [FU2-30, 45, 46] display area is shown when the Control Mode in [FU2-29] is set to [Sensorless].

Note

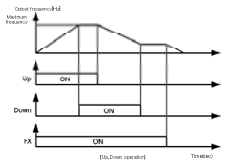
Codes in shaded rows (▭) are hidden codes that are displayed only when setting corresponding codes.

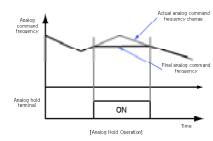
5.4 I/O Group

Table 5-4 I/O Group Parameter List

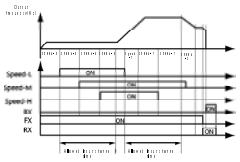
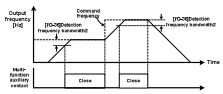
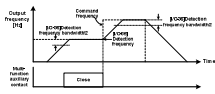
Code I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
00	9400	Jump code	Jump code	Moves directly to the code you want to use.	1 ~ 99	1	○	
01[1)]	9401	Time constant of V1 input filter	V1 filter	Sets value for built-in filter of V1 terminal while frequency command is set from outside.	0 ~ 9999 ms	10 ms	○	
02	9402	Minimum input voltage of V1	V1 volt x1	Sets the input voltage according to the minimum frequency for V1.	0 ~ [I/O-04] V1 volt x2	0.00 V	○	
03	9403	Frequency corresponding to V1 minimum voltage.	V1 Freq y1	Sets an output frequency corresponding to VI, the minimum input voltage.	0.00~ [FU1-30] Max Freq	0.00 Hz	○	
04	9404	Maximum input voltage for V1	V1 volt x2	Sets the input voltage V1corresponding to the maximum frequency.	[I/O-2] V1 volt x1 ~ 12.00 V	10.00 V	○	
05	9405	Frequency corresponding to V1 maximum voltage.	V1 Freq y2	Sets output frequency corresponding to VI, the maximum frequency input voltage.	0.00 ~ [FU1-30] Max Freq	60.00 Hz	○	
06[2)]	9406	I input filter time constant	I filter	Sets value for built-in filter of I terminal while frequency command is set from outside.	0 ~ 9999 ms	10 ms	○	
07	9407	Minimum input current I	I curr x1	Sets the input current I corresponding to a minimum frequency.	0 ~ [I/O-09] I curr x2	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~ [FU1-30] Max Freq	0.00 Hz	○	
09	9409	Maximum input current I	I curr x2	Sets the input current I for a maximum frequency.	[I/O-07] I curr x1 ~ 20.00 mA	20 mA	○	

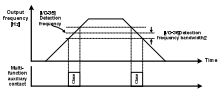
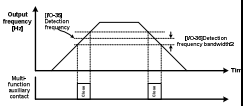
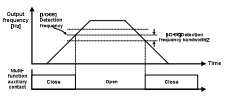
Code / I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
10	940A	Frequency/torque input	I Freq y2	Sets the output frequency corresponding to the input current I for a maximum frequency.	0.00 ~ [FU1-30] Max Freq	60.00 Hz	○	
11	940B	Select a standard for loss of analog command speed.	Wire broken	▪ Indicated on the keypad if frequency command is lost.  LOV: Lost V1 frequency command LOI: Lost I frequency command LOP: Lost Pulse frequency command ▪ None: System does not determine lost frequency even if the frequency command information 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 half of x1 below x1	None	○	
12	940C	Operation mode in case of command speed loss	Lost command	▪ None: System operates on minimum frequency or at lowest limit frequency in case of frequency command lost. ▪ Free Run: Stop free run in case of frequency command loss. ▪ Stop: Deceleration stop in case of frequency command loss	None FreeRun Stop	None	○	
13	940D	Time to judge command loss	Time out	The time to judge the analog frequency command loss.	0.1 ~ 120.0s	1.0 s	○	

Code I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
14	940E	Set multi-function input terminal M0.	M0 define	***. Refer to 6.9 Input Terminal Setup** ▪ 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 a fault. ▪ JOG: Sets the terminal as a jog operation terminal. ▪ BX: Sets the terminal as an emergency stop terminal. ▪ Speed-L, M, H, X: Refer to multi-step speed operation. ▪ Xcel-L, M, H: Refer to Multi-step Accel/Decel ▪ Up/Down (upward and downward operation): Allows acceleration, deceleration, constant speed operation based on the combination of the terminals.  ▪ 3-Wire: Multi-function input terminal is configured with 3-Wire for operation. ▪ Analog hold: Keeps the analog frequency value.	FX RX RST JOG BX Speed-L Speed-M Speed-H Speed-X Xcel-L Xcel-M Xcel-H Up Down 3-Wire Analog hold Ana. Change Xcel stop Loc/Rem Door Open Trans.OHW Trans.OHT Motor OHT Fan Trip Ext Trip1 Ext Trip2 High Voltage Run Enable Control LV PLC_Error None	RST	○	

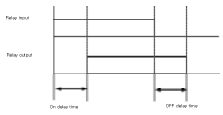
Code I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
15	940F	Set multi-function input terminal M1	M1 define	 ▪ Ana. Change: Analog operation command changes if the set terminal value is entered. ▪ Xcel stop: Decelerates and comes to a stop if the preset terminal is turned ON. ▪ Loc/Rem: Use when you want to make two types of frequency command and operation command. ▪ Door-Open: Sets the warning for opened panel door. ▪ Trans.OHW: Sets warnings against transformer overheating. ▪ Trans.OHT: Sets fault for transformer overheating. ▪ Motor OHT: Sets the fault for motor overheating. ▪ Fan Trip: Sets fault for fan failure. ▪ Ext Trip1,2: Sets the user defined external fault. ▪ High Voltage: ▪ The input switch gear receives the operation status information and checks the high input voltage. ▪ Run Enable: Can carry out RUN command when set terminal is ON.	[I/O-14] Same as M0 define	Ext Trip1	○	
16	9410	Set multi-function input terminal M2	M2 define		[I/O-14] Same as M0 define	FX	○	
17	9411	Set multi-function input terminal M3	M3 define		[I/O-14] Same as M0 define	RX	○	
18	9412	Set multi-function input terminal M4	M4 define		[I/O-14] Same as M0 define	Trans. OHT	○	
19	9413	Set multi-function input terminal M5	M5 define		[I/O-14] Same as M0 define	Fan Trip	○	
20	9414	Set multi-function input terminal M6	M6 define		[I/O-14] Same as M0 define	High Voltage	○	
21	9415	Set multi-function input terminal M7	M7 define		[I/O-14] Same as M0 define	Run Enable	○	
22	9416	Set multi-function input terminal M8	M8 define		[I/O-14] Same as M0 define	Control LV	○	
23	9417	Set multi-function input terminal M9	M9 define		[I/O-14] Same as M0 define	None	○	
24	9418	Set multi-function input terminal M10	M10 define		[I/O-14] Same as M0 define	None	○	
25	9419	Set multi-function input terminal M11	M11 define		[I/O-14] Same as M0 define	None	○	
26	941A	Set multi-function input terminal M12	M12 define		[I/O-14] Same as M0 define	None	○	

Code / I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
27	941B	Set multi-function input terminal M13	M13 define	▪ Control LV: Receives signal if the control power is turned OFF. ▪ PLC_Error: ▪ Receives the fault signal for HMI communication and signal processing PLC. ▪ None: No function is in use.	[I/O-14] Same as M0 define	None	○	
28	941C	Set multi-function input terminal M14	M14 define	BX exclusive terminal	FX BX	BX	○	
29	941D	Input terminal display	In status	Multi-function input terminal display which shows the input status of the control terminal. 0: No input, 1: Input ▪ [I/O-29] In status: Shows low 11 bit information. ▪ 000 0000 0000 (M10~M0) ▪ [I/O-30] In status_H: Shows high 4 bit information. 0000 (M14,M13,M12,M11)	*	00000000000	*	
30	941E	Input terminal display	In status_H		*	0000	*	
31	941F	Filter time constant of multi-function input terminal	Ti Filt Num	Sets the responsiveness of the input terminals (M0~M14), and any terminal changes for a period shorter than the preset time is ignored.	2 ~ 1000 ms	15 ms	○	
32	9420	Select hardware configuration of input terminal	In No/Nc Set	Selects input contact type of control input terminal. 0: Active High, 1: Active Low ▪ [I/O-32] In No/Nc Set: Selects the lower 11 bit contact form. ▪ 000 0000 0000 (M10~M0) ▪ [I/O-33] H No/Nc Set: Selects the upper 4 bit contact form. 0000 (M14,M13,M12,M11)	00000000000~11111111111	00000000000	X	
33	9421	Select hardware configuration of input terminal	H No/Nc Set		0000~1111	0000	X	

Code I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change 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 ~ 1000 ms	1 ms	X	
35	9423	Detected frequency	FDT freq	Use the frequency detection function by utilizing auxiliary contact output with multi-functions.	0 ~ [FU1-30] Max Freq	30.00 Hz	○	
36	9424	Detected frequency band	FDT band		0 ~ [FU1-30] Max Freq	10.00 Hz	○	
37	9425	Output setting of multi-function auxiliary contact (Aux terminal)	Aux mode1	▪ FDT-1: Activates if the output frequency of the LSMV in operation reaches the command frequency.  ▪ FDT-2: Works if FDT-1 conditions are satisfied and output frequency is the same as the detected frequency.  ▪ FDT-3: Activates if the output and detection frequency bandwidth matches the following conditions. Absolute value (detected - output frequency)	None FDT-1 FDT-2 FDT-3 FDT-4 FDT-5 OL IOL Stall OV LV OH Lost Command Run Stop Steady Speed Search Ready Warning FAN RUN NORMAL OCT Cell ByPass RUN_MV	Ready	○	

Code I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
38	9426	Output setting of multi-function auxiliary contact	Aux mode2	≤ Detected frequency bandwidth / 2  ▪ FDT-4 • When accelerating: Output frequency ≥ Detected frequency • When decelerating: Output frequency > (Detected frequency – Detected frequency bandwidth / 2)  ▪ FDT-5: Reverse output of FDT-4  • 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 LSMV as a standard, during	[I/O-37] Same as Aux mode1	FAN RUN	○	
39	9427	Output setting of multi-function auxiliary contact	Aux mode3		[I/O-37] Same as Aux mode1	RUN	○	
40	9428	Output setting of multi-function auxiliary contact	Aux mode4		[I/O-37] Same as Aux mode1	Warning	○	
41	9429	Output setting of multi-function auxiliary contact	Aux mode5		[I/O-37] Same as Aux mode1	None	○	
42	942A	Output setting of multi-function auxiliary contact	Aux mode6		[I/O-37] Same as Aux mode1	None	○	
43	942B	Output setting of multi-function auxiliary contact	Aux mode7		[I/O-37] Same as Aux mode1	None	○	

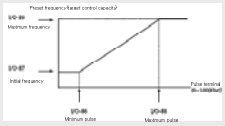
Code / I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
44	942C	Sets the multi-function auxiliary contact	Aux mode8	operation. • Stall: Outputs a signal when a stall occurs during operation. • OV: Outputs a signal when the Cell DC voltage exceeds 1050 V. • LV: Outputs a signal when the input voltage is below 70% of the rated voltage. • OH: Outputs signal when a Cell's internal temperature exceeds preset temperature due to LSMV overheating. • Lost command: Outputs a signal when frequency command is lost. ▪ Run: Outputs a signal when in operation. ▪ STOP: Outputs a signal when coming to a stop. ▪ Steady: Outputs a signal when in constant speed operation. ▪ SpeedSearch: Outputs a signal when searching the speed. ▪ Ready: Outputs a signal when the Master Control Board activates as a result of receiving control power. ▪ Warning: Outputs a signal when Trans.OHW, Door Open, Reset Start, and Cell Bypass activate. ▪ FAN RUN: Outputs the fan operation signal when high input voltage is received.	[I/O-37] Same as Aux mode1	None	○	

Code / I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
				▪ NORMAL: This is a CAN communication mode. The system is in operable status. ▪ OCT: Outputs a signal when an over current fault is working. ▪ Cell ByPass: Outputs a signal when any one of the cells that are applied to the LSMV is bypassed. ▪ Run_MV: It is similar to the Run terminal but the terminal is not cut off during LSMV Cell ByPass restart.				
45	942D	Output terminal display	Out status	Displays AXA-AXC1 - 8 and status of fault relays, 3OAT and 3OCT. 0: No terminal output, 1: Terminal output active 0 0000 0000 (fault relay, AX8~AX1)	*	000000000	*	
46	942E	Fault relay operation (3A, 3B, 3C terminals)	Relay mode	Apply these for use of relay fault output when a fault occurs. High bits: Uses the fault relay operation ▪ 0: Relay does not operate in case of any fault ▪ 1: Relay operate in case of any fault Low bits: Low voltage fault (ILVT) related ▪ 0: Does not operate in a low voltage fault. ▪ 1: Operates in a low voltage fault	00 ~ 11	10	○	
47	942F	Fault relay On delay	Relay On	Sets fault relay on/off delay time. 	0.0 ~ 999.9s	0.0 s	X	
48	9430	Fault relay Off delay	Relay Off		0.0 ~ 999.9s	0.0 s	X	
49	9431	Analog output A	SDA A read	Selects the output type for the analog out signals of DAO_A and	NONE FREQUENC	NONE	○	

Code / I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
				CM terminal	Y VOLTAGE CURRENT DC_LINK_VTG			
50	9432	Analog output A %	SDA A shift	Can increase or decrease the analog output signal, DAO_A output.	50 ~ 150%	100%	○	
51	9433	Analog output B	SDA B read	Selects the output type for the analog out signals of DAO_B and CM terminal	[I/O-49] Same as SDA A read	NONE	○	
52	9434	Analog output B %	SDA B shift	Can increase or decrease the analog out board, DAO_B output.	50 ~ 150%	100%	○	
53	9435	Analog output C	SDA 1	Selects the output type for the analog out signals of DAO_C and CM terminal	None InputCurr R InputCurr S InputCurr T InputVolt R InputVolt S InputVolt T CELL_TEMP AD VOLT VAL	None	○	
54	9436	Shift of analog output C	SDA 1 shift	Can increase or decrease the analog output signal, DAO_C output.	0 ~ 19	10	○	
55	9437	Analog output D	SDA 2	Selects the output type for the analog out signals of DAO_D and CM terminal	[IO-53] Same as SDA 1	None	○	
56	9438	Shift of analog output D	SDA 2 shift	Can increase or decrease the analog output signal, DAO_D output.	0 ~ 19	10	○	
57	9439	Set jog frequency	Jog Freq	Sets the terminal as a jog operation frequency.	[FU1-32] Start Freq ~ [FU1-30] Max Freq	10.00 Hz	○	
58[3)]	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.	[FU1-32] Start Freq ~ [FU1-30] Max Freq	40.00 Hz	○	
59	943B	Multi-step speed frequency 5	Step Freq-5			50.00 Hz	○	

Code / I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
60	943C	Multi-step speed frequency 6	Step Freq-6	***. Refer to 6.9 Input Terminal Setup**		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	○	
70	9446	Multi-step acceleration time 1	Acc time-1	You can change Accel/Decel time while in operation by setting multi-function input terminal to XCEL-L, XCEL-M, and XCEL-H. While in operation, you can select external contact input with multi-functions (M1~M13) as multi-step Accel/Decel, and apply Accel/Decel time from one to seven using these external contact inputs. *. Refer to 6.9 Input	0 ~ 6000 s	60 s	○	
71	9447	Multi-step deceleration time 1	Dec time-1			180 s	○	
72	9448	Multi-step acceleration time 2	Acc time-2			90 s	○	
73	9449	Multi-step deceleration time 2	Dec time-2			270 s	○	
74[3)]	944A	Multi-step acceleration time 3	Acc time-3			120 s	○	

Code I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
75	944B	Multi-step deceleration time 3	Dec time-3	Terminal Setup		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 ▪ P pulse set: Selects the pulse input method. Can be set to 4 times multiplier (A+B) or 1 time multiplier (A) signal. ▪ 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	(A) (A+B)	(A)	X	
85	9455	Time constant of pulse input filter	P filter		1 ~ 9999 ms	10 ms	O	
86	9456	Minimum frequency of pulse input	P pulse x1		0 ~ [I/O-88] P pulse x2	0.0 kHz	○	
87	9457	The frequency corresponding to minimum frequency of pulse	P Freq y1		0 ~ [FU1-30] Max Freq	0.00 Hz	○	
88	9458	Maximum frequency of pulse input	P pulse x2		[I/O-86] P pulse x1 ~ 100.0 kHz	10.0 kHz	○	

Code I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
89	9459	The frequency corresponding to maximum frequency of pulse	P Freq y2	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. 	0 ~ [FU1-30] Max Freq	60.00 Hz	○	
90	945A	Drive ID	Inv No.	Sets the LSMV ID for communication with the embedded RS-485. Sets RS-485 communications speed.	1 ~ 250	1	○	
91	945B	Communication speed	Baud rate	Sets the embedded RS-485 communication speed.	1200 bps 2400 bps 4800 bps 9600 bps 19200 bps 38400 bps	38400 bps	○	
92	945C	Operation mode in case of command speed loss	COM Lost Cmd	Sets operation method in case of command loss during communication. ▪ None: System operates on minimum frequency or at lowest limit frequency in case of frequency command lost. ▪ Free Run: Stop free run in case of frequency command loss. ▪ Stop: Deceleration stop in case of frequency command loss	None FreeRun Stop	None	○	
93	945D	Command Loss determining time	COM Time Out	The system determines communication command loss if the operation command signal is not received before the preset time expires, and the system operates based on the [I/O-92] COM Lost Cmd settings. The following is displayed on the keypad	0.1 ~ 120.0s	1.0 s	○	

Code / I/O	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
				in case of command loss. 				
94	945E	Communication respond delay time	Delay Time	Sets the maximum standby time for communication respond.	2 ~ 1000 ms	5 ms	○	
98	9462	UPS Off time	UPS_OFF Dly	Activates the Control LV after expiration of preset time in case of control power interruption. ***. Refer to 6.8 Fault Detection Setup**	1 ~ 9000s	60 s	○	
99	9463	Fan off time	FAN OffDly	Operates the panel fan for the duration of the time set to cool down the heat in the transformer and the cell even after turning the high voltage power OFF for LSMV operation or maintenance, and then turns the fan OFF upon expiration of the timer.	0.0 ~ 900.0s	600.0 s	○	

1) The shaded section of [IO-01~05] is shown when the Freq mode in [DRV-04] is set to [V1].
2) The shaded section of [IO-06~10] is shown when the Freq mode in [DRV-04] is set to [I].
3) The shaded section is shown when the [multi-step speed] in [IO-14~28] terminals is selected.
4) Shaded parts are shown when [acceleration/deceleration] is selected in [IO-14 to 28] terminal setting.
5) 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

Table 5-5 CELL Group Parameter List

Code CEL	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
00	9500	Jump code	Jump code	Moves directly to the code you want to use.	1 ~ 99	1	○	
01	9501	CAN Mode indication	Can mode	Display status of CAN communication mode. The current mode status can also be checked in [DRV-00].  ▪ Setting mode (SET): This is the Cell parameter setting mode and is required only during Setup. ▪ Compare mode(CMP): This mode is displayed if the Cell has no power as a result of high voltage power OFF. ▪ Normal mode (NOR): This mode is displayed when the LSMV is in normal operation status. ▪ Fault mode (FLT): This mode is displayed when the LSMV fault protection feature is engaged.	*	Compare mode	X	
02	9502	All layers indication	Total Stair	Indicates number of layers of cells. This is the Cell configuration quantity of a single LSMV layer.	*	1	X	
03	9503	Maximum layer indication	Max Stair	Displays the number of layers used during normal operation. If there is no Cell ByPass, then the count is the same as the [CEL-02] Total Stair.	*	1	X	

Code CEL	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
04	9504	U-phase communications status	U CAN Status	Connection status of communications between cells in U, V, W phases and the master. 0: Connection Normal 1: Connection Error 0000 0000 0000 (12S ~ 1S)	*	0000000000	X	
05	9505	V-phase communications status	V CAN Status		*	0000000000	X	
06	9506	W-phase communications status	W CAN Status		*	0000000000	X	
07	9507	Status of U-phase protective operation	U ProtStatus	It is displayed if fault is detected by each phase cell. 0: Normal 1: Fault 0000 0000 0000 (12S ~ 1S)	*	0000000000	X	
08	9508	Status of V-phase protective operation	V ProtStatus		*	0000000000	X	
09	9509	Status of W-phase protective operation	W ProtStatus		*	0000000000	X	
10	950A	Cell setting	Go Setting	It is used to reset the Cell quantity, layers, and ID setting as a result of maintenance or cell change.	No Yes	No	X	
11	950B	U-phase bypass	BPU 87654321	It is used to set each phase cell to bypass state. The change is applied only if the [CEL-10] Go Setting is set to Yes. 0: Normal 1: Bypass 0000 0000 0000 (12S ~ 1S)	0000000000 / 1111111111	0000000000	X	
12	950C	V-phase bypass	BPV 87654321			0000000000	X	
13	950D	W-phase bypass	BPW 87654321			0000000000	X	
16	9510	U-phase Bypass	U Bypass St	It is used to check the bypass state of each phase cell 0: Normal 1: Bypass 0000 0000 0000 (12S ~ 1S)	*	0000000000	X	
17	9511	V-phase Bypass	V Bypass St		*	0000000000	X	
18	9512	W-phase Bypass	W Bypass St		*	0000000000	X	

Code CEL	Communications Address	Function Name	Keypad Display	Function description	Range	Factory Default Value	Change during operation	Remarks
21	9515	Status of upper cell layers in U-phase (1S~4S)	U_Uper_Stair	Indicates the number of layers currently used by each cell. Ex) After normal setting of 6 layer cell: [CEL-21] U_Uper_Stair: 4321 [CEL-22] U_Lowe_Stair: 0065 If the 1st layer in above is bypassed: [CEL-21] U_Uper_Stair: 3210 [CEL-22] U_Lowe_Stair: 0054	*	0000		
22	9516	Status of cell layers in U-phase. (5S~8S)	U_Lowe_Stair		*	0000		
23	9517	Status of upper cell layers in V-phase. (1S~4S)	V_Uper_Stair		*	0000		
24	9518	Status of cell layers in V-phase. (5S~8S)	V_Lowe_Stair		*	0000		
25	9519	Status of upper cell layers in W-phase (1S~4S)	W_Uper_Stair		*	0000		
26	951A	Status of cell layers in W-phase (5S~8S)	W_Lowe_Stair		*	0000		
30	951E	Bypass mode selection	BypassMode	▪ No: Bypasses by user selection. ▪ ManualBypass: When designated fault occurs, press the RESET key from the keypad for bypass. ▪ Auto-Bypass: When designated fault happens, checks overall faults and then bypasses automatically to keep operable status. ***. Refer to 6.11 Cell Bypass Procedure**	No ManualBypass Auto-Bypass	No	X	
35	9523	Cell status reinstating	All Back	Disables the Cell Bypass.	Yes No	No	X	

6. LSMV Configuration Procedure and Details per Feature

LSMV 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 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	Function description
Power frequency	FU1-29	Sets input power frequency of the LSMV.
Maximum frequency	FU1-30	Sets maximum output frequency of the LSMV.
Base frequency	FU1-31	Sets base frequency of the motor.
Start frequency	FU1-32	Sets frequency for starting operation.
Motor voltage	FU2-40	Sets rated voltage of the motor.
Number of motor poles	FU2-41	Sets the number of poles in the motor.
Motor Slip	FU2-42	Sets motor's rated slip in frequency unit.
Motor rated current	FU2-43	Sets rated current of the motor.
Motor no-load current	FU2-44	Sets no-load current of the motor.
Operation mode	DRV-03	Sets a method of operation command.
Frequency mode	DRV-04	Sets a method for frequency command.
Setting Accel/Decel time	DRV-01, DRV-02	Sets basic Accel/Decel time.

