LS Drives.. IS7 VFD Manual

For service and technical info..

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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.

Symbol	Meaning
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 is as follows.

Symbol	Meaning
	This is the safety alert symbol. Read and follow instructions carefully to avoid dangerous
	This symbol alerts the user to the presence of “dangerous voltage”

After reading this manual, keep it in the place that the user always can contact. 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.
- **Do not touch the inverter while the input power is applied or after removed. It 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

■ Handling and installation

- Handle according to the weight of the product.
- Do not stack the inverter boxes higher than the number recommended.
- Install according to instructions specified in this manual.
- Do not open the cover during delivery.
- Do not place heavy items on the inverter.
- Check the inverter mounting orientation is correct.
- Do not drop the inverter, or subject it to impact.
- Use the ground impedance of 100ohm or less for 200 V Class and 10ohm or less for 400V class.
- Take protective measures against ESD (Electrostatic Discharge) before touching the PCB for inspection or installation.

Use the inverter under the following environmental conditions:

Environment	Ambient temp.	CT Load: - 10 ~ 50℃ (non-freezing) VT Load: -10 ~ 40℃(non-freezing) Note: Use below 80% of load when used under VT Load at 50℃
	Relative humidity	90% RH or less (non-condensing)
	Storage temp.	- 20 ~ 65 ℃
	Location	Protected from corrosive gas, combustible gas, oil mist or dust
	Altitude, Vibration	Max. 1,000m above sea level, Max. 5.9m/sec^2 (0.6G) or less
	Atmospheric pressure	70 ~ 106 kPa

■ Wiring

- Do not connect a power factor correction capacitor, surge suppressor, or RFI filter to the output of the inverter.
- The connection orientation of the output cables U, V, W to the motor will affect the direction of rotation of the motor.
- Incorrect terminal wiring could result in the equipment damage.
- Reversing connection of the input/output terminals(R,S,T / U,V,W) could damage the inverter.
- Only authorized personnel familiar with LS inverter should perform wiring and inspections.
- Always install the inverter before wiring. Otherwise, you may get an electric shock or have bodily injury.

■ Trial run

- Check all parameters during operation. Changing parameter values might be required depending on the load.
- Always apply permissible range of voltage to the each terminal as indicated in this manual. Otherwise, it could lead to inverter damage.

■ Operation precautions

- When the Auto restart function is selected, stay away from the equipment as a motor will restart suddenly after an alarm stop.
- The Stop key on the keypad is valid only when the appropriate function setting has been made. Prepare an emergency stop switch separately.
- If an alarm reset is made with the reference signal present, a sudden start will occur. Check that the reference signal is turned off in advance. Otherwise an accident could occur.
- Do not modify or alter anything inside the inverter.
- Motor might not be protected by electronic thermal function of inverter.
- Do not use a magnetic contactor on the inverter input for frequent starting/stopping of the inverter.
- Use a noise filter to reduce the effect of electromagnetic interference. Otherwise nearby electronic equipment may be affected.
- In case of input voltage unbalance, install AC reactor. Power Factor capacitors and generators may become overheated and damaged due to potential high frequency noise transmitted from inverter.

- Use an insulation-rectified motor or take measures to suppress the micro surge voltage when driving 400V class motor with inverter. A micro surge voltage attributable to wiring constant is generated at motor terminals, and may deteriorate insulation and damage motor.
- Before operating unit and prior to user programming, reset user parameters to default settings.
- Inverter can easily be set to high-speed operations, Verify capability of motor or machinery prior to operating unit.
- Stopping torque is not produced when using the DC-Break function. Install separate equipment when stopping torque is needed.

■ Fault prevention precautions

- Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.

■ Maintenance, inspection and parts replacement

- Do not conduct a megger (insulation resistance) test on the control circuit of the inverter.

■ Disposal

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

■ 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

SAFETY INSTRUCTIONS i

OPERATING PRECAUTIONS iii

Table of Contents vi

1. Operating Winder/Unwinder 1-1

1.1 Overview 1-1

1.2 Oveall Composition 1-3

1.3 Main speed command part 1-4

1.4 Web PID Controller Part 1-8

1.5 Diameter computation part 1-18

1.6 Final speed computation part 1-24

1.7 Analogue Output Part 1-30

1.8 Web Break Detection Part 1-32

2. Capstan operation 2-1

2.1 Overview 2-1

2.2 Overall Composition 2-3

2.3 Main speed command part 2-4

2.4 Web PID controller part 2-4

2.5 Analogue output part 2-4

2.6 Web break detection part 2-4

2.7 Materials thickness computation part 2-5

2.8 Final Speed Computation Part 2-11

3. Other Function 3-1

3.1 Stall level adjustment by analogue input 3-1

3.2 Speed-torque Automatic Switching Function 3-3

3.3 External PID controller 3-6

4. Application Functions 4-1

4.1 Override Frequency Setting using Auxiliary Frequency Command 4-1

4.2 Jog Operation (If you want Jog operation) 4-7

4.3 Up and Down Operation 4-10

4.4 3-Wire Operation (if you want operation using push button) 4-12

4.5 Safe Operation Mode (if you want to limit operation through terminal Input) 4-13
4.6 Dwell operation 4-14
4.7 Slip compensation operation 4-17
4.8 PID control 4-19
4.9 Auto tuning 4-27
4.10 V/F Operation using Speed Sensor 4-32
4.11 Sensorless (I) vector control 4-33
4.12 Sensorless (II) vector control 4-35
4.13 Vector control 4-40
4.14 Torque Control (When you want to control the torque) 4-46
4.15 Droop control 4-48
4.16 Speed/Torque Change Function 4-49
4.17 Kinetic Energy Buffering 4-49
4.18 Energy saving operation 4-50
4.19 Speed search operation 4-51
4.20 Automatic Restart 4-55
4.21 Operation sound selection 4-56
4.22 2nd Motor operation 4-58
4.23 By pass operation 4-61
4.24 Cooling fan control 4-62
4.25 Input power frequency selection 4-63
4.26 Inverter input voltage selection 4-63
4.27 Parameter writing and reading 4-63
4.28 Parameter initialization 4-64
4.29 Parameter view lock and Key lock 4-64
4.30 Addition to User Group (USR Grp) 4-67
4.31 Addition to Macro Group 4-69
4.32 Easy Start 4-70
4.33 Other Config (CNF) mode parameters 4-71
4.34 Timer function 4-72
4.35 Auto sequence operation 4-72
4.36 Traverse operation 4-76
4.37 Brake control 4-77
4.38 Multi-function output On/Off control 4-80

4.39 MMC function 4-80

4.40 Regeneration evasion function for press 4-88

5. Table of Functions 5-1

5.1 Parameter Mode – DRV group (➔ DRV) 5-2

5.2 Parameter mode – Basic function group (➔BAS) 5-4

5.3 Parameter mode – Extended function group (PAR➔ADV) 5-8

5.4 Parameter mode – Control function group (➔CON) 5-12

5.5 Parameter mode – Input terminal block function group (➔IN) 5-18

5.6 Parameter mode – Output terminal block function group (➔OUT) 5-23

5.7 Parameter mode – Communication function group (➔COM) 5-28

5.8 Parameter mode – Applied function group (➔APP) 5-33

5.9 Parameter mode – Option card function group (➔APO) 5-41

5.10 Parameter mode – Protective function group (➔PRT) 5-43

5.11 Parameter mode – 2nd motor function Group (➔M2) 5-47

5.12 Trip mode (TRP current (or Last-x)) 5-49

5.13 Config Mode (CNF) 5-50

6. iS7 extended common area parameter 6-1

6.1 Inverter Monitoring Area Parameter (Reading only) 6-1

6.2 Inverter Control Area Parameter (Reading and Writing Available) 6-8

6.3 Monitoring common area for dedicated product of iS7 6-11

6.4 Common Control Area for Dedicated Product of iS7 6-12

7. Setting parameter for web through examples 7-1

7.1 Overview 7-1

8. How to set up parameter 8-1

8.1 How to set up parameter of winder 8-1

8.2 How to set up parameter of unwinder 8-2

8.3 How to set up parameter of capstan 8-3

Warranty ..... A

Revision History ..... B

1. Operating Winder/Unwinder

1.1 Overview

Winder is also called as splooer. It winds web materials (steel wire, steel plate, wire strand, etc.) while maintaining constant tension. On the contrary, the unwinder unwinds the wound web materials while maintaining constant tension.

The winding and unwinding function of iS7 inverter is used for the closed loop tension control system which winds or unwinds while maintaining tension by operating PID controller to use analogue volume feedbacked from tension control detection device such as dancer or loadcell.

Also, due to the characteristics of the PID controller of the closed loop tension control system, it has some different points from the existing PID controller. Therefore, this manual named it as the Web PID controller.

$$Speed\ of\ motor\ [rpm] = \frac{Wire\ speed[mpm]}{diameter \times \pi [m]} \quad - Formula(1.1.1)$$

As the process continues, the actual diameter [m] of winder increases. As seen in the formula 1.1.1, in order to maintain a wire speed [mpm] at certain speed, the electric motor speed [rpm] has to be lowered as much as the diameter increases. The speed of the electric motor, that is, output frequency of inverter will be lowered by the Web PID controller. Also, the increasing diameter is calculated and estimated internally, and the calculated diameter is used to finally lower the output frequency of the inverter.

On the contrary, the diameter of winder decreases as the process continues. As seen in the formula 1.1.1, the speed of electric motor [rpm] has to be increased as much as the diameter decreases in order to maintain the wire speed [rpm] constantly. The speed of the electric motor, that is, output frequency of inverter will be increased by the Web PID controller. Also, the decreasing diameter is calculated and estimated internally, and the calculated diameter is used to finally increase the output frequency of the inverter.

This way shows performance much stable than the control of winder tension by only using the PID controller. Since the internally calculated diameter compensates the output frequency of inverter again, the ratio of the Web PID controller becomes very small in the output frequency.

Therefore, there is no risk for the Web PID controller to be saturated, and the ocilliation of I controller output significantly decreases.

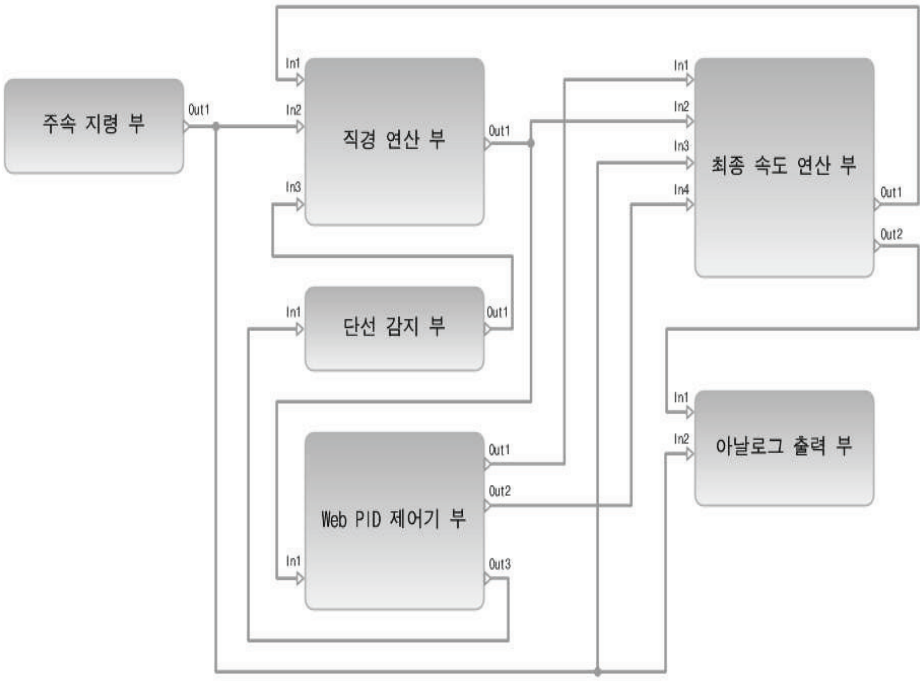
The summary of other functions are as follows;

- Function to remove transient phenomena of dancer or loadcell at the time of starting (related code: APP-51)
- Inertia compensation function (related code: APP-56~57)
- Function to stop quickly while maintaining tension (related code: APP-82)
- Function to detect before web materials are ruptured. (related code: APP-76~80)

In order to use winder (spooler) or unwinder function from iS7, set it up as following.

Group	Code No.	Function indication	Name	Setting value
APP	01	App Mode	Select application	5: Tension Ctrl
APP	02	Tnsn Ctrl Mode	Select tension control operating mode	0: Winder or 1: Unwinder

1.2 Overall Composition



The input and output of each part is as follows.

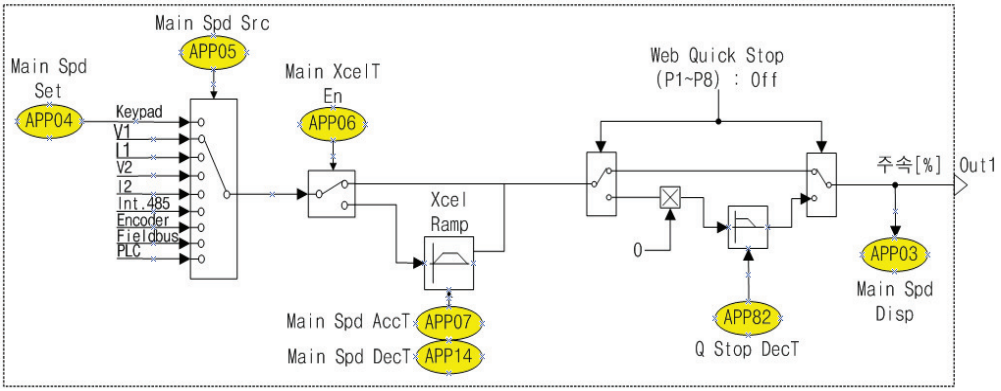
Function part	Input		Output	
main speed command part	-		Out1	main speed [%]
Web PID controller part	In1	Diameter [%]	Out1	Error conversion compensation frequency [Hz]
			Out2	PID Out [%]
			Out3	PID Feedback [%]
Diameter computation part	In1	Current output frequency [Hz]	Out1	Diameter [%]
	In2	main speed [%]		
	In3	Web Break occurrence (0/1)		
Final speed computation part	In1	Error conversion compensation frequency [Hz]	Out1	Final speed command [Hz]

Function part	Input		Output	
	In2	Diameter [%]		
	In3	main speed [%]	Out2	main speed + PID [%]
	In4	PID output [%]		
Analogue output part	In1	main speed + PID [%]	-	
	In2	main speed [%]		
Web break detection part	In1	PID Feedback [%]	Out1	Web Break occurrence (0/1)

1.3 Main speed command part

The unit of main speed command is [%], and it is same concept with the wire speed [mpm]. For example, if you would like to operate the system (maximum wire speed 800[mpm]) at 400[mpm] of wire speed, then set up the main speed command at 50[%] (=400/800 X 100 [%])

Main speed command can be ordered thorugh keypad, analogue input, communication, etc.



(1) Main speed command

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
APP	03	Main Spd Disp	Indicate main speed command	Read Only [%]		
APP	04(Note1)	Main Spd Set	Set up main speed keypad	0.00[%]	-100.00 ~ 100.00[%]	
APP	05	Main Spd Src	Main speed command method	V1	0	Keypad
					1	V1
					2	I1
					3	V2
					4	I2
					5	Int.485
					6	Encoder
					7	Fieldbus
					8	PLC
APP	06	Main XcelT En	Select main speed acceleration or deceleration	No	0	No
					1	Yes
APP	07(Note2)	Main Spd AccT	Time to accelerate main speed	10.0[sec]	0.0 ~ 300.0[sec]	
APP	14(Note2)	Main Spd DecT	Time to deccelerate main speed	20.0[sec]	0.0 ~ 300.0[sec]	

(Note 1): When APP-05 (Main Spd Src) is selected as 'Keypad,' this code appears.
(Note 2): When APP-06 (Main XcelT En) is selected as 'Yes,' this code appears.

APP-03 (Main Spd Disp): Displays main speed [%]. If the inverter is stopped, it shows target main speed [%], and shows ramp main speed [%] during the inverter operates.

APP-04 (Main Spd Set): If the APP-05 (Main Spd Src) is selected as 'Keypad,' then it is operated by main speed command entered in this code.

APP-05 (Main Spd Src): You can select the method of main speed command. If 'Keypad' is selected, it is operated at main speed [%] entered in the APP-04 (Main Spd Set)

If 'V1' or 'I1' is selected, the main speed command can be ordered by entering analogue on the basic I/O board. At this time, filter, gain and offset of analogue input is adjusted at IN-07~11(V1 Filter/Gain/Offset), IN-22~26(I1 Filter/Gain/Offset). If 'V2' or 'I2' is selected, the main speed command is ordered by analogue input of extended I/O option board. At this time, filter, gain and offset of analogue input is adjusted at IN-37~41(V2 Filter/Gain/Offset), IN-52~56(I2 Filter/Gain/Offset).

Once the encoder option board is installed, the main speed command can be ordered thorugh the pulse input of 'Encoder'.

'Int.485' can receive the main speed command through RS485 communication (Modbus-RTU, LS Inv 485) embedded in a default I/O board, and 'Fieldbus' can receive it through communication option card, and 'PLC' can receive it through PLC option card respectively. At this time, the main speed [%] command is effective down to one decimal place for 'Int.485' (RS485 communication embedded in the default I/O board), 'Fieldbus' (communication option card) and 'PLC'(PLC option card).

For example, if you would like to command main speed 60.0[%], then enter '600' in the common area address '0h0396' from the built-in 485 communication or communication option card, or PLC option card.

APP-06 (Main XcelT En): The acceleration and deceleration time of the main speed can be set up. If this code is selected as 'Yes,' then the main speed is increased/decreased by the acceleration and deceleration time entered in the APP-07(Main Spd AccT), APP-14(Main Spd DecT). The factory setting value is 'No'. Therefore, you should make the main speed ramp increased/decreased from outside upper controller. If not, the main speed command comes into the step, and it causes the system unstable.

APP-07(Main Spd AccT), APP-14(Main Spd DecT): If APP-06(Main XcelT En) is selected as 'Yes,' these codes can be seen. The acceleration and deceleration time of the main speed can be set up. The basis of the acceleration and deceleration time is main speed 100[%]. For example, APP-07(Main Spd AccT) is set up at 10[sec] which is

factory setting value, then the time required to accelerate the main speed from 0[%] to 50[%] is 5[sec] (=10[sec] * 50[%]/100[%]).

(2) Quick Stop

In case emergency situation occurs from the closed loop tension control system which uses dancer or loadcell, this function can quickly stop the system while maintaining its tension.

This function stops the inverter at the time when setting up by APP-82 (Q Stop Dec T) when multiple functions entering which are set up as 'Web Quick Stop' are turned on. The deceleration time is always constant regardless of the output frequency of the current inverter.

For example, if inverter 1, 2, 3 are interlocked and operated in the system, and current output frequency is 25Hz, 40Hz, 60Hz respectively, when the multiple function entering 'Web Quick Stop' is turned on, it is decelerated by the deceleration time of 3 [sec] which is factory setting value of APP-82(Q Stop Dec T). At this time, since the output of Web PID controller is effective, the output of inverter is not blocked, and the tension is maintained.

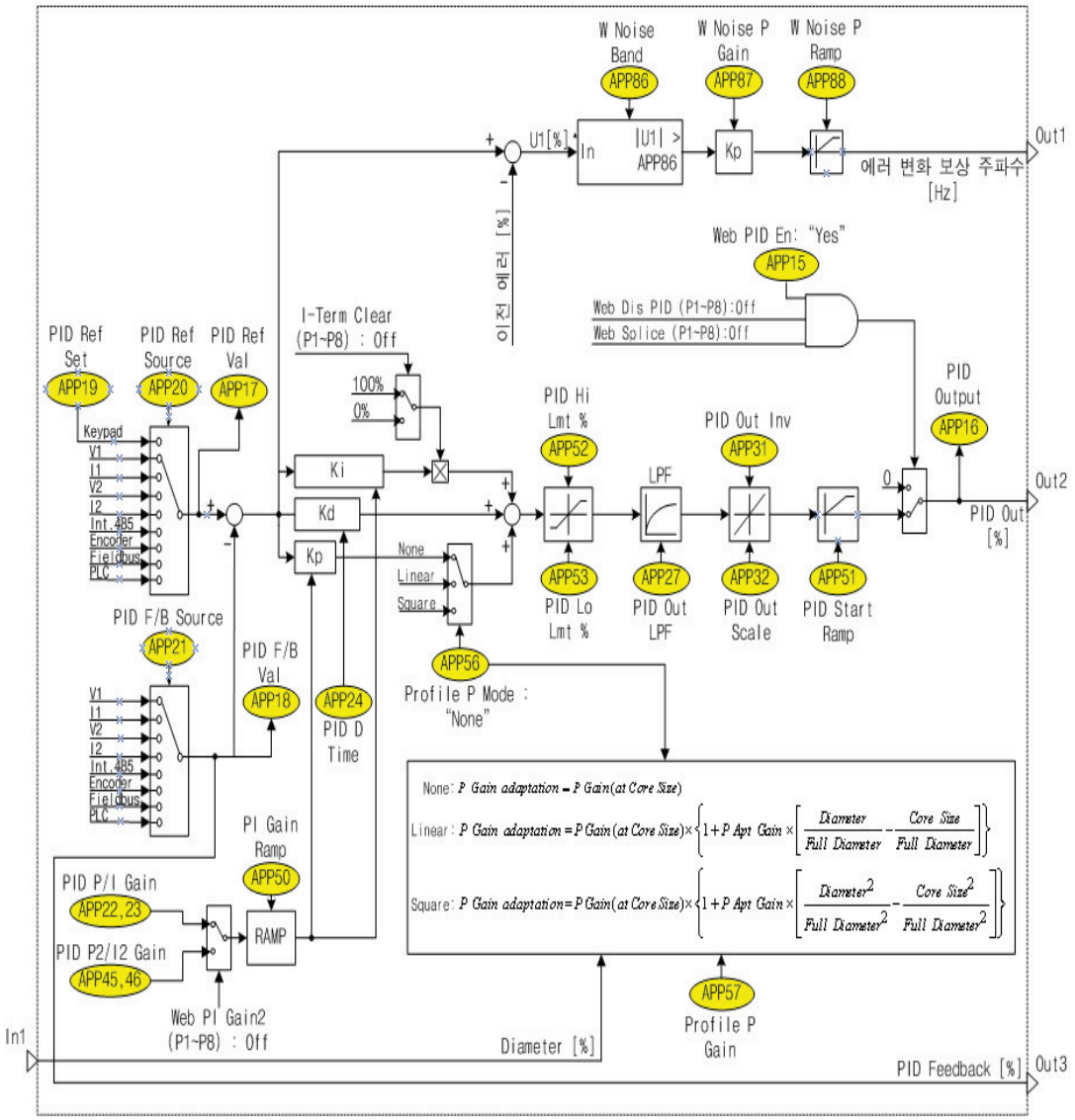
Group	Code No.	Function indication	Name	Factory setting value	Setting range
IN	65 ~ 72	Px Define	Set up multiple function input	Web Quick Stop	-
APP	82	Q Stop Dec T	Deceleration time in emergency stop	3.0[sec]	0.1 ~ 300.0[sec]

APP-82 (Quick Stop DecT): This function sets up the deceleration time in emergency stop while maintaining the tension during the operation of the inverter from the closed loop tension control system which uses dancer or loadcell.

⚠ CAUTION

Even though the 'Web Quick Stop' terminal block is turned on and it is quickly stopped, the output of inverter is not blocked. Therefore, be sure to block the output of the inverter by turning off the operation command of the inverter even after the quick stop.

1.4 Web PID Controller Part



The output of PID controller is determined by using the amount of analogue feedbacked from the tension detection device like dancer or loadcell from the closed loop tension control system. Since the PID controller is optimized to the tension control system, we defined it as the Web PID controller.

The additional main functions are as follows:

Function to improve transient phenomena of dancer or loadcell by increasing PID output with lamp at the time of start-up of inverter (APP51: PID Start Ramp), inertia compensation function to change P-gain of PID controller by using the estimated diameter [%] from the diameter calculation part (APP56: Proflle P Mode, APP57: Profile P Gain), disturbance compensation function which effectively compensates disturbance occurred during operation (APP86~88).

(1) PID controller

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
IN	65~72	Px Define	Set up multiple function input	Web Dis PID	-	
APP	15	Web PID En	Select tension PID control	1: Yes	0	No
					1	Yes
APP	16	PID Output	PID output monitor	Read Only[%]		
APP	17	PID Ref Value	PID reference monitor	Read Only[%]		
APP	18	PID Fdb Value	PID feedback monitor	Read Only[%]		
APP	19(Note1)	PID Ref Set	Set up PID reference (keypad)	50.00[%]	-100~100[%]	
APP	20	PID Ref Src	Select PID reference	0: Keypad	0	Keypad
					1	V1
					2	I1
					3	V2
					4	I2
					5	Int.485
					6	Encoder
					7	Fieldbus
					8	PLC
APP	21	PID F/B	Select PID	1: I1	0	V1

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
		Src	feedback		1	I1
					2	V2
					3	I2
					4	Int.485
					5	Encoder
					6	Fieldbus
					7	PLC
					8	Synchro
					9	Binary Type
					10	XV1
					11	XI1
					12	XV2
					13	XI2
					14	XV3
					15	XI3
					16	XV4
					17	XI4
APP	22	PID P-Gain	PIDcontroller proportional gain	50.0[%]	0.0~1000.0[%]	
APP	23	PID I-Time	PIDcontroller integral time	10.0[s]	0.0~200.0[s]	
APP	24	PID D-Time	PIDcontroller differential time	0[ms]	0~1000[ms]	
APP	27	PID Out LPF	PID output filter	0[ms]	0~10000[ms]	
APP	28	PID I Limit	I controller output limit	100[%]	0~100[%]	
APP	31	PID Out Inv	Reverse PID output	0: No	0	No
					1	Yes

Group	Code No.	Function indication	Name	Factory setting value	Setting range
APP	32	PID Out Scale	PID output scale	30.0[%]	0.0~1000.0[%]
APP	51	PID Start Ramp	PID output ramp time when starting	5.0[s]	0.0~300.0[s]
APP	52	PID Hi Lmt %	PID output upper limit[%]	100.0[%]	APP53~100.0[%]
APP	53	PID Lo Lmt %	PID output lower limit[%]	-100.0[%]	-100~APP-52[%]
APP	98	PID Sample T	PID controller implementation cycle	1[ms]	1~10[ms]

(Note 1): If APP-20 (PID Ref Source) is selected as 'Keypad,' these codes appear.

APP-15 (Web PID En): Determine whether the Web PID controller is used or not. It is combined with the multiple function input 'Web Dis PID' and used like the Table 1.4.1.

APP-15(Web PID En) Setting	Multiple function input 'Web Dis PID' status	Whether the Web PID controller is used
Yes	Off	O
Yes	On	X
No	Off	X
No	On	X

Table 1.4.1 How to select using/not using Web PID controller

APP-16 (PID Output): Shows current PID output[%].

APP-17 (PID Ref Value): Shows current PID reference[%].

APP-18 (PID Fdb Value): Show current PID feedback[%].

APP-19 (PID Ref Set): The reference of the PID controller is set up by keypad. This code appears, when APP-20(PID Ref Src) is selected as 'Keypad'.

APP-20 (PID Ref Src): You can select the input method of PID controller reference from many options (keypad, analogue, interior communication, exterior communication, PLC option).

APP-21 (PID F/B Src): You can select the input method of PID controller feedback from many options (analogue, interior communication, exterior communication, PLC option).

APP-22 (PID P-Gain): P1 gain of PID controller. If P gain is 100[%] and error is 100[%], then P controller output is 100[%].

APP-23 (PID I-Time): This is I1 gain of the PID controller. If I gain is 10[sec] and error is 100[%], then the time required for the output of I controller is saturated at 100[%] is 10 [sec].

APP-24 (PID D-Time): This is D gain of the PID controller. If D gain is 10[ms], and the change of error is 100[%], and the output of D controller is 100[%], and the output gradually decreases to about 34[%], it will take 10 [ms].

APP-27 (PID Out LPF): This sets up the number of corrections for delayed time of PID controller output. Generally, it is set up as 0 [ms], and make sure the responsiveness of PID controller fast. However, if the setting value is increased, the responsiveness of the PID controller is slow, but more stable.

APP-28 (PID I Limit): The accumulated value of I controller is limited to the upper limit of this code.

APP-31 (PID Out Inv): This selects whether the PID controller output is reversed. If selecting 'Yes,' the symbol of PID output is reversed and printed. This is usefully used when the direction of tension device like dancer or loadcell is in the opposite way.

APP-32 (PID Out Scale): This can adjust the scale of the PID controller output. First of all, let's assume the PID controller is saturated. At this time, this code is set as 100[%], the PID controller's output will be 100[%], and if this code is set as 30[%], the PID controller's output will be 30[%].

APP-51 (PID Start Ramp): The ramp can be increased during the time when the PID output is set up at the time when the inverter is started. This function make the output of the PID controller slow at the time of starting, it can improve the transient phenomena like fluctuation when dancer or loadcell starts.

The Figure 1.4.1 (b) shows the output of P controller provided that P gain is 100[%] and the PID error is 100[%] at the time of starting. The dotted line of (b) shows the output of P controller when the APP-51(PID Start Ramp) is '0[sec]'. The full line in the (b) shows that the increasing ramp of the output of PID controller during the APP-51(PID Start Ramp) time at the time of starting. That means, the dotted line is much more favorable

than the full line in the transient phenomena when starging the inverter initially.

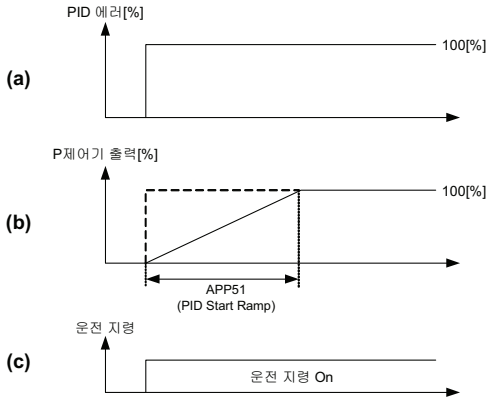


Figure 1.4.1 How to operate APP-51(PID Start Ramp)

Also, the APP-51(PID Start Ramp) is based when PID controller output is 100[%]. For example, if APP-51(PID Start Ramp) is set up at 5[sec], the time to be required for the output of PID controller to be saturated at 100[%] is 5 [sec], and the time to be required for the output of PID controller to be saturated will be 2.5 [sec].

APP-52, 53 (PID Hi/Lo Lmt %): The upper limit and lower limit of PID controlle output can be set up. Also, the accumulated value of I controller will be limited to upper limit and lower limit set up by this code.

APP-98 (PID Sample T): The implementation cycle of the Web PID controller can be changed.

(2) Inertia compensation function

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
APP	56	Profile P Mode	Select P Gain profile	0: None	0	None
					1	Linear
					2	Square
APP	57(Note1)	Profile P Gain	Profile gain	1.00[%]	0.01~10.00[%]	

(Note 1): When APP-56(Profile P Mode) is selected as ‘Linear’ or ‘Square,’ these codes appear.

As time goes by, the diameter of winder is expanded, and as the diameter increases, the inertia will be increased. Therefore, (+) inertia compensation has to be conducted as much as the diameter increases.

On the contrary, as time goes by, the diameter of unwinder decreases. As the diameter is decreased, the inertia decreases. Therefore (-) inertia compensation has to be conducted as much as the diameter decreases.

In order to do this inertia compensation, as the diameter increases, increase P-gain. The formula is as follows. Figure 1.4.2 shows the trend of P gain which changes according to the diameter.

'None' :

$$Inertiacompensation\ P\ \ Gain = P\,Gain$$

'Linear':

$$Innertia\ \text{compensation}\ P\,Gain =$$

$$P\,Gain \times \left\{ 1 + \Pr ofile\ P\ \ Gain(APP57) \times \left[\frac{Diameter}{Full\ \ Diameter} - \frac{Bobbin\ Diameter}{Full\ \ Diameter} \right] \right\}$$

'Square':

$$Innertiaco\,mpensation\ P\ \ Gain =$$

$$P\,Gain \times \left\{ 1 + \Pr ofile\ P\,Gain \times \left[\frac{Diameter^{2}}{Full\ \ Diameter^{2}} - \frac{Bobbin\ Diameter^{2}}{Full\ \ Diameter^{2}} \right] \right\}$$

Figure 1.4.2 The transition of P gain change according to the APP-56(Profile P Mode) setup

(3) P, I gain switching function

If there is any change in the input set up as multiple function input 'Web PI Gain2' during the operation of the inverter, or the user changes the setting of APP-22(PID P-Gain), APP-23(PID I-Time) by himself/herself, and the P/I gain is instantaneously switched without switching ramp time, then the response of the system may be unstable. In order to prevent this risk, let the switching of P/I gain be changed gradually according to the appropriate setting value of the APP-50 (PI Gain Ramp).

Group	Code No.	Function indication	Name	Factory setting value	Setting range
IN	65~72	Px Define	Set up multiple function input	55: Web PI Gain2	-
APP	22	PID P-Gain	PIDcontroller proportional gain	50.0[%]	0.0~1000.0[%]
APP	23	PID I-Time	PIDcontroller integrated time	10.0[s]	0.0~200.0[s]
APP	45	PID P2-Gain	PIDcontroller proportional gain2	100.0[%]	0.0~1000.0[%]
APP	46	PID I2-Time	PIDcontroller integrated time2	20.0[s]	0.0~200.0[s]
APP	47	PI Change Spd1	P/I gain switching frequency-1	0[%]	0~APP48[%]
APP	48	PI Change Spd2	P/I gain switching frequency-2	0[%]	0~100[%]
APP	50	PI Gain Ramp	PI gain switching RAMP TIME	30.0[sec]	0.0~300.0[sec]

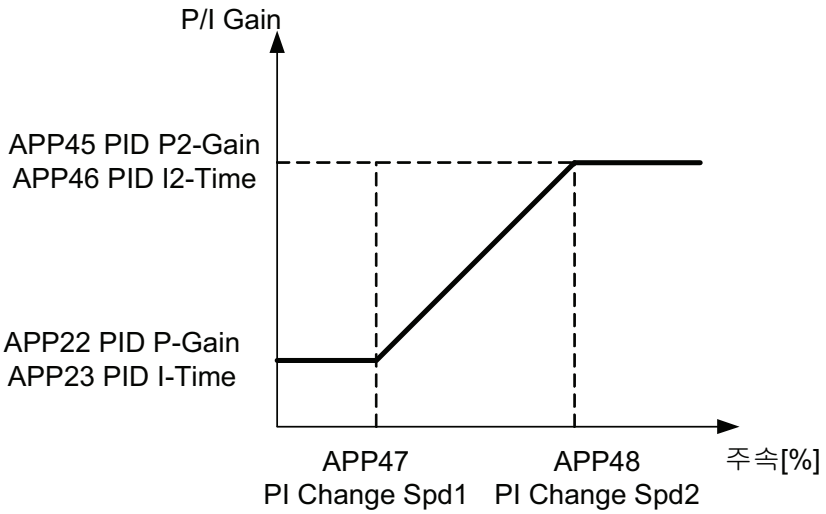


Figure 1.4.3 The transition of gain change according to the P/I switching function setting

APP-50 (PI Gain Ramp): This is the ramp time applied to the moment when the P/I gain switching occurs since there is a change in multiple function input 'Web PI Gain 2' during the operation of the inverter. Also, if a user directly changes the P/I gain by using the loader during the operation of the inverter, it applies. In case of P gain, the ramp time is switched based on 1000[%], and in case of I gain, switched based on 200[sec].

For example, if APP-50(PI Gain Ramp) is set up at 30 [sec], and P gain is switched to 200[%] from 100[%], the necessary time is 3[sec] (=30*100/1000).

Multiple function input 'Web PI Gain2' status	P/I gain to be selected
Off	APP-22 (PID P-Gain), APP-23 (PID I-Time)
On	APP-45 (PID P2-Gain), APP-46 (PID I2-Time)

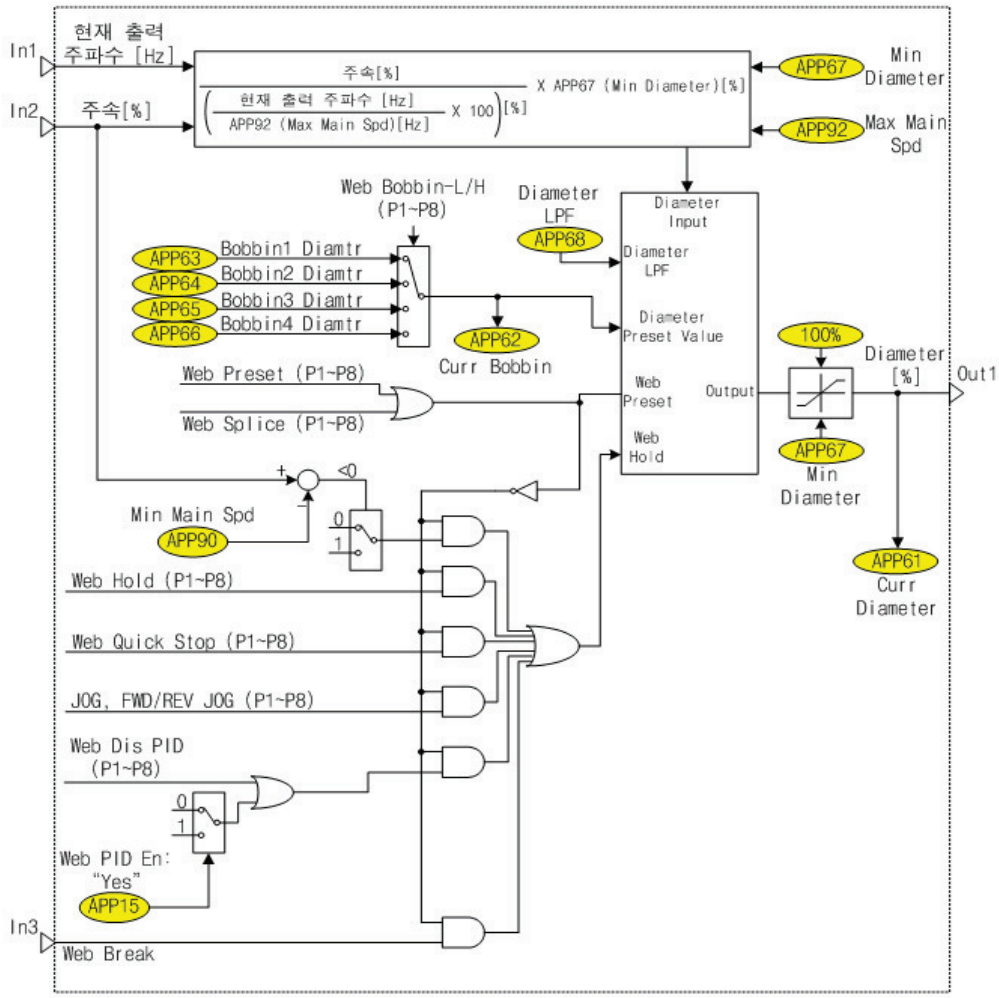
Table 1.4.2 How to select P/I gain according to multiple function input 'Web PI Gain2'

(4) Disturbance compensation function

Group	Code No.	Function indication	Name	Factory setting value	Setting range
APP	86	W Noise Band	Disturbance detection band	0.0[%]	0.0~100.0[%]
APP	87	W Noise P Gain	disturbance compensation P gain	0.0[%]	0.0~100.0[%]
APP	88	W Noise P Ramp	disturbance compensation acceleration/deceleration time	0.0[sec]	0.0~100.0[sec]

If error occurs more than the band set by APP-86 (W Noise Band) from the location of dancer or load cell due to external factors, the sudden fluctuation of the dancer or loadcell may be stabilized by using the P gain set by the APP-87(W Noise P Gain). APP-88(W Noise P Ramp) is the correction of disturbance compensation.

1.5 Diameter computation part



There is a correlation between wire speed, electric motor speed and diameter of winder/unwinder at the tension control system as seen in the formula 1.5.1.

$$Wire\ speed[mpm] = M$$

$$otor\ speed\ [rpm] \times (diameter \times \pi)[m] = schedule \quad - formula(1.5.1)$$

Please see the example of the winder at the closed loop tension control system first. Unless the user adjusts voluntarily the wire speed, the wire speed [mpm] is always constant, and the actual diameter [m] of the winder increases as time goes by. Therefore, since the wire speed which has to be constant specified in the formula 1.5.1 increases, the tension

against the dancer or loadcell increases. Therefore, the output of Web PID controller becomes (-), and the actual speed [rpm] of electric motor decreases. In turn, this decreases the wire speed in the formula 1.5.1 to maintain constant value.

You can estimate the computation of diameter as seen in the formula 1.5.2 by using the wire speed (always constant) of winder [mpm] and the actual speed (decreased) of electric motor [rpm]. It is expected that the estimated diameter will be likely increased as time goes by.

$$Estimated\ \ diameter \times \pi [m] = \frac{Wire\ \ speed[mpm]}{Motor\ \ speed\ [rpm]} \quad - Formula(1.5.2)$$

Next, let's see the example of the unwinder.

As expected, unless the user adjusts voluntarily the wire speed, the wire speed [mpm] is always constant, and the actual diameter [m] of the winder decreases this time as time goes by. Therefore, since the wire speed which has to be constant like in the formula 1.5.1 decreases, the tension against the dancer or loadcell increases like winder.

However, unlike winder, in case of the unwinder, the sign of Web PID controller output is reversed inside. Therefore, since the output of the Web PID controller becomes (+) value, the actual speed [rpm] increases contrary to the winder. The wire speed of the formula 1.5.1 increases again, and constant value will be maintained.

You can estimate the computation of diameter as seen in the formula 1.5.2 by using the wire speed (always constant) of unwinder [mpm] and the actual speed (decreased) of electric motor [rpm]. It is expected that the estimated diameter will be likely decreased as time goes by.

(1) Function to select bobbin and initialize diameter

Group	Code No.	Function indication	Name	Factory setting value	Setting range
IN	65~72	Px Define	Set up multiple function input	Web Preset	-
IN	65~72	Px Define	Set up multiple function input	Web Bobbin-L	-
IN	65~72	Px Define	Set up multiple function input	Web Bobbin-H	-
APP	62	Curr Bobbin	Display current bobbin	Read Only	

Group	Code No.	Function indication	Name	Factory setting value	Setting range
APP	63	Bobbin1 Diamtr	bobbin1 diameter[%]	10.0[%]	APP-67~100.0[%]
APP	64	Bobbin2 Diamtr	bobbin2 diameter[%]	15.0[%]	APP-67~100.0[%]
APP	65	Bobbin3 Diamtr	bobbin3 diameter[%]	20.0[%]	APP-67~100.0[%]
APP	66	Bobbin4 Diamtr	bobbin4 diameter[%]	25.0[%]	APP-67~100.0[%]

APP-62 (Curr Bobbin): This indicates the number (1~4) of the currently selected bobbin.

APP-63~66 (Bobbin # Diamtr): The diameter of bobbin will be selected as follows according to the combination of multiple function input 'Web Bobbin-L', 'Web Bobbin-H'. If the bobbin is selected, make the multiple function input 'Web Preset' On ➔ Off to initialize the diameter of the selected bobbin.

Multiple function input 'Web Bobbin-H'	Multiple function input 'Web Bobbin-L'	Selected bobbin
Off	Off	Bobbin1 (APP-63)
Off	On	Bobbin2 (APP-64)
On	Off	Bobbin3 (APP-65)
On	On	Bobbin4 (APP-66)

For example, if there are four types of bobbins as seen in the following figure, input the computated value 14.2[%], 28.5[%], 35.7[%], 50.0[%] into APP-63~66 (Bobbin # Diamtr) respectively. And then, enter the %diameter 14.2[%] of Bobbin 1, the smallest bobbin, into APP-67 (Min Diameter).

Select currently attached bobbin by combining multiple function input 'Web Bobbin-L', 'Web Bobbin-H,' and turn On➔Off multiple function input 'Web Preset' to initialize it.

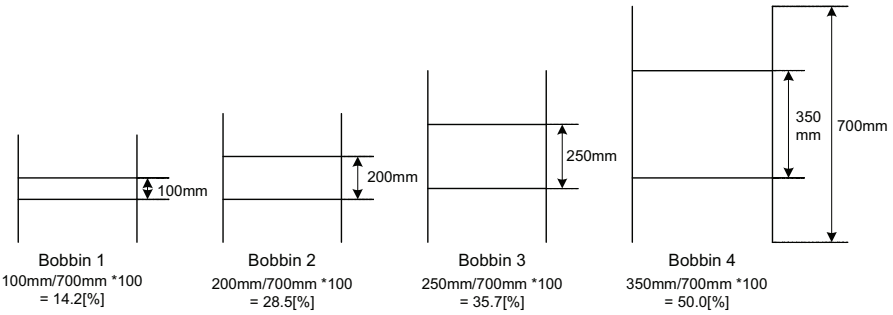


Figure 1.5.1 In case there are multiple sizes of bobbins

⚠ CAUTION

When replacing bobbin, be sure to turn On➔Off multiple function input 'Web Preset'. If the multiple function input 'Web Preset' is on, it cannot calculate the diameter.

(2) Function to computate diameter

Group	Code No.	Function indication	Name	Factory setting value	Setting range
APP	61	Curr Diameter	Display current diameter [%]	Read Only	
APP	67	Min Diameter	Min. bobbin diameter[%]	10.0[%]	5.0~100.0[%]
APP	68	Diameter LPF	Diameter computation filter	30.0[sec]	0.0~300.0[sec]
APP	92	Max Main Spd	Frequency against main speed 100%	60.0[Hz]	0.0~DRV-20[Hz]

Convert the formula 1.5.2 into [%] scale to reorganize it into the formula 1.5.3.

$$Estimated\ \ diameter\ [\%] = \frac{Main\ \ speed\,[\%]}{\frac{Current\ \ output\ \ frequency\,[Hz]}{APP-92\,(Max\ Main\ Spd)}\times 100\ [\%]} \times APP-67\,(Min\ Diameter) \quad -\ Formla\,(1.5.3)$$

If the formula 1.5.3 is explained by using the principle of winder operation, it is as follows.

Unless the user is voluntarily changed, the commaned 'main speed [%]' is always constant, and the actual diameter of winder bobbin increases as time goes by. At the same time, the scale of the tension against the

dancer or loadcell gradually increases. Therefore, the Web PID controller makes (-) output, and the 'current output frequency [Hz]' of inverter decreases. Therefore, the 'estimated diameter [%]' increases according to the formula 1.5.3. This 'estimated diameter [%]' is limited at upper limit 100[%], lower limit APP-67 (Min Diameter) internally. As the correction of the 'estimated diameter [%]' APP-68 (Diameter LPF) is set up to adjust the calculation speed of the diameter [%].

This 'estimated diameter [%]' becomes very important factor when the final speed command [Hz] of the inverter is determined. The detailed description will be provided in 1.6 Final speed computation part.

APP-61 (Curr Diameter): Indicate current diameter of bobbin[%]. After multiple function input 'Web Preset' is turned On➔Off, the diameter [%] of the selected bobbin is displayed, and the diameter [%] calculated from the formula 1.5.3 will be updated.

APP-67 (Min Diameter): Enter the ratio [%] of the bobbin's diameter which is empty against the diameter of bobbin which is full. If the types of the bobbin are diverse as seen in the Figure 1.5.1, enter the ratio [%] of the smallest diameter against the diameter of the largest bobbin. In case it is like the Figure 1.5.1, enter 14.2 [%] in the APP-67 (Min Diameter).

APP-68 (Diameter LPF): Set up the delayed correction of the diameter [%] calculation. Set it up as normal round-trip time of the traverse.

APP-92 (Max Main Spd): If the main speed command is 100[%], enter the maximum speed [Hz] of the empty diameter of the smallest bobbin. For example, please see followings. The empty diameter of the smallest bobbin in the Figure 1.5.1 is 0.1m (=100mm). Let's assume the maximum wire speed of this system is 350 [mpm], 4-pole motor, and the ratio of belt (motor is faster) is 2.3/1. At this time, the value entered into the APP-92 (Max Main Spd) is calculated by using the formula 1.5.4.

$$APP-92\,(Max\ Main\ Spd) =$$

$$\frac{350[mpm]}{0.10[m]\times\pi} \times 2.3(Belt\ ratio) \times \frac{4(poles)}{120} = 85.46[Hz] \quad -Formula\ (1.5.4)$$

(3) Function to stop computing diameter

Group	Code No.	Function indication	Name	Factory setting value	Setting range
IN	65~72	Px Define	Set up multiple function input	Web Hold	-
APP	90	Min Main Spd	Minimum main speed	3.0[%]	0.0~100.0[%]

If one of following conditions is met, the computation of diameter should be stopped: multiple function input 'Web Hold' is On, jog operation, web PID is prohibited, low speed below APP-90 (Min Main Spd), the status of web break, quick stop zone by entering multiple function input 'Web Quick Stop'. The reason is because the diameter calculation is only meaningful in case of normal operation status.

