RSi "S" Series

Open/UL Type 1

RSi "SW" Series

UL Type 4x (IP66)

Washdown (Indoor)

Variable Frequency Drive

Instruction Manual



890049-07-00 © 2020 Benshaw Inc.

Benshaw retains the right to change specifications and illustrations in text without prior notification. The contents of this not be conject without the explicit nemission of Renshaw

document may



Safety Information

Read and follow all safety instructions in this manual precisely to avoid unsafe operating conditions, property damage, personal injury, or death.

Safety symbols in this manual

A Danger

Indicates an imminently hazardous situation which, if not avoided, will result in severe injury or death.

⚠ Warning

Indicates a potentially hazardous situation which, if not avoided, could result in injury or death.

① Caution

Indicates a potentially hazardous situation that, if not avoided, could result in minor injury or property damage.

Safety information

▲ Danger

- Do not open the cover of the equipment while it is on or operating. Likewise, do not operate the VFD
 while the cover is open. Exposure of high voltage terminals or charging area to the external
 environment may result in an electric shock. Do not remove any covers or touch the internal
 circuit boards (PCBs) or electrical contacts on the product when the power is on or during
 operation. Doing so may result in serious injury, death, or serious property damage.
- Do not open the cover of the equipment even when the power supply to the VFD has been turned off unless it is necessary for maintenance or regular inspection. Opening the cover may result in an electric shock even when the power supply is off.
- The equipment may hold charge long after the power supply has been turned off. Use a multi-meter
 to make sure that there is no voltage before working on the VFD, motor or motor cable.

i

Safety Information

↑ Warning

- This equipment must be grounded for safe and proper operation.
- Do not supply power to a faulty VFD. If you find that the VFD is faulty, disconnect the power supply and have the VFD professionally repaired.
- The VFD becomes hot during operation. Avoid touching the VFD until it has cooled to avoid burns.
- Do not allow foreign objects, such as screws, metal chips, debris, water, or oil to get inside the VFD. Allowing foreign objects inside the VFD may cause the VFD to malfunction or result in a fire.
- Do not operate the VFD with wet hands. Doing so may result in electric shock.
- Check the information about the protection level for the circuits and devices.

The following connection terminals and devices are the Electrical Protection level 0. It means that the circuit protection level depends on the basic insulation. If there is no basic insulation is falled, it may cause electric shock accident. When installing or wiring the connection terminals and devices, take the same protective action as with the power wire.

- Multi-function Input: P1-P5, CM
- Analog Frequency Input: VR, V1, I2, TI
- Safety Function: SA. SB. SC
- Analog Output: AO, TO
- -Contact: Q1 FG 24 A1 B1 C1 S+ S- SG
- Fan
- . The protection level of this equipment (VFD) is the Electrical Protection level I.

① Caution

- · Do not modify the interior workings of the VFD. Doing so will void the warranty.
- The VFD is designed for 3-phase motor operation. Do not use the VFD to operate a single phase motor.
- Do not place heavy objects on top of electric cables. Doing so may damage the cable and result in an electric shock.
- For SW Series VFDs, do not operate Disconnect Switch when motor is operating.

Note

Maximum allowed prospective short-circuit current at the input power connection is defined in IEC 60439-1 as 100 kA. The S and SW Series VFDs are suitable for use in circuits capable of delivering a maximum of 100 kA RMS symmetrical amperes at the drive's maximum rated voltage, when protected by the following:

S Series: 100A kAIC Rated Breaker or Fuses

SW Series:

Working Voltage	UTE100(E/N)	UTS150(N/H/L)
240V(50/60Hz)	50/65 kA	65/100/150 kA
480V(50/60Hz)	25/35 kA	35/65/100 kA

Quick Reference Table

The following table contains situations frequently encountered by users while working with VFDs. Refer to the typical and practical situations in the table to quickly and easily locate answers to your questions. Situation	Reference
I want to run the Quick Start menu.	p. 185
I want to run a slightly higher rated motor than the VFD's rated capacity.	p. 209
I want to configure the VFD to start operating as soon as the power source is applied.	p. 83
I want to configure the motor's parameters.	p.144
I want to set up sensorless vector control.	p.147
Something seems to be wrong with the VFD or the motor.	p.226, p.333
What is auto tuning?	p.144
What are the recommended wiring lengths?	p.33_
The motor is too noisy.	p. 175
I want to apply PID control on my system.	p. 137
What are the factory default settingss for P1–P5 multi-function terminals?	p. 35
I want to view all of the parameters I have modified.	p. 183
I want to review recent fault trip and warning histories.	p. 333
I want to change the VFD's operation frequency using a potentiometer.	<u>p. 57</u>
I want to install a frequency meter using an analog terminal.	<u>p. 37</u>
I want to display the supply current to motor.	p. 60
I want to operate the VFD using a multi-step speed configuration.	p. 77
The motor runs too hot.	<u>р. 208,</u> р. 340
The VFD is too hot.	p. 216, p.333
The cooling fan does not work.	p. 342
I want to change the items that are monitored on the LCD keypad.	p. 204

•	Prep	aring tr	ie instaliation	
	1,1	VFD Id	dentification	
	1.2	Comp	onent Identification	
	1.3	Install	ation Considerations	
	1.4	Select	ing and Preparing a Site for Installation	
	1.5	Cable	Selection	1
2	Insta	lling th	e VFD	1
	2,1	Moun	ting the VFD	1
	2.2	Cable	Wiring	2
	2.3	Post-I	nstallation Checklist	4
	2.4	Test R	un	4
3	Lear	ning to	Perform Basic Operations	4
	3.1	About	the 7-Segment Display	4
		3.1.1	About the Display	4
		3.1.2	Operation Keys	4
		3.1.3	Control Menu	4
	3.2	Learni	ng to Use the 7-Segment Display	4
		3.2.1	Group and Parameter (Code) Selection	4
		3.2.2	Navigating Directly to Different Codes	4
		3.2.3	Setting Parameter Values	5
		3.2.4	Configuring the [ESC] Key	
	3.3	Actual	Application Examples	5
		3.3.1	Acceleration Time Configuration	
		3.3.2	Frequency Reference Configuration	
		3.3.3	Jog Frequency Configuration	
		3.3.4	Initializing All Parameters	5
		3.3.5	Frequency Setting (Keypad) and Operation (via Terminal Input)	5
		3.3.6	Frequency Setting (Potentiometer) and Operation (Terminal Input)	5
		3.3.7	Frequency Setting (Potentiometer) and Operation (7-Segment Display)	5

	3.4	Monit	oring the Operation	60
		3.4.1	Output Current Monitoring	60
		3.4.2	Fault Monitoring	61
4	Learn	ing Ba	sic Features	63
	4.1	Setting	g Frequency Reference	66
		4.1.1	Keypad as the Source (KeyPad-1 setting)	66
		4.1.2	Keypad as the Source (KeyPad-2 setting)	66
		4.1.3	V1 Terminal as the Source	67
		4.1.4	12 Terminal as the Source (current input)	72
		4.1.5	12 Terminal as the Source (voltage input)	73
		4.1.6	Setting a Frequency with TI Pulse Input	74
		4.1.7	Setting a Frequency Reference via RS-485 Communication	75
	4.2	Freque	ency Hold by Analog Input	76
	4.3	Chang	jing the Displayed Units (Hz↔Rpm)	77
	4.4	Setting	g Multi-step Frequency	77
	4.5	Comm	nand Source Configuration	79
		4.5.1	The Keypad as a Command Input Device	79
		4.5.2	Terminal Block as a Command Input Device (Fwd/Rev Run Commands)	79
		4.5.3	Terminal Block as a Command Input Device (Run and Rotation Direction Commands)	80
		4.5.4	RS-485 Communication as a Command Input Device	81
	4.6	Local/	Remote Mode Switching	81
	4.7	Forwa	rd or Reverse Run Prevention	83
	4.8	Power	on Run	83
	4.9	Reset	and Restart	84
	4.10	Setting	g Acceleration and Deceleration Times	85
		4.10.1	Acc/Dec Time Based on Maximum Frequency	85
		4.10.2	Acc/Dec Time Based on Operation Frequency	87
		4.10.3	Multi-step Acc/Dec Time Configuration	87
		4.10.4	Configuring Acc/Dec Time Switch Frequency	89
	4.11	Acc/D	ec Pattern Configuration	90
	4.12	Stoppi	ing the Acc/Dec Operation	92
	4.13	V/F (V	oltage/Frequency) Control	92

	4.13.1	Linear V/F Pattern Operation	92
	4.13.2	Square Reduction V/F pattern Operation	93
	4.13.3	User V/F Pattern Operation	94
4.14	Torque	Boost	95
	4.14.1	Manual Torque Boost	95
	4.14.2	Auto Torque Boost-1	96
	4.14.3	Auto Torque Boost-2	96
4.15	Outpu	t Voltage Setting	97
4.16	Start N	Node Setting	97
	4.16.1	Acceleration Start	97
	4.16.2	Start After DC Braking	98
4.17	Stop N	Node Setting	98
	4.17.1	Deceleration Stop	98
	4.17.2	Stop After DC Braking	99
	4.17.3	Free Run Stop	100
	4.17.4	Power Braking	101
4.18	Freque	ency Limit	101
	4.18.1	Frequency Limit Using Upper and Lower Limit Frequency Values	102
	4.18.2	Frequency Jump	102
4.19	Auxilia	ry (2 nd) Operation Mode Setting	104
4.20	Multi-	function Input Terminal Control	105
4,21	P2P Se	etting	106
4.22	Multi-	keypad Setting	107
4.23	User S	equence Setting	109
4.24	Fire M	ode Operation	116
4.25	Pre He	at Function	117
4.26	Overm	nodulation	118
Learn	ing Ad	vanced Features	119
5.1	Opera	ting with Auxiliary References	121
5.2	Jog op	peration	126
	5.2.1	Jog Operation 1-Forward Jog by Multi-function Terminal	126
	5.2.2	Jog Operation 2-Fwd/Rev Jog by Multi-function Terminal	127
	5.2.3	Jog Operation by 7-Segment display	128

5

5.3	Up-Down Operation	128	
5.4	3-Wire Operation13		
5.5	Safe Operation Mode	133	
5.6	Dwell Operation	134	
5.7	Slip Compensation Operation	136	
5.8	PID Control	137	
	5.8.1 PID Basic Operation	137	
	5.8.2 Pre-PID Operation	141	
	5.8.3 PID Operation Sleep Mode	142	
	5.8.4 PID Switching (PID Openloop)	143	
5.9	Auto Tuning	144	
5.10	Sensorless Vector Control	147	
	5.10.1 Sensorless Vector Control Operation Setting	149	
	5.10.2 Sensorless Vector Control Operation Guide	152	
5.11	Sensorless Vector Control for PM (Permanent-Magnet) Synchroni Motors		
	5.11.1 Detecting the Initial Pole Position	156	
	5.11.2 Sensorless Vector Control Mode Settings for PM Synchronous Motors	156	
	5.11.3 Guidelines for Running a PM Synchronous Motor in Sensorless Vector Control Mode	160	
5.12	Kinetic Energy Buffering Operation	163	
5.13	Torque Control	166	
5.14	Energy Saving Operation	169	
	5.14.1 Manual Energy Saving Operation	169	
	5.14.2 Automatic Energy Saving Operation	169	
5.15	Speed Search Operation	170	
5.16	Auto Restart Settings	173	
5.17	Operational Noise Settings (carrier frequency settings)	175	
5.18	2nd Motor Operation	176	
5.19	Supply Power Transition	177	
5.20	Cooling Fan Control	178	
5.21	Input Power Frequency and Voltage Settings	179	
5.22	Read, Write, and Save Parameters	179	

	5.23	Param	eter Initialization	180
	5.24	Param	eter View Lock	181
	5.25	Param	eter Lock	182
	5.26	Chang	ged Parameter Display	183
	5.27	User G	Group	183
	5.28	Run Q	uick Start	185
	5.29	Config	g(CNF) Mode	187
	5.30	Timer	Settings	188
	5.31	Brake	Control	189
	5.32	Multi-	Function Output On/Off Control	190
	5.33	Press I	Regeneration Prevention	191
	5.34	Analo	g Output	192
		5.34.1	Voltage and Current Analog Output	192
		5.34.2	? Analog Pulse Output	195
	5.35	_	l Output	
			Multi-function Output Terminal (Relay1 and Q1) Settings	198
		5.35.2	Pault Output using Multi-Function Output	
		F 2F 2	Terminal and Relay	
	F 20		Multi-function Output Terminal Delay Time Settings	
			d Language Settings	
			tion State Monitor	
			tion Time Monitor	
5		_	otection Features	
	6.1		Protection	
		6.1.1	Electronic Thermal Motor Overheating Prevention (ETH)	
		6.1.2	Overload Early Warning and Trip	
		6.1.3	Stall Prevention and Flux Braking	
	6.2		er and Sequence Protection	
		6.2.1	Open-phase Protection	
		6.2.2	External Trip Signal	
		6.2.3	Inverter Overload Protection	
		6.2.4	Speed Reference Loss	
	6.3	6.2.5	Dynamic Braking (DB) Resistor Configuration Load Fault Trip and Warning	
	0.3	onder	LOAU FAUIL HIP AND WATHING	22

		6.3.1	Fan Fault Detection	222
		6.3.2	Low Voltage Trip	222
		6.3.3	Output Block by Multi-Function Terminal	223
		6.3.4	Trip Status Reset	223
		6.3.5	Operation Mode on Option Card Trip	223
		6.3.6	No Motor Trip	224
		6.3.7	Low voltage trip 2	225
	6.4	Fault/\	Varning List	226
7	RS-4	85 Com	munication Features	.227
	7.1	Comm	nunication Standards	227
	7.2	Comm	nunication System Configuration	227
		7.2.1	Communication Line Connection	228
		7.2.2	Setting Communication Parameters	228
		7.2.3	Setting Operation Command and Frequency	230
		7.2.4	Command Loss Protective Operation	230
		7.2.5	Setting Virtual Multi-Function Input	231
		7.2.6	Saving Parameters Defined by Communication	231
		7.2.7	Total Memory Map for Communication	232
		7.2.8	Parameter Group for Data Transmission	232
	7.3	Comm	nunication Protocol	233
		7.3.1	LS INV 485 Protocol	233
		7.3.2	Modbus-RTU Protocol	238
	7.4	Comp	atible Common Area Parameter	241
	7.5	Expans	sion Common Area Parameter	244
		7.5.1	Monitoring Area Parameter (Read Only)	
		7.5.2	Control Area Parameter (Read/ Write)	
		7.5.3	Inverter Memory Control Area Parameter (Read and Write).	
3	Table	of Fun	ctions	.253
	8.1	Opera	tions Group	253
	8.2	Drive o	group (PAR→dr, DRV)	255
	8.3	Basic F	unction group (PAR→bA, BAS)	261
	8.4	Expan	ded Function group (PAR→Ad, ADV)	267
	0.5	Contro	I Function group (DAR + Cn. CON)	272

	8.6	Input Terminal Block Function group (PAR→In, IN)	279
	8.7	Output Terminal Block Function group (PAR→OU, OUT)	285
	8.8	Communication Function group (PAR→CM, COM)	291
	8.9	Application Function group (PAR→AP, APP)	297
	8.10	Protection Function group (PAR→Pr, PRT)	301
	8.11	2nd Motor Function group (PAR→M2, M2)	306
	8.12	User Sequence group (US, USS)	308
	8.13	User Sequence Function group(UF)	311
	8.14	Groups for LCD Keypad Only	329
		8.14.1 Trip Mode (TRP Last-x)	329
		8.14.2 Config Mode (CNF)	329
9	Troub	oleshooting	333
	9.1	Trips and Warnings	333
		9.1.1 Faults	333
		9.1.2 Warning Messages	336
	9.2	Troubleshooting Faults	337
	9.3	Troubleshooting Other Faults	339
10	Main	tenance	343
	10.1	Periodic Inspection Summary	343
	10.2	Periodic Inspection Items	344
	10.3	Storage	347
	10.4	Disposal	347
11	Techr	nical Specification	348
	11,1	Input and Output Specification	348
	11.2	Product Specification Details	356
	11.3	External Dimensions	359
	11,4	Terminal Screw Specification	367
	11.5	Braking Resistor Specification	368
	11.6	Continuous Rated Current Derating	370
	11.7	Heat Emmission	372
12	Apply	ying S Series VFDs to Single-Phase Input Application	374
	12.1	ntroduction	374

12.2	Power(HP), Input Current, and Output Current3	75
12.3	Input Frequency and Voltage Tolerance3	75

1 Preparing the Installation

This chapter provides details on product identification, part names, correct installation, and cable specifications. To install the VFD correctly and safely, carefully read and follow the instructions.

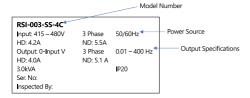
1.1 VFD Identification

The S and SW Series VFDs are manufactured in a range of models based on drive capacity and power source specifications. Product name and specifications are detailed on the nameplate. Reference the illustrations on the next pages for the location of the nameplate. Check the nameplate before installing the product and make sure that the product meets your requirements. For more detailed product specifications, refer to 11.1_
Input and Output Specification on page 348.

Note

Check the product name, open the packaging, and then confirm that the product is free from defects. Contact your supplier if you have any issues or questions about your product.

S Series



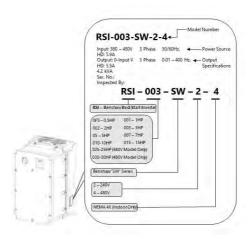
```
RSI – 003 – SS - 4C

RSI – Benshaw Redi Start Inverter
003 – HP
001 – 1HP
002 – 2HP
003 – 3HP
005 – 5HP
007 – 7.5HP
010 – 10HP

SS – Benshaw "S" Series
4 – Voltage Class: 2 – 240V
4 – 480V

C – Open Chassis
(NEMA/UL Open Type, IP-00)
```

SW Series

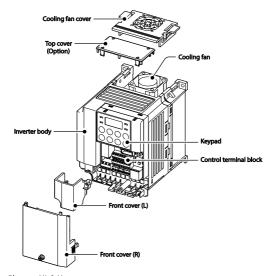


1.2 Component Identification

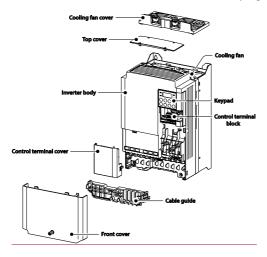
The illustration below displays part names. Details may vary between product groups.

S Series

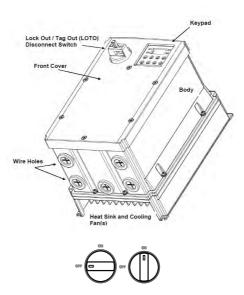
<u>Three Phase 230V/460V</u> 1HP ~ 7.5HP (0.75~5.5kW)



<u>Three Phase 230V/460V</u> <u>10HP ~ 15HP (7.5~11kW)</u>



SW Series



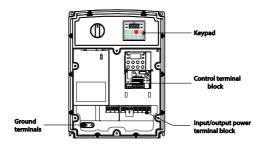
Do not operate Disconnect Switch when motor is running.

The location of the cooling fan varies according to product capacity.

0.5HP - 5.0HP: Inside 7.5HP - 10.0HP: Bottom

15.0HP - 30.0HP: Inside and Top

Front cover removed

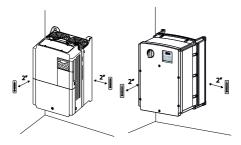


1.3 Installation Considerations

VFDs are composed of various precision electronic devices, and therefore the installation environment can significantly impact the lifespan and reliability of the product. The table below details the ideal operation and installation conditions for the VFD.

Items	Description
	S Series: Normal Duty: 14–104°F (-10–40°C)
Ambient Temperature*	S Series: Heavy Duty: 14–122°F (-10–50°C)
	SW Series: Heavy Duty: 14–104°F (-10–40°C)
Ambient Humidity	90% relative humidity (no condensation)
Storage Temperature	- 4–149°F (-20–65°C)
Environmental Factors	An environment free from corrosive or flammable gases, oil residue or
Environmental ractors	dust
	Maximum of 3,280 ft (1,000 m) above sea level/less than 1G
	(9.8m/sec2) for standard operation. From 3,280 ft (1,000 m) to
Altitude/Vibration	13,123 ft, (4,000 m) the rated input voltage and rated output current
	of the drive must be derated by 1% for every 328ft (100m) / less than
	1G (9.8m/sec²).
Air Pressure	10-15 PSI (70 –106kPa)

^{*} The ambient temperature is the temperature measured at a point 2" (5 cm) from the surface.



① Caution

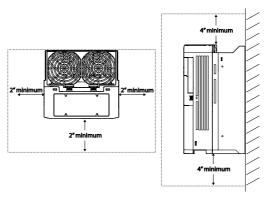
Do not allow the ambient temperature to exceed the allowable range while operating the VFD.

1.4 Selecting and Preparing a Site for Installation

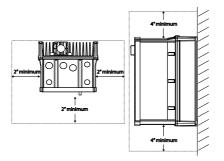
When selecting an installation location consider the following points:

- The location must be free from vibration, and the VFD must be installed on a wall that can support the VFD's weight.
- The VFD can become very hot during operation. Install the VFD on a surface that is fire-resistant or flame-retardant and with sufficient clearance around the VFD to allow air to circulate. The illustrations below detail the required installation clearances.

S Series

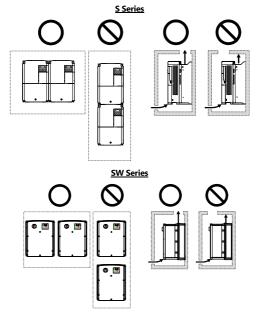


SW Series

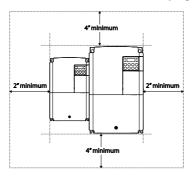


 Ensure sufficient air circulation is provided around the VFD when it is installed. If the VFD is to be installed inside a panel, enclosure, or cabinet rack, carefully consider the position of the VFD's cooling fan and the ventilation louver. The cooling fan must be positioned to efficiently transfer the heat generated by the

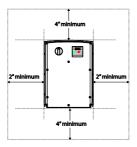
operation of the VFD.



SSeries: If you are installing multiple VFDs in one location, arrange them side-by-side.
 If you are installing multiple VFDs, of different ratings, provide sufficient clearance to meet the clearance specifications of the larger VFD.



 SW Series: If you are installing multiple VFD's of different ratings, provide sufficient clearance to meet the clearance specifications of the largest VFD.



1.5 Cable Selection

When installing power and signal cables in the terminal blocks, only use cables that meet the required specification for safe and reliable operation of the product. Refer to the following information to assist you with cable selection.

① Caution

- Wherever possible use cables with the largest cross-sectional area for main power wiring, to ensure that voltage drop does not exceed 2%.
- Use copper cables rated for 600V, 75°C for power terminal wiring.
- Use copper cables rated for 300V, 75°C for control terminal wiring.

Signal (Control) Cable Specifications

	Signal Cable					
Terminals	Without Crimp Termin (Bare Wire)	al Connectors	With Crimp Terminal Connectors (Bootlace Ferrule)			
	mm²	AWG	mm²	AWG		
P1-P5/CM/VR/V1/I2/ AO/Q1/EG/P24/TI/TO/SA ,SB,SC/S+,S-,SG	0.75	18	0.5	20		
A1/B1/C1	1.0	17	1.5	15		

S Series

Load		Ground		Power I/O				
				mm²		AWG		
	ND	ND	mm²	AWG	R/S/T	U/V/W	R/S/T	U/V/W
	HP	kW			19 57 1	0,1,11	14371	0,1,11
3–Phase 200V	1	0.75	4	12	2	2	14	14
	2	1.5						
	3	2.2						
	5	3.7						
	7.5	5.5						
	10	7.5	5.5	10	6	6	10	10
	15	11						
3–Phase 400V	1	0.75	4	12	2	2	14	14
	2	1.5						
	3	2.2						
	5	3.7						
	7.5	5.5						
	10	7.5	4	12	2.5	2.5	14	14
	15	11			4	4	12	12

SW Series

Ground Cable and Power Cable Specifications

Rating		Gro	Ground		Power	Power I/O		
				mm²		AWG		
Source	HD	HD	mm²	AWG	R/S/T	U/V/W	R/S/T	U/V/W
	HP	kW						
Single Phase	0.5	0.4	4	12				
	1	0.75			2	2	14	14
240V	2	1.5						
2.01	3	2.2			3.5	3.5	12	12
	0.5	0.4		12	2	2	14	14
	1	0.75						
	2	1.5	4					
	3	2.2						
3-Phase	5	3.7			3.5	3.5	12	12
240V	7.5	5.5	6	10	6	6	10	10
	10	7.5						
	15	11	16	6	10	10	8	8
	20	15			16	16	6	6
	0.5	0.4	4	12	2	2	14	14
	1	0.75						
3-Phase 480V	2	1.5						
	3	2.2						
	5	3.7						
	7.5	5.5	4	12	2.5	2.5	14	14
	10	7.5	10	8	4	4	12	12
	15	11						40
	20	15			6	6	10	10
	25	18.5	16	6	10	10	8	8
	30	22						

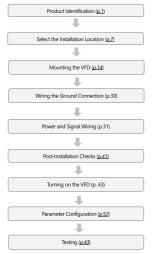
Installing the VFD 890049-07-00

2 Installing the VFD

This chapter describes the physical and electrical installation methods, including mounting and wiring of the product. Refer to the flowchart and basic configuration diagram provided below to understand the procedures and installation methods to be followed to install the product correctly.

Installation Flowchart

The flowchart lists the sequence to be followed during installation. The steps cover equipment installation and testing of the product.

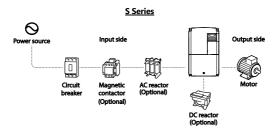


890049-07-00 Installing the VFD

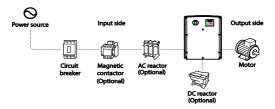
Basic Configuration Diagram

The reference diagram below shows a typical system configuration with the VFD and peripheral devices.

Prior to installing the VFD, ensure that the product is suitable for the application (power rating, capacity, etc). Ensure that all of the required peripherals and optional devices (contactors, reactors, noise filters, etc.) are available.



SW Series



① Caution

- Figures in this manual are shown with covers or circuit breakers removed to show a more detailed view of the installation arrangements. Install covers and circuit breakers before operating the VFD. Operate the product according to the instructions in this manual.
- Do not start or stop the VFD using a magnetic contactor installed on the input power supply.
- . If the VFDis damaged and control is lost, the load may create a dangerous situation. Install

Installing the VFD 890049-07-00

an additional safety device such as an emergency brake to prevent these situations.

- High levels of current draw during power-on can affect the system. Ensure that
 correctly rated circuit breakers are installed to operate safely during power-on
 cituations.
- Reactors can be installed to improve the power factor. Installation of a line reactor is recommended for added VFD protection. A line reactor must be installed if the source capacity exceeds 10 times the kVA rating of the VFD.

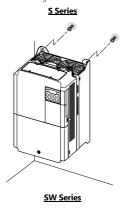
890049-07-00 Installing the VFD

2.1 Mounting the VFD

Mount the VFD on a wall or inside a panel following the procedures provided below. Before installation, ensure that there is sufficient space to meet the clearance specifications, and that there are no obstacles impeding the cooling fars air flow.

Select a wall or panel suitable to support the installation. Refer to <u>11.3 External Dimensions</u> and check the VFD's mounting bracket dimensions.

- 1 Use a level to draw a horizontal line on the mounting surface, and then carefully mark the mounting points.
- 2 Drill the two upper mounting bolt holes, and then install the mounting bolts. Do not fully tighten the bolts at this time. Fully tighten the mounting bolts after the VFD has been mounted.



S and SW Series VFD 17

Installing the VFD 890049-07-00



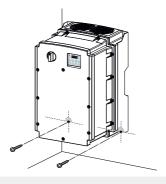
3 Mount the VFD on the wall or inside a panel using the two upper bolts, and then fully tighten the mounting bolts. Ensure that the VFD is placed flat on the mounting surface, and that the installation surface can securely support the weight of the VFD.

S Series

890049-07-00 Installing the VFD



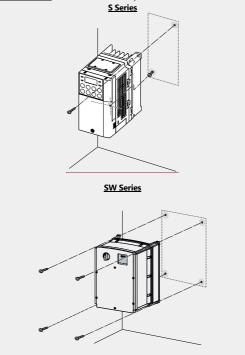
SW Series



Note

Installing the VFD 890049-07-00

The quantity and dimensions of the mounting brackets vary based on frame size. Refer to <u>11.3</u> External Dimensions for detailed information about your model.



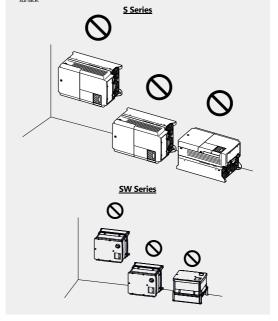
VFDs with small frames **S Series**: 1-2HP (0.8-1.5kW), **SW Series**: 0.5-1HP (0.4-0.8kW) (3-phase) have only two mounting brackets. VFDs with large frames have 4 mounting brackets.

890049-07-00 Installing the VFD

① Caution

 Do not transport the VFD by lifting with the VFD's covers or plastic surfaces. Always support the VFD using the metal frames when moving it.

- Larger VFDs are very heavy and bulky. Use an appropriate transport method that is suitable for the weight.
- Do not install the VFD on the floor or mount it sideways, horizontally against a wall. The VFD MUST be installed vertically, on a wall or inside a panel, with its rear frame on the mounting surface.



Installing the VFD 890049-07-00

2.2 Cable Wiring

Open the front cover, remove the cable guides and control terminal cover, and then install the ground connection as specified. Complete the cable connections by connecting an appropriately rated cable to the terminals on the power and control terminal blocks.

Read the following information carefully before carrying out wiring connections to the VFD. All warning instructions must be followed

① Caution

- Install the VFD before carrying out wiring connections.
- Ensure that no small metal debris, such as wire snippings, remain inside the VFD. Metal debris in the VFD may cause VFD failure.
- Tighten terminal screws to their specified torque. Loose terminal block screws may allow the cables to disconnect and cause short circuit or VFD failure. Refer to <u>11.4 Terminal Screw</u>. Specification for torque specifications.
- Do not place heavy objects on top of electric cables. Heavy objects may damage the cable and result in electric shock.
- · Only use a grounded power supply for this VFD.
- The equipment may generate ground currents in the protective ground wire. When
 installing the residual current device (RCID) or residual current monitoring (RCM), only Type
 B RCDs and RCMs, which trip at 20mA of ground current, can be used.
- Use cables with the largest cross-sectional area, appropriate for power terminal wiring, to
 ensure that voltage drop does not exceed 2%.
- Use copper cables rated at 600V, 75 °C for power terminal wiring.
- Use copper cables rated at 300V, 75 ℃ for control terminal wiring.
- · Separate control circuit wires from the power circuit and any other high voltage circuits.
- Check for short circuits or wiring failure in the control circuit. They could cause system failure or device malfunction.
- Use shielded cables when wiring the control circuit. Failure to do so may cause malfunction due to interference. If a ground is needed, use STP (Shielded Twisted Pair) cables.
- If you need to re-wire the terminals due to wiring-related faults, ensure that the VFD 7-Segment display is turned off and the charge lamp under the front cover is off before working on wiring connections. The VFD may hold a high voltage electric charge long after the power supply has been turned off.

S Series

Step 1 Front Cover, Control Terminal Cover, and Cable Guide

The front cover, control terminal cover, and cable guide must be removed to install cables. Refer to the following procedures to remove the covers and cable guide. The steps to remove these parts may vary depending on the VFD model.

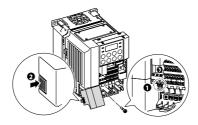
890049-07-00 Installing the VFD

1HP~5HP (0.75-3.7kW) 3-phase

1 Loosen the bolt that secures the front cover (right side). Push and hold the latch on the right side of the cover. Then remove the cover by lifting it from the bottom and moving it away from the front of the VFD.



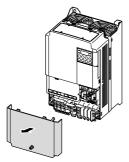
2 Remove the bolt that secures the front cover (left side) (①). Push and hold the latch on the left side of the cover. Then remove the cover by lifting it from the bottom and moving it away from the front of the inverter (②).



3 Connect the cables to the power terminals and the control terminals. For cable specifications, refer to 1.5_ Cable Selection.

7.5HP~15HP (5.5-11kW) 3-phase

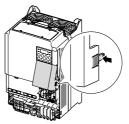
1 Loosen the bolt that secures the front cover. Then remove the cover by lifting it from the bottom and away from the front.



2 Push and hold the levers on both sides of the cable guide (1) and then remove the cable guide by pulling it directly away from the front of the VFD (2). In some models where the cable guide is secured by a bolt, remove the both first.



3 Push and hold the tab on the right side of the control terminal cover. Then remove the cover by lifting it from the bottom and moving it away from the front of the VFD.



4 Connect the cables to the power terminals and the control terminals. For cable specifications, refer to 1.5_ Cable Selection.

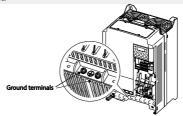
Step 2 Ground Connection

Remove the front cover(s), cable guide, and the control terminal cover. Then follow the instructions below to install the ground connection for the VFD.

1 Locate the ground terminal and connect an appropriately rated ground cable to the terminals. Refer to 1.5 <u>Cable Selection</u> to find the appropriate cable specification for your installation.

Note

To connect an LCD keypad, remove the plastic knock-out from the bottom of the front cover (right side) or from the control terminal cover. Then connect the signal cable to the RJ-45 port on the control board.



2 Connect the other ends of the ground cables to the supply earth (ground) terminal.

Note

- 200 V products require Class 3 grounding. Resistance to ground must be < 100Ω.
 - 400 V products require Special Class 3 grounding. Resistance to ground must be < 10Ω.

Install ground connections for the VFD and the motor by following the correct specifications to ensure safe and accurate operation. Using the VFD and the motor without the specified grounding connections may result in electric shock.

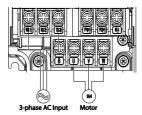
Step 3 Power Terminal Wiring

The following illustration shows the terminal layout on the power terminal block. Refer to the detailed descriptions to understand the function and location of each terminal before making wiring connections. Ensure that the cables selected meet or exceed the specifications in 1.5 *Cable Selection* before installing them.

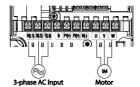
① Caution

- Apply rated torques to the terminal screws. Loose screws may cause short circuits and malfunctions.
 Tightening the screw too much may damage the terminals and cause short circuits and malfuctions.
- Use copper wires rated for 600V, 75°C for the power terminal wiring, and 300V, 75°C for the control terminal wiring.
- Do not use more than one cable per power terminal.
- The power supply must be wired to the R, S, and T terminals. Connecting these cables to the U, V, W
 terminals causes internal damages to the VFD. Arrangement of the phase sequence is not necessary.
- The motor leads should be connected to the U, V, and W Terminals.

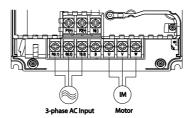
1.0HP~2.0HP (0.75~1.5kW) 3-phase



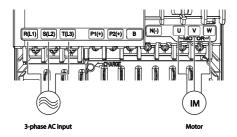
3.0HP~5.0HP (2.2-3.7kW) 3-phase



7.5HP (5.5kW) 3-phase



10HP~15HP (7.5-11kW) 3-phase

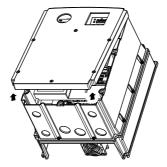


SW Series

Step 1 Front Cover

The front cover must be removed to install cables. Refer to the following procedures to remove the cover.

1 Loosen the bolts that secure the front cover. Then remove the cover by lifting it from the bottom and moving it away from the front of the VFD.



2 Place bushings in all necessary wiring holes before connecting to power and I/O board terminals. Use bushings that are a minimum of NEMA 4X (IP66).



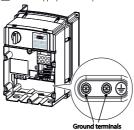
3 Connect the power cables to the power terminals and the control cables to the control terminals. For cable specifications, refer to 1.5 <u>Cable Selection</u> on page <u>12</u>.

Note

To connect an LCD keypad, remove the plastic knock-out from the bottom of the front cover (right side) or from the control terminal cover. Then connect the signal cable to the RJ-45 port on the control board

Step 2 Ground Connection

1 Locate the ground terminal and connect an appropriately rated ground cable to the terminals. Refer to 1.5 <u>Cable Selection</u> on page <u>12</u> to find the appropriate cable specification for your installation.



2 Connect the other ends of the ground cables to the supply earth (ground) terminal.

Note

- 230 V products require Class 3 grounding. Resistance to ground must be < 100Ω.
- 460 V products require special Class 3 grounding. Resistance to ground must be < 10Ω.



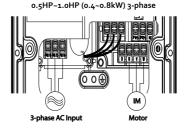
Install ground connections for the VFD and the motor by following the correct specifications to ensure safe and accurate operation. Using the VFD and the motor without the specified grounding connections may result in electric shock.

Step 3 Power Terminal Wiring

The following illustration shows the terminal layout on the power terminal block. Refer to the detailed descriptions to understand the function and location of each terminal before making wiring connections. Ensure that the cables selected meet or exceed the specifications in 1.5 <u>Cable Selection</u> on page <u>12</u> before installing them.

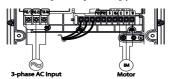
① Caution

- Apply rated torques to the terminal screws. Loose screws may cause short circuits and mafunctions. Tightening the screw too much may damage the terminals and cause short circuits and maffuctions.
- Use copper wires rated for 600V, 75°C for the power terminal wiring, and 300V, 75°C for the control terminal wiring.
- · Do not use more than one cable per power terminal.
- The power supply must be wired to the R, S, and T terminals. Connecting these cables to the U, V, W terminals causes internal damages to the VFD. Arrangement of the phase sequence is not necessary.
- The motor leads should be connected to the U. V. and W Terminals.

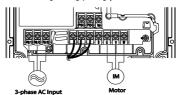


S and SW Series VFD 31

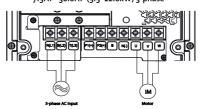
2.0HP~3.0HP (1.5-2.2kW) 3-phase



5.oHP (3.7kW) 3-phase



7.5HP~30.0HP (5.5-22.0kW) 3-phase



S and SW Series

Power Terminal Labels and Descriptions

Terminal Labels	Name	Description	
R(L1)/S(L2)/T(L3)	AC power input terminal	Mains supply AC power connections	
P1(+)/N(-)	DC link terminal	DC voltage terminals	
P1(+)/P2(+)	DC reactor terminal	DC reactor wiring connection (Remove the	
F I(T)/FZ(T)	DC reactor terminal	short-bar when you use the DC reactor.)	

Terminal Labels	Name	Description
P2(+)/B	Brake resistor terminals	Brake resistor wiring connection
U/V/W	Motor output terminals	3-phase induction motor wiring connections

Note

- Do not use 3 core cables to connect a remotely located motor to the VFD.
- When using a brake resistor, the motor may vibrate when in Flux Braking operation. In this
 case, please turn off Flux Braking (Pr.50).

Motor Cable Length:

```
0.5 HP (0.4kW) -> 5.0 HP (3.7kW) -----maximum 165ft (50m)
7.5 HP (5.5kW) -> 30 HP (22kW) -----maximum 665ft (202m)
```

- Long cable runs can cause reduced motor torque in low frequency applications due to
 voltage drop. Long cable runs also increase a circuit's susceptibility to stray capacitance and
 may trigger over-current protection devices or result in malfunction of equipment
 connected to the VFD.
- · Voltage drop is calculated by using the following formula:

Voltage $Drop(V) = [\sqrt{3} \times cable \ resistance (m\Omega/m) \ X \ cable \ length (m) \ X \ current(A)] / 1000$ Use cables with the largest possible cross-sectional area to ensure that voltage drop is minimized over long cable runs. Lowering the carrier frequency and installing a micro surge filter may also help to reduce voltage drop.

Distance	< 165ft (50m)	< 330ft (100m)	> 330ft (100m)
Allowed Carrier Frequency	< 15 kHz	< 5 kHz	< 2.5 kHz

⚠ Warning

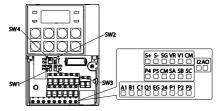
Do not connect power to the VFD until installation has been fully completed and the VFD is ready to be operated. Doing so may result in electric shock.

① Caution

- Power supply cables must be connected to the R, S, and T terminals. Connecting power cables to other terminals will damage the VFD.
- Power Terminals (R/S/T, U/V/W and B1/B2) provide a Screw Clamp type connection. It is recommended to use a Ring Vpe terminal to meet UL connection requirements. The terminals will accept Spade, Slotted Ring, Ferrule and bare wire connections.
- The VFD's power terminal connections can cause harmonics that may interfere with other communication devices located near the VFD. To reduce interference the installation of noise filters or line filters may be required.
- To avoid circuit interruption or damaging connected equipment, do not install power factor correction capacitors, surge protection, or electronic noise filters on the output side of the VFD.

Step 4 Control Terminal Wiring

The illustrations below show the detailed layout of control wiring terminals and control board switches. Refer to the detailed information provided below and 1.5 <u>Coble Selection</u> on page 12 <u>before</u> installing control terminal wiring and ensure that the cables used meet the required specifications.



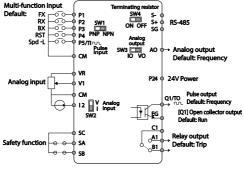
<Standard I/O>

Control Board Switches

Switch	Description
SW1	NPN/PNP mode selection switch
SW2	Analog Voltage/Current Input terminal selection switch
SW3	Analog Voltage/Current Output terminal selection switch
SW4	Terminating Resistor selection switch

R I 45 Connector

Name	Description
RJ 45 Connector	Connection for Remote Keypad (LCD) or RS-485 communications.



<Standard I/O>

Input Terminal Labels and Descriptions

Function	Label	Name	Description
Multi-function (digital input) terminals	P1P5	Multi-function Input 1-5	Configurable for multi-function input terminals. Factory default terminals and setup are as follows: P1: Fx P2: Rx P2: Rx P3: BX P4: RST P5: Speed-L
	СМ	Common Sequence	Common terminal for multi-function (digital input) terminals and analog inputs/outputs.
Andrei	VR	12V Source for Frequency Reference	Source voltage for frequency reference via analog voltage input. Maximum Voltage Output: 12V Maximum Current Output: 100mA, Potentiometer: 1–5kΩ
Analog Input Configuration	V1	Voltage Input for Frequency Reference	Voltage input for 0 - 10V frequency reference. Unipolar: 0–10V (12V Max.) Bipolar: -10–10V (±12V Max.)
	12	Current/Voltage Input for Frequency	Current 0(4)-20 mA or Voltage 0-10V frequency reference input. Switch between I2 and V2 modes with control board switch

Function	Label	Name	Description
		Reference	(SW2). 12 Mode - Input Current: 0(4)–20mA - Maximum Input Current: 24mA - Input Resistance: 249Ω V2 Mode: - Unipolar: 0–10V (12V Max.)
	TI (P5)	Pulse Input for Frequency Reference	Pulse input for 0 to 32kHz frequency reference. Low Level: 0-2.5V High Level: 3.5–12V (Pulse input TI and digital input terminal PS share the same terminal. Set the In.69 P5 Define to 54 (TI).
	SA	Safety Input A	Safe Torque Off (STO) function terminals used to block the output from the VFD in an emergency or for maintenance.
Safety Functionality Configuration	SB	Safety Input B	Normal Operation: Both the SA and SB terminals are connected to the SC terminal. Output Block: Open one or both of the SA or SB terminals to the SC terminal.
	sc	Safety Input Power Source	DC 24V, < 25mA

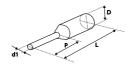
Output/Communication Terminal Labels and Descriptions

Function	Label	Name	Description		
Analog Output	AO	Voltage/Current Output	Analog output terminal (V or I) configurable to: output frequency, output current, output voltage, DC voltage and others. Switch (SW3) selects the signal output type (voltage or current) at the AO terminal. Output Signal Specifications: Output Voltage: 0–10V Maximum Output Voltage/Current: 12V/10mA Output Current: 0–20mA Maximum Output Current: 24mA Factory Default Output: OU.01 Frequency		
	TO (Q1)	Pulse Output	Pulsed output terminal configurable to: output frequency, output current, output voltage, DC voltage and others. Output Signal Specifications: Output Voltage: 0–12V Factory Default Output: OU.61 Frequency (Pulse Output TO and Multi-Function Output Q1 share the same terminal. Set OU.33: Q1 Define to 39(TO). When connecting to a pulse between the SW Series VFDs. Standard I/O <-> Standard I/O: Connect to Q1 -> P5, EG -> CM Multiple I/O <-> Standard I/O: Does not support.		
	Q1	Multi-Functional (Open Collector)	DC 26V, 100mA or less Factory Default Output: OU.33 Run		
	EG	Common	Common ground contact for an open collector (with external power source)		
	24	External 24V Power Source	Maximum Output Current: 150mA		
Digital Output	A1/C1/B1	Relay 1 Output	Configurable (Form C) relay (OU.31), activates when programmed condtion is met. Ratings: AC 250 V < 1 A, DC 30 V < 1 A. Normal operation: B1 and C1 contacts are closed, A1 and C1 are open Activated Condition: A1 and C1 contacts are closed, B1 and C1 are open Default setting is (29) Trip		

Function	Label	Name	Description
RS-485 Communication	S+/S-/SG	RS-485 Signal	Used to send or receive RS-485 signals. Refer to 7 RS-485 Communication Features on page 227 for

Preinsulated Crimp Terminal Connectors (Bootlace Ferrule)

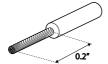
Use preinsulated crimp terminal connectors to increase reliability of the control terminal wiring. Refer to the specifications below to determine the crimp terminals to fit various cable sizes.



Cable Spec.		Dimensions (inches/mm)			
AWG	mm²	L*	P	d1	D
26		10.4	o.4 / 6.0	0.04/	0.1/
	0.25	12.4	o.5/ 8.0	1.1	
22	0.50	12.0	o.45/ 6.0	0.05/	0.125
20	0.75	12.0	0.45 <i> </i> 6.0	0.06/	0.13 / 3.4

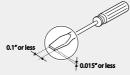
^{*} If the length (L) of the crimp terminals exceeds 0.5" (12.7mm) after wiring, the control terminal cover may not close fully.

To connect cables to the control terminals without using crimp terminals, refer to the following illustration detailing the correct length of exposed conductor at the end of the control cable.



Note

- While making wiring connections at the control terminals, ensure that the total control cable length does not exceed 165ft (50m).
- . Ensure that the length of any safety related wiring does not exceed 100ft (30m).
- Ensure that the cable length between an LCD keypad and the VFD does not exceed 10ft (3.04m). Cable connections longer than 10ft (3.04m) may cause signal errors.
- Use ferrite material to protect signal cables from electro-magnetic interference.
- Take care when supporting cables using cable ties to apply the cable ties no closer than 6
 inches from the VFD. This provides sufficient access to fully close the front cover.
- When making control cable terminal connections, use a small flat-tip screw driver (0.1in wide (2.5mm) and 0.015in thick (0.4mm) at the tip).



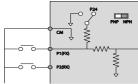
In normal operation S.A.SB, and S.C are closed (jumper on terminals) and carry 24V. Do not connect power to the VFD until installation has been fully completed and the VFD is ready to be operated. Failure to do so may result in electric shock.

Step 5 PNP/NPN Mode Selection

The S and SW Series VFD's support both PNP (Source) and NPN (Sink) modes for activating the digital inputs at the control board terminals. Select an appropriate mode to suit switching requirements using the PNP/NPN selection switch (SW1) on the control board. The following describes each mode along with connection diagrams. Switch position (status) can be viewed at parameter In.99.

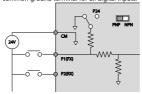
NPN Mode (Sink)

This is the factory default setting of the VFD. With SW1 in the NPN position, connect an external contact (switch, relay, transistor) between Px and CM. When the external contact closes, the input is activated by connecting the internal 24V source to CM (sink). CM is the common ground terminal for all digital input terminals.



PNP Mode (Source)

With SW1 in the PNP position, the input is activated by applying 24V to the digital input. Connect an external contact (switch, relay, transistor) between 24 and Px terminal. When the contact closes, the input is activated by applying 24V to the digital input. The 24V source can be from the VFDs 24 terminal or an external supply. When using an external 24V source, connect the external source (-) to the CM terminal. CM is the common ground terminal for all digital inputs.



Step 6 Re-assembling the Cover

Re-assemble the cover after completing the wiring and basic configurations.

2.3 Post-Installation Checklist

After completing the installation, check the items in the following table to make sure that the VFD has been safely and correctly installed.

Items	Check Point	Ref.	Result
	Is the installation location appropriate?	p.7	
	Does the environment meet the VFD's operating	p.8	
	conditions?	<u>p.o</u>	
Installation	Does the power source match the VFD's rated input?	p.348	
	Is the VFD's rated output sufficient to supply the		
I/O Verification	equipment?		
	(Degraded performance will result in certain	p.348	
	circumstances. Refer to 11.6 Continuous Rated Current		
	Derating on page <u>370</u> for details.		
	Is a circuit breaker installed on the input side of the VFD?	p.15	
	Is the circuit breaker correctly rated?	p.348	
	Are the power source cables correctly connected to the		
	R/S/T terminals of the VFD?	p. 12	
	(Caution: connecting the power source to the U/V/W	p. 12	
	terminals will damage the VFD.)		
	Are the motor output cables connected in the correct		
	phase rotation (U/V/W)?		
	(Caution: Motors will rotate in reverse direction if three	<u>p.31</u>	
	phase cables are not wired in the correct rotation		
	sequence.)		
	Are the cables used in the power terminal connections	p.12	
Miring	correctly rated?		
	Is the VFD grounded correctly?	<u>p. 30</u>	
	Are the power terminal screws and the ground terminal	p. 367	
	screws tightened to their specified torques?	<u>p. 501</u>	
	Are the overload protection circuits installed correctly		
	on the motors (if multiple motors are run using one	-	
	VFD)?		
	Is the VFD separated from the power source by a	p.15	
	magnetic contactor (if a braking resistor is in use)?	<u>p.13</u>	
	Are power factor correction capacitors, surge protection,		
	and electromagnetic interference filters installed correctly?	p.33	
	(These devices MUST not be installed on the output side	p.33	
	of the VFD.)		
,	Are STP (shielded twisted pair) cables used for control		
1	terminal wiring?		
Control Terminal	Is the shielding of the STP wiring properly grounded?	-	
Wiring	If 3-wire operation is required, are the multi-function		
i	input terminals defined prior to the installation of the	p.132	
	control wiring connections?		

Items	Check Point	Ref.	Result
	Are the control cables properly wired?	p.34	
	Are the control terminal screws tightened to their specified torques?		
	Is the total cable length of all control wiring < 165ft (100m)?	p.33	
	Is the total length of safety wiring < 100ft (30m)?	p.39_	
	Are optional cards connected correctly?	-	
	Is there any debris left inside the VFD?	p. 22	
	Are any cables contacting adjacent terminals, creating a potential short circuit risk?	-	
	Are the control terminal connections separated from the power terminal connections?	-	
Miscellaneous		-	
	Have the fans been replaced if they have been in use for > 3 years?	-	
	Has a fuse been installed for the power source?	-	
	Are the connections to the motor separated from other connections?	-	

Note

STP (Shielded Twisted Pair) cable has a highly conductive, shielded screen around twisted cable pairs. STP cables protect conductors from electromagnetic interference.

2.4 Test Run

After the post-installation checklist has been completed, follow the instructions below to test the VFD.

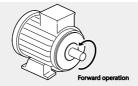
- 1 Turn on the power supply to the VFD. Ensure that the 7-Segment display is on.
- Select the command source.
- 3 Set a frequency reference, and then check the following:
 - If V1 is selected as the frequency reference source, does the reference change according to the input voltage at VR?
 - If V2 is selected as the frequency reference source, is the voltage/current selector switch (SW2) set to voltage, and does the reference change according to the input voltage?
 - If 12 is selected as the frequency reference source, is the voltage/current selector switch (SW2) set to current, and does the reference change according to the input current?
- 4 Set the acceleration and deceleration time.
- 5 Start the motor and check the following:
 - . Ensure that the motor rotates in the correct direction (refer to the note below).
 - Ensure that the motor accelerates and decelerates according to the set times, and that the motor speed reaches the frequency reference.

Verifying the Motor Rotation

- 6 On the 7-Segment display, set parameter drv (Frequency Reference Source) code in the Operation group to 0 (Keypad).
- 7 Set a frequency reference at the main screen.
- 8 Press the [RUN] key. Motor starts forward operation.
- 9 Observe the motor's rotation from the load side and ensure that the motor rotates counterclockwise (forward). If the motor rotates in the reverse direction, switch the cables at the U and V terminals.

Note

If the forward command (Fx) is on, the motor should rotate counterclockwise when viewed from the load side of the motor. If the motor rotates in the reverse direction, switch the cables at the U and V terminals



① Caution

- Check the parameter settings before running the VFD. Parameter settings may have to be adjusted depending on the load.
- To avoid damaging the VFD, do not supply the VFD with an input voltage that exceeds the rated voltage for the equipment.
- Before running the motor at maximum speed, confirm the motor's rated capacity. As VFDs can be used to easily increase motor speed, use caution to ensure that motor speeds do not accidently exceed the motor's rated capacity.

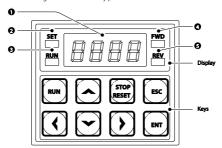
3 Learning to Perform Basic Operations

This chapter describes:

- . The 7-Segment display layout display and buttons (or keys)
- · Button (or key) operation
- · Parameter groups and navigation
- · Viewing and changing parameter settings
- · Specific examples for setting the most common functions.

3.1 **About the 7-Segment Display**

The 7-Segment display is composed of two main components – the display and the operation keys (or buttons). Refer to the following illustration to identify part names and functions.



3.1.1 About the Display

The following table lists display part names and their functions.

No.	Name	Function
0	7-Segment Display	Displays current operational status and parameter information.
SET Indicator LED flashes during parameter configuration and when		LED flashes during parameter configuration and when the ESC
•	3ET IIIGICATOI	key operates as the multi-function key.
8	RUN Indicator	LED turns on (steady) during operation and flashes during
v	KON Indicator	acceleration or deceleration.
0	FWD Indicator	LED turns on (steady) during forward operation.
6	REV Indicator	LED turns on (steady) during reverse operation.

The table below shows how characters (letters and numbers) are displayed.

Display	Number/ character	Display	Number/ character	Display	Number/ character	Display	Number/ character
0	0	R	А	R	К	IJ	U
1	í	Ь	В	1	L	u	V
2	2	Ε	С	ñ	М	"	w
3	3	d	D	ī	N	4	х
4	4	Ε	E	0	0	y	Υ
5	5	F	F	P	Р	Ξ	Z
<u>δ</u>	6	G	G	9	Q		
7	7	H	н	-	R		
8	8	1	1.	5	S		
9	9	J	J	E	Т		

3.1.2 Operation Keys

The following table lists the names and functions of the 7-Segment Display's operation keys.

Key	Name	Description	
Θ	[RUN] key	Used to start and run the VFD (inputs a RUN command).	
	[STOP/RESET] key	STOP: stops the VFD. See Caution. RESET: Resets the VFD following a fault or failure condition.	
	[▲] key, [▼] key	Up/Down, Increase/Decrease to switch between codes or to increase or decrease parameter values.	
() , ()	[◀] key, [▶] key	Switch between groups or to move the cursor during parameter setup or modification.	
Θ	[ENT] key	Used to select, confirm, or save a parameter value.	
•	[ESC] key	A multi-function key used to configure different functions, such as: Jog operation Remote/Local mode switching Cancellation of an input during parameter setup	

① Caution

Install a separate emergency stop switch in the circuit. The [STOP/RESET] key on the 7-Segment display works only when the VFD has been configured to accept the stop command from the 7-Segment display. Command Source parameter drv is set to 0 (Keypad).

3.1.3 Control Menu

The following table lists the parameter groups and a description of functions within each group.

Group	7-Segment Display	LCD Display	Description
Operation	0.00	-	Configures Acc/Dec times, Start/Stop and Reference Frequency sources. Operations Group does not appear on LCD Display
Drive	dr	DRV	Configures VFD Control Mode, Jog operation, Motor HP setting, torque boost, and parameter Read/Write/Save/Initialize.
Basic	ba	BAS	Configures all other motor parameters, 2 nd Control and 2 nd Reference Frequency sources, Auxiliary sources and Auto Tuning for SVC control.
Advanced	ad	ADV	Configures Acc/Dec patterns, Start/Stop modes, Frequency limits, Energy savings, Safe Mode, Regen Avoidance, Braking and Fire Mode.
Control	cn	CON	Configures SVC, Torque Limits, Speed Search, KEB (Ride Through) and Safe Stop features.
Input Terminal	in	IN	Configures input terminal-related features including all digital inputs and analog inputs (V1 and I2).
Output Terminal	ou	OUT	Configures output terminal-related features including Relay1 and Q1 outputs and analog output (AO1).
Communication	cm	СОМ	Configures communication features for RS-485 or other communication options.
Application	ар	APP	Configures functions related to PID control including Sleep and Wake Up functions.
Protection	pr	PRT	Configures all motor and VFD protection features along with Fault history.
Motor 2 (Secondary Motor)	m2	M2	Configures features of a 2 nd motor, when connected The 2nd motor group (M2) appears on the 7-Segment display only when one of the multi-function (digital) input terminals (In.65-In.69) has been set to 26 (2 nd Motor).
User Sequence	us	USS	
User Sequence Function	uf	USF	User Sequence Group and User Function Group are used to implement simple sequences with various function blocks.

3.2 Learning to Use the 7-Segment Display

The 7-Segment display enables movement between parameter groups and and the parameters within each group. At parameter (code) level, you can set parameter values and turn on or off specific functions. Refer to Error! Reference source not found. Error! Reference source not found. on page 253 to find the functions you need.

Confirm the correct values (or the correct range of the values), and then follow the examples below to configure the VFD with the 7-Segment display.

3.2.1 Group and Parameter (Code) Selection

Follow the examples below to learn how to switch between parmameter groups and codes.

Step	Instruction	7-Segment Display
1	Move to the group you want using the [◀] and [▶] keys.	Note that the User Sequence Group (US) and User Sequence Function Group (UF) only appear when APO2 is set to 1 (Yes). The 2 nd Motor Function Group (M2) only appears if any of In.65-69 are set to 26 (2 nd Motor).
2	Move up and down through the codes using the [▲] and [▼] keys until you locate the code that you require.	
3	and Down keys. Press [EN	ake changes using the Up

Note

For some settings, pressing the [A] or [V] key may skip choices. This is because certain code numbers have been intentionally left blank (or reserved) for new functions to be added in the future. Also some features may have been hidden (disabled) because a certain code has been set to disable the functions for relevant codes.

As an example, if Ad.24 (Frequency Limit) is set to 0 (No), the next codes, Ad.25 (Freq Limit Lo) and Ad.26 (Freq Limit Hi), will not be displayed. If you set code Ad.24 to 1 (Yes) and enable the frequency limit feature, codes Ad.25 and 26 will appear to allow the maximum and minimum frequency limitations to be set up.

3.2.2 Navigating Directly to Different Codes

The following example details navigating directly to code dr. 95 from the initial code in the Drive group (dr. 0). This example applies to all groups whenever you would like to navigate directly to a specific code number.



Step	Instruction	7-Segment Display
1	Ensure that you are currently at the first code of the Drive group (dr.0).	dr.0
2	Press the [ENT] key. Number '9' will flash.	(9'
3	Press the [▼] key to display '5' in the ones position.	(5')
4	Press the [◀] key to move to the tens posotion. The cursor will move to the left and '05' will be displayed. This time, the number '0' will be flashing.	′0′5
5	Press the [▲] key to increase the number from '0' to '9'.	95
6	Press the [ENT] key. Code dr.95 is displayed.	dr.95

3.2.3 Setting Parameter Values

Follow the instructions below to set or modify parameter values.

Step	Instruction	7-Segment Display
1	Select the group and code to set or modify parameter settings, and then press the [ENT] key. The first number on the right side of the display will flash.	5.'0'
2	Press the [◀] or [▶] key to move the cursor to the number that you would like to modify.	05.0 5.0 5.0 (35.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0
3	Press the [♠] or [▼] key to adjust the value, and then press the [ENT] key to confirm it. The selected value will flash on the display.	5.0 5.0 5.0 •••
4	Press the [ENT] key again to save the change.	-

Note

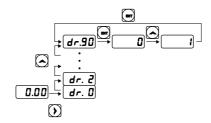
- A flashing number on the display indicates that the keypad is waiting for an input from the
 user. Changes will be saved when the [ENT] key is pressed while the number is flashing. The
 setting change will be canceled if you press any other key.
- Each code's parameter values have default features and ranges specified. Refer to Error!
 Reference source not found, Error! Reference source not found. on page 253 for information about the features and ranges before setting or modifying parameter values.

Enable or Disable features of parameters.. When a parameter has choices of Enable/Disable (On/Off), represented by bits (0000 through 1111), select whether or not to activate a function. Program the bits individually where enable (On) is represented by the upper segment being lit and disable (Off) is represented by the lower segment being lit.

Items.	Enable state of function	Disable state of function
Keypad	A	R

3.2.4 Configuring the [ESC] Key

The [ESC] key is a multi-functional key that can be configured to carry out a number of different functions. Refer to 4.6 <u>Local/Remote Mode Switching</u> on page <u>81</u> for more information about the other functions of the [ESC] key. The following example shows how to configure the [ESC] key to perform a joq operation.



Step	Instruction	7-Segment Display
1	Ensure that you are currently at the first code of the Operation group, and that code 0.00 (Command Frequency) is displayed.	0.00
2	Press the [▶] key. You have moved to the initial code (dr.0) of the Drive group.	dr.0
3	Press the [▲] or [▼] key to select code 90 (ESC key functions) and then press the [ENT] key. Code dr.90 currently has an initial parameter value of 0.	dr.90
4	Press the [A] key to modify the value to 1 (Jog key) and then press the [ENT] key. The new parameter value will flash.	(1')
5	Press the [ENT] key again to save changes.	=

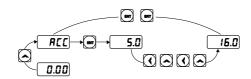
Note

- If the code dr. 90 (ESC key function) is set to 1 (JOG Key) or 2 (Local/Remote), the SET indicator will flash when the [ESC] key is pressed.
- The factory default setting for code dr. 90 is 0 (move to the initial position). You can navigate
 back to the initial position (code 0.00 of the Operation group) immediately by pressing the
 [ESC] key while configuring any codes in any groups.

3.3 Actual Application Examples

3.3.1 Acceleration Time Configuration

The following is an example demonstrating how to modify the ACC (Acceleration time) code value (from 5.0 to 16.0) in the Operations group.



Step	Instruction	7-Segment Display
1	Ensure that the first code of the Operation group is selected, and code 0.00 (Command Frequency) is displayed.	0.00
2	Press the [▲] key. The display will change to the second code (ACC) in the Operations group.	ACC
3	Press the [ENT] key. The number '5.0' will be displayed, with '0' flashing. This indicates that the current acceleration time is set to 5.0 seconds. The flashing value is ready to be modified by using the keypad.	5.′0′
4	Press the [◀] key to move to the left (ones position). '5' will be flashing now. This indicates the flashing value, '5' is ready to be modified.	'5 '.0
5	Press the [▲] key to change the number '5' to '6' in the ones position.	(6′.0)
6	Press the [◀] key to move to the tens position. The number in the tens position, '0' in '06' will start to flash	′0′6.0
7	Press the $[A]$ key to change the number from '0' to '1' and then press the $[ENT]$ key. Both digits will flash on the display.	16'.0
8	Press the [ENT] key once again to save changes. ACC' will be displayed. The change to the acceleration time setup has been completed.	ACC

3.3.2 Frequency Reference Configuration

The following is an example to demonstrate configuring a frequency reference of 30.05 (Hz) from the first code in the Operations group (0.00).



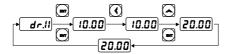
Step	Instruction	7-Segment Display
1	Ensure that the first code of the Operation group is selected, and the code 0.00 (Command Frequency) is displayed.	0.00
2	Press the [ENT] key. The value, 0.00 will be displayed with the '0' in the hundredths position will be flashing.	0.0'0'
3	Press the [◀] key 3 times to move to the tens position. The '0' in the tens position will start to flash.	(0,000)
4	Press the [▲] key to change it to '3'.	30.00
5	Press the [▶] key 3 times. The '0' at the hundredths position will flash.	30.0′0′
6	Press the [A] key to change it to '5' and then press the [ENT] key. The parameter value will flash on the display.	30.0′5′
7	Press the [ENT] key once again to save changes. Flashing stops. The frequency reference has been configured to 30.05 Hz.	30.05

Note

- A flashing number on the display indicates that the 7-Segmentdisplay is waiting for an input from the user. Changes are saved when the [ENT] key is pressed while the value is flashing. Changes will be canceled if any other key is pressed.
- The S and SW Series VFD's 7-Segment display can display up to 4 digits. However, 5-digit
 figures can be used and are accessed by pressing the [◀] or [▶] key to allow keypad input.

3.3.3 Jog Frequency Configuration

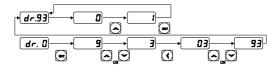
The following example demonstrates how to configure log Frequency by modifying code dr.11 (log Frequency) in the Drive group from 10.00(Hz) to 20.00(Hz), You can configure other parameters in different groups in exactly the same way.



Step	Instruction	7-Segment Display
1	Go to code 11 (Jog Frequency) in the Drive group.	dr.11
2	Press the [ENT] key. The current Jog Frequency value (10.00) for code dr.11 is displayed.	10.00
3	Press the [◀] key 3 times to move to the tens position. Number '1' at the tens position will flash.	′1′0.00
4	Press the [▲] key to change the value to '2' and then press the [ENT] key. All parameter digits will flash on the display.	′20.00′
5	Press the [ENT] key once again to save the changes. Code dr.11 will be displayed. The parameter change has been completed.	dr.11

3.3.4 Initializing All Parameters

The following example demonstrates parameter initialization using code dr.93 (Parameter Initialization) in the Drive group. When executed, parameter initialization will delete all modified values for all codes setting them to factory default values.



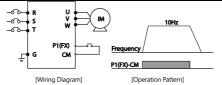
Step	Instruction	7-Segment Display
1	Go to code 0 (Jog Frequency) in the Drive group.	dr.0
2	Press the [▲] or [▼] key to select code dr.93 (Parameter Initialization) and then press the [ENT] key. Code dr.93 currently has an initial parameter value of 0 (Do not initialize.	dr.93
3	Press the [A] key to change the value to 1 (All Grp), and then press the [ENT] key. The parameter value will flash.	1
4	Press the [ENT] key once again. Parameter initialization begins. Parameter initialization is complete when code dr.93 reappears on the display.	dr.93

Note

Following parameter initialization, all parameters are reset to factory default values. Ensure that parameters are reconfigured before running the VFD again after an initialization.

3.3.5 Frequency Setting (Keypad) and Operation (via Terminal Input)

Step	Instruction	7-Segmet Display
1	Turn on the VFD.	-
2	Ensure that the first code of the Operations group is selected and code 0.00 (Command Frequency) is displayed, then press the [ENT] key. The first digit on the right will flash.	0.0'0'
3	Press the [◀] key 3 times to go to the tens position. The number '0' at the 10s place position will flash.	′0′0.00
4	Press the [A] key to change it to 1, and then press the [ENT] key. The parameter value (10.00) will flash.	′10.00′
5	Press the [ENT] key once again to save changes. A change of reference frequency to 10.00 Hz has been completed.	10.00
6	Refer to the wiring diagram at the bottom of the table and close the switch between the P1 (FX) and CM terminals. The FWD indicator light comes on steady. The RUN indicator light flashes as the drive accelerates from 0 Hz. to 10 Hz. When the drive frequency of 10 Hz. is reached, the RUN indicator light becomes teady (not flashing).	SET 10.00 Rev
7	When the frequency reference is reached (10Hz), open the switch between the PI (FX) and CM terminals. The RUN indicator light flashes again and the current deceleration frequency is displayed. When the frequency reaches OHz, the RUN and FWD indicator lights turn off, and the frequency reference (10.00Hz) is displayed again.	SET 10.00 PMD RUM 10.00 REV

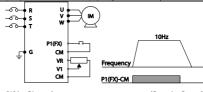


Note

The instructions in the table are based on the factory default parameter settings. The VFD may not work correctly if the default parameter settings are changed after the VFD is purchased. In such cases, initialize all parameters to reset the values to factory default parameter settings before following the instructions in the table (refer to 5.23 Parameter Initialization on page 180).

3.3.6 Frequency Setting (Potentiometer) and Operation (Terminal Input)

Step	Instruction	7-Segment Display
1	Turn on the VFD.	-
2	Ensure that the first code of the Operation group is selected and the code 0.00 (Command Frequency) is displayed.	0.00
3	Press the [A] key 4 times to go to parameter Frq (Frequency reference source).	frq
4	Press the [ENT] key. The Frq code in the Operation group is currently set to 0 (Keypad-1).	
5	Press the [A] key to change the parameter value to 2 (V1, Potentiometer), and then press the [ENT] key. The new parameter value will flash.	@
6	Press the [ENT] key once again. The Frq code will be displayed again. The frequency input has been configured for the potentiometer.	fra
7	Press the [▼] key 4 times. Returns to the first code of the Operations group (0.00). From here frequency setting values can be monitored.	0.00
8	Adjust the potentiometer to increase or decrease the frequency reference to 10Hz. The frequency reference will change eventhough the drive is not running yet.	-
9	Refer to the wiring diagram at the bottom of the table and close the switch between the P1 (F3) and CM terminals. The FWD indicator light comes on steady. The RUN indicator light flashes as the drive accelerates from 0 Hz. to the frequency reference. When the drive frequency is reached, the RUN indicator light becomes steady (not flashing).	SET 10.00 REV
10	When the frequency reference is reached (10Hz), open the switch between the P1 (FX) and CM terminals. The RUN indicator light flashes again and the current deceleration frequency is displayed. When the frequency reaches 0Hz, the RUN and FWD indicators turn off, and the frequency reference (10.00Hz) is displayed again.	SET 10.00 PMO RUM 10.00 REV



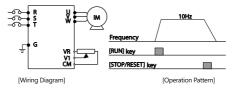
[Wiring Diagram] [Operation Pattern]

Note

The instructions in the table are based on the factory default parameter settings. The VFD may not work correctly if the default parameter settings are changed after the VFD is purchased. In such cases, initialize all parameters to reset the factory default parameter settings before following the instructions in the table (refer to 5.23 <u>Parameter Initialization</u> on page 180).

3.3.7 Frequency Setting (Potentiometer) and Operation (7-Segment Display)

Ste	Instruction	7-Segment Display
1	Turn on the VFD.	-
2	Ensure that the first code of the Operation group is selected and the code 0.00 (Command Frequency) is displayed.	0.00
3	Press the [▲] key 4 times to go to the Frq code.	Frq
4	Press the [ENT] key. The Frq code in the Operation group is currently set to 0 (Keypad-1).	0
5	Press the [A] key to change it to 2 (V1, Potentiometer), and then press the [ENT] key. The new parameter value will flash.	(2')
6	Press the [ENT] key once again. The Frq code is displayed again. The frequency input has been configured for the V1, Potentiometer).	Frq
7	Press the [▼] key 4 times. Returns to the first code of the Operation group (0.00). From here frequency setting values can be monitored. To move to the Frq (Frequency reference source) code.	0.00
8	Adjust the potentiometer to verify the frequency reference changes. The frequency reference will change eventhough the drive is not running yet.	=
9	Press the (RUN) key on the 7-Segment display. The FWD indicator light comes on steady. The RUN indicator light flashes as the drive accelerates from 0 Hz. to the frequency reference. When the drive frequency is reached, the RUN indicator light becomes steady (not flashing).	SET 10.00 PMP
10	When the frequency reaches the reference (10Hz), press the ISTOP/RESET] key on the 7-Segment display. The RUN indicator light flashes again and the current deceleration frequency is displayed. When the frequency reaches 0Hz, the RUN and FWD indicator lights turn off, and the frequency reference is displayed again.	SET 10.00 REV



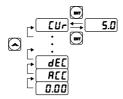
Note

The instructions in the table are based on the factory default parameter settings. The VFD may not work correctly if the default parameter settings are changed after the VFD is purchased. In such cases, initialize all parameters to reset the factory default parameter settings before following the instructions in the table (refer to 5.23 <u>Parameter Initialization</u> on page 180).

3.4 Monitoring the Operation

3.4.1 Output Current Monitoring

The following example demonstrates how to monitor the output current in the Operation group using the 7-Segment display.