■ Frequency parameter setting

The minimum frequency at which the LSMV starts rated voltage output is called the Base Freq. If the Base Freq is set to 60Hz when the [FU1-40] V/F pattern is set to Linear, the voltage increases constantly corresponding to the rise of frequency from 0Hz to 60Hz. When the frequency reaches 60Hz, the voltage reaches rated voltage. When the maximum voltage becomes 120Hz, and it is different than the Base Freq, then the rated voltage is outputted between 60Hz to120Hz. As another example, if the Base Freq is set to 30Hz, and the max frequency is set to 60Hz, then the rated voltage is reached at 30Hz, and the rated voltage is outputted between 30Hz to 60Hz.

The different setting for the maximum frequency and the Base Freq is used if the LSMV output cannot handle the load. We recommend that the LSMV power frequency is set to Base Freq and maximum frequency.

6.2 Frequency Setting Methods

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

■ Frequency Setting by Keypad

The following parameters are used when setting up frequency with the keypad. Keypad -1 is the procedure for detecting command frequency by pressing the ENTER Key after number entry when setting the frequency with the keypad, and the Keypad – 2 is the procedure for detecting command frequency without the need for pressing the ENTER Key.

*. Refer to Figure 3-3 Parameter Setup in page 3-5.

Code	Displayed Message	Function Name	Value	Function description
DRV-04	Freq Mode	Frequency mode	Keypad-1 Keypad-2	Selects the method of frequency command.
DRV-00	Cmd. Freq	Command Frequency Entry	0.00 ~ [FU-30] Max Freq	Enters the command frequency. (It is displayed by pressing the PROG KEY.)

■ Frequency setting via V1

It is the procedure for setting the LSMV command frequency by connecting 0~10V DC voltage to the corresponding terminal.

Code	Displayed Message	Function Name	Value	Function description
DRV-04	Freq Mode	Frequency mode	V1	Selects the method of frequency command.
I/O-01	V1 filter	Time constant of V1 input filter	0 ~ 9999 ms	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	0 ~ [I/O-04] V1 volt x2	Sets V1 input voltage from which the minimum frequency is generated.
I/O-03	V1 freq y1	Frequency corresponding to minimum input voltage	0.00 ~ [FU1-30] Max Freq	Output frequency that corresponds to V1 minimum input voltage.
I/O-04	V1 volt x2	Maximum input voltage	[I/O-2] V1 volt x1 ~ 10.00 V	Sets V1 input voltage from which the maximum frequency is generated.
I/O-05	V1 freq y2	Frequency corresponding to the maximum input voltage	0.00 ~ [FU1-30] Max Freq	Output frequency that corresponds to V1 maximum input voltage.

Note

Increase the value of the filter time constant if the LSMV is affected by noise which causes unstable operation.

However, the responsiveness may be reduced if you increase the value of time constant too much.

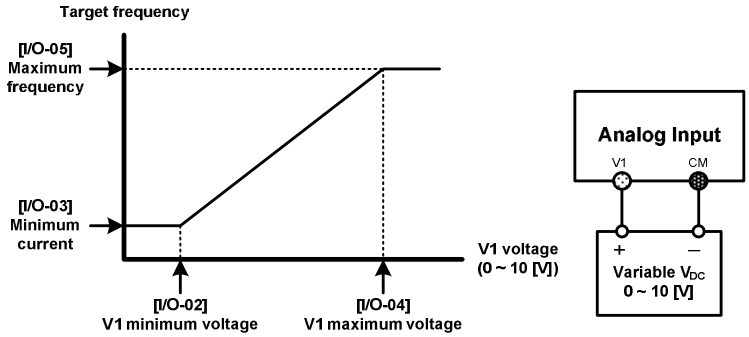


Figure 6-1 Frequency commands by voltage and wiring diagram

■ Frequency Setting via Current (I Terminal)

It is the procedure for setting the LSMV command frequency by connecting 4~20mA DC current to the corresponding terminal.

Code	Displayed Message	Function Name	Value	Function description
DRV-04	Freq Mode	Frequency mode	I	Selects the method of frequency command.
I/O-06	I filter	I input filter time constant	0 ~ 9999 ms	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	0 ~ [I/O-09] I curr x2	Sets minimum input current I from which the frequency is generated.
I/O-08	I Freq y1	Frequency corresponding to minimum input current I	0.00 ~ [FU1-30] Max Freq	Output frequency that corresponds to minimum input current I.
I/O-09	I curr x2	Maximum input current I	[I/O-07] I curr x1 ~ 20mA	Sets maximum input current I from which the frequency is generated.
I/O-10	I Freq y2	Frequency corresponding to maximum input current I	0.00 ~ [FU1-30] Max Freq	Output frequency corresponding to maximum input current I.

Note

Increase the value of the filter time constant if the LSMV is affected by noise which causes unstable operation.

However, the responsiveness may be reduced if you increase the value of time constant too much.

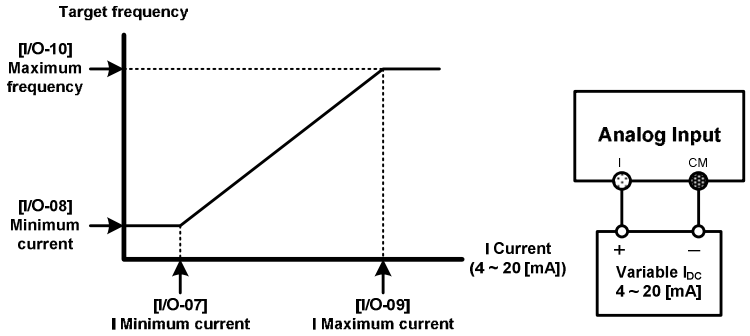


Figure 6-2 Frequency commands by current

■ Frequency Setting via Pulse

It is the procedure for setting the command frequency by connecting the 5 pulse signal that can change to 0~100kHz frequency to "A_OC, B_OC, CM" terminals. If a single pulse is used on A_OC and CM, 1 time multiplier pulse signal is inputted, and if pulse with 90° phase difference is used in A_OC and B_OC terminals, then 4 times multiplier pulse signal can be used.

Code	Displayed Message	Function Name	Value	Function description
DRV-04	Freq Mode	Frequency mode	PULSE	Selects the method of frequency command.
I/O-84	P Pulse Set	Set pulse mode	(A) (A+B)	Sets use of either four times multiplier signal or one time multiplier signal.
I/O-85	P filter	Time constant of pulse input filter	1 ~ 9999 ms	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	0 ~ [I/O-88] P pulse x2	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	0 ~ [FU1-30] Max Freq	Output frequency that corresponds to the minimum input pulse P.
I/O-88	P pulse x2	Maximum input pulse P	[I/O-86] P pulse x1 ~ 100.0 kHz	Sets pulse frequency of input P from where maximum frequency is generated.
I/O-89	P Pulse Set	Frequency corresponding to maximum input pulse P	0 ~ [FU1-30] Max Freq	Output frequency that corresponds to maximum input pulse P.

Note

Increase the value of the filter time constant if the LSMV is affected by noise which causes unstable operation.

However, the responsiveness may be reduced if you increase the value of time constant too much.

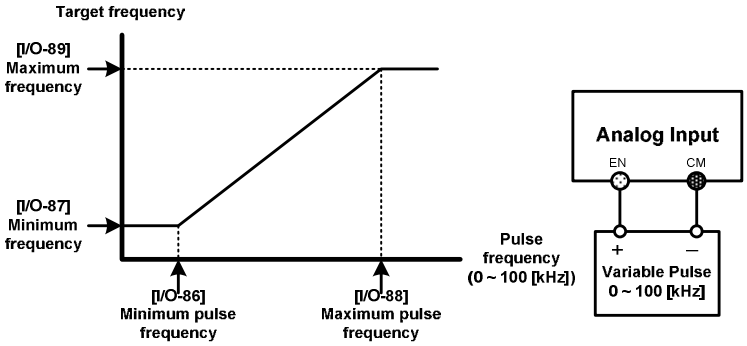


Figure 6-3 Frequency commands via pulse

6.3 Operation Command Methods

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

DRV-03 Data setting	Function 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. (Caution: Embedded RS-485 is used by the internal PLC for system control. Do not change settings)

■ Operation command by keypad.

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

DRV-03 Data Setting	Function description
Keypad	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	Function description
Fx/Rx-1 Fx/Rx-2	Operates and stops using terminal.

Data settings in IO-14 to 28	Function description
FX RX	LSMV operation and stop is controlled based on the terminal signal set to FX and RX.

- 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

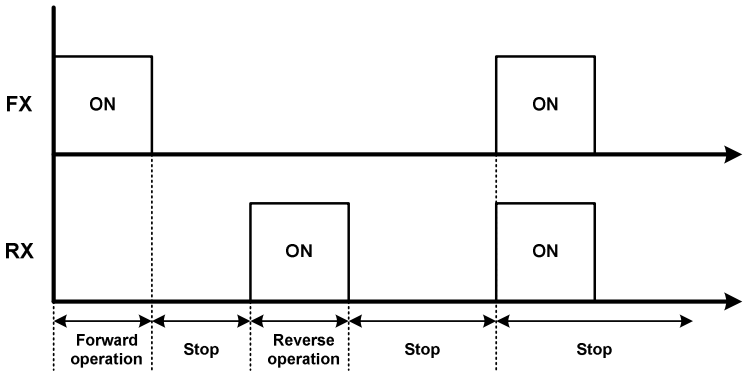


Figure 6-4 Terminal block operation (Fx/Rx-1)

- 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

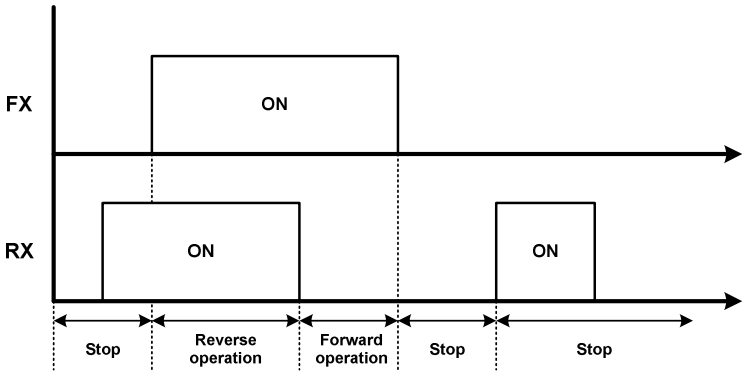


Figure 6-5 Terminal block operation (Fx/Rx-2)

6.4 Start mode

There are three ways (Accel, DC-Start, Flying-Start) of starting the LSMV.

- Accel: This is the most frequently used acceleration method. Acceleration is achieved by the increase of frequency and the voltage as the time lapses from the starting frequency ([FU1-32] Start Freq) to the command frequency.
- 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: It is the method of operation to the target frequency by identifying the motor's rotation frequency while the motor is in Free Run state. This method is used when you need to operate the system without stopping the motor.

■ Accel Start

Code	Displayed Message	Function Name	Value	Function description
FU1-06	Start mode	Start Procedure	Accel	Select Start type to Accel.
DRV-01	Acc. Time	Acceleration time	0 ~ 6000s	Set the acceleration time for up to [FU1-30] Max Freq.
FU1-02	Acc. Pattern	Accel pattern setup	Linear S-curve U-curve	Sets the frequency gradient pattern during acceleration.

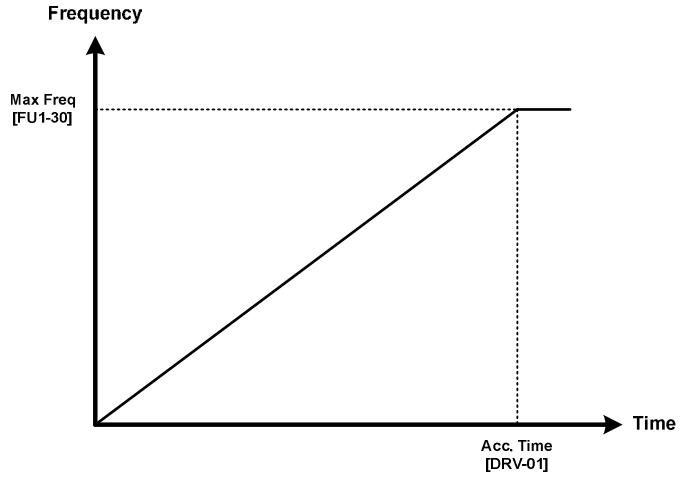


Figure 6-6 Acceleration Pattern during Accel Start (Linear)

■ DC-Start

Code	Displayed Message	Function Name	Value	Function description
FU1-06	Start mode	Start Procedure	Dc-start	Set start type to Dc-start.
DRV-01	Acc. Time	Acceleration time	0 ~ 6000s	Set the acceleration time for up to [FU1-30] Max Freq.
FU1-07	DcSt time	DC excitation time during start	1.0 ~ 60.0 s	Sets the DC excitation duration time during start.
FU1-08	DcSt value	DC excitation quantity at start	0 ~ 150%	It is the size of the DC excitation at start, and it is set to % of the rated current.

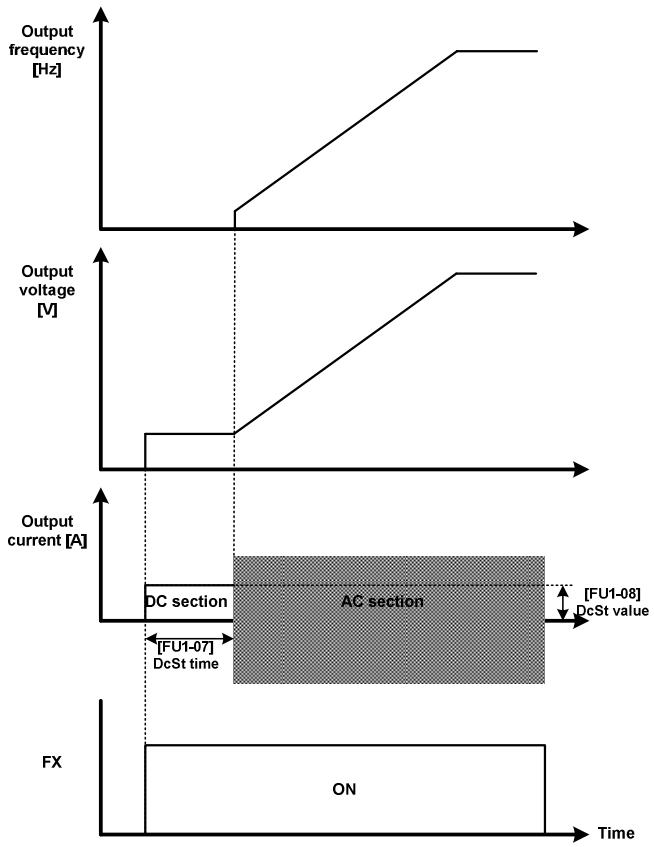


Figure 6-7 DC excitation during start

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

■ Flying-Start

Code	Displayed Message	Function Name	Value	Initial value	Function description
FU1-06	Start mode	Start Procedure	Flying-start	Accel	Set start type to Flying-start.
FU2-21	Fly-I Perc	Flying Start output current limit	50 ~ 160%	100%	Enter % of motor rated current as the output current limit during speed search.
FU2-22	Fly-Down T	Flying Start output frequency deceleration time	1.0~100.0 sec	10s	Sets the output frequency deceleration time during the speed search.

Use the Flying-start procedure if you want to operate the LSMV while the motor is in Free Run state. The Flying-start engages in speed search function to identify the motor's rotation frequency, and then uses the starting method that accelerates from the detected RPM. The [FU2-21] Fly-I Perc is the size of the limited LSMV output current while the speed search is active. If this value is set high, the speed search is done more quickly, but it may cause stress on the motor. The [FU2-22] Fly-Down T determines the time gradient that reduces frequency while the speed search is active. If this value is set low, the search time is shortened but overcurrent trip may result depending on the load condition, so factory setting is recommended.

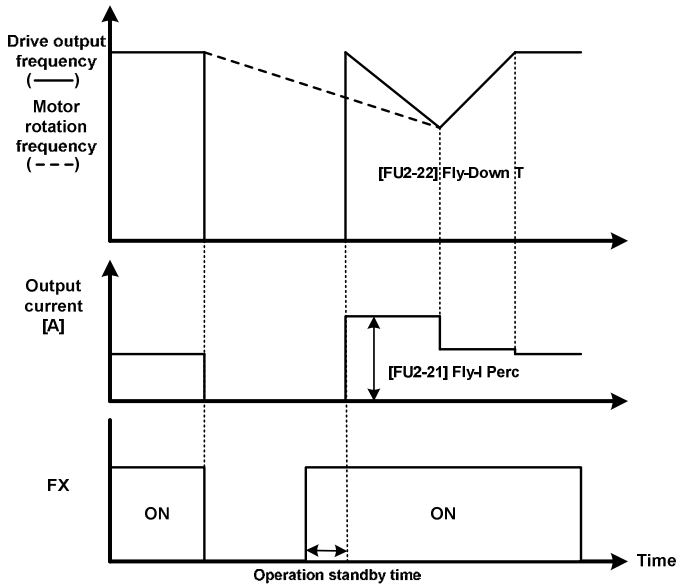


Figure 6-8 Flying-Start

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.
- Flying-start requires a few seconds of operation standby time.

6.5 Stop mode

There are three ways to stop the LSMV: 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

Code	Displayed Message	Function Name	Value	Function description
FU1-09	Stop mode	Stop mode	Free-run	Set stop type to Free-run.

If you issue a stop command during LSMV operation, the output is cut off, and voltage and frequency output become 0.

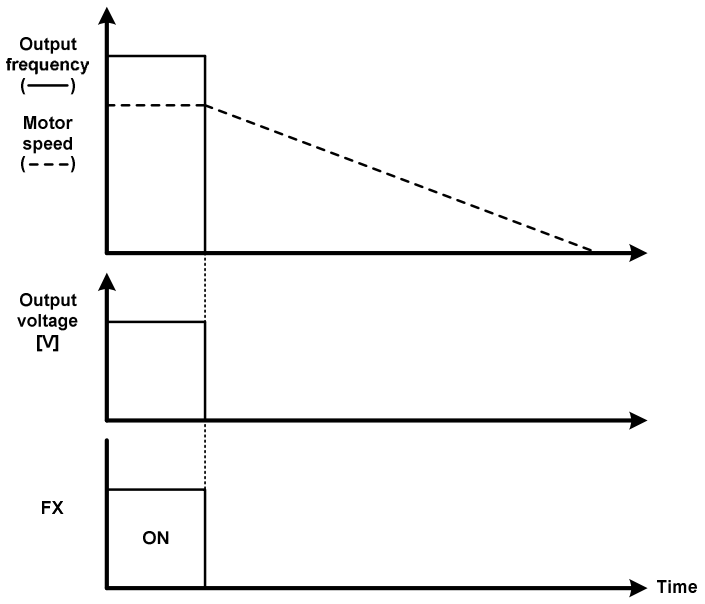


Figure 6-9 Free Run Stop

■ Decel Stop

Code	Displayed Message	Function Name	Value	Function description
FU1-09	Stop mode	Stop mode	Decel	Set stop type to Decel.
DRV-02	Dec. time	Deceleration time	0 - 6000 s	Sets the deceleration time from [FU1-30] Max Freq to 0Hz.

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

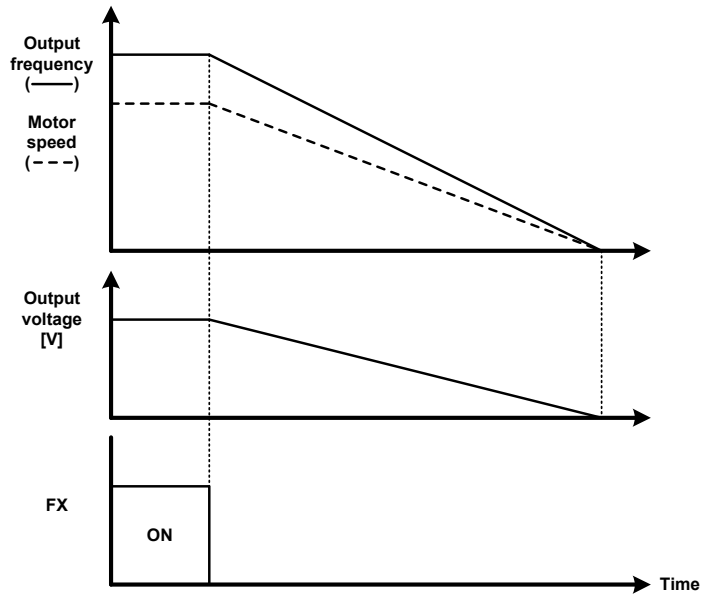


Figure 6-10 Decel Stop

■ Stop via DC-Brake

Code	Displayed Message	Function Name	Value	Function description
FU1-09	Stop mode	Stop mode	Dc-brake	Set stop type to Dc-brake.
FU1-10	DcBlk time	Output blocking time before DC braking	1.00 ~ 60.00 s	It is the time of cutting off the LSMV output before DC start begins.
FU1-11	DcBr freq	DC braking frequency	0.10 ~ 10.00 Hz	Sets the start frequency for DC braking from deceleration.
FU1-12	DcBr time	DC braking time	1.0 ~ 60.0 s	LSMV supplies DC to the motor throughout the preset time while DC stop is active.
FU1-13	DcBr value	DC braking quantity	0 ~ 200%	It is the amount of DC supplied to the motor, and it is set to % of the rated current.

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.

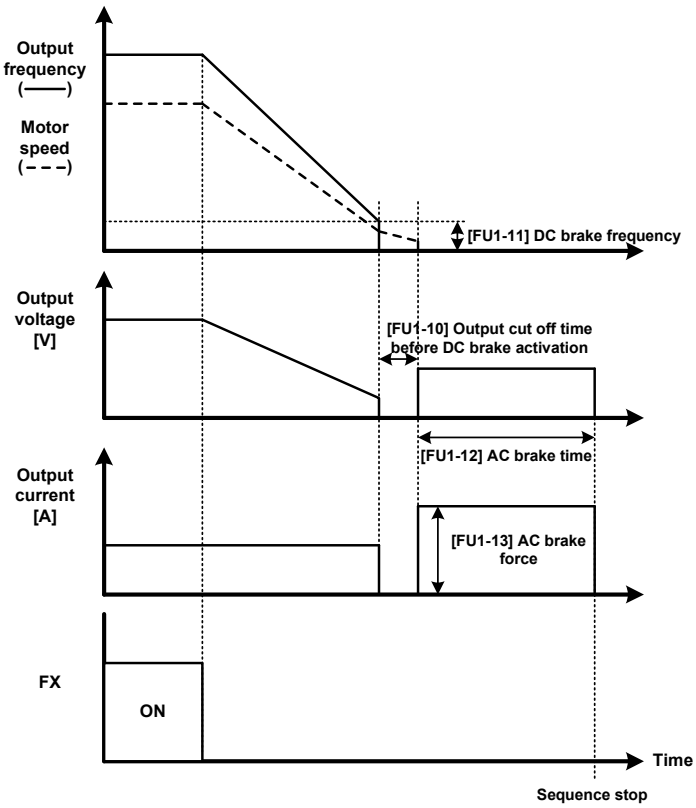


Figure 6-11 DC-Brake Stop

Note
▪ Do not set the DC braking quantity above the rated current of the LSMV. It may cause motor overheat or overload fault. ▪ 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 fault.

6.6 Frequency Accel/Decel Curve

■ Linear

Code	Displayed Message	Function Name	Value	Function description
FU1-02	Acc. pattern	Accelerating pattern	Linear	Set acceleration pattern to Linear.
FU1-03	Dec. pattern	Decelerating pattern	Linear	Set deceleration pattern to Linear.

