Thank you for purchasing LS Vector Drives!

SAFETY INSTRUCTIONS

**To prevent injury and property damage, follow these instructions.
Incorrect operation due to ignoring instructions will cause harm or damage.
The seriousness of which is indicated by the following symbols.**

⚠ **DANGER**	This symbol indicates the instant death or serious injury if you don't follow instructions
⚠ **WARNING**	This symbol indicates the possibility of death or serious injury
⚠ **CAUTION**	This symbol indicates the possibility of injury or damage to property

■ The meaning of each symbol in this manual and on your equipment i s as follows.

⚠ This is the safety alert symbol.
Read and follow instructions carefully to avoid dangerous situation.

This symbol alerts the user to the presence of "dangerous voltage" inside the product that might cause harm or electric shock.

■ After reading this manual, keep it in the place that the user always can contact easily.

■ This manual should be given to the person who actually uses the products and is responsible for their maintenance.

⚠ WARNING

- **Do not remove the cover while power is applied or the unit is in operation.**
  Otherwise, electric shock could occur.
- **Do not run the inverter with the front cover removed.**

Otherwise, you may get an electric shock due to high voltage terminals or charged capacitor exposure.

- **Do not remove the cover except for periodic inspections or wiring, even if the input power is not applied.**
  Otherwise, you may access the charged circuits and get an electric shock.

- **Wiring and periodic inspections should be performed at least 10 minutes after disconnecting the input power and after checking the DC link voltage is discharged with a meter (below DC 30V).**
  Otherwise, you may get an electric shock.

- **Operate the switches with dry hands.**
  Otherwise, you may get an electric shock.

- **Do not use the cable when its insulating tube is damaged.**
  Otherwise, you may get an electric shock.

- **Do not subject the cables to scratches, excessive stress, heavy loads or pinching.**
  Otherwise, you may get an electric shock.

⚠CAUTION

- **Install the inverter on a non-flammable surface. Do not place flammable material nearby.**
  Otherwise, fire could occur.

- **Disconnect the input power if the inverter gets damaged.**
  Otherwise, it could result in a secondary accident and fire.

- **After the input power is applied or removed, the inverter will remain hot for a couple of minutes.**
  Otherwise, you may get bodily injuries such as skin-burn or damage.

- **Do not apply power to a damaged inverter or to an inverter with parts missing even if the installation is complete.**
  Otherwise, electric shock could occur.

- **Do not allow lint, paper, wood chips, dust, metallic chips or**

other foreign matter into the drive.
Otherwise, fire or accident could occur.

OPERATING PRECAUTIONS

1) Transport and Installation

- Be sure to carry inverter in a proper way suitable for its weight, or it may result in damage to inverter.
- Do not pile up inverters above allowable limit.
- Be sure to install the inverter as directed in this instruction manual.
- Do not turn off the power supply to the damaged inverter.
- Do not open the front cover while carrying the inverter.
- Do not place the heavy material on the inverter.
- The direction of installation should be observed properly as criterions specified in this manual show.
- Make sure that you should not put screw, metal material, water, oil and the inflammable something else.
- Keep in mind that inverter is very vulnerable to drop from the mid air and strong shock.
- Be certain to use the inverter under the following conditions.

Environment	Ambient temperature	- 10 ~ 40 ℃ (Non-frozen)
	Humidity	Below 90% RH (Dewdrop should not be formed)
	Storage temperature	- 20 ~ 65 ℃
	Ambient condition	Free of corrosive gas, inflammable gas, oilwaste and dust
	Altitude/vibration	Below 1000m above sea level, Below 5.9m/sec^2 (=0.6g)

2) Wiring works

- Do not connect phase-leading capacitors, surge filter, radio noise filter to the output of inverter.
- Output terminals (terminals named U, V, W respectively) should be connected in a proper phase sequence.

3) Adjustment before starting trial operation

- Be sure to check relevant parameters for the application before starting trial operation.

4) Directions

- Be sure not to approach the machine when retry function is selected. The machine may start working suddenly.
- Stop key on the keypad should be set to be in use. For safety, additional emergency stop circuit should be required.
- Inverter restarts if alarm condition is cleared while FX/RX signal is on. Therefore, be sure to operate the alarm reset switch after checking if FX/RX signal is off.
- Never modify the inverter for inappropriate use.
- Motor may not be protected by electronic thermal protection.

- Do not start or stop the inverter by the magnetic contactor installed at the input of inverter.
- Noise filter should be used for the minimization of troubles by electro-magnetic noise. Electronic equipments close to the inverter should be protected against the damage caused by troubles.
- Be sure to install the AC reactor at the input of inverter in case of input voltage unbalance. Otherwise, generator or phase-leading capacitors may be destroyed by the harmonic current from inverter.
- If 400V class motor is used with the inverter, insulation-enforced motor should be used or countermeasures against the suppression of micro-surge voltage generated by the inverter should be carried out. Otherwise, micro-surge voltage is generated across input terminal for the motor and this voltage lowers allowable insulation break-down voltage and then, may cause the destruction of the motor.
- Be sure to set the parameters once more, in case of initialization of parameters, all values of parameters is set to values of factory setting.
- High speed operation can be set easily, therefore be sure to check the performance of motor or machine before changing parameter value.
- DC braking function cannot produce a zero-servo torque. If required, additional equipment should be installed.
- When inverter trip or emergency stop (BX) occurs without keypad connected, LED on the control board will blink by the interval of 0.5 sec. But LED will blink by 1 sec when keypad is connected.

5) Countermeasure against malfunction troubles

- If inverter is damaged and then gets into uncontrollable situation, the machine may lead to the dangerous situation, therefore to avoid this situation, be sure to install the additional equipments such as brake.

6) Maintenance, inspection and parts replacement

- Do not perform the megger (insulation resistance check) test on the control board.
- Please refer to Chapter 7 (intervals for parts replacement).

7) Disposal

- Handle the inverter as an industrial waste when disposing of it.

8) General instructions

Many of the diagrams and drawings in this instruction manual show the inverter without a circuit breaker, a cover or partially open. Never run the inverter like this. Always place the cover with circuit breakers and follow this instruction manual when operating the inverter.

Table of Contents

Chapter 1 - Basics

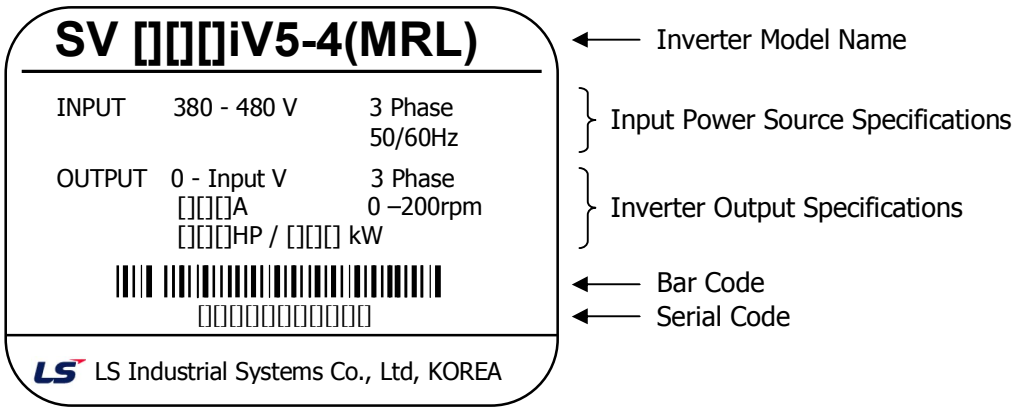
This instruction manual is designed for **LS STARVERT-iV5(MRL: Machine Roomless Elevator) Inverters**, which have excellent characteristics in speed and torque control with pulse encoder mounted on the shaft of 3 phase asynchronous motor, and covers installation, maintenance, wiring and operation for these inverters.

1.1 Features of SV-iV5(MRL)

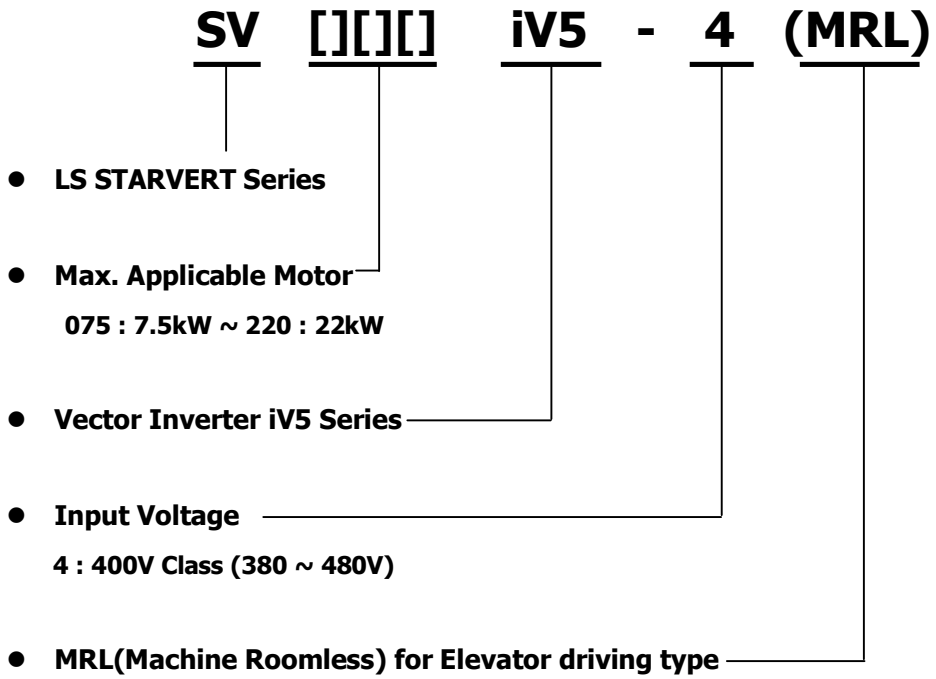
- Vector Control Inverter for asynchronous motor with Speed Sensor(Encoder) using IGBT as Power Semiconductor Device.
- Control for Machine Roomless Elevator driving.
- Auto-tuning of Motor Parameters for Sensorless motivation.
- Encoder error (H/W and S/W) detection function

1.2 Inverter Nameplate and Model

1.2.1 Inverter Nameplate (Example)



1.2.2 Inverter Model Name



Chapter 2 – Installation and wiring

This chapter describes general items for the installation and wiring of an inverter and includes instruction for wiring to power terminal and control one and caution in case of wiring, and also explains the function of each terminal for both power and control.

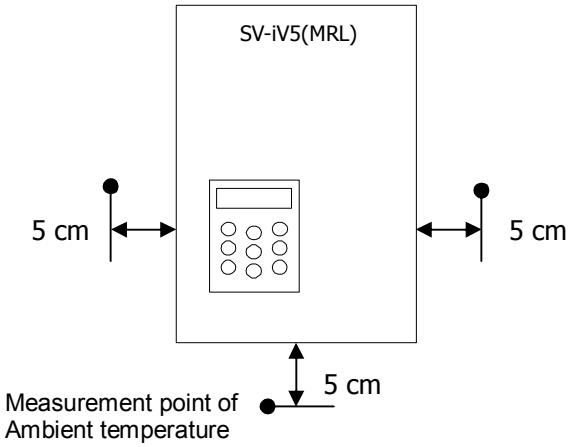
2.1 Caution on installation

2.1.1 Do not install the inverter in a location where excessive vibration is present.

Be cautious when installing on presses or moving equipment.

2.1.2 Caution on Ambient Temperature

Ambient temperature greatly affects inverter lifetime, therefore be sure to keep the ambient temperature of installation location at –10 to 40℃.



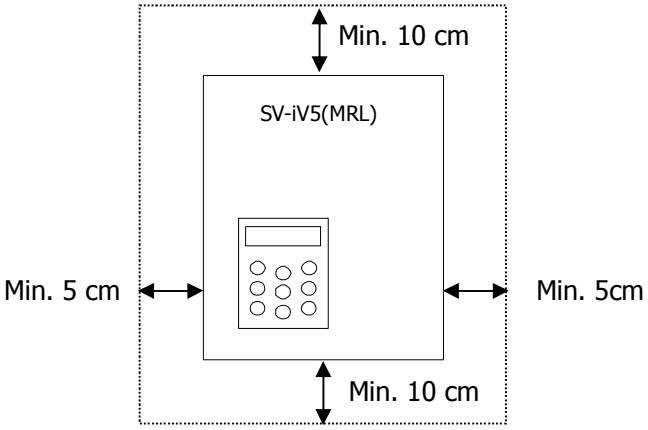
2.1.3 Install the inverter on the uninflammable material. The inverter operates at high-temperature.

2.1.4 Avoid a humid and hot location.

2.1.5 Install the inverter in a location free of oil mist and dust.

Totally enclosed panel can be used to protect the inverter against that materials.

2.1.6 Secure the installation space enough to protect the inverter against the overheating.



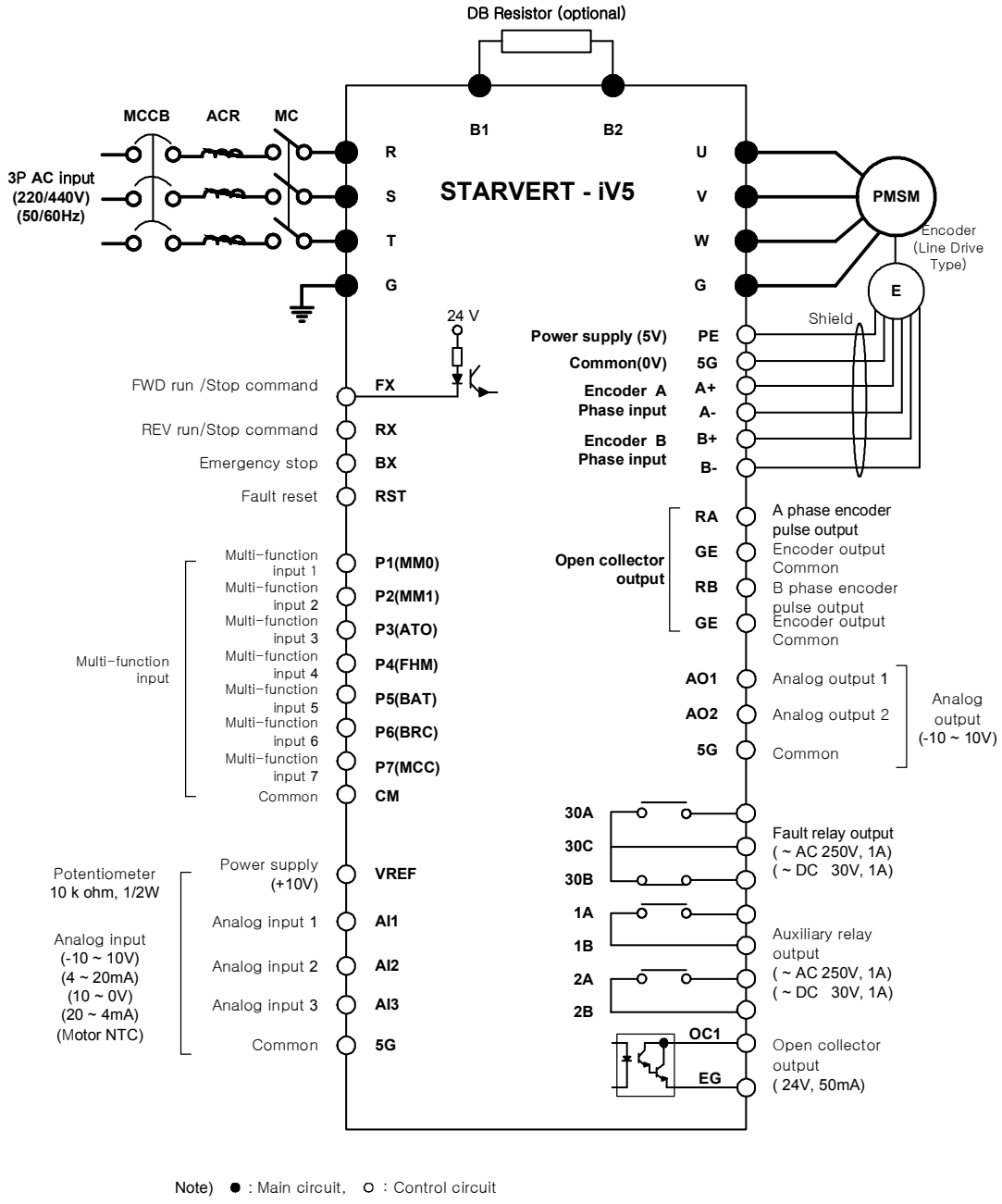
2.1.7 Special care should be taken in case the inverter is to be installed in the panel.

In case more than 2 inverters are to be installed or ventilation fan is to be installed in the panel, make sure that inverter and ventilation fan is properly installed. If they are poorly installed, it causes the increase of an ambient temperature and less effective ventilation. Therefore, be sure to keep the ambient temperature of inverter below the allowable temperature.

2.1.8 Install the inverter tightly not to get loose using proper sized bolt or screw.

2.2 Basic Wiring

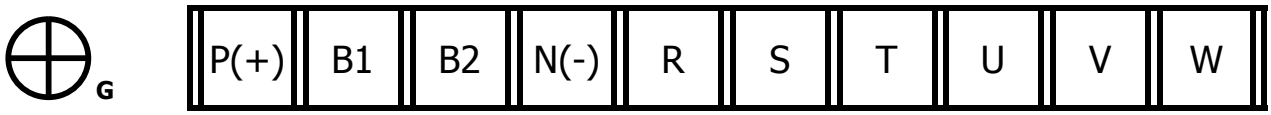
■ SV 075, 110, 150, 220iV5-4(MRL)



Note) ● : Main circuit, ○ : Control circuit

2.3 Power Circuit Terminal

■ **SV075, 110, 150, 220iV5-4(MRL)**

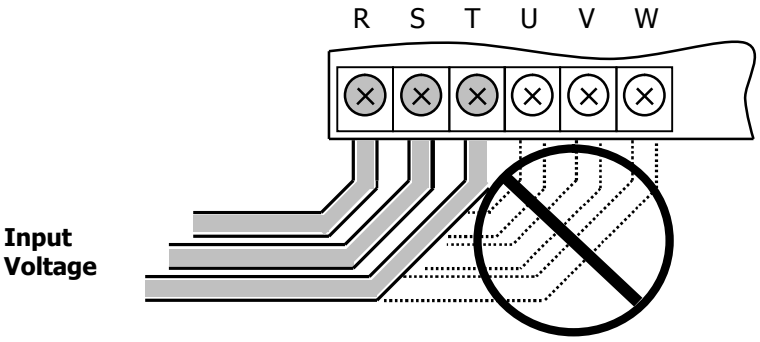


2.3.1 Power Circuit Terminal Description

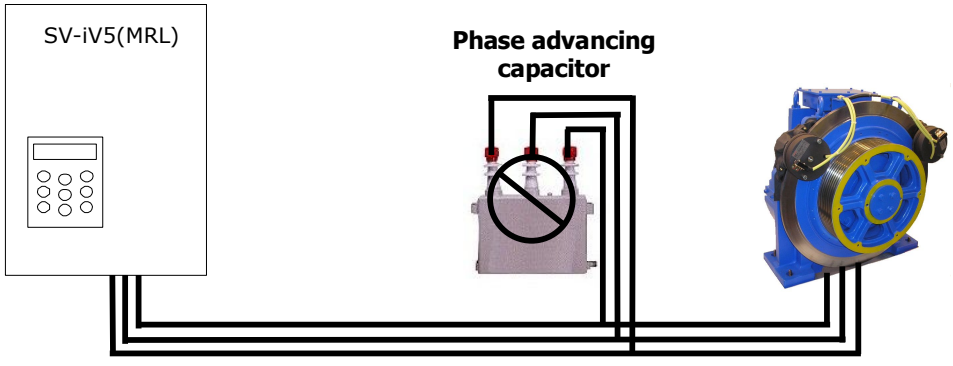
Name	Function	Description
R, S, T	3 Phase input power supply	Connected to 3 phase input power supply - 400V Class : 380 ~ 480V, 50/60Hz
U, V, W	Inverter Output	Connected to 3 phase induction motor
B1, B2	Braking Resistor	Connected to braking resistor
P(+), N(-)	DC Link Common	Used for DC link common connection
G	Grounding	Used for inverter frame earth

2.3.2 Cautions to be required for wiring to Power Circuit Terminal

① Connect terminals (R, S and T) to 3 phase input power supply after checking inverter nameplate attached on the inverter. Never connect terminals (U, V and W) to 3 phase input power supply. It results in lethal damage to the inverter.



② Never connect the phase advancing capacitor to the inverter output. If already installed, remove the phase advancing capacitor clearly.



③ Cable between inverter output and motor should be less than 300m long. If cable gets long, surge voltage appears across motor terminals depending on the cable parameters. Especially, in 400V class motor case, insulation withstanding voltage may be decreased. Use an insulation-enforced motor when 400V class motor is used.
④ Crimp terminal with insulation cap should be used for the input power supply and the motor.
⑤ After finishing wiring, be certain to remove all the wire or cable scraps inside the inverter.
⑥ Use the shield cable or twist-paired wire for control circuit terminal. Do not put them into the same wiring duct for the power terminal.
⑦ When wiring is changed after operating the inverter, be sure to check LCD window on the keypad or charge lamp is turned off. Capacitors inside inverter are charged with high voltage and it may result in lethal injury.
⑧ Below 22kW inverter, B1 and B2 on the power terminal should not be connected to anything else other than DB resistors.

2.3.3 Main Power Circuit Wire Sizes and Grounding Wire Size

① Main Power Circuit Wire Sizes

If wiring for the main power terminal is not performed properly, it may cause severe damage to inverter or lethal injury to inverter operator. **Be sure to use 600V, 75℃ copper wire.**

Inverter Capacity		Terminal screw size	ScrewTorque		Wire Size			
					mm²		AWG	
			(Kgf.cm)	(lb.in)	R, S, T	U, V, W	R, S, T	U, V, W
400V	7.5 kW	M6	30.6~38.2	26.6~33.2	3.5	3.5	12	12
	11 kW	M6	30.6~38.2	26.6~33.2	5.5	5.5	10	10
	15 kW	M6	30.6~38.2	26.6~33.2	14	8	6	8
	22 kW	M6	30.6~38.2	26.6~33.2	22	14	4	6

1) Apply the rated torque to terminal screws. Loose screws can cause of short circuit or malfunction.
Tightening the screws too much can damage the terminals and cause a short circuit or malfunction.

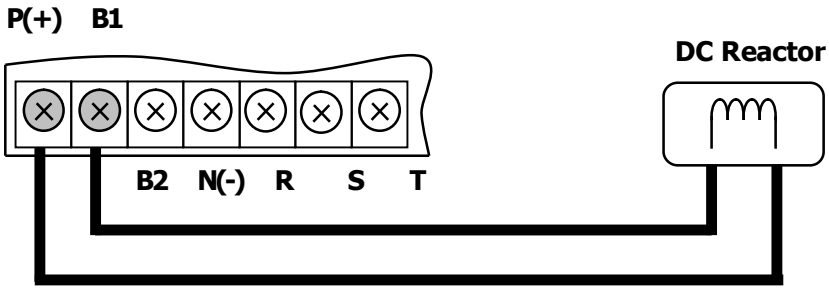
② Grounding Wire Size and Caution to be taken

- Be sure to ground the motor and the inverter to prevent electric shock injury. (200V class: ground impedance 100Ω, 400V class: ground impedance 10Ω)
- Connect the inverter ground to the ground terminal exclusively used for the inverter.
- It is strongly recommended that as thick a grounding wire as possible be used and wire be short.

Motor Capacity	Ground wire size(mm²)
	400V Class
7.5 kW	3.5
11 ~ 15 kW	8
22 kW	14

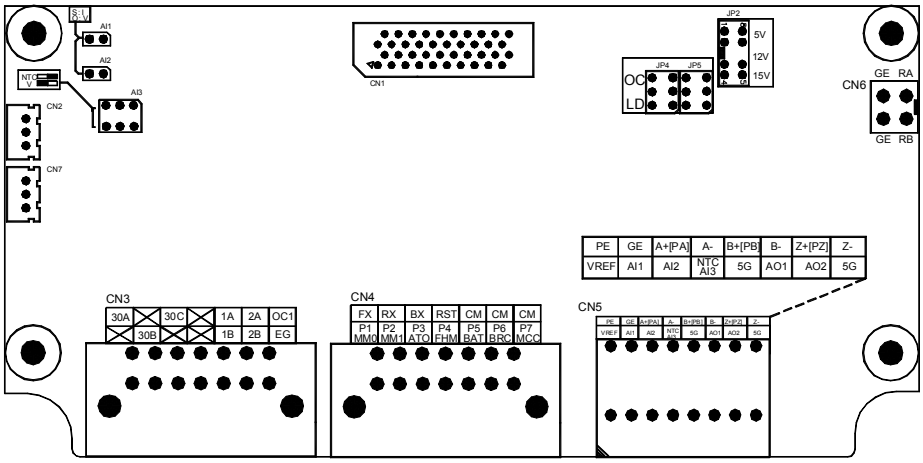
2.3.4 Wiring DC Reactor (Option) (30kW and higher)

① When DC Reactor wiring, Connect like as figure below after removing common bar which is connected between P(+) and B1 of inverter terminal.



2.4 Control Circuit Terminal

2.4.1 Control Terminal Layout



3.4.2 Control Circuit Terminal Function Description

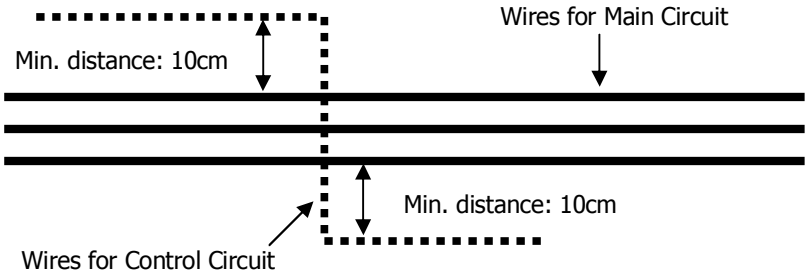
Item	Name	Function	Description
Contact Input	FX	Forward Run Command	● Forward/Reverse RUN Command is ON when closed to CM separately. ● Motor stops when FX/RX is ON or Off at the same time.
	RX	Reverse Run Command	
	BX	Emergency Stop	● ON when closed to CM, FREERUN Stop and Deceleration stop. It does not trigger fault alarm signal.
	RST	Fault Reset	Resets when fault condition is cancelled.
	P1(MM0)	Multi-function input contact	● 1 function can be selected among 27 different functions shown below. (Multi-step speed 1 / 2 / 3, Jog, MOP Up / Down / Save / Clear, Analog Hold, Main Drive, 2nd function, Accel./Decel. Time selection, 3 Wire RUN, External trip (B contact), Power failure prevention, Reverse rotation prevention, Process PI Disable, Timer input, Soft start cancel, ASR PI Gain switch-over, ASR P/PI switch-over, Flux command value switch-over, Pre-excitation, Speed/Torque control, Torque limit ON/Off, Torque bias ON/Off)
	P2(MM1)		
	P3(AT0)		
	P4(FHM)		
	P5(BAT)		
	P6(BRC)		
	P7(MCC)		
	CM	COMMON	● On when each contact is tied to CM.

Item	Name	Function	Description
Analog Input	VREF	Power supply for analog setting	● Reference voltage by variable resistor (+ 10V) : 10kΩ
	AI1	Voltage/ Current Signal Input	● Voltage signal input (-10 ~ 10V), current signal input (4 ~ 20mA), Motor NTC selectable via Multi-function Analog input. ● Selectable among following 8 different functions; Speed/Torque/Flux command, Torque bias, Torque limit, Process PI controller command, Process PI controller feedback value, Draw command, Motor NTC input) ● Jumper setting in Voltage Input: Closed (Jumper connected as **Default**) ➔ AI1, AI2: Open (Jumper disconnected), AI3: Switch set on left side ● Jumper setting in Current Input ➔ AI1, AI2: Short ● Motor NTC (When using **LG-OTIS Motor Only**) ➔ AI3: switch set on right side.
	AI2		
	AI3	Voltage/Motor NTC Input	
	5G	COMMON	● COMMON terminal for Analog input
Encoder Input	PE	P/S (Power supply) for Pulse Encoder	+5V Line Drive Power
	GE		0V
	A+	Encoder A-phase signal	● A, B signal for Line Drive Type Encoder. ● Set the JP2 switch at "P5" on I/O PCB and set the JP4 switch to "LD" for the use of Line Drive. **※ Jumpered as default** (☞ If +12V Power Type Line Drive Encoder is used, set the JP2 switch at "P12".)
	A-		
	B+	Encoder B-phase signal	
	B-		
	PE	P/S for Open Collector	+15V Open Collector Power
	GE		0V
	PA	Encoder A-phase signal	● A, B signal for Complementary or Open Collector Type Encoder. ● Set the JP2 switch at "P15" on I/O PCB and set the JP4 switch to "OC" for the use of Open Collector.
	PB	Encoder B-phase signal	
	Z+(PZ)	Encoder Z-phase signal	Note) The usages of Z-phase signal are as follows and its functions will be available soon. ● Use for Z-phase pulse provided encoders. ● Z+ and Z- signals are used for Line Drive type, so set the JP5 switch to "LD". ● PZ signal is used for Open Collector type, so set the JP5 switch to "OC".
	Z-		
Encoder Output	RA	Encoder signal output : A-phase	Encoder A, B phase signal output – Open Collector Type
	GE	Output Common	
	RB	Encoder signal output : B-phase	
	GE	Output Common	
Analog Output	AO1	Analog Output 1	● Output range: -10V ~ +10V ● Selectable among 31 (Motor speed, speed ref. 1~2, Torque command 1~2, torque current, flux ref., flux current, Inverter output current/voltage, Motor Temp, DC link voltage…)
	AO2	Analog Output 2	
	5G	COMMON	● COMMON terminal for Analog Output
Relay output	1A	Multi-function relay output 1 (A Contact)	● Selectable among the following 14 functions; Zero speed detect, Speed detect (Bi-directional), Speed detect (Uni-directional), Speed reach, Speed deviation, Torque detect, On Torque limit, Motor overheat, Inverter overheat, on low
	1B		
	2A	Multi-function relay	

Item	Name	Function	Description
	2B	output 2 (A Contact)	voltage, Inverter running, Inverter regenerating, Inverter ready, Timer output
	OC1	Open Collector Ouput	
	EG		
	30A	Fault alarm A contact	● Outputs when fault occurs. ● Deactivated in BX condition.
	30B	Fault alarm B contact	
	30C	COMMON	● COMMON for 30A, 30B
Switch	JP2	Encoder Power Supply	DC +5V / +12V / +15V selectable usages
	JP4	Encoder Input-phase Type	LD (Line Drive) / OC (Open Collector or Complementary)
	JP5	Encoder Z-phase Type	LD (Line Drive) / OC (Open Collector or Complementary)

2.4.3 Wiring the Control Circuit Terminal

① Shield wire or vinyl insulated wire are highly recommended to be used for the control circuit terminal.
② Be sure to use twisted shield wire if wiring distance gets too long.
③ Wire should be at least as thick as 0.2 ~ 0.8 mm^2 (18 ~ 26 AWG).
④ Screwing torque limit should be kept under 5.2 lb-in.
⑤ Maximum interrupting capacity of auxiliary contact 1, 2 is of AC 250V/1A, DC 30V/1A.
⑥ Maximum interrupting capacity of fault alarm relay A, B contact is of AC 250V/1A, DC 30V/1A.
⑦ Open collector output 1, 2 and 3 can be used below maximum of 24V/100mA.
⑧ Wires for the control circuit terminal should be separated from ones for the power circuit terminal, if possible and in case wires for both control circuit terminal and the power circuit one cross each other, they should be crossed at right angles (90°).



2.4.4 Caution on wiring pulse encoder

1) Check-up of the coupling and alignment of motor and encoder shaft

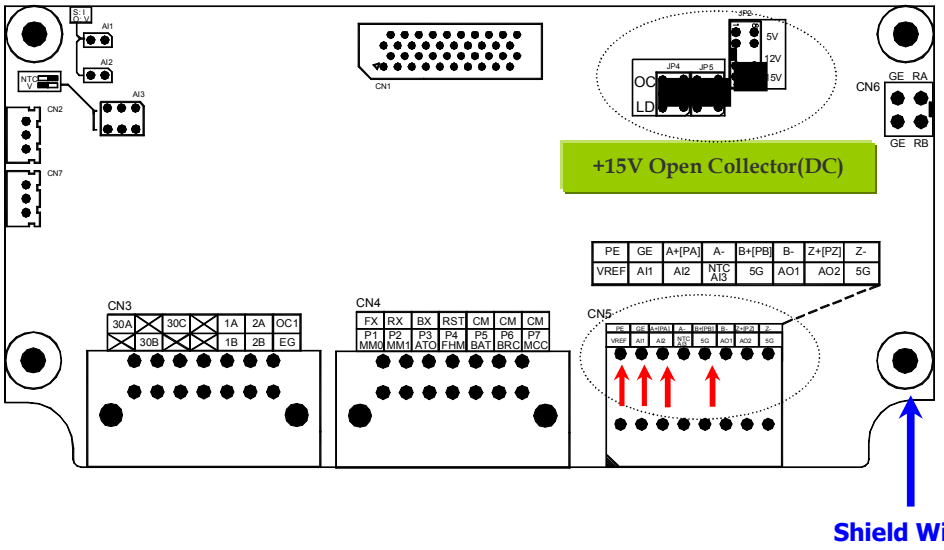
① Be sure to mount the pulse encoder at the location where it rotates at the same speed as the motor does.
② In case there is speed slip between the motor shaft and encoder shaft, the motor may not start or it causes mechanical vibration.
③ Poor alignment of motor and encoder shaft results in torque ripple and causes mechanical vibration which has the same frequency as the motor speed at the constant speed region.

2) Wiring the pulse encoder

① Be sure to **use twist paired shield wire** and **ground shield wire to screw for earth on the I/O PCB**.
② Signal wires should be separated from the power lines, if possible. Electromagnetic noise may affect the pulse encoder output signals.

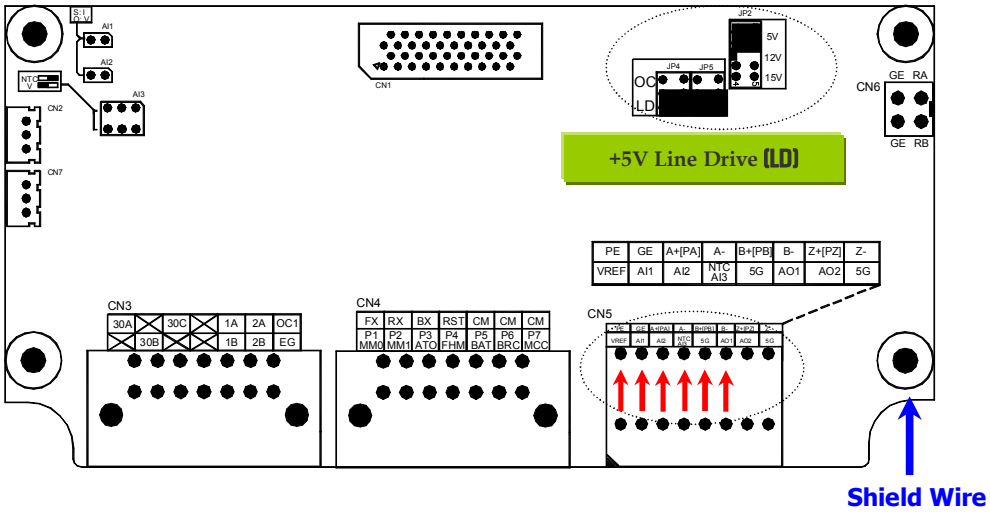
2.4.5 Encoder Wiring and Switch Setting

(Available for +12V/+15V Complementary or Open Collector, +12V / +15V power Type Encoder)



2.4.6 Wiring and Switch Setting for Line Drive Type Pulse Encoder (+5V) ※ Jumper provided as default

(☞ For +5V Power Type Line Drive Encoder)



⚠ CAUTION

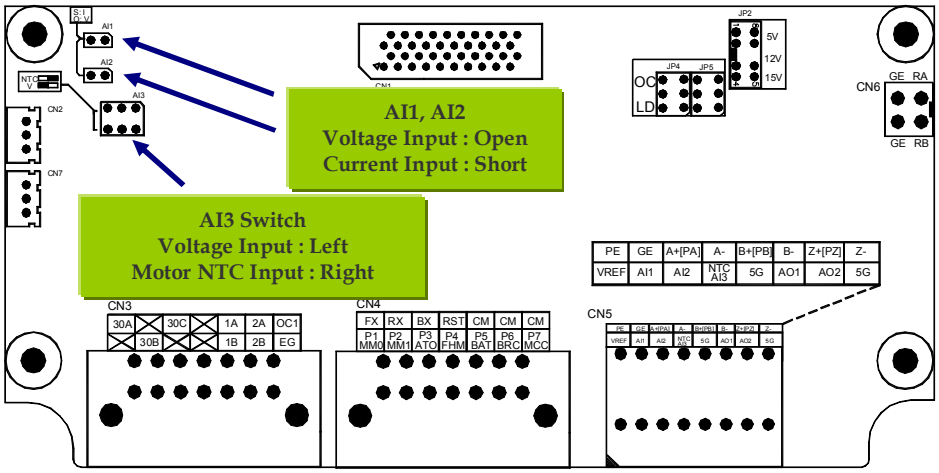
- When Encoder is wired with I/O terminal, Wire '+', '-' of Encoder is connected with PE and GE respectively.
- Be careful that do not wire '-' with 5G.

⚠ CAUTION

- NEVER change the switch setting for Encoder Type during inverter run. Otherwise, it may cause inverter trip, adversely affecting the entire system.
  Therefore, verify the switch is correctly set before operation.

2.4.7 Jumper Setting for Analog Input (Voltage/Current/Motor NTC Input)

※ Jumper setting as default : Voltage Input (OPEN)

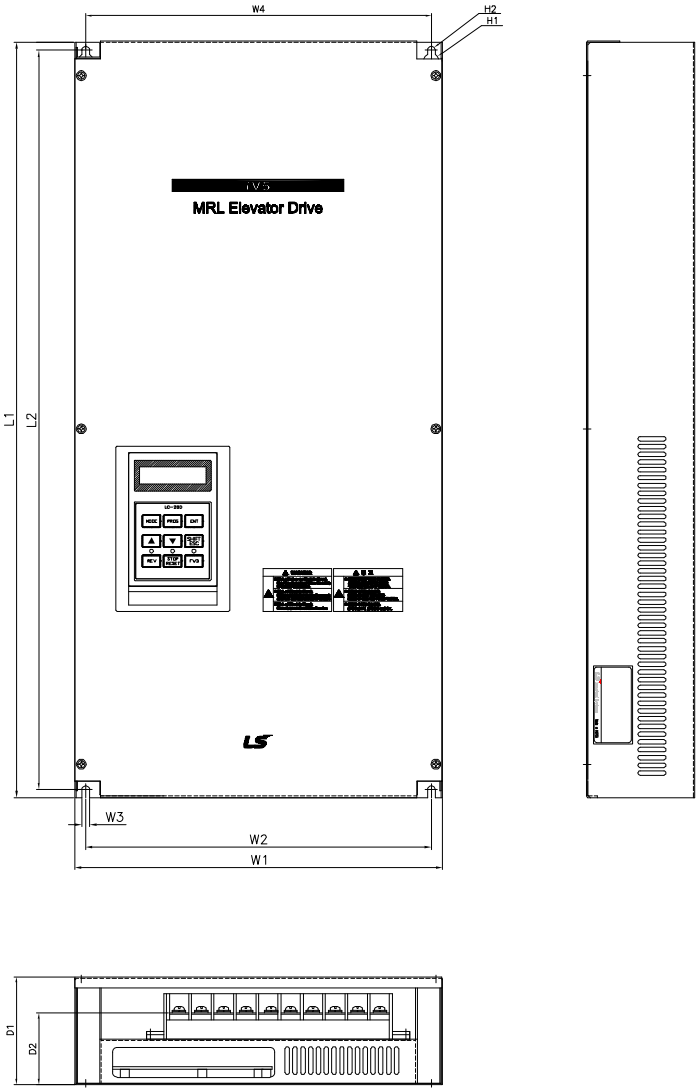


⚠ CAUTION

- NEVER change the jumper setting during inverter run. Otherwise, it may cause inverter trip, adversely affecting the entire system.
- Motor NTC input for Analog Input 3 is ONLY available when LG-OTIS Motor is connected.
  If user use a motor other than LG-OTIS with different NTC specification and use this function, it will lead to motor overheat and damage to the motor.