- **multiple function input 'Web Hold': On or**
- **main speed command[%] < APP-90 (Min Main Spd) or**
- **multiple function input 'Web Quick Stop': quick stop by On or**
- **web break detection status(Web Break) or**
- **multiple function input 'Web Dis PID': On or**
- **APP-15 (Web PID En): No or**
- **Jog operation**

➔ Stop calculating diameter

1.6 Final speed computation part

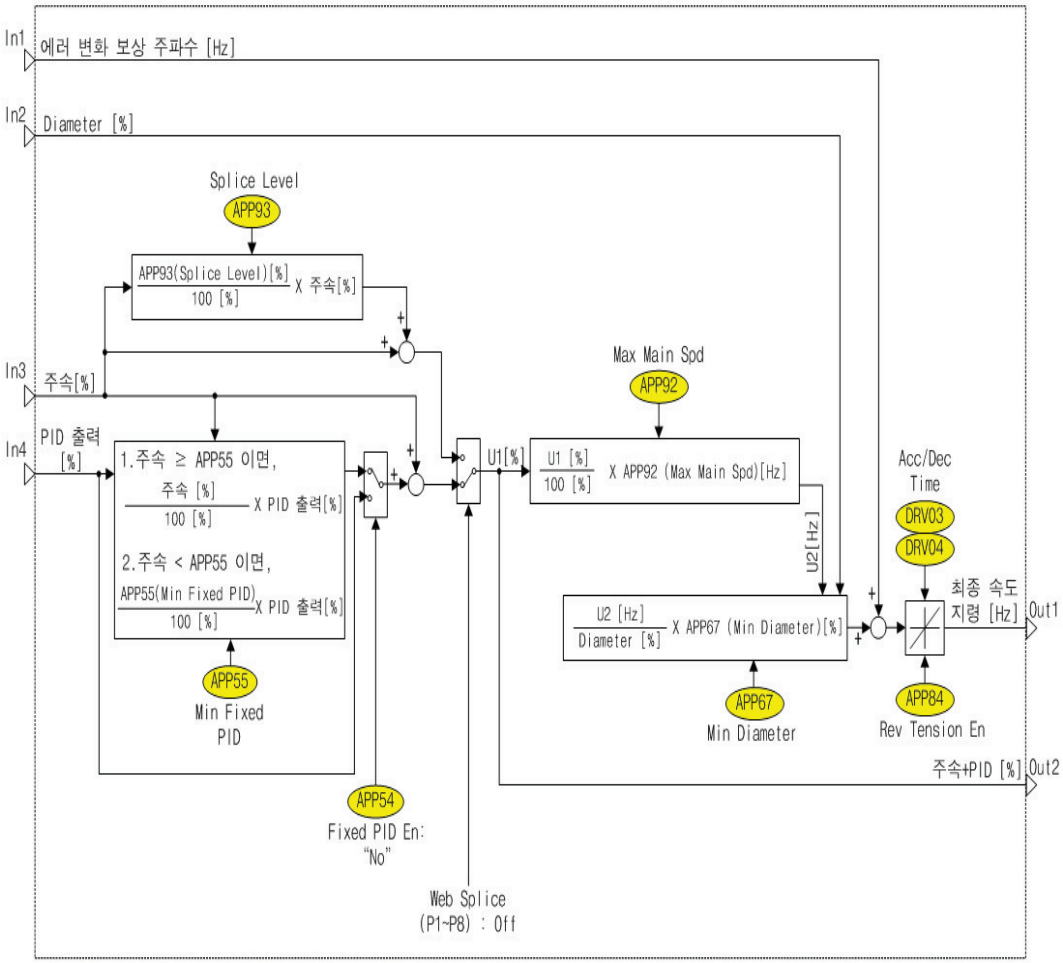


Figure 1.6.1 Final speed computation part

Final speed computation part determines the final speed command[Hz] of the inverter by using main speed (In3:main speed[%]) calculated by main speed command part, PID output (In4: PID output[%]) calculated by Web PID controller part, error change compensation frequency (In1), and diameter (In2: Diameter[%]) calculated by diameter computation part.

(1) PID output methods (Fixed/unfixed PID controller)

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
APP	54	Fixed PID En	Select fixed PID controller	0: No	0	No
					1	Yes
APP	55(Note1)	Min Fixed PID	Minimum value of fixed PID controller	10.0[%]	0.0~50.0[%]	

(Note1): If APP-54(Fixed PID En) is selected as 'No,' these codes appear.

If APP-54 (Fixed PID En) is selected as 'Yes,' the PID output[%], which is the output of the Web PID controller is always constant regardless of the size of main speed[%] as seen in the Figure 1.6.1.

$$Final\ PID\ output\ [\%] = PID\ output\ [\%] \quad -Formula\ (1.6.1)$$

If APP-54 (Fixed PID En) is selected as 'No,' which is factory setting value, the PID output[%], which is the output of the Web PID controller is always proportionate to the main speed[%] as seen in the Figure 1.6.2. That means, it maintains the ratio which PID output[%] takes up in the main speed. If the main speed [%] is decreased, the PID output [%] decreases by being proportionate to it, and if the main speed [%] increases, the PID output [%] increases in proportionate to it.

$$Final\ PID\ output\ [\%] =$$

$$PID\ output\ [\%] \times \frac{Main\ speed\ command\ [\%]}{100.0[\%]} \quad -Formula\ (1.6.2)$$

However, when the APP-54 (Fixed PID En) is selected as 'No' which is factory setting value, low main speed[%] command which is lower than the value set by APP-55 (Min Fixed PID) comes in, it operates like the formula 1.6.3. As it operates like the formula 1.6.3, it prevents the output of Web PID controller from getting too low at main speed command[%] below than APP-55 (Min Fixed PID).

$$Final\ PID\ output\ [\%] =$$

$$PID\ output\ [\%] \times \frac{APP-55(Min\ Fixed\ PID)[\%]}{100.0[\%]} \quad -Formula\ (1.6.3)$$

The Table 1.6.1 shows how the final PID output [%] is determined according to the setting of APP-54 (Fixed PID En) when APP-32(PID Out Scale) is set at '20[%]' and APP-55 (Min Fixed PID) is set at '10[%]' which is factory setting value, and assuming PID output is saturated at 20[%].

Main speed command[%]	APP-54(Fixed PID En): Yes PID output[%] when 'Yes'	APP-54(Fixed PID En): PID output[%] when 'No'
2.0	20.0	2.0(Note 1)
8.0	20.0	2.0(Note 1)
20.0	20.0	4.0(Note 2)
80.0	20.0	16.0(Note 2)

Table 1.6.1 Comparison of PID output according to the type of PID controller (APP-54:Fixed PID En)

(Note 1) of the Table 1.6.1 is determined by the formula 1.6.3 because the main speed is 2% or 8% which is below than Factory setting value 10[%] of the APP-55 (Min Fixed PID).
(Note 2) is determined by the formula 1.6.2 because the main speed is 20% or 80% which is above than Factory setting value 10[%] of the APP-55 (Min Fixed PID).

(2) Computation of final speed [Hz]

In the Figure 1.6.1, U1[%] is 'main speed command[%] + PID output[%],' and if this is converted into [Hz] unit, it is as the formula 1.6.4.

$$Main\ speed + PID\ output[Hz] = \frac{Main\ speed + PID\ output[\%]}{100.0[\%]} \times APP-92\,(Max\ Main\ Spd)[Hz] \quad -Formula\ (1.6.4)$$

Now, if the formula 1.5.1 in the chapter 1.5 is transformed, it is as the formula 1.6.5. The final speed [Hz] of the inverter is calculated and displayed by the formula 1.6.5.

$$Final\ speed[Hz] = \frac{Wire\ speed\ [mpm]}{(Diameter \times \pi)[m]} = \frac{Main\ speed + PID\ output[Hz]}{Estimated\ diameter[\%]} \times APP-67(Min\ \ Diameter)[\%] \quad -Formula\,(1.6.5)$$

Group	Code No.	Function indication	Name	Factory setting value	Setting range
APP	89	Compen Xcel %	Ratio which reflects compensation by the diameter calculation at final speed	20 [%]	0~100[%]

APP-89 (Compen Xcel %): As seen in the formula 1.6.5, the final output frequency of the inverter is compensated by the estimated diameter [%] again. The variation amount of the output frequency occurred by the estimated diameter [%] is set to see what rate and response speed is reflected against actual inverter output frequency.

The smaller the APP-89(Compen Xcel %) is (less than 50[%]), the smaller the portion which the output frequency occurred from the estimated diameter takes among the inverter output frequency, and the slower the reflected speed is.

It is desirous to set the APP-89(Compen Xcel %) below than about 50[%] for stable operation at constant speed.

⚠ CAUTION

The final speed [Hz], which is the final value of the formula 1.6.5 regularly calculated from the final speed computation part, is frequently accelerated or decelerated. The acceleration/deceleration time is DRV-03(Acc Time), DRV-04(Dec Time).

Also, if '5:Tension Ctrl' is selected from APP-01(App Mode), DRV-03(Acc Time) and DRV-04 (Dec Time) are automatically set at '0.5sec'. Although DRV-03(Acc Time) and DRV-04 (Dec Time) are set at another value, they have to be set at short time less than 2.0 [sec] in order to reflect the final speed fastly.

(3) Reverse slow speed function

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
APP	84	Rev Tension En	Select reverse slow speed function	0: No	0	No
					1	Yes

(4) Splicing function

Group	Code No.	Function indication	Name	Factory setting value	Setting range
IN	65~72	Px Define	Set up multiple function input	Web Splice	-
APP	93	Splice Level	Splicing level	0.0[%]	0.0~100.0[%]

The splicing system can replace bobbin during operation since two inverters control each motor. In the splicing system, bobbins should be replaced without change in the wire speed.

If the multiple function input which is set at '57:Web Splice' of inverter is on, the output of Web PID controller is blocked, and the final speed command of the inverter is determined by the formula 1.6.6 ~ 1.6.8 where main speed command[%] and APP-93 (Splice Level) are combined.

The reason why the second term in the right side in the formula 1.6.6 is added is as follows. The moment when materials are wound up on the new bobbin, rapid change of load may occur and the material may be drooping. In order to avoid this phenomenon, when materials are wound up on the new bobbin, slightly raise the speed as much as APP-93 (Splice Level).

For example, when APP-93 (Splice Level) is set up at 20[%], and main speed command is 50[%], if the multiple function input which is set as '57:Web Splice' is on, the main speed will be 60[%] (=50[%] + 50[%] * 20[%]/100[%]).

$$Main\ speed\ command[\%] =$$

$$Main\ speed[\%] + Main\ speed[\%] \times \frac{APP-93(Splice\ Level)[\%]}{100[\%]} \quad -formula\ (1.6.6)$$

If it is converted into frequency [Hz] unit, it is as the formula 1.6.7.

$$Main\ speed\ command[Hz] =$$

$$\frac{Final\ main\ speed\ command\ [\%]}{100.0[\%]} \times APP-92(Max\ Main\ Spd)[Hz] \quad -formula\ (1.6.7)$$

The formula 1.6.7 is finally converted into the formula 1.6.8 and displayed by the final speed command of the inverter. The reason why the 'initial diameter [%]' is in the denominator of the right side of the

formula 1.6.8 is because when multiple function which is set as '57:Web Splice' is on, the diameter of the bobbin is initialized as the diameter selected among APP-63~66 (Bobbin # Diamtr).

$$Final\ speed\ command[Hz] = \frac{Main\ speed\ command[Hz]}{Initial\ diameter[\%]} \times APP-67(Min\ Diameter)[\%] \quad - Formula(1.6.8)$$

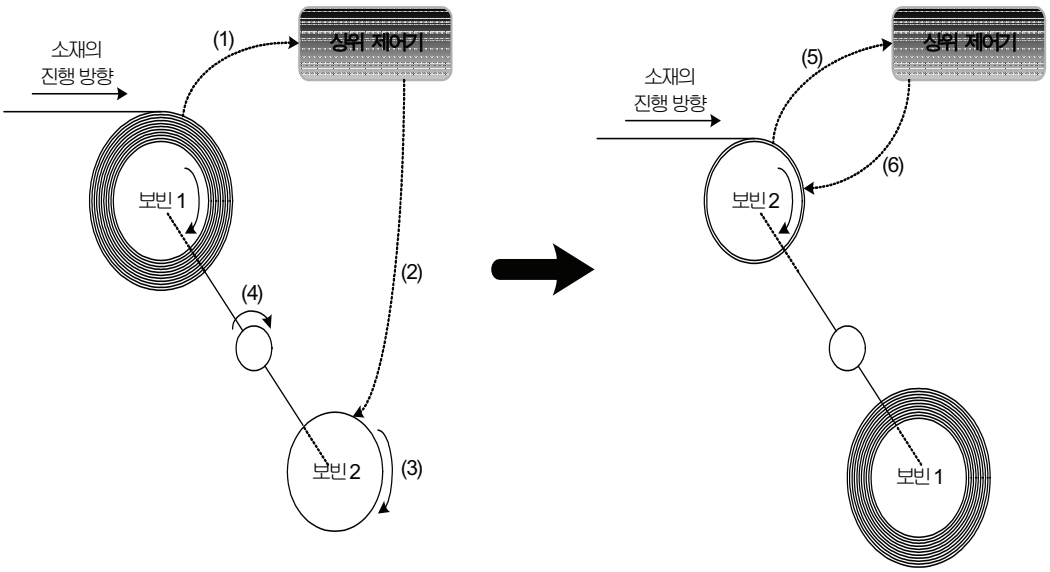


Figure 1.6.2 Conceptual diagram of splicing

Usually the splicing system of the winder is composed as the Figure 1.6.2. The motion sequency is explained with the Figure 1.6.2.

The bobbin 1 sends the signal which indicates it is almost full to the upper controller. (Figure 1.6.2 (1))

The upper controller sends 'On' signal to the relevant multiple function input which is set up as '57:Web Splice' of the inverter controlling bobbin 2 which is currently empty. (Figure 1.6.2 (2))

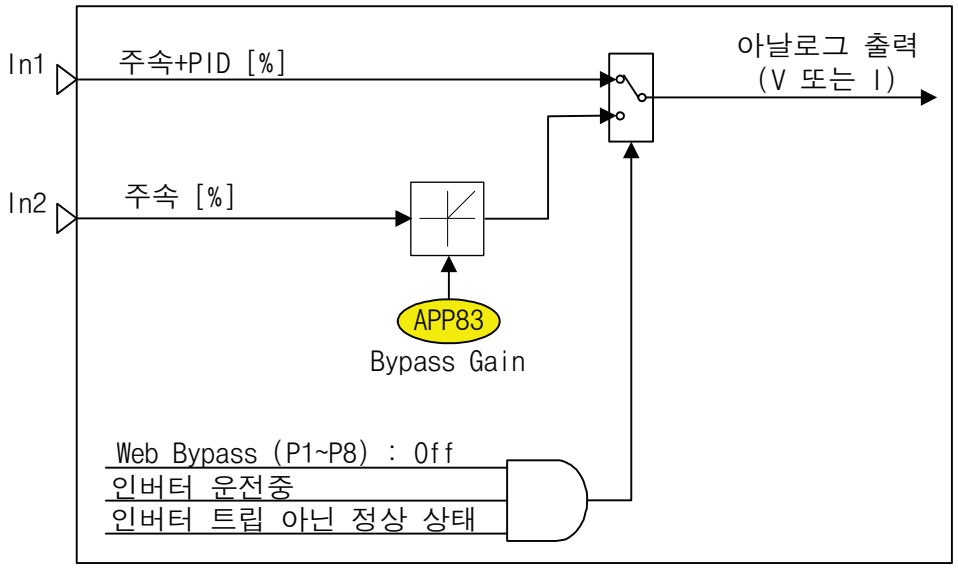
The inverter starts to run the empty bobbin 2 with the command value combining main speed command[%] and APP-93 (Splice Level) as seen in the formula 1.6.6 – 1.6.8 while the output of Web PID controller is blocked. (Figure 1.6.2 (3))

The axis replacing bobbin rotates at 180 degree to replace the position of bobbin 1 and bobbin 2. (Figure 1.6.2 (4))

Send signal it is changed to bobbin 2 to the Upper controller. (Figure 1.6.2 (5))

The upper controller sends OFF signal to relevant multiple function input set as '57: Web Splice' of inverter which controls the bobbin 2 to stop the splicing motion. Now, the Web PID controller is operating again, and the diameter is being calculated again, the inverter's output frequency is decided by the formula 1.6.5. (Figure 1.6.2 (6))

1.7 Analogue Output Part



Group	Code No.	Function indication	Name	Factory setting value	Setting range
OUT	01, 07	AO1, AO2 Mode	analogue output 1, 2	Web Spd Out	-
APP	83	Bypass Gain	Bypass gain	100.0[%]	0.0~300.0[%]

At inverter normal operation status (multiple function input 'Web Bypass' is Off , inverter is operating, inverter trip not, normal status), main speed + PID output[%] can be sent to analogue output (AO1: 0~10V voltage, AO2: 0~20mA current).

When the inverter is not normal operation status (multiple function input ‘Web Bypass’ is On, or inverter is stopped, or inverter is trip), multiply main speed[%] with APP-83 (Bypass Gain), and send it to analogue output (AO1: 0~10V voltage, AO2: 0~20mA current).

1.8 Web Break Detection Part

The closed loop tension control system uses a tension detection device like dancer or loadcell. If the value received from the detection device is smaller or larger than the setting time, the inverter determines that the web materials may be bursted, so it informs this to the upper controller through multiple function output contact point, and begin appropriate protection motion according to the setting.

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
OUT	31~33	Relay1, 2, Q1	multiple function output contact point	Web Break	-	
APP	76	Web Brk En	Select web break detection function	1: Warning	0	None
					1	Warning
					2	Free-run
APP	77(Note1)	Web Brk St Dly	Delayed time for detecting disconnection at initial run	10.0[sec]	0.0~300.0[sec]	
APP	78(Note1)	Web Brk Dly	Delayed time for detection disconnection	5.0[sec]	0.0~300.0[sec]	
APP	79(Note1)	Web Brk Lev Hi	Upper limit to detect disconnection	80.0[%]	APP80~100.0[%]	
APP	80(Note1)	Web Brk Lev Lo	Lower limit to detect disconnection	20.0[%]	0.0~APP79[%]	

(Note 1): APP-76(Web Brk En) is selected as 'Warning' or 'Free-run', this code appears.

APP-76 (Web Brk En): If 'None' is selected, the web break detection function does not work.

If 'Free-run' is selected, once the web break is detected, the inverter free-run is stopped. If the multiple function output contact point is set as '29: Trip,' then relevant multiple function output contact point becomes 'On'.

If the ‘Warning,’ which is factory setting value, is selected, once the web break is detected, the inverter free-run is not stopped. It runs normally. The digital loader displays Warning. If the multiple function output contact point is set as ‘36: Web Break,’ then the relevant multiple function output contact point will become ‘On’. If a user orders stop command to the inverter and it completely stopped, then the Warning displayed on the digital loader will be released, and the multiple function output set as ‘36: Web Break’ will become ‘Off’.

APP-77 (Web Brk St Dly): From the initial run of the inverter until it passes the time set by this code, the web break detection function does not work. Because the location of dancer or loadcell is unstable at the initial run, it is meaningless to detect the web break during this period.

APP-78 (Web Brk Dly): When the analogue amount feedbacked from the dancer or loadcell is above the web break detection level (APP-79:Web Brk Lev Hi), or below the web break detection level (APP-79:Web Brk Lev Lo), and it stay in this status for more than the time set by this code, it is considered as web break status.

APP-79 (Web Brk Lev Hi): When the analogue amount feedbacked from the dancer or loadcell is larger than the value set by this code, the web break detection action begins.

APP-80 (Web Brk Lev Lo): When the analogue amount feedbacked from the dancer or loadcell is smaller than the value set by this code, the web break detection action begins.

2. Capstan operation

2.1 Overview

The meaning of Capstan is a device to wind up heavy things at constant speed.

Capstan is located between unwinder and winder in the iron making and steel making processes, and it allows continuous process by maintaining tension.

The capstan function of the iS7 inverter is as same as the winder/unwinder function. PID controller is operated to maintain tension by feedbacking analogue amount from the tension control detection device such as dancer or loadcell.

Due to the features of PID controller of closed loop tension control system, there are some different points from the existing PID controller, this manual calls it as Web PID controller.

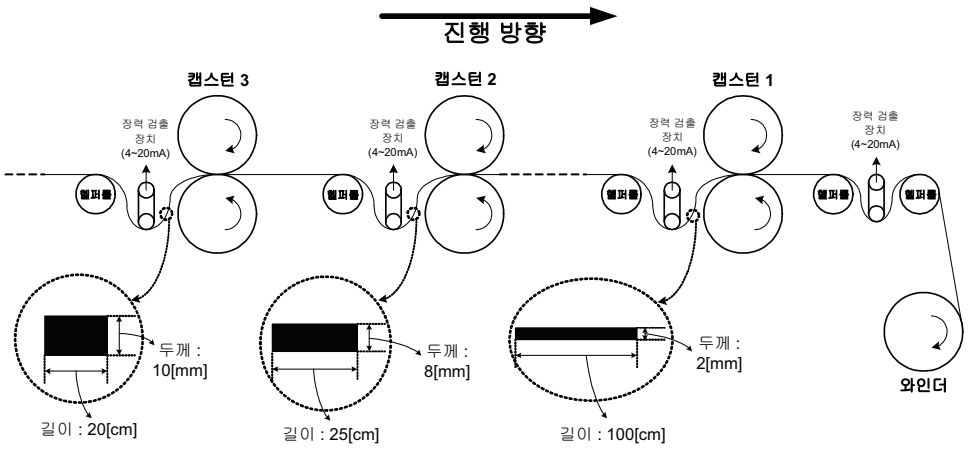


Figure 2.1.1 The principle of operating capstan

As seen in the Figure 2.1.1, in the continual process, the smaller the thickness of materials is, the faster the speed of the rotation of capstan should be. Because the materials should not be leaned to top or bottom in order to conduct the continual process well, materials which are different in thickness and length should be handled in same time. Although the thickness of materials is different by processes, if there is no loss of materials at all in each process, the volume of materials is always same. Therefore, since the thickness of materials (2[mm])

handled by the capstan 1 is 1/4 times of the thickness of materials (8[mm]) handled by the capstan 2, the length of the materials (100[cm]) to be processed by capstan 1 is 4 times longer than the length of the materials (25[cm]) to be handled by the Capstan 2. Therefore, the rotation speed of the capstan 1 should be 4 times faster than the rotation speed of the capstan 2 in order to handle materials with different lengths during same time.

According to this principle, in the capstan operation, the formula 2.1.1. is established. This is similar to the formular 1.1.1 of winder/unwinder.

$$Motor\ \ speed\ [rpm]\ =$$

$$\frac{Wire\ \ speed\,[mpm]}{Diameter\ \ of\ \ caps\tan\times\pi\,[m]}\times\frac{Base\ \ thickness\ \ of\ \ materials\ [m]}{Current\ \ thickness\ \ of\ \ materials\ [m]}\quad -\ Formula\,(2.1.1)$$

The speed of the motor, that is, the output frequency of the inverter is controlled by the Web PID controller. The ‘current thickness of materials’ is calculated and estimated internally, and the output frequency of inverter is finally decided by using the ‘current thickness of materials calculated in the formula 2.1.1.

This method shows much more stable performance than the control of tension for capstan by only using the existing PID controller. Because, the calculated thickness of materials compensates the output frequency of inverter once again, the ratio of the Web PID controller against the output frequency of inverter becomes very small. Therefore, the risk of saturation of Web PID controller disappear, and the ocilliation of I controller output will be significantly reduced.

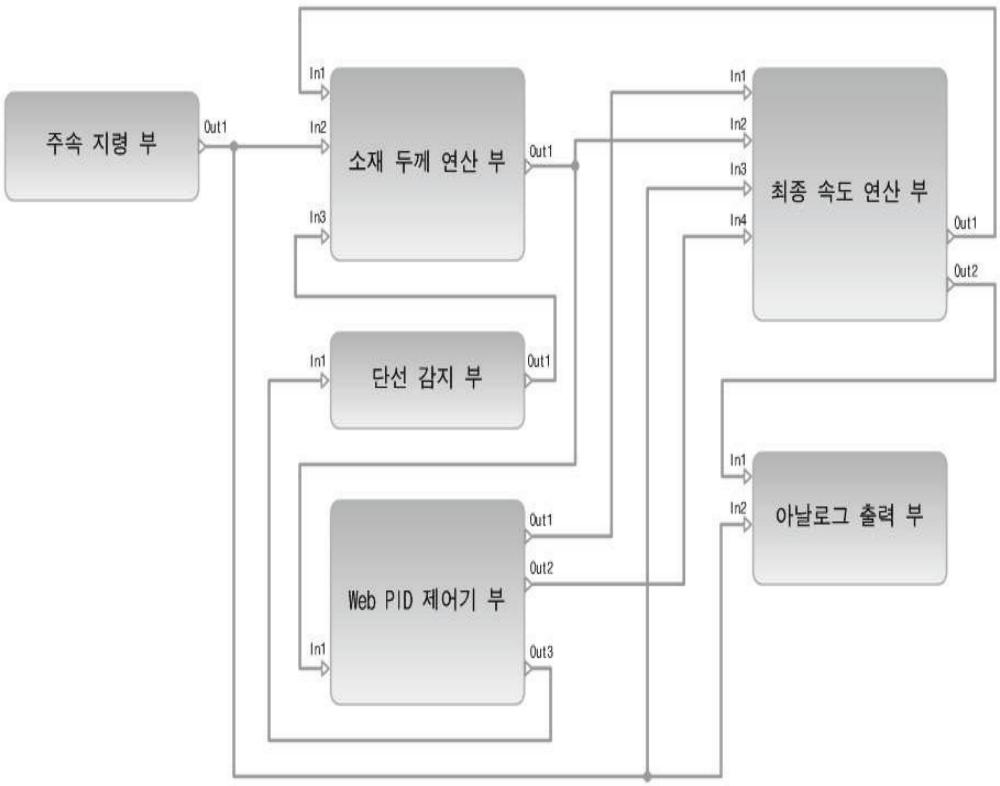
Summary of other major functions are as follows;

- Remove transient phenomena like dancer or loadcell (related code: APP-51)
- Function to stop quickly by maintaining tension (related code: APP-82)
- Function to detect web materials before burst (related code: APP-76~80)

In iS7, in order to use the Capstan function, it has to be set up as follows.

Group	Code No.	Function indication	Name	Setting value
APP	01	App Mode	Select application	5: Tension Ctrl
APP	02	Tnsn Ctrl Mode	Select tension control operating mode	2: Capstan

2.2 Overall Composition



Main speed command part | Thickness of materials calculation part | Final speed calculation part

Web break detection part

Web PID controller part | Analogue output part

The input and output of each part is as follows.

Function part	Input		Output	
main speed command part	-		Out1	main speed [%]
Web PID controller part	In1	Diameter [%]	Out1	Error conversion compensation frequency [Hz]
			Out2	PID output [%]
			Out3	PID Feedback [%]
Materials thickness computation part	In1	Current output frequency [Hz]	Out1	Thickness [%]
	In2	Main speed [%]		
	In3	Web Break		

Function part	Input		Output	
		occurrence (0/1)		
Final speed computation part	In1	Error conversion compensation frequency [Hz]	Out1	Final speed command [Hz]
	In2	Diameter [%]		
	In3	main speed [%]	Out2	main speed + PID [%]
	In4	PID output [%]		
Analogue output part	In1	main speed + PID [%]	-	
	In2	main speed [%]		
Web break detection part	In1	PID Feedback [%]	Out1	Web Break occurrence (0/1)

2.3 Main speed command part

This is same as the main speed command part of winder/unwinder specified in the 1.3. Please see 1.3.

2.4 Web PID controller part

This is same as the Web PID controller part of winder/unwinder specified in the 1.4. Please see 1.4.

2.5 Analogue output part

This is same as the Analogue output part of winder/unwinder specified in the 1.7. Please see 1.7.

2.6 Web break detection part

This is same as the Web break detection part of winder/unwinder specified in the 1.8. Please see 1.8.

2.7 Materials thickness computation part

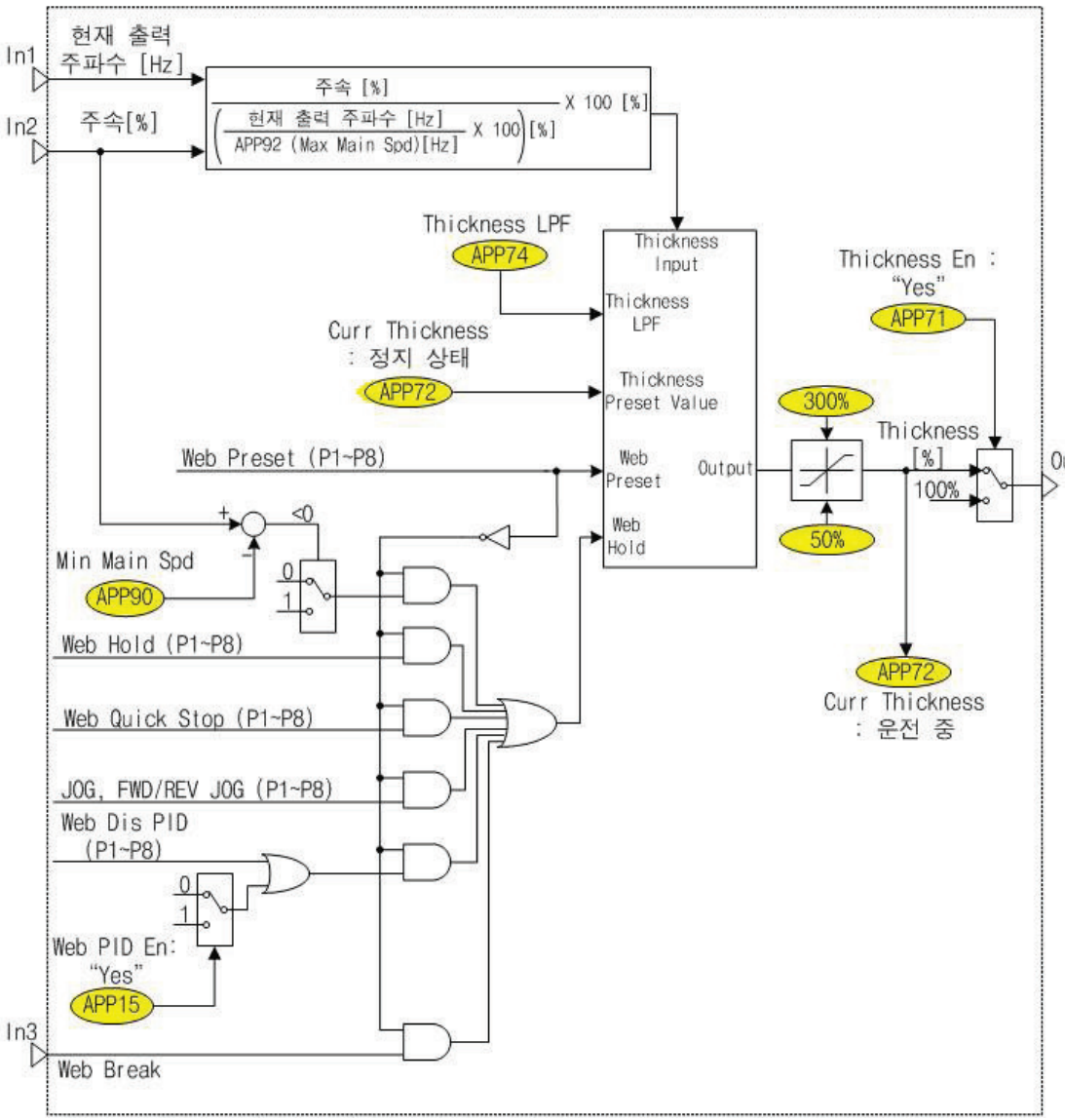


Figure 2.7.1 shows continual process among closed loop tension control system. As the process continues, the thickness of the web materials decreases. However, the volume of the materials entered into each capstan is constant. Therefore, if the thickness of materials to be entered in Capstan 3 is 10[mm], thickness of materials to be entered in the Capstan 2 is 8 [mm], and the thickness of materials to be entered in the Capstan 1 is 2 [mm], the length of the materials will be 20[cm], 25[cm] and 100[cm] for Capstan 3, 2, 1 respectively. Thus, the speed of the rotation of each capstan should be in the order of Capstan1 >

Capstan2 > Capstan3, in order for the materials not to be droop to the bottom or leaned to top, but to be operated normally.

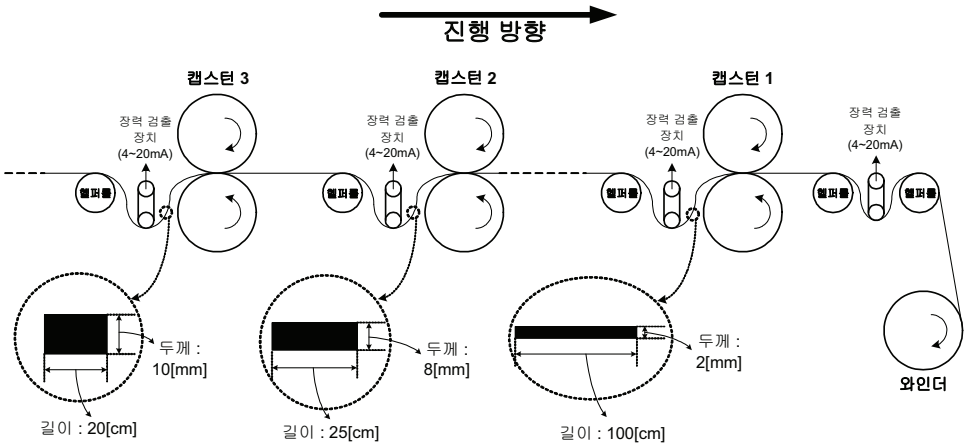


Figure 2.7.1 The principle of operating Capstan

Therefore, there is a correlation between wire speed, speed of motor and thickness of materials in the continuous process out of the tension control system as seen in the formula 2.7.1.

$$Motor\ \ speed\ [rpm]\ =$$

$$\frac{Wire\ \ speed[mpm]}{Diameter\ \ of\ \ caps\tan\times\pi[m]}\times\frac{Basethicknes\ \ of\ \ materials\ [m]}{Current\ \ thickness\ \ of\ \ materials\ [m]}\quad -\ Formula\,(2.7.1)$$

As shown in the formula 2.7.1, the speed of motor [rpm] is determined by the wire speed [mpm] and the current thickness of materials [m]. Therefore, current thickness of materials [m] should be calculated and estimated during the operation of the inverter. If the formula 2.7.1 is transformed, it is as formula 2.7.2. The thickness of materials[m] can be estimated by using the formula 2.7.2.

$$Estimated\ \ current\ \ thickness\ \ of\ \ materials[m]\ =$$

$$\frac{Wire\ \ speed[mpm]}{Motor\ \ speed[rpm]\times(Diameter\ \ of\ \ caps\tan\times\pi)[m]}\times Base\ \ thickness\ \ of\ \ materials\ [m]$$

$$-\ Formula\,(2.7.2)$$

(1) Function to initialize the thickness of materials.

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
IN	65~72	Px Define	Set up multiple function input	Web Preset	-	
APP	71	Thickness En	Select calculation of thickness of materals	1: Yes	0	No
					1	Yes
APP	72	Curr Thickness	initial thickness of materials setting and currently calculated thickness of materials displayed	100.0[%]	50.0~500.0[%]	

APP-72 (Curr Thickness): Enter the initial thickness of materials[%] in stop status. It cannot be set up during operation. During operation, it displays the thickness of materials [%] currently being operated.

For the method to set up this code, for example, please see followings.

If the inverter is installed at Capstan1, Capstan2, Capstan3 from the Figure 2.7.1, each inverter's APP-72(Curr Thickness) has '100.0[%]' value. Now, the operating begins, each inverter's APP-72 (Curr Thickness) shows the estimated thickness of materials calculated from the inside of iS7. If each capstan calculates and enters exact value in APP-92(Max Main Spd) by considering the main speed and gear ratio accurately, each inverter's APP-72(Curr Thickness) will be slowly changed within 100[%] ± 5[%].

If APP-72(Curr Thickness) is displayed less than 80[%] during the inverter operation, it means too small value was entered into APP-92(Max Main Spd). Also, if APP-72(Curr Thickness) is displayed more than 120[%] during the inverter operation, it means too large value was entered into APP-92(Max Main Spd).

If accurate value is not entered into the APP-92(Max Main Spd), check the output of the inverter and enter it into the APP-92(Max Main Spd) when main speed 100[%] is entered. Also, substitute the wire speed measured by portable tacometer and gear ratio (or belt ratio) and the diameter of capstan with the formula 2.7.4 to calculate and enter APP-92(Max Main Spd).

The details related to trial run will be explained in the Appendix.

⚠ CAUTION

Be sure to check multiple function input 'Web Preset' is Off. If multiple function input 'Web Preset' is On, it cannot calculate the thickness of materials.

(2) Function to calculate the thickness of materials

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
APP	71	Thickness En	Select to calculate the thickness of materials.	1: Yes	0	No
					1	Yes
APP	72	Curr Thickness	Initial thickness setting (stop status) or current thickness (operating)	100.0[%]	50.0~300.0[%]	
APP	74	Thickness LPF	Materials thickness calculation filter	30.0[sec]	0.0~300.0[sec]	
APP	92	Max Main Spd	Frequency against main speed 100%	60.0[Hz]	DRV-19~DRV-20[Hz]	

The formula 2.7.2 can be converted into [%] scale and reorganized as the following formula 2.7.3

$$Estimated\ thickness\ of\ materials\ [\%] = \frac{Main\ speed\ input[\%]}{\frac{Current\ output\ frequency[Hz]}{APP-92\,(Max\ Main\ Freq)}\times 100\ [\%]} \times 100[\%] \quad -\ Formula\,(2.7.3)$$

100[%] multiplied to the right side of the formula 2.7.3 is the base thickness of the materials. This 'Estimated thickness of materials[%]' is

limited to upper limit 300[%], lower limit 50[%] internally. The correction of 'Estimated thickness of materials[%]' can be adjusted by APP-74 (Thickness LPF) to adjust the correction of the calculation of the thickness [%] of materials.

How the thickness of materials[%] is estimated during inverter operation is explained as follows by using the formula 2.7.3. Let's assume Capstan 2 APP-73 (Thickness Set) is set as '150[%]' instead of '100[%]' which is factory setting value. Therefore, the inverter of Capstan 2 recognize the thickness of materials as '150[%]'. This means that the actual thickness of materials handled by Capstan 2 is 8[mm], but inside of the inverter of Capstan 2 can recognize it as 8 * 1.5=12[mm]. Therefore, since it is operated at 1/1.5 times lower than when the thickness of materials is '100[%],' the size of tension against dancer or loadcell will be reduced. Therefore, the Web PID controller shows (+) output, and the 'current output frequency [Hz]' will increase. In the formula 2.7.3, the 'Estimated thickness of materials[%]' is in inverse proportion to 'current output frequency[Hz],' it is reversely reduced and converged to the value around 100[%] of original thickness of the materials handled by the capstan 2. This 'Estimated thickness of materials[%]' is very important factor when deciding inverter's final speed command[Hz]. This will be explained in 2.8 Final speed computation part with more details.

APP-71 (Thickness En): This selects whether the function to calculate the thickness of materials. If 'No' is selected, do not calculate the thickness of materials[%].

APP-72 (Curr Thickness): Enter initial thickness of materials[%] in stop mode. It cannot be set up during operation. It displays calculated thickness of materials [%] during operation.

APP-74 (Thickness LPF): This sets up delayed correction of thickness of materials[%] calculation.

APP-92 (Max Main Spd): When main speed command is 100[%], enter output frequency of inverter. If you know machinery information like wire speed, capstan diameter and belt ratio, you can calculate APP-92(Max Main Spd) by using the formula 2.7.4.

For example, please see followings. Let's assume the diameter of capstan 1 is 0.4 [m], and the maximum wire speed of this system is 900[mpm], and 4-pole motor, and belt ratio (motor is faster) is 3.2/1. At this time, the value entered into APP-92 (Max Main Spd) is calculated as follows by using the formula 2.7.4.

$$APP92\,(Max\ Main\ \ Spd) =$$

$$\frac{900[mpm]}{0.40[m]\times\pi} \times 3.2(Belt\ ratio) \times \frac{4(poles)}{120} = 76.43[Hz] \qquad -Formula(2.7.4)$$

(3) Function to stop calculation of thickness of materials

Group	Code No.	Function indication	Name	Factory setting value	Setting range
IN	65~72	Px Define	Set up multiple function input	Web Hold	-
APP	90	Min Main Spd	Minimum main speed	3.0[%]	0.0~100.0[%]

If one of following conditions is met, the calculation of thickness of materials should be stopped; multiple function input 'Web Hold' is On, Jog operation, Web PID prohibited, low speed below than APP-90 (Min Main Spd), Web Break status, quick stop zone due to multiple function input 'Web Quick Stop'. Because the calculation of thickness of materials is meaningful only when it is in normal operation.

- **Multiple function input 'Web Hold': On or**
- **Main speed command[%] < APP-90 (Min Main Spd) or**
- **Quick stop by Multiple function input 'Web Quick Stop': On or**
- **Web Break or**
- **Multiple function input 'Web Dis PID': On or**
- **APP-15 (Web PID En): No or**
- **Jog operation**

➔ Stop the calculation of thickness

2.8 Final Speed Computation Part

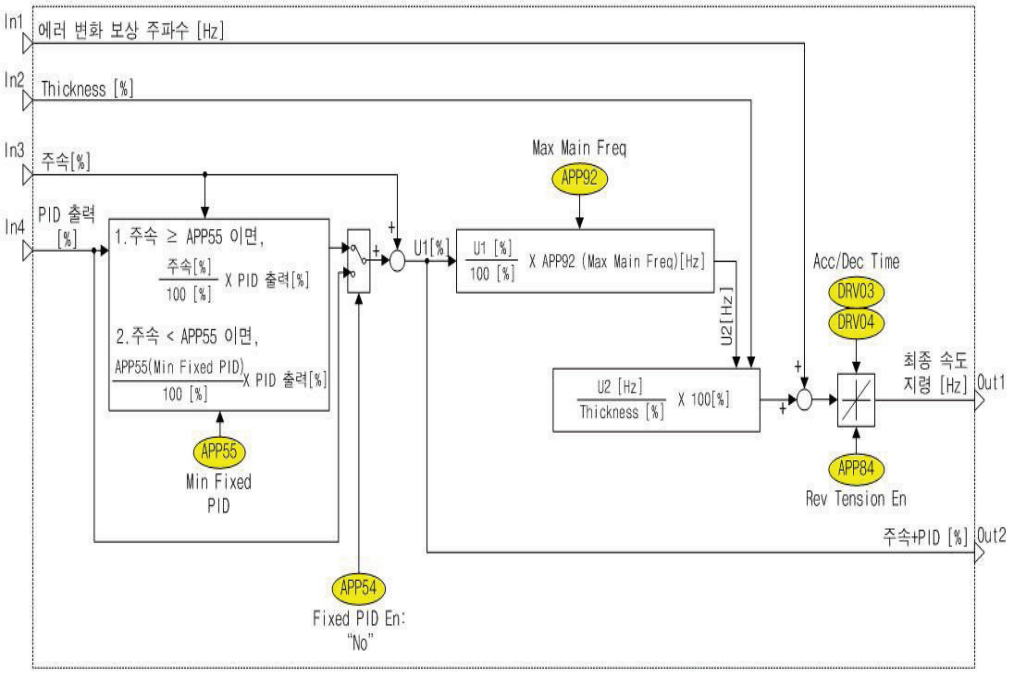


Figure 2.8.1 Final speed calculation part (Capstan)

Final speed computation part decides the final output frequency[Hz] of inverter by using main speed (In3: main speed[%]) calculated from main speed command part, PID output (In4: PID output[%]) and error compensation frequency (In1) calculated from Web PID controller part, diameter (In2: Thickness[%]) calculated from materials thickness computation part.

(1) PID output method (Fixed/unfixed PID controller)

This is same with the 1.6 '1) PID output method (Fixed/unfixed PID controller)'. Please see 1.6 '1) PID output method (Fixed/unfixed PID controller)'.

(2) Computation of final speed [Hz]

U1[%] is 'main speed command[%] + PID output[%]' from the Figure 2.8.1, and if this is converted into [Hz] unit, it is like the formula 2.8.1 .

$$\text{Main speed} + PID\ output\,[Hz] =$$

$$\frac{Main\ \ speed + PID\ output\,[\%]}{100.0\,[\%]} \times APP - 92\,(Max\ Main\ Spd)\,[Hz] \qquad -Formula\ (2.8.1)$$

Now if the formula 2.7.1 is changed, it is like the formula 2.8.2. '100[%]' which is multiplied to the right side of the formula 2.8.2 is the base thickness of the materials. This is fixed value.

The final speed [Hz] is calculated and displayed by the formula 2.8.2.

$$Final\ \ speed\,[Hz] =$$

$$\frac{Main\ \ speed + PID\ output\,[Hz]}{Estimated\ \ thickness\ \ of\ \ materials\,[\%]} \times 100\ [\%] \qquad -Formula\,(2.8.2)$$

Group	Code No.	Function indication	Name	Factory setting value	Setting range
APP	89	Compen Xcel %	Ratio to reflect compensation by the calculation of the thickness of materials from the final speed	20 [%]	0~100[%]

APP-89 (Compen Xcel %): As seen in the formula 2.8.2, the final output frequency of inverter is decided by the estimated thickness of materials[%]. The variation amount of the output frequency occurred by the estimated thickness of materials [%] is set to see what rate and response speed is reflected against actual inverter output frequency.

The smaller the APP-89(Compen Xcel %) is (less than 50[%]), the smaller the portion which the output frequency occurred from the estimated thickness of materials takes among the inverter output frequency, and the slower the reflected speed is.

In order to stably operate at normal operation status, it is desirous to set up APP-89(Compen Xcel %) less than 50[%].

⚠ CAUTION

The final speed [Hz], in the formula 2.8.2 regularly calculated from the final speed computation part, is frequently accelerated or decelerated. The acceleration/deceleration time is DRV-03(Acc Time), DRV-04(Dec Time).

Also, if '5:Tension Ctrl' is selected from APP-01(App Mode), DRV-03(Acc Time) and DRV-04 (Dec Time) are automatically set at '0.5sec'. Although DRV-03(Acc Time) and DRV-04 (Dec Time) are set at another value, they have to be set at short time less than 2.0 [sec] respectively in order to reflect the final speed fastly.

(3) Reverse slow speed function

This is same as 1.6 - 3). Please see 1.6 - 3).

(4) Splicing function

Capstan operation mode does not support splicing function.

3. Other Function

3.1 Stall level adjustment by analogue input

The stall level can be adjusted by analogue input (V1/I1, V2/I2, Pulse) during inverter operation.

As the materials are gradually released from the open loop unwinder which does not use tension control detection device like dancer or loadcell, if you raise the stall level little by little by using analogue input, it can maintain some back tension although it is not exact control.

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
PRT	48	Stall Src Sel	Stall level setting method	0: Keypad	0	Keypad
					1	V1
					2	I1
					3	V2
					4	I2
					5	Pulse
PRT (Note1)	49	Stall % Disp	Current stall level	Read Only		
PRT	50	Stall Prevent	Select stall mode	000	000~111	
PRT	52	Stall Level 1	Stall level 1	180[%]	30~250[%]	

(Note 1) PRT-49(Stall % Disp) is shown when PRT-48(Stall Src Sel) is not '0: Keypad' .

PRT-48 (Stall Src Sel): The method to set up stall level can be selected. If you select '0:Keypad', multi-level stall level is used from PRT-51~58.

In case of open loop unwinder, the method to maintain back tension by adjusting stall level during inverter operation by setting this code as analogue input, and changing analogue input is used.

PRT-50 (Stall Prevent): It decides whether stall function is used or not. In case of open loop unwinder, since stall function is used only for acceleration and normal speed, set as '011'.

PRT-52 (Stall Level 1): This is the stall level when maximum value(voltage:10V, current:20mA) is entered in analogue input. For example, let's assume PRT-52(Stall Level 1) is set at 150%, PRT-48(Stall Src Sel) is set at '1:V1'. If assuming currently 5[V] is entered as V1, the stall level of inverter is 75%(=150%*5V/10V).

