5 Function Selection

5-1 List of Function

F: Fundamental Functions

Func No.	NAME	LCD Display	Setting range	Unit	Min. Unit	Factory setting		Change during operation	User Set value
						up to 25 kW	over 30 kW		
F00	Data protection	F00 DATA PRTC	0, 1	-	-	0		no	
F01	Frequency command 1	F01 FREQ CMD 1	0 to 11	-	-	0		no	
F02	Operation method	F02 OPR METHOD	0, 1	-	-	0		no	
F03	Maximum frequency 1	F03 MAX Hz-1	50 to 400 Hz	Hz	1	50		no	
F04	Base frequency 1	F04 BASE Hz-1	25 to 400 Hz	Hz	1	50		no	
F05	Rated voltage 1 (at Base frequency 1)	F05 RATED V-1	0 V: (Output voltage proportional to source voltage) 320 to 480 V	V	1	400		no	
F06	Maximum voltage 1 (at Maximum frequency 1)	F06 MAX V-1	320 to 480 V	V	1	400		no	
F07	Acceleration time 1	F07 ACC TIME1	0.01 to 3600 s	s	0.01	6.0	20.0	yes	
F08	Deceleration time 1	F08 DEC TIME1							
F09	Torque boost 1	F09 TRQ BOOST1	0.0, 0.1 to 20.0	-	0.1	0.0		yes	
F10	Electronic thermal O/L relay for motor 1 (Select)	F10 ELCTRN OL1	0, 1, 2	-	-	1		yes	
F11	(Level)	F11 OL LEVEL1	INV rated current 20 to 135 %	A	0.01	Motor rated value		yes	
F12	(Thermal time constant)	F12 TIME CNST1	0.5 to 75.0 min	min	0.1	5.0	10.0	yes	
F13	Electronic thermal O/L relay (for braking resistor)	F13 DBR OL	[Up to 11 kW] 0, 1, 2	-	-	1		yes	
			[15 kW and above] 0			0		yes	

Func No.	NAME	LCD Display	Setting range	Unit	Min. Unit	Factory setting		Change during operation	User Set value
						up to 25 kW	over 30 kW		
F14	Restart mode after momentary power failure	F14 RESTART	0 to 5	-	-	0		no	
F15	Frequency limiter (High)	F15 H LIMITER	0 to 400 Hz	Hz	1	70		yes	
F16	(Low)	F16 L LIMITER				0			
F17	Gain (for freq set signal)	F17 FREQ GAIN	0.0 to 200.0 %	%	0.1	100.0		yes	
F18	Bias frequency	F18 FREQ BIAS	-400.0 to +400.0 Hz	Hz	0.1	0.0		yes	
F20	DC brake (Starting freq.)	F20 DC BRK Hz	0.0 to 60.0 Hz	Hz	0.1	0.0		yes	
F21	(Braking level)	F21 DC BRK LVL	0 to 100 %	%	1	0		yes	
F22	(Braking time)	F22 DC BRK t	0.0s (Inactive) 0.1 to 30.0 s	s	0.1	0.0		yes	
F23	Starting frequency (Freq.)	F23 START Hz	0.1 to 60.0 Hz	Hz	0.1	0.5		no	
F24	(Holding time)	F24 HOLDING t	0.0 to 10.0 s	s	0.1	0.0		no	
F25	Stop frequency	F25 STOP Hz	0.1 to 6.0 Hz	Hz	0.1	0.2		no	
F26	Motor sound (Carrier freq.)	F26 MTR SOUND	0.75 to 15 kHz (up to 75 kW) 0.75 to 10 kHz (over 90 kW)	kHz	1	15 (up to 75 kW) 10 (over 90 kW)		yes	
F27	(Sound tone)	F27 SOUND TONE	0 to 3	-	-	0		yes	
F30	FMA (Voltage adjust)	F30 FMA V-ADJ	0 to 200 %	%	1	100		yes	
F31	(Function)	F31 FMA FUNC	0 to 10	-	-	0		yes	
F33	FMP (Pulse rate)	F33 FMP PULSES	300 to 6000 p/s (full scale)	p/s	1	1440		yes	
F34	(Voltage adjust)	F34 FMP V-ADJ	0 %, 1 to 200 %	%	1	0		yes	
F35	(Function)	F35 FMP FUNC	0 to 10	-	-	0		yes	
F36	30RY operation mode	F36 30RY MODE	0, 1	-	-	0		no	
F40	Torque limiter1 (Driving)	F40 DRV TRQ 1	20 to 200 %, 999	%	1	180	150	yes	
F41	(Braking)	F41 BRK TRQ 1	0 %, 20 to 200 %, 999	%	1	150	100	yes	
F42	Torque vector control 1	F42 TRQVECTOR1	0, 1	-	-	0		no	

E: Extension Terminal Functions

Func No.	NAME	LCD Display	Setting range	Unit	Min. Unit	Factory setting		Change during operation	User Set value
						up to 25 kW	over 30 kW		
E01	X1 terminal function	E01 X1 FUNC	0 to 32	-	-	0		no	
E02	X2 terminal function	E02 X2 FUNC				1		no	
E03	X3 terminal function	E03 X3 FUNC				2		no	
E04	X4 terminal function	E04 X4 FUNC				3		no	
E05	X5 terminal function	E05 X5 FUNC				4		no	
E06	X6 terminal function	E06 X6 FUNC				5		no	
E07	X7 terminal function	E07 X7 FUNC				6		no	
E08	X8 terminal function	E08 X8 FUNC				7		no	
E09	X9 terminal function	E09 X9 FUNC				8		no	
E10	Acceleration time 2	E10 ACC TIME2	0.01 to 3600 s	s	0.01	10.00	100.00	yes	
E11	Deceleration time 2	E11 DEC TIME2				10.00	100.00	yes	
E12	Acceleration time 3	E12 ACC TIME3				15.00	100.00	yes	
E13	Deceleration time 3	E13 DEC TIME3				15.00	100.00	yes	
E14	Acceleration time 4	E14 ACC TIME4				3.00	100.00	yes	
E15	Deceleration time 4	E15 DEC TIME4				3.00	100.00	yes	
E16	Torque limiter 2 (Driving)	E16 DRV TRQ 2	20 to 200 %, 999	%	1	180	150	yes	
E17	(Braking)	E17 BRK TRQ 2	0 %, 20 to 200 %, 999	%	1	150	100	yes	
E20	Y1 terminal function	E20 Y1 FUNC	0 to 34	-	-	0		no	
E21	Y2 terminal function	E21 Y2 FUNC				1		no	
E22	Y3 terminal function	E22 Y3 FUNC				2		no	
E23	Y4 terminal function	E23 Y4 FUNC				7		no	
E24	Y5A, Y5C terminal func.	E24 Y5 FUNC				10		no	

Func No.	NAME	LCD Display	Setting range	Unit	Min. Unit	Factory setting		Change during opera-tion	User Set value
						up to 25 kW	over 30 kW		
E25	Y5 RY operation mode	E25 Y5RY MODE	0,1	-	1	0		no	
E30	FAR function signal (Hysteresis)	E30 FAR HYSTR	0.0 to 10.0 Hz	Hz	0.1	2.5		yes	
E31	FDT1 function signal (Level)	E31 FDT1 LEVEL	0 to 400 Hz	Hz	1	50		yes	
E32	(Hysteresis)	E32 FDT1 HYSTR	0.0 to 30.0 Hz	Hz	0.1	1.0		yes	
E33	OL1 function signal (Mode select)	E33 OL1 WARNING	0: Thermal calculation 1: Output current	-	-	0		yes	
E34	(Level)	E34 OL1 LEVEL	5 to 200 %	A	0.01	Motor rated value		yes	
E35	(Timer)	E35 OL1 TIMER	0.1 to 60.0 s	s	0.1	10.0		yes	
E36	FDT2 function (Level)	E36 FDT2 LEVEL	0 to 400 Hz	Hz	1	50		yes	
E37	OL2 function (Level)	E37 OL2 LEVEL	5 to 200 %	A	0.01	Motor rated value		yes	
E40	Display coefficient A	E40 COEF A	-999.00 to 999.00	-	0.01	0.01		yes	
E41	Display coefficient B	E41 COEF B	-999.00 to 999.00	-	0.01	0.00		yes	
E42	LED Display filter	E42 DISPLAY FL	0.0 to 5.0 s	s	0.1	0.5		yes	
E43	LED Monitor (Function)	E43 LED MNTR	0 to 12	-	-	0		yes	
E44	(Display at STOP mode)	E44 LED MNTR2	0, 1	-	-	0		yes	
E45	LCD Monitor (Function)	E45 LCD MNTR	0, 1	-	-	0		yes	
E46	(Language)	E46 LANGUAGE	0 to 5	-	-	1		yes	
E47	(Contrast)	E47 CONTRAST	0 (soft) to 10 (hard)	-	-	5		yes	

C: Control Functions of Frequency

C01	Jump frequency 1	C01 JUMP Hz 1	0 to 400 Hz	Hz	1	0	yes	
C02	Jump frequency 2	C02 JUMP Hz 2				0	yes	
C03	Jump frequency 3	C03 JUMP Hz 3				0	yes	
C04	Jump frequency Hysteresis	C04 JUMP HYSTR	0 to 30 Hz	Hz	1	3	yes	

Func No.	NAME	LCD Display	Setting range	Unit	Min. Unit	Factory setting		Change during operation	User Set value
						up to 25 kW	over 30 kW		
	Multistep frequency setting								
C05	(Freq. 1)	C05 MULTI Hz-1	0.00 to 400.00 Hz	Hz	0.01	0.00		yes	
C06	(Freq. 2)	C06 MULTI Hz-2				0.00		yes	
C07	(Freq. 3)	C07 MULTI Hz-3				0.00		yes	
C08	(Freq. 4)	C08 MULTI Hz-4				0.00		yes	
C09	(Freq. 5)	C09 MULTI Hz-5				0.00		yes	
C10	(Freq. 6)	C10 MULTI Hz-6				0.00		yes	
C11	(Freq. 7)	C11 MULTI Hz-7				0.00		yes	
C12	(Freq. 8)	C12 MULTI Hz-8				0.00		yes	
C13	(Freq. 9)	C13 MULTI Hz-9				0.00		yes	
C14	(Freq. 10)	C14 MULTI Hz10				0.00		yes	
C15	(Freq. 11)	C15 MULTI Hz11				0.00		yes	
C16	(Freq. 12)	C16 MULTI Hz12				0.00		yes	
C17	(Freq. 13)	C17 MULTI Hz13				0.00		yes	
C18	(Freq. 14)	C18 MULTI Hz14				0.00		yes	
C19	(Freq. 15)	C19 MULTI Hz15				0.00		yes	
C20	JOG frequency	C20 JOG Hz	0.00 to 400.00 Hz	Hz	0.01	5.00		yes	
C21	PATTERN operation (Mode select)	C21 PATTERN	0, 1, 2	-	-	0		no	
C22	(Stage 1)	C22 STAGE 1	Operation time: 0.00 to 6000 s F1 to F4 and R1 to R4	s	0.01	0.00 F1		yes	
C23	(Stage 2)	C23 STAGE 2				0.00 F1		yes	
C24	(Stage 3)	C24 STAGE 3				0.00 F1		yes	
C25	(Stage 4)	C25 STAGE 4				0.00 F1		yes	
C26	(Stage 5)	C26 STAGE 5				0.00 F1		yes	
C27	(Stage 6)	C27 STAGE 6				0.00 F1		yes	
C28	(Stage 7)	C28 STAGE 7				0.00 F1		yes	
C30	Frequency command 2	C30 FREQ CMD 2	0 to 11	-	-	2		no	
C31	Bias (terminal [12])	C31 BIAS 12	-100.0 to +100.0 %	%	0.1	0.0		yes	
C32	Gain (terminal [12])	C32 GAIN 12	0.0 to +200.0 %	%	0.1	100.0		yes	
C33	Analog setting signal filter	C33 REF FILTER	0.00 to 5.00 s	s	0.01	0.05		yes	

P: Motor Parameters

Func No.	NAME	LCD Display	Setting range	Unit	Min. Unit	Factory setting		Change during operation	User Set value
						up to 25 kW	over 30 kW		
P01	Number of motor 1 poles	P01 M1 POLES	2 to 14	pole	2	4		no	
P02	Motor 1 (Capacity)	P02 M1-CAP	Up to 25 kW: 0.01 to 45 kW 30 kW and above: 0.01 to 500 kW	kW	0.01	Motor Capacity		no	
P03	(Rated current)	P03 M1-Ir	0.00 to 2000 A	A	0.01	Motor rated value		no	
P04	(Tuning)	P04 M1 TUN1	0, 1, 2	-	-	0		no	
P05	(On-line Tuning)	P05 M1 TUN2	0, 1	-	-	0		no	
P06	(No-load current)	P06 M1-Io	0.00 to 2000 A	A	0.01	Motor rated value		no	
P07	(%R1 setting)	P07 M1-%R1	0.00 to 50.00 %	%	0.01	Standard motor rated value		yes	
P08	(%X setting)	P08 M1-%X	0.00 to 50.00 %	%	0.01	Standard motor rated value		yes	
P09	Slip compensation control	P09 SLIP COMP1	0.00 to 15.00 Hz	Hz	0.01	0.00		yes	

H: High Performance Functions

H03	Data initializing	H03 DATA INIT	0, 1	-	-	0	no	
H04	Auto-reset (Times)	H04 AUTO-RESET	0, 1 to 10 times	-	1	0	yes	
H05	(Reset interval)	H05 RESET INT	2 to 20 s	s	1	5	yes	
H06	Fan stop operation	H06 FAN STOP	0, 1	-	-	0	yes	
H07	ACC/DEC pattern (Mode select)	H07 ACC PTN	0, 1, 2, 3	-	-	0	no	
H08	Rev. phase sequence lock	H08 REV LOCK	0, 1	-	-	0	no	
H09	Start mode	H09 START MODE	0, 1, 2	-	--	0	no	
H10	Energy-saving operation	H10 ENERGY SAV	0, 1	-	-	0	yes	
H11	DEC mode	H11 DEC MODE	0, 1	-	-	0	yes	
H12	Instantaneous OC limiting	H12 INST CL	0, 1	-	-	1	no	

Func No.	NAME	LCD Display	Setting range	Unit	Min. Unit	Factory setting		Change during operation	User Set value
						up to 25 kW	over 30 kW		
H13	Auto-restart (Restart time)	H13 RESTART t	0.1 to 10.0 s	s	0.1	0.1	0.5	no	
H14	(Freq. fall rate)	H14 FALL RATE	0.00 to 100.00 Hz/s	Hz/s	0.01	10.00		yes	
H15	(Holding DC voltage)	H15 HOLD V	400 to 600 V	V	1	470 V		yes	
H16	(OPR command selfhold time)	H16 SELFHOLD t	0.0 to 30.0s, 999	s	0.1	999		no	
H18	Torque control	H18 TRQ CTRL	0, 1, 2	-	-	0		no	
H19	Active drive	H19 AUT RED	0, 1	-	-	0		yes	
H20	PID control (Mode select)	H20 PID MODE	0, 1, 2	-	-	0		no	
H21	(Feedback signal)	H21 FB SIGNAL	0, 1, 2, 3	-	-	1		no	
H22	(P-gain)	H22 P-GAIN	0.01 to 10.00 times	-	0.01	0.10		yes	
H23	(I-gain)	H23 I-GAIN	0.0, 0.1 to 3600 s	s	0.1	0.0		yes	
H24	(D-gain)	H24 D-GAIN	0.00s , 0.01 to 10.0 s	s	0.01	0.00		yes	
H25	(Feedback filter)	H25 FB FILTER	0.0 to 60.0 s	s	0.1	0.5		yes	
H26	PTC thermistor (Mode select)	H26 PTC MODE	0, 1			0		yes	
H27	(level)	H27 PTC LEVEL	0.00 to 5.00 V	V	0.01	1.60		yes	
H28	Droop operation	H28 DROOP	-9.9 to 0.0 Hz	Hz	0.1	0.0		yes	
H30	Serial link (Function select)	H30 LINK FUNC	0, 1, 2, 3	-	-	0		yes	
H31	RS485 (Address)	H31 ADDRESS	1 to 31	-	1	1		no	
H32	(Mode select on no response error)	H32 MODE ON ER	0, 1, 2, 3	-	-	0		yes	
H33	(Timer)	H33 TIMER	0.0 to 60.0 s	s	0.1	2.0		yes	
H34	(Baud rate)	H34 BAUD RATE	0, 1, 2, 3, 4	-	-	1		yes	
H35	(Data length)	H35 LENGTH	0, 1	-	-	0		yes	
H36	(Parity check)	H36 PARITY	0, 1, 2	-	-	0		yes	
H37	(Stop bits)	H37 STOP BITS	0 (2 bit), 1 (1 bit)	-	-	0		yes	
H38	(No response error detection time)	H38 NO RES t	0 (No detection), 1 to 60 s	s	1	0		yes	
H39	(Response interval)	H39 INTERVAL	0.00 to 1.00 s	s	0.01	0.01		yes	

A: Alternative Motor Parameters

Func No.	NAME	LCD Display	Setting range	Unit	Min. Unit	Factory setting		Change during operation	User Set value
						up to 25 kW	over 30 kW		
A01	Maximum frequency 2	A01 MAX Hz-2	50 to 400 Hz	Hz	1	50		no	
A02	Base frequency 2	A02 BASE Hz-2	25 to 400 Hz	Hz	1	50		no	
A03	Rated voltage 2 (at Base frequency 2)	A03 RATED V-2	0, 320 to 480 V	V	1	400		no	
A04	Maximum voltage 2	A04 MAX V-2	320 to 480 V	V	1	400		no	
A05	Torque boost2	A05 TRQ BOOST2	0.0, 0.1 to 20.0	-	-	0.0		yes	
A06	Electronic thermal O/L relay for motor 2 (Select)	A06 ELCTRN OL2	0, 1, 2	-	-	1		yes	
A07	(Level)	A07 OL LEVEL2	INV rated current 20 % to 135 %	A	0.01	Motor rated value		yes	
A08	(Thermal time constant)	A08 TIME CNST2	0.5 to 75.0 min	min	0.1	5.0	10.0	yes	
A09	Torque vector control 2	A09 TRQVECTOR2	0, 1	-	-	0		no	
A10	Number of motor-2 poles	A10 M2 POLES	2 to 14 poles	pole	2	4		no	
A11	Motor 2 (Capacity)	A11 M2-CAP	Up to 25 kW: 0.01 to 45 kW 30 kW and above: 0.01 to 500 kW	kW	0.01	Motor capacity		no	
A12	(Rated current)	A12 M2-Ir	0.00 to 2000 A	A	0.01	Motor rated value		no	
A13	(Tuning)	A13 M2 TUN1	0, 1, 2	-	-	0		no	
A14	(On-line Tuning)	A14 M2 TUN2	0, 1	-	-	0		no	
A15	(No-load current)	A15 M2-Io	0.00 to 2000 A	A	0.01	Motor rated value		no	
A16	(%R1 setting)	A16 M2-%R1	0.00 to 50.00 %	%	0.01	Standard motor rated value		yes	
A17	(%X setting)	A17 M2-%X	0.00 to 50.00 %	%	0.01	Standard motor rated value		yes	
A18	(Slip compensation control 2)	A18 SLIP COMP2	0.00 to 15.00 Hz	Hz	0.01	0.00		yes	

5-2 Function Explanation

F: Fundamental functions

F00 Data protection

- Setting can be made so that a set value cannot be changed by keypad panel operation.

F	0	0	D	A	T	A		P	R	T	C	

Set value 0 : The data can be changed.
1 : The data cannot be changed.

[Setting procedure]

0 to 1: Press the STOP and ∧ keys simultaneously to change the value from 0 to 1, then press the FUNC DATA to validate the change.

1 to 0: Press the STOP and ∨ keys simultaneously to change the value from 1 to 0, then press the FUNC DATA key to validate the change.