2.5 Appearance and Dimension

2.5.1 SV 075, 110, 150, 220 iV5-4(MRL)



2.5.2 Dimension(mm[inches])

Capacity	W1	W2	W3	W4	L1	L2	D1	D2	H1	H2
MRL 075-4 MRL110-4	330 [12.99]	310 [12.2]	7 [0.28]	310 [12.2]	680 [26.7]	666 [26.22]	97.2 [3.83]	64.7 [2.55]	Φ 14 [Φ0.55]	Φ7 [Φ0.28]
MRL150-4	375 [14.76]	355 [13.98]	7 [0.28]	355 [13.98]	700 [27.56]	686 [27]	108.5 [4.27]	75.7 [2.98]	Φ 14 [Φ0.55]	Φ7 [Φ0.28]
MRL220-4	375 [14.76]	355 [13.98]	7 [0.28]	355 [13.98]	700 [27.56]	686 [27]	139.2 [5.48]	101.3 [3.99]	Φ 14 [Φ0.55]	Φ7 [Φ0.28]

3.1 PeriPherals

3.1.1 MCCB(LS), ELB(LS), Magnetic contactor(LS), input/output wire specifications

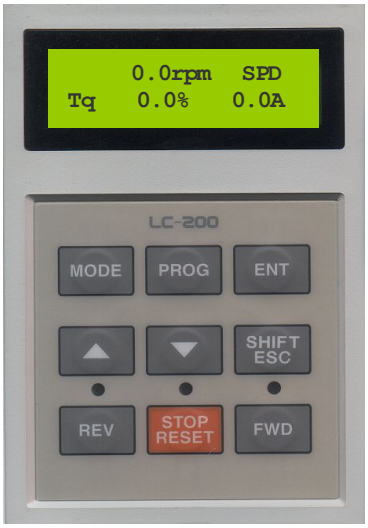
Voltage	Motor (kW)	Inverter models	MCCB, ELB (LS)	Magnetic contactor (LS)	Wire (mm²)		
					R,S,T	U,V,W	Ground
400V	7.5	SV075iV5-4DB	ABS33b,EBS33b	GMC-22	3.5	3.5	3.5
	11	SV110iV5-4DB	ABS53b,EBS53b	GMC-22	5.5	5.5	8
	15	SV150iV5-4DB	ABS63b,EBS63b	GMC-32	14	8	8
	22	SV220iV5-4DB	ABS103b,EBS103b	GMC-50	22	14	14

3.1.2 AC input fuse, AC reactor, DC reactor

Voltage	Motor (kW)	Inverter models	AC input fuse	AC reactor	DC reactor
400V	7.5	SV075iV5-4DB	30 A	1.14 mH, 20 A	4.04 mH, 19 A
	11	SV110iV5-4DB	35 A	0.81 mH, 30 A	2.76 mH, 29 A
	15	SV150iV5-4DB	45 A	0.61 mH, 38 A	2.18 mH, 36 A
	22	SV220iV5-4DB	70 A	0.39 mH, 58 A	1.54 mH, 55 A

4.1 Keypad operation

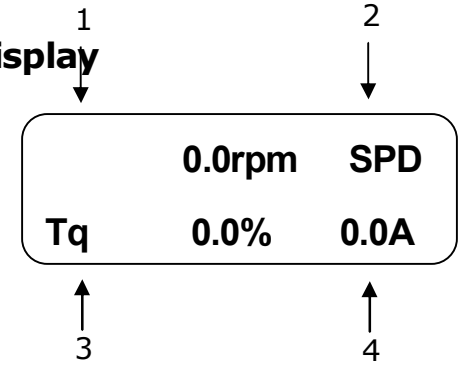
LCD Keypad can display up to 32 alphanumeric characters and monitor or set parameter values to operate the inverter and the motor properly. As follows are keypad view and explanation on each key/LED on the keypad.



Item	Display	Function	Description
KEY	MODE	Mode	Enables to move to the other groups (Initial Screen → IO → PAR → FUN…) and go to the first code in the same group.
	PROG	Program	Enables to modify setting values.
	ENT	Enter	Enables to move to the other groups (Initial Screen ← IO ← PAR ← FUN…) and save the changed setting values.
	▲(Up)	Up	Moves to the next code or increments setting values.
	▼(Down)	Down	Moves to the next code or decrements setting values.
	SHIFT/ESC	Shift/ESC	Acts as Shift key in a setting mode and as ESC key in other mode.
	REV	Reverse RUN	Reverse RUN command is enabled.
	STOP/RESET	Stop/Reset	Stop key during inverter operation. Resets fault when inverter returns to normal after fault has occurred.
	FWD	Forward RUN	Forward RUN command is enabled.
LED	(REV)	Reverse RUN	Lights when motor is in reverse revolution. Blinks on acceleration/deceleration, lit in a constant speed
	(STOP/RESET)	Stop/Reset	Lights when the motor stops. Blinks when fault has occurred.
	(FWD)	Forward RUN	Lights when motor is in forward revolution. Blinks on acceleration/deceleration, lit in a constant speed

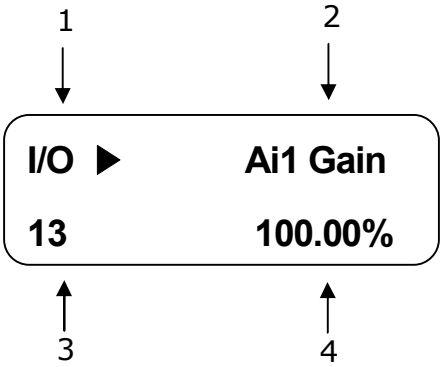
4.2 Keypad LCD Display

4.2.1 LCD Start-up display



No.	Function	Description
1	Motor speed	Real motor speed in RPM (Revolution Per Minute)
2	Motor control Mode	SPD: Speed control mode TRQ: Torque control mode BX: Emergency stop
3	Generating torque	Displays generated torque to the 100% rated output of a motor.
4	INV output current	Inverter output current in RMS

4.2.2 Group display



No.	Function	Description
1	Parameter group	Displays the name of each parameter group. There are DIS, I/O, PAR, FUN, CON, USR and 2nd group.
2	Code Type	Displays a code type to be set.
3	Code Number	Displays a code number to be set.
4	Code data and unit	Displays a code data and a code unit to be set.

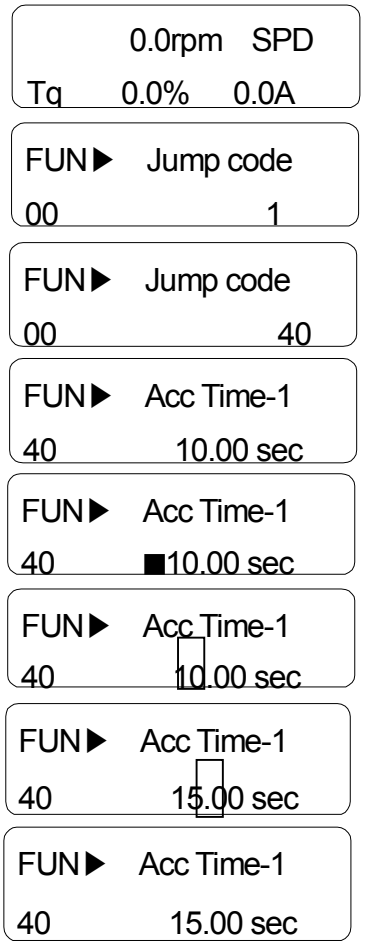
4.3 Parameter setting and modifying

Inverter has a number of parameters. In case inverter is to be in use using a keypad, proper parameter values can be set depending on the load and operation condition. For more detailed information, refer to Chapter 6.

First, move on to the code in a group where is intended to change parameter value.
cursor (■) blinks by pressing [**PROG**] key. Parameter value can be set using (SHIFT/ESC)], [▲(Up)] and [▼(Down)] keys and then can be saved by entering [ENT] key.

Note) In some cases, data will not be changed for the following two reasons.
* Some data cannot be changed during inverter operation.
* Parameter data lock function is set. (PAR_04 [Parameter Lock] is enabled)

Example) In case the 1st acceleration time is to be changed from 10(sec) to 15(sec), it can be set as shown below.



Initial screen

Move on to FUN group through [MODE] key.

After pressing [PROG] key, input 40 and press [ENT] key, using [(SHIFT/E
[▲(Up)], and [▼(Down)] keys.

The screen that can set acceleration time as 1

Press the [PROG] key. Setting mode (Cursor(■) appears and blinks.)

Move the cursor on to where you want, using [(SHIFT/ESC)] key.

Set the data using [▲(Up)], [▼(Down)] key.

Save the changed data by pressing [ENT] key. (Cursor disappears.)

4.4 Parameter group

SV-iV5[MRL] series inverters use LCD keypad for user's convenience.

Data groups are divided into 7 groups for easy access depending on the inverter application.

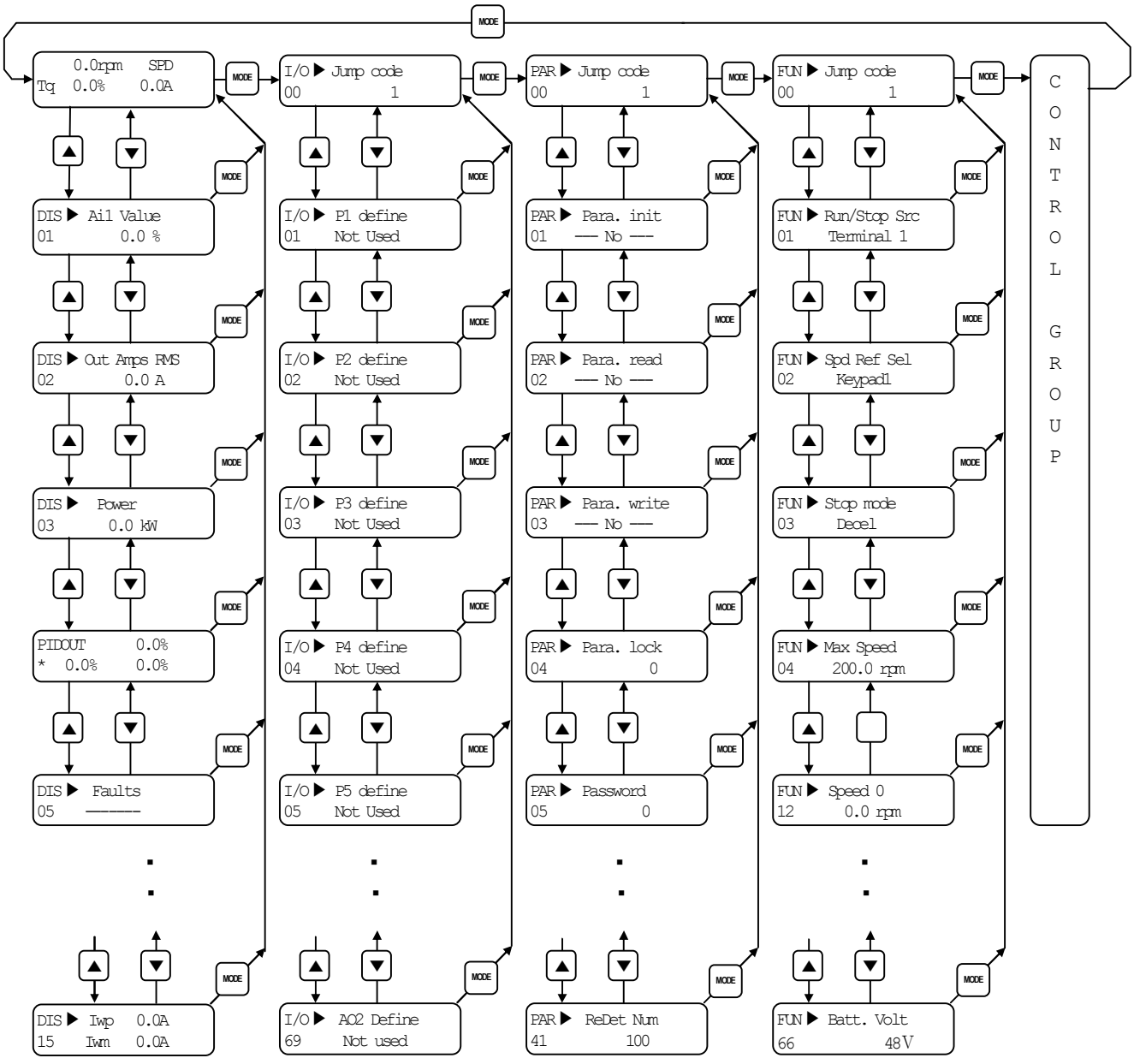
Name	LCD keypad (on the upper left)	Description
Display group	DIS	Motor speed, Motor control mode, Generating torque, Output current, User selection display, Process PID output/reference/feed-back value, Fault display, User group display setting and so on.
I/O group	I/O	Digital input parameters, Digital output parameters, Analog input related parameters, Analog input related parameters and so on.
Parameter group	PAR	Parameter initialization, Parameter read / write / lock /password, Motor related constants, Auto-tuning and so on.
Function group	FUN	Operating frequency, Operation mode, Stop mode, Acceleration /deceleration time and pattern, Carrier frequency, Electronic thermal selection and so on.
Control group	CON	Control mode, ASR PI gain, Process PID gain, Draw control setting, Droop control related constants, Torque control related constants, V/F control related constants and so on.
User group	USR	User macro function, macro function save, macro function recall
E/L group	E/L[1)]	Elevator speed pattern, parameter setting for position control and so on.

1) It is displayed only when CON_02 "Application" is set to "Elevator" after installing E/L option card.
Refer to Chapter 6. Function Description for more details.

4.4.1 LCD Group transfer in the keypad

For transfer to another group, [MODE] key is used and ▲(Up), ▼(Down) key is used to move up and down in the same group.

Display group Input/output group Parameter group Function group Control Group



User group is omitted.

4.5 Auto-Tuning

Measures stator resistance(Rs) of the synchronous motor by standstill auto tuning.

4.5.1 Motor & Encoder parameter setting for Auto-Tuning

The parameters on the nameplate of the motor and the pulse number of encoder should be set before operation.

LCD display	Description
PAR▶ Motor select 07 kW	Enter the motor capacity. General capacity is equal to the one of inverter. If there is no motor capacity on the list, select "User Define" and directly input on PAR_08.
PAR▶ UserMotorSel 08 kW	When selecting "User Define" on PAR_07, select motor capacity directly on PAR_08.
PAR▶ Enc Pulse 10 [][][][]	Set the pulse numbers per revolution of pulse encoder coupled to the motor shaft.
PAR▶ Rated Speed 17 rpm	Set the motor base speed.
PAR▶ Rated Volt 18 V	Set the rated voltage of the motor. (Voltage value on the name plate)
PAR▶ Pole number 19 []	Set the number of poles of the motor.
PAR▶ Efficiency 20 %	Set the efficiency of the motor in the case of Standstill auto tuning mode. Automatically set in the case of Rotational mode.
PAR▶ Rated-Curr 22 A	Set the rated current of the motor.

4.5.2 Standstill auto tuning

1) Precaution

Exact parameters can be found after surely fastening motor axis.

2) Auto tuning procedure

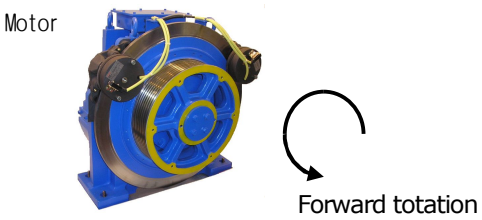
LCD Display	Description	Tuning Time
PAR ▶ AutoTuneType 23 StandStill	Set it to " **Standstill** ".	-
PAR ▶ Auto tuning 24 Rs Tuning	Find the value of stator resistance, not rotating the motor.	20 ~ 30(sec)
PAR ▶ Auto tuning 24 None PAR ▶ Auto tuning 24 Rs Error	When auto-tuning is complete successfully, **"None"** is displayed. If error occurs during auto-tuning, " **Rs Error** " is displayed. In this case, verify motor parameters and redo the auto-tuning. If the problem persists, contact LS customer service center.	

FWD/REV LED on keypad will blink during Auto-tuning.

4.6 Encoder operation check

4.6.1 The definition of forward rotation

Forward rotation is of counter-clockwise from the side view of motor shaft.

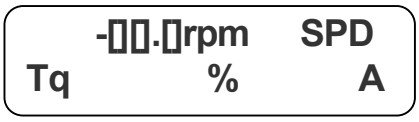


4.6.2 Forward rotaion check

Be sure to check if positive(+) speed is displayed when inverter power is on and rotates the motor in the forward direction.

4.6.3 Reverse rotaion check

Be sure to check if negative(-) speed is displayed when inverter power is on and rotates the motor in the reverse direction.



1) If speed is displayed 0.0 rpm or unchanged or speed polarity is reversed, check if wiring for the pulse encoder is properly done.
2) In case the motor shaft cannot be rotated with hands, refer to next chapter.

4.7 Permanent motor magnetic flux estimation operation

Before executing the operation, to run 4.5.1 **Motor & Encoder parameter setting for Auto-Tuning** is recommended.

4.7.1 Operation command source and speed command setting

FUN▶ Run/Stop Src 01 Keypad	1) RUN/STOP command by keypad
FUN▶ Spd Ref Sel 02 Keypad1	2) Operation speed command by keypad
FUN▶ Speed 0 12 10.0 rpm	3) Operation speed setting

4.7.2 How to operate magnetic flux estimation operation

Magnetic flux estimation operation in normal condition after checking expected current level directly rotates the motor, pressing FWD/REV keys.

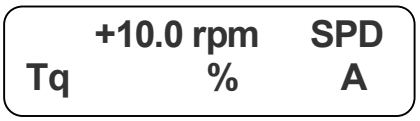
PAR▶ Mag Det Curr
37 70%

(1) Check setting for magnetic flux estimation standard level.
(2) If MagDet Err(stimulus estimation error) occurs after RUN command, increase 5% of magnetic flux estimation standard current (PAR_37) and keep commanding RUN by keypad until error message is not displayed.
(3) If OC(overcurrent) fault occurs when estimating magnetic flux, decrease 5% of magnetic flux estimation standard current level(PAR_37) and keep commanding RUN by keypad
(4) If there is no error or fault, please check the status as below.

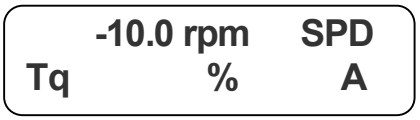
⚠ Caution
Magnetic flux estimation does not be executed every time and executed by first operation command after power-on. However, it is executed by initial operation command after reset due to error or fault.

① Low speed operation

- Check if motor speed is +10.0 rpm in the start-up LCD screen after pressing [FWD] key.



- Check if motor speed is –10.0 rpm in the start-up LCD screen after pressing [REV] key.



- In case that stimulus estimation is safely completed, operation status due to wrong wiring of encoder and motor at low speed operation is as follow.

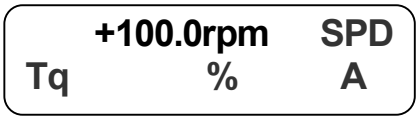
Encoder, motor wiring status	Keypad operation command	Rotation direction	Speed display	Torque display	Operation status
Right encoder and motors wiring	FWD	Forward	+10.0(rpm)	Below +10%	Normal
	REV	Reverse	-10.0(rpm)	Below -10%	
Wrong encoder wiring	FWD	Forward	-1 ~ -4(rpm)	150%(Torque Limit)	Abnormal
	REV	Reverse	1 ~ 4(rpm)	-150%(Torque Limit)	
Wrong motor wiring	FWD	Reverse	-1 ~ -4(rpm)	150%(Torque Limit)	Abnormal
	REV	Forward	1 ~ 4(rpm)	-150%(Torque Limit)	
Wrong wiring of both	FWD	Reverse	+10.0(rpm)	Below +10%	Abnormal
	REV	Forward	-10.0(rpm)	Below -10%	

If A and B phase are reversed, be sure to replace A with B phase wire after checking the pulse encoder wiring. Or user does not need to change wiring if PAR_11(Enc Dir Set) setting value is changed from "A Phase Lead" to "B Phase Lead".

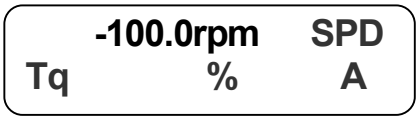
- Torque display is on the basis of the no load operation.

② High speed operation

- Change the value of FUN_12 to 1000.0(rpm) and Check the display LCD by pressing [FWD], [REV] keys shown below.
- When pressing [FWD] key



- When pressing [REV] key

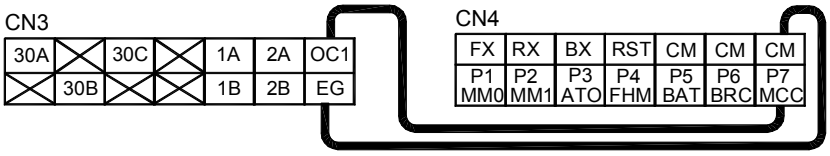


4.8 How to set Roll-back prevention by Load Cell

4.8.1 Preparations before setting

1) Input load detect signal such as Load cell at AI1-5G terminal 0~10V inputs come out.
2) During self-operation of inverter or other inverter, please check whether detect signal operates well or not.
3) When detecting wrong operation, please make it right by executing noise shielding or other management

Keypad display	Descriptions
CON▶ Trq Bias Src 32 Analog	Set torque bias of CON_32 as 'Analog'
CON▶ Trq Balance 35 0.0 %	Set torque balance of CON_35 as '0.0%'
I/O▶ P7 define 07 Analog Hold	Set I/O_07 as 'Analog Hold'
I/O▶ Ai1 Define 11 Torque Bias	Set I/O_11 as 'Torque Bias'
I/O▶ Ai1 Source 12 -10 ~ 10V	Set I/O_12 as '-10~10V'
I/O▶ Ai1 LPF 15 50ms	Set I/O_15 as much as 50ms
I/O▶ OC1 define 43 Run	Set I/O_43 as 'Run'

	Connect OC1(multi-function output OC1) of SIO board and P7(multi-function output OC1) of CN4 with Jumper. Also, connect each EG of CN3 and CN4 of EG with Jumper. -> When Run, Analog Hold operation < SIO board terminal wiring diagram schematic> 

4.8.2 Full Load up operation preparations

1) Load Full persons(100% Load) placing the Elevator into lowest floor.

2) Run Up operation, setting manual operation speed command as '0'

Keypad display	Descriptions
DIS▶ AI1 Value 01 100%	Cursor blinks if pressing [PROG] on DIS_01. Keep pressing until ▼ AI1 Value comes up. Please note the value displayed.
0.0rpm SPD Tq 100% 50A	**<in case of Multi-step operation mode>** Please note torque value displayed on initial screen of keypad, setting manual operation speed command as '0'.
Tq 100% MAN UP --F 50A	**<in case of ELIO operation mode>** Please note torque value displayed on initial screen of keypad, setting manual operation speed command as '0'. In order to show torque value on keypad, please set value on E/L_58(Display Sel).

4.8.3 No-load operation preparations

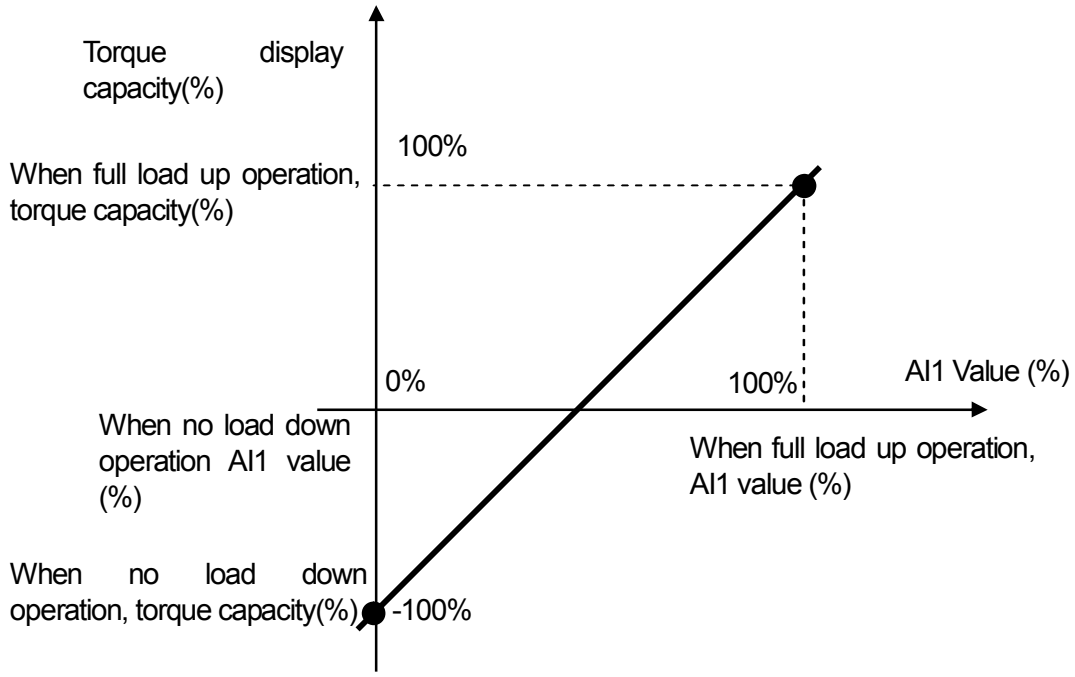
1) Make the elevator under No load(No persons) placing the elevator highest floor.

2)Run Down operation, setting manual operation speed command as '0'

Keypad display	Descriptions
DIS▶ AI1 Value 01 0%	Cursor blinks if pressing [PROG] on DIS_01. Keep pressing until ▼ AI1 Value comes up. Please note the value
0.0rpm SPD Tq -100% -50A	**<in case of Multi-step operation mode>** Please note torque value displayed on initial screen of keypad, setting manual operation speed command as '0'.

Tq -100% MAN DN --F -50A	**<in case of ELIO operation mode>** Please note torque value displayed on initial screen of keypad, setting manual operation speed command as '0'. In order to show torque value on keypad, please set value as "Trq Output" on E/L_58(Display Sel).

With data estimated above, a line as show below can be made. And with an equation, setting values can be obtained.



3) A straight line equation

If expressing a straight line passing through two points above, y=A*x + B can be displayed. In this case, A is the slope and details of it are as follow.

A=(during up operation, torque capacity – during down operation, torque capacity)/(during up operation, AI1 value – during down operation, AI1 value)

If calculating y-(during no load down operation, torque capacity) = A*(x – during no load down operation, AI1 value), **B=(**during no load down operation, torque capacity**) – A*(**during no load down operation, **AI1 value)**

<Calculation Example>

A= [100%-(-100%)]/(100%-0%)= 2

Therefore, y-(-100%)=2*(x-0%), B=[-100%]-2*[0%] = -100%.

If changing to a form of, y=A*x+B, y=2*x-100%

Thus, calculation is as follow

Keypad display	Descriptions
I/O▶ Ai1 Gain 13 200%	Input the value (AX100%) into I/O_13.
CON▶ Trq Balance 35 100%	Input the absolute value (BX(-)) into CON_35

5.1 Display group(DIS_[][])

Code No.	Function name	LCD display	Setting Data			Adjustment during run	Page
			Range	Unit	Default		
DIS_00	Motor speed/Control mode/generated torque/output current	0.0rpm SPD Tq 0.0% 0.0A					6-1
DIS_01	User display 1	Ai1 Value		%	PreRamp Ref	Yes	6-2~3
		Ai2 Value		%			
		Ai3 Value		%			
		PreRamp Ref		rpm			
		PostRamp Ref		rpm			
		ASR Inp Ref		rpm			
		Output Freq		rpm			
		Motor Speed		rpm			
		Speed Dev		rpm			
		ASR Out		%			
		Torque Bias		%			
		PosTrq Limit		%			
		NegTrq Limit		- %			
		RegTrq Limit		%			
		Torque Ref		%			
		IqeRef		A			
		Iqe		A			
		Flux Ref		%			
		Ide Ref		A			
		Ide		A			
		ACR_Q Out		V			
		ACR_D Out		V			
		VdeRef		V			
		VqeRef		V			
		Out Amps RMS		A			
		Out Volt RMS		V			
		Power		kW			
		DC Bus Volt		V			
		Proc PI Ref		%			
		Proc PI F/B		%			
		Proc PI Out		%			
		Mot Temp		deg			
		Inv Temp		deg			
		Inv i2t		%			
		MP Output		%			
		Ctrl Mode					
		S/W Version					
		Run Time					
		Terminal In					
		Terminal Out					

		Run Status					
DIS_02	User select display 2	Refer to DIS_01			DC Bus Volt	Yes	6-2~3
DIS_03	User select display 3	Refer to DIS_01			Terminal In	Yes	6-2~3
DIS_04	Process PID output Ref / FB	PIDOut 0.0% * 0.0% 0.0%					6-4
DIS_05	Malfunction status display	Faults					6-4~5
DIS_06	User group display setting	Usr Grp Disp	Not Used Dis+User Grp Display ALL		Not Used	Yes	6-6
DIS_10	Dead time voltage factor	Vcomp Factor	-30.000 ~ 30.000	m	0.000	No	6-6
DIS_13	Constant current display	Iup	Ium	A	Iup	Yes	6-6
DIS_14	Constant current display	Ivp	Ivm	A	Ivp	Yes	6-6
DIS_15	Constant current display	Iwp	Iwm	A	Iwp	Yes	6-6

Adjustment during run (YES: possible, NO: impossible)

5.2 Input/output group(I/O_[][])

Function code	Function name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
I/O_00	Function code select	Jump Code	1 ~ 71			Yes	6-7
I/O_01	Multi-function input terminal P1 definition	P1 define	Not Used Speed-L Speed-M Speed-H Jog Speed MOP Up MOP Down MOP Clear MOP Save Analog Hold Main Drive Xcel-L Xcel-H 3-Wire Ext Trip-B Prohibit FWD Prohibit REV Proc PID Dis Timer Input SoftStrtCncl ASR Gain Sel ASR P/PI Sel Flux Ref Sel PreExcite Spd/Trq Sel Use Max Trq		Not Used	No	6-7~17
I/O_02		P2 define	Refer to I/O_01		Not Used	No	6-7~17
I/O_03		P3 define	Refer to I/O_01		Not Used	No	6-7~17
I/O_04	Multi-function input terminal P2 definition	P4 define	Refer to I/O_01		Not Used	No	6-7~17
I/O_05	Multi-function input terminal P3 definition	P5 define	Refer to I/O_01		Not Used	No	6-7~17
I/O_06	Multi-function input terminal P4 definition	P6 define	Refer to I/O_01		Not Used	No	6-7~17
I/O_07	Multi-function input terminal P5 definition	P7 define	Refer to I/O_01		Not Used	No	6-7~17
I/O_08	Negative function of multi-function input terminal	Neg Func. In	0000000 ~ 1111111	bit	0000000	No	6-17

I/O_09	Multi-function Input LPF time constant	Terminal LPF	0 ~ 2000		5	Yes	6-17
I/O_10	Negative function of multi-function auxiliary output terminal	Neg Func. Out	00000 ~ 11111	bit	00000	No	6-17
I/O_11	Multi-function analog input Ai1 definition	Ai1 Define	Not Used Speed Ref Proc PID Ref Proc PID F/B Draw Ref Torque Ref Flux Ref Torque Bias Torque Limit		Not Used	Yes	6-18~20
I/O_12	Multi-function analog input Ai1 source	Ai1 Source	-10 → 10V 0 → 10V 10 → 0V 4 → 20mA 20 → 4mA		-10 → 10V	Yes	6-18~20
I/O_13	Multi-function analog input Ai1 gain	Ai1 Gain	0.00 ~ 500.00	%	100.00	Yes	6-18~20
I/O_14	Multi-function analog input Ai1 bias	Ai1 Bias	-100.00 ~ Ai1 Gain	%	0.00	Yes	6-18~20
I/O_15	Multi-function analog input Ai1 LPF time constant	Ai1 LPF	0 ~ 2000	ms	0	Yes	6-18~20
I/O_16	Multi-function analog input Ai2 definition	Ai2 Define	Refer to I/O_11 ~ I/O_15		Not Used	Yes	6-18~20
I/O_17	Multi-function analog input Ai2 source	Ai2 Source			-10 ~ 10V	Yes	6-18~20
I/O_18	Multi-function analog input Ai2 gain	Ai2 Gain			100.00	Yes	6-18~20
I/O_19	Multi-function analog input Ai2 bias	Ai2 Bias			0.00	Yes	6-18~20
I/O_20	Multi-function analog input Ai2 LPF time constant	Ai2 LPF			0	Yes	6-18~20
I/O_21	Multi-function analog input Ai3 definition	Ai3 Define	Refer to I/O_11 ~ I/O_15 (I/O_21 : Motor NTC select possible)		Not Used	Yes	6-18~20
I/O_22	Multi-function analog input Ai3 source	Ai3 Source			-10 ~ 10V	Yes	6-18~20
I/O_23	Multi-function analog input Ai3 gain	Ai3 Gain			100.00	Yes	6-18~20
I/O_24	Multi-function analog input Ai3 bias	Ai3 Bias			0.00	Yes	6-18~20
I/O_25	Multi-function analog input Ai3 LPF time constant	Ai3 LPF			0	Yes	6-18~20

Function code	Function name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
I/O_41	Definition of multi-function Auxiliary output (AX1)		Not Used INV Ready Zero Spd Det Spd Det. Spd Det(ABS) Spd Arrival Timer Out LV Warn Run Regenerating Mot OH Warn Inv OH Warn Spd Agree Trq Det. Trq Lmt Det. OverLoad Stop Steady				6-21~26
I/O_42	Definition of multi-function Auxiliary output (AX2)	AX2 Define	Same as I/O_41		Not Used	Yes	6-21~26
I/O_43	Definition of multi-function Auxiliary output (OC1)	OC1 Define	Same as I/O_41		Not Used	Yes	6-21~26
I/O_46	Fault relay mode selection (A, B, C)	Relay Mode	000 ~ 111	bit	011	Yes	6-26~27
I/O_47	Zero speed detection level	ZSD Level	0.0 ~ 480.0	rpm	10.0	Yes	6-22
I/O_48	Zero speed detection band	ZSD Band	0.1 ~ 10.0	%	0.5	Yes	6-22
I/O_49	Speed detection level	SD Level	-3600 ~ 3600	rpm	0	Yes	6-22
I/O_50	Speed detection band	SD Band	0.1 ~ 10.0	%	0.5	Yes	6-22~23
I/O_51	Speed arrival band	SA Band	0.1 ~ 10.0	%	0.5	Yes	6-23
I/O_52	Speed deviation band	SEQ Band	0.1 ~ 10.0	%	0.5	Yes	6-23
I/O_53	Torque detection level	TD Level	0.0 ~ 250.0	%	0.0	Yes	6-25
I/O_54	Torque detection band	TD Band	0.1 ~ 10.0	%	0.5	Yes	6-25
I/O_55	Timer On delay time	TimerOn Dly	0.1 ~ 3600.0	sec	0.1	Yes	6-24
I/O_56	Timer Off delay time	TimerOff Dly	0.1 ~ 3600.0	sec	0.1	Yes	6-24
I/O_57	Overload warning level	OL Level	30 ~ 250	%	150	Yes	6-25
I/O_58	Overload warning time	OL Time	0 ~ 30	sec	10	Yes	6-26
I/O_59	Overload trip selection	OLT Select	Yes/No		Yes	Yes	6-27
I/O_60	Overload trip level	OLT Level	30 ~ 250	%	180	Yes	6-27
I/O_61	Overload trip time	OLT Time	0 ~ 60	sec	60	Yes	6-27
I/O_62	Inverter overheat warning temp.	IH Warn Temp	50 ~ 85	deg	75	Yes	6-25
I/O_63	Inverter overheat warning band	IH Warn Band	0 ~ 10	deg	5	Yes	6-25
I/O_64	Motor overheat warning temp.	MH Warn Temp	75 ~ 130	deg	120	Yes	6-25
I/O_65	Motor overheat warning band	MH Warn Band	0 ~ 10	deg	5	Yes	6-25

Function code	Function name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
I/O_66	Multi-function analog output AO1 definition	AO1 Define	Not Used Ai1 Value Ai2 Value Ai3 Value PreRamp Ref PostRamp Ref ASR Inp Ref Motor Speed Speed Dev ASR Out Torque Bias PosTrq Limit NegTrq Limit RegTrq Limit Torque Ref IqeRef Iqe Flux Ref IdeRef Ide ACR_Q Out ACR_D Out VdeRef VqeRef Out Amps RMS Out Volt RMS Power DC Bus Volt Proc PI Ref PROC PI F/B Proc PI Out Mot Temp Inv Temp		Not Used	Yes	6-28
I/O_67	Multi-function analog output AO1 gain	AO1 Gain	0.0 ~ 500.0	%	100.0	Yes	6-28
I/O_68	Multi-function analog output AO1 bias	AO1 Bias	-100.0 ~ I/O_67	%	0.0	Yes	6-28
I/O_69	Multi-function analog output AO2 definition	AO2 Define	Refer to I/O_66 ~ I/O_68		Not Used	Yes	6-28
I/O_70	Multi-function analog output AO2 gain	AO2 Gain		%	100.0	Yes	6-28
I/O_71	Multi-function analog output AO2 bias	AO2 Bias		%	0.0	Yes	6-28

5.3 Parameter group(PAR_[][])

Function code	Function name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
PAR_00	Function code select	Jump Code	1 ~ 41			Yes	6-30
PAR_01	Initialize parameters	Para. init	No All Groups DIS I/O PAR FUN CON EXT USR E/L		No	No	6-30
PAR_02	Read parameters	Para. read	No Yes		No	No	6-31
PAR_03	Write parameters	Para. write	No Yes		No	No	6-31
PAR_04	Parameter write protection	Para. lock	0 ~ 255		0	Yes	6-31
PAR_05	Password	Password	0 ~ 9999		0	Yes	6-32
PAR_07	Motor capacity selection 1)	Motor select	3.7kW-NW 6.2kW-NW 6.5kW-NW 7.1kW-NW 12.5kW1-NW 12.5kW2-NW 14.1kW-NW 3.7kW-KE 6.2kW-KE 6.5kW-KE 7.5kW-KE 11kW-KE 15kW-KE 13.3kW-HS 6.7kW-FJ User Define	kW		No	6-32
PAR_08	Motor cap. selection of USER	UserMotor Sel	1.5 ~ 22.0	kW	5.5	No	6-32~33
PAR_09	Motor cooling type	Cooling Mtd	Self-cool Forced-cool		Forced-cool	Yes	6-33~34
PAR_10	Pulse no. of encoder	Enc Pulse	360 ~ 65535		8192	No	6-33~34
PAR_11	Encoder direction setting	Enc Dir Set	A Phase Lead B Phase Lead		A Phase Lead	No	6-33~34
PAR_12	Encoder error check enable	Enc Err Chk	Yes/No		Yes	No	6-33~34
PAR_13	Encoder LPF time constant	Enc LPF	0 ~ 100	ms	0	Yes	6-33~34
PAR_14	Encoder error detection time	EncFaultTime	0.00 ~ 10.00	sec	0.00	No	6-34~35
PAR_15	encoder error reference speed	EncFaultPerc	0.0 ~ 50.0	%	25.0	No	6-34~35

Function code	Code name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
PAR_17	Motor base speed	Base Speed	10.0 ~ 3600.0	rpm		No	6-36
PAR_18	Motor rated voltage	Rated Volt	120 ~ 560	V		No	6-36
PAR_19	Motor number of poles	Pole number	2 ~ 40			Yes	6-36
PAR_20	Motor efficiency	Efficiency	70.0 ~ 100.0	%		Yes	6-36
PAR_21	Motor rated slip	ASR PI Ratio	3 ~ 250	rpm		Yes	6-34~36
PAR_22	Motor rated current	Rated-Curr	1.0 ~ 450.0	A		Yes	6-36
PAR_23	Auto tuning type selection	AutoTuneType	Standstill		Standstill	No	
PAR_24	Auto Tuning type select	Auto Tuning	Rs Tuning		None	No	
PAR_28	Motor d axis inductance	Ld	0.00 ~ 500.00	mH		Yes	
PAR_30	Motor stator resistance	Rs	0.000 ~ 5.000	ohm		Yes	
PAR_35	Stimulus detect repeat count	DetAve Num	1~30		1	No	6-37
PAR_36	Stimulus detect voltage	MagDet Volt	50 ~ 200	V	80	No	6-37
PAR_37	Stimulus detect current	MagDet Curr	10 ~ 150	%	70	No	6-37
PAR_38	Speed drift detect level	RevSpdLevel	0 ~ 100	%	30	No	6-37
PAR_39	Speed drift detect time	RevSpdTime	0 ~ 9999	ms	1500	No	6-37
PAR_40	Trip select bit	MRL TripSel	0000 ~ 1111	BIT	1110	No	6-38
PAR_41	Run command count for estimating Filx repeatedly	ReDet Num	0 ~ 65535		100	No	6-38

Notice1) When selecting capacity of the motor(PAR_07), values, PAR_17, 18, 19, 20, 22, 28, 30 will automatically change. Therefore, please check whether correct values are set or not, comparing with ones on the plate.

Default of PAR_17, 18, 19, 20, 22, 28, 30 is the standard when PAR_07 is .7kW-NW. Therefore, there is no indication on user manual.

Notice2) When PAR_07 is set to "User Define", PAR_08 will be displayed.