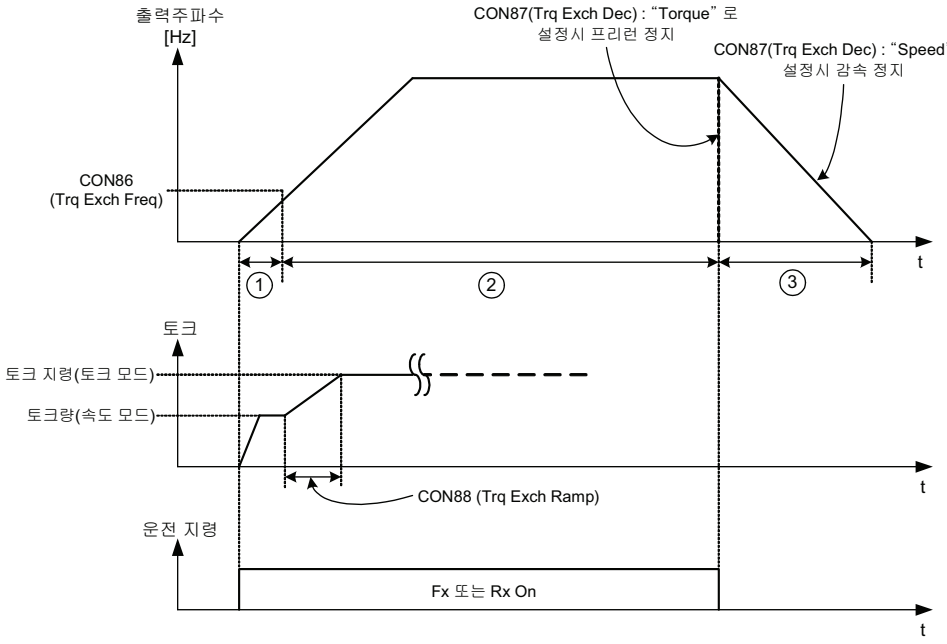
Also, PRT-49(Stall % Disp) displays 75[%] calculated above.

3.2 Speed-torque Automatic Switching Function

In the torque mode of sensorless-1/sensorless-2/sensored vector, when motor is started, it is operated as speed mode, and it is operated as torque mode above certain frequency setting (CON-86).

In particular, sensorless-1/sensorless-2 may not start according to the characteristic of load when ordering small torque command(less than 10[%]). In this case, run it as speed mode which shows excellent starting feature regardless of the characteristic of load, and if the starting successful, it turns into automatic switching to torque mode to maintain stable torque mode operation.

This can be used for open loop winder/unwinder with have no tension detection device like dancer or loadcell.



① : 속도 모드 운전 (기동)

② : 토크 모드 운전

③ : 토크 모드 프리런 정지 (CON87 Trq Exch Dec 가 "Torque" 로 설정 : 공장 출하치)
: 속도 모드 감속 정지 (CON87 Trq Exch Dec 가 "Speed" 로 설정)

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
CON	86	Trq Exch Freq	speed->torque automatic switching frequency when operating in torque mode	0.00[Hz]	0~30[Hz]	
CON	87	Trq Exch Dec	How to decelerate in torque mode operation	0: Torque	0	Torque
					1	Speed
CON	88	Trq Exch Ramp	When automatically switched, time to alleviate torque change	5.0[Sec]	0~300[sec]	

CON-86 (Trq Exch Freq): When starting it in torque mode, start it in speed mode, and set a frequency where it is automatically switched to torque mode. If it is set at 0.00[Hz], the speed-torque automatic switching is not conducted, and it is started in torque mode and always operated in torque mode.

For example, if CON-86(Trq Exch Freq) is set at 3.00[Hz], it is operated as speed mode from start to 3[Hz], and it is automatically switched to torque mode the moment when it exceeds 3[Hz].

The operation conditions for torque mode are as follows.

	sensorless-1	sensorless-2	sensored	
DRV-10 (Torque Control)	Yes	Yes	Yes	No
IN-65~75(P # Define): Speed/Torque 입력	-	-	Off	On
Operation mode	torque mode	torque mode	torque mode	

CON-87 (Trq Exch Dec): When stop command comes in during the operation in torque mode, you can select the method to stop. Factory setting value is ‘0: Torque’. If ‘0: Torque’ is selected, when the stop command comes in during operation in torque mode, stop the free-run.

If selecting ‘1: Speed,’ and stop command comes in during the operation in torque mode, it decelerates and stopped.

CON-88 (Trq Exch Ramp): The torque command value in torque mode can be ordered through keypad/analogue input/communication (RS485, Fieldbus Opt) according to the torque command source of DRV-08(Trq Ref Src) set by users. Since the amount of torque in speed mode is calculated in a very fast sampling cycle inside of the inverter, users cannot change this.

In speed->torque automatic switching function, it is started in speed mode and switched to torque mode automatically at specific frequency (CON-86:Trq Exch Freq). At the moment of automatic switching speed->torque, the impact on load occurred at the moment of automatic switching speed -> torque can be alleviated by giving ramp time to the difference between the torque amount calculated in speed mode (value that users cannot change) and the torque command value in torque mode (command users directly order through keypad/analogue/communication)

3.3 External PID controller

The PID controller(hereinafter, External PID controller) inside of inverter can be used by external devices. That means, external PID controller output can be sent out as analogue output (basic I/O: 0~10V or 4~20mA, extended I/O option: -10V~10V or 4~20mA), or communicate as communication data. The analogue output, or communication data can be received by external devices, and the external devices can be controlled in PID.

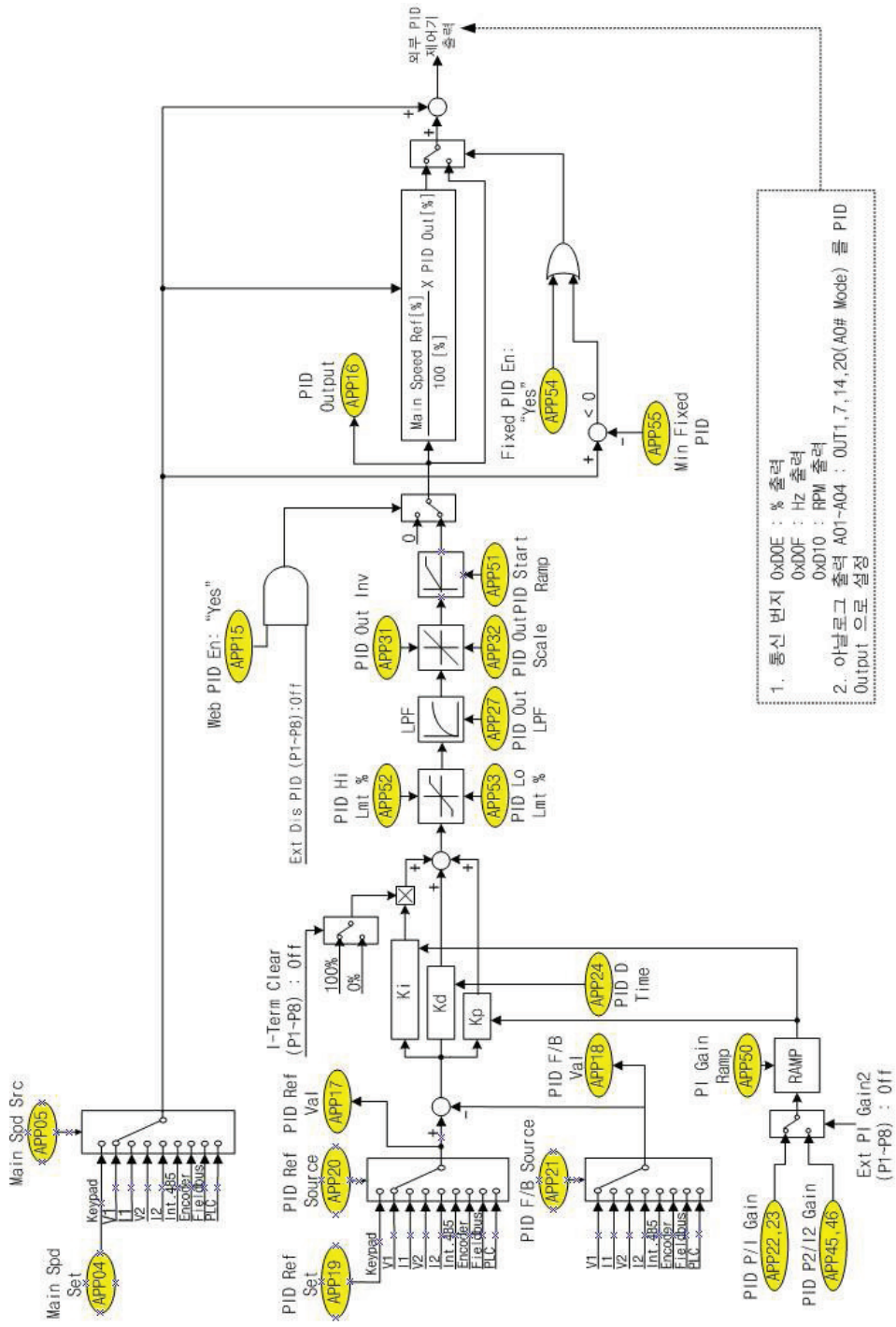
In order to send out external PID controller output as analogue output, relevant analogue output should be set as'14: PID Output' as follows.

Group	Code No.	Function indication	Name	Setting value	Remarks
Out	01	AO1 Mode	Analogue output setting	14: PID Output	0~10V(Default I/O)
Out	07	AO2 Mode	Analogue output setting	14: PID Output	4~20mA(Default I/O)
Out	14	AO3 Mode	Analogue output setting	14: PID Output	-10~10V(Extended I/O option)
Out	20	AO4 Mode	Analogue output setting	14: PID Output	4~20mA(Extended I/O option)

The communication addresses related to the main speed input of External PID controller and final output of External PID controller are as follows.

Communication address	Function	Range	R/W	Remarks
0hD85	main speed[%] input(Note3.3.1)	0.00~100.00%	W	Upper controller ➔inverter
0hD86	main speed[Hz] input(Note3.3.1)	0.00~DRV-20 Max Freq(x.xx Hz)	W	Upper controller ➔inverter
0hD87	main speed[RPM] input(Note3.3.1)	0~ DRV-20 Max Freq(x RPM)	W	Upper controller ➔inverter
0hD0E	External PID controller Output [%]	-100.00~100.00 %	R	inverter➔ Upper controller
0hD0F	External PID controller Output [Hz]	-DRV-20 Max Freq ~DRV-20 Max Freq(x.xx Hz)	R	inverter➔ Upper controller
0hD10	External PID controller Output [RPM]	-DRV-20 Max Freq ~DRV-20 Max Freq(x RPM)	R	inverter➔ Upper controller

(Note 3.3.1): When APP-05(Main Spd Src) is Int485, Fieldbus, PLC, main speed command can be received thorugh common area (0hD85~0hD87) from built-in 485 or relevant option (Fieldbus option, PLC option).


외부 PID 제어기 출력
PID Output APP16
Main Speed Ref[%] X PID Out[%] / 100 [%]
Fixed PID En: "Yes" APP54
< 0
APP55 Min Fixed PID
Web PID En: "Yes" APP15
Ext D/s PID (P1-P8):Off
PID Out Inv APP31
PID Out Start Scale APP32
PID Out Ramp APP51
LPF APP27
PID Hi Lmt % APP52
PID Lo Lmt % APP53
I-Term Clear (P1-P8) : Off
100%
0%
Ki
Kd
Kp
APP24 PID D Time
PID Ref Val APP17
PID Ref Source APP20
PID Ref Set APP19
PID F/B Source APP21
PID F/B Val APP18
PI Gain Ramp APP50
RAMP
Ext PI Gain2 (P1-P8) : Off
PID P/I Gain APP22,23
PID P2/I2 Gain APP45,46
Main Spd Src APP05
Main Spd Set APP04
Keypad
V1
I1
V2
I2
Int. 485
Encoder
FieldBus
PLC
1. 통신 번지 0x00E : % 출력
0x00F : Hz 출력
0x010 : RPM 출력
2. 아날로그 출력 AO1~AO4 : OUT1,7,14,20(AO# Mode) 를 PID Output 으로 설정

⚠ CAUTION

1. Since default I/O's analogue output is 0~10V, 4~20mA, the output of External PID controller is always (+).
2. The extended I/O option's analogue output is not only 0~10V, 4~20mA, but also -10~10V. Therefore, the output of PID controller can be both (+) and (-).
3. External PID controller's PID output communication address is 0hD0E (% output), 0hD0F(Hz output), 0hD10(RPM output) as seen in the Table above.
   Also, (-) sign will be processed as two's complement. For example, if current PID output is -15.23[%], '64013' is saved in communication address 0hD0E. This '64013' is two's complement value of '1523' (➔ The value after reversing all bits and plus 1).

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
IN	65~72	Px Define	Set up multiple function input	Ext Dis PID	-	
IN	65~72	Px Define	Set up multiple function input	Ext PI Gain2	-	
IN	65~72	Px Define	Set up multiple function input	I-Term Clear	-	
APP	01	App Mode	Select application	None	0	None
					1	Traver-se
					2	Proc - PID
					3	MMC
					4	Auto - Seq
					5	Tensio-n Ctrl
					6	Ext PID Ctrl
APP	16	PID Output	PID output monitor	Read Only[%]		
APP	17	PID Ref Value	PID reference monitor	Read Only[%]		
APP	18	PID Fdb Value	PID feedback monitor	Read Only[%]		
APP	19	PID Ref Set	PID reference setting (keypad)	50.00[%]	-100~100[%]	

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
APP	20	PID Ref Src	Select PID reference	0: Keypad	0	Keypa-d
					1	V1
					2	I1
					3	V2
					4	I2
					5	Int.485
					6	Encoder
					7	Fieldb-us
					8	PLC
					9	Synch-ro
					10	Binary Type
					11	XV1
					12	XI1
					13	XV2
					14	XI2
					15	XV3
					16	XI3
					17	XV4
					18	XI4
APP	21	PID F/B Src	Select PID feedback	1: I1	0	V1
					1	I1
					2	V2
					3	I2
					4	Int.485
					5	Encod-er

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
					6	Fieldb-us
					7	PLC
					8	Synchr-o
					9	Binary Type
					10	XV1
					11	XI1
					12	XV2
					13	XI2
					14	XV3
					15	XI3
					16	XV4
					17	XI4
APP	22	PID P-Gain	PID controller proportional gain	50.0[%]	0.0~1000.0[%]	
APP	23	PID I-Time	PID controller integrated time	10.0[s]	0.0~200.0[s]	
APP	24	PID D-Time	PID controller differential time	0[ms]	0~1000[ms]	
APP	27	PID Out LPF	PID output filter	0[ms]	0~10000[ms]	
APP	28	PID I Limit	I controller output limit	100[%]	0~100[%]	
APP	31	PID Out Inv	PID output reverse	0: No	0	No
					1	Yes
APP	32	PID Out Scale	PID output scale	100.0[%]	0.0~1000.0[%]	
APP	45	PID P2-Gain	PID controller proportional gain2	100.0[%]	0.0~1000.0[%]	
APP	46	PID I2-Gain	PID controller integrated time2	20.0[s]	0.0~200.0[s]	
APP	47	PI Change	PI gain switching	0[%]	0~APP48[%	

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
		Spd1	frequency1		]	
APP	48	PI Change Spd2	PI gain switching frequency2	0[%]	0~100[%]	
APP	50	PI Gain Ramp	PI gain switching ramp time	30.0[sec]	0.0~300.0[sec]	
APP	51	PID Start Ramp	PID output ramp time in initiation	0.0[s]	0.0~300.0[s]	
APP	52	PID Hi Lmt %	PID output upper limit[%]	100.0[%]	APP53~100.0[%]	
APP	53	PID Lo Lmt %	PID output lower limit[%]	-100.0[%]	-100~APP52[%]	
APP	85	Ext PID En	Select external PID control	1: Yes	0	No
					1	Yes
APP	98	PID Sample T	PID controller implementation cycle	1[ms]	1~10[ms]	

APP-01 (App Mode): Select Ext PID Ctrl. Regardless of inverter operation, the PID controller (External PID controller) inside of the inverter can be used by external devices.

APP-85 (Ext PID En): This determines whether the External PID controller is used. It is used as Table 3.3.1 by combining with multiple function input ‘Ext Dis PID’.

Table 3-1 External PID controller use/unuse selection method

APP-85(Ext PID En) setting	multiple function input ‘Ext Dis PID’ status	Whetehr Ext PID controller is used
Yes (Default)	Off	O
Yes (Default)	On	X
No	Off	X
No	On	X

APP-16 (PID Output): Show current PID output[%].

APP-17 (PID Ref Value): Show current PID reference[%].

APP-18 (PID Fdb Value): Show current PID feedback[%].

APP-19 (PID Ref Set): The reference of PID controller can be set up by keypad.

APP-20 (PID Ref Src): The input method of PID controller reference can be selected in various ways (keypad, analogue, embedded communication, exterior communication, PLC option).

APP-21 (PID F/B Src): PID controller feedback input method can be selected in various ways (analogue, embedded communication, exterior communication, PLC option).

APP-22 (PID P-Gain): This is P1 gain of PID controller. If P gain is 100[%], and error is 100[%], P controller output is 100[%].

APP-23 (PID I-Time): This is I1 gain of PID controller. If I gain is 10[sec], and error is 100[%], the time to be required until I controller output is saturated at 100[%] will be 10[sec].

APP-24 (PID D-Time): This is D gain of PID controller. If D gain is 10[ms], and error change is 100[%], D controller output is 100[%], and it takes 10[ms] until output becomes gradually weak and reaches to 34[%].

APP-27 (PID Out LPF): This sets up delayed time correction of PID controller output. Generally, it is set at 0[ms] to make the response of PID controller fast. However, if the setting value is raised, the responsiveness of PID controller will be delayed, but the stability will be raised.

APP-31 (PID Out Inv): This selects the reverse of PID controller output. If selecting ‘Yes’, PID output sign will be reversed and displayed.

APP-32 (PID Out Scale): PID controller output scale can be adjusted. First of all, let’s assume the PID controller is saturated. At this time, if this code is set at 100[%], the PID controller output will be 100[%], and if this code is set at 30[%], the PID controller’s output will be 30[%].

APP-50 (PI Gain Ramp): This is ramp time applied to the moment when P/I gain switching due to change in multiple function input ‘Ext PI Gain2’ during the operation of inverter. Also, if users directly change P/I gain by using loader during the operation of inverter, it applies. The ramp time is 1000[%] in case of P gain, and 200[sec] in case of I Gain for the switching. For example, if APP-50(PI Gain Ramp) is set at 30[sec], and P

gain is changed to 200[%] from 100[%], the required time would be 3[sec] (=30*100/1000).

Multiple function input 'Ext PI Gain2' status	Selected P/I gain
Off	APP-22(PID P-Gain), APP-23(PID I-Time)
On	APP-45(PID P2-Gain), APP-46(PID I2-Time)

APP-51 (PID Start Ramp): When inverter starts initially, ramp can be increased during the time set for PID output. Figure 3.3.2 (b) shows the output of P controller when P gain is 100[%], and PID error is 100[%] at the starting. The dotted line in the Figure (b) shows the output of P controller when the APP-51(PID Start Ramp) is '0[sec]'. The full line in the Figure (b) shows that the output of PID controller increases during the APP-51(PID Start Ramp) time at the starting. That means, the full line is more favorable than dotted line in the Figure (b) for the transient phenomena at the starting of inverter.

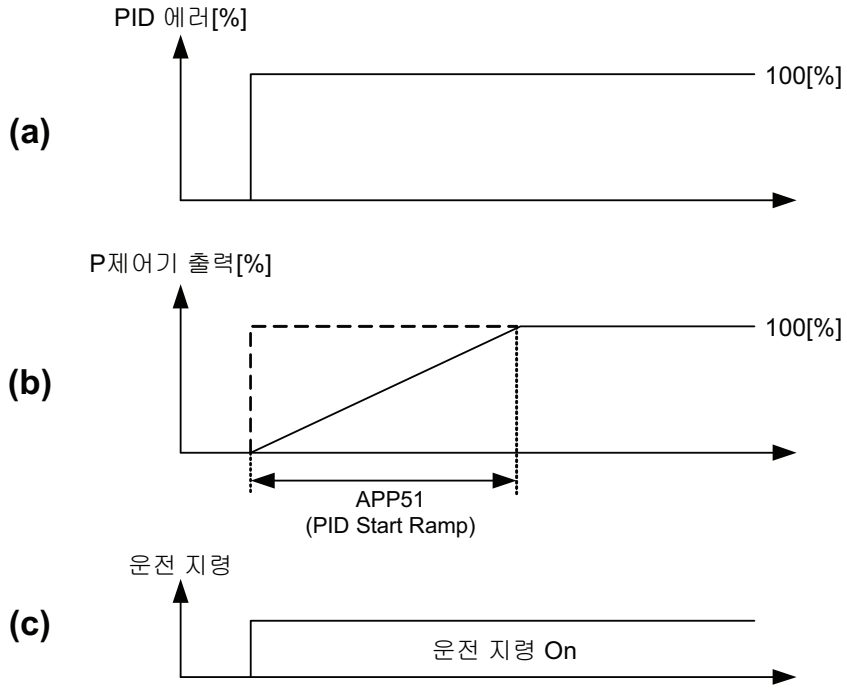


Figure 3.1 The operation method of APP-51(PID Start Ramp)

Moreover, APP-51(PID Start Ramp) is based on when PID controller output is 100[%]. For example, if APP-51(PID Start Ramp) is set at 5[sec], the required time is 5 [sec] until the PID controller output is saturated at 100[%], but at the time of initiation, the required time is 2.5 [sec] until the PID controller output is saturated at 50[%] .

APP-52, 53 (PID Hi/Lo Lmt %): Upper limit and lower limit for PID controller output can be set up. Moreover, the accumulated value of I controller is limited to upper limit, lower limit set by this code.

APP-54 Fixed PID En

APP-55 Min Fixed PID

Group	Code No.	Function indication	Name	Factory setting value	Setting range	
APP	54	Fixed PID En	Select fixed PID controller	0: No	0	No
					1	Yes
APP	55	Min Fixed PID	Fixed PID controller minimum value	10.0[%]	0.0~50.0[%]	

$$Final\ PID\ output\ [\%] = PID\ \text{output}\ [\%] \quad - formula\ (3.3.1)$$

If APP-54 (Fixed PID En) is selected as 'Yes,', the PID output[%], output of external PID controller is always constant regardless of the size of main speed[%] as seen in the formula 3.3.1.

$$Final\ PID\ output\ [\%] = PID\ \text{output}\ [\%] \quad - formula\ (3.3.1)$$

If APP-54 (Fixed PID En) is selected as 'No' which is factory setting value, the PID output[%], output of external PID controller is proportionate to the size of the main speed [%] as seen in the formula 3.3.2.

That means, the ratio of PID output[%] in the main speed is constantly maintained. If the main speed[%] is smaller, then PID output[%] is smaller proportionately, and if main speed [%] becomes larger, PID output[%] becomes larger proportionately.

$$Final\ PID\ output\ [\%] = PID\ output\ [\%] \times \frac{Main\ speed\ command\ [\%]}{100.0\ [\%]} \quad - formula\ (3.3.2)$$

However, when APP-54 (Fixed PID En) is selected as 'No' which is Factory setting value, main speed [%] command lower than the value set by APP-55 (Min Fixed PID) comes in, it operates like the formula 3.3.3. As it operates like the formula 3.3.3, it prevents the output of external PID controller becomes too small at main speed command [%] which is lower than APP-55 (Min Fixed PID).

$$Final\ PID\ output\,[\%] = PID\ output\ [\%] \times \frac{APP55(Min\ Fixed\ PID)[\%]}{100.0[\%]} \qquad -Formula\ (3.3.3)$$

Table 3.3.1 shows how final external PID output [%] is determined according to the setting of APP-54 (Fixed PID En) when setting APP-32(PID Out Scale) at '20[%]', APP-55 (Min Fixed PID) at '10[%]' which is factory setting value, and assuming PID output is currently saturated at 20[%].

In case of (Note 3.3.2) of Table 3.3.1, since main speed is 2% or 8%, and less than 10[%] which is factory setting value of APP-55 (Min Fixed PID), it is determined by the formula 3.3.3.

In case of (Note 3.3.2), since main speed is 20% or 80%, and more than 10[%] which is factory setting value of APP-55 (Min Fixed PID), it is determined by the formula 3.3.2.

main speed command[%]	PID output[%] when APP-54(Fixed PID En): Yes	PID output[%] when APP-54(Fixed PID En): No
2.0	20.0	2.0(Note3.3.2)
8.0	20.0	2.0(Note3.3.2)
20.0	20.0	4.0(Note3.3.2)
80.0	20.0	16.0(Note3.3.2)

Table 3.3.1 Comparison of PID output according to the PID controller types (APP-54: Fixed PID En)

APP-98 (PID Sample T): The implementation cycle of Ext PID controller can be changed.

4. Application Functions

4.1 Override Frequency Setting using Auxiliary Frequency Command

(Setting frequency of various computation conditions using main and auxiliary speed such as Draw operation)

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
DRV	07	Freq Ref Src	0	Keypad-1	0 ~ 9	-
BAS	01	AUX Ref Src	1	V1	0 ~ 4	-
	02	AUX Calc Type	0	M + G * A	0 ~ 7	-
	03	AUX Ref Gain	-	0.0	200 ~ 200	%
IN	65 ~ 75	Px Define	40	Dis Aux Ref	0 ~ 48	-

You can set operating frequency by simultaneously using two methods of frequency setting.

Main speed is used to set the operating frequency, and the auxiliary speed can be used for the precise adjustment during main speed frequency. For example, let's assume that the inverter has been set as in the table above. During operation at 30.00 Hz with Keypad-1 the main speed, if you supply voltage of -10 ~ +10V to V1 terminal and set the gain at 5% (variables between IN-01 ~ IN-16 are the initial values and IN-06 V1 Polarity is set as Bipolar), the precise adjustment is possible up to 33.00 ~ 27.00 Hz.

BAS-01 AUX Ref Src: Selects the type of input to be used as an auxiliary speed.

Setting Type		Function
0	None	No auxiliary speed motion
1	V1	Selects the voltage input terminal of the control terminal block as an auxiliary speed.
2	I1	Selects the current input as the auxiliary speed.
3	V2	Selects the voltage input of the extended I/O option board as an auxiliary speed.
4	I2	Selects the current input of the extended I/O option board as an auxiliary speed.

BAS-02 Aux Calc Type: The reflection ratio of the main speed can be set by the below calculation after setting the amount of the auxiliary speed as gain (BAS-03 Aux Ref Gain).

	Setting Type	Expression	Final Command Frequency Computation
0	M + (G * A)	M[Hz] + (G[%] * A[Hz])	Main speed command value + (BAS-03 x BAS-01 x IN01)
1	M * (G * A)	M[Hz] * (G[%] * A[%])	Main speed command value x (BAS-03 x BAS-01)
2	M / (G * A)	M[Hz] / (G[%] * A[%])	Main speed command value / (BAS-03 x BAS-01)
3	M + (M * (G * A))	M[Hz] + (M[Hz] * (G[%] * A[%]))	Main speed command value + (Main speed command value x (BAS-03 xBAS-01))
4	M + G * 2 * (A-50)	M[Hz] + G[%] * 2 * (A[%] - 50[%])[Hz]	Main speed command value + BAS-03 x 2 x (BAS-01 – 50) x IN01
5	M * (G * 2 * (A-50))	M[HZ] * (G[%] * 2 * (A[%] - 50[%]))	Main speed command value x (BAS-03 x 2 x (BAS-01 – 50))
6	M / (G * 2 * (A-50))	M[HZ] / (G[%] * 2 * (A[%] - 50[%]))	Main speed command value / (BAS-03 x 2 x (BAS-01 – 50))
7	M + M * G * 2 * (A-50)	M[HZ] + M[HZ] * G[%] * 2 * (A[%]-50[%])	Main speed command value + Main speed command value x BAS-03 x 2 x (BAS-01 – 50)

> ⚠ CAUTION
>
> **If the maximum frequency is higher, there might be an error of output frequency due to analog input and computation error.**

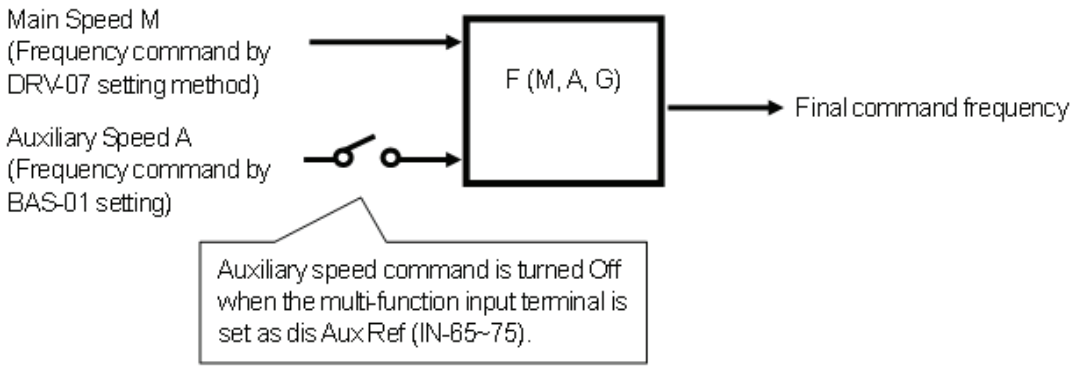
M: main speed frequency command [Hz or RPM] by DRV-07 setting,
G: auxiliary speed [Hz or RPM] or gain[%],
A: auxiliary speed frequency command [Hz or RPM] or gain [%]

Of the setting types, the number of computation list is higher than No.4 can do (+) or (-) motions through only analog input.

BAS-03 Aux Ref Gain: adjusts the amount of the input (BAS-01 Aux Ref Src) set as an auxiliary speed.

If the auxiliary speed is set as V1 or I1 and the parameter of the terminal input group IN-01 ~ IN-32 is the initial value, the auxiliary speed frequency operates as follows.

IN-65 ~ 75 Px Define: If the terminal set as No. 40 dis Aux Ref among the multi-function input terminals, the auxiliary speed command is not active but only the main speed command is effective.



Example 1) If the frequency from keypad is set to main speed and V1 analog voltage is set to auxiliary speed,

Conditions:

- Main speed (M) setting (DRV-07): Keypad (frequency is set at 30Hz.)
- Maximum frequency (Max. Freq) setting (DRV-20): 400Hz
- Auxiliary speed (A) setting (A: BAS-01): V1

  (Expresses auxiliary speed [Hz] or percentage [%] according to the computation setting condition)
- Auxiliary speed gain (G) setting (BAS-03): 50%, IN-01 ~ 32: default value

If 6V is being input into V1, the frequency corresponding to 10V is 60Hz. So, the auxiliary speed A in the below table is 36Hz (= 60[Hz] x (6[V] / 10[V])) or 60% (=100[%] X (6[V] / 10[V]) according to the condition.

Setting Type		Final Command Frequency
0	M[Hz] + (G[%] * A[Hz])	30Hz(M) + (50%(G) x 36Hz(A)) = 48Hz
1	M[Hz] * (G[%] * A[%])	30Hz(M) x (50%(G) x 60%(A)) = 9Hz
2	M[Hz] / (G[%] * A[%])	30Hz(M) / (50%(G) x 60%(A)) = 100Hz
3	M[Hz] + (M[Hz] * (G[%] * A[%]))	30Hz(M) + (30[Hz] x (50%(G) x 60%(A))) = 39Hz
4	M[Hz] + G[%] * 2 * (A[%] - 50[%])[Hz]	30Hz(M) + 50%(G) x 2 x (60%(A) – 50%) x 60Hz = 36Hz
5	M[HZ] * (G[%] * 2 * (A[%] - 50[%]))	30Hz(M) x (50%(G) x 2 x (60%(A) – 50%)) = 3Hz
6	M[HZ] / (G[%] * 2 * (A[%] - 50[%]))	30Hz(M) / (50%(G) x 2 x (60% – 50%)) = 300Hz
7	M[HZ] + M[HZ] * G[%] * 2 * (A[%] - 50[%])	30Hz(M) + 30Hz(M) x 50%(G) x 2 x(60%(A) – 50%) = 33Hz

NOTE

If the set frequency is converted into rpm, Hz indicated above changes into rpm.

Example 2) Main speed (M) setting (DRV-07): Keypad (when the frequency command is set at 30Hz)

Conditions:

- Maximum frequency (Max. Freq) setting (DRV-20): 400Hz
- Auxiliary speed (A) setting (BAS-01): I1

  (Expresses in auxiliary speed [Hz] or percentage [%] according to the condition)
- Auxiliary speed gain (G) setting (BAS-03): 50%, IN-01 ~ 32: default value

If 10.4mA is being input into I1, the frequency corresponding to 20mA is 60Hz, so the auxiliary speed A in the below table is 24Hz (= 60[Hz] x ((10.4[mA] - 4[mA]) / (20[mA] - 4[mA])) or 40% (=100[%] x ((10.4[mA] - 4[mA]) / (20 [mA] - 4[mA])).

Setting Type		Final Command Frequency
0	M[Hz] + (G[%] * A[Hz])	30Hz(M) + (50%(G) x 24Hz(A)) = 42Hz
1	M[Hz] * (G[%] * A[%])	30Hz(M) x (50%(G) x 40%(A)) = 6Hz
2	M[Hz] / (G[%] * A[%])	30Hz(M) / (50%(G) x 40%(A)) = 150Hz
3	M[Hz] + (M[Hz] * (G[%] * A[%]))	30Hz(M) + (30[Hz] x (50%(G) x 40%(A))) = 36Hz
4	M[Hz] + G[%] * 2 * (A[%] - 50[%])[Hz]	30Hz(M) + 50%(G) x 2 x (40%(A) – 50%) x 60Hz = 24Hz
5	M[HZ] * (G[%] * 2 * (A[%] - 50[%]))	30Hz(M) x (50%(G) x 2 x (40%(A) – 50%)) = -3Hz (Reverse direction)
6	M[HZ] / (G[%] * 2 * (A[%] - 50[%]))	30Hz(M) / (50%(G) x 2 x (60%–40%)) = - 300Hz (Reverse direction)
7	M[HZ] + M[HZ] * G[%] * 2 * (A[%] - 50[%])	30Hz(M) + 30Hz(M) x 50%(G) x 2 x (40%(A) – 50%) = 27Hz

Example 3) Main speed setting (DRV-07): V1 (if the frequency command is set at 5V and 30Hz)

Conditions:

- Max Freq [HZ] (DRV-20): 400Hz
- Auxiliary speed (BAS-01): I1 (Expresses in auxiliary speed [Hz] or percentage [%] according to the condition)
- Auxiliary speed gain (BAS-03): 50% (Represents G in the below table. The value is 0.5.)
- IN-01 ~ IN-32: default value

If 10.4mA is being input into I1, the frequency corresponding to 20mA is 60Hz. So, the auxiliary speed A in the below table is 24Hz (= 60[Hz] x ((10.4[mA] - 4[mA]) / (20[mA] - 4[mA])) or 40% (= 100[%] x ((10.4[mA] - 4[mA]) / (20 [mA] - 4[mA])).

Setting Type		Final Command Frequency
0	M[Hz] + (G[%]*A[Hz])	30Hz(M) + (50%(G) x 24Hz(A)) = 42Hz
1	M[Hz] * (G[%] * A[%])	30Hz(M) x (50%(G) x 40%(A)) = 6Hz
2	M[Hz] / (G[%] * A[%])	30Hz(M) / (50%(G) x 40%(A)) = 150Hz
3	M[Hz] + (M[Hz] * (G[%] * A[%]))	30Hz(M) + (30[Hz] x (50%(G) x 40%(A))) = 36Hz
4	M[Hz] + G[%] * 2 * (A[%] - 50[%]) [Hz]	30Hz(M) + 50%(G) x 2 x (40%(A) – 50%) x 60Hz = 24Hz
5	M[HZ] * (G[%] * 2 * (A[%] – 50[%]))	30Hz(M) x (50%(G) x 2 x (40%(A) – 50%)) = - 3Hz (Reverse direction)
6	M[HZ] / (G[%] * 2 * (A[%] - 50[%]))	30Hz(M) / (50%(G) x 2 x (60% – 40%)) = - 300Hz (Reverse direction)
7	M[HZ] + M[HZ] * G[%] * 2 * (A[%] - 50[%])	30Hz(M) + 30Hz(M) x 50%(G) x 2 x (40%(A) – 50%) = 27Hz

4.2 Jog Operation (If you want Jog operation)

Operation is also available using the terminal block and the multi keys of the keypad.

Jog operation 1 by terminal block

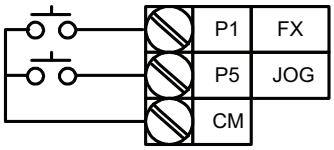
Group	Code No.	Function Display	Setting Display		Setting Range	Unit
DRV	11	JOG Frequency	-	10.00	0.5 ~ Maximum frequency	-
	12	JOG Acc Time	-	20.00	0 ~ 600	Sec
	13	JOG Dec Time	-	30.00	0 ~ 600	Sec
IN	65 ~ 75	Px Define	6	JOG	-	-

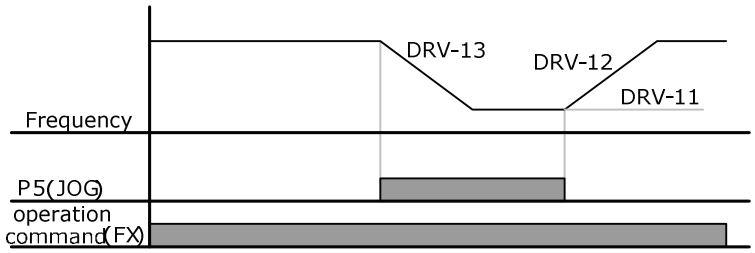
*Px: P1 ~ P8, P9 ~ P11 (option)

Select the jog frequency setting terminal from the multi-function terminals P1 ~ P11 and set the function of the appropriate terminal block of IN-65 ~ IN-75 at No. 6 JOG. If the jog terminal which has been set with the operating command input, the operating frequency moves to the jog frequency, which is described below.

DRV-11 Jog Frequency (Jog Frequency): sets the frequency necessary for jog operation. Jog operation is the highest in the priority order except the dwell operation. Therefore, during a sequential operation, a up-down operation and a 3-wire operation at a certain speed, if the jog terminal is input, it operates at the jog frequency.

DRV-12 JOG Acc Time, DRV-13 JOG Dec Time: the deceleration and acceleration time during shift to jog frequency





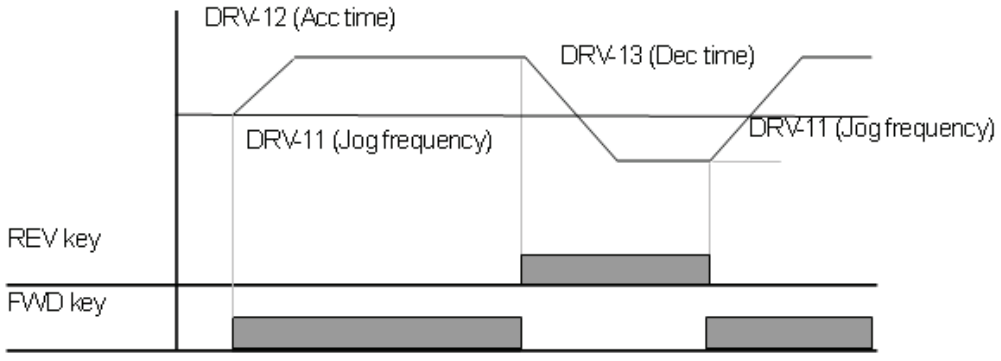
Jog operation 2 by terminal block

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
DRV	11	JOG Frequency	-	10.00	0.5 ~ maximum frequency	Hz
	12	JOG Acc Time	-	20.00	0 ~ 600	Sec
	13	JOG Dec Time	-	30.00	0 ~ 600	Sec
IN	65 ~ 75	Px Define	46	FWD JOG	-	-
	65 ~ 75	Px Define	47	REV JOG	-	-

*Px: P1 ~ P8, P9 ~ P11 (option)

Jog operation 1 is available when the operating command is inputted but jog operation 2 is available with only terminals set as the forward jog (FWD JOG) or reverse jog (REV JOG).

The priority order of terminal input (dwell, 3-wire, up/down), frequency and Acc/Dec time and so on during jog operation is the same as jog operation 1 and if an operating command is given during jog operation, operation continues at the jog frequency.



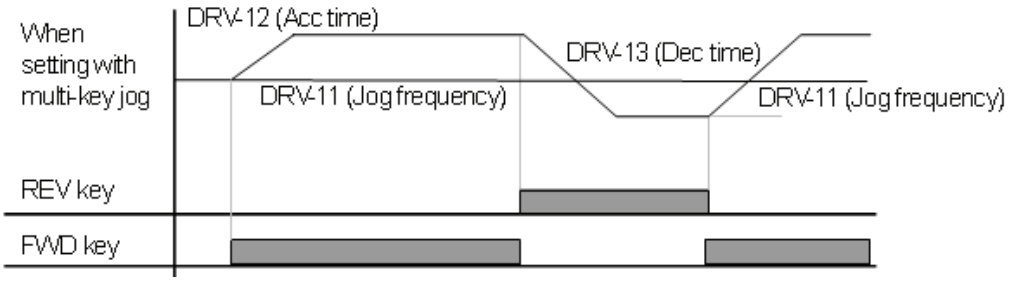
Jog operation by keypad

Mode	Group	Code No.	Function Display	Setting Display		Setting range	Unit
CNF	-	42	Multi-Key Sel	1	JOG Key	-	-
PAR	DRV	06	Cmd Source	0	Keypad	0 ~ 5	sec

*Px: P1 ~ P8, P9 ~ P11 (option)

Set code No.42 of CNF mode at No.1 JOG Key and DRV-06 of PAR mode at No.0 Keypad. If you press multi key, the symbol J at the top of the screen changes into J and then keypad jog operation becomes available. If you keep pressing FWD or REV keys, it decelerates at jog frequency (DRV-11 JOG Frequency). Otherwise it stops.

The Acc/Dec time, it takes to reach jog operation frequency is set in DRV-12 and DRV-13.



4.3 Up and Down Operation

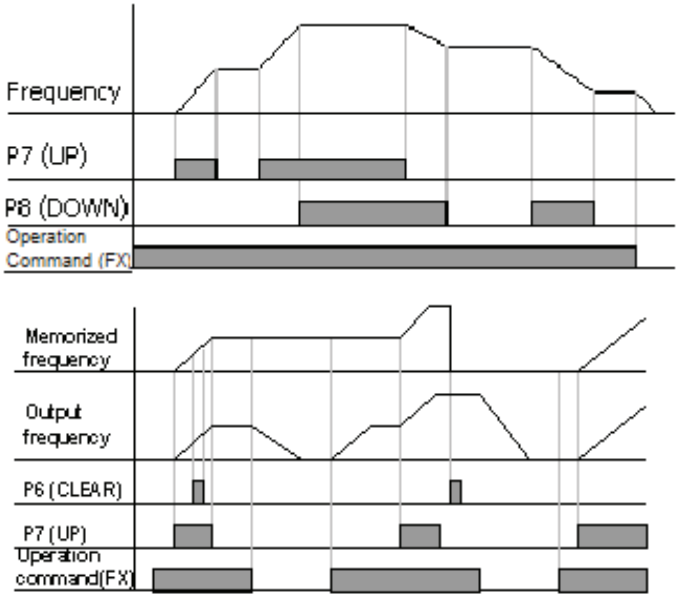
Group	Code No.	Function Display	Setting Display		Setting Range	Unit
ADV	65	U/D Save Mode	1	Yes	0 ~ 1	-
IN	65 ~ 75	Px Define	17	Up	0 ~ 48	-
	65 ~ 75	Px Define	18	Down	0 ~ 48	
	65 ~ 75	Px Define	20	U/D Clear	0 ~ 48	-

*Px: P1 ~ P8, P9 ~ P11 (option)

You can control the deceleration and acceleration by using the multi-function terminal block. This can be used for the system that uses the output signals of upper/lower limit switch from a flow meter, etc. as the acceleration/deceleration command of the motor.

Group	Code No.	Function Display	Code Description
ADV	65	U/D Save Mode	- In case, operating command (FX or RX terminal) is turned Off or a trip is occurred during constant speed operation or power is turned Off, the operating frequency is automatically saved in the memory. - If operation command becomes On or normal status, operation at set frequency is available. If you want to delete the saved frequency, use the multi-function terminal block. Set one of the multi-function terminals at No. 20 U/D Clear and input the terminal in stop or constant speed operation, the frequency that was saved in up-down operation is deleted.
IN	65 ~ 75	Px Define	- Sets the appropriate terminal function at No. 17 Up or No. 18 Down after selecting the terminal to use for up-down operation. - Acceleration follows Up signal during operation and when if it is turned Off, acceleration stops and constant speed operation follows. - Deceleration follows Down signal during operation and when if it is turned Off, deceleration stops and constant speed operation follows.

Group	Code No.	Function Display	Code Description
			- If up and down signals are simultaneously given, acceleration and deceleration both stop.



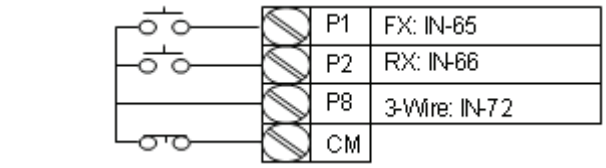
4.4 3-Wire Operation (if you want operation using push button)

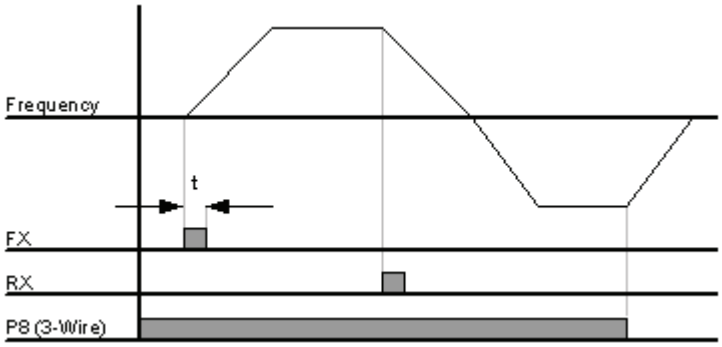
Group	Code No.	Function Display	Setting Display		Setting Range	Unit
DRV	06	Cmd Source	1	Fx/Rx - 1	0 ~ 5	-
IN	65 ~ 75	Px Define	14	3-Wire	0 ~ 48	-

*Px: P1 ~ P8, P9 ~ P11 (option)

This is the function of operation by saving (Latch) the input signals as follows.

Therefore, you can make simple configuration sequence circuit as shown below. For it to move, the minimum input time(t) of the input terminal should continue for more than 1ms. If forward and reverse operating commands are simultaneously input, it stops.





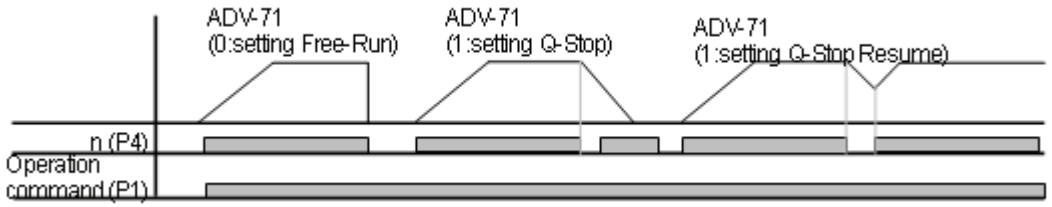
4.5 Safe Operation Mode (if you want to limit operation through terminal Input)

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
ADV	70	Run En Mode	1	DI Dependent	-	-
	71	Run Dis Stop	0	Free-Run	0 ~ 2	-
	72	Q-Stop Time	-	5.0	0 ~ 600	sec
IN	65 ~ 75	Px Define	13	Run Enable	0 ~ 48	-

This is the function of setting the operating command for it to be effective by using the multi-function input terminal.

Group	Code No.	Function Display	Code Description
IN	65 ~ 75	Px Define	Selects the terminal to operate at No. 13 Safe Operation Mode (Run Enable) among the multi-function input terminals. (if setting only multi-function terminals as Run Enable, Safe Operation is not active.)
ADV	70	Run En Mode	If setting at No. 1 DI Dependent, the operating commands it identified through the multi-function input terminal. Set at No. 0 Always Enable, the safe operation mode is not active.
	71	Run Dis Stop	Sets the motions of the inverter when the multi-function input terminal set at safe operation mode is Off. **0: Free-Run** Blocks the inverter output when the multi-function terminal is Off. **1: Q-Stop** Decelerates at the decelerating time(Q-Stop Time) used in safe operation mode. Operation resumes after the operation command is input once again even if the multi-function terminal is On. **2: Q-Stop Resume** Decelerates at the decelerating time (Q-Stop Time) of safe operation mode. Normal operation resumes when the multi-function

Group	Code No.	Function Display	Code Description
			terminal is input again with the operating command On.
	72	Q-Stop Time	If ADV-71 Run Dis Stop is set at No.1 Q-Stop or No.2 Q-Stop Resume, the decelerating time is set.