Linear Accel/Decel pattern. Used for general purpose. (factory setting)

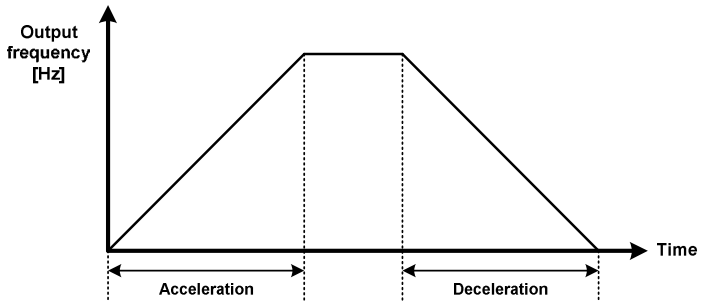


Figure 6-12 Linear Accel/Decel Pattern

■ S-curve

Code	Displayed Message	Function Name	Value	Function description
FU1-02	Acc. pattern	Accelerating pattern	S-curve	Set acceleration pattern to S-curve.
FU1-03	Dec. pattern	Decelerating pattern	S-curve	Set deceleration pattern to S-curve.
FU1-04	Start Curve	S-curve start point gradient	0 ~ 100%	Specify the gradient level of the start point.
FU1-05	End Curve	S-curve end point gradient	0 ~ 100%	Specify the gradient level of the stop point.

The S-curve Accel/Decel pattern can prevent shock during acceleration/deceleration. Accordingly, it can prevent objects from shaking on a conveyor. In addition, the gradient for the curve line at the start and the curve line when arriving at the target frequency can be set independently, which allows diverse S shape settings.

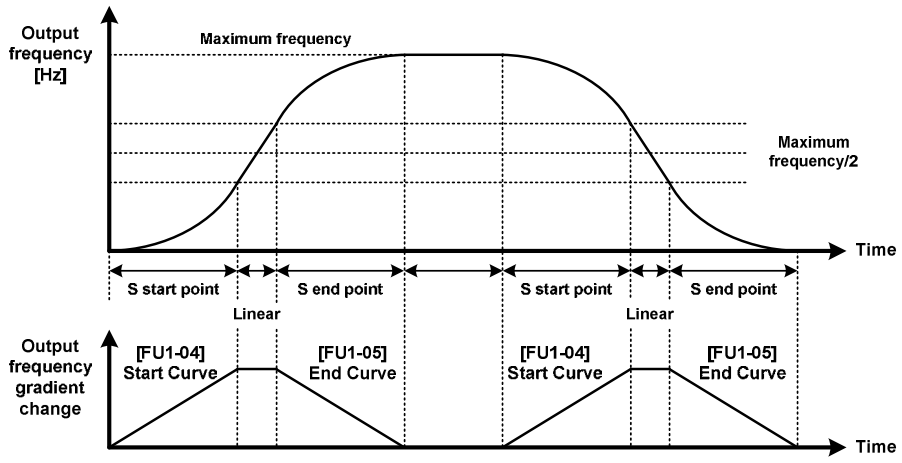


Figure 6-13 S-curve Accel/Decel Pattern

The S-curve related formula is as detailed below. If the % value of the [FU1-04] Start Curve and the [FU1-05] End Curve is increased, the acceleration/deceleration time becomes longer than the setting. If the default setting of 50% is used, the [DRV-01, 02] Acc. Time, Dec. Time is lengthened by 40%.

- 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

Code	Displayed Message	Function Name	Value	Function description
FU1-02	Acc. pattern	Accelerating pattern	U-curve	Set acceleration pattern to U-curve.
FU1-03	Dec. pattern	Decelerating pattern	U-curve	Set deceleration pattern to U-curve.

The U-curve Accel/Decel is used for conditions that requires smooth acceleration/deceleration as shown in above figure.

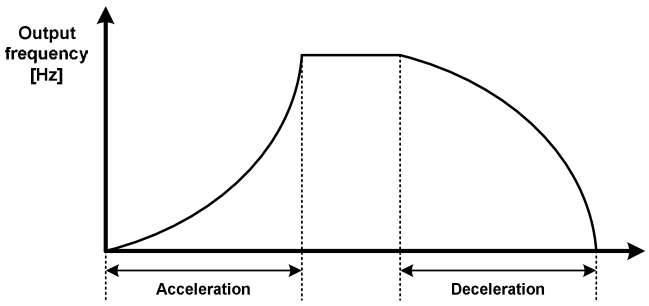


Figure 6-14 U-curve Accel/Decel Pattern

6.7 Frequency Limit Function

Set the following parameters to use frequency limit function.

Code	Displayed Message	Function Name	Value	Function description
FU1-24	Freq limit	Frequency upper/lower limit selection	No Yes	You can set whether or not to use upper/lower limit of the command frequency.
FU1-25	F-limit Lo	Lower limit frequency	0 ~ [FU1-26] F-limit Hi	Sets the lower limit of the command frequency. If a frequency below the preset frequency is received, then the commend is recognized as the preset frequency.
FU1-26	F-limit Hi	Upper limit frequency	[FU1-25] F-limit Lo ~ [FU1-30] Max Freq	Sets the upper limit of the command frequency. If a frequency above the preset frequency is received, then the commend is recognized as the preset frequency.

It is the feature for limiting the LSMV target frequency. The upper and lower limits of the output frequency is set. If the frequency 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.

6.8 Fault Detection Setup

LSMV has different functions for fault detection. The Fault Detection features include the user setting fault detection feature and the default fault detection feature, which is always engaged. The English message displayed next to the protective feature is the error message indicated on the keypad in case of fault.

■ Output current related fault detection:

The fault detection criteria is categorized into Drive rated current and Motor rated current. The Drive rated current is the LSMV product rating that can be changed by the user. The motor rated current can be set in [FU2-43] Rated-Curr.

■ Overcurrent fault (Output OCT)

The output is cut off if the LSMV output current exceeds 140% of the **Drive rated current**. (Basic fault detection)

■ Drive overload fault (Inv.OLT)

The output is cut off if the LSMV output current exceeds 140% of the **Drive rated current** for over 1 minute. Has unique characteristic during return, and if the output current is maintained at 110%, the output current is cut off after approximately 3 minutes. (Basic fault detection)

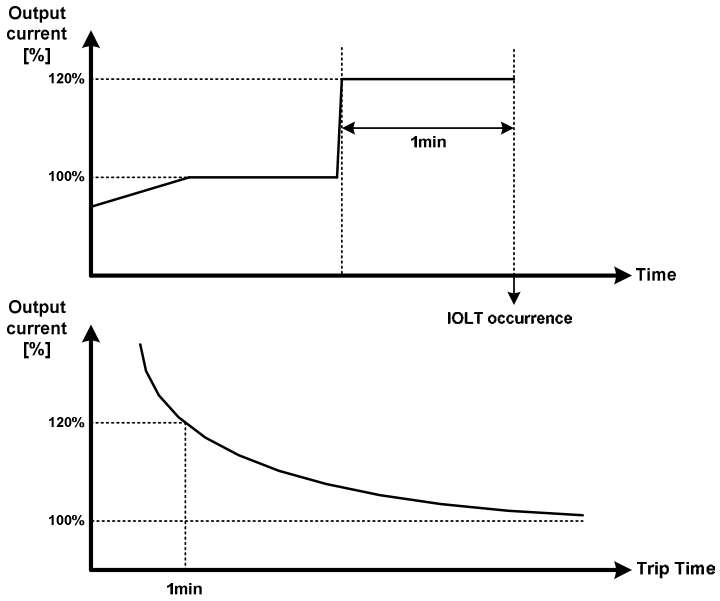


Figure 6-15 Drive Overload (Inv. OLT) Fault

■ Ground Fault

Detects the unbalanced phase in the output current and cuts off the output in case of a damage on LSMV output line that results in ground fault. In case of ground fault protection, the detection feature may not activate even if there is output ground accident if the leaked current is low. But it may be triggered by the current hunting while the system is in operation. (Basic fault detection)

■ Overload Fault (Over Load)

The output is cut off if the LSMV output current exceeds the OLT (overload) level and the OLT (overload) time set for **Motor rated current**. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
FU1-59	OLT select	Select Overload Fault	No Yes	Sets whether or not overload fault detection is used.
FU1-60	OLT level	Overload fault level	30 ~ 150%	Sets the current size compared to [FU2-43] Rated-curr motor rated current for determining overload fault.
FU1-61	OLT time	Overload fault time	0.0 ~ 60.0 s	Sets the time (in seconds) for determining fault if the [FU1-60] OLT level current continues for a certain amount of time.

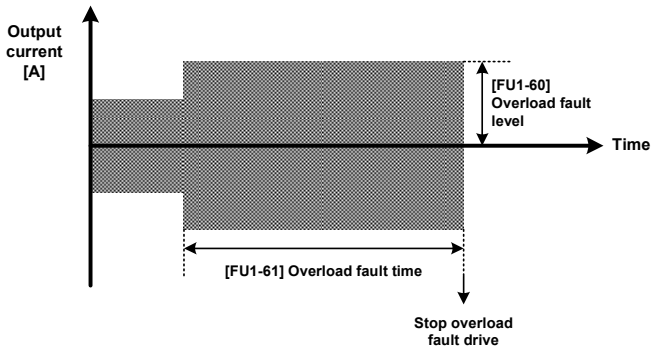


Figure 6-16 Overload Fault

■ Reference: Overload Warning (OL)

You can set overload warning to a level lower than the overload fault level to warn the user before the overload fault occurs. Unlike the overload fault, the warning does not cut off the output. One of the Aux terminal among the [I/O-37~44] Aux mode1~7 can be set to OL for overload warning.

Code	Displayed Message	Function Name	Value	Function description
FU1-57	OL level	Overload alarm level	30 ~ 110%	Sets the current size compared to [FU2-43] Rated-curr motor rated current for determining overload warning.
FU1-58	OL time	Overload warning time	0.0 ~ 30.0 s	Sets the time (in seconds) for determining warning if the [FU1-57] OL level current continues for a certain amount of time.

■ Electronic Thermal Fault (E-thermal)

This function protects the motor from overheat without adding extra thermal relay from outside. The LSMV calculates the theoretical temperature elevation of the motor via output frequency and output current and determines motor overload. **The E-thermal feature can be used properly** by setting the current size based on the motor rated current for continuous operation without overheating, and the current size that may cause damage to the motor after 1 minute of operation. In addition, the E-thermal feature has the counter-time characteristics that increases the cut off time as the output level size becomes greater than the detection level. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
FU1-53	ETH select	Select electronic thermal	No Yes	Sets whether or not E-thermal detection is used.
FU1-54	ETH 1min	One minute level of electronic thermal	[FU1-55] ETH cont ~ 200%	Sets the size of the current compared to [FU2-43] Rated-curr motor rated current that may cause overheating if flowed in the motor for 1 minute.
FU1-55	ETH cont	Continuous operation level of electronic thermal	50 ~ [FU1-54] ETH 1min	Sets the maximum size of the current compared to[FU2-43] Rated-curr motor rated current that allows normal operation even under continuous flow in the motor.
FU1-56	Motor type	Motor cooling method	Self-cool Forced-cool	Sets the motor cooling method. If self cooling method is set, then the E-thermal detection level may change based on the output frequency.

Self-cool: It is set when using the fan that is attached to an induction motor for the cooling method. 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] ETH cont electronic thermal level for continuous operation decreases by frequency as shown in Figures 6-16, 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] ETH cont electronic thermal level for continuous operation is applied.

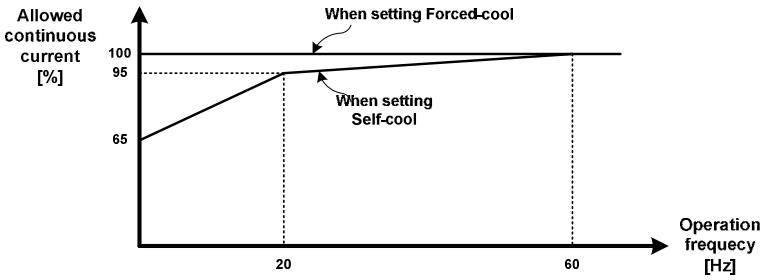


Figure 6-17 Characteristics of permissible continuous current reduction by frequency

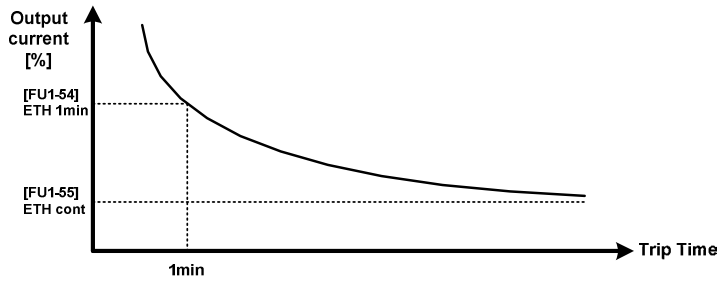


Figure 6-18 Characteristic curve of the electronic thermal level

■ Low current fault (No Motor trip)

It is a protective feature for detecting motor disconnection due to output switch gear failure while LSMV is operating. Output is cut off if the output falls below the preset **motor rated current** and operated for preset time in that condition. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
FU1-65	No Motor Sel	Operation prevention in case of low current fault	No Yes	Sets whether or not low current fault detection is used.
FU1-66	NoMotorLevel	Operation prevention detection level in case of low current fault	5 ~ 100%	Sets the low current fault detection level compared to the [FU2-43] Rated-curr motor rated current.
FU1-67	NoMotorTime	Operation prevention detection time in case of low current fault	1 ~ 3000 s	Sets the time (in seconds) for determining fault if current below the [FU1-66] NoMotorLevel flows for a certain period of time.

■ In/Output Line PhaseOpen

Input Open-Phase (InPhaseOpen): It is the protective feature in case of input open phase while LSMV is operating. InPhaseOpen detection feature activates if any one of the input phase is opened. Output is cut off if any of the input current phase is received at 10% below the **LSMV input phase's rated voltage**. (User defined fault detection)

Output Open-Phase (OutPhaseOpen): OutPhaseOpen detection feature activates if any one of the output phase is opened while LSMV is operating. Output is cut off if any of the output current phase is outputted at 3% below the **motor rated current**. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
FU1-62	PO Trip Sel	Input/output open-phase protection	None InputPO Sel OutputPO Sel InOutPO Sel	Selects whether or not to use the output open-phase detection feature.

*. [FU1-62] PO Trip Sel includes input/output open-phase protection option. You can set to detect input open-phase, output open-phase, or in/output open-phase.

Voltage related fault detection:

The fault detection criteria is categorized into LSMV input rated voltage and Cell DC voltage.

Input Overvoltage Fault (Input OVT)

Output is cut off if the transformer input terminal voltage exceeds 120% of the **LSMV input rated voltage**. (refer to basic fault detection)

Input Low Voltage Fault (Input LVT)

Output is cut off if the transformer input terminal voltage falls below 70% of the **LSMV input rated voltage**. (refer to basic fault detection)

Cell Overvoltage Fault (DC-Link OVT)

Output is cut off if any of the **DC Link voltage** in all the cells in LSMV exceeds 1050V. (Basic fault detection)

- Reference: DC voltage increase usually occurs during deceleration, and created by the regenerative energy if the [DRV-02] Dec. Time setting is shorter than the load condition. LSMV has the voltage stall feature that automatically stops deceleration if the DC voltage exceeds 1000V during deceleration. The feature maintains the frequency and if DC voltage decreases, deceleration is restarted. Accordingly, the deceleration time may become longer than the preset time.

Temperature related fault detection:

If the Cell temperature and input terminal transformer temperature is higher than spec temperature, LSMV triggers fault.

CELL OverHeat

Each cell is equipped with a temperature sensor and it sends the detected temperature information to the Master. Temperature information from the cell higher than 75 ℃ is considered a fault. (Basic fault detection)

Trans OverHeat

The input terminal transform measures the temperature with the resistance of the PT adjacent to the core, and it sends the detected temperature information to the PLC mounted on the panel. If the transformer temperature exceeds 120 degrees C, the PLC sends contact signal to the controller and detects fault through the multi-function terminal - Refer to Multi-Function Terminal Fault Detection. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
I/O-18	M4 Define	Multi-function input with Initial setting at Trans. OHT	Trans. OHT	Transform overheating default setting is M4. Do not change the M4.

Multi-function terminal fault detection:

LSMV can receive fault signal via M0~M14 multi-function terminal input. Refer to 6.9 Input Terminal Setup.

■ BX Fault (BX)

This fault detection emergency stops the LSMV. The emergency stop switch is installed on the front of the LSMV door. It can generate BX signal and the output is cut off when the switch is activated. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
I/O-28	M14 Define	BX exclusive terminal	BX	The M14 multi-function terminal is BX exclusive terminal.

■ Motor OverHeat

The trip connection for the motor temperature sensor can be connected through the multi-function terminal to cut off the output in case of motor overheating. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
I/O-23~ I/O-27	M9~M13 Define	Multi-function input with initial setting as None	*Motor OHT	Motor overheating detection has no initial setting terminal.

* If a fault without no initial setting is used for multi-function fault detection, use any one of the terminals with None as initial setting, and change the terminal information.

■ Cooling System Fault (FAN Error)

Output can be cut off through the contact signal in case of failure of the cooling system installed on top of the LSMV. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
I/O-19	M5 Define	Multi-function input with initial setting as Fan Trip	Fan Trip	Initial setting for Fan Error is set with M5. Do not change the M5.

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

The contact can be configured in accordance with the user set fault stop and sequence setting procedure to process as faults. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
I/O-15	M1 Define	Multi-function input with initial setting as Ext Trip1	Ext Trip1	Initial setting for external fault 1 is set with M1. Do not change the M1.
I/O-23~ I/O-27	M9~M13 Define	Multi-function input with initial setting as None	*Ext Trip2	External Fault 2 has no initial setting terminal.

- If a fault without no initial setting is used for multi-function fault detection, use any one of the terminals with None as initial setting, and change the terminal information.

■ Control Power Low Voltage Fault (Control LVT)

In case of low voltage on LSMV power voltage of 380V (or 440V) due to power interruption, UPS is set to detect the condition and supply emergency power to maintain stable control power supply. The user must set the emergency power duration time of the UPS to prevent the control power from being cut off. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
I/O-22	M8 Define	Multi-function input with initial setting as Control LV	Control LV	Initial setting for control power low voltage fault is set with M8. Do not change the M8.
I/O-98	UPS_OFF Dly	UPS Off time	1 ~ 9000 s	Sets the time from control power interruption to fault occurrence.

The protective feature for the control power low voltage fault engages after the expiration of the time set in [I/O-98] that starts upon power interruption. Please note that LSMV will come to a stop if the control power is cut off due to insufficient UPS power, and may result in an accident.

■ PLC Error

PLC is mounted on the control panel and is used for HMI function as well as in/output contact control. In case of PLC failure, the PLC trip contact is received to engage protective feature. (User defined fault detection)

Code	Displayed Message	Function Name	Value	Function description
I/O-23~ I/O-27	M9~M13 Define	Multi-function input with initial setting as None	*PLC_Error	PLC Fault has no initial setting terminal.

* If a fault without no initial setting is used for multi-function fault detection, use any one of the terminals with None as initial setting, and change the terminal information.

- Reference: Multi-Function Terminal Warning Detection

  It is the protective feature similar to the multi-function terminal fault detection feature. But instead of engaging protective action, the multi-function terminal can be set to alert the user with a warning. The warning detection has door open warning and input transformer overheat warning.

  - DOOR Open

    The feature uses the contact signal of the limit switch mounted on the LSMV door. A warning can be sent to the user if the door is opened.

Code	Displayed Message	Function Name	Value	Function description
I/O-23~ I/O-27	M9~M13 Define	Multi-function input with initial setting as None	*Door Open	Door open warning has not initial setting terminal.

  - Input Transformer Overheat Warning (Trans.OHW)

    The contact signal from PLC can be used to receive warning if the transformer temperature exceeds 90 degrees C.

Code	Displayed Message	Function Name	Value	Function description
I/O-23~ I/O-27	M9~M13 Define	Multi-function input with initial setting as None	*Trans.OHW	Input transformer overheat warning has not initial setting terminal.

■ Cell related fault:

It is the protective feature pertaining to the fault of a Cell in the LSMV.

■ Communication Error with the Master Cell (CAN Error)

It is the protective feature that activates in case of communication failure between the LSMV controller and Cell. Bypass can be engaged based on the cell bypass setting - Refer to 6.11 Cell Bypass Procedure. (basic fault detection)

■ Cell Trip

It is the protective feature that activates in case the Cell in LSMV self-detects fault. The fault detected by a Cell is as follows.

Protection Function	Keypad Fault Indication	Details
Overcurrent	Cell OC1	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 the output.
Cell overvoltage protection	Cell OVT	If a Cell's DC voltage exceeds 1100V, it is processed as a fault and fault signal is sent to Master and the output is cut off.
Arm short	Cell OC2	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 the output.
Communications error	Cell Can Err	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 the output.
Cell overheat	Cell OverHeat	If the heat sink in a cell overheats because of LSMV cooling system failure, 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 the output.
NTC open	Cell NtcOPEN	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 the output.
Low voltage protection	Cell LVT	If a Cell's power voltage becomes low or there is not enough torque, it may result in motor overheating. As a result, a Cell is processed as fault if the DC voltage is decreased by 660V or more from its normal state, and fault signal is sent to Master and the output is cut off.

The cell bypass feature may engage based on the type of failure. Refer to 6.11 Cell Bypass Procedure.

6.9 In/Output Terminal Setup

■ Multi-function input terminal setting:

The M0~M14 multi-function terminal input of the LSMV has various usage, including operation command, multi-step frequency command, multi-step acceleration/deceleration command, and fault contact feature.

Code	Displayed Message	Default Value
I/O-14	M0 define	RST
I/O-15	M1 define	Ext Trip1
I/O-16	M2 define	FX
I/O-17	M3 define	RX
I/O-18	M4 define	Trans. OHT
I/O-19	M5 define	Fan Trip
I/O-20	M6 define	High Voltage
I/O-21	M7 define	Run Enable
I/O-22	M8 define	Control LV
I/O-23	M9 define	None
I/O-24	M10 define	None
I/O-25	M11 define	None
I/O-26	M12 define	None
I/O-27	M13 define	None
I/O-28	M14 define	BX

It is the setting and default value of the multi-function input terminal. Do not change any terminal that has a setting other than None, if possible.

■ 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	Ana. Change	Analog input change
RX	Reverse run/stop	Xcel stop	Prohibit Accel/Decel
RST	Reset	Loc / Rem	Select local/remote
JOG	Jog	Door Open	Door Open Warning
BX	BX Fault	Trans. OHW	Transformer Overheat Warning
Speed-L	Multi-step speed - low	Trans. OHT	Transformer Overheat Fault
Speed-M	Multi-step speed - medium	Motor OHT	Motor Overheat Fault
Speed-H	Multi-step speed - high	Fan Trip	Fan error
Speed-X	Multi-step speed - additional selection	Ext Trip1	External trip 1
Xcel-L	Multi-step Accel/Decel - low	Ext Trip2	External trip 2
Xcel-M	Multi-step Accel/Decel - medium	High Voltage	High Voltage Input Contact
Xcel-H	Multi-step Accel/Decel - high	Run Enable	Selects availability of operation command

I/O-14 to 28 Value	Function Name	I/O-14 to 28 Value	Function Name
Up	Increase (up-down)	Control LV	Control Power Low Voltage Fault
Down	Decrease (up-down)	PLC_Error	PLC failure
3-Wire	3 wire	None	Does not have any function
Analog hold	Frequency fixation of analog command		

■ Operation Command Input Terminal

- 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 fault when a fault occurs.
- 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.