F01 Frequency setting 1

- This function selects the frequency setting method.

Related functions:
E01 to **E09**, **C30**

F	0	1	F	R	E	Q		C	M	D	1	

0: Setting by keypad panel operation (∧ ∨ key)
1: Setting by voltage input (terminal [12] (0 to +10 V) + terminal [V2](0 to +10 V))
2: Setting by current input (terminal [C1] (4 to 20 mA)).
3: Setting by voltage input + current input (terminal [12] +terminal [C1]) (-10 to +10 V + 4 to 20 mA).
4: Reversible operation with polarity (terminal [12] (-10 to +10 V))
5: Reversible operation with polarity (terminal [12]+[V2]+[V1](Option[1)]) (-10 to +10 V))
6: Inverse mode operation (terminal [12] +[V2] (+10 V to 0))

Related functions:
E01 to **E09** (Set value **21**)

7: Inverse mode operation (terminal [C1] (20 to 4 mA))

Related functions:
E01 to **E09** (Set value **21**)

8: Setting by UP/DOWN control mode 1 (initial value = 0) (terminals [UP] and [DOWN])

Related functions:
E01 to **E09** (Set value **17, 18**)

9: Setting by UP/DOWN control mode 2 (initial value = last final value) (terminals [UP] and [DOWN]) See the function explanation of E01 to E09 for details.

Related functions:
E01 to **E09** (Set value **17, 18**)

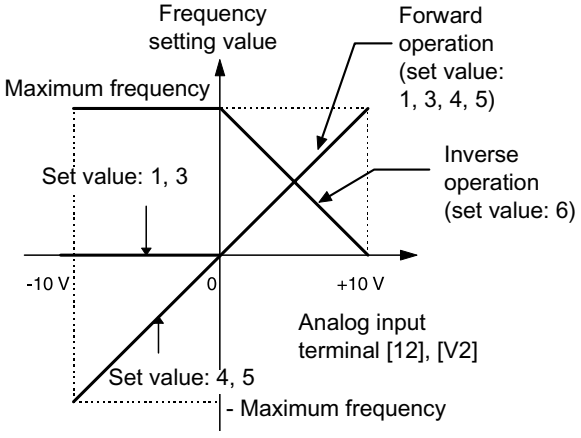
10: Setting by pattern operation. See the function explanation C21 to C28 for details.

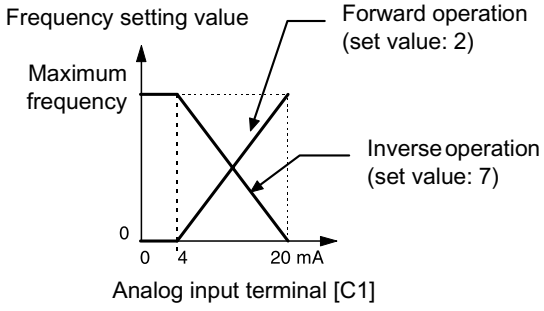
Related functions:
C21 to **C28**

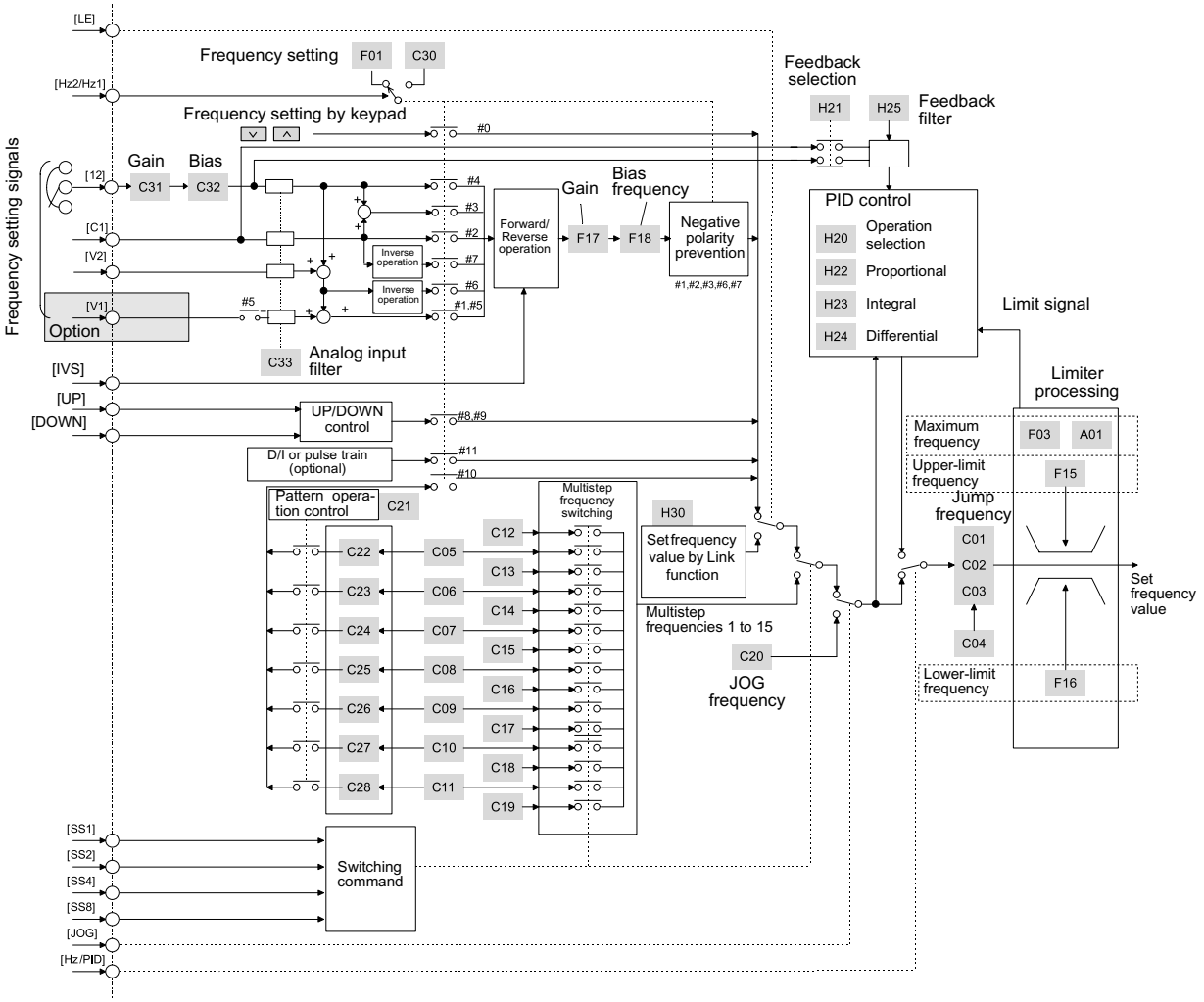
11: Setting by digital input or pulse train input. Optional[1)].

1) For details, see the instruction manual on options.

Forward / Inverse operation







Frequency setting block diagram

F02 Operation method

- This function sets the operation command input method.

F	0	2	O	P	R		M	E	T	H	O	D

Set value

0: Keypad operation
(FWD REV STOP keys).
Press the FWD for forward operation.
Press the REV for reverse operation.
Press the STOP for deceleration to a stop.
Input from terminals [FWD] and [REV] is ignored.

1: Operation by external input (terminals [FWD] and [REV]).

This function can only be changed when terminals FWD and REV are open.
REMOTE/LOCAL switching from the keypad panel automatically changes the set value of this function.

F03 Maximum output frequency 1

- This function sets the maximum output frequency for motor 1.

F	0	3	M	A	X		H	z	-	1		

Setting range: 50 to 400 Hz

Setting a value higher than the rated value of the device to be driven may damage the motor or machine. Match the rating of the device.

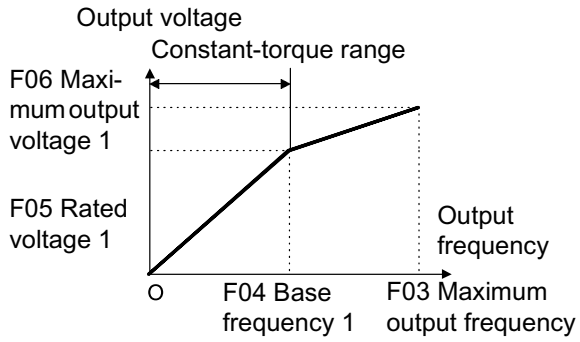
F04 Base frequency 1

- This function sets the maximum output frequency in the constant-torque range of motor 1 or the output frequency at the rated output voltage. Match the rating of the motor.

F	0	4	B	A	S	E		H	z	-	1	

Setting range: 25 to 400 Hz

Note: When the set value of base frequency 1 is higher than that of maximum output frequency 1, the output voltage does not increase to the rated voltage because the maximum frequency limits the output frequency.



F05 Rated voltage 1

- This function sets the rated value of the voltage output to motor 1. Note that a voltage greater than the supply (input) voltage cannot be output.

F	0	5	R	A	T	E	D		V	-	1	

Setting range: 0, 320 to 480 V

Value 0 terminates operation of the voltage regulation function, thereby resulting in the output of a voltage proportional to the supply voltage.

Note: When the set value of rated voltage 1 exceeds maximum output voltage 1, the output voltage does not increase to the rated voltage because the maximum output voltage limits the output voltage.

F06 Maximum output voltage 1

- This function sets the maximum value of the voltage output for motor 1. Note that a voltage higher than the supply (input) voltage cannot be output.

F	0	6	M	A	X		V	-	1			

Setting range: 320 to 480 V

F07 Acceleration time 1
F08 Deceleration time 1

- This function sets the acceleration time for the output frequency from startup to maximum frequency and the deceleration time from maximum frequency to operation stop.

F	0	7	A	C	C		T	I	M	E	1	
F	0	8	D	E	C		T	I	M	E	1	

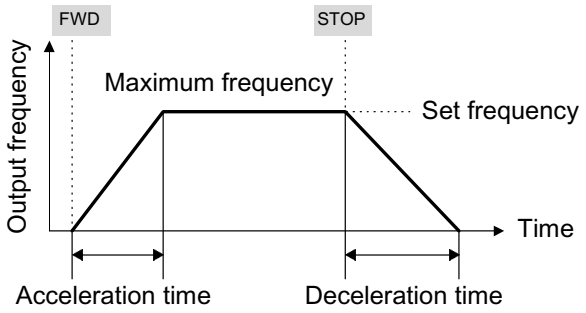
Setting range

Acceleration time 1:
0.01 to 3,600 seconds

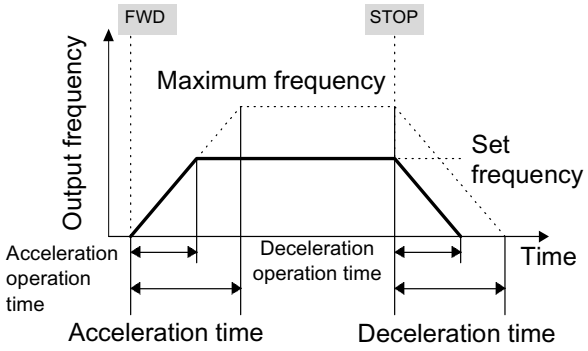
Deceleration time 1:
0.01 to 3,600 seconds

Acceleration and deceleration times are represented by the three most significant digits, thereby the setting of three high-order digits can be set.
Set acceleration and deceleration times with respect to maximum frequency. The relationship between the set frequency value and acceleration/deceleration times is as follows:

Set frequency = maximum frequency
The actual operation time matches the set value.



Set frequency < maximum frequency
The actual operation time differs from the set value.
Acceleration (deceleration) operation time = set value x (set frequency/maximum frequency)



Note: If the set acceleration and deceleration times are too short even though the resistance torque and moment of inertia of the load are great, the torque limiting function or stall prevention function becomes activated, thereby prolonging the operation time beyond that stated above.

F09 Torque boost 1

- This is a motor 1 function. The following can be selected:

F	0	9	T	R	Q		B	O	O	S	T	1

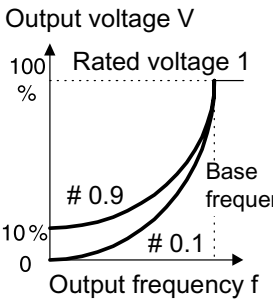
-- Selection of load characteristics such as automatic torque boost, square law reduction torque load, proportional torque load, constant torque load.

-- Enhancement of torque (V/f characteristics), which is lowered during low-speed operation. Insufficient magnetic flux of the motor due to a voltage drop in the low-frequency range can be compensated.

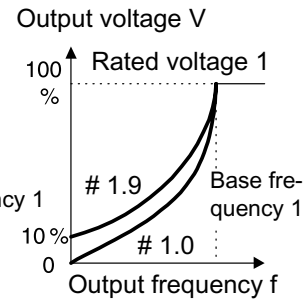
Setting range	Characteristics selected
0.0	Automatic torque boost characteristic where the torque boost value of a constant torque load (a linear change) is automatically adjusted.
0.1 to 0.9	Square law reduction torque for fan and pump loads.
1.0 to 1.9	Proportional torque for middle class loads between square law reduction torque and constant torque (linear change)
2.0 to 20.0	Constant torque (linear change)

- Torque characteristics

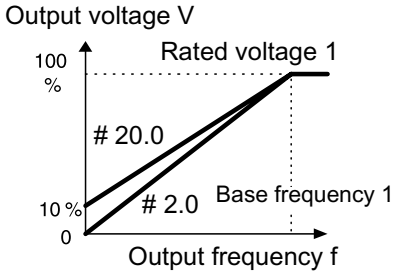
Square law reduction torque



Proportional torque



Constant torque



Note: As a large torque boost value creates overexcitation in the low-speed range, continued operation may cause the motor to overheating. Check the characteristics of the driven motor.

F10 Electronic thermal O/L relay for motor 1 (Select)

F11 Electronic thermal O/L relay for motor 1 (Level)

F12 Electronic thermal O/L relay for motor 1 (Thermal time constant)

The electronic thermal O/L relay manages the output frequency, output current, and operation time of the inverter to prevent the motor from overheating when 150 % of the set current value flows for the time set by F12 (thermal time constant).

- This function specifies whether to operate the electronic thermal O/L relay and selects the target motor. When a general-purpose motor is selected, the operation level is lowered in the low speed range according to the cooling characteristics of the motor.

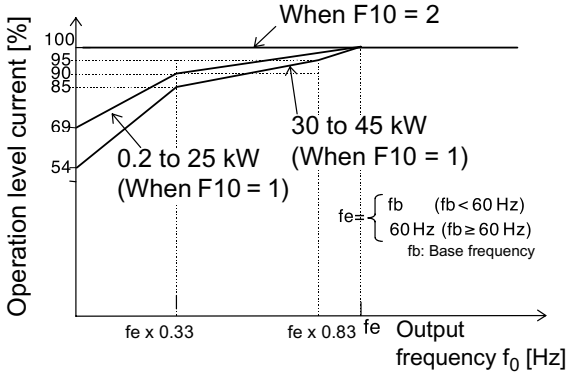
F	1	0	E	L	C	T	R	N		O	L	1

Set value 0: Inactive
1: Active
(for general-purpose motor)
2: Active (for inverter motor)

- This function sets the operation level (current value) of the electronic thermal O/L relay. Enter a value from 1 to 1.1 times the current rating value of the motor.

F	1	1	O	L		L	E	V	E	L	1	

The setting range is 5 to 135 % of the rated current of the inverter.

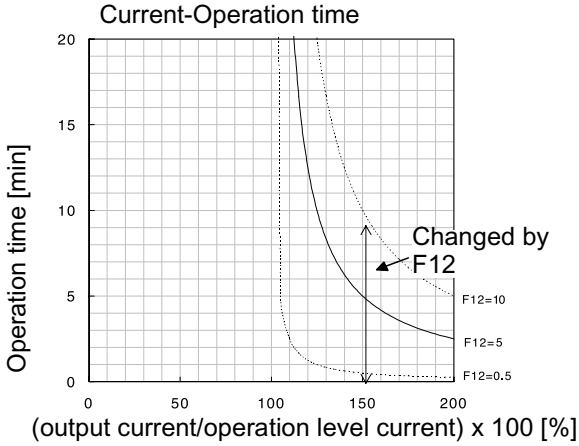


Operation level current and output

- The time from when 150 % of the operation level current flows continuously to when the electronic thermal O/L relay activates can be set.

F	1	2	T	I	M	E		C	N	S	T	1

The setting range is 0.5 to 75.0 minutes (in 0.1 minute steps).



5

F13 Electronic thermal O/L relay (for braking resistor)

- This function controls the frequent use and continuous operating time of the braking resistor to prevent the resistor from overheating.

.

F	1	3	D	B	R		O	L				

Inverter capacity	Operation
11 kW or less	0: Inactive 1: Active (built-in braking resistor) 2: Active (external braking resistor)
15 kW or more	0: Inactive

F14 Restart after momentary power failure (operation selection)

- This function selects operation if a momentary power failure occurs.
  The function for detecting power failure and activating protective operation (i.e., alarm output, alarm display, inverter output cutoff) for undervoltage can be selected.
  The automatic restart function (for automatically restarting a coasting motor without stopping) when the supply voltage is recovered can also be selected.

F	1	4	R	E	S	T	A	R	T			

Setting range: 0 to 5

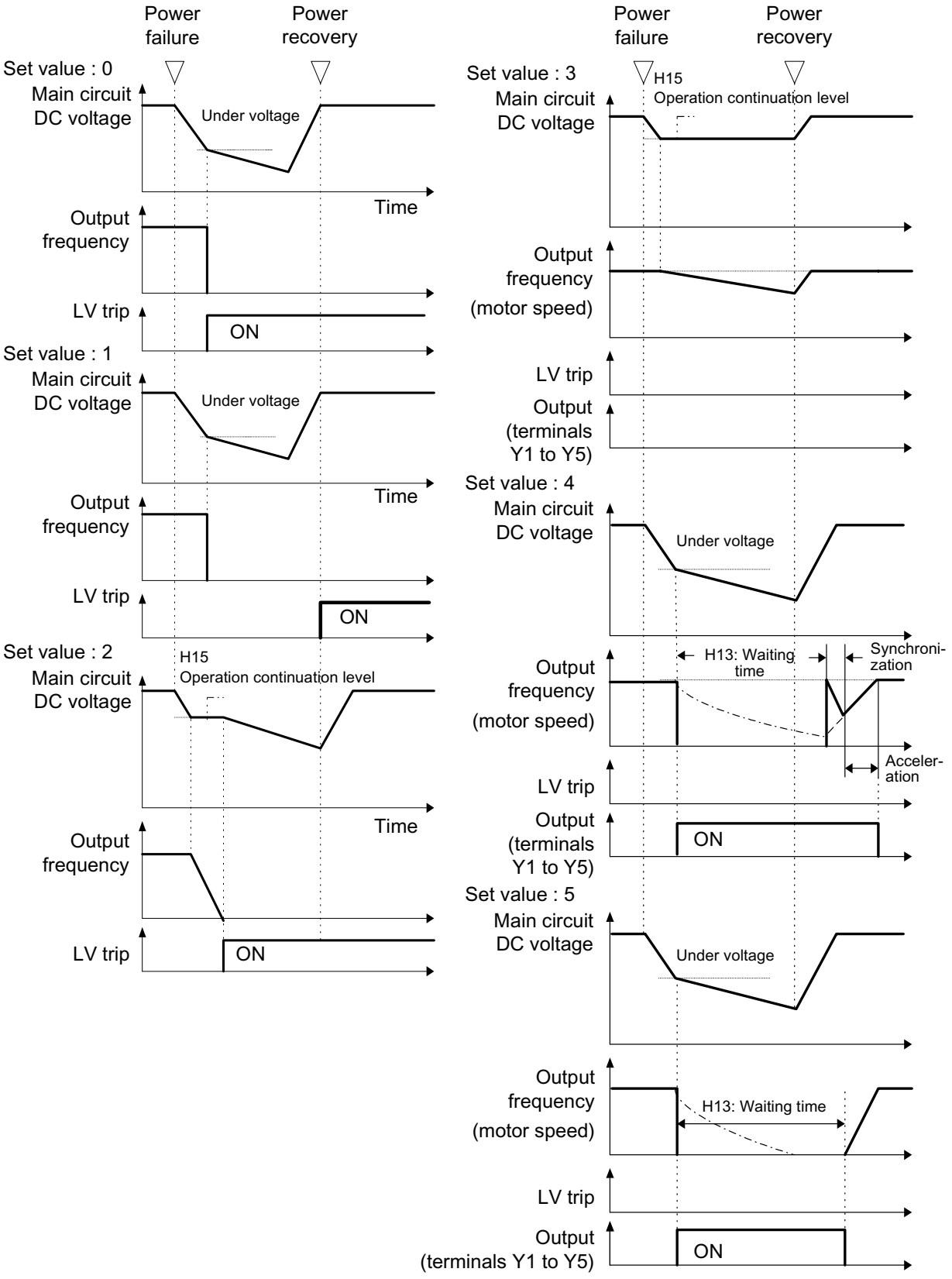
The following table lists the function details.