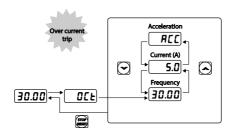
Step	Instruction	7-Segment Display
1	Ensure that the first code of the Operation group is selected and the code 0.00 (Command Frequency) is displayed.	0.00
2	Press the [▲] or [▼] key to move to the Cur code.	CUr
3	Press the [ENT] key. The output current (5.0A) is displayed.	5.0
4	Press the [ENT] key again.	cur

Note

You can use the dCL (DC link voltage monitor) and vOL (output voltage monitor) codes in the Operation group in exactly the same way as shown in the example above, to monitor each function's relevant values.

3.4.2 Fault Monitoring

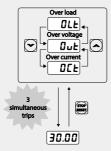
The following example demonstrates how to monitor fault conditions in the Operations group using the 7-Segment display.



Step	Instruction	Keypad Display
1	Refer to the example 7-Segment display. An over current trip fault has occurred.	oct
2	Press the [ENT] key and then the [A] key. The operating frequency at the time of the fault (30.00Hz) is displayed.	30.00
3	Press the [▲] key. The output current at the time of the fault (5.0A) is displayed.	5.0
4	Press the (A) key. The operation status at the time of the fault is displayed. ACC on the display indicates that the fault occurred during acceleration.	ACC
5	Press the [STOP/RESET] key. The VFD resets and the fault condition is cleared. The frequency reference is displayed on the keypad. The fault is stored in the Fault History, parameters Pr.91 ~ Pr.95.	30.00

Note

 If multiple faults occur at the same time, a maximum of 3 fault records can be retrieved as shown in the following example.



 If a warning condition occurs while running at a specified frequency, the current frequency and the warn signal will be displayed alternately at 1 second intervals. Refer to 9 Troubleshooting on page 333 for more details.

890049-07-00 Learning Basic Features

4 Learning Basic Features

This chapter describes the basic features of the SW Series VFD. Check the reference page in the table to see the detailed description for each of the advanced features.

Basic Tasks	Description	Ref.
Frequency reference source configuration for the 7- Segment display	Configures the VFD to allow you to setup or modify frequency reference using the 7-Segment display.	p.66
Frequency reference source configuration for the terminal block (input voltage)	Configures the VFD to allow input voltages at the terminal block (V1, V2) and to setup or modify a frequency reference.	p.67, p.73
Frequency reference source configuration for the terminal block (input current)	Configures the VFD to allow input currents at the terminal block (I2) and to setup or modify a frequency reference.	p.72
Frequency reference source configuration for the terminal block (input pulse)	Configures the VFD to allow input pulse at the terminal block (TI) and to setup or modify a frequency reference.	<u>p.74</u>
Frequency reference source configuration for RS-485 communication	Configures the VFD to allow communication signals from upper level controllers, such as PLCs or PCs, and to setup or modify a frequency reference.	<u>p.75</u>
Frequency control using analog inputs	Enables the user to hold a frequency using analog inputs at terminals.	<u>p.76</u>
Motor operation display options	Configures the display of motor operation values. Motor operation is displayed either in frequency (Hz) or speed (rpm).	<u>p.77</u>
Multi-step speed (frequency) configuration	Configures multi-step frequency operations by receiving an input at the terminals defined for each step frequency.	<u>p.77</u>
Command source configuration for 7-Segment display buttons	Configures the VFD to allow the manual operation of the [FWD], [REV] and [Stop] keys.	<u>p.79</u>
Command source configuration for terminal block inputs	Configures the VFD to accept inputs at the FX/RX terminals.	<u>p.79</u>
Command source configuration for RS-485 communication	Configures the VFD to accept communication signals from upper level controllers, such as PLCs or PCs.	p.81
Local/remote switching via the [ESC] key	Configures the VFD to switch between local and remote operation modes when the [ESC] key is pressed. When the VFD is operated using remote inputs (any input other than one from the 7-Segment display), this configuration can be used to perform maintenance on the VFD, without losing or altering saved parameter settings. It can also be used to override remotes and use the 7-Segment display immediately in emergencies.	p.81
Motor rotation control	Configures the VFD to limit a motor's rotation direction.	p.83
Automatic start-up at power-on	Configures the VFD to start operating at power-on. With this configuration, the VFD begins to run and the motor accelerates as soon as power is supplied to the VFD. To use automatic start-up configuration, the operation command terminals at the terminal block must be turned on.	p.83
Automatic restart after reset of	Configures the VFD to start operating when the VFD is reset	<u>p.84</u>

Basic Tasks	Description	Ref.
a fault trip condition	following a fault trip. In this configuration, the VFD starts to run and the motor accelerates as soon as the VFD is reset following a fault trip condition.	
	For automatic start-up configuration to work, the operation command terminals at the terminal block must be turned on.	
Acc/Dec time configuration based on the Max. Frequency	Configures the acceleration and deceleration times for a motor based on a defined maximum frequency.	p.85
Acc/Dec time configuration based on the frequency reference	Configures acceleration and deceleration times for a motor based on a defined frequency reference.	<u>p.87</u>
Multi-stage Acc/Dec time configuration using the multi- function terminal	Configures multi-stage acceleration and deceleration times for a motor based on defined parameters for the multi-function terminals.	<u>p.87</u>
Acc/Dec time transition speed (frequency) configuration	Enables modification of acceleration and deceleration gradients without configuring the multi-functional terminals.	<u>p.89</u>
Acc/Dec pattern configuration	Enables modification of the acceleration and deceleration gradient patterns. Basic patterns to choose from include linear and S-curve patterns.	<u>p.90</u>
Acc/Dec stop command	Stops the current acceleration or deceleration and controls motor operation at a constant speed. Multi-function terminals must be configured for this command .	<u>p.92</u>
Linear V/F pattern operation	Configures the VFD to run a motor at a constant torque. To maintain the required torque, the operating frequency may vary during operation.	<u>p.92</u>
Square reduction (variable torque) V/F pattern operation	Configures the VFD to run the motor with a square reduction V/F pattern (variable torque). Fans and pumps are appropriate loads for square reduction V/F operation.	<u>p.93</u>
User V/F pattern configuration	Enables the user to configure a V/F pattern to match the characteristics of a motor. This configuration is for special-purpose motor applications to achieve optimal performance.	<u>p.94</u>
Manual torque boost	Manual configuration of the VFD to produce a momentary torque boost. This configuration is for loads that require a large amount of starting torque, such as elevators or lifts.	<u>p.95</u>
Automatic torque boost	Automatic configuration of the VFD that provides "auto tuning" that produces a momentary torque boost. This configuration is for bads that require a large amount of starting torque, such as elevators or lifts.	<u>p.96</u>
Output voltage adjustment	Adjusts the output voltage to the motor when the power supply to the VFD differs from the motor's rated input voltage.	<u>p.97</u>
Accelerating start	Accelerating start is the general way to start motor operation. The typical application configures the motor to accelerate to a target frequency in response to a run command, however there may be other start or acceleration conditions defined.	<u>p.97</u>
Start after DC braking	Configures the VFD to perform DC braking before the motor starts rotating again. This configuration is used when the motor will be rotating before the voltage is supplied from the VFD.	<u>p.98</u>

Basic Tasks	Description	Ref.
Deceleration stop	Deceleration stop is the typical method used to stop a motor. The motor decelerates to 0Hz and stops on a stop command, however there may be other stop or deceleration conditions defined.	<u>p.98</u>
Stopping by DC braking	Configures the VFD to apply DC braking during motor deceleration. The frequency at which DC braking occurs must be defined and during deceleration, when the motor reaches the defined frequency, DC braking is applied.	p.99
Free-run stop	Configures the VFD to coast to a stop using a stop command. The motor will free-run until it slows down and stops.	<u>p.100</u>
Power braking	Configures the VFD to provide optimal, motor deceleration, without tripping over-voltage protection.	<u>p.101</u>
Start/maximum frequency configuration	Configures the frequency reference limits by defining a start frequency and a maximum frequency.	<u>p.101</u>
Upper/lower frequency limit configuration	Configures the frequency reference limits by defining an upper limit and a lower limit.	p.102
Frequency jump	Configures the VFD to avoid running a motor in mechanically resonating frequencies.	<u>p.102</u>
2 nd Operation Configuration	Used to configure the 2 nd operation mode and switch between the operation modes (Hand-Off-Auto) according to your requirements.	p.104
Multi-function input terminal control configuration	Enables the user to improve the responsiveness of the multi-function input terminals.	<u>p.105</u>
P2P communication configuration	Configures the VFD to share input and output devices with other VFDs.	<u>p.106</u>
Multi-keypad configuration	Enables the user to monitor multiple VFDs with one monitoring device.	<u>p.107</u>
User sequence configuration	Enables the user to implement simple sequences using various function blocks.	p.109
Fire Mode Operation	Enable Fire Mode operation during emergency situations.	p.116

4.1 Setting Frequency Reference

The S and SW Series VFDs provide several methods to setup and modify a frequency reference for operation. These include the keypad, analog inputs (for example voltage (V1, V2) and current (I2) signals, or RS-485 (digital signals from higher-level controllers, such as PC or PLC) can be used. If UserSeqLik is selected, the common area can be linked with user sequence output and can be used as frequency reference.

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
				0	KeyPad-1		
		Frequency reference source	Ref Freq Src	1	KeyPad-2		
	DRV:07 Frq			2	V1		
				4	V2		
Operation				5	12	0-12	-
				6	Int 485	-	
				8	Field Bus		
				9	UserSeqLink		
				12	Pulse		

4.1.1 Keypad as the Source (KeyPad-1 setting)

You can modify frequency reference by using the 7-Segment display and apply changes by pressing the [ENT] key. To use the 7-Segment display as a frequency reference input source, go to the Frq (Frequency reference source) code in the Operation group and change the parameter value to 0 (Keypad-1). Input the frequency reference for an operation at the 0.00 (Command Frequency) code in the Operation group.)

Group	Code	Name		Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	0	KeyPad-1	0–12	
	0.00	Frequency reference		0.00		Min to Max Frq*	Hz

^{*} You cannot set a frequency reference that exceeds the Max. Frequency, as configured with dr.20.

4.1.2 Keypad as the Source (KeyPad-2 setting)

You can use the [A] and $[\Psi]$ keys to modify a frequency reference. Go to the Frq (Frequency reference source) code in the Operation group and change the parameter value to 1 (Keypad-2). This allows frequency reference values to be increased or decreased by pressing the [A] and $[\Psi]$ keys.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	1	KeyPad-2	0–12	-
	0.00	Frequency reference		0.00		Min to Max Frq*	Hz

^{*} You cannot set a frequency reference that exceeds the Max. Frequency, as configured with dr.20.

890049-07-00 Learning Basic Features

4 1 3 V1 Terminal as the Source

You can set and modify a frequency reference by setting voltage inputs when using the V1 terminal. Use voltage inputs ranging from 0 to 10V (unipolar) for forward only operation or reverse only operation. Use voltage inputs ranging from -10 to +10V (bipolar) for both directions, where negative voltage inputs are used reverse operations.

4.1.3.1 Setting a Frequency Reference for 0-10V Input

Set code In.06 (V1 Polarity) to 0 (unipolar) in the Input Terminal group (IN), Use a voltage output from an external source or use the voltage output from the VR terminal to provide inputs to V1. Refer to the diagrams below for the wiring required for each application.





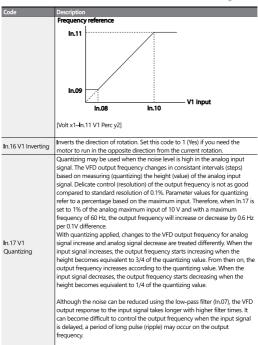
[External source application] [Internal source (VR) application]

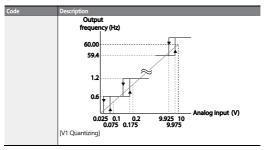
Group	Code	Name	LCD Display	Para	ameter Setting	Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	2	V1	0-12	-
	01	Frequency at maximum analog input	Freq at 100%	Maximum		0.00– Max. Frequency	Hz
	05	V1 input monitor	V1 Monitor [V]	0.00)	0.00-12.00	v
	06	V1 polarity options	V1 Polarity	0	Unipolar	0-1	-
	07	V1 input filter time constant	V1 Filter	10		0-10000	ms
In	08	V1 minimum input voltage	V1 volt x1	0.00)	0.00-10.00	v
""	09	V1 output at minimum voltage (%)	V1 Perc y1	0.00)	0.00-100.00	%
	10	V1 maximum input voltage	V1 Volt x2	10.0	00	0 .00- 12.00	v
	11	V1 output at maximum voltage (%)	V1 Perc y2	100	.00	0-100	%
	16	Rotation direction options	V1 Inverting	0	No	0–1	-
	17	V1 Quantizing level	V1 Quantizing	0.04	1	0.00*, 0.04– 10.00	%

^{*} Quantizing is disabled if '0' is selected.

0-10V Input Voltage Setting Details

Code	Description
In.01 Freq at 100%	Configures the frequency reference at the maximum input voltage when a potentiometer is connected to the control terminal block. A frequency set with code In.01 becomes the maximum frequency only if the value set in code In.11 (or In.15) is 100%). Set code In.01 to 60.00 and use default values for codes In.02–In.16.
	Motor will run at 60.00Hz when a 10V input is provided at V1.
	Set code In.11 to 50.00 (%) and use default values for codes In.01–In.16. Motor will run at 30.00Hz (50% of the default maximum frequency–60Hz) when a 10V input is provided at V1.
In.05 V1 Monitor[V]	Configures the VFD to monitor the input voltage at V1.
In.07 V1 Filter	VI Filter may be used when there are large variations to the applied reference frequency (noise filter). Variations can be mitigated by increasing the time constant, but this will delay the response time when changing the reference frequency. The value t (time) indicates the time required for the frequency to reach 63% of the reference, when external input voltages are provided in multiple steps. VI Input from external source Frequency 100% 63%
	V1 Filter(t) [V1 Filter]
In.08 V1 Volt x1– In.11 V1 Perc y2	These parameters are used to configure the gradient level and offset values of the Output Frequency, based on the Input Voltage.



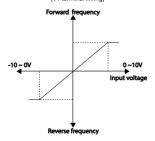


4.1.3.2 Setting a Frequency Reference for -10-10V Input

Set the Frq (Frequency reference source) code in the Operation group to 2 (V1), and then set code In.06 (V1 Polarity) to 1 (bipolar). Use the output voltage from an external source to provide input to V1.



[V1 terminal wiring]



[Bipolar input voltage and output frequency]

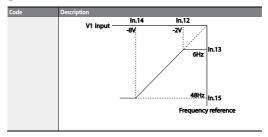
Group	Code	Name	LCD Display		ameter ting	Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	2	V1	0–12	-
	01	Frequency at maximum analog input	Freq at 100%	60.00		0– Max Frequency	Hz
	05	V1 input monitor	V1 Monitor	0.00		0.00-12.00V	٧
	06	V1 polarity options	V1 Polarity	1	Bipolar	0-1	-
	12	V1 minimum input voltage	V1- volt x1	0.0	0	10.00-0.00V	v
In	13	V1 output at minimum voltage (%)	V1- Perc y1	0.0	0	-100.00 - 0.00%	%
	14	V1maximum input voltage	V1- Volt x2	-10	0.00	-12.00 -0.00V	v
	15	V1 output at maximum voltage (%)	V1- Perc y2	-10	00.00	-100.00- 0.00%	%

Rotational Directions for Different Voltage Inputs

Command /	Input voltage				
Voltage Input	0–10V	-10-0V			
FWD	Forward	Reverse			
REV	Reverse	Forward			

-10-10V Voltage Input Setting Details

Code	Description
In.12 V1- volt x1- In.15 V1- Perc y2	Sets the gradient level (slope) and off-set value of the output frequency in relation to the input voltage. These codes are displayed only when In.06 is set to 1 (bipolar). Example, Set In.12 to -2 (V), Set In.13 to 10%, set In.14 to -8V and in.15 tp 80%. The output frequency will vary within the range of 6 - 48 Hz.



4.1.4 I2 Terminal as the Source (current input)

You can modify the frequency reference using the 2 input terminal at the control board. Set Frq (Frequency reference source) in the Operation group to 5 (2) and apply 4-20 mA input current to 12. Scaling of the input current range is done with In.53 through In.56. View the input current at In.50.

Group	Code	Name	LCD Display	Param	eter Setting	Setting Range	Unit
Operations	Frq	Frequency reference source	Freq Ref Src	5	12	0–12	-
	01	Frequency at maximum analog input	Freq at 100%	60.00		0- Maximum Frequency	Hz
	50	I2 input monitor	I2 Monitor	0.00		0.00-24.00	mA
	52	I2 input filter time constant	I2 Filter	10		0-10000	ms
	53	12 minimum input current	I2 Curr x1	4.00		0.00-20.00	mA
In	54	I2 output at minimum current (%)	I2 Perc y1	0.00		0-100	%
	55	12 maximum input current	I2 Curr x2	20.00		0.00-24.00	mA
	56	I2 output at maximum current (%)	I2 Perc y2	100.00)	0.00-100.00	%
	57	I2 rotation direction options	I2 Inverting	0	No	0–1	-
	58	I2 Quantizing level	I2 Quantizing	0.04		0*, 0.04-10.00	%

^{*} Quantizing is disabled if '0' is selected.

Input Current (I2) Setting Details

Code	Description				
	Configures the frequency reference for operation at the maximum current (when In.56 is set to 100%).				
In.01 Freq at 100%	 If In.01 is set to 60.00Hz, and default settings are used for In.53–56, 20mA input current (max) to I2 will produce a frequency reference of 60.00Hz. 				
	 If In.56 is set to 50.00 (%), and default settings are used for In.01 (60Hz) and In.53–55, 20mA input current (max) to I2 will produce a frequency reference of 30.00Hz (50% of 60Hz). 				
In.50 I2 Monitor	Used to monitor input current at I2.				
In.52 I2 Filter	Configures the time for the operation frequency to reach 63% of target frequency based on the input current at I2.				
In.53 12 Curr x1- In.56 12 Perc y2	Configures the gradient level (slope) and off-set value of the output frequency. Frequency Reference In.56 In.53 In.55 Iz Input [Gradient and off-set configuration based on output frequency]				

4.1.5 I2 Terminal as the Source (voltage input)

Set and modify a frequency reference using an input voltage at terminal I2 (V2) by setting switch SW2 to V2. Set the Frq (Frequency reference source) code in the Operation group to 4 (V2) and apply 0–12V input voltage to I2 terminal (=V2, Analog current/voltage input terminal). Codes In 35–47 will not be displayed when I2 is set to receive current input (Frq code parameter is set to 5).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	4	V2	0–12	-
	35	V2 input display	V2 Monitor 0.00			0.00-12.00	V
In	37	V2 input filter time constant	V2 Filter	10		0–10000	ms

Group	Code	Name	LCD Display			Setting Range	Unit
	38	Minimum V2 input voltage	V2 Volt x1	0.00		0.00-10.00	v
	39	Output% at minimum V2 voltage	V2 Perc y1	0.00		0.00-100.00	
	40	Maximum V2 input voltage	V2 Volt x2	10.00		0.00-10.00	v
	41	Output% at maximum V2 voltage	V2 Perc y2	100.00		0.00–100.00	%
	46	Invert V2 rotational direction	V2 Inverting	0 No		0–1	-
	47	V2 quantizing level	V2 Quantizing	0.04		0.00*, 0.04– 10.00	%

^{*} Quantizing is disabled if '0' is selected.

4.1.6 Setting a Frequency with TI Pulse Input

Set a frequency reference by setting the Frq (Frequency reference source) code in Operation group to 12 (Pulse). Set the In.69 P5 Define to 54 (TI) and provide 0–32.00kHz pulse frequency to P5.

Group	Code	Name	LCD Display		ameter ting	Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	12	Pulse	0–12	-
	69	P5 terminal function setting	P5 Define	54	П	0-54	
	01	Frequency at maximum analog input	Freq at 100%	60.	00	0.00–Maximum frequency	Hz
	91	Pulse input display	Pulse Monitor	0.0	0	0.00-50.00	kHz
	92	TI input filter time constant	TI Filter	10		0-9999	ms
In	93	TI input minimum pulse	TI Pls x1	0.0	0	0.00-32.00	kHz
	94	Output% at TI minimum pulse	TI Perc y1	0.0	0	0.00-100.00	%
	95	TI Input maximum pulse	TI Pls x2	32.	00	0.00-32.00	kHz
	96	Output% at TI maximum pulse	TI Perc y2	100	0.00	0.00-100.00	%
	97	Invert TI direction of rotation	TI Inverting	0	No	0–1	-
	98	TI quantizing level	TI Quantizing	0.0	4	0.00*, 0.04-10.00	%

^{*}Quantizing is disabled if '0' is selected.

TI Pulse Input Setting Details

Code	Description							
In.69 P5 Define	Pulse input TI and Multi-function terminal P5 share the same therminal. Set the In.69 P5 Define to 54(TI).							
In.01 Freq at	Configures the frequency reference at the maximum pulse input. The frequency reference is based on 100% of the value set with In.96. If In.01 is set to 60.00 and codes In.93–96 are set at default, 32kHz input							
100%	 to TI yields a frequency reference of 60.00Hz. If In.96 is set to 50.00 (%) and codes In.01, In.93–95 are set at default, 32kHz input to the TI terminal yields a frequency reference of 30.00Hz 							
In.91 Pulse Monitor	Displays the pulse frequency supplied at TI.							
In.92 TI Filter	Sets the time for the pulse input at TI to reach 63% of its nominal frequency (when the pulse frequency is supplied in multiple steps).							
In.93 TI PIs x1– In.96 TI Perc y2	Configures the gradient level and offset values for the output frequency. Frequency reference In 96 In 94 In 94 In 93 In 95							
In.97 TI Inverting— In.98 TI Quantizing	Identical to In.16–17 (refer to In.16 V1 Inverting/In.17.V1 Quantizing on page 68).							

4.1.7 Setting a Frequency Reference via RS-485 Communication

Control the VFD with upper-level controllers, such as PCs or PLCs, via RS-485 communication. Set the Frq (Frequency reference source) code in the Operation group to 6 (Int 485) and use the RS-485 signal input terminals (S-V-5-YG) for communication. Refer to 7, RS-485 Communication Features on page 2ZT.

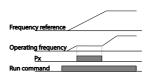
Group	Code	Name	LCD Display	Para	ameter Setting	Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	6	Int 485	0–12	-
01	01	Integrated RS-485 communication VFD ID	Int485 St ID	-	1	1-250	-
		Integrated communication protocol	Int485 Proto	0	ModBus RTU	0-2	
CM	02			1	Reserved		-
CIVI				2	LS Inv 485		
	03	Integrated communication speed	Int485 BaudR	3	9600 bps	0–7	-
	04	Integrated	Int485 Mode	0	D8/PN/S1		-

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
		communication frame		1	D8/PN/S2		
		configuration		2	D8/PE/S1	0-3	
				3	D8/PO/S1		

4.2 Frequency Hold by Analog Input

When using an analog input as the frequency reference, you can apply a hold of the output frequency at any point. Set a digital input to 21 (Analog Hold). When the input is activated, the output frequency will be maintained (Hold constant) until the input is de-activated.

group	Code	Name	LCD Display		rameter tting	Setting Range	Unit
			Freq Ref Src	0	Keypad-1		
				1	Keypad-2		
		Frequency reference source		2	V1	0–12	-
0	F			4	V2		
Operation	Frq			5	12		
				6	Int 485		
				8	Field Bus		
				12	Pulse		
In	65–69	Px terminal configuration	Px Define(Px: P1-P5)	21	Analog Hold	0~54	-



4.3 Changing the Displayed Units (Hz↔Rpm)

You can change the units used to display the operational speed of the VFD by setting Dr. 21 (Speed unit selection) to 0 (Hz) or 1 (Rpm). This function is available only with the LCD keypad.

Group	Code	Name	LCD Display	Param	eter Setting	Setting Range	Unit
4.	dr 21	Speed unit	H-/D C-1	0	Hz Display	0.1	
ar		selection	Hz/Rpm Sel	1	Rpm Display	0-1	-

4.4 Setting Multi-step Frequency

Multi-step operations (Fixed Speed Inputs) can be assigned to the Px terminals. Step 0 uses the frequency reference source set with Frq in the Operations group. Steps 1 through 7 can be configured using (3) digital input terminals. Set Px terminals to 7 (Speed-L), 8 (Speed-M) and 9 (Speed-H). These are recognized as binary inputs (000 ~ 111) and work in combination with Fx or Rx run commands. The VFD operates according to the frequencies set with parameters St1, St2 and St3 (step frequencies 1–3) and bA53 ~ bA56 (step frequencies 4–7), and the binary command combinations.

Group	Code	Name	LCD Display			Setting Range	Unit
Operation BAS	St1-St3 50-52	Multi-step frequency 1–3	Step Freq - 1-3	-		0-Maximum frequency	Hz
bA BAS	53–56	Multi-step frequency 4–7	Step Freq - 4-7	l-		0-Maximum frequency	Hz
			Px Define (Px: P1–P5)	7	Speed-L		-
	65-69			8	Speed-M	0~54	-
la.		configuration	P I-P3)	9	Speed-H		-
In	89	Multi-step command delay time	InCheck Time	1		1–5000	ms

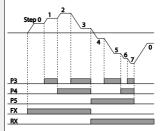
Multi-step Frequency Setting Details

Code	Description
Operation group	Configure multi-step frequency1–3.
St 1-St3	If an LCD keypad is in use, bA.50–52 is used instead of St1–St3 (multi-step
Step Freq - 1-3	frequency 1–3).
bA.53-56	Configure multi-step frequency 4–7.
Step Freq - 4-7	
	Choose the terminals to setup as multi-step inputs, and then set the relevant
In.65-69 Px Define	codes (In.65–69) to 7(Speed-L), 8(Speed-M), or 9(Speed-H).

890049-07-00

Code Description

Provided that terminals P3, P4 and P5 have been set to Speed-L, Speed-M and Speed-H respectively, the following multi-step operation will be available.



[An example of a multi-step operation]

Speed	Fx/Rx	P5	P4	P3
0	✓	-	-	-
1	✓	-	-	✓
2	✓	-	✓	-
3	✓	-	✓	~
4	✓	✓	-	-
5	✓	✓	-	√
6	✓	✓	1	-
7	/	/	/	/

Set a time interval for the VFD to check for additional terminal block inputs after receiving an input signal.

In.89 InCheck Time

After adjusting In.89 to 100ms and an input signal is received at P5, the VFD will search for inputs at other terminals for 100ms, before proceeding to accelerate or decelerate based on P5's configuration.

890049-07-00 Learning Basic Features

4.5 Command Source Configuration

The S and SW Series VFDs provide several methods to Start and Stop the VFD. Choices include the keypad, digital input terminals, RS-485 (Modbus), or Fieldbus option cards.

Group	Code	Name	LCD Display	Param	neter Setting	Setting Range	Unit
Operation drv		Command Source	Cmd Source*	0	Keypad	- - - 0–5	
				1	Fx/Rx-1		
	da.			2	Fx/Rx-2		
	arv			3	Int 485		-
				4	Field Bus		
				5	UserSeqLink		

^{*} Displayed under DRV-06 on the LCD keypad.

4.5.1 The Keypad as a Command Input Device

The 7-Segment display can be selected as a command input device to start and stop the VFD. Set parameter dry (command source) to 0 (Keypad). Press the [RUN] key on the 7-Segment display to start and the [STOP/RESET] key to stop.

Group	Code	Name	LCD Display	Parame	eter Setting	Setting Range	Unit
Operation	drv	Command source	Cmd Source*	0	KevPad	0-5	-

^{*} Displayed under DRV-06 on the LCD keypad.

4.5.2 Terminal Block as a Command Input Device (Fwd/Rev Run Commands)

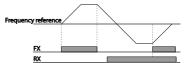
Digital input terminals can be selected as the command input device. Set parameter drv (command source) to 1 (Fx/Rx-1). Choose (2) of the digital input terminals (P1 ~ P5) to setup as Forward and Reverse. Set (2) of the correspondinig parameters (In.65~In.69) to 1 (Fx) and 2 (Rx) respectively. Activating either terminal constitutes a run command. Activating both terminals constitutes a stop command.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	1	Fx/Rx-1	0-5	-
la.	65-69	Px terminal	Px Define(Px:	1	Fx	0~54	
In	05	configuration	P1- P5)	2	Rx	0~54	-

^{*} Displayed under DRV-06 on the LCD keypad.

Fwd/Rev Command by Multi-function Terminal - Setting Details

Code	Description
Operation group	Set to 1(Fx/Rx-1).
drv-Cmd Source	Set to 1(1x/1x/-1).
In.65-69 Px	Assign a terminal for forward (Fx) operation.
Define	Assign a terminal for reverse (Rx) operation.



4.5.3 Terminal Block as a Command Input Device (Run and Rotation Direction Commands)

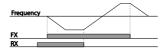
Set parameter drv (command source) to 2 (Fx/Rx-2). This configuration (Fx/Rx-2) assigns the Fx terminal as the Start/Stop input terminal and assigns the Rx terminal as the rotational direction input terminal (Open: Fwd, Closed: Rev), Choose (2) of the digital input terminals (P1 ~ P5) to setup as Forward and Reverse. Set (2) of the corresponding parameters (In65%-In69) to 1 (Fx) and 2 (Rx) respectively.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	Drv	Command source	Cmd Source*	2	Fx/Rx-2	0-5	-
la.	65-69	Px terminal	Px Define (Px: P1	1	Fx	0~54	
In		configuration	- P5)	2	Rx	0~54	_

^{*} Displayed under DRV-06 on the LCD keypad.

Run Command and Fwd/Rev Change Command Using Multi-function Terminal - Setting Details

Code	Description
Operation group dry Cmd Source	Set to 2(Fx/Rx-2).
	Assign a terminal for run command (Fx). Assign a terminal for changing rotation direction (Rx).



890049-07-00 Learning Basic Features

4.5.4 RS-485 Communication as a Command Input Device

Set drv (command source) to 3 (Int 485). Control the VFD with upper-level controllers (PCs or PLCs) via RS-485 communications using the (5+/S-) input terminals of the control board. For more details, refer to <u>ZRS-</u> 485 Communication Features on page 227.

Group	Code	Name	LCD Display	Param Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	3	Int 485	0-5	-
СМ	01	Integrated communication inverter ID	Int485 St ID	1		1–250	-
	02	Integrated communication protocol	Int485 Proto	0	ModBus RTU	0–2	-
	03	Integrated communication speed	Int485 BaudR	3	9600 bps	0–7	-
	04	Integrated communication frame setup	Int485 Mode	0	D8 / PN / S1	0–3	-

^{*} Displayed under DRV-06 on the LCD keypad.

4.6 Local/Remote Mode Switching

Local/remote switching is useful for checking the operation of an VFD or to perform an inspection while retaining all parameter values. Also, in an emergency, it can also be used to override control and operate the system manually using the 7-Segment display.

The [ESC] key is a programmable key that can be configured to carry out multiple functions. For more details, refer to 3.2.4 Configuring the [ESC] Key on page 51.

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
dr	90	[ESC] key functions	-	2	Local/Remote	0-2	-
Operation	drv	Command source	Cmd	1	Fx/Rx-1	0-5	
			Source*				-

^{*} Displayed under DRV-06 on the LCD keypad.

Local/Remote Mode Switching Setting Details

Code	Description
	Set dr.90 to 2(Local/Remote) to perform local/remote switching using the
dr.90	[ESC] key. Once the value is set, the VFD will automatically begin operating in
[ESC] key	remote mode. Changing from local to remote will not alter any previously
functions	configured parameter values and the operation of the VFD will not change.
	Press the [ESC] key to switch the operation mode back to "local." The SET

Code	Description
	light will flash, and the VFD will operate using the [RUN] key on the keypad.
	Press the [ESC] key again to switch the operation mode back to "remote."
	The SET light will turn off and the VFD will operate according to the previous
	dry code configuration.

Note

Local/Remote Operation

- Full control of the VFD is available with the 7-Segment display during local operation (local operation).
- During local operation, jog commands will only work if one of the P1–P5 multi-function terminals (codes In.65–69) is set to 13(RUN Enable) and the relevant terminal is turned on.
- During remote operation (remote operation), the VFD will operate according to the
 previously set frequency reference source and the command received from the input device.
- If Ad.10 (power-on run) is set to 0(No), the VFD will NOT operate on power-on even when
 the following terminals are turned on:
 - Fwd/Rev run (Fx/Rx) terminal
 - Fwd/Rev jog terminal (Fwd jog/Rev Jog)
 - Pre-Excitation terminal

To operate the VFD manually with the 7-Segment display, switch to local mode. Use caution when switching back to remote operation mode as the VFD will stop operating. If Ad.10 (power-on run) is set to 0(No), a command through the input terminals will work ONLY AFTER all the terminals listed above have been turned off and then turned on again.

If the VFD has been reset to clear a fault trip during an operation, the VFD will switch to local
operation mode at power-on, and full control of the VFD will be with the 7-Segment display.
The VFD will stop operating when operation mode is switched from "local" to "remote". In
this case, a run command through an input terminal will work ONLY AFTER all the input
terminals have been turned off

VFD Operation During Local/Remote Switching

Switching operation mode from "remote" to "local" while the VFD is running will cause the VFD to stop operating. Switching operation mode from "local" to "remote" however, will cause the VFD to operate based on the command source:

- Analog commands via terminal input: the VFD will continue to run without interruption based on the command at the terminal block. If a reverse operation (Rx) signal is ON at the terminal block at startup, the VFD will operate in the reverse direction even if it was running in the forward direction in local operation mode before the reset.
- Digital source commands: all command sources except terminal block command sources (which are analog sources) are digital command sources that include the 7-Segment display, LCD keypad, and communication sources. The VFD stops operation when switching to remote operation mode, and then starts operation when the next command is given.

390049-07-00 Learning Basic Features

① Caution

Use local/remote operation mode switching only when it is necessary. Improper mode switching may result in interruption of the VFD's operation.

4.7 Forward or Reverse Run Prevention

The rotation direction can be configured to prevent motors from rotating in a specific direction. Set Ad.09 to prevent rotation in either the Fwd or Rev direction. Pressing the [REV] key on the LCD keypad when Reverse direction prevention is configured, will cause the motor to decelerate to 0Hz and stop. The VFD will remain on.

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
				0	None		
Ad	09	Run prevention options	Run Prevent	1	Forward Prev	0-2	-
				2	Reverse Prev		

Forward/Reverse Run Prevention Setting Details

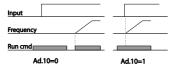
Code	Descrip	Description			
	Choos	e a direction to prev	ent.		
	Settin	ng	Description		
Ad.09 Run	0	None	Do not set run prevention.		
Prevent	1	Forward Prev	Set forward run prevention.		
	2	Reverse Prev	Set reverse run prevention.		

4.8 Power-on Run

The VFD can be set to start operating (output power to the motor) as soon as the VFD powers up. See caution below. When Ad.10, Power-on Run is set to 1 (yes) and a run command remains enabled, the VFD will start immediately upon power up. Parameter drv (command source) must be set to 1 (Fx/Rx-1) or 2 (Fx/Rx-2) along with an active run command. If drv is set to Keypad, Power On Run does not function.

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
Operation	drv	Command source	Cmd Source*	1, 2	Fx/Rx-1 or Fx/Rx-2	0–5	-
Ad	10	Power-on run	Power-on Run	1	Yes	0-1	-

^{*} Displayed under DRV-06 on the LCD keypad.



Note

- Power On Run and Speed Search A fault may be triggered if the VFD starts operation while
 the load is still rotating. With Power On Run enabled, the VFD will begin its operation in a
 normal V/F pattern and accelerate the motor. To prevent faults, set speed search CN-71, bit
 4 to 1. The VFD will perform a speed search at the beginning of the operation.
- With Power On Run not enabled, if the VFD has a run command enabled upon power up, it
 will not start. The digital input (Run command) must first be de-activated and reapplied to
 begin operation.

① Caution

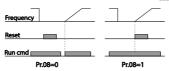
With Power On Run enabled and a Run command applied, the motor will begin rotating as soon as the VFD powers up

4 9 Reset and Restart

The VFD can be set to automatically reset faults and restart operations. See caution below. When Pr.08 is set to 1 (yes) and a nun command remains enabled, the VFD will reset the fault and restart. The number of restarts is set with Pr.09 (# of restarts) and the delay time between each restart is set with Pr.10 (restart delay time). When a fault occurs, the VFD cuts off the output and the motor will free-run. Another fault may be trigagered if the VFD begins its operation while motor load is in a free-run state.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Operation	drv	Command source	Cmd Source*	1 2	Fx/Rx-1 or Fx/Rx-2	0-5	-
	80	Reset restart setup	RST Restart	1	Yes	0-1	
Pr	09	No. of auto restart	Retry Number	0		0–10	
	10	Auto restart delay time	Retry Delay	1.0		0-60	sec

^{*} Displayed under DRV-06 in an LCD keypad.



Note

- Automatic Reset/Restart and Speed Search: A fault may be triggered if the VFD starts operation while the load is still rotating. With Automatic reset/restart enabled, the VFD will begin its operation in a normal V/F pattern and accelerate the motor. To prevent faults, set speed search CN-71, bit 2 to 1. The VFD will perform a speed search at the beginning of the operation.
- With automatic reset/restart not enabled, if the VFD has a run command enabled during a
 fault reset, it will not start. The digital input (Run command) must first be de-activated and
 reapplied to begin operationTo prevent a repeat fault trip from occurring, set Cn.71 (speed
 search options) bit 2 equal to 1. The VFD will perform a speed search at the beginning of the
 operation.

① Caution

With Automatic Reset/Restart enabled and a Run command applied, the motor will begin rotating as soon as the VFD is reset.

4.10 Setting Acceleration and Deceleration Times

4.10.1 Acc/Dec Time Based on Maximum Frequency

Acc/Dec times are based on maximum frequency (bA.08 set to 0 (MaxFreq)), not on VFD operating frequency. Acceleration time set at ACC refers to the time required for the VFD to reach the maximum frequency from a stopped (0 Hz) state. Likewise, deceleration time set at dEC refers to the time required to decelerate from the maximum frequency to a stopped state (0 Hz).

Group	Code	Name	LCD Display	Param	neter Setting	Setting Range	Unit
0	ACC	Acceleration time	Acc Time	20.0		0.0-600.0	sec
Operation	dEC	Deceleration time	Dec Time	30.0		0.0-600.0	sec
dr	20	Maximum frequency	Max Freq	60.00		40.00-400.00	Hz
bA	08	Acc/Dec reference frequency	Ramp T Mode	0	Max Freq	0–1	-
	09	Time scale	Time scale	1	0.1sec	0-2	-

Acc/Dec Time Based on Maximum Frequency - Setting Details

Set the parameter value to 0 (Max Freq) to setup Acc/Dec time based on maximum frequency. Configuration Description						
maximum frequency. Configuration Description	Code	Description				
Configuration Description O Max Freq Set the Acc/Dec time based on maximum frequency. 1 Delta Freq Set the Acc/Dec time based on operating frequency. If, for example, maximum frequency is 60.00Hz, the Acc/Dec times are set to 5 seconds, and the frequency reference for operation is set at 30Hz (half of 60Hz), the time required to reach 30Hz therefore is 2.5 seconds (half of 5 seconds). Max Freq. Wax Freq. Use the time scale for all time-related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended. Configuration Description O 0.01sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.						
0 Max Freq Set the Acc/Dec time based on maximum frequency. 1 Delta Freq Set the Acc/Dec time based on operating frequency. 1 If, for example, maximum frequency is 60.00Hz, the Acc/Dec times are set to 5 seconds, and the frequency reference for operation is set at 30Hz (half of 60Hz), the time required to reach 30Hz therefore is 2.5 seconds (half of 5 seconds). Max. Freq. Frequency Run cmd Use the time scale for all time-related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended. Configuration Description 0 0.01sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.		maximum frequency.				
0 Max Freq Set the Acc/Dec time based on maximum frequency. 1 Delta Freq Set the Acc/Dec time based on operating frequency. 1 If, for example, maximum frequency is 60.00Hz, the Acc/Dec times are set to 5 seconds, and the frequency reference for operation is set at 30Hz (half of 60Hz), the time required to reach 30Hz therefore is 2.5 seconds (half of 5 seconds). Max. Freq. Frequency Run cmd Use the time scale for all time-related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended. Configuration Description 0 0.01sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.		C C !!	D 12			
maximum frequency. 1 Delta Freq Set the Acc/Dec time based on operating frequency. If, for example, maximum frequency is 60.00Hz, the Acc/Dec times are set to 5 seconds, and the frequency reference for operation is set at 30Hz (half of 60Hz), the time required to reach 30Hz therefore is 2.5 seconds (half of 5 seconds). Max Freq. Frequency Bun cmd Use the time scale for all time-related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended. Configuration Description O 0.01sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.						
1 Delta Freq Set the Acc/Dec time based on operating frequency. If, for example, maximum frequency is 60.00Hz, the Acc/Dec times are set to 5 seconds, and the frequency reference for operation is set at 30Hz (half of 60Hz), the time required to reach 30Hz therefore is 2.5 seconds (half of 5 seconds). Max. Freq. Frequency Run.cmd Use the time scale for all time-related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended. Decription Configuration Description Description Outsec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.		U Max Freq				
bA.08 Ramp T Mode If, for example, maximum frequency is 60.00Hz, the Acc/Dec times are set to 5 seconds, and the frequency reference for operation is set at 30Hz (half of 60Hz), the time required to reach 30Hz therefore is 2.5 seconds (half of 5 seconds). Max. Freq. Use the time scale for all time-related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended. Configuration Description O 0.01sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.11 second as the minimum unit.		1 Dolta From				
If, for example, maximum frequency is 60.00Hz, the Acc/Dec times are set to 5 seconds, and the frequency reference for operation is set at 30Hz (half of 60Hz), the time required to reach 30Hz therefore is 2.5 seconds (half of 5 seconds). Max. Freq. Frequency Run cmd Use the time scale for all time-related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended. Configuration Description O 0.01sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.		1 Delta Freq				
bA.08 Ramp T Mode Seconds, and the frequency reference for operation is set at 30Hz (half of 60Hz), the time required to reach 30Hz therefore is 2.5 seconds (half of 5 seconds). Max. Freq. Frequency Run cmd Use the time scale for all time-related values. It is particularly useful when a more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended. Configuration Description O 0.01sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.11 second as the minimum unit.			operating frequency.			
more accurate Acc/Dec times are required because of load characteristics, or when the maximum time range needs to be extended. bA.09 Time scale Configuration Description 0.001sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.		5 seconds, and the freq 60Hz), the time require seconds). Max. Freq. Frequency Run.cmd Acc. time	uency reference for operation is set at 30Hz (half of t to reach 30Hz therefore is 2.5 seconds (half of 5			
or when the maximum time range needs to be extended. Description De						
Description Description Description Outset Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.						
0 0.01sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.		or when the maximum	time range needs to be extended.			
0 0.01sec Sets 0.01 second as the minimum unit. 1 0.1sec Sets 0.1 second as the minimum unit.	hA 00 Time scale	Configuration	Description			
1 0.1sec Sets 0.1 second as the minimum unit.	DA.05 TITLE SCALE					
		2 1sec				

① Caution

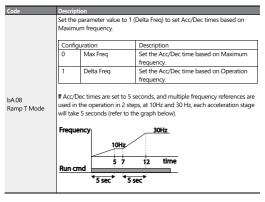
Note that the range of maximum time values may change automatically when the units are changed. If for example, the acceleration time is ext at 6000 seconds, a time scale change from 1 second to 10.1 second will result in a modified acceleration time of 60.00 seconds.

4.10.2 Acc/Dec Time Based on Operation Frequency

Acc/Dec times can be set based on the time required to reach the next step frequency from the existing operating frequency. Set bA.08 (Acc/Dec reference frequency) to 1 (Delta Freq).

Group	Cod e	Name	LCD Display	Para	meter Setting	Setting Range	Unit
0	ACC	Acceleration time	Acc Time	20.0	1	0.0-600.0	sec
Operation	dEC	Deceleration time	Dec Time	30.0	1	0.0-600.0	sec
bA	08	Acc/Dec reference	Ramp T Mode	1	Delta Freq	0–1	-

Acc/Dec Time Based on Operation Frequency - Setting Details



4.10.3 Multi-step Acc/Dec Time Configuration

Digital input terminals can be configured for different Acc and Dec times. Up to 7 acceleration times and 7 deceleration times can be set. Choose (up to 3) digital input terminals (P1 ~ P5) and set the corresponding parameters (In.65~In.69) to 11 (XCEL-I), 12 (XCEL-M) and 49 (XCEL-H). These are recognized as binary inputs (000 ~ 111). Acc times and Dec times are set with bA.70 through bA.83.

Group	Code	Name LCD Display			ameter ting	Setting Range	Unit
0	ACC	Acceleration time	Acc Time	20.	0	0.0-600.0	sec
Operation	dEC	Deceleration time	Dec Time	30.	0	0.0-600.0	sec
	70– 82	Multi-step acceleration time1–7	Acc Time 1–7	Acc Time 1–7 x.xx		0.0–600.0	sec
bA	71– 83	Multi-step deceleration time1–7	Dec Time 1–7	х.хо	<	0.0–600.0	sec
ln	65– 69	Px terminal configuration	Px Define (Px: P1–P5)	11 12 49	XCEL-L XCEL-M XCEL-H	0~54	_
	89	Multi-step command delay time	In Check Time	1		1–5000	ms

Acc/Dec Time Setup via Multi-function Terminals – Setting Details

Code	Descript	tion			
bA. 70–82 Acc Time 1–7	Set multi-step acceleration time1-7.				
bA.71–83 Dec Time 1–7	Set mul	ti-step deceleration	time1-7.		
	inputs.	and configure the to	erminals to use for multi-step Acc/Dec time Description		
	11	XCEL-L	Acc/Dec command-L		
	12	XCEL-M	Acc/Dec command-M		
	49	XCEL-H	Acc/Dec command-H		
			ognized as binary code inputs and will deceleration based on parameter values set		
In.65-69	with bA.70–82 and bA.71–83.				
Px Define (P1–P5)	If, for example, the P4 and P5 terminals are set as XCEL-L and XCEL-M respectively, the following operation will be available.				
	P4 P5 Run cm		Dec0 Dec1		

Code	Description				
	Acc/Dec time	P5	P4		
	0	-	-		
	1	=	✓		
	2	✓	-		
	3	✓	✓		
In.89 In Check Time	Set the time for the VFD 100ms and a signal is su	pplied to the P4 termina	l, the VFD searches for		
	other inputs over the next 100ms. When the time expires, the Acc/Dec				
	time will be set based on the input received at P4.				

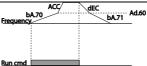
4.10.4 Configuring Acc/Dec Time Switch Frequency

You can set a switch frequency (Ad.60) to switch between 2 different Accel times and 2 different Decel times. Parameters bA.70 (step accel time1) and bA.71 (step decel time1) are in effect below the switch frequency. Parameters ACC (Accel time) and Dec (Decel time) are in effect above the switch frequency.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	ACC	Acceleration time	Acc Time	10.0	0.0-600.0	sec
Operation	dEC	Deceleration time	Dec Time	10.0	0.0-600.0	sec
bA	70	Multi-step acceleration time1	Acc Time-1	20.0	0.0-600.0	sec
DA	71	Multi-step deceleration time1	Dec Time-1	20.0	0.0-600.0	sec
bA	69	Acc/Dec time switch frequency	Xcel Change Frq	30.00	0-Maximum frequency	Hz

Acc/Dec Time Switch Frequency Setting Details

Code	Description
bA.69 Xcel Change Fr	Set the Acc/Dec transition frequency (bA.69). Acc/Dec gradients configured at bA.70 and bA.71 will be used when the VFD's operating frequency is at or below the switch frequency. When the operating frequency exceeds the switch frequency, Acc/Dec gradients configured at ACC and dEC will be used. If you configure any of the P1-P5 digital input terminals for multi-step Acc/Dec gradients (XCEL-L, XCEL-M, XCEL-H), bA.69 Acc/Dec switch frequency will not operate.



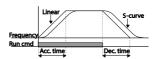
4.11 Acc/Dec Pattern Configuration

A Linear Accel and Decel pattern features a linear increase (and decrease) of the output frequency at a fixed rate. An S-curve pattern provides a smoother and more gradual increase (and/or decrease) of output frequency. Acc/Dec gradient level patterns can be configured to enhance and smooth the VFD's acceleration and deceleration curves. This is ideal for lift-type loads or elevators. An S-curve can be set with Ad.01 (accel) and Ad.02 (decel) and gradient levels can be adjusted using Ad.03 ~ Ad.06.

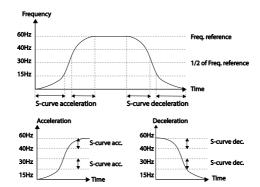
Group	Code	Name	LCD Display	Para Sett	meter ing	Setting Range	Unit
bA	08	Acc/Dec reference	Ramp T mode	0	Max Freq	0–1	-
	01	Acceleration pattern	Acc Pattern	0	Linear	0-1	-
	02	Deceleration pattern	Dec Pattern	1	S-curve	0-1	-
	03	S-curve Acc start gradient	Acc S Start	40		1–100	%
Ad	04	S-curve Acc end gradient	Acc S End	40		1–100	%
	05	S-curve Dec start gradient	Dec S Start	40		1–100	%
	06	S-curve Dec end gradient	Dec S End	40		1–100	%

Acc/Dec Pattern Setting Details

Code	Description
Ad.03 Acc S Start	Ad.03 sets the gradient level at the start of the acceleration curve. The set percentage applies to 50% below the first half of the total acceleration curve. When the frequency reference is set at 60 Hz and Ad.03 is set to 50%, S-Curve acceleration will be applied to 0–15 Hz. (50% below half the reference frequency). Linear acceleration will be applied to the 15-30 Hz section.
Ad.04 Acc S End	Ad.04 sets the gradient level at the end of the acceleration curve. The set percentage applies to the second half of the total acceleration curve where operating frequency is reaching the reference frequency. When the reference frequency is 60 Hz. and Ad.04 is set to 50%, S-Curve acceleration will be applied to 45-60 Hz. (50% above half the reference frequency). Linear acceleration will be applied to the 308°45 Hz. section.
Ad.05 Dec S Start	Sets the gradient level at the start of S-curve deceleration. S-Curve deceleration is applied to the portion of the deceleration curve that is 50% above half the reference frequency (60-45 Hz.). Same as S-Curve End acceleration.
Ad.06 Dec S End	Sets the gradient level at the end of S-curve deceleration. S-Curve deceleration is applied to the portion of the deceleration curve that is 50% below half the reference frequency (15-0 Hz.). Same as S-Curve start acceleration.



[Acceleration / deceleration pattern configuration]



[Acceleration / deceleration S-curve parrten configuration]

① Caution

The Actual Acc/Dec time during an S-curve application

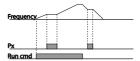
The actual Acc/Dec times become greater than user defined Acc/Dec times when S-curve Acc/Dec patterns are applied. Example:

The Actual Acc/Dec time during an S-curve application Actual acceleration time = ACC + (ACC \times Ad 03/2) + (ACC \times Ad 04/2) Settings: ACC = 10 secs, Ad 03 = 50%, Ad 04 = 50% Actual acceleration time = 10 + (10 \times .5/2) + (10 \times .5/2) = 15 secs. Actual deceleration time = Dec + (Dec \times Ad 05/2) + (Dec \times Ad 06/2).

4.12 Stopping the Acc/Dec Operation

Configures a digital input terminal to stop acceleration or deceleration and operate the VFD at a fixed frequency.

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
In	65-	Px terminal	Px Define(Px: P1-	25	XCEL Stop	0~54	-
	69	configuration	P5)				



4.13 V/F (Voltage/Frequency) Control

Configure the VFD's output voltages, gradient levels and output patterns to achieve a target output frequency with V/F control. The amount of of torque boost used during low frequency operations can also be adjusted.

4.13.1 Linear V/F Pattern Operation

A linear V/F pattern (also refered to as scaler V/Hz), configures the VFD output voltage and frequency to increase or decrease at a fixed rate throughout the speed range. This V/F characteristic is refered to as a constant V/F ratio (or V/Hz) and is applied to loads that require constant torque regardless of the speed.

Group	Code	Name	LCD Display	Paramete	r Setting	Setting Range	Unit
dr	09	Control mode	Control Mode	0	V/F	0-4	-
	18	Base frequency	Base Freq	60.00		30.00-400.00	Hz
	19	Start frequency	Start Freq	0.50		0.01-10.00	Hz
bA	07	V/F pattern	V/F Pattern	0	Linear	0-3	-

Linear V/F Pattern Setting Details

Code	Description
dr.18 Base Freq	Sets the base frequency. A base frequency is the VFD's output frequency when running at its rated voltage. Refer to the motor's nameplate to set this parameter value.
dr.19 Start Freq	Sets the start frequency. A start frequency is a frequency at which the VFD starts voltage output. The VFD does not produce output voltage while the frequency reference is lower than the set frequency. However, if a deceleration stop is made while operating above the start frequency, output voltage will continue until the operation frequency reaches a full-stop (OHz). Base Freq Frequency Start Freq Inverter's rated voltage Voltage Run cmd

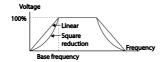
4.13.2 Square Reduction V/F pattern Operation

Square reduction V/F pattern is ideal for variable torque loads such as fans and pumps that do not require high torque at frequencies lower than base frequency. The VFD provides a non-linear V/F acceleration and deceleration pattern to sustain enough torque throughout the speed range.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
L.A	07 V/F pattern	ME	VE D	1	Square	0.3	
bA		V/F Pattern	3	Square2	0-3	-	

Square Reduction V/F pattern Operation - Setting Details

Code	Description					
	Sets the parameter value to 1(Square) or 3(Square2) according to the lo start characteristics.					
	Setting		Function			
bA.07 V/F Pattern	1	Square	The VFD produces output voltage proportional to 1.5 square of the operation frequency.			
	3	Square2	The VFD produces output voltage proportional to 2			
			square of the operation frequency. This setup is ideal			
			for variable torque loads such as fans or pumps.			



4.13.3 User V/F Pattern Operation

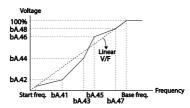
The SW Series VFD allows the configuration of user-defined V/F patterns to suit the load characteristics of special motors.

Group	Code	Name	LCD Display	Para Sett	imeter ing	Setting Range	Unit
	07	V/F pattern	V/F Pattern	2	User V/F	0-3	-
	41	User Frequency1	User Freq 1	15.0	00	0-Maximum frequency	Hz
	42	User Voltage1	User Volt 1	25		0-100	%
43	43	User Frequency2	User Freq 2	30.0	00	0-Maximum frequency	Hz
bA	44	User Voltage2	User Volt 2	50		0-100	%
	45	User Frequency3	User Freq 3	45.0	00	0–Maximum frequency	Hz
	46	User Voltage3	User Volt 3	75		0-100	%
	47	User Frequency4	User Freq 4		kimum Juency	0-Maximum frequency	Hz
	48	User Voltage4	User Volt 4	100		0-100%	%

User V/F pattern Setting Details

Code	Description
bA.41 User Freq	Set the parameter values to assign arbitrary frequencies (User Freq 1-4) for
1-	start and maximum frequencies. Voltages can also be set to correspond
bA.48 User Volt 4	with each frequency, and for each user voltage (User Volt 1-4).

The 100% output voltage in the figure below is based on the parameter settings of bA.15 (motor rated voltage). If bA.15 is set to 0 it will be based on the input voltage.



Caution

- When a normal induction motor is in use, care must be taken not to configure the output pattern away from a linear V/F pattern. Non-linear V/F patterns may cause insufficient motor torque or motor overheating due to over-excitation.
- When a user V/F pattern is in use, forward torque boost (dr.16) and reverse torque boost (dr.17) do not operate.

4.14 Torque Boost

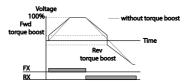
4.14.1 Manual Torque Boost

Manual torque boost enables users to adjust output voltage during starting and low speed operation. This setting improves motor starting properties and increases low speed torque. Configure manual torque boost for loads that require high starting torque.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
	15	Torque boost options	Torque Boost	0	Manual	0-1	-
dr	16	Forward torque boost	Fwd Boost	2.0		0.0-15.0	%
	17	Reverse torque boost	Rev Boost	2.0		0.0-15.0	%

Manual Torque Boost Setting Details

Code	Description
dr.16 Fwd Boost	Set torque boost for forward operation.
dr 17 Rev Boost	Set torque hoost for reverse operation



① Caution

Excessive torque boost will result in over-excitation and motor overheating .

4.14.2 Auto Torque Boost-1

Auto torque boost enables the VFD to automatically calculate the amount of output voltage required for torque boost based on the entered motor parameters. Because auto torque boost requires motor-related parameters such as stator resistance, inductance, and no-load current, auto tuning (bA.20) has to be performed before auto torque boost can be configured [Refer to 5.9 <u>Auto Tuning</u> on page <u>144</u>. Similarly to manual torque boost, configure auto torque boost while running a load that requires high starting torque, such as lift-tope loads.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Dr	15	torque boost mode	Torque Boost	1	Auto1	0-2	-
bA	20	auto tuning	Auto Tuning	3	Rs+Lsigma	0-6	-

4.14.3 Auto Torque Boost-2

In V/F operation, this adjusts the output voltage if starting/running fails due to a low output voltage and a lack of starting torque. It provides a voltage boost to the output voltage via the torque current.

Group	Code	Name		Para Setti	meter ing	Setting Range	Unit
Dr	15	torque boost mode	Torque Boost	2	Auto2	0-2	-

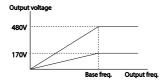
890049-07-00 Learning Basic Features

4.15 Output Voltage Setting

Output voltage settings are required when a motor's rated voltage differs from the input voltage to the VFD. Set bA.15 to configure the motor's rated operating voltage. The set voltage becomes the output voltage of the VFD's base frequency. When the VFD operates above the base frequency, and when the motor's voltage rating is lower than the input voltage at the VFD, the VFD adjusts the voltage and supplies the motor with the voltage set at bA.15 (motor rated voltage). If the motor's rated voltage is higher than the input voltage at the VFD, the VFD will supply the VFD input voltage to the motor.

If bA.15 (motor rated voltage) is set to 0, the VFD corrects the output voltage based on the input voltage in the stopped condition. If the frequency is higher than the base frequency, when the input voltage is lower than the parameter setting, the input voltage will be the VFD output voltage.

Group	Code	Name	LCD Dieplay	Parameter Setting	Setting Range	Unit
bA	15	Motor rated voltage	Motor Volt	0	0, 170-480	٧



4.16 Start Mode Setting

Select a start mode to use when the run command is applied with the motor in the stopped condition. Select 0 (acceleration start) or 1 (DC Brake Start). Excitation current (Pre-Excite) can also be applied by activating a dioital input.

4.16.1 Acceleration Start

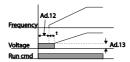
Acceleration start is the typical acceleration mode used when starting a motor from a stopped condition. If there are no other settings applied, the motor accelerates to the frequency reference when the run command is applied.

Group	Code	Name	LCD Display	Paramet Setting	er	Setting Range	Unit
Ad	07	Start mode	Start mode	0	Acc	0–1	-

4.16.2 Start After DC Braking

This start mode supplies a DC voltage and current for a set amount of time to provide DC braking before a VFD starts to accelerate a motor. Use when the motor is rotating due to its inertia, DC braking will stop the motor, allowing the motor to accelerate from a stopped condition. DC braking can also be used when a mechanical brake is connected to a motor shaft and constant torque is required after the release of the mechanical brake. DC braking at start will not operate if the control mode (dr.09) is set to IM Sensoriess.

Group	Code	Name	LCD Display	Param	eter Setting	Setting Range	Unit
	07	Start mode	Start Mode	1	DC-Start	0-1	-
Ad	12	Start DC braking time	DC-Start Time	0.00		0.00-60.00	sec
	13	DC Injection Level	DC Ini Level	50		0-200	%



① Caution

The amount of DC braking required is based on the motor's rated current. If the DC braking current is too high, or brake time is too long, the motor may owerheat or be damaged. The maximum amount of applied DC current is limited to the VFD rated current.

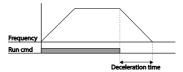
4.17 Stop Mode Setting

Select a stop mode to stop the VFD operation. Select 0 (deceleration), 1 (DC Brake), 2 (Free-Run (coast)) or 4 (Power Braking).

4.17.1 Deceleration Stop

Deceleration stop is the typical deceleration mode used when stopping a motor. If there are no other settings applied, the VFD decelerates the motor from the frequency reference down to 0 Hz and stops.

Group	Code	Name	LCD Display	Parameter	Setting	Setting Range	Unit
Ad	08	Stop mode	Stop Mode	0	Dec	0-4	-



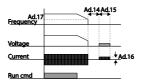
4.17.2 Stop After DC Braking

DC Braking can be applied to the motor during deceleration. The VFD stops the motor by supplying DC power to the motor. Settings include a delay time, a brake time, a brake current level and a brake frequency. During deceleration, when the VFD output frequency reaches the DC braking frequency, the VFD supplies DC voltage to the motor and stops it.

Group	Code	Name	LCD Display	Paramo Setting		Setting Range	Unit
	08	Stop mode	Stop Mode	0	Dec	0-4	-
	14	Output block time before braking	DC-Block Time	0.10		0.00-60.00	sec
Ad	15	DC braking time	DC-Brake Time	1.00		0-60	sec
	16	DC braking amount	DC-Brake Level	50		0-200	%
	17	DC braking frequency	DC-Brake Freq	5.00		0.00-60.00	Hz

DC Braking After Stop Setting Details

Code	Description
Ad.14 DC-Block Time	when the VFD applies DC voltage to the motor. To prevent overcurrent
	faults, adjust the delay time before DC braking.
Ad.15 DC-Brake Time	Set the time duration for the DC voltage supply to the motor.
Ad.16 DC-Brake Level	Set the amount of DC braking to apply. The parameter setting is based on the rated current of the motor. The maximum value of the DC braking current is limited to the VFD rated current. Maximum Dc-Brake Level = Rated Current of VFD/Rated Current of Motor x 100%.
Ad.17 DC-Brake Freq	Set the DC Brake frequency to start DC braking. When the VFD output frequency is reached, the VFD starts DC Braking. If the dwell frequency is set lower than the DC braking frequency, dwell operation will not work and DC braking will start instead.



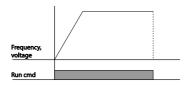
① Caution

 Note that the motor can overheat or be damaged if excessive amount of DC braking is applied to the motor, or DC braking time is set too long.

4.17.3 Free Run Stop

When the run command is removed, the VFD output turns off and the motor/load coasts to a stop.

Group	Code	Name		Param Settin		Setting Range	Unit
Ad	08	Stop Method	Stop Mode	2	Free-Run	0-4	-



① Caution

Note: With high inertia loads, the load's inertia will cause the motor to continue rotating. The VFD does not control the motor during Free-Run.

90049-07-00 Learning Basic Features

4.17.4 Power Braking

Power Braking is applied during deceleration when the VFDs DC voltage rises above a specified level due to motor regenerated energy. The VFD determines the optimum deceleration rate and will adjust the deceleration time or will reaccelerating the motor. Power braking can be used when short deceleration times are needed without brake resistors or when optimum deceleration is needed without causing an over voltage fault

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
Ad	08	Stop mode	Stop Mode	4	Power Braking	0-4	-

① Caution

- To prevent overheating or damaging the motor, do not apply power braking to the loads that require frequent deceleration.
- Stall prevention and power braking only operate during deceleration.
- Power braking takes priority over stall prevention. In other words, when both bit3 and bit4 of Pr50 (stall prevention and flux braking) are set, power braking will take precedence and operate.
- Note if deceleration time is too short or inertia of the load is too great, an overvoltage fault stll may occur.
- Note when power braking is used, the actual deceleration time can be longer than the preset deceleration time.

4.18 Frequency Limit

The VFD output frequency can be limited by setting frequency limit parameters. These include start frequency, maximum frequency, upper and lower frequency limits. Frequency Limit Using Maximum Frequency and Start Frequency

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	19	Start frequency	Start Freq	0.50	0.01-10.00	Hz
dr	20	Maximum	Max Freq	60.00	40.00-400.00	Hz

Frequency Limit Using Maximum Frequency and Start Frequency - Setting Details

Code	Description
	Set the lower limit value for speed unit parameters that are expressed in Hz
dr.19 Start Freq	or rpm. If an input frequency is lower than the start frequency, the parameter
	value will be 0.00.
dr.20 Max Freq	Set upper and lower frequency limits. All frequency selections are restricted to frequencies from within the upper and lower limits. This restriction also applies when you in input a frequency reference using the 7-Segment display.

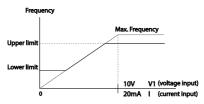
4.18.1 Fre	equency Limit	Using Upper a	nd Lower Lim	it Frequency	Values
------------	---------------	---------------	--------------	--------------	--------

Group	Code	Name	LCD Display	Param Settin		Setting Range	Unit
	24	Frequency limit	Freq Limit	0	No	0-1	-
Ad	25	Frequency lower limit value	Freq Limit Lo	0.50		0.0-maximum frequency	Hz
Ad	26	Frequency upper limit value	Freq Limit Hi	Maximum frequency		minimum– maximum frequency	Hz

Frequency Limit Using Upper and Lower Limit Frequencies - Setting Details

Code	Description
Ad.24 Freq Limit	When set to 1 (Yes), frequency limits can be applied to the output of the VFD. Frequencies can be set above the minimum and below the maximum frequency to operate within the specified range.
Ad.25 Freq Limit Lo, Ad.26 Freq Limit Hi	Set the lower and upper limits of the VFD output frequencies. The base frequency (dr.18) still remains as the output frequency at motor rated voltage.

without upper / lower limits



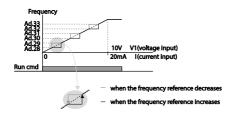
4,18,2 Frequency Jump

Use frequency jump to avoid mechanical resonance frequencies. Jump through up to three frequency bands during acceleration and deceleration. Reference frequencies cannot be set within the pre-set jump frequency band.

When the reference frequency is increased it will be maintained at the lower limit of a jump frequency band. As the reference frequency continues to increase and exceeds the range of a jump frequency band, the jump to the upper limit of the jump frequency band. Decreasing reference frequencies operate in the same

manner, jumping from upper limit to lower limit. Jump frequencies apply to all reference frequency sources (voltage, current, RS-485 communication, keypad setting).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
	27	Frequency jump	Jump Freq	0	No	0–1	-
	28	Jump frequency lower limit1	Jump Lo 1	10.00		0.00–Jump frequency upper limit 1	Hz
	29	Jump frequency upper limit1	Jump Hi 1	15.00		Jump frequency lower limit 1–Maximum frequency	Hz
Ad	30	Jump frequency lower limit 2	Jump Lo 2	20.00		0.00–Jump frequency upper limit 2	Hz
	31	Jump frequency upper limit 2	Jump Hi 2	25.00		Jump frequency lower limit 2–Maximum frequency	Hz
	32	Jump frequency lower limit 3	Jump Lo 3	30.00		0.00–Jump frequency upper limit 3	Hz
	33	Jump frequency upper limit 3	Jump Hi 3	35.00		Jump frequency lower limit 3–Maximum frequency	Hz



4.19 Auxiliary (2nd) Operation Mode Setting

Auxiliaray (2^{no}) Operation Mode is commonly referred to as Hand-Off-Auto switching or Local-Off-Remote switching. The VFD can be operated (Start/Stop and Reference frequency) with two types of operating modes and switch between them as required. The first Start/Stop source and Reference Frequency source are set with parameters drv and Frq in the Operations group. The second Start/Stop source and Reference Frequency source are set with parameters bAO1 and bAO2. A digital input terminal set to 15, Aux (2^{no}) Source will provide the switching input. Set the reference frequency after switching between operating modes as the VFD will run at the selected reference frequency.

Select one of the digital input terminals (P1~P5) and set the corresponding parameter (In.65 ~ In.69) to 15 (Aux (2^m) Source). When the digital input is open (or off), parameters drv and Frq operate the VFD (start/stop and speed). When the input is closed (or on), parameters bA.01 and bA.02 operate the VFD (start/stop and speed).

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
0	drv	Command source	Cmd Source*	1	Fx/Rx-1	0-5	-
Oper ation	Frq	Frequency reference source	Freq Ref Src**	2	V1	0–12	-
l. A	01	Command Aux (2 nd) source	Cmd Aux Src	0	Keypad	0–4	-
bA	02	Frequency Aux (2 nd) reference source	Freq Aux Src	0	KeyPad-1	0-12	-
ln	65–69	Px terminal configuration	Px Define (Px: P1-P5)	15	Aux (2 nd) Source	0~54	-

^{*} Displayed under DRV-06 in LCD keypad.

Auxiliary (2nd) Operation Mode Setting Details

Code	Description
(2nd) Src bA.02 Freq Aux	Select a 2nd Start/Stop source (bA.01) and a 2nd Reference Frequency source (bA.02). When the digital input is closed (or on), parameters bA.01 and bA.02 operate the VFD. The Aux (2 ^{rm}) command source settings cannot be changed while operating with the 1st command source (Main Source).

① Caution

Before switching operating modes using Aux (2nd) source, check the Aux (2nd) command source (Start/Stop input). The operating state will change if the Start/Stop input is closed (On). Before switching, ensure that the Aux (2nd) command source is correctly set.

 Depending on the parameter settings, the VFD may stop operating when you switch the command modes.

^{**} Displayed under DRV-07 in LCD keypad.

4.20

Multi-function Input Terminal Control

Filter time constants (On Delay and Off Delay) can be applied independently to the digital inputs. Longer time settings will delay the response of the input. Additionally, the digital inputs can be configured independently as a normally open input or a normally closed input. The status of the inputs can be viewed at In.90.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	85	Multi-function input terminal On filter	DI On Delay	10	0-10000	ms
la.	86	Multi-function input terminal Off filter	DI Off Delay	3	0-10000	ms
In	87	Multi-function input terminal selection	DI NC/NO Sel	0 0000*	-	-
	90	Multi-function input terminal status	DI Status	0 0000*	=	

^{*} Displayed as On the 7-Segment display.

	minai Contro	Setting Details		
Code	Description			
	deactivated, the		ues set at In.85 and In.86. If fault values at In.85 and In.86. If 36 are set to the corresponding	
In.84 DI Delay Sel	Туре	B terminal status (Normally Closed)	A terminal status (Normally Open)	
	7-Segment display	B	B	
	LCD keypad			
In.85 DI On Delay, In.86 DI Off Delay	Set the delay times for the selected terminals in In.84. When the terminal receives a change of state input it is recognized as On or Off after the set time.			
In.87 DI NC/NO	segment corre bottom segm terminal (Norr the terminal is	Il contact types for each input t asponds to an A (open) or B (cl. ent on, it indicates that the tern mally Open) contact. With the to configured as a B terminal (No numbered P5~P1, from right to	osed) contact input. With the ninal is configured as an A op segment on, it indicates that ormally Closed) contact.	
Sel	Туре	B terminal status (Normally Closed)	A terminal status (Normally Open)	
	7-Segment display	8	8	
	LCD keypad			
In.90 DI Status	Display the sta	atus of each contact. When a di	gital input is configured as an A	

Code	Description	Description				
	segment turne segment is tur terminal, the s	type terminal using dr.87, the On (closed) condition is indicated by the top segment turnedg on The Off condition is indicated when the bottom segment is turned on. When a digital input is configured as a B type terminal, the segment lights behave conversely. Terminals are numbered P5-P1, from right to left.				
	P5~P1, from r					
	Type	A terminal setting (On)	A terminal setting (Off)			
	7-Segment display	8	8			
	LCD keypad					

4.21 **P2P Setting**

The P2P function is used to share input and output devices between multiple VFDs. To enable P2P setting, RS-485 communication must be turned on .

VFDs connected through P2P communication are designated as either a master or slaves. The Master VFD controls the input and output of slave VFDs. Slave VFDs provide input and output actions. When using the multi-function output, a slave VFD can select to use either the master VFD's output or its own output. When using P2P communication, first designate the slave VFD and then the master VFD. If the master VFD is designated first, connected VFDs may interpret the condition as a loss of communication.