4.6 Dwell operation

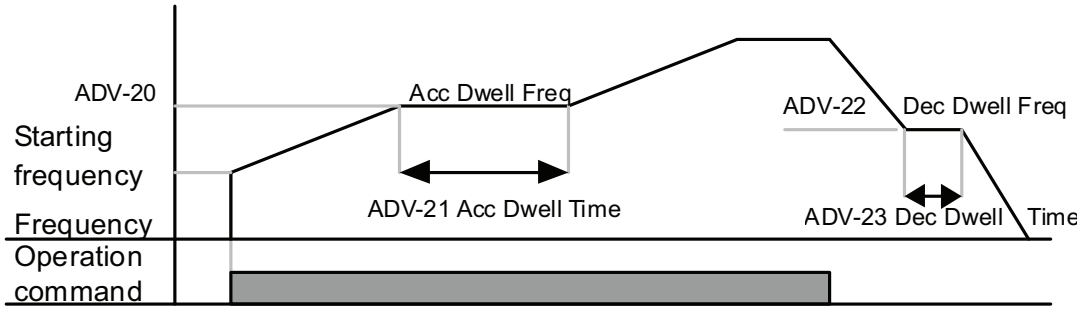
Group	Code No.	Function Display	Initial Value		Setting Range	Unit
ADV	20	Acc Dwell Freq	-	5.00	Starting frequency ~ Maximum frequency	Hz
	21	Acc Dwell Time	-	0.0	0 ~ 10	Sec
	22	Dec Dwell Freq	-	5.00	Starting frequency ~ Maximum frequency	Hz
	23	Dec Dwell Time	-	0.0	0 ~ 10	Sec

If the operating command is input, the inverter operates at constant speed for the acceleration dwell time at the set acceleration dwell frequency and resumes acceleration. If the stop command is input, inverter operates at constant speed for the deceleration dwell time at the set deceleration dwell frequency after deceleration and then stops.

If control mode (DRV-09 Control Mode) is used as the V/F mode, it can be used for opening the brake after operation at the dwell frequency before the mechanical brake is opened at the lifting load.

⚠ CAUTION

Be careful that dwell operation at a frequency higher than the rated slip of the motor with the load shown in the case above might adversely affect the life of the motor or damage the motor due to over current through the motor.



* Detailed description about Dwell operation

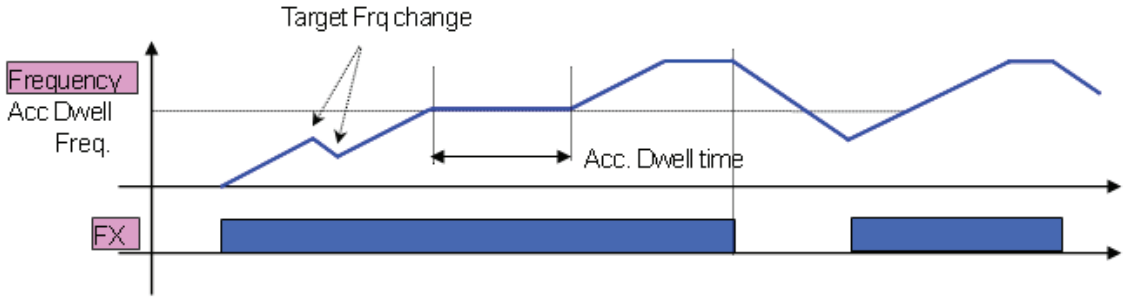
This function is useful in hoisting applications to get enough torque before a releasing mechanical brake. Inverter accelerates to Dwell frequency during set time after run command input. It operates as set speed after elapse of the Dwell acceleration run time (Acc Dwell Time) which is set in Dwell run frequency.

If Stop command is input during run, inverter will decelerate as Dwell run frequency and then it will stop as previous deceleration time after the set Dwell deceleration run time (Dec Dwell Time). If the dwell time is set at '0' or dwell frequency is set at '0', this function is not available.

Acc Dwell command is effective only first command input so it is not available in case the frequency passes by Acc Dwell frequency while resume the acceleration on stop. Dec Dwell operates when frequency passes by Dec Dwell frequency on stop command input and it is not operated on simple deceleration of frequency. Dwell operation is not operated when External brake control function is activated.

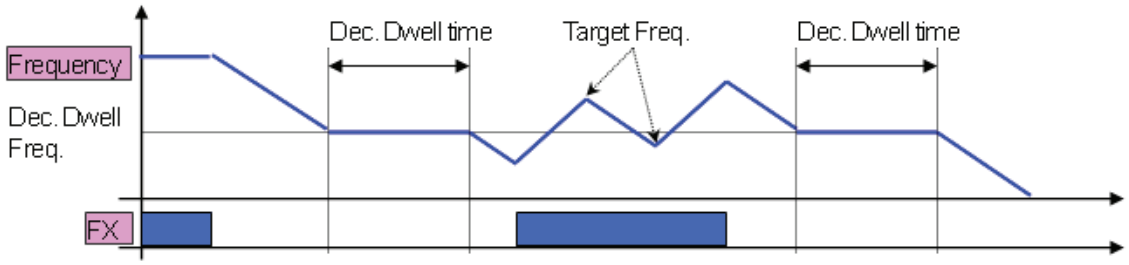
(1) Acceleration Dwell

Acc Dwell command is effective only first command input so it is not available in case the frequency passes by Acc Dwell frequency during re-acceleration on stop.



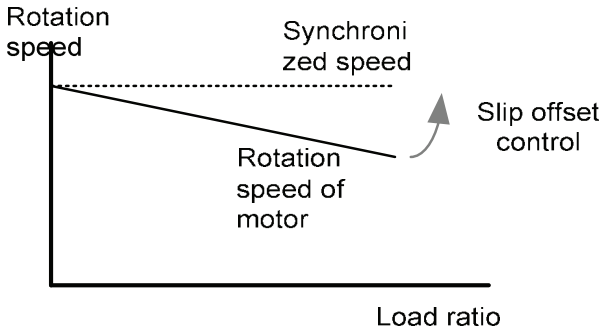
(2) Deceleration Dwell

Dec Dwell operates when frequency passes by Dec Dwell frequency on stop command input and it is not operated on simple deceleration of frequency.



4.7 Slip compensation operation

For an induction motor, the difference between the rotation speed of the motor and the set frequency varies according to the load ratio. The slip compensation operation is used for the load that should compensation the speed difference(slip). If the control mode is sensorless or vector or V/F PG, the speed difference is compensated automatically.



Group	Code No.	Function Display	Setting Display		Unit
DRV	09	Control Mode	2	Slip Compen	-
	14	Motor Capacity	2	0.75 (0.75 kW base)	kW
BAS	11	Pole Number	-	4	-
	12	Rated Slip	-	90 (0.75 kW base)	rpm
	13	Rated Curr	-	3.6 (0.75 kW base)	A
	14	Noload Curr	-	1.6 (0.75 kW base)	A
	16	Efficiency	-	72 (0.75 kW base)	%
	17	Inertia Rate	-	0 (0.75 kW base)	-

DRV-09 Control Mode: checks whether the control mode is set at No. 2 Slip Compen.
DRV-14 Motor Capacity: sets the capacity of the motor connected to the inverter output.
BAS-11 Pole Number: inputs the number of poles on the plate of the motor.
BAS-12 Rated Slip: input by using the rated revolution on the plate of the motor.
BAS-13 Rated Curr (rated current): inputs the rated current on the plate of the motor.

BAS-14 Noload Curr (no-load current): inputs the current measured when the motor operates at the rated frequency after the load device connected to the motor axis is removed. If no-load current is hard to measure, input the current 30 ~ 50% of the current on the plate of the motor.
BAS-16 Efficiency (motor efficiency): inputs the efficiency on the plate of the motor.
BAS-17 Inertia Rate (load inertia ratio): selects the load inertia on the basis of the inertia of the motor.

(0: when it is less than 10 times of motor's inertia, 1: when it is 10 times of motor's inertia, 2 ~ 8: when it is more than 10 times of motor's inertia)

$f_s = f_r - \left(\frac{rpm \times P}{120} \right)$, f_s =rated slip frequency, f_r =rated frequency, rpm =rated revolution of motor, P =motor poles

ex) rated frequency: 60Hz, rated revolution: 1740rpm, pole numbers: 4.

$$f_s = 60 - \left(\frac{1740 \times 4}{120} \right) = 2Hz$$

4.8 PID control

(1) PID Basic Operation

This is a method commonly used among the ones of auto control. PID means P: Proportional, I: Integral, and D: Differential. By combining these 3, a flexible control is available.

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
APP	01	App Mode	2	Proc PID	0 ~ 4	-
	16	PID Output	-	-	-	-
	17	PID Ref Value	-	-	-	-
	18	PID Fdb Value	-	-	-	-
	19	PID Ref Set	-	50.00	-100 ~ 100	%
	20	PID Ref Source	0	Keypad	0 ~ 10	-
	21	PID F/B Source	0	V1	0 ~ 10	-
	22	PID P-Gain	-	50.0	0 ~ 1000	%
	23	PID I-Time	-	10.0	0 ~ 32.0	Sec
	24	PID D-Time	-	0	0 ~ 1000	ms
	25	PID F-Gain	-	0.0	0 ~ 1000	%
	26	P Gain Scale	-	100.0	0 ~ 100	%
	27	PID Out LPF	-	0	0 ~ 10000	ms
	29	PID Limit Hi	-	60.00	0 ~ 300	Hz
	30	PID Limit Lo	-	0.5	0 ~ 300	Hz
	31	PID Out Inv	-	No	0 ~ 1	-
	32	PID Out Scale	-	100.0	0.1 ~ 1000	%
	34	Pre-PID Freq	-	0.00	0 ~ Max. Freq	Hz
	35	Pre-PID Exit	-	0.0	0 ~ 100	%
	36	Pre-PID Delay	-	600	0 ~ 9999	Sec
	37	PID Sleep DT	-	60.0	0 ~ 999.9	Sec

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
	38	PID Sleep Freq	-	0.00	0 ~ Max. Freq.	Hz
	39	PID WakeUp Lev	-	35	0 ~ 100	%
	40	PID WakeUp Mod	0	Below Level	0 ~ 2	-
	42	PID Unit Sel	0	Hz	0 ~ 12	-
	43	PID Unit Gain	-	100.0	0 ~ 650	%
	44	PID Unit Scale	2	X 1	0 ~ 2	-
	45	PID P2-Gain	-	100.0	0 ~ 1000	%
IN	65 ~ 75	Px Define	22	I-Term Clear	0 ~ 48	-
	65 ~ 75	Px Define	23	PID Openloop	0 ~ 48	-
	65 ~ 75	Px Define	24	P Gain2	0 ~ 48	-

The output frequency of the inverter goes through PID control in order to control the system process including the flow, temperature and tension and so on.

APP-01 App Mode (application mode): You can set the process PID functions by setting at No. 2 Proc PID(Process PID).

APP-16 PID Output: Displays the present output value of the PID controller with the unit, gain and scale set in APP-42, APP-43 and APP-44 reflected.

APP-17 PID Ref Value: Displays the currently set reference of the PID controller with the unit, gain and scale set in APP-42, APP-43 and APP-44 reflected.

APP-18 PID Fdb Value: Displays the present feedback input of the PID controller with the unit, gain and scale set in APP-42, APP-43 and APP-44 reflected.

APP-19 PID Ref Set: The reference value can be input if the reference type (APP-20) of PID control is set as keypad(0:Keypad). If the reference type is set at values other than the keypad, the value set in APP-19 is ignored.

APP-20 PID Ref Source: Selects the reference input of PID control (the items marked in grey are supposed to be provided soon in the future). If the V1 terminal is set as PID F/B Source, V1 cannot be set as the PID Ref Source. If F/B Source is changed to another item, V1 can be set as Ref Source.

Setting Type		Function	PID F/B Source possibility
0	Keypad	Inputs the PID reference on the inverter keypad.	X
1	V1	-10 ~ 10V voltage input terminal of the terminal block	O
2	I1	0 ~ 20mA current input terminal of the terminal block	O
3	V2	Voltage input terminal of the extended I/O option card	O
4	I2	Current input terminal of the extended I/O option card	O
5	Int. 485	RS-485 input terminal of the terminal block	O
6	Encoder	Pulse input of the encoder option card	O
7	FieldBus	Communication command by communication option card	O
8	PLC	Command by PLC option card	O
9	Synchro	Command by synchronized operation option card	O
10	Binary Type	Command by BCD option card	X

The set PID reference can be displayed in the monitor mode and APP-17 and monitored in the items set as No. 17 PID Ref Value among CNF-06 ~ 08 of config mode.

APP-21 PID F/B Source: Selects the feedback input of PID control. This can be selected in the inputs other than the keypad input (Keypad-1, Keypad-2) in the reference input type. The feedback cannot be set as the same input as selected in the reference.

For example, if APP-20 Ref Source is selected as No. 1 V1 terminal, the inputs other than V1 should be selected in APP-21 PID F/B Source. Set as No. 18 PID Fbk Value of CNF-06 ~ 08, the feedback can be monitored.

APP-22 PID P-Gain, APP-26 P Gain Scale: Sets the output ratio of the difference(error) between the reference and feedback. If P gain is set at 50%, 50% of the error is output. The setting range of P gain is 0.0 ~ 1000.0%. If a ratio lower than 0.1% is necessary, use P Gain Scale of APP-26.

APP-23 PID I-Time: Sets the times for output of accumulated errors. This sets the time for 100% output when the error is 100%. If the integral time (PID I-Time) is set at 1 second, 100% is output after 1 second when the error is 100%. The normal error can be reduced by the integral time. If the multi-function terminal block function is set at No.21 I-Term Clear and the terminal block is On, the entire accumulated integral amount is deleted.

APP-24 PID D-Time: Sets the output of the error change rate. If the differential time(PID D-Time) is set at 1ms, 1% is output per 10ms when the error change rate per second is 100%.

APP-25 PID F-Gain: The set goal can be added to the PID output and the ratio is set. This can obtain a rapid response characteristic.

APP-27 PID Out LPF: This is used when the entire system is instable because the PID controller output changes too fast or there is too much oscillation. Normally the responsiveness is enhanced by using a low value (the initial value is 0) but the stability can also be improved by using a higher value. The higher a value is used, the more stable the PID controller output is but the responsiveness might be down.

APP-29 PID Limit Hi, APP-30 PID Limit Lo: Limits the output of the PID controller.

APP-32 PID Out Scale: Adjusts the size of the controller output.

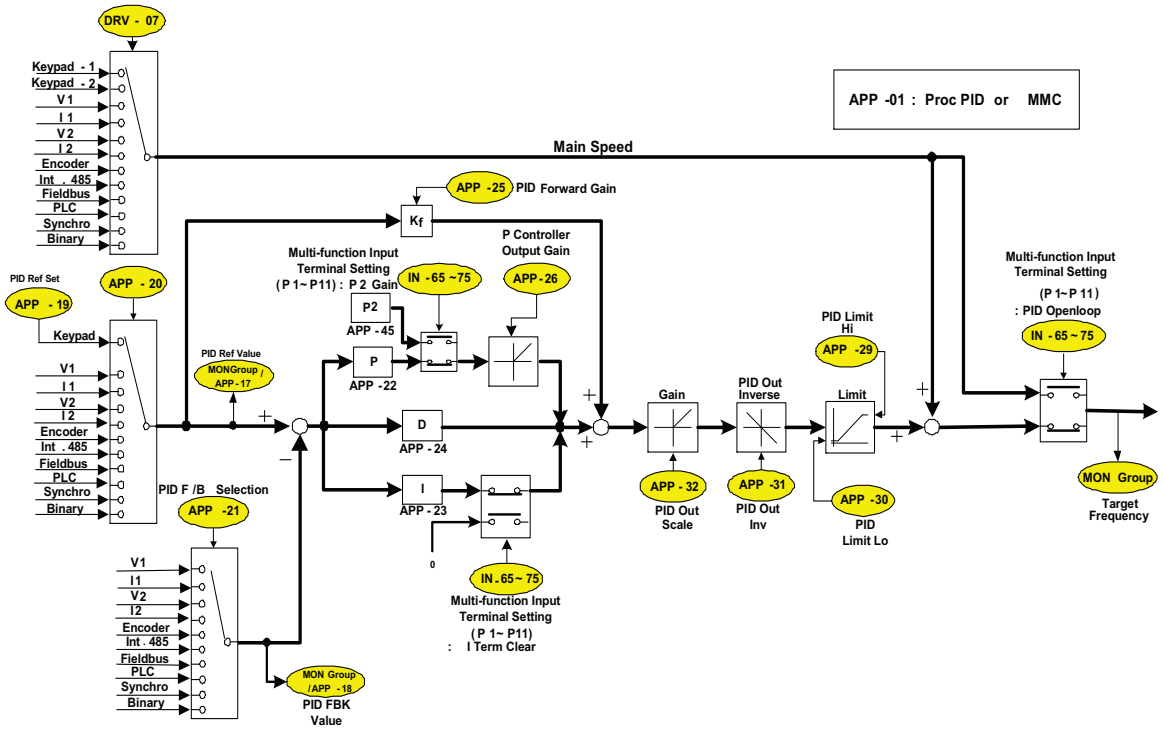
APP-42 PID Unit Sel: Sets the unit of the control.

Setting Type			Function
0	%	-	Displayed in percentage instead of a certain physical value.
1	Bar	Pressure	Various pressure units are available.
2	mBar		
3	Pa		
4	kPa		
5	Hz	Speed	Displays the inverter output frequency or motor revolution.
6	rpm		
7	V	Voltage	Displayed in voltage, current or consumed electricity.
8	I	Current	
9	kW	Electric power	
10	HP	Horse power	
11	°C	Temperature	In Fahrenheit or Centigrade.
12	°F		

APP-43 PID Unit Gain, APP-44 PID Unit Scale: Adjusts the size suited to the unit selected in APP-42 PID Unit Sel.

APP-45 PID P2-Gain: The gain of the PID controller can be changed by using the multi-function terminal. If the function of the terminal block selected from IN-65 ~ 75 is set at No. 23 P Gain2 and then the selected terminal is input, the gain set in APP-45 can be by passed instead of the gain set in APP-22 and APP-23.

(2) PID Control Block Diagram



NOTE

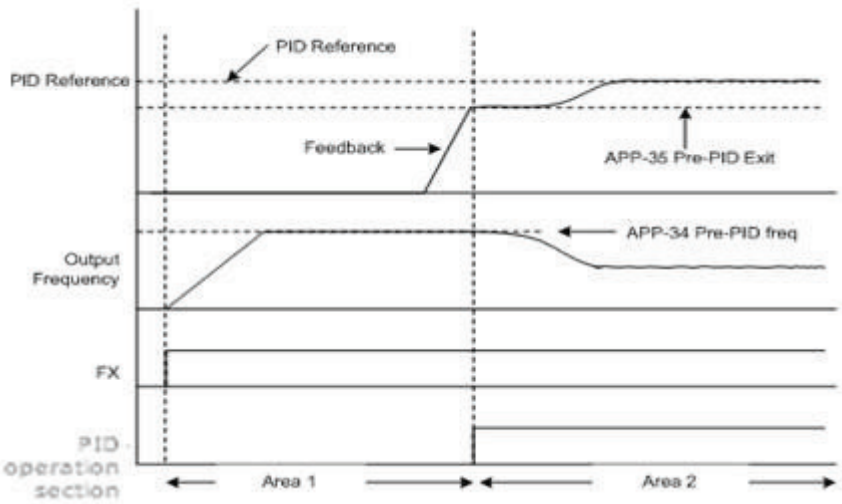
- If PID change operation (changes from PID operation to normal operation) comes into multi-function inputs (P1 ~ P11), the value of [%] is converted to the one of [Hz] and is output.
- Polarity of normal PID output PID OUT is unipolar and is limited by APP-29 (PID Limit Hi) and APP-30 (PID Limit Lo).
- 100.0% is the standard of DRV-20 (maxFreq).

(3) Pre-PID Operation

This is the function of normal acceleration to the set frequency without PID operation if an operating command is input. PID operation starts when the control amount increases to a certain degree.

APP-34 Pre-PID Freq: The frequency to normal acceleration is input if normal acceleration is necessary without PID control motion. For example, if Pre-PID Freq is set at 30Hz, normal operation continues at 30Hz until the control amount (PID feedback amount) goes up above what is set in APP-35.

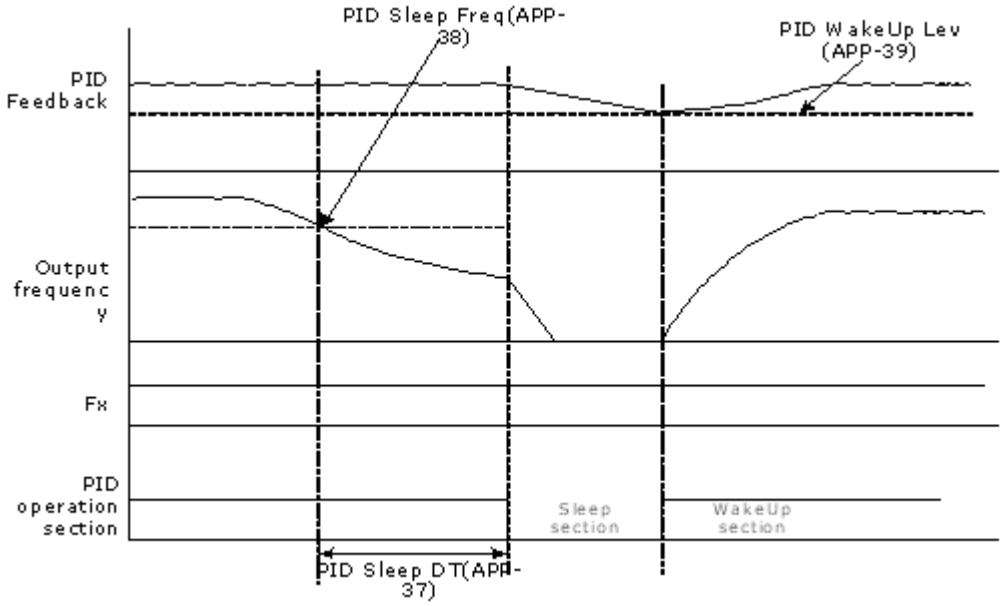
APP-35 Pre-PID Exit, APP-36 Pre-PID Delay: PID control operation starts if the input feedback amount (control amount) of the PID controller is larger than the value set in APP-35. However, if an amount smaller than the value set in APP-35 continues for the period of time set in APP-36, the output is discontinued with a 'Pre-PID Fail' trip.



(4) PID Sleep Mode (Sleep)

APP-37 PID Sleep DT, APP-38 PID Sleep Freq: If the inverter continues to operate for the time set in APP-37 PID Sleep DT under the frequency set in APP-38 Sleep Freq, is stops operating and goes into Sleep Mode. For the threshold of shift from PID Sleep Mode to PID operation mode back, see APP-39 PID WakeUp Lev.

APP-39 PID WakeUp Lev, APP-40 PID WakeUp Mod: Sets the threshold of starting PID operation from the PID sleep mode described above. If you select No.0 (Below Level) in APP-40 and the feedback is smaller than set in APP-39 PID WakeUp Lev, PID operation resumes. No. 1 (Above Level) restarts operation when it is larger than the value set in APP-39. No. 2 (Beyond Level) restarts operation when the difference between the reference and feedback is larger than the value set in APP-39.



(5) PID Operation by pass (PID Openloop)

If, among multi-function terminal blocks, the terminal set at No. 22 PID Openloop in IN-65 ~ 75 Px Define is input, PID operation stops and changes to normal operation. The terminal is turned Off, PID operation resumes.

4.9 Auto tuning

The motor parameter can be automatically measured. In addition, if the encoder option card is connected to the main body of the inverter, you can test the operation of the encoder. The motor parameters measured through auto tuning are used for auto torque boost, sensorless vector control and vector control and so on.

E.g.) 0.75kW, 220V class Motor

Group	Code No.	Function Display	Setting Display		Unit
DRV	14	Motor Capacity	2	0.75	kW
BAS	11	Pole Number	-	4	-
	12	Rated Slip	-	40	rpm
	13	Rated Curr	-	3.6	A
	14	Noload curr	-	1.6	A
	15	Rated Volt	-	220	V
	16	Efficiency	-	72	%
	20	Auto Tuning	0	None	-
	21	Rs	-	26.00	Ω
	22	Lsigma	-	179.4	mH
	23	Ls	-	1544	mH
	24	Tr	-	145	ms
APO	04	Enc Opt Mode	0	None	-

⚠ CAUTION

Be sure to conduct auto tuning after the motor stops operating.

Before conducting auto tuning, make sure that you input the number of motor poles, rated slip, rated current, rated voltage and efficiency shown on the motor plate. For the items not input, automatically set values are used.

Input voltage	Motor capacity [kW]	Rating current [A]	No load current [A]	Rating slip frequency [Hz]	Stator resistance [Ω]	Leakage inductance [mH]
200	0.2	1.1	0.8	3.33	14.0	40.4
	0.4	2.4	1.4	3.33	6.70	26.9
	0.75	3.4	1.7	3.00	2.600	17.94
	1.5	6.4	2.6	2.67	1.170	9.29
	2.2	8.6	3.3	2.33	0.840	6.63
	3.7	13.8	5.0	2.33	0.500	4.48
	5.5	21.0	7.1	1.50	0.314	3.19
	7.5	28.2	9.3	1.33	0.169	2.844
	11	40.0	12.4	1.00	0.120	1.488
	15	53.6	15.5	1.00	0.084	1.118
	18.5	65.6	19.0	1.00	0.068	0.819
	22	76.8	21.5	1.00	0.056	0.948
	30	104.6	29.3	1.00	0.042	0.711
	37	128.6	34.7	1.00	0.033	0.568
	45	156.0	42.1	1.00	0.028	0.474
	55	184.1	49.7	1.00	0.023	0.389
	75	244.5	61.1	1.00	0.016	0.284
	90	289.5	72.3	1.00	0.014	0.250
400	0.2	0.7	0.5	3.33	28.00	121.2
	0.4	1.4	0.8	3.33	14.0	80.8
	0.75	2.0	1.0	3.00	7.81	53.9
	1.5	3.7	1.5	2.67	3.52	27.9
	2.2	5.0	1.9	2.33	2.520	19.95
	3.7	8.0	2.9	2.33	1.500	13.45
	5.5	12.1	4.1	1.50	0.940	9.62
	7.5	16.3	5.4	1.33	0.520	8.53
	11	23.2	7.2	1.00	0.360	4.48
	15	31.0	9.0	1.00	0.250	3.38
	18.5	38.0	11.0	1.00	0.168	2.457
	22	44.5	12.5	1.00	0.168	2.844

Input voltage	Motor capacity [kW]	Rating current [A]	No load current [A]	Rating slip frequency [Hz]	Stator resistance [Ω]	Leakage inductance [mH]
	30	60.5	16.9	1.00	0.126	2.133
	37	74.4	20.1	1.00	0.101	1.704
	45	90.3	24.4	1.00	0.084	1.422
	55	106.6	28.8	1.00	0.069	1.167
	75	141.6	35.4	1.00	0.050	0.852
	90	167.6	41.9	1.00	0.039	0.715
	110	203.5	48.8	1.00	0.032	0.585
	132	242.3	58.1	1.00	0.027	0.488
	160	290.5	69.7	1.00	0.022	0.403
	185	335.0	77.0	1.00	0.021	0.380

(1) Motor Parameter Tuning (Rs, Lsigma, Ls, Tr, Noload curr)

BAS-20 Auto Tuning: Selects the type of auto tuning and implements auto tuning. Auto tuning starts if you select one of the items below and press PROG.

0: None
Displays the initial auto tuning item. After auto tuning is completed, that it is finished is displayed.

1: ALL
The motor parameter is measured with the motor rotating. The stator resistance (Rs), leak inductance (Lsigma), stator inductance (Ls), no-load current (Noload Curr) and rotor time constant (Tr) are all measured. When the encoder option card is mounted, the encoder state is also measured. For encoder state measurement, the related functions of the encoder should be rightly set. For setting the control mode at vector control, set the auto tuning item at No. 1 ALL. If load is connected to the motor axis, the parameter might not be correctly measured because the motor measures the parameter while rotating. Therefore, for correct measurement, remove the load attached to the motor axis before use. If Control Mode (DRV-09) is Sensorless-2, the rotor time constant (Tr) is tuned while it is static.

2: ALL (Stdstl)
Motor parameter is measured when motor is stopped. Measure stator resistance (Rs), leak inductance (Lsigma), and the rotor time constant

(Tr) all together at the same time. This mode is available when Control Mode (DRV-09) is Sensorless-2.

3: Rs+Lsigma
The parameter is measured when motor is stopped. The measured values are used for auto torque boost and sensorless vector control. Because the motor is not rotating, the connection between the motor axis and load does not affect the parameter measurement. However, be careful not to rotate the motor axis at the load side.

4: Enc. Test
Connect the encoder option card to the main body of the inverter and connect the encoder cable attached to the motor to the option card. The motor checks connection and misconnection of A and B pulses. Be sure to set related functions correctly for encoder state measurement.

5: Tr
When Control Mode (DRV-09) is Vector, the motor measures the rotor time constant(Tr) while rotating. If Control Mode (DRV-09) is Sensorless-2, the motor measures the rotor time constant(Tr) while static.

If Control Mode (DRV-09) shifts from Sensorless-2 to Vector, you should conduct time constant (Tr) tuning again.

BAS-21 Rs ~ BAS-24 Tr, BAS-14 Noload Curr: Displays the motor parameter measured in auto tuning. Of the auto tuning selected above, for the parameter missing from the measurement items, the default value is displayed.

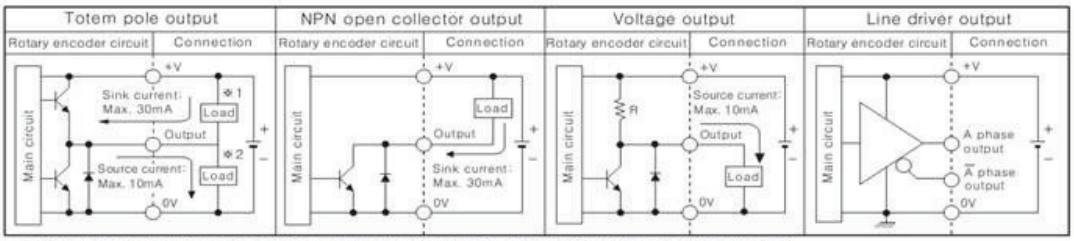
(2) Encoder Connection Status Measurement

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
BAS	20	Auto Tuning	3	Enc Test	0 ~ 4	-
APO	01	Enc Opt Mode	1	Feed-back	0 ~ 2	-
	04	Enc Type Sel	0	Line Driver	0 ~ 2	-
	05	Enc Pulse Sel	0	(A+B)	0 ~ 2	-
	06	Enc Pulse Num	-	1024	10 ~ 4096	-
	08	Enc Monitor	-	0	-	-

APO-01 Enc Opt Mode: Set at No. 1 Feed-back.

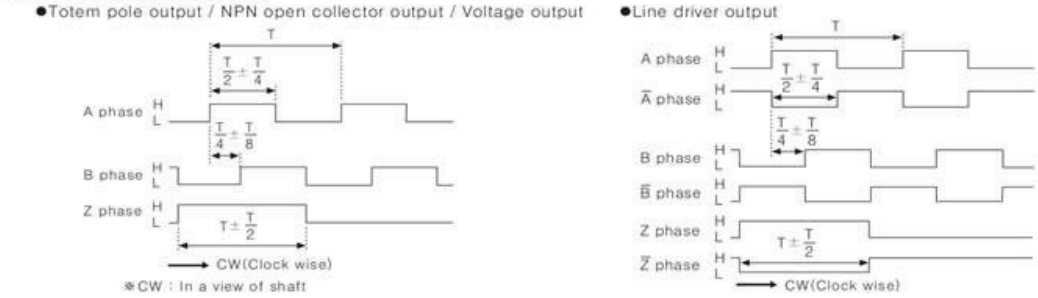
APO-04 Enc Type Sel: Selects the encoder signal transmission method according to the encoder manual. One of Line Driver (0), Totem or Com (1) and Open Collect (2) is selected.

Control output diagram



☞ Totem pole output type can be used for NPN open collector output type(※1) or Voltage output type(※2).
☞ All output circuits are the same A, B, Z phase(Line driver output is A, Ā, B, B̄, Z, Z̄)

Output waveform



APO-05 Enc Pulse Sel: Sets the encoder output pulse direction. Forward operation in case of No. 0 (A+B) and reverse operation in case of No. 2 – (A+B) are selected. No. 1 is selected for use as the frequency setting reference.

APO-06 Enc Pulse Num: Inputs the output pulse number per rotation.

APO-08 Enc Monitor: Convert encoder output in terms of motor revolution and displays it in terms of Hz and rpm.

BAS-20 Auto Tuning: Forward operation is carried out to 20Hz if you set the encoder related items described above and set auto tuning at No. 3 Enc Test. After forward operation, it decelerates and accelerates back to 20Hz in the reverse direction. In case of a failure of the encoder, the auto tuning item changes into None. In case of encoder misconnection, Enc reversed is displayed. In such a case, change APO-05 Enc Pulse Sel or change 2 lines of the inverter output lines connected to the motor with each other.

4.10 V/F Operation using Speed Sensor

Group	Code No.	Function Display		Setting Display	Setting Range	Unit
DRV	09	Control Mode	1	V/F PG	0 ~ 5	-
CON	45	PG P-Gain	-	3000	0 ~ 9999	-
	46	PG I-Gain	-	50	0 ~ 9999	-
	47	PG Slip Max %	-	100	0 ~ 200	%
APO	01	Enc Opt Mode	1	Feed-back	0 ~ 2	-

You can enhance the speed control precision of the V/F controller by mounting the encoder option card. Check the encoder connection status before operation starts.

DRV-09 Control Mode: Sets the control mode at No. 2 V/F PG. Operation is carried out with the speed controller added to No. 0 V/F control mode. The reference of the speed controller is the set frequency and the feedback is the encoder input.

CON-45 PG P-Gain, CON-46 PG I-Gain: Sets the proportional gain of the speed controller (PG P-Gain) and integral gain (PG I-Gain). The higher the proportional gain is set, the faster the responsive characteristic is, but if it is set too high, the speed controller might be instable. For the integral, the lower it is set, the faster the response is. If it is set too low, the speed controller might be instable.

CON-47 PG Slip Max %: The percentage value of the rated slip (BAS-12: Rated Slip). The set value is used for the maximum compensation slip.
For example, if this function code is set at 90% and the rated slip (BAS-12: Rated Slip) is 30rpm, the maximum compensation slip is 30 * 0.9 = 27rpm.

4.11 Sensorless (I) vector control

Group	Code No.	Function Display	Setting Display		Unit
DRV	09	Control Mode	3	Sensorless-1	-
	10	Torque Control	0	No	-
	14	Motor Capacity	x	x.xx	kW
BAS	11	Pole Number	-	4	-
	12	Rated Slip	-	2.00	rpm
	13	Rated Curr	-	3.6	A
	14	Noload curr	-	0.7	A
	15	Rated Volt	-	220	V
	16	Efficiency	-	83	%
	20	Auto Tuning	2	Rs+Lsigma	-
CON	21	ASR-SL P Gain1	-	100.0	%
	22	ASR-SL I Gain1	-	200	ms

⚠ CAUTION

Be sure to conduct auto tuning after the motor stops operating.

Before conducting auto tuning, make sure that you input the number of motor poles, rated slip, rated current, rated voltage and efficiency shown on the motor plate. For the items not input, automatically set values are used.

Before auto tuning, enter the items on the motor plate first.

DRV-14 Motor Capacity
BAS-11 Pole Number
BAS-12 Rated Slip
BAS-13 Rated Curr
BAS-15 Rated Volt
BAS-16 Efficiency

Auto tuning with motor static: If the load connected to the motor axis is hard to remove, set the auto tuning item(BAS-20 Auto Tuning) at No. 2 Rs+Lsigma for the motor parameter to be measured with the motor static. For the no-load current of the motor, the default value is used. When

auto tuning finishes, the measured values of the motor stator resistance (Rs) and leak inductance (Lsigma) are saved in BAS-21 and BAS-22.

Auto tuning with motor rotating: If the load connected to the motor axis can be removed, set the auto tuning item at No. 1 All after separating the load for the motor to measure the parameter while rotating. When auto tuning finishes, the measured values of the motor stator resistance (Rs), leak inductance (Lsigma) and no-load current (Noload Curr) are saved.

CON-21 ASR-SL P Gain1, CON-22 ASR-SL I Gain1: The speed controller gain of the sensorless(I) vector control can be changed. The controller gain is set according to the default motor parameter and Acc/Dec time.

> ⚠ CAUTION
>
> **The controller gain can be adjusted according to the load characteristic. However, motor overheat of system instability might occur according to the controller gain setting**.

DRV-10 Torque Control: Selects and uses the speed control mode and torque control mode from the sensorless(I) vector control mode. If you set the torque control (DRV-10) at Yes, change into torque control mode occurs before operation. For details on the torque control mode, see 4.14 Torque control.

> ⚠ CAUTION
>
> **Torque control is not available during low speed regeneration region and low speed with light load. Please, choose vector control.**
>
> **When using torque control, do not switch over commands of forward and reverse rotation are during operation. It may cause over current or deceleration error of reverse direction. When controlling with vector control, please set Speed Search in case that there is possibility to operate during motor free run.**
>
> **(CON-71 Speed Search = set Speed Search during acceleration(0001))**

4.12 Sensorless (II) vector control

Group	Code No.	Function Display	Setting Display		Unit
DRV	09	Control Mode	4	Sensorless-2	-
	10	Torque Control	0	No	-
	14	Motor Capacity	x	Changeable according to capacity of the motor	kW
BAS	11	Pole Number	-	4	-
	12	Rated Slip	-	Changeable according to capacity of the motor	Hz
	13	Rated Curr	-	Changeable according to capacity of the motor	A
	14	Noload curr	-	Changeable according to capacity of the motor	A
	15	Rated Volt	-	220/380/440/480	V
	16	Efficiency	-	Changeable according to capacity of the motor	%
	20	Auto Tuning	1	All	-
CON	20	SL2 G View Sel	1	Yes	-
	21	ASR-SL P Gain1	-	Changeable according to capacity of the motor	%
	22	ASR-SL I Gain1	-	Changeable according to capacity of the motor	ms
	23	ASR-SL P Gain2	-	Changeable according to capacity of the motor	%
	24	ASR-SL I Gain2	-	Changeable according to capacity of the motor	%
	26	Observer Gain1	-	10500	-
	27	Observer Gain2	-	100.0	%
	28	Observer Gain3	-	13000	-
	29	S-Est P Gain 1	-	Changeable according to capacity of the motor	-
	30	S-Est I Gain 1	-	Changeable according to capacity of the motor	-
	31	S-Est P Gain 2	-	Changeable according to capacity of the motor	%

Group	Code No.	Function Display	Setting Display		Unit
	32	S-Est I Gain 2	-	Changeable according to capacity of the motor	%
	48	ACR P-Gain	-	1200	-
	49	ACR I-Gain	-	120	-

⚠ CAUTION

The parameter of the motor connected to the output terminal of the inverter should be measured for high-performance operation. Measure the parameter using auto tuning (BAS-20 Auto Tuning) before vector operation. For high-performance control of sensorless(I) vector control, the inverter capacity should be equal to that of the motor. If the motor capacity is lower than the inverter capacity by more than 2 phases, there might be a problem with the control characteristic, so change the control mode to V/F control. In addition, in case of sensorless(I) vector control operation, do not connect more than one motor to the inverter output.

Before auto tuning, enter the items on the motor plate first.

DRV-14 Motor Capacity
BAS-11 Pole Number
BAS-12 Rated Slip
BAS-13 Rated Curr
BAS-15 Rated Volt
BAS-16 Efficiency

Separate the load connected to the motor shaft and set the auto tuning item at No. 1 All. The motor measures the parameter while rotating. When auto tuning finishes, the measured values of the motor stator resistance (Rs), leak inductance (Lsigma), stator inductance (Ls), no-load current (Noload Curr) and rotor time constant (Tr) are saved in BAS-21, BAS-22, BAS-23, BAS-14 and BAS-24 respectively.

CON-20 SL2 G View Sel: If you select No. 1 Yes, the user can set various gains (CON-23 ASR-SL P Gain2, CON-24 ASR-SL I Gain2, CON-27 Observer Gain2, CON-28 Observer Gain3, CON-31 S-Est P Gain2, CON-32 S-Est I Gain2) applied to rotation at higher than medium speed (about 1/2 of the base frequency). If you select No. 0 No, the related parameter is not displayed.

(1) Speed Controller Gain

CON-21 ASR-SL P Gain1, CON-22 ASR-SL I Gain1: The speed PI controller gain of the sensorless(II) vector control can be changed. In PI speed controller, the speed controller PI gain is the proportional gain of the speed error and has a characteristic of having higher torque output command as the speed error rises. That is why the higher the speed error is, the faster speed variance decreases. The speed controller I gain is the integral gain of the speed error. When a constant speed error continues, the speed controller I gain is the time(ms) it takes until the rated torque output command. The lower the value is, the faster the speed variance decreases.

The wave form of the speed controller gain can be improved after observing the tendency of the speed change. If the speed variance is not rapidly reduced, the speed controller P gain can be increased or I gain (time in terms of ms) can be decreased. However, if P gain is increased or I gain is decreased too much, a lot of vibration might occur. In addition, in case of oscillation of the speed wave form, it can be adjusted by increasing I gain or P gain.

CON-23 ASR-SL P Gain2, CON-24 ASR-SL I Gain2: Can be seen only when SL2 G View Sel(CON-20) is set as No. 1 Yes. The speed controller gain at higher than the medium speed of sensorless(II) vector control(about 1/2 of the base frequency).

CON-23 ASR-SL P Gain2 is set as the percentage of the low speed gain CON-23 ASR-SL P Gain1. That is, the lower P Gain2 is than 100.0%, the lower the responsiveness is. For example, if CON-23 ASR-SL P Gain1 is 50.0% and CON-23 ASR-SL P Gain2 is 50.0%, the speed controller P gain at higher than the actual medium speed is 25.0%.

CON-24 ASR-SL I Gain2 is also set in percentage of the CON-24 ASR-SL I Gain1. For I gain, as well, the lower I Gain2 is, the lower the responsiveness is. For example, if CON-23 ASR-SL I Gain1 is 100ms and CON-23 ASR-SL I Gain2 is 50.0%, the speed controller I gain at higher than the actual medium speed is 200ms. The controller gain is set according to the default motor parameter and Acc/Dec time.

(2) Magnetic Flux Observer Controller Gain

CON-26 Observer Gain1, CON-27 Observer Gain2, CON-28 Observer Gain3: For sensorless(II) vector control, the observer for estimating the stator current and rotor magnetic flux of the motor is essential. Observer Gain1 (CON-26) applies at low and medium speed and Observer Gain2 (CON-27) applies at medium and high speed and Observer Gain3 (CON-28) applies in the torque mode. It is recommended that you do not change the observer gain from its default value.

Observer Gain2 (CON-27) and Observer Gain3 (CON-28) can be see only when SL2 G View Sel (CON-20) is set at No. 1 Yes.

(3) Speed Estimator Gain

CON-29 S-Est P Gain1, CON-30 S-Est I Gain1: The speed estimator gain of sensorless(II) vector control can be changed. The speed estimator P gain or I gain can be increased or decreased by a small amount for adjustment when the displayed value of speed is not equal to the goal value in a normal state. These gains can be also adjusted when there is great vibration in the motor or high current ripple with power On. In such a case, you can conduct a test mostly by decreasing the P gain or I gain of the speed estimator. The speed estimator gain is set according to the default motor parameter and Acc/Dec time.

CON-31 S-Est P Gain2, CON-32 S-Est I Gain1: Can be see only when SL2 G View Sel (CON-20) is set at No. 1 Yes. The speed estimator gain can be changed at higher than the medium speed (above a half of the base frequency) in sensorless(II) vector control.

CON-31 S-Est P Gain2 and CON-32 S-Est I Gain1 are respectively set as the percentage of low speed gain CON-29 S-Est P Gain1 and CON-30 S-Est I Gain1. For example, if CON-29 S-Est P Gain1 is 300 and CON-31 S-Est P Gain2 is 40.0%, the speed estimator P gain at higher than the actual medium speed is 120. The setting method is the same as the low and medium speed gain setting method. The speed estimator gain is set according to the default motor parameter and Acc/Dec time.

CON-34 SL2 OVM Perc: Output Voltage has a linearity for Input Voltage at non-overmodulation area which the ratio of Output Voltage /Input Voltage is below 100%. At CON-34 (SL2 OVM Perc) can set the voltage range which is limited at Sensorless-2 overmodulation area. In a application such as impact load (Press etc.; Torque limit < load), Tripless operation can be possible by increasing the value of CON-34 (SL2 OVM Perc) when load is applied. (Default value: 120 [%])

Also, Input Voltage is lower than nominal voltage at the area where supply a unstable input voltage so OC1 Trip is occurred frequently when heavy reverse load such as impact load (Torque Limit < Load) is applied. The Trip caused by lower Output Voltage. In this case, set the CON-34 (SL2 OVM Perc) to 140 ~ 150% and you can operate Tripless operation in case heavy load is applied.

CON-48 ACR P-Gain, CON-49 ACR I Gain: Adjusts the P gain and I gain of the current PI controller.

DRV-10 Torque Control: The speed control mode and torque control mode are selected from the sensorless(II) vector control mode and used. If the torque control (DRV-10) is set as Yes, operation is carried out in the torque control mode. For details on the torque control mode, see 4.14 Torque control.

⚠ CAUTION

The controller gain can be adjusted according to the load characteristic. However, motor overheat of system instability might occur according to the controller gain setting.

Guide on Various Gain Adjustment of Sensorless (II) Vector Control: Because the sensorless(II) vector control is greatly influenced by the characteristics of the motor and load, it is sometimes necessary to adjust the controller gain. Let's assume that the sensorless(II) vector control is carried out in speed mode (DRV-10 torque control set at No. 0 No).

Firstly, if instable operation is observed at extremely low speed below (2 ~ 3Hz) or the speed bounds during starting, adjust the gain properly increasing CON-22 ASR-SL I Gain1 until it is twice as the default value.

Secondly, where regenerative load is usually used, torque ripple might occur frequently in the motor with regenerative load supplied. In such a case, try decreasing CON-21 ASR-SL P Gain1 to 50% of the default value to adjust the gain properly. If it does not work, increase CON-21 ASR-SL P Gain1 back to the default value and adjust the gain value decreasing CON-30 S-Est I Gain 1 to 50% of the default value.

4.13 Vector control

The motor operates at the vector control mode in which high precision control of speed and torque is provided with the encoder option card mounted on the main body of the inverter.

Group	Code No.	Function Display	Setting Display		Unit
DRV	09	Control Mode	5	Vector	-
	21	Hz / rpm Sel	1	Rpm Display	-
BAS	20	Auto Tuning	1	All	-
CON	09	PreExTime	-	1.0	Sec
	10	Flux Force	-	100.0	%
	11	Hold Time	-	1.0	Sec
	12	ASR P Gain 1	-	50.0	%
	13	ASR I Gain 1	-	300	ms
	15	ASR P Gain 2	-	50.0	%
	16	ASR I Gain 2	-	300	ms
	18	Gain Sw Freq	-	0.00	Hz
	19	Gain Sw Delay	-	0.10	Sec
	51	ASR Ref LPF	-	0	ms
	52	Torque Out LPF	-	0	ms
	53	Torque Lmt Src	0	Keypad-1	-
	54	FWD +Trq Lmt	-	180	%
	55	FWD –Trq Lmt	-	180	%
	56	REV +Trq Lmt	-	180	%
	57	REV –Trq Lmt	-	180	%
	58	Trq Bias Src	0	Keypad-1	-
	59	Torque Bias	-	0.0	%
	60	Trq BiasFF	-	0.0	%
IN	65 ~ 75	Px Define	36	Asr Gain 2	-
	65 ~ 75	Px Define	37	ASR P/PI	-

⚠ CAUTION

For high performance operation of the vector control mode, correct data should be input on the related functions including the motor parameter measurement and encoder and so on. Follow the setting order below before vector control operation. For high-performance control of sensorless (I) vector control, the inverter capacity should be equal to that of the motor. If the motor capacity is lower than the inverter capacity by more than 2 phases, there might be a problem with the control characteristic, so change the control mode to V/F control. In addition, in case of vector control operation, do not connect more than one motor to the inverter output.

(1) Preparation before Starting

Separate the load connected to the motor axis.

Motor parameter input: enter the following values shown on the motor plate.

DRV-14 Motor Capacity
BAS-11 Pole Number
BAS-12 Rated Slip
BAS-13 Rated Curr
BAS-15 Rated Volt
BAS-16 Efficiency

Check whether the encoder option card is mounted on the main body of the inverter.

Set the encoder option mode(APO-01) at No.1 Feed-back and input the following information according to the specification of the encoder.

APO-04 Enc Type Sel: select signal delivery method of encoder. Set with instruction manual of encoder. According to specifications of encoder, select one out of Line Driver (0), Totem or Com (1), and Open Collect (2).

APO-05 Enc Pulse Sel: set the way of encoder output pulse.

In case of (A+B) of No.0, select forward operation,
In case of –(A+B) of No.2, select reverse operation. Select No.1, select frequency reference for setting.

APO-06 Enc Pulse Num: input the number of pulse per rotation.

