e-Front runners

FUJI INVERTERS
FRENIC5000G11S/P11S
TECHNICAL INFORMATION

MEHT533

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Chapter 1

Specifications

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Chapter 1

1. Standard Specifications

1. Standard Specifications

1.1 Three-phase 230V FRENIC5000G11S Series

Item				Specifications																	
Type	FRN□□□G11S-2UX			F25	F50	001	002	003	005	007	010	015	020	025	030	040	050	060	075	100	125
Nominal applied motor HP				1/4	1/2	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100	125
Output ratings	Rated capacity *1) kVA			0.6	1.2	2.0	3.2	4.4	6.8	9.9	13	18	23	29	36	46	58	72	86	113	138
	Rated voltage *2) V			3-phase 200V/50Hz 200, 220, 230V/60Hz																	
	Rated current *3) A			1.5	3.0	5.0	8.0	11	17	25	33	46	59	74	87	115	145	180	215	283	346
	Overload capability			150% of rated current for 1min. 200% of rated current for 0.5s												150% of rated current for 1min. 180% of rated current for 0.5s					
	Rated frequency Hz			50, 60Hz																	
Input ratings	Phases, Voltage, Frequency			3-phase 200 to 230V 50/60Hz												3-phase 200 to 220V/50Hz (220 to 230V/50Hz) *11) 200 to 230V/60Hz					
	Voltage / frequency variations			Voltage : +10 to –15% (Voltage unbalance *4) : 2% or less) Frequency :+5 to –5%																	
	Momentary voltage dip capability *5)			When the input voltage is 165V or more, the inverter can be operated continuously. When the input voltage drops below 165V from rated voltage, the inverter can be operated for 15ms . The smooth recovery method is selectable.																	
	Rated current *6) A	(with DCR)		0.94	1.6	3.1	5.7	8.3	14.0	19.7	26.9	39.0	54.0	66.2	78.8	109	135	163	199	272	327
		(without DCR)		1.8	3.4	6.4	11.1	16.1	25.5	40.8	52.6	76.9	98.5	117	136	168	204	243	291	-	-
	Required power supply capacity *7) kVA			0.4	0.6	1.1	2.0	2.9	4.9	6.9	9.4	14	19	23	28	38	47	57	69	95	114
Output frequency	Setting	Maximum frequency		50 to 400Hz																	
		Base frequency		25 to 400Hz																	
		Starting frequency		0.1 to 60Hz, Holding time: 0.0 to 10.0s																	
		Carrier frequency *8)		0.75 to15kHz																	0.75 to 10kHz
	Accuracy (Stability)			• Analog setting : ±0.2% of Maximum frequency (at 25±10°C (77±50°F)) • Digital setting : ±0.01% of Maximum frequency (at –10 to +50°C (14 to 122°F))																	
	Setting resolution			• Analog setting : 1/3000 of Maximum frequency ex.) 0.02Hz at 60Hz, 0.04Hz at 120Hz, 0.15Hz at 400Hz • Digital setting : 0.01Hz at Maximum frequency of up to 99.99Hz (0.1Hz at Maximum frequency of 100Hz and above) • LINK setting : Selects from the following two items. • 1/20000 of Maximum frequency ex.) 0.003Hz at 60Hz, 0.006Hz at 120Hz, 0.02Hz at 400Hz • 0.01Hz (Fixed)																	
Control	Voltage / freq. (V/f) characteristic			Adjustable at base and maximum frequency, with AVR control : 80 to 240V																	
	Torque boost			Torque boost can be set, using Function code F09 and A05. 0.0 : Automatic (for constant torque load) 0.1 to 0.9 : Manual (for variable torque load) *9) 1.0 to 1.9 : Manual (for propotional speed torque load) 2.0 to 20.0: Manual (for constant torque load)																	
	Starting torque			200% (with Dynamic torque-vector control selected)												180% (with Dynamic torque-vector control selected)					
Braking	Standard	Braking torque *10)		150%			100%					20%				10 to 15%					
		Time s		10	5		5					No limit									
		Duty cycle %ED		10	5	3	5	3	2	3	2	No imit l									
	Using options	Standard	Braking torque	150%												100%					
			Time s	90	45	45	45	30	20		10				8	10					
			Duty cycle %ED	37	22	18	10	7	5		5				5	10					
		10%ED	Braking torque	150%												*12)					
			Time s	90	45			30	20		10										
			Duty cycle %ED	10								10		10							
	DC injection braking			Starting frequency: 0.1 to 60.0Hz Braking time: 0.0 to 30.0s Braking level: 0 to 100% of rated current *Inverter restarts at the starting frequency when operation command is input while braking is operating. *DC injection braking does not operate at the time of change-over from forward to reverse operation. *DC injection braking does not operate when frequency setting is decreased while operation command (FWD, REV) is being input.																	
Enclosure (IEC 60529)				IP 40												IP 00 (IP 20 : Option)					
Cooling method				Natural cooling		Fan cooling															
Standards				-UL/cUL -Low Voltage Directive -EMC Directive -TÜV (up to 30HP) -IEC 61800-2 (Ratings, specifications for low voltage adjustable frequency a.c. power drive systems) -IEC 61800-3 (EMC product standard including specific test methods)																	
Weight lbs (kg)				4.9 (2.2)	4.9 (2.2)	5.5 (2.5)	8.4 (3.8)	8.4 (3.8)	8.4 (3.8)	13 (6.1)	13 (6.1)	22 (10)	22 (10)	23 (10.5)	23 (10.5)	64 (29)	79 (36)	97 (44)	101 (46)	154 (70)	254 (115)

NOTES: *1) Inverter output capacity (kVA) at 230V. Rated capacity reduces when power supply voltage decreases.
*2) Output voltage cannot exceed the power supply voltage.
*3) Current derating may be required in case of low impedance loads such as high frequency motor.
*4) Use a DC REACTOR (DCR) when the voltage unbalance exceeds 2%. (This value is equivalent to FUJI's conventional allowable value.)

$$\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage [V]} - \text{Min. Voltage [V]}}{\text{Three-phase average voltage[V]}} \times 67 \qquad \text{(Conforming to EN61800-3 (5.2.3))}$$

*5) Tested at standard load condition (85% load).
*6) This value is under FUJI original calculation method.
*7) When power-factor correcting DC REACTOR (DCR) is used.
*8) When inverter is operating at a carrier frequency of 10kHz or higher, the inverter may automatically reduce the carrier frequency to 8kHz for protecting inverter.
*9) When torque boost is set at 0.1, starting torque of 50% or more can be obtained.
*10) With a nominal applied motor, this value is average torque when the motor decelerates and stops from 60Hz. (It may change according to motor loss.)
*11) Order individually.
*12) Applicable to 10%ED when using options (standard)

1.2 Three-phase 460V FRENIC5000G11S Series

Item				Specifications																									
Type	FRN□□□G11S-4UX			F50	001	002	003	005	007	010	015	020	025	030	040	050	060	075	100	125	150	200	250	300	350	400	450	500	600
Nominal applied motor			HP	1/2	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100	125	150	200	250	300	350	400	450	500	600
Output ratings	Rated capacity *1)		kVA	1.1	1.9	2.8	4.1	6.8	9.9	13	18	22	29	34	45	57	69	85	114	134	160	192	231	287	316	396	445	495	563
	Rated voltage *2)		V	3-phase 380, 400, 415V/50Hz 380, 400, 440, 460V/60Hz																									
	Rated current *3)		A	1.5	2.5	3.7	5.5	9	13	18	24	30	39	45	60	75	91	112	150	176	210	253	304	377	415	520	585	650	740
	Overload capability			150% of rated current for 1min. 200% of rated current for 0.5s											150% of rated current for 1min. 180% of rated current for 0.5s														
	Rated frequency		Hz	50, 60Hz																									
Input ratings	Phases, Voltage, Frequency			3-phase 380 to 480V 50/60Hz											3-phase 380 to 440V/50Hz 380 to 480V/60Hz *4)														
	Voltage / frequency variations			Voltage : +10 to –15% (Voltage unbalance *5) : 2% or less) Frequency :+5 to –5%																									
	Momentary voltage dip capability *6)			When the input voltage is 310V or more, the inverter can be operated continuously. When the input voltage drops below 310V from rated voltage, the inverter can be operated for 15ms . The smooth recovery method is selectable.																									
	Rated current *7)	(with DCR)		0.82	1.5	2.9	4.2	7.1	10.0	13.5	19.8	26.8	33.2	39.3	54	67	81	100	134	160	196	232	282	352	385	491	552	624	704
	A	(without DCR)		1.8	3.5	6.2	9.2	14.9	21.5	27.9	39.1	50.3	59.9	69.3	86	104	124	150	-	-	-	-	-	-	-	-	-	-	-
	Required power supply capacity *8)		kVA	0.6	1.1	2.1	3.0	5.0	7.0	9.4	14	19	24	28	38	47	57	70	93	111	136	161	196	244	267	341	383	433	488
Output frequency	Setting	Maximum frequency		50 to 400Hz																									
		Base frequency		25 to 400Hz																									
		Starting frequency		0.1 to 60Hz, Holding time: 0.0 to 10.0s																									
	Carrier frequency *9)			0.75 to 15kHz																0.75 to 10kHz									
	Accuracy (Stability)			• Analog setting : ±0.2% of Maximum frequency (at 25±10°C (77±50°F)) • Digital setting : ±0.01% of Maximum frequency (at –10 to +50°C (14 to 122°F))																									
	Setting resolution			• Analog setting : 1/3000 of Maximum frequency ex.) 0.02Hz at 60Hz, 0.04Hz at 120Hz, 0.15Hz at 400Hz • Digital setting : 0.01Hz at Maximum frequency of up to 99.99Hz (0.1Hz at Maximum frequency of 100Hz and above) • LINK setting : Selects from the following two items. • 1/20000 of Maximum frequency ex.) 0.003Hz at 60Hz, 0.006Hz at 120Hz, 0.02Hz at 400Hz • 0.01Hz (Fixed)																									
Control	Voltage / freq. (V/f) characteristic			Adjustable at base and maximum frequency, with AVR control : 320 to 480V																									
	Torque boost			Torque boost can be set, using Function code F09 and A05. 0.0 : Automatic (for constant torque load) 0.1 to 0.9 : Manual (for variable torque load) *10) 1.0 to 1.9 : Manual (for propotional speed torque load) 2.0 to 20.0: Manual (for constant torque load)																									
	Starting torque			200% (with Dynamic torque-vector control selected)											180% (with Dynamic torque-vector control selected)														
Braking	Standard	Braking torque	*11)	150%		100%					20%				10 to 15%														
		Time	s	5		5					No limit																		
		Duty cycle	%ED	5	3	5	3	2	3	2	No imit																		
	Using options	Standard	Braking torque	150%											100%														
			Time s	45			30	20		10				8	10														
			Duty cycle %ED	22	18	10	7	5		5				5	10														
		10%ED	Braking torque	150%											*13)														
			Time s	45			30	20		10																			
			Duty cycle %ED	10			10	10		10																			
	DC injection braking			Starting frequency: 0.1 to 60.0Hz Braking time: 0.0 to 30.0s Braking level: 0 to 100% of rated current * Inverter restarts at the starting frequency when operation command is input while braking is operating. * DC injection braking does not operate at the time of change-over from forward to reverse operation. * DC injection braking does not operate when frequency setting is decreased while operation command (FWD, REV) is being input.																									
Enclosure (IEC 60529)				IP 40											IP 00 (IP 20 : Option)														
Cooling method				Natural cooling	Fan cooling																								
Standards				-UL/cUL -Low Voltage Directive -EMC Directive -TÜV (up to 30HP) -IEC 61800-2 (Ratings, specifications for low voltage adjustable frequency a.c. power drive systems) -IEC 61800-3 (EMC product standard including specific test methods)																									
Weight			lbs	4.9	5.5	8.4	8.4	8.4	14	14	22	22	23	23	64	75	86	88	106	154	154	221	221	309	309	551	551	794	794
			(kg)	(2.2)	(2.5)	(3.8)	(3.8)	(3.8)	(6.5)	(6.5)	(10)	(10)	(10.5)	(10.5)	(29)	(34)	(39)	(40)	(48)	(70)	(70)	(100)	(100)	(140)	(140)	(250)	(250)	(360)	(360)

NOTES: *1) Inverter output capacity (kVA) at 460V. Rated capacity reduces when power supply voltage decreases.
*2) Output voltage cannot exceed the power supply voltage.
*3) Current derating may be required in case of low impedance loads such as high frequency motor.
*4) When the input voltage is 380 to 398V/50Hz or 380 to 430V/60Hz, the tap of the auxiliary transformer must be changed.
*5) Use a DC REACTOR (DCR) when the voltage unbalance exceeds 2%. (This value is equivalent to FUJI's conventional allowable value.)

$$\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage [V] – Min. Voltage [V]}}{\text{Three-phase average voltage[V]}} \times 67$$

(Conforming to EN61800-3 (5.2.3))

*6) Tested at standard load condition (85% load).
*7) This value is under FUJI original calculation method.
*8) When power-factor correcting DC REACTOR (DCR) is used.
*9) When inverter is operating at a carrier frequency of 10kHz or higher, the inverter may automatically reduce the carrier frequency to 8kHz for protecting inverter.
*10) When torque boost is set at 0.1, starting torque of 50% or more can be obtained.
*11) With a nominal applied motor, this value is average torque when the motor decelerates and stops from 60Hz. (It may change according to motor loss.)
*12) Consult with Fuji Electric.
*13) Applicable to 10%ED when using options (standard)

Chapter 1

1. Standard Specifications

1.3 Three-phase 230V FRENIC5000P11S Series (for variable torque load)

Item				Specifications												
Type	FRN□□□P11S-2UX			007	010	015	020	025	030	040	050	060	075	100	125	150
Nominal applied motor			HP	7.5	10	15	20	25	30	40	50	60	75	100	125	150
Output ratings	Rated capacity *1)		kVA	8.8	12	17	22	27	31	46	58	72	86	113	138	165
	Rated voltage *2)		V	3-phase 200V/50Hz 200, 220, 230V/60Hz												
	Rated current *3)		A	22	29	42	55	67	78	115	145	180	215	283	346	415
	Overload capability			110% of rated current for 1min												
	Rated frequency		Hz	50, 60Hz												
Input ratings	Phases, Voltage, Frequency			3-phase 200 to 230V 50/60Hz						3-phase 200 to 220V/50Hz (220 to 230V/50Hz) *11) 200 to 230V/60Hz						
	Voltage / frequency variations			Voltage : +10 to –15% (Voltage unbalance *4) : 2% or less) Frequency :+5 to –5%												
	Momentary voltage dip capability *5)			When the input voltage is 165V or more, the inverter can be operated continuously. When the input voltage drops below 165V from rated voltage, the inverter can be operated for 15ms . The smooth recovery method is selectable.												
	Rated current *6)	(with DCR)		19.7	26.9	39.0	54.0	66.2	78.8	109	135	163	199	272	327	400
	A	(without DCR)		40.8	52.6	76.9	98.5	117	136	168	204	243	291	-	-	-
	Required power supply capacity *7)		kVA	6.9	9.4	14	19	23	28	38	47	57	69	95	114	139
Output frequency	Setting	Maximum frequency		50 to 120Hz												
		Base frequency		25 to 120Hz												
		Starting frequency		0.1 to 60Hz, Holding time: 0.0 to 10.0s												
		Carrier frequency *8)		0.75 to 15kHz						0.75 to 10kHz					0.75 to 6kHz	
	Accuracy (Stability)			• Analog setting : ±0.2% of Maximum frequency (at 25±10°C (77±50°F)) • Digital setting : ±0.01% of Maximum frequency (at –10 to +50°C (14 to 122°F))												
	Setting resolution			• Analog setting : 1/3000 of Maximum frequency ex.) 0.02Hz at 60Hz, 0.04Hz at 120Hz • Digital setting : 0.01Hz at Maximum frequency of up to 99.99Hz (0.1Hz at Maximum frequency of 100Hz and above) • LINK setting : Selects from the following two items. • 1/20000 of Maximum frequency ex.) 0.003Hz at 60Hz, 0.006Hz at 120Hz • 0.01Hz (Fixed)												
Control	Voltage / freq. (V/f) characteristic			Adjustable at base and maximum frequency, with AVR control : 80 to 240V												
	Torque boost			Torque boost can be set, using Function code F09 and A05. 0.0 : Automatic (for constant torque load) 0.1 to 0.9 : Manual (for variable torque load) *9) 1.0 to 1.9 : Manual (for propotional speed torque load) 2.0 to 20.0 : Manual (for constant torque load)												
	Starting torque			50%												
Braking	Standard	Braking torque *10)		20%						10 to 15%						
		Time	s	No limit												
		Duty cycle	%ED	No limit												
	Using options	Standard	Braking torque	100%						75%						
			Time s	15		7		8		10						
			Duty cycle %ED	3.5		3.5		4		10						
		10%ED	Braking torque	100%						*12)						
			Time s	15		7										
			Duty cycle %ED	10		10	10	7								
	DC injection braking			Starting frequency: 0.1 to 60.0Hz Braking time: 0.0 to 30.0s Braking level: 0 to 100% of rated current * Inverter restarts at the starting frequency when operation command is input while braking is operating. * DC injection braking does not operate at the time of change-over from forward to reverse operation. * DC injection braking does not operate when frequency setting is decreased while operation command (FWD, REV) is being input.												
Enclosure (IEC 60529)				IP 40						IP 00 (IP 20 : Option)						
Cooling method				Fan cooling												
Standards				-UL/cUL -Low Voltage Directive -EMC Directive -TÜV (up to 30HP) -IEC 61800-2 (Ratings, specifications for low voltage adjustable frequency a.c. power drive systems) -IEC 61800-3 (EMC product standard including specific test methods)												
Weight			lbs (kg)	13 (5.7)	13 (5.7)	13 (5.7)	22 (10)	22 (10)	23 (10.5)	64 (29)	64 (29)	79 (36)	97 (44)	101 (46)	154 (70)	254 (115)

NOTES: *1) Inverter output capacity (kVA) at 230V. Rated capacity reduces when power supply voltage decreases.

*2) Output voltage cannot exceed the power supply voltage.

*3) Current derating may be required in case of low impedance loads such as high frequency motor.

*4) Use a DC REACTOR (DCR) when the voltage unbalance exceeds 2%. (This value is equivalent to FUJI's conventional allowable value.)

$$\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage [V]} - \text{Min. Voltage [V]}}{\text{Three-phase average voltage[V]}} \times 67 \qquad \text{(Conforming to EN61800-3 (5.2.3))}$$

*5) Tested at standard load condition (85% load).

*6) This value is under FUJI original calculation method.

*7) When power-factor correcting DC REACTOR (DCR) is used.

*8) When inverter is operating at a carrier frequency of 10kHz or higher, the inverter may automatically reduce the carrier frequency to 8kHz for protecting inverter.

*9) When torque boost is set at 0.1, starting torque of 50% or more can be obtained.

*10) With a nominal applied motor, this value is average torque when the motor decelerates and stops from 60Hz. (It may change according to motor loss.)

*11) Order individually.

*12) Applicable to 10%ED when using options (standard)

1.4 Three-phase 460V FRENIC5000P11S Series (for variable torque load)

Item				Specifications																						
Type	**FRN□□□P11S-4UX**			007	010	015	020	025	030	040	050	060	075	100	125	150	200	250	300	350	400	450	500	600	700	800
Nominal applied motor			**HP**	7.5	10	15	20	25	30	40	50	60	75	100	125	150	200	250	300	350	400	450	500	600	700	800
Output raitings	**Rated capacity *1)**		**kVA**	10	13	18	24	29	35	48	60	72	89	119	140	167	201	242	300	330	386	414	517	589	668	764
	Rated voltage *2)		**V**	3-phase 380, 400, 415V/50Hz 380, 400, 440, 460V/60Hz																						
	Rated current *3)		**A**	12.5	16.5	23	30	37	44	60	75	91	112	150	176	210	253	304	377	415	520	585	650	740	840	960
	Overload capability			110% of rated current for 1min																						
	Rated frequency		**Hz**	50, 60Hz																						
Input ratings	**Phases, Voltage, Frequency**			3-phase 380 to 480V 50/60Hz						3-phase 380 to 440V/50Hz 380 to 480V/60Hz *4)																
	Voltage / frequency variations			Voltage : +10 to –15% (Voltage unbalance *5) : 2% or less) Frequency :+5 to –5%																						
	Momentary voltage dip capability *6)			When the input voltage is 310V or more, the inverter can be operated continuously. When the input voltage drops below 310V from rated voltage, the inverter can be operated for 15ms . The smooth recovery method is selectable.																						
	Rated current *7)	**(with DCR)**		10.0	13.5	19.8	26.8	33.2	39.3	54	67	81	100	134	160	196	232	282	352	385	491	552	624	704	792	880
	A	**(without DCR)**		21.5	27.9	39.1	50.3	59.9	69.3	86	104	124	150	-	-	-	-	-	-	-	-	-	-	-	-	-
	Required power supply capacity *8)		**kVA**	7.0	9.4	14	19	24	28	38	47	57	70	93	111	136	161	196	244	267	341	383	433	488	549	610
Output frequency	**Setting**	**Maximum frequency**		50 to 120Hz																						
		Base frequency		25 to 120Hz																						
		Starting frequency		0.1 to 60Hz, Holding time: 0.0 to 10.0s																						
	Carrier frequency *9)			0.75 to 15kHz						0.75 to 10kHz					0.75 to 6kHz											
	Accuracy (Stability)			· Analog setting : ±0.2% of Maximum frequency (at 25±10°C (77±50°F)) · Digital setting : ±0.01% of Maximum frequency (at –10 to +50°C (14 to 122°F))																						
	Setting resolution			· Analog setting : 1/3000 of Maximum frequency ex.) 0.02Hz at 60Hz, 0.04Hz at 120Hz · Digital setting : 0.01Hz at Maximum frequency of up to 99.99Hz (0.1Hz at Maximum frequency of 100Hz and above) · LINK setting : Selects from the following two items. • 1/20000 of Maximum frequency ex.) 0.003Hz at 60Hz, 0.006Hz at 120Hz • 0.01Hz (Fixed)																						
Control	**Voltage / freq. (V/f) characteristic**			Adjustable at base and maximum frequency, with AVR control : 320 to 480V																						
	Torque boost			Torque boost can be set, using Function code F09 and A05. 0.0 : Automatic (for constant torque load) 0.1 to 0.9 : Manual (for variable torque load) *10) 1.0 to 1.9 : Manual (for propotional speed torque load) 2.0 to 20.0 : Manual (for constant torque load)																						
	Starting torque			50%																						
Braking	**Standard**	**Braking torque**	***11)**	20%						10 to 15%																
		Time	**s**	No limit																						
		Duty cycle	**%ED**	No limit																						
	Using options	**Standard**	**Braking torque**	100%						75%																
			Time s	15		7		8		10																
			Duty cycle %ED	3.5		3.5		4		10																
		10%ED	**Braking torque**	100%						*13)																
			Time s	15		7																				
			Duty cycle %ED	10		10		7																		
	DC injection braking			Starting frequency: 0.1 to 60.0Hz Braking time: 0.0 to 30.0s Braking level: 0 to 100% of rated current * Inverter restarts at the starting frequency when operation command is input while braking is operating. * DC injection braking does not operate at the time of change-over from forward to reverse operation. * DC injection braking does not operate when frequency setting is decreased while operation command (FWD, REV) is being input.																						
Enclosure (IEC 60529)				IP 40						IP 00 (IP 20 : Option)																
Cooling method				Fan cooling																						
Standards				-UL/cUL -Low Voltage Directive -EMC Directive -TÜV (up to 30HP) -IEC 61800-2 (Ratings, specifications for low voltage adjustable frequency a.c. power drive systems) -IEC 61800-3 (EMC product standard including specific test methods)																						
Weight			**lbs**	13	13	13	22	22	23	64	64	75	86	88	106	154	154	221	221	309	309	309	551	551	794	794
			(kg)	(6.1)	(6.1)	(6.1)	(10)	(10)	(10.5)	(29)	(29)	(34)	(39)	(40)	(48)	(70)	(70)	(100)	(100)	(140)	(140)	(140)	(250)	(250)	(360)	(360)

NOTES: *1) Inverter output capacity (kVA) at 460V. Rated capacity reduces when power supply voltage decreases.