Master Parameter

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
СМ	95	P2P Communication selection	Int 485 Func	1	P2P Master	0–3	-
	80	Analog input1	P2P In V1	0		0-12,000	%
	81	Analog input2	P2P In I2	0		-12,000- 12,000	%
US	82	Digital input	P2P In DI	0		0-0x7F	bit
	85	Analog output	P2P Out AO1	0		0-10,000	%
	88	Digital output	P2P Out DO	0		0-0x03	bit

Slave Parameter

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
CM	95	P2P Communication selection	Int 485 Func	2	P2P Slave	0–3	-
	96	P2P DO setting selection	P2P OUT Sel	0	No	0–2	bit

P2P Setting Details

Code	Description
CM.95 Int 485 Func	Set master VFD to 1(P2P Master), slave VFD to 2(P2P Slave).
US.80-82 P2P Input Data	Input data sent from the slave VFD.
US.85, 88 P2P Output Data	Output data transmitted to the slave VFD.

① Caution

- P2P features work only with code version 1.00, IO S/W version 0.11, and LCD keypad S/W version 1.07 or higher versions.
- · Set the user sequence functions to use P2P features...

4.22 Multi-keypad Setting

Use multi-keypad settings to control more than one VFD with one LCD keypad. To use this function, first configure RS-485 communication.

The group of VFDs to be controlled by the keypad will include a master VFD. The master VFD monitors the other VFDs, and slave VFD responds to the master VFD's input. When using multi-function output, a slave VFD can select to use either the master VFD's output or its own output. When using the multi keypad, first designate the slave VFD and then the master VFD. If the master VFD is designated first, connected VFDs may interpret the condition as a loss of communication.

Master Parameter

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
СМ	95	P2P Communication selection	Int 485 Func	3	KPD-Ready	0–3	1
	03	Multi-keypad ID	Multi KPD ID	3		3-99	-
CNF	42	Multi-function key selection	Multi Key Sel	4	Multi KPD	0–4	-

Slave Parameter

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
	01	Station ID	Int485 St ID	3		3-99	-
CM	95	P2P communication options	Int 485 Func	3	KPD-Ready	0–3	-

Multi-keypad Setting Details

cypau octang Details				
Code	Description			
CLARA LARGE CAR	Prevents conflict by designating a unique identification value to a VFD.			
CM.01 Int485 St ID	Values can be selected from numbers between 3–99.			
CM.95 Int 485 Func	Set the value to 3(KPD-Ready) for both master and slave VFD			
CNF-03 Multi KPD	Select a VFD to monitor from the group of VFDs.			
ID	Select a VPD to monitor from the group of VPDs.			
CNF-42 Multi key	Select a multi-function key type 4(Multi KPD) .			
Sel	Select a multi-function key type 4(Multi KPD) .			

① Caution

- Multi-keypad (Multi-KPD) features work only with code version 1.00, IO S/W version 0.11, and LCD keypad S/W version 1.07 or higher versions.
- The multi-keypad feature will not work when the multi-keypad ID (CNF-03 Multi-KPD ID) setting is identical to the RS-485 communication station ID (CM-01 Int485 st ID) setting.
- · The master/slave setting cannot be changed while the VFD is operating in slave mode.

890049-07-00 Learning Basic Features

4.23 User Sequence Setting

User Sequence creates a simple sequence from a combination of different function blocks. The sequence can comprise of a maximum of 18 steps using 29 function blocks and 30 void parameters.

1 Loop refers to a single execution of a user configured sequence that contains a maximum of 18 steps. Users can select a Loop Time of between 10-1,000ms.

The codes for user sequences configuration can be found in the US group (for user sequence settings) and the UF group (for function block settings).

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
AP	02	User sequence activation	User Seq En	0	0–1	-
	01	User sequence operation command	User Seq Con	0	0–2	-
	02	User sequence operation time	User Loop Time	0	0–5	-
	11– 28	Output address link1–18	Link UserOut1–18	0	0-0xFFFF	-
US	31– 60	Input value setting1–30	Void Para1–30	0	-9999-9999	-
	80	Analog input 1	P2P In V1(-10-10 V)	0	0–12,000	%
	81	Analog input 2	P2P In I2	0	-12,000	%
	82	Digital input	P2P In D	0	-12,000	bit
	85	Analog output	P2P Out AO1	0	0-0x7F	%
	88	Digital output	P2P Out DO	0	0-0x03	bit
	01	User function 1	User Func1	0	0–28	-
	02	User function input 1-A	User Input 1-A	0	0-0xFFFF	-
	03	User function input 1-B	User Input 1-B	0	0-0xFFFF	-
	04	User function input 1-C	User Input 1-C	0	0-0xFFFF	-
	05	User function output 1	User Output 1	0	-32767-32767	-
	06	User function 2	User Func2	0	0-28	-
UF	07	User function input 2-A	User Input 2-A	0	0-0xFFFF	-
	08	User function input 2-B	User Input 2-B	0	0-0xFFFF	-
	09	User function input 2-C	User Input 2-C	0	0-0xFFFF	-
	10	User function output 2	User Output 2	0	-32767-32767	-
	11	User function 3	User Func3	0	0–28	-
	12	User function input 3-A	User Input 3-A	0	0-0xFFFF	-
	13	User function input 3-B	User Input 3-B	0	0-0xFFFF	-

14	User function input 3-C	User Input 3-C	0	0-0xFFFF	-
15	User function output 3	User Output 3	0	-32767-32767	-
16	Uer function 4	User Func4	0	0-28	-
17	User function input 4-A	User Input 4-A	0	0-0xFFFF	-
18	User function input 4-B	User Input 4-B	0	0-0xFFFF	-
19	User function input 4-C	User Input 4-C	0	0-0xFFFF	-
20	User function output 4	User Output 4	0	-32767-32767	-
21	User function 5	User Func5	0	0-28	-
22	User function input 5-A	User Input 5-A	0	0-0xFFFF	-
23	User function input 5-B	User Input 5-B	0	0-0xFFFF	-
24	User function input 5-C	User Input 5-C	0	0-0xFFFF	-
25	User function output 5	User Output 5	0	-32767-32767	-
26	User function 6 User Func6 0 0–28		0-28	-	
27	User function input 6-A User Input 6-A 0 0-0		0-0xFFFF	-	
28	User function input 6-B	User Input 6-B	0	0-0xFFFF	-
29	User function input 6-C	User Input 6-C	0	0-0xFFFF	-
30	User function output 6	User Output 6	0	-32767-32767	-
31	User function 7	User Func7	0	0-28	-
32	User function input 7-A	User Input 7-A	0	0-0xFFFF	-
33	User function input 7-B	User Input 7-B	0	0-0xFFFF	-
34	User function input 7-C	User Input 7-C	0	0-0xFFFF	-
35	User function output 7	User Output 7	0	-32767-32767	-
36	User function 8	User Func8	0	0-28	-
37	User function input 8-A	User Input 8-A	0	0-0xFFFF	-
38	User function input8-B	User Input 8-B	0	0-0xFFFF	-
39	User function input 8-C	User Input 8-C	0	0-0xFFFF	-
40	User function output 8	User Output 8	0	-32767–32767	-
41	User function 9	User Func9	0	0-28	-
42	User function input 9-A	User Input 9-A	0	0-0xFFFF	-
43	User function input 9-B	User Input 9-B	0	0-0xFFFF	-
44	User function input 9-C	User Input 9-C	0	0-0xFFFF	
45	User function output 9	User Output 9	0	-32767–32767	-
46	User function 10	User Func10	0	0–28	
47	User function input 10-A	User Input 10-A	0	0-0xFFFF	_
48	User function input 10-B	User Input 10-B	0	0-0xFFFF	
49	User function input 10-C	User Input 10-C	0	0-0xFFFF	_

50	User function output 10	User Output 10	0	-32767-32767	ļ-
51	User function 11	User Func11	0	0–28	-
52	User function input 11-A	User Input 11-A	0	0-0xFFFF	-
53	User function input 11-B	User Input 11-B	0	0-0xFFFF	-
54	User function input 11-C	User Input 11-C	0	0-0xFFFF	-
55	User function output 11	User Output 11	0	-32767-32767	-
56	User function 12	User Func12	0	0–28	-
57	User function input 12-A	User Input 12-A	0	0-0xFFFF	-
58	User function input 12-B	User Input 12-B	0	0-0xFFFF	-
59	User function input 12-C	User Input 12-C	0	0-0xFFFF	-
60	User function output 12	User Output 12	0	-32767-32767	-
61	User function 13	User Func13	0	0–28	-
62	User function input 13-A	User Input 13-A	0	0-0xFFFF	-
63	User function input 13-B	User Input 13-B	0	0-0xFFFF	-
64	User function input 13-C	User Input 13-C	0	0-0xFFFF	-
65	User function output 13	User Output 13	0	-32767-32767	-
66	User function 14	User Func14	0	0-28	-
67	User function input 14-A	User Input 14-A	0	0-0xFFFF	-
68	User function input14-B	User Input 14-B	0	0-0xFFFF	-
69	User function input 14-C	User Input 14-C	0	0-0xFFFF	-
70	User function output14	User Output 14	0	-32767-32767	-
71	User function 15	User Func15	0	0-28	-
72	User function input 15-A	User Input 15-A	0	0-0xFFFF	-
73	User function input 15-B	User Input 15-B	0	0-0xFFFF	-
74	User function input 15-C	User Input 15-C	0	0-0xFFFF	-
75	User function output 15	User Output 15	0	-32767-32767	-
76	User function 16	User Func16	0	0–28	-
77	User function input 16-A	User Input 16-A	0	0-0xFFFF	-
78	User function input 16-B	User Input 16-B	0	0-0xFFFF	-
79	User function input 16-C	User Input 16-C	0	0-0xFFFF	-
80	User function output 16	User Output 16	0	-32767-32767	-
81	User function 17	User Func17	0	0–28	-
82	User function input 17-A	User Input 17-A	0	0-0xFFFF	-
83	User function input 17-B	User Input 17-B	0	0-0xFFFF	-
84	User function input 17-C	User Input 17-C	0	0-0xFFFF	-
85	User function output 17		-32767-32767	-	

86	User function 18	User Func18	0	0–28	
87	User function input 18-A	User Input 18-A	0	0-0xFFFF	-
88	User function input 18-B	User Input 18-B	0	0-0xFFFF	
89	User function input 18-C	User Input 18-C	0	0-0xFFFF	-
90	User function output 18	User Output 18	0	-32767-32767	-

User Sequence Setting Details

e.
ent display.
adjust
s/0.1s/0.5s/1s.
ut value is
ence (Cmd
f the Cmd
meter input is
Jser Output@
d can be used
roup.

Function Block Parameter Structure

OIT BIOCHT I MIMITIOTOL	
Туре	Description
User Func @*	Choose the function to perform in the function block.
User Input @-A	Communication address of the function's first input parameter.
User Input @-B	Communication address of the function's second input parameter.
User Input @-C	Communication address of the function's third input parameter.
User Output @	Output value (Read Only) after performing the function block.

^{* @} is the step number (1-18).

Learning Basic Features

User Function Operation Condition

890049-07-00

Number	Туре	Description
0	NOP	No Operation.
1	ADD	Addition operation, (A + B) + C
	7.00	If the C parameter is 0x0000, it will be recognized as 0.
2	SUB	Subtraction operation, (A - B) — C
_	305	If the C parameter is 0x0000, it will be recognized as 0.
3	ADDSUB	Addition and subtraction compound operation, (A + B) - C
3	ADDSOB	If the C parameter is 0x0000, it will be recognized as 0.
4	MIN	Output the smallest value of the input values, MIN(A, B, C).
4	IVIIIA	If the C parameter is 0x0000, operate only with A, B.
5	MAX	Output the largest value of the input values, MAX(A, B, C).
,	IVIDOC	If the C parameter is 0x0000, operate only with A, B.
6	ABS	Output the absolute value of the A parameter, A .
		This operation does not use the B, or C parameter.
7	NEGATE	Output the negative value of the A parameter, -(A).
		This operation does not use the B, or C parameter.
8	REMAINDER	Remainder operation of A and B, A % B
		This operation does not use the C parameter.
9	NADVDIV	Multiplication, division compound operation, (A x B)/C. If the C parameter is 0x0000, output the multiplication operation of
9	MPYDIV	(A x B).
_		Comparison operation: if (A > B) the output is C; if (A =B) the</td
		output is 0.
10	COMPARE-GT	If the condition is met, the output parameter is C. If the condition is
	(greater than)	not met, the output is 0(False). If the C parameter is 0x0000 and if the
		condition is met, the output is 1(True).
	COLUDIDE	Comparison operation; if (A >/= B) output is C; if (A <b) is<="" output="" td="" the=""></b)>
	COMPARE- GTEQ	0.
11	(great than or	If the condition is met, the output parameter is C. If the condition is
	egual to)	not met, the output is O(False). If the C parameter is 0x0000 and if the
	equal to)	condition is met, the output is 1(True).
		Comparison operation, if(A == B) then the output is C. For all other
	COMPARE-	values the output is 0.
12	EOUAL	If the condition is met, the output parameter is C. if the condition is
		not met, the output is 0(False). If the C parameter is 0x0000 and if the
		condition is met, the output is 1(True).
		Comparison operation, if(A != B) then the output is C. For all other
13	COMPARE-	values the output is 0. If the condition is met, the output parameter is C. If the condition is
15	NEQUAL	not met, the output is 0(False). If the C parameter is 0x0000 and if the
		condition is met, the output is 1(True).
		Adds 1 each time a user sequence completes a loop.
		A: Max Loop, B: Timer Run/Stop, C: Choose output mode.
14	TIMER	If input of B is 1, timer stops (output is 0). If input is 0, timer runs.
		If input of C is 1, output the current timer value.

Numbe	r Type	Description
		If input of C is 0, output 1 when timer value exceeds A(Max) value.
		If the C parameter is 0x0000, C will be recognized as 0.
		Timer overflow Initializes the timer value to 0.
		Sets a limit for the A parameter.
		If input to A is between B and C, output the input to A.
15	LIMIT	If input to A is larger than B, output B. If input of A is smaller than C,
		output C.
		B parameter must be greater than or equal to the C parameter.
16	AND	Output the AND operation, (A and B) and C.
16	AND	If the C parameter is 0x0000, operate only with A, B.
17	OR	Output the OR operation, (A B) C.
17	OR	If the C parameter is 0x0000, operate only with A, B.
18	XOR	Output the XOR operation, (A ^ B) ^ C.
10	AUK .	If the C parameter is 0x0000, operate only with A, B.
19	AND/OR	Output the AND/OR operation, (A andB) C.
15	AND/OR	If the C parameter is 0x0000, operate only with A, B.
		Output a value after selecting one of two inputs, if (A) then B
20	SWITCH	otherwise C.
20	SWITCH	If the input at A is 1, the output will be B. If the input at A is 0, the
		output parameter will be C.
		Test the B bit of the A parameter, BITTEST(A, B).
	BITTEST	If the B bit of the A input is 1, the output is 1. If it is 0, then the output
21		is 0. The input value of B must be between 0–16. If the value is higher
		than 16, it will be recognized as 16. If input at B is 0, the output is
		always 0.
		Set the B bit of the A parameter, BITSET(A, B). Output the changed
		value after setting the B bit to input at A.
22	BITSET	The input value of B must be between 0–16. If the value is higher
		than 16, it will be recognized as 16. If the input at B is 0, the output is
		always 0. This operation does not use the C parameter.
		Clear the B bit of the A parameter, BITCLEAR(A, B). Output the
		changed value after clearing the B bit to input at A.
23	BITCLEAR	The input value of B must be between 0-16. If the value is higher
		than 16, it will be recognized as 16. If the input at B is 0, the output is
		always 0. This operation does not use the C parameter.
		Output the input at A as the B filter gains time constant, B x US-02
		(US Loop Time.
24	LOWPASSFILTER	In the above formula, set the time when the output of A reaches
		63.3%
		C stands for the filter operation. If it is 0, the operation is started.
		P, I gain = A, B parameter input, then output as C.
		Conditions for PI_PROCESS output: C = 0: Const PI,
25	PI CONTROL	C = 1: PI_PROCESS-B >= PI_PROCESS-OUT >= 0,
23	LCONTROL	C = 2: PI_PROCESS-B >= PI_PROCESS-OUT >= -(PI_PROCESS-B),
		P gain = A/100, I gain = 1/(Bx Loop Time),
		If there is an error with PI settings, output -1.

Number	Type	Description
26	PI_PROCESS	A is an input error, B is an output limit, C is the value of Const PI output. Range of C is 0–32,767.
27	Upcounts the pulses and then output the value- UPCOUNT(A, B, C) After receiving a trigger input (A), outputs are upcounted by C conditions. If the B inputs is 1, do not operate and display 0. If the E inputs is 0, operate. If the C parameter is 0, upcount when the input at A changes from to 1. If the C parameter is 1, upcount when the input at A is changed fro 1 to 0. If the C parameter is 2, upcount whenever the input at A changes. Output range is: 0–32767	
28	DOWNCOUNT	Downcounts the pulses and then output the value-DOWNCOUNT(A, B, C). After receiving a trigger input (A), outputs are downcounted by C conditions. If the B input is 1, do not operate and display the initial value of C. If the B input is 0, operate. Downcounts when the A parameter changes from 0 to 1.

Note

The PI process block (PLPROCESS Block) must be used after the PI control block (PLCONTROL Block) for proper PI control operation. PI control operation cannot be performed if there is another block between the two blocks, or if the blocks are placed in an incorrect order.

① Caution

User sequence features work only with code version 1.00, IO S/W version 0.11, and LCD keypad S/W version 1.07 or higher versions.

4.24 Fire Mode Operation

Fire Mode operation is for use in emergency situations. When enabled, Fire Mode allows the VFD to provide continuous operation ignoring the majority of faults. Primarily used for fire pump operation, but can be applied when continuous operation is required due to emergencies.

When enabled, Fire mode forces the VFD to ignore all minor faults and repeats a Reset/Restart of major faults. regardless of the Reset/Restart count limit.

Fire Mode Parameter Settings

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
	80	Fire Mode selection	Fire Mode Sel	1	Fire Mode	0–2	-
0 -1	81	Fire Mode frequency	Fire Mode Freq	0-60		0-60	
	82	Fire Mode run direction	n direction Fire Mode Dir 0–1		0–1		
	83	Fire Mode operation count	Fire Mode Cnt	Not	configurable	-	-
In	65– 69	Px terminal configuration	Px Define (Px: P1– P5)	51 Fire Mode		0~54	-

The VFD runs in Fire mode when Ad. 80 (Fire Mode Sel) is set to '2 (Fire Mode)', and the multi-function terminal (In. 65-69) configured for Fire mode (51: Fire Mode) is turned on. The Fire mode count increases by 1 at Ad. 83 (Fire Mode Count) each time a Fire mode operation is run.

① Caution

Fire mode operation may result in VFD malfunction. Note that Fire mode operation voids the product warranty – the VFD is covered by the product warranty only when the Fire mode count is '0'.

Fire Mode Function Setting Details

Code	Description	Details
Ad.80	Fire mode selection	When set to 1 (Fire Mode), enables Fire Mode operation controlled with a digital input. When set to 2 (Fire Mode Test), allows testing of Fire Mode operation.
Ad.81 Fire Mode frequency	Fire mode frequency reference	The frequency set at Ad. 81 (Fire mode frequency) is used for the VFD operation in Fire mode. The Fire mode frequency takes priority over the Jog frequency, Multi-step frequencies, and the 7-Segment display input frequency.
Ad.82	Fire Mode Run direction	Set the direction of motor rotation during Fire Mode operation.
Ad.83	Fire Mode count	Counts the number of Fire Mode operations. Does not increase count during Fire Mode testing.

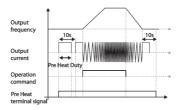
Code	Description	Details
ACC Acc Time Dec Dec Time	Fire mode Acc/Dec times	During Fire Mode operation, the VFD accelerates and decelerates based on the times set in ACC and Dec parameters. When the Px terminal in activated, the VFD accelerates based on the time set in ACC. When the Px terminal is de-activated, the VFD decelerates based on the time set in Dec.
In.65~In.69	Px terminal	Set to 51 (Fire Mode). When the digital input is activated, the
Px terminal	setting	VFD will operate in Fire Mode.
Pr.10 Retry Delay	Fault process	The majority of faults are ignored during Fire mode operation. The fault history is saved. Output relays set to trip functions are disabled. Faults that are ignored in Fire mode BX. External Trip, Low Voltage Trip, Input/Output Open Phase, Motor Overload, Fan Trip, Input/Output Open Phase, Motor Overload, Fan Trip, No Motor Trips, and other minor faults. For the following faults, the VFD performs a Reset/Restart until the trip conditions are cleared. The retry delay time set at Pr. 10 (Retry Delay) applies while the VFD performs a Reset/Restart. Faults that force a Reset/Restart in Fire mode Over Voltage, Over Current I (OCT), Ground Fault The VFD stops operating when the following faults occur: Faults that stop VFD operation in Fire mode H/W Diag, Over Current I (Arm-Short)

4.25 **Pre Heat Function**

The Pre Heat function provides current to the motor to prevent moisture and freezing when not in use. A digital input set to (27) Pre Heat must be activated to start the Pre Heat function. The amount of current (%) set with Ad.34 is based on the motor No-Load current (bA.14). The duty cycle (%) set with Ad.35 is based on 10 second intervals.

Code	Name	LCD Display	Factory Default	Setting Range	Units	Write Mode
In.65~69	P1~P5 define	P1~P5 Define	-	27: Pre Heat	-	Δ
	Pre Heat output					
Ad.34	current	Pre Heat Level	30%	1% ~ 100%	%	0
	Pre Heat output					
Ad.35	Duty	Pre Heat Duty	100%	1% ~ 100%	%	0

The Pre Heat function operates when the digital input is activated. When a start/run command is activated, the Pre Heat function stops even if the Pre Heat input is still activated. The Pre Heat function will resume after the VFD stops and the Pre Heat input is still activated.



Caution

If the value for Ad. 34 Pre Heat Level is set too high or the duty cycle Ad. 35 Pre Heat Duty is set too high (the DC current output time is too long), the motor may overheat or be damaged. The Inverter Overload trip (IOIT) may also activate. Reduce both levels to prevent damage.

4.26 Overmodulation

Improvement of the output voltage drop enables the output voltage operation to gain more output voltage and decrease the output current when the input voltage and overload settings are low.

Parameter Setting for Improvement of Output Voltage Drop

Group	Code	Name	LCD Display	Setting	Range	Initial Value
Ad	87	Overmodulation Mode Selection	OVM Mode Sel	0	No	0: No
				1	Yes	

Code	Description	Details
Ad.87	Overmodulation Mode Selection	Setting Ad.87 (Overmodulation mode selection) to "No" limits the command voltage to the linear output range. Setting Ad.87 to "Vestallows for the output of overmodulation area which extends the range of the command voltage. The output voltage command area will be enlarged for more output voltage.

5 Learning Advanced Features

This chapter describes the advanced features of the S and SW Series VFDs. Check the reference page in the table to see the detailed description for each of the advanced features.

Advanced Tasks	Description	Ref.		
Auxiliary frequency operation	Use the main and auxiliary frequencies in the predefined formulas to create various operating conditions. Auxiliary frequency operation is ideal for Draw Operation* as this feature enables fine-tuning of operation speeds.	<u>p.121</u>		
Jog operation	Jog operation is a kind of a manual operation. The VFD operates to a set of parameter settings predefined for Jog operation, while the Jog command button is pressed.			
Up-down operation	Uses the upper and lower limit value switch output signals (i.e. signals from a flow meter) as Acc/Dec commands to motors.	<u>p.128</u>		
3-wire operation	3-wire operation is used to latch an input signal. This configuration is used to operate the VFD by a push button.	<u>p.132</u>		
Safety operation mode	This safety feature allows the VFD's operation only after a signal is input to the multi-function terminal designated for the safety operation model. This feature is useful when every a real is:			
Use this feature for the lift-type loads such as elevators, when the torque needs to be maintained while the brakes are applied or released.		<u>p.134</u>		
Slip compensation	Slip compensation This feature ensures that the motor rotates at a constant speed by compensating for the motor slip as a load increases.			
PID control	PID control provides constant automated control of flow, pressure, and temperature by adjusting the output frequency of the VFD.	<u>p.137</u>		
Auto-tuning	Used to automatically measure the motor control parameters to optimize the VFD's control mode performance.	p.144		
Sensorless vector control (Induction Motor)	An efficient mode to control magnetic flux and torque without special sensors. Efficiency is achieved through the high torque characteristics at low current when compared with the V/F control mode.	<u>p.147</u>		
Sensorless vector control (Permanent Magnet Motor)	Sensorless Vector Control of Permanent Magnet motors characterized by smooth rotation, full torque at zero speed and fast acceleration and deceleration times.	<u>p.154</u>		
Energy buffering operation (KEB)	Used to maintain the DC link voltage for as long as possible by controlling the VFD output frequency during power interruptions, thus to delay a low voltage fault trip.	p.163		
Torque Control	Used to maintain a preset torque value Motor speed varies			
Energy saving operation				

Advanced Tasks	Description	Ref.
Speed search operation	Used to prevent fault trips when the VFD voltage is output while the motor is idling or free-running.	p.170
Auto restart operation	Auto restart configuration is used to automatically restart the VFD when a trip condition is released, after the VFD stops operating due to activation of protective devices (fault trips).	<u>p.173</u>
Second motor operation	Used to switch equipment operation by connecting two motors to one VFD. Configure and operate the second motor using the terminal input defined for the second motor operation.	<u>p.176</u>
Commercial power source switch operation	Used to switch the power to the motor from the VFD output to a commercial power source, or vice versa.	<u>p.177</u>
Cooling fan control	Used to control the cooling fan of the VFD.	p.178
Timer settings	Set the timer value and control the On/Off state of the multi- function output and relay.	<u>p.188</u>
Brake control	Used to control the On/Off operation of the load's electronic braking system.	p.189
Multi-function output On/Off control	Set standard values and turn On/Off the output relays or multi- function output terminals according to the analog input value.	p.190
Regeneration prevention for press operation.	Used during a press operation to avoid motor regeneration, by increasing the motor operation speed.	<u>p.191</u>

^{*} Draw operation is an open loop tension control. This feature allows a constant tension to be applied to the material that is drawn by a motor-driven device, by finer-tuning the motor speed using operation frequencies that are proportional to a ratio of the main frequency reference.

5.1 **Operating with Auxiliary References**

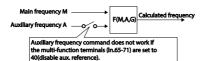
Frequency references can be configured with various calculated conditions that use the main and auxiliary frequency references simultaneously. The main frequency reference (Frg) is used as the operating frequency, while the auxiliary reference is used to modify and fine-tune the main reference.

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
Operation	Frq	Frequency reference source	Freq Ref Src	0	Keypad-1	0–12	-
	03	Auxiliary frequency reference source	Aux Ref Src	1	V1	0–4	
bA	04	Auxiliary frequency reference calculation type	Aux Calc Type	0	M+(G*A)	0–7	-
	05	Auxiliary frequency reference gain	Aux Ref Gain	0.0		-200.0–200.0	%
In	65– 69	Px terminal configuration	Px Define	40	dis Aux Ref	-	-

Auxiliary Reference Setting Details

Code	Description					
	Set t	Set the input type to be used for the auxiliary frequency reference.				
	Cor	nfiguration	Description			
	0	None	Auxiliary frequency reference is disabled.			
	1	V1	Sets the V1 (voltage) terminal at the control terminal			
			block as the source of auxiliary frequency reference.			
bA.03 Aux Ref Src	3	V2	Sets the V2 (voltage) terminal at the control terminal			
DA.US AUX REI SIC			block as the source of auxiliary frequency reference			
			(SW2 must be set to "voltage").			
	4	12	Sets the I2 (current) terminal at the control terminal			
			block as the source of auxiliary frequency reference			
			(SW2 must be set to "current").			
	5	Pulse	Sets the TI (pulse) terminal at the control terminal			
			block as the source of auxiliary frequency reference.			
	The table below list the available calculated conditions for the ma auxiliary frequency references. Set the auxiliary reference gain with (Aux Ref Gain) to configure the auxiliary reference and set the per to be reflected when calculating the main reference. Note that ite					
bA.04 Aux Calc	below may result in either plus (+) or minus (-) references (forward or					
Туре	on) even when unipolar analog inputs are used.					
	Cor	nfiguration	Formula for frequency reference			
	0	M+(G*A)	Main reference+(bA.05xbA.03xln.01)			
	1	M*(G*A)	x(bA.05xbA.03)			

Code	Description				
	2	M/(G*A)	Main reference/(bA.05xbA.03)		
	3	M+{M*(G*A)}	Main reference+{Main reference x(bA.05xbA.03)}		
	4	M+G*2*(A-50)	Main reference+bA.05x2x(bA.03-50)x In.01		
	5	M*{G*2*(A-50)}	Main reference x{bA.05x2x(bA.03–50)}		
	6	M/{G*2*(A-50)}	Main reference/{bA.05x2x(bA.03-50)}		
	7	M+M*G*2*(A-	Main reference+Main reference x		
		50)	bA.05x2x(bA.03-50)		
		M: Main frequency reference (Hz or rpm) 5: Auxiliary reference gain (%)			
	A: A	uxiliary frequency	reference (Hz or rpm) or gain (%)		
bA.05 Aux Ref Gain	Adjust the gain of the auxiliary reference source selected in bA.03 (Aux Ref Gain Ref Src).				
In.65–69 Px Define	and	Set one of the multi-function (digital) input terminals to 40 (dis Aux Ref) and activate it to disable the auxiliary frequency reference. The VFD will operate using the main frequency reference only.			



The tables below provide examples of using the available calculated conditions for the main and auxiliary frequency references. Refer to the table to see how the calculations apply with each example. When the maximum frequency value is high, output frequency deviation may result due to analog input variation and deviations in the calculations.

Auxiliary Reference Operation Ex #1

Keypad Frequency Setting is Main Frequency and V1 Analog Voltage is Auxiliary Frequency

- · Main frequency: Keypad (operation frequency 30Hz)
- · Maximum frequency setting (dr.20): 400Hz
- Auxiliary frequency setting (bA.03): V1[Display by percentage(%) or auxiliary frequency (Hz) depending on the operation setting condition]
- · Auxiliary reference gain setting (bA.05): 50%
- In.01–32: Factory default

Example: an input voltage of 6V is supplied to V1, and the frequency corresponding to 10V is 60Hz. The table below shows the auxiliary frequency A as $36Hz[=60Hz\ X\ (6V/10V)]$ or $60\%[=100\%\ X\ (6V/10V)]$.

Setting*		Calculating final command frequency**
0	M[Hz]+(G[%]*A[Hz])	30Hz(M)+(50%(G)x36Hz(A))=48Hz
1	M[Hz]*(G[%]*A[%])	30Hz(M)x(50%(G)x60%(A))=9Hz
2	M[Hz]/(G[%]*A[%])	30Hz(M)/(50%(G)x60%(A))=100Hz
3	M[Hz]+{M[Hz]*(G[%]*A[%])}	30Hz(M)+{30[Hz]x(50%(G)x60%(A))}=39Hz
4	M[Hz]+G[%]*2*(A[%]-50[%])[Hz]	30Hz(M)+50%(G)x2x(60%(A)-50%)x60Hz=36Hz
5	M[HZ]*{G[%]*2*(A[%]-50[%])}	30Hz(M)x(50%(G)x2x(60%(A)-50%)}=3Hz
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30Hz(M)/{50%(G)x2x(60%-50%)}=300Hz
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30Hz(M)+30Hz(M)x50%(G)x2x(60%(A)-50%)=33Hz

^{*}M: main frequency reference (Hz or rpm)/G: auxiliary reference gain (%)/A: auxiliary frequency reference (Hz or rpm) or gain (%).

^{**}If the frequency setting is changed to rpm, it is converted to rpm instead of Hz.

Auxiliary Reference Operation Ex #2

Keypad Frequency Setting is Main Frequency and I2 Analog Voltage is Auxiliary Frequency

- · Main frequency: Keypad (Operation frequency 30Hz)
- · Maximum frequency setting (dr.20): 400Hz
- Auxiliary frequency setting (bA.03): 12 [Display by percentage(%) or auxiliary frequency(Hz) depending on the operation setting condition]
- · Auxiliary reference gain setting (bA.05): 50%
- In.01–32: Factory default

Example: an input current of 10.4mA is applied to 12, with the frequency corresponding to 20mA of 60Hz. The table below shows auxiliary frequency As as 24Hz[-60[Hz] X ((10.4[mA]-4[mA])/(20[mA] -4[mA])) or 40%(=10(%) X ((10.4[mA] -4[mA])/(20[mA]) -4[mA])).

Cott	ing*	Calculating final command frequency**
Sett	ing	Calculating final confinant frequency
0	M[Hz]+(G[%]*A[Hz])	30Hz(M)+(50%(G)x24Hz(A))=42Hz
1	M[Hz]*(G[%]*A[%])	30Hz(M)x(50%(G)x40%(A))=6Hz
2	M[Hz]/(G[%]*A[%])	30Hz(M)/(50%(G)x40%(A))=150Hz
3	M[Hz]+{M[Hz]*(G[%]*A[%])}	30Hz(M)+{30[Hz]x(50%(G)x40%(A))}=36Hz
4	M[Hz]+G[%]*2*(A[%]-50[%])[Hz]	30Hz(M)+50%(G)x2x(40%(A)-50%)x60Hz=24Hz
5	M[HZ]*(G[%]*2*(A[%]-50[%])	30Hz(M)x{50%(G)x2x(40%(A)–50%)} = -3Hz(Reverse)
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30Hz(M)/{50%(G)x2x(60%-40%)} = -300Hz(Reverse)
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30Hz(M)+30Hz(M)x50%(G)x2x (40%(A)-50%)=27Hz

^{*} M: main frequency reference (Hz or rpm)/G: auxiliary reference gain (%)/A: auxiliary frequency reference Hz or rpm) or gain (%).

^{**}If the frequency setting is changed to rpm, it is converted to rpm instead of Hz.

Auxiliary Reference Operation Ex #3

V1 is Main Frequency and I2 is Auxiliary Frequency

Main frequency: V1 (frequency command setting to 5V and is set to 30Hz)

Maximum frequency setting (dr.20): 400Hz

Auxiliary frequency (bA.03): I2[Display by percentage (%) or auxiliary frequency (Hz) depending on the operation setting condition]

Auxiliary reference gain (bA.05): 50%

In.01-32: Factory default

Example: an input current of $10.4m_A$ is applied to 12, with the frequency corresponding to $20m_A$ of $60H_Z$. The table below shows axisilary frequency A as $24H_Z$ = $60[H_Z$ |X]($10.4[m_A]$ - $4[m_A]$)/ $20[m_A]$ - $4[m_A]$)) or 40%=10.9[x] x $(10.4[m_A]$ - $4[m_A]$)/(20] m_A]- $4[m_A]$).

Sett	ing*	Calculating final command frequency**
0	M[Hz]+(G[%]*A[Hz])	30Hz(M)+(50%(G)x24Hz(A))=42Hz
1	M[Hz]*(G[%]*A[%])	30Hz(M)x(50%(G)x40%(A))=6Hz
2	M[Hz]/(G[%]*A[%])	30Hz(M)/(50%(G)x40%(A))=150Hz
3	M[Hz]+{M[Hz]*(G[%]*A[%])}	30Hz(M)+{30[Hz]x(50%(G)x40%(A))}=36Hz
4	M[Hz]+G[%]*2*(A[%]-50[%])[Hz]	30Hz(M)+50%(G)x2x(40%(A)-50%)x60Hz=24Hz
5	M[HZ]*{G[%]*2*(A[%]-50[%])}	30Hz(M)x(50%(G)x2x(40%(A)-50%)}=-3Hz(Reverse)
6	M[HZ]/{G[%]*2*(A[%]-50[%])}	30Hz(M)/{50%(G)x2x(60%-40%)}=-300Hz(Reverse)
7	M[HZ]+M[HZ]*G[%]*2*(A[%]-50[%])	30Hz(M)+30Hz(M)x50%(G)x2x(40%(A)-50%)=27Hz

^{*} M: main frequency reference (Hz or rpm)/G: auxiliary reference gain (%)/A: auxiliary frequency reference (Hz or rpm) or gain (%).

Note

When the maximum frequency value is high, output frequency deviation may result due to analog input variation and deviations in the calculations.

^{**}If the frequency setting is changed to rpm, it is converted to rpm instead of Hz.

5.2 **Jog operation**

The jog operation allows for a temporary control of the VFD. There are two was to apply a jog and start command using the multi-function (digital) input terminals.

- . Jog-1 using a digital input terminal set to JOG along with a start command (Fx or Rx).
- · Jog-2 using a single digital input set to FWD JOG or REV JOG.

5.2.1 Jog Operation 1-Forward Jog by Multi-function Terminal

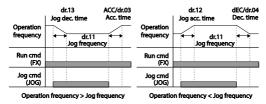
The jog operation is available in the forward (or reverse) direction, using two input terminals (Fx and JOG). The table below lists parameter settings for a forward jog operation with a separate Run (Fx) command.

Group	Code	Name	LCD Display	Parame	eter Setting	Setting Range	Unit
dr	11	Jog frequency	JOG Frequency	10.00		0.50- Maximum	Hz
						frequency	
	12	Jog operation acceleration time	JOG Acc Time	20.00		0.00-600.00	sec
	13	Jog operation deceleration time	JOG Dec Time	30.00		0.00-600.00	sec
In	65-69	Px terminal configuration	Px Define(Px: P1-P5)	6	JOG	0~54	-

Forward Jog Description Details

Code	Description
In.65–69 Px Define	Select 6 (JOG) function from In.65 ~ 69 for one of the inputs. P1 1(FX) P5 6(JOG) CM [Terminal settings for jog operation]
dr.11 JOG Frequency	Set the operation frequency.
dr.12 JOG Acc Time	Set the acceleration speed.
dr.13 JOG Dec Time	Set the deceleration speed.

If a signal is applied to the jog terminal while running (FX applied), the operating frequency changes to the jog frequency.



5.2.2 Jog Operation 2-Fwd/Rev Jog by Multi-function Terminal

A terminal that is set for a forward or reverse jog also starts the VFD. The table below lists parameter settings for a forward (or reverse) jog operation. A separate Run (Fx) command is not required.

Group	Code	Name	LCD Display	Para	meter setting	Setting Range	Unit
dr	11	Jog frequency	JOG Frequency	10.0	10	0.50-Maximum	Hz
						frequency	
	12	Jog operation	JOG Acc Time	20.0	0	0.00-600.00	sec
		acceleration time					
	13	Operation	JOG Dec Time	30.0	0	0.00-600.00	sec
		deceleration time					
In	65-69	Px terminal	Px Define(Px: P1-	46	FWD JOG	0~54	
		configuration	P5)	47	REV JOG		

NOTE: The priorities for speed reference inputs and associated Acc/Dec times via digital inputs are as follows: **Dwell** overrides **Jog** overrides **Up/Down** overrides **Fixed Speed** inputs overrides **Frq** setting.

If a different operation command is entered during a jog operation (other than dwell), it is ignored and the operation maintains the jog frequency.



5.2.3 Jog Operation by 7-Segment display

Group	Code	Name	LCD Display	Paramete Setting	er	Setting Range	Unit
dr	90	[ESC] key functions	-	1	JOG Kev	-	-
	06	Command source	Cmd Source*	0	Keynad	_	

^{*} Displayed under DRV-06 on the LCD keypad.

Set dr.90 to 1 (JOG Key) and set parameter drv in the Operation group to 0 (Keypad). When the [ESC] key is pressed, the SET display light flashes and the jog operation is ready to start. Pressing the [RUN] key starts the operation and the VFD accelerates or decelerates to the designated jog frequency. Releasing the [RUN] key stops the jog operation. Set the Acc/Dec time for the jog operation frequency at dr.12 and dr.13.



5.3 **Up-Down Operation**

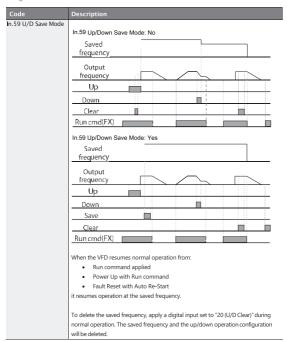
The VFD can control the speed of the motor using digital inputs set to the Up and Down functions. The Up/Down operation can be applied to systems that use upper-lower limit switches. Two digital inputs are required. One set to Up (increase speed) and one set to Down (decrease speed) operation.

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
In			U/D Save	0	No	0 - 1	 -
		frequency save	Mode	1	Yes		
Ad	85	Up/down mode Sel	U/D Mode Sel	0	U/D Normal	0:U/D Normal 1:U/D Step 2:U/D Step+Norm	
	86	Up/down Step freqency	U/D Step Freq	-	0	0-maximum frequency	Hz
				17	Up		
In	65–69	Px terminal	Px Define	18	Down	0-54	_
		configuration	(P1-P5)	19	U/D Save		
				20	U/D Clear		

The operation will follow the Up or Down inputs and will override other speed reference inputs.

Up-down Operation Setting Details

Code	Desci	ription			
	(Down) Up terr	, respectively. With the	own operation and set the run command active, acc d. Acceleration stops and c activated.	eleration begins who	en the
In.65-69 Px Define	Deceler activate	ation stops and const	n begins when the Down ant speed operation begin and Down signals are en gins.	ns when the signal is	
		Frequency P4(Up) P5(Down) Run cmd (FX)			
	condition powers or when You can	ons: the run command off. When the run in power is restored, the also save the up/dowr	g frequency is saved auto I (Fx or Rx) is removed, a fic command is reapplied, or e VFD resumes operation or operation frequency while of the digital inputs (in-65-	ault occurs, or the VF when the fault is clea at the saved frequer the VFD is operating	D is ared, ncy.
In.59 U/D Save Mode	20 (U/E		,, set one of the multi-fund te input during constant s		
			ave function is enabled via		,
		r digital inputs, the ope ing table:	rating frequency will be sa	ved as described in th	ne
		Save by keypad input (In.59) set to "1 (Yes)"	Save by digital input (In.65–69) set to "19 (U/D Save)"	U/D Save Result	
		No	No	No	
		Yes	No	Yes	
		No	Yes	Yes	
		Yes	Yes	Yes	



0	U/D Normal U/D Step U/D Step+Norm	Pressing the Up button increases the frequency to the maximum setting at a preset acceleration time. Pressing the Down button decreases the frequency at a preset deceleration time regardless of stop mode. Accelerate or decelerate according to the step frequency set in Ad.86 on the acsending edge of the digital input set to Up/Down operating mode. Accelerate or decelerate according to the step frequency set in Ad.86 on the assending edge of the digital input set to Up/Down operating mode. If acceleration or of deceleration is activated for more than 3 seconds, the settings will change to Up/Down normal mode.
	U/D	set in Ad.86 on the acsending edge of the digital input set to Up/Down operating mode. Accelerate or decelerate according to the step frequency set in Ad.86 on the acsending edge of the digital input set to Up/Down operating mode. If acceleration or deceleration is activated for more than 3 seconds, the
2		set in Ad.86 on the acsending edge of the digital input set to Up/Down operating mode. If acceleration or deceleration is activated for more than 3 seconds, the
		More than
_		
_		
		<1: U/D Step>+
req	juency	3 900
5(L	Jp)	
6(0	Down)	
un	cmd(FX)	
		<2: U/D Step+Norm>+/
	75(L 16(L 15(L 16(L 16(L 16(L)	requency 5(Up) 6(Down) tun cmd(FX) requency 5(Up) 6(Down) un cmd(FX)

5.4 **3-Wire Operation**

3-wire operation is used to latch the run command input signal (FWD or REV) when using a momentary input. This configuration is commonly used to operate the VFD with a set of momentary push buttons.

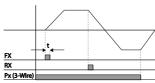
Group	Code	Name	LCD Display	Parame	ter Setting	Setting Range	Unit
Operation	drv	Command	Cmd Source*	1	Fx/Rx - 1	-	-
		source					
In	65-69	Px terminal	Px Define(Px: P1-	14	3-Wire	0~54	-
		configuration	P5)				

^{*} Displayed under DRV-06 in an LCD keypad.

To enable the 3-wire operation, the following circuit sequence is necessary. The minimum input time (t) for 3wire operation is 1ms, and the operation stops when both forward and reverse operation commands are entered at the same time.



[Terminal connections for 3-wire operation]



[3-wire operation]

5.5 Safe Operation Mode

This safety feature is used as a Run Enable/Disable input. When a digital input is set to 13 (Run Enable), the VFD will only operate when the input is closed (Enabled). The input must be closed to recognize other digital input functions. This feature is also useful for interlocking operation with other equipment.

A stop mode can be selected (In.61, Run Dis Stop) if the Run Enable input is opened during operation. Selections include coasting to a stop, Quick Stop and Quick Stop Resume. The deceleration time (In.62, Q-Stop Time) can be set for the Quick Stop functions.

Group	Code	Name	LCD Display	Para	ameter Setting	Setting Range	Unit
ln	60	Safe operation selection	Run En Mode	1	D I Dependent	=	-
	61	Safe operation stop mode	Run Dis Stop	0	Free-Run	0-2	-
	62	Safe operation deceleration time	Q-Stop Time	5.0		0.0-600.0	sec
ln	65-69	Px terminal configuration	Px Define(Px: P1-P5)	13	RUN Enable	0~54	-

Safe Operation Mode Setting Details

Code	Descri	Description					
In.65-69 Px Define	Set or	Set one of the multi-function (digital) input terminals to 13 (RUN Enable)					
	to ope	to operate in safe operation mode.					
In.60 Run En Mode	Setti	ng	Function				
	0	Always Enable	Enables safe operation mode. Input must be				
			closed (Enabled) to operate.				
	1	DI Dependent	Operation is in combination with the status of				
			Run command (Fx input).				
In.61 Run Dis Stop	Decel	erates the motor b	pased on the deceleration time (Q-Stop Time) set				
	in In.6	2. If the Enable inp	out is re-applied during deceleration and the run				
	command is maintained, the VFD will resume normal operation.						
In.62 Q-Stop Time	Sets the deceleration time when In.61 (Run Dis Stop) is set to 1 (Q-Stop) or						
	2 (Q-Stop Resume).						

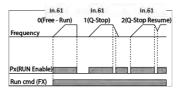
Q-Stop Function

When In.60 (Run En Mode) is set to 1 (DI Dependent) and In.61 is set to 2 (Q-Stop), if the Run Enable input is opened during operation, the VFD will decelerate to a stop based on the time set in In.62, Q-Stop Time. To restart, the Enable input must be re-applied and the Run command (Fx) must be removed then re-applied.

Q-Stop Resume Function

The Quick Start resume function operates as follows:

When In.60 (Run En Mode) is set to 1 (DI Dependent) and In.61 is set to 3 (Q-Stop Resume), this allows operation (Start/Stop) of the VFD based on the Run Enable input. If the Run Enable is opened during operation and the Run command (Fx) is maintained, closure of the Run Enable input will allow the VFD to operate (resume operation).



5.6 **Dwell Operation**

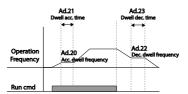
The dwell operation is used to maintain torque (speed) at programmed frequencies during the acceleration and deceleration process. This function is used in the application and release of the mechanical brakes on lift-type loads (elevators). Inverter dwell operation is based on the Acc/Dec dwell frequency (Ad.20, Ad.22) and the dwell time (Ad.21, Ad.23) set by the user. The following points also affect dwell operation:

Acceleration Dwell Operation: When a run command is applied, acceleration continues up to the acceleration dwell frequency (Ad 20) and constant speed is maintained for the acceleration dwell time (Ad 21, Acc Dwell Time). After the Acc Dwell Time has passed, acceleration is carried out based on the acceleration time and the operating speed that was originally set.

Deceleration Dwell Operation: When a stop command is applied, deceleration continues down to the deceleration dwell frequency (Ad.22) and constant speed is maintained for the deceleration dwell time (Ad.23, Dec Dwell Time). After the Dec Dwell Time has passed, deceleration is carried out based on the deceleration time that was originally set, then the operation stops.

When dr.09 (Control Mode) is set to 0 (V/F), the VFD can be used for applications requiring the use of dwell frequencies. An example is applying and releasing mechanical brakes on lift-type loads (elevators).

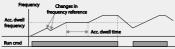
Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
Ad	20	Dwell frequency during acceleration	Acc Dwell Freq	5.00	Start frequency – Maximum frequency	Hz
	21	Operation time during acceleration	Acc Dwell Time	0.0	0.0-10.0	s
	22	Dwell frequency during deceleration	Dec Dwell Freq	5.00	Start frequency – Maximum frequency	Hz
	23	Operation time during deceleration	Dec Dwell Time	0.0	0.0-60.0	s



Note

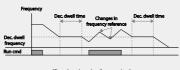
Dwell operation does not function when:

- · Dwell operation time is set to 0 sec or dwell frequency is set to 0 Hz.
- Re-acceleration is attempted from stop or during deceleration. Only the first acceleration
 dwell operation is valid through the complete process.



[Acceleration dwell operation]

Deceleration dwell operation is carried out whenever stop commands are entered and the deceleration dwell frequency is passed through. It does not work during a deceleration when the frequency (speed reference) is changed. This is not considered a deceleration due to a stop operation.



[Deceleration dwell operation]

① Caution

When a dwell operation is carried out for lift - type loads with mechanical brakes, motors can be damaged or their lifecyle reduced due to higher currents in the motor during the time the mechanical brake is applied.

5.7 Slip Compensation Operation

Slip refers to the variation between the set frequency (speed) and actual motor rotation speed. During operation a set frequency, the slip will vary as the load changes. As the load increases, slip will increase. Slip compensation is used for loads that require compensation of these speed variations.

Group	Code	Name	LCD Display	Par	ameter Setting	Setting Range	Unit
dr	09	Control mode	Control Mode	2	Slip Compen	-	-
	14	Motor capacity	Motor	2	0.75 kW	0-15	-
			Capacity		(0.75kW based)		
bA	11	Number of motor	Pole Number	4		2-48	-
		poles					
	12	Rated slip speed	Rated Slip	90	(0.75kW based)	0-3000	rpm
	13	Rated motor	Rated Curr	3.6	(0.75kW based)	1.0-1000.0	Α
		current					
	14	Motor no-load	Noload Curr	1.6	(0.75kW based)	0.5-1000.0	Α
		current					
	16	Motor efficiency	Efficiency	72	(0.75kW based)	70-100	%
	17	Load inertia rate	Inertia Rate	0 (0	0.75kW based)	0-8	-

Slip Compensation Operation Setting Details

Code	Description					
dr.09 Control Mode	Set dr.09 to 2 (Slip Com	npen) to operate in slip compensation mode.				
dr.14 Motor	Set the capacity of the	motor connected to the VFD.				
Capacity						
bA.11 Pole Number	Enter the number of po	oles from the motor name plate.				
bA.12 Rated Slip	nter the slip RPM's fron	n the motor name plate. This may be shown in Hz.				
	If so, convert to RPM's.	Slip frequency may also be calculated.				
		$f_s = f_r - \frac{Rpm \times P}{120}$				
	f _s =Rated slip frequency	y				
	f_r =Rated frequency					
	rpm=Number of the ra					
	P=Number of motor p	oles				
bA.13 Rated Curr	Enter the rated current	from the motor name plate.				
bA.14 Noload Curr	Enter the measured n	o-load current at the rated frequency. If no-load				
	current is difficult to r	measure, enter a current equivalent to 30–50%				
	of the rated motor cu	rrent.				
bA.16 Efficiency	Enter the efficiency from	m the motor name plate.				
bA.17 Inertia Rate	Select load inertia base	d on motor inertia.				
	Setting	Function				
	0	Less than 10 times motor inertia				
	1	10 times motor inertia				
	2-8	More than 10 times motor inertia				



5.8 PID Control

PID control is one of the most common auto-control methods. It uses a combination of proportional, integral, and differential (PID) control that provides effective control for automated systems. The functions of PID control can be applied to the VFD operation for control of the following:

Purpose	Function
Speed control	Control speed by using feedback of the existing speed comparing it to a target speed. The VFD adjusts the output to maintain a constant speed (the target speed).
Pressure control	Control pressure by using feedback of the existing pressure comparing it to a target pressure. The VFD adjusts the ouput to maintain a constant pressure.
Flow control	Control flow by using feedback of the existing flow comparing it to a target flow. The VFD adjusts the output to maintain a constant flow.
Temperature control	Control temperature by using feedback of the existing temperature comparing it to a target temperature. The VFD adjusts the output to maintain a constant temperature.

5.8.1 PID Basic Operation

PID operates by controlling the output frequency of the VFD in automated process control systems to maintain speed, pressure, flow, temperature.

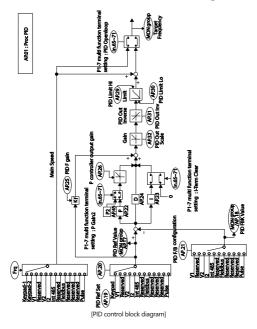
Group	Code	Name	LCD Display	Para	nmeter Setting	Setting Range	Unit
AP	01	Application function selection	App Mode	2	Proc PID	0–2	-
	16	PID output monitor	PID Output	-		-	1-
	17	PID reference monitor	PID Ref Value	-		=	-
	18	PID feedback monitor	PID Fdb Value	-		=	-
	19	PID reference setting	PID Ref Set	50.0	00	-100.00- 100.00	%
	20	PID reference source	PID Ref Source	0	Keypad	0-11	-
	21	PID feedback source	PID F/B Source	0	V1	0-10	-
	22	PID controller	PID P-Gain	50.0)	0.0-1000.0	%

Group	Code	Name	LCD Display	Para	ameter Setting	Setting Range	Unit
		proportional gain					
	23	PID controller	PID I-Time	10.0)	0.0-200.0	sec
		integral time					
	24	PID controller	PID D-Time	0		0-1000	mse
		differential time					С
	25	PID controller feed-	PID F-Gain	0.0		0-1000	%
		forward					
		compensation gain					
	26	Proportional gain	P Gain Scale	100	.0	0.0-100.0	%
		scale					
	27	PID output filter	PID Out LPF	0		0-10000	ms
	29	PID maximum	PID Limit Hi	60.0	00	-300.00-	Hz
		frequency				300.00	
	30	PID minimum	PID Limit Lo	0.5		-300.00-	Hz
		frequency				300.00	
	31	PID output reverse	PID Out Inv	0	No	0-1	-
	32	PID output scale	PID Out Scale	100		0.1-1000.0	%
	34	PID controller	Pre-PID Freq	0.00)	0-Maximum	Hz
		motion frequency				frequency	
	35	PID controller	Pre-PID Exit	0.0		0.0-100.0	%
		motion level					
	36	PID controller	Pre-PID Delay	600		0-9999	sec
		motion delay time					
	37	PID sleep mode	PID Sleep DT	60.0)	0-999.9	sec
		delay time					
	38	PID sleep mode	PID Sleep Freq	0.00)	0-Maximum	Hz
		frequency				frequency	
	39	PID wake-up level	PID WakeUp	35		0-100	%
			Lev	-	I		ļ
	40	PID wake-up mode	PID WakeUp	0	Below Level	0-2	-
		selection	Mod		0.1	0.40	-
	42	PID controller unit	PID Unit Sel	0	%	0-12	-
		selection					
	43	PID unit gain PID unit scale	PID Unit Gain PID Unit Scale	100		0-300	%
	44			2	x 1	0-4	-
	45	PID 2 nd proportional	PID P2-Gain	100	.00	0-1000	%
-	65-	gain Px terminal	Px Define (Px:	22	I Tana Class	0~54	-
In	69	configuration	P1-P5)	23	FTerm Clear PID Openloop	U~54	1-
	109	corniguration	P1-P3)	23		=	
	1		I	124	P Gain2	1	1

PID Basic Operation Setting Details

Code	Description					
AP.01 App Mode	Set to	o 2 (Proc PID) t	o enable PID Control and select functions for the			
	proc	ess PID.				
AP.16 PID Output	Disp	lays the existing	ys the existing output value of the PID controller. The unit, gain and			
·	scale	scale that were set at AP. 42-44 are applied on the display.				
AP.17 PID Ref Value	Disp	lays the existing	g reference value set for the PID controller. The unit,			
	gain, and scale that were set at AP. 42-44 are applied on the display.					
AP.18 PID Fdb Value	Disp	lays the latest for	eedback value as input to the PID controller. The unit,			
	gain	gain and scale that were set at AP.42-44 are applied on the display.				
AP.19 PID Ref Set	Whe	n AP.20 (PID ref	ference source) is set to 0 (Keypad default), the			
	refer	ence value is er	ntered here, AP.19. If the reference source (AP.20) is set			
			, the setting values for AP.19 are void.			
AP.20 PID Ref Source	Selec	ts the referenc	e source for PID control. The reference and feedback			
	(AP.2	1) cannot be th	ne same source. If V1 is set as the feedback source, V1			
	cann	ot be the refere	ence source. To set V1 as a reference source (AP.20),			
			k source (AP.21).			
	Set	ting	Function			
	0	Keypad	Keypad			
	1	V1	-10-10V input voltage terminal			
	3	V2	I2 analog input terminal			
	4	12	[When analog voltage/current input terminal			
			selection switch (SW2) at the terminal block is set			
			to I (current), input 4-20mA current. If it is set to V			
			(voltage), input 0–10V voltage]			
	5	Int. 485	RS-485 input terminal			
	7	FieldBus	Communication command via a communication			
			option card			
	9	UserSeqLink	Link the common area with the user sequence			
			output.			
	11	Pulse	TI Pulse input terminal (0-32kHz Pulse input)			
	Whe	n using the 7-9	egment display, the PID reference setting can be			
	displ	ayed at AP.17. \	When using the LCD keypad, the PID reference setting			
	can be monitored from the config mode (CNF) -06-08, set to 17 (PID Ref					
AP.21 PID F/B Source	Selec	ts feedback in:	out for PID control. Items can be selected as reference			
			ypad input (Keypad-1 and Keypad-2). Feedback			
			input item that is identical to the item selected as the			
			ple, when Ap.20 (Ref Source) is set to 1 (V1), for AP. 21			
	(PID	F/B Source), an	input other than the V1 terminal must be selected.			
	Whe	n using the LCI	keypad, the volume of feedback can be monitored			
			he config mode (CNF) -06-08, by setting it to 18 (PID			
	Fbk V	/alue).				
AP.22 PID P-Gain,	Sets	the output ratio	o for differences (errors) between reference and			
AP.26 P Gain Scale			in is set to 50%, then 50% of the error is output. The			
	settir	ng range for Pg	ain is 0.0-1,000%. For ratios below 0.1%, use AP.26 (P			
	Gain	Scale).				

Code	Descript	tion					
AP.23 PID I- Time	Sets the time to output accumulated errors. When the error is 100%, the time taken for 100% output is set. When the integral time (PID 1-Time) is set to 1 second, 100% output occurs after 1 second of the error remaining at 100%. Differences in a normal state can be reduced by PID I Time. When the multi-function terminal is set to 21 (I-Term Clear) and is activated, all of the accumulated errors are deleted.						
AP.24 PID D-Time	Sets the output volume for the rate of change in errors. If the differential						
AF24 FID D-TIME	time (PID D-Time) is set to 1ms and the rate of change in errors per sec is 100%, output occurs at 1% per 10ms.						
AP.25 PID F-Gain	Sets the ratio that adds the target to the PID output. Adjusting this value leads to a faster response.						
AP.27 PID Out LPF	Used when the output of the PID controller changes too fast or the entire system is unstable, due to severe oscillation. In general, a lower value (default value=0) is used to speed up response time, but in some cases a higher value increases stability. The higher the value, the more stable the PID controller output is, but the slower the response time.						
AP.29 PID Limit Hi,	Apply lir	Apply limits to the output of the controller.					
AP.30 PID Limit Lo							
AP.32 PID Out Scale	Adjusts the volume of the controller output.						
	2 m 3 Pa 4 kf 5 H 6 rp 7 V 8 I	ar nBar a Pa lz om	Function Displays a percentage without a physical quantity given. Various units of pressure can be selected. Displays the VFD output frequency or the motor rotation speed. Displays in voltage/current/power/horsepower.				
4 D 4 D DID 11 2 G 2			. 6.4				
AP.43 PID Unit Gain,	Adjusts	the s	ize to fit the unit selected at AP.41 PID Unit Sel.				
AP.44 PID Unit Scale	W 010						
AP.45 PID P2-Gain	(digital) Gain2), a	The PID controller's gain can be changed using the multi-function (digital) terminal. When a digital input terminal (In.65~69) is set to 24 (P Gain2), and when activated, the gain set in AP22 and AP23 will be switched to the gain set in AP45.					

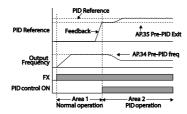


5.8.2 Pre-PID Operation

Pre-PID is a function that allows the VFD to run at a set frequency (AP.34) for a set amount of time (AP.36) prior to normal PI Control operation. There is also a Pre-PID exit value (AP.35) that must be set. The VFD will exit Pre-PID when the monitored feedback exceeds the Pre-PID Exit value. This must occur before the set time.

Pre-PID Operation Setting Details

Code	Description
AP.34 Pre-PID Freq	Set the frequency to run at prior to PID operation. Pre-PID operation
	continues until the control variable (AP.35, Pre-PID Exit) is exceeded or the
	time (AP.36, Pre-PID Delay).
AP35 Pre-PID Exit,	When the actual feedback variable exceeds the value set at AP.35, PID
AP36 Pre-PID	control operation begins. It the time (AP.36, Pre-PID Delay) expires and the
Delay	actual feedback variable is still less than the value set at AP.35, a
	"pre-PID Fail" fault will occur and the output will be blocked.

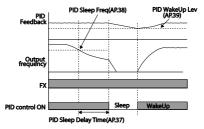


5.8.3 PID Operation Sleep Mode

During normal PID Control operation, if demand becomes minimal and VFD operation is not required, the VFD can enter Sleep Mode. A sleep frequency can be set (AP38, PID Sleep Freq) along with a sleep delay time (AP37, PID Sleep DT). If the operation continues at a frequency below the sleep frequency for the time set in sleep delay time, the VFD will enter sleep mode. During sleep mode, the VFD continues to monitor the feedback of the process variable. A Wake Up level (AP39, PID Wakeup Lev) can be set to resume normal PID Control operation. An additional setting of Wake Up mode (AP40, WakeUp Mod) can be set to further define the Wake Up Level.

PID Operation Sleep Mode Setting Details

Code	Description
AP.37 PID Sleep DT,	If an operating frequency lower than the value set in AP.38 is maintained
AP.38 PID Sleep Freq	for the time set at AP.37, the operation stops and the VFD will enter sleep
	mode.
AP.39 PID WakeUp	When in Sleep Mode, normal PID Control operation will resume when:
Lev,	AP.40 -> 0 (Below Level): the feedback variable is less than the value
AP.40 PID WakeUp	set in AP.39, PID WakeUp Lev setting.
Mod	AP.40 -> 1 (Above Level): the feedback variable is higher than the value
	set in AP.39.
	AP.40 -> 2 (Beyond Level): the difference between the reference value
	and the feedback variable is greater than the value set at AP.39.



5.8.4 PID Switching (PID Openloop)

When one of the multi-function (digital) terminals (In.65–69) is set to 23 (PID Openloop) and is activated, PID operation stops and is switched to general operation. When the terminal is de-activated, the PID operation resumes.

Operation mode	PIDOn	Normal Op.	PIDOn
Run cmd			
PID Openioop			

Note

When the PID switch operation (switching from PID operation to general operation) enters the multi-function input, [9] values are converted to [Hz] values. The normal PID output, PID OUT, is unipolar, and is limited by AP29 (PID Limit Hi) and AP30 (PID Limit Lo). A calculation of 100.0% is based on the dr.20 (Max Freq) parameter setting.

5.9 **Auto Tuning**

The motor parameters can be measured automatically and can be used for auto torque boost or sensorless vector control.

Example - Auto-Tuning Based on 0.75kW, 230V, 60Hz, 4 Pole Motor

Group	Code	Name	LCD Display	Para Sett	meter ing	Setting Range	Unit
dr	14	Motor capacity	Motor Capacity	1	0.75 kW	0-15	-
bA	11	Motor pole number	Pole Number	4		2-48	
	12	Rated slip speed	Rated Slip	40		0-3000	rpm
	13	Rated motor current	Rated Curr	3.6		1.0-1000.0	А
	14	Motor no-load current	Noload curr	1.6		0.5-1000.0	А
	15	Motor rated voltage	Motor Volt	230		170-480	٧
	16	Motor efficiency	Efficiency	72		70-100	%
	20	Auto tuning	Auto Tuning	0	None	-	-
	21	Stator resistance	Rs	26.0	00	Depends on the motor setting	Ω
	22	Leakage inductance	Lsigma	179	.4	Depends on the motor setting	mH
	23	Stator inductance	Ls	154	4	Depends on the motor setting	mH
	24	Rotor time constant	Tr	145		25-5000	ms

Auto Tuning Default Parameter Setting

Мо	Motor Capacity		Motor Capacity		Capacity Rated N		Rated Slip	Stator	Leakage
			Current (A)	Current (A)	Frequency(Hz)	Resistance(Ω)	Inductance (mH)		
230V	0.4	0.5	2.4	1.4	3.33	6.70	26.9		
	0.75	1	3.4	1.7	3.00	2.600	17.94		
	1.5	2	6.4	2.6	2.67	1.170	9.29		
	2.2	3	8.6	3.3	2.33	0.840	6.63		
	3.7	5	13.8	5.0	2.33	0.500	4.48		
	5.5	7.5	21.0	7.1	1.50	0.314	3.19		
	7.5	10	28.2	9.3	1.33	0.169	2.844		
	11	15	40.0	12.4	1.00	0.120	1.488		
	15	20	53.6	15.5	1.00	0.084	1.118		
460V	0.4	0.5	1.4	0.8	3.33	14.0	80.8		
	0.75	1	2.0	1.0	3.00	7.81	53.9		
	1.5	2	3.7	1.5	2.67	3.52	27.9		

Motor Cap	Motor Capacity		No-load	Rated Slip	Stator	Leakage
		Current (A)	Current (A)	Frequency(Hz)	Resistance(Ω)	Inductance (mH)
2.2	3	5.0	1.9	2.33	2.520	19.95
3.7	5	8.0	2.9	2.33	1.500	13.45
5.5	7.5	12.1	4.1	1.50	0.940	9.62
7.5	10	16.3	5.4	1.33	0.520	8.53
11	15	23.2	7.2	1.00	0.360	4.48
15	20	31.0	9.0	1.00	0.250	3.38
18.5	25	38.0	11.0	1.00	0.168	2.457
22	30	44.5	12.5	1.00	0.168	2.844

Auto Tuning Parameter Setting Details

Code	Description							
	Select one of the	e auto tuning options and then press the [ENT] key to						
	run the auto tur	run the auto tuning.						
	Setting	Function						
	0 None	Auto tuning function is not enabled. Also, if you select one of the auto tuning options and run it, the parameter value will revert back to "0" when the auto tuning is complete.						
bA.20 Auto Tuning	1 All (rotating type)	Measures all motor parameters, including stator resistance (Rs), stator inductance (Lsigma), no-doad current (Noload Curr), rotor time constant (Tr), etc., while the motor is rotating. As the motor is rotating while the parameters are being measured, if the load is connected to the motor spindle, the parameters may not be measured accurately. For accurate measurements, remove the load attached to the motor spindle. However, note that the rotor time constant (Tr) must be measured in a stopped position.						
	2 All (static type)	Measures all parameters while the motor is in the stopped position. Measures stator resistance (Rs), stator inductance (Lsigma, no-load current (Noload Curr), rotor time constant (Tr), etc., while the motor is in the stopped position. As the motor is not rotating while the parameters are measured, the measurements are not affected when the load is connected to the motor spindle. However, when measuring parameters, do not rotate the motor spindle on the load side.						
	3 Rs+Lsigma (rotating type)	Measures parameters while the motor is rotating. The measured motor parameters are used for auto torque boost or sensorless vector control.						
	6 Tr (static	Measures the rotor time constant (Tr) with the motor						

Code	Des	Description			
		type)	in the stopped position and Control Mode (dr.09) is		
			set to IM Sensorless.		
bA.14 Noload	Dis	Displays motor parameters measured by auto tuning. For parameters			
Curr, bA.21 Rs-	that are not included in the auto tuning measurement list, the default				
bA.24 Tr	setting will be displayed.				

① Caution

- · Perform auto tuning ONLY after the motor has completely stopped running.
- Before you run auto tuning, check the motor pole number, rated slip, rated current, rated volage and efficiency on the motor's rating plate and enter the data. The default parameter setting is used for values that are not entered.
- When measuring all parameters after selecting 2 (All static type) at bA20: compared with
 rotation type auto tuning where parameters are measured while the motor is rotating,
 parameter values measured with static auto tuning may be less accurate. Inaccuracy of the
 measured parameters may degrade the performance of sensoriess operation. Therefore, run
 static type auto tuning by selecting 2 (All) only when the motor cannot be rotated (when
 gearing and belts cannot be separated easily, or when the motor cannot be separated
 mechanically from the load).

5.10 Sensorless Vector Control

Sensorless vector control provides a more accurate estimation of the motor rotation speed compared to V/F control. When auto tuning is completed, the VFD calculates motor speed and does not require the rotating speed feedback from the motor. Sensorless vector control can also generate greater torque at a lower level of current.

Group	Code	Name LCD Display Parameter Setting		Setting Range	Uni t	
dr	09	Control mode	Control Mode	4 IM Sensorless	-	-
	14 Motor capacity		Motor Capacity			-
	18	Base frequency	Base Freq	60	30-400	Hz
In	11	Motor pole number	Pole Number	4	2-48	-
	12	Rated slip speed	Rated Slip	Depends on the motor capacity	0-3000	Hz
	13	Rated motor current	Rated Curr	Depends on the motor capacity	1-1000	А
	14	Motor no-load current	Noload curr	Depends on the motor capacity	0.5-1000	Α
	15	Rated motor voltage	Motor Volt	230/380/440/460	170-480	٧
	16	Motor efficiency	Efficiency	Depends on the motor capacity	70-100	%
	20	Auto tuning	Auto Tuning	1 All	-	-
Cn	09	Pre-Excite time	PreExTime	1.0	0.0-60.0	s
	10	Pre-Excite amount	Flux Force	100.0	100.0-300.0	%
	20	Sensorless second gain display setting	SL2 G View Sel	1 Yes	0-1	-
	21	Sensorless speed controller proportional gain1	ASR-SL P Gain1	Depends on the motor capacity	0-5000	%
	22	Sensorless speed controller integral gain 1	ASR-SL I Gain1	Depends on the motor capacity	10-9999	ms
	23*	Sensorless speed controller proportional gain 2	ASR-SL P Gain2	Depends on the motor capacity	1-1000	%
	24* Sensorless speed controller integral gain 2 Depends on the motor capacity		1-1000	%		
	26*	Flux estimator proportional gain			10-200	%
	27*			10-200	%	
	28*	Speed estimator proportional gain	S-Est P Gain1	Depends on the motor capacity	0-32767	-
	29*	Speed estimator	S-Est I Gain1	Depends on the	100-1000	-

Group	Code	Name	LCD Display	Dam	meter Setting	Setting	Uni
Group	Code	Name	LCD Display	Para	meter Setting	Range	Uni
		integral gain1				Kange	· ·
	30*	Speed estimator	S-Est I Gain2		or capacity ends on the	100-10000	
	30"	integral gain2	S-Est i Gainz		or capacity	100-10000	-
	31*	Sensorless current	ACR SL P Gain	75	or capacity	10-1000	
	31	controller proportional	ACK 3L P Galli	13		10-1000	-
		gain					
	32*	Sensorless current	ACR SL I Gain	120		10-1000	<u> </u>
	32	controller integral gain	ACK SET Gaill	120		10-1000	
	52	Torque controller	Torque Out	0		0-2000	ms
	12	output filter	LPF			0 2000	1113
	53	Torque limit setting	Torque Lmt	0	Keypad-1	0-12	-
	-	lorque innie securig	Src		псураа т	0 12	
	54	Forward direction	FWD +Trg Lmt	180.	0	0.0-200.0	%
		retrograde torque limit					
	55	Forward direction	FWD -Trq Lmt	180.	0	0.0-200.0	%
		regenerative torque					
		limit					
	56	Reverse direction	REV +Trq Lmt	180.	0	0.0-200.0	%
		retrograde torque limit					
	57	Reverse direction	REV -Trq Lmt	180.	0	0.0-200.0	%
		regenerative torque					
		limit					<u> </u>
	85*	Flux estimator	Flux P Gain1	370		100-700	-
		proportional gain 1					<u> </u>
	86*	Flux estimator	Flux P Gain2	0		0-100	-
	87*	proportional gain 2 Flux estimator	Flux P Gain3	100		0-500	-
	8/^		Flux P Gain3	100		0-500	-
	88*	proportional gain 3 Flux estimator integral	Flux I Gain1	50		0-200	
	00	gain 1	Flux I Gall I	30		0-200	-
	89*	Flux estimator integral	Flux I Gain2	50		0-200	
	05	gain2	TIUX I Gairiz	50		0-200	
	90*	Flux estimator integral	Flux I Gain3	50		0-200	t
		gain 3					
	91*	Sensorless voltage	SL Volt	30		0-60	t-
		compensation 1	Comp1				
	92*	Sensorless voltage	SL Volt	20		0-60	-
		compensation 2	Comp2				
	93*	Sensorless voltage	SL Volt	20		0-60	-
		compensation 3	Comp3				
	94*	Sensorless field	SL FW Freq	95.0		80.0-110.0	%
		weakening start					
		frequency					<u> </u>
	95*	Sensorless gain	SL Fc Freq	2.00		0.00-8.00	Hz
		switching frequency					

*Cn.23-32 and Cn.85-95 can be displayed only when Cn.20 is set to 1 (Yes).