Group	Code No.	Function Display	Setting Display	Setting Range	Unit

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
BAS	20	Auto Tuning	3	Enc Test	0 ~ 4	-
APO	01	Enc Opt Mode	1	Feed-back	0 ~ 2	-
	04	Enc Type Sel	0	Line Driver	0 ~ 2	-
	05	Enc Pulse Sel	0	(A+B)	0 ~ 2	-
	06	Enc Pulse Num	-	1024	10 ~ 4096	-
	08	Enc Monitor	-	-	-	-

APO-01 Enc Opt Mode: Set as No. 1 Feed-back.

APO-04 Enc Type Sel: Set the method to deliver a signal. Set it right, referring to the manual. Select one out of Line Driver (0), Totem or Com (1), Open Collect (2).

APO-05 Enc Pulse Sel: set the way of encoder output pulse.

In case of (A+B) of No.0, select forward operation,
In case of –(A+B) of No.2, select reverse operation. Select No.1, select frequency reference for setting.

APO-06 Enc Pulse Num: input the number of pulse per rotation.

APO-08 Enc Monitor: convert encoder output to the number of motor rotation and write in unit, Hz or rpm.

BAS-20 Auto Tuning: Forward operation is run up to 20Hz if setting Enc Test of No.3 after setting related parts of encoder explained above. After forward operation and deceleration, acceleration is run up to 20Hz. If encoder does not have any problems, auto tuning part changes to None. In case of misconnection, indicates the sign, ‘Enc reversed’. In this case, change APO-05 Enc Pulse Sel or change and connect 2 lines out of inverted output lines connected to motor.

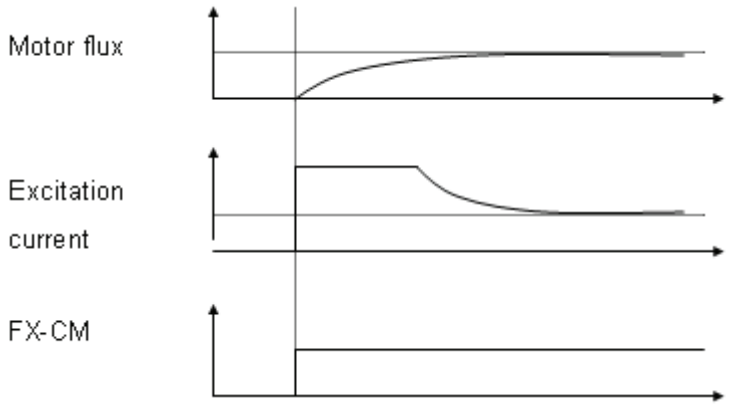
(2) Auto Tuning

Select No. 1 All in auto tuning item (BAS-20).

(3) Initial Excitation

CON-09 PreExTime: Sets the initial excitation time. Operation can be started after excitation to the rated speed of the motor.

CON-10 Flux Force: The initial excitation time can be reduced. The motor flux increases to the rated flux with the time constant in the following figure. Therefore, to reduce the time it takes to reach the rated flux, by supplying the flux-oriented value higher than the rated flux so that the actual flux approximates the rated value, an motion is taken to reduce the supplied flux-oriented value.



(4) Gain Setting

CON-12 ASR P Gain 1, CON-13 ASR I Gain 1: Sets the proportional gain and integral gain of the speed controller (ASR). The higher the proportional gain is, the faster the response is, which applied to high load. But if the gain is too high, the speed of the motor might oscillate.

CON-15 ASR P Gain 2, CON-16 ASR I Gain 2: A separate controller gain can be used according to the rotation speed of the motor and the load system. The gain of the speed controller varies according to the set values of the gain change frequency (CON-18) and gain switching delay time (CON-19).

CON-51 ASR Ref LPF: Used in vector speed mode. The filter time constant of the speed controller reference input can be adjusted.

CON-52 Torque Out LPF: Used in the vector speed or vector torque mode. In the vector speed, the filter time constant of the speed controller output can be adjusted. In the vector torque, the filter time constant of the torque command can be adjusted.

CON-48 ACR P-Gain, CON-49 ACR I Gain: Used in sensorless speed/torque and vector speed/torque modes and adjusts the P gain and I gain of the current PI controller.

IN-65 ~ 75 Px Define

36: ASR Gain2
If the set terminal is input, the gain can be changed after the gain switching delay time (CON-19).

37: ASR P/PI
Moves during stop. If the set terminal is input, the integral controller is not active.

(5) Torque Limit

The size of the torque reference is adjusted by limiting the speed controller output. Both reverse and regenerative limits for forward and reverse operation can be set.

CON-53 Torque Lmt Src: Selects the type of torque limit setting. The torque limit can be set by using the keypad, analog input of the terminal block (V1, I1) or communication option.

0: Keypad-1, 1: Keypad-2
Sets the torque limit using the keypad. Up to 200% can be set on the basis of the rated torque of the motor and the limits on the rotation direction, reverse and regenerative limits are set in the following codes.

CON-54 FWD + Trq Lmt: forward motoring operation torque limit
CON-55 FWD – Trq Lmt: forward regeneration operation torque limit
CON-56 REV + Trq Lmt: reverse motoring operation torque limit
CON-57 REV – Trq Lmt: reverse regeneration operation torque limit

2: V1, 3: I1
The torque limit is set by using the analog input terminal of the inverter terminal block. The maximum torque is set by using IN-02 Torque at 100% item. For example, if IN-02 is set at 200% and voltage input (V1) is used, the torque limit is 200% when 10V is input (only when the V1 terminal function is set at the default function). When the torque limit setting method is other than the keypad, the set value is confirmed in the monitor mode. No. 20 Torque Limit is selected in CNF-06 ~ 08 of config mode.

3: Int 485
Sets the torque limit using the communication terminal of the inverter terminal block.

(6) Torque Bias Setting

CON-58 Trq Bias Src: Selects the type of setting of the offset value added to the torque reference.

0: Keypad-1, 1: Keypad-2
Setting by using the keypad is input in CON-38 Torque Bias. up to 120% of the rated current of the motor can be set.

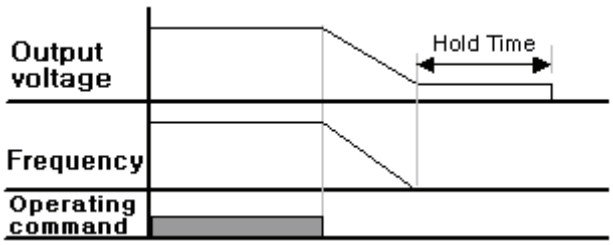
2: V1, 3: I1, 6: Int 485
The setting method is the same as the torque reference described above. The setting can be checked in monitor mode (MON mode) and select No. 21 Torque Bias among CNF-06 ~ 08.

IN-65 ~ 75 Px Define: Although the multi-function input is set at No.48 Trq Bias, if the multi-function input is not On, the Torque Bias values being input into the keypad, analog or communication are ignored.

CON-60 Trq BiasFF: This is added to the torque bias to compensate for the loss from the motor rotation direction. If a (-) value is input, the torque bias decreases by the amount of the input.

Zero-speed Control in Stop: Hold Time

CON-11 Hold Time: Zero-speed operation continues for the set period of time when the motor decelerates and stops according to the stop command and the output is blocked.



4.14 Torque Control (When you want to control the torque)

Torque control is controlling the motor for the torque output set at the torque command value. The rotation speed of the motor stays constant when the output torque and load torque of the motor are in balance. Therefore, the motor rotation speed in torque control is determined by the load. If the output torque is larger than the motor load, the motor speed gradually goes up. To prevent this, it is recommended you set the speed limit to the motor rotation speed. (You cannot control the torque during speed limit operation)

(1) Torque Control Setting

It operates when DRV-09 Control Mode sets to Sensorless-1, 2 or Vector.

DRV-09 Control Mode: Sets the control mode at No. 3 or 4 SensorlessNo.1, 2 or 5 Vector.
DRV-10 Torque Control: Sets torque control as No. 1 Yes.

Group	Code No.	Function Display	Setting Display		Unit
DRV	02	Cmd Torque	-	0.0	%
	08	Trq Ref Src	0	Keypad-1	-
	09	Control Mode	5	Vector	-
	10	Torque Control	1	Yes	-
BAS	20	Auto Tuning	1	Yes	-
CON	62	Speed Lmt Src	0	Keypad-1	-
	63	FWD Speed Lmt	-	60.00	Hz
	64	REV Speed Lmt	-	60.00	Hz
	65	Speed Lmt Gain	-	100	%
IN	65 ~ 75	Px Define	35	Speed/Torque	-
OUT	31 ~ 33	Relay x or Q1	27	Torque Dect	-
	59	TD Level	-	100	%
	60	TD Band	-	5.0	%

⚠ CAUTION

For operation in the torque control mode, the sensorless vector mode and the basic operation conditions described in the vector control mode should be set in advance.

Torque control is not available during low speed regeneration region and low speed with light load. Please, choose vector control.

When using torque control, do not switch over commands of forward and reverse rotation are during operation. It may cause over current or deceleration error of reverse way. When controlling with vector control, please set Speed Search in case that there is possibility to operate during motor free run. (CON-71 Speed Search = set Speed Search during acceleration 0001).

(2) Torque Reference Setting

Torque reference can be set in the same way as the frequency reference. The torque control mode set, the frequency reference is not active.

DRV-08 Trq Ref Src: Selects the type to use as the torque reference.

0: Keypad-1, 1: keypad-2
Input the torque reference using the keypad. The torque can be set in CON-02 Cmd Torque and up to 80% of the motor rated torque can be set.

2: V1, 3: I1
The torque reference can be input by using the voltage (V1) or current (I1) terminal block of the inverter. Set the maximum torque by using the item of IN-02 Torque at 100%. For example, if IN-02 is set at 200% and the torque reference is set with the current input (I1), you can check the setting in monitor mode (MON mode) and select No. 19 Torque Ref from CNF-06 ~ 08.

6: Int 485
Set the torque reference using the communication terminal on the terminal block.

(3) Speed Limit

During operation in the torque control mode, the operating speed can go up at the maximum operating speed according to the load condition. Therefore the speed limit function is used to prevent such divergence of speed.

CON-62 Speed Lmt Src: Selects the type of speed limit setting.

0: Keypad-1, 1: keypad-2
The speed limit is set by using the keypad. The forward speed limit is set

in CON-63 FWD Speed Lmt and the reverse speed limit is set in CON-64 REV Speed Lmt.

2: V1, 3: I1, 6: Int 485
Operates the same way as the frequency command setting method. The setting can be checked in monitor mode (MON mode) and select No.21 Torque Bias from CNF-06 ~ 08.

CON-65 Speed Lmt Gain: Sets the rate of reference decrease when the motor speed exceeds the speed limit. If No. 35 of the multi-function input terminal function items is selected and input during stop, the operation can shift from the torque control mode to vector control mode (speed control).

4.15 Droop control

This can be used to prevent saturation of the speed controller in vector control or for load balancing when one load is driven by multiple controllers.

Group	Code No.	Function Display	Initial Setting Display		Unit
CON	66	Droop Perc	-	0.0	%
	67	Droop St Torque	-	100.0	%

CON-66 Droop Perc: Sets the rate to be reflected in the speed command value on the basis of the motor rated torque.

CON-67 Droop St Torque: Sets the torque at which the droop control operation starts.
The motor speed is adjusted as follows according to the load torque on the basis of the set value.

$$Droop\ speed = Maximum\ frequency \times DroopPerc \times \frac{Torque\ reference - DroopStTorque}{100\%\ torque - DroopStTorque}$$

4.16 Speed/Torque Change Function

This function is active only in vector control. You can shift from the speed mode to torque mode or shift from the torque mode to speed mode by the multi-function input.

Group	Code No.	Function Display	Initial Setting Display		Unit
CON	68	SPD/TRQ Acc T	-	20.0	Sec
	69	SPD/TRQ Dec T	-	30.0	Sec
IN	65 ~ 75	Px Define	35	Speed/Torque	-

If the multi-function input, which is set as Speed/Torque, is ON during Vector Torque (DRV-09: Vector, DRV-10: Yes) operation, the operation shifts to the vector speed mode according to the Acc/Dec time set in CON-68 ~ 69.

If the multi-function input, which is set as Speed/Torque, is On during Vector Speed (DRV-09: Vector, DRV-10: No) operation, the operation immediately shifts to the vector torque mode.

4.17 Kinetic Energy Buffering

If a power outage occurs, the DC link voltage goes down and a low voltage failure is occurred and it makes to block output. This function maintains the DC link voltage by controlling the inverter output frequency during the outage, thereby helping maintain the interval between the instantaneous outage and the low voltage failure for a longer time.

Group	Code No.	Function Display	Setting Display		Unit
CON	77	KEB Select	1	Yes	-
	78	KEB Start Lev	-	130	%
	79	KEB Stop Lev	-	135	%
	80	KEB Gain	-	1000	-

CON-77 KEB Select: Selects Kinetic energy buffering operation with the input power Off. If No. 0 Continue is selected, normal decelerating operation is carried out until low voltage. If No.1 KEB Select is selected, the inverter DC part is charged with the regenerative energy that is generated from the motor by controlling the inverter output frequency.

CON-78 KEB Start Lev, CON-79 KEB Stop Lev: Sets the start and stop point of Kinetic energy buffering operation on the basis of low voltage (Level 100%) so that the stop level (CON-79) is higher than the start level (CON-78).

CON-80 KEB Gain: This is the gain used for controlling the kinetic energy buffering operation by using the inertia moment amount of the load. If the load inertia is high, a small gain amount is used. If the load inertia is low, a large gain amount is used. In case the motor vibrates severely when KEB function operates because of input power cut off, set the gain (CON-80: KEB Gain) to about a half value of previous set value . In this case do not lower the gain too much because low voltage trip may happen during the kinetic energy buffering operation.

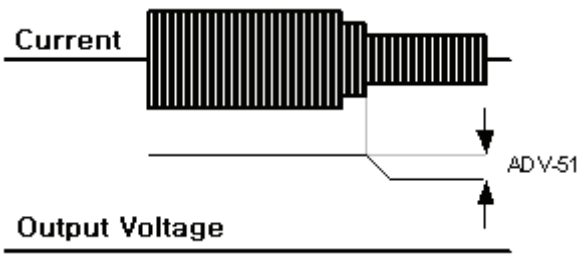
⚠ CAUTION

1. **Depending on the instantaneous interruption time and the load inertia, kinetic energy buffering may cause low voltage trip when it is decelerated.**
2. **When inverter operates Energy Buffering operation, the motor will vibrate except for the variable torque load (Fan, Pump etc.)**

4.18 Energy saving operation

■ Manual Energy Saving Operation

Group	Code No.	Function Display	Setting Display		Unit
ADV	50	E-Save Mode	1	Manual	-
	51	Energy Save	-	30	%



If the inverter output current is lower than the current set in BAS-14 Noload curr (no-load current of the motor), the output voltage is reduced by the amount set at ADV-51.The standard value is the voltage before the energy saving operation starts. This is not active during acceleration and deceleration.

■ Automatic Energy Saving Operation

Group	Code No.	Function Display	Setting Display		Unit
ADV	50	E-Save Mode	2	Auto	-

The output voltage is adjusted by automatically calculating the amount of the saved energy on the basis of the motor rated current (BAS-13) and no-load current (BAS-14).

⚠ CAUTION

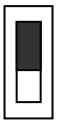
Be aware that the time required for acceleration or deceleration by a change of the operating frequency or stop command during energy saving operation might be longer than the set period of time for acceleration and deceleration because of the control time it takes the energy saving operation to come back to normal operation.

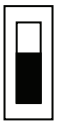
4.19 Speed search operation

This is used to prevent a failure that might occur when the inverter outputs voltage during the motor idling with the output voltage of the inverter blocked. It is not accurate speed detection since the rotation speed of the motor is easily judged on the basis of output current of the inverter.

Group	Code No.	Function Display	Initial Setting Display			Unit
CON	71	Speed Search	-	0000		Bit
	72	SS Sup-Current	-	Below 75 kW	150	%
				Above 90 kW	100	
	73	SS P-Gain	-	100		-
	74	SS I-Gain	-	200		-
	75	SS Block Time	-	1.0		Sec
OUT	31 ~ 32	Relay 1, 2	19	Speed Search		-
	33	Q1 Define	-	-		

CON-71 Speed Search: The following four types of speed search can be used. If the dot of the displayed switch is up, the corresponding bit is set and if the dot of the displayed switch is down, it is not active.

Bit Set (On): 

Bit Not Set (Off): 

Setting				Function
Bit4	Bit3	Bit2	Bit1	Bit 1 is on the far right of the display.
			✓	Speed search selection in acceleration
		✓		Reset starting after a trip
	✓			Re-starting after an instantaneous interruption
✓				Simultaneous starting at the time of power On

(1) Speed Search selection in acceleration

If bit 1 is set at 1 and the inverter operating command is input, acceleration is carried out in the speed search operation. If voltage is output with an operating command given to the inverter while the motor is rotating according to the load environment, a trip might occur, thus overworking the motor. In such a case, acceleration can continue without a trip if you use the speed search function.

⚠ CAUTION

For correct operation, please set speed search when accelerating in case of operation from the load to sensorless II mode. It may cause over current trip or over load trip.

(2) Reset starting after a trip

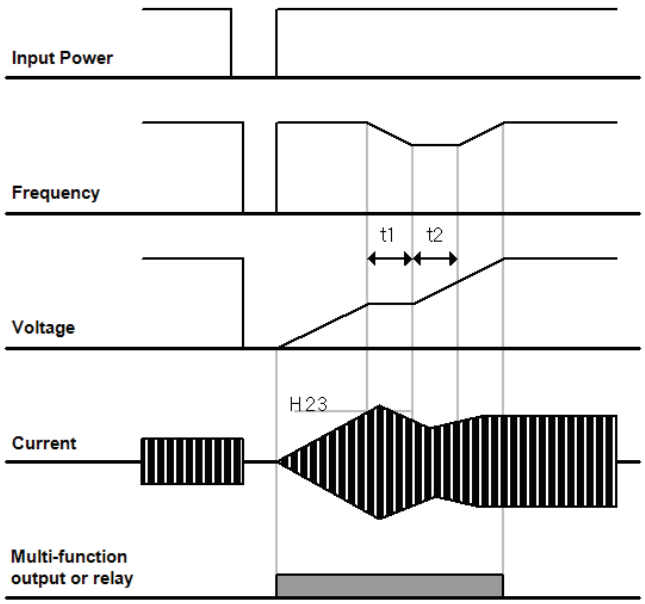
If bit 2 is set at 1 and PRT-08 RST Restart is set as Yes, acceleration is carried out to the frequency before the trip in speed search motion when the reset key (or terminal block reset) is input.

(3) Re-starting after an instantaneous interruption

If the inverter input power is Off, low voltage trip occurs and power is recovered before the internal power of the inverter is Off, acceleration is carried out to the frequency before the low voltage trip in speed search motion.

Simultaneous starting at the time of power On, Bit 4 is set at 1 and ADV-10 Power-on Run is set as Yes. If inverter input power is supplied with the inverter operating command On, acceleration is carried out to the target frequency in speed search motion.

E.g.) Speed search in case of power recovery after instantaneous interruption



⚠ CAUTION

1. **When input power is blocked due to the instantaneous interruption, inverter blocks output by making Low voltage trip (Lvt).**
2. **If input power is recovered, frequency is output and voltage increases by PI control before Low voltage trip (Lvt) occurs.**
3. **t1: Current exceeds over the size set in ADV-61 code, voltage stops increasing and frequency decreases.**
4. **t2: Current drops under the size set in ADV-61, voltage increases again and voltage stops decreasing.**
5. **Normal acceleration at the frequency before trip occurs in case of normal frequency and voltage.**

CON-72 SS Sup-Current: Controls the current during speed search motion on the basis of the motor rated current. The gain of the controller is set at CON-73 and 74.

CON-75 SS Block Time: Blocks output for the set period of time and then starts operation before starting speed search.

Speed search operation is mostly used for loads with high inertia. In case of a load with high friction, it is recommended to restart after stop.

The iS7 series is designed to conduct normal operation in case of an instantaneous interruption shorter than 15ms when being used within the rated output. The inverter with 200V input voltage and the inverter with 400V input voltage guarantee the instantaneous interruption time when the input voltage supplied to the inverter is 200 ~ 230Vac and 380 ~ 460Vac respectively. The current is on the basis of the static torque load current (CT load).

The DC voltage inside the inverter might vary according to the output load. Therefore if the instantaneous interruption time is longer than 15ms or the output is higher than the rated output, a low voltage trip(Low Voltage) might occur.

4.20 Automatic Restart

■ Automatic Restart

Group	Code No.	Function Display	Setting Range	Initial Value	Unit
PRT	08	RST Restart	0: No /1: Yes	0: No	-
	09	Retry Number	0 ~ 10	0	-
	10	Retry Delay	0 ~ 60.0	1.0	Sec
CON	71 ~ 75	SS-Related Function	-	-	-

This is used to prevent a system interruption with the inverter protective function in case of noise and so on.

PRT-08 RST Restart, PRT-09 Retry Number, PRT-10 Retry Delay: It operates when PRT-08 RST Restart set to YES and the available number of automatic restart is set at PRT-09. In case of a trip during operation, the inverter conducts automatic restart after the time set in PRT-10 Retry Delay. At each automatic restart, the number of automatic restarts decreases by 1 inside the inverter and a set number of trips occur and if the number is 0, automatic restart is not carried out even if a trip occurs.

If a trip does not occur within 60 seconds after automatic restart, the number of automatic restarts that was reduced inside the inverter increases again. The maximum increase number is limited to the number of restarts.

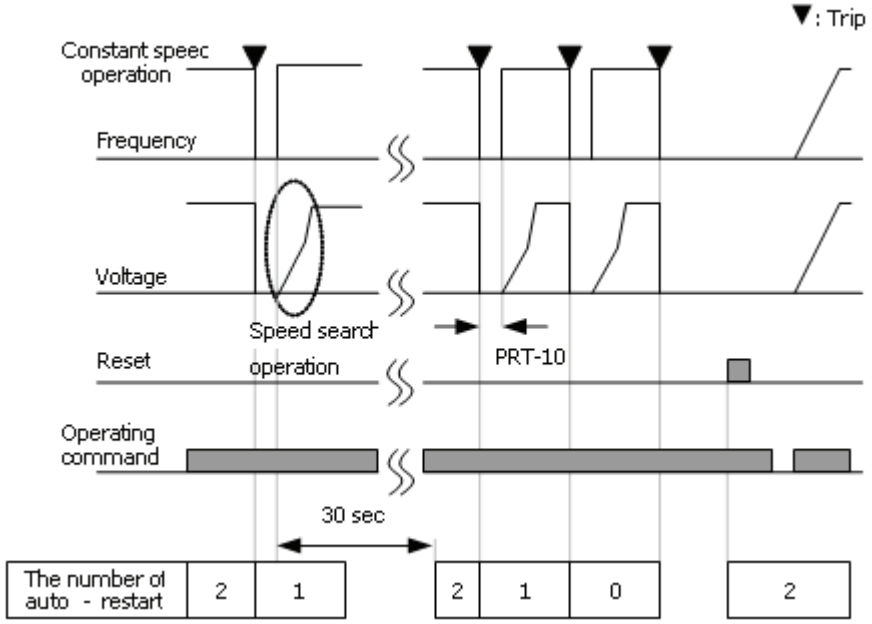
Automatic restart is not carried out in case of a stop caused by low voltage, emergency stop (Bx), overheat or hardware problem (HW Diag).

The acceleration of automatic restart is the same as speed search operation. Thus the functions of CON-72 ~ 75 can be set according to the load and for the speed search function, see Page 8-35.

⚠ CAUTION

Please be careful that in case of operation with the number of automatic restarts set, the reset is terminated and the motor is rotated automatically by the inverter.

The following figure illustrates setting the number of automatic restarts at 2.



4.21 Operation sound selection

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
CON	04	Carrier Freq	-	5.0	0.7 ~ 15 kHz	kHz
	05	PWM Mode	1	Normal PWM	Normal PWM /Low Leakage PWM	-

CON-04 Carrier Freq: Selects the operation sound from the motor. The power device (IGBT) inside the inverter generates high frequency switching voltage to supply to the motor. Here the high frequency is called carrier frequency. The higher the carrier frequency is, the lower the operation sound generated from the motor is and the lower the carrier frequency is, the higher the operation sound is.

CON-05 PWM Mode: The heat loss and leak current from the inverter can be reduced according to the load rate. If you select Normal PWM, you can reduce heat loss and leak current more than when you select Low Leakage PWM, but the motor sound increases.

The merits and demerits of each load rate and the carrier frequency are as follows.

	Carrier Frequency	
	0.7 kHz	15kHz
	LowLeakage PWM	Normal PWM
Motor Noise	↑	↓
Heat	↓	↑
Noise	↓	↑
Leak Current	↓	↑

The carrier frequency according to the inverter capacity is as follows.

0.75 ~ 22kW	30 ~ 45 kW	55 ~ 75kW	90 ~ 110 kW	132 ~ 160kW
5kHz (Max 15kHz)	5kHz (Max 10kHz)	5kHz (Max 7kHz)	3kHz (Max 6kHz)	3kHz (Max 5kHz)

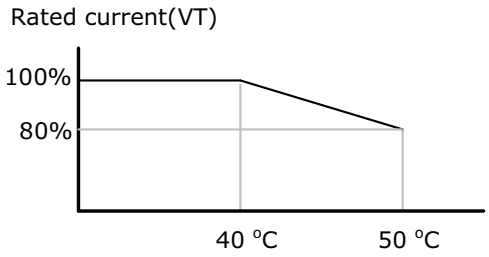
⚠ CAUTION

Carrier frequency default value of 90 ~ 160 kW is 3kHz. Please do not confuse with the value D: 5.0
which is displayed on the lower left part of the keypad as followed picture that the value is the default
value from the below 75kW product.

iS7 inverter can be used for two types of load rates. Medium load use has an over load rate of 150% per minute and normal load has an over load rate of 110% per minute. Therefore the current rating varies according to the load rate and limited according to the surrounding temperature.

Rated current degrading specification by temperature:

The following is the rated current limit according to the temperature in operation at the normal load rate (VT: Variable Torque).



Frame 1,2

Rated current degrading specification by carrier:

The following is the rated current guaranteed area according to the load and carrier frequency.

Inverter Capacity		0.75 ~ 7.5kW	11 ~ 22kW	30 ~ 75kW
CT Load	Normal Temperature (25℃)	10kHz	10kHz	5kHz
	High Temperature (40℃)	7kHz	7kHz	4kHz
	High Temperature (50℃)	5kHz	5kHz	4kHz
VT Load	Normal Temperature (25℃)	7kHz	7kHz	3kHz
	High Temperature (40℃)	2kHz	2kHz	2kHz

4.22 2nd Motor operation

(when you want to do change operation of 2 monitors with one inverter)

During change operation, connecting different 2 monitors with one inverter, 2nd operation is available when the terminal defined as the 2nd function is 1 for the parameter of 2nd monitor.

Group	Code No.	Function Display	Setting Display		Unit
IN	65 ~ 75	Px Define	26	2nd Motor	-
M2	04	M2-Acc Time	-	5.0	Sec

IN-65 ~ 75 Px Define: If you set the function item of the multi-function input terminal to No.26 2nd motor, PAR➔M2 (2nd motor group) is displayed in the parameter mode. If the multi-function terminal, which is set as 2nd motor, is input, operation is carried out in the codes set as below. During operation, input of the multi-function terminal does not make the inverter operate in the 2nd motor parameter.

In M2-08 (M2-Ctrl Mode), the operation modes of V/F PG and Vector are not available.

To use M2-28 (M2-Stall Lev), you must set PRT-50(Stall Prevent) at the value you want to use.

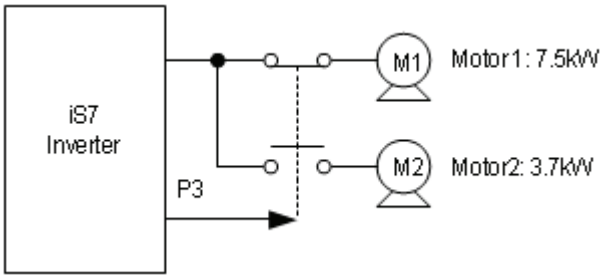
To use M2-29 (M2-ETH 1min) and M2-30(M2-ETH Cont), you must set PRT-40(ETH Trip Sel) at the value you want to use.

Code No.	Function Display	Description
04	M2-Acc Time	Acceleration time
05	M2-Dec Time	Deceleration time
06	M2-Capacity	Motor capacity
07	M2-Base Freq	Rated frequency of the motor
08	M2-Ctrl Mode	Control mode
10	M2-Pole Num	Number of poles
11	M2-Rate Slip	Rated slip
12	M2-Rated Curr	Rated current
13	M2-Noload Curr	No-load current
14	M2-Rated Volt	Rated voltage of the motor
15	M2-Efficiency	Motor efficiency
16	M2-Inertia Rt	Inertia rate of load
17	M2-Rs	Stator resistance
18	M2-Lsigma	Leakage inductance
19	M2-Ls	Stator inductance
20	M2-Tr	Rotor time constant
25	M2-V/F Patt	Output voltage pattern
26	M2-Fwd Boost	Forward torque boost
27	M2-Rev Boost	Reverse torque boost
28	M2-Stall Lev	Stall level

Code No.	Function Display	Description
29	M2-ETH 1min	1 minute electronic thermal incessant rated level
30	M2-ETH Cont	Electronic thermal operation level
40	M2-LoadSpdGain	Gain adjustment for load speed display
41	M2-LoadSpdScal	Scale adjustment for load speed display
42	M2-LoadSpdUnit	Unit adjustment for load speed display

Example: set as follows if you want to change to 3.7kW in previous 7.5kW motor by using P3 terminal with the operation function of the second motor.

Croup	Code No.	Function Display	Setting Display		Unit
IN	67	P3 Define	26	2nd Motor	-
M2	06	M2-Capacity	-	3.7kW	kW
	08	Ctrl Mode	0	V/F	-



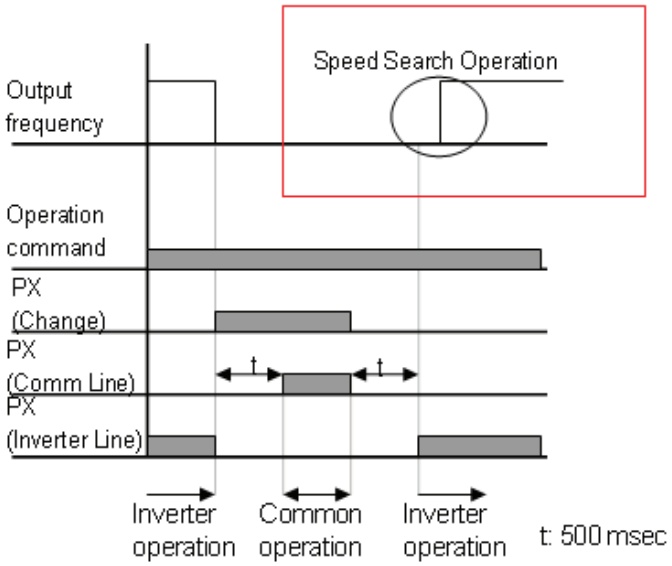
4.23 By pass operation

Group	Code No.	Function Display	Setting Display		Unit
IN	65 ~ 75	Px Define	16	Exchange	-
OUT	31 ~ 32	Relay1,2	17	Inverter Line	-
	33	Q1 Define	18	Comm Line	-

The load operating by the inverter can be exchanged with common power supply or a reverse sequence motion can be carried out.

IN-65 ~ 75 Px Define: This is input when No. 16 Exchange is set and the motor is shifted from the inverter to the common power source. If you want to shift the motor reversely, turn Off the set terminal.

OUT-31 Relay 1 ~ OUT-32 MO1 Define: Sets the multi-function relay or multi-function output at No. 17 Inverter Line and No. 18 Comm Line. For relay motion sequence, see the figure below.



4.24 Cooling fan control

Group	Code No.	Function Display	Initial Setting Display		default	Unit
ADV	64	FAN Control	0	During Run	0: During Run	-
			1	Always On		
			2	Temp Control		

This if the function of On/Off control of the fan attached for cooling the heat-sink of the inverter. This is used for frequently starting/stopping loads or for a quiet environment without the noise of the cooling fan when stopping. This also helps lengthen the life of the cooling fan.

No. 0 During Run (active during operation only): If an operating command is input with the power On in the inverter, the cooling fan starts operating. If the operating command is Off and the inverter output is blocked, the cooling fan stops. If the temperature of the inverter heat sink is higher than a certain degree, the cooling fan operates regardless of the operating command.

No. 1 Always ON (always active): The cooling fan is always active when power is supplied to the inverter.

No. 2 Temp Control (temperature check): The cooling fan is not active even when power is supplied to the inverter and an operating command is input. However, if the temperature of the inverter heat sink is higher than a certain degree, cooling fan is active.

⚠ CAUTION

Though 11 ~ 75kW class sets ADV-64 as 'During Run', FAN could be active as In case of operation above regular temperature of cooling fan by current input harmonics or noises.

4.25 Input power frequency selection

Group	Code No.	Function Display	Initial Setting Display		Unit
BAS	10	60/50 Hz Sel	0	60	Hz

Select the inverter input power frequency. If changed from 60Hz to 50Hz, the items related to the frequency (or rpm) set higher than 60Hz are all changed into 50Hz. If changed from 50Hz to 60Hz, the items related to the frequency (or rpm) set higher than 50Hz are all changed into 60Hz.

4.26 Inverter input voltage selection

Group	Code No.	Function Display	Initial Setting Display		Unit
BAS	19	AC Input Volt	-	220	V

Sets the inverter input power voltage. The low voltage failure (Low Voltage) automatically changes on the basis of the set voltage.

4.27 Parameter writing and reading

Group	Code No.	Function Display	Setting Display		Unit
CNF	46	Parameter Read	1	Yes	-
	47	Parameter Write	1	Yes	-
	48	Parameter Save	1	Yes	-

This is the function of copying the parameter saved in the inverter to the keypad and copying the parameter saved in the keypad to the inverter.

CNF-46 Parameter Read: Copies the parameter in the inverter to the keypad. The existing parameters saved in the keypad are all deleted.

CNF-47 Parameter Write: Copies the parameter saved in the keypad to the inverter. The existing parameters in the inverter are all deleted. In case of an error during parameter writing motion, the previously saved data can be directly used. If there is no data saved in the keypad, a message ‘EEP Rom Empty ‘ is displayed.

CNF-48 Parameter Save: Because the parameters set in communication are saved in the RAM area, they are all gone if the inverter power is turned Off/On. If you set parameters in communication and select Yes in CNF-48 Parameter Save, the set parameters remain unchanged even if the inverter power is turned Off/On.

4.28 Parameter initialization

Group	Code No.	Function Display	Initial Setting Display		Unit
CNF	40	Parameter Init	0	No	-

The parameter changed by the user can be initialized to the default value set at the time of delivery. This function can initialize the data of all groups or selected groups. Initialization is not available in case of a trip or during inverter operation.

1: All Groups
All the data are initialized. If you select No. 1 All Groups and press PROG, initialization starts and when initialization finishes, No. 0 No is displayed.

2: DRV ~ 13: M2
Initialization of each individual group is available. If you select the desired group and press PROG, initialization starts and when initialization finishes, No. 0 No is displayed.

4.29 Parameter view lock and Key lock

(1) Parameter Mode View Lock

Group	Code No.	Function Display	Setting Display		Unit
CNF	50	View Lock Set	-	Unlocked	-
	51	View Lock PW	-	Password	-

The user can set the PAR mode so that it is not viewed using a password on the keypad. In this case, all modes(CNF mode, user mode, macro mode, trip mode) but the parameter mode(PAR) are always viewed.

CNF-51 View Lock PW: Registers the password to use for parameter mode view lock. For setting, see the following procedure.

Procedure	Description
1	If you press PROG key in CNF-51 code, the previous password registration display is viewed. The default value is 0. When you register for the first time, enter 0.
2	If there is a previous password, register it.
3	If the entered password is the same as the previous password, a display emerges in which you can register a new password.
4	If the entered password is different from the previous password, the previous password registration display continues to viewed.
5	Register a new password.
6	When registration is completed, CNF-51 View Lock PW is displayed again.

CNF-50 View Lock Set: If you enter the registered password with the view lock unlocked, 'Locked' is displayed and the parameter group is not to be viewed on the keypad. If you enter the password again, 'Unlocked' is viewed and if you move with the mode key, the parameter mode is displayed.

⚠ CAUTION

If the parameter group View Lock function is active, you cannot change functions related to inverter operation.
Be sure to memorize the registered password.

(2) Parameter Key Lock

Group	Code No.	Function Display	Setting Display		Unit
CNF	52	Key Lock Set	-	Unlocked	-
	53	Key Lock PW	-	Password	-

The user can make the parameter unchangeable using the registered password.

CNF-53 Key Lock PW: Registers the password to use for parameter key lock. Register your password in the following procedure.

Procedure	Description
1	If you press PROG key in CNF-52 code, the previous password registration display is viewed. The default value is 0. When you register for the first time, enter 0.
2	If there is a previous password, register it.
3	If the entered password is the same as the previous password, a display emerges in which you can register a new password.
4	If the entered password is different from the previous password, the previous password registration display continues to viewed.
5	Register a new password.
6	When registration is completed, CNF-53 Key Lock PW is displayed again.

CNF-52 Key Lock Set: If you enter the registered password with the key lock unlocked, 'Locked' is displayed and if you press PROG in the function code you want to change for parameter change on the keypad, you cannot shift to the editor mode. If you enter the password one more time, 'Unlocked' is gone and you get out of the parameter key lock function.

⚠ CAUTION

If the parameter View Lock function is active, you cannot change the functions related to inverter operation.
Be sure to memorize the registered password.

(3) Display of Changed Parameter

Group	Code No.	Function Display	Initial Setting Display		Unit
CNF	41	Changed Para	0	View All	-

This function if making only the parameters different from their default values displayed. This is used for tracing the changed parameters. If you select No. 1 View Changed, only the changed parameters are displayed. If you select No. 0 View All, all the previous parameters are displayed.

4.30 Addition to User Group (USR Grp)

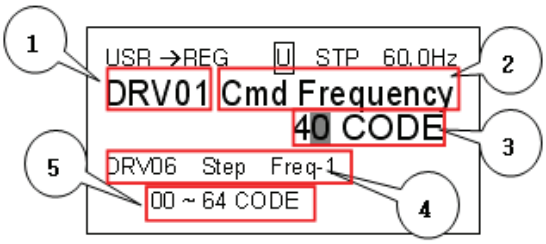
Group	Code No.	Function Display	Initial Setting Display		Unit
CNF	42	Multi-Key Sel	3	UserGrp SelKey	-
	45	UserGrp AllDel	0	No	-

You can group data you have chosen from each group of the parameter group and change them. You can register up to 64 parameters in the user group.

CNF-42 Multi-Key Sel: Selects No. 3 UserGrp SelKey among the functions of the multi-function keys.

If you do not register user group parameter, user group (USR Grp) will not appear even though multi-function key is set to UserGrp SelKey.

■ How to register parameter in USR Grp

Procedure	Description
1	If you select No. 3 UserGrp SelKey in CNF Mode Code 42, U is displayed at the top of the screen.
2	Go to the parameter you want to register in PAR Mode and press MULTI Key. For example, If you press MULTI Key in No. 1 Cmd Frequency, which is DRV Group Code 1, you will see the following display.  **Description of the Display** 1: The group and code number of the parameter to register 2: Name of the parameter to register 3: Code No. to register in the user group (if you press PROG/ENT Key in 40, it will be registered in code 40 of the user group)

Procedure	Description
	4: Information on the parameter already registered in code 40 of the user group 5: Setting range of the user group (0 is for withdrawal of setting)
3	You can set No. 3 in the display above. You can register by selecting the desired code No. and press PROG/ENT.
4	If the value changed at No. 3, the values displayed in No. 4 change too. That is, No. 4 displays the information on the registered parameters and if nothing is registered with the desired code number, Empty Code is displayed. 0 is for withdrawal of setting.
5	The parameters registered as above are registered in the user group of U&M Mode. (When necessary, parameters can be registered redundantly. For example, a certain parameter can be registered in Code 2, Code 11….and so on)

■ How to delete individual parameters registered in User Group (USR Grp)

Procedure	Description
1	If you select No. 3.UserGrp SelKey with the Multi-Key in CNF Mode Code 42, U will be seen at the top of the display.
2	Move the cursor to the code you want to delete in U&M Mode USR Group.
3	Press MULTI Key.
4	You are asked whether to delete.
5	Press YES and then PROG/ENT Key.
6	Deletion is completed.

CNF-45 UserGrp AllDel: If you select No. 1 Yes, all the parameters registered in the user group are deleted.

4.31 Addition to Macro Group

Group	Code No.	Function Display	Initial Setting Display		Unit
CNF	43	Macro Select	0	None	-

If you select the application load, the related function is displayed so that the inverter selects it and it can be changed in the macro group.

CNF-43 Macro Select: This is the function that enables you to easily set by combining various application functions. MC1 (DRAW function) or MC2 (Traverse function) group is displayed at User & Macro (U&M) on two functions DRAW and traverse functions. This function is provided by the inverter. The user cannot add or delete the function items included in the macro but data can be changed in the macro group. Please refer to 4.36 Traverse operation function for trip bus.

Draw function is one of open loop tension controls to maintain tension of materials stuck, using speed difference of motor which is operating by ratio for main commands.

For more details, please refer to chapter, 4.1, Override frequency setting using auxiliary frequency command.

4.32 Easy Start

Group	Code No.	Function Display	Initial Setting Display		Unit
CNF	61	Easy Start On	1	Yes	-

CNF-61 Easy Start On: If you set this code at Yes, 'All' is selected in CNF-40 Parameter Init for all the parameters of the inverter to be initialized and Easy Start is launched when power is Off/On first.

■ How to Launch Easy Start

Procedure	Description
1	Set CNF-61 Easy Start On as Yes.
2	Select All in CNF-40 Parameter Init and initialize all the parameters of the inverter.
3	When the power of the inverter is first Off/On, Easy Start gets started. Through the following displays on the digital loader, set proper values. (If you press ESC on the digital loader, you can immediately get out of Easy Start) - Start Easy Set: select Yes. - CNF-01 Language Sel: select the language you want. - DRV-14 Motor Capacity: select the capacity of the motor. - BAS-11 Pole Number: select the pole number of the motor. - BAS-15 Rated Volt: select the rated voltage of the motor. - BAS-10 60/50Hz Sel: select the rated frequency of the motor. - BAS-19 AC Input Volt: set the input voltage. - DRV-06 Cmd Source: selects the operating command method. - DRV-01 Cmd Frequency: select the operating frequency. Now you come back to the monitoring display. The minimum parameter to drive the motor having been set, the motor is operated by the operating command method set in DRV-06.

4.33 Other Config (CNF) mode parameters

Group	Code No.	Function Display	Initial Setting Display		Unit
CNF	2	LCD Contrast	-	-	-
	10	Inv S/W Ver	-	x.xx	-
	11	Keypad S/W Ver	-	x.xx	-
	12	KPD Title Ver	-	x.xx	-
	30 ~ 32	Option-x Type	-	None	-
	41	Changed Para	0	View All	
	44	Erase All Trip	0	No	-
	60	Add Title Del	0	No	-
	62	WH Count Reset	0	No	-
	74	Fan Time	-	00:00:00	-
	75	Fan Time Rst	0	No	-

CNF-2 LCD Contrast: can adjust the LCD brightness of the digital loader.

CNF-10 Inv S/W Ver, CNF-11 Keypad S/W Ver: can check the OS version of the inverter and digital loader.

CNF-12 KPD Title Ver: can check the title version of the digital loader.

CNF-30 ~ 32 Option-x Type: can check the type of the option board inserted in slots 1 ~ 3.

CNF-41 Changed Para: When setting as View Changed, changed parameter comparing to default value is displayed.

CNF-44 Erase All Tip: deletes all the saved failure history.

CNF-60 Add Title Del: this is a function to set to enable added codes in previous version to display and operate added functions when SW of inverter main body is updated with new coded. If you set this at Yes, extract the digital loader from the main body and insert it again, the title of the digital loader is updated.

CNF-62 WH Count Reset: The accumulated electricity is cleared.

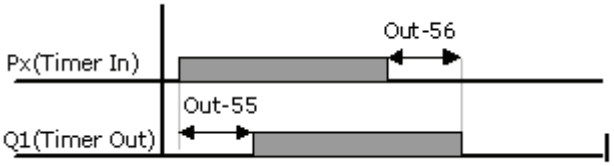
CNF-74 Fan Time, CNF-75 Fan Time Rst: displays the cumulative time for which the cooling fan has operated. If you select Yes at CNF-75 Fan Time Rst, CNF-74 Fan Time is cleared.

4.34 Timer function

Group	Code No.	Function Display	Initial Setting Display		Unit
IN	65 ~ 75	Px Define	38	Timer In	-
OUT	31 ~ 33	Relay1,2 / Q1	27	Timer Out	-
	55	TimerOn Delay	-	3.00	Sec
	56	TimerOff Delay	-	1.00	Sec

This is the timer function of the multi-function input terminal. You can turn the multi-function output (relay included) after a certain period of time.

IN-65 ~ 75 Px Define: Set the terminal to operate as the timer among multi-function input terminals at No. 38 Timer In. If you input the set terminal, the output set as Timer Out becomes active after the period of time set in OUT-55 TimerOn Delay. If the multi-function input terminal is turned off, the multi-function output (or relay) is turned off after the period of time set in OUT-56 TimerOff Delay.



4.35 Auto sequence operation

Group	Code No.	Function Display	Initial Setting Display		Unit
APP	01	App Mode	4	Auto Sequenc	-
IN	65 ~ 75	Px Define	41	SEQ-1	-
			42	SEQ-2	-
			43	Manual	-
			44	Go Step	-
			45	Hold Step	-
OUT	31 ~ 32	Relay 1, 2	20	Step Pulse	-
	33	Q1 Define	21	Seq Pulse	-

APP-01 App Mode: If you select No. 4 Auto Sequence, the auto sequence group (AUT) is displayed in the parameter mode. You can set the type of the auto sequence, Acc/Dec time and frequency of each step and the rotation direction.

IN-65 ~ 75 Px Define: Use the multi-function input terminal for auto sequence operation.

41: SEQ-1, 42: SEQ-2
The sequence type of the auto sequence operation is selected. Up to 2 sequence operations are available with different data set for each. If the terminal selected as SEQ-1 is input, the operation is carried out with the data set in sequence 1. If the terminal selected as SEQ-2 is input, the operation is carried out with the data set in sequence 2.

43: Manual
If the terminal set as No. 43 Manual is input during stop in the auto sequence operation mode, the operating command and frequency command respectively set in DRV-06(Cmd Source) and DRV-07(Freq Ref Src) will apply.

44: Go Step
The auto sequence operating method is selected. If you select Auto-B in AUT-01 code, this is used as the command of step shift.

45: Hold Step
During operation with AUT-01 Auto Mode set at Auto-A, if Hold Step terminal is input, the last step can be maintained.

If you select No. 19 Step Pulse among the function items of OUT-31 ~ 33, the output signals are output in pulses every time each step changes during auto sequence operation. The pulse width is 100ms. If you select No. 20 Seq Pulse and the pulse is output at the last step where a cycle of sequence 1 or 2, the pulse width is 100ms.

Group	Code No.	Function Display	Initial Setting Display		Unit
AUT	01	Auto Mode	0	Auto-A	-
	02	Auto Check	-	0.08	Sec
	04	Step Number	-	8	-
	10	Seq 1/1 Freq	-	11.00	Hz
	11	Seq 1/1 XcelT	-	5.0	Sec
	12	Seq 1/1 StedT	-	5.0	Sec
	13	Seq 1/1 Dir	1	Forward	-
	14	Seq 1/2 Freq	-	21.00	Hz
Displayed repeatedly as the number of set steps					

AUT-01 Auto Mode: selects the type of auto sequence operation.

0: Auto-A
This is the operating method of proceeding with the automatically set steps if the terminal set at SEQ-L or SEQ-M is a input among the multi-function terminal function items.

1: Auto-B
You can proceed with steps every time when a terminal set as Go-Step is input and the terminal set at SEQ-L or SEQ-M is input. For the motions of each, see the figure below.

AUT-02 Auto Check
Sets the time when the terminals set as SEQ-L or SEQ-M are simultaneously input. If one of the two terminals is input, another terminal is waited for to be input for the set period of time. If another terminal is input within the set period of time, they are treated as being input at the same time.

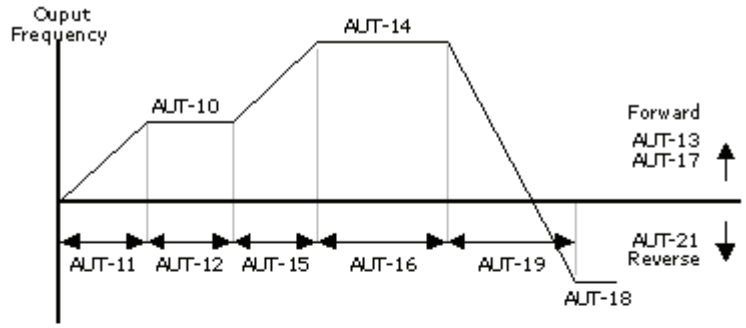
AUT-04 Step Number
Sets the number of steps of sequence operation. The frequency, Acc/Dec, constant speed and direction of each step are displayed according to the set number of steps.