*2) Output voltage cannot exceed the power supply voltage.

*3) Current derating may be required in case of low impedance loads such as high frequency motor.

*4) When the input voltage is 380 to 398V/50Hz or 380 to 430V/60Hz, the tap of the auxiliary transformer must be changed.

*5) Use a DC REACTOR (DCR) when the voltage unbalance exceeds 2%. (This value is equivalent to FUJI’s conventional allowable value.)

$$\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage [V]} - \text{Min. Voltage [V]}}{\text{Three-phase average voltage[V]}} \times 67$$

(Conforming to EN61800-3 (5.2.3))

*6) Tested at standard load condition (85% load).

*7) This value is under FUJI original calculation method.

*8) When power-factor correcting DC REACTOR (DCR) is used.

*9) When inverter is operating at a carrier frequency of 10kHz or higher, the inverter may automatically reduce the carrier frequency to 8kHz for protecting inverter.

*10) When torque boost is set at 0.1, starting torque of 50% or more can be obtained.

*11) With a nominal applied motor, this value is average torque when the motor decelerates and stops from 60Hz. (It may change according to motor loss.)

*12) Consult with Fuji Electric.

*13) Applicable to 10%ED when using options (standard)

2. Common Specifications

2.1 Outline of common specifications

Item		Explanation	Remarks	Func. code
Control	**Control method**	• V/f control (Sinusoidal PWM control) • Dynamic torque-vector control (Sinusoidal PWM control) • Vector control with PG ...G11S only	Option card (PG/Hz) required.	**F42, A09**
	Operation method	• KEYPAD operation : Forward or reverse operation by FWD or REV key Stopping by STOP key	Switching between KEYPAD operation and digital input signal operation is enabled by pressing STOP key and RESET key at the same time.	**F02**
		• Digital input signal operation : FWD·STOP command, REV·STOP command, Coast-to-stop command, etc.		
		• LINK operation : • RS-485 (standard) • Various Bus interface is available. (Option) • T-Link (FUJI private link) • Devicenet • CAN open • Profibus-DP • Modbus Plus • Interbus-S •JPCN1	(LE)	**H30 to H39**
	Frequency setting (Frequency command)	• KEYPAD operation : ∧ or ∨ key		**F01**
		• External potentiometer : Variable resistor (1 to 5kΩ 1/2W)	• Connect to terminals 13, 12, and 11. • Set Function code at ”F01: 1". • Potentiometer is required separately.	
		• Analog input : External voltage or current input 0 to +10Vdc (0 to +5Vdc) 4 to 20mAdc (Reversible operation) : Reversible operation by polarized signal can be selected. 0 to ± 10Vdc (0 to ± 5Vdc) (Inverse operation) : Inverse mode operation can be selected by digital input signal (IVS). 0 to +10Vdc → 10 to 0Vdc (terminal 12) 4 to 20mAdc → 20 to 4mAdc (terminal C1)	0 to +5Vdc, 0 to ± 5Vdc input is enabled when Func. code 17 (Gain for frequency setting) is set at 200.0%.	
		• UP/DOWN control : Output frequency increases when UP signal is ON, and decreases when DOWN signal is ON.	(UP, DOWN)	
		• Multistep frequency selection : Up to 16 different frequencies can be selected by digital input signal.	(SS1, SS2, SS4, SS8)	**C05 to C19**
		• Pulse train input : 0 to 100kp/s	Option card (PG/SY) required.	
		• Digital signal (parallel) : 12-bit parallel (12-bit binary) signal can be input.	Option card (DIO) required.	
		• LINK operation (Option) : RS-485 (standard) (RS-485FGABus) • T-Link (FUJI private link) • Profibus-DP • Interbus-S • Modbus Plus • Devicenet	(LE) Option card for open networks	**H31 to H39**
		Programmed PATTERN operation : Max. 7 stages	<STG1, STG2, STG4, TU, TO>	**F01** **C21 to C28**
	Jogging operation	This operation can be performed by KEYPAD opration (FWD, REV key) or digital input signal (FWD or REV).	• To enter jogging operation mode: • Press STOP key and ∧ key at the same time. • Digital input signal : (JOG) * During jogging operation, an indicator at “JOG” is lit on the LCD monitor.	**C20** **F02**
	Running status signal	Transistor output (4 points) : RUN, FAR, FDT, OL, LU, TL, etc. (4 output types are selectable)		**E20 to E23**
		Relay output (2 points) : • Same as transistor output. • Alarm output (for any fault)		**F36** **E24, E25**
		Analog output (1 point) : Output frequency, Output current, Output voltage, Output torque, etc.		**F31**
		Pulse output (1 point) : Output frequency, Output current, Output voltage, Output torque, etc.		**F35**
	Acceleration/ Deceleration time	0.01 to 3600s	Coast-to-stop is selectable by Function code “H11”.	**F07, F08**
		Four kinds of acceleration and deceleration times can be set independently, and the desired time is selected by combining digital input signal (2 points).	(RT1, RT2)	**E10 to E15**
		Selects acceleration/deceleration pattern from the following 4 types. • Linear • S-curve (weak) • S-curve (strong) • Non-linear (for variable torque load)		**H07**
	Active drive	When the acceleration time reaches 60s, the motor output torque is automatically reduced to rated torque. Then the motor operation mode is changed to torque limiting operation.	The acceleration time is automatically extended up to 3 times.	**H19**
	Frequency limiter	High and Low frequency limiters can be preset.		**F15, F16**

NOTE : ( ) or < > in the “Remarks” column indicates the abbreviation of terminal function assigned to digital input terminals X1 to X9 and transistor output terminals Y1 to Y5C.

2. Common Specifications

Item		Explanation	Remarks	Func. code
Control	**Bias frequency**	Bias frequency can be preset.	When the sum of setting frequency and bias frequency is minus value, the output frequency rise can be delayed. (No reverse running is performed.)	**F18**
	Gain for frequency setting	Gain for frequency setting can be preset. (0.0 to 200.0%) ex.) Analog input 0 to +5Vdc with 200% gain results in Maximum frequency at 5Vdc.		**F17**
	Jump frequency control	Jump frequency (3 points) and its common jump hysteresis width (0 to 30Hz) can be preset.		**C01 to C04**
	Rotating motor pick up (Flying start)	A rotating motor(including inverse rotating mode) can be smoothly picked up without stopping the motor. (speed search method)	(STM)	**H09**
	Auto-restart after momentary power failure	Automatic restart is available without stopping motor after a momentary power failure. (speed search method) When "Smooth recovery" mode is selected, the motor speed drop is held minimum.	The inverter searches the motor speed, and smoothly returns to setting frequency. Even if the motor circuit is temporarily opened, the inverter operates without a hitch.	**F14** **H13 to H16**
	Line/Inverter changeover operation	Controls switching operation between line power and inverter. The inverter has sequence function inside.	(SW50, SW60) <SW88, SW52-1, SW52-2>	**E01 to E09** **E20 to E24, H13**
	Slip compensation	• The inverter output frequency is controlled according to the load torque to keep motor speed constant. • When the value is set at "0.00" and "Torque-vector" is set at "active", the compensation value automatically selects the Fuji standard motor.	Slip compensation value can be manually set from 0.01 to 5.00Hz instead of 0.0 for FUJI standard motor.	**P09**
		Slip compensation can be preset for the second motor.		**A18**
	Droop operation	The motor speed droops in proportional to output torque.(-9.9 to 0.0Hz) ...G11S only	P11S series doesn't have this function.	**H28**
	Torque limiting	When the motor torque reaches a preset limiting level, this function automatically adjusts the output frequency to prevent the inverter from tripping due to an overcurrent.		**F40, F41**
		Torque limiting 1 and Torque limiting 2 can be individually set, and are selectable with a digital input signal.	(TL2/TL1)	**E16, E17**
	Torque control	Output torque (or load factor) can be controlled with an analog input signal (terminal 12).	• Torque polarity selectable. (Hz/TRQ) • P11S series doesn't have this function.	**H18**
	PID control	This function can control flowrate, pressure, etc. (with an analog feedback signal.) **• Reference signal** • KEYPAD operation (∧ or ∨ key) : Setting freq. / Maximum freq. X 100 [%] • Voltage input (terminal 12 and V2) : 0 to 10Vdc / 0 to 100% • Current input (terminal C1) : 4 to 20mAdc / 0 to 100% • Reversible operation with polarity (terminal 12) : 0 to ± 10Vdc / 0 to ±100% • Reversible operation with polarity (terminal 12 + V1) : 0 to ± 10Vdc / 0 to ± 100% • Inverse mode operation (terminal 12 and V2) : 10 to 0Vdc / 0 to 100% • Inverse mode operation (terminal C1) : 20 to 4mAdc / 0 to 100% • PATTERN operation : Setting freq. / Maximum freq. X 100 [%] • DI option input : • BCD...Setting freq. / Maximum freq. X 100 [%] • Binary...Full scale / 100% • Multistep frequency setting : Setting freq. / Maximum freq. X 100 [%] • RS-485 : Setting freq. / Maximum freq. X 100 [%] **• Feedback signal** • Terminal 12 (0 to 10Vdc / 0 to 100%, or 10 to 0Vdc / 0 to 100%) • Terminal C1 (4 to 20mAdc / 0 to 100%, or 20 to 4mAdc / 0 to 100%)	• PID control is selected by "H20". (Hz/PID). • Reference signal selection is made by "F01". In "F01", "8: UP/DOWN control 1", "9: UP/DOWN control 2", and "11: Pulse train input" cannot be used for the reference signal of PID control. • Terminal V1 is optional. • Terminal V2: EN only • Feedback signal selection is made by "H21".	**H20 to H25** **F01** **C05 to C19** **H21**
	Automatic deceleration	Torque limiter 1 (Braking) is set at "F41: 0". (Setting of Torque limiter 2 (Braking) is same.) • In deceleration : The deceleration time is automatically extended up to 3 times for tripless operation even if a braking resistor is not used. • In constant speed operation : Based on regenerative energy, the frequency is increased, and tripless operation is active.	When the deceleration time is extended to longer than three times the setting time, the inverter trips.	**F41, E17**
	Second motor's setting	This function is used for two motors switching operation. • The second motor's V/f characteristics (base and maximum frequency), rated current, torque boost, electronic thermal relay, etc. can be preset. • The second motor's circuit parameter can be preset, and torque-vector control can be applied to both motors.	(M2/M1) <SWM2>	**A01 to A18**
	Energy saving operation	This function minimizes inverter and motor losses at light load.		**H10**
	Fan stop operation	• This function detects temperature inside inverter to stop cooling fans for silent operation and extending the fans' lifetime.		**H06**
		• On/off status of cooling fans is output.	<FAN>	
	Universal DI	Transmits to main controller of LINK operation	(U-DI)	
	Universal DO	Outputs command signal from main controller of LINK operation.	<U-DO>	

NOTE : ( ) or < > in the “Remarks” column indicates the abbreviation of terminal function assigned to digital input terminals X1 to X9 and transistor (relay) output terminals Y1 to Y4 (Y5A, Y5C).

2. Common Specifications

Item		Explanation	Remarks	Func. code
Control	**Zero speed control**	The stopped motor holds its rotor angle. For a rotating motor, the rotor angle is held after deceleration.	A motor with PG and option card (OPC-G11S-PG) are necessary. (ZERO) P11S series doesn't have this function.	
	Positioning control	The SY option card can be used for positioning control by differential counter method.	Option card (PG/SY) required	
	Synchronized operation	This function controls the synchronized operation between 2 axes with PGs.	Option card is required.	
Protection	**Overload**	Protects the inverter by electronic thermal and detection of inverter temperature.		
	Overvoltage	Detects DC link circuit overvoltage, and stops the inverter.	230V : 400Vdc, 460V : 800Vdc	
	Surge protection	Protects the inverter against surge voltage between the main circuit power line and ground.	• Line voltage : 5kV • Between power line and ground : 7kV (1.2/50μs)	
	Undervoltage	Detects DC link circuit undervoltage, and stops the inverter.	230V : 200Vdc, 460V : 400Vdc • Operation details are selected by Function code F14.	**F14**
	Input phase loss	Phase loss protection for power line input		
	Overheating	Protects the inverter by detection of inverter heat sink temperature.		
	Short-circuit	Short-circuit protection for inverter output circuit		
	Ground fault	• Ground fault protection for inverter output circuit (3-phase current detection method) • Zero-phase current detection method	• 30HP or smaller inverter • 40HP or larger inverter	
	Motor overload	• The inverter trips, and then protects the motor. • Electronic thermal overload relay can be selected for standard motor or inverter motor • The second motor's electronic thermal overload relay can be preset for 2-motor changeover operation.	• Thermal time constant (0.5 to 75.0 minutes) can be preset for a special motor. • External singnal is used for changeover.	**F10 to F12** **A06 to A08**
	(Overload early warning)	• Before the inverter trips, outputs OL(Overload early warning) signal at a preset level.	Related transistor output : OL <OL1, OL2>	**E33 to E35**
	DB resistor overheating	• Prevents DB resistor overheating by internal electronic thermal overload relay. (10HP or smaller for G11S, 15HP or smaller for P11S) • Prevents DB resistor overheating by external thermal overload relay attached to DB resistor. (15HP or larger for G11S, 20HP or larger for P11S)	• The inverter stops electricity discharge operation, to protect the DB resistor. Then, usually inverter displays "OU trip". • Connects the relay output to the terminal THR, to protect the DB resistor. Then, usually the inverter displays "OH trip".	**F13**
	Output phase loss detection	When the inverter executes auto-tuning, detects each phase impedance imbalance (and stops the inverter).		
	Motor protection by PTC thermistor	When the motor temperature exceeds allowable value, the inverter trips automatically.		**H26, H27**
	Auto reset	When the inverter is tripped, it resets automatically and restarts.	Number of Auto reset times and reset interval can be preset.	**H04, H05**
Condition (Installation and operation)	**Installation location**	• Indoor use only. • Free from corrosive gases, flammable gases, oil mist, dusts, and direct sunlight.	Pollution degree 2 when complying with Low Voltage Directive is needed.	
	Ambient temperature	-10 to +50°C (14 to +122°F) (For inverters of 30HP or smaller, remove the ventilation covers when operated at temperature of 40°C (104°F)or above.)		
	Ambient humidity	5 to 95%RH (non-condensing)		
	Altitude	33ft (1000m) or less. Applicable to 9800ft (3000m) with power derating (-10% / 33ft (1000m))	* When altitude is 6600ft (2000m) or higher, interface circuit should be isolated from main power lines, to comply with Low Voltage Directive.	
	Vibration	3mm (vibration amplitude) at 2 to less than 9Hz 9.8m/s^2 at 9 to less than 20Hz 2m/s^2 at 20 to less than 55Hz (2m/s^2 at 9 to less than 55Hz : G11S 125HP, P11S 150HP or more) 1m/s^2 at 55 to less than 200Hz		
Storage condition		• Temperature : -25 to +65°C (-13 to +149°F) • Humidity : 5 to 95%RH (No-condensing)		

	LED monitor				LCD monitor	
	Item	**Explanation**	**Remarks**	**Func. code**	**Explanation**	**Func. code**
Indication	**Operation mode (Running)**	The following items can be displayed by function setting. • Output frequency 1 (Before slip compensation) [Hz] • Output frequency 2 (After slip compensation) [Hz] • Setting frequency [Hz] • Output current [A] • Output voltage [V] • Motor synchronous speed [r/min] • Line speed [m/min] • Load shaft speed [r/min] • Torque calculation value [%] • Input power [kW] • PID reference value • PID reference value (remote) • PID feedback value	• Trip history Cause of trip of the last 4 trips can be retained and displayed. (Even when main power is off, data is retained.) • PG feedback value is displayed when PG option is used.	**E43** **F01** **C30**	Languages for the LCD monitor are selectable. English, German, French, Spanish, Italian, Japanese	**E46**
					Operation monitor & Alarm monitor **• Operation monitor** Two types of monitoring is selectable by "E45". • Displays operation guidance • Bargraph • Output frequency (before slip compensation) [%] • Output current [A] • Output torque [%] **• Alarm monitor** When the inverter trips, displays the alarm.	**E45**

	LED monitor				LCD monitor	
	Item	**Explanation**	**Remarks**	**Func. code**	**Explanation**	**Func. code**
Indication	**Stopping**	Selected setting value or output value		**E44**	**Function setting & monitor** Selectable from the following 7 indications. • **Function setting** • Displays function codes and its data or data code. • Changes the data value. • **Operation condition monitoring** • Output frequency (before slip compensation) [Hz] • Output current [A] • Output voltage [V] • Torque calculation value [%] • Setting frequency [Hz] • Operation condition • FWD or REV (Forward or reverse running) • IL (Current limiting) • VL or LU (Voltage limiting or stopped by undervoltage) • TL (Torque limiting) • Motor synchronous speed [r/min] • Load shaft speed [r/min] • Line speed [m/min] • PID reference value • PID feedback value • Driving torque limiter setting value [%] • Braking torque limiter setting value [%] • **Tester function (I/O check)** Displays on/off status of digital input and output signals, level of analog input and pulse output signals. • Digital I/O : ■ (ON), □ (OFF) • Analog I/O : [V] , [mA], [H], [p/s] • **Maintenance data** • Operation time [h] • DC link circuit voltage [V] • Temperature at inside air [°C] • Temperature at heat sink [°C] • Maximum current [A] • Main circuit capacitor life [%] • Control PC board life [h] • Cooling fan operation time [h] • Communication error times (KEYPAD) • Communication error times (RS-485) • Communication error times (Option) • ROM version (Inverter) • ROM version (KEYPAD) • ROM version (Option) • **Load factor calculation** • Measurement time [s] • Maximum current [A] • Effective current [A] • Average braking power [%] • **Alarm data** Dispalys operation data immediately before a trip occurs. • Output frequency (before slip compensation) [Hz] • Output current [A] • Output voltage [V] • Torque calculation value [%] • Setting frequency [Hz] • Operation condition • FWD or REV (Forward or reverse running) • IL (Current limiting) • VL or LU (Voltage limiting or stopped by undervoltage) • TL (Torque limiting) • Operation time [h] • DC link circuit voltage [V] • Temperature at inside air [°C] • Temperature at heat sink [°C] • Communication error times (KEYPAD) • Communication error times (RS-485) • Communication error times (Option) • Digital input terminal condition (Remote) • Digital input terminal condition (Communication) • Transistor output terminal condition • Trip history code • Multiple alarm exist • **Data copy** • Function code (data and data code) is stored in one inverter and is copied to another inverter *. * Copying is only available to the inverter of the same series, same voltage class, and same capacity .	
	Trip mode	Displays the cause of trip by codes as follows. • OC1 (Overcurrent during acceleration) • OC2 (Overcurrent during deceleration) • OC3 (Overcurrent running at constant speed) • EF (Ground fault) • Lin (Input phase loss) • FUS (Fuse blown) • OU1 (Overvoltage during acceleration) • OU2 (Overvoltage during deceleration) • OU3 (Overvoltage running at constant speed) • LU (Undervoltage) • OH1 (Overheating at heat sink) • OH2 (External thermal relay tripped) • OH3 (Overtemperature at inside air) • dBH (Overheating at DB circuit) • OL1 (Motor1 overload) • OL2 (Motor2 overload) • OLU (Inverter unit overload) • OS (Overspeed) • PG (PG error) • Er1 (Memory error) • Er2 (KEYPAD panel communication error) • Er3 (CPU error) • Er4 (Option communication error) • Er5 (Option error) • Er6 (Operation procedure error) • Er7 (Output phase loss error, impedance imbalance) • Er8 (RS-485 error)	• Trip history Cause of trip of the last 4 trips can be retained and displayed. (Even when main power is off, data are retained.)			
	Charge lamp	When the DC link circuit voltage is higher than 50V, the charge lamp is ON.				