Set value	Function name	Operation at power failure	Operation at power recovery
0	Inactive (immediate inverter trip)	If undervoltage is detected, the drive will immediately trip and an undervoltage fault (LU) is displayed. The drive output stops and the motor will coast to a stop.	The drive operation is not automatically restarted. Input a reset command and operation command to restart operation.
1	Inactive (inverter trip at recovery)	If undervoltage is detected, the drive output stops and the motor will immediately coast to a stop. A drive fault is not activated	An undervoltage fault (LU) is activated at power recovery. Drive operation is not automatically restarted. Input a reset command to restart operation.
2	Inactive (inverter trip after deceleration to a stop at power failure)	When the DC bus voltage reaches the continue operation voltage level (H15), a controlled deceleration to a stop occurs. The inverter collects the inertia energy of the load to maintain the DC bus voltage and controls the motor until it stops, then an undervoltage fault (LU) is activated. The drive will automatically decrease the deceleration time if necessary. If the amount of inertia energy from the load is small, and the undervoltage level is achieved before the motor stops, the undervoltage fault is immediately activated and the motor will coast to a stop.	The drive operation is not automatically restarted. Input a reset command and operation command to restart operation.

Set value	Function name	Operation at power failure	Operation at power recovery
3	Active (operation ride through, for high-inertia loads)	When the DC bus voltage reaches the continue operation voltage level (H15), energy is collected from the inertia of the load to maintain the DC bus voltage and extend the ride through time. The drive will automatically adjust the deceleration rate to maintain DC bus voltage level. If undervoltage is detected, the protective function is not activated, but drive output stops and the motor coast to a stop.	Operation is automatically restarted. For power recovery during ride-through the drive will accelerate directly to the original frequency. If undervoltage is detected, operation automatically restarts with the frequency at the time that the undervoltage is detected.
4	Active (restart with the frequency at power failure)	If undervoltage is detected, the protective function is not activated. The drive output stops and the motor will coast to a stop.	Operation is automatically restarted with the frequency at power failure.
5	Active (restart with the start frequency, for low-inertia loads)	If undervoltage is detected, the protective function is not activated, but output stops.	Operation is automatically restarted with the frequency set by F23, "Starting frequency."

Function codes H13 to H16 are provided to control a restarting operation after momentary power failure. These functions should be understood and used.
The pick-up (speed search) function can also be selected as a method of restarting when power is recovered following a momentary failure. (For setting details, see function code H09).
The pick-up function searches for the speed of the coasting motor to restart the motor without subjecting it to excessive shock.
In a high-inertia system, the reduction in motor speed is minimal even when the motor is coasting.

A speed searching time is required when the pick-up function is active. In such a case, the original frequency may be recovered sooner when the function is inactive and the operation restarted with the frequency prior to the momentary power failure.
The pick-up function works in the range of 5 to 120 Hz. If the detected speed is outside this range, restart the motor using the regular restart function.



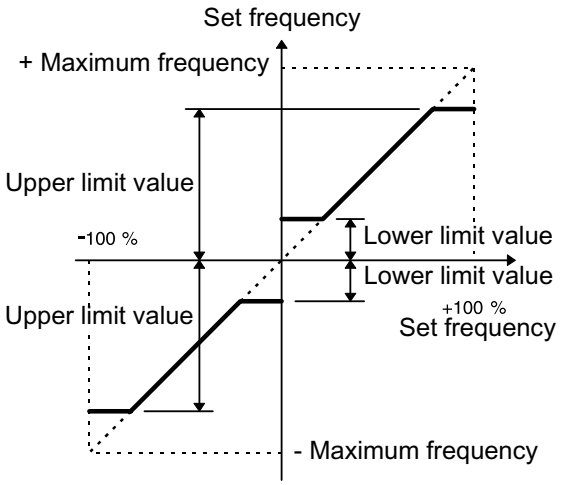
Note: Dotted-dashed lines indicate motor speed.

F15 Frequency limiter (High)
F16 Frequency limiter (Low)

- This function sets the upper and lower limits for the setting frequency.

F	**1**	**5**	H		L	I	M	I	T	E	R	
F	**1**	**6**	L		L	I	M	I	T	E	R	

Set values: 0 to 400 Hz



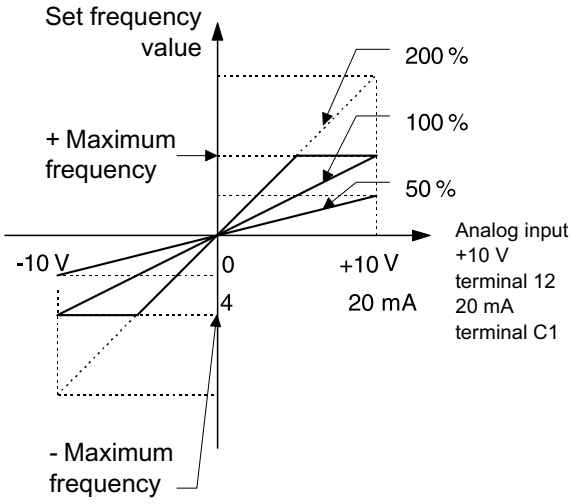
- The inverter output starts with the start frequency when operation begins, and stops with the stop frequency when operation ends.
- If the upper limit value is less than the lower limit value, the upper limit value overrides the lower limit value.

F17 Gain

- This function sets the rate of the set frequency value to analog input.

F	**1**	**7**	F	R	E	Q		G	A	I	N	

Operation follows the figure below.

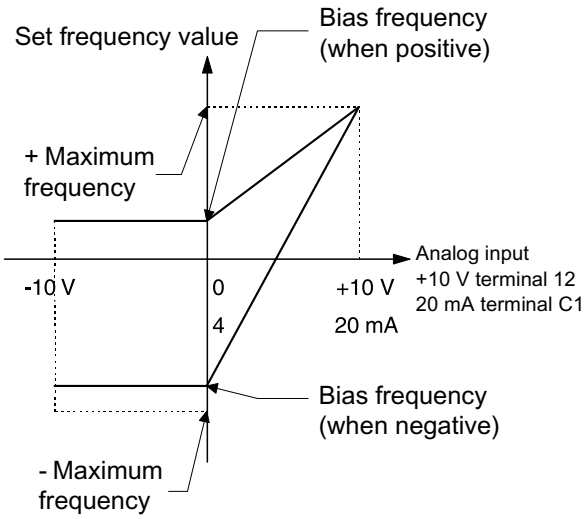


F18 Bias frequency

- This function adds a bias frequency to the set frequency value to analog input.

F	**1**	**8**	F	R	E	Q		B	I	A	S	

The operation follows the figure below.
When the bias frequency is higher than the maximum frequency or lower than the - maximum frequency, it is limited to the maximum or - maximum frequency.



When this function is used with function F17 (bias frequency), the gain set with this function is valid and the gained frequency is biased.

F20 DC brake (Starting frequency)
F21 DC brake (Braking level)
F22 DC brake (Braking time)

- Starting frequency: This function sets the frequency with which to start a DC injection brake to decelerate the motor to a stop.

F	**2**	**0**	D	C		B	R	K		H	z	

Set values: 0 to 60 Hz

- Operation level: This function sets the output current level when a DC injection brake is applied. Set a percentage of inverter rated output current in 1 % steps.

F	2	1	D	C		B	R	K		L	V	L

Set values: 0 to 100 %

- Time: This function sets the time of a DC injection brake operation.

F	2	2	D	C		B	R	K		t		

Set value 0.0: Inactive
0.1 to 30.0 seconds

CAUTION
Do not use the inverter brake function for mechanical holding.
Injury may result.

5

F23 Starting frequency (frequency)
F24 Starting frequency (Holding time)
F25 Stop frequency

The starting frequency can be set to reserve the torque at startup and can be sustained until the magnetic flux of the motor is being established.

- Frequency: This function sets the frequency at startup.

F	2	3	S	T	A	R	T		H	z		

Set values: 0.1 to 60 Hz

- Holding time: This function sets the holding time during which the start frequency is sustained at startup.

F	2	4	H	O	L	D	I	N	G		t	

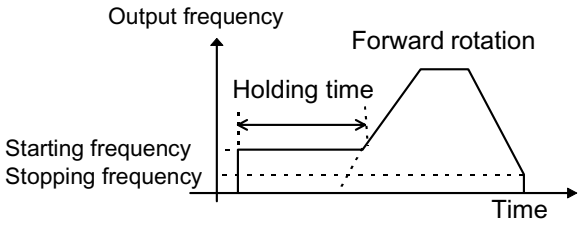
Set values: 0.1 to 10.0 seconds

- The holding time does not apply at the time of switching between forward and reverse.
- The holding time is not included in the acceleration time.
- The holding time also applies when pattern operation (C21) is selected. The holding time is included in the timer value.

- This function sets the frequency at stop.

F	2	5	S	T	O	P		H	z			

Set values: 0.0 to 6.0 Hz



The operation does not start when the setting frequency is less than the stopping frequency.

F26 Motor sound (carrier frequency)

- This function adjusts the carrier frequency, correct adjustment of which prevents resonance with the machine system, reduces motor and inverter noise, and also reduces leakage current from output circuit wiring.

F	2	6	M	T	R		S	O	U	N	D	

Series	Nominal applied motor	Setting range
GVX2000	75 kW or less	0.75 to 15 kHz
	90 kW or more	0.75 to 10 kHz

Carrier frequency	Low	High
Motor noise	High	Low
Output current waveform	Bad	Good
Leakage current	Small amount	Large amount
Noise occurrence	Extremely low	High

Notes:

1. Reducing the set value adversely affects the output current waveform (i.e., higher harmonics), increases motor loss, and raises motor temperature. For example, at 0.75 kHz, reduce the motor torque by about 15 %.
2. Increasing the set value increases inverter loss and raises inverter temperature.

F27 Motor sound (sound tone)

- The tone of motor noise can be altered when the carrier frequency is 7 kHz or lower. Use this function as required.

F	2	7	M	T	R		T	O	N	E		

Set values: 0, 1, 2, 3

F30 FMA (Voltage adjust)

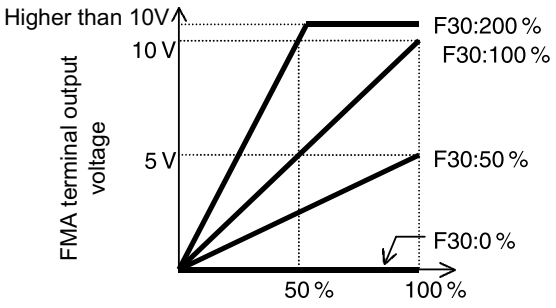
F31 FMA (Function)

Monitor data (e.g.,output frequency, output current) can be output to terminal FMA as a DC voltage. The amplitude of the output can also be adjusted.

- This function adjusts the voltage value of the monitor item selected in F31 when the monitor amount is 100 %. A value from 0 to 200 % can be set in 1 % steps.

F	3	0	F	M	A		V	-	A	D	J	

Set values: 0 to 200 %



- This function selects the monitor item to be output to terminal FMA.

F	3	1	F	M	A		F	U	N	C		

Set value	Monitor item	Definition of 100 % monitor amount
0	Output frequency 1 (before slip compensation)	Maximum output frequency
1	Output frequency 2 (after slip compensation)	Maximum output frequency
2	Output current	Rated output current of inverter x 2
3	Output voltage	400 V series: 500 V
4	Output torque	Rated torque of motor x 2
5	Load rate	Rated load of motor x 2
6	Power consumption	Rated output of inverter x 2
7	PID feedback amount	Feedback amount of 100 %
8	PG feedback amount (only when option is installed)	Synchronous speed at maximum frequency
9	DC link circuit voltage	400 V series: 1,000 V
10	Universal AO	0 to 10 V output through communication and not related to inverter operation.

F33 FMP (Pulse rate)

F34 FMP (Voltage adjust)

F35 FMP (Function)

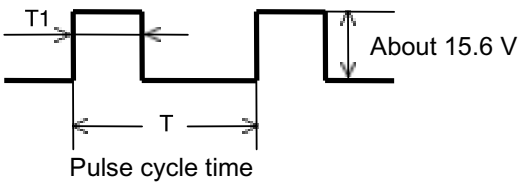
Monitor data (e.g., output frequency, output current) can be output to terminal FMP as pulse voltage. Monitor data can also be sent to an analog meter as average voltage.

When sending data to a digital counter or other instrument as pulse output, set the pulse rate in F33 to any value and the voltage in F34 to 0 %. When data is sent to an analog meter or other instrument as average voltage, the voltage value set in F34 determines the average voltage and the pulse rate in F33 is fixed to 2670 (p/s).

- This function sets the pulse frequency of the monitor item selected in F35 within a range of 300 to 6000 (p/s) in 1 p/s steps.

F	3	3	F	M	P		P	U	L	S	E	S

Set values: 300 to 6,000 p/s



Pulse frequency (p/s) = 1/T
Duty (%) = T1/T x 100
Average voltage (V) = 15.6 x T1/T

- This function sets the average voltage of pulse output to terminal FMP.

F	3	4	F	M	P		V	-	A	D	J	

Set value

0 %: The pulse frequency varies depending on the monitor amount of the monitor item selected in F35.
(The maximum value is the value set in F33).

1 to 200 %:
Pulse frequency is fixed at 2,670 p/s. The average voltage of the monitor item selected in F35 when the monitor amount is 100 % is adjusted in the 1 to 200 % range (1 % steps).
(The pulse duty varies).

- This function selects the monitor item to be output to terminal FMP.

F	3	5	F	M	P		F	U	N	C		

The set value and monitor items are the same as those of F31.

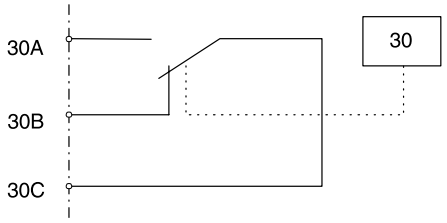
F36 30Ry operation mode

- This function specifies whether to activate (excite) the alarm output relay (30Ry) for any fault at normal or alarm status.

F	3	6	3	0	R	Y		M	O	D	E	

Set value	Operation
0	At normal 30A - 30C: OFF, 30B - 30C: ON At abnormal 30A - 30C: ON, 30B - 30C: OFF
1	At normal 30A - 30C:ON, 30B - 30C: OFF At abnormal 30A - 30C: OFF, 30B - 30C: ON

- When the set value is 1, contacts 30A and 30C are connected when the inverter control voltage is established (about one second after power on).



F40 Torque limiter 1 (Driving)
F41 Torque limiter 1 (Braking)

- The torque limit operation calculates motor torque from the output voltage, current and the primary resistance value of the motor, and controls the frequency so the calculated value does not exceed the limit. This operation enables the inverter to continue operation under the limit even if a sudden change in load torque occurs.

- Select limit values for the driving torque and braking torque.
- When this function is activated, acceleration and deceleration operation times are longer than the set values.

F	**4**	**0**	D	R	V		T	R	Q	1		
F	**4**	**1**	B	R	K		T	R	Q	1		

Function	Set value	Operation
Torque limit (driving)	20 % to 200 %	The torque is limited to the set value.
	999	Torque limiting inactive
Torque limit (braking)	20 % to 200 %	The torque is limited to the set value.
	0	Prevents OU trip due to power regeneration effect automatically.
	999	Torque limiting inactive

WARNING

When the torque limit function is selected, an operation may not match the set acceleration and deceleration time or set speed. The machine should be so designed that safety is ensured even when operation does not match set values.

F42 Torque vector control 1

- To obtain the motor torque most efficiently, the torque vector control calculates torque according to load, to adjust the voltage and current vectors to optimum values based on the calculated value.

F	**4**	**2**	T	R	Q	V	E	C	T	O	R	1

Set value	Operation
0	Inactive
1	Active

Related functions:
P01 to **P09**

- When 1 (Active) is set, the set values of the following functions differ from the written values:

1. F09 Torque boost 1
   Automatically set to 0.0 (automatic torque boosting).
2. P09 Slip compensation amount
   Slip compensation is automatically activated. When 0.0 is set, the amount of slip compensation for a standard 3-phase motor is applied. Otherwise, the written value is applied.

- Use the torque vector control function under the following conditions:

1. There must be only one motor.
   Connection of two or more motors makes accurate control difficult.
2. The function data (rated current P03, no-load current P06, %R1 P07, and %X P08) of motor 1 must be correct.
3. When the standard 3-phase motor is used, setting the capacity (function P02) ensures entry of the above data. An auto tuning operation should be performed for other motors.
4. The rated current of the motor must not be significantly less than the rated current of the inverter. A motor two ranks lower in capacity than the nominal applied motor for the inverter should be used at the smallest (depending on the model).
5. To prevent leakage current and ensure accurate control, the length of the cable between the inverter and motor should not exceed 50 m.
6. When a reactor is connected between the inverter and the motor and the impedance of the wiring cannot be disregarded, use P04, "Auto tuning," to rewrite data.

If these conditions are not satisfied, set 0 (Inactive).

E: Extension Terminal Functions

E01 **Terminal X1**
~
E09 **Terminal X9**

- Each function of digital input terminals X1 to X9 can be set as codes.

E	**0**	**1**	X	1		F	U	N	C			
E	**0**	**2**	X	2		F	U	N	C			
E	**0**	**3**	X	3		F	U	N	C			
E	**0**	**4**	X	4		F	U	N	C			
E	**0**	**5**	X	5		F	U	N	C			
E	**0**	**6**	X	6		F	U	N	C			
E	**0**	**7**	X	7		F	U	N	C			
E	**0**	**8**	X	8		F	U	N	C			
E	**0**	**9**	X	9		F	U	N	C			

Set value	Function
0, 1, 2, 3	Multistep frequency selection (1 to 15 steps) [SS1], [SS2], [SS4], [SS8]
4, 5	Acceleration and deceleration time selection (3 steps) [RT1], [RT2]
6	3-wire operation stop command [HLD]
7	Coast-to-stop command [BX]
8	Alarm reset [RST]
9	External fault [THR]
10	Jogging operation [JOG]
11	Frequency setting 2/frequency setting 1 [Hz2/Hz1]
12	Motor 2/Motor 1 [M2/M1]
13	DC brake command [DCBRK]
14	Torque limit 2/Torque limit 1 [TL2/TL1]
15	Switching operation between line and inverter (50 Hz) [SW50]
16	Switching operation between line and inverter (60 Hz) [SW60]
17	UP command [UP]
18	DOWN command [DOWN]
19	Write enable for KEYPAD (data change permission) [WE-KP]
20	PID control cancel [Hz/PID]
21	Inverse mode changeover (terminals 12 and C1) [IVS]
22	Interlock signal (52-2) [IL]
23	Torque control cancel [Hz/TRQ]
24	Link enable (RS485 standard, BUS) [LE]
25	Universal DI [U-DI]
26	Pick up start mode [STM]
27	SY-PG enable (Option) [PG/Hz]
28	Synchronization command (Option) [SYC]
29	Zero speed command with PG option [ZERO]
30	Forced stop command with deceleration [STOP1]
31	Forced stop command with deceleration time 4 [STOP2]
32	Pre-exiting command with PG option [EXITE]

Note: Data numbers which are not set in the functions from E01 to E09, are assumed to be inactive.