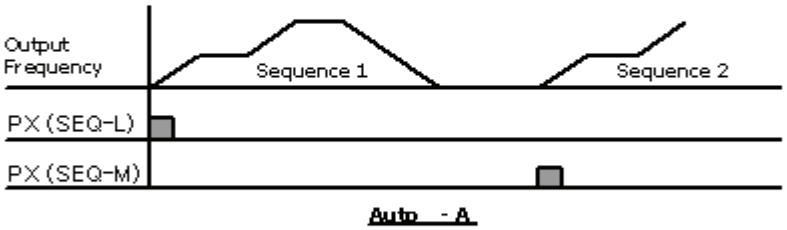
AUT-10 Seq 1/1 Freq:
Displays the operating frequency of step 1. The first 1 of 1/1, which is displayed on the message, shows the sequence type and the second 1 shows the number of steps. For example, if the terminal set as No. 42 SEQ-2 among the multi-function input terminal functions is input, operation starts from the frequency set at Seq 2/1 Freq.

AUT-11 Seq 1/1 XceIT
Sets the Acc/Dec time and the time it takes to move to the frequency set at AUT-10.

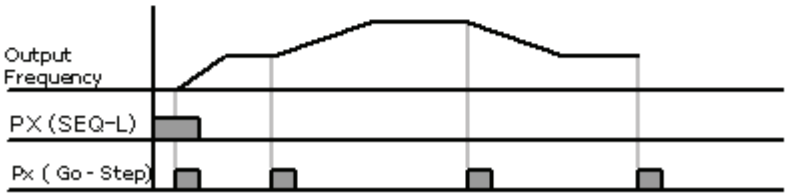
AUT-12 Seq 1/1 StedT
Sets the time of constant speed operation at the frequency set at AUT-10.

AUT-13 Seq 1/1 Dir
Sets the direction of rotation.





Auto - A



Auto - B

4.36 Traverse operation

Group	Code No.	Function Display	Initial Setting Display		Unit
APP	01	App Mode	1	Traverse	-
	08	Trv Amplit %	-	0.0	%
	09	Trv Scramb %	-	0.0	%
	10	Trv Acc Time	-	2.0	Sec
	11	Trv Dec Time	-	3.0	Sec
	12	Trv Offset Hi	-	0.0	%
	13	Trv Offset Lo	-	0.0	%
IN	65 ~ 75	Px Define	27	Trv Offset Lo	-
	65 ~ 75	Px Define	28	Trv Offset Hi	-

APP-01 App Mode: Sets the application mode at No. 1 Traverse. The functions necessary for traverse operation are displayed.

APP-08 Trv Amplit %: Selects the magnitude of the traverse operating frequency in percentage on the basis of the operating frequency.

$$Trv.Amp\ Frequency = \frac{Operation\ \ frequency * TrvAmplit\%}{100}$$

APP-09 Trv Scramb %: Selects the magnitude of the scramble operating frequency and the frequency jump at the starting point of deceleration.

$$Trv.Scr\ \ frequency = Trv.Amp\ \ frequency - \frac{Trv.Amp\ \ frequency * (100 - TrvScramb\%)}{100}$$

APP-10 Trv Acc Time, APP-11 Trv Dec Time: Sets the Acc/Dec time of traverse operation.

APP-12 Trv Offset Hi: If you select and input No. 28 Trv Offset Hi among the multi-function input terminal functions, operation is carried out at the frequency pattern that has increased by the value set at APP-12.

$$Trv.OffsetHi\ \ frequency = \frac{Operation\ \ frequency * TrvOffsetHi}{100}$$

APP-13 Trv Offset Lo: If you select and input No. 27 Trv Offset Lo among the multi-function input terminal functions, operation is carried out at the frequency pattern that has decreased by the value set at APP-13.

$$Trv.OffsetLo\ \ frequency = \frac{Operation\ \ frequency * TrvOffsetLo}{100}$$

4.37 Brake control

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
DRV	09	Control Mode	0	V/F	-	
ADV	41	BR Rls Curr	-	50.0	0 ~ 180%	%
	42	BR Rls Dly	-	1.00	0 ~ 10.0	Sec
	44	BR Rls Fwd Fr	-	1.00	0 ~ Maximum frequency	Hz
	45	BR Rls Rev Fr	-	1.00	0 ~ Maximum frequency	Hz
	46	BR Eng Dly	-	1.00	0 ~ 10	Sec
	47	BR Eng Fr	-	2.00	0 ~ Maximum frequency	Hz
OUT	31 ~ 33	Relay x or Q1	35	BR Control	-	-

This is used for controlling the On/Off motions of the brake in the load system using the electronic brake. The motion sequence varies according to the set value of the control mode (DRV-09). Before constructing the sequence, check the control mode setting.

When the brake control is active, the starting DC braking (ADV-12) and dwell operation (ADV-20 ~ 23) are not active. When torque control (DRV-10) is set, brake control is not active.

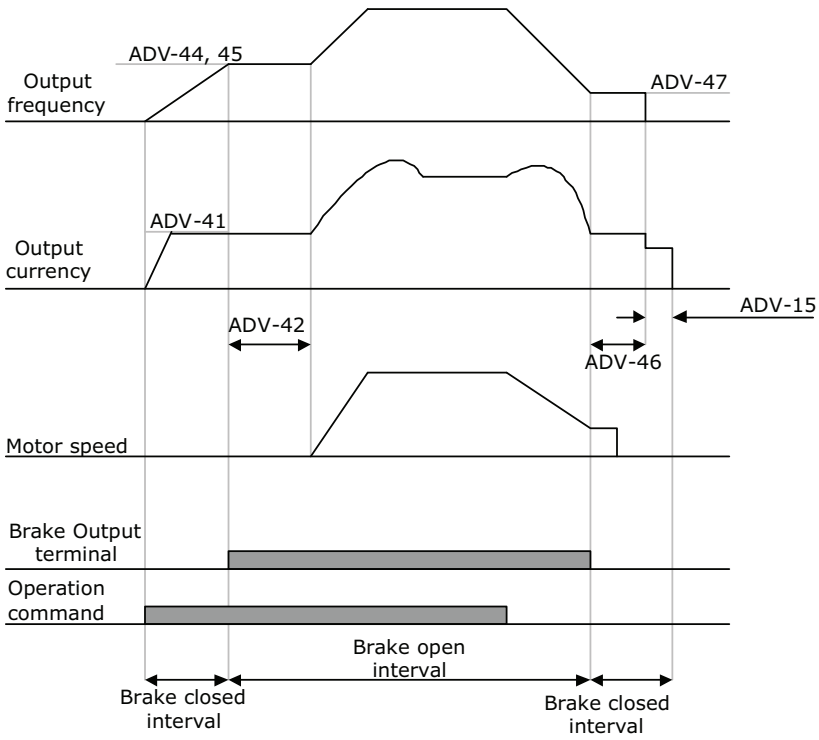
■ When the control mode is not vector

- Brake Open Sequence

  If an operating command is given with the motor static, the inverter accelerates to the open frequency (ADV-44, 45) forward or reversely. When the current through the motor reaches the brake open current (BR Rls Curr) after reaching the brake open frequency, the brake open signals are released with the output relay or multi-function output terminal set for brake control. Acceleration starts after the frequency is maintained for the brake open delay time (BR Rls Dly).

- Brake Closed Sequence

  If a stop command is given during operation, the motor decelerates. When the output frequency reached the brake closed frequency (BR Eng Fr), deceleration stops and the brake closed signal is released to the set output terminal. After being maintained for the brake closed delay time (BR Eng Dly), the output frequency becomes 0. If the DC braking time (ADV-15) or DC braking amount (ADV-16) is set, inverter output is blocked after DC braking.



When Control Mode Is Not Set at Vector

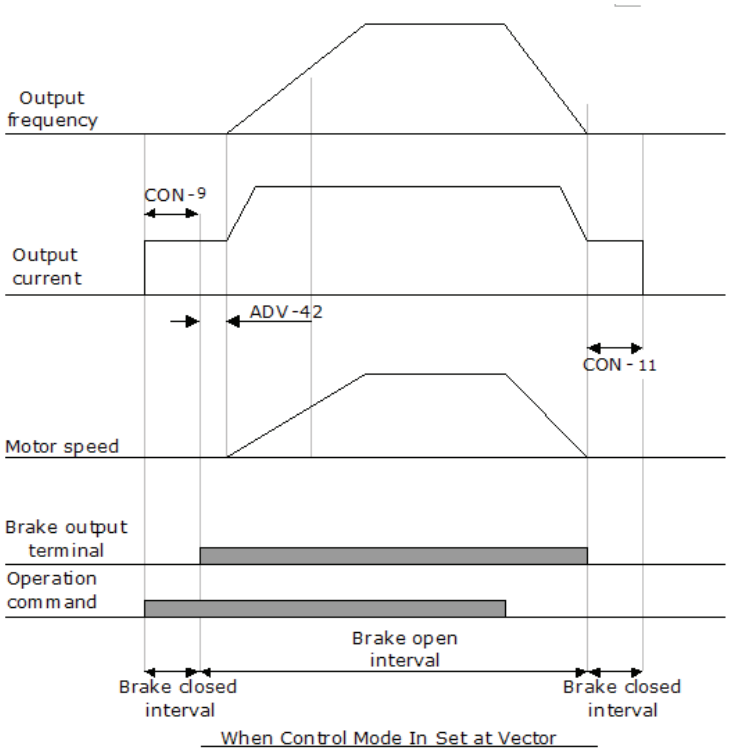
■ When the control mode is set at vector

- Brake Open Sequence

  If the operating command is input, the brake open signal is released with the output terminal set after the initial excitation time. Acceleration starts after the brake open delay time (BR Rly Dly).

- Brake Closed Sequence

  If a stop command is given, deceleration is carried out until the speed reaches 0 and the brake closed signal is released. Output is blocked after the set brake closed delay time (BR Eng Dly). This is not active in the torque control mode.



When Control Mode In Set at Vector

4.38 Multi-function output On/Off control

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
ADV	66	OnOff Ctrl Src	1	V1	-	-
	67	On-C Level	-	90.00	10 ~ 100%	%
	68	Off-C Level	-	10.00	0 ~ Output contact on level	%
OUT	31 ~ 33	Relay x or Q1	34	On/Off Control	-	-

If the analog input value is over the set value, the output relay or multi-function output terminal can be turned On or Off. Select the analog input to use for On/Off control at ADV-66 and set the levels at which the output terminal is On and Off at ADV-67 and 68 respectively. If the analog input value is over the value set at ADV-67, the output terminal is On and if below ADV-68, it is Off.

4.39 MMC function

This is used when multiple motors are controlled by one inverter in the fan or pump system. The motor connected to the inverter output (main motor) controls speed by PID control and other motors (auxiliary motors), connected to the common power source by the relay inside the inverter, conduct On/Off control.

For the relay for control of the auxiliary motors, the Relay 1 and 2 of the standard I/O card of the inverter and multi-function output terminal Q1 are used. If the extended I/O option card is connected to the inverter option slot, up to 3 relay outputs are available.

Group	Code No.	Function Display	Setting Display		Setting Range	Unit
APP	01	App Mode	3	MMC	-	-
APO	20	Aux Motor Run	-	0	0 ~ 4	-
	21	Starting Aux	-	1	1 ~ 4	-
	22	Auto Op Time	-	0:00	xx:xx	Min
	23	Start Freq 1	-	49.99	0 ~ 60	Hz
	24	Start Freq 2	-	49.99	0 ~ 60	Hz
	25	Start Freq 3	-	49.99	0 ~ 60	Hz
	26	Start Freq 4	-	49.99	0 ~ 60	Hz
	27	Stop Freq 1	-	15.00	0 ~ 60	Hz
	28	Stop Freq 1	-	15.00	0 ~ 60	Hz
	29	Stop Freq 1	-	15.00	0 ~ 60	Hz
	30	Stop Freq 1	-	15.00	0 ~ 60	Hz
	31	Aux Start DT	-	60.0	0 ~ 3600.0	Sec
	32	Aux Stop DT	-	60.0	0 ~ 3600.0	Sec
	33	Num of Aux	-	4	0 ~ 4	-
	34	Regul Bypass	0	No	No/Yes	-
	35	Auto Ch Mode	0	Aux	None/Aux/Main	-
	36	Auto Ch Time	-	72:00	0 ~ 99:00	Min
	38	Interlock	0	No	No/Yes	-
	39	Interlock DT	-	5.0	0.1 ~ 360.0	Sec
	40	Actual Pr Diff	-	2	0 ~ 100%	%
	41	Aux Acc Time	-	2.0	0.0 ~ 600.0	Sec
	42	Aux Dec Time	-	2.0	0.0 ~ 600.0	Sec
OUT	31 ~ 33	Relay x or Q1	24	MMC	-	-
	34 ~ 36	Qx Define	24	MMC	-	-

(1) Basic Operation

APP-01 APP Mode

If you select No. 3 MMC as the applied function, the items related to the MMC function are displayed in the option card function group (APO) and the PID control related functions are displayed in APP. In APP, application functions group, functions such as PID control are displayed.

APO-20, 21, 33

If the number of auxiliary motors is set at APO-33 and there are more than one auxiliary motor, the number of the auxiliary motor first operated is input into APO-21. For example, if there are three auxiliary motors and each of them is controlled by Relay 1,2 and Q1 control, the auxiliary motors operate in the sequence of Relay 2, Q1 and Relay 1 when 2 in input in APO-21. The auxiliary motors stop in the sequence of Relay 1, Q1 and Relay 2. In the APO-20, the number of currently operating auxiliary motors can be monitored.

APO-23 ~ 26 Start Freq 1 ~ 4

The starting frequency of auxiliary motors is set. As the main motor is operated by PID control, its operating frequency is risen by the load change and the operation of an auxiliary motor is necessary. The condition of the output terminal of the inverter (Relay or multi-function output(Qx)) being On for the operation of an auxiliary motor is as follows. The auxiliary motor can operate when

the speed of the main motor rises above the starting frequency (APO-23 ~ 26) of the auxiliary motor,

the starting delay time (APO-13) of the auxiliary motor passes and

the difference between the reference and the feedback of the main motor PID controller becomes larger than the pressure difference of the auxiliary motor motion (APO-40).

APO-27 ~ 30 Stop Freq 1 ~ 4

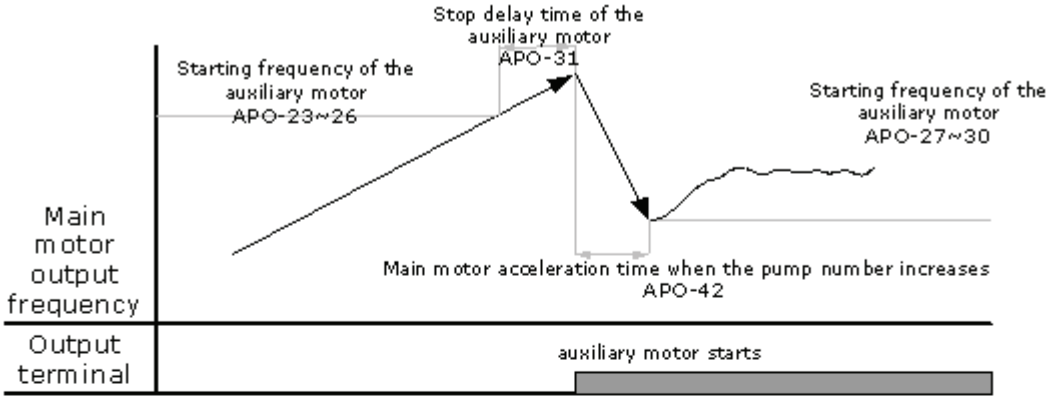
The stop frequency of the auxiliary motor is set. If the operating frequency of the main motor goes down below a certain frequency while the auxiliary motor is running, the auxiliary motor should be stopped. The condition of the auxiliary motor being stopped is as follows. The auxiliary motor can be stopped when

1. the speed of the main motor goes down below the stop frequency (APO-27 ~ 30) of the auxiliary motor,
2. the stop delay time (APO-32) of the auxiliary motor passes and

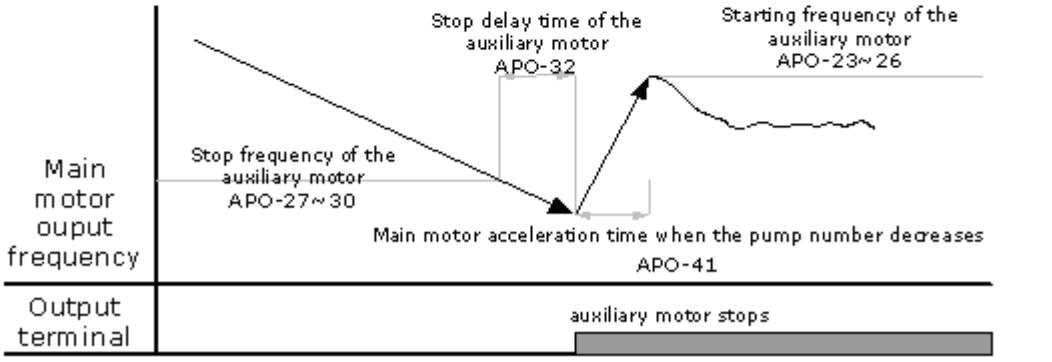
3. the difference between the reference and the feedback of the main motor PID controller becomes smaller than the pressure difference (APO-40) of the auxiliary motor motion.

APO-41 Aux Acc Time, APO-42 Aux Dec Time

The main motor stops PID control and operates the normal acceleration and deceleration operation when the auxiliary motor runs or stops. When the auxiliary motor runs, the main motor decelerates to the decelerating frequency of the auxiliary motor for the decelerating time set at APO-42. Inversely, when the auxiliary motor stops, the main motor accelerates to the starting frequency for the accelerating time set at APO-41. For details on the PID control of the main motor, see 4.8 PID Control.



stop sequence of the auxiliary motor following load increase



Stop sequence of the auxiliary motor following load decrease

(2) Automatic Change of Motor (Auto Change)

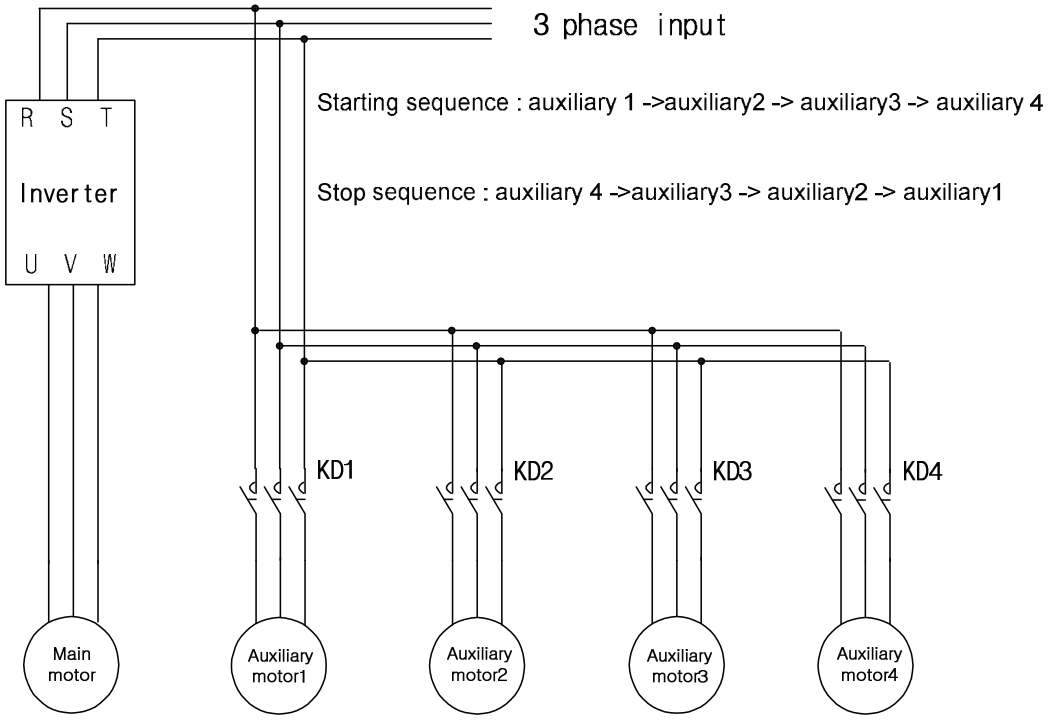
The motion sequence of the main and auxiliary motors can be automatically changed. If only a particular motor continues running, the life of the motor might be affected. Therefore the motion sequence can be reversed to keep the use time of the motors equal.

APO-35 Auto Ch Mode: Selects the type of motions of the automatic change.

0: None
The motion sequence of the auxiliary motor starts with the auxiliary motor selected in APO-21 (starting auxiliary motor selection) and the automatic change function is not active.

1: Aux
The motion sequence of the auxiliary motor starts with the auxiliary motor selected in APO-21 (starting auxiliary motor selection). When the cumulative operating time of a main and auxiliary motor exceeds the auto change time (APO-36), the auto change condition is met. If the main motor is stopped by a stop command or sleep operation mode after in the auto change condition, the start sequence of the auxiliary motor selected in APO-21 is changed.

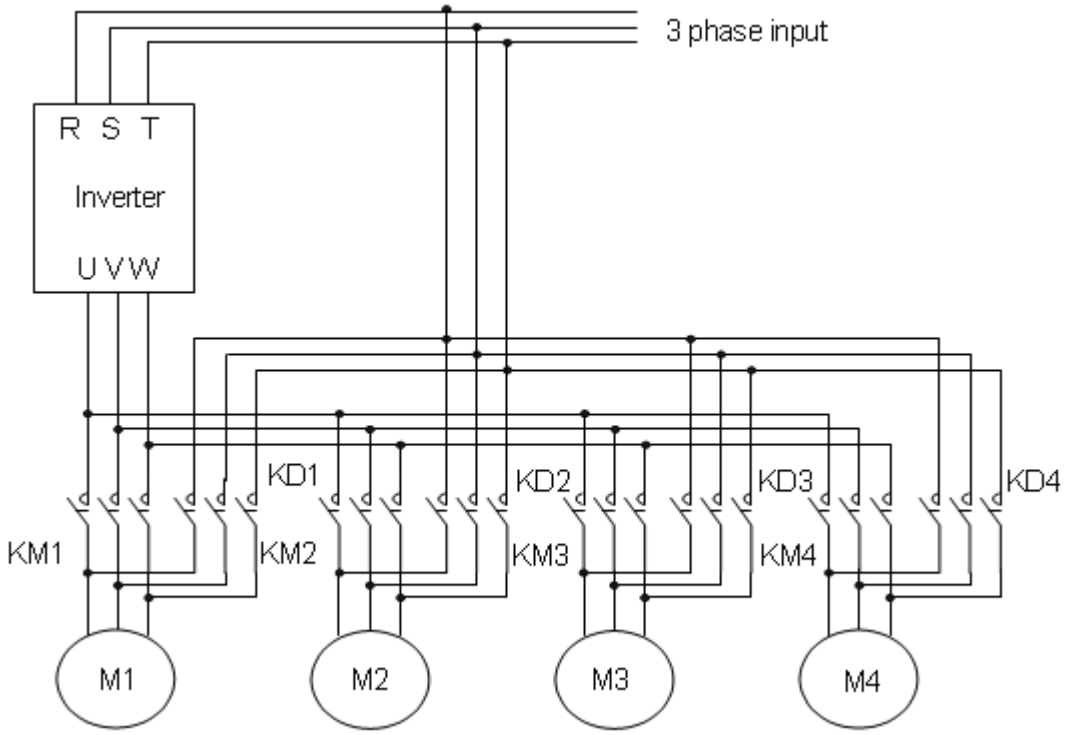
For example, if there are four auxiliary motors operating and No. 4 is selected in APO-21, the start sequence of the auxiliary motor automatically changes to No. 1. Therefore, the previous start sequence of the auxiliary motor of 4,1,2,3 changes to 1,2,3,4 and if the condition goes back to the auto change condition, the sequence changed to 2,3,4,1.



2: Main

Automatic change is available without distinction between the main and auxiliary motors. The auto change condition is met if the cumulative operating time of the motor connected to the inverter output exceeds the auto change time (APO-36).

If the inverter is stopped by a stop command or sleep operation mode, the operating sequence of the motor automatically changes. For example, if the starting auxiliary motor selection (APO-21) is set at No.2, the inverter output is connected to No. 2 motor. If there are four motors and the auxiliary motor operating condition is met, motors 3, 4 and 1 starts operating one after another in sequence. If the inverter stops in the auto change condition, motor No. 3 is connected to the inverter output in the next restart and the auxiliary motors operates in the sequence of 4, 1 and 2.



(3) Interlock

This is the function of stopping the motor operating and replacing it with another motor in case of a failure of the motor. If the failure signal is input into the input terminal and the functions of the relevant terminals are set as Interlock 1 ~ 4, it will be decided whether to operate the motor according to the terminal input status. The replacement operation sequence varies according to the set values of the motor auto change mode selection (APO-35) described above.

IN-65 ~ 75 Px Define

The terminal to use as the interlock among the IN-65 ~ 72 (~75 if there is extended I/O) is selected and Interlock 1 ~ 4 are set according to the motor sequence. If the auto change mode selection (APO-35) is set at 0 (None) or 1 (Aux) and if auxiliary motors 1, 2 and 3 are connected to inverter output terminals Relay1, 2 and Q1 when a total of four motor including the main motor is operating, the interlock numbers 1, 2 and 3 correspond to the motor connected to Relay1, 2 and Q1.However, if the auto change mode selection (APO-35) is set at 2 (Main) and the main and auxiliary motors are connected to inverter output terminals Relay1, 2, Q1 and Q2 (extended I/O used) respectively, Interlock 1, 2, 3 and 4 correspond to the motors connected to Relay1, 2, Q1 and Q2.

APO-38 Interlock: Select No. 1 Yes.

① If there are a total of 5 motors and the auto change mode selection (APO-35) is set at 0 (None) or 1 (Aux), the operation is as follows. If signals are input into the terminal block set at Interlock 3 with a failure of motor 3 when it is static, the auxiliary motors operate in the sequence of 1, 2 and 4. (when the starting auxiliary motor selection APO-21 is 1) If the terminal block signals are withdrawn, the motion sequence is 1, 2, 3 and 4. If signals are input to the terminal of Interlock 3, the auxiliary motor 3 is stopped and the auxiliary motor 4 operates. If the interlock signal is withdrawn, the auxiliary motor 4 is stopped and the auxiliary motor 3 operates again.

② If there are four motors in total and the auto change mode selection (APO-35) is set at 2 (Main), the operation is as follows. If the starting auxiliary motor selection APO-21 is set at 1, motor 1 is operated by the inverter and the remaining 2, 3 and 4 are operated by the auxiliary motors and interlock signals are input to the auxiliary motors, the operation sequence is the same as the procedure described in 1) above. However if there is a problem with motor 1, which is connected to the inverter, the output is immediately blocked and motor 2 gets connected to the inverter output and the operation sequence of the auxiliary motor is 3, 4. If the interlock signal of motor 1 is withdrawn, the operation sequence of the auxiliary motor is 3, 4, 1.

(4) Bypass Operation (Regul Bypass)

The speed of the main motor can be controlled by the feedback without using the PID. The operation and stop of the auxiliary motor is controlled according to the feedback amount.

APP-34 Regul Bypass: Select No. 1 Yes. If there are four main motors and auxiliary motors (APP-33) in total, the operation is as follows. If the feedback input value is between 0 ~ 10V and operating frequency of the maximum input value (10V) is 60Hz, the auxiliary motor 1 is started when the feedback amount is 2.5V (15Hz of main motor operating frequency). If the feedback amount reaches 5V again, the auxiliary motor 2 is operated. At maximum 10V input, all three auxiliary motors operated.

$$\text{Operation level of auxiliary motor n} = n * \frac{\text{Maximum feedback amount}}{\textit{The number of auxiliary motor}(APO-33)}$$

4.40 Regeneration evasion function for press

(To evade control operation in the status of regeneration during press)

This function is the one to prevent regeneration region, raising the speed of motor operation speed during press in the status of motor regeneration.

Group	Code No.	Function Display	Setting Display and Range		Initial Value	Unit
ADV	74	RegenAvd Sel	0	No	0: No	-
			1	Yes		
	75	RegenAvd Level	200V class: 300 ~ 400V		350V	V
			400V class: 600 ~ 800V		700V	
	76	CompFreq Limit	0 ~ 10.00Hz		1.00[Hz]	Hz
	77	RegenAvd Pgain	0 ~ 100.0%		50.0[%]	%
	78	RegenAvd Igain	20 ~ 30,000ms		500[ms]	ms

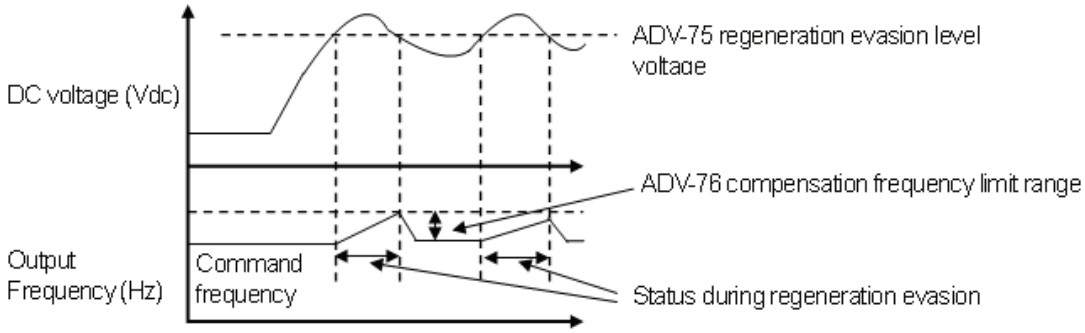
ADV-74 RegenAvd Sel (select regeneration evasion function for press):
During constant speed operation of the motor, select when frequent regeneration voltage occurs, damage and short life of DB Unit due to excessive DB Unit operation or DB Unit operation is evaded limiting DC Link voltage.

ADV-75 RegenAvd Level (set regeneration evasion level for press):
Set DB operation evasion voltage when DC Link voltage goes up by regeneration voltage.

ADV-76 CompFreq Limit (limit regeneration evasion compensation frequency for press):
Set changeable frequency range for real command frequency during regeneration operation region.

ADV-77 RegenAvd P gain (P gain set for regeneration evasion compensation control machine function for press)
ADV-78 RegenAvd I gain (I gain set for regeneration evasion

compensation control machine function for press):
Set P, I Gain of DC Link voltage limit PI control machine for regeneration operation region.



⚠ CAUTION

Regeneration evasion function for press is available only when motor operation status is constant speed section.

(not available in the section of acceleration/deceleration) Output frequency can change as much as frequency set

ADV-76 CompFreq Limit in spite of constant speed operation during evasion operation.

5. Table of Functions

Before reading the table, please refer to below description.

1. The grey code refers to hidden code, emerging only in case of setting of the code.
2. Effectiveness of each code according to the Control Mode setting

Control Mode	Abbreviation
V/F mode (PG included)	V/F
Sensorless-1,2 mode	SL
Vector mode	VC
Sensorless-1,2 torque mode	SLT
Vector torque mode	VCT

3. Abbreviation in Table

Abbreviation	Original word
Freq. (freq.)	Frequency (frequency)
Acc. (acc.)	Acceleration (acceleration)
Dec. (dec.)	Deceleration (deceleration)
Max. (max.)	Maximum (maximum)
Min. (min.)	Minimum (minimum)
Volt. (volt.)	Voltage (voltage)
Curr. (curr.)	Current (current)
Comm.	Communication
No.	Number
Aux. (aux.)	Auxiliary

4. Refer to option manual for function of option.

5.1 Parameter Mode – DRV group (➔ DRV)

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Operation	Control Mode				
							V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0~99	9	O	O	O	O	O	O
01	0h1101	Cmd Frequency	target freq.	0 ~ max. freq. [Hz]	0.0	O	O	O	O	X	X
02	0h1102	Cmd Torque	torque command	-180~180[%]	0.0	O	X	X	X	O	O
03	0h1103	Acc Time	acc. time	0~600[sec]	Below 75kW: 20.0 Above 90kW: 60.0	O	O	O	O	O	O
04	0h1104	Dec Time	dec. time	0 ~ 600[sec]	Below 75kW: 30.0 Above 90kW: 90.0	O	O	O	O	O	O
06	0h1106	Cmd Source	operating command method	0 Keypad 1 Fx/Rx-1 2 Fx/Rx-2 3 Int 485 4 Field Bus 5 PLC	1:Fx/Rx-1	X	O	O	O	O	O
07	0h1107	Freq Ref Src	freq. setting method	0 Keypad-1	0:Keypad-1	X	O	O	O	X	X
08	0h1108	Trq Ref Src	torque command method	0 Keypad-1 1 Keypad-2 2 V1 3 I1 4 V2 5 I2 6 Int 485 7 Encoder 8 Fied Bus 9 PLC	0:Keypad-1	X	X	X	X	O	O
09 Note1)	0h1109	Control Mode	control mode	0 V/F 1 V/F PG 2 Slip Compen 3 Sensorless-1	0:V/F	X	O	O	O	O	O

No.	Comm	Function	Name	Setting	Initial	Shift	Control Mode				
				4 Sensorless-2 5 Vector							
10	0h110A	Torque Control	torque control	0 No 1 Yes	0: No	X	X	X	X	O	O
11	0h110B	Jog Frequency	jog freq.	0.5 ~ max. freq. [Hz]	10.00	O	O	O	O	O	O
12	0h110C	Jog Acc Time	jog operation acc. time	0 ~ 600[sec]	20.0	O	O	O	O	O	O
13	0h110D	Jog Dec Time	jog operation dec. time	0 ~ 600[sec]	30.0	O	O	O	O	X	X
14	0h110E	Motor Capacity	motor capacity (unit: kW)	0: 0.2 1: 0.4 2: 0.75 3: 1.5 4: 2.2 5: 3.7 6: 5.5 7: 7.5 8: 11 9: 15 10: 18.5 11: 22 12: 30 13: 37 14: 45 15: 55 16: 75 17: 90 18: 110 19: 132 20: 160 21: 185	It depends on motor capacity.	X	O	O	O	O	O
15	0h110F	Torque Boost	torque boost method	0 Manual 1 Auto	0:Manual	X	O	X	X	X	X
16 Note2)	0h1110	Fwd Boost	forward torque boost	0 ~ 15[%]	Below 75kW: 2.0 Above 90kW: 1.0	X	O	X	X	X	X
17	0h1111	Rev Boost	reverse torque boost	0 ~ 15[%]	Below 75kW: 2.0 Above 90kW: 1.0	X	O	X	X	X	X
18	0h1112	Base Freq	base freq.	30 ~ 400[Hz]	60.00	X	O	O	O	O	O
19	0h1113	Start Freq	starting freq.	0.01 ~ 10[Hz]	0.50	X	O	X	X	X	X
20	0h1114	Max Freq	max. freq.	40 ~ 400	60.00	X	O	O	O	O	O
21	0h1115	Hz/Rpm Sel	speed unit selection	0 Hz Display 1 Rpm Display	0:Hz	O	O	O	O	O	O

Note 2) DRV-16 ~ 17 code is displayed only when DRV-15 (Torque Boost) code value is 'Manual'.

5.2 Parameter mode – Basic function group (➔BAS)

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0 ~ 99		20	O	O	O	O	O	O
01	0h1201	Aux Ref Src	aux. command setting method	0	None	0:None	X	O	O	O	X	X
				1	V1							
				2	I1							
				3	V2							
				4	I2							
02 Note3)	0h1202	Aux Calc Type	aux. command movement selection	0	M+(G*A)	0: M+(G*A)	X	O	O	O	X	X
				1	M*(G*A)							
				2	M/(G*A)							
				3	M+(M*(G*A))							
				4	M+G*2(A-50%)							
				5	M*(G*2(A-50%))							
				6	M/(G*2(A-50%))							
				7	M+M*G*2(A-50%)							
03	0h1203	Aux Ref Gain	aux. command gain	-200.0 ~ 200.0[%]		100.0	O	O	O	O	X	X
04	0h1204	Cmd 2nd Src	2nd operation command method	0	Keypad	1: Fx/Rx-1	X	O	O	O	O	O
				1	Fx/Rx-1							
				2	Fx/Rx-2							
				3	Int 485							
				4	FieldBus							
				5	PLC							
05	0h1205	Freq 2nd Src	2nd freq. Setting method	0	Keypad-1	0:Keypad-1	O	O	O	O	X	X

Note 3) BAS-02 code is displayed only when BAS-01 (Aux Ref Src) code has a value other than 'NONE'.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
06	0h1206	Trq 2nd Src	2nd torque command method	0	Keypad-1	0: Keypad-1	O	X	X	X	O	O
				1	Keypad-2							
				2	V1							
				3	I1							
				4	V2							
				5	I2							
				6	Int 485							
				7	Encoder							
				8	FieldBus							
				9	PLC							
				10	Synchro							
				11	Binary Type							
				12	Keypad-2							
07	0h1207	V/F Pattern	V/F pattern	0	Linear	0:Linear	X	O	O	X	X	X
				1	Square							
				2	User V/F							
				3	Square2							
08	0h1208	Ramp T Mode	Acc./dec standard freq.	0	Max Freq	0:Max Freq	X	O	O	O	X	X
				1	Delta Freq							
09	0h1209	Time Scale	time unit setting	0	0.01 sec	1:0.1 sec	X	O	O	O	X	X
				1	0.1 sec							
				2	1 sec							
10	0h120A	60/50 Hz Sel	input power freq.	0	60Hz	0:60Hz	X	O	O	O	O	O
				1	50Hz							
11	0h120B	Pole Number	motor pole	2 ~ 48		It depends on inverter capacity.	X	O	O	O	O	O
12	0h120C	Rated Slip	rated sleep speed	0 ~ 3000[rpm]			X	O	O	O	O	O
13	0h120D	Rated Curr	motor rated current	1 ~ 200[A]			X	O	O	O	O	O
14	0h120E	Noload Curr	motor No-load	0.5 ~ 200[A]			X	O	O	O	O	O
15	0h120F	Rated Volt	motor rated voltage	180 ~ 480[V]		0	X	O	O	O	O	O
16	0h1210	Efficiency	motor	70 ~ 100[%]		It depends on inverter capacity.	X	O	O	O	O	O
17	0h1211	Inertia Rate	load inertia	0 ~ 8			X	O	O	O	O	O
18	0h1212	Trim Power %	power display adjustment	70 ~ 130[%]			O	O	O	O	O	O

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Opera.	Control Mode				
19	0h1213	AC Input Volt	input power voltage	170 ~ 230[V] 320 ~ 480[V]	220 V: 220 440 V: 380	O	O	O	O	O	O
20	-	Auto Tuning	auto tuning	0 None 1 All 2 ALL(Stdstl) 3 Rs+Lsigma 4 Enc Test 5 Tr 6 Tr(Stdstl)	0:None	X	X	O	O	O	O
21	-	Rs	stator resistance	It depends on motor.	-	X	X	O	O	O	O
22	-	Lsigma	leak inductance	It depends on motor.	-	X	X	O	O	O	O
23	-	Ls	stator inductance	It depends on motor.	-	X	X	O	O	O	O
24 Note4	-	Tr	rotor time constant	25 ~ 5000[ms]	-	X	X	O	O	O	O
41 Note5	0h1229	User Freq 1	user freq. 1	0 ~ max. freq.[Hz]	15.00	X	O	X	X	X	X
42	0h122A	User Volt 1	user voltage 1	0 ~ 100[%]	25	X	O	X	X	X	X
43	0h122B	User Freq 2	user freq. 2	0 ~ max. freq.[Hz]	30.00	X	O	X	X	X	X
44	0h122C	User Volt 2	user voltage 2	0 ~ 100[%]	50	X	O	X	X	X	X
45	0h122D	User Freq 3	user freq. 3	0 ~ max. freq.[Hz]	45.00	X	O	X	X	X	X
46	0h122E	User Volt 3	user voltage 3	0 ~ 100[%]	75	X	O	X	X	X	X
47	0h122F	User Freq 4	user freq. 4	0 ~ max. freq.[Hz]	60.00	X	O	X	X	X	X
48	0h1230	User Volt 4	user voltage 4	0 ~ 100[%]	100	X	O	X	X	X	X
50 Note6	0h1232	Step Freq-1	multi-step speed freq. 1	0 ~ max. freq.[Hz]	10.00	O	O	O	O	X	X
51	0h1233	Step Freq-2	multi-step speed freq. 2	0 ~ max. freq.[Hz]	20.00	O	O	O	O	X	X
52	0h1234	Step Freq-3	multi-step speed freq. 3	0 ~ max. freq.[Hz]	30.00	O	O	O	O	X	X
53	0h1235	Step Freq-4	multi-step speed freq. 4	0 ~ max. freq.[Hz]	40.00	O	O	O	O	X	X
54	0h1236	Step Freq-5	multi-step speed freq. 5	0 ~ max. freq.[Hz]	50.00	O	O	O	O	X	X
55	0h1237	Step Freq-6	multi-step speed freq. 6	0 ~ max. freq.[Hz]	60.00	O	O	O	O	X	X
56	0h1238	Step Freq-7	multi-step speed freq. 7	0 ~ max. freq.[Hz]	60.00	O	O	O	O	X	X
57	0h1239	Step Freq-8	multi-step speed freq. 8	0 ~ max. freq.[Hz]	55.00	O	O	O	O	X	X
58	0h123A	Step Freq-9	multi-step speed freq. 9	0 ~ max. freq.[Hz]	50.00	O	O	O	O	X	X

No.	Comm. No	Function Display	Name	Setting Range	Initial Value	Shift in Opera	Control Mode				
59	0h123B	Step Freq-10	multi-step speed freq. 10	0 ~ max. freq.[Hz]	45.00	O	O	O	O	X	X
60	0h123C	Step Freq-11	multi-step speed freq. 11	0 ~ max. freq.[Hz]	40.00	O	O	O	O	X	X
61	0h123D	Step Freq-12	multi-step speed freq. 12	0 ~ max. freq.[Hz]	35.00	O	O	O	O	X	X
62	0h123E	Step Freq-13	multi-step speed freq. 13	0 ~ max. freq.[Hz]	25.00	O	O	O	O	X	X
63	0h123F	Step Freq-14	multi-step speed freq. 14	0 ~ max. freq.[Hz]	15.00	O	O	O	O	X	X
64	0h1240	Step Freq-15	multi-step speed freq. 15	0 ~ max. freq.[Hz]	5.00	O	O	O	O	X	X
70	0h1246	Acc Time-1	multi-step acc. time 1	0 ~ 600[sec]	20.0	O	O	O	O	X	X
71	0h1247	Dec Time-1	multi-step dec. time 1	0 ~ 600[sec]	20.0	O	O	O	O	X	X
72 Note7	0h1248	Acc Time-2	multi-step acc. time 2	0 ~ 600[sec]	30.0	O	O	O	O	X	X
73	0h1249	Dec Time-2	multi-step dec. time 2	0 ~ 600[sec]	30.0	O	O	O	O	X	X
74	0h124A	Acc Time-3	multi-step acc. time 3	0 ~ 600[sec]	40.0	O	O	O	O	X	X
75	0h124B	Dec Time-3	multi-step dec. time 3	0 ~ 600[sec]	40.0	O	O	O	O	X	X

Note 4) BAS-24 is shown only when DRV-09 Control Mode is ‘Sensorless-2’ or ‘Vector’.

Note 5) BAS-41 ~ 48 is displayed only when it is set as ‘User V/F’ even if there is only one BAS-07 or M2-V/F Patt (M2-25).

Note 6) IN-50 ~ 64 is displayed only when it is set as ‘multi-step speed’(Speed –L.M.H,X) even if there is only one among multi-function input IN-65 ~ 72.

Note 7) It is displayed only when it is set as ‘multi-step Acc/Dec’ (Xcel-L, M, H) even if there is only one among IN-72 ~ 75 multi-function input

5.3 Parameter mode – Extended function group (PAR→ADV)

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0 ~ 99		24	O	O	O	O	O	O
01	0h1301	Acc Pattern	acc. pattern	0	Linear	0: Linear	X	O	O	O	X	X
02	0h1302	Dec Pattern	dec. pattern	1	S-curve		X	O	O	O	X	X
03	0h1303	Acc S Start	S acc. starting slope	1 ~ 100[%]		40	X	O	O	O	X	X
04	0h1304	Acc S End	S acc. end slope	1 ~ 100[%]		40	X	O	O	O	X	X
05	0h1305	Dec S Start	S dec. starting slope	1 ~ 100[%]		40	X	O	O	O	X	X
06	0h1306	Dec S End	S dec. end slope	1 ~ 100[%]		40	X	O	O	O	X	X
07	0h1307	Start Mode	starting method	0	Acc	0: Acc	X	O	O	O	X	X
				1	Dc-Start							
08	0h1308	Stop Mode	stop method	0	Dec	0: Dec	X	O	O	O	X	X
				1	Dc-Brake							
				2	Free-Run							
				3	Flux Braking							
				4	Powr Braking							
09	0h1309	Run Prevent	rotation preventing direction selection	0	None	0: None	X	O	O	O	X	X
				1	Forward Prev							
				2	Reverse Prev							
10	0h130A	Power-on Run	power input starting	0	No	0: No	O	O	O	O	X	X
				1	Yes							
12 Note8	0h130C	Dc-Start Time	starting DC braking time	0 ~ 60[sec]		0.00	X	O	O	O	X	X
13	0h130D	Dc Inj Level	DC supply	0 ~ 200[%]		50	X	O	O	O	X	X
14 Note9)	0h130E	Dc-Block Time	pre-DC braking output block time	0 ~ 60[sec]		0.10	X	O	O	O	X	X
15	0h130F	Dc-Brake Time	DC braking time	0 ~ 60[sec]		1.00	X	O	O	O	X	X
16	0h1310	Dc-Brake	DC braking	0 ~ 200[%]		50	X	O	O	O	X	X

Note 8) ADV-12 is displayed only when ADV-07 'Stop Mode' is set as 'Dc-Start'.
Note 9) ADV-14 ~ 17 is displayed only when ADV-08 'Stop Mode' is set as 'DC-Brake'.