① Caution

For high-performance operation, the parameters of the motor connected to the VFD output must be measured. Use auto tuning (bA.20 Auto Tuning) to measure the parameters before you run sensorless vector operation. To run high-performance sensorless vector control, the VFD and the motor must have the same capacity. If the motor capacity is smaller than the VFD capacity by more than two levels, control may be inaccurate. In that case, change the control mode to V/F control. When operating with sensorless vector control, do not connect multiple motors to the VFD output.

5.10.1 Sensorless Vector Control Operation Setting

To run sensorless vector control operation, set dr.09 (Control Mode) to 4 (IM sensorless), select the capacity of the motor at dr.14 (Motor Capacity), and enter the nameplate information of the motor in the below parameters.

Code	Input (Motor Rating Plate Information)
drv.18 Base Freq	Base frequency
bA.11 Pole Number	Motor pole number
bA.12 Rated Slip	Rated slip
bA.13 Rated Curr	Rated current
bA.15 Motor Volt	Motor rated voltage
bA.16 Efficiency	Efficiency (when no information is on the rating plate, default values are
	used.)

After setting the above, set bA.20 (Auto tuning) to 1 (All - rotation type) or 2 (All - static type) and run auto tuning. Rotation type auto tuning is more accurate than Static type. Set 1 (All -Rotation type) if the motor can be rotated

Note

Excitation Current

A motor can be operated only after magnetic flux is generated by current flowing through the stator. When the motor is connected to the output of the VFD, excitation current flowing in the stator creates the magnetic flux required to operate the motor.

Sensorless Vector Control Operation Setting Details

Code	Description	n
Cn.20 SL2 G View Sel	Setting	Function
		lo Does not display sensorless (II) vector control gain code.
		es Allows the user to set various gains applied when the
	' '	motor rotates faster than medium speed (approx. 1/2 of
		the base frequency) through sensorless (II) vector
		control.
	Codes av	ailable when setting to 1 (Yes): Cn.23 ASR-SL P Gain2/Cn.24
	ASR-SL I	Gain2/Cn.26 Flux P Gain/Cn.27 Flux I Gain Gain3/Cn.28 S-Est P
	Gain1/Cn	.29 S-Est I Gain1/Cn.30 S-Est I Gain1/Cn.31 ACR SL P
	Gain/Cn.3	32 ACR SL I Gain
Cn.09 PreExTime	Sets pre-	excitation time. Pre-excitation is used at the start of the
	operation	to perform excitation up to the motor's rated flux.
Cn.10 Flux Force	Allows fo	r the reduction of the pre-excitation time. The motor flux
	increases	up to the rated flux with the time constant as shown in the
	following	figure. To reduce the time taken to reach the rated flux, a
	higher m	otor flux base value than the rated flux must be provided.
		e magnetic flux reaches the rated flux, the provided motor flux
	base valu	e is reduced.
	Mag	netic flux
	-	
		Cn.10 Flux Force
	Excitatio	n current
	LACIGATIO	in content
		→ Cn.09 PreExTime
		Run cmd
Cn.11 Hold Time		zero-speed control time (hold time) after deceleration in the
	stopped	position. The output is blocked after the Hold Time.
		1
		Hold time at stop cmd
	Output v	/ortage
	Frequen	CV
		<u> </u>
	Run cmc	
Cn.21 ASR-SL P Gain1,		the speed PI controller gain during sensorless vector control.
Cn.22 ASR-SL I Gain1		peed controller, P gain is a proportional gain for the speed
		. If speed deviation becomes higher than the torque the output
		d increases accordingly. As the value increases, the faster the
		viation decreases. The speed controller I gain is the integral
	gain for s	peed deviation. It is the time taken for the gain to reach the

	Description				
Code					
			mmand while a constant speed deviation		
			ne value becomes, the faster the speed deviation		
	decreases.				
Cn.23 ASR-SL P Gain2, Cn.24 ASR-SL I Gain2	Appears only when 1 (Yes) is selected for Cn.20 (SL2 G view Sel). The speed controller gain can be increased to more than the medium speed for sensorless vector control. Cn.23 ASR-SL P Gain 2 is set as a percentage of the low speed gain Cn.21 ASR-SL P Gain 1 - if P Gain 2 is set shan 100%, the responsiveness decreases. For example, if Cn.21 ASR-SL P Gain 1 is 50.0% and Cn.23 ASR-SL P Gain 2 is 50.0%, the actual middle speed or faster speed controller P gain is 25.0%.				
	Cn.24 ASR-SL I Gain2 is also set as a percentage of the Cn.22 ASR-SL I Gain1. For I gain, the smaller the I gain 2 becomes, the slower the response time becomes. For example, if Cn.22 ASR-SL I Gain1 is 100ms and Cn.24 ASR-SL I Gain2 is 50.0%, the middle speed or faster speed controller I gain is 200 ms. The controller gain is set according to the default motor parameters and Acc/Dec time.				
Cn.26 Flux P Gain,	Sensorless vector control requires the rotor flux estimator. For the				
Cn.27 Flux I Gain,	adjustment of flux estimator gain, refer to 5.10.2 Sensorless Vector				
Cn.85-87 Flux P	Control	Operation Guid	<i>le</i> to on page <u>152</u> .		
Gain13,					
Cn.88-90 Flux I Gain1-					
3					
Cn.28 S-Est P Gain1,	Speed e	stimator gain f	or sensorless vector control can be adjusted. To		
Cn.29 S-Est I Gain1,			gain, refer 5.10.2 Sensorless Vector Control		
Cn.30 S-Est I Gain2		on Guide to on			
Cn.31 ACR SL P Gain.			ns of the sensorless current controller. For the		
Cn.32 ACR SL I Gain,			ss current controller gain, refer to 5.10.2		
CH.52 ACR SL I Gdill					
			ol Operation Guide to on page 152.		
Cn.53 Torque Lmt Src	Select a source for torque limit setting. Either keypad, analog inputs VI, V2 or I2), communications or pulsed input. When setting torque limit, adjust the torque amount by limiting the speed controller output. Set the retrograde and regenerative limits for forward and reverse operation.				
	Settino	1	Function		
	0	KeyPad-1	Sets the torque limit with the 7-Segment		
	1	KeyPad-2	display.		
	2	V1	Sets the torque limit with the analog input		
	4	V2	terminal of the terminal block.		
	5		terminar of the terminal block.		
		12	C. d. P. S. St.d.		
	6	Int 485	Sets the torque limit with the communication terminal of the terminal block.		
	8	FieldBus	Sets the torque limit with the FieldBus communication option.		
	9	UserSeqLink	This enters the torque reference by linking the common area with the user sequence output.		

Code	Description				
Code					
	12	Pulse	Sets the torque limit with the pulse input of		
			the terminal block.		
	The tord	que limit can be	e set up to 200% of the rated motor torque.		
Cn.54 FWD +Trq Lmt	Sets the	torque limit fo	r forward retrograde (motoring) operation.		
Cn.55 FWD -Trq Lmt	Sets the	torque limit fo	r forward regenerative operation.		
Cn.56 REV +Trq Lmt	Sets the	torque limit fo	r reverse regenerative operation.		
Cn.57 REV -Trq Lmt	Sets the torque limit for reverse retrograde (motoring) operation.				
In.02 Torque at 100%	When using an analog input as the Torque Limit source (Cn.53), sets the				
	torque l	imit percentage	e at the maximum analog input. For example, if		
	V1 is used as the torque limit source and In.02 is set to 200%, the torque				
	limit is 200% at 10 V. However, when the VI terminal is set up with the				
	factory default setting and the torque limit setup uses a method other				
	than the 7-Segment display, check the parameter settings in the monitor				
			ode CNF.21-23 (only displayed when using LCD		
	keypad)	, select 21(Torq	ue limit).		
Cn.91-93	Adjust output voltage compensation values for sensorless vector				
SL Volt Comp1-3	control. For output voltage compensation, refer to 5.10.2 Sensorless				
	Vector Control Operation Guide to on page 152.				
Cn.52 Torque Out LPF			for torque command by setting the torque		
'	controller output filter.				

① Caution

Adjust the controller gain according to the load's characteristics. However, the motor can overheat or the system may become unstable depending on the controller gain settings.

Note

Speed controller gain can improve the speed control waveform while monitoring the changes in speed. If speed deviation does not decrease quickly, increase the speed controller P gain or decrease I gain (time in ms). However, if the P gain is increased too high or I gain is decreased too low, severe vibration may occur. If oscillation occurs in the speed waveform, try to increase I qain (ms) or reduce P gain to adjust the waveform.

5,10,2 Sensorless Vector Control Operation Guide

Problem	Function code	Troubleshooting
The amount of starting torque is insufficient.	bA.24 Tr Cn.09 PreExTime Cn.10 Flux Force Cn.31 ACR SL P Gain Cn.54–57 Trq Lmt Cn.93 SL Volt Comp3	Set the value of Cn. 90 to be more than 3 times the value of bA.24 or increase the value of Cn.10 by increments of 50%. If the value of Cn.10 is high, an overcurrent trip at start can occur. In this case, reduce the value of Cn.31 by decrements of 10. Increase the value of Tig Lmt (Cn.54-57) by increments of 10%.

Problem	Function code	Troubleshooting
		Increase the value of Cn.93 by increments of 5.
The output frequency is higher than the base frequency during no-load operation at low speed (10Hz or lower).	Cn.91 SL Volt Comp1	Decrease the value of Cn.91 by decrements of 5.
The motor hunts or the amount of torque is not	Cn.04 Carrier Freq Cn.21 ASR-SL P	If the motor hunts at low speed, increase the value of Cn.22 by increments of 50m/s, and if hunting does not occur, increase the value of Cn.21 to find the optimal operating condition.
sufficient while the load is increasing at low speed	Gain1 Cn.22 ASR-SL I Gain1	If the amount of torque is insufficient, increase the value of Cn.93 by increments of 5.
(10Hz or lower).	Cn.93 SL Volt Comp3	If the motor hunts or the amount of torque is insufficient in the 5-10Hz range, decrease the value of Cn.04 by increments of 1kHz (if Cn.04 is set to exceed 3kHz).
The motor hunts or overcurrent trip occurs in regenerative load at low speed (10 Hz or lower).	Cn.92 SL Volt Comp2 Cn.93 SL Volt Comp3	Increase the value of Cn.92-93 by increments of 5 at the same time.
Over voltage trip occurs due to sudden acceleration/deceleration or sudden load fluctuation (with no brake resistor installed) at mid speed (30Hz or higher).	Cn.24 ASR-SL I Gain2	Decrease the value of Cn.2 by decrements of 5%.
Over current trip occurs due to sudden load	Cn.54–57 Trq Lmt	Decrease the value of Cn.54-57 by decrements of 10% (if the parameter setting is 150% or higher).
fluctuation at high speed (50 Hz or higher).	Cn.94 SL FW Freq	Increase/decrease the value of Cn.94 by increments/decrements of 5% (set below 100%).
The motor hunts when the load increases from the base frequency or higher.	Cn.22 ASR-SL I Gain1 Cn.23 ASR-SL I Gain2	Increase the value of Cn.22 by increments of 50m/s or decrease the value of Cn.24 by decrements of 5%.
The motor hunts as the load increases.	Cn.28 S-Est P Gain1 Cn.29 S-Est I Gain1	At low speed (10Hz or lower), increase the value of Cn.29 by increments of 5. At mid speed (30 Hz or higher), increase the value of Cn.28 by increments of 500. If the parameter setting is too extreme, over current trip may occur at low speed.
The motor speed level decreases.	bA.20 Auto Tuning	Select 6. Tr (static type) from bA. 24 and run bA.24 Rotor time constant tuning.

^{*}Hunting: Symptom of irregular vibration of the equipment.

5.11 Sensorless Vector Control for PM (Permanent-Magnet) Synchronous Motors

Sensorless vector control is an operation that carries out vector control without rotation speed feedback from the motor but, instead, with an estimation of the motor rotation speed calculated by the VFD.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	09	Control mode	Control Mode	6 PM Sensorless	-	-
	14	Motor capacity	Motor Capacity	Depends on the motor capacity	0–15	-
dr	18	Base frequency	Base Freq	Depends on the PM motor capacity	30–180	Hz
	20	Maximum frequency	Max Freq	Depends on the PM motor capacity	40–180	Hz
	11	Motor pole number	Pole Number	4	2-48	-
	13	Rated motor current	Rated Curr	Depends on the motor capacity	1–1000	Α
	15	Motor-rated voltage	Rated Volt	230/380/440/460	170-480	V
	16	Motor efficiency	Efficiency	Depends on the motor capacity	64–100	%
	19	AC Input voltage	AC Input Volt	240/480	170-480	
bA	20	Auto tuning	Auto Tuning	7	All (PM)	-
	32	Q-axis inductance scale	Lq (PM) Scale	100%	50–150	%
	34	Auto tuning level for Ld and Lq	Ld,Lq Tune Lev	33.3%	20.0-50.0	%
	Auto tuning 35 frequency for Ld and La		Ld,Lq Tune Hz	100.0%	80.0–150.0	%
	12	PM speed controller P gain 1	ASR P Gain 1	100	0-5000	-
	13	PM speed controller I gain 1	ASR I Gain 1	150	0-5000	-
	15	PM speed controller P gain 2	ASR P Gain 2	100	0-5000	-
	16	PM speed controller I gain 2	ASR I Gain 2	150	0-9999	-
	33	PM D-axis back-EMF estimated gain (%)	PM EdGain Perc	100.0	0-300.0	%
Cn	34	PM Q-axis back-EMF estimated gain (%)	PM EqGain Perc	100.0	0-300.0	%
	35	Initial pole position estimation retry	PD Repeat Num	2	0–10	-
	36	Initial pole position estimation interval	Pulse Interval	20	1–100	ms
	37	Initial pole position estimation pulse current (%)	Pulse Curr %	15	10–100	%
	38	Initial pole position	Pulse Volt %	500	100-4000	-

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
		estimation pulse voltage (%)				
	39	PM dead-time range (%)	PMdeadBand Per	100.0	50.0-200.0	%
	40	PM dead-time voltage (%)	PMdeadVolt Per	100.0	50.0-200.0	%
	41	PM speed estimator proportional gain	PM SpdEst Kp	100	0-32000	-
	42	PM speed estimator integral gain	PM SpdEst Ki	10	0-32000	-
	43	PM speed estimator proportional gain 2	PM SpdEst Kp 2	300	0-32000	-
	44	PM speed estimator integral gain 2	PM SpdEst Ki 2	30	0-32000	-
	45	Speed estimator feedforward high speed range (%)	PM Flux FF %	300	0–1000	%
	46	Initial pole position estimation type	Init Angle Sel	1: Angle Detect	0–2	0-2
	48	Current controller P gain	ACR P Gain	1200	0-10000	-
	49	Current controller I gain	ACR I Gain	120	0-10000	-
	50	Voltage controller limit	V Con HR	10.0%	0-1000	%
	51	Voltage controller I gain	V Con Ki	10.0%	0-20000	%
	52	Torque controller output filter	Torque Out LPF	0	0-2000	msec
	53	Torque limit source	Torque Lmt Src	0	Keypad-1	0-12
	54	FWD reverse torque limit	FWD +Trq Lmt	180.0	0.0–200.0	%
	55	FWD regenerative torque limit	FWD -Trq Lmt	180.0	0.0-200.0	%
	56	REV regenerative torque limit	REV +Trq Lmt	180.0	0.0–200.0	%
	57	REV reverse torque limit	REV -Trq Lmt	180.0	0.0-200.0	%

① Caution

For high-performance operation, the parameter values of the motor connected to the VFD output must be estimated. Configure the motor-related Basic function group parameters by entering the motor specification values on the rating plate. Then, perform auto tuning by setting IbA. 20 (Auto Tuning) to 7 [All (PMI)] to automatically measure other parameters before operating a PM synchronous motor in sensorless vector control mode. For high-performance PM sensorless vector control, the VFD and the motor must have the same capacity. The VFD control may be inaccurate if the motor capacity and the VFD capacity do not match.

S and 5 es VFD 155

In sensorless vector control mode, do not connect multiple motors to the VFD output.

5.11.1 Detecting the Initial Pole Position

Initial pole position detection is a process to match the rotor position calculated by the VFD and the actual rotor position in a motor. In a permanent-magnet (PM) synchronous motor, rotor flux is generated from the permanent magnet attached to the rotor. Therefore, to run the motor in vector control mode, the exact rotor position (flux position) must be detected for accurate control of the torque generated by the motor.

At Cn. 46 (InitAngle Sel), select the type of initial pole position detection.

When Cn. 46 is set to 0 (None), the motor is operated according to the pole position estimated by the VFD's sensorless control algorithm, instead of actually detecting the physical position of the rotor pole.

When Cn. 46 is set to 1 (Angle Detect), the motor is operated according to the pole position detected by changes in the current. The voltage pulse input is used to detect the pole position and results in a small amount of noise at motor startup.

When Cn. 46 is set to 2 (Alignment), the VFD forcefully align the rotor position by supplying DC current for a certain period of time.

Group	Code	Name	LCD display		Setting	Setting range	Unit
	35	Pole position detection retry count	PD Repeat Num	1		0–10	-
	36	Pole position detection interval	Pulse Interval 20			1-100	Ms
Cn	37	Pole position detection pulse current (%)	Pulse Curr % 15		10–100	%	
Cn	38	Pole position detection pulse voltage (%)	Pulse Volt %		0	100-4000	-
				0	None		
	46	Pole position detection type	Init Angle Sel	1	Angle Detect	0–2	-
				2	Alignment		

5.11.2 Sensorless Vector Control Mode Settings for PM Synchronous Motors

To operate a PM synchronous motor in sensorless vector control mode, set dr.09 (Control Mode) to 6 (PM Sensorless), select the motor capacity at dr.14 (Motor Capacity), and enter the appropriate codes in the Basic (bA) group with the motor specification values found on the motor's rating plate. If a specific motor capacity does not exist in the setting options, select a higher motor capacity that is closest to the actual motor capacity.

Code	Input Values (Motor's Rating Plate Information)		
dr.18 Base Freq	Base frequency		
dr.20 Max Freq	Maximum frequency		
bA.11 Pole Number	Motor pole number		

Code	Input Values (Motor's Rating Plate Information)
bA.13 Rated Curr	Rated current
bA.15 Rated Volt	Rate voltage
bA.16 Efficiency	Efficiency
bA.19 AC Input Volt	Input power voltage

After entering the codes, set bA.20 (Auto tuning) to 7 [All(PMI)] and perform a static auto tuning operation. When auto tuning is complete, the bA.21 (Rs), bA.28 Ld (PMI), bA.29 Lq (PM), and bA.30 (PM Flux Ref) parameters are automatically measured and saved.

Sensorless Vector Control Operation Setting Details

Code	Description				
Cn.4 Carrier Freq	Sets the PWM interrupter cycle and sampling frequency cycle for a PM synchronous motor operation in sensorless vector control mode. The default carrier frequency is set at 5 kHz, and the setting range is 2–10 kHz.				
	Sets the zero-speed control time (hold time) in the stopped position. The output is blocked after zero-speed operation for a set period when the motor decelerates and is stopped by a stop command.				
Cn.11 Hold Time	Output voltage				
	Frequency				
	Run cmd				
Cn.12 ASR P Gain1, Cn.13 ASR I Gain1 Cn.15 ASR P Gain2 Cn.16 ASR I Gain2	Changes the speed PI controller gain during a PM synchronous motor operation in sensorless vector control mode. For a PI speed controller, P gain is a proportional gain for the speed deviation. If the speed deviation becomes greater than the torque, the output command will increase accordingly. The higher the value becomes, the faster the speed deviation will decrease. The speed controller I gain is the integral gain for speed deviation. It is the time taken for the gain to reach the rated torque output command while constant speed deviation continues. The lower the value becomes, the faster the speed deviation will decrease.				
	As the motor inertia varies by motor, the gain values should be changed according to the motor speeds. Cn.12 and Cn. 13 set the low speed P/I controller gain values, while Cn.15 and Cn.16 set the high speed P/I controller gain values, so that an appropriate gain value can be used for different motor speeds.				
Cn.33 PM EdGain Perc,	To ensure that the back-EMF with rotor position information can be				
Cn.34 PM EqGain Perc	appropriately estimated during a PM synchronous motor operation in				

Code	Description				
		ol mode, set these values as a percent			
		h is designed to have stable estimator			
	Higher values result in faster responses, with higher chances of increased motor vibration.				
		Excessively low values may result in motor startup failure due to slow response			
	rate.	nay result in motor startup failure due	to slow response		
		change the speed estimator gain du	ring a PM		
Cn.41 PM SpdEst Kp,	synchronous motor op	eration in sensorless vector control mo	ode.		
Cn.42 PM SpdEst Ki		cessive oscillation is observed at low s			
Cn.43 PM SpdEst Kp2		% decrements until the motor operate			
Cn.44 PM SpdEst Ki2		normal operation, increase the value a			
	motors.	d Cn.44 are used for low speed operati	ions in 230 V		
		nsation values during a PM synchrono	nus motor		
	operation in sensorless				
Cn.39 PMdeadBand Per		erate at low speeds at or below 5% of			
Cn.40PMdeadVolt Per		ues set at Cn.39 and Cn.40 by 10% inci			
		ements if a clanking noise occurs at m	otor startup and		
	motor stop.	ortion of the feed forward rate against	the back EME		
Cn.45 PM Flux FF %	during a PM synchronous motor operation in sensorless vector control mode. Feed forwarding enhances operation of the speed estimator.				
	Increase the value at Cn.45 in 10% increments to suppress motor oscillation				
	under load. A fault trip may occur if this value is set too high.				
		the PI current controller in a synchror			
	The P gain is the proportional gain for the current deviation. The current				
	deviation decreases faster with higher values, as the deviation in voltage output command increases with increased deviation.				
Cn.48 ACR P-Gain	The I gain is the integral gain for the current deviation. Deviation in normal				
Cn.49 ACR I-Gain	operation decreases with higher values.				
	However, the gain values are limited by the carrier frequency. A fault trip may occur due to interference if you set the gain values too high.				
		ce if you set the gain values too high. ue limit input: Keypad, terminal block	analog input A/1		
	and I2), or input via net		analog input (v I		
	and 12), or input via network communication.				
	The torque limit value is used to adjust the torque reference size by limiting				
	the speed controller output. The reverse and regenerative torque limits may be set for operations in the forward or reverse direction.				
			7		
	Setting	Function	_		
Cn.53 Torque Lmt Src	0 KeyPad-1	Sets the torque limit via the			
	1 KeyPad-2	7-Segment display.			
	2 V1 4 V2	Sets the torque limit via the			
	5 12	analog input terminals of the terminal block.			
	 	Sets the torque limit via the	1		
	6 Int 485	communication terminal of			
		the terminal block.			

Code			Description		
	8	FieldBus	Sets the torque limit with the FieldBus communication option.		
	9	UserSeqLink	Sets the torque limit with a user sequence output. The torque reference is received via the common area addresses.		
	12	Pulse	Sets the torque limit with the pulse input of the terminal block.		
	The to	rque limit can be set	up to 200% of the rated motor tor	que.	
Cn.54 FWD +Trq Lmt	Sets th	e reverse torque limi	t for forward operation.		
Cn.55 FWD -Trq Lmt	Sets th	e regenerative torqu	e limit for forward operation.		
Cn.56 REV +Trq Lmt	Sets th	e regenerative torqu	e limit for reverse operation.		
Cn.57 REV – Trq Lmt	Sets th	e reverse torque limi	t for reverse operation.		
In.02 Torque at 100%	Sets the maximum torque. For example, if In.Q2 is set to 200% and an input voltage (V1) is used, the torque limit will be 200% when 10 V is entered. However, when the V1 terminal is set to the factory default setting and the torque limit input source is any device other than the keypad, check the parameter settings in Monitor mode. Set CnF.21–23 (only displayed when an LCD keypad is used) to 21 (Torque limit).				
Cn.52 Torque Out LPF	Sets the time constant for torque command by setting the torque controller output filter.				

① Caution

Adjust the controller gain according to the load's characteristics. However, the motor can overheat or the system can become unstable depending on the controller gain settings.

Note

Speed controller gain can improve the speed control waveform while monitoring the changes in speed. If the speed deviation does not decrease fast enough, increase the speed controller P gain or decrease I gain (time in ms). However, if the P gain value is increased too much or the I gain value is decreased too much, severe vibrations may occur. If oscillation occurs in the speed waveform, try to increase the I gain (ms) or reduce the P gain to a disust the waveform,

5.11.3 Guidelines for Running a PM Synchronous Motor in Sensorless Vector Control

Problem	Relevant function code	Troubleshooting
Starting torque is insufficient.	Cn.48 ACR P-Gain Cn.39 PMdeadBand Per Cn.40 PMdeadVolt Per	If an overcurrent trip occurs at startup, try decreasing the value at Cn.48 in 10% decrements. Try increasing the value at Cn.39 or Cn.40 in 10% increments.
The motor hunts when starting up.	Cn.40 PMdeadVolt Per	Try decreasing the value at Cn.40 in 10% decrements.
The motor hunts with regenerative load at low speed (10Hz or lower), or an "OCT" fault trip occurs.	Cn.40 PMdeadVolt Per	Try increasing the value at Cn.40 in 10% increments.
The motor hunts* or the torque is not sufficient while the load is increasing at low speed (10Hz or	Cn.04 Carrier Freq Cn.12 ASR P Gain 1	If the motor hunts at low speeds, try increasing the value at Cn.13 in 50 msec increments. If the motor does not hunt, try increasing the value at Cn.12 in 10% increments until the motor runs in an optimal operation condition.
lower).	Cn.13 ASR I Gain 1	If the motor hunts and the torque is not sufficient at 5–10Hz speed range, and if the carrier frequency at Cn.04 is set to more than 3 kHz, try decreasing the value in 1 kHz decrements.
The motor hunts excessively during no-load operation when rated current is supplied to the motor.	Cn.12 ASR P Gain 1 Cn.13 ASR I Gain 1 Cn.15 ASR P Gain 2 Cn.16 ASR I Gain 2	Try decreasing the speed controller gains at Cn. 12–16 in 30% decrements.
The value at bA.30 (PM Flux Ref) becomes "0" after performing an	bA.11 Pole Number	Refer to the motor's rating plate and set the pole number at bA.11 (Pole Number), or enter a calculated pole number: Pole Number = (120 x BaseFreq/BaseRPM)
auto tuning operation by setting bA. 20 to 7 [All (PM)].	bA.15 Rated Volt dr.18 Base Freq	Refer to the motor's rating plate and set the rated voltage and base frequency at bA-15 (Rated Volt) and dr.18 (Base Freq), and then run auto tuning again by setting bA-20 (Auto Tuning) to 7 [All (PM)].
Faults occur after a static auto tuning.	bA.21 Rs bA.28 Ld (PM) bA.29 Lq (PM) bA.30 PM Flux Ref	Motor operation may fail if a static PM auto tuning result is not accurate. Refer to the motor's rating plate and set the motor-related parameters again.
"OVT" occurs due to abrupt acceleration, deceleration, or massive load change while the motor is operated at mid-speed (above 30Hz).	Cn.16 ASR I Gain 2	Try decreasing the value at Cn.16 in 5% decrements.
Speed variation occurs during an	Cn.45 PM Flux FF %	If the motor is operated at the rated speed, try

Problem	Relevant function code	Troubleshooting
operation at rated motor speed, or during an overloaded high speed operation.	Cn.50 V Con HR Cn.51 V Con Ki	decreasing the value at Cn.50 in 5% increments. If the motor response is slow, try increasing the value at Cn.51 in 5% increments (or, try increasing the value at Cn.45 in 100% increments).
"OC1" fault trip or jerking occurs during a high speed operation.	Cn.41 PM SpdEst Kp Cn.42 PM SpdEst Ki	Try increasing the value at Cn. 41 in increments of 10 and the value at Cn.42 in increments of 1. Note that a fault trip may occur if the values at Cn. 41 and Cn.42 are set too high.
Jerking occurs during a low speed operation.	Cn.13 ASR I Gain 1	Try increasing the value at Cn.13 (low speed range speed controller I gain) to eliminate jerking.
A "clanking" noise is heard at the beginning of startup or during deceleration.	Cn.12 ASR P Gain 1 Cn.13 ASR I Gain 1 Cn.40 PMdeadVolt Per	Try increasing the values at Cn.12 and Cn.13 in 10% increments, or try decreasing the value at Cn.40 in 10% decrements.
The motor cannot reach the speed reference when it is operated at or above the rated speed, or when the acceleration is not responsive.	Cn.50 V Con HR Cn.51 V Con Ki	Try increasing the value at Cn.50 in 1% increments if the motor cannot reach the speed reference. Try increasing the value at Cn.51 in 10% increments if the motor acceleration is not responsive.
"OC1" trip occurs after an abrupt regenerative load (over 100%).	Cn.12 ASR P Gain 1 Cn.13 ASR I Gain 1	Try decreasing the values at Cn.12 and Cn.13 in 10% decrements.
The motor jerks during acceleration.	Cn.42 PM SpdEst Ki	Try increasing the speed estimator proportional gain at Cn.42 in increments of 5.
A massive current rises when the motor is stopped during a 20:1 speed startup.	Cn.13 ASR I Gain 1	Try increasing the value at Cn. 13 in 10% increments.
An oscillation occurs when an abrupt load is applied to the motor during a low speed operation.	Cn.41 PM SpdEst Kp Cn.42 PM SpdEst Ki	Try increasing the values at Cn. 41 and Cn.42 in 10% increments.
During a PM speed search, the speed search stops at around 20% of the base frequency, and the motor is stopped and starts again after a massive current rises.	Cn.69 SS Pulse Curr	Try decreasing the value at Cn.69 in 5% decrements.
During a high-speed operation in PM control mode utilizing the kinetic energy buffering, a massive current rises at around 20% of the base frequency, the motor is stopped, and it fails to start.	Cn.78 KEB Start Lev Cn.79 KEB Stop Lev Cn.80 KEB P Gain Cn.81 KEB I Gain	Try increasing the values at Cn.78 and Cn.79 in 5% increments, or try doubling the gain values at Cn.80 and Cn. 81.
1. When the motor is overloaded, the maximum torque limit current is supplied to the motor at startup,	bA.29 Lq (PM)	This happens when the Lq parameter value is decreasing due to certain causes, such as self-saturation.

Problem	Relevant function code	Troubleshooting
and the motor fails to operate due to an VFD overload fault trip. 2. Speed search fails when the a load exceeding the rated load is applied to the motor at each speed section, or a current equal to or exceeding 150% of the rated current is supplied to the motor.		Try increasing the value (100%) at bA.32 in 5% increments.
A fault trip occurs when the motor tries to start up or accelerate from a free run at certain speed range.	Cn.71 Speed Search	During a PM synchronous motor operation in sensorless vector mode, the motor starts up after the initial pole position detection is made. To accelerate the motor in a free-run state, enable speed search at acceleration by setting bit 0 (0001) at Cn.71 (Speed Search).
During a low speed operation, the output speed search becomes unstable when a massive load exceeding the rated load is abruptly applied to the motor.	Cn.13 ASR I Gain 1 Cn.40 PMdeadVolt Per	The motor control may become unstable due to input voltage deviation during a low-speed operation with low voltage input. Try decreasing the values at Cn.31 and Cn.40 in 10% decrements.

5.12 Kinetic Energy Buffering Operation

When the input power is disconnected, the VFD's DC link voltage decreases, and a low voltage trip occurs blocking the output. Kinetic energy buffering operation can be used to decelerate the motor safely under these conditions. The VFD uses regenerative energy from the motor during the power outage to maintain the DC link voltage. This extends the time for a low voltage trip to occur. For the KEB feature to operate properly, parameter bA 19 (input voltage) must be set correctly.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
		Kinetic energy buffering		0	None		
	77	selection	KEB Select	1	KEB-1	0~2	-
		Sciection		2	KEB-2		
	78	Kinetic energy buffering start level	KEB Start Lev	125.0		110.0~200.0	%
Cn	79	Kinetic energy buffering stop level	KEB Stop Lev	130.0		Cn-78~210.0	%
CII	80	Energy buffering P gain	KEB P Gain	1000		0-20000	
	81	Energy buffering I gain	KEB I Gain	500		1~20000	
	82	Energy buffering Slip gain	KEB Slip Gain	30.0		0~2000.0%	
	83 Energy buffering acceleration time		KEB Acc Time	10.0		0.0~600.0(s)	-
ln	65 ~69	Pn terminal function setting	Pn Define	52	KEB-1 Select		

Kinetic Energy Buffering Operation Setting Details

Code	Descr	iption				
Cn.77 KEB Select	disco outpri from opera moto KEB- to 52 to rui	nnected ut freque the mot ation after or to a sa 1 can be (KEB-1:	etic energy buffering operation when the input power is . If KEB-1 or KEB-2 is selected, it controls the VFD's ency and charges the DC link with regenerative energy or. KEB-1 operation will allow the VFD to resume prower is restored. KEB-2 operation will decelerate the fe stop. activated with a digital input. Set Px terminal (In.65~69) Select), and activate the terminal block upon power loss B-1 operation. If KEB-1 Select is selected via the terminal, -2 cannot be set in Cn.77.			
	Sett	ing	Function			
	0 None General deceleration is carried out until a low voltage tr					
	1	KEB-1	 When the input power is blocked, VFD operation charge 			

Code	Docon	iption			
Code	Descr	iption	La port in the same of the		
			the DC link with regenerated energy. When the input		
			power is restored, the VFD changes to normal operation		
			from the KEB-1 energy buffering operation. The		
			acceleration time set in Cn.83 (KEB Acc Time) is applied		
			when restoring to normal operation.		
	2	KEB-2	When the input power is blocked, VFD operation charges		
			the DC link with regenerated energy. When the input		
			power is restored, it changes from the KEB-2 energy		
			buffering operation to the deceleration stop operation.		
			The decel time set in the dEC parameter of the		
			operations group is applied during the deceleration stop		
			operation.		
	[KEB-	1]			
		-	(ON-79		
			CON-78		
	DC lini	kvoltage			
			Starting		
	Output fr	equency	frequency		
			KEB control Retrun to operation (CON-89)		
	_	Px (FX)			
	IVED	21			
	[KEB-	-2]			
			CON-29		
			CON-78		
	DC Ini	cvoltage			
	Output fr	equency			
			REB control Deceleration stop (DRV-04)		
	_	Px (FX)			
Cn.78 KEB Start Lev,			and stop points of the kinetic energy buffering operation.		
Cn.79 KEB Stop Lev			must be based on the low voltage trip level as 100% and		
C/ 5 KED Stop Lev			(Cn. 79) must be set higher than the start level (Cn.78).		
			P Gain is for maintaining the voltage of the DC power		
Cn.80 KEB P Gain			the kinetic energy buffering operation. Change the setting		
v			low voltage trip occurs right after a power failure.		
			I Gain is for maintaining the voltage of the DC power		
Cn.81 KEB I Gain			the kinetic energy buffering operation. Sets the gain value		
	to maintain the frequency during the kinetic energy buffering operation				

Code	Description
	until the VFD stops.
Cn.82 KEB Slip Gain	The slip gain is for preventing a low voltage trip due to load when the kinetic energy buffering operation start from blackout.
	When power is restored, sets the acceleration time of the operating frequency when the VFD returns to normal operation from KEB mode.

① Caution

Depending on the duration of Instantaneous power interruptions and the amount of load inertia, a low voltage trip may occur even during a kinetic energy buffering operation. Motors may vibrate during kinetic energy buffering operation for some loads except variable torque load (for example, fan or pump loads).

5.13 Torque Control

The torque control function controls the motor to maintain the preset torque value. The motor rotation speed is constant when the output torque and load torque are balanced. Therefore, the motor rotation speed is decided by the load when controlling the torque.

When the motor output torque is greater than the load, the speed of motor becomes too fast. To prevent this, set the speed limit. (The torque control function cannot be used while the speed limit function is running.)

Torque control setting option

Group	Code	Name	LCD Display Pa		meter Setting	Unit
4.	09	Control mode	Control Mode	4	IM Sensorless	-
dr	10	Torque control	Torque Control	1	Yes	_

Torque control setting option details

Group	Code	Name	Parameter Setting		Unit
	02	Cmd Torque	-	0.0	%
	08	Trq Ref Src	0	Keypad-1	-
dr	09	Control Mode	4	IM Sensorless	-
ar	10	Torque Control	1	Yes	-
	22	(+) Trq Gain	-	50-150	%
	23	(-) Trq Gain	-	50-150	%
bA	20	Auto Tuning	Tuning 1 Yes		-
	62	Speed LmtSrc	0	Keypad-1	-
Cn	63	FWD Speed Lmt	-	60.00	Hz
Ch	64	REV Speed Lmt	-	60.00	Hz
65		Speed Lmt Gain	-	100	%
In	65-69	Px Define	35	Speed/Torque	-
OU	31-33	Relay 1 or Q1	27	Torque Dect	-
OU	59	TD Level	-	100	%
OU	60	TD Band	-	5.0	%

Note

- To operate in torque control mode, basic operation conditions must be set. For more information, refer to <u>5.10.2 Sensorless Vector Control Operation Guide</u> on page <u>152</u>.
- · The torque control cannot be used in a low speed regeneration area or low load conditions.
- If you change the rotation direction while operating, an over current trip or low speed reverse direction error will be generated.

Torque reference setting option

The torque reference can be set using the same settings as the reference frequency setting. If Torque Control Mode is selected, the reference frequency is not used.

Group	Code	Name	LCD Display	Pai	Parameter Setting	
	02	Torque command	Cmd Torque	-18	0-180	%
				0	Keypad-1	
				1	Keypad-2	
				2	V1	
dr				4	V2	
ui	80	Torque reference setting	Trq Ref Src	5	12	-
				6	Int 485	
				8	FieldBus	
				9	UserSeqLink	
				12	Pulse	
			Speed LmtSrc	0	Keypad-1	
		Speed limit setting		1	Keypad-2	
				2	V1	
	62			4	V2	
	62			5	12]-
Cn				6	Int 485	1
CII				7	FieldBus	1
				8	UserSeqLink	1
	63	Positive-direction speed limit	FWD Speed Lmt	nt 0-Maximum frequency		Hz
	64	Negative-direction speed limit	REV Speed Lmt	0- Maximum frequency		Hz
	65	Speed limit operation gain	Speed Lmt Gain	10	100-5000	
In	02	Torque at maximum analog input	Torque at 100%	-12.00-12.00		mA
	21	Monitor mode display 1	Monitor Line-1	1	Speed	
CNF*	22	Monitor mode display 2	Monitor Line-2	2	Output Current	
	23	Monitor mode display 3	Monitor Line-3	3	Output Voltage	

^{*} For LCD keypad

Torque reference setting detail

reference security details						
Code	Descri	Description				
	Select	an input to use	as the torque reference.			
dr-08	Parar	Parameter Setting Description				
	0 Keypad-1		Input the torque reference with the 7-Segment			
	1	Keypad-2	display.			

Code	Descrip	tion			
	2,4,5 V1,V2,I2		Input the torque reference using the voltage or current input terminal of the terminal block.		
	6	Int 485	Input the torque reference with the communication terminal of the terminal block.		
	8	FieldBus	Input the torque reference using the VFD's FieldBus option.		
	9	UserSeqLink	Input the torque reference by linking common area with the user sequence output.		
	12	Pulse	Input the torque reference using the pulse input on the VFD's terminal block.		
Cn-02	The tor torque		an be set up to 180% of the maximum rated motor		
In-02	Sets the maximum torque. You can check the set maximum torque in Monitor (MON) mode.				
CNF-21-23	Select : Ref).	a parameter fro	m the Config (CNF) mode and then select 19 (Torque		

Speed limit details

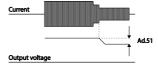
imit details						
Code	Descrip	tion				
	Select a method for setting the speed limit value.					
	Param	neter Setting	Description			
	0	Keypad-1	Input the speed limit value with the 7-Segment			
Cn-62	1	Keypad-2	display.			
	2,4,5	V1,V2,I2	Input the speed limit value using the same method			
	6	Int 485	as the reference frequency. You can check the			
	7	FieldBus	setting in Monitor (MON) mode.			
	8	UserSeqLink				
Cn-63	Sets the	e positive-direc	tion speed limit value.			
Cn-64	Sets the	e negative-dire	ction speed limit value.			
Cn-65		e decrease rate s the speed lim	of the torque reference when the motor speed nit value.			
CNF-21~23	Select a Bias).	a parameter fro	om the Config (CNF) mode and then select 21 (Torque			
	Select a	multi-function	nal input terminal to set as 35 (Speed/Torque). If you			
In 65-69			vhile the operation is stopped, it operates in vector			
	control	(speed limit) n	node.			

5.14 Energy Saving Operation

5.14.1 Manual Energy Saving Operation

If the VFD output current is lower than the current which is set at bA.13 (Motor Rated Curr), the output voltage is reduced by the percentage set in Ad.51 (Energy Save). The voltage before the energy saving operation starts will become the base value of the percentage. Manual energy saving operation will not be carried out during acceleration and deceleration.

Group	Code	Name	LCD Display	Parame	ter Setting	Setting Range	Unit
Ad	50	Energy saving operation	E-Save Mode	1	Manual	-	-
Au	51	Energy saving amount	Energy Save	30		0-30	%



5.14.2 Automatic Energy Saving Operation

The amount of energy saving can be automatically calculated based on the rated motor current (bA.13) and the no-load current (bA.14). From the calculations, the output voltage can be adjusted.

Group	Code	Name	LCD Display	Parame	ter Setting	Setting Range	Unit
Ad	50	Energy saving operation	E-Save Mode	2	Auto	=	-

① Caution

The VFD will exit the energy saving mode, when the reference frequency is changed or during acceleration and deceleration. The actual Acc/Dec time may take longer than the set Acc/Dec time due to the time required to return to normal operation.

5.15 Speed Search Operation

Speed Search is used to start the VFD while the motor/load are already spinning (idling). Speed Search synchronizes the VFD output (voltage and frequency) to that of the spinning motor. This is accomplished by ramping the output voltage up, then ramping the output frequency down. Speed Search estimates the motor rotation speed based on the VFD output current, therefore it may not match the exact speed. Speed Search can prevent faults that occur when starting the VFD while the motor/load are spinning. There are two modes of Speed Search (Flying Start-1 and Flying Start-2 and Flying Start-2 and retend in the spinning Start spinning spinning start spinning start spinning spin

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
	70	Speed search mode selection	SS Mode	0	Flying Start-1	=	-
	71	Speed search operation selection	Speed Search	0000*		-	bit
Cn	72	Speed search reference current	SS Sup- Current	-	Below 75kW	80–200	%
Cn	73	Speed search proportional gain	SS P-Gain	100		0-9999	-
	74	Speed search integral gain	SS I-Gain	200		0-9999	-
	75	Output block time before speed search	SS Block Time	1.0		0–60	sec
OII	31	Multi-function relay 1 item	Relay 1	19	Speed		
OU	33	Multi-function output 1 item	Q1 Define	2	Search	-	

^{*}Displayed as Displayed Disp

Speed Search Operation Setting Details

Code	Descri	iption	
	Selec	t a speed se	arch type.
	Sett	ing	Function
Cn.70 SS Mode	0	Flying Start-1	The speed search is carried out as it controls the VFD output current during idling below the Cn.72 (SS Sup-Current) parameter setting. Use when the direction of the idling motor and the direction of operation command at restart are the same. A stable speed search function can be performed at about 10 Hz or lower. However, if the direction of the idling motor and the direction of the start command at restart are different the speed search does

			not	produce	a satisfactory	results. The direction of the			
	II I				cannot be est				
	1	Flying				out as it PI controls the ripple			
		Start-2	cur	rent which	h is generated	by the counter electromotive			
			for	force during no-load rotation. The counter electrome					
		force is proportional to the idle speed. This mode							
			est	ablishes t	he direction of	the idling motor			
			(for	ward/rev	erse) and the	speed search function is stable			
						of the idling motor and			
						nand. However because the			
						requency is not determined			
						bout 10-15 Hz). Re-			
					may start fron				
						nding bit is set to 1 (enabled).			
		the botto	om LED segment is on, the corresponding bit is 0 (disable						
	Item		Bit S	Setting Or	n Status	Bit setting Off Status			
		gment	H			H			
	displa		-			_			
	LCD F	keypad							
	Speed	search ca	an be sel	ected to d	operate amon	g the following 4 conditions.			
	l .				operate amon				
	Type a	and Fund	ctions o	f Speed :					
	Туре а	and Fun		f Speed :	Search Settir				
	Type a	and Fund	bit2	f Speed :	Search Settin Function				
Cn.71 Speed	Type a	and Funding bit3	ctions o	f Speed :	Search Settin Function Speed searc	ch for general acceleration			
Cn.71 Speed Search	Type a	and Fund	bit2	f Speed :	Search Settin Function Speed searc	ng ch for general acceleration			
	Type a	and Funding bit3	bit2	f Speed :	Search Settin Function Speed searc Initialization Restart afte interruption	ch for general acceleration after a fault trip r instantaneous power			

before the internal power shuts down, the speed search operation accelerates the motor back to its frequency reference before the low

Code	Description
	voltage trip.
	When an instantaneous power interruption occurs, the VFD generates a low voltage trip and blocks the output. When the input power returns, speed search accelerates the motor back to its operating frequency prior to the low voltage trip and the voltage is increased by the VFD's inner PI control.
	If the current increases above the value set at Cn.72, the voltage stops increasing and the frequency decreases (11 zone). If the current decreases below the value set at Cn.72, the voltage increases again and the frequency stops decelerating (t2 zone). When the normal frequency and voltage are resumed, speed search accelerates the motor back to its operating frequency prior to the fault.
	Power input
	Frequency
	Voltage
	Cn.72
	Multi-function output or relay
	Starting with power-on: Set bit 4 to 1 (enabled) and Ad.10 (Power-on Run) to 1 (Yes). If VFD input power is applied and the run command is active (on), speed search accelerates the motor up to the frequency reference.
Cn.72 SS Sup- Current	During Flying Start-1 (Cn.70 set to 0), the amount of current is controlled. The percentage is based on the motor's rated current. If Cn.70 (SS mode) is set to 1 (Flying Start-2), this code is not visible.
Cn.73 SS P/I-Gain, Cn.75 SS Block Time	The P/I gain of the speed search controller can be adjusted. If Cn.70 (SS Mode) is set to I (Flying Start-2), different factory defaults are used based on motor capacity, defined in dr.14 (Motor Capacity, defined in dr.14 (Motor Capacity), Gr.75 (SS Block Time) prevents overvoltage faults due to counter electromotive force (emf).

Note

- If operated within the rated output, the S and SW Series VFDs are designed to withstand instantaneous power interruptions within 15 ms and maintain normal operation. Based on the rated heavy load current, safe operation during an instantaneous power interruption is guaranteed for 230V and 460V VFDs (whose rated input voltages are 200-240 VAC and 380-480 VAC respectively).
- The DC voltage inside the VFD may vary depending on the output load. If the power interruption time is longer than 15 ms, a low voltage trip may occur.

① Caution

When operating in sensorless II mode for proper operation during free-run, the speed search function (for general acceleration) must be set for smooth operation. If the speed search function is not set, an overcurrent trip or overload frip may occur.

5.16 Auto Restart Settings

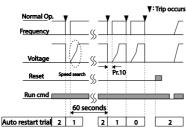
For continued operation, the VFD can be automatically reset and restarted after a fault. Enable the auto reset/restart function with parameter Pr.08. The number of reset/restart attempts and the time delay between attempts are set with parameters Pr.09 and Pr.10. Certain faults cannot be auto reset. These include low voltage, emergency stop (8bx), inverter overheating, and hardware diagnostic faults.

Group	Code	Name	LCD Display	Paramo	eter Setting	Setting Range	Unit
	08	Select start at trip reset	RST Restart	0	No	0-1	-
Pr	09	Auto restart count	Retry Number	0		0–10	-
	10	Auto restart delay time	Retry Delay	1.0		0.0-60.0	s
	71	Select speed search operation	Speed Search	-		0000*-1111	bit
	72	Speed search startup current	SS Sup- Current	150		80-200	%
Cn	73	Speed search proportional gain	SS P-Gain	100		0-9999	
	74	Speed search integral gain	SS I-Gain	200		0-9999	
	75	Output block time before speed search.	SS Block Time	1.0		0.0-60.0	s

^{*}Displayed as Don the 7-Segment display.

Auto Restart Setting Details

Code	Description
Pr.08 RST Restart, Pr.09 Retry Number, Pr.10 Retry Delay	Only operates when PD8 (RST Restart) is set to 1/(es). The number of attempts to try the auto restart is set at Pr.09 (Auto Restart Count), if a fault occurs during operation, the VFD automatically restarts after the set time programmed at Pr.10 (Retry Delay). At each restart, the VFD counts the number of tries and subtracts it from the number set at Pr.09 until the retry number count reaches 0. After an auto restart, if a fault trip does not occur within 60 sec, it will increase the restart count number. The maximum count number is limited by the number set at Pr.09 (Auto Restart Count). At auto restart, the acceleration options are identical to those of speed search operation. Codes Cn.72–75 can be set based on the load. Information about the speed search function can be found at 0_ Speed Search Operation on page 170.



[Example of auto restart with a setting of 2]

① Caution

When auto reset/restart is enabled (Pr.08, RST Restart), the VFD will reset from a fault and automatically start to rotate.

5.17 Operational Noise Settings (carrier frequency settings)

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
	04	Carrier Frequency	Carrier Freq	3.0		1.0-15.0	kHz
Cn	05	Switching Mode	PWM* Mode	0	Normal	0–1	-

^{*} PWM: Pulse width modulation

Operational Noise Setting Details

Code	Description							
Cn.04 Carrier Freq	Power transistors (IGBI) at the output of the VFD generate and supply a high frequency switching voltage to the motor. This switching speed is refered to as the carrier frequency. Adustment of the carrier frequency affects motor operating noise. A higher carrier frequency reduces operational noise. A lower carrier frequency increases operational noise.							
	lower carrier frequency increases operational noise. The heat loss and leakage current from the VFD can be reduced by changing the load rate option at Cn.05 (PWM Mode). Selecting 1 (LowLeakage PWM) reduces heat loss and leakage current, compared to when 0 (Normal PWM) is selected. However, it increases the motor noise. Low leakage PWM uses 2 phase PWM modulation mode, which helps minimize degradation and reduces switching loss by approximately 30%.							
Cn.05 PWM	I tem	Carrier fr	equency					
Mode		1.0kHz	15kHz					
		Low Leakage PWM	Normal PWM					
	Motor noise	†	1					
	Heat generation	1	1					
	Noise generation	ţ	1]				
	Leakage current	1	1					

5.18 **2nd Motor Operation**

2nd motor operation is used when a single VFD switches its output between two motors. Parameters for the 2nd motor are set in the M2 parameter group. 2nd motor operation is enabled when a digital input terminal defined as "2nd motor" function is activated.

Group	Code	Name	LCD Display	Parame	ter Setting	Setting Range	Unit
In	65-	Px terminal	Px Define(Px: P1-	26	2nd	0~54	
	69	configuration	P5)	20	Motor	0-34	_

2nd Motor Operation Setting Details

Code	Description
	Set one of the digital input terminals (P1~P5) to 26 (2nd Motor) to
	display the M2 (2nd motor) group. When activated, the VFD will
	monitor and control the 2nd motor according to the settings listed
	below. An external method of switching the VFD output between the
In.65-69 Px	2 motors is required.
Define	NOTE: When the VFD is in operation, switching of the digital input
	will not be acknowledged.
	Pr.50 (Stall Prevent) must be set first, before M2.28 (M2.Stall Lev)
	settings can be used. Also, Pr.40 (ETH Trip Sel) must be set first,
	before M2.29 (M2.ETH 1min) and M2.30 (M2.ETH Cont) settings.

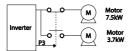
Parameter Setting at Multi-function Terminal Input on a 2nd Motor

Code	Description	Code	Description
M2.04 Acc Time	Acceleration time	M2.16 Inertia Rt	Load inertia rate
M2.05 Dec Time	Deceleration time	M2.17 Rs	Stator resistance
M2.06 Capacity	Motor capacity	M2.18 Lsigma	Leakage inductance
M2.07 Base Freq	Motor base frequency	M2.19 Ls	Stator inductance
M2.08 Ctrl Mode	Control mode	M2.20 Tr	Rotor time constant
M2.10 Pole Num	Pole number	M2.25 V/F Patt	V/F pattern
M2.11 Rate Slip	Rated slip	M2.26 Fwd Boost	Forward torque boost
M2.12 Rated Curr	Rated current	M2.27 Rev Boost	Reverse torque boost
M2.13 Noload Curr	No-load current	M2.28 Stall Lev	Stall prevention level
M2.14 Rated Volt	Motor rated voltage	M2.29 ETH 1min	Motor heat protection 1min
			rating
M2.15 Efficiency	Motor efficiency	M2.30 ETH Cont	Motor heat
			protection
			continuous rating

Example - 2nd Motor Operation

Use the 2nd motor operation when switching operation between a 7.5kW motor and a secondary 3.7kW motor. Refer to the following settings.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
In	67	Terminal P3 configuration	P3 Define	26	2nd Motor	-	-
1.40	06	Motor capacity	M2-Capacity	-	3.7kW	-	-
M2	08	Control mode	M2-Ctrl Mode	0	V/F	_	-



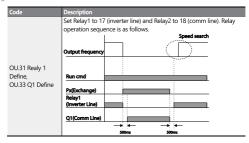
5.19 **Supply Power Transition**

Power Source Transition is used to switch the power source to the motor from the VFD output to the main supply power source (commercial power source), and vice versa.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
1	65-69	Px terminal	Px Define(Px:	16	Exchange	0~54	
In	65-69	configuration	P1-P5)	16			-
	31	Multi-function relay1	Relav1	17	Inverter	-	
OII		items	Relay I		Line		
OU	22	Multi-function	Q1 Define	10	18 Comm Line	-	
	33	output1 items		10			[-

Supply Power Transition Setting Details

Code	Description
	Set one of the digital input terminals (P1~P5) to 16
	(Exchange). Set the two output relays (Relay1 and Relay2) to 17
In.65–69 Px Define	(Inverter) and 18 (Comm Line) respectively. When the digital input is
III.05-05 FX Deline	activated, the output relays will change state. An external method of
	switching the VFD output to the commercial line is required. To
	reverse the transition, de-activate the digital input terminal.



5.20 Cooling Fan Control

This function controls the operation of the VFD's heat-sink cooling fan. It is used in situations with frequent starting and stopping, or noise free environment is required. The correct use of cooling fan control can extend the life of the cooling fan.

Group	Code	Name	LCD Display	Parar	meter Setting	Setting Range	Unit	
Ad	64	Cooling fan control			During Run		-	

Cooling Fan Control Detail Settings

Code	Description					
	Set	tings	Description			
Ad.64 Fan	0	During Run	Cooling fan runs when the VFD is running. The cooling fan stops when the VFD stops. If the VFD heat sink temperature is higher than a set value, the cooling fan will operate regardless of the VFD's operation status.			
	1	Always On	Cooling fan runs constantly when power is supplied to the VFD.			
	2	Temp	With power connected and the start command on, the cooling			
		Control	fan will not operate unless the temperature in the heat sink reaches a set temperature.			

Note

Regardless of setting Ad.64 to 0 (During Run), if the heat sink temperature reaches a set level, the cooling fan may run as a protection function.

5.21 Input Power Frequency and Voltage Settings

Select the frequency of input power. When the frequency is set to 50 Hz, the frequencies set for 60 Hz (including the maximum frequency and base frequency) will change to 50 Hz. Likewise, changing the input power frequency setting from 50 Hz to 60 Hz will change all related settings from 50 Hz to 60 Hz.

Group	Code	Name	LCD Display	Param	eter Setting	Setting Range	Unit
bA	10	Input power frequency	60/50 Hz Src	0	60Hz	0-1	-

Set VFD input power voltage. Low voltage fault level changes automatically to the set voltage standard.

Group	Code	Name	LCD Display	Param	eter Setting	Setting Range	Unit
	10	land to a constant	AC Immust Valt	240V	240	170-240	V
bA	19	Input power voltage	AC Input Volt	480V	480	320-480	

5.22 Read, Write, and Save Parameters

Use read, write and save function parameters of the VFD to copy parameters from the VFD to the LCD keypad or from the LCD keypad to the VFD.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
	46	Parameter read	Parameter	1	Yes	-	-
			Read	l '			
CNF*	47	17 Parameter write	Parameter	1	Yes		
	47		Write	'	ies	_	_
	48	Parameter save	Parameter Save	1	Vec	_	

^{*}Available on LCD keypad only.

Read, Write, and Save Parameter Setting Details

Code	Description
CNF-46 Parameter Read	Copies saved parameters from the VFD to the LCD keypad. Saved parameters on the LCD keypad will be deleted and replaced with copied parameters.
CNF-47 Parameter Write	Copies saved parameters from the LCD keypad to the VFD. Saved parameters on the VFD will be deleted and replaced with copied parameters. If an error occurs during parameter writing, previous saved data will be used. If there is no saved data on the LCD Keypad, 'EEP Rom Empty' message will be displayed.
CNF-48 Parameter Save	Parameters changes are saved to RAM. The changed values will be lost if the power is cycled. Select 1 (Yes) at CNF-48 to save the changed parameters to VFD memory.

5.23 Parameter Initialization

The parameters changed by the user can be initialized to the factory default settings. Initialize parameters in all groups by selecting 1 (All GRP) or select specific groups. The parameters cannot be initialized if the VFD is operating or during a fault condition.

Group	Code	Name	LCD Display	Param	eter Setting	Setting Range	Unit
dr*	93	Parameter initialization	-	0	No	0–16	
CNF**	40	Parameter initialization	Parameter Init	0	No	0–16	

^{*} For 7-Segment display

Parameter Initialization Setting Details

Code	Description			
	Sett	ing	LCD Display	Function
	0	No	No	-
	1	Initialize all groups	All Grp	Initialize all data. Select 1(All Grp) and press [PROG/ENT] key to start initialization. On completion, 0 (No) will be displayed.
	2	Initialize dr group	DRV Grp	Initialize data by groups.
dr.93,	3	Initialize bA group	BAS Grp	Select initialize group and
CNF-40 Parameter Init	4	Initialize Ad group	ADV Grp	press [PROG/ENT] key to
	5	Initialize Cn group	CON Grp	start initialization. On
	6	Initialize In group	IN Grp	completion, 0 (No) will be
	7	Initialize OU group	OUT Grp	displayed.
	8	Initialize CM group	COM Grp	
	9	Initialize AP group	APP Grp	
	12	Initialize Pr group	PRT Grp	
	13	Initialize M2 group	M2 Grp	
	16	Initialize OperationGroup	SPS Grp	

^{**} For LCD keypad

5.24 Parameter View Lock

Use parameter view lock to hide parameters after registering and entering a user password.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	50	Parameter view lock	View Lock Set	Unlocked	0-9999	
CNF*	51	Parameter view lock	View Lock Pw	Password	0-9999	

^{*} Available on LCD keypad only.

Parameter View Lock Setting Details

Code	Description			
	Register a password to be used with CNF-50. Follow the steps below to register a password.			
	No	Procedure		
	1	Pressing [PROG/ENT] key on CNF-51 will show the previous password input window. If registration is made for the first time, enter 0. It is the factory default.		
CNF-51 View Lock Pw	2	If a password had been set, enter the saved password.		
	3	If the entered password matches the saved password, a new window prompting the user to enter a new password will be displayed (the process will not progress to the next stage until the user enters a valid password).		
	4	Register a new password.		
	5	After registration, code CNF-51 will be displayed.		
CNF-50 View Lock Set	To enable parameter view lock, enter a registered password. [Locked] sign will be displayed on the screen to indicate that parameter view loct is enabled. To disable parameter view lock, re-enter the password. The [locked] sign will disappear.			

5.25 Parameter Lock

Use parameter lock to prevent unauthorized changes to parameter settings. To enable parameter lock, register a user password first in dr.94 or CNF-53. To lock and unlock parameter changes, enter the password in dr.95 or CNF-52.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	94	Password registration	-	=-	0-9999	-
dr	95	Parameter lock password	=	_	0-9999	-
	52	Parameter lock	Key Lock Set	Unlocked	0-9999	-
CNF*	53	Parameter lock password	Key Lock PW	Password	0-9999	-

^{*}Available on LCD keypad only.

Parameter Lock Setting Details

Code	Description					
	Register a password to prohibit parameter modifications. Follow the					
	proced	procedures below to register a password.				
	No	Procedures				
	1	Press the [PROG/ENT] key on CNF-53 code and the saved				
		password input window will be displayed. If password				
		registration is being made for the first time, enter 0. It is the				
CNF-53 Key Lock Pw		factory default.				
CINF-33 Key LOCK FW	2	If a saved password has been set, enter the saved password.				
	3	If the entered password matches the saved password, then a				
		new window to enter a new password will be displayed. (The				
		process will not move to next stage until the user enters a valid password).				
	4	Register a new password.				
	5	After registration, Code CNF-51 will be displayed.				
	To enable parameter lock, enter the registered password. [Locked] sign					
	will be displayed on the screen to indicate that parameter lock is enabled.					
CNF-52 Key Lock Set	Once enabled, Pressing the [PROG/ENT] key on function code will not					
	allow the display edit mode to run. To enable parameter modification, re-					
	enter t	he password. The [Locked] sign will disapear.				

① Caution

If parameter view lock and parameter lock functions are enabled, no VFD operation related function changes can be made. It is very important that you memorize the password.

5.26 Changed Parameter Display

This feature displays all the parameters that are different from the factory defaults. Use this feature to track changed parameters.

Group	Code	Name	LCD Display	Parame Setting	ter	Setting Range	Unit
CNF*	41	Changed parameter	Changed Para	0	View All	-	-

^{*} Available on LCD keypad only.

Changed Parameter Display Setting Details

Code	Description			
CNF-41 Changed	Setting		Function	
Para Changed	0	View All	Display all parameters	
Turu	1	View Changed	Display changed parameters only	

5.27 User Group

Create a user defined group and register user-selected parameters from the existing parameter groups. The user group can carry up to a maximum of 64 parameter registrations.

Gr	oup	Code	Name	LCD Display	Parar	neter Setting	Setting Range	Unit
CNIE		42	Multi-function key settings	Multi Key Sel	3	UserGrp SelKey	-	-
CI	CNF*	45	Delete all user registered codes	UserGrp AllDel	0	No	-	-

^{*} Available on LCD keypad only.

User Group Setting Details

roup setting betails					
Code	Descripti	ion			
CNF-42 Multi-Key Sel	If user g key to ti group (I	(UserGrp SelKey) from the multi-function key setting options. roup parameters are not registered, setting the multi-function he user group select key (UserGrp SelKey) will not display user JSR Grp) item on the LCD Keypad. The procedures below to register parameters to a user group.			
	No	Procedure			
	1	Set CNF- 42 to 3 (UserGrp SelKey). A 🔲 icon will be			
		displayed at the top of the LCD display.			
	2	In the parameter mode (PAR Mode), move to the			

Code	Descript	ion
		parameter you need to register and press the [MULTI] key. For example, if the [MULTI] key is pressed in the frequency reference in DRV 01 (Cmd Frequency), the screen below will be displayed. USR → REG
		Group name and code number of the parameter Name of the parameter Code number to be used in the user group. Pressing the [PRGOS/ENT] key on the code number (40 Code) will register DRV-01 as code 40 in the user group. Existing parameter registered as the user group code 40 Setting range of the user group code. Entering 0 cancels the settings.
	3	Set a code number (3) to use to register the parameter in the user group. Select code number and press [PROG/ENT] key.
	4	Changing the value in ③ will also change the value in ④. If no code is registered, 'Empty Code' will be displayed. Entering 0 cancels the settings.
	5	The registered parameters are listed in the user group in U&IM mode. You can register one parameter multiple times if necessary. For example, a parameter can be registered as code 2, code 11, and more in the user group.
	Follow t	the procedures below to delete parameters in the user group.
	No.	Settings
	1	Set CNF- 42 to 3 (UserGrp SelKey). A U icon will be displayed at the top of the LCD display.
	2	In the USR group in U&M mode, move the cursor to the code that is to be deleted.
	3	Press the [MULTI] key.
	4	Move to YES on the deletion confirmation screen, and press the [PROG/ENT] key.
	5	Deletion completed.
CNF-25 UserGrp	Set to 1	(Yes) to delete all registered parameters in the user group.

Code	Description
AllDel	

5.28 Run Quick Start

The VFD LCD boots up to the "Quick Start" menu on power up. The parameters in the below table will be displayed in order to quickly setup the VFD. These include the Control Source, Frequency Reference Source, Motor and Protection parameters. The Quick Start menu contains basic parameter settings for control and protection of a standard induction motor when using the optional remote LCD keypad/display. The default settings are used for a standard induction motor controlled with a linear (fixed) V/Hz. pattern with a base frequency of 60 Hz.

- During programming, use escape (ESC) to exit the Quick Start menu.
- To access the Quick Start menu when already powered up, set DRV.31 (PopUp Q. Start) to "Yes" to return to the Run Quick Start menu.
- CNF.61 (Run Quick Start?) is set to "Yes" by default. The VFD will display the Quick Start menu on every power up. To disable the Quick Start menu, set CNF.61 to "No".

Group	Code	Name	LCD Display	Paramete	er Setting	Setting Range	Unit
DRV*	31	Quick Start Pop Up menu	PopUp Q.	0	No	0 - 1	
DRV* 31	31	Quick Start Pop Up menu	Start	1	Yes	0-1	-
CNF*	61	0.11.0	Run	0	No	0 1	
CINF*	ы	Quick Start menu setting	OuickStart?	1	Yes	0 - 1	-

^{*}Available on LCD keypad only.

Quick Start Setting Details

CNF-61

Select "Yes" at the Run QuickStart display. Make selections for each of the parameters in the Quick Start menu. After making all selections, the display will return to the Monitor menu.

Procedures

Make selections of the following parameters on the LCD keypad. To escape from the Quick Start menu, press the [ESC] key.

- DRV-06 Cmd Source: Set command source
- DRV-07 Freq Ref Src: Set Frequency Reference.
- PRT-04 Load Duty: Set Load Duty.
- . DRV-14 Motor Capacity: Set motor capacity.
- BAS-10 60/50 Hz Sel: Set motor rated frequency.
- · BAS-11 Pole Number: Set motor pole number.
- . BAS-13 Rated Curr: Set rated Curr.
- . BAS-15 Rated Volt: Set motor rated voltage.
- · BAS-19 AC Input Volt: Set input voltage.
- ADV-09 Run Prevent: Set run Prevent direction.
- · PRT-05 Phase Loss Chk: Set phase loss mode..
- · PRT-20 OL Trip Select: Set of trip selection.
- PRI-20 OL Trip Select: Set of trip selection
- Run PRT-21 OL Trip Level: Set of trip level.
- QuickStart? PRT-22 OL Trip Time: Set of trip time.
 - · PRT-40 ETH Trip Sel: Set eth trip selection.
 - PRT-41 Motor Cooling: Set motor cooling mode.
 - PRT-42 ETH 1min: Set eth thermal 1 minute rating.
 - PRT-43 ETH Cont: Set electronic thermal continuous rating.

If DRV-07, Freq Ref Source is set to Keypad-1, program the reference frequency at the first line of the Monitor menu or at parameter DRV.01, Cmd Frequency..

If DRV-06, Cmd Source (Start/Stop) is set to Kepad, the VFD can be started with the FWD and REV buttons on the LCD Keypad.

When the settings are completed, the minimum parameter settings for motor control and protection have been made. The LCD keypay will return to a monitoring display. Now the motor can be operated with the command source set at DRV-06 and the reference frequency set at DRV-07.

5.29 Config(CNF) Mode

The config mode parameters are used to configure the LCD keypad related features.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
	2	LCD brightness/contrast adjustment	LCD Contrast	-	-	
	10	Inverter S/W version	Inv S/W Ver	X.XX	-	
CNF*	11	LCD Keypad S/W version	Keypad S/W Ver	x.xx	-	-
CINF"	12	Keypad title version	KPD Title Ver	X.XX	-	-
	30-32	Power slot type	Option-x Type	None	-	-
	44	Erase trip history	Erase All Trip	No	-	-
	60	Add title update	Add Title Up	No	-	-
	62	Initialize accumulated electric energy	WH Count Reset	No	-	

^{*} Available on the LCD keypad only.

Config Mode Parameter Setting Details

wode raidifieter Setting Details				
Code	Description			
CNF-2 LCD contrast	Adjusts LCD brightness/contrast on the LCD keypad.			
CNF-10 Inv S/W Ver, CNF-11 Keypad S/W Ver	Check OS version in the VFD and on the LCD keypad.			
CNF-12 KPD title Ver	Checks title version on the LCD keypad.			
CNF-30-32 Option-x type	Checks type of powerboard installed in 1–3 power slot.			
CNF-44 Erase all trip	Deletes stored trip history.			
CNF-60 Add Title Up	When VFD S/W version is updated and more code is added, CNF-60 settings will add, display, and operate the added codes. Set CNF-60 to 1(Yes) and disconnect the LCD keypad from the VFD. Reconnecting the LCD keypad to the VFD updates titles.			
CNF-62 WH Count Reset	Initialize accumulated electric energy consumption count.			

5.30 Timer Settings

Add a timer function to one of the outputs (Relay1 or Q1). Set a digital input to activate the timer and set On/Off delay times to output Relay1 or Q1.

Group	Code	Name	LCD Display	Para Setti	meter ng	Setting Range	Unit
In	65–69	Px terminal configuration	Px Define(Px: P1– P5)	38	Timer In	0~54	-
	31	Multi-function relay1	Relay 1				
OU	33	Multi-function output1	Q1 Define	28	Timer Out	-	-
	55	Timer on delay	Timer on delay 3.0			0.00-100	sec
	56	Timer off delay	Timer off delay	1.00		0.00-100	sec

Timer Setting Details

2	etting Details					
	Code	Description				
In.65–69 Px Define		Choose one of the digital input terminals and set it to 38 (Timer In). Ativate the terminal to start the timer function.				
	OU.31 Relay1, OU.33 Q1 Define	Set multi-function output terminal Relay1 or Q1 to be used as a timer to 28 (Timer out).				
	OU.55 TimerOn Delay,	Set the On Delay time. When the digital input is activiated, the output relay will change state after the On Delay time has passed.				
	OU.56 TimerOff Delay	Set the Off Delay time. When the digital input is de-activated, the output relay will change state after the Off Delay time has passed				

		OU.56	
Px(Timer In)		•	
	OU.55		
Q1(Timer Out)	1		

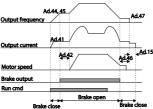
5 31 Brake Control

This feature controls the On/Off operation of the load's electro-mechanical braking system.

Group	Code	Name	LCD Display	Para	neter Setting	Setting Range	Unit
dr	09	Control mode	Control Mode	0	V/F	-	-
	41	Brake open current	BR RIs Curr	50.0		0.0-180%	%
	42	Brake open delay time	BR RIs Dly	1.00		0.0-10.0	sec
	44	Brake open forward frequency	BR RIs Fwd Fr	1.00		0-Maximum frequency	Hz
Ad	45	Brake open reverse frequency	BR RIs Rev Fr	1.00		0-Maximum frequency	Hz
	46	Brake close delay time	BR Eng Dly	1.00		0.00-10.00	sec
	47	Brake close frequency	BR Eng Fr	2.00		0-Maximum frequency	Hz
OU	31	Multi-function relay1 item	Relay 1	35	BR Control:		
00	33	Multi-function output1 item	Q1 Define	33	DV COURSE		

When brake control is activated, DC braking (Ad.12) and dwell operation (Ad.20-23) do not operate.