2.2 Protective functions

Function	Description		LED monitor	Alarm output (30Ry) *)	Func. code
Overcurrent protection **(Short-circuit)** **(Ground fault)**	• Stops running to protect inverter from an overcurrent resulting from overload. • Stops running to protect inverter from an overcurrent due to a short-circuit in the output circuit. • Stops running to protect inverter from an overcurrent due to a ground fault in the output circuit.	During acceleration	OC1	○	
		During deceleration	OC2		
		While running at constant speed	OC3		
	• Stops running to protect inverter from an overcurrent resulting from ground fault in the output circuit by detecting zero-phase current. (30kW or larger model only)	Groung fault	EF		
Overvoltage protection	• The inverter stops when it detects an overvoltage in the DC link circuit. (230V : 400Vdc or more, 460V : 800Vdc or more) • Protection is not assured if excess AC line voltage is applied inadvertently.	During acceleration	OU1	○	
		During deceleration	OU2		
		While running at constant speed	OU3		
Incoming surge protection	• Protects the inverter against surge voltage between the main circuit power line and ground. • Protects the inverter against surge voltage in the main circuit power line. • The inverter may be tripped by some other protective function.				
Undervoltage protection	• Stops the inverter when the DC link circuit voltage drops below undervoltage level. (230V series : 200V DC or less, 460V series : 400V DC or less) • Alarm signal is not output even if the DC link circuit voltage drops, when “F14 : 3 to 5” is selected.		LU	△	F14
Input phase loss protection	• The inverter is protected from being damaged when open-phase fault occurs.		Lin	○	
Overheat protection	• Stops the inverter when it detects excess heat sink temperature in case of cooling fan failure or overload.		OH1	○	
	• Stops the inverter when it detects an abnormal rise in temperature in the inverter unit caused by insufficient ventilation in cubicles or an abnormal ambient temperature. • Stops the inverter when it detects an abnormal rise in temperature inside the inverter.		OH3	○	
	• When the built-in or external braking resistor overheats, the inverter stops discharging and running. • Function data appropriate for the resistor type (built-in/external) must be set. (G11S: 10HP or smaller only)		dbH	○	F13
Electronic thermal overload relay (Motor protection)	• This function stops the inverter by detecting an inverter overload.		OLU	○	
	• This function stops the inverter by detecting an overload in a standard motor or inverter motor.	Motor 1 overload	OL1	○	F10 to F12
		Motor 2 overload	OL2	○	A06 to A08
Fuse blown	• When a blown fuse is detected, the inverter stops running. (40HP or larger model only)		FUS	○	
Stall prevention (Momentary overcurrent limitation)	• When an output current exceeds the limit during acceleration, this function lowers output frequency to prevent the occurrence of an OC1 trip. • The stall prevention function can be disabled.		–	–	F40, F41 E16, E17 H12
Active drive	• During running in which acceleration is 60s or longer, this function increases the acceleration time to prevent the occurrence of an OLU trip. • The acceleration time can be prolonged up to three times the preset time.				
External alarm input	• The inverter stops on receiving external alarm signals. • Use THR terminal function (digital input).		OH2	○	
Overspeed protection	• Stops the inverter when the output frequency exceeds the rated maximum frequency by 20%.		OS	○	
PG error	• If disconnection occurs in pulse generator circuits, the inverter issues an alarm.		PG	○	
Alarm output (for any fault)	• The inverter outputs a relay contact signal when the inverter issued an alarm and stopped.	• Output terminals: 30A, 30B, and 30C • Use the RST terminal function for signal input. • Even if main power input is turned off, alarm history and trip-cause data are retained.			F36
Alarm reset command	• An alarm-stop state of the inverter can be cleared with the RESET key or by a digital input signal (RST).				
Alarm history memory	• Store up to four instances of previous alarm data.				
Storage of data on cause of trip	• The inverter can store and display details of the latest alarm history data.				
Memory error	• The inverter checks memory data after power-on and when the data is written. If a memory error is detected, the inverter stops.		Er1	○	
KEYPAD panel communication error	• If an error is detected in communication between the inverter and KEYPAD when the Keypad panel is being used, the inverter stops. • When operated by external signals, the inverter continues running. The alarm output (for any fault) is not output. Only Er2 is displayed.		Er2	△	F02
CPU error	• If the inverter detects a CPU error caused by noise or some other factor, the inverter stops.		Er3	○	
Option communication error	• If a checksum error or disconnection is detected during communication, the inverter issues an alarm.		Er4	○	
Option error	• If a linkage error or other option error is detected, the inverter issues an alarm.		Er5	○	
Operation procedure error	Er6 is indicated only when the inverter is forcedly stopped by [STOP1] or [STOP2] operation in E01 to E09 (Set value: 30 or 31)		Er6	○	
Output phase loss error	If an unbalance of output circuits is detected during auto-tuning, this function issues an alarm (and stops the inverter).		Er7	○	
RS-485 communication error	• If an RS-485 communication error is detected, the inverter issues an alarm.		Er8	○	

*) △ : By function code setting, alarm output can be disabled.

NOTES : 1) Retaining alarm signal when auxiliary controll power supply is not used :
If the inverter power supply is cut off while an internal alarm signal is being output, the alarm signal cannot be retained.
2) To issue the RESET command, press the RESET key on the KEYPAD panel or connect terminals RST and CM and disconnect them afterwards.
3) Fault history data is stored for the past four trips.

2.3 Function settings

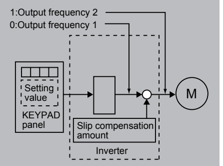
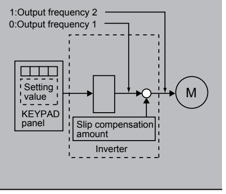
The function marked ▨ can be set while the inverter is running. Other functions must be set while the inverter is stopped.

Fundamental Functions

Function			Setting range	Unit	Min. unit	Factory setting		Remarks
Code	Name	LCD monitor				30HP	40HP	
F00	Data protection	F00 DATA PRTC	0 : Data change enable 1 : Data protection	-	-	0		Setting can be made so that a set value cannot be easily changed by KEYPAD panel operation.
F01	Frequency command 1	F01 FREQ CMD 1	0 : KEYPAD operation (∧ or ∨ key) 1 : Voltage input (terminal 12) (0 to 10Vdc, 0 to 5Vdc) 2 : Current input (terminal C1) (4 to 20mAdc) 3 : Voltage and current input (terminals 12 and C1) 4 : Reversible operation with polarity (terminal 12) (0 to ± 10Vdc) 5 : Reversible operation with polarity (terminal 12 and V1) (0 to ± 10Vdc) 6 : Inverse mode operation (terminal 12) (+10 to 0Vdc) 7 : Inverse mode operation (terminal C1) (20 to 4mAdc) 8 : UP/DOWN control 1 (initial freq. = 0Hz) 9 : UP/DOWN control 2 (initial freq. = last value) 10 : PATTERN operation 11 : DI option or Pulse train input	-	-	0		
F02	Operation method	F02 OPR METHOD	0 : KEYPAD operation (FWD or REV or STOP key) 1 : External signal input (digital input) (Operation by FWD or REV command)	-	-	0		Sets the operation command input method.
F03	Maximum frequency 1	F03 MAX Hz-1	G11S : 50 to 400Hz P11S : 50 to 120Hz	Hz	1	60		Sets the maximum output frequency for motor 1.
F04	Base frequency 1	F04 BASE Hz-1	G11S : 25 to 400Hz P11S : 25 to 120Hz	Hz	1	60		Sets the base frequency for motor 1.
F05	Rated voltage 1 (at Base frequency 1)	F05 RATED V-1	0V : The output voltage in proportion to the power supply voltage is set. 80 to 240V : AVR active (230V) 320 to 480V : AVR active (460V)	V	1	230:(230V class) 460:(460V class)		Sets the output voltage at the Base frequency 1 “F04”.
F06	Maximum voltage 1 (at Maximum frequency 1)	F06 MAX V-1	80 to 240V : AVR active (230V) 320 to 480V : AVR active (460V)	V	1	230:(230V class) 460:(460V class)		Sets the output voltage at the Maximum frequency 1 “F03”.
F07	Acceleration time 1	F07 ACC TIME1	0.01 to 3600s	s	0.01	6.0	20.0	During deceleration, Coast-to-stop can be selected by setting of “H11”.
F08	Deceleration time 1	F08 DEC TIME1	0.01 to 3600s	s	0.01	6.0	20.0	
F09	Torque boost 1	F09 TRQ BOOST1	0.0 : Automatic (for constant torque load) 0.1 to 0.9 : Manual (for variable torque load) 1.0 to 1.9 : Manual (for proportional torque load) 2.0 to 20.0 : Manual (for constant torque load)	-	0.1	G11S : 2.0 P11S : 2.0		Torque boost for motor 2 can also be set by “A05”.
F10	Electronic (Select) thermal overload relay	F10 ELCTRN OL1	0 : Inactive 1 : Active (for 4-pole standard motor) 2 : Active (for 4-pole inverter motor)	-	-	1		Selection fo motor 2 can also be made by “A06”.
F11	for motor 1 (Level)	F11 OL LEVEL1	Approx. 20 to 135% of rated current of the inverter rated current, in Ampere	A	0.01	Motor rated current		Level setting for motor 2 can also be made by “A07”.
F12	(Thermal time constant)	F12 TIME CNST1	0.5 to 75.0 min	min	0.1	5.0	10.0	Setting for motor 2 can also be made by “A08”.
F13	Electronic thermal overload relay (for braking resistor)	F13 DBR OL	G11S [10HP or smaller] 0 : Inactive 1 : Active (for built-in braking resistor) 2 : Active (for external braking resistor)	-	-	1		Not provided with models 15HP or larger.
			[15HP or larger] 0 : Inactive	-	-	0		
			P11S [15HP or smaller] 0 : Inactive 2 : Active (for external braking resistor)	-	-	0		Not provided with models 20HP or larger.
			[20HP or larger] 0 : Inactive	-	-	0		
F14	Restart mode (Select) after momentary power failure	F14 RESTART	0 : Inactive (Trip and alarm when power failure occurs.) 1 : Inactive (Trip, and alarm when power recovers.) 2 : Inactive (Deceleration stop, and alarm) 3 : Active (Smooth recovery by continuous operation mode) 4 : Active (Momentarily stops and restarts at output frequency of before power failure) 5 : Active (Momentarily stops and restarts at starting frequency)	-	-	0		For detailed setting procedure, see “H13” to “H16”.
F15	Frequency (High)	F15 H LIMITER	G11S: 0 to 400Hz P11S : 0 to 120Hz	Hz	1	70		
F16	limiter (Low)	F16 L LIMITER	G11S: 0 to 400Hz P11S : 0 to 120Hz	Hz	1	0		
F17	Gain (for frequency setting signal)	F17 FREQ GAIN	0.0 to 200.0%	%	0.1	100.0		
F18	Bias frequency	F18 FREQ BIAS	G11S: -400.0 to 400.0Hz P11S : -120.0 to 120.0Hz	Hz	0.1	0.0		Minus bias setting is possible.
F20	DC brake(Starting freq.)	F20 DC BRK Hz	0.0 to 60.0Hz	Hz	0.1	0.0		
F21	(Braking level)	F21 DC BRK LVL	G11S : 0 to 100% P11S : 0 to 80%	%		1 0		
F22	(Braking time)	F22 DC BRK t	0.0 (DC brake inactive), 0.1 to 30.0s	s	0.1	0.0		

2. Common Specifications

The function marked ▨ can be set while the inverter is running. Other functions must be set while the inverter is stopped.

Function				Setting range	Unit	Min.	Factory setting		Remarks
Code	Name	LCD monitor				unit	30HP	40HP	
F23	Starting frequency (Freq.)	F23	START Hz	0.1 to 60.0Hz	Hz	0.1	0.5		
F24	(Holding time)	F24	HOLDING t	0.0 to 10.0s	s	0.1	0.0		
F25	Stop frequency	F25	STOP Hz	0.1 to 6.0Hz	Hz	0.1	0.2		Sets the frequency at stopping.
F26	Motor sound (Carrier freq.)	F26	MTR SOUND	0.75-15kHz 0.75-10kHz 0.75-6kHz G11S -75HP 100HP – P11S -30HP 40-100HP 125HP	kHz	1	2		* In case of VT use, carrier frequency should be adjusted depending on capacity
F27	(Sound tone)	F27	MTR TONE	0 : Level 0 1 : Level 1 2 : Level 2 3 : Level 3	-	-	0		Four types of tone can be selected. This setting is effective when the carrier frequency "F26" is set at 7kHz or lower. This selection can be made at 7kHz or higher, but the tone does not change.
F30	FMA (Voltage adjust)	F30	FMA V-ADJ	0 to 200%	%		1 100		
F31	(Function)	F31	FMA FUNC	0 : Output frequency 1 (Before slip compensation) 1 : Output frequency 2 (After slip compensation) 2 : Output current 3 : Output voltage 4 : Output torque 5 : Load factor 6 : Input power 7 : PID feedback value 8 : PG feedback value 9 : DC link circuit voltage 10 : Universal AO	-	-	0		About 0 and 1 
F33	FMP (Pulse rate)	F33	FMP PULSES	300 to 6000 p/s (at full scale)	p/s	1	1440		
F34	(Voltage adjust)	F34	FMP V-ADJ	0% : Pulse rate output (50% duty) 1 to 200% : Voltage adjust : 2670 p/s (duty adjust)	%		1 0		Percent indication based on inverter rated voltage
F35	(Function)	F35	FMP FUNC	0 : Output frequency 1 (Before slip compensation) 1 : Output frequency 2 (After slip compensation) 2 : Output current 3 : Output voltage 4 : Output torque 5 : Load factor 6 : Input power 7 : PID feedback value 8 : PG feedback value 9 : DC link circuit voltage 10 : Universal AO	-	-	0		About 0 and 1 
F36	30RY operation mode	F36	30RY MODE	0 : The relay(30) excites on trip mode 1 : The relay(30) excites on normal mode	-	-	0		
F40	Torque limiter 1 (Driving)	F40	DRV TRQ 1	G11S : 20 to 200, 999% (999: No limit) *2) P11S : 20 to 150, 999% (999: No limit)	%		1 999		
F41	(Braking)	F41	BRK TRQ 1	G11S : 0 (Automatic deceleration control), 20 to 200, 999% (999: No limit) *2) P11S : 0 (Automatic deceleration control), 20 to 150, 999% (999: No limit)	%		1 999		
F42	Torque vector control 1	F42	TRQVECTOR1	0 : Inactive 1 : Active	-	-	0		

Extension Terminal Functions

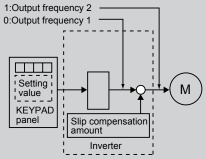
Function				Setting range	Unit	Min.	Factory setting		Remarks
Code	Name	LCD monitor				unit	30HP	40HP	
E01	X1 terminal function	E01	X1 FUNC	Selects from the following items.	-	-	0		
E02	X2 terminal function	E02	X2 FUNC		-	-	1		
E03	X3 terminal function	E03	X3 FUNC		-	-	2		
E04	X4 terminal function	E04	X4 FUNC		-	-	3		
E05	X5 terminal function	E05	X5 FUNC		-	-	4		
E06	X6 terminal function	E06	X6 FUNC		-	-	5		
E07	X7 terminal function	E07	X7 FUNC		-	-	6		
E08	X8 terminal function	E08	X8 FUNC		-	-	7		
E09	X9 terminal function	E09	X9 FUNC		-	-	8		
				0 : Multistep freq. select (1 to 4bit) (16 steps) [SS1] 1 : [SS2] 2 : [SS4] 3 : [SS8] 4 : 4 steps of ACC/DEC time selectioin (1 to 2bit) [RT1] 5 : [RT2] 6 : 3-wire operation stop command [HLD] 7 : Coast-to-stop command [BX] 8 : Alarm reset [RST] 9 : Trip command (External fault) [THR] 10 : Jogging operation [JOG] 11 : Freq. set. 2 / Freq. set. 1 [Hz2/Hz1] 12 : Motor 2 / Motor 1 [M2/M1]					12: Switches motor parameters to motor 2 when this signal is on.

The function marked ▨ can be set while the inverter is running. Other functions must be set while the inverter is stopped.

Function			Setting range	Unit	Min. unit	Factory setting		Remarks
Code	Name	LCD monitor				30HP	40HP	
			13 : DC brake command [DCBRK] 14 : Torque limiter 2 / Torque limiter 1 [TL2/TL1] 15 : Switching operation between line and inverter (50Hz) [SW50] 16 : Switching operation between line and inverter (60Hz) [SW60] 17 : UP command [UP] 18 : DOWN command [DOWN] 19 : Write enable for KEYPAD [WE-KP] 20 : PID control cancel [Hz/PID] 21 : Inverse mode changeover (terminals 12 and C1) [IVS] 22 : Interlock signal for 52-2 [IL] 23 : TRQ control cancel [Hz/TRQ] 24 : Link enable (Bus, RS-485) [LE] 25 : Universal DI [U-DI] 26 : Pick up start mode [STM] 27 : SY-PG enable [PG/Hz] 28 : Synchronization command [SYC] 29 : Zero speed command [ZERO] 30 : Forced stop command [STOP1] 31 : Forced stop command with Deceleration time 4 [STOP2] 32 : Pre-exciting command [EXITE]					15, 16: When 15 or 16 is turned on, the operation smoothly changes to commercial power operation at 50 or 60Hz, without stopping the motor. From 50Hz power line : (SW50) From 60Hz power line : (SW60) 17, 18 : "F01" must be set at "8: UP/DOWN control 1" or "9: UP/DOWN control 2". 20 :When this signal is on, PID control is canceled and KEYPAD operation is effective. 23 :When this signal is on, torque control is canceled. 27 : PG/Hz is option. 28 : SY is option. 29 : ZERO is option. 32 : EXITE is option.
E10	Acceleration time 2	E10 ACC TIME2	0.01 to 3600s	s	0.01	6.00	20.00	
E11	Deceleration time 2	E11 DEC TIME2		s	0.01	6.00	20.00	
E12	Acceleration time 3	E12 ACC TIME3		s	0.01	6.00	20.00	
E13	Deceleration time 3	E13 DEC TIME3		s	0.01	6.00	20.00	
E14	Acceleration time 4	E14 ACC TIME4		s	0.01	6.00	20.00	F07
E15	Deceleration time 4	E15 DEC TIME4		s	0.01	6.00	20.00	F08
E16	Torque limiter 2 (Driving)	E16 DRV TRQ 2	G11S : 20 to 200%, 999% (999: No limit) *2) P11S : 20 to 150%, 999% (999: No limit)	%		1	999	
E17	(Braking)	E17 BRK TRQ 2	G11S : 0 (Automatic deceleration control), 20 to 200%, 999% (999: No limit) *2) P11S : 0 (Automatic deceleration control), 20 to 150%, 999% (999: No limit)	%		1	999	F40, F41
E20	Y1 terminal function	E20 Y1 FUNC	Selects from the following items.	-	-	0		
E21	Y2 terminal function	E21 Y2 FUNC		-	-	1		
E22	Y3 terminal function	E22 Y3 FUNC		-	-	2		
E23	Y4 terminal function	E23 Y4 FUNC		-	-	7		
E24	Y5A,Y5C terminal function	E24 Y5 FUNC		-	-	10		
			0 : Inverter running [RUN] 1 : Frequency equivalence signal [FAR] 2 : Frequency level detection [FDT1] 3 : Undervoltage detection signal [LU] 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 (for 88) [SW88] 12 : Line/Inv changeover (for 52-2) [SW52-2] 13 : Line/Inv changeover (for 52-1) [SW52-1] (11 to 13: For Line/Inverter changeover operation) 14 : Motor 2 / Motor 1 [SWM2] 15 : Auxiliary terminal (for 52-1) [AX] 16 : Time-up signal [TU] 17 : Cycle completion signal [TO] 18 : Stage No. indication 1 [STG1] 19 : Stage No. indication 2 [STG2] 20 : Stage No. indication 4 [STG4] (16 to 20: For PATTERN operation) 21 : Alarm indication 1 [AL1] 22 : Alarm indication 2 [AL2] 23 : Alarm indication 4 [AL4] 24 : Alarm indication 8 [AL8] (21 to 24: For Alarm signal output) 25 : Fan operation signal (for 40HP and above) [FAN] 26 : Auto-resetting [TRY] 27 : Universal DO [U-DO] 28 : Overheat early warning [OH] 29 : Synchronization completion signal [SY] 30 : Lifetime alarm [LIFE] 31 : 2nd Freq. level detection [FDT2] 32 : 2nd OL level early warning [OL2] 33 : Terminal C1 off signal [C1OFF] 34 : Speed existence signal [DNZS]	-	-			29 : SY is option. 34: DNZS is option.
E25	Y5 RY operation mode	E25 Y5RY MODE	0 : Inactive (Y5 Ry excites at "ON signal" mode.) 1 : Active (Y5 Ry excites at "OFF signal" mode.)			0		

2. Common Specifications

The function marked ▨ can be set while the inverter is running. Other functions must be set while the inverter is stopped.

Function			Setting range	Unit	Min. unit	Factory setting		Remarks
Code	Name	LCD monitor				30HP	40HP	
E30	FAR function (Hysteresis) signal	E30 FAR HYSTR	0.0 to 10.0 Hz	Hz	0.1	2.5		E20 to E24: 1
E31	FDT1 function (Level)	E31 FDT1 LEVEL	G11S : 0 to 400 Hz P11S : 0 to 120 Hz	Hz	1	60		E20 to E24: 2
E32	signal (Hysteresis)	E32 FDT HYSTR	0.0 to 30.0 Hz	Hz	0.1	1.0		
E33	OL1 function(Mode select) signal	E33 OL1 WARNING	0 : Thermal calculation 1 : Output current	-	-	0		E20 to E24: 7
E34	(Level)	E34 OL1 LEVEL	G11S : Approx. 5 to 200% of rated current P11S : Approx. 5 to 150% of rated current	A	0.01	Motor rated current		
E35	(Timer)	E35 OL TIMER	0.0 to 60.0s	s	0.1	10.0		
E36	FDT2 function (Level)	E36 FDT2 LEVEL	G11S : 0 to 400Hz P11S : 0 to 120Hz	Hz	1	60		
E37	OL2 function (Level)	E37 OL2 LEVEL	G11S : Approx. 5 to 200% of rated current P11S : Approx. 5 to 150% of rated current	A	0.01	Motor rated current		
E40	Display coefficient A	E40 COEF A	-999.00 to 999.00	-	0.01	0.01		
E41	Display coefficient B	E41 COEF B	-999.00 to 999.00	-	0.01	0.00		
E42	LED Display filter	E42 DISPLAY FL	0.0 to 5.0s	s	0.1	0.5		
E43	LED Monitor (Function)	E43 LED MNTR	0 : Output frequency 1 (Before slip compensation) 1 : Output frequency 2 (After slip compensation) [Hz] 2 : Setting frequency [Hz] 3 : Output current [A] 4 : Output voltage [V] 5 : Motor synchronous speed [r/min] 6 : Line speed [m/min] 7 : Load shaft speed [r/min] 8 : Torque calculation value [%] 9 : Input power [kW] 10 : PID reference value 11 : PID reference value (remote) 12 : PID feedback value	-	-	0		About 0 and 1 
E44	(Display at STOP mode)	E44 LED MNTR2	0 : Setting value 1 : Output value	-	-	0		Selects items displayed on the LED monitor when inverter is stopping.
E45	LCD Monitor (Function)	E45 LCD MNTR	0 :Displays operation guidance 1 :Bar graph (Output freq., Output current, and Output torque)	-	-	0		Indicates based on inverter rated current.
E46	(Language)	E46 LANGUAGE	0 :Japanese 1 :English 2 :German 3 :French 4 :Spanish 5 :Italian	-	-	1		
E47	(Contrast)	E47 CONTRAST	0 (Soft) to 10 (Hard)	-	-	5		

Control Functions of Frequency

Function			Setting range	Unit	Min. unit	Factory setting		Remarks
Code	Name	LCD monitor				30HP	40HP	
C01	Jump (Jump freq. 1)	C01 JUMP Hz 1	G11S : 0 to 400Hz P11S : 0 to 120Hz	Hz	1	0		
C02	frequency(Jump freq. 2)	C02 JUMP Hz 2		Hz	1	0		
C03	(Jump freq. 3)	C03 JUMP Hz 3		Hz	1	0		
C04	(Hysteresis)	C04 JUMP HYSTR	0 to 30Hz	Hz	1	3		
C05	Multistep (Freq. 1)	C05 MULTI Hz-1	G11S : 0.00 to 400.00Hz P11S : 0.00 to 120.00Hz	Hz	0.01	0.00		
C06	frequency (Freq. 2)	C06 MULTI Hz-2		Hz	0.01	0.00		
C07	setting (Freq. 3)	C07 MULTI Hz-3		Hz	0.01	0.00		
C08	(Freq. 4)	C08 MULTI Hz-4		Hz	0.01	0.00		
C09	(Freq. 5)	C09 MULTI Hz-5		Hz	0.01	0.00		
C10	(Freq. 6)	C10 MULTI Hz-6		Hz	0.01	0.00		
C11	(Freq. 7)	C11 MULTI Hz-7		Hz	0.01	0.00		
C12	(Freq. 8)	C12 MULTI Hz-8		Hz	0.01	0.00		
C13	(Freq. 9)	C13 MULTI Hz-9		Hz	0.01	0.00		
C14	(Freq.10)	C14 MULTI Hz10		Hz	0.01	0.00		
C15	(Freq.11)	C15 MULTI Hz11		Hz	0.01	0.00		
C16	(Freq.12)	C16 MULTI Hz12		Hz	0.01	0.00		
C17	(Freq.13)	C17 MULTI Hz13		Hz	0.01	0.00		
C18	(Freq.14)	C18 MULTI Hz14		Hz	0.01	0.00		
C19	(Freq.15)	C19 MULTI Hz15		Hz	0.01	0.00		
C20	JOG frequency	C20 JOG Hz	G11S : 0.00 to 400.00Hz P11S : 0.00 to 120.00Hz	Hz	0.01	5.00		
C21	PATTERN operation (Mode select)	C21 PATTERN	0 : Active (Mono-cycle operation, and then stops.) 1 : Active (Continuous cyclic operation during operation command is effective.) 2 : Active (Mono-cycle operation, and after continues at the latest setting frequency.)	-	-	0		

The function marked ▨ can be set while the inverter is running. Other functions must be set while the inverter is stopped.