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Opera-tion	Control Mode				
							V/F	SL	VC	SLT	VCT
17	0h1311	Dc-Brake Freq	DC braking freq.	Starting freq. ~ 60[Hz]	5.00	X	O	O	O	X	X
20	0h1314	Acc Dwell Freq	acc. dwell freq.	Starting freq. ~ max. freq.[Hz]	5.00	X	O	O	O	X	X
21	0h1315	Acc Dwell Time	acc. dwell operation time	0 ~ 60.0[sec]	0.00	X	O	O	O	X	X
22	0h1316	Dec Dwell Freq	dec. dwell freq.	Starting freq. ~ max. freq. [Hz]	5.00	X	O	O	O	X	X
23	0h1317	Dec Dwell Time	dec. dwell operation time	0 ~ 60.0[sec]	0.00	X	O	O	O	X	X
24	0h1318	Freq Limit	freq. limit	0 No 1 Yes	0: No	X	O	O	O	X	X
25 Note10)	0h1319	Freq Limit Lo	freq. lower limit	0 ~ upper limit[Hz]	0.50	O	O	O	O	X	X
26	0h131A	Freq Limit Hi	freq. upper limit	0.5 ~ max. freq.[Hz]	60.00	X	O	O	O	X	X
27	0h131B	Jump Freq	freq. jump	0 No 1 Yes	0: No	X	O	O	O	X	X
28 Note11)	0h131C	Jump Lo 1	jump freq. lower limit 1	0 ~ jump freq.upper limit 1 [Hz]	10.00	O	O	O	O	X	X
29	0h131D	Jump Hi 1	jump freq. upper limit 1	Jump freq. lower limit 1 ~ max. freq.[Hz]	15.00	O	O	O	O	X	X
30	0h131E	Jump Lo 2	jump freq. lower limit 2	0 ~ jump freq. upper limit 2[Hz]	20.00	O	O	O	O	X	X
31	0h131F	Jump Hi 2	jump freq. upper limit 2	Jump freq. lower limit 2 ~ max. freq.[Hz]	25.00	O	O	O	O	X	X
32	0h1320	Jump Lo 3	jump freq. lower limit 3	0 ~ jump freq. upper limit 3[Hz]	30.00	O	O	O	O	X	X
33	0h1321	Jump Hi 3	jump freq. upper limit 3	Jump freq. lower limit 3 ~ max. freq.[Hz]	35.00	O	O	O	O	X	X
41 Note12)	0h1329	BR Rls Curr	brake open current	0 ~ 180.0[%]	50.0	O	O	O	O	X	X
42	0h132A	BR Rls Dly	brake open delay time	0 ~ 10.00[sec]	1.00	X	O	O	O	X	X
44	0h132C	BR Rls Fwd Fr	brake open forward freq.	0 ~ max. freq.[Hz]	1.00	X	O	O	O	X	X

Note 10) ADV-25 ~ 26 is displayed only when ADV-24 (Freq Limit) is set as 'Freq Limit'.
Note 11) ADV-28 ~ 33 is displayed only when ADV-27 (Jump Freq) set as 'Yes'.
Note 12) ADV-41 ~ 47 is displayed only when a code of OUT-31 ~ 33 is set as 'BR Control'.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
45	0h132D	BR Rls Rev Fr	brake open reverse freq.	0 ~ max. freq.[Hz]		1.00	X	O	O	O	X	X
46	0h132E	BR Eng Dly	brake close delay time	0 ~ 10[sec]		1.00	X	O	O	O	X	X
47	0h132F	BR Eng Fr	brake close freq.	0 ~ max. freq.[Hz]		2.00	X	O	O	O	X	X
50	0h1332	E-Save Mode	energy saving operation	0	None	0: None	X	O	O	X	X	X
				1	Manual							
				2	Auto							
51 Note1	0h1333	Energy Save	energy saving amount	0 ~ 30[%]		0	O	O	O	O	X	X
60	0h133C	Xcel Change Fr	Acc/Dec time exchange freq.	0 ~ max. freq.[Hz]		0.00	X	O	O	O	X	X
61	-	Load Spd Gain	revolution display gain	1 ~ 6000.0[%]		100.0	O	O	O	O	X	X
62	-	Load Spd Scale	revolution display scale	0	x 1	0: x 1	O	O	O	O	X	X
				1	x 0.1							
				2	x 0.01							
				3	x 0.001							
				4	x 0.0001							
63	0h133F	Load Spd Unit	revolution display unit	0	rpm	0: rpm	O	O	O	O	O	O
				1	mpm							
64	0h1340	FAN Control	cooling fan control	0	During Run	0: During Run	O	O	O	O	X	X
				1	Always ON							
				2	Temp Control							
65	0h1341	U/D Save Mode	up/down operation freq. saving	0	No	0: No	O	O	O	O	X	X
				1	Yes							
66	0h1342	On/Off Ctrl Src	On/Off control reference source	0	None	0: None	X	O	O	O	O	O
				1	V1							
				2	I1							
				3	V2							
				4	I2							
67	0h1343	On-C Level	output contact point On level	10 ~ 100[%]		90.00	X	O	O	O	O	O
68	0h1344	Off-C Level	output contact point Off level	-100.00 ~ output contact point ON level[%]		10.00	X	O	O	O	O	O

Note 13) ADV-51 is displayed only when ADV-50 (E-Save Mode) is set as values other than 'None'.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Opera-tion	Control Mode				
								V/F	SL	VC	SLT	VCT
70	0h1346	Run En Mode	safety operation	0	Always Enable	0: Always Enable	X	O	O	O	O	O
				1	DI Dependent							
71 Note14)	0h1347	Run Dis Stop	safety operation stop method	0	Free-Run	0: Free-Run	X	O	O	O	O	O
				1	Q-Stop							
				2	Q-Stop Resume							
72	0h1348	Q-Stop Time	safety operation dec. time	0 ~ 600.0[sec]		5.0	O	O	O	O	O	O
74	0h134A	RegenAvd Sel	selection of avoidance of regeneration function for press	0	No	No	X	O	O	O	O	O
				1	Yes							
75	0h134B	RegenAvd Level	operational Voltage level of avoidance of regeneration for press	200V: 300 ~ 400		350V	X	O	O	O	X	X
				400V: 600 ~ 800		700V						
76 Note15)	0h134C	CompFreq Limit	restriction of compensational freq. of avoidance of regeneration for press	0 ~ 10.00Hz		1.00[Hz]	X	O	O	O	X	X
77	0h134D	RegenAvd Pgain	P-gain of avoidance of regeneration for press	0 ~ 100.0%		50.0[%]	O	O	O	O	X	X
78	0h134E	RegenAvd Igain	I-gain of avoidance of regeneration for press	20 ~ 30000[ms]		500[ms]	O	O	O	O	X	X

Note 14) ADV-71 ~ 72 is displayed only when ADV-70 (Run En Mode) is set as 'DI Dependent'.
Note15) ADV-76 ~ 78 is displayed only when ADV-75 (RegenAvd Sel) is set as 'Yes'.

5.4 Parameter mode – Control function group (➔CON)

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0 ~ 99		51	O	O	O	O	O	O
04	0h1404	Carrier Freq	carrier freq.	Below 22kW	0.7~15[kHz]	5.0	O	O	O	O	O	O
				30~45kW	0.7~10[kHz]	5.0						
				55~75kW	0.7~7[kHz]	5.0						
				90~110kW	0.7~6[kHz]	3.0						
				132~160kW	0.7~5[kHz]	3.0						
05	0h1405	PWM Mode	switching mode	0	Normal	0: Normal PWM	X	O	O	O	O	O
				1	Lowleakage							
09	0h1409	PreExTime	Initial excitation time	0 ~ 60[sec]		1.00	X	X	X	O	O	O
10	0h140A	Flux Force	Initial excitation power supply	100 ~ 500[%]		100.0	X	X	X	O	O	O
11	0h140B	Hold Time	permanent operation sustaining time	0 ~ 60[sec]		1.00	X	X	X	O	X	X
12	0h140C	ASR P Gain 1	speed control period proportional gain1	10 ~ 500[%]		50.0	O	X	X	O	X	X
13	0h140D	ASR I Gain 1	speed control period integral calculus gain1	10 ~ 9999[ms]		300	O	X	X	O	X	X
15	0h140F	ASR P Gain 2	speed control period proportional gain2	10 ~ 500[%]		50.0	O	X	X	O	X	X
16	0h1410	ASR I Gain 2	speed control period integral calculus gain2	10 ~ 9999[ms]		300	O	X	X	O	X	X

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Operation	Control Mode				
							V/F	SL	VC	SLT	VCT
18	0h1412	Gain SW Freq	gain exchange freq.	0 ~ 120[Hz]	0.00	X	X	X	O	X	X
19	0h1413	Gain Sw Delay	gain exchange time	0 ~ 100[sec]	0.10	X	X	X	O	X	X
20	0h1414	SL2 G View Sel	Sensorless-2 2nd gain display setting	0 No 1 Yes	0: No	O	X	X	X	X	X
21	0h1415	ASR-SL P Gain1	Sensorless-1,2 speed control period proportional gain1	0 ~ 5000[%]	It depends on motor capacity.	O	X	O	X	X	X
22	0h1416	ASR-SL I Gain1	sensorless-1,2 speed control period integral calculus gain1	10 ~ 9999[ms]	It depends on motor capacity.	O	X	O	X	X	X
23 Note 16)	0h1417	ASR-SL P Gain2	sensorless-2 speed control period proportional gain2	1 ~ 1000[%]	It depends on motor capacity.	O	X	X	X	X	X
24	0h1418	ASR-SL I Gain2	sensorless-2 speed control period integral calculus gain2	1 ~ 1000[%]	It depends on motor capacity.	O	X	X	X	X	X
26	0h141A	Observer Gain1	sensorless-2 measurer gain1	0 ~ 30000	10500	O	X	X	X	X	X
27	0h141B	Observer Gain2	sensorless-2 measurer gain2	1 ~ 1000[%]	100.0	O	X	X	X	X	X
28	0h141C	Observer Gain3	sensorless-2 measurer gain3	0 ~ 30000	13000	O	X	X	X	X	X
29	0h141D	S-Est P Gain1	sensorless-2 speed estimator proportional gain1	0 ~ 30000	It depends on motor capacity.	O	X	X	X	X	X

Note 16) CON-23 ~ 28, 31 ~ 32 are displayed only when DRV-09 (Control Mode) is 'Sensorless-2' and CON-20 (SL2 G View Sel) is set as 'YES'.

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Operation	Control Mode				
							V/F	SL	VC	SLT	VCT
30	0h141E	S-Est I Gain1	sensorless-2 speed estimator integral calculus gain1	0 ~ 30000	It depends on motor capacity.	O	X	X	X	X	X
31	0h141F	S-Est P Gain2	Sensorless-2 speed estimator proportional gain2	1 ~ 1000[%]	It depends on motor capacity.	O	X	X	X	X	X
32	0h1420	S-Est I Gain2	Sensorless-2 speed estimator integral calculus gain2	1 ~ 1000[%]	It depends on motor capacity.	O	X	X	X	X	X
34	0h1422	SL2 OVM Perc	Sensorless2 overvoltage modulation range adjustment	100~180[%]	120	X	X	O	X	X	X
45 Note17)	0h142D	PG P Gain	PG operation proportional gain	0 ~ 9999	3000	O	O	X	X	X	X
46	0h142E	PG I Gain	PG operation integral calculus gain	0 ~ 9999	50	O	O	X	X	X	X
47	0h142F	PG Slip Max%	PG operation max. sleep	0 ~ 200	100	X	O	X	X	X	X
48	-	ACR P Gain	Current control period P gain	0 ~ 10000	1200	O	X	O	O	O	O
49	-	ACR I Gain	Current control period I gain	0 ~ 10000	120	O	X	O	O	O	O
51	0h1433	ASR Ref LPF	speed control period reference filter	0 ~ 20000[ms]	0	X	X	O	O	X	X
52	0h1434	Torque Out LPF	Torque control period Output filter	0 ~ 2000[ms]	0	X	X	X	X	O	O

Note 17) CON-45 ~ 47 are displayed when Encoder Board is inserted and Control mode is V/F PG.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
53	0h1435	Torque Lmt Src	Torque limit Setting method	0	Keypad-1	0: Keypad-1	X	X	X	X	O	O
				1	Keypad-2							
				2	V1							
				3	I1							
				4	V2							
				5	I2							
				6	Int 485							
				7	Encoder							
				8	FiedBus							
				9	PLC							
				10	Synchro							
				11	Binary Type							
54 Note18)	0h1436	FWD +Trq Lmt	forward offsetting Torque limit	0 ~ 200[%]		180.0	O	X	X	X	O	O
55	0h1437	FWD –Trq Lmt	forward regenerative	0 ~ 200[%]		180.0	O	X	X	X	O	O
56	0h1438	REV +Trq Lmt	reverse offsetting	0 ~ 200[%]		180.0	O	X	X	X	O	O
57	0h1439	REV –Trq Lmt	reverse regenerative	0 ~ 200[%]		180.0	O	X	X	X	O	O
58	0h143A	Trq Bias Src	torque bias setting method	0	Keypad-1	0: Keypad-1	X	X	X	O	X	X
				1	Keypad-2							
				2	V1							
				3	I1							
				4	V2							
				5	I2							
				6	Int 485							
				7	FiedBus							
				8	PLC							
59	0h143B	Torque Bias	torque bias	-120 ~ 120[%]		0.0	O	X	X	O	X	X
60	0h143C	Torque Bias FF	torque bias compensation	0 ~ 100[%]		0.0	O	X	X	O	X	X
62	0h143D	Speed Lmt Src	Speed limit setting method	0	Keypad-1	0: Keypad-1	O	X	X	X	X	O
				1	Keypad-2							
				2	V1							

Note 18) CON-54 ~ 57 are displayed only when DRV-09(Control Mode) is set as ‘Sensorless-1, 2’ or ‘Vector’. In addition, initial value of torque limit is changed to 150% when ADV-74 RegenAvd Level function sets.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
62	0h143D	Speed Lmt Src	Speed limit setting method	3	I1	0: Keypad-1	O	X	X	X	X	O
				4	V2							
				5	I2							
				6	Int 485							
				7	FiedBus							
				8	PLC							
63	0h143F	FWD Speed Lmt	forward speed limit	0 ~ max. freq.[Hz]		60.00	O	X	X	X	X	O
64	0h1440	REV Speed Lmt	reverse speed limit	0 ~ max. freq.[Hz]		60.00	O	X	X	X	X	O
65	0h1441	Speed Lmt Gain	Speed limit operation gain	100 ~ 5000[%]		500	O	X	X	X	X	O
66	0h1442	Droop Perc	droop operation amount	0 ~ 100[%]		0.0	O	X	X	X	X	O
67 Note19)	0h1443	Droop St Trq	droop start torque	0 ~ 100[%]		100.0	O	X	X	X	X	O
68	0h1444	SPD/TRQ Acc T	torque mode →speed mode exchange acc. time	0 ~ 600[sec]		20.0	O	X	X	X	X	O
69	0h1445	SPD/TRQAcc T	torque mode →speed mode exchange dec. time	0 ~ 600[sec]		30.0	O	X	X	X	X	O
70	0h1446	SS Mode	Selection of Speed search mode	0	Flying Start - 1	0	X	O	O	O	X	X
				1	Flying Start - 2							
71	0h1447	Speed Search	Speed search operation selection	Bit	0000 ~ 1111	0000	X	O	O	O	X	X
				1	acc. speed search selection							
				2	Reset start after trip							
				3	Re-start after instantaneous interruption							
				4	Start immediately after power ON							

Note 19) CON-67 is displayed only when Encoder option board is mounted.

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Operation	Control Mode				
							V/F	SL	VC	SLT	VCT
72	0h1448	SS Sup-Current	speed search standard current	80 ~ 200[%]	Below 75kW: 150 Above: 100	O	O	O	X	X	X
73	0h1449	SS P-Gain	speed search proportional gain	0 ~ 9999	100	O	O	O	X	X	X
74	0h144A	SS I-Gain	speed search integral calculus gain	0 ~ 9999	200	O	O	O	X	X	X
75	0h144B	SS Block Time	Pre-speed search output block time	0 ~ 60.0[sec]	1.0	X	O	O	X	X	X
77	0h144D	KEB Select	energy buffering selection	0 No 1 Yes	0: No	X	O	O	O	X	X
78 Note20)	0h144E	KEB Start Lev	energy buffering start amount	110 ~ 140[%]	125.0	X	O	O	O	X	X
79	0h144F	KEB Stop Lev	energy buffering stop amount	130 ~ 145[%]	130.0	X	O	O	O	X	X
80	0h1450	KEB Gain	energy buffering gain	1 ~ 2000	1000	O	O	O	O	X	X
82 Note21)	0h1452	ZSD Frequency	permanent detection freq.	0 ~ 10[Hz]	2.00	O	X	X	O	X	O
83	0h1453	ZSD Band	permanent detection freq. band	0 ~ 2[Hz]	1.00	O	X	X	O	X	O

Note 20) CON-78 ~ 80 are displayed only when CON-77 (KEB Select) is set as 'Yes'.
Note 21) CON-82 ~ 83 are displayed only when DRV-09 (Control Mode) is set as 'Vector'.

5.5 Parameter mode – Input terminal block function group (➔IN)

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Operation	Control Mode				
							V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0 ~ 99	65	O	O	O	O	O	O
01	0h1501	Freq at 100%	Analog max. input freq.	Starting freq. ~ max. freq.[Hz]	60.00	O	O	O	O	X	X
02	0h1502	Torque at100%	Analog max. input torque	0 ~ 200[%]	100.0	O	X	X	O	O	O
05	0h1505	V1 Monitor[V]	V1 input amount display	0 ~ 10[V]	0.00	O	O	O	O	O	O
06	0h1506	V1 Polarity	V1 input polar selection	0 Unipolar 1 Bipolar	0: Unipolar	X	O	O	O	O	O
07	0h1507	V1 Filter	V1 input filter time constant	0 ~ 10000[ms]	10	O	O	O	O	O	O
08	0h1508	V1 Volt x1	V1 input min. voltage	0 ~ 10[V]	0.00	O	O	O	O	O	O
09	0h1509	V1 Perc y1	V1 min. voltage output %	0 ~ 100[%]	0.00	O	O	O	O	O	O
10	0h150A	V1 Volt x2	V1input max. voltage	0 ~ 10[V]	10.00	O	O	O	O	O	O
11	0h150B	V1 Perc y2	V1 max. voltage output %	0 ~ 100[%]	100.00	O	O	O	O	O	O
12 Note22)	0h150C	V1 (–)Volt x1'	V1(–)input min. voltage	-10 ~ 0[V]	0.00	O	O	O	O	O	O
13	0h150D	V1(–)Perc y1'	V1(–) min. voltage output %	-100 ~ 0[%]	0.00	O	O	O	O	O	O
14	0h150E	V1(–)Volt x2'	V1(–)input max. voltage	-10 ~ 0[V]	-10.00	O	O	O	O	O	O
15	0h150F	V1(–)Perc y2'	V1(–) max. voltage output %	-100 ~ 0[%]	-100.00	O	O	O	O	O	O
16	0h1510	V1 Inverting	rotation direction	0 No 1 Yes	0: No	O	O	O	O	O	O

Note 22) IN-12 ~ 15 codes are displayed only when IN-06 (V1 Polarity) is set as 'Bipolar'.

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Operation	Control Mode				
							V/F	SL	VC	SLT	VCT
17	0h1511	V1 Quantizing	V1 quantization	0.04 ~ 10[%]	0.04	X	O	O	O	O	O
20	0h1514	I1 Monitor[mA]	I1input amount display	0 ~ 20[mA]	0.00	O	O	O	O	O	O
22	0h1516	I1 Filter	I1input filter time constant	0 ~ 10000[ms]	10	O	O	O	O	O	O
23	0h1517	I1 Curr x1	I1input min. current	0 ~ 20[mA]	4.00	O	O	O	O	O	O
24	0h1518	I1 Perc y1	Output at I1 min. current %	0 ~ 100[%]	0.00	O	O	O	O	O	O
25	0h1519	I1 Curr x2	I1input max. current	4 ~ 20[mA]	20.00	O	O	O	O	O	O
26	0h151A	I1 Perc y2	Output at I1 maximum	0 ~ 100[%]	100.00	O	O	O	O	O	O
31	0h151F	I1 Inverting	rotation direction change	0 No 1 Yes	0: No	O	O	O	O	O	O
32	0h1520	I1 Quantizing	I1 quantization level	0.04 ~ 10[%]	0.04	O	O	O	O	O	O
35 Note 23)	0h1523	V2 Monitor[V]	V2 input amount display	0 ~ 10[V]	0.00	O	O	O	O	O	O
36	0h1524	V2 Polarity	V1 input polarity selection	0 Unipolar 1 Bipolar	1: Bipolar	O	O	O	O	O	O
37	0h1525	V2 Filter	V2 input filter time constant	0 ~ 10000 [ms]	10	O	O	O	O	O	O
38	0h1526	V2 Volt x1	V2 input min. voltage	0 ~ 10[V]	0.00	O	O	O	O	O	O
39	0h1527	V2 Perc y1	output % at V2 min. voltage	0 ~ 100[%]	0.00	O	O	O	O	O	O
40	0h1528	V2 Volt x2	V2 input max. voltage	0 ~ 10[V]	10.00	O	O	O	O	O	O
41	0h1529	V2 Perc y2	output % at V2 max. voltage	0 ~ 100[%]	100.00	O	O	O	O	O	O
42	0h152A	V2 –Volt x1’	V2 –input min. voltage	-10 ~ 0[V]	0.00	O	O	O	O	O	O
43	0h152B	V2–Perc y1’	output % at V2–min.	-100 ~ 0[%]	0.00	O	O	O	O	O	O

Note 23) IN-35 ~ 62 codes are displayed only when the extended IO board is mounted.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Opera-tion	Control Mode				
								V/F	SL	VC	SLT	VCT
44	0h152C	V2 –Volt x2’	V2 –input max. voltage	-10 ~ 0[V]		-10.00	O	O	O	O	O	O
45	0h152F	V2 –Perc y2’	output % at V2–max.	-100 ~ 0[%]		-100.00	O	O	O	O	O	O
46	0h1530	V2 Inverting	rotation direction change	0	No	0: No	O	O	O	O	O	O
				1	Yes							
47	0h1532	V2 Quantizing	V2 quantization	0.04 ~ 10[%]		0.04	O	O	O	O	O	O
50	0h1534	I2 Monitor[mA]	I2 input amount display	0 ~ 20[mA]		0.00	O	O	O	O	O	O
52	0h1535	I2 Filter	I2 input filter time constant	0 ~ 10000 [ms]		15	O	O	O	O	O	O
53	0h1536	I2 Curr x1	I2 input min. current	0 ~ 20[mA]		4.00	O	O	O	O	O	O
54	0h1537	I2 Perc y1	Output % at I2 min. current	0 ~ 100[%]		0.00	O	O	O	O	O	O
55	0h1538	I2 Curr x2	I2 input max. current	0 ~ 20[mA]		20.00	O	O	O	O	O	O
56	0h153D	I2 Perc y2	output% at I2 max. current	0 ~ 100[%]		100.00	O	O	O	O	O	O
61	0h153E	I2 Inverting	rotation direction	0	No	0: No	O	O	O	O	O	O
				1	Yes							
62	0h153F	I2 Quantizing	I2 quantization level	0.04 ~ 10[%]		0.04	O	O	O	O	O	O
65	0h1541	P1 Define	P1 terminal function setting	0	NONE	1: FX	X	O	O	O	O	O
				1	FX							
66	0h1542	P2 Define	P2 terminal function setting	2	RX	2: RX	X	X	X	O	O	O
67	0h1543	P3 Define	P3 terminal function setting	3	RST	5: BX	X	O	O	O	O	O
68	0h1544	P4 Define	P4 terminal function setting	4	External Trip	4: Ex.t	X	O	O	O	O	O
69	0h1545	P5 Define	P5 terminal function setting	5	BX	7: Sp-L	X	O	O	O	O	O
70	0h1546	P6 Define	P6 terminal function setting	6	JOG	8: Sp-M	X	O	O	O	O	O
71	0h1547	P7 Define	P7 terminal function setting	7	Speed-L	9: Sp-H	X	O	O	O	O	O
72	0h1548	P8 Define	P8 terminal function setting	8	Speed-M	6: JOG	X	O	O	O	O	O

No.	Comm. No	Function Display	Name	Setting Range		Initial Value	Shift in Opera	Control Mode				
73 Note24)	0h1549	P9 Define	P9 terminal function setting	9	Speed-H	0: NONE	X	O	O	O	O	O
74	0h154A	P10 Define	P10 terminal function setting	10	Speed-X	0: NONE	X	O	O	O	O	O
75	0h154B	P11 Define	P11 terminal function setting	11	XCEL-L	0: NONE	X	O	O	O	O	O
				12	XCEL-M							
				13	RUN Enable							
				14	3-Wire							
				15	2nd Source							
				16	Exchange							
				17	Up							
				18	Down							
				19	-reserved-							
				20	U/D Clear							
				21	Analog Hold							
				22	I-Term Clear							
				23	PID Openloop							
				24	P Gain2							
				25	XCEL Stop							
				26	2nd Motor							
				27	Trv Offset Lo							
				28	Trv Offset Hi							
				29	Interlock 1							
				30	Interlock 2							
				31	Interlock 3							
				32	Interlock 4							
				33	-Reserved-							
				34	Pre Excite							
				35	Speed/Torque							
				36	ASR Gain 2							
				37	ASR P/PI							
				38	Timer In							
				39	Thermal In							
				40	Dis Aux Ref							

Note 24) IN-73 ~ 75 codes are displayed only when the extended IO board is mounted.

No.	Comm.	Function	Name	Setting Range	Initial Value	Shift in	Control Mode

	No.	Display					Opera-tion	V/F	SL	VC	SLT	VCT
				41	SEQ-1							
				42	SEQ-2							
				43	Manual							
				44	Go Step							
				45	Hold Step							
				46	FWD JOG							
				47	REV JOG							
				48	Trq Bias							
				49	Web Dis PID							
				50	Web Quik Stop							
				51	Web Hold							
				52	Web Preset							
				53	Web Bobbin-L							
				54	Web Bobbin-H							
				55	Web PI Gain2							
				56	Web Bypass							
				57	Web Splice							
				58	web Taper Dis							
				59	web Boost En							
				60	web Down En							
				61	Ext Dis PID							
				62	Ext PI Gain2							
85	0h1555	DI On Delay	multi-function	0 ~ 10000[ms]		10	O	O	O	O	O	O
86	0h1556	DI Off Delay	multi-function	0 ~ 10000[ms]		3	O	O	O	O	O	O
87	0h1557	DINC/NO Sel	multi-function input contact point selection	P8 – P1		0000 0000	X	O	O	O	O	O
				0	A contact point (NO)							
				1	B contact point (NC)							
88	0h1558	RunOn Delay	operating command delay time	0 ~ 100[sec]		0.00	X	O	O	O	O	O
89	0h1559	InCheck Time	sequential command delay time	1 ~ 5000[ms]		1	X	O	O	O	O	O
90	0h155A	DI Status	multi-function input terminal status	P8 – P1		0000 0000	O	O	O	O	O	O
				0	Open (Off)							
				1	Connection (On)							

5.6 Parameter mode – Output terminal block function group (➔OUT)

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
00	-	JumpCode	jump code	0 ~ 99		30	O	O	O	O	O	O
01	0h1601	AO1 Mode	analog output1 item	0	Frequency	0: Frequency	O	O	O	O	O	O
				1	Current							
				2	Voltage							
				3	DC Link Volt							
				4	Torque							
				5	Watt							
				6	Idss							
				7	Iqss							
				8	Target Freq							
				9	Ramp Freq							
				10	Speed Fdb							
				11	Speed Dev							
				12	PIDRef Value							
				13	PIDFbk Value							
				14	PID Output							
				15	Constant							
				16	Web Spd Out							
02	0h1602	AO1 Gain	analog output 1 gain	-1000 ~ 1000[%]		100.0	O	O	O	O	O	O
03	0h1603	AO1 Bias	analog output 1 bias	-100 ~ 100[%]		0.0	O	O	O	O	O	O
04	0h1604	AO1 Filter	analog output1 filter	0 ~ 10000[ms]		5	O	O	O	O	O	O
05	0h1605	AO1 Const %	analog constant output	0 ~ 1000[%]		0.0	O	O	O	O	O	O
06	0h1606	AO1 Monitor	analog output 1 monitor	0 ~ 1000[%]		0.0	-	O	O	O	O	O
07	0h1607	AO2 Mode	analog output 2 item	0	Frequency	0: Frequency	O	O	O	O	O	O
				1	Current							
				2	Voltage							
				3	DC Link Volt							
				4	Torque							
				5	Watt							

No.	Comm.	Function	Name	Setting Range		Initial Value	Shift in	Control Mode				
07	0h1607	AO2 Mode	analog output 2 item	6	Idss	0: Frequency	O	O	O	O	O	O
				7	Iqss							
				8	Target Freq							
				9	Ramp Freq							
				10	Speed Fdb							
				11	Speed Dev							
				12	PIDRef Value							
				13	PIDFbk Value							
				14	PID Output							
				15	Constant							
				16	Web Spd Out							
08	0h1608	AO2 Gain	analog output 2 gain	-1000 ~ 1000[%]		100.0	O	O	O	O	O	O
09	0h1609	AO2 Bias	analog output 2bias	-100 ~ 100[%]		0.0	O	O	O	O	O	O
10	0h160A	AO2 Filter	analog output 2 filter	0 ~ 10000[ms]		5	O	O	O	O	O	O
11	0h160B	AO2Const %	analog constant output	0 ~ 100[%]		0.0	O	O	O	O	O	O
12	0h160C	AO2 Monitor	analog output 2 monitor	0 ~ 1000[%]		0.0	O	O	O	O	O	O
14 Note25)	0h160E	AO3 Mode	analog output3 item	0	Frequency	0: Frequency	O	O	O	O	O	O
				1	Current							
				2	Voltage							
				3	DC Link Volt							
				4	Torque							
				5	Watt							
				6	Idss							
				7	Iqss							
				8	Target Freq							
				9	Ramp Freq							
				10	Speed Fdb							
				11	Speed Dev							
				12	PID Ref Value							
				13	PID Fbk Value							
				14	PID Output							
				15	Constant							

Note 25) OUT 14 ~ 25 codes are displayed only when the extended IO board is mounted.

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Opera-	Control Mode				
							V	S	V	S	V

						tion	/ F	L	C	L T	C T
00	-	JumpCode	jump code	0 ~ 99	30	O	O	O	O	O	O
15	0h160F	AO3 Gain	analog output	-1000 ~ 1000[%]	100.0	O	O	O	O	O	O
16	0h1610	AO3 Bias	analog output	-100 ~ 100[%]	0.0	O	O	O	O	O	O
17	0h1611	AO3 Filter	analog output	0 ~ 10000[ms]	5	O	O	O	O	O	O
18	-	AO3	analog	0 ~ 100[%]	0.0	O	O	O	O	O	O
19	0h1613	AO3 Monitor	analog output	-1000 ~ 1000[%]	0.0	O	O	O	O	O	O
20	0h1614	AO4 Mode	analog output4 item	0 Frequency 1 Current 2 Voltage 3 DC Link Volt 4 Torque 5 Watt 6 Idss 7 Iqss 8 Target Freq 9 Ramp Freq 10 Speed Fdb 11 Speed Dev 12 PID Ref Value 13 PID Fbk Value 14 PID Output 15 Constant	0: Frequency		O	O	O	O	O
21	0h1615	AO4 Gain	analog output 2 gain	-1000 ~ 1000[%]	100.0	-	O	O	O	O	O
22	0h1616	AO4 Bias	analog output 2 bias	-100 ~ 100[%]	0.0	O	O	O	O	O	O
23	0h1617	AO4 Filter	analog output 2 filter	0 ~ 10000[ms]	5	O	O	O	O	O	O
24	-	AO4 Const %	analog constant output	0 ~ 100[%]	0.0	O	O	O	O	O	O
25	0h1619	AO4 Monitor	analog output 2 monitor	0 ~ 1000[%]	0.0	O	O	O	O	O	O
30	0h161E	Trip Out Mode	failure output item	Bit 000 ~ 111 1 low voltage 2 Failure other than low voltage 3 Final failure of automatic re-start	010	O	O	O	O	O	O

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
31	0h161F	Relay 1	multi-function relay 1 item	0	NONE	29: Trip	O	O	O	O	O	O
32	0h1620	Relay 2	multi-function relay 2 item	1	FDT-1	14: Run	O	O	O	O	O	O
33	0h1621	Q1 Define	multi-function output 1 item	2	FDT-2	1: FDT-1	O	O	O	O	O	O
34 Note26)	0h1622	Relay 3	multi-function relay 3 item	3	FDT-3	2: FDT-2	O	O	O	O	O	O
35	0h1623	Relay 4	multi-function relay 4 item	4	FDT-4	3: FDT-3	O	O	O	O	O	O
36	0h1624	Relay 5	multi-function relay 5 item	5	Over Load	4: FDT-4	O	O	O	O	O	O
				6	IOL							
				7	Under Load							
				8	Fan Warning							
				9	Stall							
				10	Over Voltage							
				11	Low Voltage							
				12	Over Heat							
				13	Lost Command							
				14	Run							
				15	Stop							
				16	Steady							
				17	Inverter Line							
				18	Comm Line							
				19	Speed Search							
				20	Step Pulse							
				21	Seq Pulse							
				22	Ready							
				23	Trv Acc							
				24	Trv Dec							
				25	MMC							
				26	Zspd Dect							
				27	Torque Dect							
				28	Timer Out							
				29	Trip							

Note 26) OUT 34 ~ 36 codes are displayed only when the extended IO board is mounted.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Opera-tion	Control Mode				
								V/F	SL	VC	SLT	VCT
				30	Lost Keypad							
				31	DB Warn %ED							
				32	ENC Tune							
				33	ENC Dir							
				34	On/Off Control							
				35	BR Control							
				36	Web Break							
41	0h1629	DO Status	multi-function output	-		000	X	-	-	-	-	-
50	0h1632	DO On Delay	multi-function output On	0 ~ 100[sec]		0.00	O	O	O	O	O	O
51	0h1633	DO Off Delay	multi-function output Off	0 ~ 100[sec]		0.00	O	O	O	O	O	O
52	0h1634	DO NC/NO Sel	multi-function output contact point selection	Q1,Relay2,Relay1		000	X	O	O	O	O	O
				0	A contact point (NO)							
				1	B contact point (NC)							
53	0h1635	TripOut OnDly	failure output On delay	0 ~ 100[sec]		0.00	O	O	O	O	O	O
54	0h1636	TripOut OffDly	failure output Off delay	0 ~ 100.00[sec]		0.00	O	O	O	O	O	O
55	0h1637	TimerOn Delay	timer On delay	0 ~ 100.00[sec]		0.00	O	O	O	O	O	O
56	0h1638	TimerOff Delay	timer Off delay	0 ~ 100.00[sec]		100.0	O	O	O	O	O	O
57	0h1639	FDT Frequency	detection freq.	0 ~ max. freq.[Hz]		30.00	O	O	O	O	O	O
58	0h163A	FDT Band	detection freq. width	0 ~ max. freq.[Hz]		10.00	O	O	O	O	O	O
59	0h163B	TD Level	detection torque amount	0 ~ 150[%]		100	O	X	X	O	X	O
60	0h163C	TD Band	detection torque width	0 ~ 10[%]		5.0	O	X	X	O	X	O

5.7 Parameter mode – Communication function group (➔COM)

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0 ~ 99		20	O	O	O	O	O	O
01	0h1701	Int485 St ID	built-in comm. inverter ID	0 ~ 250		1	O	O	O	O	O	O
02	0h1702	Int485 Proto	built-in comm. protocol	0	ModBus RTU	0: ModBus RTU	O	O	O	O	O	O
				1	--Reserved --							
				2	Serial Debug							
03	0h1703	Int485 BaudR	built-in comm. speed	0	1200 bps	3: 9600 bps	O	O	O	O	O	O
				1	2400 bps							
				2	4800 bps							
				3	9600 bps							
				4	19200 bps							
				5	38400 bps							
04	0h1704	Int485 Mode	built-in comm. frame setting	0	D8/PN/S1	0: D8/PN/S1	-	O	O	O	O	O
				1	D8/PN/S2							
				2	D8/PE/S1							
				3	D8/PO/S1							
05	0h1705	Resp Delay	Transmission delay after	0 ~ 1000[ms]		5ms	O	O	O	O	O	O
06 Note27)	0h1706	FBus S/W Ver	comm. option S/W version	-		1.00	O	O	O	O	O	O
07	0h1707	FBus ID	comm. option inverter ID	0 ~ 255		1	O	O	O	O	O	O
08	0h1708	FBUS BaudRate	FBus comm. speed	-		12 Mbps		O	O	O	O	O
09	0h1709	FieldBus LED	comm. option LED status	-		-	O	O	O	O	O	O
30	0h171E	ParaStatus Num	-	0 ~ 8		3	O	O	O	O	O	O
31	0h171F	Para Stauts-1	output address 1	0000 ~ FFFF Hex		000A	O	O	O	O	O	O
32	0h1720	Para Stauts-2	output address 2	0000 ~ FFFF Hex		000E	O	O	O	O	O	O

Note 27) COM 06 ~ 17 codes are displayed only when the communication option card is mounted. Refer to Option manual for Option.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
33	0h1721	Para Stauts-3	output address 3	0000 ~ FFFF Hex		000F	O	O	O	O	O	O
34	0h1722	Para Stauts-4	output address 4	0000 ~ FFFF Hex		0000	O	O	O	O	O	O
35	0h1723	Para Stauts-5	output address 5	0000 ~ FFFF Hex		0000	O	O	O	O	O	O
36	0h1724	Para Stauts-6	output address 6	0000 ~ FFFF Hex		0000	O	O	O	O	O	O
37	0h1725	Para Stauts-7	output address 7	0000 ~ FFFF Hex		0000	O	O	O	O	O	O
38	0h1726	Para Stauts-8	output address 8	0000 ~ FFFF Hex		0000	O	O	O	O	O	O
50	0h1732	Para Ctrl	-	0 ~ 8		2	O	O	O	O	O	O
51	0h1733	Para Control-1	input address 1	0000 ~ FFFF Hex		0005	X	O	O	O	O	O
52	0h1734	Para Control-2	input address 2	0000 ~ FFFF Hex		0006	X	O	O	O	O	O
53	0h1735	Para Control-3	input address 3	0000 ~ FFFF Hex		0000	X	O	O	O	O	O
54	0h1736	Para Control-4	input address 4	0000 ~ FFFF Hex		0000	X	O	O	O	O	O
55	0h1737	Para Control-5	input address 5	0000 ~ FFFF Hex		0000	X	O	O	O	O	O
56	0h1738	Para Control-6	input address 6	0000 ~ FFFF Hex		0000	X	O	O	O	O	O
57	0h1739	Para Control-7	input address 7	0000 ~ FFFF Hex		0000	X	O	O	O	O	O
58	0h173A	Para Control-8	input address 8	0000 ~ FFFF Hex		0000	X	O	O	O	O	O
70	0h1746	Virtual DI 1	comm. multi-function input 1	0	None	0: None	O	O	O	O	O	O
71	0h1747	Virtual DI 2	comm. multi-function input 2	1	FX	0: None	O	O	O	O	O	O
72	0h1748	Virtual DI 3	comm. multi-function input 3	2	RX	0: None	O	O	O	O	O	O
73	0h1749	Virtual DI 4	comm. multi-function input 4	3	RST	0: None	O	O	O	O	O	O
74	0h174A	Virtual DI 5	comm. multi-function input 5	4	External Trip	0: None	O	O	O	O	O	O
75	0h174B	Virtual DI 6	comm. multi-function input 6	5	BX	0: None	O	O	O	O	O	O

No.	Comm.	Function	Name	Setting Range		Initial Value	Shift in	Control Mode				
76	0h174C	Virtual DI 7	comm. multi-function input 7	6	JOG	0: None	O	O	O	O	O	O
77	0h174D	Virtual DI 8	comm. multi-function input 8	7	Speed-L	0: None	O	O	O	O	O	O
78	0h174E	Virtual DI 9	comm. multi-function input 9	8	Speed-M	0: None	O	O	O	O	O	O
79	0h174F	Virtual DI 10	comm. multi-function input 10	9	Speed-H	0: None	O	O	O	O	O	O
80	0h1750	Virtual DI 11	comm. multi-function input 11	10	Speed-X	0: None	O	O	O	O	O	O
81	0h1751	Virtual DI 12	comm. multi-function input 12	11	XCEL-L	0: None	O	O	O	O	O	O
82	0h1752	Virtual DI 13	comm. multi-function input 13	12	XCEL-M	0: None	O	O	O	O	O	O
83	0h1753	Virtual DI 14	comm. multi-function input 14	13	RUN Enable	0: None	O	O	O	O	O	O
84	0h1754	Virtual DI 15	comm. multi-function input 15	14	3-Wire	0: None	O	O	O	O	O	O
85	0h1755	Virtual DI 16	comm. multi-function input 16	15	2nd Source	0: None	O	O	O	O	O	O
				16	Exchange							
				17	Up/Down							
				19	Reserved							
				20	U/D Clear							
				21	Analog Hold							
				22	I-Term Clear							
				23	PID Openloop							
				24	P Gain2							
				25	XCEL Stop							
				26	2nd Motor							
				27	Trv Offset Lo							
				28	Trv Offset Hi							
				29	Interlock 1							
				30	Interlock 2							
				31	Interlock 3							
				32	Interlock 4							
				33	Reserved							

No.	Comm.	Function	Name	Setting Range		Initial Value	Shift in	Control Mode				
				34	Pre Excite							
				35	Speed/Torque							
				36	ASR Gain 2							
				37	ASR P/PI							
				38	Timer In							
				39	Thermal In							
				40	Dis Aux Ref							
				41	SEQ-1							
				42	SEQ-2							
				43	Manual							
				44	Go Step							
				45	Hold Step							
				46	FWD JOG							
				47	REV JOG							
				48	Trq Bias							
				49	Web Dis PID							
				50	Web Quik Stop							
				51	Web Hold							
				52	Web Preset							
				53	Web Bobbin-L							
				54	Web Bobbin-H							
				55	Web PI Gain2							
				56	Web Bypass							
				57	Web Splice							
				58	web Taper Dis							
				59	web Boost En							
				60	web Down En							
				61	Ext Dis PID							
				62	Ext PI Gain2							
86	0h1756	Virt DI Status	Comm. Multi-function input monitoring	-	-	0	X	O	O	O	O	O

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Opera-tion	Control Mode				
								V/F	SL	VC	SLT	VCT
90	0h175A	Comm Mon Sel	monitor type selection	0	Int 485	0: Int 485	O	O	O	O	O	O
				1	Keypad							
				2	Field Bus							

No.	Comm.	Function	Name	Setting Range		Initial Value	Shift in	Control Mode				
91	0h175B	RcvFrame Num	Number of reception frames	-		0	-	O	O	O	O	O
92	0h175C	Err Frame Num	Number of error frames	-		0	-	O	O	O	O	O
93	0h175D	Nak Frame Num	Number of writing error	-		0	-	O	O	O	O	O
94 note 28)	-	Comm Update		0	No	0	-	O	O	O	O	O
				1	Yes							

note28) COM 94 is displayed when communication option board is inserted.

5.8 Parameter mode – Applied function group (➔APP)

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Opera-tion	Control Mode				
								V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0 ~ 99		20	O	O	O	O	O	O
01[note29]	0h1801	App Mode	applied function selection	0	None	0: None	X	O	O	O	X	X
				1	Traverse							
				2	Proc PID							
				3	Reserved							
				4	Auto Sequence							
				5	Tension Ctrl							
02	0h1802	Tnsn Ctrl Mode	operation mode selection of tension control	0	Winder	0: Winder	X	O	O	O	X	X
				1	Unwinder							
				2	Capstan							
03	0h1803	Main Spd Disp	main speed display	Read Only[%]		-	O	O	O	O	X	X
04[note30]	0h1804	Main Spd Set	main speed command (Keypad)	-100.00 ~ 100.00[%]		0.00	O	O	O	O	X	X
05	0h1805	Main Spd Src	selection of main speed command source	0	Keypad	1: V1	X	O	O	O	X	X
				1	V1							
				2	I1							
				3	V2							
				4	I2							
				5	Int 485							
				6	Encoder							
				7	FieldBus							
				8	PLC							
06	0h1806	Main XcelT En	selection of main speed acc./dec.	0	No	1: Yes	O	O	O	O	X	X
				1	Yes							
07[note31]	0h1807	Main Spd AccT	acc. time of main speed	0.0 ~ 300.0[sec]		10.0	O	O	O	O	X	X

Note 29) APP-02~99 codes are displayed only when APP-01 (App Mode) is set as 'Tension Ctrl'.
Note 30) APP-04 code is displayed only when APP-05 (Main Spd Src) is set as 'keypad'.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Opera-tion	Control Mode				
								V/F	SL	VC	SLT	VCT
14 note3 1)	0h180E	Main Spd DecT	dec. Time of main speed	0.0 ~ 300.0[sec]		20.0	O	O	O	O	X	X
15	0h180F	Web PID En	Selection of tension PID	0	No	1: Yes	O	O	O	O	X	X
				1	Yes							
16	0h1810	PID Output	PID output monitor	Read Only[%]		-	-	O	O	O	X	X
17	0h1811	PID Ref Value	PID reference monitor	Read Only[%]		-	-	O	O	O	X	X
18	0h1812	PID Fdb Value	PID feedback monitor	Read Only[%]		-	-	O	O	O	X	X
19	0h1813	PID Ref Set	PID reference setting (keypad)	-100 ~ 100[%]		50%	O	O	O	O	X	X
20	0h1814	PID Ref Source	Select PID reference	0	Keypad	0: Keypad	X	O	O	O	X	X
				1	V1							
				2	I1							
				3	V2							
				4	I2							
				5	Int 485							
				6	Encoder							
				7	FieldBus							
				8	PLC							
				9	Synchro							
				10	Binary Type							
				11	XV1							
				12	XI1							
				13	XV2							
				14	XI2							
				15	XV3							
				16	XI3							
				17	XV4							
				18	XI4							
21	0h1815	PID F/B Source	Select PID feedback	0	V1	1: I1	X	O	O	O	X	X
				1	I1							
				2	V2							

Note 31) APP-07, 14 codes are displayed only when APP-06 (Main XcelT En) is set as 'Yes'.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
21	0h1815	PID F/B Source	Select PID feedback	3	I2	1: I1	X	O	O	O	X	X
				4	Int 485							
				5	Encoder							
				6	FieldBus							
				7	PLC							
				8	Synchro							
				9	Binary Type							
				10	XV1							
				11	XI1							
				12	XV2							
				13	XI2							
				14	XV3							
				15	XI3							
				16	XV4							
				17	XI4							
22	0h1816	PID P-Gain	PIDcontroller proportional	0 ~ 1000[%]		50.0	O	O	O	O	O	X	X
23	0h1817	PID I-Time	PIDcontroller integral time	0 ~ 200.0[sec]		10.0	O	O	O	O	O	X	X
24	0h1818	PID D-Time	PIDcontroller differential time	0 ~ 1000[ms]		0	O	O	O	O	O	X	X
27	0h181B	PID Out LPF	PID output filter	0 ~ 10000[ms]		0	O	O	O	O	O	X	X
28	0h181C	PID I Limit	I controller output limit	0~100[%]		100	O	O	O	O	O	X	X
31	0h181F	PID Out Inv	PID output reverse	0	No	0: No	O	O	O	O	O	X	X
				1	Yes							
32	0h1820	PID Out Scale	PID output scale	0.1 ~ 1000[%]		30.0	X	O	O	O	O	X	X
42	0h182A	PID Unit Sel	PID control period unit selection	0	%	0: %	O	O	O	O	O	X	X
				1	Bar							
				2	mBar							
				3	Pa							
				4	KPa							
				5	Hz							
				6	rpm							
				7	V							

No.	Comm.	Function	Name	Setting Range		Initial Value	Shift in	Control Mode				
42	0h182A	PID Unit Sel	PID control period unit selection	8	I	0: %	O	O	O	O	X	X
				9	kW							
				10	HP							
				11	℃							
				12	°F							
43	0h182B	PID Unit	PID unit gain	0 ~ 300[%]		100.00	O	O	O	O	X	X
44	0h182C	PID Unit Scale	PID unit scale	0	X 100	2: x 1	O	O	O	O	X	X
				1	X 10							
				2	X 1							
				3	X 0.1							
				4	X 0.01							
45	0h182D	PID P2-Gain	PIDcontroller proportional gain2	0 ~ 1000[%]		100.0	O	O	O	O	X	X
46	0h182E	PID I2-Gain	PIDcontroller integrated time2	0 ~ 200.0[sec]		20.0	O	O	O	O	X	X
47	0h182F	PI Change Spd1	P/I gain switching frequency-1	0 ~ set value of APP-48[%]		0	O	O	O	O	X	X
48	0h1830	PI Change Spd2	P/I gain switching frequency-2	0~100[%]		0	O	O	O	O	X	X
50	0h1832	PI Gain Ramp	PI gain switching RAMP TIME	0.0~300.0[sec]		30.0	O	O	O	O	X	X
51	0h1833	PID Start Ramp	PID output ramp time in initiation	0.0~300.0[sec]		5.0	O	O	O	O	X	X
52	0h1834	PID Hi Lmt %	PID output upper limit[%]	APP-53~100.0[%]		100.0	O	O	O	O	X	X
53	0h1835	PID Lo Lmt %	PID output lower limit[%]	-100.0~APP-52[%]		-100.0	O	O	O	O	X	X
54	0h1836	Fixed PID En	Select fixed PID controller	0	No	0: No	O	O	O	O	X	X
				1	Yes							
55 note32)	0h1837	Min Fixed PID	Minimum value of fixed PID controller	0.0~50.0[%]		10.0	O	O	O	O	X	X

Note 32) APP-55 code is displayed only when APP-54 (Fixed PID En) is set as 'No'.