5.4 Function group(FUN_[][])

Function code	Function name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
FUN_00	Function code select	Jump code	1 ~ 66			Yes	6-39
FUN_01	RUN/STOP command source selection	Run/Stop Src	Terminal 1 Terminal 2 Keypad Option		Terminal 1	No	6-39~40
FUN_02	Speed setting source selection	Spd Ref Sel	Analog Keypad1 Keypad2 Option		Keypad1	No	6-40
FUN_03	Stop mode selection	Stop mode	Decel Free-run		Decel	No	6-40
FUN_04	Max. motor speed	Max Speed	10.0 ~ 3600.0	rpm	200.0	No	6-40
FUN_12	Multi-step speed 0	Speed 0	0.0~Max Speed	rpm	0.0	Yes	6-41
FUN_13	Multi-step speed 1	Speed 1	0.0~Max Speed	rpm	0.0	Yes	6-41
FUN_14	Multi-step speed 2	Speed 2	0.0~Max Speed	rpm	0.0	Yes	6-41
FUN_15	Multi-step speed 3	Speed 3	0.0~Max Speed	rpm	0.0	Yes	6-41
FUN_16	Multi-step speed 4	Speed 4	0.0~Max Speed	rpm	0.0	Yes	6-41
FUN_17	Multi-step speed 5	Speed 5	0.0~Max Speed	rpm	0.0	Yes	6-41
FUN_18	Multi-step speed 6	Speed 6	0.0~Max Speed	rpm	0.0	Yes	6-41
FUN_19	Multi-step speed 7	Speed 7	0.0~Max Speed	rpm	0.0	Yes	6-41
FUN_20	JOG speed	Jog Speed	0.0~Max Speed	rpm	100.0	Yes	6-41
FUN_21	Dwell Speed	Dwell Speed	0.0~Max Speed	rpm	100.0	No	6-42
FUN_22	Dwell Time	Dwell Time	0.00 ~ 100.00	sec	0.00	No	6-42
FUN_33	Acc./Dec. reference Speed	Acc/Dec Ref	Max Speed Ref Speed		Max Speed	No	6-42~43
FUN_36	S ratio 1 in acceleration start	Acc S Start	0.0 ~ 50.0	%	0.0	No	6-44~46
FUN_37	S ratio 2 in acceleration end	Acc S End	0.0 ~ 50.0	%	0.0	No	6-44~46
FUN_38	S ratio 1 in deceleration start	Dec S Start	0.0 ~ 50.0	%	0.0	No	6-44~46
FUN_39	S ratio 2 in deceleration end	Dec S End	0.0 ~ 50.0	%	0.0	No	6-44~46
FUN_40	Acceleration time 1	Acc Time-1	0.00 ~ 6000.0	sec	2.00	Yes	6-43~44
FUN_41	Deceleration time 1	Dec Time-1	0.00 ~ 6000.0	sec	2.00	Yes	6-43~44
FUN_42	Acceleration time 2	Acc Time-2	0.00 ~ 6000.0	sec	3.00	Yes	6-43~44
FUN_43	Deceleration time 2	Dec Time-2	0.00 ~ 6000.0	sec	3.00	Yes	6-43~44
FUN_44	Acceleration time 3	Acc Time-3	0.00 ~ 6000.0	sec	4.00	Yes	6-43~44
FUN_45	Deceleration time 3	Dec Time-3	0.00 ~ 6000.0	sec	4.00	Yes	6-43~44
FUN_46	Acceleration time 4	Acc Time-4	0.00 ~ 6000.0	sec	5.00	Yes	6-43~44
FUN_47	Deceleration time 4	Dec Time-4	0.00 ~ 6000.0	sec	5.00	Yes	6-43~44
FUN_48	Deceleration time selection for zero speed	Use 0 Dec T	No/Yes		No	Yes	6-46
FUN_49	Deceleration time for zero speed	0 Dec Time	0.00 ~ 6000.0	sec	0.00	Yes	6-46
FUN_51	Deceleration time for emergency stop	BX Time	0.0 ~ 6000.0	sec	0.0	Yes	6-46~47
FUN_52	Pre-excitation time	PreExct Time	0 ~ 10000	ms	0	No	6-47

Function code	Function name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
FUN_53	Hold Time	Hold Time	100 ~ 10000	ms	1000	No	6-47
FUN_54	Electronic thermal selection	ETH Select	No/Yes		No	Yes	6-48~49
FUN_55	Electronic thermal level for 1 minute	ETH 1 min	FUN_56 ~ 200	%	150	Yes	6-48~49
FUN_56	Electronic thermal level for continuous	ETH Cont	50 ~ FUN_55 (available up to 150%)	%	100	Yes	6-48~49
FUN_57	Switching frequency select	PWM Freq	2.5 ~ 10.0	kHz	8.0	No	6-49
FUN_58	Power on Run selection	Power-on Run	No Yes		No	Yes	6-50
FUN_59	Restart after fault reset	RST Restart	No Yes		No	Yes	6-50
FUN_60	Number of auto restart try	Retry Number	0 ~ 10		0	Yes	6-50~51
FUN_61	Delay time before Auto restart	Retry Delay	0.0 ~ 60.0	sec	1.0	Yes	6-50~51
FUN_62	Wait time for Restart upon Stop	Restart Time	0.00 ~ 10.00	sec	0.00	No	6-51~52
FUN_63	Overspeed Detection Level	OverSpdLevel	100.0 ~ 130.0	%	120.0	No	6-51~52
FUN_64	Overspeed Detection Time	OverSpd Time	0.00 ~ 2.00	sec	0.00	No	6-51~52
FUN_65	Batter operation speed	Batt. Speed	2.5 ~ 200	rpm	50	No	6-52
FUN_66	Batter input voltage	Batt. Voltage	12 ~ PAR18	V	48	No	6-52

Notice 1) FUN_55, 56 will display when setting FUN_54 as "YES".

5.5 Control group(CON_[][])

Function code	Function name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
CON_00	Function code select	Jump Code	1 ~ 49			Yes	6-53
CON_01	Control mode setting	Control Mode	Speed Torque		Speed	No	6-53
CON_02*	Application mode setting	Application	General Vect Elevator		General Vect	No	6-53
CON_03	ASR P Gain 1	ASR P Gain1	0.1 ~ 200.0	%	100.0	Yes	6-54
CON_04	ASR I Gain 1	ASR I Gain1	0 ~ 50000	ms	500	Yes	6-54
CON_05	ASR LPF time constant 1	ASR LPF1	0 ~ 20000	ms	0	Yes	6-54
CON_06	ASR P Gain 2	ASR P Gain2	0.1 ~ 200.0	%	5.0	Yes	6-54
CON_07	ASR I Gain 2	ASR I Gain2	0 ~ 50000	ms	3000	Yes	6-54
CON_08	ASR LPF time constant 2	ASR LPF2	0 ~ 20000	ms	0	Yes	6-54
CON_09	Ramp time for ASR gain switch-over	ASR RAMP	10 ~ 10000	ms	1000	Yes	6-55~56
CON_10	Target Speed after ASR gain switch-over	ASR TarSpd	0.0 ~ 3600.0	rpm	0.0	No	6-55~56
CON_11	Process PID reference (keypad)	Proc PID Ref	-100.0 ~ 100.0	%	0.0	Yes	6-57
CON_13	Process PID P gain	Proc PID Kp	0.0 ~ 999.9	%	0.0	Yes	6-57
CON_14	Process PID I gain	Proc PID Ki	0.0 ~ 100.0	%	0.0	Yes	6-57
CON_15	Process PID D gain	PROC PID Kd	0.0 ~ 100.0	%	0.0	Yes	6-57
CON_16	Process PID positive limit	Proc Pos Lmt	-100.0 ~ 100.0	%	100	Yes	6-57
CON_17	Process PID negative limit	Proc Neg Lmt	-100.0 ~ 100.0	%	100	Yes	6-57
CON_18	Process PID output LPF time constant	Proc Out LPF	0 ~ 500	ms	0	Yes	6-58
CON_19	Process PID output gain	Proc OutGain	-250.0 ~ 250.0	%	0.0	Yes	6-58
CON_20	Process PID output enable	Proc PID Enb	Disable Enable Terminal		Disable	No	6-13~14
CON_21	Process PID Hold Time	PID HoldTime	0 ~ 10000	ms	5000	No	6-58
CON_22	Draw quantity	Draw %	-100.0 ~ 100.0	%	0.0	Yes	6-59
CON_23	Droop quantity	Droop %	0.0 ~ 100.0	%	0.0	Yes	6-60
CON_24	Low speed limit of Droop control	Droop MinSpd	0.0 ~ 3600.0	rpm	0.0	Yes	6-60
CON_25	Starting torque of Droop control	Droop MinTrq	0.0 ~ 100.0	%	0.0	Yes	6-60
CON_26	Torque reference source selection	Trq Ref Src	None Analog Keypad Option		None	No	6-61

Function code	Function name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
CON_27	Torque Reference(keypad)	Torque Ref	-180.0 ~ 180.0	%	0.0	Yes	6-61
CON_28	Torque limit source selection	Trq Lmt Src	Kpd Kpd Kpd Kpd Kpd Ax Kpd Ax Kpd Kpd Ax Ax Ax Kpd Kpd Ax Kpd Ax Ax Ax Kpd Ax Ax Ax Opt Opt Opt		Kpd Kpd Kpd	No	6-63~64
CON_29	Torque limit in forward run	Pos Trq Lmt	0.0 ~ 250.0	%	150.0	Yes	6-63~64
CON_30	Torque limit in reverse run	Neg Trq Lmt	0.0 ~ 250.0	%	150.0	Yes	6-63~64
CON_31	Torque limit in regeneration	Reg Trq Lmt	0.0 ~ 250.0	%	150.0	Yes	6-63~64
CON_32	Torque Bias source selection	Trq Bias Src	None Analog Keypad Option		None	No	6-62
CON_33	Torque Bias quantity	Trq Bias	-150.0 ~ 150.0	%	0.0	Yes	6-62
CON_34	Torque bias feedforward	Trq Bias FF	-150.0 ~ 150.0	%	0.0	Yes	6-63
CON_35	Torque Balance quantity	Trq Balance	0.0 ~ 100.0	%	50.0	Yes	6-62
CON_49	Speed search setting	Speed Search	0000 ~ 1111 (Bit setting)		0100	No	6-64~65

5.6 User group(USR_[][])

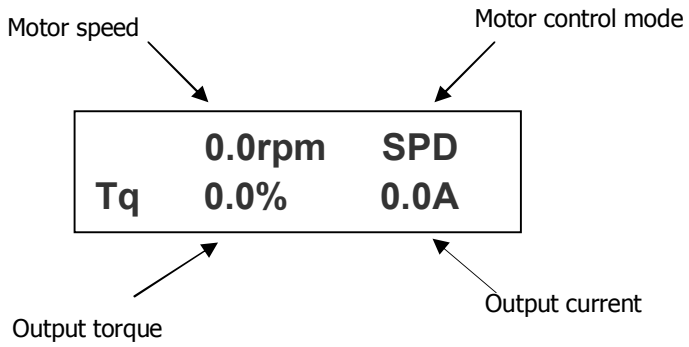
Function code	Function name	LCD display	Setting data			Adjustment during run	Page
			Range	Unit	Default		
USR_00	Function code select	Jump Code	1 ~ 67			Yes	6-66
USR_01	Initialize Macro	Macro Init	User Define E/L		User Define	No	6-66
USR_02	User data save	User Save	No Yes		No	No	6-66
USR_03	Recall saved user data	User Recall	No Yes		No	No	6-66
USR_04	User group data	User Grp				No	6-67

Chapter 6 – Function Description

6.1 Display group (DIS_[][])

6.1.1 DIS_00 (Motor control status monitoring)

Displayed when Power ON.



Code	Parameter name	Unit	Description
DIS_00	Motor speed	rpm	Actual motor rotating speed displayed in rpm.
	Motor control mode		SPD : Speed control mode TRQ : Torque control mode BX : BX operating
	Output torque	%	100% = Rated torque of motor
	Inverter output current	A	Inverter actual output current displayed

6.1.2 DIS_01 ~ 03 (User display 1, 2, 3)

Select one of the followings each to be displayed in DIS_01, 02 and 03.

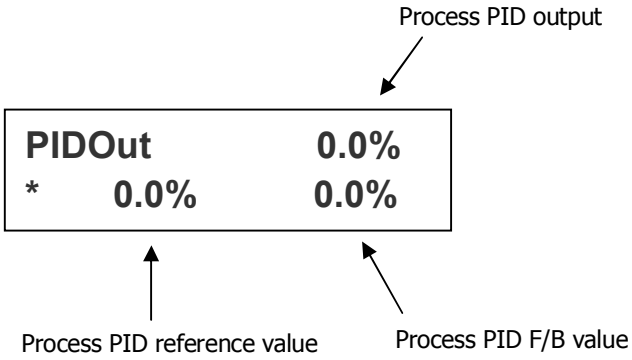
Factory default: **DIS_01**= **" PreRamp Ref "**, **DIS_02**= **"DC Bus Volt"**, **DIS_03= " Terminal In "**

Code	Parameter name	LCD display	Unit	Description
DIS_01 ~ DIS_03	Multi-function analog input value	Ai1 Value ~ Ai3 Value	%	Displayed as the percentage of multi-function analog input value (10V / 100%, 20mA / 100%)
	Pre Ramp Reference	PreRamp Ref	rpm	Speed reference before ramping
	Post ramp reference	PostRamp Ref	rpm	Speed reference after ramping
	ASR Input Reference	ASR Inp Ref	rpm	Final speed reference input value to ASR (Automatic Speed Regulator) displayed (Draw and Droop included)
	Motor Rotating Speed	Motor Speed	rpm	Actual motor rotating speed
	Speed Deviation	Speed Dev	rpm	Deviation between speed ref and actual rotating speed
	ASR Output	ASR Out	%	ASR output to rated torque
	Torque bias	Torque Bias	%	Torque bias to rated torque
	Positive Trq Limit	Pos Trq Limit	%	Positive torque limit to rated torque

<table>
<tr><th>Code</th><th>Parameter name</th><th>LCD display</th><th>Unit</th><th>Description</th></tr>
<tr><td></td><td>Negative Trq Limit</td><td>Neg Trq Limit</td><td>%</td><td>Negative torque limit to rated torque</td></tr>
<tr><td></td><td>Regeneration Trq Limit</td><td>Reg Trq Limit</td><td>%</td><td>Regeneration torque limit to rated torque</td></tr>
<tr><td></td><td>Torque Reference</td><td>Torque Ref</td><td>%</td><td>Torque reference to rated torque</td></tr>
<tr><td></td><td>Torque current ref.</td><td>IqeRef</td><td>%</td><td>Torque current reference to rated torque current</td></tr>
<tr><td></td><td>Torque current</td><td>Iqe</td><td>%</td><td>Actual torque current to rated torque current</td></tr>
<tr><td></td><td>Flux reference</td><td>Flux Ref</td><td>%</td><td>Flux reference to the rated flux</td></tr>
<tr><td></td><td>Flux Current ref.</td><td>IdeRef</td><td>%</td><td>Flux current reference to rated flux current</td></tr>
<tr><td></td><td>Flux Current</td><td>Ide</td><td>%</td><td>Actual flux current to rated flux current</td></tr>
<tr><td></td><td>ACR output of axis Q</td><td>ACR_Q Out</td><td>V</td><td>ACR output value of axis Q</td></tr>
<tr><td></td><td>ACR output of axis D</td><td>ACR_D Out</td><td>V</td><td>ACR output value of axis D</td></tr>
<tr><td></td><td>Voltage reference of axis D</td><td>VdeRef</td><td>V</td><td>Voltage reference value of axis D</td></tr>
<tr><td></td><td>Voltage reference of axis Q</td><td>VqeRef</td><td>V</td><td>Voltage reference value of Q axis Q</td></tr>
<tr><td></td><td>Output current</td><td>Out Amps RMS</td><td>A</td><td>Inverter output current (rms)</td></tr>
<tr><td></td><td>Output voltage</td><td>Out Volt RMS</td><td>V</td><td>Inverter output voltage (rms)</td></tr>
<tr><td></td><td>Output power</td><td>Power</td><td>kW</td><td>Motor output power</td></tr>
<tr><td></td><td>DC LINK voltage</td><td>DC Bus Volt</td><td>V</td><td>Inverter DC link voltage</td></tr>
<tr><td></td><td>Process PI reference</td><td>Proc PI Ref</td><td>%</td><td>Reference value of Process PID routine</td></tr>
<tr><td></td><td>Process PI Feedback</td><td>Proc PI F/B</td><td>%</td><td>Feedback value of Process PID routine</td></tr>
<tr><td></td><td>Process PI output</td><td>Proc PI Out</td><td>%</td><td>Output value of Process PID routine</td></tr>
<tr><td></td><td>Motor temperature</td><td>Mot Temp</td><td>deg</td><td>Motor temp displayed. 25℃ displayed when motor NTC is not provided with the motor.</td></tr>
<tr><td></td><td>Inverter temperature</td><td>Inv Temp</td><td>deg</td><td>Inverter Heatsink temp displayed</td></tr>
<tr><td></td><td>Inverter i2t</td><td>Inv i^2t</td><td>%</td><td>Inverter overload capability displayed. In the case Overload capability is 150% for 1 min, i^2t becomes 100% when 150% of rated current is flowing for 1 min.</td></tr>
<tr><td></td><td>MOP output</td><td>MP Output</td><td>%</td><td>Set value displayed when operation is done by potentiometer on terminal input.</td></tr>
<tr><td></td><td>Control mode</td><td>Ctrl Mode</td><td></td><td>Selected control mode displayed</td></tr>
<tr><td></td><td>Software version</td><td>S/W Version</td><td></td><td>S/W version displayed</td></tr>
<tr><td></td><td>Running time</td><td>Run Time</td><td></td><td>Inverter running time displayed after Power On</td></tr>
<tr><td></td><td>Input terminal status</td><td>Terminal In</td><td></td><td>ON/OFF status of Input terminal displayed
(0: OFF, 1: ON)
<table><tr><th></th><th>FX</th><th>RX</th><th>BX</th><th>P1</th><th>P2</th><th>P3</th><th>P4</th><th>P5</th><th>P6</th><th>P7</th></tr><tr><td>0 : OFF
1 : ON</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0/1</td></tr></table></td></tr>
<tr><td></td><td>Output terminal status</td><td>Terminal Out</td><td></td><td>ON/OFF status of open collector output, fault relay and contact output.
(0: OFF, 1: ON)
<table><tr><th></th><th>AX1</th><th>AX2</th><th>OC1</th><th>NC</th><th>NC</th><th>30A (30B)</th></tr><tr><td>0 : OFF
1 : ON</td><td>0/1</td><td>0/1</td><td>0/1</td><td>0</td><td>0</td><td>0/1</td></tr></table></td></tr>
<tr><td></td><td>Running status</td><td>Run Status</td><td></td><td>Operating status displayed</td></tr>
</table>

6.1.3 DIS_04 (Process PID Controller)

Information on Output, reference, F/B values of Process PID controller is displayed in this code.



6.1.4 DIS_05 (Fault display)

Current fault status, previous two faults, the number of faults occurred and faults information reset are available using [SHIFT/ESC] key in DIS_05.

Code	LCD display	Parameter name	Description
DIS_05	Faults	Current Trip displayed	"**-------**" displayed when normal. Trip information given when tripped.
	Last Fault1	2nd fault displayed	**Refer to Chapter 8. Troubleshooting.**
	Last Fault2	1st fault displayed	
	Fault Count	Total number of faults	The number of total faults in memory is displayed.
	Fault Clear	Reset	Clear the faults and initialize to "0".

Faults information, speed reference before fault occurs, speed F/B value, output frequency/ current/ Voltage, torque current reference & actual value, DC Link voltage, input terminal status, output terminal status, Run status, running time can be monitored using [PROG], [▲(Up)] / [▼(Down)] keys. Pressing [ENT] key will return to top. To enter the fault info into memory as [Last Fault 1], press [RESET] key. Refer to [Chapter 8 troubleshooting and maintenance] for more details.

No	Trip information	LCD display	No	Trip information	LCD display
1	Overcurrent in Phase U	OC–U	12	Ground fault	Ground Fault
2	Overcurrent in Phase V	OC–V	13	Inverter overheat	InvOver Heat
3	Overcurrent in Phase W	OC–W	14	Electronic thermal	E-Thermal
4	Fuse open	Fuse Open	15	Overload trip	Over Load
5	Overvoltage	Over Voltage	16	External trip B	Ext-B Trip
6	IGBT short in phase U	Arm Short–U	17	Option error	Option Err
7	IGBT short in phase V	Arm Short–V	18	Inverter overload	Inv OLT
8	IGBT shot in phaseW	Arm Short–W	19	Motor overheat	MotOver Heat
9	IGBT shot in phase DB	Arm Short–DB	20	Inverter thermal open	InvThem OP
10	Encoder Error	Encoder Err	21	Motor thermal open	MotThem OP
11	Low voltage	Low Voltage	22	Motor overspeed	Over Speed

※ **Note :**

When multiple faults occur at the same time, the MOST CRITICAL fault will be displayed and the rest of others can be inferred from the value using [PROG], [▲(Up)] / [▼(Down)] keys .

6.1.5 DIS_06(User group display selection)

User can make "User group" by collecting frequently used codes. In DIS_06, user can set whether User group is displayed or not in three selections.

Code	LCD display	Parameter name	Description	
DIS_06	Usr Grp Disp	User group display selection	Not Used	User group not displayed
			Dis+Usr Grp	Only Display + User group displayed. The rest of groups are not displayed. If you want to display the rest, move to other group in Jump code or change the selection.
			Display ALL	Display all groups including User group. But, 2nd group is displayed only when 2nd group is defined. EXT group is displayed when Option board is installed.

6.1.6 DIS_10 (Dead time voltage factor)

Code	LCD display	Parameter name	Setting range	Unit	Default Value
DIS_10	Vcomp Factor	Dead time voltage factor	-30.000 ~ 30.000		0

6.1.7 DIS_13~15 (3 phase current amount under magnetic flux estimation)

Display current values on each phase when supplied with +, - voltage pulse during its initial magnetic flux estimation.

Code	LCD display	Parameter name	Description
DIS_13	Iup Ium	Current on U phase upon magnetic flux estimation	Display current values on each phase when supplied with +, - voltage pulses during its initial magnetic flux estimation. Thus it is used for reference purposes to see the estimate of current flowing on each phase under its initial magnetic flux estimation.
DIS_14	Ivp Ivm	Current on V phase upon magnetic flux estimation	
DIS_15	Iwp Iwm	Current on W phase upon magnetic flux estimation	

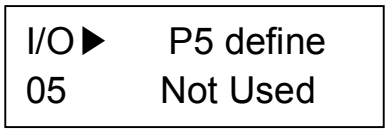
6.2 I/O group (I/O_[][])

6.2.1 Jump code (I/O_00)

In I/O_00, jumping directly to any parameter code can be accomplished by entering the desired code number.

(Example) Moving to I/O_05

Press [PROG] and set to 5 using [SHIFT/ESC] / [▲(Up)] / [▼(Down)] and press [ENT] key to move to I/O_05. If the desired code cannot be set, the closest code will be displayed.



Jumping other code is available using [▲(Up)] / [▼(Down)] keys.

6.2.2 Multi-function Input Terminal

1) I/O_01 ~ I/O_07 (Multi-function input terminal P1 ~ P7 define)

It defines Multi-function input terminals. SV-iV5 has 7 dedicated terminals (P1 ~ P7) for the setting of parameters below. However, the multiple terminals cannot be selected for the same function and if so, the invalid terminal definition is displayed as "Not Used". And the selected function cannot be adjusted while running.

No	Set value	Description	No	Set value	Description
1	Speed-L	Multi-step speed-Low	15	Ext Trip-B	External trip B contact
2	Speed-M	Multi-step speed-Middle	16	Prohibit FWD	Forward Run Disabled
3	Speed-H	Multi-step speed-High	17	Prohibit REV	Reverse Run Disabled
4	Jog Speed	Jog speed	18	Proc PID Dis	PID operation disabled
5	MOP Up	MOP UP operation	19	Timer Input	Timer ON
6	MOP Down	MOP Down operation	20	SoftStrtCncl	Cancel Soft start
7	MOP Clear	MOP Speed Clear (Reset)	21	ASR Gain Sel	Switch ASR gain
8	MOP Save	MOP Speed Save	22	ASR P/PI Sel	Switch ASR P/PI
9	Analog Hold	Analog speed ref. Hold	23	Flux Ref Sel	Switch Flux reference
10	Main Drive	Exchange between Option and Inverter	24	PreExcite	Pre-excitation
11	2nd Func	The 2nd function	25	Spd/Trq Sel	Speed/Torque control select
12	Xcel-L	Multi-accel/decel-Low	26	Use Max Trq	Torque limit ON/OFF
13	Xcel-H	Multi-accel/decel-High	27	Use Trq Bias	Torque bias ON/OFF
14	3-Wire	3 Wire			

1.1) Speed-L

1.2) Speed-M

1.3) Speed-H

1.4) JOG operation

By defining P1 ~ P4 as "Speed-L", "Speed-M", "Speed-H" and "Jog Speed", the selected references in FUN goup 12 ~ 20 (Multi-step speed 0 ~ 7 and Jog speed) become active as speed reference.

(Example) To define Multi-function input terminals P1, P2, P3 as Speed-L, Speed-M, Speed-H and P4 as Jog Speed;

Code	LCD display	Description	Setting range	Unit	Set value
I/O_01	P1 define	Multi-function input terminal P1 define			Speed-L
I/O_02	P2 define	Multi-function input terminal P1 define			Speed-M
I/O_03	P3 define	Multi-function input terminal P3 define			Speed-H
I/O_04	P4 define	Multi-function input terminal P4 define			Jog Speed

When multi-step speed 0 (FUN_12: Speed 0) is selected (P1, P2, P3 = OFF), speed reference is input by the method set in FUN_02 (Analog, keypad 1/2, option). If the jog (FUN_20) is active, inverter operates with jog frequency regardless of other terminal signal input.

P1	P2	P3	P4	Set Vaule
OFF	OFF	OFF	OFF	FUN_02: keypad→ FUN_12(Speed 0)
ON	OFF	OFF	OFF	FUN_13(Speed 1)
OFF	**ON**	OFF	OFF	FUN_14(Speed 2)
ON	**ON**	OFF	OFF	FUN_15(Speed 3)
OFF	OFF	**ON**	OFF	FUN_16(Speed 4)
ON	OFF	**ON**	OFF	FUN_17(Speed 5)
OFF	**ON**	**ON**	OFF	FUN_18(Speed 6)
ON	**ON**	**ON**	OFF	FUN_19(Speed 7)
X	X	X	**ON**	FUN_20(Jog Speed)

1.5) MOP (Motor Operated Potentiometer) Up

1.6) MOP Down

1.7) MOP Clear

1.8) MOP Save

When multi-function input terminals P1 ~ P7 is set to "MOP Up", "MOP Down", inverter performs Accel/Decel Constant Run according to the terminal input. Generally, MOP function is used to adjust the speed simply with terminal ON/OFF. When MOP UP/Down is selected, inverter ignores FUN_02 setting, and performs MOP operation. To cancel it, change the defined terminal to "Not Used". If this function is selected with "Main Drive" function, operating reference is done by MOP and the rest will be defined by "Main Drive" function. Max speed limit is FUN_04(Max Speed).

If "MOP Save" is entered during MOP operation, the current speed reference value is saved as "MOP Data" and

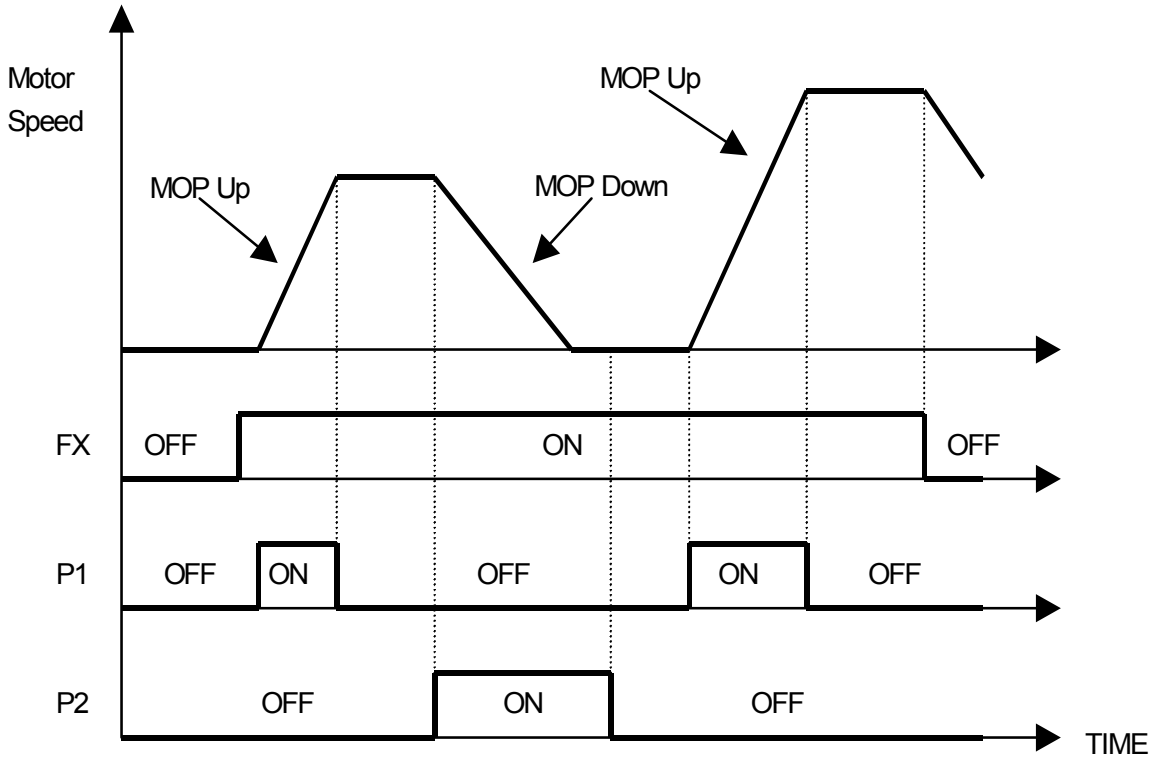
retained. When the MOP operation resumes, the retained value will be used as speed reference.

"MOP Clear" resets the MOP Data value to "0". It is used to change the saved value.

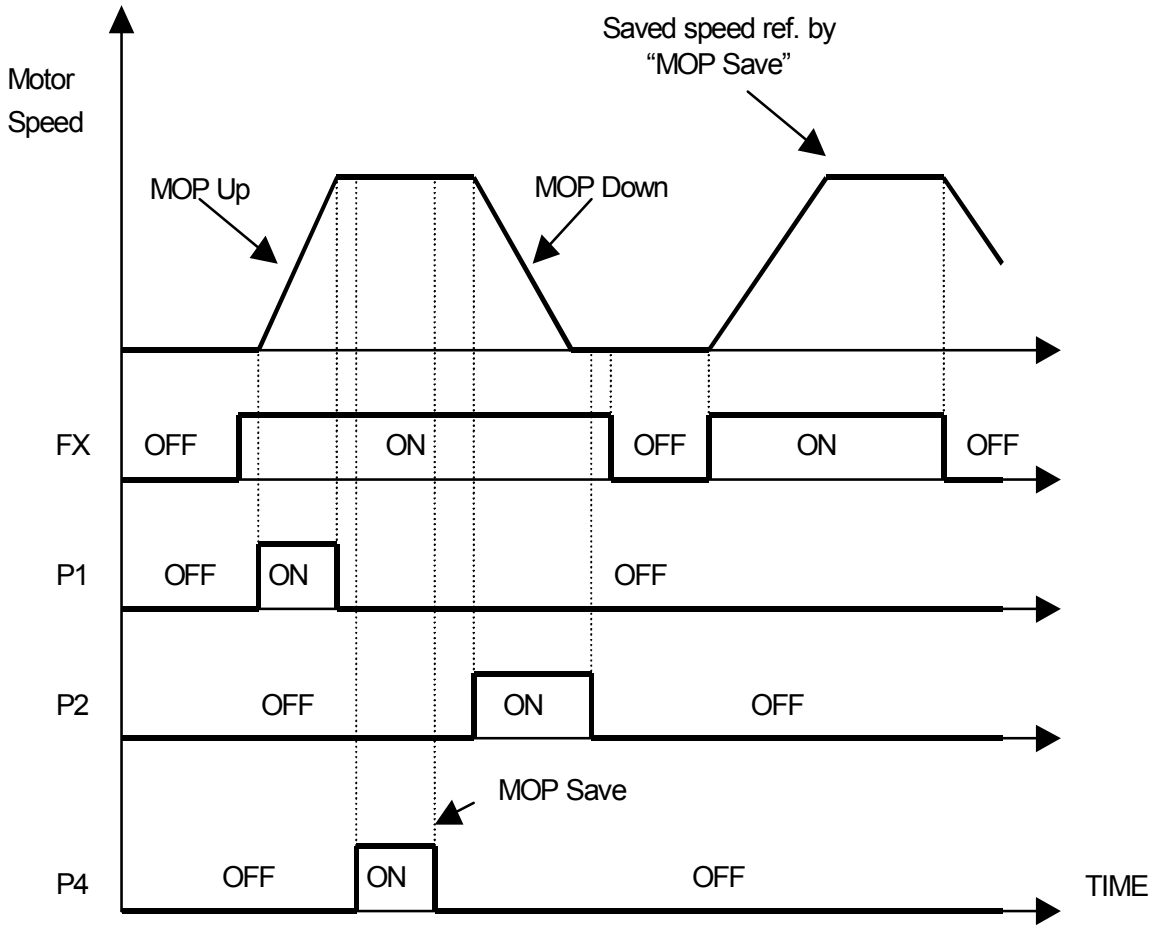
(Example) MOP function setting and operation method is as follows;

Code	LCD display	Description	Setting range	Unit	Set value
I/O_01	P1 define	Multi-function input terminal P1 define			MOP Up
I/O_02	P2 define	Multi-function input terminal P1 define			MOP Down
I/O_03	P3 define	Multi-function input terminal P3 define			MOP Clear
I/O_04	P4 define	Multi-function input terminal P4 define			MOP Save

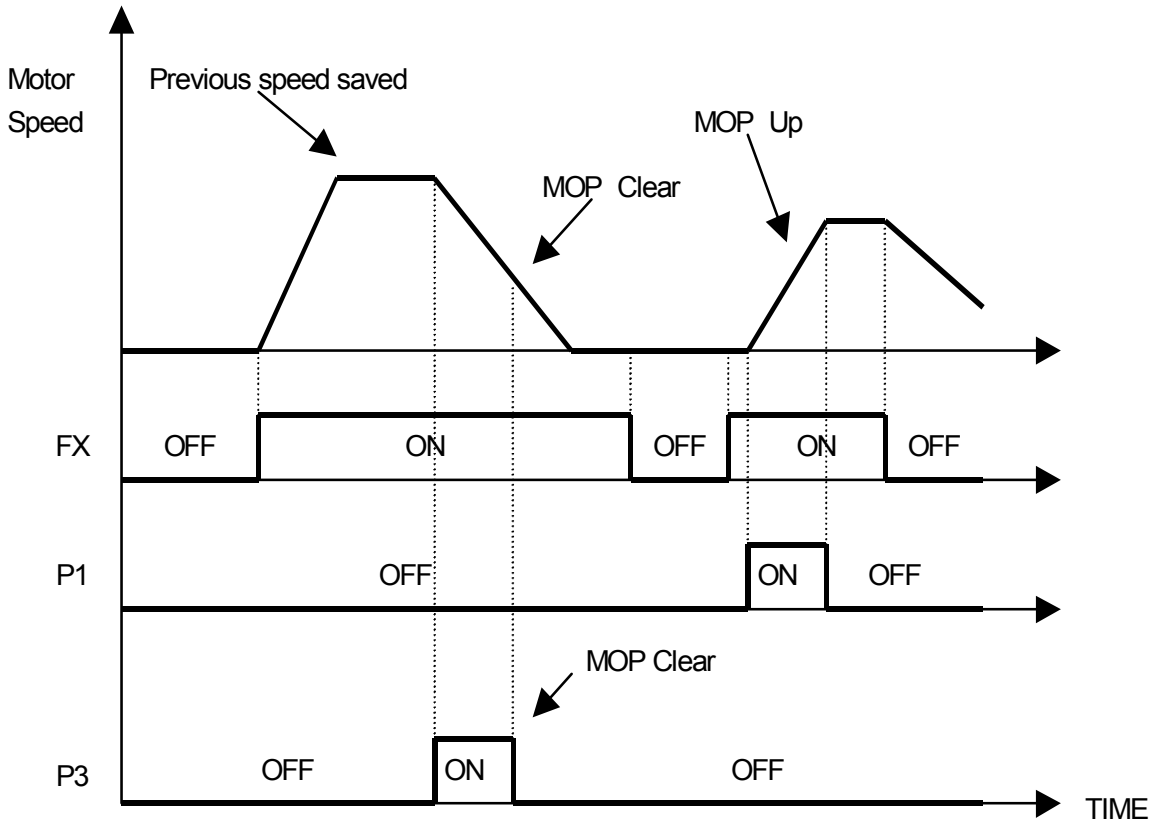
(MOP Up/Down example 1) This is used only if terminal ON/OFF is required for speed control.



(MOP Save example 2) In case terminal input assigned to MOP Save function is ON, operation speed at that instant is memorized and operates at the saved speed when operation resumes.

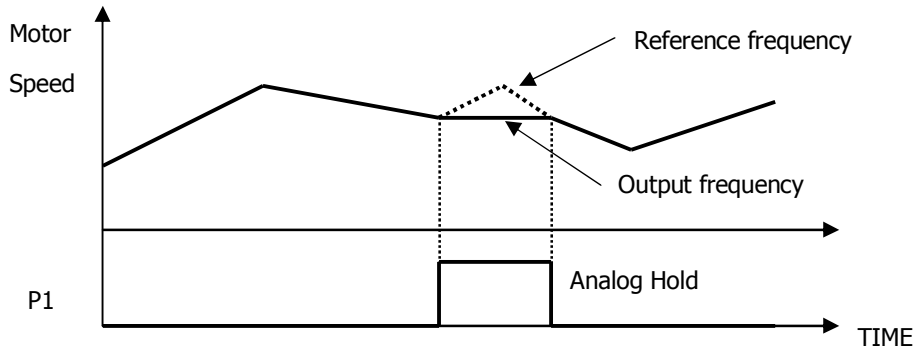


(MOP Clear setting example 3) To clear the saved speed by MOP Save function, use "MOP Clear ON/OFF". If MOP Clear is ON during running, the inverter decelerates its speed to zero speed. If MOP is ON during stop, this function resets the speed reference to "0".



1.9) Analog Hold

When FUN_02 is set to "analog" and one of the selected terminal set to "Analog Hold" is ON, inverter fixes its output frequency, regardless of the frequency reference change. The changed frequency reference is applied when the terminal is OFF. This function is useful when a system requires constant speed after acceleration.



1.10) Main Drive

When an option board is installed and used for the frequency setting and the RUN/STOP command, the inverter operation can be changed to manual using this function without changing the user-setting parameter values. To make this function active, set the selected terminal for "Main Drive" to ON during stop. When this terminal is ON, changing operating speed reference, operating method, and torque limit is done via Keypad ONLY. To turn off the terminal, the changed value is not saved and previous value is restored. Changing control mode during Main Drive operation is available only when the 2nd function is defined using terminal ON/OFF.

The following parameters cannot be changed while Main Drive function is active.

Code	Description	Note
FUN_01	Run/Stop Src (RUN/STOP source select)	
FUN_02	Spd Ref Sel (speed reference selection)	
CON_01	Control Mode (Control mode setting)	Adjsutable during the 2nd function
CON_28	Trq Lmt Src (Torque limit source)	

1.11) 2nd Func (the 2nd function setting)

The iV5 inverter has the capability to control 2 motors independently. A second motor may be active by selecting one terminal for this function and turn it ON. 2nd function is not displayed if the terminal is not defined for this or the defined terminal is OFF.

※ Cross reference table for **1st function and& 2nd function**

Parameter	2nd function		1st function	
Acceleration time	2nd_09	2nd Acc time	FUN_40	Acc. Time 1
Deceleration time	2nd_10	2nd Dec time	FUN_41	Dec. time 1
Encoder-related parameter	2nd_12 ~ 2nd_14		PAR_11 ~ PAR_15	
Motor constants	2nd_15 ~ 2nd_26		PAR_16 ~ PAR 30	
Electronic thermal level for 1 min	2nd_32	2nd ETH 1min	FUN_55	ETH 1min
Electronic thermal level for continous	2nd_33	2nd ETH Cont	FUN_56	ETH Cont

※ Note : 1st & 2nd function switch-over should be selected when the motor is stopped.

If selected during RUN, 2nd function is not active until motor stop.