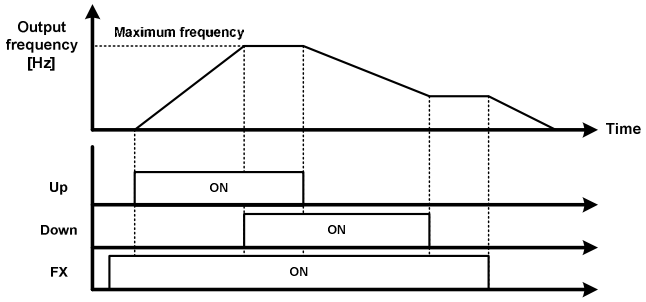


Figure 6-19 UP/DOWN Operation

- 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.)

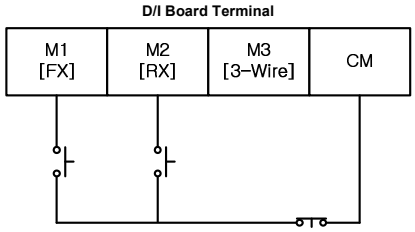


Figure 6-20 Example of a 3-Wire Operation Connection

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

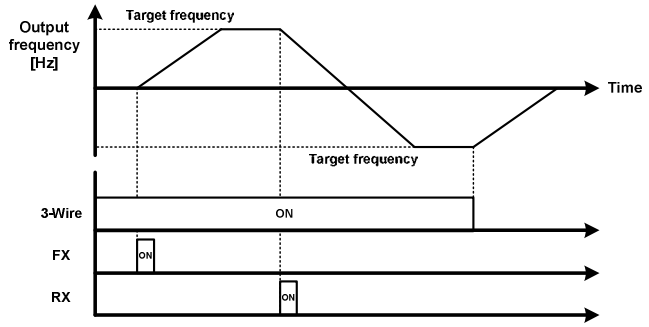


Figure 6-21 3-Wire Operation

- Analog hold

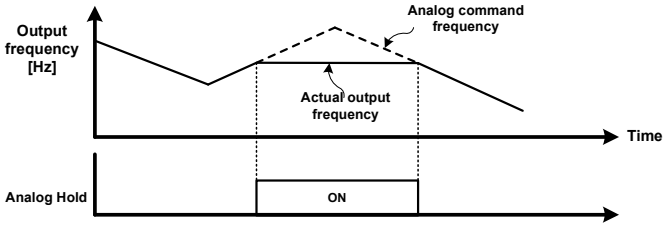


Figure 6-22 Analog Hold Operation

If the frequency command [DRV 04] Freq mode is set to analog command V1 and I, and the terminal set to “Analog Hold” is turned ON, the frequency is maintained even if the analog frequency command is changed. This can be applied when command frequency change is not needed in a constant speed section after the LSMV is accelerated. 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: The V1 and I setting in [DRV 04] Freq mode is changed if the set terminal is inputted. If the V1 operation is set to [DRV 04] Freq mode and the set terminal is turned ON, the mode changes to I operation. If the terminal is turned ON when the mode is I, then it swatches back to V1.
- 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] Drive mode, Freq mode and [DRV-91, 92] Drive mode2, Freq mode2. If the set terminal is turned ON while stopped, the mode switches to mode2.
- Xcel stop: Stops Accel/Decel if set terminal is ON.
- High Voltage: It is the contact for determining high voltage input by using the contact signal of the LSMV input shaft switch gear.
- Run Enable: Can carry out RUN command when set terminal is ON.

■ Multi-step frequency selection input terminal

- JOG, Speed-L, Speed-M, Speed-H, Speed-X

  The command frequency is set depending on the terminal combination as shown below. The Keypad Step Freq 0 ~ 15 frequency value is selected as the command frequency based on the digital information of Speed-L, Speed-M, Speed-H, and Speed-X.

Related Code	Displayed Message	Command Speed	Speed-X	Speed-H	Speed-M	Speed-L	JOG
DRV-00	Cmd. freq	Speed-0 (speed 0)	0	0	0	0	0
I/O-57	Jog Freq	Jog frequency	X	x	x	x	1
DRV-05	Step Freq-1	Speed-1 (speed 1)	0	0	0	1	0
DRV-06	Step Freq-2	Speed-2 (speed 2)	0	0	1	0	0
DRV-07	Step Freq-3	Speed-3 (speed 3)	0	0	1	1	0
I/O-58	Step Freq-4	Speed-4 (speed 4)	0	1	0	0	0
I/O-59	Step Freq-5	Speed-5 (speed 5)	0	1	0	1	0
I/O-60	Step Freq-6	Speed-6 (speed 6)	0	1	1	0	0
I/O-61	Step Freq-7	Speed-7 (speed 7)	0	1	1	1	0
I/O-62	Step Freq-8	Speed-8 (speed 8)	1	0	0	0	0
I/O-63	Step Freq-9	Speed-9 (speed 9)	1	0	0	1	0
I/O-64	Step Freq-10	Speed-10 (speed 10)	1	0	1	0	0
I/O-65	Step Freq-11	Speed-11 (speed 11)	1	0	1	1	0
I/O-66	Step Freq-12	Speed-12 (speed 12)	1	1	0	0	0
I/O-67	Step Freq-13	Speed-13 (speed 13)	1	1	0	1	0
I/O-68	Step Freq-14	Speed-14 (speed 14)	1	1	1	0	0
I/O-69	Step Freq-15	Speed-15 (speed 15)	1	1	1	1	0

- 0: OFF, 1: ON, x: Not considered
- Ex)

  M1 input terminal = Speed-L

  M2 input terminal = Speed-M

  M3 input terminal = Speed-H

  M4 input terminal = Jog

  M5 input terminal = BX

  M7 input terminal = FX

  M8 input terminal = RX

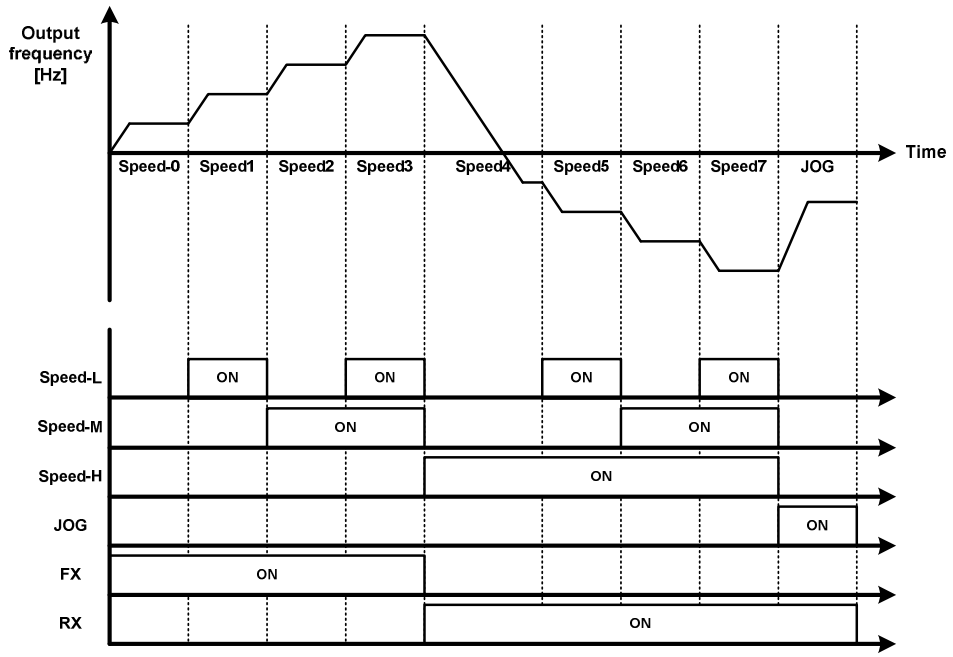


Figure 6-23 Jog and multi-step speed operation

■ Multi-step Accel/Decel time selection input terminal

- Xcel-L, Xcel-M, Xcel-H

  The Accel/Decel time is set depending on the terminal combination as shown below. The Accel/Decel time can be changed to [I/O-70~83] 1 ~ 7 Accel/Decel time setting while in operation.

Code	Displayed Message	Function Name	Xcel-H	Xcel-M	Xcel-L
DRV-01	Acc time	No. 0 Acc time	0	0	0
DRV-02	Dec time	No. 0 Dec time	0	0	0
I/O-70	ACC-1	No. 1 Acc time	0	0	1
I/O-71	DEC-1	No. 1 Dec time	0	0	1
I/O-72	ACC-2	No. 2 Acc time	0	1	0
I/O-73	DEC-2	No. 2 Dec time	0	1	0
I/O-74	ACC-3	No. 3 Acc time	0	1	1
I/O-75	DEC-3	No. 3 Dec time	0	1	1
I/O-76	ACC-4	No. 4 Acc time	1	0	0
I/O-77	DEC-4	No. 4 Dec time	1	0	0
I/O-78	ACC-5	No. 5 Acc time	1	0	1
I/O-79	DEC-5	No. 5 Dec time	1	0	1
I/O-80	ACC-6	No. 6 Acc time	1	1	0
I/O-81	DEC-6	No. 6 Dec time	1	1	0
I/O-82	ACC-7	No. 7 Acc time	1	1	1

Code	Displayed Message	Function Name	Xcel-H	Xcel-M	Xcel-L
I/O-83	DEC-7	No. 7 Dec time	1	1	1

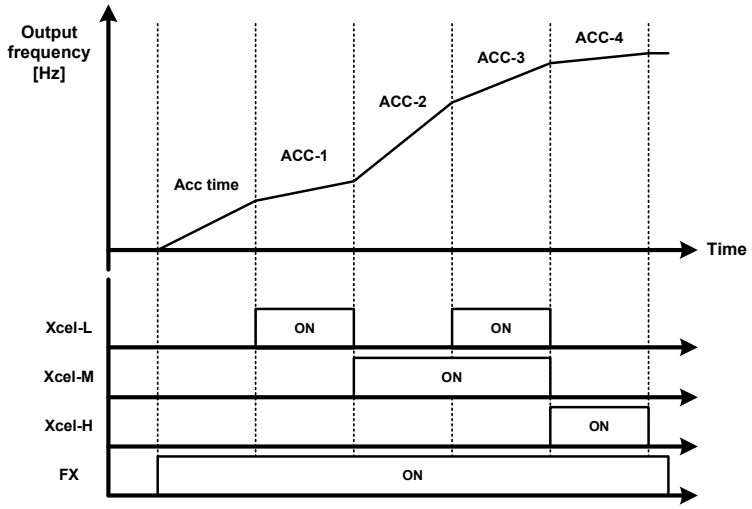


Figure 6-24 Applying Accel/Decel Time

■ Multi-Function Terminal Fault Detection

- Refer to 6.9 Fault Detection Setup - Multi-Function Terminal Fault Detection.
- BX: Sets internally set terminal as an emergency stop terminal.
- Door Open: Warning for LSMV panel door open.
- Trans. OHW: Warning for transformer overheat.
- Trans. OHT: Fault for transformer overheat.
- Motor OHT: Fault for motor overheat.
- Fan Trip: Cooling system fault.
- Ext Trip1: Blocks the output and generates a fault message if set terminal is ON.
- Ext Trip2: Blocks the output and generates a fault message if set terminal is ON.
- Control LV: Control Power Interruption Fault
- PLC_Error: Cuts off the output and displays fault message in case of PLC fault.

■ To view the condition of the multi-function input terminal.

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].

Code	Displayed Message	Input Display Method	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
I/O-29	In status	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

Code	Displayed Message	Input Display Method	M14	M13	M12	M11
			14 Bit	13 Bit	12 Bit	11 Bit
I/O-30	In status_H	0: OFF 1: ON	0/1	0/1	0/1	0/1

■ To change the respond performance of the multi-function input terminal,

The allowed time for [I/O-31] input change sets the input terminal respond performance. 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 Terminal

You can set the multi-function input contact type to either Normal Open (A contact) or Normal Close (B contact).

Selects input contact type of keypad.

Code	Displayed Message	setting method	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
I/O-32	In No/Nc Set	0: N/O 1: N/C	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Code	Displayed Message	setting method	M14	M13	M12	M11
			14 Bit	13 Bit	12 Bit	11 Bit
I/O-33	H No/Nc Set	0: N/O 1: N/C	0/1	0/1	0/1	0/1

■ 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.)

Code	Displayed Message	Function Name	Default Value	Range
I/O-34	In CheckTime	Filter time constant of multi-function input terminal	1 ms	1 ~ 1000 ms

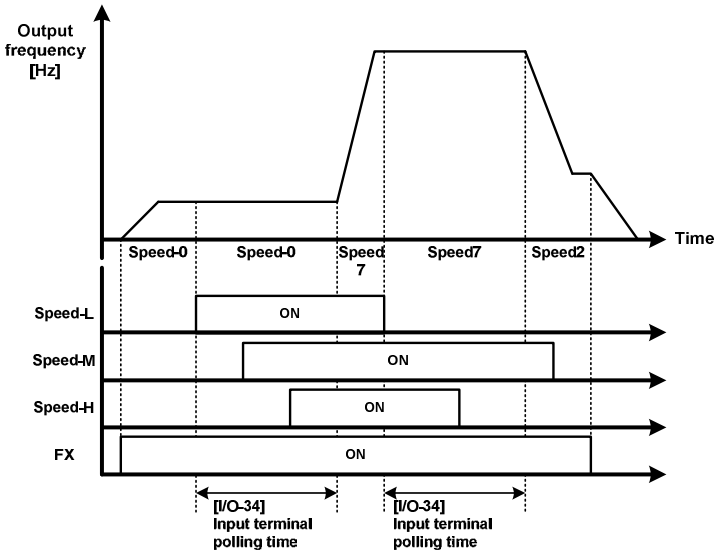


Figure 6-25 Change of allowed time for input

■ Multi-function output terminal setting:

The Aux 1~8 terminals are the contact output terminals for informing the user with the LSMV status information, operation information, fault, and warning.

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

It is the setting and default value of the multi-function input terminal. Do not change any terminal that has a setting other than None, if possible.

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

I/O -37 to 44 Data Setting	Function description	I/O -37 to 44 Data Setting	Function 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 warning	Warning	Warning
IOL	Drive overload warning	FAN RUN	Fan operation
Stall	Stall	NORMAL	Operation available
OV	Overvoltage	OCT	Overcurrent fault
LV	Low voltage	Run_ MV	MV operation
OH	Drive overheat		

- FDT-1: Sends out contact output if the output frequency of the LSMV in operation reaches the detection frequency.

Code	Displayed Message	Function Name	Value	Function description
I/O-35	FDT freq	Detected frequency	0 ~ [FU1-30] Max Freq	Sets the base frequency for FDT output frequency detection.
I/O-36	FDT band	Detected frequency band	0 ~ [FU1-30] Max Freq	Sets the base frequency bandwidth for FDT output frequency detection.

- Operating condition:

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

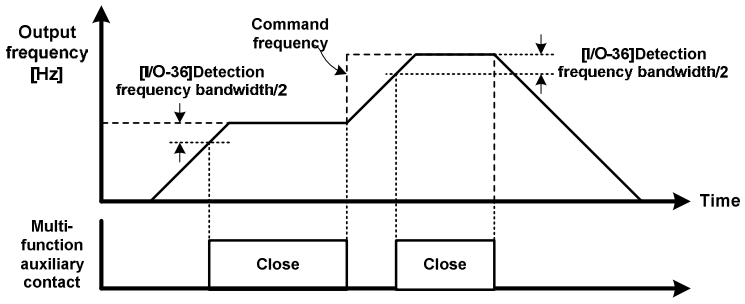


Figure 6-15 Frequency Detection (FDT-1)

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

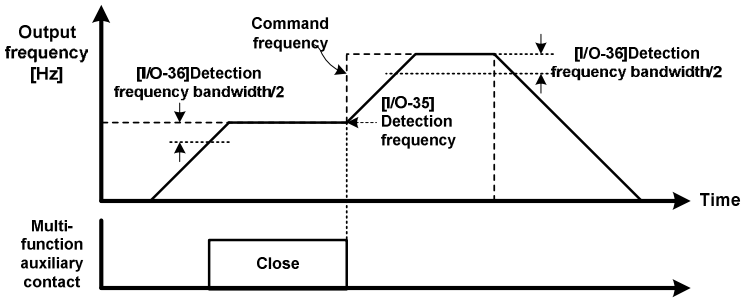


Figure 6-16 Frequency Detection (FDT-2)

- FDT-3: Works when output frequency, detected frequency and detected frequency bandwidth are in the following conditions. Select to use frequency match.
  - Operating condition: Absolute value (detected frequency – output frequency) ≤ detected frequency band / 2

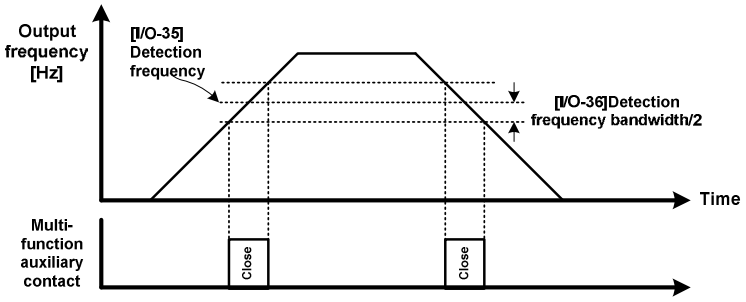


Figure 6-17 Frequency Detection (FDT-3)

- FDT-4: Works when output frequency, detected frequency and detected frequency bandwidth are in the following conditions. Select to use frequency detection.
  - Operating condition:
    - When accelerating: Output frequency ≥ Detected frequency
    - When decelerating: Output frequency > (Detected frequency – Detected frequency bandwidth / 2)

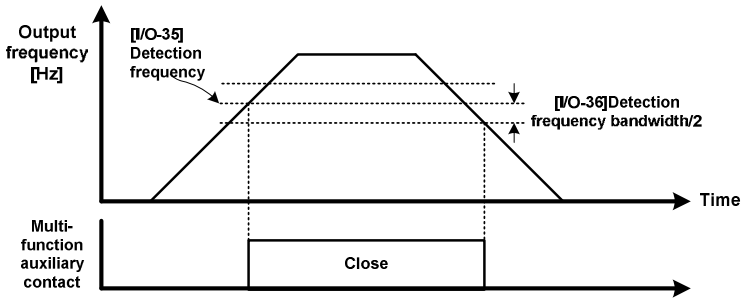


Figure 6-18 Frequency Detection (FDT-4)

- FDT-5: Reverse output of FDT-4. Select to use frequency detection.
  - Operating condition:
    - When accelerating: Output frequency ≤ Detected frequency
    - When decelerating: Output frequency < (Detected frequency – Detected frequency bandwidth / 2)

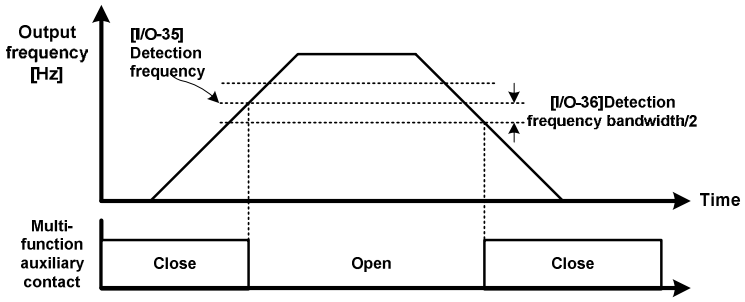


Figure 6-19 Frequency Detection (FDT-5)

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

  Stall is a feature that lowers the frequency to reduce the LSMV output current during acceleration/constant speed if the output current compared to the motor rated current exceeds the preset value set in the [FU1-64] Stall level. It can be easily applied to the fan and pump loads. Stall function is divided into two sections - acceleration / constant speed, and deceleration. Accel/Constant Speed determines stall via output current, and determines deceleration with the DC voltage of the Cell.

Code	Displayed Message	Function Name	Initial 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 LSMV.
- 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 Cell overheat.
- Lost command: Outputs a signal when frequency command is lost.
- Run: Outputs signal when the LSMV is operating. (Signal is not outputted during DC brake and bypass switch.)
- Stop: Outputs a signal when the LSMV is stopped.
- Steady: Outputs a signal when the LSMV is operating in constant speed.
- Speed search: Outputs a signal when the LSMV is in speed search.
- Ready: It's the LSMV control power ON state.
- Warning: Trans. Signal is outputted if the OHW or Door Open warning is activated.
- FAN RUN: Fan operation signal is outputted if high voltage power is supplied to the LSMV.
- NORMAL: Indicates the normal communication state between the Master and the Cell, and LSMV is in operable condition.
- OCT: Outputs a signal when an overcurrent fault occurs.
- RUN_MV: A function of which terminal status is similar to Run. Gate output is not actually sent from the LSMV during restart by using Cell Bypass but the RUN_MV signal is outputted even during bypass switch.

6.10 Restart Methods after a Fault

Code	Displayed Message	Function Name	Value	Function description
FU2-25	Reset Start	Restart after fault reset	No Yes	Set to Yes to enable Restart after a fault.
FU2-26	Reset Num	Number of restart	0 ~ 10	Select the Restart count after auto reset in case of a fault.

In case of partial fault (refer to Reset Start Target Fault) while the LSMV is operating and the [FU2-25] Reset Start is set to Yes, the LSMV resets automatically after elapse of the time for exhausting the counter electromotive force of the motor. The fault is cleared and the system automatically restarts without the LSMV receiving the Stop command. When a LSMV fault occurs, it blocks the output. The motor performs Free Run. If you do not restart and directly operate at this time, it may cause an overcurrent fault. LSMV automatically uses flying start mode when it restarts. (It is not set by the user.)

■ Reset Start Target Fault

Current related faults – Overcurrent fault (Output OCT), Drive overload fault (Inv.OLT), Overload fault, E-thermal fault, Low current fault (No Motor trip)

Voltage related faults – Input overvoltage fault (Input OVT), Input low voltage fault (Input LVT), Cell DC overvoltage fault (DC-Link OVT)

*. Reset Start feature is not applicable for temperature related faults, multi-function terminal fault, input/output open phase, ground fault detection feature, and voltage/current related Cell faults.

■ Restarting Repeatedly

If [FU2-25] Reset Start is set to Yes [FU2-26] Reset number is specified, it automatically tries to restart a number of times set in [FU2-26] when a trip occurs due to a fault. In case of fault while the [FU2-26] Reset Num is set to 2, and fault occurs again within 30 seconds after the first restart, the system resets again and engages restart. And if a fault occurs again after that within 30 seconds, the LSMV remains in Trip state. It will not restart if [FU2-26] Reset number is set to 0.

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.

6.11 Cell Bypass Modes

LSMV 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. Even if only one of three phases has a fault, also perform bypass for the cells on other phases to keep voltage balance.

CEL-30 Setting Data	Function description
No	Bypass by user selection.
ManualBypass	In case of NTC Open or CAN Error while in Cell fault, the bypass is engaged automatically if the RESET key on the Master Controller is pressed.
Auto-Bypass	When NTC Open or Can Error occurs while in Cell fault, the system automatically performs bypass after a certain time without involving the user and keeps the system 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 and automatic bypass if NTC Open or CAN Error occurs.

■ When Mode is NO

CEL-30	Bypass mode selection	
Related functions	CEL-10	Cell Mode setting (Go setting)
	CEL-11 ~ 13	Bypass setting
	CEL-04 ~ 06	CAN communication state for each phase
	CEL-07 ~ 09	Cell fault state for each phase

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 the [CEL-10] setting mode is set to Yes when starting the bypass, the maximum number of [CEL-03] layers is decreased by the maximum value bypassed in each phase. 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.