0, 1, 2, 3 - Multistep frequency selection

The frequency can be switched to a preset frequency in function codes C05 to C19 by switching the external digital input signal. Assign values 0 to 3 to the target digital input terminal. The combination of input signals determines the frequency.

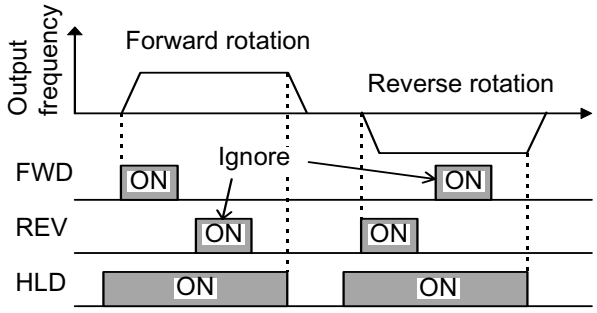
Combination of set value input signals				Frequency selected	
0 [SS1] (X1)	1 [SS2] (X2)	2 [SS4] (X3)	3 [SS8] (X4)		
off	off	off	off	Assigned by F01 or C30	
on	off	off	off	C05 MULTI Hz-1	Related functions: **C05** to **C19** Setting range 0.00 to 400.00 Hz
off	on	off	off	C06 MULTI Hz-2	
on	on	off	off	C07 MULTI Hz-3	
off	off	on	off	C08 MULTI Hz-4	
on	off	on	off	C09 MULTI Hz-5	
off	on	on	off	C10 MULTI Hz-6	
on	on	on	off	C11 MULTI Hz-7	
off	off	off	on	C12 MULTI Hz-8	
on	off	off	on	C13 MULTI Hz-9	
off	on	off	on	C14 MULTI Hz-10	
on	on	off	on	C15 MULTI Hz-11	
off	off	on	on	C16 MULTI Hz-12	
on	off	on	on	C17 MULTI Hz-13	
off	on	on	on	C18 MULTI Hz-14	
on	on	on	on	C19 MULTI Hz-15	

4, 5 - Acceleration and deceleration time selection

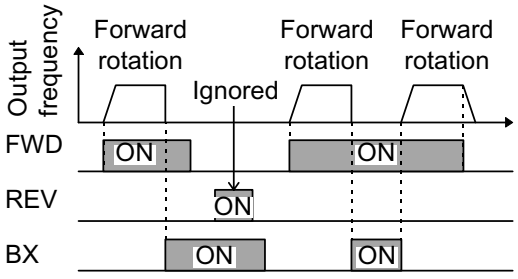
The acceleration and deceleration time can be switched to a preset time in function codes E10 to E15 by switching the external digital input signal. Assign values 4 and 5 to the target digital input terminal. The combination of input signals determines the acceleration and deceleration times.

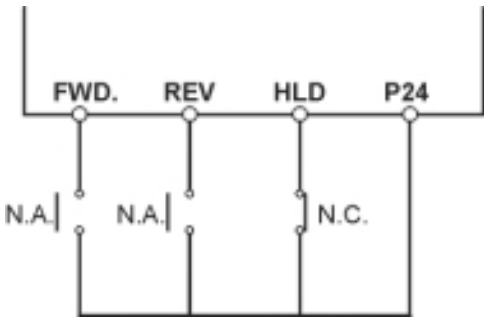
Combination of set value input signals		Acceleration and deceleration times selected	
4 [RT1] (X5)	5 [RT2] (X6)		
off	off	F07 ACC TIME1 F08 DEC TIME1	Related functions: **F07~F08** **E10~E15**
on	off	E10 ACC TIME2 E11 DEC TIME2	
off	on	E12 ACC TIME3 E13 DEC TIME3	
on	on	E14 ACC TIME4 E15 DEC TIME4	

6 - 3 wire operation stop command [HLD]
This selection is used for 3-wire operation. The FWD or REV signal is self-held when [HLD] is on, and the self-hold is cleared when [HLD] is turned off. To use this [HLD] terminal function, assign 6 to the target digital input terminal.



7 - Coast-to-stop command [BX]
When BX and P24 are connected, inverter output is cut off immediately and the motor starts to coast-to-stop. An alarm signal is neither output nor self-held. If BX and P24 are disconnected when the operation command (FWD or REV) is on, operation starts at the start frequency. To use this BX terminal function, assign value "7" to the target digital input terminal.





3 wire operation command

8 - Alarm reset [RST]
When an inverter trip occurs, connecting RST and P24 clears the alarm output (for any fault); disconnecting them clears trip indication and re-starts operation. To use this RST terminal function, assign value "8" to the target digital input terminal.

9 - External fault [THR]
Disconnecting THR and P24 during operation cuts off inverter output (i.e., motor starts to coast-to-stop) and outputs alarm OH2, which is self-held internally and cleared by RST input. This function is used to protect an external brake resistor and other components from overheating. To use this THR terminal function, assign value "9" to the target digital input terminal. ON input is assumed when this terminal function is not set.

10 - Jogging operation [JOG]
This function is used for jogging (inching) operation to position a work piece. When JOG and P24 are connected, the operation is performed with the jogging frequency set in function code C20 while the operation command (FWD-P24 or REV-P24) is on. To use this JOG terminal function, assign value "10" to the target digital input terminal.

11 - Frequency setting 2/frequency setting 1 [Hz2/Hz1]
This function switches the frequency setting method set in function codes F01 and C30 by an external digital input signal.

Set value input signal	Frequency setting method selected
11	
off	F01 FREQ CMD1
on	C30 FREQ CMD2

12 - Motor 2/Motor 1 [M2/M1]
This function switches motor constants using an external digital input signal.
This input is effective only when the operation command to the inverter is off and operation has stopped and does not apply to the operation at 0Hz.

Set value input signal	Motor selected
12	
off	Motor 1
on	Motor 2 Related functions: **A01~A18**

13 - DC brake command [DCBRK]
When the external digital input signal is on, DC injection braking starts when the inverter's output frequency drops below the frequency preset in function code F20 after the operation command goes off (The operation command goes off when the STOP key is pressed at keypad panel operation and when both terminals FWD and REV go on or off at terminal block operation). The DC injection braking continues while the digital input signal is on. In this case, the longer time of the following is selected:
- The time set in function code F22.
- The time which the input signal is set on.

Set value input signal	Operation selected
13	
off	No DC injection brake command is given.
on	A DC injection brake command is given.

14 - Torque limit 2/Torque limit 1 [TL2/TL1]
This function switches the torque limit value set in function codes F40 and F41, and E16 and E17 by an external digital input signal.

Set value input signal	Torque limit value selected	
14		
off	F40 DRV TRQ1 F41 BRK TRQ1	Related functions: **F40~F41 E16~E17**
on	E16 DRV TRQ2 E17 BRK TRQ2	Setting range DRV 20 to 200 %, 999 BRK 0, 20 to 200 %, 999

15 - Switching operation between line and inverter (50 Hz) [SW50]

Motor operation can be switched from 50 Hz commercial power operation to inverter operation without stopping the motor by switching the external digital input signal.

Set value input signal	Function
15	
off → on	Inverter operation to line operation (50 Hz)
on → off	Line operation to inverter operation (50 Hz)

16 - Switching operation between line and inverter (60 Hz) [SW60]

Motor operation can be switched from 60 Hz commercial power operation to inverter operation without stopping the motor by switching the external digital input signal.

Set value input signal	Function
16	
off → on	Inverter operation to line operation (60 Hz)
on → off	Line operation to inverter operation (60 Hz)

- When the digital input signal goes off, 50 or 60 Hz is output according to the set value input signal after the restart waiting time following a momentary power failure (function code H13). The motor is then directed to inverter operation.

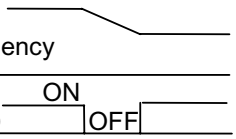
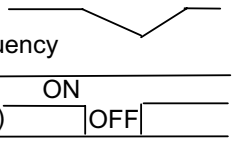
17, 18 - UP command [UP]/ DOWN command [DOWN]

When an operation command is input (on), the output frequency can be increased or decreased by an external digital input signal.

The change ranges from 0 to maximum frequency. Operation in the opposite direction of the operation command is not allowed.

Combination of set value input signals		Function selected (when operation command is on)
18	17	
off	off	Holds the output frequency.
off	on	Increases the output frequency according to the acceleration time.
on	off	Decreases the output frequency according to the deceleration time.
on	on	Holds the output frequency.

There are the two types of UP/DOWN operations as shown below. Set the desired type by setting the frequency (F01 or C30).

Frequency setting (F01 or C30)	Initial value at power input on	Operation command reentry during deceleration
8 (UP/ DOWN1)	0 Hz	Operates at the frequency at reentry. 
9 (UP/ DOWN2)	Previous frequency	Returns to the frequency before deceleration 

19 - Write enable for KEYPAD (data change permission) [WE-KP]
This function allows the data to be changed only when an external signal is being input, thereby making it difficult to change the data.

Set value input signal	Function
19	
off	Inhibit data changes.
on	Allow data changes.

Note: If a terminal is set to value 19, the data becomes unable to be changed. To change the data, turn on the terminal and change the terminal setting to another number.

20 - PID control cancel [Hz/PID]
The PID control can be disabled by an external digital input signal.

Set value input signal	Function selected Related functions: **H20~H25**
20	
off	Enable PID control.
on	Disable PID control (frequency setting from keypad panel).

21 - Inverse mode changeover (terminals 12 and C1) [IVS]
The analog input (terminals 12 and C1) can be switched between forward and inverse operations by an external digital input signal.

Set value input signal	Function selected Related functions: **F01**
21	
off	Forward operation when forward operation is set and vice versa.
on	Inverse operation when forward operation is set and vice versa.

22 - Interlock signal (52-2) [IL]
When a contactor is installed on the output side of the inverter, the contactor opens at the time of a momentary power failure, which hinders the reduction of the DC circuit voltage and may prevent the detection of a power failure and the correct restart operation when power is recovered. The restart operation at momentary power failure can be performed effectively with power failure information provided by an external digital input signal.

Set value input signal	Function
22	
off	No momentary power failure detection operation by digital input
on	Momentary power failure detection operation by digital input

23 - Torque control cancel [Hz/TRQ]
When function code H18 (torque control function selection) is set to be active (value 1 or 2), this operation can be canceled externally
Assign value "23" to the target digital input terminal and switch between operation and no operation in this input signal state.

Set value input signal	Function selected Related functions: **H18**
23	
off	Torque control function active. The input voltage to terminal 12 is the torque command value.
on	Torque control function inactive. The input voltage to terminal 12 is the frequency command value. PID feedback amount when PID control operation is selected (H20 = 1 or 2).

24 - Link enable (RS485 standard, BUS) [LE]
Frequency and operation commands from the link can be enabled or disabled by switching the external digital input signal. Select the command source in H30, "Link function." Assign value "24" to the target digital input terminal and enable or disable commands in this input signal state.

Set value input signal	Function selected Related functions: **H30**
24	
off	Link command disabled.
on	Link command enabled.

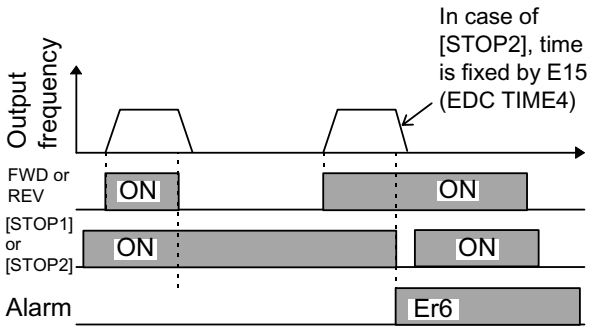
25 - Universal DI [U-DI]
Assigning value "25" to a digital input terminal renders the terminal a universal DI terminal. The ON/OFF state of signal input to this terminal can be checked through the RS485 and BUS option. This input terminal is only used to check for an incoming input signal through communication and does not affect inverter operation.

26 - Pick up start mode [STM]
The start characteristics function (pick-up mode) in function code H09 can be enabled or disabled by switching the external digital input signal. Assign value "26" to the target digital input terminal and enable or disable the function in this input signal state.

Set value input signal	Function selected Related functions: **H09**
26	
off	Start characteristic function disabled
on	Start characteristic function enabled

27 - SY-PG enable (Option) [PG/Hz]
28 - Synchronization command (Option) [SYC]
29 - Zero speed command with PG option [ZERO]
32 - Pre-exiting command with PG option [EXITE]
These functions are used for PG-Option or SY-Option card.
Refer to each instruction manual.

30 - Forced stop command with deceleration [STOP1]
31 - Forced stop command with deceleration time 4 [STOP2]
Normally this terminal should be "ON", when this terminal goes off during motor running, the motor decelerates to stop, and outputs alarm "Er6 ".
In case of terminal [STOP2], the deceleration time is determined by E15 (DEC TIME4).
This function is prioritized under any operation (Terminal. Keypad, Communication...operation).



Settings when shipped from the factory

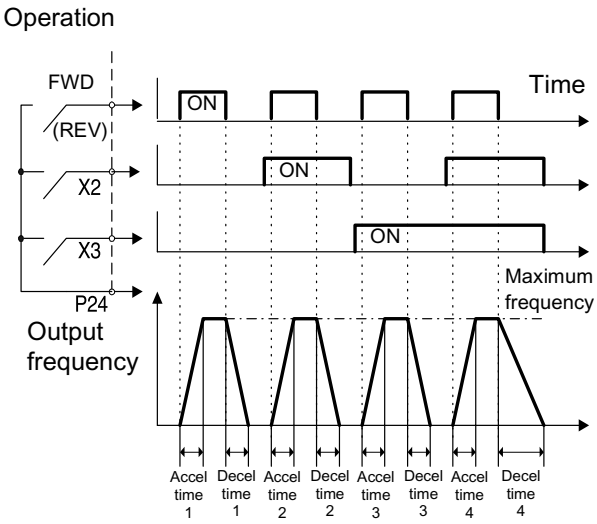
Digital input	Setting at factory shipment	
	Set value	Description
Terminal X1	0	Multistep frequency selection [SS1]
Terminal X2	1	Multistep frequency selection [SS2]
Terminal X3	2	Multistep frequency selection [SS4]
Terminal X4	3	Multistep frequency selection [SS8]
Terminal X5	4	Acceleration and deceleration time selection [RT1]
Terminal X6	5	Acceleration and deceleration time selection [RT2]
Terminal X7	6	3-wire operation stop command [HLD]
Terminal X8	7	Coast-to-stop command [BX]
Terminal X9	8	Alarm reset [RST]

E10 Acceleration time 2
E11 Deceleration time 2
E12 Acceleration time 3
E13 Deceleration time 3
E14 Acceleration time 4
E15 Deceleration time 4

- Acceleration time 1 (F07) and deceleration time 1 (F08) as well as three other types of acceleration and deceleration time can be selected.
- The operation and setting ranges are the same as those of acceleration time 1 and deceleration time 1. See explanations for F07 and F08.
- For switching acceleration and deceleration times, select any two terminals from terminal X1 (function selection) in E01 to terminal X9 (function selection) in E09 as switching signal input terminals. Set "4" (acceleration and deceleration time 1) and "5" (acceleration and deceleration time 2) to the selected terminals and input a signal to each terminal to switch acceleration and deceleration times. Switching is possible during acceleration, deceleration, or constant-speed operation.

E	**1**	**0**	A	C	C		T	I	M	E	2	
E	**1**	**1**	D	E	C		T	I	M	E	2	
E	**1**	**2**	A	C	C		T	I	M	E	3	
E	**1**	**3**	D	E	C		T	I	M	E	3	
E	**1**	**4**	A	C	C		T	I	M	E	4	
E	**1**	**5**	D	E	C		T	I	M	E	4	

- Example: When 4 and 5 are set to terminals X2 and X3:



E16 Torque limiter 2 (Driving)
E17 Torque limiter 2 (Braking)

- This function is used to switch the torque limit level set in F40 and F41 by an external control signal. Input an external signal by selecting any of the control input terminals (X1 to X9) as torque limit 2/torque limit 1 (value 14) in E01 to E09.

E	**1**	**6**	D	R	V		T	R	Q	2	
E	**1**	**7**	B	R	K		T	R	Q	2	

Related functions:
E01 to **E09** (Set value: 14)

E20 ~ E24 Terminal Y1 (function selection) ~ Terminals Y5A and Y5C (function selection)

- Some control and monitor signals can be selected and output from terminals [Y1] to [Y5]. Terminals [Y1] to [Y4] use transistor output; terminals [Y5A] and [Y5C] use relay contacts.

E	**2**	**0**	Y	1		F	U	N	C			
E	**2**	**1**	Y	2		F	U	N	C			
E	**2**	**2**	Y	3		F	U	N	C			
E	**2**	**3**	Y	4		F	U	N	C			
E	**2**	**4**	Y	5		F	U	N	C			

Set value	Output signal
0	Inverter running [RUN]
1	Frequency equivalence signal [FAR]
2	Frequency level detection [FDT1]
3	Undervoltage detection signal [LV]
4	Torque polarity [B/D]
5	Torque limiting [TL]
6	Auto-restarting [IPF]
7	Overload early warning [OL1]
8	Keypad operation mode [KP]
9	Inverter stopping [STP]
10	Ready output [RDY]
11	Line / Inv changeover [SW88]
12	Line / Inv changeover [SW52-2]
13	Line / Inv changeover [SW52-1]
14	Motor 2 / Motor 1 [SWM2]
15	Auxiliary terminal [AX]
16	Time-up signal for pattern operation [TU]
17	Cycle completion signal for pattern operation [TO]
18	Stage No. indication for pattern operation [STG1]
19	Stage No. indication for pattern operation [STG2]
20	Stage No. indication for pattern operation [STG4]
21	Alarm indication [AL1]
22	Alarm indication [AL2]
23	Alarm indication [AL4]
24	Alarm indication [AL8]
25	Fan operation signal [FAN]
26	Auto-resetting [TRY]
27	Universal DO [U-DO]
28	Overheat early warning [OH]
29	Synchronization completed by synchronous operation card [SY] *
30	-
31	2nd Freq. level detection [FDT2]
32	2nd OL level early warning [OL2]
33	Terminal C1 off signal [C1OFF]
34	Speed existence signal [N-EX] *

Note: For output signals marked *, refer to instruction manuals for the PG or the synchronous operation card.

0- Inverter running [RUN]
"Running" means that the inverter is outputting a frequency. "RUN" signal is output as when there is output speed (frequency). When the DC injection brake function is active, "RUN" signal is off.

1 - Frequency equivalence signal [FAR]
See the explanation of function code E30 (frequency arrival [detection width]).

2 - Frequency level detection [FDT1]
See the explanation of function codes E31 and E32 (frequency detection).

3 - Undervoltage detection signal [LV]
If the undervoltage protective function activates, i.e. when the main circuit DC voltage falls below the undervoltage detection level, an ON signal is output. The signal goes off when the voltage recovers and increases above the detection level. The ON signal is retained while the undervoltage protective function is activating.
Undervoltage detection level 400 V

4 - Torque polarity [B/D]
This function determines the torque polarity calculated in the inverter and outputs a signal indicating driving or braking torque. An OFF signal is output for driving torque; an ON signal is output for braking torque.

5 - Torque limiting [TL]
When the torque limiting activates, the stall prevention function is automatically activated to change the output frequency. The torque limiting signal is output to lighten the load, and also used to display overload conditions on the monitor device. This ON signal is output during the current or torque is limited or power regeneration is prevented.