- Brake release sequence: When a run command is applied, the VFD accelerates up to brake release
 frequency (Ad.44 Forward or Ad.45 Reverse). After reaching the brake release frequency, when the motor
 current reaches brake release current (Ad.41 BR RIs Curr), the outputs (OU.31 or OU.33) set to 35 (BR
 Cotrol) sends a release signal. Once the signal has been sent, acceleration will begin after maintaining
 frequency for brake release delay time (Ad.42 BR RIS DIV).
- Brake engage sequence: When a stop command is applied, the motor decelerates. When the output frequency reaches brake engage frequency (Ad.47 BR Eng Fr), the motor stops deceleration and the outputs (OU.31 or OU.33) set to 35 (BR Cotrol) sends a brake engage signal. Frequency is maintained for the brake engage delay time (Ad.46 BR Eng Dly) and will become 0 afterwards. If Stop Mode (Ad.08) is set to 1 (DC brake), VFD output is blocked after DC braking, For DC braking, refer to 4.17.2 <u>Stop After DC</u> Braking on page 99.



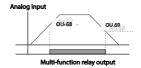
5.32 Multi-Function Output On/Off Control

This feature operates a digital output (Relay1 or Q1) based on the analog input level. Set the On level (OU.68) to activate the relay and the Off level (OU-69) to de-activate the relay.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit		
	67	Output terminal on/off control mode	On/Off Ctrl Src	1	V1	1	-		
						Output terminal			
OU	68	Output terminal on level	On-C Level	90.00		off level-	%		
		levei				100.00%			
	69	Output terminal off	Off-C Level	10.00		0.00-Output	%		
	09	level	OII-C Level	10.	00	terminal on level	76		
OU	31	Multi-function relay1 item	Relay 1				On/Off		
00	33	Multi-function output1 item	Q1 Define	34 On/Off		-	-		

Multi-function Output On/Off Control Setting Details

Code	Description
OU.67 On/Off Ctrl Src	Select an analog input to be used for On/Off control.
OU-68 On-C Level , OU-69 Off-C Level	Set the On/Off levels for the output (Relay1 or Q1).



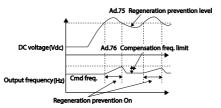
5.33 **Press Regeneration Prevention**

Press regeneration prevention is used during press operations to prevent braking during the regeneration process. When motor regeneration occurs during a press operation, motor operation speed automatically increases to avoid the regeneration zone.

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
	74	Select press regeneration prevention for press	RegenAvd Sel	0	No	0–1	=
	75	Press regeneration prevention operation	RegenAvd Level	350V		230V: 300- 400V	v
		voltage level	Regenava Lever	700V		460V: 600- 800V	
Ad	76	Press regeneration prevention compensation frequency limit	CompFreq Limit	1.00(Hz)		0.00 10.00Hz	Hz
	77	Press regeneration prevention P gain	RegenAvd Pgain	50.0(%)		0 .0- 100.0%	%
	78	Press regeneration prevention I gain	RegenAvd Igain	500(ms)		20–30000ms	ms

Press Regeneration Prevention Setting Details

Code	Description
Ad.74 RegenAvd Sel	Frequent regeneration voltage from a press load during constant speed motor operation may force excessive work on the brake unit which may damage or shorten the brake life. To prevent this situation, select Ad.74 (RegenAvd Sel) to control DC link voltage and disable the brake unit operation.
Ad.75 RegenAvd Level	Set the DC Link voltage level to activate Regen Avoidance.
Ad.76 CompFreq Limit	Set a frequency limit above operating frequency during Regen Avoidance.
Ad.77 RegenAvd Pgain, Ad.78 RegenAvd Igain	Set the P gain and I gain in the DC link voltage suppress PI controller while in Regen Avoidance.



Note

Press regeneration prevention only operates during constant speed motor operation. It does not operate during accelerations or decelerations. When regeneration prevention is activated, output frequency may change within the range set at Ad.76 (CompFreq Limit).

5.34 Analog Output

The analog output terminal (AO) provides outputs of 0-10V voltage, 4-20mA current, or 0-32kHz pulse.

5.34.1 Voltage and Current Analog Output

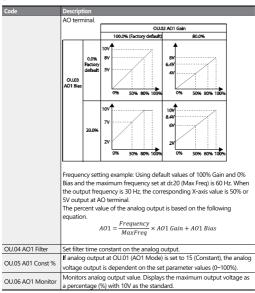
The analog output can represent one of a variety of signals (OU.01). Scaling and filtering can also be applied to the signal. On the control board, set SW3 to voltage or current output.

Group	Code	Name	LCD Display	Paran Settin		Setting Range	Unit
	01	Analog output1	AO1 Mode	0	Frequency	0-15	-
	02	Analog output1 gain	AO1 Gain	100.0		-1000.0-1000.0	%
	03	Analog output1 bias	AO1 Bias	0.0		-100.0-100.0	%
OU	04	Analog output1 filter	AO1 Filter	5		0-10000	ms
	05	Analog constant output1	AO1 Const %	0.0		0.0-100.0	%
	06	Analog output1 monitor	AO1 Monitor	0.0		0.0-1000.0	%

Voltage and Current Analog Output Setting Details

Code	Description
	Select the type of signal to output. The following example uses a 0- 10V output at the AO terminal.

Code	Description				
	Sett		Function		
	0	Frequency	Outputs operation frequency as a standard. 10V output is made from the frequency set at dr.20 (Max Freq)		
	1	Output Current	10V output is made from 200% of VFD rated current (heavy load).		
	2	Output Voltage	Sets the outputs based on the VFD output voltage. 10V output is made from a set voltage in bA.15 (Motor Voltage). If 0V is set in bA.15, 230V/460V VFD's output 10V based on the actual input voltages.		
	3	DC Link Volt	Outputs VFD DC link voltage as a standard. Outputs 10V when the DC link voltage is 410Vdc for 230V VFD's, and 820Vdc for 460V models.		
	4	Torque	Outputs the generated torque as a standard. Outputs 10V at 250% of motor rated torque.		
	5	Ouput Power	Monitors output wattage. 200% of rated output is the maximum display voltage (10V).		
	6	Idse	Outputs the maximum voltage at 200% of no load current.		
	7	Iqse	Outputs the maximum voltage at 250% of rated torque current $rated\ torque\ current \\ = \sqrt{rated\ current^2 - no\ load\ current^2}$		
	8	Target Freq	Outputs set frequency as a standard. Outputs 10V at the maximum frequency (dr.20).		
	9	Ramp Freq	Outputs frequency calculated with Acc/Dec function as a standard. May vary with actual output frequency. Outputs 10V.		
	12	PID Ref Value	Outputs command value of a PID controller as a standard. Outputs approximately 6.6V at 100%.		
	13	PID Fdk Value	Outputs feedback amount of a PID controller as a standard. Outputs approximately 6.6V at 100%.		
	14	PID Output	Outputs the output value of a PID controller as a standard. Outputs approximately 10V at 100%.		
	15	Constant	Outputs OU.05 (AO1 Const %) value as a standard.		
OU.02 AO1 Gain, OU.03 AO1 Bias	The Gain and Bias settings provide scaling adjustment of the analog output voltage. The graphs below illustrate adjustments of OU.02 (AO1 Gain) and OU.03 (AO1 Bias) percentages and the affect on the analog output voltage (AO1). The X-axis is the % value of the selected output item and the Y-axis is the corresponding output voltage (O-10 V) at the				



Note

Tuning Mode on 4-20mA output, OU.02 (AO Gain) and OU.03 (AO Bias)

- 1 Set OU.01 (AO1 Mode) to constant and set OU.05 (AO1 Const %) to 0.0 %.
- 2 Set OU.03 (AO1 Bias) to 20.0% and then check current output. 4mA output should be displayed.
- 3 If the value is less than 4mA, gradually increase OU.03 (AO1 Bias) until 4mA is measured. If the value is more than 4mA, gradually decrease OU.03 (AO1 Bias) until 4mA is measured.
- 4 Set OU.05 (AO1 Const %) to 100.0%

Set OU.02 (AO1 Gain) to 80.0% and measure current output at 20mA. If the value is less than 20mA, gradually increase OU.02 (AO1 Gain) until 20mA is measured. If the value is more than 20mA, gradually decrease OU.02 (AO1 Gain) until 20mA is measured.

The functions for each code are identical to the descriptions for the 0–10V voltage outputs with an output range 4–20mA.

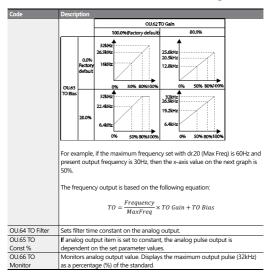
5.34.2 Analog Pulse Output

The pulse output terminal (TO) can represent one of a variety of signals (OU.61). Scaling and filtering can also be applied to the signal.

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
	33	Multi-function output 1	Q1 define	39	TO	0-38	-
	61	Pulse output setting	TO Mode	0	Frequency	0-15	-
	62	Pulse output gain	TO Gain	Gain 100.0		-1000.0- 1000.0	%
OU	63	Pulse output bias	TO Bias	0.0		-100.0-100.0	%
	64	Pulse output filter	TO Filter	5		0-10000	ms
	65	Pulse output constant output2	TO Const %	0.0		0.0-100.0	%
	66	Pulse output monitor	TO Monitor	0.0		0.0-1000.0	%

Analog Pulse Output Setting Details

Code	Description
OU33 Q1 Define	Pulse output TO and multi-function output Q1 share the same terminal. Set OU.33 to 32kHz pulse output and follow the instructions below to make wiring connections that configure the open collector output circuit. 1. Connect a 1/4W, 560Ω resistor between VR and Q1 terminals. 2. Connect EG and CM terminals. When wiring the resistor, a resistance of 560Ω or less is recommended to stably provide 32kHz pulse output. 1. Set VP PS CM Set Set VI CM PS CM PS CM Set VI CM PS C
OU.62 TO Gain, OU.63 TO Bias	signal. The graphs below illustrate adjustments of OU.62 (TO Gain) and OU.63 (TO Gain) and OU.63 (TO Bias) percentages and the affect on the pulse output signal (TO). The X-axis is the % value of the selected output item and the Y-axis is the corresponding frequency (0-32kHz) at the Q1/TO terminal.



5.35 **Digital Output**

5.35.1 Multi-function Output Terminal (Relay1 and Q1) Settings

Group	Code	Name	LCD Display	Para Sett	meter ing	Setting Range	Unit
	30	Fault output item	Trip Out Mode	010	*	-	bit
3	31	Multi-function relay1 setting	Relay 1	29	Trip	-	-
	33	Multi-function output1 setting	Q1 Define	14	Run	-	-
OU	41	Multi-function output monitor	DO Status	-		00–11	bit
	57	Detection frequency	FDT Frequency	30.00		0.00-	Hz
	58	Detection frequency band	FDT Band	10.00		Maximum frequency	
ln	65– 69	Px terminal configuration	Px Define	16	Exchange	0~54	-

^{*}Displayed as On the 7-Segment display.

Multi-function Output Terminal and Relay Setting Details

Code	Desc	Description					
OU.31 Relay1	Sele	Select relay (Relay 1) output options.					
OU.33 Q1 Define		Select output options for multi-function output terminal (Q1). Q1 is open collector TR output.					
	Set F	Relay1 and Q1 ou	tput functions.				
	Set	ting	Function				
	0	None	No output signal.				
	1	FDT-1	Relay changes state when the output frequency reaches the reference frequency within frequency bandwidth / 2.				
			Conditions are: Absolute value (Ref frequency -				
			output frequency) <= frequency bandwidth/2 (OU.58 / 2).				
OU.41 DO Status			Example: Frequency Reference is 20 Hz. Bandwidth (OU.58) is 10 Hz. Relay changes state at 15 Hz. 40Hz				
			Frequency 20Hz reference 40Hz				
			Operation 15Hz 20Hz 35Hz				
			Run cmd				

Carla	D		
Code		ription	
	2	FDT-2	Relay changes state when the reference frequency and detection frequency (OU.57) are equal and fulfills FDT-1 condition at the same time. Conditions are: [Absolute value (Ref frequency-detection frequency) - (frequency bandwidth/2] & [FDT-1] Example: Frequency Reference is 30 Hz. Detection frequency (OU.57) is 30 Hz. Frequency bandwidth (OU.58) is 10 Hz. Relay changes state at 25 Hz. Frequency 30Hz Frequency SOHZ Frequency 25Hz Frequency 25Hz Frequency 21 Run cmd
	3	FDT-3	Relay changes state when the output frequency is within the frequency bandwidth (OU.58) centered around the detection frequency (OU.57). Conditions are: Absolute value (output frequency-operating frequency) - frequency bandwidth/2 Example: Detection frequency (OU.57) is 30 Hz. Frequency bandwidth (OU.58) is 10 Hz. Relay changes state when the output frequency is between 25 Hz. and 35 Hz. 35Hz 35Hz 18Hz 19Hz 19
	4	FDT-4	Relay changes state based on separate conditions for acceleration and deceleration. In acceleration: Operation frequency≧ Detected frequency In deceleration: Operation frequency—Detected frequency—Detected frequency—Detected frequency—Detected frequency width/2) Example: Detection frequency (OU.57) is 30 Hz. Frequency bandwidth (OU.58) is 10 Hz. During acceleration, relay changes state when output frequency reaches detection frequency. During deceleration, the relay changes state when the

Code	Doce	ription	
Code	Desc	nption	- to the form of the least of the form of
			output frequency is below the frequency
			bandwidth/2.
			30Hz
			25Hz
			Frequency
			Q1
			Run cmd
			Run cma
	5	Overload	Delevely and the VED time of the second
	5	Overload	Relay changes state when VFD trips on motor overload.
	6	IOL	Relay changes state when VFD trips on VFD
	ь	IOL	overload
	7	Underload	
	/	Underload	Relay changes state when VFD trips on motor
	9	Stall	underload.
	9	Stall	Relay changes state when the VFD detects a motor
	40	0 1	stall condition.
	10	Over voltage	Relay changes state when the VFD trips on Over
		1 1/1	Voltage.
	11	Low Voltage	Relay changes state when the VFD trips on Low
	40	Over Heat	Voltage.
	12	Over Heat	Relay changes state when the VFD trips on
	4.7		Overheat.
	13	Lost command	Relay changes state when the VFD trips on Lost Command, Lost command includes lost reference
		command	
			frequency from: Analog input
			RS-485 communication
			Option Cards (Extended I/O and communications)
	14	RUN	Relay changes state when a run command is applied
	14	KUN	and the VFD outputs voltage. There is no output
			when reference frequency is at zero or during DC braking.
			braking.
			_ /
			Frequency
			Q1
			Run cmd
	15	Stop	Relay changes state when a stop command is
			applied and when there is no VFD output voltage.
	16	Steady	Relay changes state during steady state operation.
	17	Inverter line	Used in combination with "Comm Line" function.
			Relay maintains state while the motor is driven by
			the VFD output.
	_		P · · ·

Code	Desc	ription	
	18	Comm line	Relay changes state when a digital input set to "exchange" function is applied. For details, refer to 5.19 Supply Power Transition on page 177.
	19	Speed search	Relay changes state during speed search operation. For details, refer to 5.15 <u>Speed Search Operation on</u> page 170.
	22	Ready	Relay changes state when the VFD is in stand by operation and ready to receive a run command.
	28	Timer Out	Used in combination with a digital input set to "Timer In" function. The relay changes state when the digital input is activated and after the time delay settings. For more details, refer to 5.30 <u>Timer</u> <u>Settings</u> on page 188.
	29	Trip	Relay changes state after a fault condition. Refer to 5.32 Multi-Function Output On/Off Control on page 190.
	31	DB Warn %ED	Relay changes state when the Dynamic Brake Duty Cycle (Pr.66) is exceeded. Refer to 6.2.5 <u>Dynamic</u> <u>Braking (DB) Resistor Configuration</u> on page <u>219</u> .
	34	On/Off Control	Relay changes state based on the analog input signal levels set with Ad.66~Ad.68. Refer to 5.32_ <u>Multi-Function Output On/Off Control</u> on page 190.
	35	BR Control	Used for external electro-mechanical brake control. Relay operates based on Ad.41~Ad.47 settings. Refer to 5.31 <u>Brake Control</u> on page <u>189</u> .
	36	Pre Heat	Relay changes state when the Pre Heat function is activated. Refer to <u>4.25 Pre Heat Function</u> on page <u>117.</u>
	37	Aux Source (2 nd)	Relay changegs state when Auxiliary Mode is selected. Refer to <u>4.19 Auxiliary (2nd) Operation Mode Setting</u> on page <u>104</u> .
	38	Fire Mode	Relay changes state when Fire Mode is activated. Refer to 4.24 Fire Mode Operation on page 116.
	40	KEB Operating	Relay changes state when the VFD is operating in KEB mode. This outputs in the energy buffering state before the input power restoration regardless of KEB-1 and KEB-2 mode settings. Refer to <u>5.12 Kinetic Energy Buffering Operation</u> on page <u>163</u>

5.35.2 Fault Output using Multi-Function Output Terminal and Relay

With Relay1 or Q1 set to 29 (Trip), OU.30 (Fault Output) can further define relay activation during low voltage faults, all faults and auto restart functions. Additionally, On and Off time delays can also be applied specifically to the outputs when set to 29 (Trip).

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
	30	Fault trip output mode	Trip Out Mode	010		=	bit
OU 33	31	Multi-function relay1	Relay 1	29	Trip	-	-
	33	Multi-function output1	Q1 Define	14	Run	=	
	53	Fault trip output on delay	TripOut OnDly	0.00		0.00-100.00	sec
	54	Fault trip output off delay	TripOut OffDly	0.00		0.00-100.00	sec

Fault Trip Output by Multi-function Output Terminal and Relay - Setting Details

Code	Descript	ion						
	Bit On/Off representation on display.							
	Item bit on				bit off			
	7-Segr	nent	A		A			
	display		-					
	LCD ke	eypad						
OU.30 Trip Out Mode	Set OU.31 (Relay1) or OU.33 (Q1) to 29 (Trip). When a fault occurs, th output will be activated. Output activation can be set based on trip typer the table below.							
	Setting			Function				
	bit3	bit2	bit1					
			✓		w voltage fault trips occur			
		✓		Operates when fa voltage occur	ult trips other than low			
	✓			Operates when au	uto restart fails (Pr. 08–09)			
OU.31 Relay1	Configu	re Rela	y1 outpu	t function.				
OU.33 Q1 Define	Configure Q1 output function.							
OU.53 TripOut On	When a trip occurs, the relay (Relay1 or Relay2) will be activated							
Dly,	after the delay time set in OU.53 (On Dly). After a reset, the relay will							
OU.54 TripOut OffDly	be initia	alized a	after the	delay time set in C	OU.54 (Off Dly).			

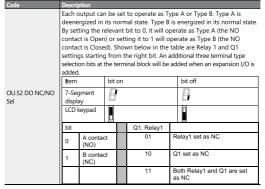
5.35.3 Multi-function Output Terminal Delay Time Settings

Set On/Off delay times to adjust the relay operation time. The delay times set in OU.50 and OU.51 will be applied to both Relay 1 and Q1 except when either output function is set to (29) Trip.

Group	Code	Name	LCD Display	Parameter Setting	Setting Range	Unit
OU	50	Multi-function output On delay	DO On Delay	0.00	0.00-100.00	s
	51	Multi-function output Off delay	DO Off Delay	0.00	0.00-100.00	s
	52	Select multi-function output terminal	DO NC/NO Sel	00*	00–11	bit

^{*} Displayed as On 7-Segment display.

Output Terminal Delay Time Setting Details





5.36 **Keypad Language Settings**

Select the language to be displayed on the LCD keypad. Keypad S/W Ver 1.04 and above provides language selections.

Group	Code	Name	LCD Display	Parameter Setting			
CNF*	01	Select keypad	Language Cal	0	English		
	01	language	Language Sel	1	Korean	-	-

^{*} Available on LCD keypad only.

5.37 **Operation State Monitor**

With the LCD keypad, the VFD's operating condition can be monitored. In the config (CNF) mode, a maximum of four items can be selected and monitored simultaneously. Monitoring mode displays three different items on the LCD keypad (CNF-21, 22 and 23). An additional item can be displayed in the status window (CNF-20).

Group	Code	Name	LCD Display	Pa	rameter Setting	Setting Range	Uni t
	20	Display item condition display window	Anytime Para	0	Frequency	-	-
	21	Monitor mode display 1	Monitor Line-1	0	Frequency	-	Hz
CNF*	22	Monitor mode display 2	Monitor Line-2	2	Output Current	-	Α
	23	Monitor mode display 3	Monitor Line-3	3	Output Voltage	-	٧
	24	Monitor mode initialize	Mon Mode Init	0	No	-	-

^{*}Available on LCD keypad only.

Operation State Monitor Setting Details

on state Monitor Setting Details							
Code	Descr	iption					
		ay on the top-right side of the LCD keypad 20–23 share the same setting options as listed					
	Sett	ing	Function				
CNF-20 AnyTime Para	0	Frequency	On stop, displays the set frequency. During operation, displays the actual output frequency (Hz).				
	1	Speed	On stop, displays the set speed (rpm). During operation, displays the actual operating speed (rpm).				
	2	Output Current	Displays output current.				
	3	Output	Displays output voltage.				

Code	Descri	ption	
		Voltage	
	4	Output Power	Displays output power.
	5	WHour	Displays VFD power consumption.
	-	Counter	
	6	DCLink	Displays DC link voltage within the VFD.
		Voltage	
	7	DI Status	Displays input terminal status of the
			terminal block. Starting from the right,
			displays P1-P5 (P6-P8 option card).
	8	DO Status	Displays output terminal status of the
			terminal block. Starting from the right,
			Relay1, Space, Q1.
	9	V1 Monitor[V]	Displays the input voltage value at terminal V1 (V).
	10	V1 Monitor[%]	Displays input voltage terminal V1 value as a percentage. If -10V, 0V, +10V is measured, -100%, 0%, 100% will be displayed.
	13	V2 Monitor[V]	Displays input voltage terminal V2 value (V).
	14	V2 Monitor[%]	Displays input voltage terminal V2 value as a percentage.
	15	12	Displays input current terminal I2 value (A).
		Monitor[mA]	
	16	I2 Monitor[%]	Displays input current terminal I2 value as a percentage.
	17	PID Output	Displays output of PID controller.
	18	PID Ref Value	Displays reference value of PID controller.
	19	PID Fdb Value	Displays feedback volume of PID controller.
	20	Torque	If the torque reference command mode (DRV-08) is set to a value other than keypad (0 or 1), the torque reference value is displayed.
	21	Torque Limit	If torque limit setting (Cn.53) is set to a value other than keypad (0 or 1), the torque limit value is displayed.
	23	Spd Limit	If the speed limit setting (Cn.62) on torque control mode is set to a value other than keypad (0 or 1), the speed limit setting is displayed.
	24	Load Speed	Displays the speed of a load in the desired scale and unit. Displays the speed of a load that ADV-61 (Load Spd Gain) and ADV-62 (Load Spd Scale) are applied as rpm or mpm set at ADV-63 (Load Spd Unit). See details below.

Code	Description
CNF-21~23 Monitor	Select the items to be displayed in monitor mode. Monitor mode
	is the first displayed mode when the VFD is powered on. A total of
	three items, from monitor line-1 to monitor line-3, can be
	displayed simultaneously.
CNF-24 Mon Mode Init	Selecting 1(Yes) initializes CNF-20–23.

Load Speed Display Setting

Group	Code	Name	LCD Display	Parameter Setting		Setting Range	Unit
ADV(M2)	61(40)	Rotation count speed gain	Load Spd Gain	-	100.0	1~6000.0[%]	-
	62(41)	Rotation count speed scale	Load Spd Scale	0	x 1	0~4	Hz
	63(42)	Rotation count speed unit	Load Spd Unit	2	rpm	0~1	Α

Load Speed Display Setting Detail

Code	Description
ADV-61(M2-40) Load Spd Gain	If monitoring item 24 Load Speed and if the motor spindle and the load are connected with belt, the actual number of revolutions can be displayed by calculating the pulley ratio.
ADV-62(M2-41) Load Spd Scale	Selects the decimal places that item 24 Load Speed displays (from x1–x0.0001).
ADV-63(M2-42) Load Spd Unit	Selects the unit of item 24 Load Speed. Selects between RPM (Revolution Per Minute) and MPM (Meter Per Minute) for the unit. For example, if line speed is 300 [mpm] at 800 [rpm], set ADV-61 (Load Spd Gain) to "37.5%" to display the line speed. Also, set ADV-62 (Load Sped Scale) or X0.1" to display the value to the first decimal point. And set ADV-63 (Load Spd Unit) to mpm. Now, the monitoring item 24 Load Speed is displayed on the keypad display as 300.0 mpm instead of 800 rpm.

VFD power consumption

Values are calculated using voltage and current. Electric power is calculated every second and the results are accumulated. Setting CNF-62 (WH Count Reset) value to 1(Yes) will reset cumulated electric energy consumption. Power consumption is displayed as shown below:

- · Less than 1,000 kW: Units are in kW, displayed in 999.9 kW format.
- . 1-99 MW: Units are in MW, displayed in 99.99 MWh format.
- 100–999 MW: Units are in MW. displayed in 999.9 MWh format.
- More than 1,000 MW: Units are in MW, displayed in 9,999 MWh format and can be displayed up to 65,535 MW. (Values exceeding 65,535MW will reset the value to 0, and units will return to kW. It will be displayed in 999 9 kW format).

5.38 **Operation Time Monitor**

Monitors VFD and fan operation time.

Group	Code	Name	LCD Display	Para	meter Setting	Setting Range	Unit
	70	VFD operation accumulated time	On-time	0/00	/00 00:00	-	min
	71	VFD operation accumulated time	Run-time	0/00	/00 00:00	-	min
CNF*	72	VFD operation accumulated time initialization	Time Reset	0	No	0–1	-
	74	Cooling fan operation accumulated time	Fan time	0/00	/00 00:00	-	min
	75	Cooling fan operation accumulated time initialization	Fan Time Reset	0	No	0–1	-

^{*}Available on LCD keypad only.

Operation Time Monitor Setting Details

Code	Description
CNF-70 On-time	Displays accumulated power supply time (On-time). Information is displayed in [YY/MM/DD Hr: Min (0/00/00 00: 00)] format.
CNF-71 Run-time	Displays accumulated time (Run-time) of voltage output by run command input. Information is displayed in [YY/MM/DD Hr: Min (0/00/00 00: 00)] format.
CNF-72 Time Reset	Setting 1(Yes) will delete power supply accumulated time (On-time) and operation accumulated time (Run-time) and is displayed as 0/00/00 00:00 format.
CNF-74 Fan time	Displays accumulated time of VFD cooling fan operation. Information will be displayed in [YY/MM/DD Hr: Min (0/00/00 00: 00)] format.
CNF-75 Fan Time Reset	Setting 1(Yes) will delete cooling fan operation accumulated time (on- time) and operation accumulated time (Run-time) and will display it in 0/00/00 00:00 format.

6 Learning Protection Features

Protection features provided by the S and SW Series VFDs are categorized into two types: Motor Protection (Overload, Underload, Over Heat (ETH), Stall Prevention, etc.) and VFD Protection (Open Phase, Inverter Overload, Fan Fault, External Trip, etc.).

6.1 Motor Protection

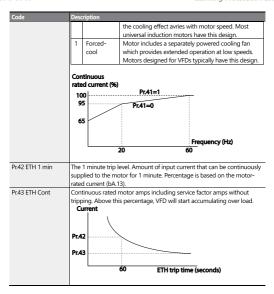
6.1.1 Electronic Thermal Motor Overheating Prevention (ETH)

ETH is an electronic thermal protective function that uses the output current of the VFD to predict a rise in motor temperature without a separate temperature sensor. Protection of the motor is based on current, time, and speed. The VFD responds to an ETH fault based on the setting of parameter Pr.40 (ETH Trip Selection).

Grou p	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	40	Electronic thermal prevention fault trip selection	ETH Trip Sel	1	Free-Run	0-2	-
	41	Motor cooling fan type	Motor Cooling	0	Self-cool	-	-
	42	Electronic thermal one minute rating	ETH 1min	150		120-200	%
			ETH Cont	115		50-150	%

Electronic Thermal (ETH) Prevention Function Setting Details

Code	Des	cription							
Pr.40 ETH Trip Sel	ETH Run met	ETH can be selected to provide motor thermal protection. Select 1 (Free- Run) or 2 (Dec) to activate the ETH function and to determine the stop method when an ETH fault occurs. The LED display will show "EtH". The LCD screen displays "E-Thermal."							
	Se	tting	Function						
	0	None	The ETH function is not activated.						
	1	Free-Run	The VFD output is blocked. The motor coasts to a stop (free-run).						
	2	Dec	The VFD decelerates the motor to a stop.						
Pr.41 Motor Cooling	Sele	ct motor cooli	ng type (fan configuration) attached to the motor.						
_	Se	tting	Function						
	0	Self-cool	The cooling fan is connected to the motor shaft and						



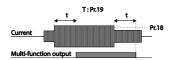
6.1.2 Overload Early Warning and Trip

The VFD provides motor overload protection and will trip on an Overload Fault (OLI) fault based on amount of current (% motor amps) and time. The VFD responds to an overload fault based on the setting of parameter Pr.20 (OL Trip Select). Select 1 (Free-Run) or 2 (Dec) to activate the overload function and to determine the stop method when an overload fault occurs. Either Relay1 or Q1 (OU.31 or OU.33) can be set to 5 (Overload) to provide an output signal. The VFD can also provide an overload warning (OLIW) based on the settings of parameters Pr.17 (OL Warn Select), Pr.18 (OL Warn Level) and PR-19 (OL Warn Time). Set parameter Pr.17 to 1 (Yes) to activate the overload warning function. Set the output current level in parameter Pr.18, set the time in Pr.19. Either Relay1 or Q1 (OU.31 or OU.33) can be set to 5 (Overload) to provide an output warning sinal. The VFD does not trip when warning levels are reached.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	17	Overload warning selection			0-1	-	
	18	Overload warning level	OL Warn Level	150		30-180	%
	19 Overload warning time		OL Warn Time	10.0		0-30	s
	20	Motion at overload trip	OL Trip Select	1	Free-Run	-	-
	21	Overload trip level	OL Trip Level	150		30-200	%
	22	Overload trip time	OL Trip Time	60.0		0-60.0	S
OU	31	Multi-function relay 1 item	Relay 1	5	Over Load		-
	33	Multi-function output 1 item	Q1 Define				

Overload Early Warning and Trip Setting Details

Coden	Desc	ription						
Pr. 04 Load Duty	Sele	ct the load leve	el.					
			1					
	Set	ting	Function					
		Normal	Used in light loads, like fans and pumps (overload					
	0	Duty	tolerance: 120% of rated underload current for 1					
	ľ	(S Series	minute).					
		Only)						
		Heavy Duty	Used in heavy loads, like hoists, cranes, and parking					
	1	(S and SW	devices (overload tolerance: 150% of rated heavy load					
		Series) current for 1 minute).						
Pr.17 OL Warn			tivate the overload warning function. If 0 (No) is selected,					
Select	_	the function is disabled.						
Pr.18 OL Warn			o the motor is greater than the overload warning level					
Level,			d continues at that level for the overload warning time					
Pr.19 OL Warn Time			e multi-function outputs (Relay 1 or Q1) send a warning					
			on Relay1 or Q1 output a signal if OU.31 or OU.33 are set					
			ne VFD does not trip when warning levels are					
	reac							
Pr.20 OL Trip Select	Sele	ct the VFD pro	tective action in the event of an overload fault.					
		-1						
		ting	Function					
	0	None	No protective action is taken.					
	1	Free-Run	VFD output is blocked and the motor will coast to a					
	3	_	stop.					
		Dec	The VFD decelerates the motor to a stop.					
Pr.21 OL Trip Level,			supplied to the motor is greater than the value set in the					
Pr.22 OL Trip Time			(OL Trip Level) and continues for the overload trip time					
			VFD output is either blocked or decelerates according to					
	the I	Pr.20 selection.						



Note

The overload warning signal will not work if the overload warn level (OL Warn Level) and the overload warn time (OL Warn Time) are set higher than the overload trip level (OL Trip Level) and overload trip lime (OL Trip Time).

6.1.3 Stall Prevention and Flux Braking

The stall prevention function is a protective function that prevents motor stall caused by overloads. When high currents are sensed during acceleration and/or constant speed, the output frequency is decreased automatically. During deceleration, when the DC Link voltage increases, the deceleration time is extended.

Flux braking is used to determine the optimum deceleration time to avoid overvoltage trips and without utilizing brake resistors. When using flux braking, the output frequency is increased and the regenerative energy is expended at the motor. Flux braking does not operate in IM Sensorless Vector.

Group	Code	Name	LCD Display	Pa	rameter Setting	Setting range	Unit	
Pr	50	Stall prevention and	Stall Prevent	00	00*	-	bit	
		flux braking						
	51	Stall frequency 1	Stall Freq 1	60	.00	Start frequency-	Hz	
						Stall Freq 1		
	52	Stall level 1	Stall Level 1	18	0	30-250	%	
	53	Stall frequency 2	Stall Freq 2	60	.00	Stall Freq 1-Stall	Hz	
						Freq 3		
	54	Stall level 2	Stall Level 2	18	0	30-250	%	
	55	Stall frequency 3	Stall Freq 3	60	.00	Stall Freq 2-Stall	Hz	
						Freq 4		
	56	Stall level 3	Stall Level 3	18	0	30-250	%	
	57	Stall frequency 4	Stall Freq 4	60	.00	Stall Freq 3-	Hz	
						Maximum		
						frequency		
	58	Stall level 4	Stall Level 4	18	0	30-250	%	
OU	31	Multi-function relay 1	Relay 1					
		item		9	Stall			
	33	Multi-function output	Q1 Define	9	Stall	_	-	
		1 item						

^{*} The value is displayed on the 7-Segment display as \Box

Stall Prevention Function and Flux Braking Setting Details

Code	Description			
Pr.50	When the top L	ED/LCD segment is on, the co	orresponding bit is set (On). Whe	n the bottom
Stall	LED/LCD segme	ent is on, the corresponding b	it is off.	
Prevent	Item	Bit Status (On)	Bit Status (Off)	
	Keypad	Ħ	B	
	LCD keypad			

Stall prevention can be configured for acceleration, deceleration, or constant speed

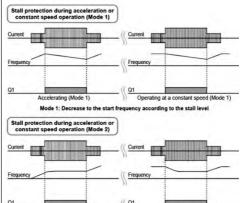
operation.		,						
			Des	cription				
		Setting		Eurotion				
bit 5	bit 4	bit 3	bit 2	bit 1	Function			
				√	Stall Protection during Acceleration			
			~		Stall Protection during Constant Speed			
		✓			Stall Protection during Deceleration			
	1				Flux Braking during Deceleration			
1					Stall Protection Mode 2			

	Setting	Function
bit	0 0000 - 1 1111	Function
0 0001	Accelerating Mode 1	If the VFD output current exceeds the preset stall level (Pr.52, 54, 56, 58) during acceleration, the motor stops accelerating and starts decelerating. If the current level stays above the stall level, the motor decelerates to the start frequency (dr.19). If the current level causes deceleration below the preset level, the motor resumes acceleration.
1 0001	Accelerating Mode 2	If the VFD output current exceeds the preset stall level (Pr.52, 54, 56, 58) during acceleration, the VFD adjusts the output frequency according to the current through PI control. If the current level causes deceleration below the unlock level, the motor resumes acceleration.
0 0010	Constant Speed Mode 1	Similar to stall protection during acceleration (Mode 1), the motor starts decelerating and lowers the output frequency automatically when the current level exceeds the preset stall level. If the load current decreases below the unlock level, the motor resumes acceleration.

Code	Description		
	0 1000	Constant Speed Mode 2	Similar to stail protection during acceleration (Wode 2), the VFD adjusts the output frequency according to load current amount when the current level exceeds the preset stail level. If the load current decreases below the unlock level, the motor resumes acceleration.
	# 0100	Decelerating	The VFD decelerates and keeps the DC link voltage below a certain level to prevent an over-voltage fault during deceleration. As a result, deceleration times may be longer than the set time depending on the load.
	# 1000	Flux Braking	When using flux braking, the deceleration time may be reduced because regenerative energy is expended at the motor.
	# 1100	Stall and Flux Braking	Stall protection and flux braking operate together during deceleration to achieve the shortest and most stable deceleration performance.

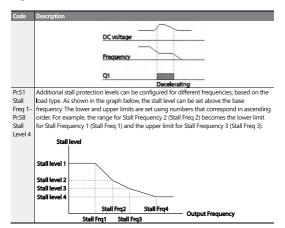
The "#" mark includes both 0 and 1 selections.

Accelerating (Mode 2)



Mode 2: Frequency adjustment according to the stall level and load current amount

Operating at a constant speed (Mode 2)



Note

Stall protection and flux braking operate together only during deceleration. Turn on the third and fourth bits of Pr.50 (Stall Prevention) to achieve the shortest and most stable deceleration performance without triggering an overvoltage fault trip for loads with high inertia and short deceleration times. Do not use this function when frequent deceleration of the load is required, as the motor can overheat and may be damaged.

When operating Brake resistor, the motor may vibrate under the Flux braking operation. In this case, turn off the Flux braking (Pr.50).

① Caution

- Acceleration stops when stall protection operates during acceleration.
- Use caution when using stall protection during deceleration as the deceleration time can take longer than the time set.
- When the motor is operating, Stall Level 1 applies and determines the operation of stall protection.

6.2 Inverter and Sequence Protection

6.2.1 Open-phase Protection

Open-phase monitoring and protection can be set to either or both the input and output of the VFD. The protection is used to prevent overcurrent levels at the VFD input and/or output due to an open-phase. An openphase at output may cause the motor to stall due to a lack of torque. For input phase open, a voltage level can be set (Pr.06), below which the VFD will trip.

Group	Code	Name	LCD Display	Parameter Setting	Setting range	Unit
Pr	05	Input/output open- phase protection	Phase Loss Chk		Bit setting 00 ~ 11	bit
	06	Open-phase input voltage band	IPO V Band	15	1-100V	V

^{*} The value is displayed on the 7-Segment display as

Input and Output Open-phase Protection Setting Details

Code	Description								
Pr.05 Phase Loss Chk	top LED segmer bottom LED seg	nput and output phase protection can be selected separately. When the op LED segment is on, the corresponding bit is set On (1). When the oottom LED segment is on, the corresponding bit is Off (0). Bit 0 is for output phase monitoring, Bit 1 is for input phase monitoring.							
	Item	Bit status (On)	Bit status (Off)						
	7-Segment display		8						
	LCD keypad								
		Setting	Function						
	Bit 2	Bit 1							
		✓	Output open-phase protection						
	✓		Input open-phase protection						
Pr.06 IPO V Band	The initial value of input voltage during open-phase input is 15V with a setting range of 0 \sim 100V.								

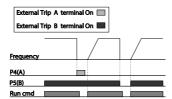
6.2.2 External Trip Signal

Set one of the multi-function (digital) input terminals In.65 - In.69 to 4 (External Trip). When activated, the VFD trips (Ext) and blocks the output. The five input terminals can be set independently with IN-87 to activate the trip when closed or opened (set as NO or NC).

Group	Code	Name	LCD Display	Paran	neter Setting	Setting range	Unit
In	65-69	Px terminal setting	Px Define	4	External	0~54	-
		options	(Px: P1-P5)		Trip		
	87	Multi-function input contact selction	DI NC/NO Sel	8	388	=	bit

External Trip Signal Setting Details

Code	Description											
In.87 DI NC/NO	Selects the	Selects the type of digital input contact to operate as Type A or Type B. Type										
Sel	A is norma	is normally open (NO), close to trip. Type B is normally closed (NC), open to										
	trip. By set	trip. By setting the relevant bit to 0, it will operate as Type A (NO) or setting it										
	to 1 will op	to 1 will operate as Type B (NC).										
	The corres	pondi	ng teri	minals	for ea	ach bit	are as	follo	NS:			
	Bit											
	Terminal							P5	P4	P3	P2	P1



6.2.3 Inverter Overload Protection

In addition to motor overload settings, the VFDs have built in VFD overload protection. When the VFD input current exceeds the rated current, a protective function is activated to prevent damages to the VFD. This VFD overload protection is based on inverse proportional characteristics.

An VFD overload warning signal (relay output) can be provided before the VFD overload protection function ((OL) operates. Set OU.31 or OU.33 to 6 (IOL). When the overcurrent time reaches 60% of the allowed overcurrent time (150%, 1 min), the output will change state (signal output at 150%, 36 sec).

Group	Code	Name	LCD Display	Paramete	r Setting	Setting range	Unit
OU	31	Multi-function relay 1	Relay 1	6	IOL	-	-
	33	Multi-function output 1	Q1 Define				

6.2.4 Speed Reference Loss

When setting the operating speed using an analog input, a pulsed input, through communications option or the keypad, the speed reference loss setting can be used to select the response of the VFD after the signal loss.

A digital output can be used to provide a signal when the speed reference is lost. Set OU.31 or OU.33 to 13 (Lost Command).

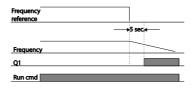
Group	Code	Name	LCD Display	Paran	neter Setting	Setting range	Unit
Pr	12	Speed command loss operation mode	Lost Cmd Mode	1	Free-Run	=	-
	13	Time to determine speed command loss	Lost Cmd Time	1.0		0.1-120	S
	14	Operation frequency at speed command loss	Lost Preset F	0.00		Start frequency— Max. frequency	Hz
	15	Analog input loss decision level	Al Lost Level	0	Half of x1		-
OU	31	Multi-function Relay 1	Relay 1	13	Lost Command	-	-
	33	Multi-function output 1	Q1 Define				

Speed Command Loss Setting Details

Command Loss 3	land Loss Setting Details							
Code	Descri	Description						
Pr.12 Lost Cmd		The VFD responds to the Speed Reference Loss based on the setting of						
Mode	Pr.12 (Lost Command Mode).							
	Setti	ng	Function					
	0	None	The speed reference becomes the operating frequency (zero if lost) without any protection function					
	1	Free-Run	The VFD blocks output. The motor coasts to a stop.					
2		Dec	The motor decelerates and stops based on the time set at Pr.07 (Trip Dec Time).					
	3 F	Hold Input	The VFD calculates the average input value for 10 seconds before the loss of the speed reference and uses it as the speed reference.					

Code	Description				
	4	Hold Output	The VFD calculates the average output frequency for 10 seconds before the loss of the speed reference and runs at that speed.		
	5	Lost Preset	The VFD operates at the frequency set at Pr. 14 (Lost Preset F).		
Pr.15 AI Lost Level, Pr.13 Lst Cmd Time		ire the voltage le n analog input.	evel and time delay for speed reference loss when		
	Settin)	Function		
	0	Half of x1	ased on the values set at In.08 and In.12, protective operation starts when the input signal is reduced to half of the initial value of the analog input set using the speed reference (Frq code in Operations group) and it continues for the time (speed loss decision time) set at Pr.13 (Lost Cmd Time). For example, set the reference frequency to 2 (V1) at the Frq code, and In.06 (V1 Polarity) to 0 (Unipolar). When the voltage input drops to less than half of the value set at In.08 (V1 Volt x 1), the protective function is activated.		
	1	Below x1	The protective operation starts when the signal becomes smaller than the initial value of the analog input set by the speed reference and it continues for the speed loss decision time set at Pr.13 (Lost Cmd Time). Codes In.08 and In.12 are used to set the standard values.		
Pr.14 Lost Preset F	To run a	t a fixed speed,	set the operation mode Pr.12 (Lost Cmd Mode) to 5		
	(Lost Pr	eset). When the	protection function operates, this sets the		
frequency for continued operation.					

Example: Set Pr.15 (Al Lost Level) to 1 (Below x 1), Pr.12 (Lost Cmd Mode) to 2 (Dec), and Pr.13 (Lost Cmd Time) to 5 sec. Then it operates as follows:



Note

If speed reference is lost while using communication (option cards or the integrated RS-485), the protection function operates regardless of Pr.12 setting. Operates after the command loss decision time set at Pr.13 (Lost Cmd Time) has passed.

When using analog signals, when signal returns above the level set in Pr.15, the VFD dears the fault and returns to normal operation.

6.2.5 Dynamic Braking (DB) Resistor Configuration

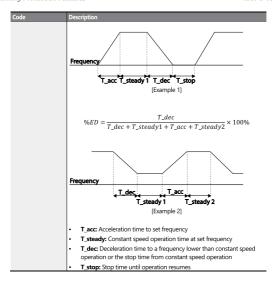
The braking transistor (IGBT) and monitoring/control circuit is integrated inside the VFD. An external brake resistor is required, connected externally to the VFD. Refer to <u>11.5 Braking Resistor Specification</u> on page <u>368</u>. The standard for braking torque is 150% at a working rate, Pr.66 of 5% (%ED or duty cycle). If the Pr.66 %ED is increased to 10%, the rated capacity (W) of the brake resistor must be doubled.

A digital output can be used to provide a warning when the duty cycle (%ED) has been exceeded. Set OU.31 or OU.33 to 31 (DB Warn %ED).

Group	Code	Name	LCD Display	Paran	neter Setting	Setting range	Unit
Pr	66	Braking resistor configuration	DB Warn %ED	10		0-30	%
OU	31	Multi-function relay 1 item	Relay 1	31	DB Warn %ED	=-	-
	33	Multi-function output 1 item	Q1 Define				

Dynamic Breaking Resistor Setting Details

Code	Description
Pr.66 DB Warn %ED	Set the Enable Duty (%ED). This sets the rate at which the braking resistor
	operates for one operation cycle. If the Enable Duty (%ED) is set to 0%,
	braking can be used without restriction. However, precaution is necessary
	as there is a risk of the VFD tripping and/or over heating of the resistor. The
	maximum time for continuous braking is 15 secs. and turns off after the 15
	sec period has expired. The time when the next braking cycle is available
	(after the 15 seconds continuous) is calculated as below.
	$T = \frac{(100\% - \%ED) \times 15}{\%ED} [s]$
	Examples of braking resistor setup are as follows:
	$\%ED = \frac{T_dec}{T_acc + T_steady + T_dec + T_stop} \times 100\%$



① Caution

Do not set the Enable Duty that will exceed the resistor's power rating. If overloaded, it can overheat and cause a fire. When using a resistor with a thermal switch, the switch output can be used as an external trip input signal to the VFD or shunt trip the main breaker.

6.3 Under Load Fault Trip and Warning

The VFD can be set to monitor and trip if needed, when low motor current conditions exist during operation. This will protect against pump cavitation, deadhead and dry running operating conditions. Set Pr.27, Under load fault selection to Free-Run or Decelerate to enable the protection. Current detection levels are set with Pr.29 and Pr.30. Either digital output (OU.31 or OU.33) can be set to 7 (Under Load) to provide an output signal.

Group	Code	Name	LCD Display	Param	eter Setting	Setting range	Unit
Pr	25	Under load warning selection	UL Warn Sel	1	Yes	0-1	-
	26	Under load warning time	UL Warn Time	10.0		0-600	sec
	27	Under load trip selection	UL Trip Sel	1	Free-Run	=-	-
	28	Under load trip timer	UL Trip Time	30.0		0-600	sec
	29	Under load upper limit level	UL LF Level	30		10-100	%
	30	Under load lower limit level	UL BF Level	30		10-100	%

Under Load Trip and Warning Setting Details

Code	Description
Pr.27 UL Trip Sel	Sets the VFD reaction to an under load condition. If set to 0 (None), underload is not monitored. If set to 1 (Free-Run), the output is blocked and the motor coasts to a stop. If set to 2 (Dec), the motor decelerates, then stops.
Pr.25 UL Warn Sel	To activate an under load warning, set to 1 (Yes) and set one of the digital outputs, Relay1 or Q1 (OU.31 or OU.33) to 7 (UnderLoad).
Pr.26 UL Warn Time, Pr.28 UL Trip Time	Delay times can be set to provide a warning signal (via the output relays) after the time set in Pr26, UL Warn Time and a trip after the time set in Pr28, UL Trip Time. This function does not operate if energy-saving operation is activated at Ad.50 (E-Save Mode).
Pr.29 UL LF Level, Pr.30 UL BF Level	 Based on Pr.04 Setting of Heavy Duty. The under load trip level (% of motor amps) is based on a constant torque curve when operating between 2 x slip frequency (bA.12) and the base frequency (dr.18). The trip level setting (Pr.30) applies throughout the speed range. Pr.29 is not used.
	Output current Pr.30

6.3.1 Fan Fault Detection

The VFD monitors the cooling fan for proper operation. When an error or fan failure occurs, the VFD responds to the failure based on the setting of Pr.79 (cooling fan fault selection). The VFD will display a fan fault (Fan) or warning (FanW). Either Relay1 or Q1 (OU.31 or OU.33) can be set to 8 (Fan Warning) to provide an output signal.

Group	Code	Name	LCD Display	Par	ameter Setting	Setting range	Unit
Pr	79	Cooling fan fault	FAN Trip	0		Trip	
		selection	Mode				
OU	31	Multi-function relay 1	Relay 1	8	FAN Warning		-
OU	33	Multi-function output 1	Q1 Define				

Fan Fault Detection Setting Details

Code	Descrip	Description					
Pr.79 FAN Trip	Set the	Set the cooling fan fault mode.					
Mode							
	Settin	Setting Function					
	0	Trip	The VFD output is blocked and the fan trip (Fan)				
			is displayed				
	1	Warning	The VFD continues operation and the fan				
		warning (FanW) is displayed.					
OU.31 Relay1	Set eith	Set either parameter OU.31 or OU.33 to 8 (FAN Warning), a fan warning					
OU.33 Q1 Define,	signal is	signal is output and operation continues. However, the VFD will eventually					
	trip on	inverter overhea	t (OHt) protection				

6.3.2 Low Voltage Trip

When the internal DC link voltage drops due to a power loss, the VFD turns off the output and a low voltage fault (Lut) occurs after the delay time set in Pr.81 (Low voltage fault delay time). When the voltage recovers, the fault clears and the VFD is ready to resume operation. Either Relay1 or Q1 (OU.31 or OU.33) can be set to 11 (Low Voltage) to provide an output signal.

Group	Code	Name	LCD Display	Paran	neter Setting	Setting range	Unit
Pr	81	Low voltage trip decision	LVT Delay	0.0		0-60	sec
		delay time					
OU	31	Multi-function relay 1	Relay 1	11	Low Voltage		-
	33	Multi-function output 1	O1 Define				

Low Voltage Fault Trip Setting Details

Code	Description
	When a low voltage condition occurs, the VFD blocks it output. A relay, if set to 11 (Low Voltage) will change state immediately. Then, after the delay
	time, the VFD generates a low voltage fault (Lut). The LVT Delay time does
	not apply to the relay outputs.

6.3.3 Output Block by Multi-Function Terminal

Set one of the digital input terminals (P1 \sim P5) to 5 (BX). When activated (bx on display), the VFD response is determined by Pr.45 (Bx Trip Mode). Set to (0) coast to a stop, Set to (1) decelerate to a stop.

Group	Code	Name	LCD Display	Parar	neter Setting	Setting range	Unit
ln	65-69	Px terminal setting	Px Define (Px: P1-	5	BX	0~54	-
		options	P5)				

Output Block by Multi-Function Terminal Setting Details

Code	Description
In.65-69 Px Define	When a digital input terminal is set to 5 (BX) and is activated during
	operation, the VFD response is determined by Pr.45 (Bx Trip Mode).
	0: Coast -> The motor coasts to a stop
	1: Decelerate -> The motor decelerates to a stop.
	While "bx" is displayed, the VFD's operating information (frequency and
	current) at the time of BX signal can be monitored. The VFD resumes
	operation when the BX terminal is de-activated provided that the Start/Run
	command is still active.

6.3.4 Trip Status Reset

After a fault, the VFD can be reset using the 7-Segment display (Stop/Reset) button or a digital input.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
In	65-69	Px terminal setting options	Px Define (Px: P1- P5)	3	RST	0~54	-

Trip Status Reset Setting Details

Code	Description
In.65-69 Px Define	Set the multi-function (digital) input terminal to 3 (RST) and activate the
	terminal to reset the fault. A reset can also be performed by pressing the
	[Stop/Reset] button on the 7-Segment display.

6.3.5 Operation Mode on Option Card Trip

The VFD monitors communication between installed option cards and will fault on an "Option Trip" (**OPt**) when a communication error occurs. The VFD responds to an Option Trip based on the setting of Pr.80 (motion at option trip).

Group	Code	Name		Parameter Setting		Setting range	Unit
Pr	80	Operation mode on	Opt Trip Mode	0	None	0-3	-
		option card trip		1	Free-Run		
				2	Dec		

Operation Mode on Option Trip Setting Details

Code	Descript	Description					
Pr.80 Opt Trip Mode	Setting		Function				
	0	None	No operation				
	1	Free-Run	The VFD output is blocked. The motor coasts to a stop.				
	2	Dec	The motor decelerates to the value set at Pr.07 (Trip Dec Time).				

6.3.6 No Motor Trip

The VFD can detect a low motor current condition and will trip on "no motor trip" (nmt) if the VFD output current is below the Pr.32 detection level for the Pr.33 detection time. The VFD responds to a no motor trip condition when Pr.31 (No Motor detection) is set to (1) Free-Run. Pr.31 may be set to (0) None (default) for testing with no motor connected.

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Pr	31	Operation on no motor trip	No Motor Trip	0	None Free-Run	0-1	-
		No motor trip current level	No Motor Level	5	•	1-100	%
	33	No motor detection time	No Motor Time	3.0		0.1-10	s

No Motor Trip Setting Details

Code	Description
Pr.31 No Motor Trip	0: None -> No action.
Pr.32 No Motor Level,	1: Free-Run -> Activates trip based on Pr.32 and Pr.33 settings. VFD will
Pr.33 No Motor Time	coast to a stop.
	If the output current value [based on the rated current (bA.13)] is lower
	than the value set at Pr.32 (No Motor Level), and if this continues for the
	time set at Pr33 (No Motor Time), a 'no motor trip' (nmt) occurs

① Caution

If bA.07 (V/F Pattern) is set to 1 (Square), a 'no motor trip' may occur due to lower output current. If so, set Pr.32 (No Motor Level) to a lower value than the factory default.

6.3.7 Low voltage trip 2

The standard Low Voltage fault (Lut) will automatically clear when the DC Link voltage returns (above) the LV Trip level and it is not saved in the fault history. Settings for Pr.82 (LV2 Selection) determine if the Low Voltage fault will:

- 1. Require a fault reset (change from level to latch fault)
- 2. Be saved in the fault history.

Group	Code	Name	LCD Display	P	arameter Setting	Setting range	Unit
Pr		LV2 Selection	LV2 Enable	00	LV2 not enabled		
	82			01	LV2 enabled Fault history not saved Bit sett		bit
				10	LV2 not enabled	00 ~ 11	
				11	LV2 enabled and Fault history saved		

When LVZ is enabled (bit 1 set to 1) and a low voltage condition occurs, the VFD will trip on a Low Voltage Trip 2 (Lu2) and require a reset. When the fault history is enabled (bit 2 set to 1), the LV2 fault (Lu2) will be saved in the fault history.

6.4 Fault/Warning List

See 9 Troubleshooting on page 333 for details about faults and warnings.

Category		LCD Display	Details
Major fault	Latch type	Over Current1	Over current trip
major radic		Over Voltage	Over voltage trip
		External Trip	Trip due to an external signal
		NTC Open	Temperature sensor fault trip
		Over Current2	ARM short current fault trip
		Option Trip-x*	Option fault trip*
		Over Heat	Over heat fault trip
		Out Phase Open	Output open-phase fault trip
		In Phase Open	Input open-phase fault trip
		Inverter OLT	Inverter overload fault trip
		Ground Trip	Ground fault trip
		Fan Trip	Fan fault trip
		E-Thermal	Motor overheat fault trip
		Pre-PID Fail	Pre-PID operation failure
		IO Board Trip	IO Board connection fault trip
		Ext-Brake	External brake fault trip
		No Motor Trip	No motor fault trip
		Low Voltage 2	Low voltage fault trip during operation
		ParaWrite Trip**	Write parameter fault trip
	Level type	Low Voltage	Low voltage fault trip
		BX	Emergency stop fault trip
		Lost Command	Command loss trip
		Safety A(B) Err	Safety A(B) contact trip
	Hardware	EEP Err	External memory error
	damage	ADC Off Set	Analog input error
		Watch Dog-1	CPU Watch Dog fault trip
		Watch Dog-2	
Minor fault		Over Load	Motor overload fault trip
		Under Load	Motor underload fault trip
Warning		Lost Command	Command loss fault trip warning
		Over Load	Overload warning
		Under Load	Under load warning
		Inverter OLT	Inverter overload warning
		DB Warn %ED	Braking resistor braking rate warning
		Retry Tr Tune	Rotor time constant tuning error

^{*} Applies only when an option board is used.

^{**} Displayed on an LCD keypad only.

7 RS-485 Communication Features

This section in the user manual explains how to control the VFD with a PLC or a computer over a long distance using the RS-485 communication features. To use the RS-485 communication features, connect the communication cables and set the communication parameters on the VFD. Refer to the communication protocols and parameters to configure and use the RS-485 communication features.

7.1 Communication Standards

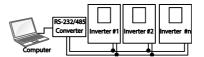
Following the RS-485 communication standards, S and SW Series VFD's exchange data with a PLC and computer. The RS-485 communication standards support the Multi-drop Link System and offer an interface that is strongly resistant to noise. Please refer to the following table for details about the communication standards.

Item	Standard
Communication method/	RS-485/Bus type, Multi-drop Link System
Transmission type	
VFD type name	SW
Number of connected VFDs/	Maximum of 16 VFDs / Maximum1,200m (recommended distance: within 700m)
Transmission distance	
Recommended cable size	0.75mm², (18AWG), Shielded Type Twisted-Pair (STP) Wire
Installation type	Dedicated terminals (S+/S-/SG) on the control terminal block
Power supply	Supplied by the VFD - insulated power source from the VFD's internal circuit
Communication speed	1,200/2,400/9,600/19,200/38,400/57,600/115,200 bps
Control procedure	Asynchronous communications system
Communication system	Half duplex system
Character system	Modbus-RTU: Binary / LS Bus: ASCII
Stop bit length	1-bit/2-bit
Frame error check	2 bytes
Parity check	None/Even/Odd

7.2 Communication System Configuration

In an RS-485 communication system, the PLC or computer is the master device and the VFD is the slave device. When using a computer as the master, the RS-232 converter must be integrated with the computer, so that it can communicate with the VFD through the RS-232/RS-485 converter. Specifications and performance of converters may vary depending on the manufacturer, but the basic functions are identical. Refer to the converter manufacturer's user manual for details about features and specifications.

Connect the wires and configure the communication parameters on the VFD by referring to the following illustration of the communication system configuration.



7.2.1 Communication Line Connection

Make sure that the VFD is turned off completely, and then connect the RS-485 communication line to the S+/S-/SG terminals of the terminal block. The maximum number of VFDs you can connect is 16. For communication lines. use shielded twisted pair (STP) cables.

The maximum length of the communication line is 1,200 meters, but it is recommended to use no more than 700 meters of communication line to ensure stable communication. Please use a repeater to enhance the communication speed when using a communication line longer than 1,200 meters or when using a large number of devices. A repeater is effective when smooth communication is not available due to noise interference.

① Caution

When wiring the communication line, make sure that the SG terminals on the PLC and VFD are connected. SG terminals prevent communication errors due to electronic noise interference.

7.2.2 Setting Communication Parameters

Before proceeding with setting communication configurations, make sure that the communication lines are connected properly. Turn on the VFD and set the communication parameters.

Group	Code	Name	LCD Display	Par	ameter Setting	Setting range	Unit
CM	01	Built-in communication VFD ID	Int485 St ID	1		1-250	-
	02	Built-in communication protocol	Int485 Proto	0	ModBus RTU	0, 2	-
	03	Built-in communication speed	Int485 BaudR	3	9600 bps	0-7	-
	04	Built-in communication frame setting	Int485 Mode	0	D8/PN/S1	0-3	-
	05	Transmission delay after reception	Resp Delay	5		0-1000	ms

Communication Parameters Setting Details

Code	Descrip	ntion	
CM.01 Int485 St ID	Set the	VFD station ID bet	tween 1 and 250.
CM.02 Int485 Proto	Select	one of the two buil	t-in protocols: Modbus-RTU or LS INV 485.
	_		
	Settin	7	Function
	0	Modbus-RTU	Modbus-RTU compatible protocol
	2	LS INV 485	Dedicated protocol for the LS VFD
CM.03 Int485 BaudR	Set a c	ommunication sett	ing speed up to 115,200 bps.
	_		
	Settin	g	Function
	0		1,200 bps
	1		2,400 bps
	2		4,800 bps
	3		9,600 bps
	4		19,200 bps
	5		38,400 bps
	7		56K bps
C1.10.11.10.5.11.1			115 Kbps
CM.04 Int485 Mode		ommunication con er of stop bits.	figuration. Set the data length, parity check method, and the
	numbe	er of stop bits.	
	Settin		Function
	0	D8/PN/S1	8-bit data / no parity check / 1 stop bit
	1	D8/PN/S2	8-bit data / no parity check / 2 stop bits
	2	D8/PE/S1	8-bit data / even parity / 1 stop bit
	3	D8/PO/S1	8-bit data / odd parity / 1 stop bit
CM.05 Resp Delay			the slave (VFD) to react to the request from the master.
			a system where the slave device response is too fast for the
			Set this code to an appropriate value for smooth master-
	slave o	ommunication.	
		Request	Request
	Maste	r	•••
			<u> </u>
			T I I
		*	<u> </u>
	Slave	` †	` <u>†</u>
		R	esponse Response
		c	M.5 Resp Delay CM.5 Resp Delay

7.2.3 Setting Operation Command and Frequency

To select the built-in RS485 communication as the source of command, set the Frq code to 6 (Int485) on the keypad (basic keypad with 7-segment display). On an LCD keypad, set the DRV code to 3 (Int485). Then, set common area parameters for the operation command and frequency via communication.

Group	Code	Name	LCD Display	Paran	neter Setting	Setting range	Unit
Pr	12	Speed command loss operation mode	Lost Cmd Mode	1	Free-Run	0-5	-
	13	Time to determine speed command loss	Lost Cmd Time	1.0		0.1-120	s
	14	Operation frequency at speed command loss	Lost Preset F	0.00		Start frequency— Maximum frequency	Hz
OU	31	Multi-function relay 1	Relay 1	13	Lost	0-35	-
	33	Multi-function output 1	Q1 Define		Command		

Group	Code	Name	LCD Display	Parameter Setting		Setting range	Unit
Operation	DRV	Command source	Cmd Source*	3	Int 485	0-5	-
	Frq	Frequency setting	Freq Ref Src	6	Int 485	0-12	-
	1	method					

^{*} Displayed in DRV-06 on an LCD keypad.

7.2.4 Command Loss Protective Operation

Configure the command loss decision standards and protective operations run when a communication problem lasts for a specified period of time.

Command Loss Protective Operation Setting Details

Code	Descrip	Description				
Pr.12 Lost Cmd Mode,		he operation to t at Pr. 13.	run when a communication error has occurred and lasted exceeding the			
Pr.13 Lost Cmd	Setting	9	Function			
Time	0	None	The speed command immediately becomes the operation frequency without any protection function.			
	1	Free-Run	The VFD blocks output. The motor performs in free-run condition.			
	2	Dec	The motor decelerates and then stops at the time set at Pr.07 (Trip Dec Time).			
	3	Hold Input	The VFD calculates the average input value for 10 seconds before the loss of the speed command and uses it as the speed reference.			
	4	Hold Output	The VFD calculates the average output value for 10 seconds before the loss of the speed command and uses it as the speed reference.			
	5	Lost Preset	The VFD operates at the frequency set at Pr. 14 (Lost Preset F).			

7.2.5 Setting Virtual Multi-Function Input

Multi-function input can be controlled using a communication address (0h0385). Set codes CM.70–77 to the functions to operate, and then set the BIT relevant to the function to 1 at 0h0322 to operate it. Virtual multi-function operates independently from In.65-69 analog multi-function inputs and cannot be set redundantly. Virtual multi-function input can be monitored using CM.86 (Virt DI Status). Before you configure the virtual multi-function inputs, set the DRV code according to the command source.

Group	Code	Name	LCD Display	Param	eter Setting	Setting range	Unit
CM	70-77	Communication multi-	Virtual DI x	0	None	0-49	-
		function input x	(x: 1-8)				
	86	Communication multi-	Virt DI Status	-	-	-	-
		function input monitoring					

Example: When sending an Fx command by controlling virtual multi-function input in the common area via Int485, set CM.70 to FX and set address 0h0322 to 0h0001.

Note

The following are values and functions that are applied to address 0h0322:.

Setting	Function
0h0001	Forward operation (Fx)
0h0003	Reverse operation (Rx)
0h0000	Stop

7.2.6 Saving Parameters Defined by Communication

If you turn off the VFD after setting the common area parameters or keypad parameters via communication and operate the VFD, the changes are lost and the values changed via communication revert to the previous setting values when you turn on the VFD.

Set CNF-48 to 1 (Yes) to allow all the changes over comunication to be saved, so that the VFD retains all the existing values even after the power has been turned off.

Setting address 0h03E0 to 0 and then setting it again to 1 via communication allows the existing parameter settings to be saved. However, setting address 0h03E0 to 1 and then setting it to 0 does not carry out the same function. Parameters defined by communication can only be saved using an LCD keypad.

Group	Code	Name	LCD Display	Param	eter Setting	Setting range	Unit
CNF*	48	Save parameters	Parameter Save	0	No	0 -1	-
				1	Yes		

^{*}Available on an LCD keypad only.

7.2.7 Total Memory Map for Communication

Communication Area	Memory Map	Details
Communication common compatible area	0h0000-0h00FF	iS5, iP5A, iV5, iG5A compatible area
Parameter registration type area	0h0100-0h01FF	Areas registered at CM.31-38 and CM.51-58
	0h0200-0h023F	Area registered for User Group
	0h0240-0h027F	Area registered for Macro Group
	0h0280-0h02FF	Reserved
SW communication common area	0h0300-0h037F	Inverter monitoring area
	0h0380-0h03DF	Inverter control area
	0h03E0-0h03FF	Inverter memory control area
	0h0400-0h0FFF	Reserved
	0h1100	dr Group
	0h1200	bA Group
	0h1300	Ad Group
	0h1400	Cn Group
	0h1500	In Group
	0h1600	OU Group
	0h1700	CM Group
	0h1800	AP Group
	0h1B00	Pr Group
	0h1C00	M2 Group

7.2.8 Parameter Group for Data Transmission

By defining a parameter group for data transmission, the communication addresses registered in the communication function group (CM) can be used in communication. Parameter group for data transmission may be defined to transmit multiple parameters at once, into the communication frame.

Group	Code	Name	LCD Display	Parame	eter Setting	Setting range	Unit
CM	31-38	Output communication address x	Para Status-x	-	-	0000-FFFF	Hex
	51-58	Input communication address x	Para Control-x	-	-	0000-FFFF	Hex

Currently Registered CM Group Parameter

Address	Parameter	Assigned content by bit
0h0100-0h0107	Status Parameter-1-	Parameter communication code value registered at CM.31-38
0110100-0110107	Status Parameter-8	(Read-only)
0h0110-0h0117	Control Parameter-1-	Parameter communication code value registered at CM.51-58
UNU110-UNU117	Control Parameter-8	(Read/Write access)

Note

When registering control parameters, register the operation speed (0h0005, 0h0380, 0h0381) and operation command (0h0006, 0h0382) parameters at the end of a parameter control frame. For example, when the parameter control frame has 5 parameter control items (Para Control – x), register the operation speed at Para Control-4 and the operation command to Para Control-5.

7.3 Communication Protocol

The built-in RS-485 communication supports LS INV 485 and Modbus-RTU protocols.

7.3.1 LS INV 485 Protocol

The slave device (VFD) responds to read and write requests from the master device (PLC or PC).

Request

ENQ	Station ID	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n bytes	2 bytes	1 byte

Normal Response

ACK	Station ID	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Error Response

NAK	Station ID	CMD	Error code	SUM	EOT
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

- · A request starts with ENQ and ends with EOT.
- · A normal response starts with ACK and ends with EOT.
- · An error response starts with NAK and ends with EOT.
- A station ID indicates the VFD number and is displayed as a two-byte ASCII-HEX string that uses characters 0-9 and A-F.
- CMD: Uses uppercase characters (returns an IF error if lowercase characters are encountered)—please
 refer to the following table.

Character	ASCII-HEX	Command
'R'	52h	Read
'W'	57h	Write
X	58h	Request monitor registration
Υ;	59h	Perform monitor registration

- Data: ASCII-HEX (for example, when the data value is 3000: 3000 → '0"B"B"8"h → 30h 42h 42h 38h).
- Error code: ASCII-HEX (refer to 7.3.1.4 Error Code on page 236)
- · Transmission/reception buffer size: Transmission=39 bytes, Reception=44 bytes
- · Monitor registration buffer: 8 Words
- SUM: Checks communication errors via sum.

 $SUM = a\ total\ of\ the\ lower\ 8\ bits\ values\ for\ station\ ID,\ command\ and\ data\ (Station\ ID+CMD+Data)\ in\ ASCII-HEX.$

ENQ	Station ID	CMD		Number of Addresses	SUM	EOT
05h	'01'	'R'	'3000'	'1'	'A7'	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

Note

Broadcasting sends commands to all VFDs connected to the network simultaneously. When commands are sent from station ID 255, each VFD acts on the command regardless of the station ID. However no response is issued for commands transmitted by broadcasting.

7.3.1.1 Detailed Read Protocol

Read Request: Reads successive n words from address XXXX.

ENQ	Station ID	CMD		Number of Addresses	SUM	EOT
05h	'01'-'FA'	'R'	'XXXXX'	'1'-'8' = n	'XX'	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

Total bytes=12. Characters are displayed inside single quotation marks(').

Read Normal Response

ACK	Station ID	CMD	Data	SUM	EOT
06h	'01'-'FA'	'R'	'XXXX'	'XX'	04h
1 byte	2 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= (7 x n x 4): a maximum of 39

Read Error Response

NAK	Station ID	CMD	Error code	SUM	EOT
15h	'01'-'FA'	'R'	****	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	2 hytes	1 byte

Total bytes=9

7.3.1.2 Detailed Write Protocol

Write Request: Writes successive n words to address XXXX.

ENQ	Station ID	CMD		Number of Addresses	Data	SUM	EOT
05h	'01'-'FA'	'W'	'XXXX'	'1'-'8' = n	'XXXX'	'XX'	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= $(12 + n \times 4)$: a maximum of 44

Write Normal Response

ACK	Station ID	CMD	Data	SUM	EOT
06h	'01'-'FA'	'W'	'XXXX'	'XX'	04h
1 byte	2 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= (7 + n x 4): a maximum of 39

Write Error Response

NAK	Station ID	CMD	Error Code	SUM	EOT
15h	'01'-'FA'	'W'	1991	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes=9

7.3.1.3 Monitor Registration Detailed Protocol

Monitor registration request is made to designate the type of data that requires continuous monitoring and periodic updating.

Monitor Registration Request: Registration requests for n addresses (where n refers to the number of addresses. The addresses do not have to be contiquous.)

ENQ	Station ID	CMD	Number of Addresses	Address	SUM	EOT
05h	'01'-'FA'	'X'	'1'-'8'=n	'XXXX'	'XX'	04h
1 byte	2 bytes	1 byte	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= $(8 + n \times 4)$: a maximum of 40

Monitor Registration Normal Response

ACK	Station ID	CMD	SUM	EOT
06h	'01'-'FA'	χ	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bytes=7

Monitor Registration Error Response

NAK	Station ID	CMD	Error Code	SUM	EOT
15h	'01'-'FA'	'X'	***	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes=9

Monitor Registration Perform Request: A data read request for a registered address, received from a monitor registration request

ENQ	Station ID	CMD	SUM	EOT
05h	'01'-'FA'	Υ'	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bytes=7

Monitor Registration Execution Normal Response

ACK	Station ID	CMD	Data	SUM	EOT
06h	'01'-'FA'	Υ	'XXXX'	'XX'	04h
1 byte	2 bytes	1 byte	n x 4 bytes	2 bytes	1 byte

Total bytes= (7 + n x 4): a maximum of 39

Monitor Registration Execution Error Response

NAK	Station ID	CMD	Error Code	SUM	EOT
15h	'01'-'FA'	Ύ′	1991	'XX'	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes=9

7.3.1.4 Error Code

Code	Abbreviation	Description
ILLEGAL FUNCTION	IF	The requested function cannot be performed by a slave because
		the corresponding function does not exist.
ILLEGAL DATA ADDRESS	IA	The received parameter address is invalid at the slave.
ILLEGAL DATA VALUE	ID	The received parameter data is invalid at the slave.
WRITE MODE ERROR	WM	Tried writing (W) to a parameter that does not allow writing (read-
		only parameters, or when writing is prohibited during operation)
FRAME ERROR	FE	The frame size does not match.