Function				Setting range	Unit	Min.	Factory setting		Remarks
Code	Name	LCD monitor				unit	30HP	40HP	
C22	(Stage 1)	C22	STAGE 1	• Operation time: 0.00 to 6000s	s	0.01	0.00 F1		
C23	(Stage 2)	C23	STAGE 2	• F1 to F4 and R1 to R4	s	0.01	0.00 F1		
C24	(Stage 3)	C24	STAGE 3	**Code FWD/REV ACC/DEC**	s	0.01	0.00 F1		
C25	(Stage 4)	C25	STAGE 4	F1: FWD ACC1 / DEC1	s	0.01	0.00 F1		
C26	(Stage 5)	C26	STAGE 5	F2: FWD ACC2 / DEC2	s	0.01	0.00 F1		
C27	(Stage 6)	C27	STAGE 6	F3: FWD ACC3 / DEC3	s	0.01	0.00 F1		
C28	(Stage 7)	C28	STAGE 7	F4: FWD ACC4 / DEC4	s	0.01	0.00 F1		
	* Setting for operation time, FWD/REV rotation and ACC/DEC time select.			R1: REV ACC1 / DEC1 R2: REV ACC2 / DEC2 R3: REV ACC3 / DEC3 R4: REV ACC4 / DEC4					
C30	Frequency command 2	C30	FREQ CMD 2	0 : KEYPAD operation (Λ or key) 1 : Voltage input (terminal 12) (0 to 10Vdc, 0 to 5Vdc) 2 : Current input (terminal C1) (4 to 20mAdc) 3 : Voltage and current input (terminals 12 and C1) 4 : Reversible operation with polarity (terminal 12) (0 to ± 10Vdc) 5 : Reversible operation with polarity (terminal 12 and V1) (0 to ± 10Vdc) 6 : Inverse mode operation (terminal 12) (10 to 0Vdc) 7 : Inverse mode operation (terminal C1) (20 to 4mAdc) 8 : UP/DOWN control 1 (initial freq. = 0Hz) 9 : UP/DOWN control 2 (initial freq. = last value) 10 : PATTERN operation 11 : DI option or Pulse train input	-	-	2		F01, H30 F17,18 E01-09:11,20,23 Data 2, 3, and 7 are always inactive E01-E09:21 E01-E09:21 E01-E09:17 E01-E09:18 C21-C28
C31	Offset (Terminal 12)	C31	OFFSET 12	-5.0 to +5.0%	%	0.1	0.0		
C32	Offset (Terminal C1)	C32	OFFSET C1	-5.0 to +5.0%	%	0.1	100.0		
C33	Analog setting signal filter	C33	REF FILTER	0.00 to 5.00s	s	0.01	0.05		

Motor Parameters

Function				Setting range	Unit	Min.	Factory setting		Remarks
Code	Name	LCD monitor				unit	30HP	40HP	
P01	Number of motor 1 poles	P01	M1 POLES	2 to 14	pole	2	4		Sets the number poles of the motor 1.
P02	Motor 1 (Capacity)	P02	M1-CAP	30HP or smaller : 0.01 to 45.00 kW 40HP or larger : 0.01 to 500.00 kW	kW	0.01	Motor Capacity		Set the applied motor capacity. This setting automatically sets "P03" and "P06" to "P08". Frame must be from -2 to +1. When a frame is outside this range, take a special note.
P03	(Rated current)	P03	M1-Ir	0.00 to 2000 A	A	0.01	Motor rated current		Sets the motor rated current.
P04	(Tuning)	P04	M1 TUN1	0 : Inactive 1 : Active (One time tuning of %R1 and %X (on motor stopping mode)) 2 : Active (One time tuning of %R1, %X and Io (on motor running mode))	-	-	0		Measure %R1 of motor, and %X and Io at base frequency. When "1" is selected, data is stored in "P07" and "P08". When "2" selected, data is stored in "P06" to "P08".
P05	(On-line Tuning)	P05	M1 TUN2	0 : Inactive 1 : Active (Real time tuning of %R2)	-	-	0		Data in "P07" and "P08" is not updated.
P06	(No-load current)	P06	M1-Io	0.00 to 2000 A	A	0.01	Fuji standard rated value		Sets exciting current at torque-vector control.
P07	(%R1 setting)	P07	M1-%R1	0.00 to 50.00 %	%	0.01	Fuji standard rated value		Sets motor primary coil resistance manually. $\%R1=\frac{R1+Cable\ R}{V/(\sqrt{3}\ x\ I)}\ x\ 100$ R1: Motor primary resistance [Ω] Cable R : Resistance at output side cable V : Rated voltage [V] I : Motor rated current [A]
P08	(%X setting)	P08	M1-%X	0.00 to 50.00 %	%	0.01	Fuji standard rated value		Sets motor leakage inductance at base frequency manually. $\%X=\frac{X1+X2\ x\ \frac{XM}{X2+XM}+Cable\ X}{V/\ (\sqrt{3}\ x\ I)}\ x\ 100$ X1 : Motor primary leakage reactance [Ω] X2 : Motor secondary leakage reacstance [Ω] XM : Excitation reactance [Ω] Cable X : Cable resctance (Primary conversion value) [Ω] V : Rated voltage [V] I : Motor rated current [A]
P09	(Slip compensation control 1)	P09	SLIP COMP1	0.00 to +15.00 Hz	Hz	0.01	0.00		Sets the slip frequency.

NOTE: Percent shall be set according to Function code "P02" or "A09", motor capacity.
Torque referenced here may not be obtainable when "P02" or "A09" is set at "0".

2. Common Specifications

The function marked ▨ can be set while the inverter is running. Other functions must be set while the inverter is stopped.

High Performance Functions

Function			Setting range	Unit	Min.	Factory setting		Remarks
Code	Name	LCD monitor			unit	30HP	40HP	
H03	Data initializing (Data reset)	H03 DATA INIT	0 : Manual set value 1 : Return to factory set value	-	-	0		When data code is set at "1", all function data is returned to initial data (factory setting data). Automatically returns to "0" after initializing.
H04	Auto-reset (Times)	H04 AUTO-RESET	0 (Inactive), 1 to 10 times	-	1	0		
H05	(Reset interval)	H05 RESET INT	2 to 20s	s	1	5		
H06	Fan stop operation	H06 FAN STOP	0 : Inactive 1 : Active (Fan stops at low temperature mode (2HP or larger)	-	-	0		
H07	ACC/DEC pattern (Mode select)	H07 ACC PTN	0 : Linear 1 : S-curve (weak) 2 : S-curve (strong) 4 : Non-linear (For variable torque load)	-	-	0		
H08	Rev. phase sequence lock	H08 REV LOCK	0 : Inactive 1 : Active	-	-	0		
H09	Start mode (Rotating motor pick up)	H09 START MODE	0 : Inactive 1 : Active (Only Auto-restart after momentary power failure mode) 2 : Active (All start mode)	-	-	0		
H10	Energy-saving operation	H10 ENERGY SAV	0 : Inactive 1 : Active (Only when torque boost "F09" is in manual setting mode	-	-	G11S:0 P11S:1		
H11	DEC mode	H11 DEC MODE	0 : Normal (According to "H07" mode) 1 : Coast-to-stop	-	-	0		
H12	Instantaneous overcurrent limiting	H12 INST CL	0 : Inactive 1 : Active	-	-	1		
H13	Auto-restart (Restart time)	H13 RESTART t	0.1 to 10.0s	s	0.1	0.5		Time required until motor residual voltage reduces to zero.
H14	(Freq. fall rate)	H14 FALL RATE	0.00 to 100.00 Hz/s	Hz/s	0.01	10.00		
H15	(Holding DC voltage)	H15 HOLD V	200 to 300V (230V) 400 to 600V (460V)	V		230V class : 235V 460V class : 470V		
H16	(OPR command selfhold time)	H16 SELFHOLD t	0.0 to 30.0s, 999s (999s: The operation command is held during DC link circuit voltage is larger than 50V)	s	0.1	999		
H18	Torque control	H18 TRQ CTRL	G11S 0 : Inactive (Frequency control) 1 : Active (Torque control by terminal 12 (Driving)) (0 to +10V/0 to 200%) 2 : Active (Torque control by terminal 12 (Driving & Braking)) (0 to +10V/0 to 200%)	-	-	0		P11S series does not have this function. Gain for frequency setting is disabled.
			P11S 0 : Inactive (Fixed)	-	-	0		
H19	Active drive	H19 AUT RED	0 : Inactive 1 : Active	-	-	0		When the acceleration time is longer than 60s, this function prevents inverter trip due to overvurrent, to accelerates motor in a shortest time.
H20	PID control (Mode select)	H20 PID MODE	0 : Inactive 1 : Active 2 : Active (inverse operation mode)	-	-	0		E01-E09:20 C33 E01-E09:21
H21	(Feedback signal)	H21 FB SIGNAL	0 : Terminal 12 (0 to +10V) 1 : Terminal C1 (4 to 20mA) 2 : Terminal 12 (+10 to 0V) 3 : Terminal C1 (20 to 4mA)	-	-	1		
H22	(P-gain)	H22 P-GAIN	0.01 to 10.00	-	0.01	0.1		
H23	(I-gain)	H23 I-GAIN	0.0 : Inactive 0.1 to 3600.0s	s	0.1	0.0		
H24	(D-gain)	H24 D-GAIN	0.00 : Inactive 0.01 to 10.0s	s	0.01	0.00		
H25	(Feedback filter)	H25 FB FILTER	0.0 to 60.0s	s	0.1	0.5		
H26	PTC thermistor (Mode select)	H26 PTC MODE	0 : Inactive 1 : Active	-	-	0		
H27	(Level)	H27 PTC LEVEL	0.00 to 5.00V	V	0.01	1.60		
H28	Droop operation	H28 DROOP	G11S: -9.9 to 0.0Hz P11S: 0.0 (Fixed)	Hz	0.1	0.0		P11S does not have this function.
H30	Serial link (Function select)	H30 LINK FUNC	(Code) (Monitor) (Frequency command) (Operation command) 0 : X - - 1: X X - 2 : X - X 3 : X X X (X: Valid -: Invalid)	-	-	0		Selects type of LINK operation in LINK operation mode. F01:11, C30:11, E01-E09:24,25, F02
H31	RS-485 (Address)	H31 485ADDRESS	1 to 31	-	1	1		
H32	(Mode select on no response error)	H32 MODE ON ER	0 : Trip and alarm (Er8) 1 : Operation for H33 timer, and alarm (Er8) 2 : Operation for H33 timer,and retry to communicate. * If the retry fails, then the inverter trips("Er 8"). 3 : Continuous operation	-	-	0		
H33	(Timer)	H33 TIMER	0.0 to 60.0s	s	0.1	2.0		
H34	(Baud rate)	H34 BAUD RATE	0 : 19200 bit/s 1 : 9600 2 : 4800 3 : 2400 4 : 1200	-	-	1		

The function marked ▨ can be set while the inverter is running. Other functions must be set while the inverter is stopped.

Function				Setting range	Unit	Min.	Factory setting		Remarks
Code	Name	LCD monitor				unit	30HP	40HP	
H35	(Data length)	H35	LENGTH	0 : 8 bit 1 : 7 bit	-	-	0		
H36	(Parity check)	H36	PARITY	0 : No checking 1 : Even parity 2 : Odd parity	-	-	0		
H37	(Stop bits)	H37	STOP BITS	0 : 2 bit 1 : 1 bit	-	-	0		
H38	(No response error detection time)	H38	NO RES t	0 (No detection), 1 to 60s	s	1	0		
H39	(Response interval)	H39	INTERVAL	0.00 to 1.00s	s	0.01	0.01		

Alternative Motor Parameters

Function				Setting range	Unit	Min.	Factory setting		Remarks
Code	Name	LCD monitor				unit	30HP	40HP	
A01	Maximum frequency 2	A01	MAX Hz-2	G11S : 50 to 400Hz P11S : 50 to 120Hz	Hz	1	60		Sets the maximum output frequency for motor 2.
A02	Base frequency 2	A02	BASE Hz-2	G11S : 25 to 400Hz P11S : 25 to 120Hz	Hz	1	60		
A03	Rated voltage 2 (at Base frequency 2)	A03	RATED V-2	0V (Free) : The output voltage in proporpion to the power supply voltage is set. 80 to 240V : AVR active (230V) 320 to 480V : AVR active (460V)	V		1 220:(230V class) 380:(460V class)		Sets the output voltage at the Base frequency 2 "A02".
A04	Maximum voltage 2 (at Maximum frequency 2)	A04	MAX V-2	80 to 240V : AVR active (230V) 320 to 480V : AVR active (460V)	V	1	220:(230V class) 380:(460V class)		Sets the output voltage at the Maximum frequency 2 "A01".
A05	Torque boost 2	A05	TRQ BOOST2	0.0 : Automatic (for constant torque load) 0.1 to 0.9 : Manual (for variable torque load) 1.0 to 1.9 : Manual (for proportional torque load) 2.0 to 20.0 : Manual (for constant torque load)	-	0.1	G11S : 2.0 P11S : 2.0		
A06	Electronic thermal overload relay (Select)	A06	ELCTRN OL2	0 : Inactive 1 : Active (for 4-pole standard motor) 2 : Active (for 4-pole inverter motor)	-	-	1		
A07	for motor 2 (Level)	A07	OL LEVEL2	Approx. 20 to 135% of the inverter rated current, in Ampere	A	0.01	Motor rated current		
A08	(Thermal time constant)	A08	TIME CNST2	0.5 to 75.0 min	min	0.1	5.0	10.0	
A09	Torque vector control 2	A09	TRQVECTOR2	0 : Inactive 1 : Active	-	-	0		
A10	Number of motor-2 poles	A10	M2 POLES	2 to 14	-		2	4	Sets the number of poles of motor 2.
A11	Motor 2 (Capacity)	A11	M2-CAP	30HP or smaller : 0.01 to 45.00 kW 40HP or larger : 0.01 to 500.00 kW	kw	0.01	Motor Capacity		Set the applied motor capacity. This setting automatically sets "P03" and "P06" to "P08". Frame must be from -2 to +1. When a frame is outside this range, take a special note.
A12	(Rated current)	A12	M2-Ir	0.00 to 2000 A	A	0.01	Motor rated current		Sets the motor rated current.
A13	(Tuning)	A13	M2 TUN1	0 : Inactive 1 : Active (One time tuning of %R1 and %X (on motor stopping mode)) 2 : Active (One time tuning of %R1, %X and Io (on motor running mode))	-	-	0		Measure %R1 of motor, and %X and Io at base frequency. When "1" is selected, data is stored in "A16" and "A17". When "2" selected, data is stored in "A15" to "A17".
A14	(On-line Tuning)	A14	M2 TUN2	0 : Inactive 1 : Active (Real time tuning of %R1 and %X)	-	-	0		Data in "A16" and "A17" is not updated.
A15	(No-load current)	A15	M2-Io	0.00 to 2000 A	A	0.01	Fuji standard rated value		Sets exciting current at torque-vector control.
A16	(%R1 setting)	A16	M2-%R1	0.00 to 50.00 %	%	0.01	Fuji standard rated value		Sets motor primary coil resistance manually. $\%R1= \frac{R1+Cable\ R}{V/(\sqrt{3} \times I)} \times 100$ R1: Motor primary resistance [Ω] Cable R : Resistance at output side cable V : Rated voltage [V] I : Motor rated current [A]
A17	(%X setting)	A17	M2-%X	0.00 to 50.00 %	%	0.01	Fuji standard rated value		Sets motor leakage inductance at base frequency manually. $\%X= \frac{X1+X2 \times \frac{XM}{X2+XM} + Cable\ X}{V/ (\sqrt{3} \times I)} \times 100$ X1 : Motor primary leakage reactance [Ω] X2 : Motor secondary leakage reactance [Ω] XM : Excitation reactance [Ω] Cable X : Cable resctance (Primary conversion value) [Ω] V : Rated voltage [V] I : Motor rated current [A]
A18	(Slip compensation control 2)	A18	SLIP COMP2	0.00 to +15.00 Hz	Hz	0.01	0.00		Sets the slip frequency.

User Functions

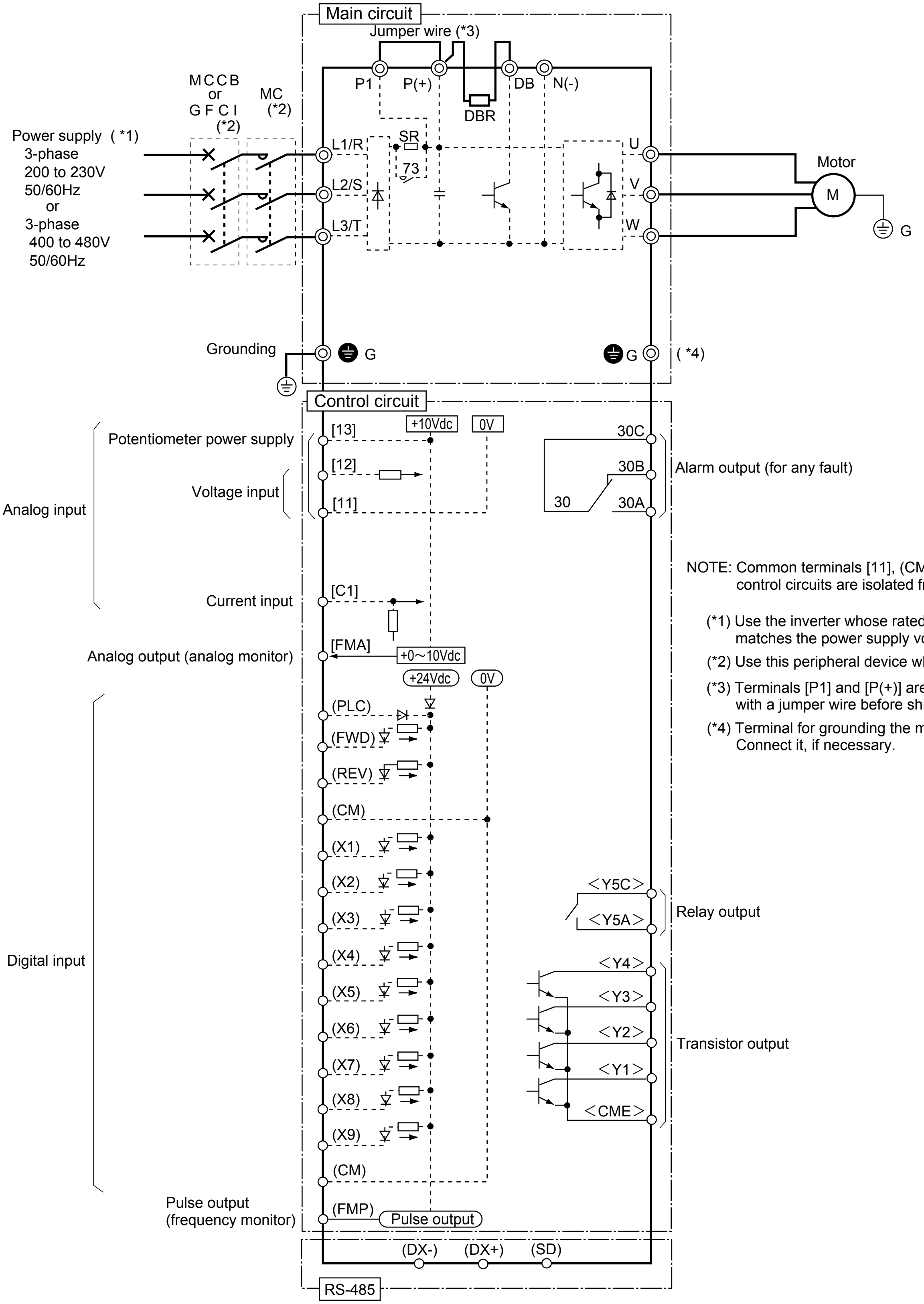
Function			Setting range	Unit	Min. unit	Factory setting		Remarks
Code	Name	LCD monitor				30HP	40HP	
U01	Maximum compensation frequency during braking torque limit	U01 USER 01	0 to 65535	-	1	75		
U02	1st S-shape level at acceleration	U02 USER 02	1 to 50%	%	1	10		
U03	2nd S-shape level at acceleration	U03 USER 03	1 to 50%	%	1	10		
U04	1st S-shape level at deceleration	U04 USER 04	1 to 50%	%	1	10		
U05	2nd S-shape level at deceleration	U05 USER 05	1 to 50%	%	1	10		
U08	Main DC link capacitor (Initial value)	U08 USER 08	0 to 65535	-	1	xxxx		
U09	(Measured value)	U09 USER 09	0 to 65535	-	1	0		
U10	PC board capacitor powered on time	U10 USER 10	0 to 65535h	h	1	0		
U11	Cooling fan operating time	U11 USER 11	0 to 65535h	h	1	0		
U13	Magnetize current vibration damping gain	U13 USER 13	0 to 32767	-	1	819	410	
U15	Slip compensation filter time constant	U15 USER 15	0 to 32767	-	1	556	546	
U23	Integral gain of continuous operation at power failure	U23 USER 23	0 to 65535	-	1	1738	1000	
U24	Proportional gain of continuous operation at power failure	U24 USER 24	0 to 65535	-	1	1024	1000	
U48	Input phase loss protection	U48 USER 48	0, 1, 2	-	-	-75HP 0	100HP- 1	
U49	RS-485 protocol selection	U49 USER 49	0, 1	-	-	0		
U56	Speed agreement (Detection width)	U56 USER 56	0 to 50%	%	1	10		
U57	/PG error (Detection timer)	U57 USER 57	0.0 to 10.0s	s	0.1	0.5		
U58	PG error selection	U58 USER 58	0, 1	-	-	1		
U59	Braking-resistor function select (up to 30HP) Manufacturer's function (40HP or more)	U59 USER 59	00 to A8(HEX)	-	1	00		
U60	Regeneration avoidance at deceleration	U60 USER 60	0, 1	-	-	0		
U61	Voltage detect offset and gain adjustment	U61 USER 61	Up to 30HP : F0(Fixed.) 40HP or more : F0, 1, 2	-	-	0		

Caution	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

3. Wiring Diagram

3.1 Wiring diagram before shipment from factory

(1) 230V/460V FRENIC5000G11S: 1/4 to 1HP / 1/2, 1HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) Use this peripheral device when necessary.