Status of each phase's bypass before setting the [CEL-10] Go Setting to Yes

Code	Function Name	Display
CEL-03	Maximum layers	6
CEL-11	U-phase bypass	00000101
CEL-12	V-phase bypass	00000000
CEL-13	W-phase bypass	00000000

Status of each phase's bypass after setting the [CEL-10] Go Setting to Yes

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

■ Reset Bypass Mode for All Cells

CEL-35	Cell Bypass Initialization

Code	Function Name	Default Value	Range
CEL-35	Disables the Cell Bypass.	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

Code	Displayed Message	Function Name	Value	Function description
FU1-73	Ride-Through	Continuous operation feature in case of instantaneous power interruption	No Yes	Select Yes to use toe continuous operation feature in case of instantaneous power interruption.
FU1-75	Slip Perc	Applied Slip ratio in case of instantaneous power interruption	10 ~ 500 %	The frequency is momentarily decreased when the instantaneous power interruption is detected. Set the frequency decrease size and enter the value in % of the motor's rated slip.
FU1-76	Short time S	LV Trip time during instantaneous power interruption	0.01~30.00 sec	Sets the time interval for disabling the input low voltage (Input LVT) protective feature to maintain continuous operation during instantaneous power interruption.
FU1-77	Ride Down T	Output frequency decrease time during instantaneous power interruption	1.0~100 sec	Sets the output frequency decrease gradient during the continuous operation function in case of instantaneous power interruption.

The LSMV can be continuously operated, even if the power supply condition is poor or if there is instantaneous power interruption due to lighting surge, etc. The continuous operation time during this instantaneous power interruption may vary depending on the inertia and the amount of the load, and current related fault or voltage related fault may result based on the relevant parameter setting. The last frequency (the target frequency just before the instantaneous power interruption) is kept as the command frequency during instantaneous power interruption time. The graph below shows how to deal with instantaneous power interruption.

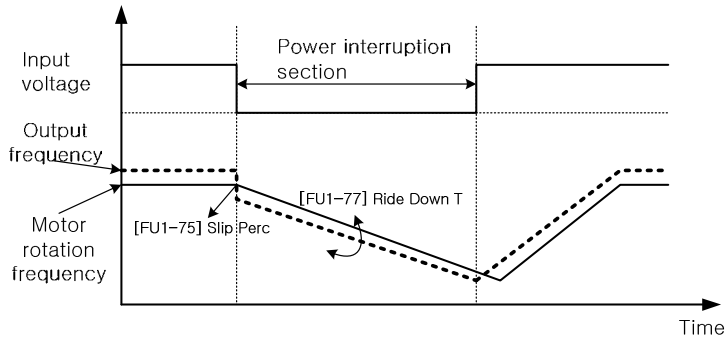


Figure 6-20 Continuous Operation Feature for Instantaneous Power Interruption

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 LSMV. Alarm functions include fault detection, warning detection, operation error detection, and auto-set error detection.

If a warning alarm was sensed on LSMV, 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

The output is cut off via activation of error connection output when the LSMV detects an error. (procedure for stopping due to error is selected. From this point on, this method will be used to handle these errors.) The fault information will be displayed on keypad or HMI. When a fault occurs, check the content on the following table and refer to the cause and solution of the error.

Reset errors before restarting the LSMV as follows:

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

7.2 Fault indication

When a fault occurs in the LSMV, the protective function takes effect, issues an alarm, and displays the content of the trip on keypad. Reset when the protective function is working. See below for keypad loader display.

■ Display of Master Controller Faults

Master displays faults on cells as cell fault collectively. Refer to Chapter 6.8 Fault Detection Setting for detailed information on Fault.

Protection Function	Displayed Message	Details
Overcurrent	Output OCT	The output is cut off if the LSMV output current exceeds 140% of the **Drive rated current**.
Drive overload	Inv.OLT	The output is cut off if the LSMV output current exceeds 140% of the **Drive rated current** for over 1 minute.
Output Ground Fault	Ground Fault	Detects the unbalanced phase in the output current and cuts off the output in case of a damage on LSMV output line that results in ground fault.
Overload	Over Load	The output is cut off if the LSMV output current exceeds the OLT (overload) level and the OLT (overload) time set for **Motor rated current**.
Electronic thermal	E-thermal	The LSMV calculates the theoretical temperature elevation of the motor via output frequency and output current and determines motor overload.
Low current	No Motor trip	It is a protective feature for detecting motor disconnection due to output switch gear failure while LSMV is operating.
Output line open-phase	OutPhaseOpen	It is the protective feature in case of output open phase while LSMV is operating.
Input overvoltage	Input OVT	Output is cut off if the transformer input terminal voltage exceeds 120% of the **LSMV input rated voltage**.
Input low voltage	Input LVT	Output is cut off if the transformer input terminal voltage falls below 120 % of the **LSMV input rated voltage**.
Input line open-phase	InPhaseOpen	It is the protective feature in case of input open phase while LSMV is operating.
Cell DC overvoltage	DC-Link OVT	Output is cut off if any of the DC Link voltage in all the cells in LSMV exceeds 1050V.
Cell overheat	CELL OverHeat	Temperature information from the cell higher than 75 ℃ is considered a fault.
Transformer overheat	Trans OverHeat	Multi-function terminal is used to detect fault if the transformer temperature exceeds 120 degrees C.
BX	BX	This fault detection emergency stops the LSMV. ⚠**Caution: Use this with caution.**
Motor overheating	Motor OverHeat	The trip contact for the motor temperature sensor can be connected through the multi-function terminal to cut off the output in case of motor overheating.

Protection Function	Displayed Message	Details
Fan error	FAN Error	In case of failure of the cooling fan installed at the top of the LSMV, the contact signal can be used to cut off the output.
External fault 1, 2	Ext.Trip 1, Ext.Trip 2	The contact can be configured in accordance with the user set fault stop and sequence setting procedure to process as faults.
Control power low voltage	Control LVT	The output is cut off in case of low voltage due to power interruption of the 380V (or 440V) used for LSMV control power.
PLC failure	PLC ERROR	PLC is mounted on the control panel and is used for HMI function as well as in/output contact control. In case of PLC failure, the PLC trip contact is received to engage protective feature.
Communication failure between Master and Cell	CAN Error	It is the protective feature that activates in case of communication failure between the LSMV controller and Cell.
Cell fault	Cell Trip	It is the protective feature that activates in case the Cell in LSMV self-detects fault.

■ Call Fault Display

In case of Cell Trip, press ENTER in Fault History List in the Keypad to view the fault Cell ID and the Cell fault details.

Protection Function	Displayed Message	Details
Overcurrent	Cell OC1	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 the output.
Arm short	Cell OC2	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 the output.
Cell overvoltage protection	Cell OVT	If a Cell's DC voltage exceeds 1100V, it is processed as a fault and fault signal is sent to Master and the output is cut off.
Low voltage protection	Cell LVT	If a Cell's power voltage becomes low or there is not enough torque, it may result in motor overheating. As a result, a Cell is processed as fault if the DC voltage is decreased by 660V or more from its normal state, and fault signal is sent to Master and the output is cut off.
Communications error	Cell Can Err	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 the output.
Cell overheat	Cell OverHeat	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 the output.
NTC open	Cell NtcOPEN	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 the output.

■ Troubleshooting

Fault name	Cause	Measure
Overcurrent (Output OCT)	▪ Accel/Decel time is too fast compared to the load GD².	▪ Set Accel/Decel time longer.
	▪ LSMV load is greater than rated load.	▪ Expand the LSMV capacity.
	▪ The output is supplied while motor is in Free Run.	▪ Operate when the motor has stopped.
	▪ Output short circuit and ground fault have occurred.	▪ Check the output wiring.
	▪ Main circuit device overheats due to cooling system failure.	▪ Inspect the cooling system.
Drive overload (Inv.OLT)	▪ LSMV load is greater than rated load.	▪ Expand the LSMV capacity.
	▪ Wrong motor capacity is set.	▪ Set a correct motor capacity.
Output Ground Fault (Ground Fault)	▪ There is ground fault in LSMV output line	▪ Check the LSMV output wiring.
	▪ Insulation of the motor has become deteriorated.	▪ Replace the motor.
Overload (Over Load)	▪ LSMV load is greater than rated load.	▪ Expand the capacities for motor and LSMV.
	▪ Wrong motor capacity is set.	▪ Set a correct motor capacity.
	▪ Wrong V/F pattern is set.	▪ Set a correct V/F pattern.
Electronic thermal (E-thermal)	▪ Motor is overheated.	▪ Reduce the load.
	▪ Motor load is greater than the rating.	▪ Expand the motor capacity.
	▪ ETH set level is low.	▪ Adjust the ETH level appropriately.
	▪ Operated for long time with low speed.	▪ Lengthy operation in low-speed may cause stress on the motor.
Low current (No Motor trip)	▪ Output switch gear malfunctioned.	▪ Check the life-span and rating for the output switch gear.

Fault name	Cause	Measure
	▪ Output switch gear is set to OFF and operation command is issued.	▪ Check the output switch gear condition.
Output line open-phase (OutPhaseOpen)	▪ Bad output wiring	▪ Check output wiring with Megger ohm tester.
Input overvoltage (Input OVT)	▪ Power voltage is high.	▪ Check power voltage. Change the input terminal transformer tab.
Input low voltage (Input LVT)	▪ Power voltage is low.	▪ Check power voltage.
	▪ A load that is larger than the power capacity is connected to the power system. (i.e.: direct on line of a motor with a large starting current)	▪ Change the transformer tab. Expand the power capacity.
Input line open-phase (InPhaseOpen)	▪ Bad input wiring	▪ Check input wiring with Megger ohm tester.
Cell DC overvoltage (DC-Link OVT)	▪ Deceleration time is too short compared to the load GD².	▪ Set deceleration time shorter.
	▪ Power voltage is high.	▪ Check power voltage.
Cell overheat (CELL OverHeat)	▪ Cooing fan is broken or foreign substances are stuck in the fan.	▪ Replace the cooling fan or remove foreign substances.
	▪ The cooling system has a problem.	▪ Clean the air filter.
	▪ Ambient temperature is high.	▪ Install an A/C system and decrease the ambient temperature to less than 40 degrees Celsius.
Transformer overheat (Trans OverHeat)	▪ Cooing fan is broken or foreign substances are stuck in the fan.	▪ Replace the cooling fan or remove foreign substances.
	▪ The cooling system has a problem.	▪ Clean the air filter.
	▪ Ambient temperature is high.	▪ Install an A/C system and decrease the ambient temperature to less than 40 degrees Celsius.
BX (BX)	▪ BX switch is activated while cleaning the exterior.	▪ BX switch is for emergency stop. Do not touch the switch if it is not an emergency situation.
Motor overheating (Motor OverHeat)	▪ Motor temperature sensor contact malfunctioned.	▪ Check the motor temperature sensor condition.
Cooling system failure (FAN Error)	▪ Low voltage drive for fan control malfunctioned.	▪ Change the low voltage drive.

Fault name	Cause	Measure
	▪ Fan life-span is exceeded and resulted in malfunction.	▪ Cool fan has preset life-span. Change the life-span expired fan during maintenance.
External fault 1, 2 (Ext.Trip 1, 2)	▪ 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.
Control power low voltage (Control LVT)	▪ UPS capacity is insufficient.	▪ Take appropriate measures to supply the control power with commercial power supply.
	▪ Insulation on the control power connection line shows sign of thermal degradation.	▪ Check the control power connection line condition.
PLC failure (PLC ERROR)	▪ PLC fault has occurred.	▪ Contact LSMV agency or the A/S center.
Communication failure between Master and Cell (CAN Error)	▪ There is a problem on CAN communication module.	▪ Engage bypass.
	▪ Poor optical cable.	▪ Replace the optical cable.
Cell fault (Cell Trip)	▪ Fault occurred in Cell OC1	▪ It may be due to sudden load change. Reset and then restart after the motor comes to full stop. ▪ If the fault occurs again after a restart, replace the Cell.
	▪ Fault occurred in Cell OC2.	▪ Replace the cell.
	▪ Fault occurred in Cell OVT.	▪ Set longer deceleration time. ▪ Check power voltage.
	▪ Fault occurred in Cell LVT.	▪ In case of LVT in all cells, check the power voltage. ▪ If LVT occurred in certain cells, replace the corresponding cells.
	▪ Can Err, or NtcOPEN fault occurred in a Cell.	▪ Use the bypass function.
	▪ Fault occurred in Cell OverHeat.	▪ Inspect the cooling fan.

⚠Caution

If the fault 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 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? **Check parameter settings** ▪ Did you set the reverse rotation protection [FU1-01]? ▪ Is the operation mode [DRV-03] set correctly? ▪ Is the frequency not set to 0? **Checking Load** ▪ Is the load small? ▪ Is the motor shaft stuck? (mechanical 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? ▪ 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? (over 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 LSMV, parts must be operated in appropriate ways. Continuous inspection of the LSMV is mandatory. It allows you to identify fault signals and take prompt and proper action. Our service for LSMV 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 LSMV to operate with the original features and handling methods.

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

⚠Caution

- LSMV 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 LSMV 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 LSMV or measuring device may be damaged.

■ Warranty Period

The warranty period for LSMV series is explained as follows:

Warranty period: LSMV 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 manufacturing 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 inspect
The entire system	Temperature	Check ambient temperature, humidity, harmful gases and oil leakage.
	Entire LSMV	Check abnormal vibration and noise.
	Supplied Voltage	Check voltage on the main circuit and control board.
Main circuit	Transformer	Check for abnormal smell and buzzing sound.

Location	Item	Things to inspect
Cooling system	Cooling fan	Check abnormal vibration and noise.
		Check air filter.
Sign	Gauge	Make sure it produces accurate measures and indicators.

■ Periodic Inspections

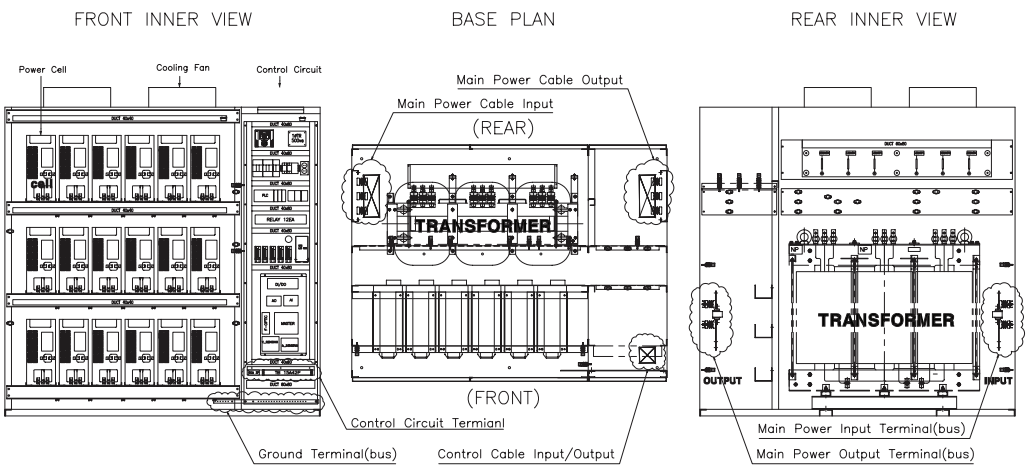
Check the following items for periodic inspections.

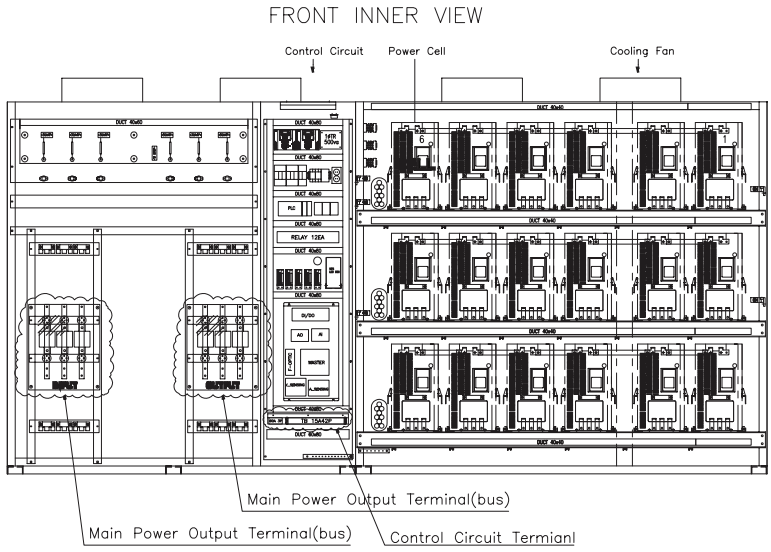
Turn off power supply system and confirm that all keypads at the front of the cell are turned off. Wait at least five minutes before you start the inspection. (Wait 10 minutes for high voltage power supply system.)

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	What to Inspect
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.





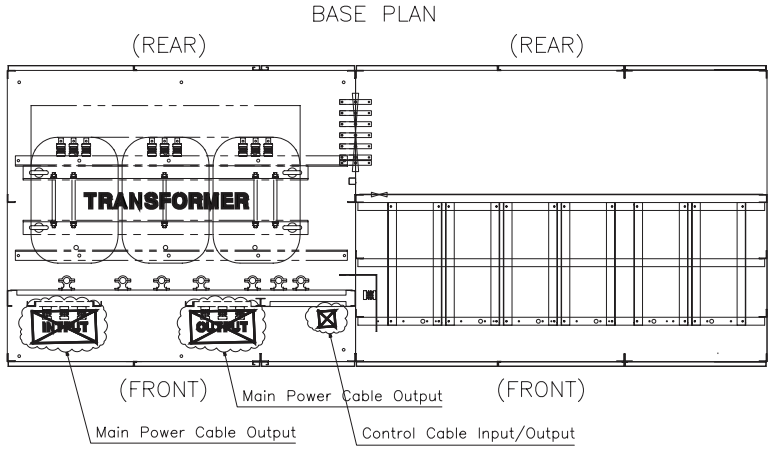


Figure 8-1 Part location

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. LSMV is composed of many parts. To use all the functions of the LSMV 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 LSMV 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 in 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 recommend 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	-
	SMPS board	PCB ASS'Y, SMPS, MV-CELL	Varies based on cell capacity.
Master	Control 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	-
	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	-
105A cell	PCM-630V105A	-
131A cell	PCM-630V131A	-
175 A cell	PCM-630V175A, PCM-630V175A-A	-
260 A cell	PCM-630V260A, PCM-630V260A-A	-
350 A cell	PCM-630V350A	-
438 A cell	PCM-630V438A	-
657A cell	PCM-630V657A	-

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	-

Part Name	Model Name	Remarks
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	XGK-CPUE	-
HMI	XP80-TTA/DC	-
UPS	BR550GI	-

8.4 Cooling Fan Replacement Procedure

Refer to Figure 8-2 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 LSMV 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.

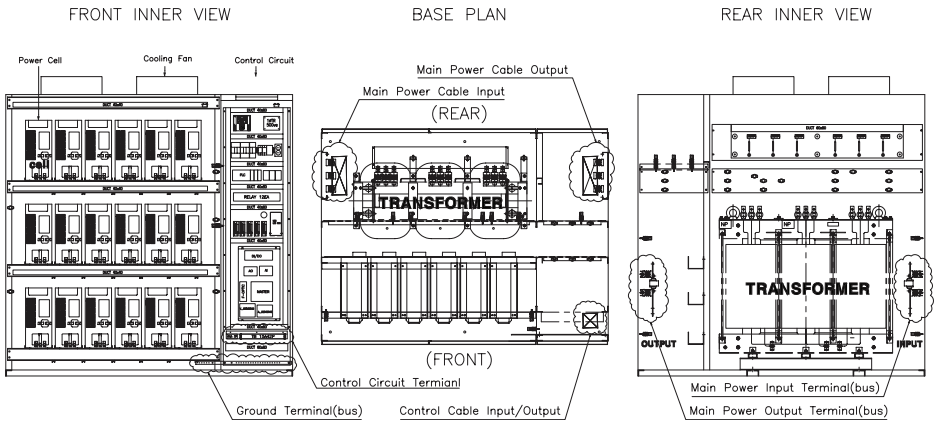


Figure 8-2 Fan replacement

8.5 Removing and Reinstalling a Cell

The procedure to remove a cell in the supply section is as follows: Refer to Figure 8-3 for the part name.

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.

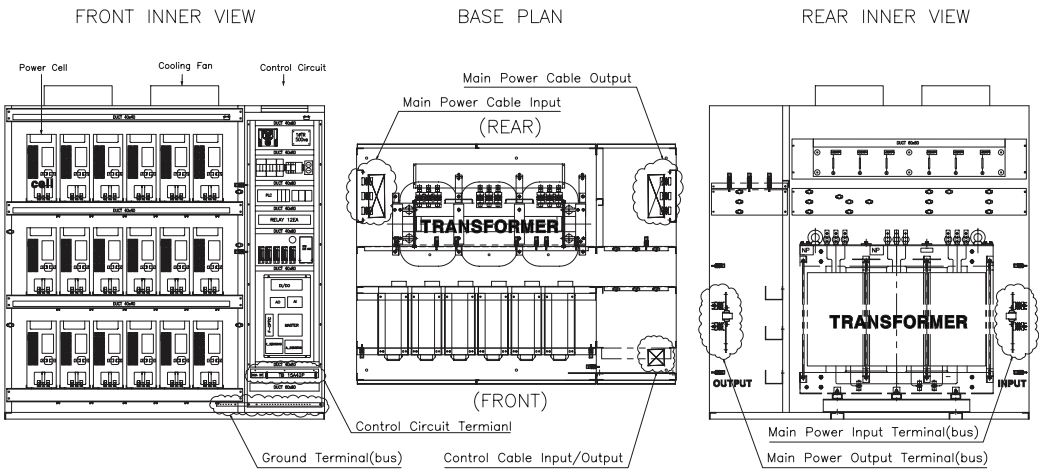


Figure 8-3 Cell replacement

9. LSMV Series Rating

9.1 Standard Ratings of LSMV High Voltage Drive Series

Table 9-1 Standard Ratings

Item		Standard Rating												
3 kV Class	LSMV-033S□□□ 60 Hz	200	300	400	500	600	750	10H	12H	15H	20H	25H	30H	37H
	LSMV-030F□□□ 50 Hz	200	300	400	500	600	750	10H	12H	15H	20H	25H	30H	37H
	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	12H	15H	19H	25H	31H	37H	47H
	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	10H	12H	15H	20H	25H	30H	40H	50H	60H	75H
	LSMV-060F□□□ 50 Hz	400	600	800	10H	12H	15H	20H	25H	30H	40H	50H	60H	75H
	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

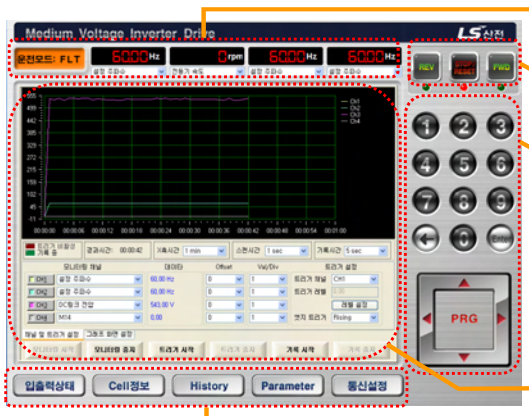
Item		Standard Rating												
10 kV Class	LSMV-033S□□□ 50 Hz	600	900	12H	15H	18H	22H	30H	37H	45H	60H	75H	90H	110H
	Output Capacity (kVA)	600	900	1200	1500	1800	2200	3000	3700	4500	6000	7500	9000	11000
	Rated current (A)	35	53	70	88	105	131	175	218	260	350	438	525	657
	Maximum applicable motor capacity (kW)	500	750	1000	1250	1500	1800	2500	3150	3800	5000	6200	7200	9300
Power factor		Approx. 95% (rated speed and load condition)												
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. 37 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 touch screen 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)												

Item		Standard Rating
Protection Function		Overcurrent, drive overload, ground fault in output line, overload, electronic thermal, open output line, output line open-phase, input overvoltage, input low voltage, input line open-phase, Cell DC overvoltage, Cell overheat, transformer overheat, etc.
Communications function		RS-485 embedded, 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	Temperature	0~40℃
	Humidity	Max. 85% (should not have condensation)
	Altitude	1,000 m or less
	Installation	Indoor
	Input transformer	Class H, air-cooling, N/+5%/10% or -5%/N/+5%

10. MV SYSTEM VIEW (Option)

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

■ Screen Layout and Features



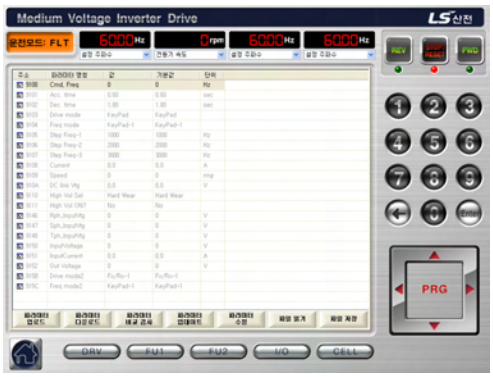
Basic drive operating information display

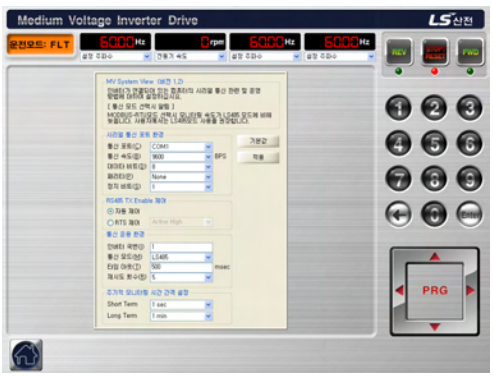
Forward/reverse direction / stop command button and LED display

Touch based keypad organization

Display drive information through 4-channel graph with real time data. Stop Trigger monitoring feature.