7.3.1.5 ASCII Code

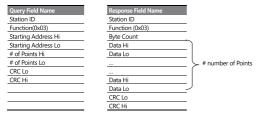
Character	Hex	Character	Hex	Character	Hex
A	41	q	71	@	40
В	42	r	72	[5B
С	43	s	73	\ \	5C
D	44	t	74	1	5D
E	45	u	75		5E
F	46	v	76		5F
G	47	w	77		60
Н	48	x	78	{	7B
1	49	у	79	1	7C
J	4A	z	7A	}	7D
K	4B	0	30	-	7E
L	4C	1	31	BEL	07
M	4D	2	32	BS	08
N	4E	3	33	CAN	18
0	4F	4	34	CR	0D
P	50	5	35	DC1	11
Q	51	6	36	DC2	12
R	52	7	37	DC3 DC4	13 14
S	53	8	38	DEL DEL	7F
T	54	9	39	DLE	10
U	55	space	20	EM	19
V	56	!	21	ACK	06
W	57		22	ENQ	05
X	58	#	23	EOT	04
Υ	59	\$	24	ESC	1B
Z	5A	%	25	ETB	17
a	61	&	26	ETX	03
b	62	1	27	FF	0C
C	63	(28	FS	1C
d	64)	29	GS	1D
e	65	*	2A	HT	09
f	66	+	2B	LF	0A
g	67	,	2C	NAK	15
h	68	-	2D	NUL	00
i	69	1	2E	RS	1E
j	6A	/	2F	S1	OF
k	6B	:	3A	SO	0E
I	6C	;	3B	SOH	01
m	6D	<	3C	STX	02
n	6E	=	3D	SUB	1A
0	6F	>	3E	SYN	16
p	70	?	3F	US	1F
				VT	OB

7.3.2 Modbus-RTU Protocol

7.3.2.1 Function Code and Protocol (unit: byte)

In the following section, station ID is the value set at CM.01 (Int485 St. ID), and starting address is the communication address. (starting address size is in bytes). For more information about communication addresses, refer to 7.4 Compatible Common Area Parameter on page 241.

Function Code #03: Read Holding Register



Function Code #04: Read Input Register

Query Field Name	Response Field Name	
Station ID	Station ID	_
Function(0x04)	Function (0x04)	
Starting Address Hi	Byte Count	
Starting Address Lo	Data Hi	_)
# of Points Hi	Data Lo	_
# of Points Lo		# number of Points
CRC Lo		_ (
CRC Hi	Data Hi	_
	Data Lo	-)
	CRC Lo	
	CRC Hi	_

Query Field Name	Response Field Name
Station ID	Station ID
Function (0x06)	Function (0x06)
Starting Address Hi	Register Address Hi
Register Address Lo	Register Address Lo
Preset Data Hi	Preset Data Hi

Preset Data Lo	Preset Data Lo
CRC Lo	CRC Lo
CRC Hi	CRC Hi

Function Code #16 (hex 0h10): Preset Multiple Register

Query Field Name		Response Field Name
Station ID		Station ID
Function (0x10)		Function (0x10)
Starting Address Hi		Starting Address Hi
Starting Address Lo		Starting Address Lo
# of Register Hi		# of Register Hi
# of Register Lo		# of Register Lo
Byte Count		CRC Lo
Data Hi	\supset	CRC Hi
Data Lo		
		# number of Points
		" Humber of Folins
Data Hi		
Data Lo	ノ	
CRC Lo		

Exception Code

CRC Hi

Code
01: ILLEGAL FUNCTION
02: ILLEGAL DATA ADRESS
03: ILLEGAL DATA VALUE
06: SLAVE DEVICE BUSY

Response

Field Name
Station ID
Function*
Exception Code
CRC Lo
CRC Hi

^{*} The function value uses the top level bit for all query values.

Example of Modbus-RTU Communication in Use

When the Acc time (Communication address 0x1103) is changed to 5.0 sec and the Dec time (Communication address 0x1104) is changed to 10.0 sec.

Frame Transmission from Master to Slave (Request)

Item	Station ID	Function	Starting Address	# of Register	Byte Count	Data 1	Data 2	CRC
Hex	0x01	0x10	0x1102	0x0002	0x04	0x0032	0x0064	0x1202
Description	CM.01	Preset	Starting	-	-	50	100	-
	Int485	Multiple	Address -1			(ACC	(DEC	
	St ID	Register	(0x1103-1)			time	time	
						5.0sec)	10.0sec)	

Frame Transmission from Slave to Master (Response)

Item	Station ID	Function	Starting Address	# of Register	CRC
Hex	0x01	0x10	0x1102	0x0002	0xE534
Description	CM.01	Preset Multiple	Starting Address -	-	-
	Int485 St ID	Register	1		
			(0x1103-1)		

7.4 Compatible Common Area Parameter

The following are common area parameters compatible with iS5, iP5A, iV5, and iG5A.

Comm. Address	Parameter	Scale	Unit	R/W	Assigned Content by Bit
0h0000	VFD model	-	-	R	6: SW
0h0001	VFD capacity	-	-	R	0: 0.75 kW, 1: 1.5 kW, 2: 2.2 kW
					3: 3.7 kW, 4: 5.5 kW, 5: 7.5 kW
					6: 11 kW, 7: 15 kW, 8: 18.5 kW
					9: 22 kW
					256: 0.4 kW, 257: 1.1 kW, 258: 3.0 kW
					259: 4.0 kW
0h0002	VFD input voltage	-	-	R	0: 230V product
					1: 460V product
0h0003	Version	-	-	R	Example 0h0100: Version 1.00
					Example 0h0101: Version 1.01
0h0004	Reserved	-	-	R/W	
0h0005	Command frequency	0.01	Hz	R/W	
0h0006	Operation command	-	-	R	B15 Reserved
	(option)				B14 0: Keypad Freq,
					B13 1: Keypad Torq
					B12 2-16: Terminal block multi-step
					B11 speed
					B10 17: Up, 18: Down
					B9 19: STEADY
					22: V1, 24: V2, 25: I2,
					26: Reserved
					27: Built-in 485
					28: Communication option
					30: JOG, 31: PID
					B8 0: Keypad
					B7 1: Fx/Rx-1
					B6 2: Fx/Rx-2
					3: Built-in 485
					4: Communication option
				R/W	B5 Reserved
					B4 Emergency stop B3 W: Trip initialization (0→1), R: Trip
					B3 W: Trip initialization (0→1), R: Trip status
					B2 Reverse operation (R)
					B1 Forward operation (F)
					BO Stop (S)
0h0007	Acceleration time	0.1	s	R/W	-
0h0008	Deceleration time	0.1	s	R/W	-
0h0009	Output current	0.1	Α	R	-
0h000A	Output frequency	0.01	Hz	R	-
0h000B	Output voltage	1	٧	R	-

SW Series VFD 241

Comm. Address	Parameter	Scale	Unit	R/W	Assigned C	Content by Bit
0h000C	DC link voltage	1	٧	R	-	
0h000D	Output power	0.1	kW	R	-	
0h000E	Operation status	-	-	R	B15	0: Remote, 1: Keypad Local
					B14	1: Frequency command source
						by communication (built-in,
						option)
					B13	1: Operation command source
						by communication (built-in,
						option)
					B12	Reverse operation command
					B11	Forward operation command
					B10	Brake release signal
					B9	Jog mode
					B8	Drive stopped.
					B7	DC Braking
					B6	Speed reached
					B5	Decelerating
					B4	Accelerating
					B3	Fault Trip - operates according to
						OU.30 setting
					B2	Operating in reverse direction
					B1	Operating in forward direction
					B0	Stopped
0h000F	Fault trip information	-	-	R	B15	Reserved
	'				B14	Reserved
					B13	Reserved
					B12	Reserved
					B11	Reserved
					B10	H/W-Diag
					B9	Reserved
					B8	Reserved
					B7	Reserved
					B6	Reserved
					B5	Reserved
					B4	Reserved
					B3	Level Type trip
					B2	Reserved
					B1	Reserved
					BO	Latch Type trip
0h0010	Input terminal	-	_	R	B15-	Reserved
	information		1	1	B7	1
					B6	Reserved
					B5	Reserved
					B4	P5
					B3	P4
			1	1	100	_!' '

Comm. Address	Parameter	Scale	Unit	R/W	Assigned	Content by Bit
					B2	P3
					B1	P2
					B0	P1
0h0011	Output terminal	-	-	R	B15	Reserved
	information				B14	Reserved
					B13	Reserved
					B12	Reserved
					B11	Reserved
					B10	Reserved
					В9	Reserved
					B8	Reserved
					B7	Reserved
					B6	Reserved
					B5	Reserved
					B4	Reserved
					B3	Reserved
					B2	Reserved
					B1	МО
					B0	Relay 1
0h0012	V1	0.01	%	R	V1 input	voltage
0h0013	V2	0.01	%	R	V2 input	voltage
0h0014	12	0.01	%	R	12 input c	urrent
0h0015	Motor rotation speed	1	rpm	R	Displays 6	existing motor rotation speed
0h0016	Reserved	-	-	-	-	-
- 0h0019						
0h001A	Select Hz/rpm	-	-	R	0: Hz unit	t, 1: rpm unit
0h001B	Display the number of	-	-	R	Display the number of poles for the selected	
	poles for the selected			1	motor	•
	motor			1		

SW Series VFD 243

7.5 Expansion Common Area Parameter

7.5.1 Monitoring Area Parameter (Read Only)

Comm. Address	Parameter	Scale	Unit	Assigned co	ontent by bit
0h0300	VFD model	-	-	S/SW: 000	6h
0h0301	VFD capacity	-	-	0.4 kW: 19	00h, 0.75 kW: 3200h
				1.1 kW: 40	11h, 1.5 kW: 4015h
				2.2 kW: 40	22h, 3.0 kW: 4030h
				3.7 kW: 40	37h, 4.0 kW: 4040h
				5.5 kW: 40	55h, 7.5 kW: 4075h
				11 kW: 40E	30h, 15 kW: 40F0h
				18.5 kW: 4	125h, 22 kW: 4160h
0h0302	VFD input	-	-		le phase self cooling: 0120h, 200 V 3-
	voltage/power				ed cooling: 0231h
	(Single phase, 3- phase)/cooling				le phase forced cooling: 0121h, 400 V
	method				se self cooling: 0420h le phase self cooling: 0220h, 400 V 3-
					cooling: 0430h
					nase self cooling: 0230h, 400 V single
					ed cooling: 0421h
					le phase forced cooling: 0221h, 400 V 3-
0h0303	VFD S/W version	_	_		ed cooling: 0431h 0: Version 1.00
0110303	VFD 3/ VV Version	-			1: Version 1.01
0h0304	Reserved	_		011010	1. VEISION 1.01
0h0305	VFD operation state	-		B15	0: Normal state
0110303	VFD operation state	-		B14	4: Warning occurred
				B13	8: Fault occurred [operates according to
				B12	Pr. 30 (Trip Out Mode) setting.]
				B11 -	_
					-
				B8	
				B7	1: Speed searching 2: Accelerating
				B6	3: Operating at constant rate
				B5	4: Decelerating
				B4	5: Decelerating to stop
					6: H/W OCS
					7: S/W OCS 8: Dwell operating
				B3	0: Stopped
				B2	1: Operating in forward direction
		1			

Comm. Address	Parameter	Scale	Unit	Assigned	content by bit
				B1	2: Operating in reverse direction
				B0	3: DC operating (0 speed control)
0h0306	VFD operation	-	-	B15	Operation command source
	frequency command			B14	0: Keypad
	source			B13	1: Communication option
				B12	2: User Sequence
				B11	3: Built-in RS 485
				B10	4: Terminal block
				B9	
				B8	
				B7	Frequency command source
				B6	0: Keypad speed
				B5	1: Keypad torque
				B4	2-4: Up/Down operation speed
				B3	5: V1, 7: V2, 8: I2
				B2	9: Pulse
				B1	10: Built-in RS 485
				B0	11: Communication option 12: User Sequence
					13: Jog
					13. JOG 14: PID
					25-39: Multi-step speed frequency
0h0307	LCD keypad S/W version	-	-	(Ex.) 0h01	00: Version 1.00
0h0308	LCD keypad title	_	-	(Ex.) 0h01	01: Version 1.01
0110500	version			(200) 01101	on valuent nov
0h0309 -0h30F	Reserved	-	-	-	
0h0310	Output current	0.1	Α	-	
0h0311	Output frequency	0.01	Hz	-	
0h0312	Output rpm	0	rpm	-	
0h0313	Motor feedback speed	0	rpm	-32768 rp	om-32767 rpm (directional)
0h0314	Output voltage	1	٧	-	
0h0315	DC Link voltage	1	٧	-	
0h0316	Output power	0.1	kW	-	
0h0317	Output torque	0.1	%	-	
0h0318	PID reference	0.1	%	-	
0h0319	PID feedback	0.1	%	-	
0h031A	Display the number	-	-	Displays t	he number of poles for the first motor
	of poles for the 1st				
	motor				
0h031B	Display the number	-	-	Displays t	the number of poles for the 2nd motor
	of poles for the 2 nd				
	motor		-		
0h031C	Display the number	-	-	Displays t	he number of poles for the selected

SW Series VFD 245

Comm. Address	Parameter	Scale	Unit	Assigned cont	ent by bit
	of poles for the selected motor			motor	
0h031D	Select Hz/rpm	-	1_	0: Hz, 1: rpm	
0h031E	Reserved	-	1_		
- 0h031F	neserved				
0h0320	Digital input			BI5	Reserved
	information			-	-
				B7	Reserved
				B6	Reserved
				B5	Reserved
				B4	P5(I/O board)
				B3	P4(I/O board)
				B2	P3(I/O board)
				B1	P2(I/O board)
				BO	P1(I/O board)
0h0321	Digital output	-	1_	BI5	Reserved
0110021	information			-	Reserved
				B4	Reserved
				B3	Reserved
				B2	Reserved
				B1	Q1
				BO	Relay 1
0h0322	Virtual digital input	-	-	B15	Reserved
***************************************	information			-	Reserved
				B8	Reserved
				B7	Virtual DI 8(CM.77)
				B6	Virtual DI 7(CM.76)
				B5	Virtual DI 6(CM.75)
				B4	Virtual DI 5(CM.74)
				B3	Virtual DI 4(CM.73)
				B2	Virtual DI 3(CM.72)
				B1	Virtual DI 2(CM.71)
				BO	Virtual DI 1(CM.70)
0h0323	Display the selected motor	-	-	0: 1st motor/	
0h0324	Al1	0.01	%	Analog input	V1 (I/O board)
0h0325	Reserved	0.01	%	Jg mpar	
0h0326	Al3	0.01	%	Analog input	V2 (I/O board)
0h0327	Al4	0.01	%		I2 (I/O board)
0h0328	AO1	0.01	%		it 1 (I/O board)
0h0329	AO2	0.01	%		it 2 (I/O board)
0h032A	AO3	0.01	%	Reserved	
0h032B	AO4	0.01	%	Reserved	
0h032C	Reserved	-	-	-	
0h032D	VFD module	1	°C	-	

Comm. Address	Parameter	Scale	Unit	Assigned	content by bit
Commi. Address		Scale	Offic	Assigned	ontent by bit
0h032E	temperature VFD power				
UNUSZE	consumption	1	kWh	-	
0h032F	VFD power				
010321	consumption	1	MWh	-	
0h0330	Latch type trip	-	-	BI5	Fuse Open Trip
	information - 1			BI4	Over Heat Trip
				BI3	Arm Short
				BI2	External Trip
				BI1	Overvoltage Trip
				BIO	Overcurrent Trip
				B9	NTC Trip
				B8	Reserved
				B7	Reserved
				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	-	-	BI5	Reserved
	information - 2			BI4	Reserved
				BI3	Safety B
				BI2	Safety A
				BI1	Reserved
				BI0	Bad option card
				B9	No motor trip
				B8	External brake trip
				B7	Bad contact at basic I/O board
				B6	Pre PID Fail
				B5	Error while writing parameter
				B4	Reserved
				B3	FAN Trip
				B2	PTC (Thermal sensor) Trip
				B1	Reserved
				B0	MC Fail Trip
0h0332	Level type trip	-	-	B15	Reserved
	information			-	-
				B8	Reserved
			1	B7	Reserved
				B6	Reserved
			1	B5	Reserved
				B4	Reserved
				B3	Keypad Lost Command

SW Series VFD 247

Comm. Address	Parameter	Scale	Unit	Assigned cont	ent by bit
				B2	Lost Command
				B1	LV
				B0	BX
0h0333	H/W Diagnosis Trip	-	-	B15	Reserved
	information			-	Reserved
				B6	Reserved
				B5	Queue Full
				B4	Reserved
				B3	Watchdog-2 error
				B2	Watchdog-1 error
				B1	EEPROM error
				B0	ADC error
0h0334	Warning information	-	-	B15	Reserved
				-	Reserved
				B10	Reserved
				B9	Auto Tuning failed
				B8	Keypad lost
				B7	Encoder disconnection
				B6	Wrong installation of encoder
				B5	DB
				B4	FAN running
				B3	Lost command
				B2	Inverter Overload
				B1	Underload
				BO	Overload
0h0335 -0h033F	Reserved	-	1-	-	Overload
0h0340	On Time date	0	Day	Total number on	of days the VFD has been powered
0h0341	On Time minute	0	Min	Total number	of minutes excluding the total
				number of Or	
0h0342	Run Time date	0	Day		of days the VFD has driven the motor
0h0343	Run Time minute	0	Min	Total number number of Ru	of minutes excluding the total
0h0344	Fan Time date	0	Day		of days the heat sink fan has been
01105-44	Turrime date		Duy	running	or days the neat sink farrius been
0h0345	Fan Time minute	0	Min	Total number number of Fa	of minutes excluding the total n Time days
0h0346	Reserved	-	-	-	
-0h0348					
0h0349	Reserved	-	-	-	
0h034A	Option 1	-	-	0: None, 9: CA	Nopen
0h034B	Reserved	-	-		· .

C	omm. Address	Parameter	Scale	Unit	Assigned content by bit
O	n034C	Reserved			

7.5.2 Control Area Parameter (Read/ Write)

Comm. Address	Parameter	Scale	Unit	Assigned	Content by Bit
0h0380	Frequency command	0.01	Hz	Commar	nd frequency setting
0h0381	RPM command	1	rpm	Commar	nd rpm setting
0h0382	Operation	-	-	B7	Reserved
	command			B6	Reserved
				B5	Reserved
				B4	Reserved
				B3	0 → 1: Free-run stop
				B2	0 → 1: Trip initialization
				B1	0: Reverse command, 1: Forward command
				B0	0: Stop command, 1: Run command
				Example	Forward operation command 0003h,
				Reverse	operation command 0001h.
0h0383	Acceleration time	0.1	s	Accelera	tion time setting
0h0384	Deceleration time	0.1	s	Decelera	tion time setting
0h0385	Virtual digital	-	-	BI5	Reserved
	input control (0:			-	Reserved
	Off, 1:On)			B8	Reserved
				B7	Virtual DI 8(CM.77)
				B6	Virtual DI 7(CM.76)
				B5	Virtual DI 6(CM.75)
				B4	Virtual DI 5(CM.74)
				B3	Virtual DI 4(CM.73)
				B2	Virtual DI 3(CM.72)
				B1	Virtual DI 2(CM.71)
				B0	Virtual DI 1(CM.70)
0h0386	Digital output	-	-	BI5	Reserved
	control			BI4	Reserved
	(0:Off, 1:On)			BI3	Reserved
				BI2	Reserved
				BI1	Reserved
				BIO	Reserved
				B9	Reserved
				B8	Reserved
				B7	Reserved
				B6	Reserved
				B5	Reserved

SW Series VFD 249

	-				
Comm. Address	Parameter	Scale	Unit		Content by Bit
				B4	Reserved
				B3	Reserved
				B2	Reserved
				B1	Q1 (I/O board, OU.33: None)
				BO	Relay 1 (I/O board, OU.31: None)
0h0387	Reserved	-	-	Reserved	i
0h0388	PID reference	0.1	%	PID refer	ence command
0h0389	PID feedback	0.1	%	PID feed	back value
	value				
0h038A	Motor rated	0.1	Α	-	
	current				
0h038B	Motor rated	1	٧	-	
	voltage				
0h038C-	Reserved			-	
0h038F					
0h0390	Torque Ref	0.1	%	Torque c	ommand
0h0391	Fwd Pos Torque	0.1	%	Forward	motoring torque limit
	Limit				
0h0392	Fwd Neg	0.1	%	Forward	regenerative torque limit
	Torque Limit				
0h0393	Rev Pos Torque	0.1	%	Reverse	motoring torque limit
	Limit				- '
0h0394	Rev Neg Torque	0.1	%	Reverse	regenerative torque limit
	Limit				
0h0395	Torque Bias	0.1	%	Torque b	ias
0h0396- 0h399	Reserved	-	-	-	
0h039A	Anytime Para	-	-	Set the C	NF.20° value (refer to 5.37 Operation State
					on page 204)
0h039B	Monitor Line-1		1_		1 0 -
0110335	IVIOITIOI EITIC T				NF.21° value (refer to 5.37 Operation State
				<u>Monitor</u>	on page 204)
0h039C	Monitor Line-2	-	-	Set the C	NF.22° value (refer to 5.37 Operation State
				Monitor	on page 204)
0h039D	Monitor Line-3	-	-	Set the C	NF.23° value (refer to 5.37 Operation State
					on page 204)
		1		PIOHEOL	on page 201)

^{*} Displayed on an LCD keypad only.

Note

A frequency set via communication using the common area frequency address (0h0380, 0h0005) is not saved even when used with the parameter save function. To save a changed frequency to use after a power cycle, follow these steps:

- 1 Set dr.07 to Keypad-1 and select a random target frequency.
- 2 Set the frequency via communication into the parameter area frequency address (0h1101).
- 3 Perform the parameter save (0h03E0: '1') before turning off the power. After the power cycle, the frequency set before turning off the power is displayed.

7.5.3 Inverter Memory Control Area Parameter (Read and Write)

Comm. Address	Parameter	Scale	Unit	Changeable During Operation	Function
0h03E0	Save parameters	-	-	X	0: No, 1:Yes
0h03E1	Monitor mode	-	-	0	0: No, 1:Yes
	initialization				
0h03E2	Parameter	-	-	X	0: No, 1: All Grp, 2: Drv Grp
	initialization				3: bA Grp, 4: Ad Grp, 5: Cn Grp
					6: In Grp, 7: OU Grp, 8: CM Grp
					9: AP Grp, 12: Pr Grp, 13: M2 Grp
					Setting is prohibited during fault
					trip interruptions.
0h03E3	Display changed parameters	-	-	0	0: No, 1: Yes
0h03E4	Reserved	-	-	-	<u> -</u>
0h03E5	Delete all fault	-	-	0	0: No, 1: Yes
	history				
0h03E6	Delete user-	-	-	0	0: No, 1: Yes
	registrated codes				
0h03E7	Hide parameter	0	Hex	0	Write: 0-9999
	mode				Read: 0: Unlock, 1: Lock
0h03E8	Lock parameter	0	Hex	0	Write: 0-9999
	mode				Read: 0: Unlock, 1: Lock
0h03E9	Easy start on (easy	-	-	0	0: No, 1: Yes
	parameter setup				
	mode)				
0h03EA	Initializing power	-	-	0	0: No, 1: Yes
	consumption				
0h03EB	Initialize VFD	-	-	0	0: No, 1: Yes
	operation				
	accumulative time				
0h03EC	Initialize cooling fan	-	-	0	0: No, 1: Yes
	accumulated				
	operation time				

Note

- When setting parameters in the VFD memory control area, the values are reflected to
 the VFD operation and saved. Parameters set in other areas via communication are
 reflected to the VFD operation, but are not saved. All set values are cleared following an
 VFD power cycle and revert back to its previous values. When setting parameters via
 communication, ensure that a parameter save is completed prior to shutting the VFD
 down.
- Set parameters very carefully. After setting a parameter to 0 via communication, set it to another value. If a parameter has been set to a value other than 0 and a non-zero value

SW Series VFD 251

- is entered again, an error message is returned. The previously-set value can be identified by reading the parameter when operating the VFD via communication.
- The addresses 0h03E7 and 0h03E8 are parameters for entering the password. When the
 password is entered, the condition will change from Lock to Unlock, and vice versa.
 When the same parameter value is entered continuously, the parameter is executed just
 once. Therefore, if the same value is entered again, change it to another value first and
 then re-enter the previous value. For example, if you want to enter 244 twice, enter it in
 the following order: 244 → 0 → 244.

① Caution

It may take longer to set the parameter values in the VFD memory control area because all data is saved to the VFD. Be careful as communication may be lost during parameter setup if parameter setup is continues for an extended period of time.

8 Table of Functions

The following tables list the parameter groups and all the parameters within each group. Set the parameters according to your operating requirements. The following messages may be displayed during programming of parameters.

- · rd: Re-Do Value or selection not allocated in software.
- · OL: OverLap An input is already programmed to the same function.
- · no: Not Allowed The selection or set value is not allowed.

Parameters shaded in gray will be displayed when a related parameter has been selected. The column labeled "Property", "V/F", and "SL" shows whether the parameter can be changed while the VFD is running and which display shows the parameter:

O: Write enabled during run, X: Write Disabled during run, "-": Read only.

Property: 7-7 segment LED Display, L - LCD Keypad/Display, A - Common to LED and LCD

Additionally, columns "V/F" and "SL" relate to parameter dr.09, Control Mode settings.

V/F: Volts/Frequency Mode, SL: Sensorless Vector Mode, I: Induction Motor, P: Permanent Magnet Motor.

8.1 **Operations Group**

The Operations group is shown only on the standard (7 segment LED) display, It will not be displayed on an LCD keypad display. If the LCD keypad is connected, the corresponding functions will be found in the Drive (DRV) and Basic (BAS) groups.

Code	Comm. Address	Name	Keypad Display	Setti	ng Range	Initial Value	Property*	V/F	SL	Ref.
	0h1F00	Target frequency	0		ximum ency(Hz)	0	O/7	0	0	<u>p.79</u>
-	0h1F01	Acceleration time	ACC	0.0-6	00.0(s)	20	O/7	0	0	p.85
-	0h1F02	Deceleration time	dEC	0.0-600.0(s) 0 Keypad		30	O/7	0	0	<u>p.85</u>
				0	Keypad					
				1	Fx/Rx-1					
		Command		2	Fx/Rx-2					
-	0h1F03	source	drv	3	Int 485	0: Keypad	X/7	0	0	<u>p.79</u>
				4	Field Bus[1]	1				
				5	UserSeq Link					
				0	Keypad-1					
	0h1F04	Frequency reference	Frq	1	Keypad-2	0: Kormod 1	X/7	0	0	
1	01111104	source	riq	2	V1	0: Keypad-1	~ /	_	0	<u>p.66</u>
				4	V2	Ī				

Code	Comm. Address	Name	Keypad Display	Set	ting Range	Initial Value	Property*	V/F	SL	Ref.
				5	12					
				6	Int 485					
				8	Field Bus[1]					
				9	UserSeq Link					
				12	Pulse					
				13	V3[1]					
				15	V4[1]					
				16	14[1]					
-	0h1F05	Multi-step speed frequency 1	St1)-Maximum uency(Hz)	10	0/7	О	0	<u>p.77</u>
-	0h1F06	Multi-step speed frequency 2	St2)-Maximum uency(Hz)	20	O/7	0	0	<u>p.77</u>
-	0h1F07	Multi-step speed frequency 3	St3)-Maximum uency(Hz)	30	O/7	0	0	<u>p.77</u>
	0h1F08	Output current	CUr				-/7	0	0	p.60
-	0h1F09	Motor revolutions per minute	Rpm				-/7	0	0	-
-	0h1F0A	VFD direct current voltage	dCL	-		-	-/7	0	0	<u>p.60</u>
-	0h1F0B	VFD output voltage	vOL				-/7	0	0	<u>p.60</u>
-	0h1F0C	Out of order signal (FAULT)	nOn				-/7	О	0	<u>p.61</u>
-	0h1F0D	Select rotation direction	drC	F	Forward run	F	0/7	0	0	-
		direction		r	Reverse run					

^[1] Selection applies to option card.

8.2 **Drive group (PAR→dr, DRV)**

In the following table, data shaded in grey will be displayed when the related code has been selected.

Code	Comm. Address	Name	LCD Display	Setting R	ange	Initial value	Property*	V/F	SL	Ref.
00	-	Jump Code	Jump Code	1 ~ 99		9	O/A	0	0	<u>0.49</u>
01[1]	0h1101	Target frequency	Cmd Frequency	Start frequency	uency - Maximum (Hz)	0	O/L	0	0	p.56
02[5]	0h1102	Torque command	Cmd Torque	-180~180	[%]	0	O/A	×	0	p.166
03[1]	0h1103	Acceleration time	Acc Time	0.0-600.0	(s)	20	O/L	0	0	p.85
04[1]	0h1104	Deceleration time	Dec Time	0.0-600.0	(s)	30	O/L	0	0	p.85
				0	Keypad					
				1	Fx/Rx-1					
06[1]	0h1106	Command source	Cmd Soumo	2	Fx/Rx-2	0: Keypad	X/L	0	0	p. 79
OU[1]	0111100	Command source	Citia Source	3	Int 485	o. Reypau	W.L			0.73
				4	Field Bus[6]					
				5	UserSeqLink					
				0	Keypad-1					
				1	Keypad-2					
				2	V1					
				4	V2					
				5	12					
07[1]	0h1107	Frequency	Freq Ref Src	6	Int 485	0: Keypad-1	X/L	0	0	p.66
		reference source		8	Field Bus[6]					
				9	UserSeqLink					
				12	Pulse					
				13	V3[6]					
				15	V4[6]					
				16	1 4[6]					

Code	Comm. Address	Name	LCD Display			Initial value	Property*	V/F	SL	Ref.
				0	Keypad-1					
				1	Keypad-2					
				2	V1					
				4	V2					
8[5]	0h1108	Torque reference setting	Trq Ref Src	5	12	0: Keypad-1	X/A	×	О	<u>p.166</u>
				6	Int 485					
				8	FieldBus					
				9	UserSeqLink					
				12	Pulse					
				0	V/F					p.92
09	0h1109	Control mode	Control Mode	2	Slip Compen	0: V/F	X/A	0	0	p.136 p.147
				4	IM Sensorless					p.154
				6	PM Sensorless					
10[5]	0h110A	Torque Control	Torque	0	No	0: No	X/A	x	0	p.166
			Control	1	Yes					
11	0h110B	Jog frequency	Jog Frequency		t frequency- frequency(Hz)	10	O/A	0	О	p.126
12	0h110C	Jog run acceleration time	Jog Acc Time	0.0-600.0	(s)	20	O/A	0	0	p.126
13	0h110D	Jog run deceleration time	Jog Dec Time	0.0-600.0	(s)	30	O/A	0	o	p.126
				0	0.3 HP					
				1	0.5 HP					
				2	1.0 HP					
14	0h110E	Motor capacity	Motor Capacity	3	1.5 HP	Varies by Motor capacity	X/A	0	О	<u>p.144</u>
				4	2.0 HP					
				5	3.0 HP					
				6	4.0 HP					

Comm. Address	Name	LCD Display			I nitial value	Property*	V/F	SL	Ref.
			7	5.0 HP					
			8	5.5 HP					
			9	7.5 HP					
			10	10 HP					
			11	15 HP					
			12	20 HP					
			13	25 HP					
			14	30 HP					
			0	Manual					
0h110F	Torque boost options	Torque Boost	1	Auto1	0: Manual	X/A	0	х	<u>p.95</u>
			2	Auto2					
0h1110	Forward Torque boost	Fwd Boost	0.0-15.0(9	%)	2	X/A	0	x	p.95
0h1111	Reverse Torque boost	Rev Boost	0.0-15.0(9	%)	2	X/A	0	×	p.95
0h1112	Base frequency	Base Freq	[V/F, Slip 40.00~12	Compen] 0.00(Hz)	60	X/A	0	l/P	p.92
			30.00~18	0.00(Hz)					
0h1113	Start frequency	Start Freq	0.01-10.0	0(Hz)	0.5	X/A	0	0	<u>p.92</u>
				, ,					
0h1114	Maximum	Max Freq	40.00~12	0.00(Hz)	60	X/A	0	l/P	p.101
	trequency		[IM Senso	orless]			ľ		
	Oh110F Oh1110 Oh1111 Oh1111 Oh11113	Oh110F Torque boost options Oh1110 Poward Torque boost Oh1111 Powers Torque boost Oh1111 Reverse Torque boost Oh1112 Base frequency Oh1113 Start frequency	Oh110F Torque boost options Torque Boost Oh1110 Forward Torque boost Oh1111 Reverse Torque Rev Boost Oh1111 Base frequency Base Freq Oh1112 Base frequency Base Freq Oh1113 Start frequency Start Freq	Address Name Cool pisplay Setting it Setting	Address Same CD Display Setting Range	Address Name CD Display Setting Kange Intra Value 7 5.0 HP 8 5.5 HP 9 7.5 HP 10 10 HP 11 15 HP 12 20 HP 13 25 HP 14 30 HP 14 30 HP 15 Auto1 0: Manual 1 Auto1 0: Manual 2 Auto2 0: Manual 3 Auto2 0: Manual 4 Auto1 0: Manual 5 Auto2 0: Manual 6 Auto2 0: Manual 7 5.0 HP 10 10 HP 11 15 HP 12 20 HP 13 25 HP 14 30 HP 2 Auto2 0: Manual 2 Auto2 0: Manual 3 Auto2 0: Manual 4 Auto1 0: Manual 5 Auto2 0: Manual 6 Auto2 0: Manual 7 5.0 HP 10 10 HP 11 15 HP 12 20 HP 13 25 HP 2 Auto2 0: Manual 2 Auto2 0: Manual 3 Auto2 0: Manual 4 Auto1 0: Manual 5 Auto2 0: Manual 6 Auto2 0: Manual 7 5.0 HP 10 10 HP 11 15 HP 12 20 HP 13 25 HP 14 30 HP 2 Auto2 0: Manual 3 Auto2 0: Manual 4 Auto2 0: Manual 5 Auto2 0: Manual 6 Auto2 0: Manual 7 5.0 HP 6 Auto2 0: Manual 7 5.0 HP 8 5.5 HP 10 10 HP 11 15 HP 12 20 HP 13 25 HP 2 Auto2 0: Manual 3 Auto2 0: Manual 4 Auto2 0: Manual 5 Auto2 0: Manual 6 Auto2 0: Manual 7 Auto1 0: Manual 8 Auto2 0: Manual 9 Auto2 0: Manual 9 Auto2 0: Manual 1 Auto1 0: Manual 2 Auto2 0: Manual 3 Auto2 0: Manual 4 Auto2 0: Manual 5 Auto2 0: Manual 6 Auto2 0: Manual 7 Auto2 0: Manual 8 Auto2 0: Manual 9 Auto2 0: Manual 1 Auto1 0: Manual 1 Auto1 0: Manual 2 Auto2 0: Manual 3 Auto2 0: Manual 4 Auto2 0: Manual 5 Auto2 0: Manual 6 Auto2 0: Manual 7 Auto2 0: Manual 8 Auto2 0: Manual 9 Auto2 0: Manual 9 Auto2 0: Manual 1 Auto1 0: Manual 1 Auto2 0: Manual 1 Auto2 0: Manual 2 Auto2 0:	Address Name Cob Display Setting Kange Intra Value Property 7 5.0 HP 8 5.5 HP 10 10 HP 11 15 HP 12 20 HP 13 25 HP 14 30 HP 14 30 HP 15 Auto1 2 Auto2 0h1110 Forward Torque Boost poost poots poot poots 2 Auto2 0h1111 Reverse Torque Rev Boost poots 0h1112 Sase frequency Base Freq 0h1112 Sase frequency Base Freq 10 Manual 1 Auto1 2 Auto2 0h100 Poward Torque poots 2 Auto2 0h1111 Reverse Torque Rev Boost poots 0h15.0(%) 2 XVA 30.00-40.00(Hz) V/F, Slip Compen) 40.00-120.00(Hz) M Sensortess) 30.00-40.00(Hz) M Sensortess) 30.00-40.00(Hz) M Sensortess) 40.00-40.00(Hz) V/F, Slip Compen)	Address Name CoD Display Setting Kange Initial value Property NF-	Address Name Cob Display Setting Range Initial value Separty Vir. St.

Code	Comm. Address	Name	LCD Display	Setting	Range	Initial value	Property*	V/F	SL	Ref.
21[1]	0h1115	Select speed unit	Hz/Rpm Sel	0	Hz Display Rpm Display	0:Hz Display	O/L	0	0	p.77
22[3]	0h1116	(+)Torque gain	(+)Trq Gain	50.0 ~ 1	50.0[%]	100	O/A	х	О	p.166
23[3]	0h1117	(-)Torque gain	(-)Trq Gain	50.0 ~ 1	50.0[%]	100	O/A	×	0	p.166
24[3]	0h1118	(-)Torque gain 0	(-)Trq Gain0	50.0 ~ 1	50.0[%]	80	O/A	x	0	p.166
25[3]	0h1119	(-)Torque offset	(-)Trq Offset	0.0 ~ 10	0.0[%]	40	O/A	x	О	p.166
30		Display kW/HP	kW/HP Select	0	kW	1: HP	X/A	x	×	
50		Display Kvv/i II	KWITTIF SEIGCE	1	HP	1	~~	^	Î	
31		Pop Up Quick	Popup Q.Start	0	No	0:No	X/7	x	×	p.185
51		Start	горор сезын	1	Yes	0.140	~′	^	Î	D. 100
80[4]	0h1150	Select ranges at power input		at power of the po	Run frequency Acceleration time Deceleration time Command source Frequency reference source Multi-step speed	Orun frequency	0/7	О	0	

Code	Comm. Address	Name	LCD Display	Setting	g Range	Initial value	Property*	V/F	SL	Ref.
				12	Currently out of order					
				13	Select run direction					
				14	output current2					
				15	Motor RPM2					
				16	Inverter DC voltage2					
				17	User select signal (dr.81)					
				Monito	rs user selected code					
		Select monitor		0	Output voltage(V)					
81[4]	0h1151	code	-	1	Output electric power(kW)	0:Output voltage	0/7	0	О	-
				2	Torque(kgf · m)					
89[4]	0h03E3	Display changed		0	View All	0:View All	0/7	0	0	p.183
00[4]	ONOOLO	parameter		1	View Changed	0.41047411	O11		Ŭ	0.100
		[ESC] key		0	Move to initial position					p.51
90[4]	0h115A	functions	_	1	JOG Key	0:None	X/7	0	0	0.46
				2	Local/Remote					
				0	None					
91	0h115B	Smart copy	SmartCopy	1	SmartDownload	0:None	X/A	0	0	-
				3	SmartUpLoad					
				0	No					
				1	All Grp					
93[4]	0h115D	Parameter		2	dr Grp	0:No	X/7	0 0	0	p.180
- 0[1]		initialization		3	bA Grp				ĺ	
				4	Ad Grp					
				5	Cn Grp					

Code	Comm. Address	Name	LCD Display	Setting	g Range	Initial value	Property*	V/F	SL	Ref.
				6	In Grp					
				7	OU Grp					
				8	CM Grp					
				9	AP Grp					
				12	Pr Grp					
				13	M2 Grp					
				16	run Grp					
94[4]	0h115E	Password registration		0-9999			0/7	0	0	p.181
95[4]	0h115F	Parameter lock settings		0-9999	ı		0/7	0	0	p.182
97[4]	0h1161	Software version					-17	0	0	-
98	0h1162	Display I/O board version	IO S/W Ver				-/A	0	О	
				0	Multiple IO					
99	0h1163	Display I/O board H/W version	IO H/W Ver	1	Standard IO	Standard IO	-/A	0	0	ŀ
				2	Standard IO (M)					

- [1] Only displayed when an LCD keypad is in use.
- [2] Displayed when dr.15 is set to 0 (Manual) or 2 (Auto2)
- [3] Displayed when dr.10 is set to 1 (YES)
- [4] Will not be displayed when an LCD keypad is in use
- [5] Only displayed when dr.09 is set to IM Sensorless.
- [6] Selection applies to option card.

8.3 Basic Function group (PAR→bA, BAS)

In the following table, the data shaded in grey will be displayed when a related code has been selected.

Code	Comm. Address	Name	LCD Display	Setting	g Range	Initial Value	Property*	V/F	SL	Ref.
00	-	Jump Code	Jump Code	1 ~ 99		20	О	0	0	<u>p.49</u>
				0	Keypad					
				1	Fx/Rx-1					
01	0h1204	2nd command source	Cmd Aux (2nd) Src	2	Fx/Rx-2	1:Fx/Rx-1	X/A	0	О	p.104
				3	Int 485					
				4	FieldBus[7]					
				0	Keypad-1					
				1	Keypad-2					
				2	V1					
				4	V2					
				5	12					
02	0h1205	2nd frequency source	Freq Aux (2nd) Src	6	Int 485	0:Keypad-1	O/A	0	0	p.104
		source	(zna) Src	8	FieldBus[7]					
				9	UserSeqLink					
				12	Pulse					
				13	V3[7]					
				15	V4[7]					
					14[7]					
				0	None					
				1	V1	1				
03	0h1201	Auxiliary reference	Aux Ref Src	3	V2	0:None	X/A	0	О	p.121
		source		4	12	1				
				6	Pulse	1				
				7	V3[7]					

Code	Comm. Address	Name	LCD Display	Setting	g Range	Initial Value	Property*	V/F	SL	Ref.
				9	V4[7]					
				10	14[7]					
				0	M+(G*A)					
				1	Mx (G*A)					
				2	M/(G*A)					
04[1]	0h1202	Auxiliary command	Aux Calc	3	M+[M*(G*A)]	0: M+(GA)	X/A	0	О	p.121
77[1]	0111202	calculation type	Туре	4	M+G*2(A-50%)	_0. W1 (GA)	~~		Ĭ	0.121
				5	Mx[G*2(A-50%)					
				6	M/[G*2(A-50%)]					
				7	M+M*G*2(A-50%)					
05[1]	0h1203	Auxiliary command gain	Aux Ref Gain	-200.0	200.0(%)	100	O/A	0	0	p.121
				0	Keypad-1					
				1	Keypad-2					
				2	V1					
		2nd Torque		4	V2					
06	0h1206	command source	Trq 2nd Src	5	12	0:Keypad-1	0	х	О	-
				6	Int 485					
				8	FieldBus					
				9	UserSeqLink					
				12	Pulse					
				0	Linear					
07	0h1207	V/F pattern	V/F Pattern	1	Square	0:Linear	X/A	0	x	p.92
		options		2	User V/F					
				3	Square 2					
08	0h1208	Acc/dec standard	Ramp T Mode	0	Max Freq	0:Max Freq	X/A	0	О	p.85
		frequency		1	Delta Freq				ľ	
09	0h1209	Time scale	Time Scale	0	0.01 sec	1:0.1 sec	X/A	0	0	p.85

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
		settings		1 2	0.1 sec 1 sec					
10	0h120A	Input power frequency	60/50 Hz Src	0	60Hz 50Hz	0:60Hz	X/A	0	0	p.179
11	0h120B	Number of motor poles	Pole Number	2~48			X/A	0	0	p.136
12	0h120C	Rated slip speed	Rated Slip	0-3000	(Rpm)	Dependent on	X/A	0	0	p.136
13	0h120D	Motor rated current	Rated Curr	1.0-100	00.0(A)	motor setting	X/A	0	0	p.136
14	0h120E	Motor noload current	Noload Curr	0.0-100	00.0(A)		X/A	0	0	p.136
15	0h120F	Motor rated voltage	Rated Volt	0, 170-	480(V)	230/460	X/A	0	0	p.136
16	0h1210	Motor efficiency	Efficiency	70-100	(%)	Dependent on motor setting	X/A	0	О	p.136
17	0h1211	Load inertia rate	Inertia Rate	0-8			X/A	0	0	p.136
18	0h1212	Trim power display	Trim Power %	70-130	(%)		O/A	0	О	-
19	0h1213	Input power (source) voltage	AC Input Volt	170-48	0V	240/480V	O/A	0	0	p.179
				0	None					
				1	All (Rotation type)					
				2	All (Static type)					
20	=	Auto Tuning	Auto Tuning	3 Rs+Lsigma (Rotation type)		0:None	X/A	X	0	p.144
				6	Tr (Static type)					
				7	All (PM)					
21	_	Stator resistance	Rs	Depen	dent on motor setting	Dependent on motor setting	X/A	×	0	p.144
22	-	Leakage	Lsigma			octarig	X/A	Х	0	p.144

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property*	V/F	SL	Ref.
		inductance							
23	_	Stator inductance	Ls			X/A	×	0	p.144
24	_	Rotor time constant	Tr	25-5000(ms)		X/A	×	ı	p.144
25[2]	-	Stator inductance scale	Ls Scale	50 ~ 150[%]	100	X/A	х	i	p.144
26[2]	-	Rotor time constant scale	Tr Scale	50 ~ 150[%]	100	X/A	x	ì	p.144
28[8]	-	D-axis inductance	Ld (PM)		0	X/A	×	Р	p.154
29[8]		Q-axis inductance	Lq (PM)	Settings vary depending on the motor specifications.	0	X/A	×	Р	p.154
30[8]		Flux reference	PM Flux Ref		0.147	X/A	х	Р	p.154
31[2]		Regeneration inductance scale	Ls Regen Scale	70 ~ 100[%]	80	Χ/A	х	i	p.144
32[8]		Q-axis inductance scale	Lq(PM) Scale	50–150[%]	100	X/A	×	Р	p.154
34[8]	-	PM auto tuning level	Ld,Lq Tune Lev	20.0–50.0[%]	33.3	X/A	×	Р	p.154
35[8]	-	PM auto tuning frequency	Ld,Lq Tune Hz	80.0-150.0[%]	100	X/A	×	Р	p.154
41[3]	0h1229	User frequency1	User Freq 1	0.00-Maximum frequency(Hz)	15	X/A	0	×	p.94
42[3]	0h122A	User voltage1	User Volt 1	0-100(%)	25	X/A	0	х	p.94
43[3]	0h122B	User frequency2	User Freq 2	0.00-0.00- Maximum frequency(Hz)	30	X/A	0	x	p.94
44[3]	0h122C	User voltage2	User Volt 2	0-100(%)	50	X/A	0	х	p.94
45[3]	0h122D	User frequency3	User Freq 3	0.00-Maximum frequency(Hz)	45	X/A	0	×	p.94
46[3]	0h122E	User voltage3	User Volt 3	0-100(%)	75	X/A	0	х	p.94

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property*	V/F	SL	Ref.
47[3]	0h122F	User frequency4	User Freq 4	0.00-Maximum frequency(Hz)	Maximum Frequency	X/A	0	х	p.94
48[3]	0h1230	User voltage4	User Volt 4	0-100(%)	100	X/A	0	х	p.94
50[4]	0h1232	Multi-step speed frequency1	Step Freq-1	0.00-Maximum frequency(Hz)	10	O/L	0	0	<u>p.77</u>
51[4]	0h1233	Multi-step speed frequency2	Step Freq-2	0.00-Maximum frequency(Hz)	20	O/L	0	0	p.77
52[4]	0h1234	Multi-step speed frequency3	Step Freq-3	0.00-Maximum frequency(Hz)	30	O/L	0	0	p.77
53[5]	0h1235	Multi-step speed frequency4	Step Freq-4	0.00-Maximum frequency(Hz)	40	O/A	0	0	<u>p.77</u>
54[5]	0h1236	Multi-step speed frequency5	Step Freq-5	0.00-Maximum frequency(Hz)	50	O/A	0	0	p.77
55[5]	0h1237	Multi-step speed frequency6	Step Freq-6	0.00-Maximum frequency(Hz)	Maximum Frequency	O/A	0	0	p.77
56[5]	0h1238	Multi-step speed frequency7	Step Freq-7	0.00-Maximum frequency(Hz)	Maximum Frequency	O/A	0	0	<u>ρ.77</u>
69	0h133C	Acc/Dec time transition frequency	Xcel Change Fr	0.00-Maximum frequency(Hz)	0	X/A	0	0	p.87
70	0h1246	Multi-step acceleration time1	Acc Time-1	0.0-600.0(s)	20	O/A	0	0	p.87
71	0h1247	Multi-step deceleration time1	Dec Time-1	0.0-600.0(s)	20	O/A	0	0	p.87
72[6]	0h1248	Multi-step acceleration time2	Acc Time-2	0.0-600.0(s)	30	O/A	0	0	p.87
73[6]	0h1249	Multi-step deceleration time2	Dec Time-2	0.0-600.0(s)	30	O/A	0	0	p.87

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property*	V/F	SL	Ref.
74[6]	0h124A	Multi-step acceleration time3	Acc Time-3	0.0-600.0(s)	40	O/A	0	0	p.87
75[6]	0h124B	Multi-step deceleration time3	Dec Time-3	0.0-600.0(s)	40	O/A	О	О	p.87
76[6]	0h124C	Multi-step acceleration time4	Acc Time-4	0.0-600.0(s)	50	O/A	О	О	p.87
77[6]	0h124D	Multi-step deceleration time4	Dec Time-4	0.0-600.0(s)	50	O/A	0	0	p.87
78[6]	0h124E	Multi-step acceleration time5	Acc Time-5	0.0-600.0(s)	40	O/A	0	0	p.87
79[6]	0h124F	Multi-step deceleration time5	Dec Time-5	0.0-600.0(s)	40	O/A	О	О	p.87
80[6]	0h1250	Multi-step acceleration time6	Acc Time-6	0.0-600.0(s)	30	O/A	0	0	p.87
81[6]	0h1251	Multi-step deceleration time6	Dec Time-6	0.0-600.0(s)	30	O/A	О	О	p.87
82[6]	0h1252	Multi-step acceleration time7	Acc Time-7	0.0-600.0(s)	20	O/A	О	О	p.87
83[6]	0h1253	Multi-step deceleration time7	Dec Time-7	0.0-600.0(s)	20	O/A	0	0	p.87

- [1] Displayed if bA.03 is not set to 0 (None).
- [2] Displayed when dr.09 is set to 4(IM Sensorless)
- [3] Displayed if either bA.07 or M2.25 is set to 2 (User V/F).
- [4] Displayed when an LCD keypad is in use.
- [5] Displayed if one of In.65-69 is set to Speed-L/M/H
- [6] Displayed one of In.65-69 is set to Xcel-L/M/H.
- [7] Selection applies to option card.
- [8] Displayed when dr.09 is set to 6 (PM Sensorless)

8.4 Expanded Function group (PAR→Ad, ADV)

In the following table, the data shaded in grey will be displayed when a related code has been selected.

Code	Comm. Address	Name	LCD Display Setting Range		Initial Value	Property*	V/F	SL	Ref.	
00	-	Jump Code	Jump Code	1 ~ 99	,	24	O/A	0	0	<u>0.49</u>
01	0h1301	Acceleration pattern	Acc Pattern	0	Linear	0: Linear	X/A	0	0	p.90
				1	S-curve Linear					
02	0h1302	Deceleration pattern	Dec Pattern	1	S-curve	0: Linear	X/A	0	0	<u>p.90</u>
03[1]	0h1303	S-curve acceleration start point gradient	Acc S Start	1-100	(%)	40	X/A	О	0	<u>p.90</u>
04[1]	0h1304	S-curve acceleration end point gradient	Acc S End	1-100	(%)	40	X/A	0	0	<u>p.90</u>
05[2]	0h1305	S-curve deceleration start point gradient	Dec S Start	1-100	(%)	40	X/A	О	0	p.90
06[2]	0h1306	S-curve deceleration end point gradient	Dec S End	1-100	(%)	40	X/A	0	0	<u>p.90</u>
07	0h1307	Start Mode	Start Mode		Acc	0:Acc	X/A	0	0	p.97
				1	DC-Start					
				0	Dec					
08	0h1308	Stop Mode	Stop Mode	1	DC-Brake	0:Dec	X/A	0	0	p.98
			."	2	Free-Run					
				4	Power Braking					
		Selection of		0	None					
09	0h1309	prohibited rotation direction	Run Prevent	1	Forward Prev	0: None	X/A	0	0	p.83
				2	Reverse Prev					
10	0h130A	Starting with power		0	No	0:No	O/A	0	0	p.83
		on	Run	1	Yes					
		•	•	•	•	•		•	•	•

Code	Comm. Address	Name	LCD Display	Settin	g Range	Initial Value	Property*	V/F	SL	Ref.
12[3]	0h130C	DC braking time at startup	DC-Start Time	0.00-6	i0.00(s)	0	X/A	0	0	p.98
13[3]	0h130D	Amount of applied DC	DC Inj Level	0-200	(%)	50	X/A	0	0	p.98
14[4]	0h130E	Output blocking time before DC braking	DC-Block Time	0.00-	60.00(s)	0.1	X/A	0	0	p.99
15[4]	0h130F	DC braking time	DC-Brake Time	0.00-	60.00(s)	1	X/A	o	0	p.99
16[4]	0h1310	DC braking rate	DC-Brake Level	0-200	(%)	50	X/A	o	0	p.99
17[4]	0h1311	DC braking frequency	DC-Brake Freq	Start f	requency-60Hz	5	X/A	0	0	p.99
20	0h1314	Dwell frequency on acceleration	Acc Dwell Freq		requency-Maximum ncy(Hz)	5	X/A	О	0	<u>p.134</u>
21	0h1315	Dwell operation time on acceleration	Acc Dwell Time	0.0-60	1.0(s)	0	X/A	О	0	p.134
22	0h1316	Dwell frequency on deceleration	Dec Dwell Freq		requency-Maximum ency(Hz)	5	X/A	o	0	p.134
23	0h1317	Dwell operation time on deceleration	Dec Dwell Time	0.0-60	1.0(s)	0	X/A	o	0	p.134
24	0h1318	Frequency limit	Freq Limit	1	No Yes	0:No	X/A	o	0	p.101
25[5]	0h1319	Frequency lower limit value	Freq Limit Lo		Jpper limit ncy(Hz)	0.5	O/A	o	0	p.101
26[5]	0h131A	Frequency upper limit value	Freq Limit Hi		limit frequency- num frequency(Hz)	maximum frequency	X/A	О	0	p.101
27	0h131B	Frequency jump	Jump Freq	0	No Yes	0:No	X/A	o	0	p.102
28[6]	0h131C	Jump frequency lower limit1	Jump Lo 1		ump frequency limit1(Hz)	10	O/A	0	0	p.102

Code	Comm. Address	Name	LCD Display	Settin	g Range	Initial Value	Property*	V/F	SL	Ref.
29[6]	0h131D	Jump frequency upper limit1	Jump Hi 1	limit1-l	frequency lower Maximum ncy(Hz)	15	O/A	0	0	p.102
30[6]	0h131E	Jump frequency lower limit2	Jump Lo 2		ump frequency limit2(Hz)	20	O/A	0	0	p.102
31[6]	0h131F	Jump frequency upper limit2	Jump Hi 2	limit2-l	frequency lower Maximum ncy(Hz)	25	O/A	О	0	p.102
32[6]	0h1320	Jump frequency lower limit3	Jump Lo 3		ump frequency limit3(Hz)	30	O/A	О	0	<u>o.102</u>
33[6]	0h1321	Jump frequency upper limit3	Jump Hi 3	limit3-l	frequency lower Maximum ncy(Hz)	35	O/A	О	0	p.102
34		Pre Heat output current	Pre Heat Level	1% ~ 1	100%	30%	X/A	x	x	<u>o.117</u>
35		Pre Heat output Duty	Pre Heat Duty	1% ~ 1	100%	100%	X/A	x	х	<u>o.117</u>
41[7]	0h1329	Brake release current	BR RIs Curr	0.0-18	0.0(%)	50	O/A	0	0	p.189
42[7]	0h132A	Brake release delay time	BR RIs Diy	0.00-1	0.00(s)	1	X/A	О	0	o.189
44[7]	0h132C	Brake release Forward frequency	BR Rls Fwd Fr	ļ	laximum ncy(Hz)	1	X/A	О	0	p.189
45[7]	0h132D	Brake release Reverse frequency	BR RIs Rev Fr		laximum ncy(Hz)	1	X/A	o	0	p.189
46[7]	0h132E	Brake engage delay time	BR Eng Dly	0.00-1	0.00(s)	1	X/A	o	0	<u>o.189</u>
47[7]	0h132F	Brake engage frequency	BR Eng Fr		laximum ncy(Hz)	2	X/A	О	0	o.189
50	0h1332	Energy saving operation	E-Save Mode	0 1 2	None Manual Auto	0:None	X/A	0	×	p.169
51[8]	0h1333	Energy saving level	Energy Save	0-30(%)		0	O/A	0	х	p.169
61	0h133D	Rotation count	Load Spd	0.1~6000.0[%]		100	O/A	0	0	p.206

Code	Comm. Address	Name	LCD Display Setting Range		Initial Value	Property*	V/F	SL	Ref.	
		speed gain	Gain							
				0	x 1					
				1	x 0.1					
62	0h133E	Rotation count speed scale	Load Spd Scale	2	x 0.01	0: x 1	O/A	0	0	p.206
				3	x 0.001					
				4	x 0.0001					
63	0h133F	Rotation count	Load Spd	0	Rpm	0: rpm	O/A	0	0	p.206
0.5	UIII33F	speed unit	Unit	1	mpm	O. rpiii	OIA	0		0.200
				0	During Run					
64	0h1340	Cooling fan control	FAN Control	1	Always ON	0:During Run	O/A	0	0	p.178
				2	Temp Control					
74	0h134A	Selection of regeneration	RegenAvd	0	No	0:No	X/A	О	0	p.191
		evasion function for press	Sel	1	Yes					
75	0h134B	Voltage level of regeneration	RegenAvd	230V	: 300-400V	350	X/A	0	0	p.191
		evasion motion for press	Level	460V	: 600-800V	700				
76[10]	0h134C	Compensation frequency limit of regeneration evasion for press	CompFreq Limit	0.00-	10.00Hz	1	X/A	0	0	<u>p.191</u>
77[10]	0h134D	Regeneration evasion for press P gain	RegenAvd Pgain	0.0- 10	00.0%	50	O/A	0	0	p.191
78[10]	0h134E	Regeneration evasion for press I gain	RegenAvd Igain	20-30	000(ms)	500	O/A	О	0	p.191
79	0h134F	DB Unit turn on	DB Tum On	230V:	Min[11]~400[V]	390[V]	X/A	0	0	p.368
	0111041	voltage level	Lev	460V:	Min[11]~800[V]	780[V]		Ĩ		2.500
80	0h1350	Fire mode selection	Fire Mode	0	None	0:None	X/A	О	х	p.116

Code	Comm. Address	Name	LCD Display	Settin	g Range	Initial Value	Property*	V/F	SL	Ref.
			Sel	1	Fire Mode					
				2	Fire Mode Test					
81[12]	0h1351	Fire mode frequency	Fire Mode Freq	0.00~	60.00(Hz]	60	X/A	0	×	o .116
82[12]	0h1352	Fire mode direction	Eira Moda Dir	0	Forward	0:Forward	X/A	0	х	p.116
OZĮIZJ	0111332	i lie mode direction	I lie wode bii	1	Reverse	o.i oiwaid	NA .	Ĩ	^	0.110
83[12]		Fire Mode Count	Fire Mode Cnt	Can n	ot be modified					p.116
				0	U/D Normal					
85		Up/Down Mode Selection	U/D Mode Sel	1	U/D Step	0:U/D Normal	X/A	0	х	
				2	U/D Step+Norm					p.128
86		Up/Down Step Frequency	U/D Step Freq	0-max	imum frequency	0	X/A	0	×	
87		Overmodulation	OVM Mode	0	No	0:No	X/A	0	x	p.118
,		Mode Selection	Sel	1	Yes	010				0.710

- [1] Displayed when Ad. 01 is set to 1 (S-curve).
- [2] Displayed when Ad. 02 is set to 1 (S-curve).
- [3] Displayed when Ad. 07 is set to 1 (DC-Start).
- [4] Displayed when Ad. 08 is set to 1 (DC-Brake).
- [5] Displayed when Ad. 24 is set to 1 (Yes).
- [6] Displayed when Ad. 27 is set to 1 (Yes).
- [7] Displayed if either OU.31 or OU.33 is set to 35 (BR Control).
- [8] Displayed if Ad.50 is not set to 0 (None).
- [10] Displayed when Ad.74 is set to 1 (Yes).
- [11] DC voltage value (convert bA.19 AC Input voltage) + 20V (230V VFD) or + 40V (460V VFD)
- [12] Displayed when Ad.80 is set to 1 (Yes).

8.5 Control Function group (PAR→Cn, CON)

In the following table, the data shaded in grey will be displayed when a related code has been selected.

Code	Comm. Address	Name	LCD Display	Setting F	Range	Initial Value	Property*	V/F	SL	Ref.
00		Jump Code	Jump Code	1 ~ 99		4	O/A	0	О	p.49
04	0h1404	Carrier frequency	Carrier Freq	V/Hz:1.0- 15.0(kHz) [1] Heavy Duty SL:2.0-15.0(kHz) PM:2.0-10.0(kHz)		3	O/A	o	0	<u>p.175</u>
				Normal Duty	V/Hz:1.0-5.0(kHz) [2] SL:2.0-5.0(kHz)	2				p.175
05	0h1405	Switching mode	PWM Mode	0	Normal PWM Lowleakage PWM	0:Normal PWM	X/A	0	0	p.175
9[3]	0h1409	Initial excitation time	PreExTime	0.00-60.0	10(s)	1	X/A	x	ı	p.147
10[3]	0h140A	Initial excitation amount	Flux Force	100.0-300	0.0(%)	100	X/A	х	i	p.147
11[3]	0h140B	Continued operation duration	Hold Time	0.00-60.0	10(s)	0	X/A	x	ì	p.147
12[12]	0h140D	PM S/L speed controller proportional gain1	ASR P Gain 1	0~5000		100	X/A	×	Р	p.154
13[12]	0h140F	PM S/L speed controller integral gain1	ASR P Gain 1	0~5000		150	X/A	×	Р	p.154
15[12]	0h1410	PM S/L speed controller proportional gain2	ASR P Gain 1	0~5000		100	X/A	×	Р	p.154
16[12]	0h1410	PM S/L speed controller integral gain2	ASR P Gain 1	0~9999		150	X/A	x	Р	p.154
20[3]	0h1414	Sensorless 2 nd gain display setting	SL2 G View Sel	0 No 1 Yes		0:No	O/A	x	ı	p.147

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property*	V/F	SL	Ref.
21[3]	0h1415	Sensorless speed controller proportional gain1	ASR-SL P Gain1	0-5000(%)	Dependent on motor setting	O/A	x	į	<u>p.147</u>
22[3]	0h1416	Sensorless speed controller integral gain1	ASR-SL I Gain1	10-9999(ms)	g	O/A	×		p.147
23[3]	0h1417	Sensorless speed controller proportional gain2	ASR-SL P Gain2	1.0-1000.0(%)		O/A	x	ı	<u>p.147</u>
24[3]	0h1418	Sensorless speed controller integral gain2	ASR-SLI Gain2	1.0-1000.0(%)		O/A	х		p.147
25[3]	0h1419	Sensorless speed controller integral gain0	ASR-SL I Gain0	10~9999(ms)		O/A	×		p.147
26[3]	0h141A	Flux estimator proportional gain	Flux P Gain	10-200(%)		O/A	x		p.147
27[3]	0h141B	Flux estimator integral gain	Flux I Gain	10-200(%)	Dependent on motor setting	O/A	×	i	p.147
28[3]	0h141C	Speed estimator proportional gain	S-Est P Gain1	0-32767		O/A	×		p.147
29[3]	0h141D	Speed estimator integral gain1	S-Est I Gain1	100-1000		O/A	×	i	p.147
30[3]	0h141E	Speed estimator integral gain2	S-Est I Gain2	100-10000		O/A	x		p.147
31[3]	0h141F	Sensorless current controller proportional gain	ACR SL P Gain	10-1000		O/A	×		p.147
32[3]	0h1420	Sensorless current controller integral gain	ACR SL I Gain	10 -1000		O/A	×		p.147
33[12]	0h1421	PM D-axis back- EMF estimation gain [%]	PM EdGain Perc	0~300.0[%]	100	X/A	х	Р	<u>p.154</u>

Code	Comm. Address	Name	LCD Display	Setting	Range	Initial Value	Property*	V/F	SL	Ref.
34[12]	0h1422	PM Q-axis back- EMF estimation gain [%]	PM EqGain Perc	0~300.0	0[%]	100	X/A	×	Р	p.154
35[12]	0h1423	Initial pole position detection retry number	PD Repeat Num	0~10		2	X/A	x	Р	p.154
36[12]	0h1424	Initial pole position detection pulse interval	Pulse Interval	1~100		20	X/A	x	Р	p.154
37[12]	0h1425	Initial pole position detection current level [%]	Pulse Curr %	10~100		15	X/A	x	Р	p.154
38[12]	0h1426	Initial pole position detection voltage level [%]	Pulse Volt %	100~40	00	500	X/A	×	Р	p.154
39[12]	0h1427	PM dead time range [%]	PMdeadBand Per	50.0~10	00.0	100	X/A	x	Р	p.154
40[12]	0h1428	PM dead time voltage [%]	PMdeadVolt Per	50.0~10	00.0	100	X/A	×	Р	p.154
41[12]	0h1429	Speed estimator P gain1	PM SpdEst Kp	0~3200	0	100	X/A	x	Р	p.154
42[12]	0h142A	Speed estimator I gain1	PM SpdEst Ki	0~3200	0	10	X/A	x	Р	p.154
43[12]	0h142B	Speed estimator P gain2	PM SpdEst Kp 2	0~3200	0	300	X/A	x	Р	p.154
44[12]	0h142C	Speed estimator I gain2	PM SpdEst Ki 2	0~3200	0	30	X/A	x	Р	p.154
45[12]	0h142D	Speed estimator feed forward high speed rate [%]	PM Flux FF %	0~100[%	6]	30	X/A	×	Р	p.154
46[12]	0h142E	Initial pole position detection options	Init Angle Sel	0 None 1 Angle 2 Align		1	X/A	×	Р	<u>p.154</u>
48[3]		Current controller P gain	ACR P Gain	0-10000		1200	O/A	x	l/P	p.147

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
49[3]		Current controller I gain	ACR I Gain	0-10000		120	O/A	x	l/P	p.147
50[12]	0h1432	Voltage controller limit	V Con HR	0~100.0[%]		10	X/A	х	Р	p.154
51[12]	0h1433	Voltage controller I gain	V Con Ki	0~1000.0[%]		10	X/A	х	Р	p.154
52[3]	0h1434	Torque controller output filter	Torque Out LPF	0-2000(ms)		0	X/A	x	l/P	p.147
53[3]	0h1435	Torque limit setting options	Torque Lmt Src	0 1 2 4 5 6 8 9	Keypad-1 Keypad-2 V1 V2 I2 Int 485 FieldBus UserSeqLink Pulse	0.Keypad-1	X/A	x	x	0.147
54[4]	0h1436	Positive-direction reverse torque limit	FWD +Trq Lmt	0.0-200.0(%)		180	O/A	x	l/P	p.147 p.154
55[4]	0h1437	Positive-direction regeneration torque limit	FWD –Trq Lmt	0.0-200.0(%)		180	O/A	x	l/P	p.147 p.154
56[4]	0h1438	Negative-direction reverse torque limit	REV +Trq Lmt	0.0-200	0.0(%)	180	O/A	×	l/P	p.147 p.154
57[4]	0h1439	Negative-direction regeneration torque limit	REV -Trq Lmt	0.0-200	0.0(%)	180	O/A	х	l/P	p.147 p.154
62[4]	0h143E	Speed limit Setting	Speed Lmt Src	0 1 2	Keypad-1 Keypad-2 V1	0:Keypad-1	X/A	×	0	p.166

Code	Comm. Address	Name	LCD Display	y Setting Range Ir		Initial Value	Property*	V/F	SL	Ref.
				4	V2					
				5	12					
				6	Int 485					
				7	FieldBus					
				8	UserSeqLink					
63[4]	0h143F	Positive-direction speed limit	FWD Speed Lmt	0.00~ M	laximum frequency (Hz)	60	O/A	x	0	p.166
64[4]	0h1440	Negative-direction speed limit	REV Speed Lmt	0.00~ M	laximum frequency (Hz)	60	O/A	х	0	p.166
65[4]	0h1441	Speed limit operation gain	Speed Lmt Gain	100~50	00[%]	500	O/A	x	0	p.166
69{12}		PM speed search current	SS Pulse Curr	15		10~100	O/A	x	Р	p.154
70	0h 1446	Speed search	SS Mode	0	Flying Start-1[5]	0:Flying Start-1	X/A	0	0	p.170
		mode selection		1	Flying Start-2	,,				
				bit	0000- 1111					
				1	Selection of speed search on acceleration					
71	0h1447	Speed search operation selection	Speed Search	10	When starting on initialization after a fault	0000[6]	X/A	0	0	<u>p.170</u>
				100	When restarting after instantaneous power interruption					
				1000	When starting with power on					
72[7]	0h1448	Speed search reference current	SS Sup- Current	80-200(%)	150	O/A	0	0	p.170
						Flying Start-1				
73[8]	0h1449	Speed search	SS P-Gain	0-9999		: 100	O/A	0	0	p.170
		proportional gain				Flying Start-2				
						: 600[9]				

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property*	V/F	SL	Ref.
74[8]	0h144A	Speed search integral gain	SS I-Gain	0-9999	Flying Start-1 : 200 Flying Start-2 : 1000	O/A	0	0	p.170
75[8]	0h144B	Output blocking time before speed search	SS Block Time	0.0-60.0(s)	1	X/A	0	0	p.170
76[8]	0h144C	Speed search Estimator gain	Spd Est Gain	50-150(%)	100	O/A	0	0	p.170
77	0h144D	Energy buffering selection	KEB Select	0 No 1 KEB-1 2 KEB-2	0:No	X/A	О	О	p.163
78[10]	0h144E	Energy buffering start level	KEB Start Lev	110.0-200.0(%)	125	X/A	О	О	p.163
79[10]	0h144F	Energy buffering stop level	KEB Stop Lev	Cn78~210.0(%)	130	X/A	0	О	p.163
80[10]	0h1450	Energy buffering P gain	KEB P Gain	0-20000	1000	O/A	0	0	p.163
81[10]	0h1451	Energy buffering I gain	KEB I Gain	1~20000	500	O/A	О	О	p.163
82[10]	0h1452	Energy buffering Slip gain	KEB Slip Gain	0~2000.0%	30	O/A	О	О	p.163
83[10]	0h1453	Energy buffering acceleration time	KEB Acc Time	0.0~600.0(s)	10	O/A	О	О	p.163
85[11]	0h1455	Flux estimator proportional gain1	Flux P Gain1	100-700	370	O/A	x	0	p.147
86[11]	0h1456	Flux estimator proportional gain2	Flux P Gain2	0-100	0	O/A	х	0	p.147

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property*	V/F	SL	Ref.
87[11]		Flux estimator proportional gain3	Flux P Gain3	0-500	100	O/A	×	0	p.147
88[11]		Flux estimator integral gain1	Flux I Gain1	0-200	50	O/A	х	0	p.147
89[11]		Flux estimator integral gain2	Flux I Gain2	0-200	50	O/A	х	0	p.147
90[11]		Flux estimator integral gain3	Flux I Gain3	0-200	50	O/A	x	0	p.147
91[11]	0h145B	Sensorless voltage compensation1	SL Volt Comp1	0-60		O/A	х	0	p.147
92[11]	0h145C	Sensorless voltage compensation2	SL Volt Comp2	0-60	Dependent on motor setting	O/A	х	0	p.147
93[11]	0h145D	Sensorless voltage compensation3	SL Volt Comp3	0-60		O/A	х	0	p.147
94[11]		Sensorless field weakening start frequency	SL FW Freq	80.0-110.0(%)	100	X/A	×	0	p.147
95[11]		Sensorless gain switching frequency	SL Fc Freq	0.00-8.00(Hz)	2	X/A	×	0	p.147

- [1] In case of 0.4~4.0kW, the setting range is 2.0~15.0(kHz).
- [2] In case of 0.4~4.0kW, the setting range is 2.0~5.0(kHz).
- [3] Displayed when dr.09 is set to 4 (IM Sensorless) and Cn.20 is set to 1 (YES).
- [4] Displayed when dr.09 is set to 4 (IM Sensorless). This will change the initial value of the parameter at Ad.74 (Torque limit) to 150%.
 - [5] Will not be displayed if dr.09 is set to 4 (IM Sensorless).
- [6] The initial value 0000 will be displayed on the 7-Segment display as:
- AAAA
- [7] Displayed when any of the Cn.71 code bits are set to 1 and Cn70 is set to 0 (Flying Start-1).
- [8] Displayed when any of the Cn.71 code bits are set to 1.
- [9] The initial value is 1200 when the motor-rated capacity is less than 7.5 kW
- [10] Displayed when Cn.77 is not set to 0 (No).
- [11] Displayed when Cn.20 is set to 1 (Yes).
- [12] Displayed when dr.09 is set to 6 (PM Sensorless).