1.12) XCEL-L

1.13) XCEL-H

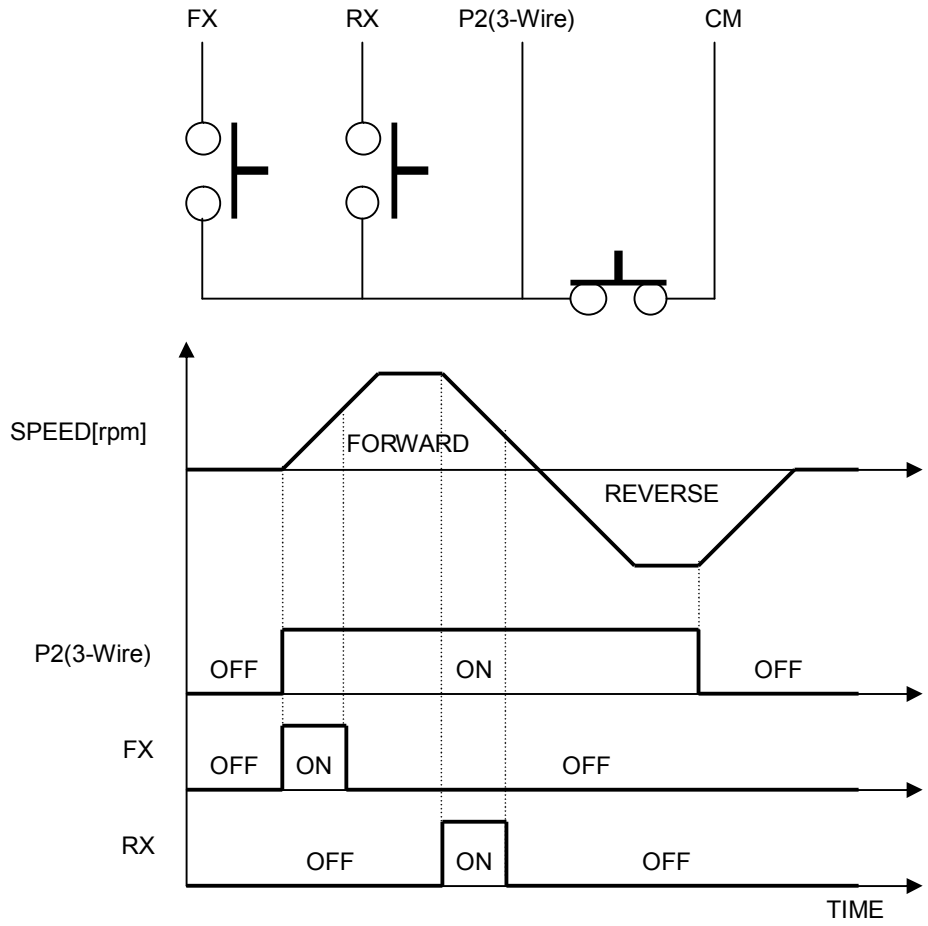
Refer to FUN_40 ~ 47 (Accel/ Decel time 1, 2, 3, 4).

Code	LCD display	Description	Factory setting
FUN_40	Acc Time-1	Accel time 1	2.00(sec)
FUN_41	Dec Time-1	Decel time 1	2.00(sec)
FUN_42	Acc Time-2	Accel time 2	3.00(sec)
FUN_43	Dec Time-2	Decel time 2	3.00(sec)
FUN_44	Acc Time-3	Accel time 3	4.00(sec)
FUN_45	Dec Time-3	Decel time 3	4.00(sec)
FUN_46	Acc Time-4	Accel time 4	5.00(sec)
FUN_47	Dec Time-4	Decel time 4	5.00(sec)

1.14) 3-Wire operation

When FX or RX terminal is turned ON and turned OFF, the terminal is maintained ON using this parameter.

(Operating method when P2 is set to 3-Wire)



[3 Wire operation]

1.15) Ext Trip-B (External trip signal input by b contact)

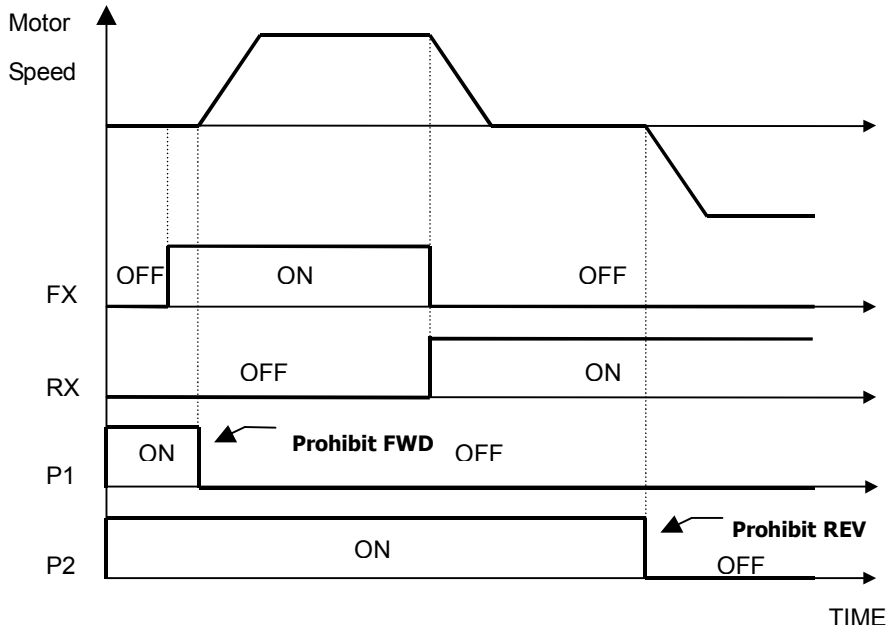
If the terminal set to this function is off, the inverter disables the gating of IGBT and then the motor freely rotates to a stop. The message written as "External Trip Signal B contact" appears on the LCD screen and STOP LED is blinking in the keypad. This signal can be used as an external latch trip.

1.16) Prohibit FWD (Prohibition of Forward Rotation)

1.17) Prohibit REV (Prohibition of Reverse Rotation)

If Prohibit FWD or Prohibit REV is set, it prohibits forward or reverse rotation, respectively. If Prohibit FWD is used, speed command becomes 0 when it has positive value. Similarly, If Prohibit REV is used, speed command becomes 0 when it has negative value.

(Example) When multi-function input terminal P1 is set to "prohibit FWD" and P2 to "prohibit REV" the following diagram will be shown.



1.18) Proc PID Dis (Process PID Disabled)

This function is used to disable the Process PID controller. If Proc PID Enb at the CON_20 is ON and also this terminal is ON, the output of Process PID controller becomes zero. Otherwise, Process PID controller generates its output depending on the controller operation. 'Proc PID Enb' at CON_20 determines whether this function is used or not. The setting for this code is as follows.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_20	Proc PID Enb	Proc PID contoller Enable/Disable	Disable Enable Terminal		Disable

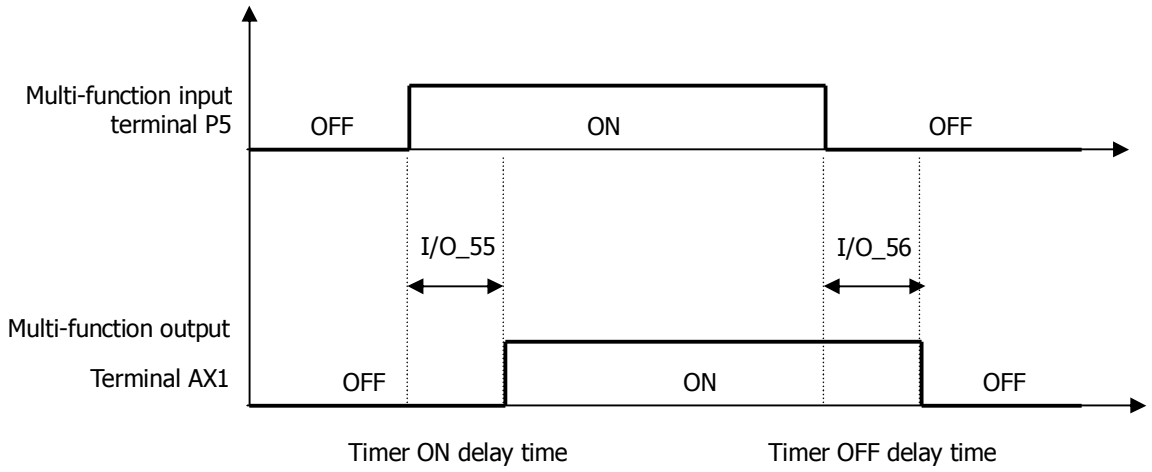
'Disable' at CON_20 blocks the output of Process PID controller and 'Enable' at CON_20 enables the Process PID controller. If 'Terminal' is set, the multi-function terminal set to 'Proc PID Dis' determines whether the output of Process PID controller is enabled or not. To prevent the saturation of Process PID controller, Process PID controller is enabled only if the multi-function input terminal is set to 'Proc PID Dis' and its terminal input is OFF and operation command is 'ON'. Process PID controller does not work if operation command is not ON or 'Process PID Disable' is not set. Truth table is as follows.

CON_20	Proc PID Dis	Operating reference	
	Multi-function input signal	ON	OFF
Terminal	ON	Disable	Disable
	OFF	Enable	Disable
Enable		Enable	Disable
Disable		Disable	Disable

1.19) Timer Input

The multi-function input terminals P1~P7 can generate the timer output based on the timer ON delay time at I/O_55 and timer Off delay time at I/O_56. The following example is the case where I/O_05 is set to timer input and the multi-function output terminal AX1 at I/O_41 is set to 'Timer Out'.

Code	LCD display	Description	Setting range	Unit	Setting value
I/O_05	P5 Define	Multi-function input terminal P5 Define			Timer Input
I/O_41	AX1 Define	Multi-function output terminal AX1 Define			Timer Out
I/O_55	TimerOn Dly	Timer On Delay Time	0.1 ~ 3600.0	sec	
I/O_56	TimerOff Dly	Timer Off Delay Time	0.1 ~ 3600.0	sec	



1.20) SoftStartCncl (Soft Start Cancel)

Soft start cancel is used when the shortest acceleration/deceleration time is required without using the existing accel/decel time. In this case, real acceleration/deceleration time depends on the load condition and response characteristic of speed controller. The following table shows what kind of acceleration/deceleration time is used when P1, P2 and P3 are used for the transfer of accel/decel time or soft start cancel function is enabled.

(Example) Programming P3 as SoftStrtCncl

P1 (Xcel-L)	P2 (Xcel-H)	P3 (SoftStartCncl)	Accel/Decel time
OFF	OFF	OFF	Accel/Decel 1
ON	OFF	OFF	Accel/Decel 2
OFF	ON	OFF	Accel/Decel 3
ON	ON	OFF	Accel/Decel 4
X	X	ON	The shortest Accel./Decel.

1.21) ASR Gain Sel (Switch Automatic Seed Regulator PI gain)

Using 'ASR Gain Sel' function, one of the two P and I gains can be selected for PI speed controller (ASR).

(Example) Programming P5 as ASR PI Gain

Code	LCD display	Description	Setting range	Unit	Setting value
I/O_05	P5 define	Multi-function input terminal P5 Define			ASR Gain Sel
CON_03	ASR P Gain1	ASR (Automatic Speed Regulator) P Gain 1	0.0 ~ 200.0	%	P5 : OFF
CON_04	ASR I Gain1	ASR I Gain 1	0 ~ 50000	ms	
CON_05	ASR LPF1	ASR LPF time constant 1	0 ~ 20000	ms	
CON_06	ASR P Gain2	ASR P Gain 2	0.0 ~ 200.0	%	P5 : ON
CON_07	ASR I Gain2	ASR I Gain 2	0 ~ 50000	ms	
CON_08	ASR LPF2	ASR LPF time constant 2	0 ~ 20000	ms	

1.22) ASR P/PI Sel (ASR P/PI Transfer)

The ASR could be P controller or PI controller by MFi programmed as ASR P/PI Sel. When the ASR Gain is switched to each other, the effective P gain could be changed gradually with the time ASR Ramp CON_09 in order to prevent the shock in the machine because of the quick change of P gain.

(Programming Example) Programming P6 as ASR P/PI Sel.

Code	LCD display	Description	Setting range	Unit	Factory setting
I/O_05	P5 define	Multi-function input terminal P5 Define			ASR P/PI Sel

1.23) Flux Ref Sel (Flux reference selection)

If the flux reference selection is ON, flux reference is set to the value which analog voltage (-10 ~ 10V) is converted to % ratio of the rated flux.

1.24) PreExcite (Pre-excitation)

This function enables the motor to build up the flux by flowing the magnetizing current into it before run command is ON so that speed control characteristic can be improved at the time of the acceleration of the motor.

1.25) Spd/Trq Sel (Speed/Torque Control Transfer)

Speed and torque control can be switched using this function. This terminal input overrides the input from the keypad.

1.26) Use Max Torque (Maximum Torque Enable)

If this input is ON, the torque limit value of the speed controller is fixed to its maximum value. On the contrary, when this input turns off, the value defined at CON_29 ~ CON_31 applies to torque limit value. This function disables the inverter continous operation.

If this function is used continously, it may lead to damage to the motor and inverter. Take caution when using this function.

1.27) Use Trq Bias (Torque Bias Enable)

If one of the multi-function terminals (P1 ~ P7) is selected as "Use Trq Bias", torque bias value is fed into the inverter following the input signal. Besides, if "Use Trq Bias" is not set, and 'Keypad' is set at CON_32, torque bias value set at CON_33 is fed into the inverter. And, if "Analog" is set at CON_32 (Trq Bias Src), and the input is selected as "Torque Bias", the torque bias value is fed into the inverter. Therefore, in order not to use the torque bias value, 'None' should be set at CON_32 or one of the multi-function terminals (P1 ~ P7) should be selected as "Use Trq Bias" and then be kept the terminal Open.

2) I/O_08 (Reversal of Multi-function input terminal)

Multi-function input terminal is based on the 'A' contact operation. If a specific terminal should be changed to 'B' contact operation, the relevant terminal setting should be set from '0' to '1', Once the relevant terminal is set to '1', the terminal operates on the basis of 'B' contact and it is effective before it is changed to '0'. But, in case of the external trip 'B' contact, it is changed to 'A' contact operation. Terminals are displayed in the order of P1, P2, P3, P4, P5, P6 and P7 from the beginning.

(P1 ~ P7: A contact)

```
I/O▶Neg Function
08          0000000
```

(P1, P6: B contact)

```
I/O▶Neg Function
08          1000010
```

3) I/O_09 (Low Pass Filter Time Constant for the Terminals)

This setting affects the response speed of the control circuit terminals (FX, RX, BX, P1 ~ P7, RST). It is greatly effective when electro-magnetic noise signal is present in the input signal. The larger the time constant becomes, the slower response speed becomes. Response speed is approximately proportional to the setting value times 2.5 [m sec].

4) I/O_10 Inversion of Multi-function aux contact output (Relay output, Open collector output)

Factory default settinf of Multi-function Relay outputs is A contact. To change it to B contact, set it to "1".

See the below for setting example: (terminal layout is AX1, AX2, OC1, NC, NC from left.)

(Setting example)

(AX1 ~ OC1: A contact)

I/O▶ Neg Func.Out	
10	00000

(AX1, OC1: B contact)

I/O▶ Neg Func.Out	
10	10100

6.2.3 Multi-function analog input

1) I/O_11 ~ 25(Definition of Multi-function analog input terminal, Gain, Bias, LPF time constant)

3 analog inputs are assigned for IO board. Ai3 serves as the Motor NTC input port and voltage or current signal can be fed into Ai1 and Ai2 by the jumper setting. Analog input on the control circuit terminal can be used as single function among the following 8 functions on the table shown below (9 functions for Ai3). Voltage input range is –10 ~ +10V and current input range is 4~20mA. Any analog input cannot be set as the same function as the other inputs. If 2 analog inputs are set to the same function, last set analog input is changed to 'Not Used'. In case analog input is changed to the other function, previously set value is initialized to 0.

Set value	Paramter name	description
Speed Ref	Speed Reference	±10V input is equivalent to ±100% of maximum speed
Proc PID Ref	Process PID Reference	±10V input is equivalent to ±100% of reference of Process PI controller
Proc PID F/B	Process PID F/B	±10V input is equivalent to ±100% of feedback of Process PI controller
Draw Ref	Draw Reference	±10V input is equivalent to ±100% of reference of Draw controller
Torque Ref	Torque reference	±10V input is equivalent to ±100% of rated torque It can be set up to –250 ~ 250% of rated torque by the gain and bias adjustment.
Flux Ref	Flux Reference	±10V input is equivalent to 100% of rated flux
Torque Bias	Torque Bias	±10V input is equivalent to ±100% of rated torque It can be set up to –250 ~ 250% of rated torque by the gain and bias adjustment.
Torque Limit	Torque Limit	10V input is equivalent to 100% of rated torque It can be set up to 0 ~ 250% of rated torque by the gain and bias adjustment.
Use Mot NTC	Use Motor NTC	Thermal sensor in the motor is fed into this terminal. In this case, the motor temperature is displayed and motor overheat alarm and trip signal can be triggered. **Caution: This is applied only to LG-OTIS Vector-controlled Motor.**

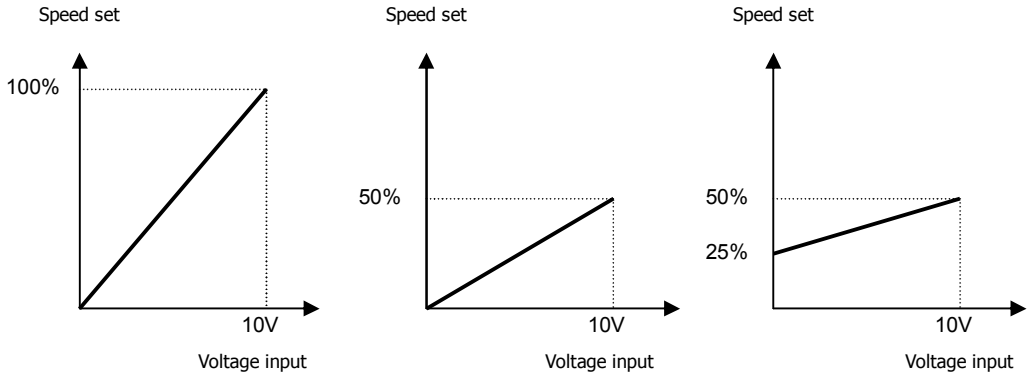
Code setting related to multi-function analog input is shown in the table below.

Code	Display	Description	Range	Unit	Default
I/O_11	Ai1 Define	Multi function analog input Definition of Ai1	Speed Ref Proc PID Ref Proc PID F/B Draw Ref Torque Ref Flux Ref Torque Bias Torque Limit		Not Used
I/O_12	Ai1 Source	Multi function analog input Definition of Ai1 input source	-10 → 10V 0 → 10V 10 → 0V 4 → 20mA 20 → 4mA		-10 → 10 V
I/O_13	Ai1 Gain	Input gain of Ai1	0.00 ~ 250.00	%	100.0
I/O_14	Ai1 Bias	Input bias of Ai1	-100.00 ~ 100.00	%	0.0
I/O_15	Ai1 LPF	Input LPF time constant of Ai1	0 ~ 2000	ms	0

I/O_16 ~ I/O_25 (Ai2 ~ Ai3) setting method is the same as 1(Ai1) above.

The following figures are the example of 50% input gain and 25% of input bias for 0 ~ 10V analog input.

Voltage input **50% Gain** **25% Bias**



Maximum of the setting value depends on the Gain and starting point on the Bias. In the example above, Maximum value is set to 50% by the Gain and starting point to 25% by the Bias. Consequently, 25 to 50% of the analog command value is effective for 0 to 10V of input voltage.

2) Adjusting Gain and Bias by Keypad

- Gain Adjustment: Supply 10V to terminal Ai1 and follow next steps.

(The same procedure is applied to Ai2/Ai3. Set the potentiometer High (Max).)

Key	LCD Display	Description
	I/O▶ Ai1 Gain 13 100.00 %	Initial Gain (Factory setting)
PROG	I/O▶Ai1 98.00 % 13 Gain 100.00 %	When pressing the [PROG] key, current output [%] to input value is displayed on the first line and current setting gain on the second line.
▲	I/O▶Ai1 100.00 % 13 Gain 102.00 %	If you want to adjust Gain to be 100.00% at 10V input on the first line, adjust gain to be 102.00% using [▲(Up)] key.
ENT	I/O▶ Ai1 Gain 13 102.00 %	After setting 102.00% Gain and pressing [ENT] key, it is displayed and the changed gain is saved.

- Bias Adjustment: Supply 0V to Ai1 and follow next steps.

(The same procedure is applied to Ai2/Ai3. Set the potentiometer Low (Min.).)

Key	LCD Display	Description
	I/O▶ Ai1 Bias 14 0.00 %	Initial Gain (Factory setting)
PROG	I/O▶Ai1 0.18 % 14 Bias 0.00 %	When pressing the [PROG] key, current output [%] to input value is displayed on the first line and current setting bias on the second line.
▲	I/O▶Ai1 0.00 % 14 Bias 0.18 %	If you want to adjust Bias to be 0.00% at 0V input on the first line, adjust it to be 0.00% using [▲(Up)] key.
ENT	I/O▶ Ai1 Bias 14 0.18 %	After setting 0.00% Bias and pressing [ENT] key, it is displayed and the changed value is saved.

6.2.4 Multi Function Outputs (MFO)

1) I/O_41 ~ 43 (Multi-function aux contact output (AX1 ~ AX2) and Open collector (OC1) output setting)

Multi-function digital output terminal serves as one of the functions listed in the table below. Multi-function aux contact is activated when the selected function is ON.

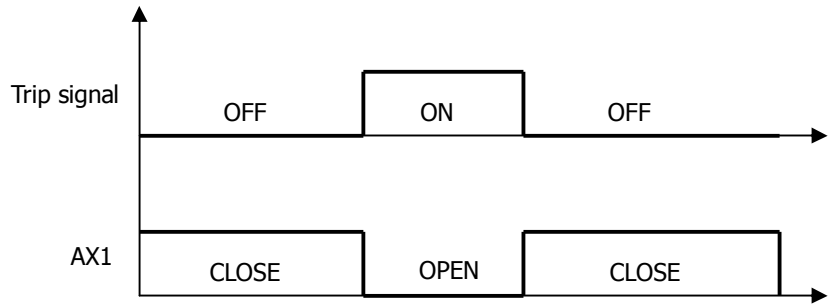
No	Set value	No	Set value
1	Not Used	10	Regenerating
2	INV Ready	11	Mot OH Warn
3	Zero Spd Det	12	INV OH Warn
4	Spd Det.	13	Speed Agr.
5	Spd Det (ABS)	14	Trq Det.
6	Spd Arrival	15	Trq Lmt Det.
7	Timer Out	16	OverLoad
8	LV Warn	17	Stop
9	Run	18	Steady

1.1) Not Used

It is set unless multi-function output is not used as any function listed above.

1.2) INV Ready

INV Ready becomes ON when inverter is ready to operate normally. If trip signal occurs, INV Ready is left OPEN immediately as shown in the figure below.

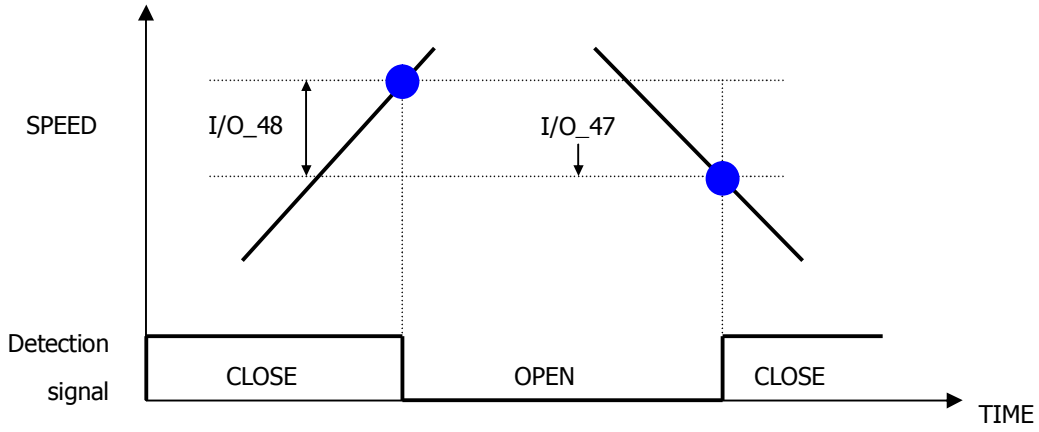


1.3) Zero Spd Det

Detects zero speed of motor. See the figure below.

Code	Display	Description	Range	Unit	Default
I/O_47	ZSD Level	Zero Speed Detect Level	0.0 ~ 480.0	rpm	10
I/O_48	ZSD Band	ZSD hysteresis band	0.1 ~ 10.0	%	0.5

- I/O_48(ZSD Band) is set as the percentage of FUN_04 Max motor speed.



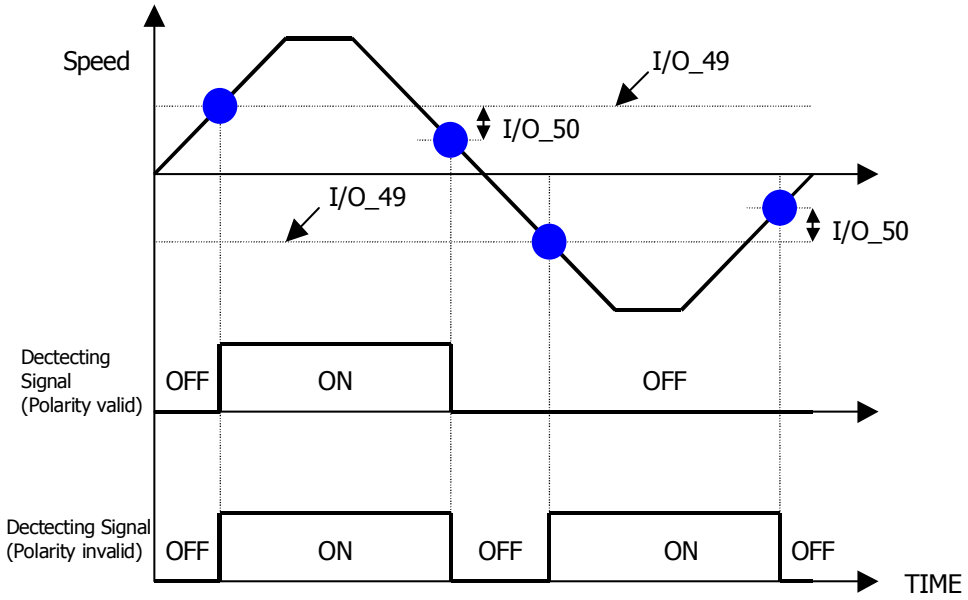
1.4) Spd Det. – Polarity valid

1.5) Spd Det.(ABS) – Polarity invalid

This is ON when the real motor speed reaches the arbitrary speed. The polarity of detecting speed is valid for Spd Det. But, the polarity is invalid for Spd Det(ABS).

Code	Display	Description	Range	Unit	Default
I/O_49	SD Level	Speed Detect Level	-3600 ~ 3600	rpm	0
I/O_50	SD Band	Speed Hysterisis Band	0.1 ~ 10.0	%	0.5

- I/O_49(SD Band) is set as the percentage of FUN_04 Max motor speed.
  Detection signal



1.6) Spd Arrival

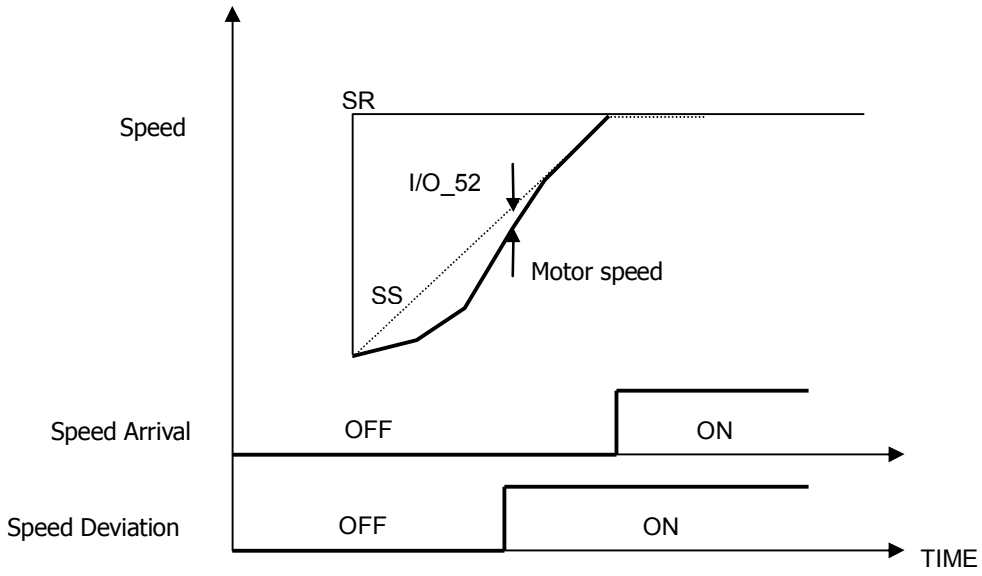
It detects whether the motor reaches the set speed band.

Code	Display	Description	Range	Unit	Default
I/O_51	SA Band	SA hysterisis band	0.1~10.0	%	0.5

1.7) Spd Agree

This is ON when the motor speed becomes equal to the set speed.

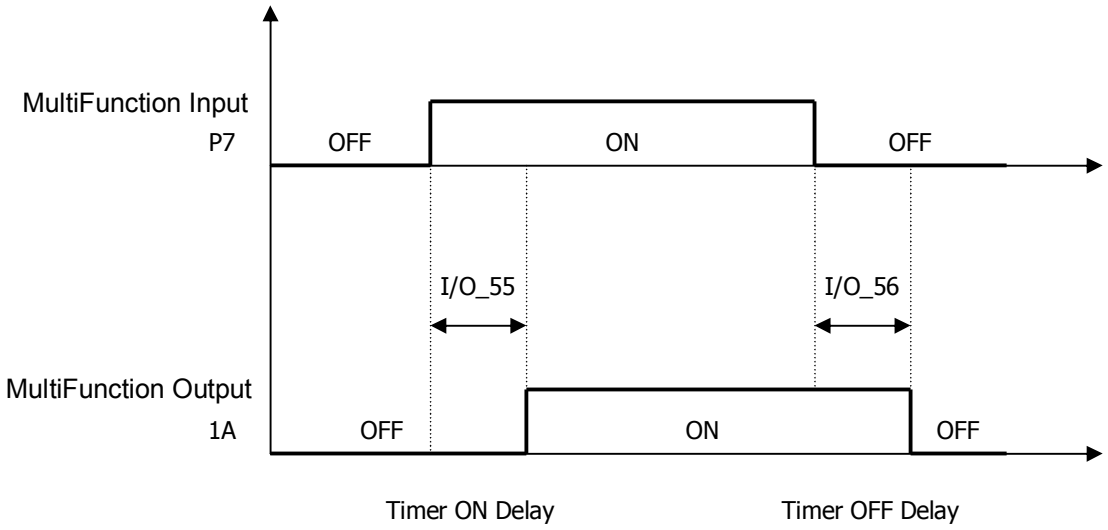
Code	Display	Description	Range	Unit	Default
I/O_52	SEQ Band	SEQ hysterisis band	0.1 ~ 10.0	%	0.5



1.8) Timer Out

Timer Out acts as an output signal to the timer input signal defined in the one of the multi-function input terminals P1~P7 and it uses the set values of Timer On delay time at I/O_55 and of Timer Off delay time at I/O_56. The example of code setting is shown in the table below when I/O_07 is set to Timer Input and I/O_41 is set to Timer Output.

Code	Display	Description	Range	Unit	Default
I/O_07	P7 define	Definition of P7			Timer Input
I/O_41	AX1 Define	Definition of multi-function output terminal relay output 1 (1A, 1B)			Timer Out
I/O_55	TimerOn Dly	Timer On delay	0.1 ~ 3600.0	sec	0.1
I/O_56	TimerOff Dly	Timer Off delay	0.1 ~ 3600.0	sec	0.1



1.9) LV Warn

LV is enabled when the DC link voltage of the inverter is less than the detecting level of low voltage alarm.

1.10) Run

It is ON when the inverter is running.

1.11) Regenerating

It is ON when the motor is regenerating.

1.12) Mot OH Warn (Motor Overheat Warning)

Using NTC signal built in the motor, Motor Overheat is ON when the temperature inside the motor is higher than the overheat alarm level. This signal is only for an alarm, not for the inverter trip. Active when I/O_21 [Ai3 Define] is set to "Use Mot Ntc".

Code	Display	Description	Range	Unit	Default
I/O_64	MH Warn Temp	Motor overheat detect	75 ~ 150	°C	140
I/O_65	MH Warn Band	MH hysterisis band	0 ~ 10	°C	5

1.13) Inv OH Warn (Inverter Overheat Warning)

Inverter Overheat is ON, when the heatsink inside the inverter is higher than the overheat alarm level. This signal is only for an alarm, not for the inverter trip.

Code	Display	Description	Range	Unit	Default
I/O_62	IH Warn Temp	Inverter Overheat Detection Temperature	50 ~ 85	°C	75
I/O_63	IH Warn Band	Inverter Overheat Detection Bandwidth	0 ~ 10	°C	5

1.14) Trq Det.

Trq Det is ON when the torque output of ASR reaches the setting torque level.

Code	Display	Description	Range	Unit	Default
I/O_53	TD level	Torque Detect Level	0.0 ~ 250.0	%	0.0
I/O_54	TD Band	TD hysterisis band	0.1 ~ 10.0	%	0.5

1.15) Trq Lmt Det

Trq Lmt Det is ON when the output of ASR (Torque reference) is saturated so that its limit value is generated.

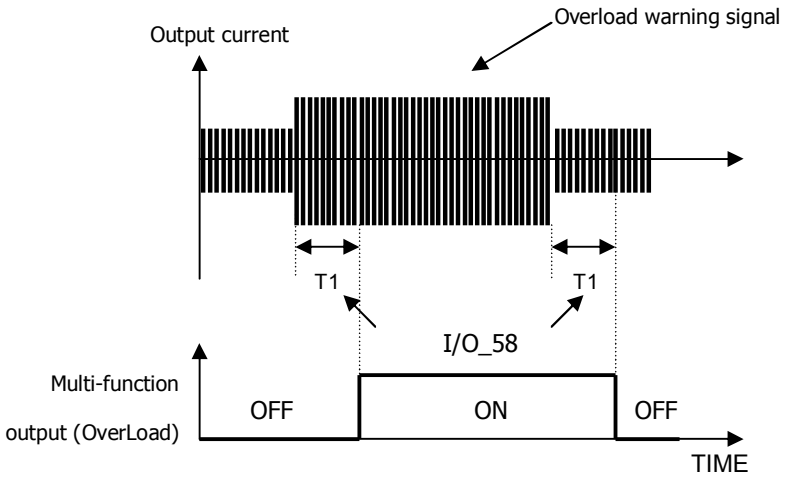
1.16) OverLoad

Overload is ON when the inverter output current is higher than the overload alarm level. (On the basis of the rated current of the motor) Refer to the following values of overload alarm level (I/O_57) and overload alarm time (I/O_58).

- **I/O_57: [Overload warning level], I/O_58 [Overload warning time]**

If the inverter output current keeps flowing more than overload alarm level (I/O_57) and longer than overload alarm time (I/O_58), alarm signal is triggered. The overload signal is canceled when the inverter output current flows less than overload alarm level (I/O_57) and longer than overload alarm time (I/O_58) has passed.

Overload alarm signal can be generated by the multi-function outputs (1A-1B, 2A-2B, OC1-EG). "OL" should be set in the I/O_41, 42 and 43 [Multi-function auxiliary terminal output setting] to use this function. Even if overload occurs, its alarm signal is generated through the multi-function output terminal and the inverter keeps running.



Code	Display	Description	Range	Unit	Default
I/O_57	OL level	Overload warning level	30 ~ 250	%	150
I/O_58	OL time	Overload warning time	0 ~ 30	sec	10

- Note: The set value of overload alarm level is of percentage(%) to the rated current of the motor.

1.17) Stop

'Stop' is ON when the inverter keeps stopping.

1.18) Steady

This is ON when the inverter is running at the constant speed.

2) I/O_46 (Fault Output Relay (30A, 30B, 30C))

This function can be used when the inverter fault signal is generated through the relay contact. the fault alarm is triggered differently by setting the bits related to the low voltage trip, inverter trip and the number of retry.

Code	Display	Description	Range	Unit	Default
I/O_46	Relay mode	Relay mode	000 ~ 111		011

Code	Bit 2 (Number of Auto retry)	Bit 1 (Inverter trip)	Bit 0 (LV trip)
I/O_46	0/1	0/1	0/1

Bit	Setting	Description
Bit 0 (LV)	0	Deactivated at Low Voltage Trip
	1	Activated at Low Voltage Trip
Bit 1 (Trip)	0	Deactivated at any fault
	1	Activated at any fault except Low Voltage Trip
Bit 2 (Retry)	0	Deactivated at the auto retry attempt
	1	Activated at the number of auto retry attempt

3) I/O_59 ~ 61 (Overload trip enable, level, time)

If the inverter output current higher than the overload limit level is kept for the overload limit time, the inverter blocks the gating of IGBTs and issues the trip message.

Code	Display	Description	Range	Unit	Default
I/O_59	OLT select	Overload trip enable	Yes/No		Yes
I/O_60	OLT level	Overload trip level	30 ~ 250	%	180
I/O_61	OLT time	Overload trip time	0 ~ 60	sec	60

- Note: I/O_60 is set as the percentage of Motor rated current.

6.2.5 Analog output

SV-iV5[MRL] has 2 analog outputs [AO1, AO2] (-10V ~ +10V) and are defined as one of 29 functions as below.

Code	Display	Description	Range	Unit	Default
I/O_66	AO1 Define	Definition of Multi-function analog output 1			Not Used
I/O_67	AO1 Gain	AO1 Gain	0.0 ~ 500.0	%	100.0
I/O_68	AO1 Bias	AO1 Bias	-100.0 ~ 100.0	%	0.0
I/O_69	AO2 Define	Definition of Multi-function analog output 1			Not Used
I/O_70	AO2 Gain	AO2 Gain	0.0 ~ 500.0	%	100.0
I/O_71	AO2 Bias	AO2 Bias	-100.0 ~ 100.0	%	0.0

Setting	Description	Output signal level
AiX Value	Analog input value	±10 V: 10V, 20mA
PreRamp Ref	Pre Ramp Reference	±10 V: Max Speed
PostRamp Ref	Post ramp reference	±10 V: Max Speed
ASR Inp Ref	ASR Input Reference	±10 V: Max Speed
Motor Speed	Motor Rotating Speed	±10 V: Max Speed
Speed Dev	Speed Deviation	±10 V: Rated slip * 2
ASR Out	ASR Output	±10 V: 250%
Torque Bias	Torque bias	+6 V: 150%
PosTrq Limit	Positive Trq Limit	10V: 250%
NegTrq Limit	Negative Trq Limit	10V: 250%
RegTrq Limit	Regeneration Trq Limit	10V: 250%
Torque Ref	Torque Reference	±10 V: 250%
IqeRef	Torque current ref.	±10V: 250% of rated torque current
Iqe	Torque current	±10V: 250% of rated torque current
Flux Ref	Flux reference	10V: Flux rating * 2
IdeRef	Flux Current ref.	±10V: Rated flux current * 2
Ide	Flux Current	±10V: Rated flux current * 2
ACR_Q Out	ACR output of axis Q	±10 V: 300/600
ACR_D Out	ACR output of axis D	±10 V: 300/600
VdeRef	Voltage reference of axis D	±10 V: 300/600
VqeRef	Voltage reference of axis Q	±10 V: 300/600
Out Amps RMS	Output current	10 V: Rated current * 2
Out Volt RMS	Output voltage	±10 V : 300/600
Power	Output power	±10 V: Rated output * 2
DC Bus Volt	DC LINK voltage	10 V: 500/1000V
Proc PI Ref	Process PI reference	±10 V: Rating
Proc PI FB	Process PI Feedback	±10 V: Rating
Proc PI Out	Process PI output	±10 V: Rating
Mot Temp	Motor temperature	±10 V: 150°C
Inv Temp	Inverter temperature	±10 V: 100°C
Inv i2t	Inverter i2t	10 V: 150%

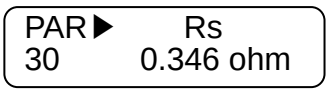
6.3 Parameter group (PAR_[][])

6.3.1 Jump code (PAR_00)

In PAR_00, jumping directly to any parameter code can be accomplished.

(Example) Moving to PAR_30

Press [PROG] and set to 30 using [SHIFT/ESC] / [▲(Up)] / [▼(Down)] and press [ENT] key. If the desired code cannot be set (void), the nearest code will be displayed.



Use [▲(Up)] / [▼(Down)] to move to other codes.

6.3.2 Parameter group function

1) PAR_01 (Parameter initialize)

This is used to initialize all parameters or each group back to the factory defaults. After performing this, be sure to check **PAR_07 (Motor Select) is properly set**.