6 - Auto-restarting [IPF]
Following a momentary power failure, this function reports the start of the restart mode, the occurrence of an automatic pull-in, and the completion of the recovery operation.
Following a momentary power failure, an ON signal is output when power is recovered and a synchronization (pull-in) operation is performed. The signal goes off when the frequency (before power failure) is recovered.
For 0 Hz restart at power recovery, no signal is output because synchronization ends when power is recovered. The frequency is not recovered to the frequency before the power failure occurence.

7 - Overload early warning [OL1]
Before the motor stops by the trip operation of an electronic thermal O/L relay, this function outputs an ON signal when the load reaches the overload early warning level.
Either the electronic thermal O/L relay early warning or output current overload early warning can be selected.
For setting procedure, see "E33 Overload early warning (operation selection)", and "E34 Overload early warning (operation level)."
Note: This function is effective for motor 1 only.

8 - Keypad operation mode [KP]
An ON signal is output when operation command keys (FWD , REV and STOP) on the keypad panel can be used (i.e., 0 set in "F02 Operation") to issue operation and stop commands.

9 - Inverter stopping [STP]
This function outputs an inverted signal to Running (RUN) to indicate zero speed. An ON signal is output when the DC injection brake function is operating.

10 - Ready output [RDY]
This function outputs an ON signal when the inverter is ready to operate. The inverter is ready to operate when the main circuit and control circuit power is established and the inverter protective function is not activating.
About one second is required from power-on to ready for operation in normal condition.

11, 12, 13 - Line / Inv changeover [SW88] [SW52-2] [SW52-1]
To perform switching operation between the line and the inverter, the sequence prepared in the inverter can be used to select and output signals for opening and closing the magnetic contactors connected to the inverter. As the operation is complex, refer to technical documentation for the GVX2000 series when using this function.
As the sequence will operate automatically when SW88 or SW52-2 is selected, do not select when not using the sequence.

14 - Motor 2 / Motor 1 [SWM2]
When a signal for switching to motor 2 is input from the terminal selected by terminals [X1] to [X9], this function selects and outputs the signal for switching the magnetic contactor for the motor. As this switching signal is not output during running including when the DC injection braking function is operating, a signal must be re-input after output stops.

15 - Auxiliary terminal [AX]
When an operation (forward or reverse) command is entered, this function outputs an ON signal. When a stop command is entered, the signal goes off after inverter output stops. When a coast-to-stop command is entered and the inverter protective function operates, the signal goes off immediately.

16 - Time-up signal for pattern operation [TU]
When the pattern operation stage changes, this function outputs a one-shot (100 ms) ON signal to report a stage change.

17 - Cycle completion signal for pattern operation [TO]
When the seven stages of a pattern operation are completed, this function outputs a one-shot (100 ms) ON signal to report the completion of all stages.

18, 19, 20 - Stage No. indication for pattern operation [STG1], [STG2], [STG4]
During pattern operation, this function reports the stage (operation process) being operated.

Pattern operation stage No.	Output terminal		
	STG 1	STG 2	STG 4
Stage 1	on	off	off
Stage 2	off	on	off
Stage 3	on	on	off
Stage 4	off	off	on
Stage 5	on	off	on
Stage 6	off	on	on
Stage 7	on	on	on

When pattern operation is not activated (i.e., no stage is selected), the terminals do not output a signal.

21, 22, 23, 24 - Alarm indication [AL1] [AL2] [AL4] [AL8]

This function reports the operating status of the inverter protective function.

Alarm detail (inverter protective function)	Output terminal			
	AL1	AL2	AL4	AL8
Overcurrent, ground fault, fuse blown	on	off	off	off
Overvoltage	off	on	off	off
Undervoltage shortage, input phase failure	on	on	off	off
Motors 1 and 2 overload	off	off	on	off
Inverter overload	on	off	on	off
Heat sink overheating, inverter inside overheating	off	on	on	off
External alarm input, braking resistor overheating	on	on	on	off
Memory error, CPU error	off	off	off	on
Keypad panel communication error, option communication error	on	off	off	on
Option error	off	on	off	on
Output wiring error	off	off	on	on
RTU communication error	on	off	on	on
Overspeed, PG disconnection	off	on	on	on

In normal operation terminals do not output a signal.

25 - Fan operation signal [FAN]

When used with "H06 Cooling fan ON/OFF control," this function outputs a signal while the cooling fan is operating.

26 - Auto-resetting [TRY]

When a value of 1 or larger is set to "H04 Retry operating," the signal is output while retry operation is activating when the inverter protective function is activated.

27 - Universal DO [U-DO]

Assigning value "27" to a transistor output terminal renders the terminal a universal DO terminal. This function enables ON/OFF through the RS485 and BUS option.

This function serves only to turn on and off the transistor output through communication and is not related to inverter operation.

28 - Overheat early warning [OH]

This function outputs a early warning signal when heat sink temperature is (overheat detection level - 10 °C) or higher.

31 - 2nd Freq. level detection [FDT2]

This function is same as Frequency detection [FDT1], the detection level of the output frequency and hysteresis width are determined by E36 and E32.

32 - 2nd OL level early warning [OL2]

This function outputs an ON signal when the output current exceeds "E37 OL2 LEVEL" for longer than "E35 OL TIMER".

33 - Terminal C1 off signal [C1OFF]

This function outputs an ON signal when the input current of terminal C1 is less than 2 mA.

Settings when shipped from the factory

Digital input	Setting at factory shipment	
	Set value	Description
Terminal Y1	0	Inverter running [RUN]
Terminal Y2	1	Frequency equivalence signal [FAR]
Terminal Y3	2	Frequency level detection [FDT1]
Terminal Y4	7	Overload early warning [OL1]
Terminal Y5	10	Ready output [RDY]

E25 Y5 Ry operation mode

- This function specifies whether to excite the Y5 relay at "ON signal mode" or "OFF signal mode".

E	2	5	Y	5	R	Y		M	O	D	E	

Set value	Operation
0	At "OFF signal mode" Y5A - Y5C: OFF At "ON signal mode" Y5A - Y5C: ON
1	At "OFF signal mode" Y5A - Y5C: ON At "ON signal mode" Y5A - Y5C: OFF

- When the set value is 1, contacts Y5A and Y5C are connected when the inverter control voltage is established (about one second after power on).

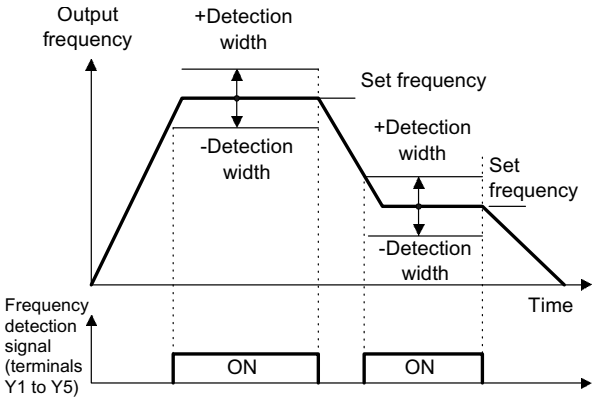
E30 FAR function signal (Hysteresis)

- This function adjusts the detection width when the output frequency is the same as the set frequency (operating frequency).
  The detection width can be adjusted from 0 to ±10 Hz of the setting frequency.

E	3	0	F	A	R		H	Y	S	T	R	

Setting range: 0.0 to 10.0 Hz

When the frequency is within the detection width, an ON signal can be selected and output from terminals [Y1] to [Y5]



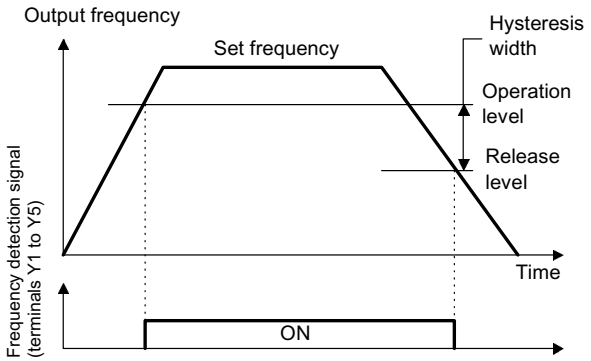
E31 FDT1 function signal (Level)

E32 FDT1 function signal (Hysteresis)

- This function determines the operation (detection) level of the output frequency and hysteresis width for operation release. When the output frequency exceeds the set operation level, an ON signal can be selected and output from terminals [Y1] to [Y5].

E	3	1	F	D	T	1	L	E	V	E	L	
E	3	2	F	D	T		H	Y	S	T	R	

Setting range
(Operation level): 0 to 400 Hz
(Hysteresis width): 0.0 to 30.0 Hz



E33 OL1 function signal (Mode select)

- Select one of the following two types of overload early warning: early warning by electronic thermal O/L relay function or early warning by output current.

E	3	3	O	L	1	W	A	R	N	I	N	G

Set value 0: Electronic thermal O/L relay
1: Output current

Set value	Function	Description
0	Electronic thermal O/L relay	Overload early warning by electronic thermal O/L relay (having inverse-time characteristics) to output current. The operation selection and thermal time constant for the inverse-time characteristics are the same as those of the electronic thermal O/L relay for motor protection (F10 and F12).
1	Output current	An overload early warning is issued when output current exceeds the set current value for the set time.

E34 OL1 function signal (Level)

- This function determines the operation level of the electronic thermal O/L relay or output current.

E	3	4	O	L	1	L	E	V	E	L		

Setting range: Inverter rated output current x (5 to 200 %)

The operation release level is 90 % of the set value.

E35 OL1 function signal (Timer)

E	3	5	O	L		T	I	M	E	R		

- This function is used when 1 (output current) is set to "E33 Overload early warning (operation selection)."
  Setting range: 0.1 to 60.0 seconds
- Set the time from when the operation level is attained until the overload early warning function is activated.

E36 FDT2 function (Level)

- This function determines the operation (detection) level of output frequency for "2nd Freq. level detection [FDT2]".

E	3	6	F	D	T	2	L	E	V	E	L	

Setting range (Operation level): 0 to 400 Hz

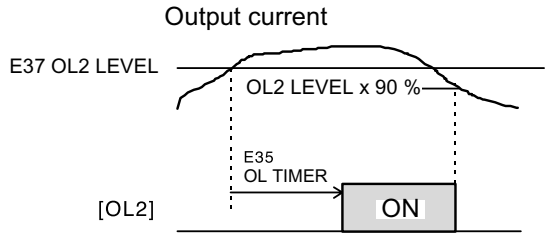
E37 OL2 function (Level)

- This function determines the operation level of the output current for "2nd OL level detection [OL2]".

E	3	7	O	L	2	L	E	V	E	L		

Setting range: Inverter rated output current x (5 to 200 %)

The operation release level is 90 % of the set value.



E40 Display coefficient A
E41 Display coefficient B

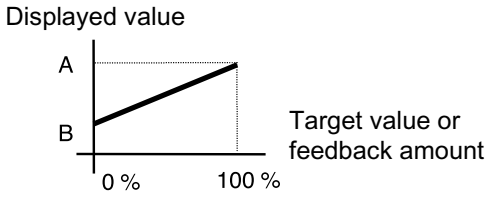
- These coefficients are conversion coefficients which are used to determine the load and line speed and the target value and feedback amount (process amount) of the PID controller displayed on the LED monitor.

E	**4**	**0**	C	O	E	F		A				
E	**4**	**1**	C	O	E	F		B				

Setting range
Display coefficient A:
-999.00 to 0.00 to +999.00
Display coefficient B:
-999.00 to 0.00 to +999.00

- Load and line speed.
  Use the display coefficient A.
  Displayed value = output frequency x (0.01 to 200.00)
  Although the setting range is 999.00, the effective value range of display data is 0.01 to 200.00. Therefore, values smaller or larger than this range are limited to a minimum value of 0.01 or a maximum value of 200.00.

- Target value and feedback amount of PID controller.
  Set the maximum value of display data in E40, "Display coefficient A," and the minimum value in E41, "Display coefficient B."
  Displayed value =
  (target value or feedback amount)
  X (display coefficient A - B) + B



E42 LED display filter

- Among data in "E43 LED monitor (display selection)," some data need not be displayed instantaneously when the data changes. For such data, a flickering suppression filter can be used.

E	**4**	**2**	D	I	S	P	L	A	Y		F	L

Setting range: 0.0 to 5.0 seconds

- Monitored items in "E43 LED monitor (display selection)"

Set value	Display item	Set value	Display item
3	Output current	8	Calculated torque value
4	Output voltage	9	Power consumption

E43 LED monitor (Function)

E44 LED monitor (Display at stop mode)

- The data during inverter operation, during stopping, at frequency setting, and at PID setting is displayed on the LED.
- Display during running and stopping.
  During running, the items selected in "E43 LED monitor (Function)," are displayed.
  In "E44 LED monitor (Display at stop mode)," specify whether to display some items out of the set values or whether to display the same items as during running.

E	**4**	**3**	L	E	D		M	N	T	R		
E	**4**	**4**	L	E	D		M	N	T	R	2	

Value set to E43	E44=0		E44=1	
	At stopping	During running	At stopping	During running
0	Set frequency value (Hz)	Output frequency (before slip compensation) [Hz]		
1	Set frequency value (Hz)	Output frequency (after slip compensation) [Hz]		
2	Set frequency value [Hz]			
3	Output current [A]			
4	Output voltage (command value) [V]			
5	Synchronous speed set value (r/min.)	Synchronous speed [r/min]		
6	Line speed set value (m/min.)	Line speed [m/min]		
7	Load speed set value (r/min.)	Load speed [r/min]		
8	Calculated torque value [%]			
9	Output power [kW]			
10	PID target value 1 (direct input from keypad panel)			
11	PID target value 2 (input from "F02 Frequency 1")			
12	PID feedback amount			

Note: For the values 10 to 12 set to E43, the data is displayed only when selected in "H20 PID control (operation selection)."

- Display at frequency setting.
  When a set frequency is checked or changed by the keypad panel, the set value shown below is displayed.
  Select the display item by using "E43 LED monitor (Function)." This display is not affected by "E44 LED monitor (Display at stop mode)."

Value set to E43	Frequency setting
0, 1, 2, 3, 4	Set value of frequency [Hz]
5	Set value of synchronous speed [r/min]
6	Set value of line speed [m/min]
7	Set value of load speed [r/min]
8,9	Set value of frequency [Hz]
10, 11, 12	Set value of frequency [Hz]

Note: For the values 10 to 12 set to E43, the data is displayed only when selected in "H20 PID control (operation selection)."

E45 LCD monitor (Function)

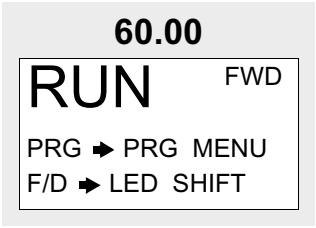
- This function selects the item to be displayed on the LCD monitor in the operation mode.

E	4	5	L	C	D		M	N	T	R		

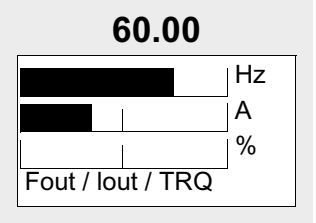
Set value	Display item
0	Operation status, rotating direction, operation guide
1	Output frequency (before slip compensation), output current, calculated torque value in bar graph

During running

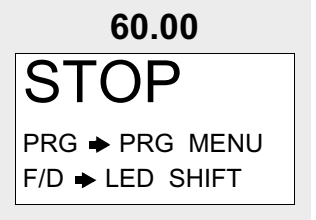
Set value: 0



Set value: 1



When stopping



Full-scale value of bar graph

Display item	Full-scale
Output frequency	Maximum frequency
Output current	200 % of inverter rated value
Calculated torque value	200 % of motor rated value

Note: The scale cannot be adjusted.

E46 LCD monitor (Language)

- This function selects the language for data display on the LCD monitor.

E	4	6	L	A	N	G	U	A	G	E		

Set value	Language displayed	Set value	Language displayed
0	Japanese	3	French
1	English	4	Spanish
2	German	5	Italian

Note: English language is used for all LCD screens in this manual. For other languages, refer to the relevant instruction manual.

E47 LCD monitor (Contrast)

- This function adjusts the LCD contrast. Increase the set value to raise contrast and decrease to lower contrast.

E	4	7	C	O	N	T	R	A	S	T		

Set value	0, 1, 2 • • • • • • 8, 9, 10
Screen	Low ⟷ High

C: Control Functions of Frequency

C01 **Jump frequency 1**
C02 **Jump frequency 2**
C03 **Jump frequency 3**
C04 **Jump frequency hysteresis**

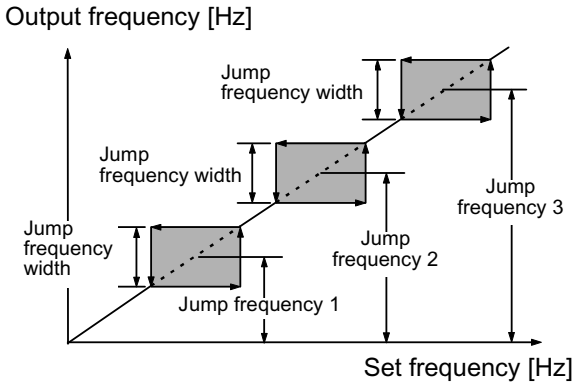
- This function makes the set frequency jump so that the inverter's output frequency does not match the mechanical resonance point of the load.
- Up to three jump points can be set.
- This function is ineffective when jump frequencies 1 to 3 are set to 0 Hz.
- A jump does not occur during acceleration or deceleration.
  When a jump frequency setting range overlaps another range, both ranges are added to determine the actual jump area.

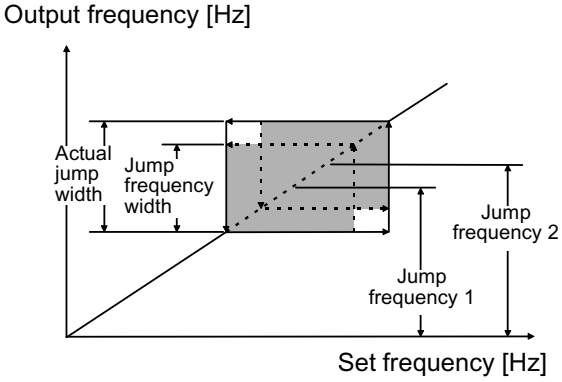
C	**0**	**1**	J	U	M	P		H	z		1	
C	**0**	**2**	J	U	M	P		H	z		2	
C	**0**	**3**	J	U	M	P		H	z		3	

Set value 0 to 400 Hz
In 1 Hz steps (min.)

C	**0**	**4**	J	U	M	P		H	Y	S	T	R

Set value 0 to 30 Hz
In 1 Hz steps (min.)





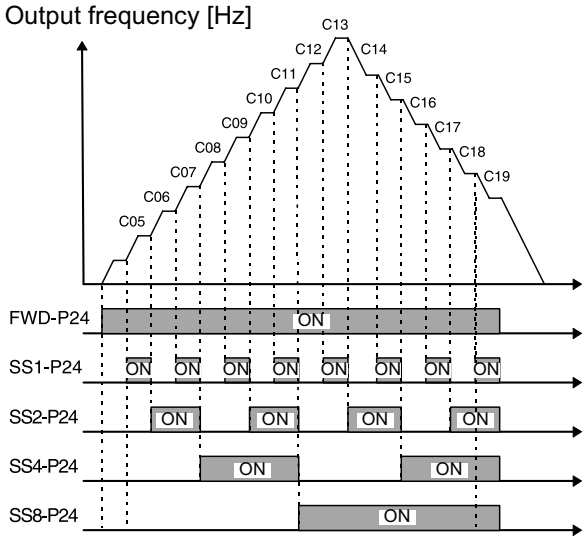
C05 Multistep frequency 1
~
C19 Multistep frequency 15

- Multistep frequencies 1 to 15 can be switched by turning on and off terminal functions SS1, SS2, SS4, and SS8. (See E01 to E09 for terminal function definitions).
- OFF input is assumed for any undefined terminal of SS1, SS2, SS4, and SS8.