Configure and monitor History (operation, fault information), Parameter (set drive parameters), Comm and Selection (communications setting), etc.





- Displays communications, fault and bypass information for each cell on U, V and W phases.
- Displays DC-Link voltage information.
- Displays the LSMV 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, LSMV temperature and fault 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 LSMV ID and communications method.

11. HMI

11.1 Overview

11.1.1 S/W Operation Environment

■ **Master S/W**

1. MV Drive HMI S/W operates in Master S/W Ver 2.0-00 or higher version.
2. Use the keypad to check the S/W version in Parameter FU2-82.

■ **HMI**

1. MV Drive Monitor is optimized for XGT PANEL Series XP80 (800 * 600 px).
2. Please contact the service agent if you want to use the MV Drive Monitor for other models.

■ **PLC**

1. MV Drive Monitor supports XGB and XGK Series.
2. The program is different for each corresponding PLC, so please check before using the program.

11.1.2 Configuration

■ MV Drive, PLC, and HMI Configuration

The configuration for MV Drive, PLC and HMI is as shown in below Figure.

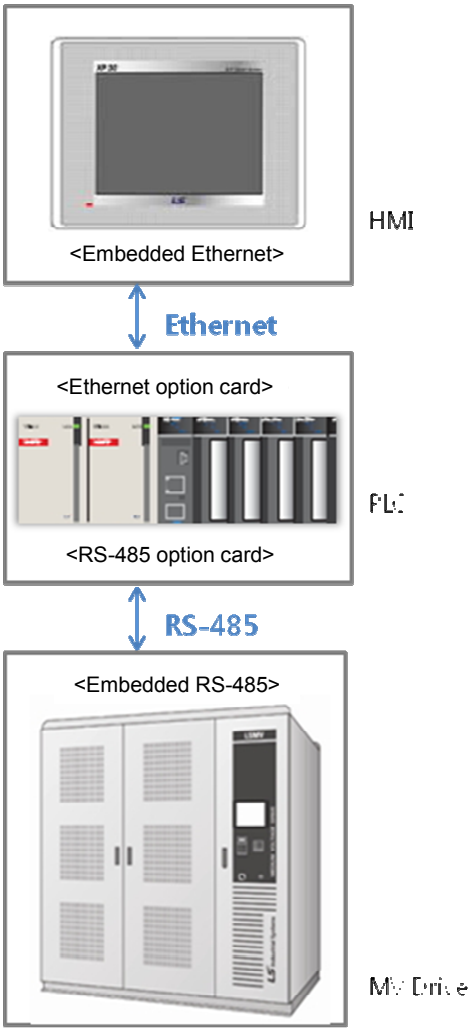


Figure 11-1 HMI Configuration

11.2 Installation

11.2.1 PLC/SW

11.2.1.1 PLC Settings Download

■ **Launch XG-PD**

Launch the Network Manager (XG-PD) from the XG5000 Tool Menu.

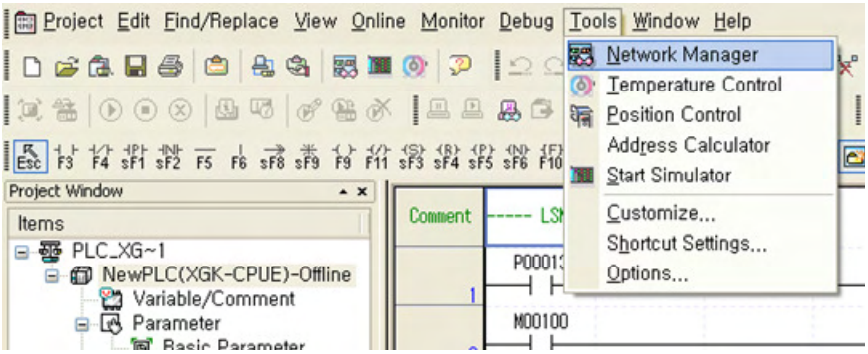


Figure 11-2 Launching XG-PD

■ **Open Environment Settings**

Open environment settings with xfg extension from the XG-PD.

Figure 11-3 Open Environment Settings

■ Cnet (RS485) Settings

Double click on the Cnet in the Project Window and set the 485 communication settings as detailed below.

※ Check the option card since the channel is changed based on the 485 option card type.

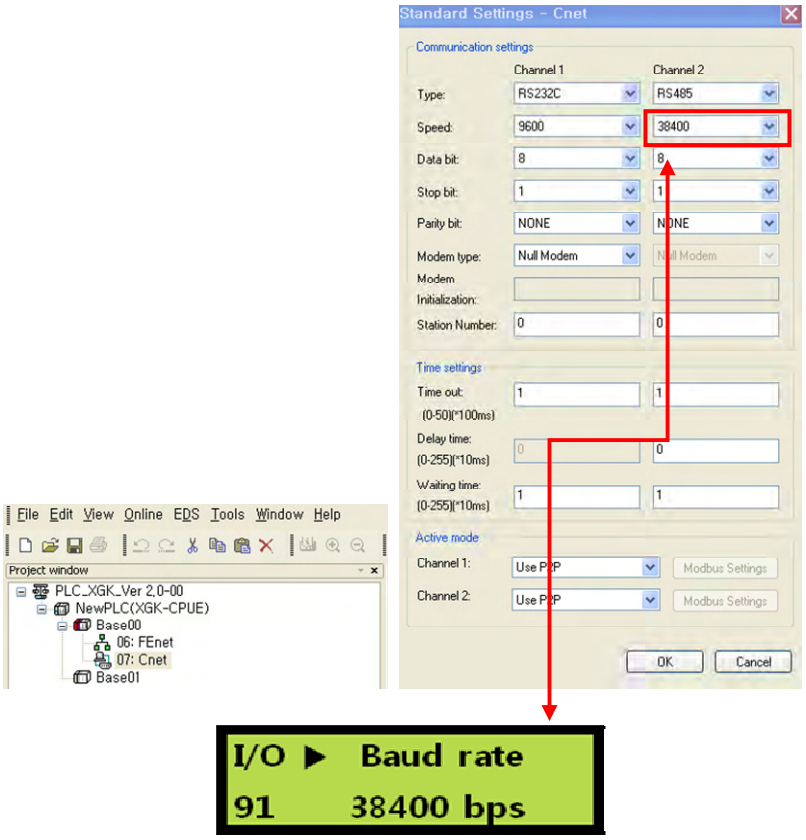


Figure 11-4 Cnet (RS485) Settings

※ The set communication speed (38,400 bps) must match with the parameter setting of the Master.

■ FEnet (Ethernet) Settings

1. Double click on the FEnet in the Project Window and set the TCP/IP as detailed below.

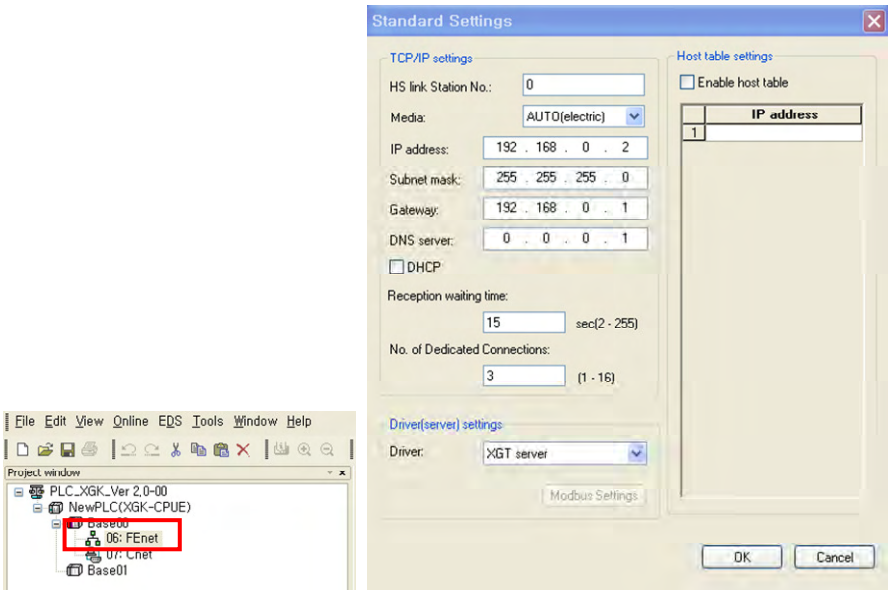


Figure 11-5 TCP/IP Settings

2. Connect to PLC.

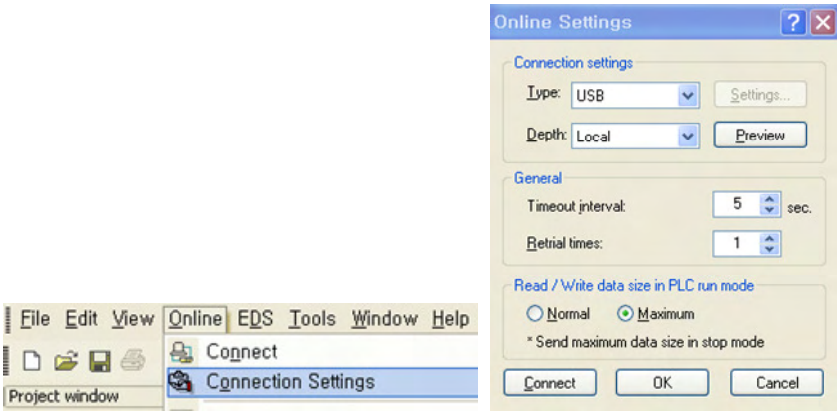


Figure 11-6 PLC Connection

3. Download the Environment Settings file to PLC. (check all the check boxes)

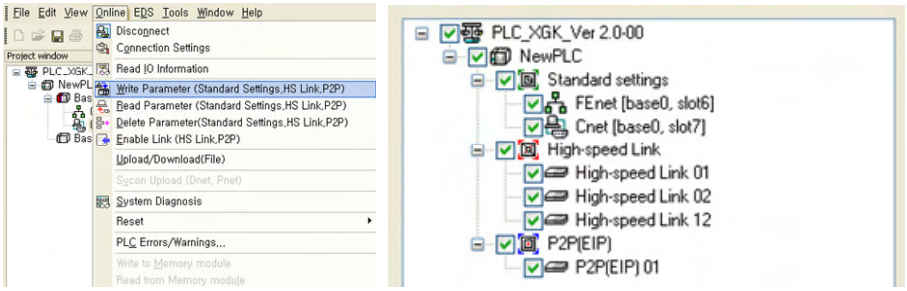


Figure 11-7 Download Environment Settings File

4. Click Enable Link (Check only the P2P(EIP) 01)

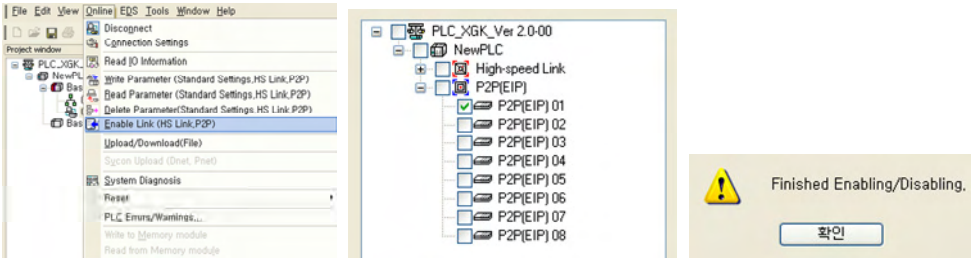


Figure 11-8 Enable Link

✱ You must reset the PLC to apply the downloaded features.

11.2.1.2 PLC S/W Download

■ Open file

Launch XG5000 and open the file with xgp extension.

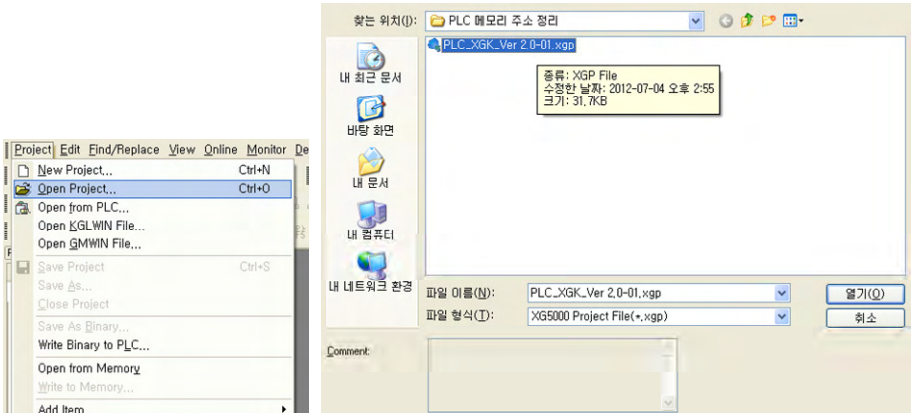


Figure 11-9 Open File

■ Connect the computer with the PLC

Use a USB cable to connect the computer with the PLC.

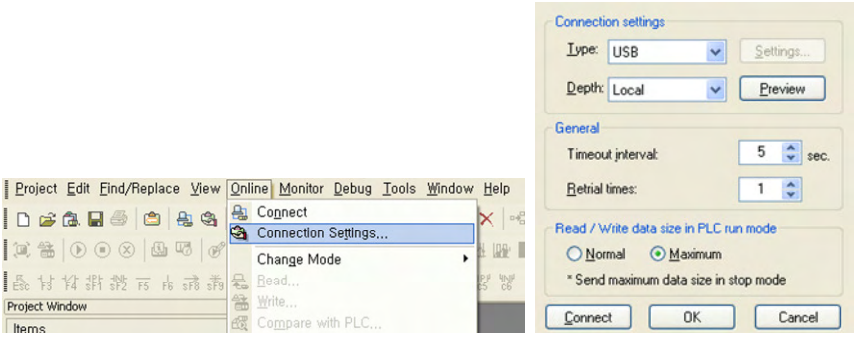


Figure 11-10 Computer and PLC Connection

■ S/W Download

Download the software to the PLC.

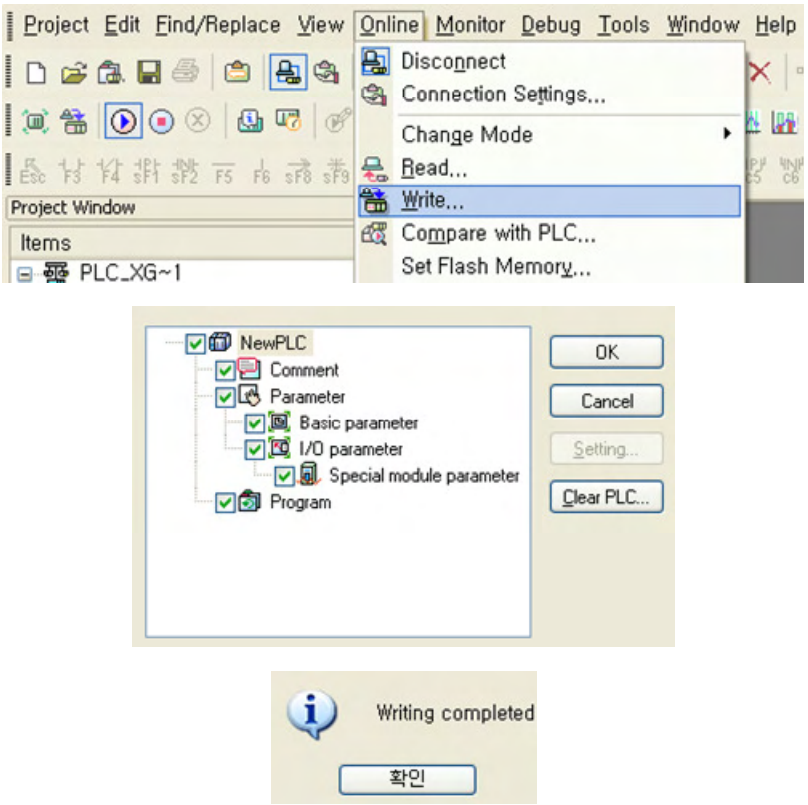


Figure 11-11 S/W Download

11.2.1.3 PID Settings

■ Launch PID Monitoring

Click on the PID Monitoring while the PLC is connected with the computer.

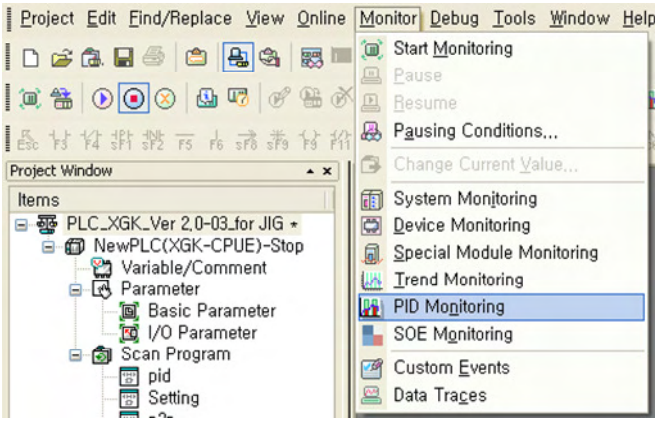


Figure 11-12 Launch PID Monitoring

■ Stop Auto Monitoring

The system automatically switches to the Monitoring status when the PID Monitoring is launched.

Stop the Monitoring by clicking the End Monitoring as shown below.

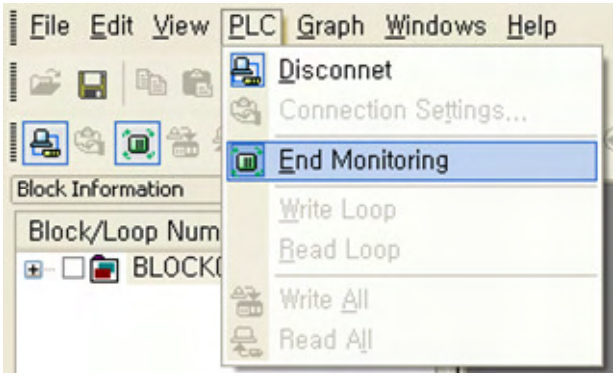


Figure 11-13 End Auto Monitoring

■ Open Loop Window

Check the Loop00 and the Loop01 and then double click to open the Loop0_00 window.

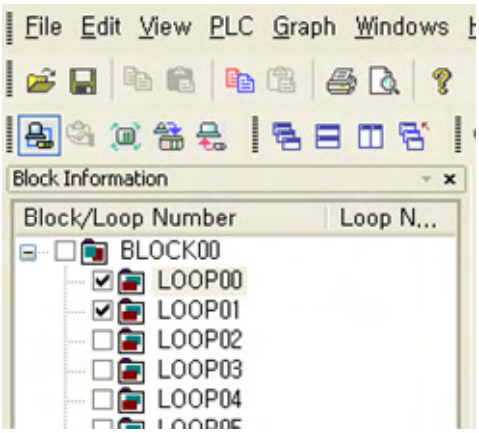


Figure 11-14 Open Loop Window

■ Select PLC Action

Select PLC Action from the Menu and click on the Write Loop.

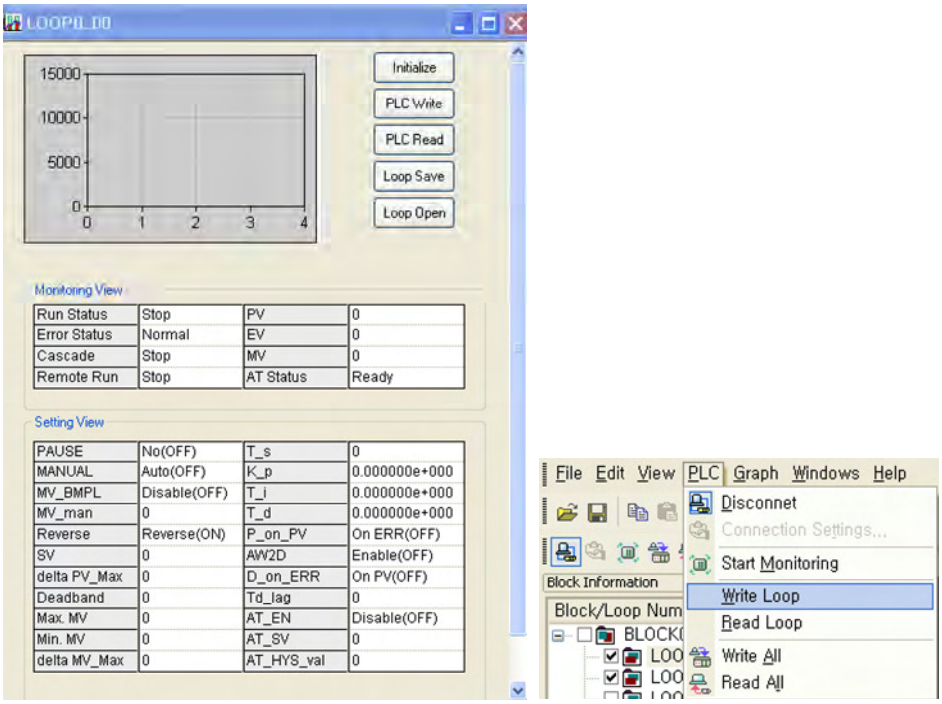


Figure 11-15 Select PLC Action

Select PLC Action as shown above and set PLC Loop Write for LOOP01.

11.2.1.4 PLC Settings Download

■ Launch XG-PD

Launch the Network Manager (XG-PD) from the XG5000 Tool Menu.