8.6 Input Terminal Block Function group (PAR→In, IN)

In the following table, the data shaded in grey will be displayed when a related code has been selected.

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property*	V/F	SL	Ref.
00	-	Jump Code	Jump Code	1~99	65	O/A	0	0	p.49
01	0h1501	Frequency for maximum analog input	Freq at 100%	Start frequency- Maximum frequency(Hz)	Maximum frequency	O/A	0	0	p.67 p.72
02[9]	0h1502	Torque at maximum analog input	Torque at100%	0.0-200.0(%)	100	O/A	х	x	p.166
05	0h1505	V1 input voltage display	V1 Monitor(V)	-12.00-12.00(V)	0.00	-/A	0	0	p.67
06	0h1506	V1 input polarity selection	V1 Polarity	0 Unipolar 1 Bipolar	0:Unipolar	X/A	0	0	<u>p.67</u>
07	0h1507	Time constant of V1 input filter	V1 Filter	0-10000(ms)	10	O/A	0	0	p.67
08	0h1508	V1 Minimum input voltage	V1 Volt x1	0.00-10.00(V)	0	O/A	0	0	p.67
09	0h1509	V1 output at Minimum voltage (%)	V1 Perc y1	0.00-100.00(%)	0	O/A	0	0	p.67
10	0h150A	V1 Maximum input voltage	V1 Volt x2	0.00-12.00(V)	10	O/A	0	0	p.67
11	0h150B	V1 output at Maximum voltage (%)	V1 Perc y2	0.00-100.00(%)	100	O/A	0	0	p.67
12[1]	0h150C	V1 Minimum input voltage	V1 –Volt x1'	-10.00- 0.00(V)	0.00	O/A	0	0	p.70
13[1]	0h150D	V1output at Minimum voltage (%)	V1 –Perc y1'	-100.00-0.00(%)	0	O/A	0	0	p.70
14[1]	0h150E	V1 Maximum input voltage	V1 –Volt x2'	-12.00- 0.00(V)	-10.00	O/A	0	0	p.70
15[1]	0h150F	V1 output at Maximum voltage	V1 –Perc y2'	-100.00-0.00(%)	-100	O/A	0	0	p.70

Code	Comm. Address	Name	LCD Display	Setting Ran	ge	Initial Value	Property*	V/F	SL	Ref.
		(%)								
16	0h1510	V1 rotation direction change	V1 Inverting	0	No Yes	0: No	O/A	0	0	p.67
17	0h1511	V1 quantization level	V1 Quantizing	0.00[2], 0.04	10.00(%)	0.04	X/A	0	0	p.67
35[3]	0h1523	V2 input voltage display	V2 Monitor(V)	0.00-12.00(\)	0	-/A	0	0	p.73
37[3]	0h1525	V2 input filter time constant	V2 Filter	0-10000(ms)		10	O/A	0	0	p.73
38[3]	0h1526	V2 Minimum input voltage	V2 Volt x1	0.00-10.00(V)	0	O/A	х	x	p.73
39[3]	0h1527	V2 output at Minimum voltage (%)	V2 Perc y1	0.00-100.00(%)	0	O/A	0	0	p.73
40[3]	0h1528	V2 Maximum input voltage	V2 Volt x2	0.00-10.00(\)	10	O/A	х	х	p.73
41[3]	0h1529	V2 output at Maximum voltage (%)	V2 Perc y2	0.00-100.00(%)	100	O/A	0	0	p.73
46[3]	0h152E	V2 rotation direction change	V2 Inverting	0	No Yes	0:No	O/A	0	0	p.73
47[3]	0h152F	V2 quantization level	V2 Quantizing	0.00[2], 0.04	10.00(%)	0.04	O/A	0	0	p.73
50[4]	0h1532	I2 input current display	12 Monitor (mA)	0-24(mA)		0	-/A	0	0	p.72
52[4]	0h1534	12 input filter time constant	12 Filter	0-10000(ms)		10	O/A	0	О	p.72
53[4]	0h1535	12 minimum input current	12 Curr x1	0.00-20.00(n	ıA)	4	O/A	0	0	p.72
54[4]	0h1536	12 output at Minimum current (%)	12 Perc y1	0.00-100.00(%)		0	O/A	0	0	p.72
55[4]	0h1537	12 maximum input current	12 Curr x2	0.00-24.00(mA)		20	O/A	0	0	p.72

Code	Comm. Address	Name	LCD Display			Initial Value	Property*	V/F	SL	Ref.	
56[4]	0h1538	I2 output at Maximum current (%)	12 Perc y2	,		100	O/A	o	0	p.72	
57[4]	0h153D	Changing rotation direction of I2	12 Inverting	0		No Yes	0:No	O/A	0	0	p.72
58[4]	0h153E	12 quantization level	12 Quantizing	0.00[2],	0.04	10.00(%)	0.04	O/A	0	0	p.72
59	0h1341	Up/down operation frequency save	U/D Save Mode	0		No	0:No	O/A	0	0	p.128
		liequelicy save		1		Yes					
60	0h1346	Safe operation	Run En Mode	0	Alwa	iys Enable	0:Always	X/A	0	0	p.133
		selection		1	DI D	ependent	Enable				
				0	Free	-Run					
61[8]	0h1347	Safe operation stop options	Run Dis Stop	1	Q-S	ор	0:Free-Run	X/A	О	О	p.133
				2	Q-S Res	op ume					
62[8]	0h1348	Safe operation deceleration time	Q-Stop Time	0.0-600	.0(s)		5	O/A	0	0	p.133
65	0h1541	P1 terminal function	P1 Define	0	Non	Э	1:Fx	X/A	0	0	p.79
		setting		1	Fx						
66	0h1542	P2 terminal function setting	P2 Define	2	Rx		2:Rx	X/A	0	0	p.79
67	0h1543	P3 terminal function setting	P3 Define	3	RST		5:BX	X/A	0	0	p.223
68	0h1544	P4 terminal function setting	P4 Define	4	Exte	mal Trip	3:RST	X/A	0	0	p.216
69	0h1545	P5 terminal function setting	P5 Define	5	вх		7:Sp-L	X/A	0	0	p.223
				6	JOG	1					p.126
				7	Spe	ed-L		X/A	0	0	p.77
				8	Spe	ed-M		NA.			p.77
				9	Spe	ed-H	1				p.77

Code Comm. Address	Name	LCD Display	Setting	Range	Initial Value	Property*	V/F	SL	Ref.
			11	XCEL-L					p.87
			12	XCEL-M					p.87
			13	RUN Enable					p.133
			14	3-Wire					p.132
			15	Aux (2nd) Source					p.104
			16	Exchange					p.177
			17	Up					
			18	Down					p.128
			19	U/D Save					D. 120
			20	U/D Clear					
			21	Analog Hold					p.76
			22	I-Term Clear					p.137
			23	PID Openloop					p.137
			24	P Gain2					p.137
			25	XCEL Stop					p.87
			26	2nd Motor					p.176
			27	Pre Heat					p.117
			34	Pre Excite					p.97
			38	Timer In					p.188
			40	dis Aux Ref					p.121
			46	FWD JOG					p.127
			47	REV JOG					p.127
			49	XCEL-H					p.87
			50	User Seq					p.109
			51	Fire Mode					p.116
			52	KEB-1 Select					p.163

Code	Comm. Address	Name	LCD Display	Setting	Range	Initial Value	Property*	V/F	SL	Ref.
				54	T1[5]					p.74
		14. W. 6		P5 ~ P1						
84	0h1554	Multi-function input terminal On filter selection	DI Delay Sel	0	Disable(Off)	1 1111[6]	O/A	0	0	p.105
		Sciection		1	Enable(On)					
85	0h1555	Multi-function input terminal On filter	DI On Delay	0-10000	D(ms)	10	O/A	0	0	p.105
86	0h1556	Multi-function input terminal Off filter	DI Off Delay	0-10000)(ms)	3	O/A	0	0	p.105
				P5-P1						
87	0h1557	Multi-function input contact selection	DI NC/NO Sel	0	A contact (NO)	0 0000[7]	X/A	0	0	p.105
				1	B contact (NC)					
89	0h1559	Multi-step command delay time	InCheck Time	1-5000(ms)	1	X/A	o	0	p.77_
				P5-P1						
90	0h155A	Multi-function input terminal status	DI Status	0	release(Off)	0 0000[7]	-/A	0	0	p.105
		icini ilai status		1	Connection (On)					
91	0h155B	Pulse input amount display	Pulse Monitor (kHz)	0.00-50	.00(kHz)	0	-/A	0	0	p.74
92	0h155C	TI input filter time constant	TI Filter	0-9999(ms)	10	O/A	0	0	p.74
93	0h155D	TI Minimum input pulse	TI Pls x1	0.00-32	.00(kHz)	0	O/A	0	0	p.74
94	0h153E	TI output at Minimum pulse (%)	TI Perc y1	0.00-10	0.00(%)	0	O/A	0	0	p.74
95	0h155F	TI Maximum input pulse	TI Pls x2	0.00-32	.00(kHz)	32	O/A	0	0	p.74
96	0h1560	TI Output at Maximum pulse (%)	TI Perc y2	0-100(%	6)	100	O/A	0	0	p.74

Code	Comm. Address	Name	LCD Display	Setting	Setting Range		Initial Value	Property*	V/F	SL	Ref.
97	0h1561	TI rotation direction	TI Inverting	0		No	0:No	O/A	0	0	p.74
J1	0111301	change	TT III WOLDING	1		Yes	0.140	OIA			0.74
98	0h1562	TI quantization level	TI Quantizing	0.00[2],	0.04	10.00(%)	0.04	O/A	О	0	p.74
		SW1(NPN/PNP)		Bit	00~	11					
		SW2(V1/V2[i2])		0	V2, I	NPN					
99	0h1563	status	IO SW State	1	V2, I	PNP	0	-/A	О	0	-
				10 I2, NPN 11 I2, PNP							
						NP					

- [1] Displayed when In.06 is set to 1 (Bipolar).
- [2] Quantizing is not used when set to 0.
- [3] Displayed when V is selected on the analog current/voltage input circuit selection switch (SW2).
- [4] Displayed when I is selected on the analog current/voltage input circuit selection switch (SW2).
- [5] Displayed when P5 is selected on Px terminal function.(Only Standard I/O)
- [6] The initial value 11111 will be displayed on the 7-Segment display as

888

[7] The initial value 0000 will be displayed on the 7-Segment display as:

144

- [8] Displayed when Ad.60 is set to 1 (DI Dependent).
- [9] Displayed when dr.10 is set to Yes.

8.7 Output Terminal Block Function group (PAR→OU, OUT)

In the following table, the data shaded in grey will be displayed when a related code has been selected.

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
00	-	Jump Code	JumpCode	1 - 99		30	O/A	0	0	p.49
				0	Frequency					
				1	Output Current					
				2	Output Voltage					
				3	DCLink Voltage					
				4	Torque					
				5	Output Power					
				6	Idse					
01	0h1601	Analog output 1 item	AO1 Mode	7	lqse	0:Frequency	O/A	0	0	p.192
				8	Target Freq					
				9	Ramp Freq					
				10	Speed Fdb					
				12	PID Ref Value					
				13	PID Fdb Value					
				14	PID Output					
				15	Constant					
02	0h1602	Analog output 1 gain	AO1 Gain	-1000.0	-1000.0(%)	100	O/A	0	0	p.192
03	0h1603	Analog output 1 bias	AO1 Bias	-100.0-1	100.0(%)	0	O/A	0	0	p.192
04	0h1604	Analog output 1 filter	AO1 Filter	0-10000)(ms)	5	O/A	0	0	p.192
05	0h1606	Analog constant output 1	AO1 Const %	0.0-100.0(%)		0	O/A	0	0	p.192
06	0h1606	Analog output	AO1 Monitor	0.0-1000.0(%)		0	-/A	О	0	p.192

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
		1 monitor								
				bit	000-111					
				1	Low voltage					
30	0h161E	Fault output item	Trip Out Mode	2	Any faults other than low voltage	010[1]	O/A	0	0	p.202
				3	Automatic restart final failure					
				0	None					
				1	FDT-1					
				2	FDT-2					
				3	FDT-3					
				4	FDT-4					
				5	Over Load					
				6	IOL					
				7	Under Load					
				9	Stall					
				10	Over Voltage					
31	0h161F	Multi-function relay 1 item	Relay 1	11	Low Voltage	29:Trip	O/A	0	0	p.198
				12	Over Heat					
				13	Lost Command					
				14	Run					
				15	Stop					
				16	Steady					
				17	Inverter Line					
				18	Comm Line					
				19	Speed Search					
				22	Ready					
				28	Timer Out					

Code	Comm. Address	Name	LCD Display	Setting	Range	Initial Value	Property*	V/F	SL	Ref.
				29	Trip					
				31	DB Wam%ED					
				34	On/Off Control					
				35	BR Control					
				36	Pre Heat					
				37	Aux 2nd Source					
				38	Fire Mode					
				39	TO[2]					
				40	KEB Operating					
				0	None					
				1	FDT-1					
				2	FDT-2					
				3	FDT-3					
				4	FDT-4					
				5	Over Load					
				6	IOL					
				7	Under Load					
33	0h1621	Multi-function	Q1 Define	8	Fan Waming	14:Run	O/A	0	0	p.198
33	OITIOZI	output1 item	Q1 Deline	9	Stall	14:XGI1				0.130
				10	Over Voltage					
				11	Low Voltage					
				12	Over Heat					
				13	Lost Command					
				14	Run	1				
				15	Stop	1				
				16	Steady	1				
				17	Inverter Line					

Code	Comm. Address	Name	LCD Display	Setting	Range	Initial Value	Property*	V/F	SL	Ref.
				18	Comm Line					
				19	Speed Search					
				22	Ready					
				28	Timer Out					
				29	Trip					
				31	DB Wam%ED					
				34	On/Off Control					
				35	BR Control					
				36	Pre Heat					
				37	Aux 2nd Source					
				38	Fire Mode					
				39	TO[2]					
				40	KEB Operating					
41	0h1629	Multi-function output monitor	DO Status	-		0	-/A	-	-	-
50	0h1632	Multi-function output On delay	DO On Delay	0.00-10	0.00(s)	0	O/A	0	0	p.203
51	0h1633	Multi-function output Off delay	DO Off Delay	0.00-10	0.00(s)	0	O/A	0	0	p.203
		Multi-function		Q1, Rel	ay1					
52	0h1634	output contact selection	DO NC/NO Sel	0	A contact (NO)	00[3]	X/A	0	0	p.203
		001004011		1	B contact (NC)					
53	0h1635	Fault output On delay	TripOut OnDly	0.00-10	0.00(s)	0	O/A	0	0	p.202
54	0h1636	Fault output Off delay	TripOut OffDly	0.00-10	0.00(s)	0	O/A	0	0	p.202
55	h1637	Timer On delay	TimerOn Delay	0.00-10	0.00(s)	0	O/A	0	0	p.188
56	0h1638	Timer Off delay	TimerOff	0.00-10	0.00(s)	0	O/A	0	0	p.188

Code	Comm. Address	Name	LCD Display	Setting	Range	Initial Value	Property*	V/F	SL	Ref.
			Delay							
57	0h1639	Detected frequency	FDT Frequency	0.00-Ma frequen	aximum cy(Hz)	30	O/A	0	0	p.198
58	0h163A	Detected frequency band	FDT Band	0.00-Ma frequen		10	O/A	0	0	p.198
				0	Frequency					
				1	Output Current					
				2	Output Voltage	1				
				3	DCLink Voltage					
				4	Torque					
				5	Output Power					
				6	ldse					
61	0h163D	Pulse output	TO Mode	7	lqse	0:Frequency	O/A	0	0	p.195
				8	Target Freq					
				9	Ramp Freq					
				10	Speed Fdb					
				12	PID Ref Value					
				13	PID Fdb Value					
				14	PID Output					
				15	Constant					
62	0h163E	Pulse output gain	TO Gain	-1000.0	-1000.0(%)	100	O/A	0	0	p.195
63	0h163F	Pulse output bias	TO Bias	-100.0-	100.0(%)	0	O/A	0	0	p.195
64	0h1640	Pulse output filter	TO Filter			5	O/A	0	0	p.195
65	0h1641	Pulse output constant output 2	TO Const %			0	O/A	0	0	p.195
66	0h1642	Pulse output	TO Monitor	0.0-100	0.0(%)	0	-/A	0	0	p.195

Code	Comm. Address	Name	LCD Display	Setting	Range	Initial Value	Property*	V/F	SL	Ref.
		monitor								
				0	None					
				1	V1					
				3	V2					
		Output contact	On/Off Ctrl	4	12	Ĺ	l			
67	0h1342	On/Off control options	Src	6	Pulse	0:None	X/A	0	0	p.190
				7	V3[4]					
				9	V4[4]					
				10	14[4]					
68	0h1343	Output contact On level	On-Ctrl Level	Output 1	contact off level- %	90	X/A	0	0	p.190
69	0h1344	Output contact Off level	Off-Ctrl Level	-100.00 level (%	output contact on	10.00	X/A	0	0	p.190

[1] The initial value 0010 will be displayed on the 7-Segment display as:

HHHH

[2] Supprted only Standard I/O

[3] The initial value 0000 will be displayed on the 7-Segment display as:

AAAA

[4] Selection applieis to option card

8.8 Communication Function group (PAR→CM, COM)

In the following table, the data shaded in grey will be displayed when a related code has been selected.

Code	Comm. Address	Name	LCD Display	Setti	ng Range	Initial Value	Property*	V/F	SL	Ref.
00	-	Jump Code	Jump Code	1 - 9	9	20	O/A	0	0	<u>p.49</u>
01	0h1701	Built-in communication VFD ID	Int485 St ID	1-25	ס	1	O/A	0	0	p.227
02[1]	0h1702	Built-in communicationprotocol	Int485 Proto		ModBus RTU	0: ModBus RTU	O/A	О	0	p.227
		communicationprotocol		2	LS Inv 485	KIO				
				0	1200 bps					
				1	2400 bps					
				2	4800 bps					
03[1]	0h1703	Built-in communication	Int485 BaudR	3	9600 bps	3:9600 bps	O/A	0	0	p.227
00[1]	0111700	speed	IN-100 Badan	4	19200 bps	0.5000 000	Oi/ C			D.E.E.
				5	38400 bps					
				6	56 Kbps					
				7	115 Kbps[2]					
				0	D8/PN/S1					
04[1]	0h1704	Built-in communication	Int485 Mode	1	D8/PN/S2	0:D8/PN/S1	O/A	0	0	p.227
O4[1]	0111704	frame setting	I I I I I I I I I I I I I I I I I I I	2	D8/PE/S1	0.5011431	O/A		Ĭ	0.221
				3	D8/PO/S1					
05[1]	0h1705	Transmission delay after reception	Resp Delay	0-10	00(ms)	5ms	O/A	0	0	p.227
06[3]	0h1706	Communication option S/W version	FBus S/W Ver	r -		0	O/A	0	0	-
07[3]	0h1707	Communication option VFD ID	FBus ID	0-256		1	O/A	0	0	_

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property*	V/F	SL	Ref.
08[3]	0h1708	FIELD BUS communication speed	FBUS BaudRate	-	12Mbps	-/A	0	0	
09[3]	0h1709	Communication option LED status	FieldBus LED	-	_	O/A	0	0	-
30	0h171E	Number of output parameters	ParaStatus Num	0-8	3	O/A	0	0	
31[4]	0h171F	Output Communication address1	Para Stauts-1	0000-FFFF Hex	000A	O/A	0	0	p.232.
32[4]	0h1720	Output Communication address2	Para Stauts-2	0000-FFFF Hex	000E	O/A	0	0	p.232
33[4]	0h1721	Output Communication address3	Para Stauts-3	0000-FFFF Hex	000F	O/A	0	0	p.232
34[4]	0h1722	Output Communication address4	Para Stauts-4	0000-FFFF Hex	0	O/A	0	0	p.232
35[4]	0h1723	Output Communication address5	Para Stauts-5	0000-FFFF Hex	0	O/A	0	О	p.232
36[4]	0h1724	Output Communication address6	Para Stauts-6	0000-FFFF Hex	0	O/A	0	О	p.232
37[4]	0h1725	Output Communication address7	Para Stauts-7	0000-FFFF Hex	0	O/A	0	0	p.232
38[4]	0h1726	Output Communication address8	Para Stauts-8	0000-FFFF Hex	0	O/A	0	0	p.232
50	0h1732	Number of input parameters	Para Ctrl Num	0-8	2	O/A	0	0	
51[5]	0h1733	Input Communication address1	Para Control-1	0000-FFFF Hex	5	X/A	0	0	p.232

Code	Comm. Address	Name	LCD Display	Setting R	ange	Initial Value	Property*	V/F	SL	Ref.
52[5]	0h1734	Input Communication address2	Para Control-2	0000-FFF	F Hex	6	X/A	0	0	p.232
53[5]	0h1735	Input Communication address3	Para Control-3	0000-FFF	F Hex	0	X/A	0	0	p.232
54[5]	0h1736	Input Communication address4	Para Control-4	0000-FFF	F Hex	0	X/A	0	0	p.232
55[5]	0h1737	Input Communication address5	Para Control-5	0000-FFF	F Hex	0	X/A	0	0	p.232
56[5]	0h1738	Input Communication address6	Para Control-6	0000-FFF	F Hex	0	X/A	0	0	p.232
57[5]	0h1739	Input Communication address7	Para Control-7	0000-FFF	F Hex	0	X/A	0	0	p.232
58[5]	0h173A	Input Communication address8	Para Control-8	0000-FFF	F Hex	0	X/A	0	0	p.232
68	0h1744	Field bus data swap	FBus Swap Sel	0	No Yes	0:No	X/A	0	0	p.232
				1	Yes					
70	0h1746	Communication multi- function input 1	Virtual DI 1	0	None	0:None	O/A	0	О	p.231
71	0h1747	Communication multi- function input 2	Virtual DI 2	1	Fx	0:None	O/A	0	0	p.231
72	0h1748	Communication multi- function input 3	Virtual DI 3	2	Rx	0:None	O/A	0	0	p.231
73	0h1749	Communication multi- function input 4	Virtual DI 4	3	RST	0:None	O/A	0	0	p.231
74	0h174A	Communication multi- function input 5	Virtual DI 5	4	External Trip	0:None	O/A	0	0	p.231

Code	Comm. Address	Name	LCD Display	Setting R	lange	Initial Value	Property*	V/F	SL	Ref.
75	0h174B	Communication multi- function input 6	Virtual DI 6	5	вх	0:None	O/A	0	0	p.231
76	0h174C	Communication multi- function input 7	Virtual DI 7	6	JOG	0:None	O/A	o	0	p.231
				7	Speed-L					
				8	Speed-M					
				9	Speed-H					
				11	XCEL-L					
				12	XCEL-M					
				13	RUN Enable					
				14	3-Wire					
				15	2nd Source					
				16	Exchange					
				17	Up					
				18	Down	1				
77	0h174D	Communication multi- function input 8	Virtual DI 8	20	U/D Clear	0:None	O/A	О	О	p.231
		, i		21	Analog Hold					
				22	l-Term Clear	1				
				23	PID Openloop	1				
				24	P Gain2	1				
				25	XCEL Stop	1				
				26	2nd Motor	1				
				34	Pre Excite	1				
				38	Timer In	1				
				40	dis Aux Ref	1				
				46	FWD JOG	1				
l				47	REV JOG	1				

Code	Comm. Address	Name	LCD Display	Setting R	Range		Initial Value	Property*	V/F	SL	Ref.
				49	XCE	L-H					
				50	Use	r Seq					
				51	Fire	Mode					
				52	KEB	I-1 Select					
				54	TI[6]					
86	0h1756	Communication multi- function input monitoring	Virt DI Status	-			0	X/A	0	0	p.231
90	0h175A	Selection of data frame communication	Comm Mon Sel	0	Int48	35	0	O/A	0	0	
		monitor		1	Keyl	Pad					
91	0h175B	Data frame Rev count	Rcv Frame Num	0~65535			0	O/A	0	0	-
92	0h175C	Data frame Err count	Err Frame Num	0~65535			0	O/A	0	0	-
93	0h175D	NAK frame count	NAK Frame Num	0~65535			0	O/A	0	0	-
94[7]		Communication data	Comm Update	0		No	0:No	-/A	0	0	
0 1[1]		upload	COMMIT OPERATE	1		Yes	0.110	,,			
				0	ı	Disable All					
		P2P communication		1		P2P Master					
95	0h1760	selection	Int 485 Func	2		P2P Slave	0:Disable All	X/A	0	0	p.106
				3		M-KPD Ready					
				Bit	•	000~111					
96[8]	-	DO setting selection	P2P OUT Sel	1		Analog output	0:No	O/A	0	0	p.106
				10	1	Multi- function relay					

Code	Comm. Address	Name	LCD Display	Setting Rang	Setting Range I		Property*	V/F	SL	Ref.
				100	Multi- function output					

- [1] Will not be displayed when P2P and MultiKPD is set.
- [2] 115,200bps
- [3] Displayed only when a communication option card is installed.
- [4] Only the range of addresses set at COM-30 is displayed.
- [5] Only the range of addresses set at COM-50 is displayed.
- [6] Displayed when P5 is selected on Px terminal function
- [7] Displayed only when a communication option card is installed.
- [8] Displayed when AP.01 is set to 2 (Proc PID).

8.9 Application Function group (PAR→AP, APP)

In the following table, the data shaded in grey will be displayed when a related code has been selected.

Code	Comm. Address	Name	LCD Display	Setting	g Rar	ige	Initial Value	Property*	V/F	SL	Ref.
00	-	Jump Code	Jump Code	1 - 99			20	O/A	0	0	p.49
		Application		0		None					
01	0h1801	function selection	App Mode	1		-	0:None	X/A	О	0	p.137
		selection		2		Proc PID					
02		Enable user	User Seg En	0		No	0:No	X/A	0	0	p.109
-		sequence		1		Yes		[
16[1]	0h1810	PID output monitor	PID Output	(%)			0	-/A	0	0	p.137
17[1]	0h1811	PID reference monitor	PID Ref Value	(%)			50	-/A	0	0	p.137
18[1]	0h1812	PID feedback monitor	PID Fdb Value	(%)			0	-/A	О	0	p.137
19[1]	0h1813	PID reference setting	PID Ref Set	-100.00	-100	.00(%)	50	O/A	0	0	p.137
				0	Key	/pad					
				1	V1						
				3	V2						
20[1]	0h1814	PID reference	PID Ref Source	4	12		0:Keypad	X/A	0	0	p.137
20[1]	0111014	source	FID Rei Soulce	5	Int 4	185	o.reypau	WA.	ľ		<u>0.131</u>
				7	Fiel	dBus					
				8	Use	erSeqLink					
				11	Pul	se					
				0	V1		Ì				
21[1]	0h1815	PID feedback	PID F/B Source	2	V2		0:V1	X/A	0	0	p.137
,		source		3	12						
				4	Int 4	185					

Code	Comm. Address	Name	LCD Display	Setting	Rar	ige	Initial Value	Property*	V/F	SL	Ref.
				6	Fiel	dBus					
				7	Use	erSeqLink					
				10	Pul	se					
22[1]	0h1816	PID controller proportional gain	PID P-Gain	0.0-100	0.0(9	%)	50	O/A	О	О	p.137
23[1]	0h1817	PID controller integral time	PID I-Time	0.0-200	.0(s)		10	O/A	0	0	p.137
24[1]	0h1818	PID controller differentiation time	PID D-Time	0-1000(ms)		0	O/A	0	0	p.137
25[1]	0h1819	PID controller feed-forward compensation gain	PID F-Gain	0.0-100	0.0(9	%)	0	O/A	0	О	p.137
26[1]	0h181A	Proportional gain scale	P Gain Scale	0.0-100	.0(%)	100	X/A	0	0	p.137
27[1]	0h181B	PID output filter	PID Out LPF	0-10000)(ms)	0	O/A	0	0	p.137
28[1]	0h181C	PID Mode	PID Mode	0		Process PID Normal PID	0	X/A	0	0	p.137
29[1]	0h181D	PID upper limit frequency	PID Limit Hi	PID low 300.00(nit frequency-	60	O/A	О	0	p.137
30[1]	0h181E	PID lower limit frequency	PID Limit Lo	-300.00 frequen) upper limit z)	-60.00	O/A	О	0	p.137
31[1]	0h181F	PID output inverse	PID Out Inv	0	No Yes		0:No	X/A	0	0	p.137
32[1]	0h1820	PID output scale	PID Out Scale	0.1-100	0.0(9	%)	100	X/A	0	0	p.137
34[1]	0h1822	PID controller motion frequency	Pre-PID Freq	0.00-Ma frequen			0	X/A	o	О	p.137

Code	Comm. Address	Name	LCD Display	Setting	Range	Initial Value	Property*	V/F	SL	Ref.
35[1]	0h1823	PID controller motion level	Pre-PID Exit	0.0-100	.0(%)	0	X/A	0	0	p.137
36[1]	0h1824	PID controller motion delay time	Pre-PID Delay	0-9999(s)	600	O/A	0	0	p.137
37[1]	0h1825	PID sleep mode delay time	PID Sleep DT	0.0-999	.9(s)	60	O/A	0	О	p.137
38[1]	0h1826	PID sleep mode frequency	PID Sleep Freq	0.00-Ma frequen		0	O/A	0	О	p.137
39[1]	0h1827	PID wake-up level	PIDWakeUp Lev	0-100(%	6)	35	O/A	0	0	p.137
				0	Below Level					
40[1]	0h1828	PID wake-up mode setting	PID WakeUp Mod	1	Above Level	0:Below Level	O/A	0	0	p.137
				2	Beyond Level					
				0	%					
				1	Bar					
				2	mBar					
				3	Pa					
				4	kPa					
				5	Hz					
42[1]	0h182A	PID controller unit selection	PID Unit Sel	6	rpm	0:%	O/A	О	0	p.137
				7	v					
				8	ı					
				9	kW					
				10	HP					
				11	°C					
				12	°F					

Code	Comm. Address	Name	LCD Display	Setting Rar	ige	Initial Value	Property*	V/F	SL	Ref.
43[1]	0h182B	PID unit gain	PID Unit Gain	0.00-300.00	(%)	100	O/A	0	0	p.137
				0	x100					
				1	x10					
44[1]	0h182C	PID unit scale	PID Unit Scale	2	x 1	2:x 1	O/A	0	0	p.137
				3	x 0.1					
				4	x 0.01					
45[1]	0h182D	PID 2nd proportional gain	PID P2-Gain	0.0-1000.0(9	%)	100	X/A	0	0	p.137

^[1] Displayed when AP.01 is set to 2 (Proc PID).

8.10 **Protection Function group (PAR→Pr, PRT)**

In the following table, the data shaded in grey will be displayed when a related code has been selected.

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
00	-	Jump Code	Jump Code	1 - 99		40	O/A	0	0	p.49
04	0h1B04	Load level setting	Load Duty	0	Normal Duty	1:Heavy Duty	X/A	0	0	p.185
	0111501	Esca is to i souring	Load Daty	1	Heavy Duty	in loary buty	, , , ,			0.100
				bit 00-11						
05	0h1B05	Input/output open- phase protection	Phase Loss Chk	01	Output open phase	00[1]	X/A	0	0	p.215
				10	Input open phase	1				
06	0h1B06	Input voltage range during open-phase	IPO V Band	1-100(V)	15	X/A	0	0	p.215
07	0h1B07	Deceleration time at fault trip	Trip Dec Time	0.0-600.	0(s)	3	O/A	0	О	p.217 p.223
08	0h1B08	Selection of startup on trip reset	RST Restart	0	No Yes	0:No	O/A	0	О	p.173
09	0h1B09	Number of automatic restarts	Retry Number	0-10	l .	0	O/A	0	О	p.173_
10[2]	0h1B0A	Automatic restart delay time	Retry Delay	0.0-60.0	(s)	1	O/A	0	О	p.173
				0	None					
				1	Free-Run					
12	0h1B0C	Motion at speed	Lost Cmd Mode	2	Dec	0:None	O/A	0	0	p.217
12	UITIBUC	command loss	Lost Citia Mode	3 Hold Input		0.None	CIA	0	0	<u>0.211</u>
				4 Hold Output		1				
				5	Lost Preset	1				
13[3]	0h1B0D	Time to decide speed command loss	Lost Cmd Time	0.1-120(s)		1	O/A	0	О	p.217

Code	Comm. Address	Name	LCD Display	, ,		Initial Value	Property*	V/F	SL	Ref.
14[3]	0h1B0E	Operation frequency at speed command loss	Lost Preset F	Start frequency- Maximum frequency(Hz)		0	O/A	0	0	p.217
15[3]	0h1B0F	Analog input loss decision level	Al Lost Level	0	Half x1 Below x1	0:Half of x1	O/A	0	0	p.217
17	0h1B11	Overload warning selection	OL Warn Select	0	No Yes	.0:No	O/A	0	О	p.209
18	0h1B12	Overload alarm level	OL Warn Level	30-180(%)	150	O/A	0	0	p.209
19	0h1B13	Overload warning time	OL Warn Time	0.0-30.0	(s)	10	O/A	0	0	p.209
20	0h1B14	Motion at overload fault	OL Trip Select	1 2	None Free-Run Dec	1:Free-Run	O/A	О	0	p.209
21	0h1B15	Overload fault level	OL Trip Level	30-200(%)	180	O/A	0	0	p.209
22	0h1B16	Overload fault time	OL Trip Time	0.0-60.0	(s)	60	O/A	0	0	p.209
25	0h1B19	Underload warning selection	UL Warn Sel	0	No Yes	0:No	O/A	О	О	p.221
26	0h1B1A	Underload warning time	UL Wam Time	0.0-600.	0(s)	10	O/A	0	0	p.221
27	0h1B1B	Underload fault selection	UL Trip Sel	1 2	None Free-Run Dec	0:None	O/A	0	О	<u>p.221</u>
28	0h1B1C	Underload fault time	UL Trip Time	0.0-600.	0(s)	30	O/A	0	0	p.221
29	0h1B1D	Underload lower limit level	UL LF Level	10-30(%	b)	30	O/A	0	0	p.221
30	0h1B1E	Underload upper limit level	UL BF Level	30-100(%)	30	O/A	0	О	p.221
31	0h1B1F	No motor motion at detection	No Motor Trip	0	None Free-Run	0:None	O/A	0	О	p.224

Code	Comm. Address	Name	LCD Display	· · · · · · · · · · · · · · · · · · ·		Initial Value	Property*	V/F	SL	Ref.
32	0h1B20	No motor detection current level	No Motor Level	1-100(%)		5	O/A	0	0	p.224
33	0h1B21	No motor detection delay	No Motor Time	0.1-10.0(s)		3	O/A	0	0	p.224
40	0h1B28	Electronic thermal fault selection	ETH Trip Sel	1 2	None Free-Run Dec	0:None	O/A	0	0	p.208
41	0h1B29	Motor cooling fan type	Motor Cooling	1	Self-cool Forced-cool	0:Self-cool	O/A	0	0	p.208
42	0h1B2A	Electronic thermal 1 minute rating	ETH 1min	120-200	1(%)	150	O/A	0	0	p.208
43	0h1B2B	Electronic thermal continuous rating	ETH Cont	50-150(%)	120	O/A	0	0	p.208
45	0h1B2D	BX trip mode	BX Mode	0	Free-Run Dec	0	X/A	0	0	p.223
50	0h1B32	Stall prevention motion and flux braking	Stall Prevent	bit 0 0001 1 0001 0 1000 # 0100 # 1100 # 1100	0000-1111 Accelerating Mode 1 Accelerating Mode 2 Constant Speed Mode 1 Constant Speed Mode 2 Decelerating Flux Braking Stall and Flux Braking	0	X/A	О	o	<u>p.211</u>
			Th	he "#" mark includes both 0 and		1 selections.				
51	0h1B33	Stall frequency1	Stall Freq 1	Start frequency-Stall frequency2(Hz)		60	O/A	0	0	p.211
52	0h1B34	Stall level1	Stall Level 1	30-250(%)	180	X/A	0	0	p.211

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property*	V/F	SL	Ref.
53	0h1B35	Stall frequency2	Stall Freq 2	Stall frequency1-Stall frequency3(Hz)	60	O/A	0	0	p.211
54	0h1B36	Stall level2	Stall Level 2	30-250(%)	180	X/A	0	0	p.211
55	0h1B37	Stall frequency3	Stall Freq 3	Stall frequency2-Stall frequency4(Hz)	60	O/A	0	0	p.211
56	0h1B38	Stall level3	Stall Level 3	30-250(%)	180	X/A	0	0	p.211
57	0h1B39	Stall frequency4	Stall Freq 4	Stall frequency3-Maximum frequency(Hz)	60	O/A	0	0	p.211
58	0h1B3A	Stall level4	Stall Level 4	30-250(%)	180	X/A	0	0	p.211
59	0h1B3B	Flux braking gain	Flux Brake Kp	0 ~ 150[%]	0	O/A	0	0	-
66	0h1B42	DB resistor warning level	DB Warn %ED	0-30(%)	o	O/A	0	О	p.219
73	0h1B22	Speed deviation trip	Speed Dev Trip	0 No 1 Yes	0:No	O/A	0	0	
74[5]	0h1B23	Speed deviation band	Speed Dev Band	1~20	5	O/A	0	0	
75[5]	0h1B24	Speed deviation time	Speed Dev Time	0 ~ 120	60	O/A	0	0	
79	0h1B4F	Cooling fan fault selection	FAN Trip Mode	0 Trip 1 Warning	1:Warning	O/A	0	0	p.222
80	0h1B50	Motion selection at option trip	Opt Trip Mode	0 None 1 Free-Run 2 Dec	1:Free-Run	O/A	О	О	p.223
81	0h1B51	Low voltage fault decision delay time	LVT Delay	0.0-60.0(s)	0	X/A	0	0	p.222
82	0h1B52	LV2 Selection	LV2 Enable	bit setting 00 ~ 11 00 LV2 not enabled LV2 enabled 1 Fault history not saved	00	X/A	0	0	p.225

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
				10	LV2 not enabled					
				11	LV2 enabled and Fault history saved					
90[6]	0h1B5A	Warning information			•	-	-/7	0	0	-
91[6]	0h1B5B	Fault history 1		-		-	-/7	0	0	p.329
92[6]	0h1B5C	Fault history 2		-		-	-/7	0	0	p.329
93[6]	0h1B5D	Fault history 3				-	-/7	0	0	p.329
94[6]	0h1B5E	Fault history 4		-		-	-/7	0	0	p.329
95[6]	0h1B5F	Fault history 5		-		-	-/7	0	0	p.329
96[6]	0h1B60	Fault history		0 No		0:No	-/7	0	c	p.329
oolol	0111200	deletion		1 Yes		0.110				0.020

[1] The initial value 0000 will be displayed on the 7-Segment display as:

HHHH

[2] Displayed when Pr.09 is set higher than 0.

[3] Displayed when Pr.12 is not set to 0 (NONE).

[4] The Pr.61-63 codes are displayed when the Pr.60(CAP.DiagPrec) is set to more than 0.

[5] Displayed when Pr.73 is set to 1(YES)

[6] Will not be displayed when an LCD keypad is in use.

8.11 2nd Motor Function group (PAR→M2, M2)

The 2nd Motor function group will be displayed if any of In.65-69 are set to 26 (2nd MOTOR). In the following table, the data shaded in grey will be displayed when a related code has been selected.

Code	Comm. Address	Name	LCD Display	Setti	Setting Range		Initial Value	Property*	V/F	SL	Ref.
00	-	Jump Code	Jump Code	1 - 99	1 - 99		14	O/A	0	0	p.49
04	0h1C04	Acceleration time	M2-Acc Time	0.0-6	0.0-600.0(s)		20	O/A	0	0	<u>p.176</u>
05	0h1C05	Deceleration time	M2-Dec Time	0.0-6	00.0)(s)	30	O/A	0	0	<u>p.176</u>
				0		0.3 HP					
				1		0.5 HP					
				2		1.0 HP					
				3		1.5 HP					
				4		2.0 HP					
				5 3.0 HP							
				6							
06	0h1C06	Motor capacity	M2- Capacity	7		5.0 HP] -	X/A	0	0	p.176
				8		5.5 HP					
				9		7.5 HP					
				10)	10 HP					
				11		15 HP					
				12	:	20 HP]				
				13		25 HP					
				14		30 HP					
07	0h1C07	Base frequency	M2-Base Freq	30.00)-40	0.00(Hz)	60	X/A	0	0	<u>p.176</u>
				0	V/	F					
		Control	M2-Ctrl	2	Sli	p Compen					
80	0h1C08	mode	Mode Mode	4		ensorless	0:V/F	X/A	0	0	p.176
				6	PN	/I ensorless					
10	0h1C0A	Number of motor poles	M2-Pole Num	2 - 48		maoneaa		X/A	0	0	p.176
11	0h1C0B	Rated slip speed	M2-Rated Slip	0-300	00(η	om)		X/A	0	О	<u>p.176</u>
12	0h1C0C	Motor rated current	M2-Rated Curr	1.0-1	1.0-1000.0(A)		Dependent	X/A	0	0	<u>p.176</u>
13	0h1C0D	Motor no- load current	M2-Noload Curr	0.5-1000.0(A)		on motor settings	X/A	0	0	<u>p.176</u>	
14	0h1C0E	Motor rated voltage	M2-Rated Volt	170-480(V)			X/A	0	0	<u>p.176</u>	
15	0h1C0F	Motor efficiency	M2- Efficiency	64-10	64-100(%)			X/A	0	0	<u>p.176</u>

Code	Comm.	Name	LCD	Settir	ng F	Range	Initial Value	Property*	V/F	SL	Ref.
	Address		Display		Ĭ		Value				
16	0h1C10	Load inertia rate	M2-Inertia Rt	0-8				X/A	0	0	<u>p.176</u>
17	-	Stator resistance	M2-Rs					X/A	0	0	p.176
18	-	Leakage inductance	M2-Lsigma	Deper	nde set	nt on ttings		X/A	0	0	<u>p.176</u>
19	-	Stator inductance	M2-Ls					X/A	0	0	<u>p.176</u>
20[1]	-	Rotor time constant	M2-Tr	25-50	00(ms)		X/A	0	0	p.176
				0	Lir	near					
25	0h1C19	V/F pattern	M2-V/F Patt	1	Sq	uare	0: Linear	X/A	0	0	p.176
				2	Us	er V/F					
26	0h1C1A	Forward Torque boost	M2-Fwd Boost	0.0-1	5.0(%)	_	X/A	0	0	<u>p.176</u>
27	0h1C1B	Reverse Torque boost	M2-Rev Boost	0.0-1	5.0(%)	2	X/A	0	0	p.176
28	0h1C1C	Stall prevention level	M2-Stall Lev	30-15	0(%	6)	150	X/A	0	0	<u>p.176</u>
29	0h1C1D	Electronic thermal 1 minute rating	M2-ETH 1min	100-2	:00(%)	150	X/A	0	0	<u>p.176</u>
30	0h1C1E	Electronic thermal continuous rating	M2-ETH Cont	50-15	0(%	ó)	100	X/A	0	0	p.176
40	0h1C28	Rotation count speed gain	Load Spd Gain	0~600	0.00	0[%]	100	O/A	0	0	p.206
				0		x 1					
		Rotation	l <u>.</u> .	1 × 0.1							
41	0h1C29	count speed	Load Spd Scale	2 x 0.01		0: x 1	O/A	0	0	p.206	
		scale		3		x 0.001					
		L		4 x 0.0001							
42	0h1C2A	Rotation count speed	Load Spd Unit	0		Rpm	0: rpm	O/A	0	0	p.206
		unit	Offic	1 mpm			l				

^[1] Displayed when M2.08 is set to 4 (IM Sensorless).

8.12 User Sequence group (US, USS)

This group appears when AP.02 is set to 1 (Yes) or CM.95 is set to 2 (P2P Master). The parameter cannot be changed while the user sequence is running.

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property *	V/F	SL	Ref.
00		Jump code	Jump Code	1 - 99	31	O/A	0	0	p.49
01	0h1D01	User sequence operation command	User Seq Con	0 Stop 1 Run 2 Digital In Run	0:Sto p	X/A	0	0	p.109
02	0h1D02	User sequence operation loop time	US Loop Time	0 0.01s 1 0.02s 2 0.05s 3 0.1s 4 0.5s 5 1s	1:0.02 s	X/A	0	0	p.109
11	0h1D0B	Output address link1	Link UserOut1	0-0xFFFF	0	X/A	0	0	p.109
12	0h1D0C	Output address link2	Link UserOut2	0-0xFFFF	0	X/A	0	0	<u>p.109</u>
13	0h1D0D	Output address link3	Link UserOut3	0-0xFFFF	0	X/A	0	0	p.109
14	0h1D0E	Output address link4	Link UserOut4	0-0xFFFF	0	X/A	0	0	p.109
15	0h1D0F	Output address link5	Link UserOut5	0-0xFFFF	0	X/A	0	0	p.109
16	0h1D10	Output address link6	Link UserOut6	0-0xFFFF	0	X/A	0	0	p.109
17	0h1D11	Output address link7	Link UserOut7	0-0xFFFF	0	X/A	0	0	p.109
18	0h1D12	Output address link8	Link UserOut8	0-0xFFFF	0	X/A	0	0	p.109
19	0h1D13	Output address link9	Link UserOut9	0-0xFFFF	0	X/A	0	0	p.109
20	0h1D14	Output address link10	Link UserOut10	0-0xFFFF	0	X/A	0	0	p.109
21	0h1D15	Output address link11	Link UserOut11	0-0xFFFF	0	X/A	0	0	<u>p.109</u>
22	0h1D16	Output address link12	Link UserOut12	0-0xFFFF	0	X/A	0	0	<u>p.109</u>
23	0h1D17	Output address link13	Link UserOut13	0-0xFFFF	0	X/A	0	0	p.109
24	0h1D18	Output address link14	Link UserOut14	0-0xFFFF	0	X/A	0	0	<u>p.109</u>

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property *	V/F	SL	Ref.
25	0h1D19	Output address link15	Link UserOut15	0-0xFFFF	0	X/A	0	0	p.109
26	0h1D1A	Output address link16	Link UserOut16	0-0xFFFF	0	X/A	0	0	p.109
27	0h1D1B	Output address link17	Link UserOut17	0-0xFFFF	0	X/A	0	0	p.109
28	0h1D1C	Output address link18	Link UserOut18	0-0xFFFF	0	X/A	0	0	p.109
31	0h1D1F	Input constant setting1	Void Para1	-9999-9999	0	X/A	0	0	p.109
32	0h1D20	Input constant setting2	Void Para2	-9999-9999	0	X/A	0	0	p.109
33	0h1D21	Input constant setting3	Void Para3	-9999-9999	0	X/A	0	0	p.109
34	0h1D22	Input constant setting4	Void Para4	-9999-9999	0	X/A	0	0	p.109
35	0h1D23	Input constant setting5	Void Para5	-9999-9999	0	X/A	0	0	p.109
36	0h1D24	Input constant setting6	Void Para6	-9999-9999	0	X/A	0	0	p.109
37	0h1D25	Input constant setting7	Void Para7	-9999-9999	0	X/A	0	0	p.109
38	0h1D26	Input constant setting8	Void Para8	-9999-9999	0	X/A	0	0	p.109
39	0h1D27	Input constant setting9	Void Para9	-9999-9999	0	X/A	0	0	p.109
40	0h1D28	Input constant setting10	Void Para10	-9999-9999	0	X/A	0	0	p.109
41	0h1D29	Input constant setting11	Void Para11	-9999-9999	0	X/A	0	0	p.109
42	0h1D2A	Input constant setting12	Void Para12	-9999-9999	0	X/A	0	0	p.109
43	0h1D2B	Input constant setting13	Void Para13	-9999-9999	0	X/A	0	0	p.109
44	0h1D2C	Input constant setting14	Void Para14	-9999-9999	0	X/A	0	0	p.109

Code	Comm. Address	Name	LCD Display	Setting Range	Initial Value	Property *	V/F	SL	Ref.
45	0h1D2D	Input constant setting15	Void Para15	-9999-9999	0	X/A	0	0	p.109
46	0h1D2E	Input constant setting16	Void Para16	-9999-9999	0	X/A	0	0	p.109
47	0h1D2F	Input constant setting17	Void Para17	-9999-9999	0	X/A	0	0	p.109
48	0h1D30	Input constant setting18	Void Para18	-9999-9999	0	X/A	0	0	p.109
49	0h1D31	Input constant setting19	Void Para19	-9999-9999	0	X/A	0	0	p.109
50	0h1D32	Input constant setting20	Void Para20	-9999-9999	0	X/A	0	0	p.109
51	0h1D33	Input constant setting21	Void Para21	-9999-9999	0	X/A	0	0	p.109
52	0h1D34	Input constant setting22	Void Para22	-9999-9999	0	X/A	0	0	p.109
53	0h1D35	Input constant setting23	Void Para23	-9999-9999	0	X/A	0	0	p.109
54	0h1D36	Input constant setting24	Void Para24	-9999-9999	0	X/A	0	o	p.109
55	0h1D37	Input constant setting25	Void Para25	-9999-9999	0	X/A	0	0	p.109
56	0h1D38	Input constant setting26	Void Para26	-9999-9999	0	X/A	0	0	p.109
57	0h1D39	Input constant setting27	Void Para27	-9999-9999	0	X/A	0	0	p.109
58	0h1D3A	Input constant setting28	Void Para28	-9999-9999	0	X/A	0	0	p.109
59	0h1D3B	Input constant setting29	Void Para29	-9999-9999	0	X/A	О	0	p.109
60	0h1D3C	Input constant setting30	Void Para30	-9999-9999	0	X/A	0	0	p.109
80	0h1D50 S	Analog input 1	P2P In V1	0-12,000		-/A	0	0	p.109
81	0h1D51	Analog input2	P2P In I2	-12,000-12,000		-/A	0	0	p.109
82	0h1D52	Digital input	P2P In DI	0-0x7F		-/A	0	0	p.109
85	0h1D55	Analog output	P2P OutAO1	0-10,000	0	X/A	0	0	p.109
88	0h1D58	Digital output	P2P OutDO	0-0x03	0	X/A	0	0	p.109

8.13 User Sequence Function group(UF)

This group appears when AP.02 is set to 1 (Yes) or CM.95 is set to 2 (P2P Master). The parameter cannot be changed while the user sequence is running.

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
00	-	Jump code	Jump Code	1 - 99		41	O/A	0	0	<u>p.49</u>
				0	NOP					
				1	ADD					
				2	SUB					
				3	ADDSUB					
				4	MIN					
				5	MAX					
				6	ABS					
				7	NEGATE					
				8	MPYDIV					
				9	REMAINDER					
				10	COMPARE-GT					
				11	COMPARE-GEQ					
				12	COMPARE-EQUAL					
		User		13	COMPARE- NEQUAL					
01	0h1E01	function1	User Func1	14	TIMER	0:NOP	X/A	0	0	p.109
				15	LIMIT					
				16	AND					
				17	OR					
				18	XOR					
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
02	0h1E02	User function input1-A	User Input1-A	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
03	0h1E03	User function input1-B	User Input1-B	0-0×	FFFF	0	X/A	0	0	p.109

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
04	0h1E04	User function input1-C	User Input1-C	0-0×	FFFF	0	X/A	0	0	p.109
05	0h1E05	User function output1	User Output1	-32767-32767		0	-/A	О	0	p.109
				0	NOP					
				1	ADD					
				2	SUB					
				Э	ADDSUB					
				4	MIN					
				5	MAX					
				6	ABS					
				7	NEGATE					
				8	MPYDIV					
				9	REMAINDER	1				
				10	COMPARE-GT					
				11 COMPARE-GEQ 12 COMPARE-EQUAL		1				
						1				
		l		13 COMPARE- NEQUAL 14 TIMER						
06	0h1E06	User function 2	User Func2		TIMER	0:NOP	X/A	0	0	<u>p.109</u>
				15	LIMIT	1				
				16	AND	1				
				17	OR	1				
				18	XOR	1				
				19	ANDOR	1				
				20	SWITCH	1				
				21	BITTEST	1				
				22	BITSET	1				
				23	BITCLEAR	1				
				24	LOWPASSFILTER	1				
				25	PI_CONTROL	1				
	l			26	PI_PROCESS	1	l			
	l			27	UPCOUNT	1	l			
	1			28	DOWNCOUNT	1	l			
07	0h1E07	User function input2-A	User Input2-A	0-0x	FFFF	0	X/A	0	0	p.109
08	0h1E08	User function input2-B	User Input2-B	0-0x	FFFF	0	X/A	О	0	p.109
09	0h1E09	User function input2-C	User Input2-C	0-0×	FFFF	0	X/A	0	0	p.109

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
10	0h1E0A	User function output2	User Output2	-327	67-32767	0	-/A	0	0	p.109
11	0h1E0B	User function3	User Func3	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27	NOP ADD ADD ADD SUB ADDSUB MIN MAX ABS NEGATE MPYDIV REMAINDER COMPARE-GQ COMPARE-GQU COMPARE-GQUAL TIMER LIMIT AND OR AND SWITCH BITTEST BITSET BITSET BITCLEAR LOWPASSFILTER P_CONTROL P_PPCOCESS UPCOUNT	0:NOP	X/A	0	٥	p.109
12	0h1E0C	User function input3-A	User Input3-A	28 0-0×	DOWNCOUNT	0	X/A	0	0	p.109
13	0h1E0D	User function input3-B	User Input3-B	0-0x	FFFF	0	X/A	0	0	p.109
14	0h1E0E	User function input3-C	User Input3-C	0-0×	FFFF	0	X/A	О	0	p.109
15	0h1E0F	User function output3	User Output3	-327	67-32767	0	-/A	0	0	p.109
16	0h1E10		User Func4	0	NOP	0:NOP	X/A	0	0	p.109

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
				1	ADD					
				2	SUB					
				3	ADDSUB					
				4	MIN					
				5	MAX					
				6	ABS					
				7	NEGATE					
				8	MPYDIV					
				9	REMAINDER					
				10	COMPARE-GT					
				11	COMPARE-GEQ					
				12	COMPARE-EQUAL					
				13	COMPARE- NEQUAL					
		User		14	TIMER					
		function4		15	LIMIT					
				16	AND					
				17	OR					
				18	XOR					
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
17	0h1E11	User function input4-A	User Input4-A	0-0x	FFFF	0	X/A	0	0	<u>p.109</u>
18	0h1E12	User function input4-B	User Input4-B	0-0x	FFFF	0	X/A	0	0	p.109
19	0h1E13	User function input4-C	User Input4-C	0-0x	FFFF	0	X/A	0	0	p.109
20	0h1E14	User function output4	User Output4	-327	67-32767	0	-/A	0	0	p.109
				0	NOP					
04	054545	User	Hara France	1	ADD	ONOR	V/A	_	_	- 400
21	0h1E15	function5	User Func5	2	SUB	0:NOP	X/A	0	0	p.109
				3	ADDSUB					

	4 5 6 7 8 9	MIN MAX ABS NEGATE MPYDIV REMAINDER					
	6 7 8 9 10	ABS NEGATE MPYDIV					
	7 8 9	NEGATE MPYDIV					
	8 9 10	MPYDIV					
	9 10						
	10	DEMAINDED					
		KEWMINDEK					
		COMPARE-GT					
	11	COMPARE-GEQ					
	12	COMPARE-EQUAL					
	13	COMPARE- NEQUAL					
	14	TIMER					
	15	LIMIT					
	16	AND					
	17	OR					
	18	XOR					
	19	ANDOR					
	20	SWITCH					
	21	BITTEST					
	22	BITSET					
	23	BITCLEAR					
	24	LOWPASSFILTER					
	25	PI_CONTROL					
	26	PI_PROCESS					
	27	UPCOUNT					
	28	DOWNCOUNT					
22 0h1E16 User function input5-A Use	er out5-A 0-0x	FFFF	0	X/A	0	0	p.109
23 0h1E17 User function input5-B User	er out5-B 0-0x	FFFF	0	X/A	0	0	p.109
User User	er out5-C 0-0x	FFFF	0	X/A	0	0	p.109
User User	er tput5 -327	767-32767	0	-/A	0	0	p.109
	0	NOP					
1 1 1 1	1	ADD					
User	_ 2	SUB					
26 0h1E1A User function6 User	er Func6 3	ADDSUB	0:NOP	X/A	0	0	p.109
	4	MIN					
1 1 1 1	5	MAX					

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
				6	ABS					
				7	NEGATE					
				8	MPYDIV					
				9	REMAINDER					
				10	COMPARE-GT					
				11	COMPARE-GEQ					
				12	COMPARE-EQUAL					
				13	COMPARE- NEQUAL					
				14	TIMER					
				15	LIMIT					
				16	AND					
				17 OR						
				18 XOR						
				19 ANDOR						
				20 SWITCH						
				21	BITTEST					
				22 BITSET						
				23 BITCLEAR						
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
27	0h1E1B	User function input6-A	User Input6-A	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
28	0h1E1C	User function input6-B	User Input6-B	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
29	0h1E1D	User function input6-C	User Input6-C	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
30	0h1E1E	User function output6	User Output6	-327	67-32767	0	-/A	0	0	<u>p.109</u>
				0	NOP					
				1	ADD					
				2	SUB		l			
31	0h1E1F	User function7	User Func7	3	ADDSUB	0:NOP	X/A	0	0	p.109
				4	MIN					
				5	MAX		l			
				6	ABS		l			

Code	Comm. Address	Name	LCD Display	Setting Range 7 NEGATE		Initial Value	Property*	V/F	SL	Ref.
				8	MPYDIV	1				
				9	REMAINDER	1				
				10	COMPARE-GT					
				11	COMPARE-GEQ					
				12	COMPARE-EQUAL	1				
				13	COMPARE- NEQUAL					
				14	TIMER	1				
				15	LIMIT	1				
				16	AND	1				
				17 OR						
				18 XOR						
				19 ANDOR		1				
				20 SWITCH		1				
				21 BITTEST						
				22 BITSET						
				23 BITCLEAR		1				
				24 LOWPASSFILTER						
				25	PI_CONTROL					
				26	PI_PROCESS	1				
				27	UPCOUNT	1				
				28	DOWNCOUNT	1				
32	0h1E20	User function input7-A	User Input7-A	0-0×	FFFF	0	X/A	0	0	p.109
33	0h1E21	User function input7-B	User Input7-B	0-0×	FFFF	0	X/A	0	0	p.109
34	0h1E22	User function input7-C	User Input7-C	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
35	0h1E23	User function output7	User Output7	-32767-32767		0	-/A	0	0	p.109
				0	NOP					
				1	ADD	1				
				2	SUB	1				
00	01.4504	User		3	ADDSUB	a Non		_	_	
36	0h1E24	function8	User Func8	4	MIN	0:NOP	X/A	0	0	p.109
	l			5 MAX]	l			
	l			6	ABS]	l			
	l			7	NEGATE]	l			

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
				8	MPYDIV					
				9	REMAINDER					
				10	COMPARE-GT					
				11	COMPARE-GEQ					
				12	COMPARE-EQUAL					
				13	COMPARE- NEQUAL					
				14	TIMER					
				15	LIMIT					
				16	AND					
				17	OR					
				18	XOR					
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
37	0h1E25	User function input8-A	User Input8-A	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
38	0h1E26	User function input8-B	User Input8-B	0-0×	FFFF	0	X/A	0	0	p.109
39	0h1E27	User function input8-C	User Input8-C	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
40	0h1E28	User function output8	User Output8	-327	67-32767	0	-/A	0	0	p.109
				0	NOP					
				1	ADD		l			
				2	SUB					
				3	ADDSUB					
l	l _	User	l	4	MIN	1	l	١_	١_	l
41	0h1E29	function9	User Func9	5	MAX	0:NOP	X/A	0	0	p.109
				6	ABS	1				
				7	NEGATE	1				
				8	MPYDIV	1	l			
				9	REMAINDER	1				

Code	Comm. Address	Name	LCD Display	Setting Range		Initial Value	Property*	V/F	SL	Ref.
				10	COMPARE-GT					
				11	COMPARE-GEQ					
				12	COMPARE-EQUAL					
				13	COMPARE- NEQUAL					
				14	TIMER					
				15	LIMIT					
				16	AND					
				17	OR					
				18	XOR					
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23 BITCLEAR						
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
42	0h1E2A	User function input9-A	User Input9-A	0-0×	FFFF	0	X/A	0	0	p.109
43	0h1E2B	User function input9-B	User Input9-B	0-0x	FFFF	0	X/A	0	0	<u>p.109</u>
44	0h1E2C	User function input9-C	User Input9-C	0-0x	FFFF	0	X/A	0	0	<u>p.109</u>
45	0h1E2D	User function output9	User Output9	-327	67-32767	0	-/A	0	0	p.109
				0	NOP					
				1	ADD					
				2	SUB					
				3	ADDSUB					
				4	MIN					
46	0h1E2E	User function10	User Func10	5	MAX	0:NOP	X/A	0	0	p.109
				6	ABS]				
				7	NEGATE]				
	l			8	MPYDIV]				
				9	REMAINDER	1				
				10	COMPARE-GT					

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
				11 COMPARE-GEQ						
				12	COMPARE-EQUAL	1				
				13	COMPARE- NEQUAL	1				
				14	TIMER					
				15	LIMIT	i				
				16 AND						
				17 OR		i				
				18	XOR	1				
				19 ANDOR		i				
				19 ANDOR 20 SWITCH		i				
				21 BITTEST		1				
				22 BITSET		1				
				23 BITCLEAR		i				
				24 LOWPASSFILTER		1				
				25 PI CONTROL		1				
				26 PI_PROCESS		1				
				27 UPCOUNT						
				28 DOWNCOUNT		1				
47	0h1E2F	User function input10-A	User Input10-A	0-0×	FFFF	0	X/A	0	0	p.109
48	0h1E30	User function input10-B	User Input10-B	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
49	0h1E31	User function input10-C	User Input10-C	0-0x	FFFF	0	X/A	0	0	<u>p.109</u>
50	0h1E32	User function output10	User Output10	-327	67-32767	0	-/A	0	0	p.109
				0	NOP					
				1	ADD]				
	l			2	SUB]	l			
				3	ADDSUB	1				
	l			4	MIN]	l			
51	0h1E33	User	User	5 MAX		0:NOP	X/A	0	0	p.109
31	OIIIE33	function11	Func11	6 ABS		U.INOF	A/A	ľ	,	<u>μ.109</u>
	l			7 NEGATE]	l			
				8	MPYDIV]				
				9	REMAINDER]				
				10	COMPARE-GT]				
				11	COMPARE-GEQ					

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
				12 COMPARE-EQUAL						
				13	COMPARE- NEQUAL					
				14	TIMER					
				15	LIMIT					
				16 AND						
				17 OR						
				18	XOR					
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26 PI_PROCESS						
				27 UPCOUNT						
				28 DOWNCOUNT						
52	0h1E34	User function input11-A	User Input11-A	0-0xFFFF		0	X/A	0	0	p.109
53	0h1E35	User function input11-B	User Input11-B	0-0×	FFFF	0	X/A	0	0	p.109
54	0h1E36	User function input11-C	User Input11-C	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
55	0h1E37	User function output11	User Output11	-327	67-32767	0	-/A	0	0	<u>p.109</u>
				0	NOP					
				1	ADD					
				2	SUB					
				3	ADDSUB					
				4	MIN					
				5 MAX						
56	0h1E38	User function12	User Func12	6 ABS		0:NOP	X/A	0	0	p.109
				7 NEGATE						
	l			8 MPYDIV]				
				9 REMAINDER]				
	l			10	COMPARE-GT]				
				11	COMPARE-GEQ	1				
				12	COMPARE-EQUAL					

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
				13	COMPARE- NEQUAL					
				14	TIMER	1				
				15	LIMIT	1				
				16	AND	1				
				17	OR	1				
				18	XOR	1				
				19	ANDOR	1				
				20	SWITCH					
				21	BITTEST	1				
				22	BITSET	1				
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
57	0h1E39	User function input12-A	User Input12-A	0-0x	FFFF	0	X/A	0	o	<u>p.109</u>
58	0h1E3A	User function input12-B	User Input12-B	0-0×	FFFF	0	X/A	0	0	p.109
59	0h1E3B	User function input12-C	User Input12-C	0-0×	FFFF	0	X/A	0	0	p.109
60	0h1E3C	User function output12	User Output12	-327	767-32767	0	-/A	0	0	<u>p.109</u>
				0	NOP					
				1	ADD	1				
				2	SUB	1				
				3	ADDSUB	1				
				4	MIN	1				
				5	MAX	1				
		User	User	6	ABS	1				
61	0h1E3D	function13	Func13	7	NEGATE	0:NOP	X/A	0	0	p.109
	l			8	MPYDIV	1	l			
				9	REMAINDER	1				
				10	COMPARE-GT	1				
	l			11	COMPARE-GEQ	1	l			
	l			12	COMPARE-EQUAL	1	l			
				13	COMPARE- NEQUAL	1				

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
				14	TIMER					
				15	LIMIT					
				16	AND					
				17	OR					
				18	XOR					
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
62	0h1E3E	User function input13-A	User Input13-A	0-0×	FFFF	0	X/A	0	0	p.109
63	0h1E3F	User function input13-B	User Input13-B	0-0×	FFFF	0	X/A	0	0	p.109
64	0h1E40	User function input13-C	User Input13-C	0-0×	FFFF	0	X/A	0	0	p.109
65	0h1E41	User function output13	User Output13	-327	67-32767	0	-/A	0	О	p.109
				0	NOP					
				1	ADD					
				2	SUB					
				3	ADDSUB					
				4	MIN					
				5	MAX					
				6	ABS					
66	0h1E42	User	User	7	NEGATE	0:NOP	X/A	0	0	p.109
00	OIIIL42	function14	Func14	8	MPYDIV	0.1401	747	ľ	0	<u>p.103</u>
				9	REMAINDER					
	l			10	COMPARE-GT	1	l			
	l			11	COMPARE-GEQ	1	l			
				12	COMPARE-EQUAL	1				
				13	COMPARE- NEQUAL					
	l			14	TIMER	1	l			

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
				15	LIMIT					
				16	AND					
				17	OR					
				18	XOR					
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS	1				
				27	UPCOUNT					
				28	DOWNCOUNT					
67	0h1E43	User function input14-A	User Input14-A	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
68	0h1E44	User function input14-B	User Input14-B	0-0xFFFF		0	X/A	o	0	p.109
69	0h1E45	User function input14-C	User Input14-C	0-0x	FFFF	0	X/A	0	0	p.109
70	0h1E46	User function output14	User Output14	-327	67-32767	0	-/A	0	0	p.109
				0	NOP					
				1	ADD	1				
				2	SUB	1				
				3	ADDSUB	1				
				4	MIN	1				
				5	MAX	1				
				6	ABS	1				
				7	NEGATE	1				
71	0h1E47	User function15	User Func15	8	MPYDIV	0:NOP	X/A	0	0	p.109
			1	9	REMAINDER	1				
				10	COMPARE-GT	1	l			
				11	COMPARE-GEQ	1	l			
				12	COMPARE-EQUAL	1	l			
	1 1 1 -	13	COMPARE- NEQUAL	1						
				14	TIMER	1	l			
				15	LIMIT	1	l			

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
				16	AND					
				17	OR					
				18	XOR					
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
72	0h1E48	User function input15-A	User Input15-A	0-0×	FFFF	0	X/A	0	0	<u>p.109</u>
73	0h1E49	User function input15-B	User Input15-B	0-0xFFFF		0	X/A	0	0	<u>p.109</u>
74	0h1E4A	User function input15-C	User Input15-C	0-0xFFFF		0	X/A	О	0	<u>p.109</u>
75	0h1E4B	User function output15	User Output15	-327	67-32767	0	-/A	0	0	p.109
		· ·		0	NOP					
				1	ADD	1				
				2	SUB	1				
				3	ADDSUB	1				
				4	MIN	1				
				5	MAX	1				
				6	ABS	1				
				7	NEGATE	1				
76	0h1E4C	User	User	8	MPYDIV	0:NOP	X/A	0	0	p.109
1	SIIILTO	function 16	Func16	9	REMAINDER	3.1101		١Ŭ	ľ	0.100
	l		10 1: 12 13	10	COMPARE-GT	1	l			
	l			11	COMPARE-GEQ	1	l			
	l			12	COMPARE-EQUAL	1	l			
				13	COMPARE- NEQUAL					
				14	TIMER					
		15	LIMIT							
	L		L	16	AND	<u> </u>	L		L_	

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
				17	OR					
				18	XOR					
				19	ANDOR	1				
				20	SWITCH	1				
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
77	0h1E4D	User function input16-A	User Input16-A	0-0x	FFFF	0	X/A	0	0	p.109
78	0h1E4E	User function input16-B	User Input16-B	0-0xFFFF		0	X/A	0	0	<u>p.109</u>
79	0h1E4F	User function input16-C	User Input16-C	0-0xFFFF		0	X/A	0	0	<u>p.109</u>
80	0h1E50	User function output16	User Output16	-327	67-32767	0	-/A	0	0	<u>p.109</u>
				0	NOP					
				1	ADD					
				2	SUB					
				3	ADDSUB					
				4	MIN					
				5	MAX					
				6	ABS					
				7	NEGATE					
		User	User	8	MPYDIV	1				
81	0h1E51	function 17	Func17	9	REMAINDER	0:NOP	X/A	0	0	p.109
				10	COMPARE-GT	1				
			-	11	COMPARE-GEQ					
	l			12	COMPARE-EQUAL		l			
	l			13	COMPARE- NEQUAL	1	l			
	l		<u> </u>	14	TIMER	1				
	l			15	LIMIT	1	l			
				16	AND	1				
	l			17	OR	1	l			

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
				18	XOR					
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26	PI_PROCESS					
				27	UPCOUNT					
				28	DOWNCOUNT					
82	0h1E52	User function input17-A	User Input17-A	0-0x	FFFF	0	X/A	o	0	<u>p.109</u>
83	0h1E53	User function input17-B	User Input17-B	0-0x	0-0xFFFF		X/A	0	0	p.109
84	0h1E54	User function input17-C	User Input17-C	0-0xFFFF		0	X/A	0	0	<u>p.109</u>
85	0h1E55	User function output17	User Output17	-327	67-32767	0	-/A	0	o	<u>p.109</u>
				0	NOP					
				1	ADD					
				2	SUB					
				3	ADDSUB					
				4	MIN					
				5	MAX					
				6	ABS					
				7	NEGATE					
				8	MPYDIV					
86	0h1E56	User	User	9	REMAINDER	0:NOP	X/A	0	0	p.109
00	OTTLOO	function 18	Func18	10	COMPARE-GT	0.1101	7071	_		p. 100
				11	COMPARE-GEQ	1				
				12	COMPARE-EQUAL	1				
		13	COMPARE- NEQUAL	1						
				14	TIMER	1				
				15	LIMIT	1				
				16	AND	1				
				17	OR	1				
				18	XOR	1				

Code	Comm. Address	Name	LCD Display	Sett	ing Range	Initial Value	Property*	V/F	SL	Ref.
				19	ANDOR					
				20	SWITCH					
				21	BITTEST					
				22	BITSET					
				23	BITCLEAR					
				24	LOWPASSFILTER					
				25	PI_CONTROL					
				26 PI_PROCESS						
				27	UPCOUNT					
				28	DOWNCOUNT					
87	0h1E57	User function input18-A	User Input18-A	0-0x	FFFF	0	X/A	0	0	<u>p.109</u>
88	0h1E58	User function input18-B	User Input18-B	0-0x	FFFF	0	X/A	0	0	<u>p.109</u>
89	0h1E59	User function input18-C	User Input18-C	0-0xFFFF		0	X/A	0	0	p.109
90	0h1E5A	User function output18	User Output18	-32767-32767		0	-/A	0	0	<u>p.109</u>

8.14 Groups for LCD Keypad Only

8.14.1 Trip Mode (TRP Last-x)

Code	Name	LCD Display	Setting Range		Initial Value	Ref.
0	Trip type display	Trip Name(x)	-		-	-
1	Frequency reference at trip	Output Freq	-		-	-
2	Output current at trip	Output Current	-		-	-
3	Acceleration/Deceleration state at trip	Inverter State	-		-	-
4	DC section state	-	-			
5	NTC temperature	Temperature	-		-	-
6	Input terminal state	DI Status	-		0000 0000	-
7	Output terminal state	DO Status	-		000	-
8[1]	Trip time after Power on	Trip On Time	-		0/00/00 00:00	-
9[1]	Trip time after operation start	Trip Run Time			0/00/00 00:00	-
10	Delete trip history	Trip Delete?	0	No		
10	Delete trip filstory	Trip Delete?	1	Yes		

^[1] Information is displayed in [YY/MM/DD Hr: Min (0/00/00 00:00)] format.