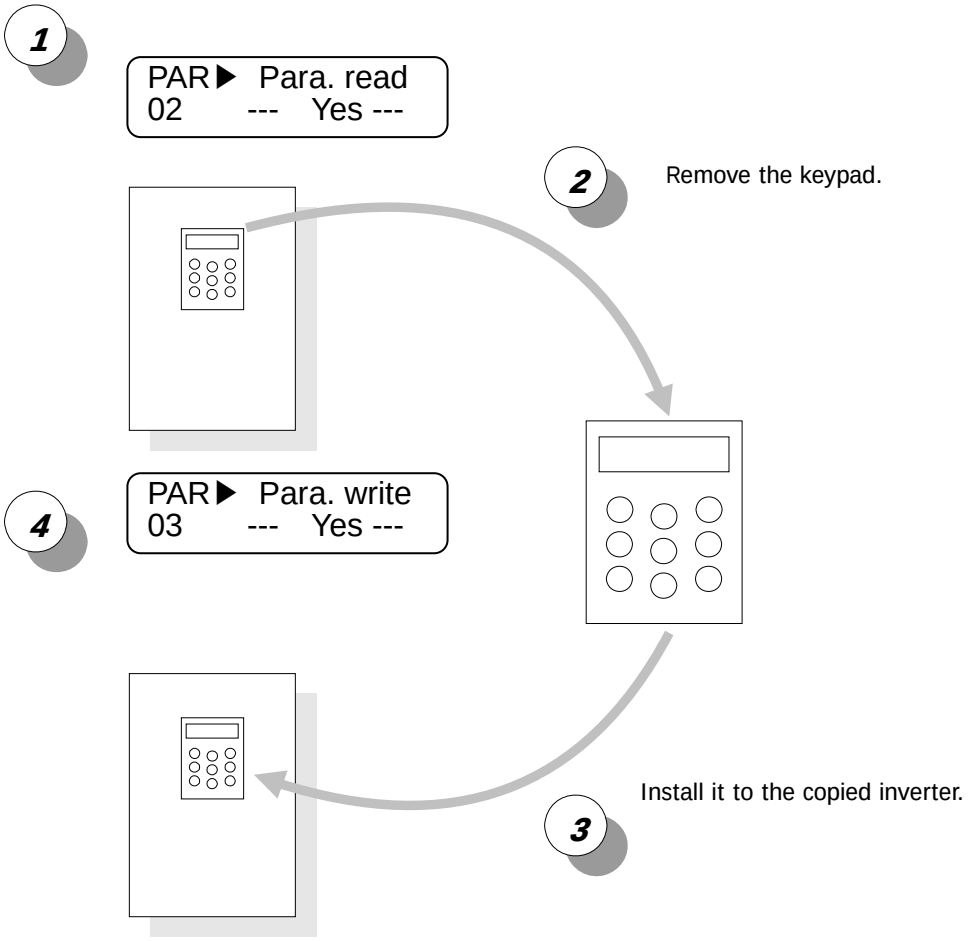
Code	LCD display	Description	Setting range	Unit	Factory setting
PAR_01	Para. init	Initialize parameters as factory defaults	No All Groups DIS I/O PAR FUN CON EXT USR E/L[1)] 2ND		No

1) E/L is only displayed when CON_02 ”Application” is set to “Elevator”.

2) PAR_02 ~ 03 (All Parameter Read/Write)

Parameters setting can be copied to other inverters using keypad. To do this, set **PAR_02** ‘Parameter Read’ to “Yes” to upload the parameter setting from the inverter. Take the keypad out and install it to the copied inverter and set **PAR_03** ‘Parameter Write’ to “Yes” to download the function parameters.

Code	LCD display	Description	Setting range	Unit	Factory setting
PAR_02	Para. Read	All Paramter Read	No Yes		No
PAR_03	Para. Write	All Paramter Write	No Yes		No



3) PAR_04 (Parameter Lock)

Set it to “12” to disable “paramter change”.

Code	LCD display	Description	Setting range	Unit	Factory setting
PAR_04	Para. Lock	Parameter lock	0 ~ 255		0

4) PAR_05 (Password)

When user put any four-digit number except “0” and cycle the power, only Display groupd will appear. Press [Mode] key and PAR_05 ”Password” will be directed. If the right password is entered, all other groups can be accessed and adjustable. To clear the password, set it to “0”. When you forget the password, enter “5052”. It is the master password and it resets the password to “0”.

Code	LCD display	Description	Setting range	Unit	Factory setting
PAR_05	Password	Password	0 ~ 9999		0

6.3.3 Motor parameters setting

1) PAR_07(Motor rating setting)

Company	Capacity (Kw)
Ex) Company 1	3.7kW, 6.2kW, 6.5kW, 7.1kW, 12.5kW, 14.1Kw
Ex) Company 2	3.7kW, 6.2kW, 6.5kW, 7.5kW, 11kW, 15Kw
Ex) Company 3	13.3kw
Ex) Company 4	6.7kw

* Advise to compare and validate set up values with motor ratings' plate, since PAR_17, 18, 19, 20, 21, 22, 28, and 30 are to change automatically upon motor capacity selections.

2) PAR_08(Motor cap. Selection of User)

Select the motor rating. Its factory default value is the same as inverter capacity. If this is set, motor parameters are automatically set. These are designed to fit for LG-OTIS vector motor. When other makers' motor is used, program the motor parameters properly. When using a motor having a rating not specified in this code, select "**User Define**". Then, PAR_08 will be displayed. Enter motor rating in this code. Then, enter motor parameters in the name plate and perform Auto-tuning to gain proper parameters before use.

Code	LCD display	Description	Setting range	Unit	Factory setting
PAR_07	Motor select	Motor rating select	2.2 ~ 220.0 User Define	kW	Same as inverter rating
PAR_08	UserMotorSel	Motor cap. Selection of User	1.5 ~ 220.0	kW	5.5

3) PAR_09 (Motor Cooling method)

Select the cooling method of the motor to use. 'Motor cooling method' is used to check if the motor is currently overloaded or not. The self-cooled motor should be set to 'Self-Cool' and the forced cooled motor to 'Forced-Cool'.

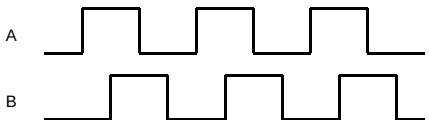
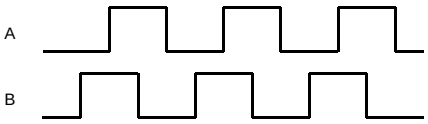
Code	LCD display	Description	Setting range	Unit	Factory setting
PAR_09	Cooling Mtd	Motor Cooling method	Forced-cool Self-cool		Forced-cool

4) Encoder parameters (PAR_10 ~ 13: Pulse number of Encoder, direction, Error detection, LPF)

Enter the pulse number of encoder mounted on the motor shaft at the **PAR_10 (the pulse number of encoder).** If **PAR_12**(**Encoder error check enable)** is set to '**Yes**', Encoder error signal is detected and then triggers fault alarm in the case of the wire cut or the miswiring. But, **for open collector type encoder, it is unable to detect the encoder error, therefore PAR_12 should be set to 'No'.** In case the wiring for encoder (A, B phase) or inverter output (U, V, W) is changed, '**Enc AB Chgd**' message is shown during the auto-tuning operation. In this case, **PAR_11 (Enc Dir Set)** can be changed without changing the wiring of pulse encoder. If encoder signal is mixed with electromagnetic noise signal, encoder

signal may be less affected by the electromagnetic noise signal by adjusting **PAR_13** (**Encoder LPF Time Constant)**.

Code	LCD display	Description	Setting range	Factory setting
PAR_11	Enc Dir Set	Encoder direction setting	A Phase Lead/B Phase Lead	A Phase Lead

Setting	Description	Encoder pulse (In FWD RUN)
A Phase Lead	A phase leads in FWD rotation. B phase leads in REV rotation.	
B Phase Lead	B phase leads in FWD rotation. A phase leads in REV rotation.	

Improper setting of encoder parameters may deteriorate accurate speed control and lead to “overcurrent” or “overvoltage” trips. Refer to chapter 8 “Troubleshooting”.

Code	LCD display	Description	Setting range	Unit	Factory setting
PAR_10	Enc Pulse	Number of encoder pulse	360 ~ 4096		1024
PAR_12	Enc Err Chk	Encoder error check	Yes No		Yes
PAR_13	Enc LPF	Encoder LPF time constant	0 ~ 100	ms	1

6.3.4 Encoder S/W error detection (PAR_14 ~ 15: Encoder error detection time, encoder error reference speed)

To achieve correct motor speed detection and control using encoder, proper wiring of encoder and motor should be preceded. If operation is continued with faulty wiring of Encoder/Motor, overcurrent flows to the motor, damaging the motor. Therefore, encoder should have functions to detect encoder input error and wrong wiring.

SV-iV5 can monitor encoder H/W error by setting PAR_12 to “Yes” and it monitors encoder pulse signal input status to detect H/W faults such as encoder disconnection error. However, wrong wiring error cannot be detected with this function. In this case, perform “Rotational Auto-tuning”. Set PAR_23 (AutoTuneType) to “Rotational” and perform Encoder Test. Then wiring problem can be detected by applying voltage and checking speed detection level while motor is running.

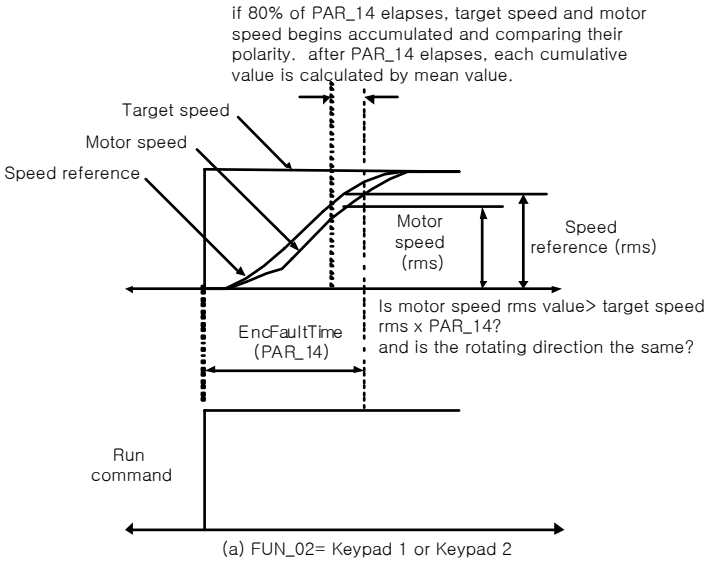
There are some loads (ex. Elevator) performing Encoder Test described above is difficult. To solve this fault, iV5 adopts the following functions to detect S/W faults.

Code	LCD display	Description	Setting range	Unit	Factory setting
PAR_14	EncFaultTime	Encoder error detection time	0.00 ~ 10.00	sec	0.00
PAR_15	EncFaultPerc	Encoder error reference speed	0.0 ~ 50.0	%	25.0
PAR_21	Rated-Slip	Motor rated slip	10 ~ 250	rpm	

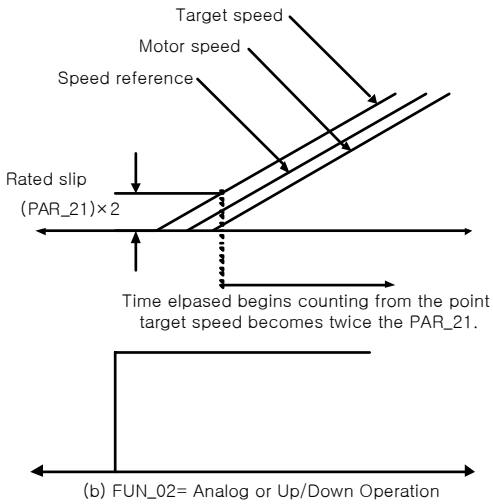
When encoder/motor wiring is reversed, motor cannot perform acceleration due to overcurrent. Encoder S/W error detection is adopted to detect the errors such as wrong wiring and incorrect pulse input during normal operation, not during Auto-tuning. Inverter determines encoder error if motor speed is not accelerated proportional to operating time and target speed after PAR_14 EncFaultTime elapses and polarity does not match.

To activate S/W error detection function, set CON_01 = Speed, Auto Tuning is not selected and set EncFaultTime except 0. If run command is removed before “EncFaultTime” elapses or acceleration is turned to deceleration due to target speed change, inverter cannot detect encoder S/W error. Inverter determines encoder S/W error by comparing motor speed and Target speed XEncFaultPerc while operation status is acceleration after EncFaultTime elapses.

Encoder S/W error detection is performed only once after operation starts and activates when target speed becomes twice the rated slip. For example, when target speed is 500(rpm) and rated slip is 40(rpm), the detection active level is 80(rpm).



(a) FUN_02= Keypad 1 or Keypad 2



(b) FUN_02= Analog or Up/Down Operation

6.3.5 Auto-Tuning

The motor parameters for the Vector Control are autotuned by Starvert-iV5. The stator resistance, Stator Inductance, Leakage Inductance and Rotor time constant are found and saved. User can select the type of Auto-tuning in Rotational or Standstill mode.

1) Motor and Encoder parameters setting for Auto-tuning

The following paramters should be set according to motor nameplate to find motor parameters correctly.

Code	LCD display	Description	Setting range	Unit	Factory setting
PAR_07	Motor Select	Motor capacity selection	2.2 ~ 220.0 User Define		
PAR_08	UserMotorSel	Motor cap. selection of USER	1.5 ~ 220.0		5.5
PAR_10	Enc Pulse	Pulse no. of encoder	360 ~ 4096		1024
PAR_17	Base Speed	Motor base speed	100.0 ~ 3600.0	rpm	1800.0
PAR_18	Rated Volt	Motor rated voltage	120 ~ 560	V	220 or 440
PAR_19	Pole Number	Motor number of poles	2 ~ 12		4
PAR_20	Efficiency	Motor efficiency	0.0 ~ 100.0	%	
PAR_21	ASR PI Ratio	ASR PI gain ratio	3~ 250	rpm	20
PAR_22	Rated-Curr	Motor rated current	1.0 ~ 450.0	A	

In order to set motor capacities in **PAR_07** other than its initial default value, select **"User Define"**. Then **PAR_08 "User Motor Selection"** will be displayed. Under the user motor selection section, put motor capacities.

PAR_17 "**Motor base speed**" is the frequency inverter outputs its rated voltage. It is to be set within the range of Motor Max speed. **Set motor speed and rated voltage according to motor rating.** When standard motor is used, 60Hz (1800rpm) is the normal rating.

PAR_18 "Motor rated voltage"

For 200V class inverters, factory default is 220(V) and for 400V class is 440(V). When input voltage is 380(V), change it to 380V. This value is input to Voltage controller and used to prevent voltage saturation. It should be set correctly because it affects Flux current value during Auto-tuning.

PAR_20 "Motor efficiency" should be entered for (PAR_23[AutoTuneType] : StandStill), not needed for (PAR_23 [AutoTuneType] : Rotational).

PAR_21 "ASI PI Gain Ratio"

With a synchronous motor, "ASI PI Gain Ratio" is used as a standard value for the speed controller's proportional and integral gain.

Refer to **4.5 Auto Tuning** under Chapter 4. Loader manual and basic functions for auto tuning functions.

2) PAR_35 (Repetition numbers for magnetic flux detection)

Display repetition number of magnetic flux detection operations

Function Code	Loader Display	Function Name	Setting Range	Unit	Default Value
PAR_35	DetAve Num	Repetition number for magnetic flux detection	1~30		1

3) PAR_36 (Magnetic flux detection voltage)

Set up the size of supplied voltage pulse when magnetic flux detection is running.

Function Code	Loader Display	Function Name	Setting Range	Unit	Default Value
PAR_36	MagDet Volt	Magnetic flux detection voltage	50 ~ 200		80

4) PAR_37 (Magnetic flux detection current)

Set up initial magnetic flux current level as a percentage of **PAR_22 (Rated current of motor)**.

Function Code	Loader Display	Function Name	Setting Range	Unit	Default Value
PAR_37	MagDet Curr	Magnetic flux detection current	10 ~ 150	%	70

5) PAR_38 (Speed deviation detection level)

Generate a trouble signal from magnetic flux detections if differential between command speed and actual motor speed exceeds its setting values which is a percentage of PAR_16(Motor base speed) for more than its setting time in PAR_39(Speed accumulated error time).

Function Code	Loader Display	Function Name	Setting Range	Unit	Default Value
PAR_38	RevSpdLevel	Speed deviation detection level	0 ~ 100	%	30

6) PAR_39 (Speed deviation detection time)

It expains about the passage time of speed deviation detection level from **PAR_38**

If differential value between elavator's command speed and actual spead is larger than **PAR_38**'s speed deviation detection level and its deviation remains longer than its setting time in **PAR_39**, speed deviation detection time error signal is generated.

Function Code	Loader Display	Function Name	Setting Range	Unit	Default Value
PAR_39	RevSpdTime	Speed deviation detection time	0 ~ 9999	ms	1500

7) PAR_40 (Trip Selection Bit)

Function Code	Loader Display	Function Name	Setting Range	Unit	Default Value
PAR_40	MRL TripSel	Trip Selection Bit	0000~ 1111	BIT	1110

First Bit : Output phase loss

Second Bit : Input phase loss

Third Bit : Magnetic Detection Error

Fourth Bit : Speed Deviation Error

8) PAR_41 (Operation command accumulated value for repetition of magnetic flux estimation)

Function Code	Loader Display	Function Name	Setting Range	Unit	Default Value
PAR_41	ReDet Num	Number of operation commands for repetition magnetic flux estimation	0 ~ 65535		100

Once inverter is supplied with power first, magnetic flux estimation takes place when its first operation command is given. Then number of operation commands is accumulated until it has reached its setting value for magnetic flux estimation again.

6.4 Function group (FUN_[][])

6.4.1 Jump code (FUN_00)

Jumping directly to any parameter code can be accomplished using FUN_00 [Jump code].

Press [PROG] key first and set 2 using [▲(Up)], [▼(Down)], [SHITF/ESC] and press [ENT] key to jump to FUN_02. If the desired code cannot be accessed or void, it automatically jumps to closest code.

After jumping, it is available to jump to other codes using [▲(Up)], [▼(Down)].

6.4.2 Operating method select

1) FUN_01(RUN/STOP source select)

There are four methods for issuing RUN/STOP command of the motor.

- Terminal 1/ Terminal 2: Digital input of the FX/RX terminal
- Keypad: [FWD], [REV], [STOP] key on the keypad
- Option: using Option card. (Factory setting: Terminal 1)

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_01	Run/Stop Src	RUN/STOP source select	Terminal 1 Terminal 2 Keypad Option		Terminal 1

Difference between Terminal 1 and Terminal 2 setting

Run/Stop source select	Terminal ON/OFF		FWD/REV select
Terminal 1	FX	ON	FWD run command
		OFF	Stop command
	RX	ON	REV run command
		OFF	Stop command
Terminal 2	FX	ON	Run command
		OFF	Stop command
	RX	ON	REV rotation
		OFF	FWD rotation

For Analog speed setting, applying (+) Voltage marks FWD Run command and (-) voltage REV Run command.

Analog speed setting range	FX / FWD / Option FWD	RX / REV / Option REV
0 ~ +10 V	Forward direction	Reverse direction
-10 ~ 0 V	Reverse direction	Forward direction

2) FUN_02 (Speed setting method)

There are four methods to set operating speed.

- Keypad 1/Keypad 2: Digital setting via keypad
- Analog: speed setting via analog input terminal define
- Option: speed setting via option card

To change speed reference in Keypad 1 method, change the value in FUN_12 Speed 0 using [▲(Up)], [▼(Down)] key and press [ENT] key to enter the value into memory. However, in Keypad 2, the changed value is reflected real-time without pressing [ENT] key.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_02	Spd Ref Src	Speed setting method	Analog Keypad 1 Keypad 2 Option		Keypad 1

3) FUN_03 (Stop method)

This determines the stop mode of the motor. If this is set to 'Decel' and then stop command is ON, the motor decelerates to a stop within the deceleration time set at FUN_39 (Deceleration Time 1). But, if the motor does not stop within the deceleration time, it is freely rotating after the deceleration time. If this is set to 'Free-run' and then stop command is ON, the motor freely rotates immediately.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_03	Stop Mode	Stop method	Decel Free-run		Decel

6.4.3 Motor Max Speed Reference

Maximum value of the speed command to the motor is set to the sum of setting speed, reference speed in Draw control , reference speed in Process PID control and reference speed in Droop control. In this case, final speed command output is limited to the maximum speed command to the motor.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_04	Max Speed	Max. motor speed	10.0 ~ 3600.0	rpm	200.0

6.4.4 Multi-step speed and Dwell Speed setting methods

1) FUN_12 ~ 19(Multi-step speed 0 ~ 7)

2) FUN_20(JOG speed)

If the multi-function terminal is selected as a multi-step speed setting or jog operation, the speed command is determined by the combination of multi-function terminals P1 to P7 and jog speed command.

Multi-speed command by the combination of P1, P2 and P3 is generated as follows. In case multi-step speed 0 is selected (P1, P2 and P3 all are OFF), One of the speed commands from the keypad, analog voltage input and option board is fed into the inverter. In case P4 is ON, it ignores the speed command selection by other terminals and jog operation command has a priority. In this case, the motor is operated at the speed of FUN_20 (Jog speed command).

P1	P2	P3	P4	Setting speed
OFF	OFF	OFF	OFF	Speed command source is selected at FUN_02. (One of analog inputs, FUN_12 and Option board)
ON	OFF	OFF	OFF	FUN_13
OFF	ON	OFF	OFF	FUN_14
ON	ON	OFF	OFF	FUN_15
OFF	OFF	ON	OFF	FUN_16
ON	OFF	ON	OFF	FUN_17
OFF	ON	ON	OFF	FUN_18
ON	ON	ON	OFF	FUN_19
X	X	X	ON	FUN_20 (JOG speed command)

The values of the multi-step speed command are shown below.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_12	Speed 0	Multi-step speed 0	0.0 ~ FUN_04	rpm	0.0
FUN_13	Speed 1	Multi-step speed 1	0.0 ~ FUN_04	rpm	0.0
FUN_14	Speed 2	Multi-step speed 2	0.0 ~ FUN_04	rpm	0.0
FUN_15	Speed 3	Multi-step speed 3	0.0 ~ FUN_04	rpm	0.0
FUN_16	Speed 4	Multi-step speed 4	0.0 ~ FUN_04	rpm	0.0
FUN_17	Speed 5	Multi-step speed 5	0.0 ~ FUN_04	rpm	0.0
FUN_18	Speed 6	Multi-step speed 6	0.0 ~ FUN_04	rpm	0.0
FUN_19	Speed 7	Multi-step speed 7	0.0 ~ FUN_04	rpm	0.0
FUN_20	Jog Speed	JOG speed	0.0 ~ FUN_04	rpm	100.0

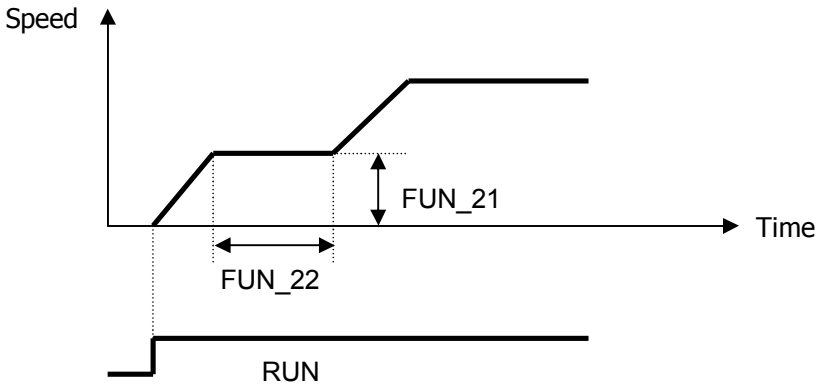
- FUN_04: Max. motor speed

3) FUN_21(Dwell Speed), FUN_22(Dwell Time)

Acceleration is instantly stopped and restarted before driving a heavy load such as hoists when selected.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_21	Dwell Speed	Dwell Speed	0.0 ~ FUN_04	rpm	100.0
FUN_22	Dwell Time	Dwell Time	0.00 ~ 100.00	sec	0.00

- FUN_04: Maximum motor speed
- Disabled when FUN_22 is set to "0".

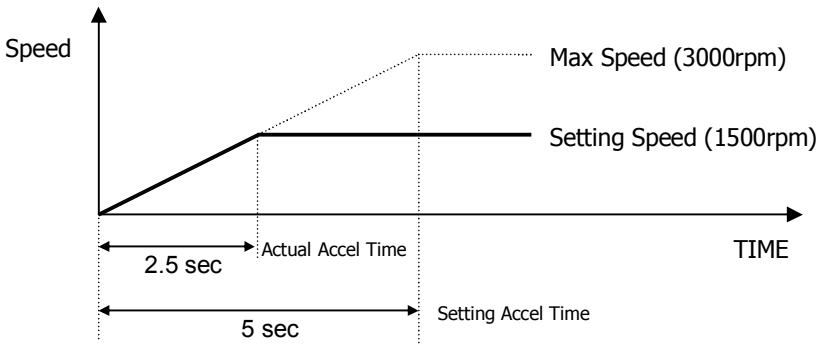


6.4.5 Accel/Decel pattern and time selection

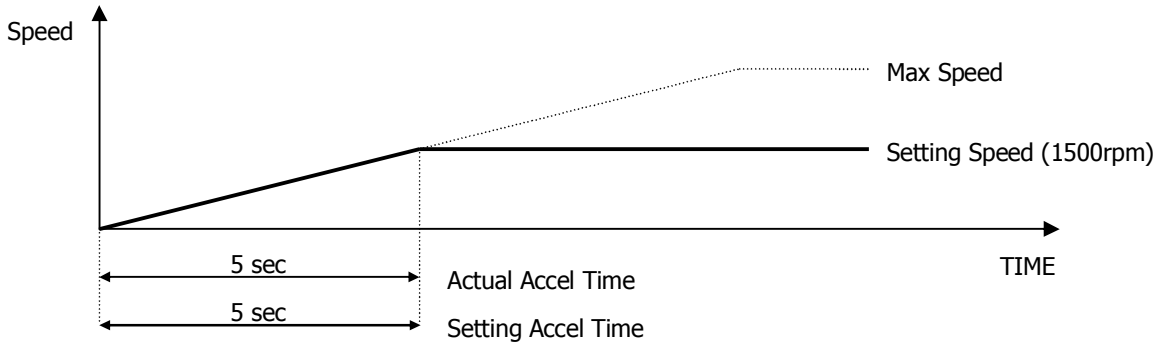
1) FUN_33 (Accel/Decel reference speed)

Acceleration time, deceleration time and BX time is set on the basis of the value at **FUN_33(Accel./decel. reference speed)**, which is 'Max speed'or 'Ref speed'.

(Setting example 1) if FUN_33= "Max Speed", Max motor speed= 3000rpm and Operating speed= 1500rpm, Accel time= 5 sec, accel time from 0 (stop) to 1500rpm would be 2.5 sec.



(Setting example 2) If FUN_33 is set to 'Ref Speed' and speed command and acceleration time is set to 1500rpm and 5 seconds, respectively, it takes 5 seconds to accelerate from the standstill to 1500rpm.



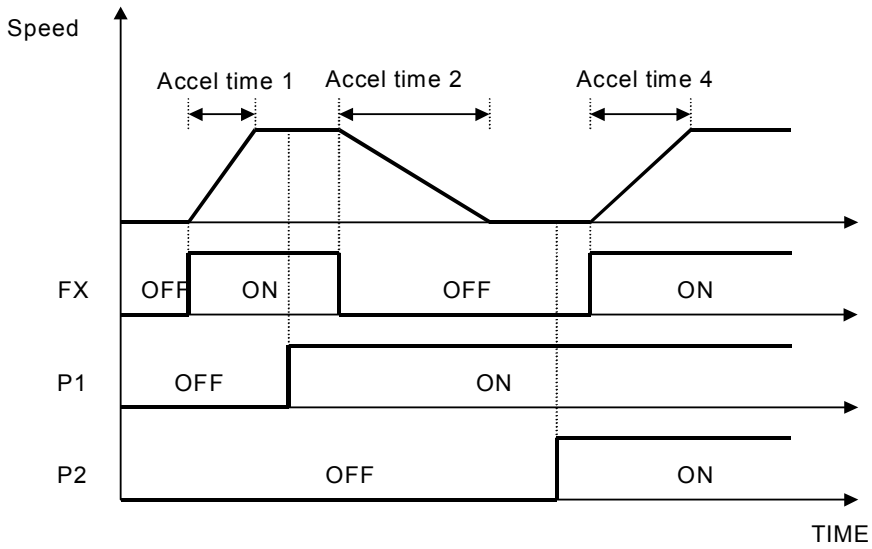
2) FUN_40 ~ 47(Accel/Decel time 1 ~ 4)

Accel/Decel time 1-4 can be set in SV-iV5[MRL] as shown below.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_40	Acc Time-1	Acceleration time 1	0.00 ~ 6000.0	sec	2.00
FUN_41	Dec Time-1	Deceleration time 1	0.00 ~ 6000.0	sec	2.00
FUN_42	Acc Time-2	Acceleration time 2	0.00 ~ 6000.0	sec	3.00
FUN_43	Dec Time-2	Deceleration time 2	0.00 ~ 6000.0	sec	3.00
FUN_44	Acc Time-3	Acceleration time 3	0.00 ~ 6000.0	sec	4.00
FUN_45	Dec Time-3	Deceleration time 3	0.00 ~ 6000.0	sec	4.00
FUN_46	Acc Time-4	Acceleration time 4	0.00 ~ 6000.0	sec	5.00
FUN_47	Dec Time-4	Deceleration time 4	0.00 ~ 6000.0	sec	5.00

(Example) Code setting in case that using multi function input terminal P1, P2

Code	LCD display	Description	Setting range	Unit	Factory setting
I/O_01	P1 define	Definition of P1 input			Xcel – L
I/O_02	P2 define	Definition of P2 input			Xcel – H



Following table shows Accel/Decel time is to be decided while by-passing Accel/Decel time or using soft-start cancel function through P1, P2, P3.

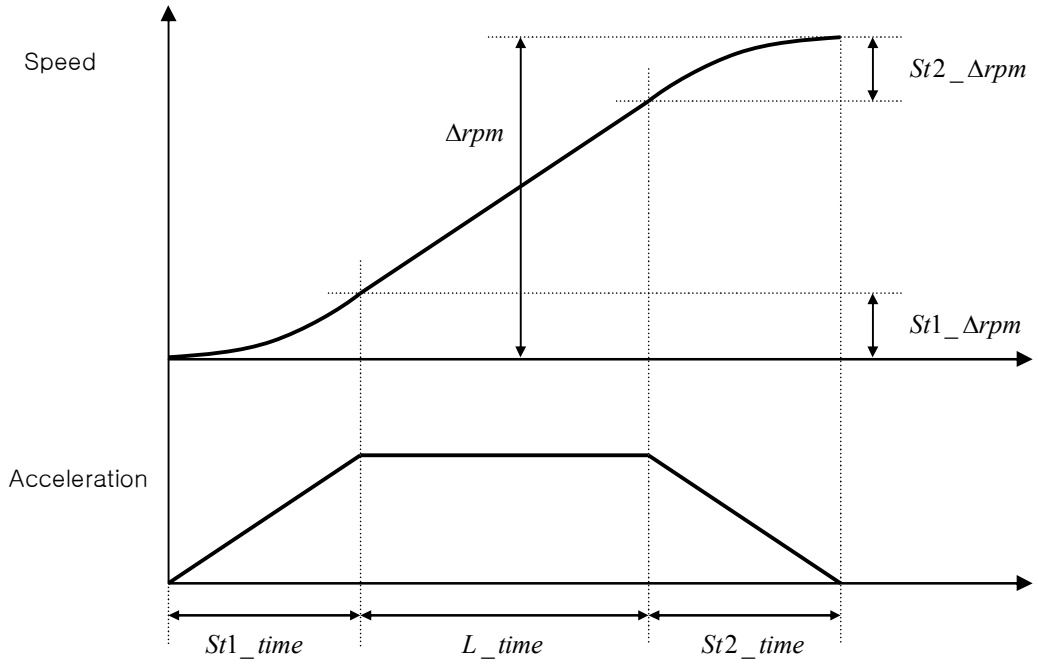
P1 (Xcel-L)	P2 (Xcel-H)	P3 (SoftStartCncl)	Accel/Decel time
OFF	OFF	OFF	Accel/Decel 1
ON	OFF	OFF	Accel/Decel 2
OFF	ON	OFF	Accel/Decel 3
ON	ON	OFF	Accel/Decel 4
X	X	ON	Max Accel/Decel

3) FUN_36 ~ 39(S curve ratio during Accel/Decel 1 ~ 2)

The ramping pattern of the Linear and S Curve could be used by setting the parameters below. S Curve pattern is used to control the acceleration of the machine as linear to minimize the shock at the start. The parameters, FUN_36 ~ 39 determine the rate of S Curve pattern as in the figure below. FUN_36, 37 are applied in the acceleration and FUN_38, 39 in the deceleration.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_36	Acc S Start	Curve ratio at the beginning of acceleration	0.0 ~ 50.0	%	0.0
FUN_37	Acc S End	Curve ratio at the end of acceleration	0.0 ~ 50.0	%	0.0
FUN_38	Dec S Start	Curve ratio at the beginning of deceleration	0.0 ~ 50.0	%	0.0
FUN_39	Dec S End	Curve ratio at the end of deceleration	0.0 ~ 50.0	%	0.0

- **Programming example of S curve pattern**



- **Basic equation**

*St1_time = AccTime * (FUN_36 / 50.0%)*

*St2_time = AccTime * (FUN_37 / 50.0%)*

*St1_Δrpm = St1_time * (MaxSpeed / AccTime) * 0.5*

*St2_Δrpm = St2_time * (MaxSpeed / AccTime) * 0.5*

- **Calculation 1**

Δrpm ≥ St1_Δrpm + St2_Δrpm

Δrpm = The difference between the current speed and the target speed

*L_time = (Δrpm – St1_Δrpm – St2_Δrpm) * (AccTime / MaxSpeed)*

***Effective Acceleration Time* = St1_time + L_time + St2_time**

- **Calculation 2**

Δrpm < St1_Δrpm + St2_Δrpm

$St1'\_time = \sqrt{\{[\Delta rpm * AccTime^2 * St1\_time^2] / [25 * MaxSpeed * (St1\_time + St2\_time)]\}}$

$St2'\_time = \sqrt{\{[\Delta rpm * AccTime^2 * St2\_time^2] / [25 * MaxSpeed * (St1\_time + St2\_time)]\}}$

Effective Acceleration Time = **St1'_time + St2'_time**

Δrpm: Speed difference

MaxSpeed : Maximum speed (FUN_04)

AccTime : Set acceleration time (FUN_40, 42, 44, 46)

St1_Δrpm: Acc S Start ST (%) of FUN_36 at the time of acceleration,
Dec S End ST (%) of FUN_39 at the time of deceleration

St2_Δrpm: Acc S End ST (%) of FUN_37 at the time of acceleration,
Dec S Start ST (%) of FUN_38 at the time of deceleration

St1_time: The time when St1_Δrpm is formed.

St2_time: The time when St2_Δrpm is formed.

4) FUN_48 (Deceleration time for zero speed selection)

5) FUN_49 (Zero speed deceleration time)

This is the time when the motor decelerates from the arbitrary speed to 0 rpm in speed. This is valid only when FUN_48 is set to 'Yes'. If 'No' is set, the set deceleration time is applied.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_48	Use 0 Dec T	Deceleration time selection for zero speed	No/Yes		No
FUN_49	0 Dec Time	Deceleration time for zero speed	0.00~6000.0	sec	0.00

6) FUN_51(Decel time when emergency stop)

When the motor should be stopped immediately in case of emergency, BX on the control circuit terminal can be used. When BX is ON, the motor decelerates to a stop within 'Emergency deceleration time' set at FUN_51. But, if the motor does not stop within the deceleration time, it rotates freely after the deceleration time. If the motor is intended to stop at the instant BX is ON, FUN_51 is set to '0'.

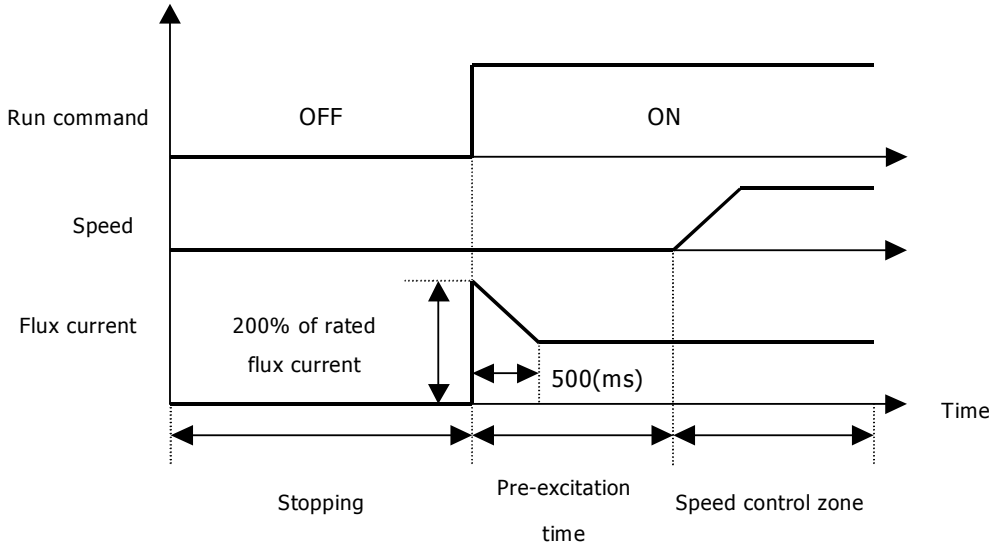
Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_51	BX Time	Deceleration time for emergency stop	0.0 ~ 6000.0	sec	0.0

7) FUN_52 (Pre-excitation Time)

FUN_52 (Motor Pre-excitation Time) can be used for the flux build-up in the induction motor to obtain the best control characteristic.

- **FUN_52 is activated only when FUN_02(Spd Ref Sel) is set to Keypad1 or Keypad2.**

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_52	PreExct Time	Pre-excitation time	0 ~ 10000	ms	0



8) FUN_53(Hold Time)

The motor maintains the zero speed for 'Motor Hold Time' after the motor decelerates to a stop.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_53	Hold Time	Motor Hold Time	100 ~ 10000	ms	1000

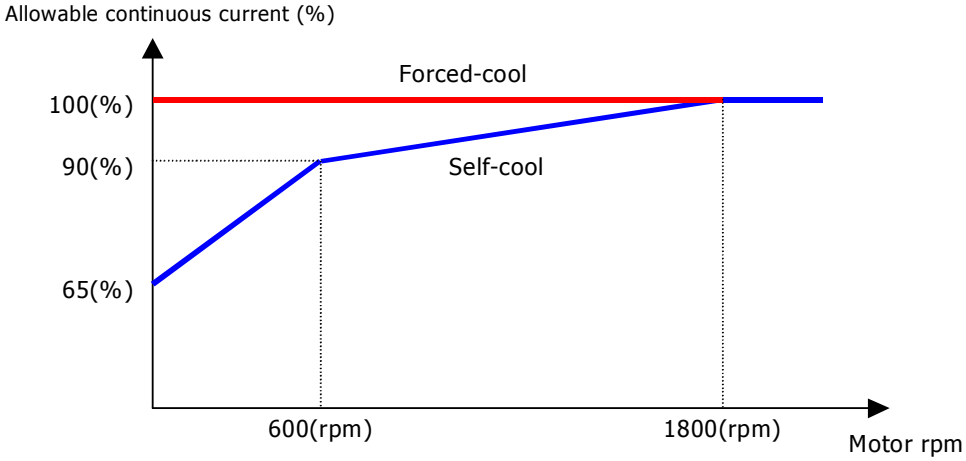
6.4.6 Electronic Thermal (Motor I^2T) Selection

These functions are required when the motor should be protected against the overheat without installing the thermal relay between the inverter and the motor. If electronic thermal protection is ON, the inverter blocks the IGBT gating signals and issues the trip message.

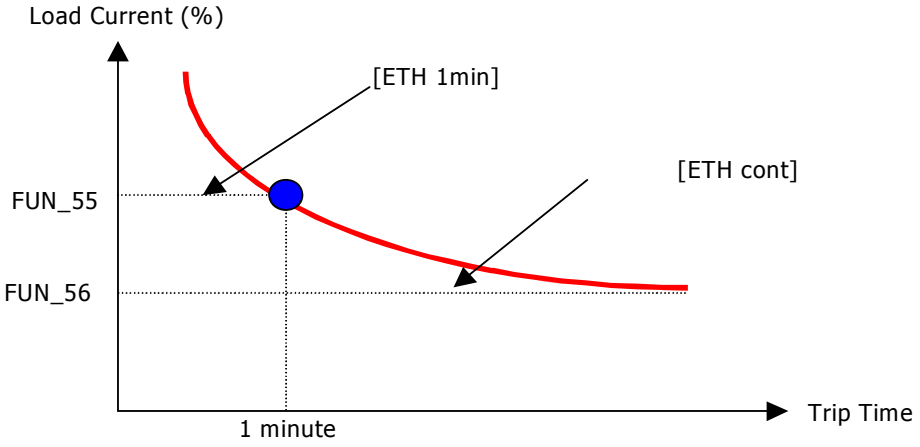
Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_54	ETH Select	Electronic thermal selection	No Yes		No
FUN_55	ETH 1 Min	Electronic thermal level for 1 minute	FUN_56 ~ 200	%	150
FUN_56	ETH Cont	Electronic thermal level for continuous	50 ~ FUN_55 (up to 150%)	%	100
PAR_09	Cooling Mtd	Motor cooling method	Self-cool Forced-cool		Forced-cool

Electronic thermal protection level is set in % based on the 'Motor rated current' at PAR_22. '1 min.level of electronic thermal' at FUN_55 is the current level which should be referred to when the motor is operated for a minute and the motor is estimated to be overheated. 'Continuous level of electronic thermal' at FUN_56 is the current level which should be referred to when the motor is operated continuously and the motor is estimated to be in thermal equilibrium. Continuous level is set to the motor rated current (100%) and should be less than '1 min.level of electronic thermal' at FUN_55. PAR_09 'Cooling type' should be set correctly to ensure the proper electronic thermal protection.

- **Self-cool** : This should be set when cooling fan mounted on the motor shaft is used for cooling. The cooling performance is greatly reduced when the motor is operated at the low speed. Compared to high speed region, the motor is rapidly overheated at the low speed region even if the same current flows into it.
- **Forced-cool** : This should be set when the cooling fan is powered by the separate power supply. 'Continuous level of electronic thermal' at FUN_56, which is allowable continuous current is applied, regadless of the operating frequency.