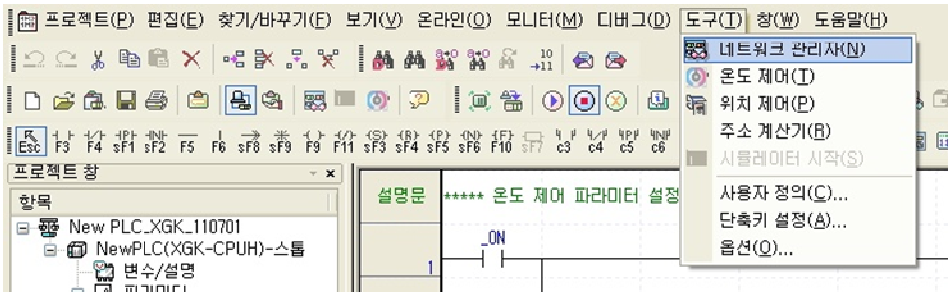


Figure 11-16 Launching XG-PD

■ Open Environment Settings

Open environment settings with xfg extension from the XG-PD.

Figure 11-17 Open Environment Settings

■ Cnet (RS485) Settings

Double click on the Cnet in the Project Window and set the 485 communication settings as detailed below.

※ Check the option card since the channel is changed based on the 485 option card type.

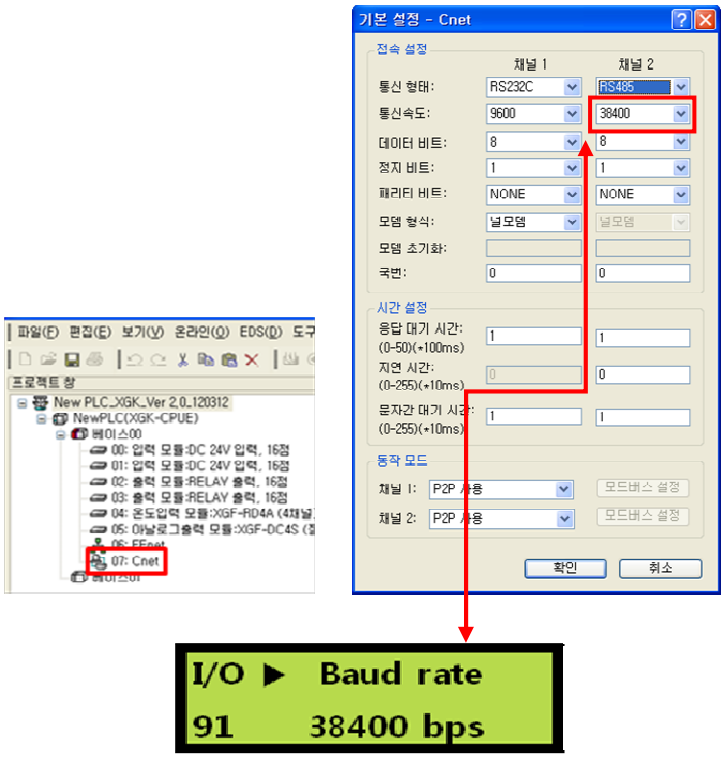


Figure 11-18 Cnet (RS485) Settings

✱ The set communication speed (38,400 bps) must match with the parameter setting of the Master.

■ FEnet (Ethernet) Settings

1. Double click on the FEnet in the Project Window and set the TCP/IP as detailed below.

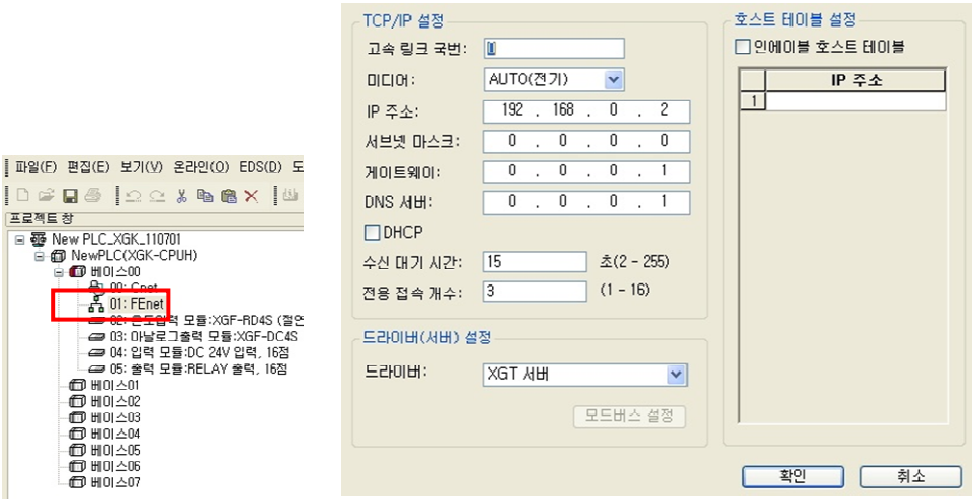


Figure 11-19 TCP/IP Settings

2. Connect to PLC.

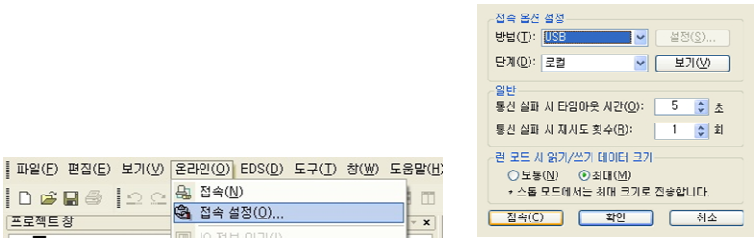


Figure 11-20 PLC Connection

3. Download the Environment Settings file to PLC. (check all the check boxes)

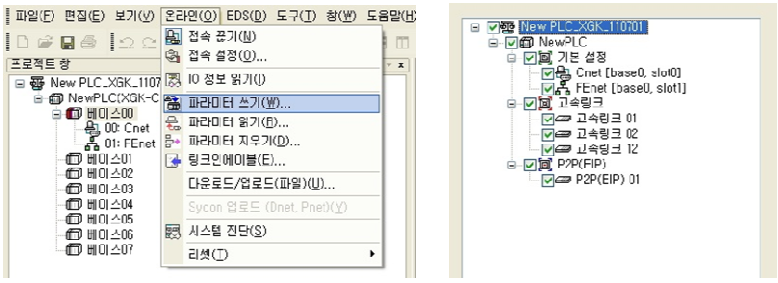


Figure 11-21 Download Environment Settings File

1. Click Enable Link (Check only the P2P(EIP) 01)

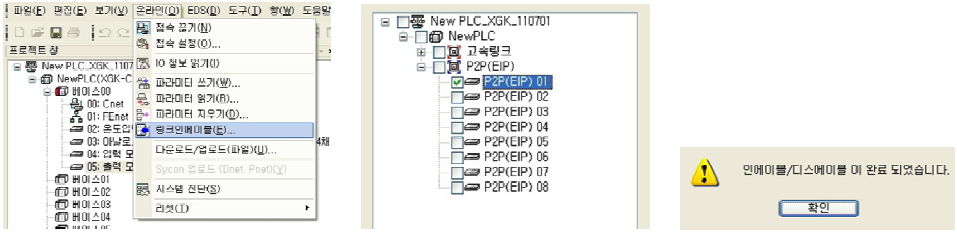


Figure 11-22 Enable Link

※ You must reset the PLC to apply the downloaded features.

11.2.1.5 PLC S/W Configuration

■ Scan program configuration

PLC S/W scan program is composed of sections.

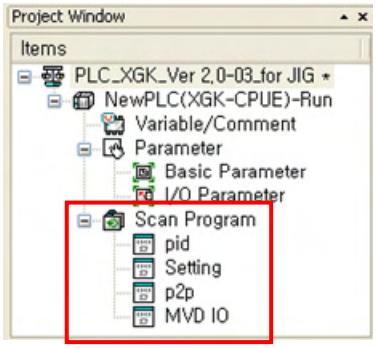


Figure 11-23 Scan Program

1. **Setting:** This menu requires to be edited based on the customer requirements and/or on-site conditions.

   - Temperature control related parameter settings

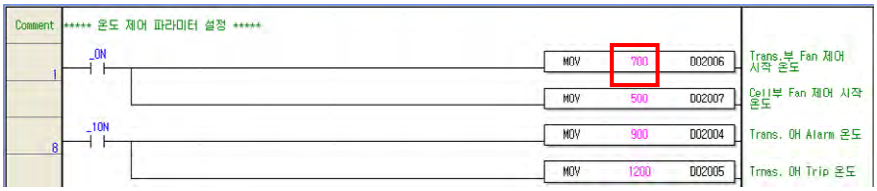


Figure 11-24 Temperature Control

   - The input variable scale is in 10:1 ratio.

     Ex) To set the Trans. Fan control start temperature to 75'C as per customer's request, double click on 750 in the above image and enter 750, and then click Confirm.

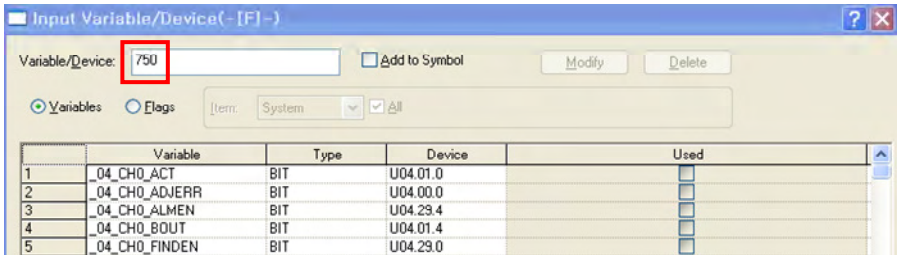


Figure 11-25 Changing Temperature Control Setting

- Processing PLC IO Help documents in HMI

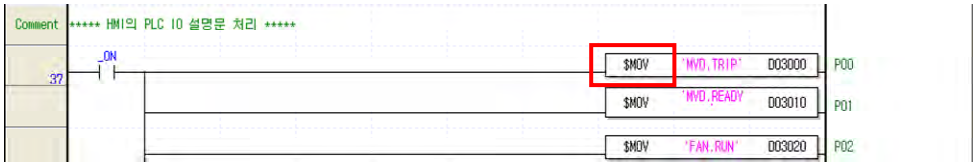


Figure 11-26 Processing PLC I/O Help Documents

- This is the HMI Menu for entering the PLC I/O Help documents.

  Ex) If you wish to change the P00 contact from INV. TRIP → NONE, double click on the square in the above image and enter "NONE", and then click Confirm.

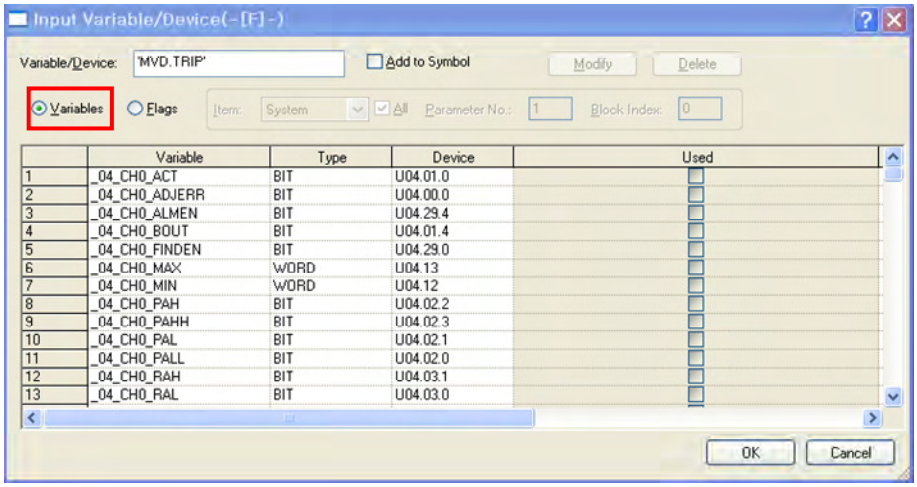


Figure 11-27 Changing Contact Name

2. **MVD IO :** This is the section for processing MVD input/output contact.

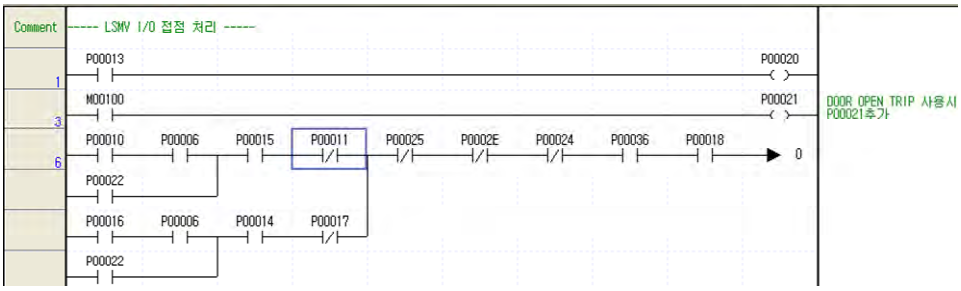


Figure 11-28 Processing Input/Output Contact

3. **p2p :** This is the section for setting communication between the PLC and the HMI.

   - Changing the setting may cause PLC and/or HMI error.

4. **pid :** This is the section for processing the PLC analog input and output.

   - Analog input

     Channel 0, Channel 1, Channel 2: Receives the temperature data from the Trans. via 3 line type PT100 Ohm.

- Analog Output
  - Channel 0: Outputs the current (4~20mA) for Trans. temperature control.
  - Channel 1: Outputs the current (4~20mA) for Cell temperature control.
  - Channel 2: Outputs the Trans. temperature status. (0'C: 4mA – 150'C: 20mA)
- Please inquire your service representative if source change is required as a result of addition of a panel and/or fan.

11.2.2 HMI S/W

11.2.2.1 HMI S/W Download

■ Open file

Launch the XP-Builder and open the file with xpd extension.

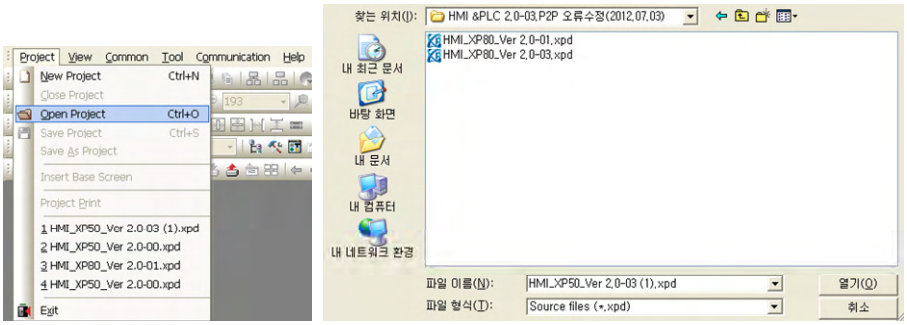


Figure 11-29 Open XPD File

■ Download via LAN Cable

1. Set the IP address of the computer as shown below and connect the computer to the HMI via LAN cable

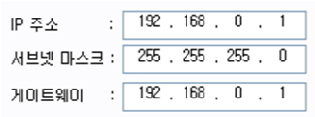


Figure 11-30 Computer IP Address

2. Set the IP of the target HMI from the Comm. Settings Menu.

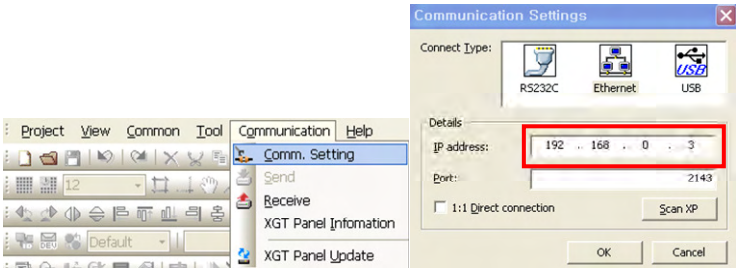


Figure 11-31 HMI IP Address

3. Open Send menu and select "Send to XGT Panel". Check "Send All Project" and click Send.

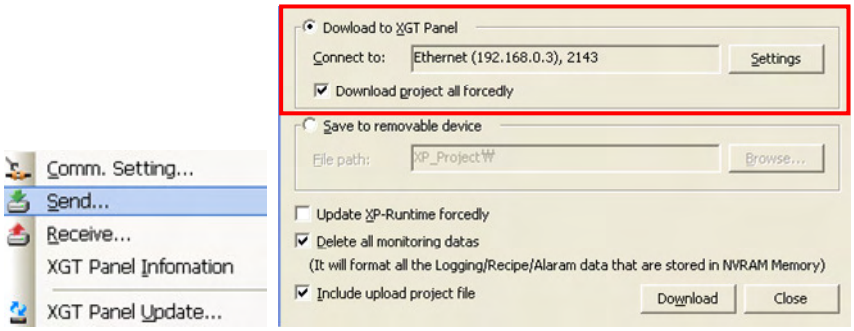


Figure 11-32 Send to XGT Panel

■ Downloading to USB Memory

1. Insert USB Memory into the computer.
2. Create XP_Project folder in the USB Memory's root directory, and then add desired folder as the sub folder. (ex: F:\XP_Project\New_HMI)
3. Open Send menu and select "Save to removal device", and click on the "Browse..." button to select the newly created folder, and then click Send.

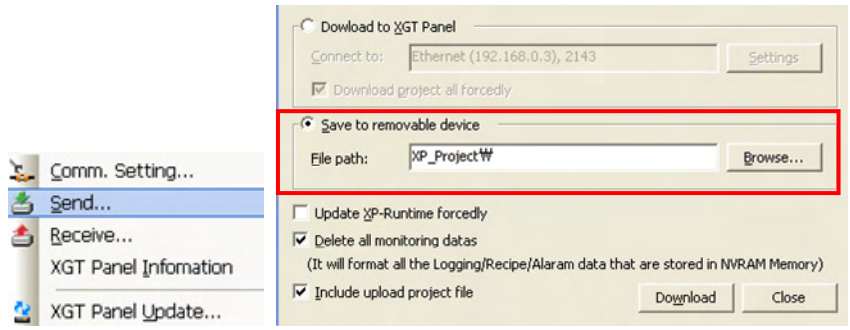


Figure 11-33 Send to XGT Panel

4. Insert the USB with the Project file to the HMI.
5. Set the settings in the HMI screen as shown below, and download the S/W.

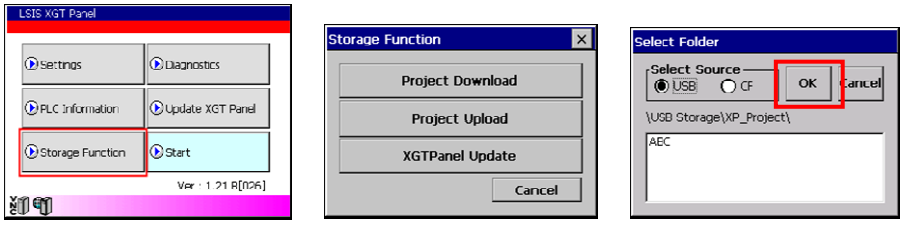


Figure 11-34 HMI S/W Download

11.2.2.2 HMI Settings

■ HMI IP Settings

Enter the HMI IP address.

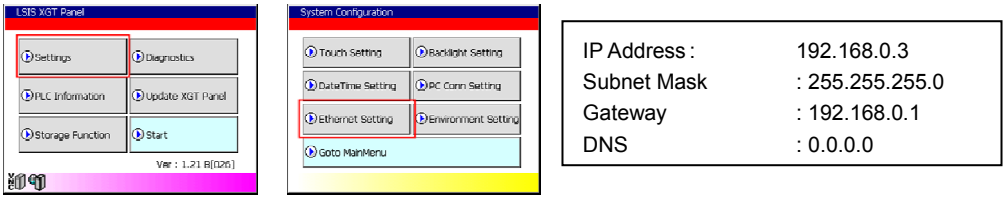


Figure 11-35 Enter HMI IP

■ PLC IP Settings

Enter the PLC IP address.

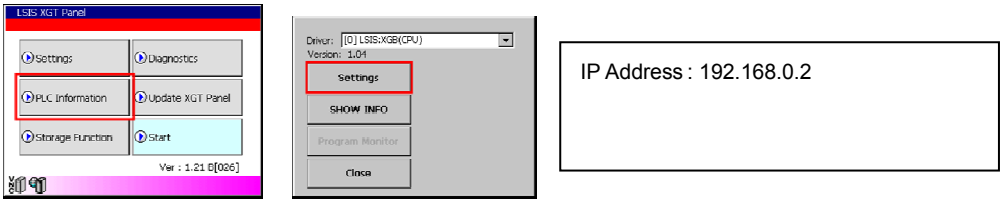


Figure 11-36 Enter PLC IP

11.3 Using HMI

11.3.1 Main Screen

■ Select Language

MV Drive HMI S/W supports 7 languages (Korean, English, Chinese, Russian, Spanish, Thai, and Portuguese).

Figure 11-37 HMI Main Screen

Figure 11-38 HMI Main Screen

11.3.2 Main Screen

■ Enter Model No.

You must enter the Model Number in the Main Screen after installing the MV Drive Monitor.

Figure 11-39 Enter Model Name

Figure 11-40 Enter Password

Click on the Model Name and the corresponding Cell image is opened.

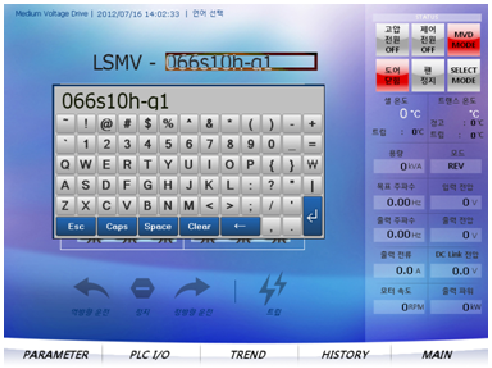


Figure 11-41 Model Name Entry Window

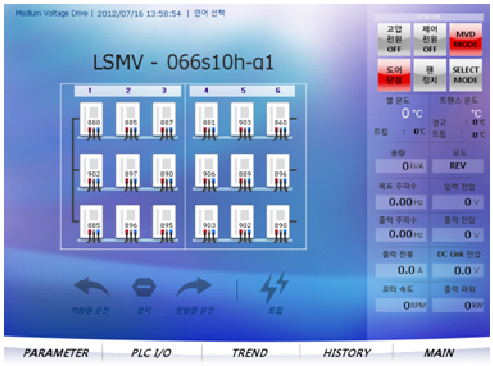


Figure 11-42 After Entering the Model Name

■ Cell DC-Link voltage monitoring

View the Cell DC-Link voltage for each Cell. (Normal = 890V±10%)

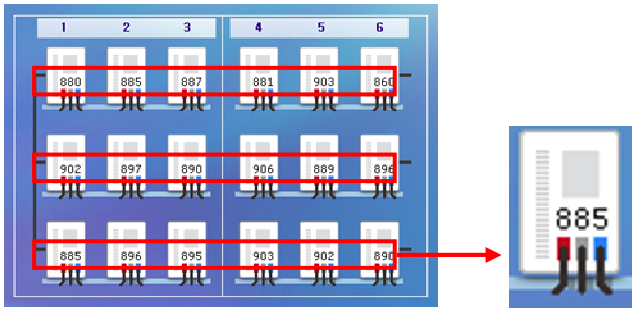


Figure 11-43 DC-Link Voltage

■ Check for Cell fault occurrence

The Cell indicator blinks in red in case of a fault in the corresponding Cell.

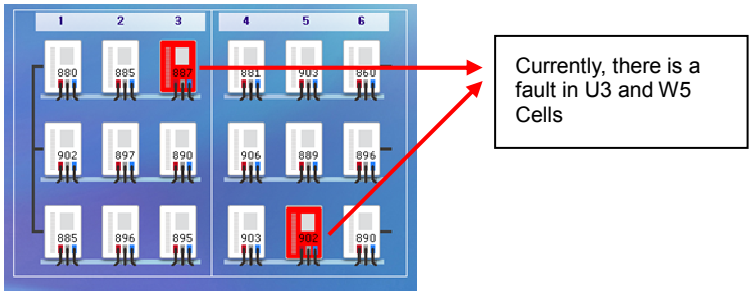


Figure 11-44 Cell Fault

■ Check Cell Bypass status

The Cell indicator blinks in gray if the Cell Bypass action is engaged for the corresponding Cell.