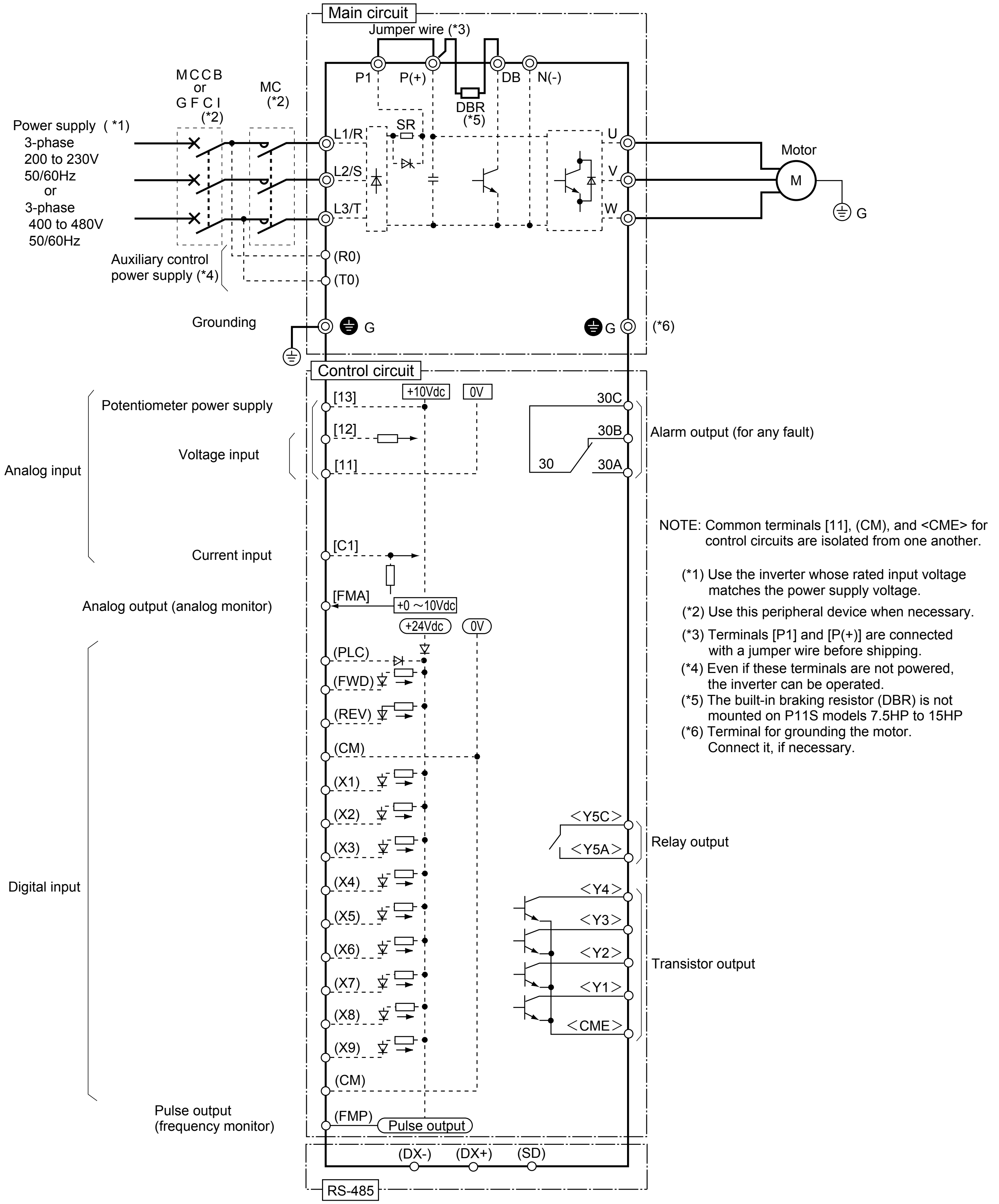
(*3) Terminals [P1] and [P(+)] are connected with a jumper wire before shipping.

(*4) Terminal for grounding the motor. Connect it, if necessary.

3. Wiring Diagram

Caution	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

(2) 230V/460V FRENIC5000G11S : 2 to 10HP
FRENIC5000P11S : 7.5 to 15HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) Use this peripheral device when necessary.

(*3) Terminals [P1] and [P(+)] are connected with a jumper wire before shipping.

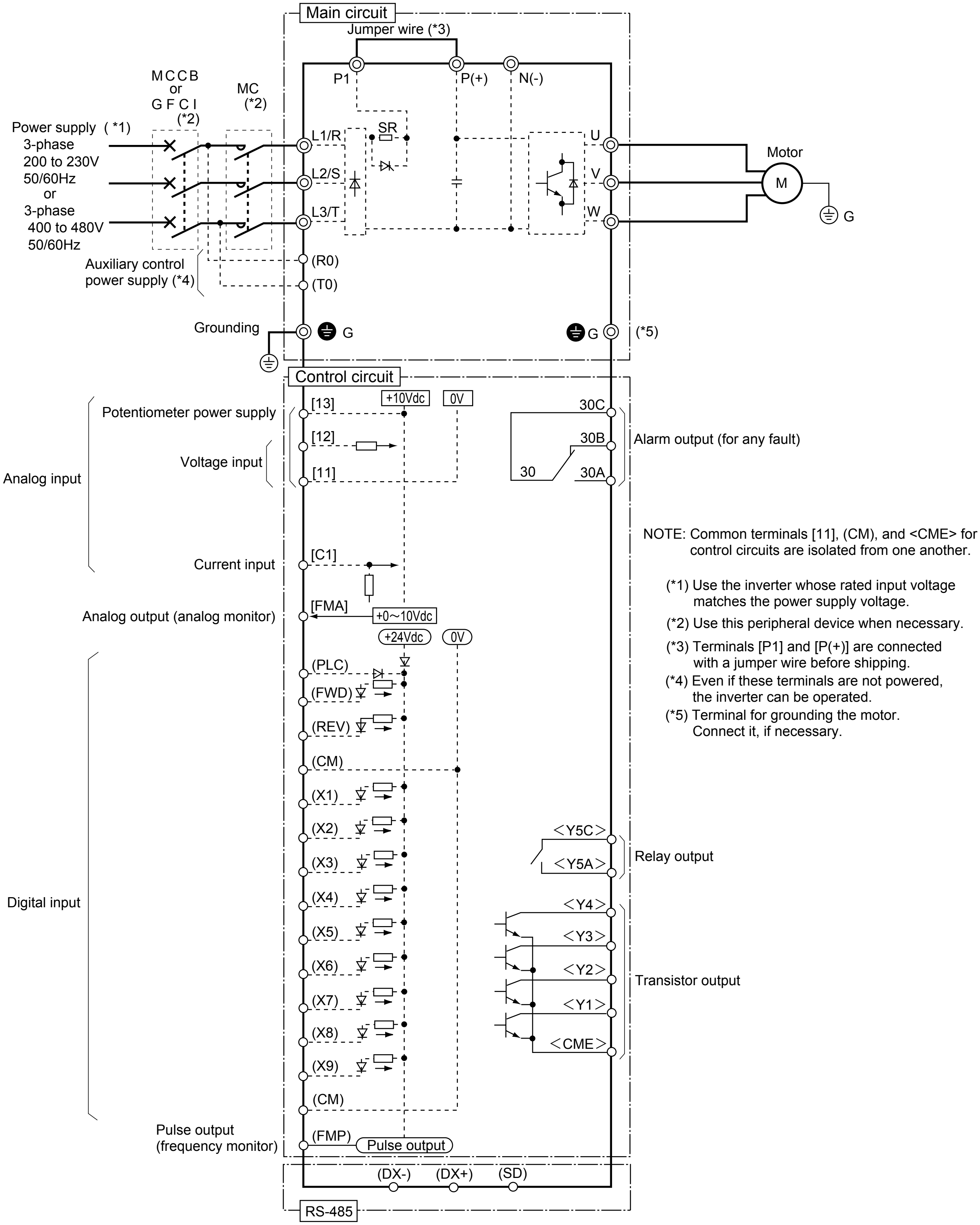
(*4) Even if these terminals are not powered, the inverter can be operated.

(*5) The built-in braking resistor (DBR) is not mounted on P11S models 7.5HP to 15HP

(*6) Terminal for grounding the motor. Connect it, if necessary.

⚠ **Caution**	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

(3) 230V/460V FRENIC5000G11S : 15 to 30HP
FRENIC5000P11S : 20 to 30HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) Use this peripheral device when necessary.

(*3) Terminals [P1] and [P(+)] are connected with a jumper wire before shipping.

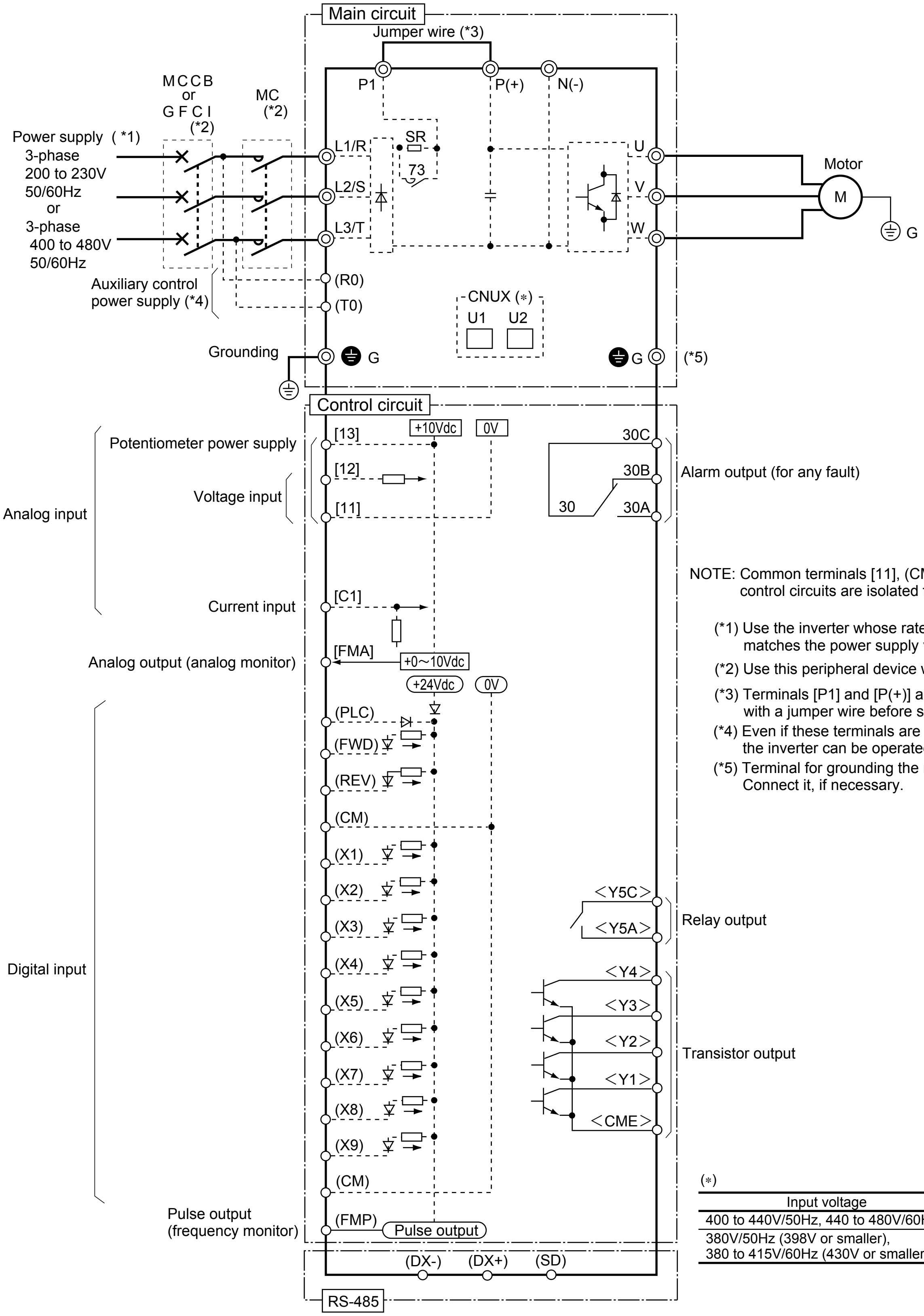
(*4) Even if these terminals are not powered, the inverter can be operated.

(*5) Terminal for grounding the motor. Connect it, if necessary.

3. Wiring Diagram

⚠ **Caution**	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

(4) 230V/460V FRENIC5000G11S : 40 to 75HP
FRENIC5000P11S : 40 to 75HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) Use this peripheral device when necessary.

(*3) Terminals [P1] and [P(+)] are connected with a jumper wire before shipping.

(*4) Even if these terminals are not powered, the inverter can be operated.

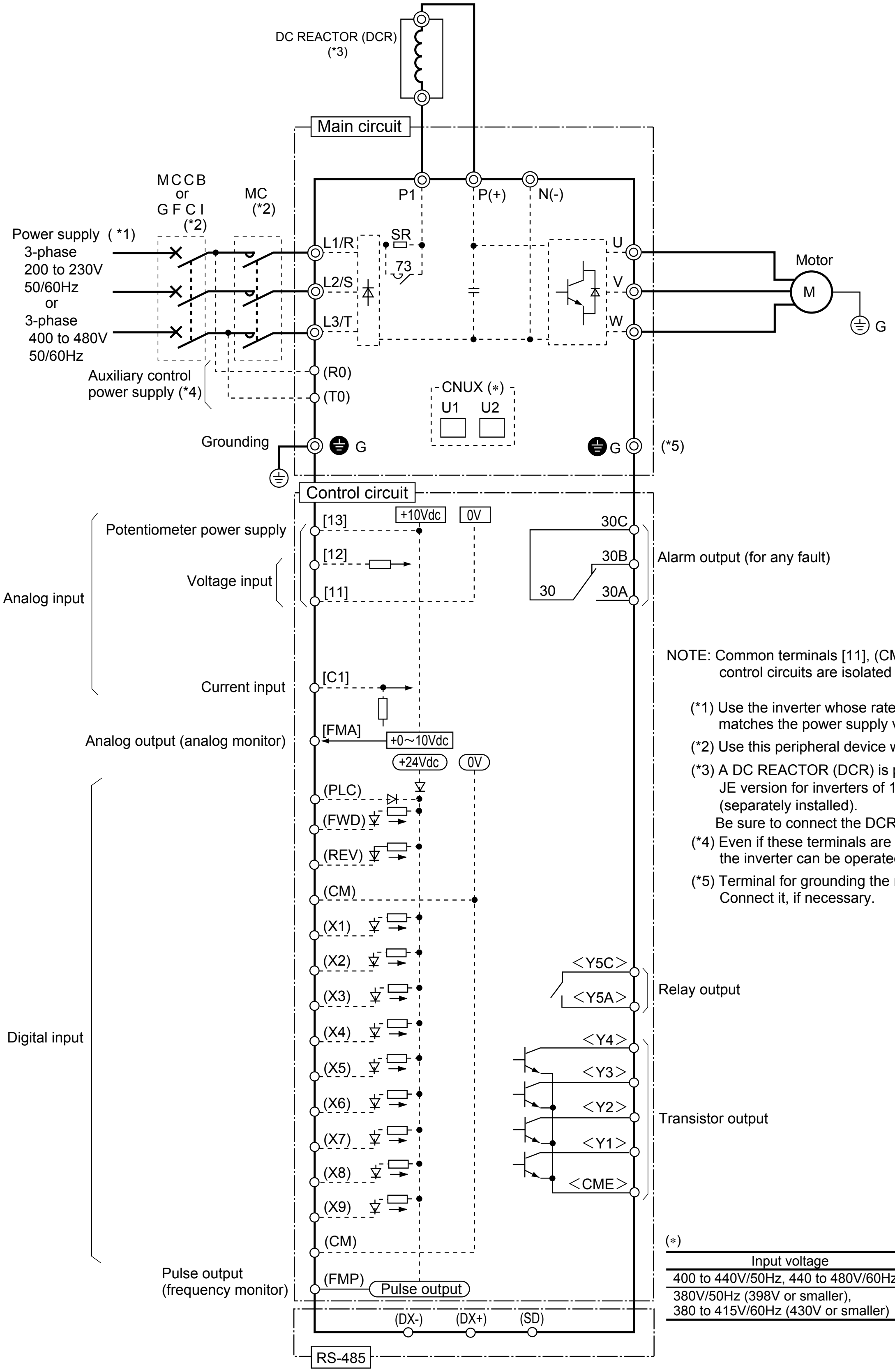
(*5) Terminal for grounding the motor. Connect it, if necessary.

(*)

Input voltage	CNUX connector
400 to 440V/50Hz, 440 to 480V/60Hz	U1
380V/50Hz (398V or smaller), 380 to 415V/60Hz (430V or smaller)	U2

Caution	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

(5) 2300V/460V FRENIC5000G11S : 100, 125HP / 100 to 600HP
FRENIC5000P11S : 100 to 150HP / 100 to 800HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) Use this peripheral device when necessary.

(*3) A DC REACTOR (DCR) is provided as standard in JE version for inverters of 100HP or larger (separately installed).
Be sure to connect the DCR properly.

(*4) Even if these terminals are not powered, the inverter can be operated.

(*5) Terminal for grounding the motor. Connect it, if necessary.

(∗)

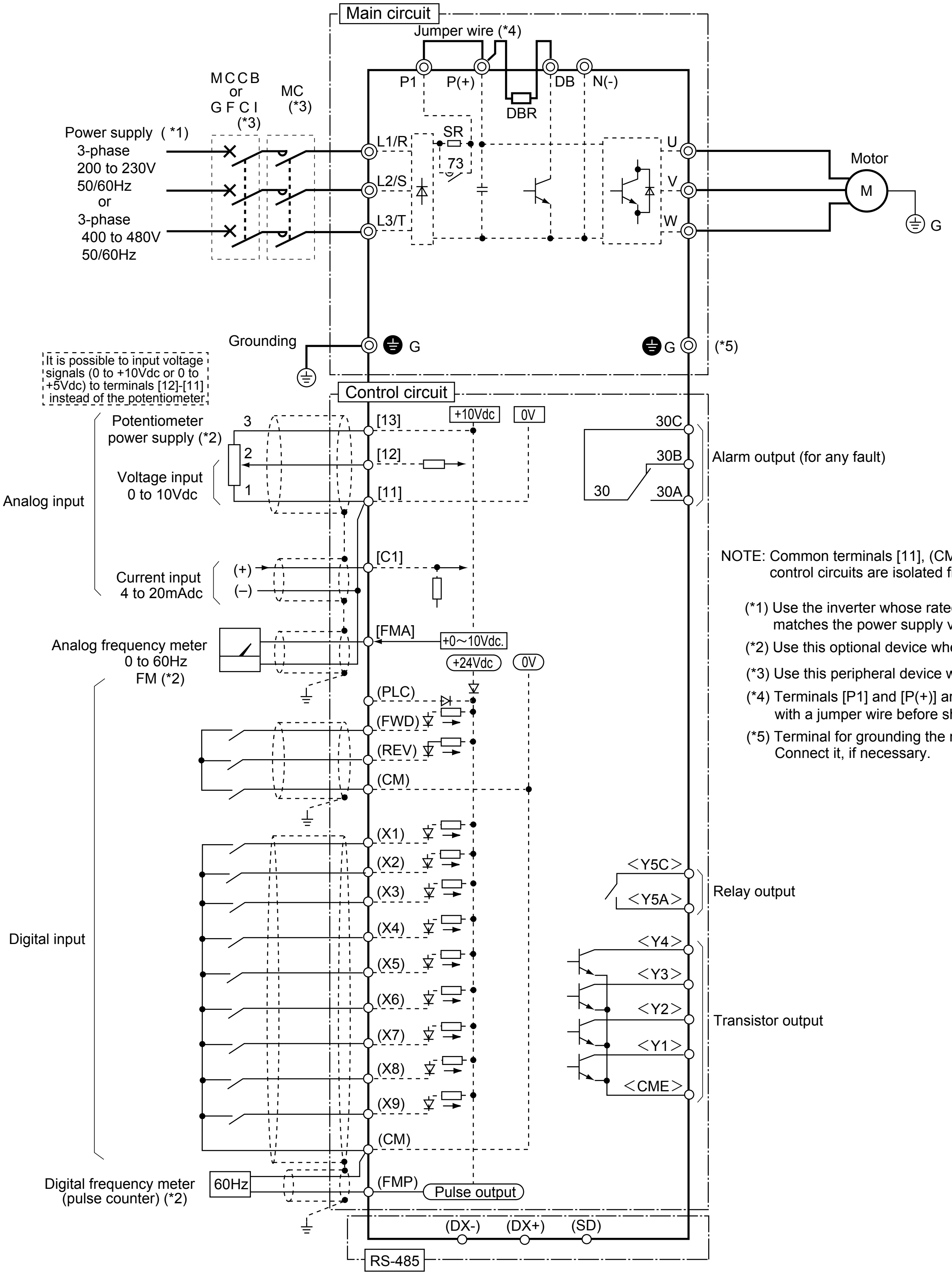
Input voltage	CNUX connector
400 to 440V/50Hz, 440 to 480V/60Hz	U1
380V/50Hz (398V or smaller), 380 to 415V/60Hz (430V or smaller)	U2

3. Wiring Diagram

⚠ **Caution**	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

3.2 Basic wiring diagram

(1) 230V/460V FRENIC5000G11S : 1/4 to 1HP / 1/2, 1HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) Use this optional device when necessary.