[The characteristic of allowable continuous current with respect to 4 pole, 60Hz motor]



[Motor i^2t Characteristic Curve]

- The motor protection is possible by calculating and accumulating I^2t even in load variation and frequent run/stop.

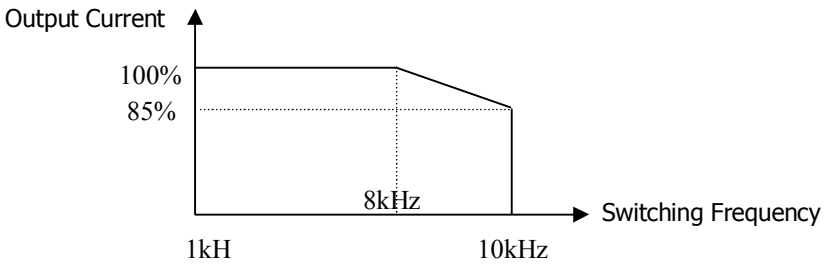
6.4.7 Inverter switching frequency select

1) FUN_57 (Inverter switching frequency select)

This parameter affects the audible sound of the motor, noise emission from the inverter, inverter termperature, and leakage current. If the ambient temperature where the inverter is installed is high or other equipment may be affected by potential inverter noise, set this value lower. (setting range: 2.5 ~ 10.0 kHz).

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_57	PWM Freq	Switching frequency select	2.5~10.0	kHz	8.0

- **Continuous Operation Derating Information**



The above graph is only applied when the inverter is operated in the allowable temperature.

Pay attention to the air cooling when the inverter is installed in a panel box, and the inside temperature should be within an allowable temperature range. This derating curve is based on inverter current rating when rated motor is connected.

6.4.8 Power ON Start Selection (FUN_58)

In case 'No' is set, the inverter can be operated only if the terminal should be 'On' again after it is 'Off' once. In case 'Yes' is set, the inverter starts to run at the instant the power is supplied to the inverter if FX terminal input is 'On' or RX terminal input is 'On'. If the inverter starts to run while the motor is freely rotating, first, the motor decelerates to a stop and restart.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_58	Power-on Run	Power on start selection	Yes No		No

⚠ CAUTION

Particular attention should be directed to this function due to potential hazard as motor starts to run suddenly upon applying AC input power.

6.4.9 Restart after fault reset (FUN_59)

In case 'No' is set, the inverter can be operated only if the terminal should be 'On' again after it is 'Off' once. In case 'Yes' is set, the inverter starts to run at the instant the inverter fault is cleared if FX terminal input is 'On' or RX terminal input is 'On'. At the time of the inverter trip, the motor start to coast to a stop because the inverter blocks the IGBT gating signals. If the inverter starts to run while the motor is freely rotating, first, the motor decelerates to a stop and restart. If set CON_49 [Speed search] to bit 1 from previous bit 2, operation begin by speed search function when fault is reset.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_59	RST Restart	Restart after fault reset	Yes No		No

⚠ CAUTION

Take caution for this function. When FUN_59 is set, motor runs immediately upon fault is reset.

6.4.10 Restart After Fault Reset

1) FUN_60 (Number of auto restart try)

2) FUN_61(Delay time before Auto restart)

This function prevents the permanet stop of the inverter due to the trip. The inverter automatically resets the fault and restarts and continues to run after the fault occurs if the number of automatic restart is set and the inveter operation is possible.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_60	Retry Number	Number of auto restart try	0 ~ 10		0
FUN_61	Retry Delay	Delay time before Auto restart	0.0 ~ 60.0	sec	1.0

In case the inverter trip occurs, the inverter restarts by **'The number of automatic restart'** at FUN_60. In case of the inverter trip, the inverter resets the fault automatically and waits for '**Delay time before automatic restart'** at FUN_61 and restarts. The inverter will not restart any more, blocks the IGBT gating signals and issues the trip message if the inverter trip occurs more than **'The number of automatic restart'** at FUN_60.

⚠ CAUTION

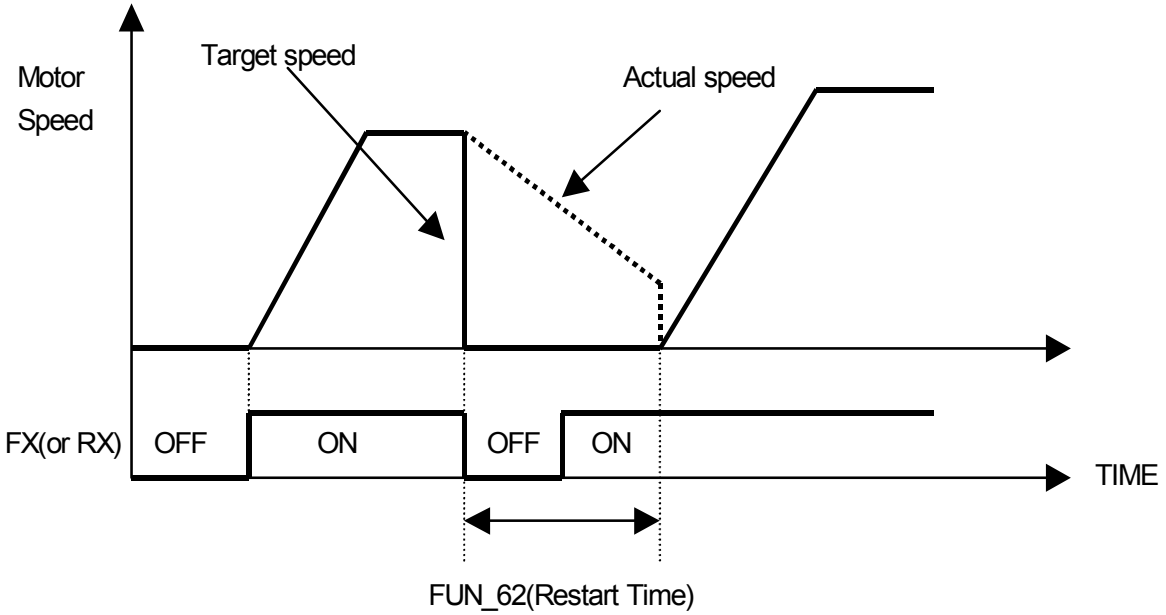
- Particular attention should be directed to this function as the inverter clears the fault automatically and motor suddenly restarts when trip occurs.
- Auto restart function is disabled when the following trips occur.
  - ① BX (Emergency stop)
  - ② Low Voltage
  - ③ Arm Short-U (V, W, DB)
  - ④ Fuse Open
  - ⑤ Ext Trip-B (External trip B)
  - ⑥ InvOver Heat (inverter overheated)
  - ⑦ MotOver Heat (Motor overheated)
  - ⑧ Encoder Err (Encoder error)
  - ⑨ Over Load (Overload trip)
  - ⑩ E-Thermal (Electronic thermal protection)
- If trip does not occur for 30 sec after restart, inverter adds the number of restart by one automatically and this cannot exceed setting value.

6.4.11 Wait time for restart upon stop

- Only active when FUN_03 is set to 'Free-run' and operating method is 'Terminal'.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_62	Restart Time	Wait time for Restart upon Stop	0.00 ~ 10.00	sec	0.00
FUN_03	Stop mode	Stop method	Decel **Free-run**		Decel

Even though restart command is input after stopping the operation, inverter does not run until FUN_62 setting time elapses.



6.4.12 Overspeed error detection

- Inverter detects error if motor rpm exceeds its limit. User can set the detection level and time of overspeed.

Code	LCD display	Description	Setting range	Unit	Factory setting
FUN_63	OverSpdLevel	Overspeed Detection Level	100.0 ~ 130.0	%	120.0
FUN_64	OverSpd Time	Overspeed Detection Time	0.00 ~ 2.00	sec	0.00

- FUN_63 is based on 100% of FUN_04(Max Speed).
- When motor speed exceeds FUN_63 (Overspeed Detection Level) and FUN_64(Overspeed Detection Time) elapses, overspeed error detection is activated.
- If FUN_64 is set to 0.00(sec) and motor rpm exceeds FUN_63, inverter immediately detects overspeed error.

6.4.13 Battery Operation (* For additional details, request for user manuals)

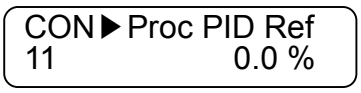
Code	Loader display	Description	Setting range	Unit	Factory Setting
FUN_65	Batt. Speed	Battery operation speed	2.5 ~ 200	rpm	50
FUN_66	Batt. Voltage	Battery input voltage	12 ~ PAR18	V	48

6.5 Control group (CON_[][])

6.5.1 Jump code (CON_00)

Jumping directly to any parameter code can be accomplished using CON_00 [Jump code].

Press [PROG] key first and set 11 using [▲(Up)], [▼(Down)], [SHITF/ESC] and press [ENT] key to jump to CON_11. If the desired code cannot be accessed or void, it automatically jumps to closest code.



After jumping, it is available to jump to other codes using [▲(Up)], [▼(Down)].

6.5.2 Control mode select (CON_01)

In the motor control mode, there are **speed** and **torque** control modes based on the vector control. The speed sensor such as the pulse encoder is required if speed control (‘**Speed**’) and torque control (‘**Torque**’) are to be used.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_01	Control Mode	Control mode selection	Speed Torque		Speed

6.5.3 Application mode (CON_02)

General vector mode or Elevator mode can be selected in CON_02.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_02	Application	Application mode setting	General Vect Elevator		General Vect

※ Only displayed with Elevator option board (EL_IO) installed.

6.5.4 Automatic Speed Regulator: ASR

1) CON_05(ASR LPF Time Constant 1)

2) CON_08(ASR LPF Time Constant 2)

One of the two PI gains of ASR can be selected depending on the status of the multi-function terminal input set as the ‘ASR Gain Selection’. That is, if the multi-function terminal input is ‘Off’, 1-numbered gain and LPF time constant is selected. On the contrary, if this input is ‘On’, 2-numbered gain and LPF time constant are selected.

(Example) Programming P4 as ASR PI Gain

Code	LCD display	Description	Setting range	Unit	Set value
I/O_04	P4 define	Multi-function input terminal P4 definition			ASR Gain Sel

The two sets of Lowpass Filter are as follow:

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_05	ASR LPF1	ASR LPF time constant 1	0 ~ 20000	ms	0
CON_08	ASR LPF2	ASR LPF time constant 2	0 ~ 20000	ms	0

3) CON_03 ~ 04(ASR PI Gain 1)

4) CON_06 ~ 07(ASR PI Gain 2)

One of 2 sets of PI gain can be selected by "ASR Gain Sel" in Multi-function input terminal.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_03	ASR P Gain1	ASR P Gain 1	0.0 ~ 200.0	%	50.0
CON_04	ASR I Gain1	ASR I Gain 1	0 ~ 50000	ms	300
CON_06	ASR P Gain2	ASR P Gain 2	0.0 ~ 200.0	%	5.0
CON_07	ASR I Gain2	ASR I Gain 2	0 ~ 50000	ms	3000

5) CON_09 (Ramp time for ASR gain Transfer)

6) CON_10 (Motor Speed at the time of ASR Gain Transfer)

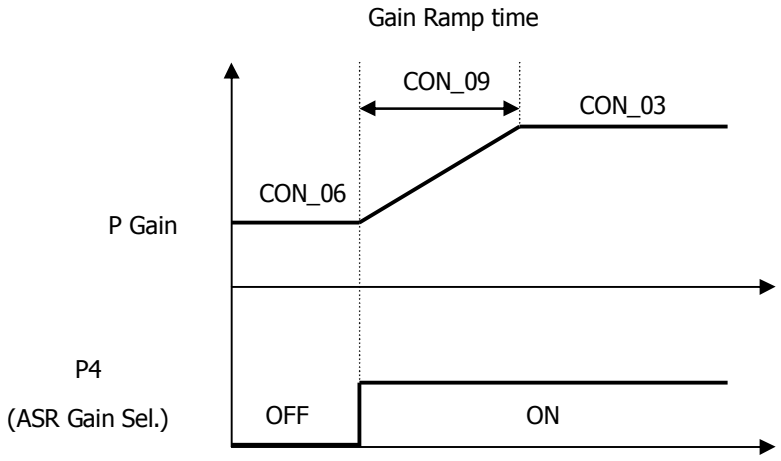
ASR PI controller can be transferred to P controller depending on the status of the multi-function terminal input set as '**ASR P/PI transfer**'.

(Example) When P6 is set to ASR P/PI transfer:

Code	LCD display	Description	Setting range	Unit	Factory setting
I/O_06	P6 define	Multi-function input terminal P6 definition			ASR P/PI Sel

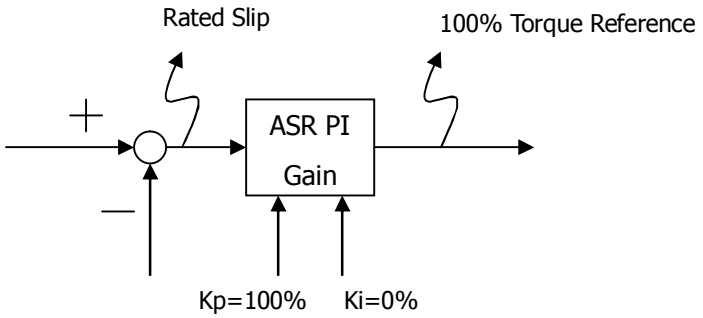
To avoid the shock to the control system due to the rapid change P and I gain in case of ASR gain transfer, if the multi-function terminal input set to '**ASR Gain Sel**' is 'On', the transferred P gain changes gradually for the time set at CON_09. P gain 2 is transferred to P gain 1 at the higher speed than the value set at CON_10. This happens when the multi-function terminal input set to 'ASR Gain Sel' is 'On', not 'Off"

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_09	ASR Ramp	Ramp time for ASR gain switch-over	10 ~ 10000	ms	1000
CON_10	ASR TarSpd	Target Speed after ASR gain switch-over	0.0 ~ 3600.0	rpm	0.0



- **How to set the P and I gain of the ASR (Automatic Speed Regulator)**

The P gain(%) of ASR becomes equal to the torque reference(%) when the speed difference between the speed command and the real speed fed back to the ASR is identical to the rated slip. The I gain is the time to be taken to accumulate the torque reference from 0 to 100%. That is, The output of ASR becomes equal to the 100% of the torque reference when P gain is set to 100% and the speed difference is equal to the rated slip. Speed response characteristic may be better, but the control system may be unstable when P gain is increased or I gain is decreased. On the contrary, Speed response characteristic may be degraded if P gain is decreased or I gain is increased.



6.5.5 Process PID Control

Process PID controller is added ouside the speed control loop and a wide variety of process control can be implemented without using the stand-alone PID controller outside the speed control loop or PLC. '**Process PID Enb**' at CON_20 determines whether Process PID controller is enabled or not. '**Process PID Enb**' at CON_20 can be set as follows.

(Example) programming CON_20 "Process PID Enable/Disable"

CON_20 (Proc PID Enb)	RUN/STOP command	
	ON	OFF
Disable	Disable	Disable
Enable	**Enable**	Disable
Terminal	Depending on terminal definition	Disable

If '**Process PID Enb**' at CON_20 is set to 'Terminal', Process PID controller is enabled using 'Proc PID Dis', which is the one of the functions of the multi-function terminal input. To avoid the saturation of the process PID controller, process PI controller is enabled only when the multi-function terminal is set to 'Proc PID Dis' and the terminal is 'OFF' and the run command is 'ON'.

Multi-function input terminal defined as "Proc PID Dis"		RUN/STOP command	
Input signal		ON	OFF
Defined	ON	Disable	Disable
	OFF	**Enable**	Disable
Not defined		Disable	Disable

The command to Process PID controller uses the digital value (CON_10) set using the keypad or the analog value ('Process PID F/B') which is the one of the multi-function analog output. The setting range of Process PID digital input at CON_11 is from –100 to100% and the setting range of analog input command is from –10 to 10V.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_11	Proc PID Ref	Process PID Reference Source (Keypad)	-100.0 ~ 100.0	%	0.0

The definition of P gain and I gain in the Process PID controller is as follows. If P gain is 100% and I gain is 0% and the input error of the Process PID controller (CON_11 + Proc PID Ref - Proc PID F/B) is 100%, the output of Process PID controller is 100%. If I gain is 10% and P gain is 0 and the input error is 100%, it takes the output of the Process PI controller 1 second to be accumulated up to 100%. The higher I gain becomes, the faster the response becomes reducing the accumulated time. Finally, the output of Process PID controller (%) multiplied by the maximum motor speed (FUN_04) is added to the total speed command.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_13	Proc PID Kp	Process PID P gain	0.0 ~ 999.9	%	0.0
CON_14	Proc PID Ki	Process PID I gain	0.0 ~ 100.0	%	0.0
CON_15	Proc PID Kd	Process PID D gain	0.0 ~ 100.0	%	0.0

To prevent the Process PID controller from being saturated by the malfunction of the Process PID controller, the output of the Process PID controller can be limited to the positive or negative value, separately from the main speed controller.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_16	Proc Pos Lmt	Process PID positive limit	-100 ~ 100	%	100
CON_17	Proc Neg Lmt	Process PID negative limit	-100 ~ 100	%	100

Low pass filter at the output of the Process PID controller can be used. In this case, filter output is multplied by the output gain and fed to the speed command.

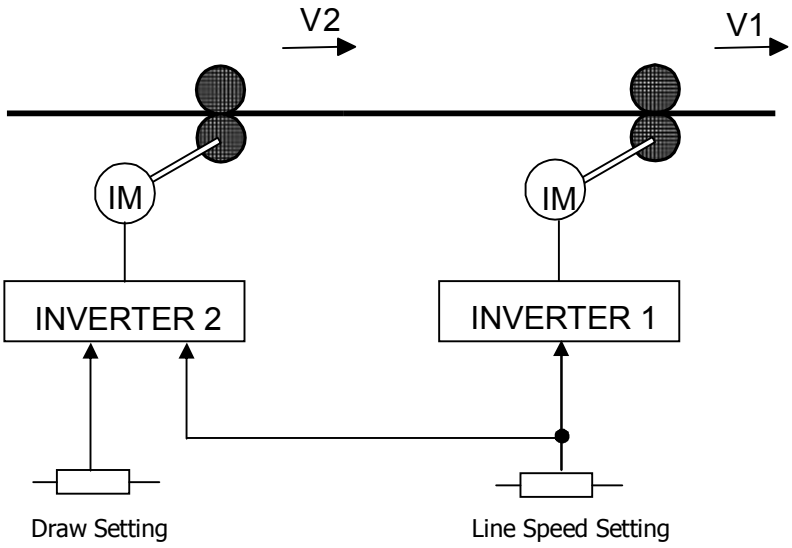
Code	LCD display	Description	Setting range	Unit	Factory setting
CON_18	Proc Out LPF	Process PID output LPF time constant	0 ~ 500	ms	0
CON_19	Proc OutGain	Process PID output gain	-250.0 ~ 250.0	%	0.0

If the output error of Process PID exists at stopping, it keeps current motor speed during "PIDHoldTime" and then free-runs to stop. If output error is "0", motor is stopped regardless of "PIDHoldTime" setting.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_21	PIDHoldTime	Process PID Hold Time	0 ~ 10000	ms	0

6.5.6 Draw Control

Draw control is a sort of Open Loop tension control. Draw is the ratio of speed difference between one roll and the other. Tension is generated as in the following equation.



$$T = E \times S \times \frac{V1 - V2}{V2} = E \times S \times D$$

Where,

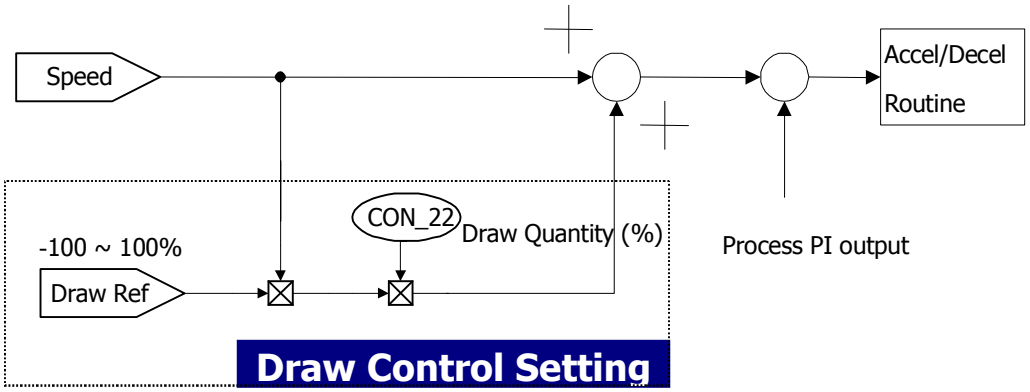
V1, V2: Transfer speed of each roll (m/min)

T: Tension (kg)

E: Elasticity coefficient of processed material (kg/mm2)

S: Sectional area of processed material (mm2)

Draw reference multiplied by draw quantity set at CON_22 is added up to the speed command and the sum acts as the final speed command.

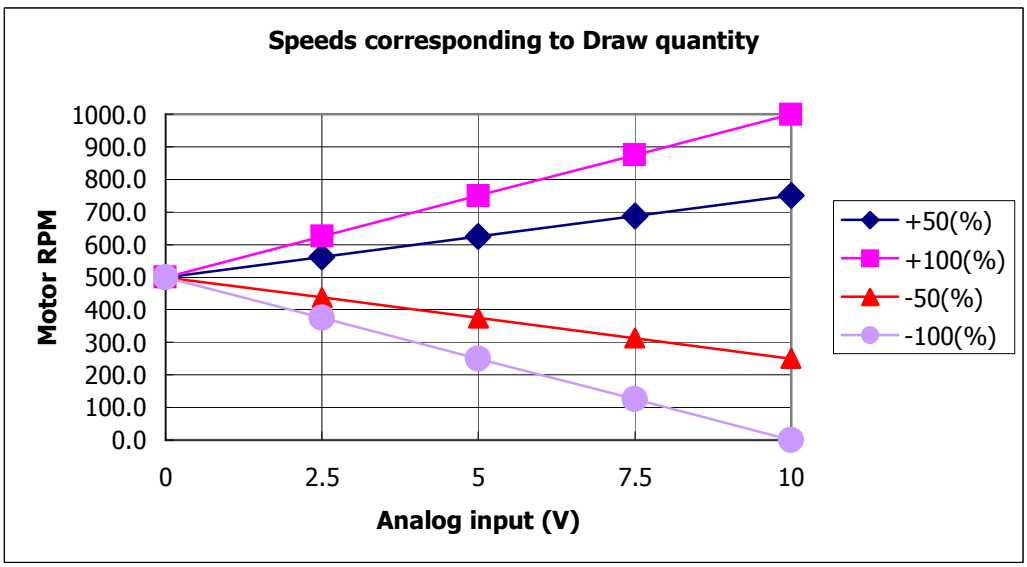


One of the multi-function analog input is set to the draw command ranging from –100% to 100% and the speed command multiplied by Draw quantity is added up to the speed command (Speed Ref) to obtain the final speed command.

(Example) Programming Ai2 as the Draw Reference

Code	LCD display	Description	Setting range	Unit	Factory setting
I/O_16	Ai2 Define	Multi-function analog input Ai2 definition			Draw Ref
FUN_02	Spd Ref Sel	Speed reference selection			Keypad1
FUN_12	Speed 0	Multi-speed 0	0.0 ~ 3600.0	rpm	500.0
CON_22	Draw %	Draw Quantity	-100.0 ~ 100.0	%	

☞ **Run speed=Spd Ref value+(Spd Ref value*[Draw quantity(%)/100(%)]*[Analog input(V)/ 10(V)])**

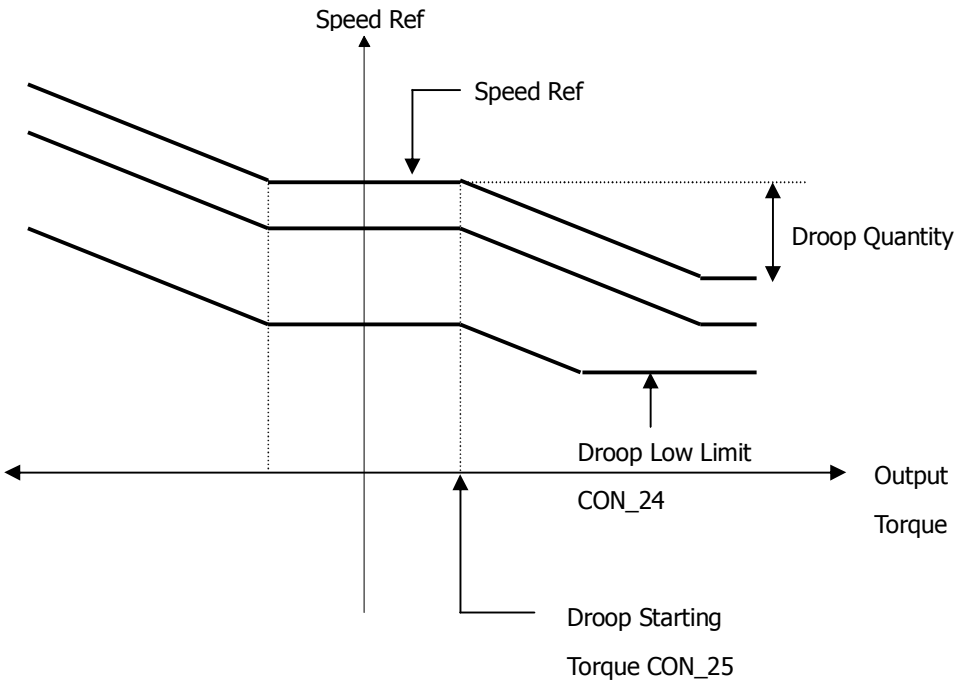


6.5.7 Droop Control

Droop control uses the drooping characteristic of the speed with respect to the torque reference. This control method is used to prevent the saturation of the speed controller due to the difference between the speed reference and the real speed when the inverter is used for load balancing of the multiple motors and helper roll, which is the auxiliary device of the main roll. As shown in the figure below, the speed command is adjusted properly depending on the torque reference.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_23	Droop %	Droop Quantity	0.0 ~ 100.0	%	0.0
CON_24	Droop MinSpd	Low speed limit of Droop control	0.0 ~ 3600.0	rpm	0.0
CON_25	Droop MinTrq	Starting torque of Droop control %	0.0 ~ 100.0	%	0.0

If the torque reference (the output of the speed controller) becomes higher than the set Droop start torque, it reduces the speed command and consequently, decreasing the torque reference. Speed command in the Droop control is as in the following equation.



((Droop Control Calculation))

- **When Torque Ref is Positive:**

Droop Ref speed = (Torque Ref [%] – Droop Starting Torque[%]) * Droop Quantity[%]

The result value becomes positive. Therefore, final speed ref value decreases and it should be,

(Speed Ref – Droop Ref speed) > Droop low limit speed

Droop Ref speed < (Speed Ref – Droop low limit speed)

Therefore, positive limit is "**Speed Ref – Droop Low Limit Speed"**.

- **When Torque Ref is Negative:**

Droop Ref speed = –(Torque Ref [%] – Droop Starting Torque[%]) * Droop Quantity [%]

The result value becomes negative. Therefore, final speed ref value increases and it should be,

(Speed Ref – Droop Ref speed) < Max Motor speed

Droop Ref speed > –(Max Motor speed – Speed Ref)

Therefore, negative limit is "**Max Motor speed – Speed Ref**".

6.5.8 Torque Control

One mode among the speed control mode and torque control mode can be set at CON_01('Control Mode'). The default is the speed control mode. Control mode can be selected using the multi-function terminal input set to 'Speed/Torque control selection'. This method has a priority over the one by CON_01.

(Setting example) Programming P6 as Torque control

Code	LCD display	Description	Setting range	Unit	Setting
I/O_06	P6 define	Multi-function input terminal P6 definition			Spd/Trq sel
CON_01	Control Mode	Control mode setting	Speed Torque		Torque

1) CON_26 (Torque Reference Source Selection)

In the speed control mode, the output of the ASR acts as the torque reference. In the torque control mode, the torque reference is set by the analog input signal defined as 'Trq Ref Src' on the control circuit terminal or by the option board and the polarity is reversed if the direction of the speed command is changed. If the analog input is used as the torque reference, the analog input ranging from –10V to 10V is converted to the percentage of the rated torque (-100~100%) to obtain the torque reference, which can set from –250% to 250% by the settings of Gain and Bias.

CON_27 "Torque Ref" defines torque ref. value when torque source is set to Keypad.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_26	Trq Ref Src	Torque reference source selection	None/Analog Keypad/Option		None
CON_27	Torque Ref	Torque Ref (keypad)	-180.0 ~180.0	%	0.0

2) CON_32 (Torque Bias Source Select)

The Torque Bias is the feedforward compensation which is added to the Torque Reference. The source of Torque Bias could be selected by the Keypad (CON_32) as one of Multi Function Analog Input and the Option. The Torque Bias is enabled by MFi programmed as UseTrq Bias. The MFI should be ON for enabling the Torque Bias.

The Analog Input [-10~+10V] is converted to [-100~+100%] and this could be expanded up to [-250~+250%] with gain and bias.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_32	Trq Bias Src	Torque Bias source selection	None Analog Keypad Option		None
CON_33	Trq Bias	Torque Bias quantity	-150.0 ~ 150.0	%	0.0

3) CON_35 (Torque Balance)

In the lift use, the load torque balance can be adjusted to obtain a good riding comfort at start-up using the load cell, which is a sort of an weighing devices installed at the bottom of the lift. CON_35 is adjusted to show 50% after the car weight becomes equal to the weight of counter-weight.

The value displayed when pressing [PROG] key on the keypad is the loadcell voltage input to the inverter. Therefore, adjust the percent using [▲(Up)] / [▼(Down)] to make it to be setpoint of actual load compensation.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_35	Trq Balance	Torque Balance quantity	0.0 ~ 100.0	%	50.0

4) Torque Bias Enable/Disable

Torque bias is enabled depending on the status of the multi-function terminal input set to 'Torque bias enable'. But, if 'Torque bias enable' is not set and CON_32 is set to 'Keypad', the torque bias command set at CON_32 by the keypad, is fed directly to the torque bias quantity regardless of the status of the terminal. Therefore, In order not to use the torque bias command set at CON_33, CON_32 should be set to 'None' or the multi-function terminal input should be set to 'Torque bias enable' and then the terminal should be left open.

(Example) Programming P5 as Torque Bias EnableTorque Bias

Code	LCD display	Description	Setting range	Unit	Factory setting
I/O_05	P5 define	Multi-function input terminal P5 definition			Use Trq Bias

5) CON_34(Torque Bias F/F)

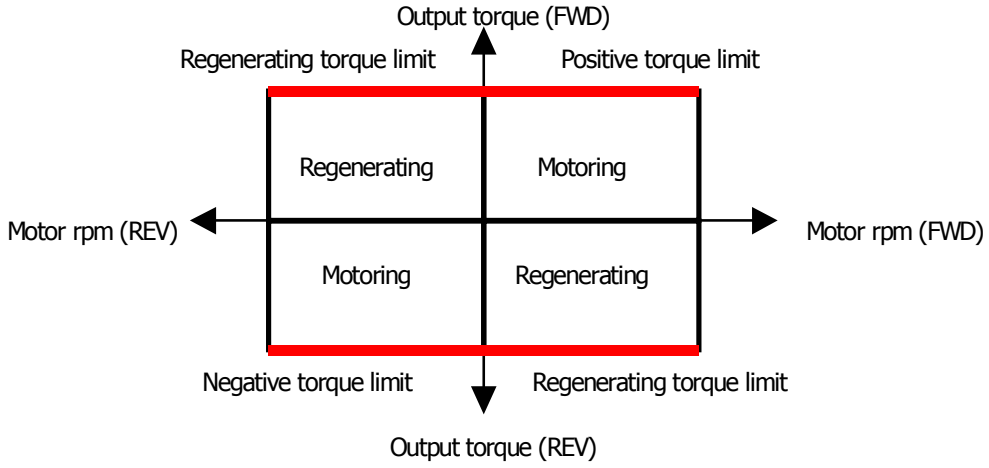
This is the torque bias quantity to compensate for the friction loss, which varies with the rotational direction of the motor and added up to the torque bias quantity.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_34	Trq Bias FF	Torque compensation for Friction loss	-150.0 ~ 150.0	%	0.0

6) CON_28 ~ 31 (Torque Limit Define, Torque Limit during FWD RUN /REV RUN/Regenerating)

The torque limit can be selected separately depending on the motor control mode such as forward rotation and reverse rotation and regeneration modes. In all modes, the limit values can be set by the function code, the multi-function terminal input and the option board, respectively.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_28	Trq Lmt Src	Torque Limit Source select			Kpd Kpd Kpd



Torque Limit

Torque Limit value is determined one of the 9 different combinations shown below depending on CON_28 setting.

CON_28 set value	Positive Torque Limit	Negative Torque Limit	Regenerating Torque Limit
Kpd Kpd Kpd	CON_29	CON_30	CON_31
Kpd Kpd Ax	CON_29	CON_30	Vx
Kpd Ax Kpd	CON_29	Vx	CON_31
Kpd Ax Ax	CON_29	Vx	Vx
Ax Kpd Kpd	Vx	CON_30	CON_31
Ax Kpd Ax	Vx	CON_30	Vx
Ax Ax Kpd	Vx	Vx	CON_31
Ax Ax Ax	Vx	Vx	Vx
Opt Opt Opt	Positive Torque Limit of Option	Negative Torque Limit of Option	Regenerating Torque Limit of Option

※ Vx marks the Torque Limit value defined in analog input terminal.

6.5.9 Speed Search

This is used to restart the motor during coasting without stopping the motor. CON_49 are required for this function. The proper values should be set depending on the inertia moment (GD^2) of the load and the torque of the motor in use.

Code	LCD display	Description	Setting range	Unit	Factory setting
CON_49	Speed Search	Speed search setting	1111		0100
FUN_58	Power-on Run	Power on Run selection	Yes No		No
FUN_59	RST Restart	Restart after fault reset	Yes No		No

CON_49 speed search setting is as follows.

Code	Set value				Description
	Bit4	Bit3	Bit2	Bit1	
CON_49				√	Speed search during Accelerating
			√		Speed search during a Fault Reset restarting
		√			Speed search during Instant Power Failure restarting.
	√				Speed search when FUN_58 Power ON starting is set to "Yes"

(1) Bit 1
0: The motor is normally accelerated without the speed search operation.
1: The speed search operation is enabled at the time of acceleration.
(Automatic restart and FUN_58[Power-on start enable] included)

(2) Bit 2
0: The motor is normally accelerated without the speed search operation after the trip occurs.
1: The speed search is enabled at the time of restart after the trip occurs.
(Automatic restart and FUN_59[Restart enable after fault reset] included)

(3) Bit 3
0: The motor stops when instantaneous power failure occurs. Run command should be turned ON again to restart the operation.
1: The speed search is enabled at the time of restart after the instantaneous power failure occurs.

(4) Bit 4
0: The motor is normally accelerated only when FUN_58 [Power-on start enable] is set to Yes.
1: The speed search operation is enabled at the time of acceleration when FUN_58 [Power-on start enable] is set to Yes.

6.6 User Group (USR_[][])

User group can be generated by collecting the frequently-used function codes, and it also can be created by using the existing function codes for the specific application.

6.6.1 Jump code (USR_00)

Jumping directly to any parameter code can be accomplished using USR_00.

(Example) Jumping to USR_03

Press [PROG] key first and set 3 using [▲(Up)], [▼(Down)], [SHITF/ESC] and press [ENT] key to jump to USR_03. If the desired code cannot be accessed or void, it automatically jumps to closest code.

After jumping, it is available to jump to other codes using [▲(Up)], [▼(Down)].

6.6.2 Macro

1) USR _01 (Macro Init)

The initialization of the code type can be defined according to the application the user defines.

Code	LCD display	Description	Setting range	Unit	Factory setting
USR_01	Macro Init	Use Macro Definition	User Define E/L		User Define

2) USR_02(User Save)

This enables the code type and the set value which the user define to be saved into the memory.

3) USR_03(User Recall)

This enables the code type and the set value saved by USR_02('User Save') to be recalled from the memory.

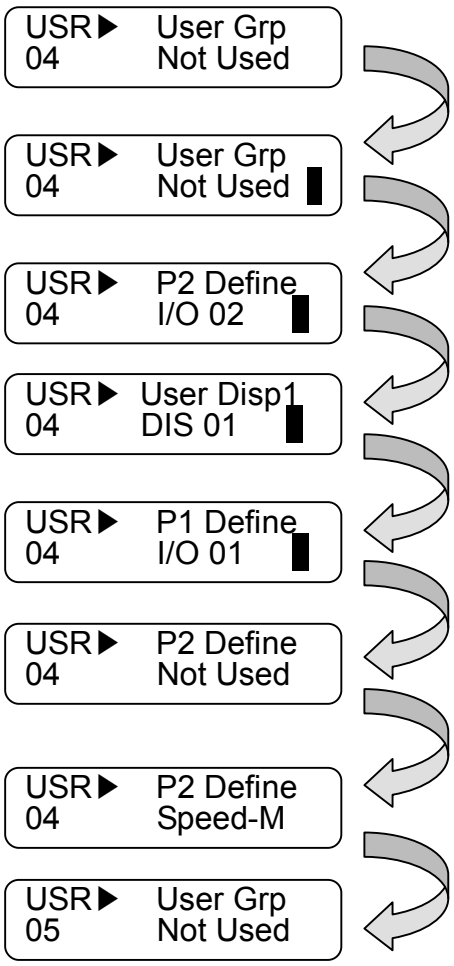
Code	LCD display	Description	Setting range	Unit	Factory setting
USR_02	User Save	User data save selection	No Yes		No
USR_03	User Recall	Recall saved user data	No Yes		No

6.6.3 User code define (USR_04 ~ 67)

It displays the type and value of the user code when [PROG] key is pressed. The code can be set in the same manner as the codes in the other group can be. If the code is 'User Grp' and its set value is 'Not Used', the code can be changed by pressing the [PROG] key once more.

Total 64 user group data can be programmed and saved. To make the unused data invisible, set it to "Not Used".

Changing User group codes



Press the [PROG] key once.