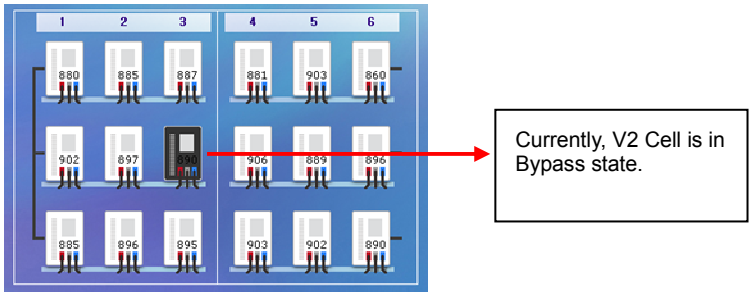


Figure 11-45 Cell Bypass

■ MVD Status

The MV Drive status is indicated via 6 warning lamps on the upper right section in the Main Screen.

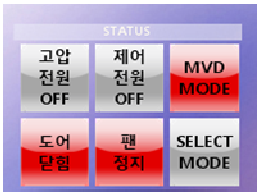


Figure 11-46 MVD Status

■ Cell and Transformer Temperature

The Cell and Transformer temperature is indicated via Temp Indicator on the right section in the Main Screen.

Figure 11-47 Cell and Trans. Temperature

1. If the Cell temperature is above 60'C, and the Trans. temperature is above 90'C, the text indication changes to red color.

Figure 11-48 Cell and Trans. Warning Temp.

2. The trip temperature of a Cell can be set from the MAK-27 Cel Temp T of the Master Keypad.

   The Trans. trip temperature can be changed by clicking on the HMI.

Figure 11-49 Trans. Temp. Settings

■ Operation status indication

Indicates the MVD operation status.

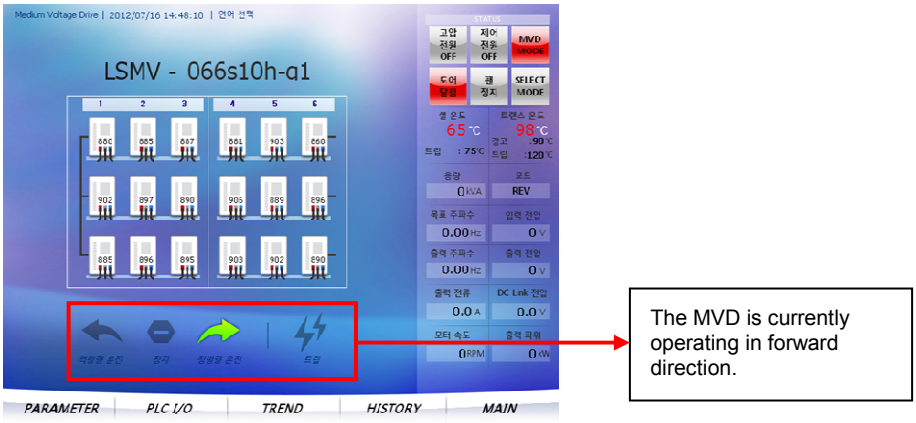


Figure 11-50 Operation Status Indication

■ Menu Navigation

Click on the Menu on the bottom of the screen to switch to a different screen.

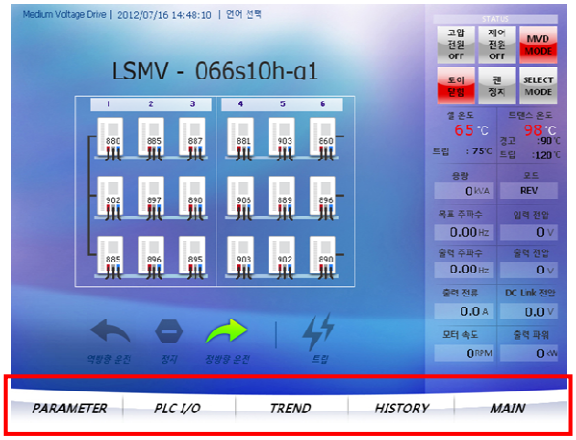


Figure 11-51 Menu Navigation

11.3.3 PARAMETER

■ How to select

1. Click PARAMETER, and then select the PARAMETER GROUP from the displayed menu.

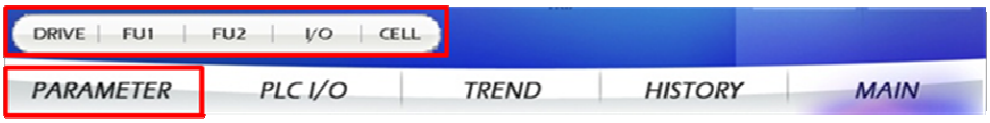


Figure 11-52 Selecting PARAMETER

2. Click the sub-menu to switch to the corresponding PARAMETER screen. (if FU1 is selected)

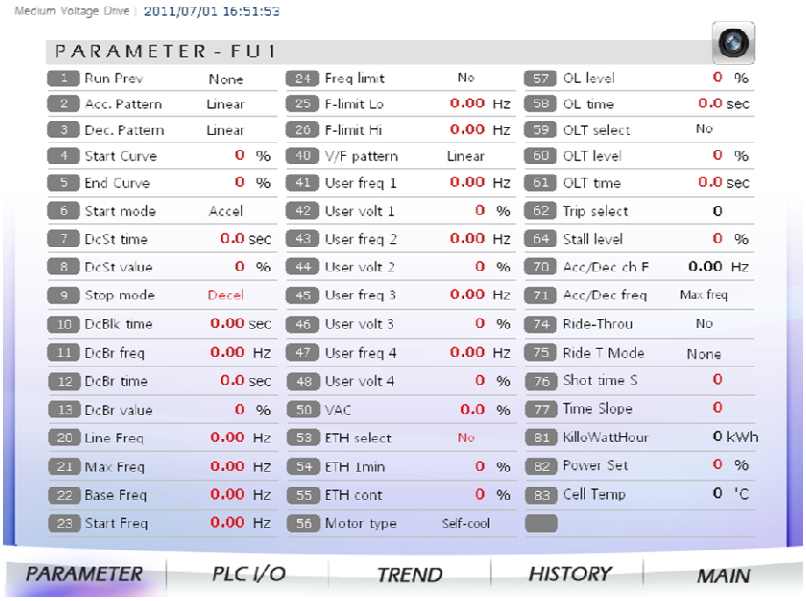


Figure 11-53 PARAMETER-FU1

■ Changed Parameter Indication

If the setting is different than the default factory setting, the changes are indicated in red.

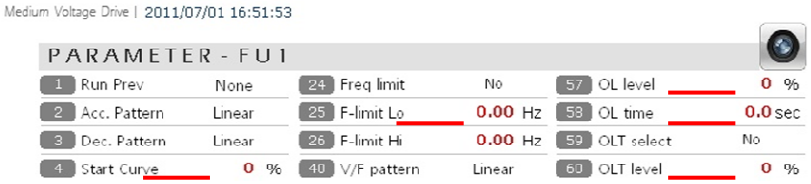


Figure 11-54 Changed Parameter

■ Parameter Screen Capture

Click on the Camera icon to save the current screen image to the USB Memory.

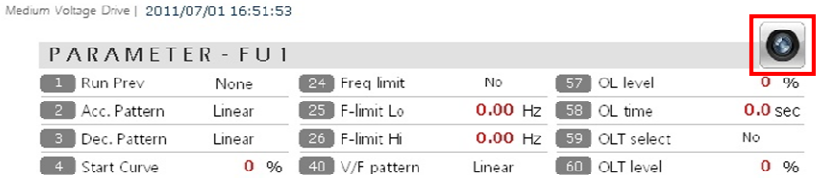


Figure 11-55 Parameter Screen Capture

※ The image file is saved in the ScreenCapture folder in a BMP file format.

11.3.4 PLC I/O

■ How to select

Click on the PLC I/O at the bottom of the Main Screen to open the sub-menu.

Figure 11-56 Select PLC I/O

DI: Displays the status of the 32 PLC input contacts (P00~P1F).

DO: Displays the status of the 32 PLC output contacts (P20~P3F).

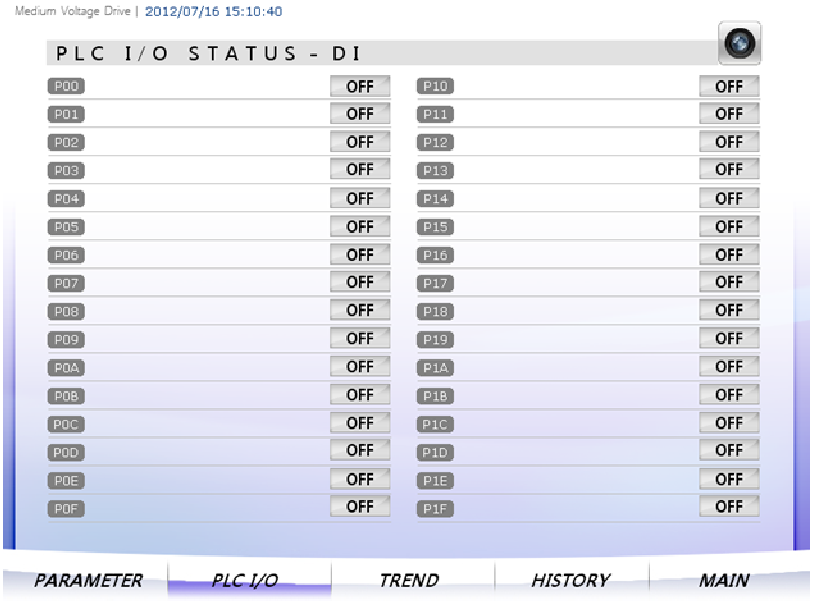


Figure 11-57 PLC I/O DI Screen

■ Opening the DI and DO Help documents of the PLC S/W

1. Click on the square boxin below image for 3 seconds top open the Change Mode window.

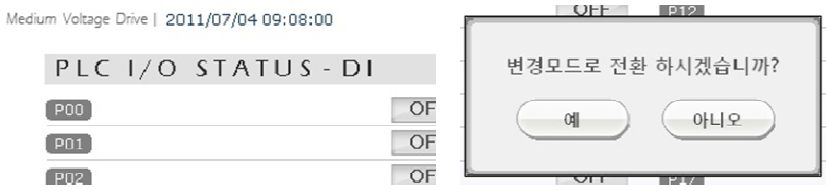


Figure 11-58 PLC I/O Change Mode

2. Switch to the Change Mode and click on the Open button to open the PLC S/W Settings.

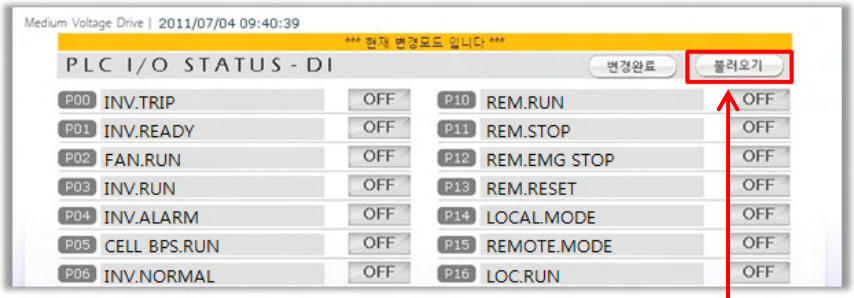


Figure 11-59 Open PLC I/O

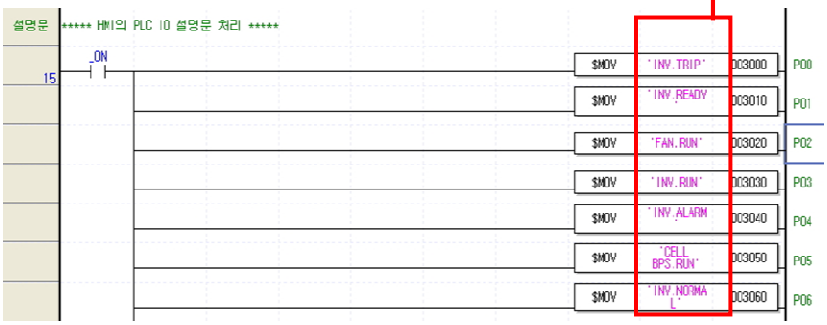


Figure 11-60 PLC S/W I/O Help Documents

■ Editing I/O Help Documents

1. Click on the square box in below image for 3 seconds to open the Change Mode window.

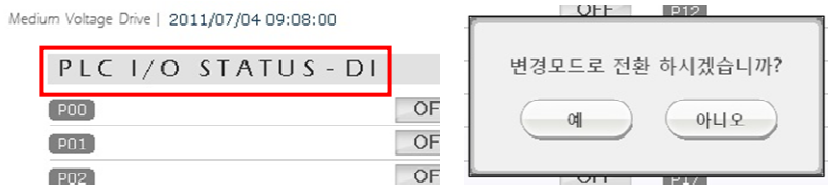


Figure 11-61 Switch to PLC I/O Change Mode

2. Switch to the Change Mode and click on the Help Document for each contact to input the details.

Figure 11-62 PLC I/O Input Mode

3. After entering the details, click on the Finish button to complete the entry.

11.3.5 TREND

■ How to select

Click on the TREND button at the bottom of the Main Screen to switch to the TREND Screen.

Figure 11-63 Select TREND

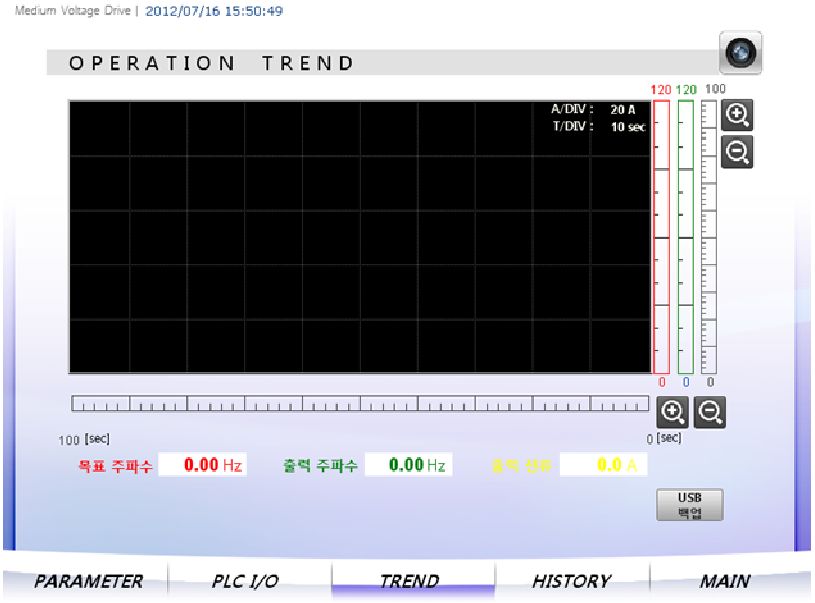


Figure 11-64 TREND Screen

■ Adjusting Scale

1. Target Frequency and Output Frequency

Click on +,- button to set the **Y-axis scale** at 120Hz, and have the **X-axis scale** at variable setting between 50~500sec.

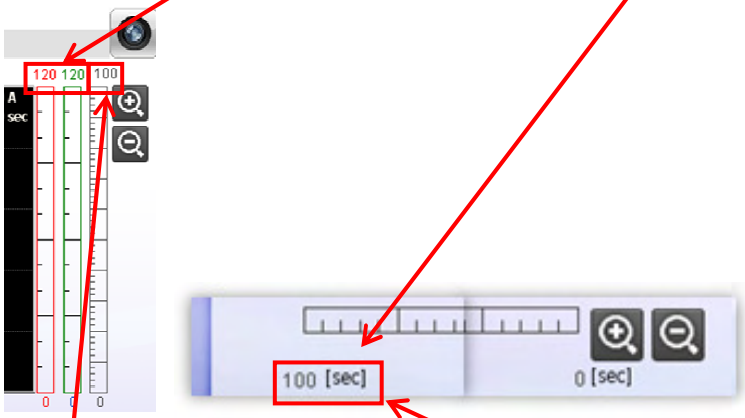


Figure 11-65 X, Y Axis Scale

2. Output current

The Y-axis scale can be variably set to 100~1,000A, and the **X-axis scale can be variably set to 50~500sec.**

■ USB Backup

To save the current TREND settings to the USB, click on the USB Backup button.

※ Backed up file is saved in the Logging folder in a CSV file format.

Figure 11-66 TREND USB Backup

11.3.6 HISTORY

■ How to select

Click on the HISTORY button at the bottom of the Main Screen to switch to the HISTORY Screen.

Figure 11-67 Select HISTORY

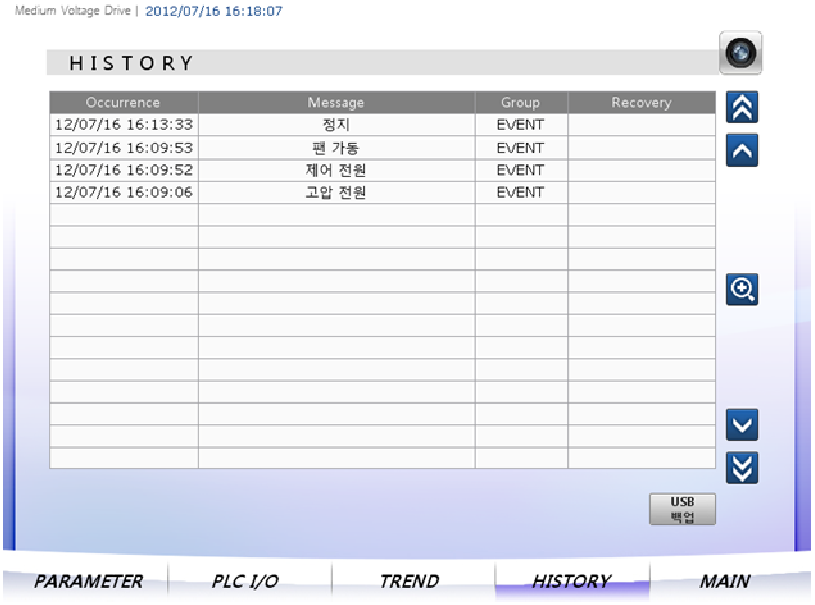


Figure 11-68 HISTORY Screen

■ Detailed Event Description

Click on each event and then click on the Magnifying Glass icon to view the description for the corresponding event.

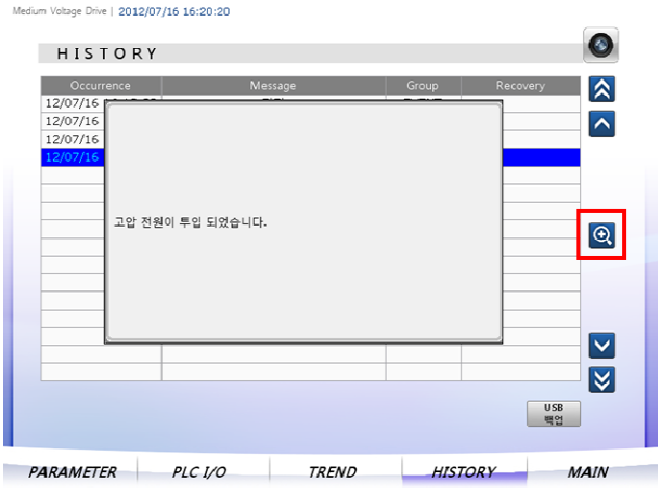


Figure 11-69 Detailed Event Description

■ USB Backup

To save the current HISTORY settings to the USB, click on the USB Backup button.

※ Backed up file is saved in the Alarm folder in a CSV file format.

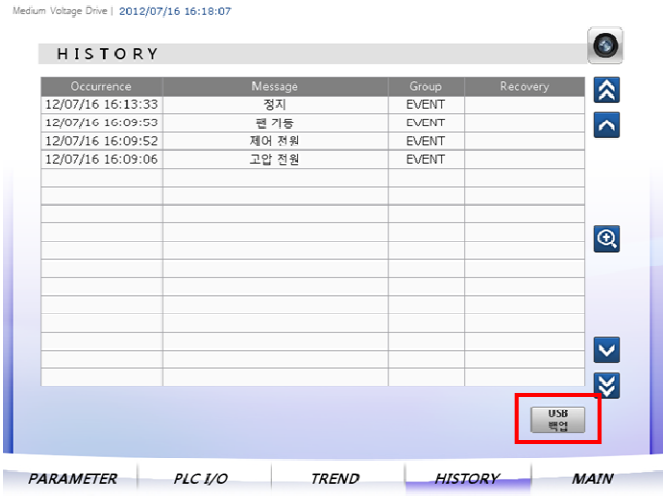


Figure 11-70 Backup History in USB

■ Deleting History

Click on the square box below and enter the Password to switch to the Delete Mode.

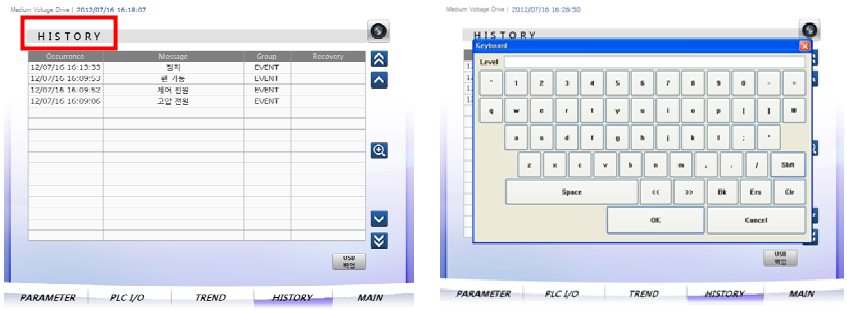
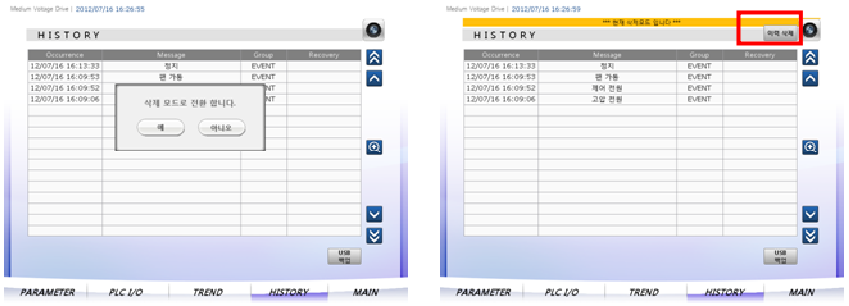


Figure 11-71 Entering History Delete Mode

After entering the Delete Mode, click on the Delete History button to delete History.

※ Delete History function only deletes the recovered event history.



Warranty

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

Notes

This inverter has been manufactured by LSIS using strict quality control and inspection processes.

The warranty period is 18 months from the date of installation. A period of 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 the contract.

Free after-sales servicing

If the drive fails as a result of normal usage during the warranty period, contact our agency or designated service center. We will repair the drive free of charge.

Paid Servicing

In the following instances, repair services are provided for a fee:

- If the damage is the result of deliberate action or negligence.
- If the damage is the result of power supply problems or an improper connecting device.
- If the damage is the result of a natural disaster (for example, fire, flood, gas, earthquake, etc.).
- If the inverter has been modified or repaired somewhere other than our agency or service center.
- If there is no LSIS name plate attached.
- If the warranty period is over.

Please visit the LSIS homepage (http://www.lsis.biz) for more useful information and services:

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