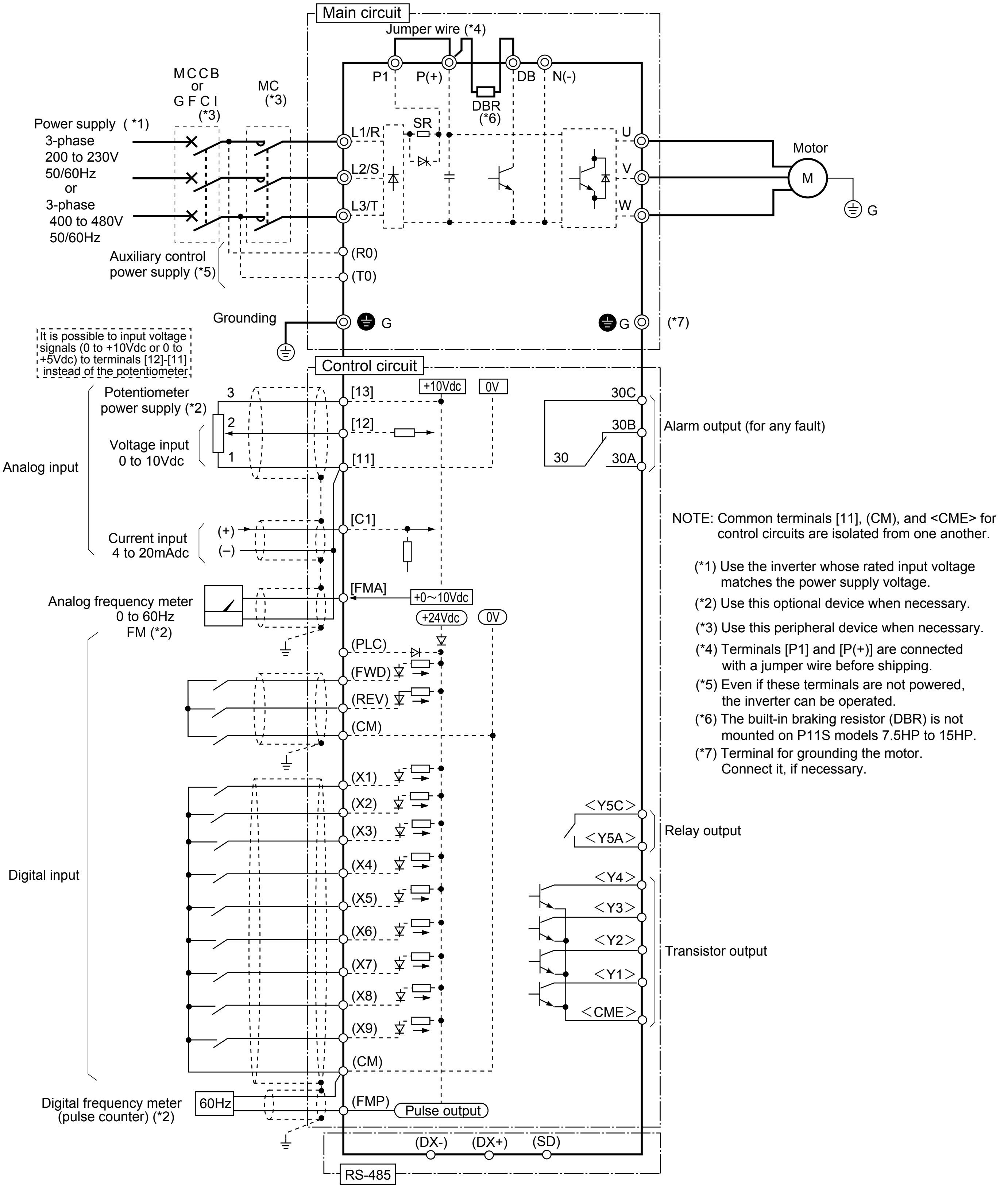
(*3) Use this peripheral device when necessary.

(*4) Terminals [P1] and [P(+)] are connected with a jumper wire before shipping.

(*5) Terminal for grounding the motor. Connect it, if necessary.

⚠ **Caution**	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

(2) 230V/460V FRENIC5000G11S : 2 to 10HP
FRENIC5000P11S : 7.5 to 15HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) Use this optional device when necessary.

(*3) Use this peripheral device when necessary.

(*4) Terminals [P1] and [P(+)] are connected with a jumper wire before shipping.

(*5) Even if these terminals are not powered, the inverter can be operated.

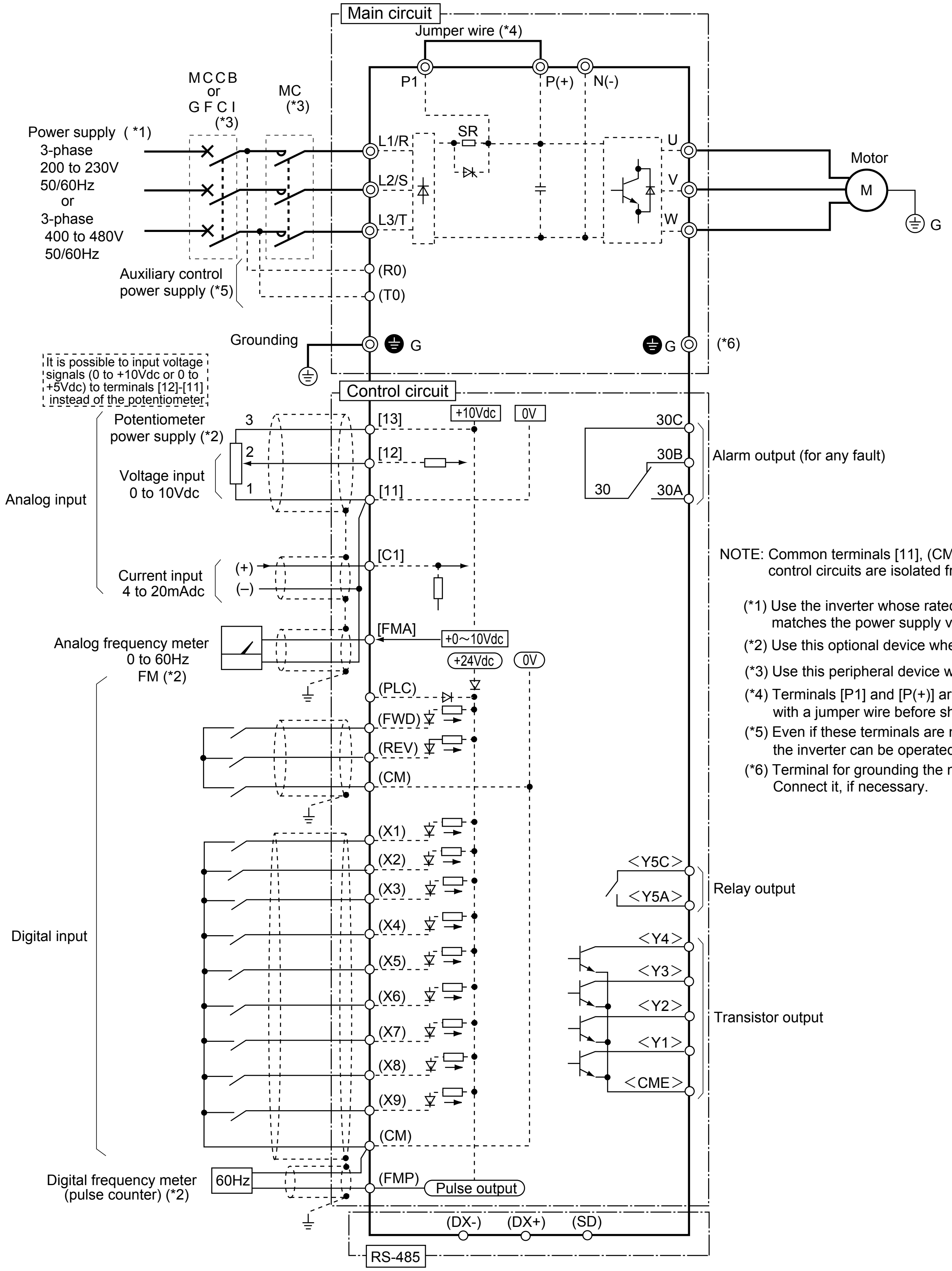
(*6) The built-in braking resistor (DBR) is not mounted on P11S models 7.5HP to 15HP.

(*7) Terminal for grounding the motor. Connect it, if necessary.

3. Wiring Diagram

⚠ **Caution**	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

(3) 230V/460V FRENIC5000G11S : 15 to 30HP
FRENIC5000P11S : 20 to 30HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) Use this optional device when necessary.

(*3) Use this peripheral device when necessary.

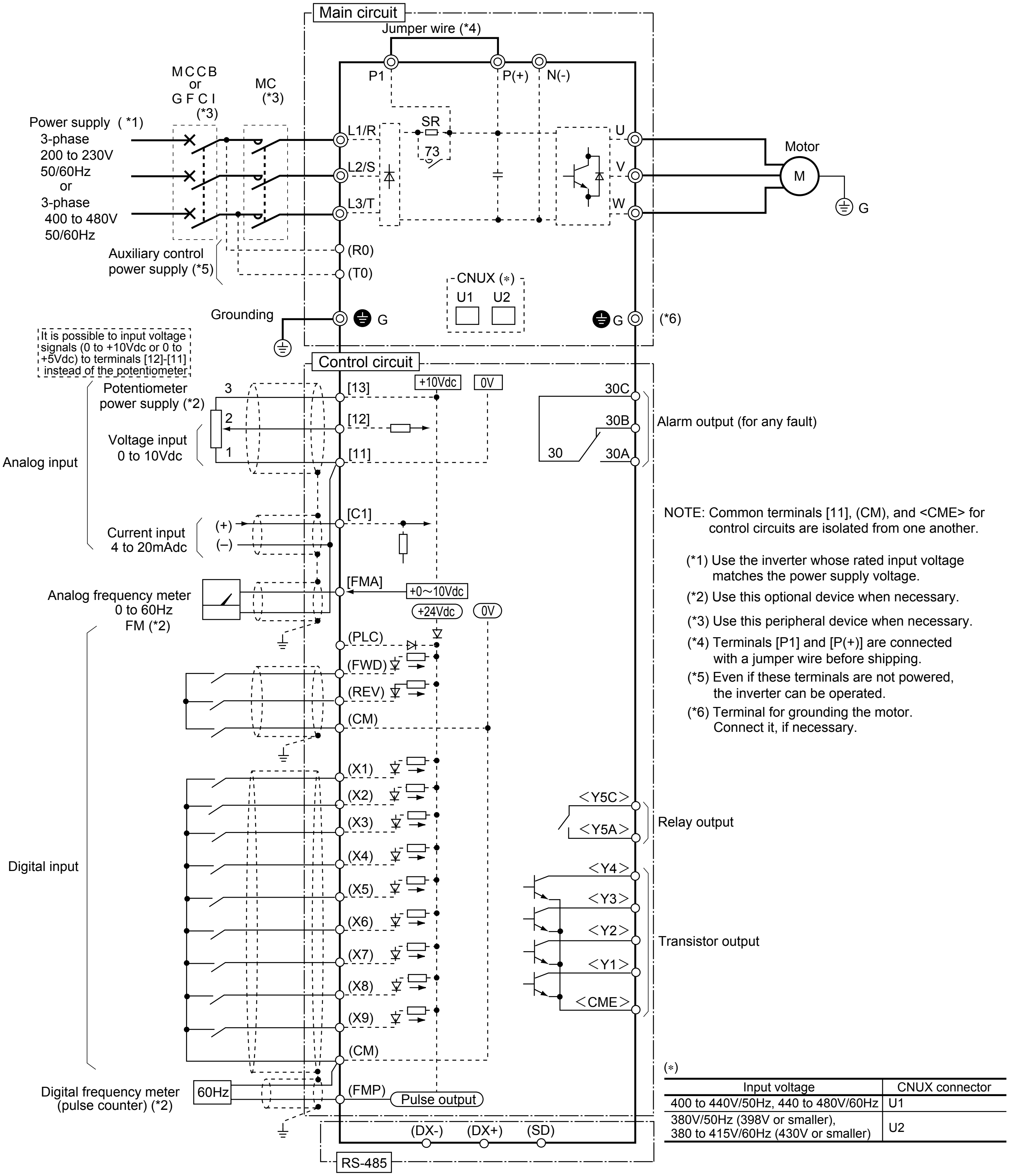
(*4) Terminals [P1] and [P(+)] are connected with a jumper wire before shipping.

(*5) Even if these terminals are not powered, the inverter can be operated.

(*6) Terminal for grounding the motor. Connect it, if necessary.

Caution	The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.

(4) 230V/460V FRENIC5000G11S : 40 to 75HP
FRENIC5000P11S : 40 to 75HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) Use this optional device when necessary.

(*3) Use this peripheral device when necessary.

(*4) Terminals [P1] and [P(+)] are connected with a jumper wire before shipping.

(*5) Even if these terminals are not powered, the inverter can be operated.

(*6) Terminal for grounding the motor. Connect it, if necessary.

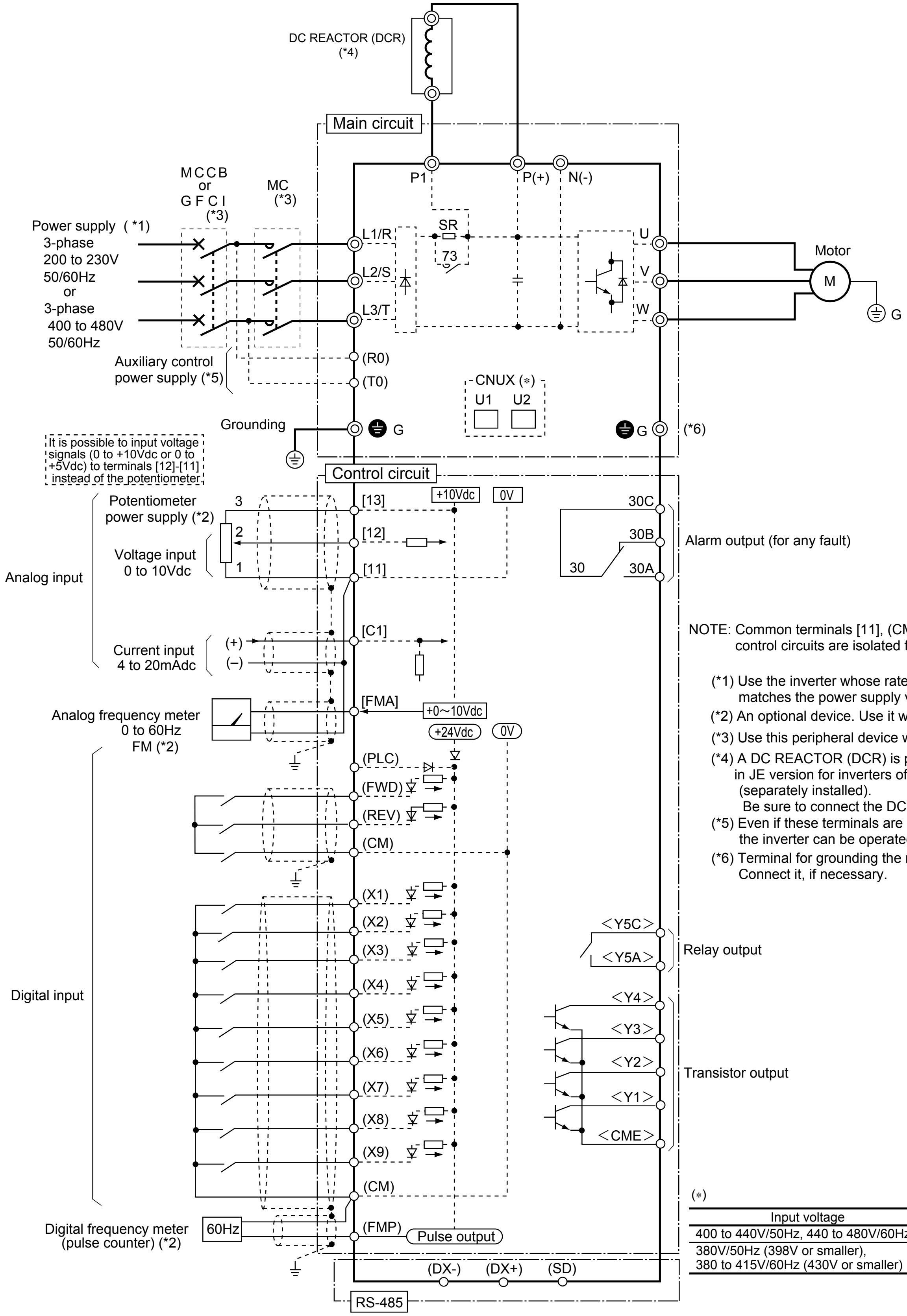
(*)

Input voltage	CNUX connector
400 to 440V/50Hz, 440 to 480V/60Hz	U1
380V/50Hz (398V or smaller), 380 to 415V/60Hz (430V or smaller)	U2

3. Wiring Diagram

⚠ **Caution**	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

(5) 230V/460V FRENIC5000G11S : 100, 125HP / 100 to 600HP
FRENIC5000P11S : 100 to 150HP / 100 to 800HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.
(*2) An optional device. Use it when necessary.
(*3) Use this peripheral device when necessary.
(*4) A DC REACTOR (DCR) is provided as standard in JE version for inverters of 100HP or larger (separately installed). Be sure to connect the DCR properly.
(*5) Even if these terminals are not powered, the inverter can be operated.
(*6) Terminal for grounding the motor. Connect it, if necessary.

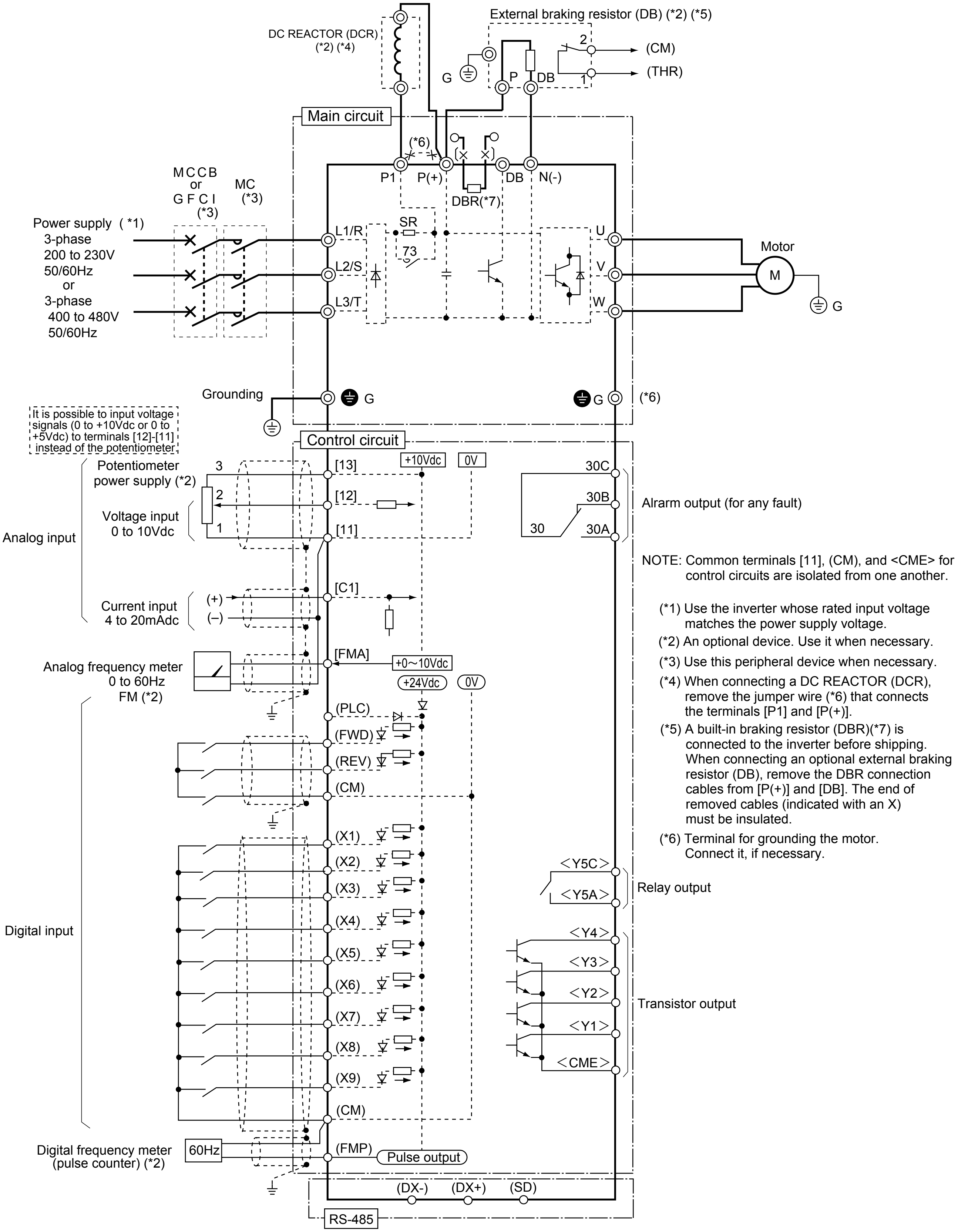
(*)

Input voltage	CNUX connector
400 to 440V/50Hz, 440 to 480V/60Hz	U1
380V/50Hz (398V or smaller), 380 to 415V/60Hz (430V or smaller)	U2

⚠ Caution	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

3.3 Wiring diagram using options

(1) 230V/460V FRENIC5000G11S : 1/4 to 1HP / 1/2, 1HP



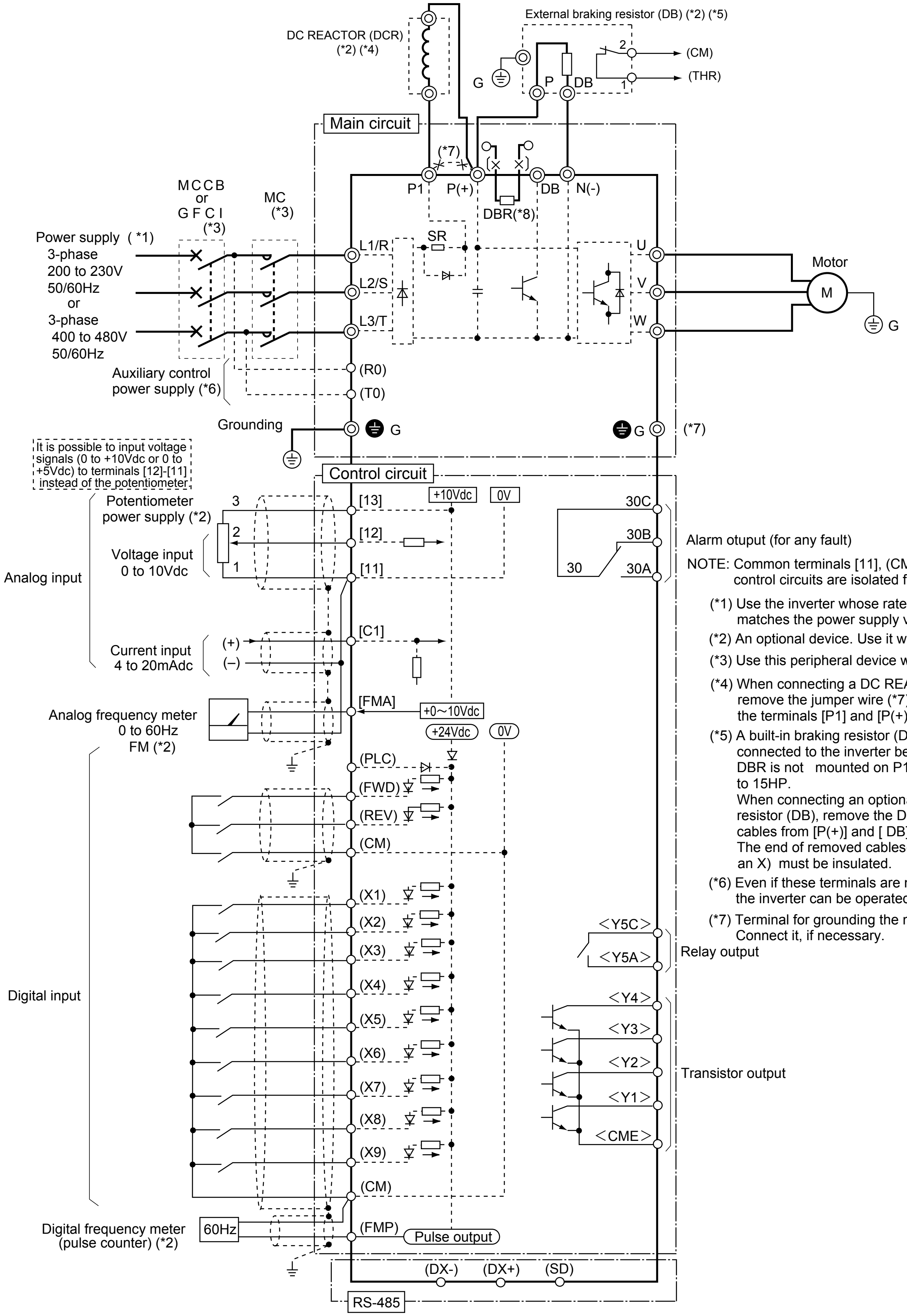
NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.
(*2) An optional device. Use it when necessary.
(*3) Use this peripheral device when necessary.
(*4) When connecting a DC REACTOR (DCR), remove the jumper wire (*6) that connects the terminals [P1] and [P(+)].
(*5) A built-in braking resistor (DBR)(*7) is connected to the inverter before shipping. When connecting an optional external braking resistor (DB), remove the DBR connection cables from [P(+)] and [DB]. The end of removed cables (indicated with an X) must be insulated.
(*6) Terminal for grounding the motor. Connect it, if necessary.