Pressing the [PROG] key once more and press the [SHIFT/ESC] key to change the group.
(DIS →I/O →PAR →FUN →CON →DIS)

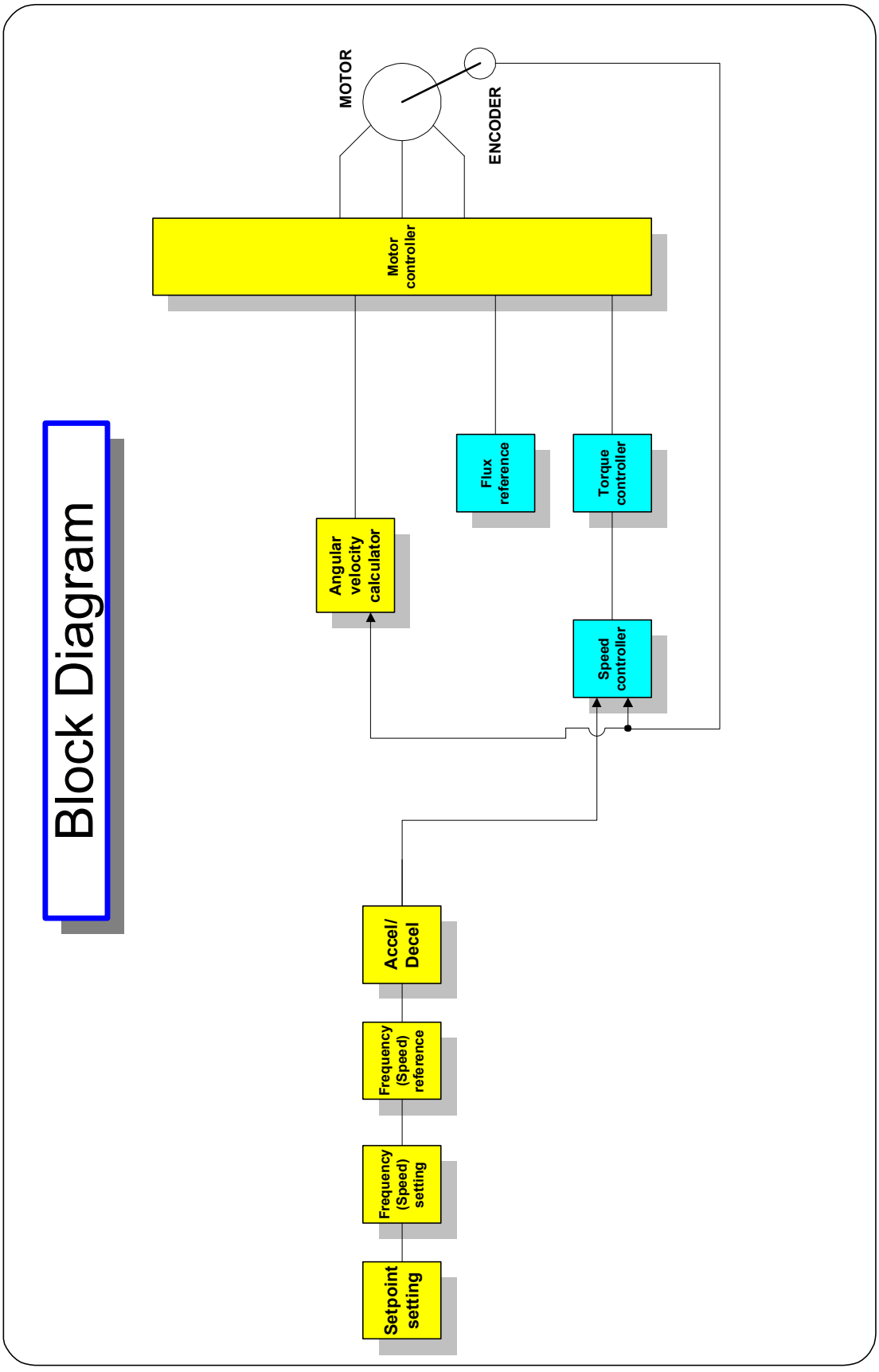
Press the [SHIFT/ESC] key once more and the group is changed.(DIS→I/O)

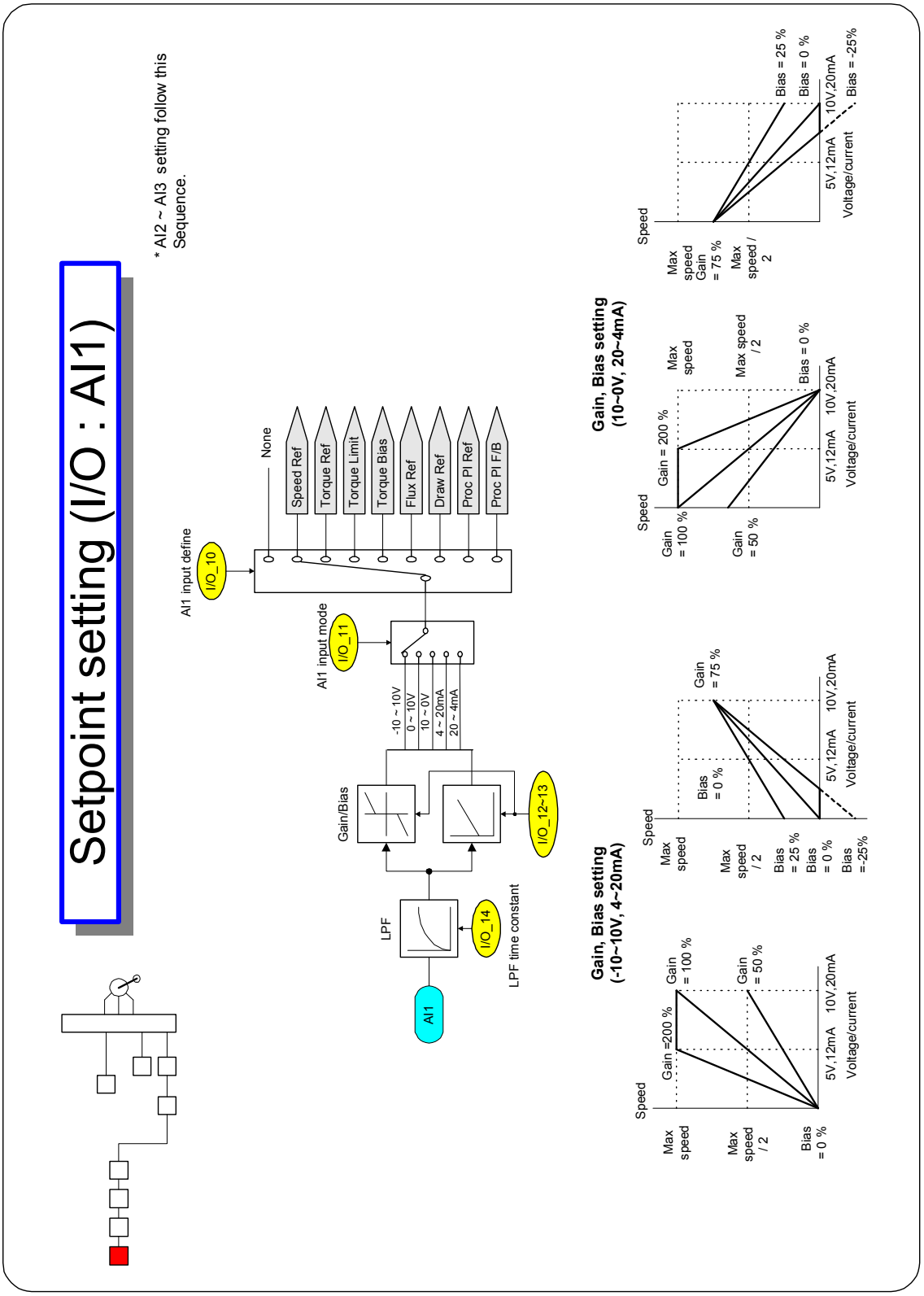
Pressing [▲(Up)] / [▼(Down)] key navigates the codes in the selected group.

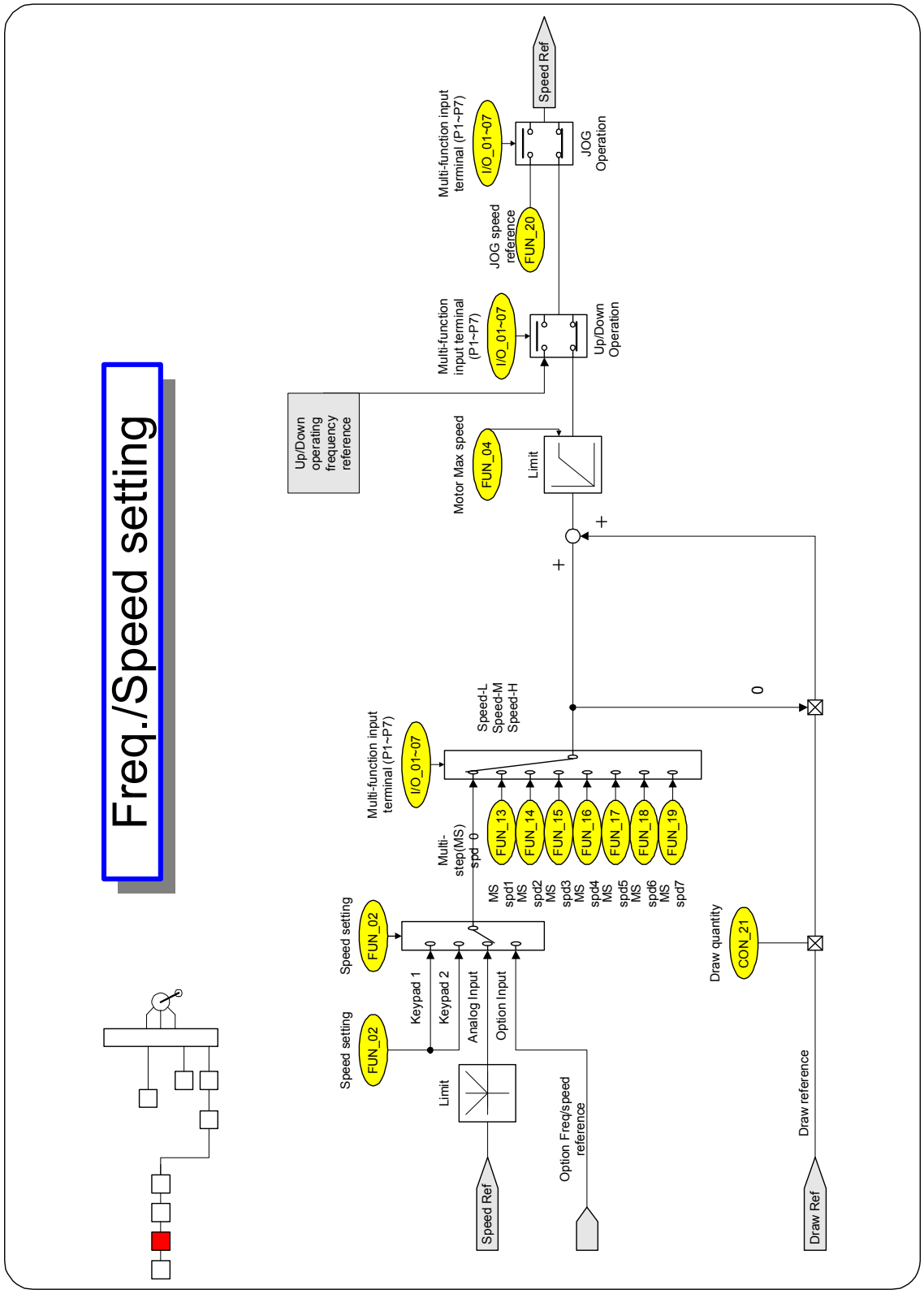
Pressing the [ENT] key changes the code.

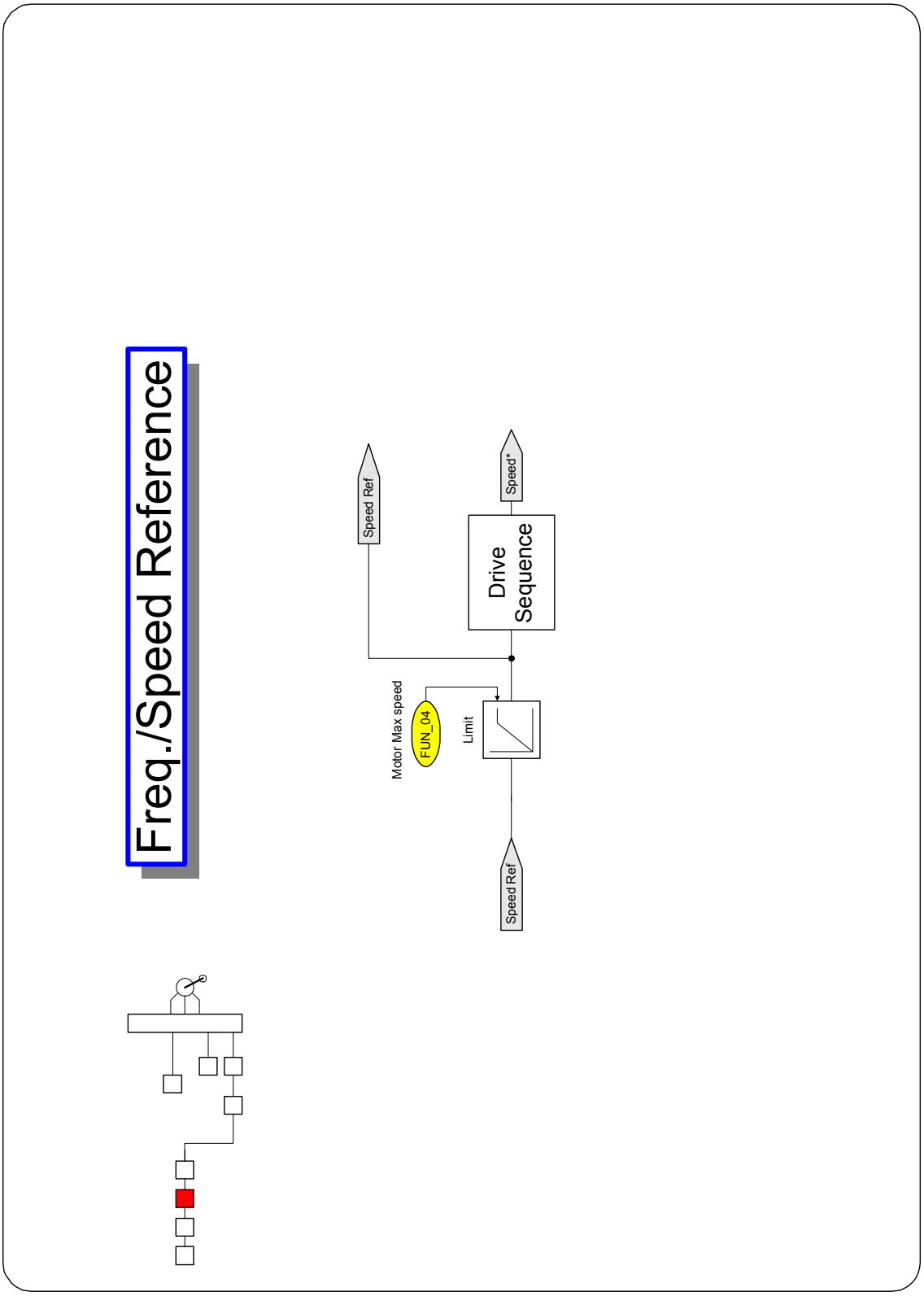
Press [PROG] key and change the value using [▲(Up)] / [▼(Down)] and then press [ENT] key to save the value into memory.

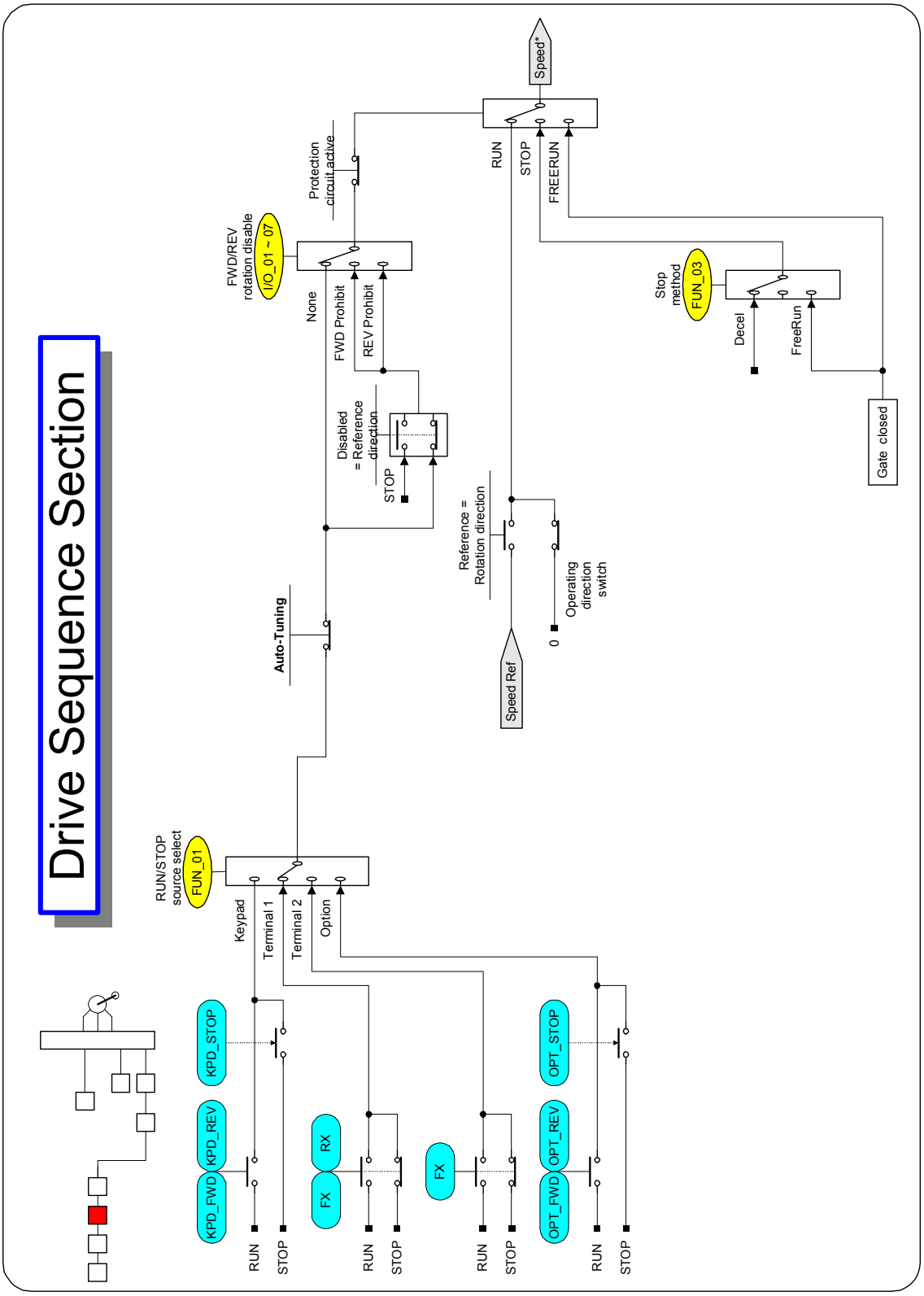
Use the [▲(Up)] key to move to other codes in the same group.

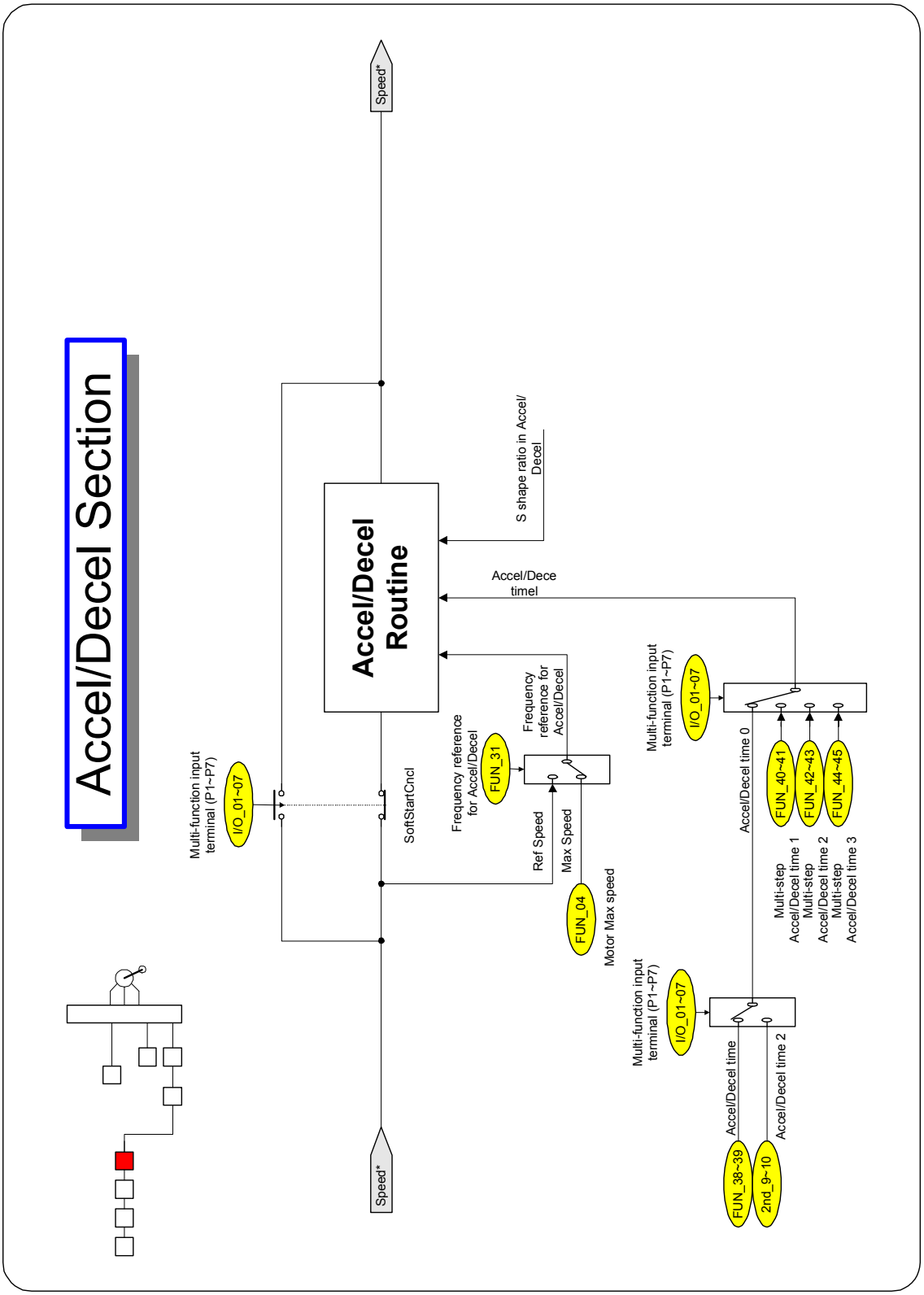

Block Diagram
MOTOR
ENCODER
Motor controller
Flux reference
Torque controller
Angular velocity calculator
Speed controller
Accel/ Decel
Frequency (Speed) reference
Frequency (Speed) setting
Setpoint setting

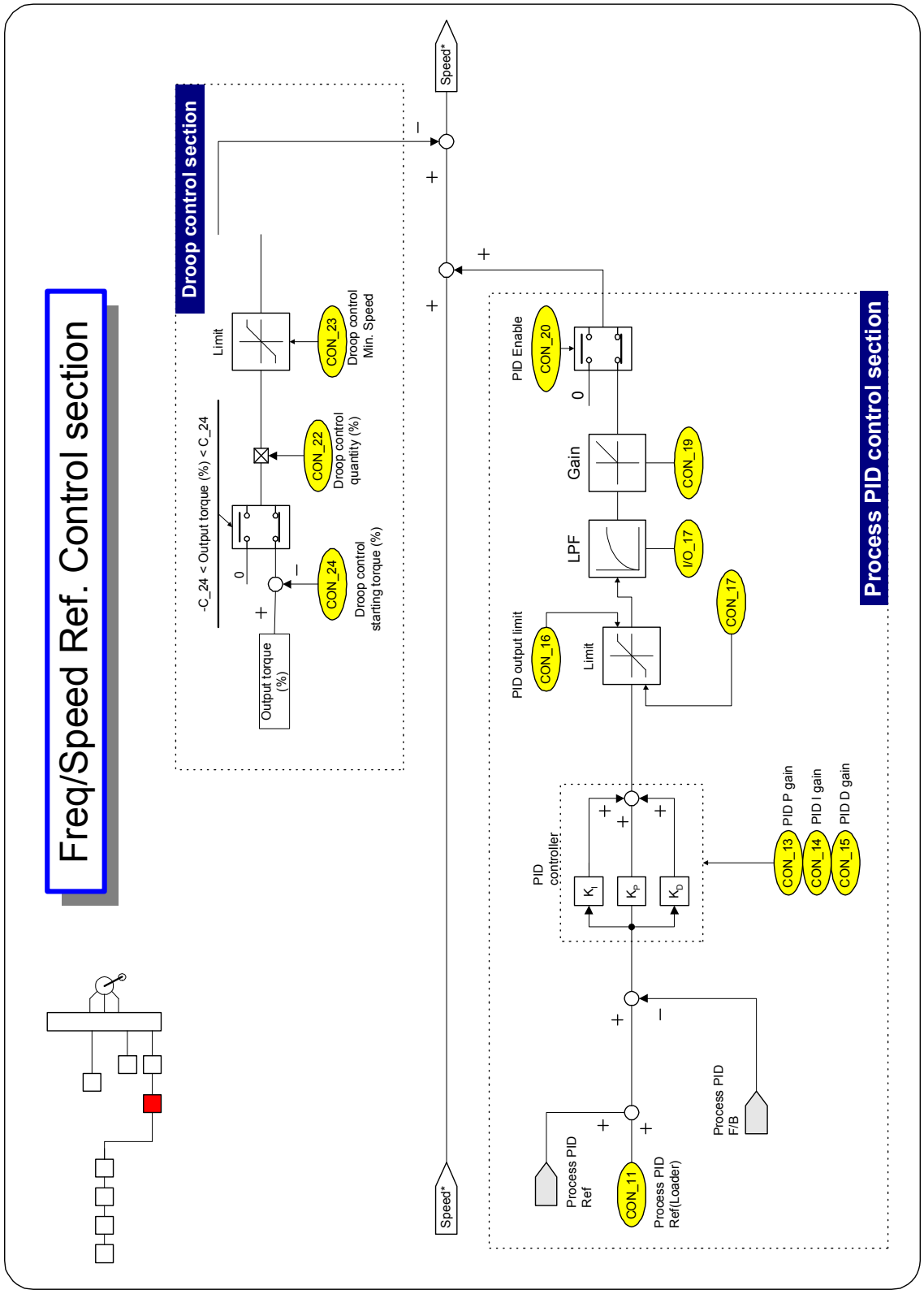

Setpoint setting (I/O : AI1)
* AI2 ~ AI3 setting follow this Sequence.
AI1 input define
I/O_10
None
Speed Ref
Torque Ref
Torque Limit
Torque Bias
Flux Ref
Draw Ref
Proc PI Ref
Proc PI F/B
AI1 input mode
I/O_11
-10 ~ 10V
0 ~ 10V
10 ~ 0V
4 ~ 20mA
20 ~ 4mA
Gain/Bias
I/O_12~13
LPF
I/O_14
LPF time constant
AI1
Gain, Bias setting (10~0V, 20~4mA)
Speed
Max speed
Gain = 200 %
Gain = 100 %
Max speed / 2
Gain = 50 %
Bias = 0 %
5V,12mA
10V,20mA
Voltage/current
Max speed Gain = 75 %
Max speed / 2
Bias = 25 %
Bias = 0 %
Bias = -25%
Gain, Bias setting (-10~10V, 4~20mA)
Gain =200 %
Gain = 100 %
Gain = 50 %
Bias = 0 %
Gain = 75 %
Bias = 25 %
Bias =-25%

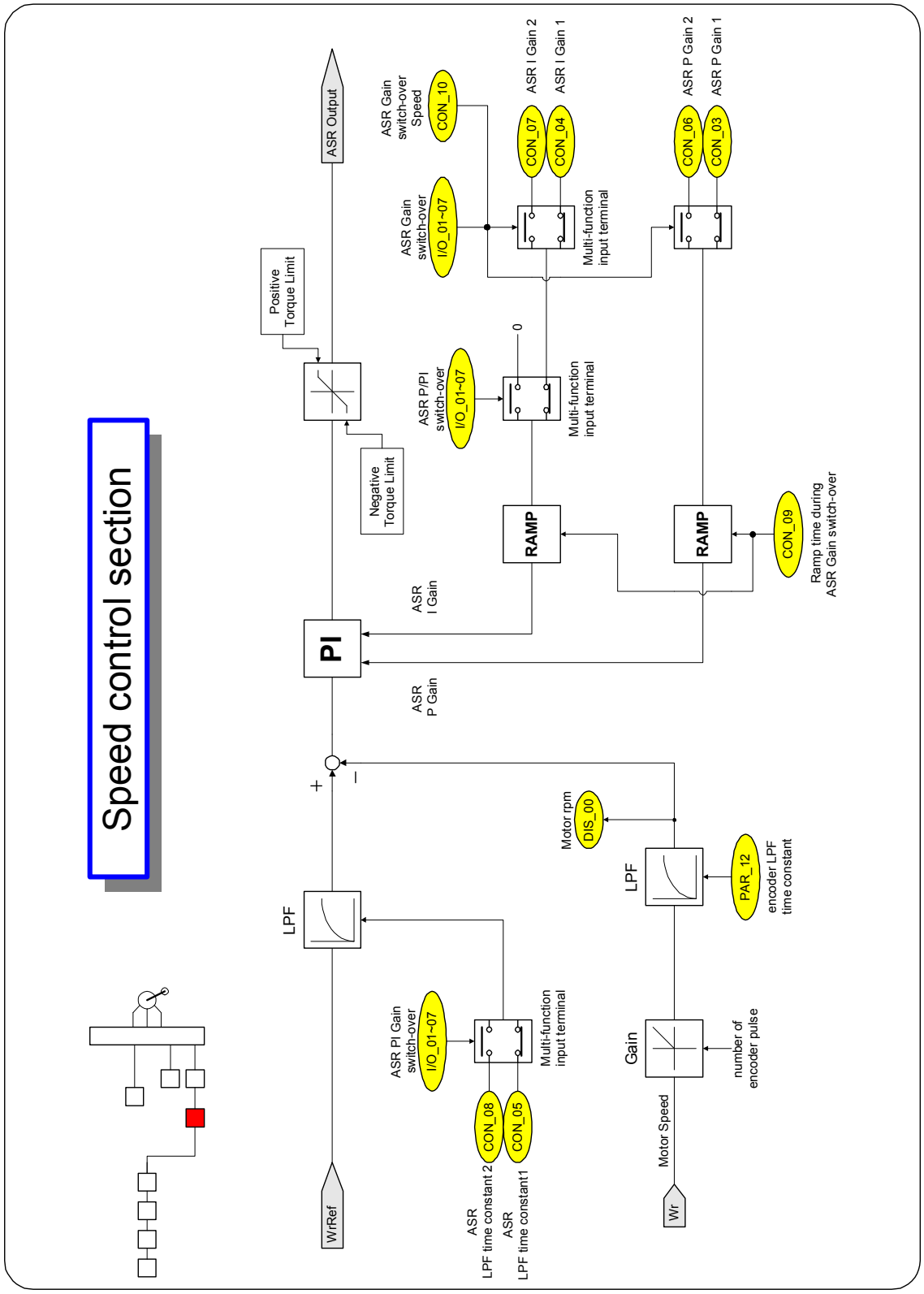

Freq./Speed setting
Speed Ref
Multi-function input terminal (P1~P7)
I/O_01~07
JOG Operation
JOG speed reference
FUN_20
Multi-function input terminal (P1~P7)
I/O_01~07
Up/Down Operation
Up/Down operating frequency reference
Motor Max speed
FUN_04
Limit
+
+
Speed-L
Speed-M
Speed-H
Multi-function input terminal (P1~P7)
I/O_01~07
Multi-step(MS) spd 0
FUN_13
FUN_14
FUN_15
FUN_16
FUN_17
FUN_18
FUN_19
MS spd1
MS spd2
MS spd3
MS spd4
MS spd5
MS spd6
MS spd7
0
Draw quantity
CON_21
Speed setting
FUN_02
Keypad 1
Keypad 2
Analog Input
Option Input
Speed setting
FUN_02
Limit
Speed Ref
Option Freq/speed reference
Draw reference
Draw Ref

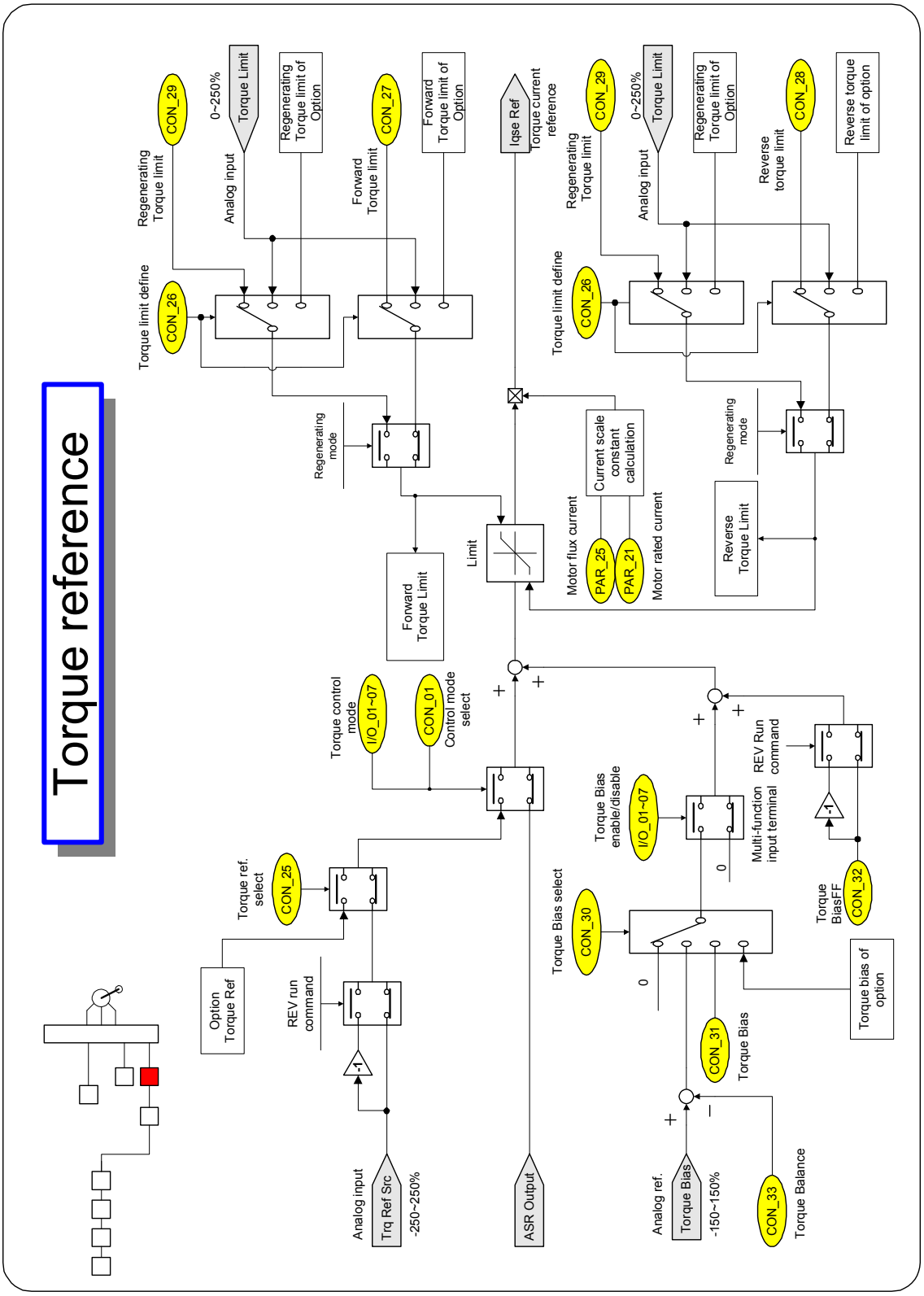

Freq./Speed Reference
Speed Ref
Speed*
Drive Sequence
Motor Max speed
FUN_04
Limit
Speed Ref

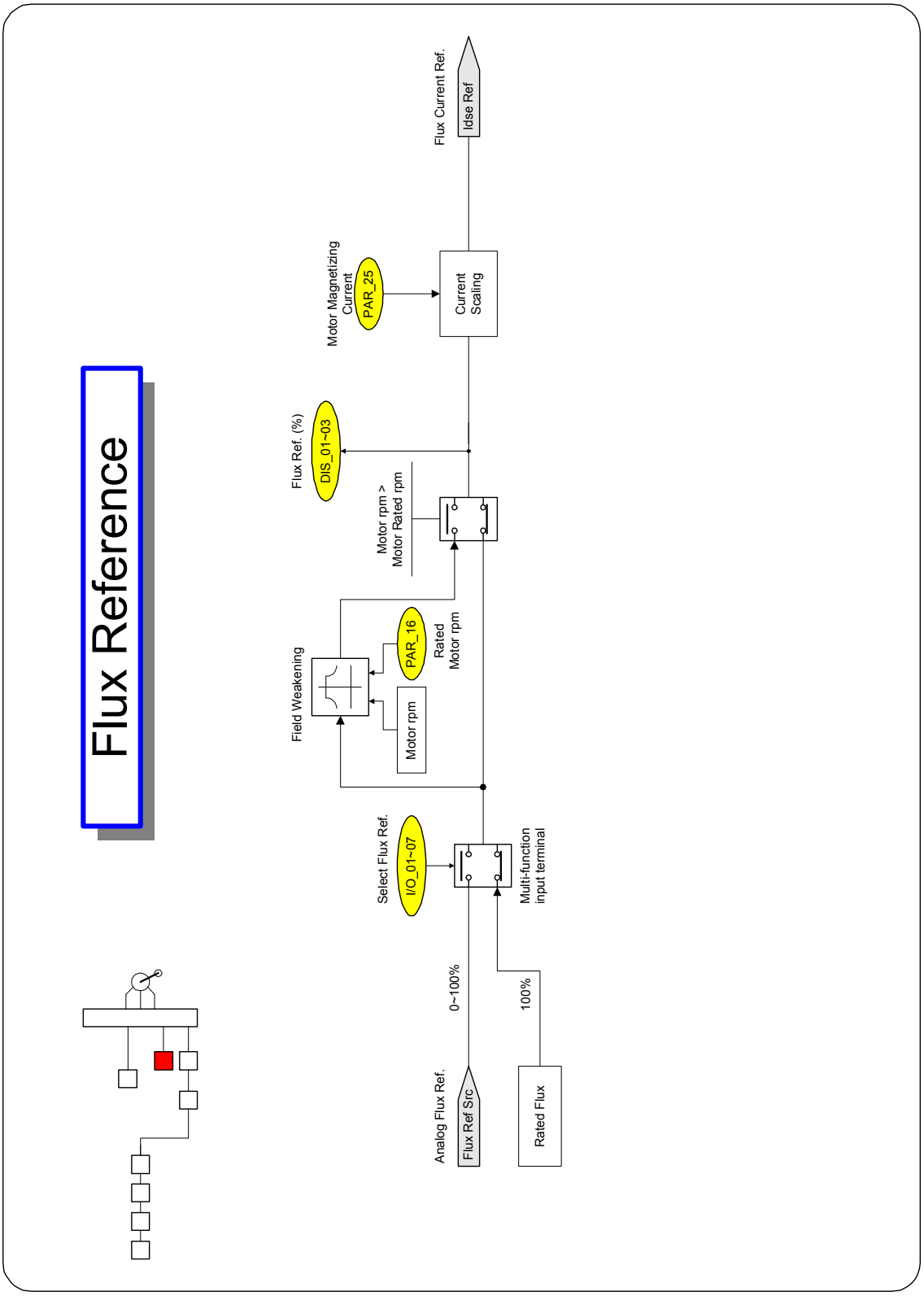

Drive Sequence Section
RUN/STOP source select
FUN_01
Keypad
Terminal 1
Terminal 2
Option
Auto-Tuning
FWD/REV rotation disable
I/O_01 ~ 07
None
FWD Prohibit
REV Prohibit
Protection circuit active
Disabled = Reference direction
STOP
Reference = Rotation direction
Speed Ref
0
Operating direction switch
Speed*
RUN
STOP
FREERUN
Stop method
FUN_03
Decel
FreeRun
Gate closed
KPD_FWD
KPD_REV
KPD_STOP
FX
RX
FX
OPT_FWD
OPT_REV
OPT_STOP
RUN
STOP

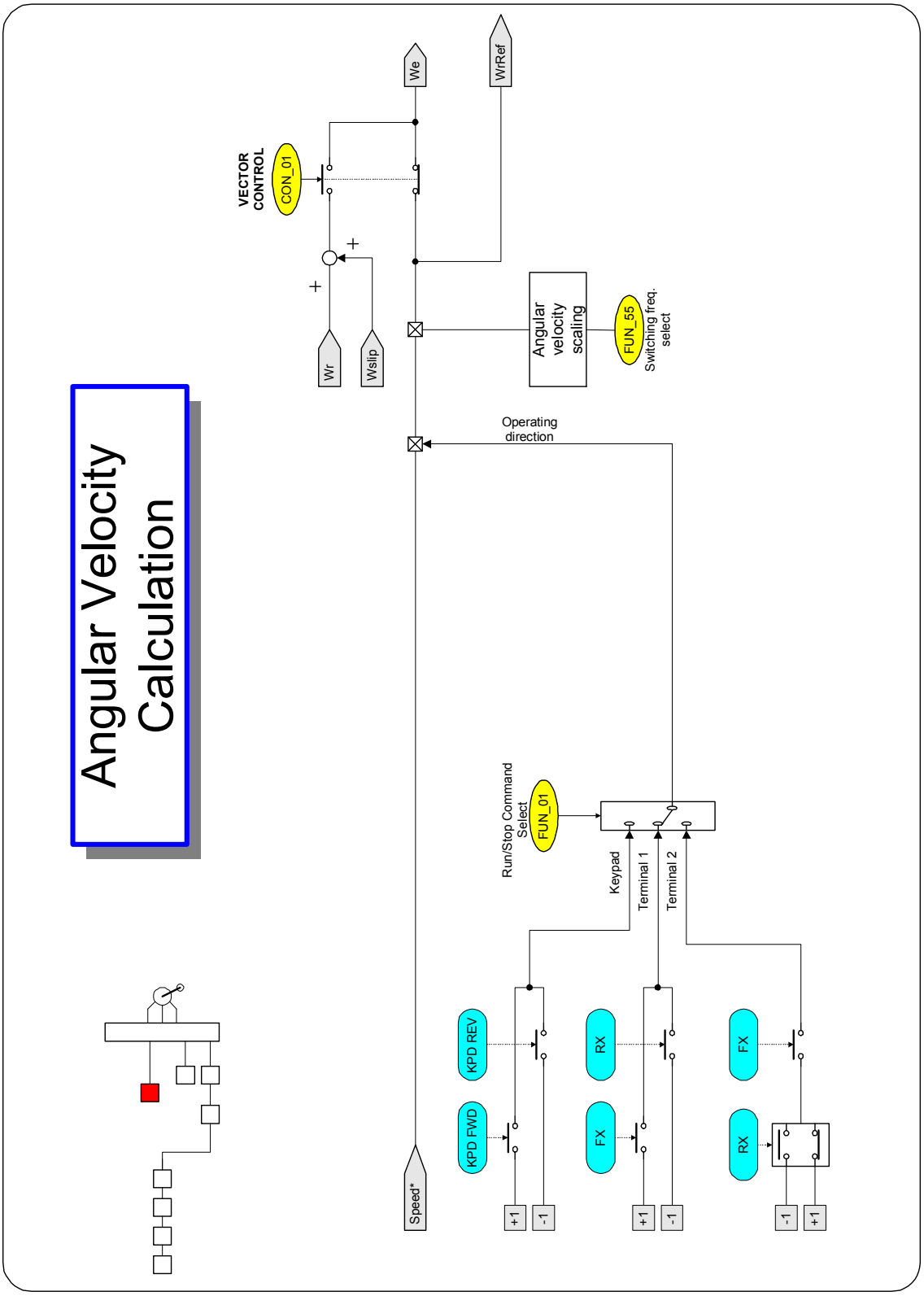

Accel/Decel Section
Speed*
Accel/Decel Routine
S shape ratio in Accel/ Decel
Accel/Dece time1
Multi-function input terminal (P1~P7)
I/O_01~07
SoftStartCncl
Frequency reference for Accel/Decel
FUN_31
Frequency reference for Accel/Decel
Ref Speed
Max Speed
FUN_04
Motor Max speed
Multi-function input terminal (P1~P7)
I/O_01~07
Accel/Decel time 0
FUN_40~41
FUN_42~43
FUN_44~45
Multi-step Accel/Decel time 1
Multi-step Accel/Decel time 2
Multi-step Accel/Decel time 3
Multi-function input terminal (P1~P7)
I/O_01~07
Accel/Decel time
Accel/Decel time 2
FUN_38~39
2nd_9~10
Speed*