For LED display (7 segment)

- · Present fault displayed in Operations Group at parameter "nOn".
- . After reset, fault history is at Pr.91 (most recent) through Pr.95.
- · Stored history contains 1, 2 and 3 above.
- . Pr.96 when set to 1 (Yes) will clear fault history.

8.14.2 Config Mode (CNF)

Code	Name	LCD Display	S	etting Range	Initial Value	Ref.
00	Jump code	Jump Code	1 - 99)	42	p.49
01	Keypad language selection	Language Sel	0 : Er	nglish	0 : English	p.204
02	LCD constrast adjustment	LCD Contrast	-		-	<u>p.187</u>
03	Multi keypad ID	Multi KPD ID	3 - 99		3	<u>p.107</u>
10	VFD S/W version	Inv S/W Ver	-		=	p.187
11	LCD keypad S/W version	Keypad S/W Ver	-		-	<u>p.187</u>
12	LCD keypad title version	KPD Title Ver	-		-	<u>p.187</u>
20	Status window display item	Anytime Para	0	Frequency	0: Frequency	p.204

Code	Name	LCD Display	8	Setting Range	Initial Value	Ref.	
21	Monitor mode display item1	Monitor Line-1	1	Speed	0: Frequency	p.204	
22	Monitor mode display item2	Monitor Line-2	2	Output Current	2:Output Current	p.204	
			3	Output Voltage Output Power			
			5	WHour Counter			
			6	DCLink Voltage			
			7	DI State	1		
			8	DO State			
			9	V1 Monitor(V)			
			10	V1 Monitor(%)			
			13	V2 Monitor(V)			
23	Monitor mode	Monitor	14	V2 Monitor(%)	3:Output	p.204	
20	display item3	Line-3	15	12 Monitor(mA)	Voltage	D.204	
			16	12 Monitor(%)			
			17	PID Output			
			18	PID Ref Value			
			19	PID Fdb Value			
			20	Torque			
			21	Torque Limit			
			23	Speed Limit			
			24	Load Speed			
	Monitor mode	Mon Mode	0	No			
24	initialization	Init	1	Yes	0:No	p.204	
30	Option slot 1 type display	Option-1 Type	0	None	0:None	p.187	
31	Option slot 2 type display	Option-2 Type	6	Ethernet	0:None	p.187	
32	Option slot 3 type display	Option-3 Type	9	CANopen	0:None	p.187	
		,,	0	No			
			1	All Grp			
			2	DRV Grp			
			3	BAS Grp			
	Parameter initialization		4	ADV Grp			
		Parameter	5	CON Grp	1		
40		Init	6	IN Grp	0:None	p.180	
			7	OUT Grp	1		
			8	COM Grp	1		
			9	APP Grp	1		
			11	APO Grp[1]	1		
			12	PRT Grp	1		

Code	Name	LCD Display	8	Setting Range	Initial Value	Ref.
			13	M2 Grp		
41	Display changed	Changed	0	View All	0.15	400
41	Parameter	Para	1	View Changed	0:View All	p.183
			0	None		
			1	JOG Key		
42	Multi key item	Multi Key Sel	2	Local/Remote	0:None	p.183
			3	UserGrp SelKey		
			4	Multi KPD		
43	Macro function item	Macro Select	0	None	0:None	-
44	Trip history	Erase All	0	No	0:No	p.187
***	deletion	Trip	1	Yes	0.140	p. 101
45	User registration	UserGrp	0	No	0:No	p.183
40	code deletion	AllDel	1	Yes	0.140	<u>p. 100</u>
46	Read	Parameter	0	No	0:No	p.179
70	parameters	Read	1	Yes	0.140	p.115
47	Write	Parameter	0	No	0: No	p.179
71	parameters	Write	1	Yes	0.140	<u>p.173</u>
48	Save	Parameter	0	No	0:No	p.179
70	parameters	Save	1	Yes	0.140	<i>p.110</i>
50	Hide parameter mode	View Lock Set	0-999	99	Un-locked	p.181
51	Password for hiding parameter mode	View Lock Pw	0-999	99	Password	p.181
52	Lock parameter edit	Key Lock Set	0-999	19	Un-locked	p.182
53	Password for locking parameter edit	Key Lock Pw	0-999	99	Password	<u>p.182</u>
60	Additional title	Add Title	0	No	0:No	p.187
8	update	Up	1	Yes	0.140	p. 101
61	Simple parameter	Run Quick	0	No	1:Yes	p.185
•	setting	Start?	1	Yes	11100	<u>p.100</u>
62	Power consumption	WHCount	0	No	0:No	p.187
-	initialization	Reset	1	Yes		
70	Accumulated VFD motion time	On-time		month/day minute	_	<u>p.207</u>
71	Accumulated VFD operation time	Run-time		month/day minute	-	<u>p.207</u>

Code	Name	LCD Display	Setting Range		Initial Value	Ref.
72	Accumulated		0	No	0:No	- 207
12	VFD operation time initialization	Tille Reset	1	Yes		p.207
74	Accumulated cooling fan operation time	Fan Time		month/day minute	-	p.207
75	Reset of accumulated cooling fan operation time	Fan Time Rst	0	No	0:No	<u>p.207</u>

890049-07-00 Troubleshooting

9 Troubleshooting

This chapter explains how to troubleshoot a problems when VFD protective functions are activated (faults and warnings). If the VFD does not work normally after following the suggested troubleshooting steps, please contact the Benshaw customer service center.

9.1 Trips and Warnings

When the VFD detects a fault, it stops operating (trips) and displays a fault message at parameter nOn in the Operations Group and/or sends out a warning signal. When a fault or warning occurs, the 7-Segment display shows the information briefly. The fault/warning message can be viewed at parameter P:90. When more than two trips occur at the same time, the 7-Segment display shows the higher priority fault code. The fault history can be viewed at parameters Pr:91 ~ Pr:95 The fault history can be cleared by setting parameter P:96 to (1) Yes.

The fault conditions are categorized as follows:

- Level: When the fault is corrected, the fault or warning signal disappears and the fault is not saved in the fault history.
- Latch: When the fault is corrected and a reset is performed (keypad or external), the fault or warning signal disappears. The fault is saved in the Fault History.
- Fatal: When the fault is corrected, the fault or warning signal disappears only after the VFD power is
 cycled. When powered off, wait until the charge indicator light goes off then turn the VFD on again. If
 the VFD is still in a faulted condition after powering it on again, please contact the supplier or the
 customer service center.

911 Faults

Protection Functions for Output Current and Input Voltage

Keypad Display	LCD Display	Туре	Description
olt	Over Load	Latch	Displayed when the motor overload trip is activated and the actual load level exceeds the set level. Operates when Pr.20 is set to a value other than 0.
ult	Under Load	Latch	Displayed when the motor underload trip is activated and the actual load level is less than the set level. Operates when Pr.27 is set to a value other than 0.
oct	Over Current1	Latch	Displayed when VFD output current exceeds 200% of the rated current.
ovt	Over Voltage	Latch	Displayed when internal DC circuit voltage exceeds the specified value.
lvt	Low Voltage	Level	Displayed when internal DC circuit voltage is less than the specified value.
[lv2	Low Voltage2	Latch	Displayed when internal DC circuit voltage is less than

Troubleshooting 890049-07-00

Keypad Display	LCD Display	Туре	Description
gft	Ground Trip*	Latch	Displayed when a ground fault trip occurs on the output side of the VFD and causes the current to exceed the specified value. The specified value varies depending on VFD capacity.
eth	E-Thermal	Latch	Displayed based on inverse time-limit thermal characteristics to prevent motor overheating. Operates when Pr.40 is set to a value other than 0.
pot	Out Phase Open	Latch	Displayed when a 3-phase VFD output has one or more phases in an open circuit condition. Operates when bit 1 of Pr.05 is set to 1.
ipo	In Phase Open	Latch	Displayed when a 3-phase VFD input has one or more phases in an open circuit condition. Operates only when bit 2 of Pr.05 is set to 1.
iol	Inverter OLT	Latch	Displayed when the VFD has been protected from overload and resultant overheating, based on inverse time-limit thermal characteristics. Allowable overload rates for the VFD are 150% for 1 min and 200% for 4 sec. Protection is based on VFD rated capacity, and may vary depending on the device's capacity.
nmt	No Motor	Latch	Displayed when the motor is not connected during VFD operation. Operates when Pr31 is set to 1

^{*} SW Series VFDs rated for 4.0kW or less do not support the ground fault trip (GFT) feature. Therefore, an over current trip (OCT) or over voltage trip (OVT) may occur when there is a low-resistance ground fault.

Protection Functions Using Abnormal Internal Circuit Conditions and External Signals

Keypad Display	LCD Display	Туре	Description
oht	Over Heat	Latch	Displayed when the tempertature of the VFD heat sink exceeds the specified value.
oc2	Over Current2	Latch	Displayed when the DC circuit in the VFD detects a specified level of excessive, short circuit current.
ext	External Trip	Latch	Displayed when an external fault signal is provided by the multi-function terminal. Set one of the multi-function input terminals at In.65-69 to 4 (External Trip) to enable external trip.
bx	BX	Level	Displayed when the VFD output is blocked by a signal provided from the multi-function terminal. Set one of the multi-function input terminals at In.65-69 to 5 (BX) to enable input block function.
hwt	H/W-Diag	Fatal	Displayed when an error is detected in the memory (EEPRom), analog-digital converter output (ADC Off Set), or CPU watchdog (Watch Dog-1, Watch Dog-2).

890049-07-00 Troubleshooting

Keypad Display	LCD Display	Туре	Description
			EEP Err: An error in reading/writing parameters due to keypad or memory (EEPRom) fault. ADC Off Set: An error in the current sensing circuit (U/V/W terminal. current sensor, etc.).
ntc	NTC Open	Latch	Displayed when an error is detected in the temperature sensor of the Insulated Gate Bipolar Transistor (IGBT).
fan	Fan Trip	Latch	Displayed when an error is detected in the cooling fan. Set Pr.79 to 0 to activate fan trip (for models below 22kW capacity).
pid	Pre-PID Fail	Latch	Displayed when pre-PID is operating with functions set at AP34-AP36. A fault trip occurs when a controlled variable (PID feedback) is measured below the set value and the low feedback continues, as it is treated as a load fault.
xbr	Ext-Brake	Latch	Operates when the external brake signal is provided by the multi-function terminal. Occurs when the VFD output starting current remains below the set value at Ad.41. Set either digital output (OU.31 or OU.33) to 35 (BR Control).
sfa sfb	Safety A(B) Err	Latch	Displayed when at least one of the two safety input signals is off.

Protection Functions for Communication Options

Keypad Display	LCD Display	Туре	Description			
lor	Lost Command	Level	Displayed when a frequency or operation command error is detected during VFD operation by controller- than the keypad (e.g., using a terminal block ar communication mode). Activate by setting Pr.12 to a value other than 0.			
s100	IO Board Trip	Latch	Displayed when the I/O board or external communication card is not connected to the VFD or there is a bad connection.			
errc			Displayed when the s1000 error code continues for more than 5 sec. ('Errc' -> 'Errc' -> 'Errc' -> 'Err-' -			

Troubleshooting 890049-07-00

Keypad Display	LCD Display	Туре	Description
par	ParaWrite Trip	Latch	Displayed when communication fails during parameter writing. Occurs when using an LCD keypad due to a control cable fault or a bad connection.
opt	Option Trip- 1	Latch	Displayed when a communication error is detected between the VFD and the communication board. Occurs when the communication option card is installed.

9.1,2 Warning Messages

Keypad Display	LCD Display	Description
olw	Over Load	Displayed when the motor is overloaded. Operates when Pr17 is set to 1. To operate, select 5. Set either digital output (OU.31 or OU.33) to 5 (Over Load) to receive overload warning output signals.
ulw	Under Load	Displayed when the motor is underloaded. Operates when Pr.25 is set to 1. Set Set either digital output (OU.31 or OU.33) to 7 (Under Load) to receive underload warning output signals.
iolw	INV Over Load	Displayed when the overload time equivalent to 60% of the VFD overheat protection (inverter IOLT) level, is accumulated. Set either digital output (OU.31 or OU.33) to 6 (IOL) to receive VFD overload warning output signals.
lcw	Lost Command	Lost command warning alarm occurs even with Pr.12 set to 0. The warning alarm occurs based on the condition set at Pr.13- 15. Set either digital output (OU.31 or OU.33) to 13 (Lost Command) to receive lost command warning output signals. If the communication settings and status are not suitable for P2P, a Lost Command alarm occurs.
fanw	Fan Warning	Displayed when an error is detected from the cooling fan while Pr.79 is set to 1. Set either digital output (OU.31 or OU.33) to 8 (Fan Warning) to receive fan warning output signals
dbw	DB Warn %ED	Displayed when the DB resistor usage rate exceeds the set value. Set the detection level at Pr.66.
trer	Retry Tr Tune	Tr tune error warning alarm is activated when Dr.9 is set to 4. The warning alarm occurs when the motor's rotor time constant (Tr) is either too low or too high.

890049-07-00 Troubleshooting

9.2 Troubleshooting Faults

When a fault trip or warning occurs due to a protection function, refer to the following table for possible causes and remedies.

Type	Cause	Remedy		
Over Load	The load is greater than the motor's	Ensure that the motor and VFD have		
	rated capacity.	appropriate capacity ratings.		
	The set value for the overload trip level	Increase the set value for the overload		
	(Pr.21) is too low.	trip level.		
Under Load	There is a motor-load connection	Replace the motor and VFD with		
	problem.	models with lower capacity.		
	The set value for underload level (Pr.29,	Reduce the set value for the underload		
	Pr.30) is less than the system's minimum	level.		
	load.			
Over	Acc/Dec time is too short, compared to	Increase Acc/Dec time.		
Current1	load inertia (GD2).			
	The VFD load is greater than the rated	Replace the VFD with a model that has		
	capacity.	increased capacity.		
	The VFD supplied an output while the	Operate the VFD after the motor has		
	motor was idling.	stopped or use the speed search		
		function (Cn.60).		
	The mechanical brake of the motor is	Check the mechanical brake.		
	operating too fast.			
Over Voltage	Deceleration time is too short for the	Increase the acceleration time.		
	load inertia (GD2).			
	A generative load occurs at the VFD	Use the braking unit.		
	output.	Determine William to the beautiful to		
	The input voltage is too high.	Determine if the input voltage is above		
Law Valesas	The income of the second	the specified value. Determine if the input voltage is below		
Low Voltage	The input voltage is too low.	the specificed value.		
	A load greater than the power capacity is	Increase the power capacity.		
	connected to the system (e.g., a welder,	increase the power capacity.		
	direct motor connection, etc.)			
	The magnetic contactor connected to	Replace the magnetic contactor.		
	the power source has a faulty	replace the magnetic contactor.		
	connection.			
Low Voltage2	The input voltage has decreased during	Determine if the input voltage is above		
	the operation.	the specified value.		
	An input phase-loss has occurred.	Check the input wiring.		
	The power supply magnetic contactor is	Replace the magnetic contractor.		
	faulty.	'		
Ground Trip	A ground fault has occurred in the VFD	Check the output wiring.		
	output wiring.			
	The motor insulation is damaged.	Replace the motor.		
E-Thermal	The motor has overheated.	Reduce the load or operation		

Troubleshooting 890049-07-00

Туре	Cause	Remedy		
		frequency.		
	The VFD load is greater than the rated	Replace the VFD with a model that has		
	capacity.	increased capacity.		
	The set value for electronic thermal	Set an appropriate electronic thermal		
	protection is too low.	level.		
	The VFD has been operated at low speed	Replace the motor with a model that		
	for an extended duration.	supplies extra power to the cooling		
		fan.		
Output Phase	The magnetic contactor on the output	Check the magnetic contactor on the		
Open	side has a connection fault.	output side.		
	The output wiring is faulty.	Check the output wiring.		
Input Phase	The magnetic contactor on the input	Check the magnetic contactor on the		
Open	side has a connection fault.	input side.		
	The input wiring is faulty.	Check the input wiring.		
	The DC link capacitor needs to be	Replace the DC link capacitor. Contact		
	replaced.	the retailer or the LSIS customer		
		service center.		
Inverter OLT	The load is greater than the rated motor	Replace the motor and VFD with		
	capacity.	models that have increased capacity.		
	The torque boost level is too high.	Reduce the torque boost level.		
Over Heat	There is a problem with the cooling	Determine if a foreign object is		
	system.	obstructing the air inlet, outlet, or vent.		
	The VFD cooling fan has been operated	Replace the cooling fan.		
	for an extended period.			
	The ambient temperature is too high.	Keep the ambient temperature below		
		50°C.		
Over	Output wiring is short-circuited.	Check the output wiring.		
Current2	There is a fault with the electronic	Do not operate the VFD. Contact the		
	semiconductor (IGBT).	retailer or the LSIS customer service		
		center.		
NTC Open	The ambient temperature is too low.	Keep the ambient temperature above		
		-10°C.		
	There is a fault with the internal	Contact the retailer or the LSIS		
	temperature sensor.	customer service center.		
FAN Lock	A foreign object is obstructing the fan's	Remove the foreign object from the air		
	air vent.	inlet or outlet.		
	The cooling fan needs to be replaced.	Replace the cooling fan.		
IP54 FAN Trip	The fan connector is not connected.	Connect the fan connector.		
эр	The fan connector needs to be replaced.	Replace the fan connector.		
	id. replaced.	replace the fair confliction		

890049-07-00 Troubleshooting

9.3 **Troubleshooting Other Faults**

When a fault other than those identified as fault trips or warnings occurs, refer to the following table for possible causes and remedies.

Туре	Cause	Remedy		
Parameters	The VFD is in operation (driving mode).	Stop the VFD to change to program		
cannot be set.		mode and set the parameter.		
	The parameter access is incorrect.	Check the correct parameter access		
		level and set the parameter.		
	The password is incorrect.	Check the password, disable the		
		parameter lock and set the		
		parameter.		
	Low voltage is detected.	Check the power input to resolve the		
		low voltage and set the parameter.		
The motor does	The frequency command source is set	Check the frequency command		
not rotate.	incorrectly.	source setting.		
	The operation command source is set	Check the operation command		
	incorrectly.	source setting.		
	Power is not supplied to the terminal	Check the terminal connections R/S/T		
	R/S/T.	and U/V/W.		
	The charge lamp is turned off.	Turn on the VFD.		
	The operation command is off.	Turn on the operation command		
		(RUN).		
	The motor is locked.	Unlock the motor or lower the load		
		level.		
	The load is too high.	Operate the motor independently.		
	An emergency stop signal is input.	Reset the emergency stop signal.		
	The wiring for the control circuit	Check the wiring for the control		
	terminal is incorrect.	circuit terminal.		
	The input option for the frequency	Check the input option for the		
	command is incorrect.	frequency command.		
	The input voltage or current for the	Check the input voltage or current for		
	frequency command is incorrect.	the frequency command.		
	The PNP/NPN mode is selected	Check the PNP/NPN mode setting.		
	incorrectly.			
	The frequency command value is too	Check the frequency command and		
	low.	input a value above the minimum		
		frequency.		
	The [STOP/RESET] key is pressed.	Check that the stoppage is normal, if		
		so resume operation normally.		
	Motor torque is too low.	Change the operation modes (V/F,		
		IM, and Sensorless). If the fault		
		remains, replace the VFD with a		
		model with increased capacity.		
The motor	The wiring for the motor output cable	Determine if the cable on the output		

Troubleshooting 890049-07-00

Туре	Cause	Remedy		
rotates in the	is incorrect.	side is wired correctly to the phase		
opposite		(U/V/W) of the motor.		
direction to the	The signal connection between the	Check the forward/reverse rotation		
command.	control circuit terminal (forward/reverse	wiring.		
	rotation) of the VFD and the			
	forward/reverse rotation signal on the			
	control panel side is incorrect.			
The motor only	Reverse rotation prevention is selected.	Remove the reverse rotation		
rotates in one		prevention.		
direction.	The reverse rotation signal is not	Check the input signal associated		
	provided, even when a 3-wire sequence	with the 3-wire operation and adjust		
	is selected.	as necessary.		
The motor is	The load is too heavy.	Reduce the load.		
overheating.		Increase the Acc/Dec time.		
		Check the motor parameters and set		
		the correct values.		
		Replace the motor and the VFD with		
		models with appropriate capacity for		
		the load.		
	The ambient temperature of the motor	Lower the ambient temperature of		
	is too high.	the motor.		
	The phase-to-phase voltage of the	Use a motor that can withstand		
	motor is insufficient.	phase-to-phase voltages surges		
		greater than the maximum surge		
		voltage.		
		Only use motors suitable for		
		apllications with VFDs.		
		Connect the AC reactor to the VFD		
		output (set the carrier frequency to 2		
		kHz).		
	The motor fan has stopped or the fan is	Check the motor fan and remove any		
	obstructed with debris.	foreign objects.		
The motor stops	The load is too high.	Reduce the load.		
during		Replace the motor and the VFD with		
acceleration or		models with capacity appropriate for		
when connected		the load.		
to load.				
The motor does	The frequency command value is low.	Set an appropriate value.		
not accelerate.	The load is too high.	Reduce the load and increase the		
/The		acceleration time. Check the		
acceleration		mechanical brake status.		
time is too long.	The acceleration time is too long.	Change the acceleration time.		
	The combined values of the motor	Change the motor related		
	properties and the VFD parameter are	parameters.		
	incorrect.			
	The stall prevention level during	Change the stall prevention level.		

890049-07-00 Troubleshooting

Туре	Cause	Remedy
	acceleration is low.	
	The stall prevention level during	Change the stall prevention level.
	operation is low.	
	Starting torque is insufficient.	Change to vector control operation
		mode. If the fault is still not corrected,
		replace the VFD with a model with
		increased capacity.
Motor speed	There is a high variance in load.	Replace the motor and VFD with
varies during		models with increased capacity.
operation.	The input voltage varies.	Reduce input voltage variation.
	Motor speed variations occur at a	Adjust the output frequency to avoid
	specific frequency.	a resonance area.
The motor	The V/F pattern is set incorrectly.	Set a V/F pattern that is suitable for
rotation is	, ,	the motor specification.
different from		
the setting.		
The motor	The deceleration time is set too long.	Change the setting accordingly.
deceleration	The motor torque is insufficient.	If motor parameters are normal, it is
time is too long	'	likely to be a motor capacity fault.
even with		Replace the motor with a model with
Dynamic		increased capacity.
Braking (DB)	The load is higher than the internal	Replace the VFD with a model with
resistor	torque limit determined by the rated	increased capacity.
connected.	current of the VFD.	
Operation is	The carrier frequency is too high.	Reduce the carrier frequency.
difficult in	Over-excitation has occurred due to an	Reduce the torque boost value to
underload	inaccurate V/F setting at low speed.	avoid over-excitation.
applications.		
While the VFD is	Noise occurs due to switching inside	Change the carrier frequency to the
in operation, a	the VFD.	minimum value.
control unit		Install a micro surge filter in the VFD
malfunctions or		output.
noise occurs.		
When the VFD	An earth leakage breaker will interrupt	Connect the VFD to a ground
is operating, the	the supply if current flows to ground	terminal.
earth leakage	during VFD operation.	Check that the ground resistance is
breaker is		less than 100Ω for 230V VFDs and
activated.		less than 10Ω for 460V VFDs.
		Check the capacity of the earth
		leakage breaker and make the
		appropriate connection, based on the
		rated current of the VFD.
		Lower the carrier frequency.
		Make the cable length between the
		VFD and the motor as short as
		possible.
		possible.

Troubleshooting 890049-07-00

Туре	Cause	Remedy
The motor	Phase-to-phase voltage of 3-phase	Check the input voltage and balance
vibrates severely	power source is not balanced.	the voltage.
and does not		Check and test the motor's insulation.
rotate normally.		
The motor	Resonance occurs between the motor's	Slightly increase or decrease the
makes	natural frequency and the carrier	carrier frequency.
humming, or	frequency.	
loud noises.	Resonance occurs between the motor's	Slightly increase or decrease the
	natural frequency and the VFD's output	carrier frequency.
	frequency.	Use the frequency jump function to
		avoid the frequency band where
		resonance occurs.
The motor	The frequency input command is an	In situations of noise inflow on the
vibrates/hunts.	external, analog command.	analog input side that results in
		command interference, change the
		input filter time constant (In.07).
	The wiring length between the VFD	Ensure that the total cable length
	and the motor is too long.	between the VFD and the motor is
		less than 200m (50m for motors
		rated 3.7 kW or lower).
The motor does	It is difficult to decelerate sufficiently,	Adjust the DC braking parameter.
not come to a	because DC braking is not operating	Increase the set value for the DC
complete stop	normally.	braking current.
when the VFD		Increase the set value for the DC
output stops.		braking stopping time.
The output	The frequency reference is within the	Set the frequency reference higher
frequency does	jump frequency range.	than the jump frequency range.
not increase to	The frequency reference is exceeding	Set the upper limit of the frequency
the frequency	the upper limit of the frequency	command higher than the frequency
reference.	command.	reference.
	Because the load is too heavy, the stall	Replace the VFD with a model with
	prevention function is working.	increased capacity.
The cooling fan	The control parameter for the cooling	Check the control parameter setting
does not rotate.	fan is set incorrectly.	for the cooling fan.

Maintenance

10 Maintenance

This chapter explains:

Periodic Inspections

Storage and Disposal

The Benshaw model S and SW series VFD's are industrial electronic products with advanced semiconductor components. A reasonable life expectancy of 8 to 10 years can be expected however, there are factors that may affect their continued long term operation. Environmental issues (temperature and humidity) and mechanical issues (vibration and connections) are the most common reasons for premature failure of drives. To avoid problems, it is recommended to perform periodic inspections of the drive.



- . Be sure to remove the drive's power input while performing maintenance. Lock out all sources of
- Be sure to perform maintenance only after checking that the DC bus voltage has discharged. The voltage between terminal P1-N (or P2-N) should be less than 30VDC. The DC bus capacitors can still be charged even after the power is turned off. The DC bus LED (if equipped) is not a definitive indication of the absence of DC voltage.
- Preventive maintenance should always be performed by a trained technician.
- Clean with a dry cloth. Do not use water, solvents or detergents.

101 **Periodic Inspection Summary**

Refer to the attached Table for specific frequency of inspection.

The conditions of the installed location

- · Observe any physical damage to enclosure or enclosure degradation.
- Any signs of liquid leakage into the enclosure.
- Any signs of corrosion or rust resulting from leakage into the enclosure.

The conditions of the drive cooling. Causes for abnormal heating are:

- Check for any deposits or dirt inside the enclosure, in the cooling fans/filters and the drive fan(s).
- Remove with compressed air.
- Check the rotating condition of the cooling fan(s).

Abnormal vibration

- Are there any loose nuts or bolts as a result of the vibration?
- Loose connections will show signs of heated connectors and wires. Tighten or replace.

Maintenance 890049-07-00

10.2 **Periodic Inspection Items**

				Period		Inspection Method		Customer use
	Inspection Item	Inspection	Monthly	1 year	2 year		Criterion	Check/ Initial /Date
Environment	Ambient Temperature/	Is the ambient temperature and humidity within the design range?	×	×		Measure/ Monitor (Thermometer, Hygrometer, Recorder)	S Series: Normal Duty: 14– 104°F (-10– 40°C) S Series: Heavy Duty: 14–122°F (-	
Enviro	Humidity						10–50°C) SW Series: Heavy Duty: 14–104°F (- 10–40°C) Humidity: Under 90% non-	
		Any signs of physical damage to the enclosure		х		Visual	condensing	
	Physical	of the VFD? Any signs of liquid leaking into enclosure of the VFD?		×			Yes/No	
		Are there any signs of rust inside the VFD enclosure?		х				
_		Are there any signs of rust inside the panel where the VFD is housed.?		x		visual	resino	
spection		Are there any abnormal vibrations or oscillations of the VFD/Panel?		х				
Physical Inspection	Physical (Cables and Connections)	Are there any signs of overheated connections (discolored lugs, insulation melted)?		×				
Ą		Are there any signs of rusted or coroded connections?		х				
		Are there any signs of cracked terminal blocks?		х		Visual	Yes/No	
		Is there any damage to cable insulation?		х				
	Physical (Fans)	Inspect fans and filters for debris and dust accumulation.	х					
		Inspect fans for free rotation.	Х					

890049-07-00 **Maintenance**

			Period					Customer use
	Inspection Item	Inspection	Monthly	1 year	2 year	Inspection Method	Criterion	Check/ Initial /Date
Non-Powered VFD Checks/Measurements	IGBT Module	Check the resistance between each of the terminals.			x	Disconnect the VFD three phase input and measure the resistance between R, S, T and P, N.	Digital or Analog meter.	
	Input Diode/SCR Modules					Disconnect the VFD three phase output and measure the resistance between U, V, W and P, N.		
	DC Bus Capacitors	Is there any visible leakage coming out?			×	Visual check	Yes/No	
		Inspect the pressure relief vent (or pin). Is there any swelling or rupture?			х			
	Motor (Note 1)			Х		Megger Test	500 MΩ	
Powered VFD - Not Running Checks/Measurements	Input Voltages	Is the input voltage from the main within spec of the VFD?		×		Measure the voltage between the terminals R, S, T.	VFD rating +/-15%	
		Is the input voltage from the main balanced within spec of the VFD?			х		2%	
	DC Bus Voltage	Is the DC Bus Higher or Lower than normal?			×	Measure the DC Voltage between the Pos. and Neg. terminals of the VFD.	Input Voltage x SQRT2 (+/- 10%)	
	Cooling Fan	Is there any abnormal oscillations or noise?		×		Turn OFF the power and turn the fan by hand.	Must rotate smoothly.	
	Trip Circuit (Input to VFD)	Is VFD trip circuit funciotnal?		×		Identify the VFD input trip circuit. Open or Close external trip mechanism.	VFD must trip.	
Powered VFD - Running Checks/Measurements	Output Voltages	Is there any voltage imbalance between phases of the output?			х	Measure the voltage between the output terminals U, V and W.	Tol. +/-2% 230V 5V) 460V (10V).	
		Does the displayed Output Voltage agree with measurement?			х	Display parameter for Output Voltage, compare to measured value.	Tol. -10%, +20% Note 2	

Maintenance 890049-07-00

	Inspection Item	Inspection	Period					Customer use	
			Monthly	1 year	2 year	Inspection Method	Criterion	Check/ Initial /Date	
		Is there any current imbalance between phases of the output?			х	Measure the current out of each phase U, V, W.	Tol. +/-3%		
	Output Curent Motor						Note 2		
		Does the displayed Output Current agree with measurement?			×	Display parameter for Output Current, compare to measured value.	Tol. +/-5%		
							Note 2		
		Are there any abnormal vibrations or noise?		х		Auditory, sensory, visual check.	Mounting and Coupling		
		Is there any unusual odor?		х		Check for overheat and damage.			
Note 1	Do not run an insulation resistance test (Megger) on the VFD or with VFD connected to supply and motor, damage will occur.								
Note 2	Multimeter measurements of VFD output could vary decending on the type of meter.								

① Caution

ESD (Electrostatic discharge) To prevent damage to the PCB from ESD, touch a metal object with your hands to discharge any electricity before working on the PCB, or wear an antistatic wrist strap and ground it on a metal object.

① Caution

Do not run an insulation resistance test (Megger) on the control circuit as it may result in damage to the product.

① Caution

If the VFD has not been operated for a long time, capacitors lose their charging characteristics and are depleted. To prevent depletion, turn on the product once a year and allow the device to operate for 30-60 min. Run the device under no-load conditions.

890049-07-00 Maintenance

10.3 Storage

If you are not using the product for an extended period, adhere to the following guidelines:

Store the product in the environmental conditions as specified. Refer to 11.2 Product Specification
 Details on page 356.

- When storing the product for a period longer than 3 months, store it between 14°F (-10 °C) and 86°F (30 °C), to prevent depletion of the electrolytic capacitor. See Caution below.
- If the VFD has not been operated for a long time, capacitors lose their charging characteristics and are
 depleted. To prevent depletion, turn on the product once a year and allow the device to operate for 3060 min. Run the device under no-load conditions.
- Do not expose the VFD to snow, rain, fog, or dust.
- Package the VFD in a way that prevents contact with moisture. Keep the moisture level below 70% in the
 package by including a desiccant, such as silica gel.
- Do not allow the VFD to be exposed to dusty or humid environments. If the VFD is installed in such
 environments (for example, a construction site) and the VFD will be unused for an extended period,
 remove the VFD and store it in a safe place.

① Caution

If the VFD has been stored for one year, capacitors start to lose their charging characteristics and can become depleted. To prevent depletion, turn on the product once a year and allow the device to operate for 30-60 min. Run the device under no-load conditions.

10.4 Disposal

When disposing of the product, categorize it as general industrial waste. Recyclable materials are included in the product, so recycle them whenever possible. The packing materials and all metal parts can be recycled. The plastic can also be recycled.

11 Technical Specification

11.1 Input and Output Specification

S Series

3 Phase 240V, 1 HP-15 HP (0.75 - 11 kW)

Model RSI	-xxx-SS-2-C		1.0	2.0	3.0	5.0	7.5	10	15		
Applied	Heavy	HP	0.5	1.0	2.0	3.0	5.5	7.5	10		
motor	load	kW	0.4	0.75	1.5	2.2	4.0	5.5	7.5		
	Normal	HP	1.0	2.0	3.0	5.0	7.5	10	15		
	load	kW	0.75	1.5	2.2	3.7	5.5	7.5	11		
Rated output	Rated apacity	Heavy load	1.0	1.9	3.0	4.2	6.1	9.1	12.2		
	(kVA)	Normal load	1.2	2.3	3.8	4.6	6.9	11.4	15.2		
	Rated current	Heavy load	2.5	5.0	8.0	11.0	16.0	24	32		
	[3-Phase input] (A)	Normal load	3.1	6.0	9.6	12.0	18.0	30	40		
	Rated current [Single-	Heavy load	1.5	2.8	4.6	6.1	8.8	13	18		
		Normal load	1.8	3.3	5.7	6.6	9.9	16	22		
	Output fre	quency	0-400 Hz (IM Sensorless: 0-120 Hz)								
	Output vo	ltage (V)	3-phase 200-240 V								
Rated input	Working v	oltage (V)	3-phase 200-240 VAC (-15% to +10%) Single phase 240VAC(-5% to +10%)								
·	Input frequ	uency				ut frequency					
	Rated current	Heavy Ioad	2.2	4.9	8.4	11.8	17.5	25.8	34.9		
	(A)	Normal load	3.0	6.3	10.8	13.1	19.4	32.7	44.2		
Weight (lb	/kg)		2/0.9	2/0.9	2.86/1.3	3.3/1.5	4.4/2.0	7.3/3.3	7.3/3.3		

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 200 V inverters is based on a 240 V supply voltage, and for 400V inverters is based on a 480 V supply voltage.

890049-07-00 Technical Specification

- The rated output current is limited based on the carrier frequency set at Cn.04.
- The output voltage becomes 20~40% lower during no-load operations to protect the inverter from tripping on OCT faults when the load returns (0.4~4.0kW models only).

3-Phase 480V, 1 HP - 15 HP (0.75 - 11 kW)

Model RSI->	oxx-SS-4-C		1.0	2.0	3.0	5.0	7.0	10	15	
Applied	Heavy load	HP	0.5	1.0	2.0	3.0	5.5	7.5	10	
motor	neavy load	kW	0.4	0.75	1.5	2.2	4.0	5.5	7.5	
	Normal	HP	1.0	2.0	3.0	5.0	7.5	10	15	
	load	kW	0.75	1.5	2.2	3.7	5.5	7.5	11	
Rated output	Rated capacity	Heavy load	1.0	1.9	3.0	4.2	6.1	9.1	12.2	
	(kVA)	Normal load	1.5	2.4	3.9	5.3	7.6	12.2	17.5	
	Rated current [3-	Heavy load	1.3	2.5	4.0	5.5	8.0	12	16	
	Phase input] (A)	Normal load	2.0	3.1	5.1	6.9	10.0	16	23	
See	Rated current [Single- Phase input] (A)	Heavy load	0.8	1.5	2.3	3.1	4.8	7.1	9.5	
Warning		Normal load	1.3	1.9	3.0	3.9	5.9	9.5	14	
	Output frequ	uency	0-400 Hz (IM Sensorless: 0-120 Hz)							
	Output volta	ige (V)	0 – Input (-15% to +10%) Single phase 480VAC(-5% to +10%)							
Rated input	Working vol	tage (V)	3-phase 3	80-480 VA	C (-15% to	+10%)				
	Input freque	ncy	50-60 Hz (In case of		se input, in	put freque	ncy is only 6	50Hz(±5%).)	ı	
	Rated current (A)	Heavy load	1.1	2.4	4.2	5.9	8.7	12.9	17.5	
		Normal load	2.0	3.3	5.5	7.5	10.8	17.5	25.4	
Weight (lb,	/kg) w/EMC fil	ter	2.6/1.18	2.6/1.18	3.9/1.77	4/1.80	4.9/2.23	7.3/3.3	7.5/3.4	

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 200 V inverters is based on a 240 V supply voltage, and for 400V inverters is based on a 480 V supply voltage.
- The rated output current is limited based on the carrier frequency set at Cn.04.
- The output voltage becomes 20~40% lower during no-load operations to protect the inverter from the impact of the motor closing and opening (0.4~4.0kW models only).
- Warning 480V units only When using single phase input, the built-in EMC filter must be disconnected. See section 2.2, Cable Wiring, Step 6.

Note

Precautions for 1-phase input to 3-phase drive

- Warning 480V units only When using single phase input, the built-in EMC filter must be disconnected. See section 2.2, Cable Wiring, Step 6.
- Please connect single-phase input to R(L1) and T(L3).
- AC or DC reactor is necessary to reduce DC ripple. For 0.5HP-10HP (0.4~7.5kW), external AC or DC reactor should be installed.
- Same peripheral devices (including a fuse and reactor) as 3-phase can be used for 1phase as well.
- If phase open trip occurs, turn off the input phase protection(PR-05).
- Protection for output current like OCT or IOLT is based on 3-phase ratings. User should set the parameters that are relative to motor information(bA-11~16), overload trip(Pr-17~22) and E-thermal functions(Pr-40~43)
- Performance of sensorless control could be unstable depending on DC ripple.
 - The minimum input voltage must be larger than 228Vac for 240Vac supply and 456Vac for 480Vac supply to ensure motor voltage production of 207Vac and 415Vac, respectively.
- To minimize the effect of voltage deprivation, please choose 208Vac motor for 240Vac supply and 400Vac motor for 480Vac supply.

SW Series

230V. 0.5 HP - 5 HP (0.4 - 3.7kW)

Model R	SI-XXX-SW-	24	0F5	001	002	003	005		
Applied	Heavy	HP	0.5	1	2	3	5		
motor	load	kW	0.4	0.75	1.5	2.2	3.7		
	Rated Cap	acity (kVA)	1	1.9	3	4.2	6.1		
	Current (A) 3 Input	3-Phase	2.5	5	8	11	16		
Rated	Current (A) 1-Phase		1.5	2.8	4.6	6.1	8.8		
output	Output freq	uency	0-400 Hz (V/Hz, Slip Comp.) 0-120 Hz (IM Sensorless) 0-180 Hz (PM Sensorless)						
	Output volt	age (V)	3-phase	0 - 240 V					
	Working vo	Itage (V)			AC (-15% /AC (-5% t				
Rated input	Input freque	ency		50 - 60 Hz (nase 60 Hz					
		ent (A)	2.2	4.9	8.4	11.8	17.5		

Heat Dissipation	Watts	11.6	10.5	39.5	41.9	100.0		
Weight	lbs.	7.9	7.9	11.5	11.9	12.1		
weight	kg	3.6 3.6 5.2 5.4 5						
Degree of Protection	ction IP66 (NEMA 4X Indoor Only)							

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 230 V VFDs is based on a 220 V supply voltage, and for 460V VFDs is based on a 440 V supply voltage.
- . The rated output current is limited based on the carrier frequency set at Cn.04.
- The output voltage becomes 20~40% lower during no-load operations to protect the VFD from faults (0.5 HP~5.0 HP models only).

230V, 7.5 HP - 20 HP (5.5 - 15 kW)

Model R	SI-XXX-SW-	24	007	010	015	020		
Applied	Heavy	HP	7.5	10	15	20		
motor	load	kW	5.5	7.5	11	15		
	Rated Capa	acity (kVA)	9.1	12.2	17.5	22.9		
	Current (A) Input	3-Phase	24	32	46	60		
Rated	Current (A) Input	1-Phase	13	18	26	33		
output	Output freq	uency	0-400 Hz (V/Hz, Slip Comp.) 0-120 Hz (IM Sensorless) 0-180 Hz (PM Sensorless)					
	Output volta	age (V)	3-phase	0 - 240 V				
	Working vo	Itage (V)			AC (-15% /AC (-5% t			
Rated input	Input freque	ency		3-phase 50-60 Hz (±5%) Single Phase 60 Hz (±5%)				
	Rated curre	ent (A)	25.8	34.9	50.8	66.7		
Heat Dis	sipation	Watts	137	149	191	302		
Woight		lbs.	19.4	19.4	20.7	26.2		
Weight		kg	8.8	8.8	9.4	11.9		
Degree o	of Protection	•	IP66	NEMA 4	X Indoor C	Only)		

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 230 V VFDs is based on a 220 V supply voltage, and for 460V VFDs is based on a 440 V supply voltage.
- The rated output current is limited based on the carrier frequency set at Cn.04.

460V, 0.5 HP - 5 HP (0.4 - 3.7kW)

Model R	SI-XXX-SW-	14	0F5	001	002	003	005			
Applied	Heavy	HP	0.5	1	2	3	5			
motor	load	kW	0.4	0.75	1.5	2.2	3.7			
	Rated Capa	city (kVA)	1	1.9	3	4.2	6.1			
	Current (A) Input	3-Phase	1.3	2.5	4	5.5	8			
Rated	Current (A) Input	1-Phase	0.8	1.5	2.3	3.1	4.8			
output	Output freq	uency	0-400 Hz (V/Hz, Slip Comp.) 0-120 Hz (IM Sensorless) 0-180 Hz (PM Sensorless)							
	Output volta	age (V)	3-phase 0-480V							
	Working vo	Itage (V)		3-phase 380-480VAC (-15% to +10%) Single phase 480VAC(-5% to +10%)						
Rated input	Input freque	ency		50-60 Hz (nase 60 Hz						
	Rated curre	ent (A)	1.1	2.4	4.2	5.9	8.7			
Heat Dis	sipation	Watts	8.1	4.7	27.9	25.6	62.8			
Weight		lbs.	7.9	7.9	11.5	11.9	12.1			
weight		kg	3.6 3.6 5.2 5.4 5.8				5.5			
Degree o	of Protection			IP66 (NE	MA 4X Ind	oor Only)				

- · The standard motor capacity is based on a standard 4-pole motor
- The standard used for 230 V VFDs is based on a 220 V supply voltage, and for 460V VFDs is based on a 440 V supply voltage.
- The rated output current is limited based on the carrier frequency set at Cn.04.
- The output voltage becomes 20~40% lower during no-load operations to protect the VFD from faults (0.5 HP~5.0HP models only).

Technical Specification

460V, 7.5 HP - 30 HP (5.5 - 22 kW)

Model R	si-xxx-sw-	44	007	010	015	020	025	030			
Applied	Heavy	HP	7.5	10	15	20	25	30			
motor	load	kW	5.5	7.5	11	15	18.5	22			
	Rated capa	city (kVA)	9.1	12.2	18.3	22.9	29.7	34.3			
	Current (A) Input	3-Phase	12	16	24	30	39	45			
Rated	Current (A) Input	1-Phase	7.1	9.5	15	18	23	27			
output	Output freq	uency	0-400 Hz (V/Hz, Slip Comp.) 0-120 Hz (IM Sensorless) 0-180 Hz (PM Sensorless)								
	Output volta	age (V)	3-phase	0 - 480V							
	Working vo	ltage (V)	3-phase 380-480VAC (-15% to +10%) Single phase 480VAC(-5% to +10%)								
Rated input	Input freque	ency		3-phase 50-60 Hz (±5%) Single Phase 60 Hz (±5%)							
	Rated current (A)	Heavy load	12.9	17.5	26.5	33.4	43.6	50.7			
Heat Diss	sipation	Watts	95	87	155	169	277	287			
Weight		lbs.	19	19.2	20.7	21.2	26.9	26.9			
vveignt		kg	8.6	8.7	9.4	9.6	12.2	12.2			
Degree o	of Protection			IP66	NEMA 4	X Indoor C	Only)				

- The standard motor capacity is based on a standard 4-pole motor.
- The standard used for 230 V VFDs is based on a 220 V supply voltage, and for 460V VFDs is based on a 440 V supply voltage.
- The rated output current is limited based on the carrier frequency set at Cn.04.

11.2 **Product Specification Details**

Items			Description				
	Control m	ethod	V/F control, Slip compensation	, Sensorless vector (IM and PM)			
	Frequenc	v setting	Digital command: 0.01 Hz				
	resolution	-	Analog command: 0.06 Hz (60	Hz standard)			
Control	Frequenc	y accuracy	1% of maximum output frequer	ncy			
	V/F patter	'n	Linear, Square Reduction, Use	r V/F			
	Overload	capacity	Heavy Duty: 150%, 1 minute				
	Torque bo	ost	Manual torque boost, Automati	c torque boost			
	Operation	n type					
	Start/Stop)	Keypad, terminal strip or comm	nunications			
	Fragueno	v cottings	Analog type: -10~10V, 0~10V, 4~20mA				
	Frequency settings		Digital type: Keypad, Pulse Tra	in input, communications			
			Basic	Advanced			
			Start/Stop Operation	Auto Tuning			
			Frequency Reference				
			Sources	Sensorless Vector Control			
			Accel/Decel Times	Torque Limits			
			2nd Source (HOA)	Slip Compensation			
			Multi-Step Speeds	PID Control			
			Jog	Auxiliary Frequency Reference			
			Auto Start	Multi-Step Accel/Decel Times			
			Auto Reset/Restart	User V/Hz.			
	Operation	function	Accel/Decel Patterns	Dwell Frequency Operation			
			V/Hz. Control	Regen Avoidance			
Operation			Liniear, Squared	Stall Prevention			
			Motor Rotation Prohibit	Speed Search			
			Torque Boost	VFD Fan Control			
			Start Modes	Loss of Power			
			Stop Modes	Ride Through (KEB)			
			Frequency Limits	Safe Stop			
			Jump Frequencies	Braking			
			3-Wire Control	DC Injection, Power Braking			
			Fire Mode	Flux Brakinig, External Brake			
			Select PNP (Source) or NPN (Sink) mode.			
			Functions of the digital inputs a	are set with parameters In.65- In.69.			
		(5) Multi-	 Forward/Reverse 	Run Enable (Interlock)			
	Immust	function	Reset	External trip			
	Input	input terminals	Emergency stop	 Jog operation (FWD/REV) 			
		(P1 - P5)	 Multi-Step frequencies 	Multi step acc/dec			
			 DC braking during stop 	Second motor selection			
			Frequency increase	Up/Down Frequency			

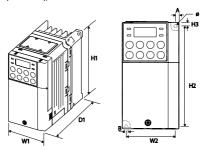
Items			Description				
			3-wire	Analog Hold (frequency)			
			acc/dec/stop	Exit PID Operation			
			Select acc/dec/stop	Auxiliary Input (2nd Source), HOA			
		Pulse train	0-32 kHz, Low Level: 0-2.5V, F	ligh Level: 3.5-12V			
		Open collector (Q1)	Fault output, VFD operating	Less than DC 24V, 50mA			
	Output	Relay, R1	status, many others	Less than (N.O., N.C.) AC250V 1A,			
			0.40141 (0.04 1) 0.1 14	Less than DC 30V, 1A			
		Analog output	0-12Vdc (0-24mA): Select freq voltage, DC terminal voltage a				
		Pulse train	Maximum 32 kHz, 10-12V				
			Motor Overload	Under Torque			
			Motor Under Load	Inverter Over Heat			
			Over Current (OC1)	Short Circuit (OC2)			
			Over Voltage	External Trip			
	Trip		Low Voltage	Hardware Fault			
			Ground Fault	Temperature Sensor (NTC)			
			Motor Over Heat (Eth)	Fan Fault			
			Phase Open (In/Out)	Pre-PID Operation Failure			
Protection			Inverter Overload	External Brake Trip			
1 Totection			No Motor Trip	Reference Loss			
			Over Torque	Option Board trip			
			Safety (STO) A, B Trip				
	Alarm		Warnings: Reference Loss, Motor Overload, Motor Under Load, Inverter Overload, Fan, Dynamic Braking Rate Warning, Auto Tuning Error, Inverter Overheat				
	Inetantan	eous Loss	Heavy Duty: Less than 15 ms ((~ 1 cycle)			
	of Power	eous Loss	For longer outages use KEB of operation	peration and/or Auto Restart			
			Forced fan cooling structure				
	Cooling ty	/ре	Forced cooling type: 230V: 0.5 460V: 0.5 HP~30HP (0.4-22 kV				
	Protection	structure	IP66 (NEMA 4X Indoor Only)				
Structure			S Series: Normal Duty: 14–104°	F (-10-40°C)			
/working environment	Ambient t	emperature	S Series: Heavy Duty: 14–122°F	(-10−50°C)			
CHVIIOIIIICH		opo.a.a.	SW Series: Heavy Duty: 14-10	4°F (-10– 40°C)			
			No ice or frost should be prese	ent			
	Ambient I	numidity	Less than 90% RH (to avoid co	ondensation forming)			
	Storage temperati	ıre.	-4°F ~ +149°F (-20°C ~ +65°C)			

Items		Description
	Surrounding environment	Prevent contact with corrosive gases, inflammable gases, oil stains, dust, and other pollutants (Pollution Degree 3 Environment).
		3280 ft (1,000 m).
	Operation altitude Vibration	Apply derating of 1% voltage/output current for every 328 ft. (100 m) above 3280 ft. (1,000 m), maximum of 13123 ft. (4,000 m).
		Less than 9.8 m/sec ² (1G).
	Pressure	10 ~ 15 PSI (70 ~106 kPa)

11.3 External Dimensions

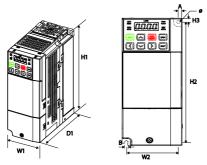
S Series

240V, 1.0 HP - 2.0 HP (0.75-1.5 kW), 3-Phase



Voltage	HP (kW)	W1	W2	H1	H2	Н3	D1	A	В	Φ
240 1.0 (0.75)	10(075)	68	61.1	128	119	5	123	3.5	4	4.2
240	1.0 (0.73)	(2.68)	(2.41)	(5.04)	(4.69)	(0.20)	(4.84)	(0.14)	(0.16)	(0.17)
240	20/15	68	61.1	128	119	5	128	3.5	4	4
240	2.0 (1.5)	(2.68)	(2.41)	(5.04)	(4.69)	(0.20)	(5.04)	(0.14)	(0.16)	(0.16)

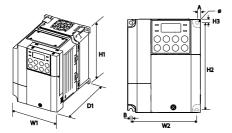
480V, 1.0 HP - 2.0 HP (0.75 -1.5kW), 3-Phase, EMC filter Type



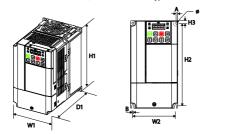
Voltage	HP (kW)	W1	W2	H1	H2	H3	D1	A	В	Φ
480 EMC Type	1.0 (0.75) 2.0 (1.5)	68 (2.68)	63.5 (2.50)	180 (7.09)	170.5 (6.71)	5 (0.20)	130 (5.12)	4.5 (0.18)		4.2 (0.17)

Units: mm (inches)

240V, 3.0 HP - 5.0 HP (2.2-3.7 kW), 3-Phase

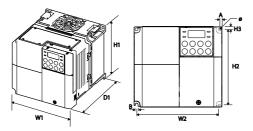


480V, 3.0 HP - 5.0 HP (2.2~3.7kW), 3-Phase, EMC filter Type

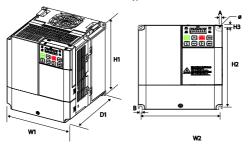


Voltage	HP(kW)	W1	W2	H1	H2	H3	D1	A	В	Ф
240	3.0 (2.2)									
240	5.0 (3.7)	100 (3.94)	91 (3.58)	128 (5.04)		4.5 (0.18)	145 (5.71)	4.5 (0.18)		4.5 (0.18)
480 EMC Type	3.0(2.2) 5.0 (3.7)	100 (3.94)	91 (3.58)	180 (7.09)	170 (6.69)	5 (0.20)	140 (5.51)	4.5 (0.18)		4.2 (0.17)

240V, 7.5 HP (4.0kW), 3 Phase



480V, 7.5 HP (4.0kW), 3-Phase, EMC filter Type



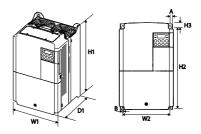
Voltage	HP (kW)	W1	W2	H1	H2	H3	D1	Α	В	Φ
240	7.5 (4.0)	140 (5.51)	132.2 (5.20)	128 (5.04)	120.7 (4.75)	3.7 (0.15)	145 (5.71)	3.9 (0.15)	4.4 (0.17)	4.5 (0.18)
480 EMC Type	7.5 (4.0)	140 (5.51)	132 (5.20)	180 (7.09)	170 (6.69)	5 (0.20)	140 (5.51)	4 (0.16)	4 (0.16)	4.2 (0.17)

Units: mm (inches)

890049-07-00 Technical Specification

240V, 10 HP - 15 HP (7.5-11 kW), 3-Phase

480V, 10 HP – 15 HP (7.5-11 kW), 3-Phase, EMC Filter Type

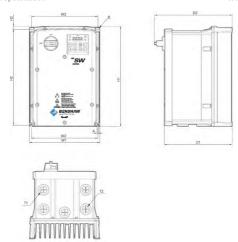


Voltage	HP (kW)	W1	W2	H1	H2	H3	D1	Α	В	Φ
240	10 (7.5)	160	137	232	216.5	10.5	140	5	5	[-
	15 (11)	(6.30)	(5.39)	(9.13)	(8.52)	(0.41)	(5.51)	(0.20)	(0.20)	
480	10 (7.5)	160	137	232	216.5	10.5	140	5	5	[-
	15 (11)	(6.30)	(5.39)	(9.13)	(8.52)	(0.41)	(5.51)	(0.20)	(0.20)	

Units: mm (inches)

SW Series

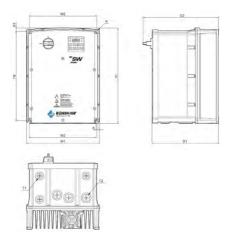
230V/460V, 0.5 HP - 5.0 HP (0.4~3.7kW)



Items		W1	W2	H1	H2	Н3	D1	D2	Α	θ	T1	T2
	VFD-RSI-0F5-SW-24	7.09	6.69	10.1	9.65	0.32	6.85	7.41	0.18	0.18	0.88	_
	VFD-RSI-001-SW-24	(180)	(170)	(256.6)	(245)	(8.2)	(174.1)	(188.2)	(4.5)	(4.5)	(22.3	-
3-phase												
230V	VFD-RSI-002-SW-24						7.91 (201)					
	VFD-RSI-003-SW-24	8.66 (220)	8.03 (204)		9.49 (241)	0.46 (11.8)		8.46 (215)	(5.5)	(5.5)	0.88	1.13
	VFD-RSI-005-SW-24	()	()					,,	(***)	(****)	,	
	VFD-RSI-0F5-SW-44	7.09	6.69	10.1	9.65	0.32	6.85	7.41	0.18	0.18	0.88	_
	VFD-RSI-001-SW-44	(180)	(170)	(256.6)	(245)	(8.2)	(174.1)	(188.2)	(4.5)	(4.5)	(22.3	
3-phase												
460V	VFD-RSI-002-SW-44											
-	VFD-RSI-003-SW-44	8.66 (220)	8.03 (204)	10.19 (258.8)	9.49	0.46 (11.8)	7.91 (201)	8.46 (215)	0.22 (5.5)	0.22 (5.5)	0.88	1.13
	VFD-RSI-005-SW-44	,,	((241)						(22.3	

Units: Inches (mm)

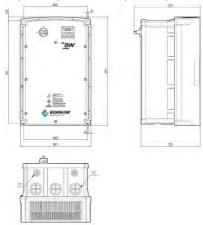
230V/460V, 7.5 HP - 10 HP (5.5~7.5kW)



Items		W1	W2	H1	H2	Н3	D1	D2	Α	Φ	T1	T2
3-phase	VFD-RSI-007-SW-24	9.84	9.13	12.91	12.13	0.43	8.94	9.5	0.24	0.24	0.88	1.13
230V	VFD-RSI-010-SW-24	(250)	(232)	(328)	(308)	(11)	(227.2)	(241.2)	(6)	(6)	(22.3)	(28.6)
3-phase	VFD-RSI-007-SW-44	9.84	9.13	12.91	12.13	0.43	8.94 (227.2)	9.5	0.24	0.24	0.88	1.13

Units: Inches (mm)

230V: 15 HP - 20 HP (11.0-15.0kW), 460V: 15 HP-30 HP (11.0~22.0kW)



Items		W1	W2	H1	H2	Н3	D1	D2	A	Ф	T1	T2
3-phase	VFD-RSI-015-SW-24	10.24	9.02	15.73	14.84	0.57	9.66	10.22	0.26		0.88	1.37
230V	VFD-RSI-020-SW-24	(260)	(229.2)	(399.6)	(377)	(14.6)	(245.4)	(259.6)	(6.5)	-	(22.3)	(34.9)

	VFD-RSI-015-SW-44	10.24	9.02	15.73	14.84	0.57	9.66	10.22	0.26		0.88	1.37
	VFD-RSI-020-SW-44	(260)	(229.2)	(399.6)	(377)	(14.6)	(245.4)	(259.6)	(6.5)		(22.3)	(34.9)
3-phase 460V												
	VFD-RSI-025-SW-44	11.81	10.66	18.11	17.19	0.61	9.84	10.39	0.28		0.88	1.75
	VFD-RSI-030-SW-44	(300)	(270.8)	(460)	(436.5)	(15.5)	(250)	(264)	(7)	-	(22.3)	(44.5)

Units: Inches (mm)

11.4 Terminal Screw Specification

Input/Output Terminal Screw Specification

S Series

Product	kW	НР	R/S/T, U/V/W Terminal Screw Size	Screw Torque in-lbs (Nm)	
	0.75	1			
	1.5	2	M3.5	7 - 8.9	
3-phase 230V	2.2	3	IVI3.3	(0.8 - 1.0)	
	3.7	5			
	5.5	7.5		400 404	
	7.5	10	M4	10.6 - 12.4 (1.2 - 1.4)	
	11	15		(1.2 1.4)	
	0.75	1			
	1.5	2	M3.5	7 - 8.9	
0	2.2	3	IVIO.0	(0.8 - 1.0)	
3-phase 460V	3.7	5			
	5.5	7.5		100 101	
	7.5	10	M4	10.6 - 12.4 (1.2 - 1.4)	
	11	15		(1.2 11.4)	

SW Series

Product	kW	НР	R/S/T, U/V/W Terminal Screw Size	Screw Torque in-lbs (Nm)		
	0.4	0.5				
	0.75	1	M3.5	7 - 8.9		
	1.5	2	IVIO.O	(0.8 - 1.0)		
0 -1	2.2	3				
3-phase 230V	3.7	5		400 404		
2001	5.5	7.5	M4	10.6 - 12.4 (1.2 - 1.4)		
	7.5	10		(1.2 1.4)		
	11	15	M5	17.7 - 21.2		
	15	20	CIVI	(2.0 - 2.4)		
	0.4	0.5				
3-phase	0.75	1	M3.5	7 - 8.9		
460V	1.5	2	1410.0	(0.8 - 1.0)		
	2.2	3				

3.7 5.5 7.5	7.5 10	M4	10.6 - 12.4 (1.2 - 1.4)		
11	15				
15	20	ME	17.7 - 21.2		
18.5	25	M5	(2.0 - 2.4)		
22	30				

Control Circuit Terminal Screw Specification

Terminal	Terminal Screw Size	Screw Torque in-lbs (Nm)
P1-P5/		1.95 - 2.21
CM/VR/V1/I2/AO/Q1/EG/24/	M2	(0.22 - 0.25)
SA,SB,SC/S+,S-,SG		
A1/B1/C1	M2.6	3.54
	IVIZ.0	(0.4)

11.5 **Braking Resistor Specification**

S Series

Product	kW	НР	Resistance (Ω)	Rated Capacity (W)
	0.75	1	300	100
	1.5	2	150	150
	2.2	3	60	300
3-phase 230V	3.7	5	50	400
2001	5.5	7.5	33	600
	7.5	10	20	800
	11	15	15	1,200
	0.75	1	1,200	100
	1.5	2	600	150
	2.2	3	300	300
3-phase 460V	3.7	5	200	400
4004	5.5	7.5	130	600
	7.5	10	85	1,000
	11	15	60	1,200

SW Series

Product	kW	HP	Resistance (Ω)	Rated Capacity (W)
	0.4	0.5	300	100
	0.75	1	150	150
	1.5	2	60	300
	2.2	3	50	400
3-phase 230V	3.7	5	33	600
2300	5.5	7.5	20	800
	7.5	10	15	1,200
	11	15	10	2,400
	15	20	8	2,400
	0.4	0.5	1,200	100
	0.75	1	600	150
	1.5	2	300	300
	2.2	3	200	400
	3.7	5	130	600
3-phase 460V	5.5	7.5	85	1,000
4004	7.5	10	60	1,200
	11	15	40	2,000
	15	20	30	2,400
	18.5	25	20	3,600
	22	30	20	3,600

- . The standard for braking torque is 150% at a working rate of 5% (%ED or duty cycle).
- . If the ED% is increased to 10%, the rated capacity (W) of the brake resistor must be doubled.
- Related parameters: Pr.66 (ED%) Range 0 30%, Ad.79 (DB Turn On Level).
- Outputs Relay1 (OU.31) or Q1 (OU.33) can be set to (31): DBWarn%ED which toggles the output when duty cycle is exceeded.

① Caution

Loose screws may cause short circuits and malfunctions. Apply the rated torque when tightening terminal screws. Overtightening terminal screws may damage the terminals. Use copper conductors only, rated at 600V, 75°C for power terminal wiring, and rated at 300V, 75°C for control terminal wiring.

11.6 Continuous Rated Current Derating

Derating based on Single Phase Input

A Single-phase power source can be safely applied to three-phase rated VFDs provided that care is taken to properly oversize the VFD. **NOTE**: The output is always three phase. Below is a summary of operating conditions that occur in the VFD when powered with a single-phase power source compared to a threephase source. For more detail, see Benshaw VFD Application Note -Sizing VFD's for use with a Single-Phase Power Source.

Frequency - The DC bus ripple becomes 120 Hz vs. the normal 360 Hz. from a three-phase power source. The result is the DC bus ripple voltage is higher and the DC Bus circuit is subject to higher stress in order for the VFD to deliver equivalent power. Output current ratings are valid for a 60 Hz single-phase power source only.

Input Current - The input current through the two phases of the diode bridge converter will approximately double

Harmonics - Input current harmonics increase resulting in current distortion levels of 90% THDi and greater compared to approximately 40% with a three-phase power source. The result is lower input power factor. A line reactor is always required. Size the reactor based on VFD rating.

Voltage - A stricter input voltage tolerance of -5% applies compared to -15% when powering the VFD with a three-phase power source. The average bus voltage will be lower than the equivalent from a three-phase power source. The minimum input voltage must be no less than 228Vac for 230 volt models and 456Vac for 460 volt models. It will be necessary to maintain a rigid incoming line voltage so that adequate motor voltage can be produced. To minimize the effect of voltage deprivation at the motor, consider operating the motor at reduced speed (reduced power) or using a motor with a base voltage that is lower than the incoming AC power source rating (EX: 480V source, 415V motor).

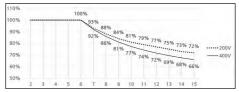
The result of all the above is that derating of the VFD's output current and horsepower is required. Improper selection of the VFD will result in poor performance and premature failure. Refer to the Input/Output Specification tables at the beginning of this Technical Specifications Chapter. Identify the VFD's rated output current with single phase input conditions. This current rating must meet or exceed the motor current rating.

Precautions

- Add a line reactor matched to the VFD rating. A three phase reactor can be wired as single phase.
 Connect single-phase power source to R(L1) and T(L3).
- · Output current ratings are valid for a 60Hz power source only.
- · Verify minimum input voltage.
- . If an input phase open fault occurs, turn off the input phase open protection (Pr.05).
- Set Motor Data and Protections Set the parameters that are related to motor information (dr.14, bA.11 ~ bA.16), overload trip (Pr.20 ~ Pr.22) and E-thermal functions (Pr.40 ~ Pr.43).

Derating based on Carrier Frequency

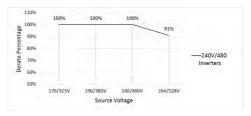
The continuous rated current of the VFD is limited based on the carrier frequency setting. Parameter Cn.04 allows for adjustment of the carrier frequency. The default setting is 3 kHz. Refer to the following graph and table for derating of output current for carrier frequency settings above 6 kHz.



	Inverter Capacity		Current Derating %									
	Heavy Duty			Carrier Frequency (kHz.)								
	kW	HP	1~6	7	8	9	10	11	12	13	14	15
3-phase 230V	0.4 - 15	0.5 - 20	100	93	88	84	81	79	77	75	73	72
3-phase 460V	0.4 - 22	0.5 - 30	100	92	86	81	77	74	72	69	68	66

Derating by Input Voltage

The continuous rated current of the VFD can be limited when higher than normal input voltages are applied. Parameter bA.19, Input Voltage settings are 240V and 480V maximum. For input voltages higher than the 240V and 480V ratings, up to a maximum of +10%, refer to the following graph for current derating percentages.



11.7 Heat Emmission

The following table provides data on the heat generated by the VFDs. Heat emissions are based on operation at room temperature and the carrier frequency set at default. The following table shows the VFDs heat emission characteristics by voltage and HP rating.

S Series

Product	kW	НР	Heat Emmission (Watts)
	0.75	1	12
	1.5	2	10
	2.2	3	40
3-phase 230V	3.7	5	42
2001	5.5	7.5	100
	7.5	10	137
	11	15	149
	0.75	1	8
	1.5	2	5
	2.2	3	28
3-phase 460V	3.7	5	26
	5.5	7.5	63
	7.5	10	95
	11	15	87

SW Series

Product	kW	НР	Heat Emmission (Watts)
	0.4	0.5	12
	0.75	1	10
	1.5	2	40
	2.2	3	42
3-phase 230V	3.7	5	100
2001	5.5	7.5	137
	7.5	10	149
	11	15	191
	15	20	302
			•
	0.4	0.5	8

890049-07-00 Technical Specification

	0.75	1	5
	1.5	2	28
	2.2	3	26
	3.7	5	63
3-phase	5.5	7.5	95
460V	7.5	10	87
	11	15	155
	15	20	169
	18.5	25	277
	22	30	287

Heat emission data is based on operations with default carrier frequencysettings, under normal operating conditions. For detailed information on carrier frequency, refer to 5.17 <u>Operational Noise Settings (carrier frequency settings)</u> on page 175.

12 Applying S Series VFDs to Single-Phase Input Application

12.1 Introduction

Single-Phase Input is available only on the S Series, not the SW Series. When applying single-phase power to a three-phase VFD, there are several constraints that need to be considered. Standard Pulse-Width-Modulated (PWM) VFDs use a 6-pulse diode rectifier. The 6-pulse rectification results in 360 Hz DC bus ripple when used with a three-phase 60 Hz supply.

However, under single-phase use, the DC bus ripple becomes 120 Hz and the VFDs DC bus circuit is subject to higher stress in order to deliver equivalent power.

Additionally, input currents and harmonics increase beyond those encountered with three-phase input.

Input current distortion of 90% THD and greater can be expected under single-phase input compared to approximately 40% with three-phase input as indicated in Figure 2.

Therefore, single-phase use requires the three-phase VFD power rating be reduced (derated) to avoid over stressing the rectifier and DC link components.

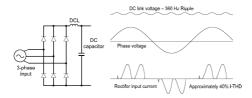


Figure-1 Typical Three-Phase Configuration

890049-07-00 Technical Specification

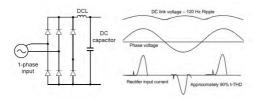


Figure-2 Typical Single-Phase Configuration

12.2 Power(HP), Input Current, and Output Current

When using a three-phase VFD with single-phase input, derating the drive's output current and horsepower will be necessary because of the increase in DC bus ripple voltage and current. In addition, the input current through the remaining two phases on the diode bridge converter will approximately double, creating another derating consideration for the VFD. Input current harmonic distortion will increase beyond that with a three-phase supply making the overall input power factor low. Input current distortion over 100% is likely under single-phase conditions without a reactor. Therefore, the reactor is always required. Do not use a motor and drive of the same rating when using single phase input. This will result in poor performance and premature drive failure. The selected drive for single-phase current ratings must meet or exceed the motor current rating.

12.3 Input Frequency and Voltage Tolerance

The single-phase current ratings are valid for 60Hz input only, The AC supply voltage must be within the required voltage range of 240/480Vac +10% to -5% to maximize motor power production. Standard product with three-phase voltage input has an allowable range of +10% to -15%. Therefore, a stricter input voltage tolerance of +10 to -5% applies when using the drive with a single-phase supply. The average bus voltage with single-phase input is lower than the equivalent of a three-phase input. The refore, the maximum output voltage (motor voltage) will be lower with a single-phase input. The minimum input voltage must be no less than 228Vac for 240 volt models and 456Vac for 480 volt models, to ensure motor voltage production of 207Vac and 415Vac, respectively. Thus, if full motor torque must be developed near base speed (full power) it will be necessary to maintain a rigid incoming line voltage so that adequate motor voltage can be produced. Operating a motor at reduced speed (reduced power), or using a motor with a base voltage that is lower than the incoming AC supply rating (ex. 208Vac motor with a 240Vac supply), will also minimize the effect of voltage deprivation. (240VAc Input +> 360V motor) wortage deprivation. (240VAc Input +> 360V motor)

UL Mark



The UL mark applies to products in the United States and Canada. This mark indicates that UL has tested and evaluated the products and determined that the products satisfy the UL standards for product safety. If a product received UL certification, this means that all components inside the product had been certified for UL standards as well.

Suitable for Installation in a compartment Handing Conditioned Air

CE mark

The CE mark indicates that the products carrying this mark comply with European safety and environmental regulations. European standards include the Machinery Directive for machine manufacturers, the Low Voltage Directive for electronics manufacturers and the EMC quidelines for safe noise control.

Low Voltage Directive

We have confirmed that our products comply with the Low Voltage Directive (EN 61800-5-1).

EMC Directive

The Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3) covers requirements stated for drives.

EAC mark



The EAC (EurAsian Conformity) mark is applied to the products before they are placed on the market of the Furasian Customs Union member states.

It indicates the compliance of the products with the following technical regulations and requirements of the Eurasian Customs Union:

Technical Regulations of the Customs Union 004/2011 "On safety of low voltage equipment" Technical Regulations of the Customs Union 020/2011 "On electromagnetic compatibility of technical products"

Manual Revision History

Revision History

No	Date	Edition	Changes
0	Dec. 2020	Initial Release	Software Version 12.89



615 Alpha Drive Pittsburgh, PA 15238 Phone: (412) 968-0100 Fax: (412) 968-5415

BENSHAW Canada 550 Bright Street Listowel, Ontario N4W 3W3 Phone: (519) 291-5112 Fax: (519) 291-2595