C	**0**	**5**	M	U	L	T	I		H	z	-	1
C	**0**	**6**	M	U	L	T	I		H	z	-	2
C	**0**	**7**	M	U	L	T	I		H	z	-	3
C	**0**	**8**	M	U	L	T	I		H	z	-	4
C	**0**	**9**	M	U	L	T	I		H	z	-	5
C	**1**	**0**	M	U	L	T	I		H	z	-	6
C	**1**	**1**	M	U	L	T	I		H	z	-	7
C	**1**	**2**	M	U	L	T	I		H	z	-	8
C	**1**	**3**	M	U	L	T	I		H	z	-	9
C	**1**	**4**	M	U	L	T	I		H	z	1	0
C	**1**	**5**	M	U	L	T	I		H	z	1	1
C	**1**	**6**	M	U	L	T	I		H	z	1	2
C	**1**	**7**	M	U	L	T	I		H	z	1	3
C	**1**	**8**	M	U	L	T	I		H	z	1	4
C	**1**	**9**	M	U	L	T	I		H	z	1	5

Set value 0 to 400 Hz
In 0.01 Hz steps (min.)

Related functions:
E01 to **E09** (Set value: 0 to 3)



C20 JOG frequency

- This function sets the frequency for jogging operation of motor, which is different from the normal operation.

C	**2**	**0**	J	O	G		H	z				

Setting range: 0.00 to 400.00 Hz

- Starting with the jogging frequency is combined with jogging select signal input from the keypad panel or control terminal. For details, see the explanations of "E01 Terminal X1," to "E09 Terminal X9."

C21 Pattern operation (Mode Select)

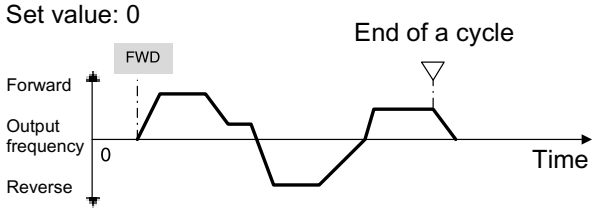
- Pattern operation is an automatic operation according to preset operation time, direction of rotation, acceleration and deceleration time, and frequency.
  When using this function, set 10 (pattern operation) to "F01 Frequency setting."
  The following operation patterns can be selected.

C	2	1	P	A	T	T	E	R	N			

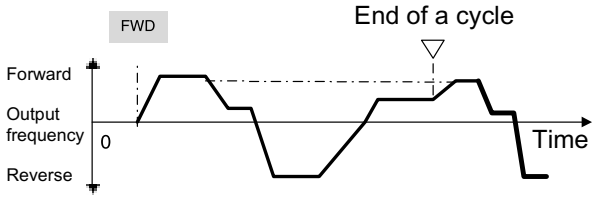
Related functions:
F01, **C30** (Set value:10)

Set value	Operation pattern
0	Perform a pattern operation cycle, then stop operation.
1	Perform pattern operation repeatedly. Stop operation using a stop command.
2	Perform a pattern operation cycle, then continue operation with the last frequency set.

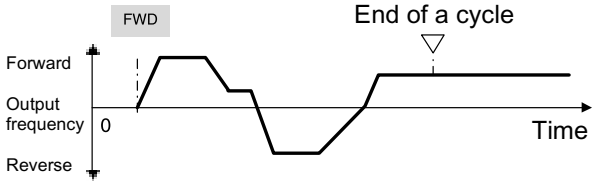
Set value: 0



Set value: 1



Set value: 2



C22 ~ C28 Pattern operation (stage 1) ~ Pattern operation (stage 7)

- Seven stages are operated in order (of function codes) according to the values set in "C22 Pattern operation (stage 1)," to "C28 Pattern operation (stage 7)." Each function sets the operation time and the rotating direction for each stage and assigns set values of the acceleration and deceleration time.

C	2	2	S	T	A	G	E		1			
C	2	3	S	T	A	G	E		2			
C	2	4	S	T	A	G	E		3			
C	2	5	S	T	A	G	E		4			
C	2	6	S	T	A	G	E		5			
C	2	7	S	T	A	G	E		6			
C	2	8	S	T	A	G	E		7			

Set or assign item	Value range
Operation time	0. 00 to 6000 s
Rotation direction	F: Forward R: Reverse
Acceleration and deceleration time	1: Acceleration time 1 (F07), deceleration time 1 (F08)
	2: Acceleration time 2 (E10), deceleration time 2 (E11)
	3: Acceleration time 3 (E12), deceleration time 3 (E13)
	4: Acceleration time 4 (E14), deceleration time 4 (E15)

Note: The operation time is represented by the three most significant digits, hence, can be set with only three high-order digits.

- Setting example

100 F 3
- 3: Acceleration and deceleration time (code): 3
- F: Motor rotating direction: Forward
- 100: Operation time: 100s

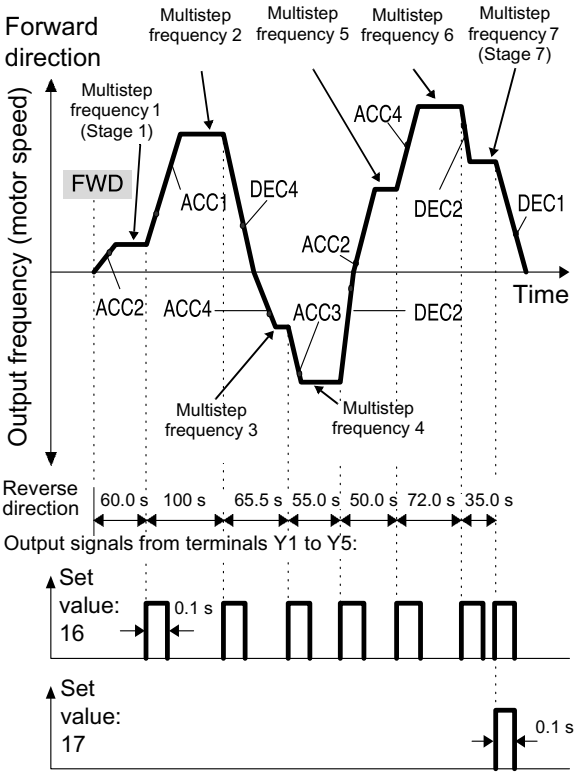
Set the operation time to 0.00 for stages not used, which are skipped in operation.
With regard to the set frequency value, the multistep frequency function is assigned as listed in the table below. Set frequencies to "C05 Multistep frequency 1," to "C11 Multistep frequency 7."

Stage No.	Operation frequency to be set
Stage 1	Multistep frequency 1 (C05)
Stage 2	Multistep frequency 2 (C06)
Stage 3	Multistep frequency 3 (C07)
Stage 4	Multistep frequency 4 (C08)
Stage 5	Multistep frequency 5 (C09)
Stage 6	Multistep frequency 6 (C10)
Stage 7	Multistep frequency 7 (C11)

- Pattern operation setting example

Function	Set value	Operation frequency to be set
C21 (operation selection)	1	-
C22 (stage 1)	60.0F2	Multistep frequency 1 (C05)
C23 (stage 2)	100F1	Multistep frequency 2 (C06)
C24 (stage 3)	65.5R4	Multistep frequency 3 (C07)
C25 (stage 4)	55.0R3	Multistep frequency 4 (C08)
C26 (stage 5)	50.0F2	Multistep frequency 5 (C09)
C27 (stage 6)	72.0F4	Multistep frequency 6 (C10)
C28 (stage 7)	35.0F2	Multistep frequency 7 (C11)

The following diagram shows this operation.



- Running and stopping are controlled by pressing the FWD and STOP keys and by opening and closing the control terminals.
  When using the keypad panel, pressing the FWD key starts operation.
  Pressing the STOP key pauses stage advance.
  Pressing the FWD key again restarts operation from the stop point according to the stages.
  If an alarm stop occurs, press the RESET key to release operation of the inverter protective function, then press the FWD key to restart stage advance.
  If required to start operation from the first stage "C22 Pattern operation (stage 1)," enter a stop command and press the RESET key. If an alarm stop occurs, press the RESET key to release the protective function, then press the key again.

Notes:

1. The direction of rotation cannot be reversed by a command issued from the REV key on the keypad panel or terminal [REV]. Any reverse rotation commands entered are canceled. Select forward or reverse rotation by the data in each stage. When the control terminals are used for operation, the self-hold function of operation command also does not work. Select an alternate type switch when using.
2. At the end of a cycle, the motor decelerates-to-stop according to the value set to "F08 Deceleration time 1."

C30 Frequency setting 2

- This function selects the frequency setting method.

C	3	0	F	R	E	Q		C	M	D		2

Related functions:
E01 to **E09** (Set value: 11) **F01**

0: Setting by keypad panel operation (△ ▽ key)
1: Setting by voltage input (terminal [12] (0 to +10 V))
2: Inactive
3: Inactive
4: Reversible operation with polarity (terminal [12] (-10 to +10 V))
5: Reversible operation with polarity (terminal [12]+[V1](Option[1)]) (-10 to +10 V))
6: Inverse mode operation (terminal [12] (+10 V to 0))

Related functions:
E01 to **E09** (Set value: 21)

7: Inactive
8: Setting by UP/DOWN control mode 1 (initial value = 0) (terminals [UP] and [DOWN])

Related functions:
E01 to **E09** (Set value: 17, 18)

9: Setting by UP/DOWN control mode 2 (initial value =last final value) (terminals [UP] and [DOWN]) See the function explanation of E01 to E09 for details.

Related functions:
E01 to **E09** (Set value: 11, 18)

10: Setting by pattern operation
See the function explanation C21 to C28 for details.

Related functions:
C21 to **C28**

11: Setting by digital input or pulse train input. Optional.[1)]

1) For details, see the instruction manual on options.

For the setting method, see the explanation for F01.

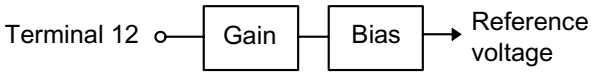
C31 Bias (terminal[12])

C32 Gain (terminal[12])

- This function sets the Gain and Bias of the analog input (terminals [12]).

C	3	1	B	I	A	S		1	2			
C	3	2	G	A	I	N		1	2			

The setting range:
BIAS: -100 to +100 %
GAIN: 0.0 to 200 %



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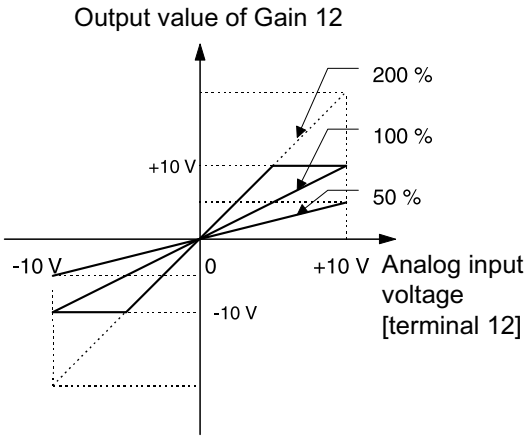
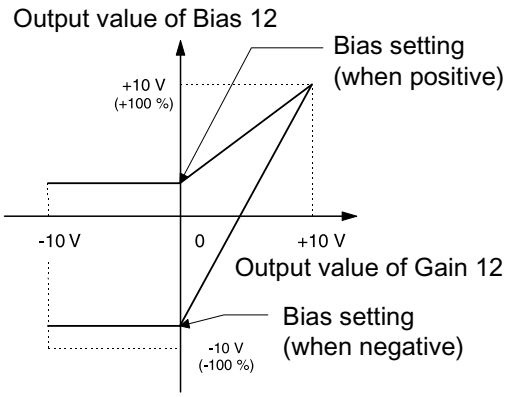




C33 Analog setting signal filter

- Analog signals input from control terminal 12 or C1 may contain noise, which renders control unstable. This function adjusts the time constant of the input filter to remove the effects of noise.

C	3	3	R	E	F		F	I	L	T	E	R

Setting range: 0.00 to 5.00 seconds

- An set value too large delays control response though stabilizing control. A set value too small speeds up control response but renders control unstable.

If the optimum value is not known, change the setting when control is unstable or response is delayed.

Note: The set value is commonly applied to terminals 12 and C1.
For input of PID feedback amount, the PID control feedback filter (set in H25) is used.

Motor 1 (P: Motor Parameters)

P01 Number of motor 1 poles

- This function sets the number of poles of motor 1 to be driven.
  If this setting is not made, an incorrect motor speed (synchronous speed) is displayed on the LED.

P	0	1	M	1		P	O	L	E	S		

Set values: 2, 4, 6, 8, 10, 12, 14

P02 Motor 1 (capacity)

- The nominal applied motor capacity is set at the factory. The setting should be changed when driving a motor with a different capacity.

P	0	2	M	1	-	C	A	P				

Set value for models with nominal applied motor of 25 kW or less: 0.01 to 45 kW
Models with nominal applied motor of 30 kW or more: 0.01 to 500 kW

- Set the nominal applied motor capacity listed in 9-1, "Standard Specifications." Also set a value in the range from two ranks lower to one rank higher than the nominal applied motor capacity. When a value outside this range is set, accurate control cannot be guaranteed. If a value between two nominal applied motor capacities is set, data for the lower capacity is automatically written for related function data.

- When the setting of this function is changed, the values of the following related functions are automatically set to data of a 3-phase standard motor.
  -- P03 Motor 1 (rated current)
  -- P06 Motor 1 (no-load current)
  -- P07 Motor 1 (% R1)
  -- P08 Motor 1 (% X1)

Note: The set values for the 3-phase standard motor are 200 V, 50 Hz, 4 poles for the 200 V series; 400 V, 50 Hz, 4 poles for the 400 V series.

P03 Motor 1 (rated current)

- This function sets the rated current value of motor 1.

P	0	3	M	1	-	I	r					

Set value: 0.00 to 2,000 A

P04 Motor 1 (Tuning)

- This function measures and automatically writes motor data.

P	0	4	M	1		T	U	N	1			

Set value	Operation
0	Inactive
1	Measure the primary resistance (%R1) of the motor and leakage reactance (%X) of the base frequency when the motor is stopping and automatically write both values in P07 and P08 (static tuning).
2	Measure the primary resistance (%R1) of the motor and leakage reactance (%X) of the base frequency when the motor is stopping, measure the no-load current (Io) when the motor is running, and automatically write these values in P06, P07, and P08 (dynamic tuning).

Note: Measure the no-load current only with uncoupled motor (no load, no gear).

- Perform auto tuning when data written beforehand in "P06 No-load current," "P07 %R1," and "P08 %X," differs from actual motor data. Typical cases are listed below. Auto tuning improves control and calculation accuracy.

  - When a motor other than the standard 3-phase motor is used and accurate control is required (Torque vector, PG vector).
  - When output-side impedance cannot be ignored as when cable between the inverter and the motor is too long or when a reactor is connected.
  - When a non-standard or special motor is used and %R1 or %X is unknown.

Tuning procedure

1. Adjust the voltage and frequency according to motor characteristics. Adjust functions "F03 Maximum output frequency," "F04 Base frequency," "F05 Rated voltage," and "F06 Maximum output voltage."
2. Enter untunable motor constants first. Set functions "P02 Capacity," "P03 Rated current," and "P06 No-load current," (input of no-load current not required when P04=2, for running the motor at tuning, is selected).
3. When tuning the no-load current (P04=2), beware of motor rotation.
4. Set 1 (static tuning) or 2 (dynamic tuning) to function "P04 Auto tuning." Press the FUNC DATA key to write the set value and press the FWD key or REV key to start tuning simultaneously.
5. Tuning takes several seconds to several tens of seconds (when 2 is set. As the motor accelerates up to half the base frequency according to acceleration time, is tuned for the no-load current, and decelerates according to the deceleration time, the total tuning time varies depending on set acceleration and deceleration times).
6. Press the STOP key after the tuning is completed .
7. End of procedure.

Note: Use function "A13 Motor 2 (auto tuning)," to tune motor 2. In this case, set values described in 1 and 2 above are for the function (A01 -) of motor 2.

WARNING

When the auto tuning value is set to 2, the motor rotates at a maximum of half the base frequency. Beware of motor rotation, **as injury may result.**

P05 Motor 1 (On-line Tuning)

- Long-time operation affects motor temperature and motor speed. Online tuning minimizes speed changes when motor temperature changes.

P	0	5	M	1		T	U	N	2			

Set value	Operation
0	Inactive
1	Active

P06 Motor 1 (no-load current)

- This function sets the no-load current (exciting current) of motor 1.

P	0	6	M	1	-	I	O					

Set value: 0.00 to 2,000 A

P07 Motor 1 (%R1 setting)

P08 Motor 1 (%X setting)

- Write this data when using a motor other than a standard 3-phase motor and when the motor constant and the impedance between the inverter and motor are known.

P	0	7	M	1	-	%	R	1				
P	0	8	M	1	-	%	X					

- Calculate %R1 using the following formula:

$$\%\,R\,1 = \frac{R\,1 + \text{Cable R}}{V / (\sqrt{3} \bullet I)} \times 100\ [\%]$$

R1:Primary coil resistance value of the motor [Ω]
Cable R: Output-side cable resistance value [Ω]
V: Rated voltage [V]
I: Motor rated current [A]

- Calculate %X using following formula:

$$\%X = \frac{X1+X2 \bullet XM/(X2 + XM)+\text{Cable X}}{V / (\sqrt{3} \bullet I)} \times 100[\%]$$

X1: Primary leakage reactance of the motor [Ω]
X2: Secondary leakage reactance (converted to a primary value) of the motor [Ω]
XM: Exciting reactance of the motor [Ω]
Cable X: Output-side cable reactance [Ω]
V: Rated voltage [V]
I: Motor rated current [A]

Note: For reactance, use a value in the data written in "F04 Base frequency 1."

- When connecting a reactor or filter to the output circuit, add its value. Use value 0 for cable X values that can be ignored.

P09 Slip compensation control

- Changes in load torque affect motor slippage, thus causing variations in motor speed.
  The slip compensation control adds a frequency (proportional to motor torque) to the inverter output frequency to minimize variations in motor speed due to torque changes.

P	0	9	S	L	I	P		C	O	M	P	1

Set value: 0.00 to 15.00 Hz

- Calculate the amount of slip compensation using the following formula:

$$\text{Slip compensation amount} = \text{Base frequency} \times \frac{\text{Slippage [r/min]}}{\text{Synchronous speed [r/min]}}\ [\text{Hz}]$$

Slippage = Synchronous speed - Rated speed

High Performance functions (H:High Performance function)

H03 Data initializing

- This function returns all function data changed by the customer to the factory setting data. (initialization).

H	0	3	D	A	T	A		I	N	I	T	

Set value 0: Disabled.
1: Initializing data.

- To perform initialization, press the STOP and ∧ keys together to set 1, then press the FUNC DATA key. The set values of all functions are initialized. The set value in H03 automatically returns to 0 following the end of initialization.

H04 Auto-reset (Times)
H05 Auto-reset (Reset interval)

- When the inverter protective function which invokes the retry operation is activated, this function releases operation of the protective function and restarts operation without issuing an alarm or terminating output.
  Set the protective function release count and waiting time from its operation startup to release.

H	0	4	A	U	T	O	-	R	E	S	E	T
H	0	5	R	E	S	E	T		I	N	T	

Setting range
(Times): 0, 1 to 10
(Reset interval): 2 to 20 seconds

To disable the retry function, set 0 to "H04 Auto-reset (Times)."

- Inverter protective functions that can invoke retry function.