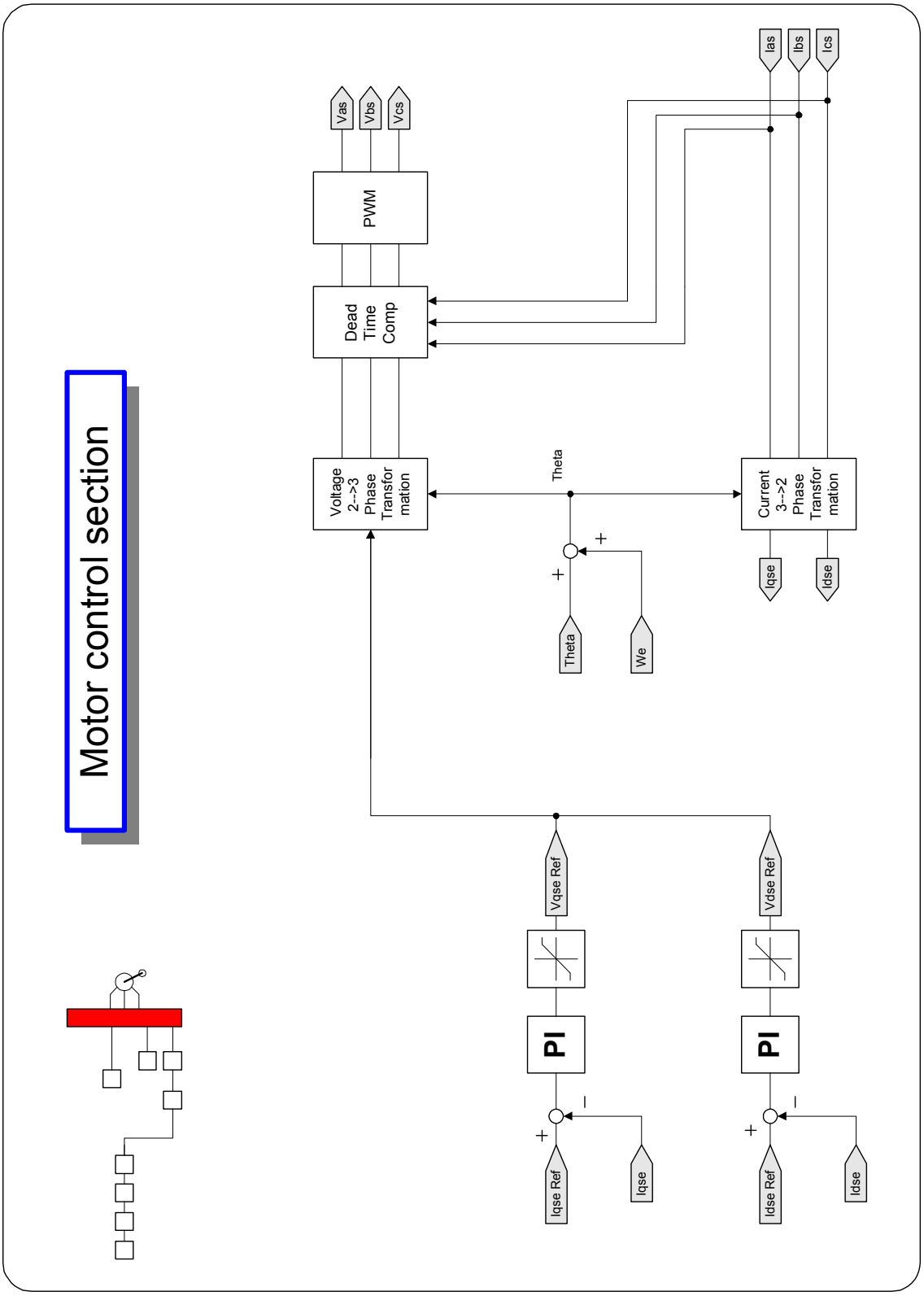

Freq/Speed Ref. Control section
Droop control section
Limit
CON_23
Droop control Min. Speed
-C_24 < Output torque (%) < C_24
CON_22
Droop control quantity (%)
0
CON_24
Droop control starting torque (%)
Output torque (%)
Speed*
Speed*
Process PID control section
PID Enable
CON_20
0
Gain
CON_19
LPF
I/O_17
PID output limit
CON_16
Limit
CON_17
PID controller
K_I
K_P
K_D
PID P gain
PID I gain
PID D gain
CON_13
CON_14
CON_15
Process PID Ref
CON_11
Process PID Ref(Loader)
Process PID F/B

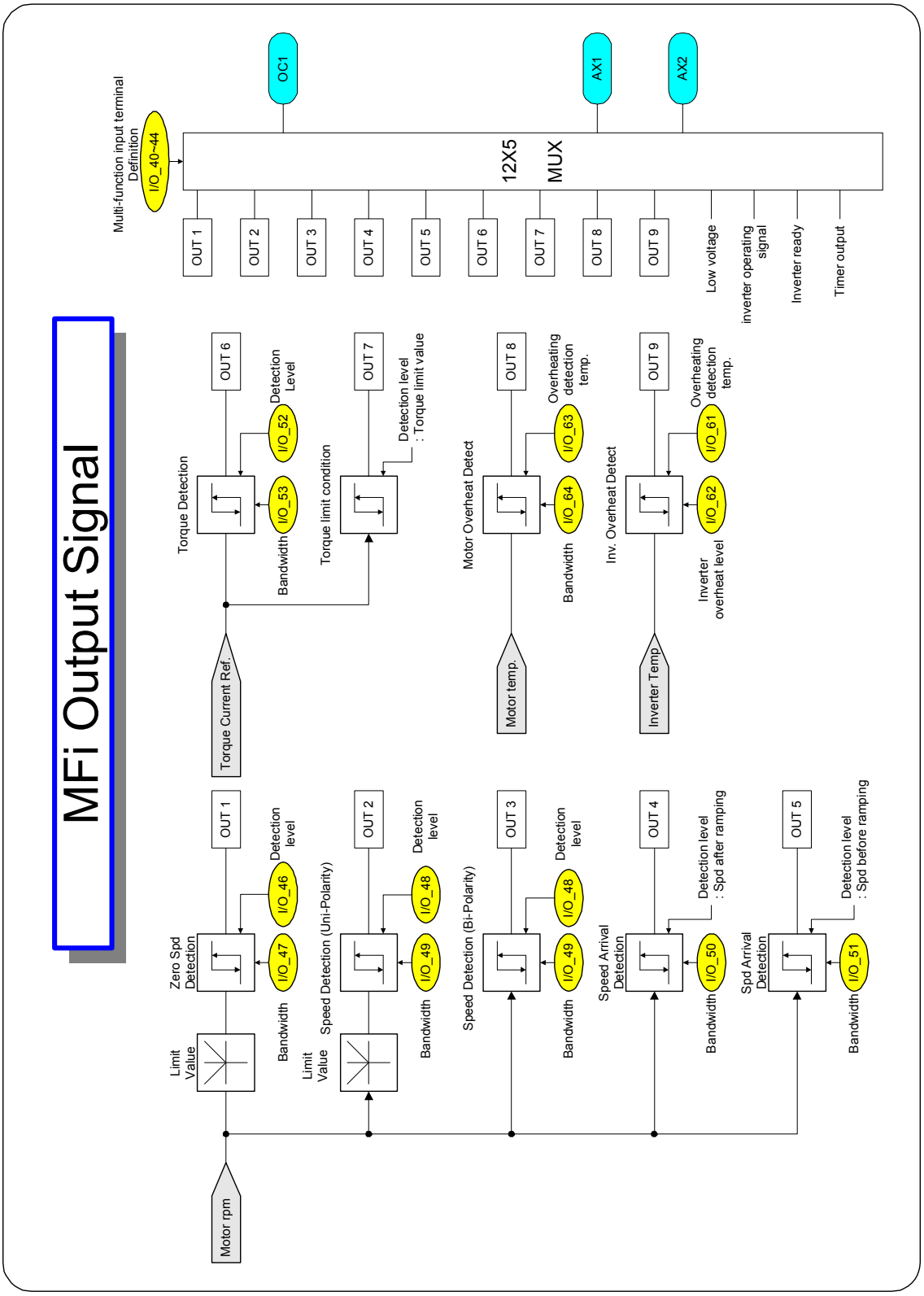

Speed control section
WrRef
LPF
ASR PI Gain switch-over
I/O_01~07
Multi-function input terminal
CON_08
CON_05
ASR LPF time constant 2
ASR LPF time constant1
+
−
ASR P Gain
PI
ASR I Gain
Positive Torque Limit
Negative Torque Limit
ASR Output
ASR P/PI switch-over
I/O_01~07
0
Multi-function input terminal
RAMP
RAMP
CON_09
Ramp time during ASR Gain switch-over
ASR Gain switch-over Speed
CON_10
ASR Gain switch-over
I/O_01~07
CON_07
CON_04
ASR I Gain 2
ASR I Gain 1
Multi-function input terminal
CON_06
CON_03
ASR P Gain 2
ASR P Gain 1
Motor rpm
DIS_00
LPF
PAR_12
encoder LPF time constant
Gain
number of encoder pulse
Motor Speed
Wr


Torque reference
Regenerating Torque limit
CON_29
Torque limit define
CON_26
Analog input
0~250%
Torque Limit
Regenerating Torque limit of Option
Forward Torque limit
CON_27
Forward Torque limit of Option
Iqse Ref
Torque current reference
Regenerating Torque limit
CON_29
Torque limit define
CON_26
Analog input
0~250%
Torque Limit
Regenerating Torque limit of Option
Reverse torque limit
CON_28
Reverse torque limit of option
Regenerating mode
Current scale constant calculation
Motor flux current
PAR_25
PAR_21
Motor rated current
Regenerating mode
Reverse Torque Limit
Limit
Forward Torque Limit
Torque control mode
I/O_01~07
CON_01
Control mode select
Torque ref. select
CON_25
Option Torque Ref
REV run command
-1
Analog input
Trq Ref Src
-250~250%
ASR Output
Torque Bias enable/disable
I/O_01~07
Multi-function input terminal
REV Run command
-1
Torque Bias select
CON_30
0
0
Torque BiasFF
CON_32
Torque bias of option
CON_31
Torque Bias
Analog ref.
Torque Bias
-150~150%
CON_33
Torque Balance


Flux Reference
Flux Current Ref.
Idse Ref
Motor Magnetizing Current
PAR_25
Current Scaling
Flux Ref. (%)
DIS_01~03
Motor rpm > Motor Rated rpm
Field Weakening
PAR_16
Rated Motor rpm
Motor rpm
Select Flux Ref.
I/O_01~07
Multi-function input terminal
0~100%
100%
Analog Flux Ref.
Flux Ref Src
Rated Flux


Angular Velocity Calculation
We
WrRef
VECTOR CONTROL
CON_01
+
+
Wr
Wslip
Angular velocity scaling
FUN_55
Switching freq. select
Operating direction
Run/Stop Command Select
FUN_01
Keypad
Terminal 1
Terminal 2
KPD REV
KPD FWD
RX
FX
FX
RX
+1
-1
+1
-1
-1
+1
Speed*


Motor control section
Vas
Vbs
Vcs
PWM
Dead Time Comp
Voltage 2-->3 Phase Transfor mation
Theta
Current 3-->2 Phase Transfor mation
Ias
Ibs
Ics
Iqse
Idse
Theta
We
Vqse Ref
Vdse Ref
PI
PI
Iqse Ref
Iqse
Idse Ref
Idse


MFi Output Signal
Multi-function input terminal Definition
I/O_40~44
OC1
AX1
AX2
12X5
MUX
OUT 1
OUT 2
OUT 3
OUT 4
OUT 5
OUT 6
OUT 7
OUT 8
OUT 9
Low voltage
inverter operating signal
Inverter ready
Timer output
Torque Detection
Detection Level
I/O_52
Bandwidth
I/O_53
Torque limit condition
Detection level : Torque limit value
Torque Current Ref.
Motor Overheat Detect
Overheating detection temp.
I/O_63
I/O_64
Motor temp.
Inv. Overheat Detect
I/O_61
I/O_62
Inverter overheat level
Inverter Temp
Zero Spd Detection
I/O_46
I/O_47
Limit Value
Speed Detection (Uni-Polarity)
I/O_48
I/O_49
Speed Detection (Bi-Polarity)
Speed Arrival Detection
Detection level : Spd after ramping
I/O_50
Spd Arrival Detection
Detection level : Spd before ramping
I/O_51
Motor rpm

8.1 Fault display

⚠ Caution
When a fault occurs, the inverter turns off its output and displays the fault status described below. In this case, the cause must be corrected before the fault can be cleared. If protective function keeps active, it could lead to reduction in product life and damage to the equipment.

Protective function	Keypad display	Description
Over Current	OC-U OC-V OC-W	The inverter turns off its output when the output current of the inverter flows more than 200% of the inverter rated current.
Ground Fault Protection	Ground Fault	The inverter turns off its output when a ground fault occurs and the ground fault current is more than the internal setting value of the inverter. Over current trip function may protect the inverter when a ground fault occurs due to a low ground fault resistance
Over voltage protection	Over Voltage	The inverter turns off its output if the DC voltage of the main circuit increases higher than the rated value (400V class: 820 V dc) when the motor decelerates or when regenerative energy flows back to the inverter due to a regenerative load. This fault can also occur due to a surge voltage generated at the power supply system.
Low Voltage Protection	Low Voltage	The inverter turns off its output if the DC voltage is below the detection level (400V class: 400Vdc) because insufficient torque or over heating of the motor can occurs when the input voltage of the inverter drops.
Overload (trip) Protection	Over Load	The inverter turns off its output if the output current of the inverter flows at 180% of the inverter rated current for more than the current limit time (S/W).
Inverter overheat	InvOver Heat	The inverter turns off its output if the heat sink over heats due to a damaged cooling fan or an alien substance in the cooling fan by detecting the temperature of the heat sink.
Inverter NTC Thermistor Open	InvThem OP	When inverter NTC Thermistor is open, inverter stops its output.
Motor overheat	MotOver Heat	When motor temp exceeds 150℃ , inverter stops its output to protect motor from overheated.
Motor NTC Thermistor Open	MotThem OP	When motor NTC Thermistor is open, inverter stops its output.
Electronic Thermal	E-Thermal	The internal electronic thermal of the inverter determines the over heating of the motor. If the motor is overloaded the inverter turns off the output. The inverter cannot protect the motor when driving a multi-pole motor or when driving multiple motors, so consider thermal relays or other thermal protective devices for each motor. Overload capacity: 180% for 1 min.
External fault B	Ext Trip-B	Use this function if the user needs to turn off the output by an external fault signal.
IGBT Short	Arm Short-U Arm Short-V Arm Short-W Arm Short-DB	Inverter output is stopped when IGBT Arm short or output short occurs.
Encoder error	Encoder Err	Displayed when Encoder signal fault occurs.

Protective function	Keypad display	Description
BX protection (Instant Cut Off)	BX	Used for the emergency stop of the inverter. The inverter instantly turns off the output when the BX terminal is turned ON, and returns to regular operation when the BX terminal is turned OFF. Take caution when using this function.
Motor overspeed	Over Speed	Displayed when motor rotates over 120% its rated speed.
Communication Error	COM Error CPU Error	This fault is displayed when the inverter cannot communicate with the keypad.
Magnetic detect error	Mag Det Err	Displayed when there are problem with initial magnetic detection of Permanent magnet motor.
Speed drift error	Spd Dev Err	This error is displayed when there is a difference between above a prescribed value command speed and real speed.

8.2 Checking fault status and history

8.2.1 Monitoring current faults

Code	Keypad display	Description
DIS_05	OC-U	Current fault displayed. (U-phase overcurrent)

Check the current fault display before pressing reset key. pressing [PROG] key and [▲(Up)],[▼(Down)] shows operating status at the time of the fault such as output frequency, current, voltage, F/B value, torque current reference/actual value, dc link voltage, input/output terminal status, operating status and run time) and the fault contents. Press [ENT] key to exit. Pressing [RESET] key will store the value in DIS_05 [Last Fault1].

8.2.2 Monitoring previous faults

Previous 2 faults are saved in DIS_05 "Last fault 1/2". Last fault 1 is more recent fault than Last fault 2. Refer to "8.2.1 monitoring fault display" to check the fault contents.

Code	Keypad display	Description
DIS_05	Last Fault1	Previous fault 1
DIS_05	Last Fault2	Previous fault 2

DIS_05 " Fault Clear" is the function to remove Last Fault1, Last Fault2 data. It is displayed as default.

8.3 Inverter reset

There are 3 ways to reset the inverter. After performing this, the number of automatic restart is initialized.
1) Use [RESET] key on the keypad.
2) Short the RST-CM terminal to reset.
3) Cycle the power (turn the power OFF and turn it ON).

8.4 Fault remedy

8.4.1 Check the below diagnosis before troubleshooting.

1) Is the wiring of a motor and an inverter conducted correctly?
   ☞ Refer to Main Circuit Terminal
2) Is the Encoder-type jumper on I/O PCB set correctly?
   ☞ Refer to Encoder wiring
   If encoder type is either Complementary or Open collector, slide JP1 switch to "OC" and short the JP2 jumper to "P15". If encoder type is Line Drive, slid the JP1 switch to "LD" and short the JP2 jumper to "P5".
   Factory default: Line Drive Type
3) Is motor rotating direction set correctly?
   ☞ Refer to Monitoring Encoder operation
   STARVERT-iV5[MRL] defines Forward rotation when motor rotates in clockwise from the view of Rear Bracket (Motor FAN).
4) Is inverter operating correctly in no load condition?
   ☞ Refer to Operation via Keypad and Control Terminal

8.4.2 Check list before installation

Check (1) ~ (9) before installation. Check (10) ~ (16) when problem has occurred during use.

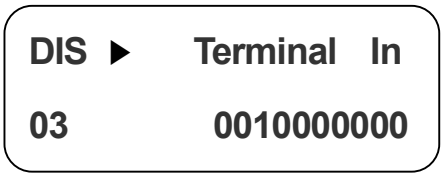
1) The Motor Does Not Rotate when Red lamp on [STOP], [REV], [FWD] key is ON.

(1) Is red lamp lit?

☞ Check whether other trips occur in DIS_05.

If fault occurs, press [RESET] key to clear trip status and try operation.

☞ Check whether BX (Emergency stop) signal is applied on keypad and input terminal defined as BX is ON in DIS_03. If so, release BX and try operation.



(2) RUN/STOP method is properly set ?

☞ Check FUN_01 RUN/STOP method setting matches the actual operation mode(RUN/STOP via keypad or terminal). If FUN_01 is set to terminal but operation is not performed, change it to keypad mode and try operation. If FUN_02 is set to Keypad but operation is not performed, change it to Terminal and try operation. If either way cannot work, refer to (6).

2) **The motor does not rotate when Green lamp on [REV], [FWD] key is ON.**

(1) Is inverter U, V, W output correctly wired to motor U, V, W output?

☞ Refer to Main circuit terminal

(2) ② Is the motor shaft jammed by brake or other mechanical devices?

☞ check the directly connected brake's relay on time and brake open time.

(3) On DIS_01 PreRamp Ref, is speed reference displayed not "0"?

☞ set the desired speed reference if it is set to "0". If it is incorrectly set, refer to (7).

(4) Is PAR_07 [motor rating] properly set?

☞ check the motor nameplate and setting matches.

(5) Is PAR_17 [motor speed] properly set?

☞ check the motor nameplate and setting matches.

(6) Is PAR_22 [motor rated current] properly set?

☞ check the motor nameplate and setting matches.

(7) Is PAR_26 [motor flux current] properly set?

☞ If LG-OTIS vector motor is not used, consult LS representative or set the correct value in accordance with application. However, it cannot set to exceed PAR_22 [motor rated current]. Normally it is 30~40 % of rated motor current.

(8) Is PAR_21 [motor rated slip] properly set?

☞ check the motor nameplate and setting matches.

(9) Is PAR_19 [number of motor poles] properly set?

☞ check the motor nameplate and setting matches

(10)CON_28 [Torque limit setting] is set to " Kpd Kpd Kpd ". Is CON_29 ~ CON_31 setting correct?

☞ CON_29 ~ CON_31 marks upper limit in inverter output torque. For the application lower torque limit is required, when torque shortage occurs, increase this value a little. STARVERT-iV5 's overload capacity is 180%/1 min. when using torque limit over 180%, time and the number of use should be limited.

(11)When CON_28[torque limit setting] Analog or Option, the corresponding input value is properly set?

☞ CON_28 is set to Analog, one of Ai1/Ai2/Ai3 should be defined as "Torque limit". If set to Option, refer to Option manual for proper setting.

3) **Motor speed is not increasing while it is running.**

(1) Is PAR_10 [number of Encoder pulse] set properly?

☞ factory default is 8192. If it is not LG-OTIS vector motor, contact with Encoder maker.

(2) FUN_01 is set to "Keypad",FUN_02 to "Keypad1", FUN_12(Speed 0) to 100.0rpm and press [FWD] key but motor speed is not 100.0rpm. In this case, check for encoder wiring.

☞ If encoder wiring is disconnected or switched, it rotates only uni-direction with low speed (30.0 ~ 60.0rpm) and over 150% its rated current. Check the encoder wiring and whether wiring of defined terminal and motor encoder terminal is shorted.

(3) If motor speed does not increase and keeps abnormally 1.0 ~ 4.0 rpm, stop the motor and switch the wiring of A and B phase of Encoder. Check whether motor rotating direction is reversed as seen in (4).

☞ In the case of Line Drive type encoder, wire A+, A- phase to B+, B- and B+, B- phase to A+, A-. Complementary / for the case of Open Collector type encoder, reverse the wiring of PA and PB.

Or switch the encoder direction in PAR 11 (Enc Dir Set) and try RUN.

4) **Motor rotates in reverse direction.**

☞ Switch the wiring of output phase V and W. Switch the wiring of encoder phase A and B as indicated in (3) **Or switch the encoder direction in PAR_11(Enc Dir Set) and try RUN.**

5) **Motor rotating direction cannot be changed.**

(1) Is RUN/STOP setting proper?

☞ Check FUN_01 RUN/STOP command setting matches the actual operating mode. If FUN_01 is set to Terminal (Keypad) but operation cannot be made, change it to Keypad (Terminal). If it does not work, refer to (6)

(2) Is one of the terminal defined as FWD/REV Run Disable ON?

☞ Check one of I/O_01 ~ I/O_07 terminals is defined as "Prohibit FWD" or "Prohibit REV". If so, check input terminal status in DIS_01 ~ DIS_03. If rotating direction is not changed, check the terminal is ON.

6) **Keypad or terminal malfunctions.**

(1) When [REV], [FWD], [STOP] key on the keypad is lit Red or Green

☞ Refer to (1) if RUN/STOP is not activated by Keypad or Terminal. If setting change is not available, PAR_04 may set to prohibit parameter write. To release this setting, enter 12 in PAR_04. If problem persists, contact LS representatives.

(2) When [STOP] key is blinking

☞ This marks trip condition or BX active status. Check any other trips occur in DIS_05. Reset the trip and try run. Check BX signal is ON on the keypad and input terminal signal in DIS_01 ~ DIS_03. Reset BX and try run.

(3) When green lamp on [REV], [FWD] key is blinking

☞ It marks accel/decel is in operation. If inverter keeps operation in this condition, it means load capacity calculation is incorrect and exceeds inverter rating. Refer to 16).

7) **Operating speed does not change during run.**

(1) Is FUN_02 speed setting proper?

☞ Speed setting methods in STARVERT-iV5 are Analog input, Keypad and Option. Select appropriate one among them.

(2) Is DIS_01(PreRamp Ref) setting the correct value?

☞ Current speed ref. Values are displayed in DIS_01 ~ DIS_03. Check the displayed value matches the setting value. If speed is not variable, check the encoder. (Refer to 13)

(3) Speed setting method is "Keypad" and speed ref displayed DIS_01 ~ DIS_03 is not correct.

☞ Check terminal setting in I/O_01 ~ I/O_07 defined as Multi-step speed setting.

(4) When speed setting method is Analog and DIS_01 ~ DIS_03 display is not desired value

☞ Check one of Ai1 ~ Ai3 is defined as "Speed Ref.".

8) **Motor keeps rotating at OV condition when speed setting is via Analog input.**

(1) When I/O_11 Definition of Ai1 input is set to "Speed Ref"

☞ Adjust the Ai1_Bias at I/O_14. (Setting unit: %)

The displayed value is speed command. Set the desired value (ex: 0.0%) and press [ENTER] key.

(2) Follow the same steps to check Ai2 ~ Ai3.

9) Motor detects speed reference but motor rpm is showing decreasing while motor is overheated or hunting.

(1) Check the motor wiring.

☞ There is a possibility of incorrect motor wiring when motor is 220V / 380V dual rating. Motor does not normally rotate when pole number setting is incorrect. However, motor may get damaged in case of miswiring. If this problem occurs, contact motor sales office. Refer to Power terminal description in this manual.

(2) Is motor capacity set correctly?

☞ Check PAR_07 motor rating selection is set the same as motor in use. See the nameplate for motor rating.

(3) Is motor parameter set correctly?

☞ Motor parameters vary by manufacturer.

10) Nothing displayed on the LCD?

(1) Is the connection of inverter and keypad tight?

☞ Check the inverter and Keypad connection.

(2) Is input power turned on ?

☞ Check inverter power is applied. If nothing is displayed on the LCD in this condition, contact LS representatives.

11) Motor speed oscillates and speed is not constant during constant Run.

(1) Is encoder wired using twisted shield cable?

☞ encoder signal wiring should be conducted with Twisted Shield Cable. Otherwise, speed may oscillate at low speed (or high speed) due to encoder input noise, leading to motor vibration or abnormal motor sound at stop.

(2) Is the connection of inverter and motor and encoder grounding proper?

☞ Check the grounding of inverter and encoder is connected. This could occur when not connected. Fixed screw for the connection of encoder grounding and the inverter is located on the right bottom side of the control PCB. Loosen the fixed screw and insert the ground wire of the encoder and tighten the screw. (Refer to encoder wiring diagram). For grounding the motor, use G of the inverter

Main terminal.

(3) Connect inverter panel grounding connected with motor grounding to the building grounding.

☞ If not, incorrect motor speed may be input due to encoder input noise.

(4) Is too large speed gain assigned to the inverter while motor load is light?

☞ Motor oscillates at stop when PI gain is set much larger than the actual load in CON_03 and CON_04. Therefore, gain should be set accordingly. Responsiveness increases when P gain is set higher and I lower but system may become unstable. Gain value varies system but generally set **30 ~ 100%** for **P gain** and set **100 ~ 500ms** **for I gain.**

(5) Increase PAR_13 Enc LPF setting value.

(6) Is there slip present at the connection of encoder and motor shaft?

☞ Poor encoder and motor connection may generate slip. Check the connection is tight.

12) Parameter change is not saved.

☞ Turn the power off and turn it on. If problem persists, contact LS representatives.

13) Motor input current is too large.

(1) Check the motor wiring.

☞ Check the motor wiring for the use of 220V / 380V transition type motor. (Refer to Main circuit terminal)

(2) Are motor and inverter capacity set correctly?

(3) Is the setting of motor constants appropriate?

☞ Refer to 2) and 9) and check the motor and inverter setting.

14) OC-U (V,W) trip occurs frequently during operation. (Motor input current is oscillating.)

(1) check the encoder installation.

☞ If encoder connection is poor, motor vibration affects encoder and incorrect encoder signal is input to the inverter. Vector inverter controls the speed from Encoder F/B value so it follows the input signal whether correct or not, increasing inverter current. If so, contact motor maker or encoder commission company.

(2) Is there no inverter output phase loss?

(3) Is the motor insulation not damaged?

☞ Refer to 13) and check the inverter and motor.

15) Accel/Decel cannot be made properly and green lamp in [REV], [FWD] key is blinking. (load and frequency reference signal is oscillating.)

(1) Check motor wiring.

(2) FUN_40 ~ FUN_47 Accel/Decel time and DIS_00 motor load.

☞ Blinking Green lamp marks motor is accelerating or decelerating. If the rotating speed oscillates and green lamp is blinking, it marks inverter output torque shortage due to mis-calculation of load. In this case, increase the torque limit to enable inverter to accelerate/decelerate within its rating. If load is set too high, it will shorten inverter life or damage to the unit.

8.5 Lists for maintenance and check

Machine Roomless Elevator of LS industrial systems for STARVERT-iV5(MRL) is an industrial product with s high technology semiconductor device that may have malfunction due to product life expired and environmental factors such as temperature, humidity, vibration. In order not to face those cases, daily check is surely needed.

⚠ Caution

- **Please, check the power input of inverter during maintenance.**
- **Even after turning the power off, the power in mass storage electrolytic condenser could be still charged. Therefore, please check whether the power is discharged or not first.**
  When measuring output voltage of inverter, correct voltage value is calculated only with rectifier voltage meter. General or digital meters may cause wrong value display due to high frequency PWM output voltage.

8.5.1 Daily check

1) Field environment to install is safe?

2) Cooling diagram is safe?

☞ Check the status of air filter.

3) Check whether there are vibrations or noises.

4) Check whether there is overheating or discoloration.

8.5.2 Regular check

1) Check whether bolts and nuts are looses or corroded.
   ☞ Please, fasten or change bolts and nuts since they could be looses or get rusty in environment with excessive vibrations.
2) Check whether cooling plate inside the inverter are covered with foreign substances or not.
   ☞ Please, remove those foreign substances.
3) Check whether PCB of the inverter is covered with foreign substances or not.
   ☞ Please, remove those foreign substances.
4) Check several connections of inverter's PCB are correct or not.
   ☞ Please, check the status of connector.

8.5.3 Meger test

1) When doing Megar test on external circuit, please be careful not to put test voltage into inner part of inverter after loosening all wiring of the inverter.
2) When doing transmission test on control circuit, please do not use Megar buzzer.
3) Megar test of the inverter is available only for main circuit terminals (R, S, T, U, V, W), but unavailable for control circuit.

8.6 Exchange main components and maintenance

Name	Stand life	Status	How to exchange and manage
Cooling fan	2 ~ 3 years	Rotation fault	Contact A/S center and exchange for new one
Main circuit electrolytic condenser	3 years	Capacity decreased	Contact A/S center and exchange for new one
Relay of control board	-	Operation fault	Contact A/S center
Braking resister	-	Capacity decreased	Contact A/S center and exchange for new one

Since life span for main parts is based on continuous operation by rated load, it may change due to conditions to use and environment.

9.1 Standard specifications

1) 400V class

SV[][][]iV5-4(MRL)		075	110	150	220
Max. applicable motor	[HP]	10	15	20	30
	[kW]	7.5	11	15	22
Output	Capacity [kVA](note 1)	13.7	20.6	27.5	39.6
	Rated current [A]	18	27	36	52
	Output speed	0 ~ 200(rpm)			
	Output voltage	380 ~ 480V(주2)			
Input	Voltage	3ϕ 380 ~ 480V(-10% ~ +10%)(주3)			
	Frequency	50 ~ 60 Hz (±5%)			
Inverter weight [kg(lbs)]		14(30.8)	14(30.8)	18.7(41)	19(41.8)

1. Rated capacity (=√3*V*I) is calculated based on 220V for 200V class, 440V for 400V class.
2. Maximum output voltage cannot be generated above specified input voltage.
3. Derate the rated current by 10% when the input voltage is in the range of 507 ~ 528V.

9.2 Common specifications

Items			Specifications
Inverter type			Voltage source inverter using IGBT
Control	Control method		Field oriented vector control inverter using Encoder feedback (5.5 ~ 220kW)
	Speed control accuracy		● Analog setting: ± 0.2%(25 ± 10℃) of max. Speed ● Digital setting : ± 0.01%(0 ~ 40℃) of max. Speed
	Speed setting resolution		● Analog setting: ± 0.005% of maximum Speed ● Digital setting: 0.01% of maximum Speed
	Speed control feedback speed		50Hz
	Torque control accuracy		3%
	Accel/ Decel	Time setting	0.00 ~ 6000.0(sec)
		Combination	4 Combinations of acceleration/Deceleration Time
		Pattern	Linear, S-Curve
Braking	Braking method		Dynamic braking using external resistors
	Braking torque		180%
	BrakingUnit		internal
	Braking resistor		External braking resistor should be provided.
Input	Speed settings		● Digital setting via keypad ● Multi-step speed setting by input terminal selection ● Analog input settings of –10~10V or 4~20mA ● Remote setting by option card
	Analog input		● 3 channels (AI1, AI2, AI3*) ● -10 ~ 10V, 0~10V, 10 ~ 0V, 40~20mA, 20 ~ 4mA, (*AI3: -10 ~ 10V, 0~10V, 10 ~ 0V, Motor NTC only) ● Selectable among 9 different user-defined functions ● Ai3 (Motor NTC): only available with a LG-OTIS motor used.
	Contact input		● FX, RX, BX, RST, P1 ~ P7 ● Selectable among 26 different user-defined input functions

Items		Specifications
Output	Analog output	● 2 channels (AO1, AO2) ● -10V ~ 10V Voltage output ● Selectable among 31 different user-defined functions
	Contact output	● 2 channels (1A-1B, 2A-2B) ● Fault alarm relay: 1 channel (30A-30C, 30B-30C)
	Open Collector	1 Channel (OC1/EG)
Protection function		Overcurrent, Overvoltage, Low voltage, Inverter overheat, Inverter thermal sensor malfunction, Motor overheat, Motor thermal sensor malfunction, Overspeed, Instantaneous IGBT gate block (BX), Fuse blown open, External Trip, Pulse encoder malfunction, Electronic thermal function, Inverter overload, Ground fault current, IGBT short, Communication error
Environment	Installation condition	Indoor, Free of Corrosive gas and Direct sunlight
	Ambient temperature	-10 ~ 40°C (Non-frozen condition)
	Humidity	Below RH 90% (Dewdrop should not be formed)
	Cooling method	Forced ventilation by cooling fan
	Altitude, Vibration	Below 1000m above sea level, Below 5.9m/s^2 (=0.6G)
	Installation condition	ESD-4 (RH-2)

9.3 Braking resister specifications

1) Braking resister specifications per capacity

Resistances on the chart below are calculated based on braking torque 150%, 5% ED(note 1). When using 10% ED, please make rated watt of the resistor double.

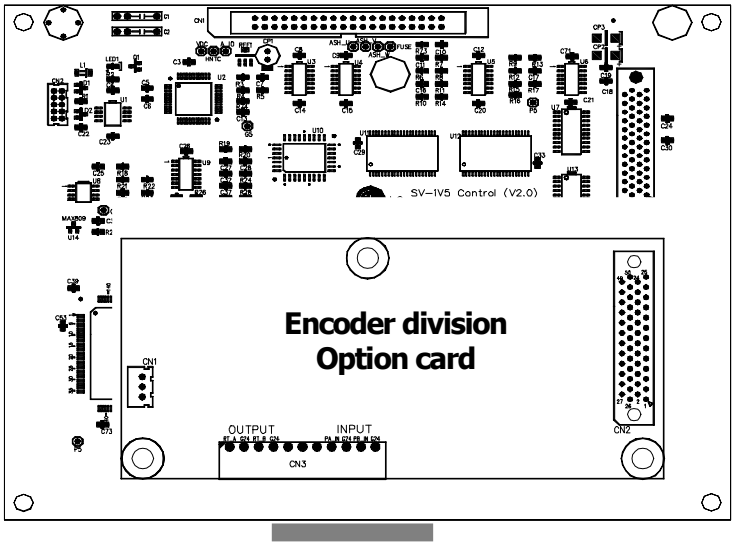
Type	Applicable inverter	Capacity (5% ED)	
		[Ω]	[W](note 2)
BR1200W060J	SV 075iV5-4 DB	60	1200
BR2000W040J	SV 110iV5-4 DB	40	2400
BR2400W030J	SV 150iV5-4 DB	30	2400
BR3600W020J	SV 220iV5-4 DB	20	3600

(note 1) : 100sec is the standard for ED. (note 2) : self cooling is standard for Resister.

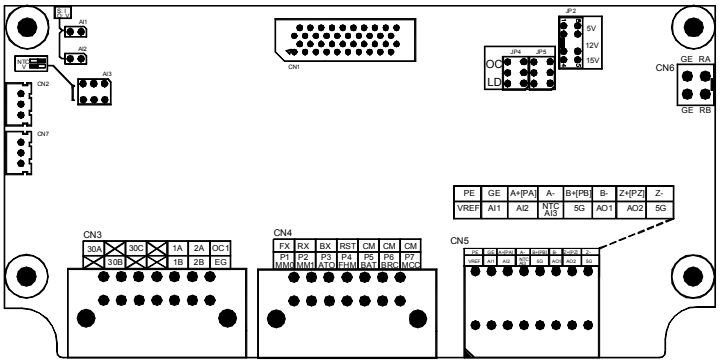
9.4 Encoder division option card(open collector)

9.4.1 How to treat encoder division option card

Please, attatch CN2 coneector of encoder division option card to CN4 connector of control board.



▶ **Control board**



▶ **I/O board**

9.4.2 How to wire encoder division option card (Wire)

Please, connect output terminal(open collector output) of I/O board with input terminal of encoder division option card.

Encoder division option card terminal name		Encoder division option card terminal description	Connection board and terminal
Input	PA_IN	encoder A phase division input	I/O board: RA(A phase output)
	G24	GND	I/O board: GE(GND)
	PB_IN	encoder B phase division input	I/O board: RB(B phase output)
	G24	GND	I/O board: GE(GND)
Output	RT_A	encoder A phase division output	peripheral controller: A phase input
	G24	GND	peripheral controller: GND

	RT_B	encoder B phase division output	peripheral controller: B phase input
	G24	GND	peripheral controller: GND

Encoder division output function

Only in case of having encoder division output option card, this function is available. When connecting encoder output with pulse input device of peripheral equipment, set division비.

Function code	Keypad display	Function name	Setting range	Unit	Default
PAR_31	EncDiv Ratio	Encoder pulse output division ratio	1 ~ 1128		1
PAR_32	EncDivFilter	Encoder division output filter	0 ~ 15		0

Encoder division output option card makes 1 output pulse, calculating encoder division input option card when input pulse as PAR_31 reaches the number as much as division ratio set by a user. Phase relation of output A, B pulses is set to maintain same as input A, B pulses, and division ratio can be set within the range from 1(1 output pulse per 1 input pulse) to 1/128(one output pulse per 128 input pulses).
Setting range of PAR_31 is from 0001 to 1128 and can set the values of a denominator and numerator of division ratio. Value above 1 as division ratio is not available, only 1 and 2 are available as a numerator. When the number in thousands unit is N among setting values of PAR_31, and the number below thousands is M(PAR_31 setting value = N×1000 + M), division ratio is calculated as below.

division = (1+N)/M
Setting range : N(0 , 1), M(1 ~ 128)
PAR_31 = [] [] [] []
N M

When the value of PAR_31 is below 1000(N=0), a numerator of division ratio is 1. When above 10000(N=1), it is 2. For example, when the value of PAR_31 is 15, division ratio is 1/15. When the value of PAR_31 is 1015, it is 2/15. Also, you can set division ratio up to 1/128. Since setting with the value above 1is not available, please use Up and Down keys of Keypad. When increasing the value of PAR_31 by Up key, PAR_31 values will increase such as 1 → 2 → 3 → 4 → … → 127 → 128(division비 1/128) → 1002 (division ratio 1) → 1003 → … → 1128(division비 1/64). When decreasing by Down key, same procedure will be made.

Maker	LS Industrial Systems Co., Ltd.		**Installation (Start-up) Date**	
Model No.	**SV-iV5[MRL]**		**Warranty Period**	
Customer Information	Name			
	Address			
	Tel.			
Sales Office (Distributor)	Name			
	Address			
	Tel.			

Warranty period is 12 months after installation or 18 months after manufactured when the installation date is unidentified. However, the guarantee term may vary on the sales term.

■ **IN-WARRANTY service information**

If the defective part has been identified under normal and proper use within the guarantee term, contact your local authorized LS distributor or LS Service center.

■ **OUT-OF WARRANTY service information**

The guarantee will not apply in the following cases, even if the guarantee term has not expired.

- Damage was caused by misuse, negligence or accident.
- Damage was caused by abnormal voltage and peripheral devices' malfunction (failure).
- Damage was caused by improper repair or altering by other than LS authorized distributor or service center.
- Damage was caused by an earthquake, fire, flooding, lightning, or other natural calamities.
- When LS nameplate is not attached.
- When the warranty period has expired.

Revision History

No.	Date	Edition	Changes
1	Oct, 2006	First Release	Ver. 1.00