3. Wiring Diagram

Caution	The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.

(2) 230V/460V FRENIC5000G11S : 2 to 10HP
FRENIC5000P11S : 7.5 to 15HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) An optional device. Use it when necessary.

(*3) Use this peripheral device when necessary.

(*4) When connecting a DC REACTOR (DCR), remove the jumper wire (*7) that connects the terminals [P1] and [P(+)].

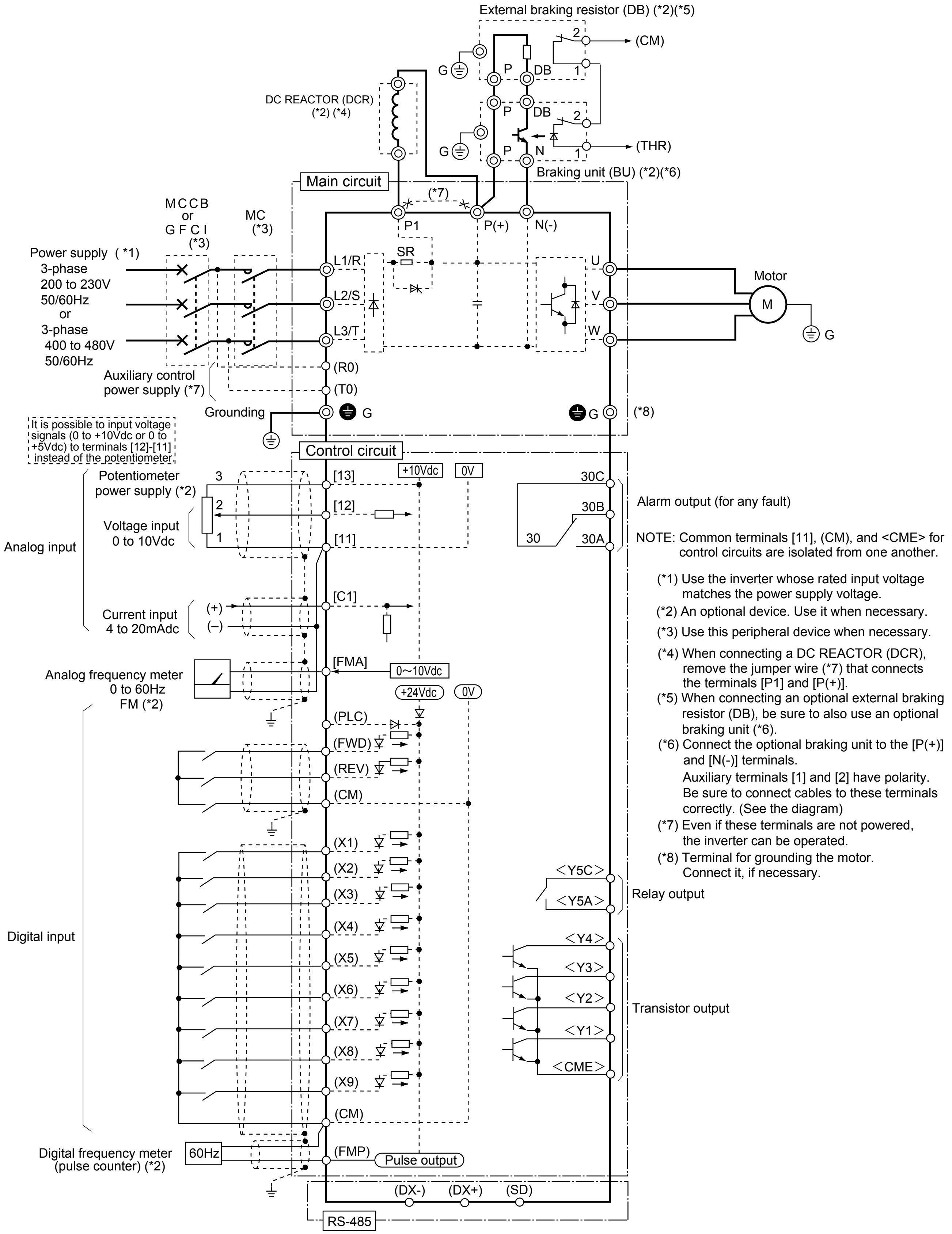
(*5) A built-in braking resistor (DBR)(*8) is connected to the inverter before shipping. DBR is not mounted on P11S models of 7.5 to 15HP.
When connecting an optional external braking resistor (DB), remove the DBR connection cables from [P(+)] and [DB].
The end of removed cables(indicated with an X) must be insulated.

(*6) Even if these terminals are not powered, the inverter can be operated.

(*7) Terminal for grounding the motor. Connect it, if necessary.

Caution	**The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.**

(3) 230V/460V FRENIC5000G11S : 15 to 30HP
FRENIC5000P11S : 20 to 30HP



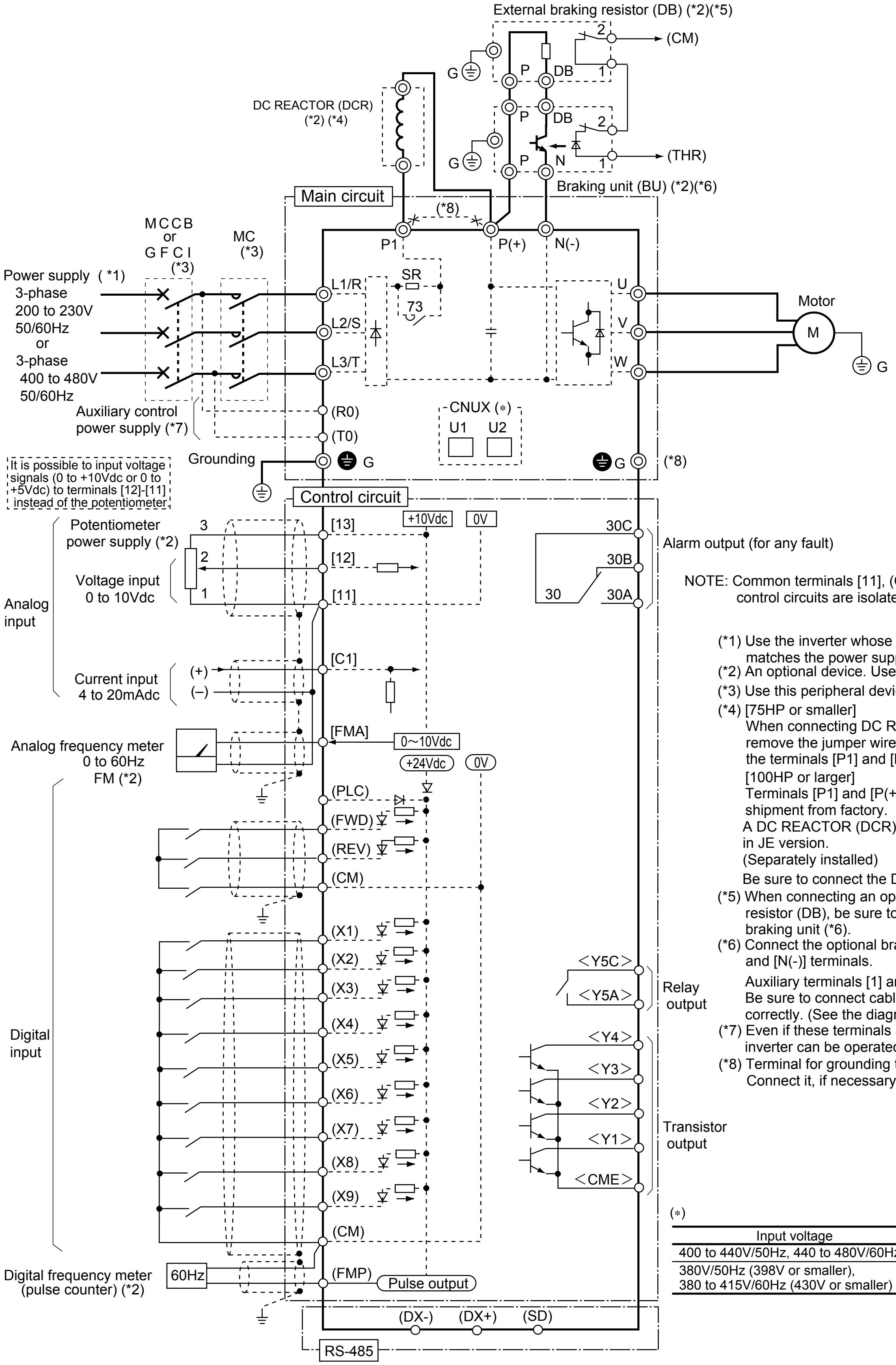
NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.
(*2) An optional device. Use it when necessary.
(*3) Use this peripheral device when necessary.
(*4) When connecting a DC REACTOR (DCR), remove the jumper wire (*7) that connects the terminals [P1] and [P(+)].
(*5) When connecting an optional external braking resistor (DB), be sure to also use an optional braking unit (*6).
(*6) Connect the optional braking unit to the [P(+)] and [N(-)] terminals.
Auxiliary terminals [1] and [2] have polarity. Be sure to connect cables to these terminals correctly. (See the diagram)
(*7) Even if these terminals are not powered, the inverter can be operated.
(*8) Terminal for grounding the motor. Connect it, if necessary.

3. Wiring Diagram

Caution	The information described in this document is for the purpose of selecting the appropriate product only. Before actually using this product, be sure to read the Instruction Manual carefully to ensure proper operation.

(4) 230V/460V FRENIC5000G11S : 40 to 125HP / 40 to 600HP
FRENIC5000P11S : 40 to 150HP / 40 to 800HP



NOTE: Common terminals [11], (CM), and <CME> for control circuits are isolated from one another.

(*1) Use the inverter whose rated input voltage matches the power supply voltage.

(*2) An optional device. Use it when necessary.

(*3) Use this peripheral device when necessary.

(*4) [75HP or smaller]
When connecting DC REACTOR (DCR), remove the jumper wire (*8) that connects the terminals [P1] and [P(+)].
[100HP or larger]
Terminals [P1] and [P(+)] are not connected at shipment from factory.
A DC REACTOR (DCR) is provided as standard in JE version.
(Separately installed)
Be sure to connect the DCR.

(*5) When connecting an optional external braking resistor (DB), be sure to also use an optional braking unit (*6).

(*6) Connect the optional braking unit to the [P(+)] and [N(-)] terminals.
Auxiliary terminals [1] and [2] have polarity. Be sure to connect cables to these terminals correctly. (See the diagram)

(*7) Even if these terminals are not powered, the inverter can be operated.

(*8) Terminal for grounding the motor. Connect it, if necessary.

(*)

Input voltage	CNUX connector
400 to 440V/50Hz, 440 to 480V/60Hz	U1
380V/50Hz (398V or smaller), 380 to 415V/60Hz (430V or smaller)	U2

4. Terminal

4.1 Terminal functions

	Symbol	Terminal name	Functions	Remarks	Func. code
Main circuit	**L1/R, L2/S, L3/T**	**Power input**	Connect a 3-phase power supply.		
	U, V, W	**Inverter output**	Connect a 3-phase induction motor.		
	P1, P(+)	**For DC REACTOR**	Connect the DC REACTOR for power-factor correcting or harmonic current reducing.	DC REACTOR: Option (for 75HP or smaller)	
	P(+), N(-)	**For BRAKING UNIT**	• Connect the BRAKING UNIT (Option). • Used for DC bus connection system.	BRAKING UNIT (Option): G11S:15HP or larger, P11S: 20HP or larger	
	P(+), DB	**For EXTERNAL BRAKING RESISTOR**	Connect the EXTERNAL BRAKING RESISTOR (Option)	Only for 10HP or smaller (G11S), 15HP or smaller (P11S)	
	⏚ G	**Grounding**	Ground terminal for inverter chassis (housing).		
	R0, T0	**Auxiliary control power supply**	Connect the same AC power supply as that of the main circuit to back up the control circuit power supply.	1HP or smaller: Not correspond	
Analog input	**13**	**Potentiometer power supply**	+10V DC power supply for frequency setting POT (POT: 1 to 5kΩ)	· Allowable maximum output current : 10mA	F01, C30
	12	**Voltage input** **(Reversible operation)** **(Inverse mode operation)**	• 0 to +10V DC/0 to 100% (0 to +5V DC/0 to 100%) • Selected by function setting. 0 to ±10V DC /0 to ±100% (0 to ±5V DC/0 to ±100%) (Setting resolution of 0 to ± 10V DC is twice.) • Selected by function setting or digital input signal. +10 to 0V DC/0 to 100%	· Input impedance: 22kΩ · Allowable maximum input voltage: ±15V DC · If input voltage is 10 to 15V DC, the inverter estimates it to10V DC.	
		(Torque control)	Used for torque control reference signal.		H18
		(PID control)	Used for PID control reference signal or feedback signal.		F01, H21
		(PG feedback)	Used for reference signal of PG feedback control (option)		
	C1	**Current input** **(Inverse mode operation)**	• 4 to 20mA DC/0 to 100% • Selected by function setting or digital input signal. 20 to 4mA DC/0 to 100%	· Input impedance: 250Ω · Allowable maximum input current: 30mA DC · If input current is 20 to 30mA DC , the inverter estimates it to 20mA DC.	
		(PID control)	Used for PID control reference signal or feedback signal.		F01, H21
		(PTC thermistor input)	The PTC thermisor (for motor protection) can be connnected to terminal 13-C1-11.		H26, H27
	11	**Common**	Common for analog signal	Isolated from terminal CME and CM.	
Digital input	**FWD**	**Forward operation commond**	FWD : ON .... The motor runs in the forward direction. FWD : OFF .... The motor decelerates and stops.	When FWD and REV are simultaneously ON, the motor decelerates and stops.	F02
	REV	**Reverse operation commond**	REV : ON .... The motor runs in the reverse direction. REV : OFF .... The motor decelerates and stops.		
	X1	**Digital input 1**	These terminals can be preset as follows.	· ON state maximum input voltage: 2V (maximum source current : 5mA) · OFF state maximum terminal voltage: 22 to 27V (allowable maximum leakage current: 0.5mA)	E01 to E09
	X2	**Digital input 2**			
	X3	**Digital input 3**			
	X4	**Digital input 4**			
	X5	**Digital input 5**			
	X6	**Digital input 6**			
	X7	**Digital input 7**			
	X8	**Digital input 8**			
	X9	**Digital input 9**			
	(SS1) **(SS2)** **(SS4)** **(SS8)**	**Multistep freq. selection**	(SS1) : 2 (0, 1) different frequencies are selectable. (SS1,SS2) : 4 (0 to 3) different frequencies are selectable. (SS1,SS2,SS4) : 8 (0 to 7) different frequencies are selectable. (SS1,SS2,SS4,SS8) : 16 (0 to 15) different frequencies are selectable.	Frequency 0 is set by F01 (or C30). (All signals of SS1 to SS8 are OFF)	C05 to C19
	(RT1) **(RT2)**	**ACC / DEC time selection**	(RT1) : 2 (0, 1) different ACC / DEC times are selectable. (RT1,RT2) : 4 (0 to 3) different ACC / DEC times are selectable.	Time 0 is set by F07/F08. (All signals of RT1 to RT2 are OFF)	F07, F08 E10 to E15
	(HLD)	**3-wire operation stop command**	Used for 3-wire operation. (HLD): ON ..... The inverter self-holds FWD or REV signal. (HLD): OFF ... The inverter releases self-holding.	Assigned to terminal X7 at factory setting.	

	Symbol	Terminal name	Functions	Remarks	Func. code
Digital input	**(BX)**	**Coast-to-stop command**	(BX): ON .... The inverter output is cut off immediately and the motor will coast-to-stop. (No alarm signal will be output.)	· The motor restarts from 0Hz by turning off BX with the operation command (FWD or REV) ON. · Assigned to terminal X8 at factory setting.	
	(RST)	**Alarm reset**	(RST): ON ...... Faults are reset. (This signal should be held for more than 0.1s.)	· During normal operating, this signal is ignored. · Assigned to terminal X9 at factory setting.	
	(THR)	**Trip command (External fault)**	(THR): OFF .... • The inverter output is cut off and the motor coasts-to-stop. Alarm signal will be output. • This signal is held internally and is reset by inputting RST signal. • Used to protect overheating of external braking resistor.	This alarm signal is held internally.	
	(JOG)	**Jogging operation**	(JOG): ON .... JOG frequency is effective.	This signal is effective only while the inverter is stopping.	C20
	(Hz2/Hz1)	**Freq. set 2 / Freq. set 1**	(Hz2/Hz1): ON ..... Freq. set 2 is effective.	If this signal is changed while the inverter is running, the signal is effective only after the inverter stops.	C30, F01
	(M2/M1)	**Motor 2 / Motor 1**	(M2/M1): ON .... The motor circuit parameter and V/f characteristics are changed to the second motor's ones.	If this signal is changed while the inverter is running, the signal is effective only after the inverter stops.	A10 to A18, P01 to P09
	(DCBRK)	**DC brake command**	(DCBRK): ON ..... The DC inUXction brake is effective. (In the inverter deceleration mode)	If the operation command(FWD/REV) is input while DC braking is effective, the operation command (FWD/REV) has priority.	F20 to F22
	(TL2/TL1)	**Torque limiter 2 / Torque limiter 1**	(TL2/TL1): ON .... Torque limiter 2 is effective.		E16, E17, F40, F41
	(SW50)	**Switching operation between line and inverter (50Hz)**	(SW50(SW60)): ON The motor is changed from inverter operation to line operation. (SW50(SW60)): OFF The motor is changed from line operation to inverter operation.	Main circuit changeover signals are output through Y1 to Y5 terminal.	
	(SW60)	**Switching operation between line and inverter (60Hz)**			
	(UP)	**UP command**	(UP): ON .... The output frequency increases.	When UP and DOWN commands are simultaneously ON, DOWN signal is effective.	F01,C30
	(DOWN)	**DOWN command**	(DOWN): ON .... The output frequency decreases. · The output frequency change rate is determined by ACC / DEC time. · Restarting frequency can be selected from 0Hz or setting value at the time of stop.		
	(WE-KP)	**Write enable for KEYPAD**	(WE-KP): ON .... The data is changed by KEYPAD.		F00
	(Hz/PID)	**PID control cancel**	(Hz/PID): ON .... The PID control is canceled, and frequency setting by KEYPAD (∧ or ∨)is effective.		H20 to H25
	(IVS)	**Inverse mode changeover**	(IVS): ON ... Inverse mode is effective in analog signal input.	If this signal is changed while the inverter is running, the signal is effective only after the inverter stops.	F01, C30
	(IL)	**Interlock signal for 52-2**	When a switch is connected between inverter and motor, connect its auxiliary NC contact to this terminal. When a momentary power failure occurs, this signal is input.		
	(Hz/TRQ)	**TRQ control cancel**	(Hz/TRQ): ON ... The torque control is canceled, and ordinary operation is effective.		H18
	(LE)	**Link enable (RS-485, Bus)**	(LE): ON .... The link opereation is effective. Used to switch operation between ordinary operation and link operation to communication.	RS-485: Standard, Bus: Option	H30
	(U-DI)	**Universal DI**	This signal is transmitted to main controller of LINK operation.		
	(STM)	**Pick up start mode**	(STM): ON .... The "Pick up" start mode is effective.		H09
	(PG/Hz)	**SY-PG enabled**	(PG/Hz): ON ..... Synchronized operation or PG-feedback operation is effective.	Option	
	(SYC)	**Synchronization command**	(SYC): ON .... The motor is controlled for synchronized operation between 2 axes with PGs.	Option	
	(ZERO)	**Zero speed command**	(ZERO): ON ...... The motor speed is controlled with the speed reference of zero.	This function can be selected at PG feedback control. Option	

	Symbol	Terminal name	Functions	Remarks	Func. code
Digital input	**(STOP1)**	**Forced stop command**	(STOP1): OFF .. The motor decelerates and stops.	Er6 is indicated after the motor stops.	
	(STOP2)	**Forced stop command with Deceleration time4**	(STOP2): OFF .. The motor decelerates and stops with Deceleration time4.		E15
	(EXITE)	**Pre-exciting command**	(EXITE): ON ..... The magnetic flux can be established preliminary before starting at PG vector mode.		
	PLC	**PLC terminal**	Connect PLC power supply to avoid malfunction of the inveter that has SINK type digital input,when PLC power supply is off.		
	CM	**Common**	Common for digital signal.	Isolated from terminals CME and 11.	
Analog output	**FMA** **(11)**	**Analog monitor** **(Common)**	Output voltage (0 to 10V DC) is proportional to selected function's value as follows. The proportional coefficient and bias value can be preset. • Output frequency 1 (Before slip compensation) (0 to max. frequency) • Output frequency 2 (After slip compensation) (0 to max. frequency) • Output current (0 to 200%) • Output voltage (0 to 200%) • Output torque (0 to 200%) • Load factor (0 to 200%) • Input power (0 to 200%) • PID feedback value (0 to 100%) • PG feedback value (0 to max. speed) • DC link circuit voltage (0 to 1000V) • Universal AO (0 to 100%)	• Allowable maximum output current: 2mA • Up to two analog voltmeters can be connnected (Input impedance : 10kΩ)	F30 to F31
Pulse output	**FMP** **(CM)**	**Pulse rate monitor** **(Common)**	• Pulse rate mode : Pulse rate is proportional to selected function's value (50% duty pulse) • Average voltage mode : Average voltage is proportional to selected function's value (2670p/s pulse width control) • Output frequency 1 (Before slip compensation) (0 to max. frequency) • Output frequency 2 (After slip compensation) (0 to max. frequency) • Output current (0 to 200%) • Output voltage (0 to 200%) • Output torque (0 to 200%) • Load factor (0 to 200%) • Input power (0 to 200%) • PID feedback value (0 to 100%) • PG feedback value (0 to max. speed) • DC link circuit voltage (0 to 500V: 230V) (0 to 1000V: 460V) • Universal AO (0 to 100%)	• Allowable maximum output current: 2mA • Up to two analog voltmeters can be connnected (Input impedance : 10kΩ)	F33 to F35
Tran-sistor output	**Y1**	**Transistor output 1**	Output the selected signals from the following items.	• ON state maximum output voltage : 2V (Allowable maximum sink current : 50mA) • OFF state maximum leakage current : 0.1mA (Allowable maximum voltage : 27V)	E20 to E23
	Y2	**Transistor output 2**			
	Y3	**Transistor output 3**			
	Y4	**Transistor output 4**			
	(RUN)	**Inverter running**	Outputs ON signal when the output frequency is higher than starting frequency.		
	(FAR)	**Frequency equivalence signal**	Outputs ON signal when the difference between output frequency and setting frequency is smaller than FAR hysteresis width.		E30
	(FDT1)	**Frequency level detection**	Outputs ON signal by comparison of output frequency and preset value (level and hysteresis).	• Operation level G11S : 0 to 400Hz, P11S : 0 to 120Hz • Hysteresis width : 0.0 to 30.0Hz	E31, E32
	(LU)	**Undervoltage detection signal**	Outputs ON signal when the inverter stops by undervoltage while the operation command is ON.		
	(B/D)	**Torque polarity**	Outputs ON signal in braking or stopping mode, and OFF signal in driving mode.		
	(TL)	**Torque limiting**	Outputs ON signal when the inverter is in torque-limiting mode.		
	(IPF)	**Auto-restarting**	Outputs ON signal during auto restart operation (Instantaneous power failure) mode. (including "restart time")		