OC1, OC2, OC3: Overcurrent	dBH: Braking resistor overheating
OV1, OV2, OV3: Overvoltage	OL1: Motor 1 overload
OH1: Heat sink overheating	OL2: Motor 2 overload
OH3: Inverter inside overheating	OLU: Inverter overload

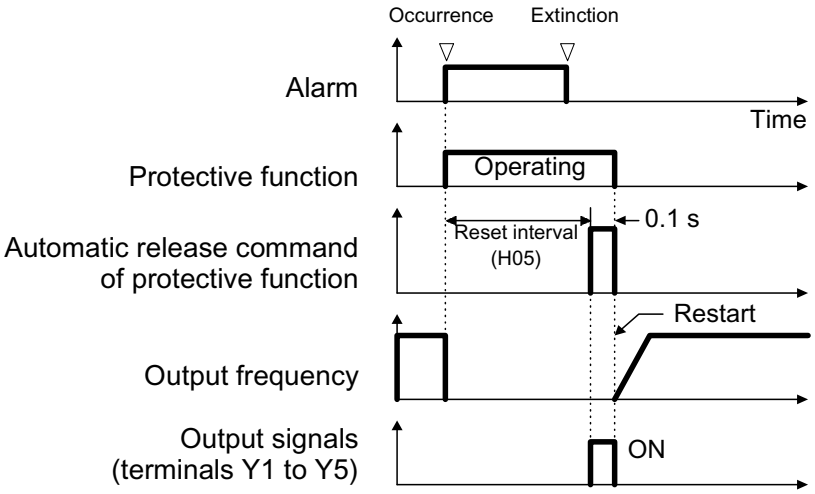
- When the value of "H04 Auto-reset (Times)," is set from 1 to 10, an inverter run command is immediately entered following the wait time set in "H05 Auto-reset (Reset interval)," and the startup of the retry operation. If the cause of the alarm has been removed at this time, the inverter starts without switching to alarm mode. If the cause of the alarm still remains, the protective function is reactivated according to the wait time set in "H05 Auto-reset (Reset interval)." This operation is repeated until the cause of the alarm is removed. The restart operation switches to alarm mode when the retry count exceeds the value set in "H04 Auto-reset (Times)."
  The operation of the retry function can be monitored from terminals Y1 to Y5.

WARNING

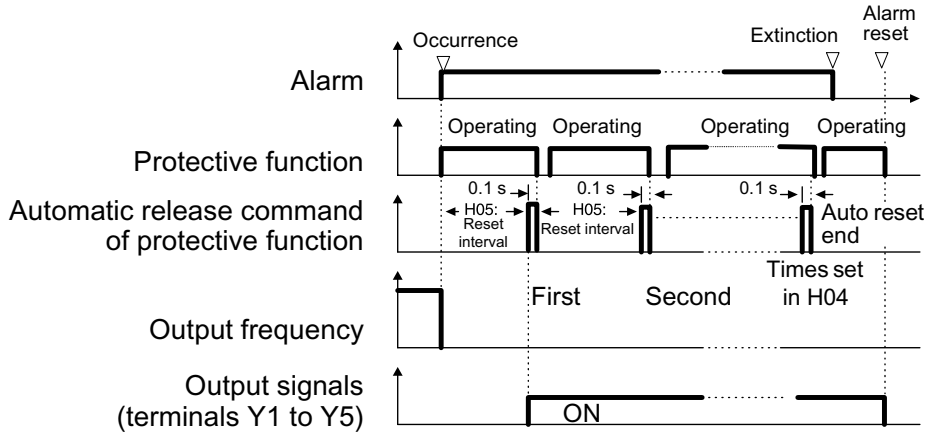
When the retry function is selected, operation automatically restarts depending on the cause of the trip stop. (The machine should be designed to ensure safety during a restart)

5

When retry succeeded



Retry failed



H06 Fan stop operation

- This function specifies whether cooling fan ON/OFF control is automatic. While power is applied to the inverter, the automatic fan control detects the temperature of the cooling air in the inverter and turns the fan on or off.
  When the inverter is in Run mode, the fan is always turned on. If the inverter returns to Stop mode it may take several minutes until fan switches off.
  When this control is not selected, the cooling fan rotates continually.

H	0	6	F	A	N		S	T	O	P		

Set value 0: ON/OFF control disabled.
1: ON/OFF control enabled.

The cooling fan operating status can be monitored from terminals Y1 to Y5.

H07 ACC/DEC (Mode select) pattern

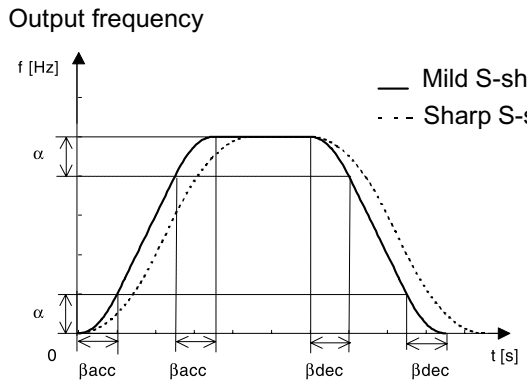
- This function selects the acceleration and deceleration pattern.

H	0	7	A	C	C		P	T	N			

Set value 0: Inactive (linear acceleration and deceleration)
1: S-shape acceleration and deceleration (mild)
2: S-shape acceleration and deceleration (sharp)
3: Curvilinear acceleration and deceleration

S-shape acceleration and deceleration

This pattern reduces shock by mitigating output frequency changes at the beginning/end of acceleration and deceleration.



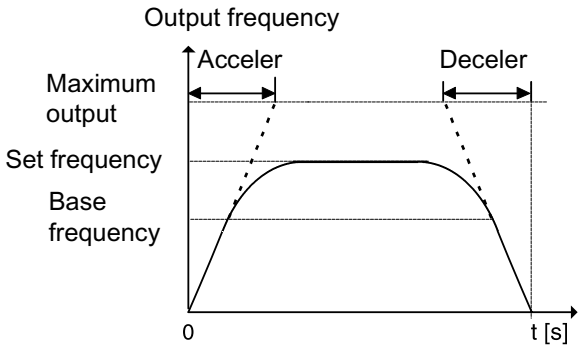
Pattern constants

	When 1 is selected in H07 (mild S-shape pattern)	When 2 is selected in H07 (sharp S-shape pattern)
Range of S-shape(α)	0.05 x maximum output frequency [Hz]	0.10 x maximum output frequency [Hz]
Time for S-shape at acceleration (β acc)	0.10 x acceleration time [s]	0.20 x acceleration time [s]
Time for S-shape at deceleration (β dec)	0.10 x deceleration time [s]	0.20 x deceleration time [s]

When acceleration and deceleration times are very long or short, acceleration and deceleration are rendered linear.

Curvilinear acceleration and deceleration

This function is used to minimize motor acceleration and deceleration times in the range that includes a constant-output range.



5

H08 Rev. phase sequence lock

- When accidental reversing is expected to cause a malfunction, this function can be set to prevent reversal.
  This function prevents a reversing operation resulting from a connection between the REV and P24 terminals, inadvertent activation of the REV key, or negative analog input from terminal 12 or V1

H	0	8	R	E	V		L	O	C	K		

Set value 0: Inactive
1: Active

H09 Start mode

- This function smoothly starts the motor which is coasting after a momentary power failure or after the motor has been subject to external force, without stopping motor.
  At startup, this function detects the motor speed and outputs the corresponding frequency, thereby enabling a shock-free motor startup. Although the normal startup method is used, when the coasting speed of the motor is 120 Hz or more as an inverter frequency and when the value set to "F03 Maximum frequency," exceeds the value set to "F15 Frequency limiter (upper limit)."

H	0	9	S	T	A	R	T		M	O	D	E

Setting range 0, 1, 2

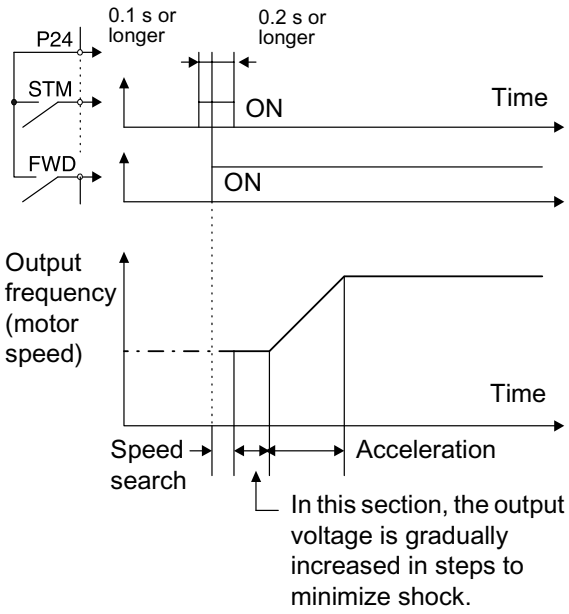
Set value	Normal startup	Restart after a momentary power failure	Line-to-inverter switching
0	Inactive	Inactive	Inactive
1	Inactive	Active	Active
2	Active	Active	Active

- Explanation of set values

-1: This function is effective when 3, 4, or 5 is set to "F14 Restart mode after momentary power failure (operation selection)." This function is also effective when operation is switched from the line to the inverter. The motor is started with the same frequency as the current coasting speed.

-2: In addition to restarting following a momentary power failure and switching between the line and the inverter, this function detects the coasting speed of the motor and starts the motor at the same frequency as all startups (including when an ON operation command is entered).

- By assigning value "26" (pick up start mode) to terminals X1 to X9, this function can be externally selected as the normal startup method when an ON operation command is entered.



Note: The dotted-dashed line indicates motor speed.

H10 Energy-saving operation

- When the output frequency is fixed (constant-speed operation) at light loads and except for "0.0" is set to F09, "Torque boost 1," this function automatically reduces the output voltage, while minimizing the product (power) of voltage and current.

H	1	0	E	N	E	R	G	Y		S	A	V

Set value 0: Inactive
1: Active

Notes:

- Use this function for square law reduction torque loads (e.g., fans, pumps). When used for a constant-torque load or rapidly changing load, this function causes a delay in control response.
- The energy-saving operation automatically stops during acceleration and deceleration and when the torque limiting function is activated.

H11 DEC mode

- This function selects the inverter stopping method when a stop command is entered.

H	1	1	D	E	C		M	O	D	E		

Set value 0: Deceleration-to-stop based on data set to "H07 Non-linear acceleration and deceleration"
1: Coasting-to-stop

Note: This function is effective only when a stop command is entered and, therefore, is ineffective when the motor is stopped by lowering the set frequency.

H12 Instantaneous overcurrent limiting

- An overcurrent trip generally occurs when current flows above the inverter protective level following a rapid change in motor load. The instantaneous overcurrent limiting function controls inverter output and prohibits the flow of a current exceeding the protective level even when the load changes.
- As the operation level of the instantaneous overcurrent limiting function cannot be adjusted, the torque limiting function must be used.
- As motor generation torque may be reduced when instantaneous overcurrent limiting is applied, set this function to be inactive for equipment such as elevators, which are adversely affected by reduced motor generation torque, in which case an overcurrent trip occurs when the current flow exceeds the inverter protective level. A mechanical brake should be used to ensure safety.

H	1	2	I	N	S	T		C	L			

Set value 0: Inactive
1: Active

H13 Auto-restart (Restart time)

- Instantaneous switching to another power line (when the power of an operating motor is cut off or power failure occurs) creates a large phase difference between the line voltage and the voltage remaining in the motor, which may cause electrical or mechanical failure. To rapidly switch power lines, write the remaining voltage attenuation time to wait for the voltage remaining in the motor to attenuate. This function operates at restart after a momentary power failure.

H	1	3	R	E	S	T	A	R	T		T	

Setting range: 0.1 to 5.0 seconds

- When the momentary power failure time is shorter than the wait time value, a restart occurs following the wait time. When the power failure time is longer than the wait time value, a restart occurs when the inverter is ready to operate (after about 0.2 to 0.5 second).

H14 Auto-restart (Freq. fall rate)

- This function determines the reduction rate of the output frequency for synchronizing the inverter output frequency and the motor speed. This function is also used to reduce the frequency and thereby prevent stalling under a heavy load during normal operation.

H	1	4	F	A	L	L		R	A	T	E	

Setting range: 0.00, 0.01 to 100.00 Hz/s

- When 0.00 is set, the frequency is reduced according to the set deceleration time.

Note: A too large frequency reduction rate may temporarily increase the regeneration energy from the load and invoke the overvoltage protective function. Conversely, a rate that is too small extends the operation time of the current limiting function and may invoke the inverter overload protective function.

H15 Auto-restart (Holding DC voltage)

- This function is for when 2 (deceleration-to-stop at power failure) or 3 (operation continuation) is set to "F14 Restart mode after momentary power failure (Mode select)."
  Either function starts a control operation if the main circuit DC voltage drops below the set operation continuation level.

H	1	5	H	O	L	D		V				

Setting range: 400 to 600 V

- When power supply voltage to the inverter is high, control can be stabilized even under an excessive load by raising the operation continuation level. However, when the level is too high, this function activates during normal operation and causes unexpected motion. Please contact Bonfiglioli Riduttori Silectron sistemi division when changing the initial value.

H16 Auto-restart (OPR command selfhold time)

- As the power to an external operation circuit (relay sequence) and the main power to the inverter is generally cut off at a power failure, the operation command issued to the inverter is also cut off. This function sets the time an operation command is to be held in the inverter. If a power failure lasts beyond the self-hold time, power-off is assumed, automatic restart mode is released, and the inverter starts operation at normal mode when power is applied again. (This time can be considered the allowable power failure time).

H	1	6	S	E	L	F	H	O	L	D		T

Setting range: 0.0 to 30.0 seconds, 999

When 999 is set, an operation command is held (i.e., considered a momentary power failure) while control power in the inverter is being established or until the main circuit DC voltage is about 0.

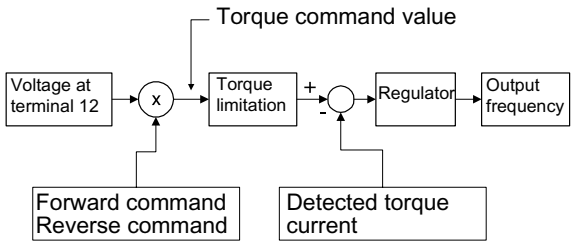
H18 Torque control

- This function controls motor torque according to a command value.

H	1	8	T	R	Q		C	T	R	L		

Related functions:
E01 to **E09** (Set value: 23)

Set value	Operation
0	Inactive (operation by frequency command)
1	Torque control active A 0 to +10 V analog voltage input to terminal 12 and the direction of rotation (FWD or REV) is used for the torque command value. 0 is used for 0 to -10 V.
2	Torque control active A -10 to +10 V analog voltage input to terminal 12 and the direction of rotation (FWD or REV) is used for the torque command value.



Torque control block diagram

The torque command value is +200 % when the voltage at terminal 12 is +10 V and is -200 % when the voltage is -10 V.

- In torque control, the torque command value and motor load determine the speed and direction of rotation.
- When the torque is controlled, the upper limit of frequency refers to the minimum value among the maximum frequency , the frequency limiter (upper limiter) value, and 120 Hz. Maintain the frequency at least one-tenth of the base frequency because torque control performance deteriorates at lower frequencies.
- If the operation command goes off during a torque control operation, the operation is switched to speed control and the motor decelerates-to-stop. At this time, the torque control function does not operate.

H19 Active drive

- This function automatically extends accelerating time against acceleration operation of 60 seconds or longer to prevent an inverter trip resulting from a temperature rise in inverter due to overcurrent.

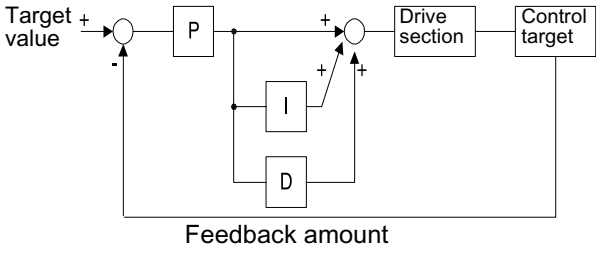
H	1	9	A	U	T		R	E	D			

Set value 0: Inactive
1: Active

(When the active drive function is activated, the acceleration time is three times the selected time).

H20 PID control (Mode select)
~
H25 PID control (Feedback filter)

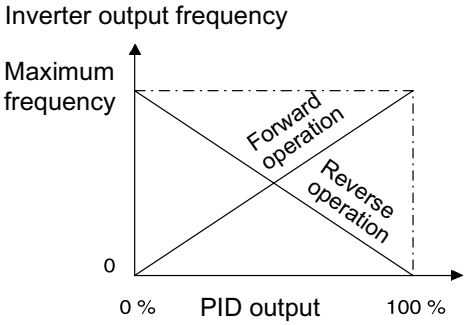
- PID control detects the amount of control (feedback amount) from a sensor of the control target, then compares it with the target value (e.g., reference temperature). If the values differ, this function performs a control to eliminate the deviation. In other words, this control matches the feedback amount with the target value.
  This function can be used for flow control, pressure control, temperature control, and other process controls.



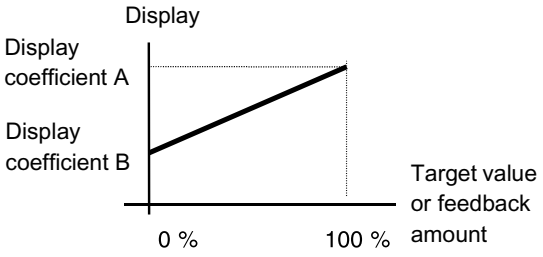
- Forward or reverse operations can be selected for PID controller output. This enables motor revolutions to be faster or lower according to PID controller output.

H	2	0	P	I	D		M	O	D	E		

Set value 0: No operation
1: Forward operation
2: Reverse operation



- The target value can be entered using F01, "Frequency command 1," or directly from the keypad panel. Select any terminal of Terminals X1 (E01) to X9 (E09) and set value 11 (frequency setting switching).
  For entry from F01, "Frequency setting 1," input an OFF signal to the selected terminal. For direct entry from the keypad panel, turn on the selected terminal.
- For the target value and feedback amount, the process amount can be displayed according to the values set in E40, "Display coefficient A," and E41, "Display coefficient B."

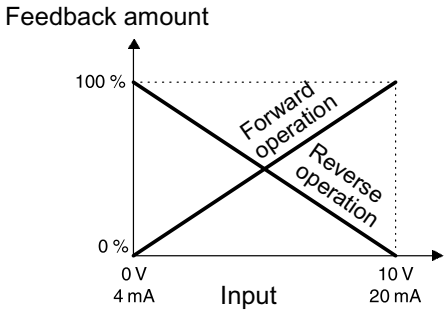


H21 PID control (Feedback signal)

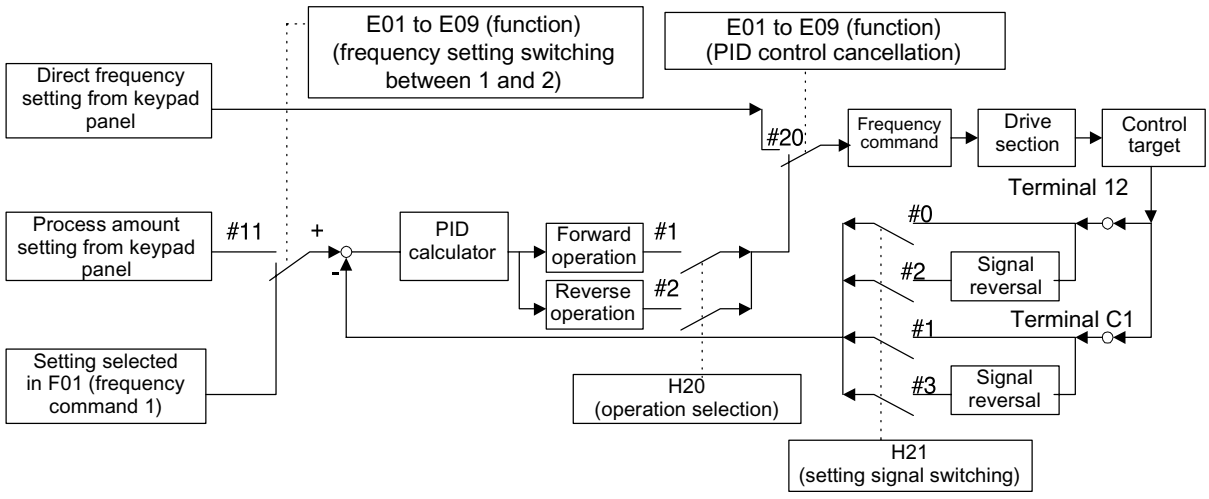
This function selects the feedback amount input terminal and electrical specifications of the terminal. Select a value from the table below according to sensor specifications.