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Operation	Control Mode				
							V/F	SL	VC	SLT	VCT
56	0h1838	Profile P Mode	P gain profile selection	0 None 1 Linear 2 Square	0: None	O	O	O	O	X	X
57	0h1839	Profile P	profile gain	0.01~10.00[%]	1.00	O	O	O	O	X	X
58	0h183A	Tapper Sel	tapper type selection	0 None 1 Linear 2 Hyperbolic	0: None	X	O	O	O	X	X
59	0h183B	Tapper SetPt	tapper set point	-100.0 ~ 100.0[%]	0	O	O	O	O	X	X
61 note34)	0h183D	Curr Diameter	Display current diameter [%]	APP-67 ~ 100.0[%]	Current diameter	X	O	O	O	X	X
62 note34)	0h183E	Curr Bobbin	Display current bobbin	Read Only (1~4)	-	-	O	O	O	X	X
63 note34)	0h183F	Bobbin1 Diamtr	bobbin1 diameter[%]	APP67 ~ 100.0[%]	10.0	O	O	O	O	X	X
64 note34)	0h1840	Bobbin2 Diamtr	bobbin2 diameter[%]	APP-67 ~ 100.0[%]	15.0	O	O	O	O	X	X
65 note34)	0h1841	Bobbin3 Diamtr	bobbin3 diameter[%]	APP-67 ~ 100.0[%]	20.0	O	O	O	O	X	X
66 note34)	0h1842	Bobbin4 Diamtr	bobbin4 diameter[%]	APP-67 ~ 100.0[%]	25.0	O	O	O	O	X	X
67 note34)	0h1843	Min Diameter	Min. bobbin diameter[%]	5.0 ~ 100.0[%]	10.0	X	O	O	O	X	X
68 note34)	0h1844	Diameter LPF	Diameter computation filter	0.0 ~ 300.0[sec]	30.0	O	O	O	O	X	X
69	0h1845	Web Hold Freq	hold freq. of diameter/thickn-ess computation	0.0 ~ 30.0[Hz]	5.0	O	O	O	O	X	X

Note34) APP-61 ~ 68 codes are displayed only when APP-02 (Tnsn Ctrl Mode) is set as 'Winder' or 'Unwinder'.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Opera-tion	Control Mode				
								V/F	SL	VC	SLT	VCT
71 note35)	0h1847	Thickness En	Select calculation of thickness of materals	0	No	1: Yes	X	O	O	O	X	X
				1	Yes							
72 note35)	0h1848	Curr Thickness	initial thickness of materials setting and currently calculated thickness of materials	50.0 ~ 300.0[%]		100.0	X	O	O	O	X	X
74 note35)	0h184A	Thickness LPF	Materials thickness calculation filter	0.0 ~ 300.0[sec]		30.0	O	O	O	O	X	X
76	0h184C	Web Brk En	Select web break detection function	0	None	1: Warning	O	O	O	O	X	X
				1	Warning							
				2	Free-run							
77 note36)	0h184D	Web Brk St Dly	Delayed time for detecting disconnection at initial run	0.0 ~ 300.0[sec]		10.0	O	O	O	O	X	X
78 note36)	0h184E	Web Brk Dly	Delayed time for detection disconnection	0.0 ~ 300.0[sec]		5.0	O	O	O	O	X	X
79 note36)	0h184F	Web Brk Lev Hi	Upper limit to detect disconnection	APP-80 ~ 100.0[%]		80.0	O	O	O	O	X	X
80 note36)	0h1850	Web Brk Lev Lo	Lower limit to detect disconnection	0.0 ~ APP-79[%]		20.0	O	O	O	O	X	X
82	0h1852	Q Stop Dec T	dec. time of emergency stop	0.1 ~ 300.0[sec]		3.0	O	O	O	O	X	X
83	0h1853	Bypass Gain	Bypass gain	0.0 ~ 300.0[%]		100.0	O	O	O	O	X	X
84	0h1854	Rev Tension En	Select reverse slow speed	0	No	0: No	O	O	O	O	X	X
				1	Yes							

Note35) APP-71 ~ 74 codes are displayed only when APP-02 (Tnsn Ctrl Mode) is set as 'Capstan'.
Note36) APP-77 ~ 80 codes are displayed only when APP-76 (Web Brk En) is set as 'Warning' or 'Free-run'.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
85 note37)	0h1855	Ext PID En	Select external PID control	0	No	1: Yes	O	O	O	O	X	X
				1	Yes							
86	0h1856	W Noise Band	Disturbance detection band	0.0 ~ 50.0[%]		0.0	O	O	O	O	X	X
87	0h1857	W Noise P Gain	disturbance compensation P gain	0.0 ~ 50.0[%]		0.0	O	O	O	O	X	X
88	0h1858	W Noise Ramp	disturbance compensation acceleration/deceleration time	0.0 ~ 300.0[sec]		0.0	O	O	O	O	X	X
89	0h1859	Compen Xcel %	Ratio to reflect compensation by the calculation of the thickness of materials from the final speed	0 ~ 100[%]		70	O	O	O	O	X	X
90	0h185A	Min Main Spd	Minimum main speed	0.0 ~ 50.0[%]		3.0	O	O	O	O	X	X
92	0h185C	Max Main Spd	Frequency against main speed 100%	DRV-19 ~ DRV-20[Hz]		60.00	O	O	O	O	X	X
93 note38)	0h185D	Splice Level	Splicing level	0.0 ~ 100.0[%]		0	O	O	O	O	X	X
94	0h185E	Tns Boost In	tension increment setting	0 ~ 50.0[%]		0	O	O	O	O	X	X
95	0h185F	Tns Boost Type	tension increment selection	0	Fixed	0 : Fixed	X	O	O	O	X	X
				1	Proportional							
96	0h1860	Tns Down In	tension decrement setting	0 ~ 50.0[%]		0	O	O	O	O	X	X
97	0h1861	Tns Down Type	tension decrement selection	0	Fixed	0 : Fixed	X	O	O	O	X	X
				1	Proportional							

Note37) APP-85 code is displayed only when APP-01 (App Mode) is set as 'Ext PID Ctrl'.
Note38) APP-93 code is displayed only when APP-02 (Tnsn Ctrl Mode) is set as 'Winder' or 'Unwinder'.

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Operation	Control Mode				
							V/F	SL	VC	SLT	VCT
98	0h1862	PID Sample T	PID computation cycle	1~10[ms]	1	X	O	O	O	X	X
99	0h1863	Web S/W Ver	dedicated software version	Read Only (1.xx)	-	-	O	O	O	X	X

5.9 Parameter mode – Option card function group (➔APO)

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0 ~ 99		20	O	O	O	O	O	O
01 Note39)	0h1A01	Enc Opt Mode	encoder function item	0	None	0: None	O	O	O	O	O	O
				1	Feed-Back							
				2	Reference							
04	0h1A04	Enc Type Sel	encoder type selection	0	Line Driver	0: Line Driver	X	O	O	O	O	O
				1	Totem or Com							
				2	Open Collector							
05	0h1A05	Enc Pulse Sel	encoder pulse direction	0	(A+B)	0: (A+B)	X	O	O	O	O	O
				1	-(A+B)							
				2	A							
06	0h1A06	Enc Pulse Num	Number of encoder pulses	10 ~ 4096		1024	X	O	O	O	O	O
08	0h1A08	Enc Monitor	Feed Back monitor	-		-	O	O	O	O	O	O
09	0h1A09	Pulse Monitor	Reference monitor	-		-	O	O	O	O	O	O
10	0h1A0A	Enc Filter	encoder input filter	0 ~ 10000[ms]		3	O	O	O	O	O	O
11	0h1A0B	Enc Pulse x1	Enc input min. pulse	0 ~ 100[kHz]		0.0	O	O	X	O	X	O
12	0h1A0C	Enc Perc y1	output% at Enc min. pulse	0 ~ 100[%]		0.00	O	O	X	O	X	O
13	0h1A0D	Enc Pulse x2	Enc input max. pulse	0 ~ 200[kHz]		100	O	O	X	O	X	O
14	0h1A0E	Enc Perc y2	Enc max. pulse output%	0 ~ 100[%]		100	O	O	X	O	X	O
58 Note40)	0h1A3A	PLC LED Status	PLC option LED status	-		-	O	O	O	O	O	O
59	0h1A3B	PLC S/W Ver	PLC option card S/W version	-		1.X	O	O	O	O	O	O

Note 40) APO-58 ~ 83 codes are displayed only when PLC option board is mounted.

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Operation	Control Mode				
							V/F	SL	VC	SLT	VCT
60	0h1A3C	PLC Wr Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
61	0h1A3D	PLC Wr Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
62	0h1A3E	PLC Wr Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
63	0h1A3F	PLC Wr Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
64	0h1A40	PLC Wr Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
65	0h1A41	PLC Wr Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
66	0h1A42	PLC Wr Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
67	0h1A43	PLC Wr Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
76	0h1A4C	PLC Rd Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
77	0h1A4D	PLC Rd Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
78	0h1A4E	PLC Rd Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
79	0h1A4F	PLC Rd Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
80	0h1A50	PLC Rd Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
81	0h1A51	PLC Rd Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
82	0h1A52	PLC Rd Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O
83	0h1A53	PLC Rd Data	-	0 ~ FFFF[Hex]	0000	O	O	O	O	O	O

5.10 Parameter mode – Protective function group (➔PRT)

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Opera-tion	Control Mode				
							V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0 ~ 99	40	O	O	O	O	O	O
04	0h1B04	Load Duty	Load amount setting	0 Normal Duty 1 Heavy Duty	1: Heavy Duty	X	O	O	O	O	O
05	0h1B05	Phase Loss Chk	input/output phase open protection	Bit 00 ~ 11 1 Output phase 2 Input phase open	00	X	O	O	O	O	O
06	0h1B06	IPO V Band	input phase open voltage band	1 ~ 100[V]	40	X	O	O	O	O	O
07	0h1B07	Trip Dec Time	dec. time in case of failure	0 ~ 600[sec]	3.0	O	O	O	O	O	O
08	0h1B08	RST Restart	starting selection in case of failure reset	0 No 1 Yes	0: No	O	O	O	O	O	O
09	0h1B09	Retry Number	Number of auto restarts	0 ~ 10	0	O	O	O	O	O	O
10 Note4 1)	0h1B0A	Retry Delay	Auto restart delay time	0 ~ 60.0[sec]	1.0	O	O	O	O	O	O
11	0h1B0B	Lost KPD Mode	movement in case of Keypad command loss	0 None 1 Warning 2 Free-Run 3 Dec	0: None	O	O	O	O	O	O
12	0h1B0C	Lost Cmd Mode	movement in case of speed command loss	0 None 1 Free-Run 2 Dec 3 Hold Input 4 Hold Output 5 Lost Preset	0: None	O	O	O	O	O	O
13 Note4 2)	0h1B0D	Lost Cmd Time	Speed command loss judgment time	0.1 ~ 120[sec]	1.0	O	O	O	O	O	O

Note 41) PRT-10 codes are displayed only when PRT-09 (Retry Number) is set above '0'.
Note 42) PRT-13 ~ 15 codes are displayed only when PRT-12 (Lost Cmd Mode) is not 'NONE'.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Opera-tion	Control Mode				
								V/F	SL	VC	SLT	VCT
14	0h1B0E	Lost Preset F	operation freq. in case of speed command loss	starting freq. ~ max. freq.[Hz]		0.00	O	O	O	O	O	O
15	0h1B0F	AI Lost Level	Analog input loss judgment level	0	Half of x1	0: Half of x1	O	O	O	O	O	O
				1	Below x1							
17	0h1B11	OL Warn Select	overload alarm selection	0	No	0: No	O	O	O	O	O	O
				1	Yes							
18	0h1B12	OL Warn Level	overload alarm level	30 ~ 180[%]		150	O	O	O	O	O	O
19	0h1B13	OL Warn Time	overload alarm time	0 ~ 30.0[sec]		10.0	O	O	O	O	O	O
20	0h1B14	OL Trip Select	movement in case of overload failure	0	None	1: Free-Run	O	O	O	O	O	O
				1	Free-Run							
				2	Dec							
21	0h1B15	OL Trip Level	Overload trip	30 ~ 200[%]		180	O	O	O	O	O	O
22	0h1B16	OL Trip Time	overload failure	0 ~ 60[sec]		60.0	O	O	O	O	O	O
25	0h1B19	UL Warn Sel	light load alarm selection	0	No	0: No	O	O	O	O	O	O
				1	Yes							
26	0h1B1A	UL Warn Time	light load alarm time	0 ~ 600.0[sec]		10.0	O	O	O	O	O	O
27	0h1B1B	UL Trip Sel	light load failure selection	0	None	0: None	O	O	O	O	O	O
				1	Free-Run							
				2	Dec							
28	0h1B1C	UL Trip Time	light load	0 ~ 600[sec]		30.0	O	O	O	O	O	O
29	0h1B1D	UL LF Level	light load lower	10 ~ 30[%]		30	O	O	O	O	O	O
30	0h1B1E	UL BF Level	light load upper	10 ~ 100[%]		30	O	O	O	O	O	O
31	0h1B1F	No Motor Trip	movement in case of no	0	None	0: None	O	O	O	O	O	O
				1	Free-Run							
32 Note43)	0h1B20	No Motor Level	no motor detection current level	1 ~ 100[%]		5	O	O	O	O	O	O
33	0h1B21	No Motor Time	no motor detection delay	0.1 ~ 10.0[sec]		3.0	O	O	O	O	O	O

Note 43) PRT-32 ~ 33 codes are displayed only when PRT-31 (No Motor Trip) is set as 'Free-Run'.

No.	Comm. No.	Function Display	Name	Setting Range		Initial Value	Shift in Operation	Control Mode				
								V/F	SL	VC	SLT	VCT
34	0h1B22	Thermal-T Sel	movement selection after motor overheat detection	0	None	0: None	O	O	O	O	O	O
				1	Free-Run							
				2	Dec							
35	0h1B23	Thermal In Src	motor overheat detection sensor input selection	0	None	0: None	X	O	O	O	O	O
				1	V1							
				2	I1							
				3	V2							
				4	I2							
36	0h1B24	Thermal-T Lev	motor overheat detection sensor failure level	0 ~ 100[%]		50.0	O	O	O	O	O	O
37	0h1B25	Thermal-T Area	motor overheat detection sensor failure area	0	Low	0: Low	O	O	O	O	O	O
				1	High							
40	0h1B28	ETH Trip Sel	electric thermal failure selection	0	None	0: None	O	O	O	O	O	O
				1	Free-Run							
				2	Dec							
41	0h1B29	Motor Cooling	motor cooling fan	0	Self-cool	0: Self-cool	O	O	O	O	O	O
				1	Forced-cool							
42	0h1B2A	ETH 1min	electric thermal 1 minute rating	120 ~ 200[%]		150	O	O	O	O	O	O
43	0h1B2B	ETH Cont	electric thermal consecutive rating	50 ~ 200[%]		120	O	O	O	O	O	O
50	0h1B32	Stall Prevent	stall preventing movement	Bit	0000 ~ 1111	0000	X	O	O	X	O	X
				1	Accelerating							
				2	Steady speed							
				3	Decelerating							
51	0h1B33	Stall Freq 1	stall freq. 1	starting freq. ~ stall freq. 1[Hz]		60.00	O	O	O	X	O	X
52	0h1B34	Stall Level 1	stall level 1	30 ~ 250[%]		180	X	O	O	X	O	X
53	0h1B35	Stall Freq 2	stall freq. 2	stall freq. 1 ~ stall freq. 2[Hz]		60.00	O	O	O	X	O	X
54	0h1B36	Stall Level 2	stall level 2	30 ~ 250[%]		180	X	O	O	X	O	X

No.	Comm.	Function	Name	Setting Range	Initial Value	Shift in	Control Mode				
55	0h1B37	Stall Freq 3	stall freq. 3	stall freq. 2	60.00	O	O	O	X	O	X
56	0h1B38	Stall Level 3	stall level 3	30 ~ 250[%]	180	X	O	O	X	O	X
57	0h1B39	Stall Freq 4	stall freq. 4	stall freq. 3	60.00	O	O	O	X	O	X
58	0h1B3A	Stall Level 4	stall level 4	30 ~ 250[%]	180	X	O	O	X	O	X
66	0h1B42	DB	DB resistance	0 ~ 30[%]	0	O	O	O	O	O	O
70	0h1B46	Over SPD	overspeed	20 ~ 130[%]	120.0	O	X	X	O	X	O
72	0h1B48	Over SPD	overspeed	0.01 ~ 10.00[sec]	0.01	O	X	X	O	X	O
73	0h1B49	Speed Dev Trip	speed error failure	0 No 1 Yes	0: No	O	X	X	O	X	X
74	0h1B4A	Speed Dev	speed error	2 ~ max. freq.[Hz]	20.00	O	X	X	O	X	X
75	0h1B4B	Speed Dev	speed error	0.1 ~ 1000.0[sec]	1.0	O	X	X	O	X	X
77	0h1B4D	Enc Wire Check	Encoder option connection	0 No 1 Yes	0: No	O	X	X	O	X	O
78	0h1B4E	Enc Check	Encoder	0.1 ~ 1000.0[sec]	1.0	O	X	X	O	X	O
79	0h1B4F	FAN Trip Mode	cooling fan failure	0 Trip 1 Warning	0: Trip	O	O	O	O	O	O
80	0h1B50	Opt Trip Mode	movement selection in case of option trip	0 None 1 Free-Run 2 Dec	1: Free-Run	O	O	O	O	O	O
81	0h1B51	LVT Delay	low voltage	0 ~ 60.0[sec]	0.0	X	O	O	O	O	O

5.11 Parameter mode – 2nd motor function Group (➔M2)

No.	Comm. No.	Function Display	Name	Setting Range	Initial Value	Shift in Opera-tion	Control Mode				
							V/F	SL	VC	SLT	VCT
00	-	Jump Code	jump code	0 ~ 99	14	O	O	O	X	O	X
04	0h1C04	M2-Acc Time	acc. time	0 ~ 600[sec]	Below 20.0 Above 60.0	O	O	O	X	O	X
05	0h1C05	M2-Dec Time	dec. time	0 ~ 600[sec]	Below 30.0 Above 90.0	O	O	O	X	O	X
06	0h1C06	M2-Capacity	motor capacity	0~ 0.2kW 21 185kW	-	X	O	O	X	O	X
07	0h1C07	M2-Base Freq	base freq.	30 ~ 400[Hz]	60.00	X	O	O	X	O	X
08	0h1C08	M2-Ctrl Mode	control mode	0 V/F 1 V/F PG 2 Slip Compen 3 Sensorless-1 4 Sensorless-2	0: V/F	X	O	O	X	O	X
10	0h1C0A	M2-Pole Num	motor pole	2 ~ 48	It depends on motor capacity.	X	O	O	X	O	X
11	0h1C0B	M2-Rated Slip	rated sleep speed	0 ~ 3000[rpm]		X	O	O	X	O	X
12	0h1C0C	M2-Rated Curr	motor rated current	1 ~ 200[A]		X	O	O	X	O	X
13	0h1C0D	M2-Noload Curr	motor no load current	0.5 ~ 200[A]		X	O	O	X	O	X
14	0h1C0E	M2-Rated Volt	motor rated voltage	180 ~ 220[V]		X	O	O	X	O	X
15	0h1C0F	M2-Efficiency	motor	70 ~ 100[%]		X	O	O	X	O	X
16	0h1C10	M2-Inertia Rt	load inertia	0 ~ 8		X					
17	-	M2-Rs	stator	0 ~ 9.999[Ω]		X					
18	-	M2-Lsigma	leak	0 ~ 99.99[mH]		X					
19	-	M2-Ls	stator	0 ~ 999.9[mH]		X	O	O	X	O	X
20	-	M2-Tr	rotor time	25 ~ 5000[ms]		X	O	O	X	O	X

No.	Comm.	Function	Name	Setting Range		Initial Value	Shift in	Control Mode				
25	0h1C19	M2-V/F Patt	V/F pattern	0	Linear	0: Linear	X	O	O	X	O	X
				1	Square							
				2	User V/F							
26	0h1C1A	M2-Fwd Boost	forward torque boost	0 ~ 15[%]		Below 75kW: 2.0 Above 90kW: 1.0	X	O	O	X	O	X
27	0h1C1B	M2-Rev Boost	reverse torque boost	0 ~ 15[%]			X	O	O	X	O	X
28	0h1C1C	M2-Stall Lev	stall preventing level	30 ~ 150[%]		150	X	O	O	X	O	X
29	0h1C1D	M2-ETH 1min	electric thermal 1 minute rating	100 ~ 200[%]		150	X	O	O	X	O	X
30	0h1C1E	M2-ETH Cont	electric thermal consecutive	50 ~ 150[%]		100	X	O	O	X	O	X
40	0h1C28	M2-LoadSpd Gain	revolution display gain	0.1 ~ 6000.0%		100.0	O	O	O	O	O	O
41	0h1C29	M2-LoadSpdScal	revolution display scale	0	x 1	0: x 1	O	O	O	O	O	O
				1	x 0.1							
				2	x 0.01							
				3	x 0.001							
				4	x 0.0001							
42	0h1C2A	M2-LoadSpdUnit	revolution display unit	0	rpm	0: rpm	O	O	O	O	O	O
				1	mpm							

5.12 Trip mode (TRP current (or Last-x))

No.	Function Display	Name	Setting Range		Initial Value
00	Trip Name (x)	failure type display	-		-
01	Output Freq	operation frequency in case of failure	-		-
02	Output Current	output current in case of failure	-		-
03	Inverter State	Acc/Dec status in case of failure	-		-
04	DCLink Voltage	DC voltage	-		-
05	Temperature	NTC temperature	-		-
06	DI State	status of Input terminals	-		0000 0000
07	DO State	status of output terminals	-		000
08	Trip On Time	failure time since power on	-		0/00/00 00:00
09	Trip Run Time	failure time since start to run	-		0/00/00 00:00
10	Trip Delete?	deletion of failure history	0	No	0: No
			1	Yes	

5.13 Config Mode (CNF)

No.	Function Display	Name	Setting Range		Initial Value
00	Jump Code	jump code	0 ~ 99		1
01	Language Sel	keypad language selection	0. English 1. Russian 2. Spanish 3. Italian 4. Turkish		0. English
02	LCD Contrast	LCD brightness adjustment	-		-
10	Inv S/W Ver	body S/W version	-		1.XX
11	KeypadS/W Ver	keypad S/W version	-		1.XX
12	KPD Title Ver	keypad Title version	-		1.XX
20 Note44)	Anytime Para	status display item	0	Frequency	0: Frequency
21	Monitor Line-1	monitor mode display item1	1	Speed	0: Frequency
22	Monitor Line-2	monitor mode display item2	2	Output Current	2: Output Current
23	Monitor Line-3	Monitor mode display item3	3	Output Voltage	3: Output Voltage
			4	Output Power	
			5	WHour Counter	
			6	DCLink Voltage	
			7	DI State	
			8	DO State	
			9	V1 Monitor[V]	
			10	V1 Monitor[%]	
			11	I1 Monitor[mA]	
			12	I1 Monitor[%]	
			13	V2 Monitor[V]	
			14	V2 Monitor[%]	
			15	I2 Monitor[mA]	
			16	I2 Monitor[%]	
			17	PID Output	
			18	PID ref Value	
			19	PID Fdb Value	
			20	Torque	
			21	Torque Limit	
			22	Trq Bias Ref	
			23	Speed Limit	

Note 44) Item 7 and 8 are not existed in Anytime Para item

No.	Function Display	Name	Setting Range		Initial Value
23	Monitor Line-3	Monitor mode display item3	24	Load Speed	3: Output Voltage
24	Mon Mode Init	monitor mode initialization	0	No	0: No
			1	Yes	
30	Option-1 Type	option slot 1 type display	0	None	0: None
31	Option-2 Type	option slot 2 type display	1	PLC	0: None
32	Option-3 Type	option slot 3 type display	2	Profi	0: None
			3	Ext. I/O	
			4	Encoder	
40	Parameter Init	parameter initialization	0	No	–
			1	All Grp	
			2	DRV Grp	
			3	BAS Grp	
			4	ADV Grp	
			5	CON Grp	
			6	IN Grp	
			7	OUT Grp	
			8	COM Grp	
			9	APP Grp	
			10	AUT Grp	
			11	APO Grp	
			12	PRT Grp	
			13	M2 Grp	
41	Changed Para	changed parameter display	0	View All	0: View All
			1	View Changed	
42	Multi Key Sel	multi-function key item	0	None	0: None
			1	JOG Key	
			2	Local/Remote	
			3	UserGrp SelKey	
43	Macro Select	macro function item	0	None	0: None
			1	Draw App	
			2	Traverse	
44	Erase All Trip	deletion of failure history	0	No	0: No
			1	Yes	
45	UserGrp AllDel	deletion user registration code	0	No	0: No
			1	Yes	

No.	Function Display	Name	Setting Range		Initial Value
46	Parameter Read	parameter reading	0	No	0: No
			1	Yes	
47	Parameter Write	parameter writing	0	No	0: No
			1	Yes	
48	Parameter Save	comm. parameter saving	0	No	0: No
			1	Yes	
50	View Lock Set	parameter mode hiding	0 ~ 9999		Un-locked
51	View Lock Pw	parameter mode hiding password	0 ~ 9999		Password
52	Key Lock Set	parameter editing lock	0 ~ 9999		Un-locked
53	Key Lock Pw	parameter editing lock	0 ~ 9999		Password
60	Add Title Del	Keypad title version up	0	No	0: No
			1	Yes	
61	Easy Start On	Easy parameter setting	0	No	0: No
			1	Yes	
62	WHCount Reset	consumed power amount initialization	0	No	0: No
			1	Yes	
70	On-time	inverter movement cumulative time	mm/dd/yy hh:mm		-
71	Run-time	inverter operation cumulative time	mm/dd/yy hh:mm		-
72	Time Reset	inverter operation cumulative time initialization	0	No	0: No
			1	Yes	
74	Fan Time	cooling fan operation cumulative time	mm/dd/yy hh:mm		-
75	Fan Time Rst	cooling fan operation cumulative time initialization	0	No	-
			1	Yes	

6. iS7 extended common area parameter

6.1 Inverter Monitoring Area Parameter (Reading only)

Address	Parameter	Scale	unit	Allotment for Bits	
0h0300	Inverter model	-	-	iS7: 000Bh	
0h0301	Inverter capacity	-	-	0.75kW: 3200h	
				1.5kW: 4015h, 2.2kW: 4022h, 3.7kW: 4037h, 5.5kW: 4055h, 7.5kW: 4075h, 11kW: 40B0h 15kW: 40F0h, 18.5kW: 4125h, 22kW: 4160h, 30kW: 41E0h, 37kW: 4250h, 45kW: 42D0h 55kW: 4370h, 75kW: 44B0h, 90kW: 45A0h 110kW: 46E0h, 132kW: 4840h, 160kW: 4A00h 185kW: 4B90h	
0h0302	Inverter input voltage / power supply type (single phase, 3 phase) / cooling method	-	-	200V single phase open air cooling: 0220h	
				200V 3 phase open air cooling: 0230h	
				200V single phase forced cooling: 0221h	
				200V 3 phase forced cooling: 0231h	
				400V single open air cooling: 0420h	
				400V 3 phase open air cooling: 0430h	
				400V single phase forced cooling: 0421h	
				400V 3 phase forced cooling: 0431h	
0h0303	Inverter S/W version	-	-	(e.g.) 0x0100: Version 1.00	
				0x0101: Version 1.01	
0h0304	Reserved	-	-	-	
0h0305	Inverter operating status	-	-	B15	0: normal status 4: Warning status 8: Fault status (operates according to set value of PRT-30 Trip Out Mode)
				B14	
				B13	
				B12	
				B11	-
				B10	
				B9	
				B8	
				B7	1: speed search 2: accelerating 3: steady speed
				B6	
				B5	

Address	Parameter	Scale	unit	Allotment for Bits	
				B4	4: decelerating 5: decelerating stop 6: H/W OCS 7: S/W OCS 8: dwell operating
				B3	0: stop 1: forward operating 2: reverse operating 3: DC operating (0 speed control)
				B2	
				B1	
				B0	
0h0306	Inverter run frequency command source	-	-	B15	Run command source 0: Keypad 1: Communication option 2: App/PLC 3: Built-in 485 4: Terminal Block 5: reserved 6: Auto 1 7: Auto 2
				B14	
				B13	
				B12	
				B11	
				B10	
				B9	
				B8	
				B7	Frequency command source 0: Keypad speed 1: Keypad torque 2 ~ 4: Up/Down run speed 5: V1 6: I1 7: V2 8: I2 9: Pulse 10: Built-in485 11: Communication option 12: App(PLC) 13: Jog 14: PID 15 ~ 22: Auto Step 25 ~ 39: Multi-step speed frequency
				B6	
				B5	
				B4	
				B3	
				B2	
				B1	
				B0	
0h0307	Keypad S/W version	-	-	(E.g.) 0x0100: Version 1.00	
0h0308	Keypad Title version	-	-	0x0101: Version 1.01	
0h0309 ~ 0h30F	reserved	-	-	-	
0h0310	Output current	0.1	A	-	
0h0311	Output frequency	0.01	Hz	-	
0h0312	Output RPM	0	RPM	-	
0h0313	Motor feedback speed	0	RPM	- 32768 rpm ~ 32767 rpm (Having a polarity.)	
0h0314	Output voltage	1	V	-	
0h0315	DC Link voltage	1	V	-	
0h0316	Output power	0.1	kW	-	
0h0317	Output Torque	0.1	%	-	

Address	Parameter	Scale	unit	Allotment for Bits	
0h0318	PID reference	0.1	%	-	
0h0319	PID feedback	0.1	%	-	
0h031A	Number of No.1 motor display	-	-	Number of No.1 motor display	
0h031B	Number of No.2 motor display	-	-	Number of No.2 motor display	
0h031C	Number of selected motor display	-	-	Number of selected motor display	
0h031D	Selection among Hz/rpm	-	-	0: Hz unit 1: rpm unit	
0h031E ~ 0h031F	Reserved	-	-	-	
0h0320	Digital input information	-	-	BI5	Reserved
				BI4	Reserved
				BI3	Reserved
				BI2	Reserved
				BI1	Reserved
				BI0	P11 (Extended I/O)
				B9	P10 (Extended I/O)
				B8	P9 (Extended I/O)
				B7	P8 (Basic I/O)
				B6	P7 (Basic I/O)
				B5	P6 (Basic I/O)
				B4	P5 (Basic I/O)
				B3	P4 (Basic I/O)
				B2	P3 (Basic I/O)
				B1	P2 (Basic I/O)
				B0	P1 (Basic I/O)
0h0321	Digital output information	-	-	BI5	Reserved
				BI4	Reserved
				BI3	Reserved
				BI2	Reserved
				BI1	Reserved
				BI0	Reserved
				B9	Reserved
				B8	Reserved
				B7	Reserved
				B6	Reserved
				B5	Relay 5 (Extended I/O)
				B4	Relay 4 (Extended I/O)
				B3	Relay 3 (Extended I/O)

Address	Parameter	Scale	unit	Allotment for Bits	
				B2	Q1 (Basic I/O)
				B1	Relay 2 (Basic I/O)
				B0	Relay 1 (Basic I/O)
0h0322	Virtual digital input information	-	-	B15	Virtual DI 16 (COM-85)
				B14	Virtual DI 15 (COM-84)
				B13	Virtual DI 14 (COM-83)
				B12	Virtual DI 13 (COM-82)
				B11	Virtual DI 12 (COM-81)
				BI0	Virtual DI 11 (COM-80)
				B9	Virtual DI 10 (COM-79)
				B8	Virtual DI 9 (COM-78)
				B7	Virtual DI 8 (COM-77)
				B6	Virtual DI 7 (COM-76)
				B5	Virtual DI 6 (COM-75)
				B4	Virtual DI 5 (COM-74)
				B3	Virtual DI 4 (COM-73)
				B2	Virtual DI 3 (COM-72)
				B1	Virtual DI 2 (COM-71)
				B0	Virtual DI 1 (COM-70)
0h0323	Selected motor display	-	-	0: No.1 motor / 1: No.2 motor	
0h0324	AI1	0.01	%	Analog input1 (Basic I/O)	
0h0325	AI2	0.01	%	Analog input2 (Basic I/O)	
0h0326	AI3	0.01	%	Analog input3 (Extended I/O)	
0h0327	AI4	0.01	%	Analog input4 (Extended I/O)	
0h0328	AO1	0.01	%	Analog output1 (Basic I/O)	
0h0329	AO2	0.01	%	Analog output2 (Basic I/O)	
0h032A	AO3	0.01	%	Analog output3 (Extended I/O)	
0h032B	AO4	0.01	%	Analog output4 (Extended I/O)	
0h032C	Reserved	-	-	-	
0h032D	Reserved	-	-	-	
0h032E	Reserved	-	-	-	
0h032F	Reserved	-	-	-	
0h0330	Latch type trip information-1	-	-	BI5	Fuse Open Trip
				BI4	Overheat Trip
				BI3	Arm Short
				BI2	External Trip
				BI1	Overvoltage Trip

Address	Parameter	Scale	unit	Allotment for Bits	
				BI0	Overcurrent Trip
				B9	NTC Trip
				B8	Overspeed Deviation
				B7	Overspeed
				B6	Input open-phase trip
				B5	Output open-phase trip
				B4	Ground Fault Trip
				B3	E-Thermal Trip
				B2	Inverter Overload Trip
				B1	Underload Trip
				B0	Overload Trip
0h0331	Latch type trip information-2	-	-	BI5	Reserved
				BI4	Reserved
				BI3	Inverter output cutoff by terminal block input on Safety Option (applied to above 90kW)
				BI2	Slot3 option board contact defectiveness
				BI1	Slot2 option board contact defectiveness
				BI0	Slot1 option board contact defectiveness
				B9	No MotorTrip
				B8	External Brake Trip
				B7	Basic IO board contact defectiveness
				B6	Pre PID Fail
				B5	Error on Parameter Write
				B4	Reserved
				B3	FAN Trip
				B2	PTC (Thermal sensor) Trip
				B1	Encoder Error Trip
				B0	MC Fail Trip
0h0332	Level type trip information	-	-	B15	Reserved
				B14	Reserved
				B13	Reserved
				B12	Reserved

Address	Parameter	Scale	unit	Allotment for Bits	
				B11	Reserved
				B10	Reserved
				B9	Reserved
				B8	Reserved
				B7	Reserved
				B6	Reserved
				B5	Reserved
				B4	Reserved
				B3	Keypad Lost Command
				B2	Lost Command
				B1	LV
				B0	BX
0h0333	H/W Diagnosis Trip information	-	-	B15	Reserved
				B14	Reserved
				B13	Reserved
				B12	Reserved
				B11	Reserved
				B10	Reserved
				B9	Reserved
				B8	Reserved
				B7	Reserved
				B6	Reserved
				B5	Reserved
				B4	Gate Drive Power Loss
				B3	Watchdog-2 error
				B2	Watchdog-1 error
				B1	EEPROM error
				B0	ADC error
0h0334	Warning information	-	-	B15	Reserved
				B14	Reserved
				B13	Reserved
				B12	Reserved
				B11	Reserved

Address	Parameter	Scale	unit	Allotment for Bits	
				B10	Reserved
				B9	Auto Tuning fail
				B8	Keypad Lost
				B7	Encoder miss-wiring
				B6	Encoder miss-installation
				B5	DB
				B4	FAN operation
				B3	Lost command
				B2	Inverter Overload
				B1	Underload
				B0	Overload
0h0335 ~ 0h033F	Reserved	-	-	-	
0h0340	On Time date	0	Day	Total number date of inverter power On	
0h0341	On Time minute	0	Min	Total minute except for total date of inverter On Time	
0h0342	Run Time date	0	Day	Total number day of inverter run	
0h0343	Run Time minute	0	Min	Total minute except for total day of Run Time	
0h0344	Fan Time date	0	Day	Total day of cooling fan run	
0h0345	Fan Time minute	0	Min	Total minute except for total day of Fan time	
0h0346	Reserved	-	-	-	
0h0347	Reserved	-	-	-	
0h0348	Reserved	-	-	-	
0h0349	Reserved	-	-	-	
0h034A	Option 1	-	-	0: None 2: Reserved 4: Reserved 6: Reserved 8: Reserved 10: PLC 23: Encoder	1: Reserved 3: Profibus, 5: Reserved 7: RNet, 9: Reserved 20: External IO-1
0h034B	Option 2	-	-		
0h034C	Option 3				

6.2 Inverter Control Area Parameter (Reading and Writing Available)

Address	Parameter	Scale	unit	Allotment for Bits	
0h0380 note1)	Frequency command	0.01	Hz	command frequency setting	
0h0381	RPM command	1	rpm	command RPM setting	
0h0382	Operating command	-	-	B7	Reserved
				B6	Reserved
				B5	Reserved
				B4	Reserved
				B3	0➔1: free run stop
				B2	0➔1: trip reset
				B1	0: reverse command 1: forward command
				B0	0: stop command 1: run command
				E.g.) forward operating command: 0003h, reverse operating command: 0001h	
0h0383	Accelerating time	0.1	sec	accelerating time setting	
0h0384	Decelerating timed	0.1	sec	decelerating time setting	
0h0385	Virtual digital input control (0: Off, 1: On)	-	-	BI5	Virtual DI 16 (COM-85)
				BI4	Virtual DI 15 (COM-84)
				BI3	Virtual DI 14 (COM-83)
				BI2	Virtual DI 13 (COM-82)
				BI1	Virtual DI 12 (COM-81)
				BI0	Virtual DI 11 (COM-80)
				B9	Virtual DI 10 (COM-79)
				B8	Virtual DI 9 (COM-78)
				B7	Virtual DI 8 (COM-77)
				B6	Virtual DI 7 (COM-76)
				B5	Virtual DI 6 (COM-75)
				B4	Virtual DI 5 (COM-74)
				B3	Virtual DI 4 (COM-73)
				B2	Virtual DI 3 (COM-72)

Address	Parameter	Scale	unit	Allotment for Bits	
				B1	Virtual DI 2 (COM-71)
				B0	Virtual DI 1 (COM-70)
0h0386	Digital output control (0: Off, 1: On)	-	-	BI5	Reserved
				BI4	Reserved
				BI3	Reserved
				BI2	Reserved
				BI1	Reserved
				BI0	Reserved
				B9	Reserved
				B8	Reserved
				B7	Reserved
				B6	Reserved
				B5	Q4 (extended I/O, OUT-36: None)
				B4	Q3 (extended I/O, OUT-35: None)
				B3	Q2 (extended I/O, OUT-34: None)
				B2	Q1 (basic I/O, OUT-33: None)
				B1	Relay2 (basic I/O, OUT-32: None)
				B0	Relay1 (basic I/O, OUT-31: None)
0h0387	Reserved	-	-	Reserved	
0h0388	PID reference	0.1	%	PID reference command released	
0h0389	PID feedback value	0.1	%	PID feedback value	
0h038A ~ 0h038F	Reserved	-	-	-	
0h0390	Torque Ref	0.1	%	torque command	
0h0391	Fwd Pos Torque Limit	0.1	%	forward motor ring torque limit	
0h0392	Fwd Neg Torque Limit	0.1	%	forward regenerative torque limit	
0h0393	Rev Pos Torque Limit	0.1	%	reverse motorring torque limit	
0h0394	Rev Neg Torque Limit	0.1	%	reverse regenerative torque limit	
0h0395	Torque Bias	0.1	%	torque Bias	
0h0395	Reserved	-	-	-	

Address	Parameter	Scale	unit	Allotment for Bits
~ 0h399				
0h039A	Anytime Para	-	-	CNF-20 value setting (see page 13-40)
0h039B	Monitor Line-1	-	-	CNF-21 value setting (see page 13-40)
0h039C	Monitor Line-2	-	-	CNF-22 value setting (see page 13-40)
0h039D	Monitor Line-3	-	-	CNF-23 value setting (see page 13-40)

6.3 Monitoring common area for dedicated product of iS7

Address	Parameter	Scale	Unit	Allotment for Bits
0h0D00	Extended I/O-2 V1 input	0.01	%	Extended I/O-2 voltage (V1) input
0h0D01	Extended I/O-2 V2 input	0.01	%	Extended I/O-2 voltage (V2) input
0h0D02	Extended I/O-2 V3 input	0.01	%	Extended I/O-2 voltage (V3) input
0h0D03	Extended I/O-2 V4 input	0.01	%	Extended I/O-2 voltage (V4) input
0h0D04	reserved	-	-	-
0h0D05	Extended I/O-2 I1 input	0.01	%	Extended I/O-2 current (I1) input
0h0D06	Extended I/O-2 I2 input	0.01	%	Extended I/O-2 current (I2) input
0h0D07	Extended I/O-2 I3 input	0.01	%	Extended I/O-2 current (I3) input
0h0D08	Extended I/O-2 I4 input	0.01	%	Extended I/O-2 current (I4) input
0h0D09	reserved	-	-	-
0h0D0A	Extended I/O-2 AO1	0.01	%	Extended I/O-2 analog output 1(AO1)
0h0D0B	Extended I/O-2 AO2	0.01	%	Extended I/O-2 analog output 2(AO2)
0h0D0C	Extended I/O-2 AO3	0.01	%	Extended I/O-2 analog output 3(AO3)
0h0D0D	Extended I/O-2 AO4	0.01	%	Extended I/O-2 analog output 4(AO4)
0h0D0E	External PID controller output	0.01	%	External PID controller (APP-01 App Mode: Ext PID Ctrl) output[%]
0h0D0F	External PID controller output	0.01	Hz	External PID controller (APP-01 App Mode: Ext PID Ctrl) output [Hz]
0h0D10	External PID controller output	0	RPM	External PID controller (APP-01 App Mode: Ext PID Ctrl) output [RPM]
0h0D11 ~ 0h0D7F	reserved	-	-	-

6.4 Common Control Area for Dedicated Product of iS7

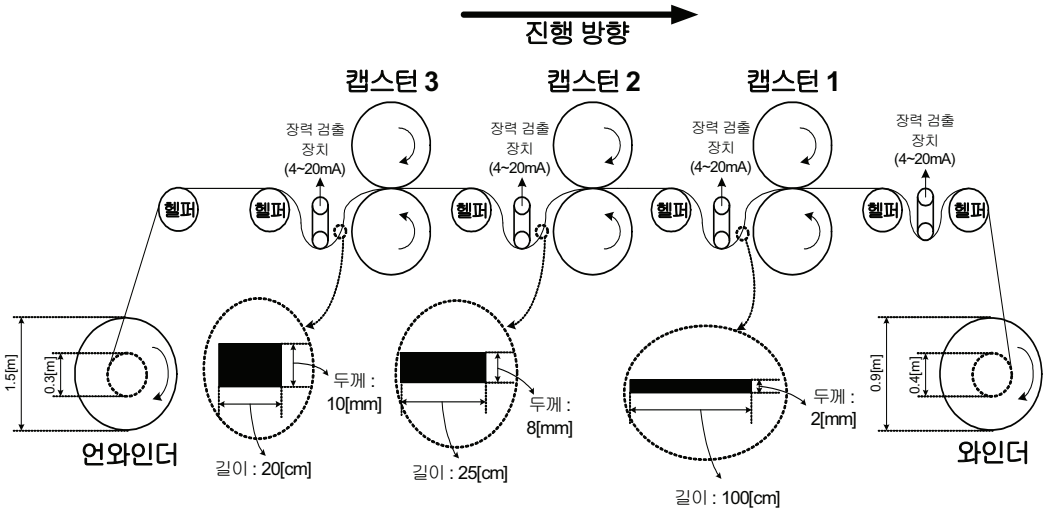
Address	Parameter	Scale	Unit	Allotment for Bits
0h0D80	Web Main Spd	0.1	%	Main speed command (refer to page 1-4)
0h0D81	reserved	-	-	-
0h0D82	reserved	-	-	-
0h0D83	reserved	-	-	-
0h0D84	reserved	-	-	-
0h0D85	Main speed input of external PID controller	0.01	%	Main speed input of external PID controller (APP-01 App Mode: Ext PID Ctrl) [%]
0h0D86	Main speed input of external PID controller	0.01	Hz	Main speed input of external PID controller (APP-01 App Mode: Ext PID Ctrl) [Hz]
0h0D87	Main speed input of external PID controller	0	RPM	Main speed input of external PUD controller (APP-01 App Mode : Ext PID Ctrl) [RPM]
0h0D88 ~ 0h0DFF	reserved	-	-	-

7. Setting parameter for web through examples

7.1 Overview

This appendix assumes virtual tension control system. The method to set up parameter of each inverter and trial run method will be explained by using basic machine information of winder, unwinder and capstan which are the composition factors of the virtual tension control system.

First of all, the virtual tension control system is assumed as the Figure 7-1.



7-1 Virtual tension control system

Table 7-1 shows machine information of each inverter. This is general data provided by the machine manufacturer.

7-1 Virtual tension control system

	Unwinder	Capstan3	Capstan2	Capstan1	Winder
Number of poles	4	4	4	4	4
minimum diameter[m]	0.3	0.6	0.6	0.6	0.4
Belt ratio (Gear ratio)	1:6.5	1:13.4	1:9.7	1:7.3	1:4.1
maximum wire speed[mpm]	250 (Note1)	250 (Note1)	340 (Note2)	450 (Note3)	600 (Note4)

(Note1) : maximum wire speed measured between Unwinder and capstan3
(Note2) : maximum wire speed measured between capstan3 and capstan2
(Note3) : maximum wire speed measured between capstan2 and capstan1
(Note4) : maximum wire speed measured between capstan1 and winder

8. How to set up parameter

8.1 How to set up parameter of winder

First of all, enter APP-92(Max Main Spd) by using machine information of winder in the Table A1.1. The meaning of APP-92(Max Main Spd) is that the rotation speed(Hz or RPM) of maximum motor at minimum diameter when it is maximum wire speed. The calculation method is as follows.

$$APP-92\,(Max\ Main\ Spd) = \frac{600[mpm]}{0.4[m]\times\pi} \times 4.1(Beltratio) \times \frac{4(pole)}{120} = 65.29[Hz]$$

In order to set up APP-92(Max Main Spd), release the limit of DRV-20(Max Freq). Considering the frequency added from PID controller, enter about 1.2 times of APP-92(Max Main Spd) to DRV-20(Max Freq).

Now enter the diameter of bobbin. Using the conditions that the minimum diameter of Figure A1.1 is 0.4[m], maximum diameter is 0.9[m], calculate the minimum diameter compared to maximum diameter in [%] unit as follows.

$$Minimum\ \ Diameter\,[\%] = \frac{0.4[m]}{0.9[m]} \times 100[\%] = 44.4[\%]$$

Enter the calculated value 44.4[%] into APP-63(Bobbin 1 Diameter) and APP-67(Min Diameter).

When replacing bobbin, be sure to reset the diameter of bobbin. In order to do so, allocate the function to reset the diameter of bobbin on one out of multi-function input. Select one out of IN-65~72(P# Define), and set as '52 : Web Preset'.

Finally, the operation command method is set up at DRV-06(Cmd Source), and the parameter related to main speed command is set up at APP-03~14, parameter related to PID controller is set up at APP-15~57, and other functions (web break detection, emergency stop, bypass, reverse slow speed) are set up at APP-76~90 according to necessity.

8.2 How to set up parameter of unwinder

First of all, enter APP-92(Max Main Spd) by using machine information of unwinder in the Table A1.1. The meaning of APP-92(Max Main Spd) is rotation speed (Hz or RPM) at minimum diameter when it is maximum wire speed. The calculation method is as follows.

$$APP-92\,(Max\ Main\ Spd) = \frac{250[mpm]}{0.3[m]\times\pi} \times 6.5(Belt\ \ ratio) \times \frac{4(Poles)}{120} = 57.50[Hz]$$

In order to set up APP-92(Max Main Spd), release the limit of DRV-20(Max Freq). Considering the frequency added from PID controller, enter about 1.2 times of APP-92(Max Main Spd) to DRV-20(Max Freq).

Now enter the diameter of bobbin. Using the conditions that the minimum diameter of Figure A1.1 is 0.3[m], maximum diameter is 1.5[m], calculate the minimum diameter compared to maximum diameter in [%] unit as follows.

$$Minimum\ \ Diameter\,[\%] = \frac{0.3[m]}{1.5[m]} \times 100[\%] = 20.0[\%]$$

Enter the calculated value 20.0[%] into APP-67(Min Diameter).

Also, enter 100.0 [%] into APP-63 (Bobbin 1 Diamtr) since maximum diameter should be entered.

Like winder, unwinder needs to reset diameter of bobbin when replacing bobbin. In order to do so, allocate the function to reset the diameter of bobbin on one out of multi-function input. Select one out of IN-65~72(P# Define), and set up as “52 : Web Preset”.

Finally, the operation command method is set up at DRV-06(Cmd Source), and the parameter related to main speed command is set up at APP-03~14, parameter related to PID controller is set up at APP-15~57, and other functions (web break detection, emergency stop, bypass, reverse slow speed) are set up at APP-76~90 according to necessity.

8.3 How to set up parameter of capstan

First of all, enter APP-92(Max Main Spd) by using machine information of Capstan 1,2,3 in the Table A1.1. The meaning of APP-92(Max Main Spd) is rotation speed (Hz or RPM) of maximum motor at the base thickness of materials when it is maximum wire speed. The calculation method is as follows.

$$Capstan\ 1\ \ APP-92\,(Max\ Main\ Spd) = \frac{450[mpm]}{0.6[m]\times\pi} \times 7.3(Belt\ \ ratio) \times \frac{4(Poles)}{120} = 58.12[Hz]$$

$$Capstan\ 2\ \ APP-92\,(Max\ Main\ Spd) = \frac{340[mpm]}{0.6[m]\times\pi} \times 9.7(Belt\ \ ratio) \times \frac{4(Poles)}{120} = 58.35[Hz]$$

$$Capstan\ 3\ \ APP-92\,(Max\ Main\ Spd) = \frac{250[mpm]}{0.6[m]\times\pi} \times 13.4(Belt\ \ ratio) \times \frac{4(Poles)}{120} = 59.27[Hz]$$

In order to set up APP-92(Max Main Spd) of each inveter, release the limit of DRV-20(Max Freq) of each inverter. Considering the frequency added from PID controller, enter about 1.2 times of APP-92(Max Main Spd) of each inverter to DRV-20(Max Freq) of each inverter.

Finally, the operation command method is set up at DRV-06(Cmd Source), and the parameter related to main speed command is set up at APP-03~14, parameter related to PID controller is set up at APP-15~57, and other functions (web break detection, emergency stop, bypass, reverse slow speed) are set up at APP-76~90 according to necessity.

Warranty

Maker	**LS Industrial Systems Co., Ltd.**	**Installation (Start-up) Date**	
Model No.	**SV-iS7**	**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 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	Version No.	Changes
1	2007.11	First Edition	1.00	-
2	2009.02	2nd Edition	1.10	IP54 contents added
3	2010.05	3rd Edition	1.20	200V contents added