H	2	1	F	B		S	I	G	N	A	L	

Set value	Descriptions
0	Control terminal 12, forward operation (0 to 10 V voltage input)
1	Control terminal C1, forward operation (4 to 20 mA current input)
2	Control terminal 12, reverse operation (10 to 0 V voltage input)
3	Control terminal C1, reverse operation (20 to 4 mA current input)



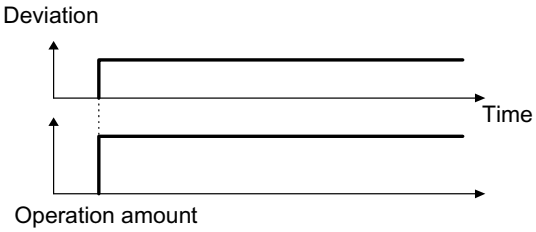
Only positive values can be input for this feedback amount of PID control.
Negative values (e.g., 0 to -10 V, -10 to 0 V) cannot be input, thereby the function cannot be used for a reverse operation by an analog signal.



H22 PID control (P-gain)
H23 PID control (I-gain)
H24 PID control (D-gain)

- These functions are not generally used alone but are combined like P control, PI control, PD control, and PID control.

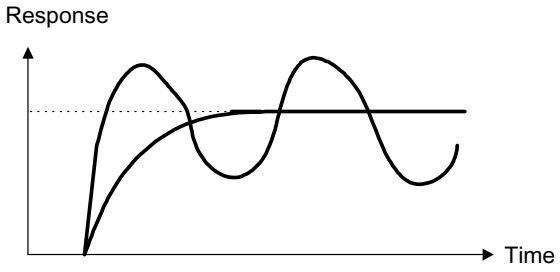
- P operation
  Operation using an operation amount (output frequency) proportional to deviation is called P operation, which outputs an operation amount proportional to deviation, though it cannot eliminate deviation alone.



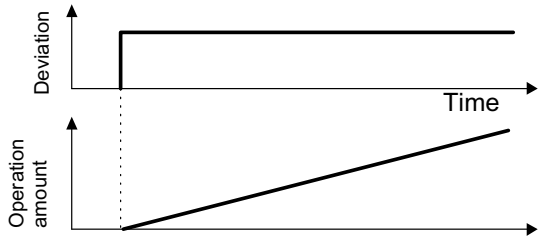
H	2	2	P	-	G	A	I	N				

Setting range: 0.01 to 10.0 times

P (gain) is the parameter that determines the response level for the deviation of P operation. Although an increase in gain speeds up response, an excessive gain causes vibration, and a decrease in gain delays response.



- I operation
  An operation where the change speed of the operation amount (output frequency) is proportional to the deviation is called an I operation. An I operation outputs an operation amount as the integral of deviation and, therefore, has the effect of matching the control amount (feedback amount) to the target value (e.g., set frequency), though it deteriorates response for significant changes in deviation.

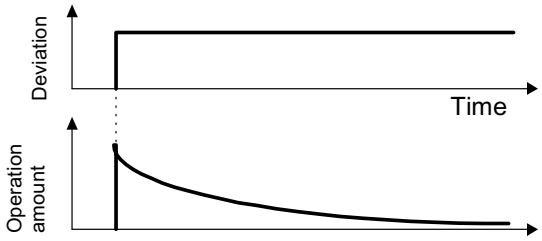


H	2	3	I	-	G	A	I	N				

Setting range: 0.0 (Inactive),
0.1 to 3600 seconds

"H23 I-gain" is used as a parameter to determine the effect of I operation. A longer integration time delays response and weakens resistance to external elements. A shorter integration time speeds up response, but an integration time that is too short causes vibration.

- D operation
  An operation where the operation amount (output frequency) is proportional to the deviation differential is called a D operation, which outputs an operation amount as the deviation differential and, therefore, is capable of responding to sudden changes.



H	2	4	D	-	G	A	I	N				

Setting range: 0.00 (Inactive),
0.01 to 10.0 seconds

"H24 D-gain" is used as a parameter to determine the effect of a D operation. A longer differentiation time causes vibration by P operation quickly attenuating at the occurrence of deviation. Excessive differentiation time could cause vibration. Shortening the differentiation time reduces attenuation at the occurrence of deviation.

- PI control
  P operation alone does not remove deviation completely. P + I control (where I operation is added to P operation) is normally used to remove the remaining deviation. PI control always operates to eliminate deviation even when the target value is changed or there is a constant disturbance. When I operation is strengthened, however, the response for rapidly changing deviation deteriorates. P operation can also be used individually for loads containing an integral element.

- PD control
  If deviation occurs under PD control, an operation amount larger than that of D operation alone occurs rapidly and prevents deviation from expanding. For a small deviation, P operation is restricted. When the load contains an integral element, P operation alone may allow responses to vibrate due to the effect of the integral element, in which case PD control is used to attenuate the vibration of P operation and stabilize responses. In other words, this control is applied to loads in processes without a braking function.

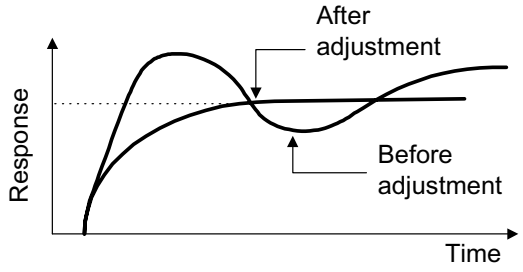
- PID control
  PID control combines the P operation, the I operation which removes deviation, and the D operation which suppresses vibration. This control achieves deviation-free, accurate, and stable responses.

- Adjusting PID set value
  Adjust the PID value while monitoring the response waveform on an oscilloscope or other instrument if possible. Proceed as follows:

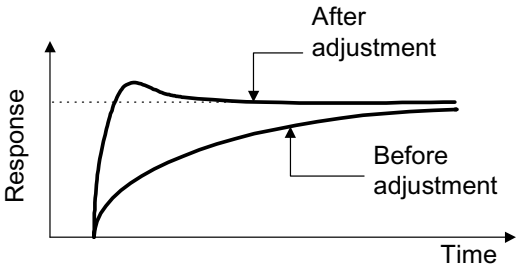
- Increase the value of "H22 P-gain" without generating vibration.
- Decrease the value of "H23 I-gain" without generating vibration.
- Increase the value of "H24 D-gain" without generating vibration.

Adjust the response waveform as follows:

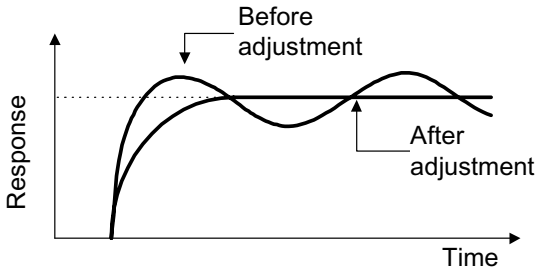
- To remove the overshoot, increase the value of "H23 I-gain," then decrease the value of "H24 D-gain."



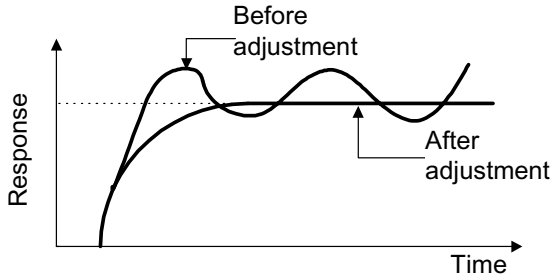
- To stabilize response quickly (i.e., allowing for a little overshoot):
  decrease the value of "H23 I-gain," or
  increase the value of "H24 D-gain."



- To suppress vibration with a period longer than the value of "H23 I-gain," increase the value of H23.



- To suppress vibration with a frequency roughly equivalent to the value "H24 D-gain," decrease the value of H24. If there is residual vibration with 0.0, decrease the value of "H22 P-gain."



H25 PID control (Feedback filter)

- This filter is for feedback signal input from terminal [12] or [C1]. This filter stabilizes operation of the PID control system. A set value that is too large, however, deteriorates response.

H	2	5	F	B		F	I	L	T	E	R	

Setting range: 0.0 to 60.0 seconds

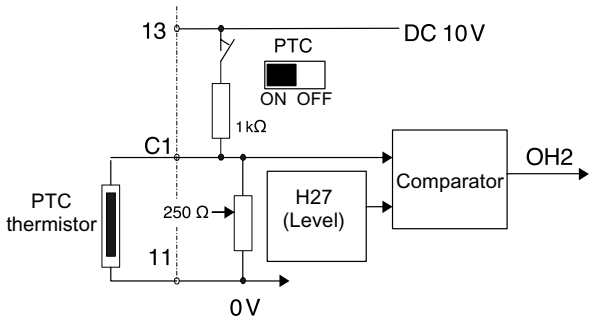
H26 PTC thermistor (Mode select)

- Set this function active when the motor has a PTC thermistor for overheat protection.

H	2	6	P	T	C		M	O	D	E		

Set value 0: Inactive
1: Active

- Connect the PTC thermistor as shown in the figure below.
  Turn on switch "PTC" on the control PCB.
  The trip mode is activated by "OH2:External thermal relay tripped."



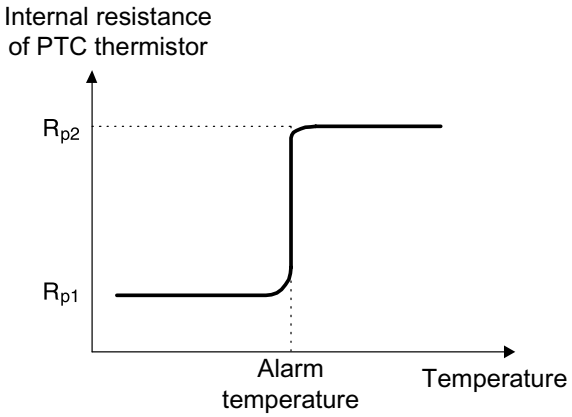
H27 PTC thermistor (Level)

- The voltage input to terminal [C1] is compared to the set voltage (Level). When the input voltage is equal to or greater than the set voltage (Level), "H26 PTC thermistor (Mode select)," starts.

H	2	7	P	T	C		L	E	V	E	L	

Setting range: 0.00 to 5.00 V

- The PTC thermistor has its own alarm temperature. The internal resistance value of the thermistor largely change at the alarm temperature. The operation (voltage) level is set using this change in the resistance value.



The figure in "H26 PTC thermistor (Mode select)," shows that resistor 250 Ω and the thermistor (resistance value R_p) are connected in parallel. Hence, voltage V_{C1} (Level) at terminal [C1] can be calculated by using the following formula.

$$V_{C1} = \frac{\frac{250 \cdot R_p}{250 + R_p}}{1000 + \frac{250 \cdot R_p}{250 + R_p}} \times 10 \text{ [V]}$$

The operation level can be set by bringing R_p in the V_{C1} calculation formula into the following range.

$R_{p1} < R_p < R_{p2}$

To obtain R_p easily, use the following formula.

$$R_p = \frac{R_{p1} + R_{p2}}{2} \text{ [}\Omega\text{]}$$

H28 Droop operation

When two or more motors drive a single machine, a higher load is placed on the motor rotating the fastest. Droop operation achieves a good load balance by applying drooping characteristics to speed against load variations.

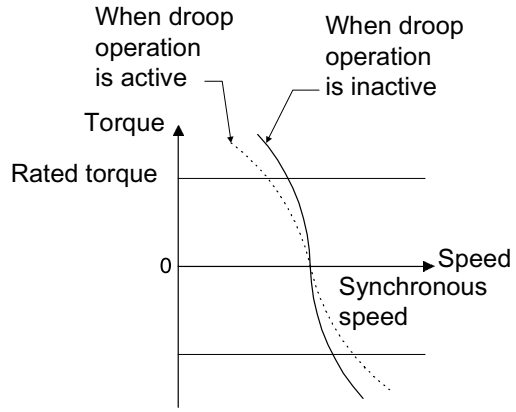
- Calculate the droop amount using the following formula:

$$\text{Droop amount} = \text{Base frequency} \times \frac{\text{Speed droop at rated torque [r/min]}}{\text{Synchronous speed [r/min]}} \text{[Hz]}$$

H	2	8	D	R	O	O	P					

Set value : -9.9 Hz to 0.0 Hz

Characteristics of the motor



H30 Serial link (Function select)

- The link function (communication function) provides RS485 (provided as standard) and bus connections (optional).

The serial link function includes:

1) Monitoring (data monitoring, function data check)
2) Frequency setting
3) Operation command (FWD, REV, and other commands for digital input)
4) Write function data

H	3	0	L	I	N	K		F	U	N	C	

Setting range: 0 to 3

Communication can be enabled and disabled by a digital input. This function sets the serial link function when communication is enabled.

Set value	Frequency command	Operation command
0	Disabled	Disabled
1	Enabled	Disabled
2	Disabled	Enabled
3	Enabled	Enabled

The data monitoring and function data write functions are always enabled. Disabling communication using digital input brings about the same result as when 0 is set to this function. When the bus option is installed, this setting selects the function of the option and the RS485 interface is restricted to monitoring and writing function data. When the option is not installed, this setting selects the RS485 function.

H31 RS485 (Address)
~
H39 RS485 (Response interval)

These functions set the conditions of RS485 communication. Set the conditions according to the upstream device. Refer to technical manual for the protocol.

- This function sets the station address of RS485.

H	3	1	A	D	D	R	E	S	S			

Setting range: 1 to 31

- This function sets processing at communication error and sets the error processing timer value.

H	3	2	M	O	D	E		O	N		E	R
H	3	3	T	I	M	E	R					

Setting range: 0 to 3

Set value	Processing at communication error
0	Immediate Er 8 trip (forced stop)
1	Continue operation within timer time, Er 8 trip after timer time.
2	Continue operation and effect retry within timer time, then invoke an Er 8 trip if a communication error occurs. If an error does not occur, continue operation.
3	Continue operation.

- This function sets the baud rate.

H	3	4	B	A	U	D		R	A	T	E	

Setting range: 0 to 4

Set value	Baud rate
0	19200 bit/s
1	9600 bit/s
2	4800 bit/s
3	2400 bit/s
4	1200 bit/s

- This function sets data length.

H	3	5	L	E	N	G	T	H				

Set value	Data length
0	8 bit
1	7 bit

- This function sets the parity bit.

H	3	6	P	A	R	I	T	Y				

Set value	Parity bit
0	None
1	Even
2	Odd

- This function sets the stop bit.

H	3	7	S	T	O	P		B	I	T	S	

Set value	Stop bit
0	2 bit
1	1 bit

- In a system where the local station is always accessed within a specific time, this function detects that access was stopped due to an open-circuit or other fault and invokes an Er 8 trip.
  This function sets the No response error detection time.

H	3	8	N	O		R	E	S		t		

Setting range: 0 (No detection)
1 to 60 seconds

- This function sets the time from when a request is issued from the upstream device to when a response is returned (response interval).

H	3	9	I	N	T	E	R	V	A	L		

Setting range: 0.00 to 1.00 second

Motor 2 (A: Alternative Motor Parameters)

A01 Maximum frequency 2

- This function sets the maximum frequency for motor 2 output by the inverter. This function operates the same as "F03 Maximum frequency 1."
  For details, see the explanation for F03.

A	0	1	M	A	X		H	z	-	2		

A02 Base frequency 2

- This function sets the maximum output frequency in the constant-torque area of motor 2 (i.e., output frequency at rated output voltage). This function operates the same as "F04 Base frequency 1."
  For details, see the explanation for F04.

A	0	2	B	A	S	E		H	z	-	2	

A03 Rated voltage 2

- This function sets the rated value of voltage output to motor 2. This function operates the same as "F05 Rated voltage 1."
  For details, see the explanation for F05.

A	0	3	R	A	T	E	D		V	2		

A04 Maximum voltage 2

- This function sets the maximum value of the inverter output voltage of motor 2. This function operates the same as "F06 Maximum voltage 1."
  For details, see the explanation for F06.

A	0	4	M	A	X		V	-	2			

A05 Torque boost 2

- This function sets the torque boost function of motor 2. This function operates the same as "F09 Torque boost 1."
  For details, see the explanation for F09.

A	0	5	T	R	Q		B	O	O	S	T	2

A06 Electronic thermal overload relay for motor 2 (Select)

A07 Electronic thermal overload relay for motor 2 (Level)

A08 Electronic thermal overload relay for motor 2 (Thermal time constant)

- This function sets the function of the electronic thermal overload relay for motor 2. This function operates the same as F10 to F12, "Electronic thermal overload relay for motor 1." For details, see the explanations for F10 to F12.

A	0	6	E	L	C	T	R	N		O	L	2
A	0	7	O	L		L	E	V	E	L	2	
A	0	8	T	I	M	E		C	N	S	T	2

A09 Torque vector control 2

- This function sets the torque vector function of motor 2. This function operates the same as "F42 Torque vector control 1."
  For details, see the explanation for F42.

A	0	9	T	R	Q	V	E	C	T	O	R	2

A10 Number of motor-2 poles

- This function sets the number of poles of motor 2 to be driven. This function operates the same as "P01 Number of motor-1 poles."
  For details, see the explanation for P01.

A	1	0	M	2		P	O	L	E	S		

A11 Motor 2 (Capacity)

- This function sets the capacity of motor 2. This function operates the same as "P02 Motor 1 (Capacity)." For details, see the explanation for P02. However, the related motor data functions change to "A12 Motor 2 (Rated current)," "A15 Motor 2 (No-load current)," "A16 Motor 2 (%R1 setting)," and "A17 Motor 2 (%X setting)."

A	**1**	**1**	M	2	-	C	A	P				

A12 Motor 2 (Rated current)

- This function sets the rated current of motor 2. This function operates the same as "P03 Motor 1 (Rated current)."
  For details, see the explanation for P03.

A	**1**	**2**	M	2	-	I	r					

A13 Motor 2 (Tuning)

- This function sets the auto tuning of motor 2. This function operates the same as "P04 Motor 1 (Tuning)."
  For details, see the explanation for P04.

A	**1**	**3**	M	2		T	U	N	1			

A14 Motor 2 (On-line tuning)

- This function sets the online tuning of motor 2. This function operates the same as "P05 Motor 1 (On-line tuning)."
  For details, see the explanation for P05.

A	**1**	**4**	M	2		T	U	N	2			

A15 Motor 2 (No-load current)

- This function sets the no-load current of motor 2. This function operates the same as "P06 Motor 1 (No-load current)."
  For details, see the explanation for P06.

A	**1**	**5**	M	2	-	I	o					

A16 Motor 2 (%R1 setting)

A17 Motor 2 (%X setting)

- This function sets %R1 and %X of motor 2. This function operates the same as "P07 Motor 1 (%R1 setting)," and "P08 Motor 1 (%X setting)." For details, see the explanations for P07 and P08.

A	**1**	**6**	M	2	-	%	R	1				
A	**1**	**7**	M	2	-	%	X					

A18 Slip compensation control 2

- This function sets the amount of slip compensation for motor 2. This function operates the same as "P09 Slip compensation control."
  For details, see the explanation for P09.

A	**1**	**8**	S	L	I	P		C	O	M	P	2

5