	Symbol	Terminal name	Functions	Remarks	Func. code
Tran-sistor output	(OL1)	Overload early warning	• Outputs ON signal when the electronic thermal value is higher than preset alarm level. • Outputs ON signal when the output current value is higher than preset alarm level.		E33 to E35
	(KP)	KEYPAD operation mode	Outputs ON signal when the inverter is in KEYPAD operation mode.		F02
	(STP)	Inverter stopping	Outputs ON signal when the inverter is in stopping mode or in DC braking mode.		
	(RDY)	Ready output	Outputs ON signal when the inverter is ready for operation.		
	(SW88)	Line/Inv changeover (for 88)	Outputs 88's ON signal to a switch for line operation in Line/Inverter changeover operation.		
	(SW52-2)	Line/Inv changeover (for 52-2)	Outputs 52-2's ON signal to a switch on inverter power supply side in Line/Inverter changeover operation.		
	(SW52-1)	Line/Inv changeover (for 52-1)	Outputs 52-1's ON signal to a switch on inverter output side in Line/Inverter changeover operation.		
	(SWM2)	Motor2/Motor1	Outputs the motor changeover switch ON signal from motor 1 to motor 2.		A01 to A18
	(AX)	Auxiliary terminal (for 52-1)	Used for auxiliary circuit of 52-1. (Same function as AX1, AX2 terminal by FRENIC5000G9S series. (40HP or larger))	Refer to wiring diagram example.	
	(TU)	Time-up signal	Outputs time up signal (100ms ON pulse) at every stage end of PATTERN operation.		C21 to C28
	(TO)	Cycle completion signal	Outputs one cycle completion signal (100ms ON pulse) at PATTERN operation.		
	(STG1) (STG2) (STG4)	Stage No. indication 1 Stage No. indication 2 Stage No. indication 4	Outputs PATTERN operation's stage No. by signals STG1, STG2, and STG4.		
	(AL1) (AL2) (AL4) (AL8)	Alarm indication 1 Alarm indication 2 Alarm indication 4 Alarm indication 8	Outputs trip alarm No. by signals AL1, AL2, AL4, and AL8.		
	(FAN)	Fan operation signal	Outputs the inverter cooling fan operation status signal.	40HP or larger only.	H06
	(TRY)	Auto-resetting	Outputs ON signal at auto resetting mode. (Including "Reset interval")		H04, H05
	(U-DO)	Universal DO	Outputs command signal from main controller of LINK operation.		
	(OH)	Overheat early warning	Outputs ON signal when the temperature difference between the heat sink and the trip level is less than 10°C (50°F), and outputs OFF signal when the temperature difference is more than 15°C (59°F).		
	(SY)	Synchronization completion signal	Synchronization completion signal for synchronized operation.	Option	
	(LIFE)	Lifetime alarm	Outputs ON signal when the calculated lifetime is longer than preset alarm level.		
	(FDT2)	2nd Freq. level detection	2nd-outputs ON signal by comparison of output frequency and preset value (FDT2 level).		
	(OL2)	2nd OL level early warning	2nd-outputs ON signal when the output current value is larger than preset alarm level (OL2 level).		
	(C1OFF)	Terminal C1 off signal	Outputs ON signal when the C1 current is smaller than 2mA.		
	(DNZS)	Speed existence signal	Outputs ON signal at detection of motor speed when using OPC-G11S-PG/PG2/SY.		
	CME	Common (transistor output)	Common for transistor output signal. Isolated from terminals CM and 11.		
Relay output	30A, 30B 30C	Alarm relay output	Outputs a contact signal when a protective function is activated.	· Contact rating : 250V AC, 0.3A, cosø=0.3 48V DC, 0.5A, non-inductive	F36
			Changeable exciting mode active or non-exciting mode active by function "F36".		
	Y5A, Y5C	Relay output	Functions can be selected the same as Y1 to Y4.		E24
			Changeable exciting mode active or non-exciting mode active by function "E25".		E25
			Used for closing/opening a magnetic contactor connected to main power supply input.		
LINK	DX+, DX-, SD	RS-485 I/O terminal	• Connect to a personal computer or programmable logic controller (PLC). • Up to 31 inverters can be connected when using daisy chain connection.		

4.2 Main circuit and control circuit terminals

4.2.1 Terminal block arrangement

Table 1-1 Terminal block arrangement

Power supply voltage	Nominal applied motor [HP]	G11S series		P11S series	
		Inverter type	Fig. No.	Inverter type	Fig. No.
Three-phase 230V	1/4	FRNF25G11S-2UX	1	–	–
	1/2	FRNF50G11S-2UX			
	1	FRN001G11S-2UX			
	2	FRN002G11S-2UX			
	3	FRN003G11S-2UX			
	5	FRN005G11S-2UX			
	7.5	FRN007G11S-2UX	2	FRN007P11S-2UX	2
	10	FRN010G11S-2UX		FRN010P11S-2UX	
	15	FRN015G11S-2UX		FRN015P11S-2UX	
	20	FRN020G11S-2UX		FRN020P11S-2UX	
	25	FRN025G11S-2UX		FRN025P11S-2UX	
	30	FRN030G11S-2UX		FRN030P11S-2UX	
	40	FRN040G11S-2UX	3	FRN040P11S-2UX	3
	50	FRN050G11S-2UX	4	FRN050P11S-2UX	
	60	FRN060G11S-2UX		FRN060P11S-2UX	4
	75	FRN075G11S-2UX		FRN075P11S-2UX	
	100	FRN100G11S-2UX	5	FRN100P11S-2UX	
	125	FRN125G11S-2UX	7	FRN125P11S-2UX	5
	150	–	–	FRN150P11S-2UX	7
Three-phase 460V	1/2	FRNF50G11S-4UX	1	–	–
	1	FRN001G11S-4UX			
	2	FRN002G11S-4UX			
	3	FRN003G11S-4UX			
	5	FRN005G11S-4UX			
	7.5	FRN007G11S-4UX	2	FRN007P11S-4UX	2
	10	FRN010G11S-4UX		FRN010P11S-4UX	
	15	FRN015G11S-4UX		FRN015P11S-4UX	
	20	FRN020G11S-4UX		FRN020P11S-4UX	
	25	FRN025G11S-4UX		FRN025P11S-4UX	
	30	FRN030G11S-4UX		FRN030P11S-4UX	
	40	FRN040G11S-4UX	3	FRN040P11S-4UX	3
	50	FRN050G11S-4UX		FRN050P11S-4UX	
	60	FRN060G11S-4UX		FRN060P11S-4UX	
	75	FRN075G11S-4UX		FRN075P11S-4UX	
	100	FRN100G11S-4UX	4	FRN100P11S-4UX	
	125	FRN125G11S-4UX		FRN125P11S-4UX	4
	150	FRN150G11S-4UX		FRN150P11S-4UX	
	200	FRN200G11S-4UX	6	FRN200P11S-4UX	
	250	FRN250G11S-4UX		FRN250P11S-4UX	6
	300	FRN300G11S-4UX	7	FRN300P11S-4UX	
	350	FRN350G11S-4UX		FRN350P11S-4UX	7
	400	FRN400G11S-4UX		FRN400P11S-4UX	
	450	FRN450G11S-4UX		FRN450P11S-4UX	
	500	FRN500G11S-4UX		FRN500P11S-4UX	
	600	FRN600G11S-4UX		FRN600P11S-4UX	
	700	–	–	FRN700P11S-4UX	
	800	–		FRN800P11S-4UX	

Terminal block arrangement

Fig.1

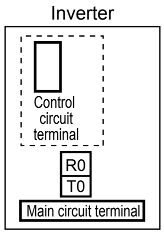


Fig.2

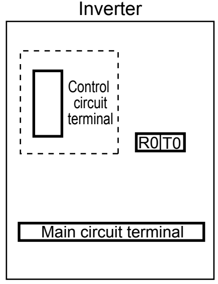


Fig.3

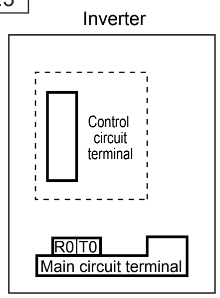


Fig.4

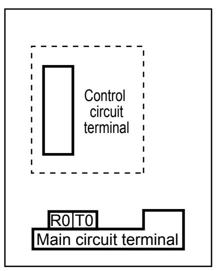


Fig.5

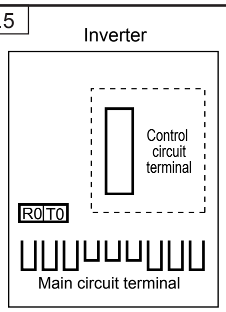


Fig.6

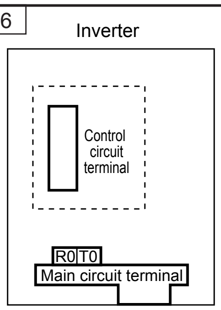
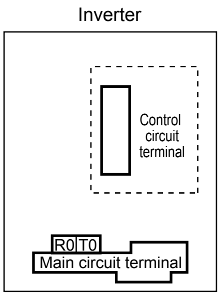


Fig.7



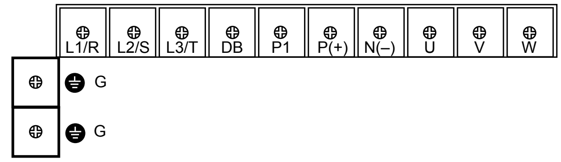
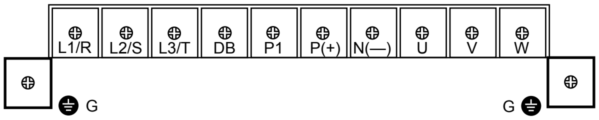
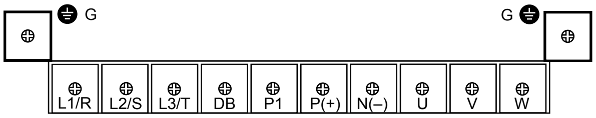
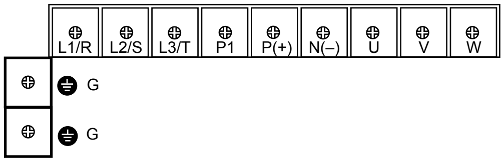
NOTES: R0 and T0 are not provided with inverters of 1HP or smaller.

4.2.2 Main circuit terminal

■ Main circuit terminal arrangement

(a) Three-phase 230V

Table 1-2 (a) Main circuit terminal arrangement

Power supply voltage	Nominal applied motor [HP]	G11S series		P11S series		Terminal arrangement
		Inverter type	Fig. No.	Inverter type	Fig. No.	
Three-phase 230V	1/4	FRNF25G11S-2UX	1	–	–	Fig.1 
	1/2	FRNF50G11S-2UX				
	1	FRN001G11S-2UX				
	2	FRN002G11S-2UX	2, 10			
	3	FRN003G11S-2UX				Fig.2 
	5	FRN005G11S-2UX				
	7.5	FRN007G11S-2UX	3, 11	FRN007P11S-2UX	3, 11	
	10	FRN010G11S-2UX		FRN010P11S-2UX		
	15	FRN015G11S-2UX	4, 11	FRN015P11S-2UX		
	20	FRN020G11S-2UX		FRN020P11S-2UX	4, 11	Fig.3 
	25	FRN025G11S-2UX		FRN025P11S-2UX		
	30	FRN030G11S-2UX		FRN030P11S-2UX		
	40	FRN040G11S-2UX	5, 11	FRN040P11S-2UX	5, 11	
	50	FRN050G11S-2UX		FRN050P11S-2UX		
	60	FRN060G11S-2UX		FRN060P11S-2UX		Fig.4 
	75	FRN075G11S-2UX		FRN075P11S-2UX		
	100	FRN100G11S-2UX	6, 11	FRN100P11S-2UX		
	125	FRN125G11S-2UX	7, 11	FRN125P11S-2UX	6, 11	
	150	–	–	FRN150P11S-2UX	7, 11	

NOTE: See Table 1-2 (b) for Fig.5 and later.

(b) Three-phase 460V

Table 1-2 (b) Main circuit terminal arrangement

Power supply voltage	Nominal applied motor [HP]	G11S series		P11S series	
		Inverter type	Fig. No.	Inverter type	Fig. No.
Three-phase 460V	1/2	FRNF50G11S-4UX	1	–	–
	1	FRN001G11S-4UX			
	2	FRN002G11S-4UX	2, 10		
	3	FRN003G11S-4UX			
	5	FRN005G11S-4UX			
	7.5	FRN007G11S-4UX	3,11	FRN007P11S-4UX	3, 11
	10	FRN010G11S-4UX		FRN010P11S-4UX	
	15	FRN015G11S-4UX	4, 11	FRN015P11S-4UX	
	20	FRN020G11S-4UX		FRN020P11S-4UX	4, 11
	25	FRN025G11S-4UX		FRN025P11S-4UX	
	30	FRN030G11S-4UX		FRN030P11S-4UX	
	40	FRN040G11S-4UX	5, 11	FRN040P11S-4UX	5, 11
	50	FRN050G11S-4UX		FRN050P11S-4UX	
	60	FRN060G11S-4UX		FRN060P11S-4UX	
	75	FRN075G11S-4UX		FRN075P11S-4UX	
	100	FRN100G11S-4UX		FRN100P11S-4UX	
	125	FRN125G11S-4UX		FRN125P11S-4UX	
	150	FRN150G11S-4UX		FRN150P11S-4UX	
	200	FRN200G11S-4UX	7, 11	FRN200P11S-4UX	
	250	FRN250G11S-4UX		FRN250P11S-4UX	7, 11
	300	FRN300G11S-4UX		FRN300P11S-4UX	
	350	FRN350G11S-4UX		FRN350P11S-4UX	
	400	FRN400G11S-4UX	8, 12	FRN400P11S-4UX	
	450	FRN450G11S-4UX		FRN450P11S-4UX	8, 12
	500	FRN500G11S-4UX	9, 12	FRN500P11S-4UX	
	600	FRN600G11S-4UX		FRN600P11S-4UX	
	700	–	–	FRN700P11S-4UX	9, 12
	800	–		FRN800P11S-4UX	

Terminal arrangement

Fig.5

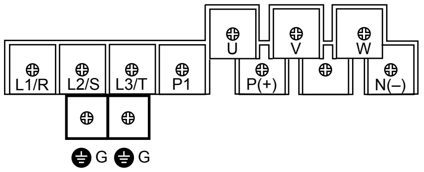


Fig.6

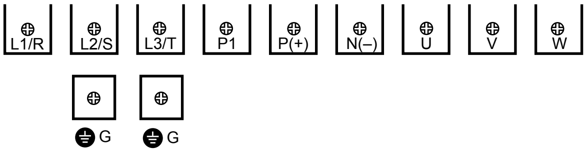


Fig.7

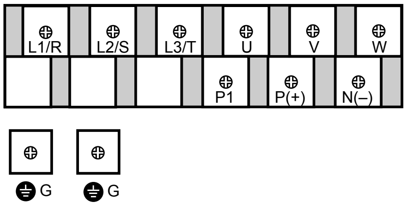


Fig.8

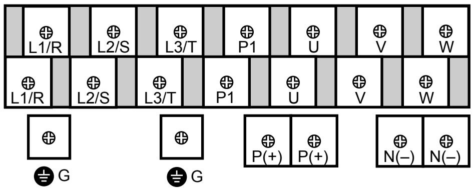


Fig.9

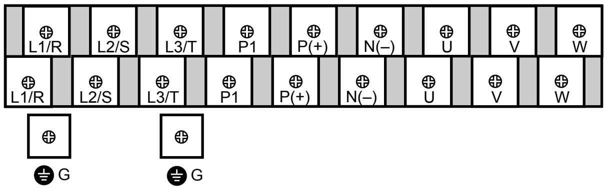


Fig.10

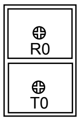


Fig.11

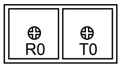
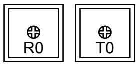


Fig.12



NOTES: See Table 1-2 (a) for Fig. 1 to Fig. 4.

■ Main circuit terminal size

Table 1-3 Main circuit terminal size (G11S/P11S)

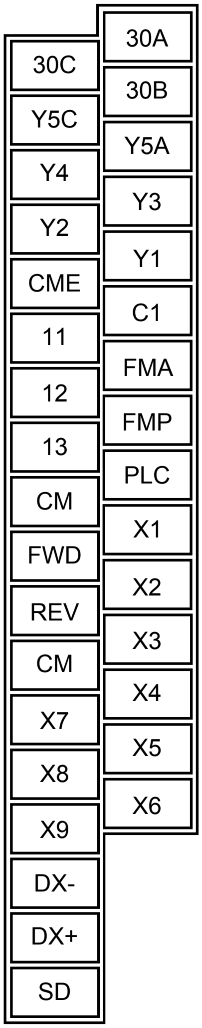
Power supply voltage	Nominal applied motor [HP]	Inverter type	Terminal size					Inverter type	Terminal size				
		G11S series	L1/R, L2/S. L3/T U, V, W	P1,P (+) N (-)	DB	⏚ G	R0,T0 *1)	P11S series	L1/R, L2/S. L3/T U, V, W	P1,P (+) N (-)	DB	⏚ G	R0,T0 *1)
Three-phase 230V	1/4	FRNF25G11S-2UX	M3.5	M3.5	M3.5	M3.5	–	–	–				
	1/2	FRNF50G11S-2UX											
	1	FRN001G11S-2UX											
	2	FRN002G11S-2UX	M4	M4	M4	M4	M3.5						
	3	FRN003G11S-2UX											
	5	FRN005G11S-2UX											
	7.5	FRN007G11S-2UX	M5	M5	M5	M5	M3.5	FRN007P11S-2UX	M5	M5	M5	M5	M3.5
	10	FRN010G11S-2UX						FRN010P11S-2UX					
	15	FRN015G11S-2UX	M6	M6	–	M6	M3.5	FRN015P11S-2UX					
	20	FRN020G11S-2UX						FRN020P11S-2UX	M6	M6	M6	M6	M3.5
	25	FRN025G11S-2UX						FRN025P11S-2UX					
	30	FRN030G11S-2UX						FRN030P11S-2UX					
	40	FRN040G11S-2UX	M8	M8		M8	M4	FRN040P11S-2UX	M8	M8	–	M8	M4
	50	FRN050G11S-2UX	M10	M10				FRN050P11S-2UX					
	60	FRN060G11S-2UX						FRN060P11S-2UX	M10	M10			
	75	FRN075G11S-2UX						FRN075P11S-2UX					
	100	FRN100G11S-2UX	M12	M12		M10	M4	FRN100P11S-2UX					
	125	FRN125G11S-2UX						FRN125P11S-2UX	M12	M12		M10	M4
	150	–	–	–		–	–	FRN150P11S-2UX					
Three-phase 460V	1/2	FRNF50G11S-4UX	M3.5	M3.5	M3.5	M3.5	–	–	–				
	1	FRN001G11S-4UX											
	2	FRN002G11S-4UX	M4	M4	M4	M4	M3.5						
	3	FRN003G11S-4UX											
	5	FRN005G11S-4UX											
	7.5	FRN007G11S-4UX	M5	M5	M5	M5	M3.5	FRN007P11S-4UX	M5	M5	M5	M5	M3.5
	10	FRN010G11S-4UX						FRN010P11S-4UX					
	15	FRN015G11S-4UX	M6	M6	–	M6	M3.5	FRN015P11S-4UX					
	20	FRN020G11S-4UX						FRN020P11S-4UX	M6	M6	M6	M6	M3.5
	25	FRN025G11S-4UX						FRN025P11S-4UX					
	30	FRN030G11S-4UX						FRN030P11S-4UX					
	40	FRN040G11S-4UX	M8	M8		M8	M4	FRN040P11S-4UX	M8	M8	–	M8	M4
	50	FRN050G11S-4UX						FRN050P11S-4UX					
	60	FRN060G11S-4UX						FRN060P11S-4UX					
	75	FRN075G11S-4UX						FRN075P11S-4UX					
	100	FRN100G11S-4UX	M10	M10				FRN100P11S-4UX					
	125	FRN125G11S-4UX						FRN125P11S-4UX	M10	M10			
	150	FRN150G11S-4UX						FRN150P11S-4UX					
	200	FRN200G11S-4UX	M12	M12		M10	M4	FRN200P11S-4UX					
	250	FRN250G11S-4UX						FRN250P11S-4UX	M12	M12		M10	M4
	300	FRN300G11S-4UX						FRN300P11S-4UX					
	350	FRN350G11S-4UX						FRN350P11S-4UX					
	400	FRN400G11S-4UX						FRN400P11S-4UX					
	450	FRN450G11S-4UX						FRN450P11S-4UX					
	500	FRN500G11S-4UX						FRN500P11S-4UX					
	600	FRN600G11S-4UX						FRN600P11S-4UX					
	700	–	–					FRN700P11S-4UX					
	800	–						FRN800P11S-4UX					

NOTES: *1) Provided as standard for 2HP or larger inverter. (Not available for 1HP or smaller inverter)

4.2.3 Control circuit terminal

■ Control circuit terminal size and arrangement

Table 1-5 Control circuit terminal size and arrangement

Nominal applied motor [HP]	Inverter type		Control circuit terminal	
	G11S series	P11S series	Screw size	Terminal arrangement
1/4	FRNF25G11S-2UX	–	M3	
1/2	FRNF50G11S-2UX			
	FRNF50G11S-4UX			
1	FRN001G11S-2UX			
	FRN001G11S-4UX			
2	FRN002G11S-2UX			
	FRN002G11S-4UX			
3	FRN003G11S-2UX			
	FRN003G11S-4UX			
5	FRN005G11S-2UX			
	FRN005G11S-4UX			
7.5	FRN007G11S-2UX	FRN007P11S-2UX		
	FRN007G11S-4UX	FRN007P11S-4UX		
10	FRN010G11S-2UX	FRN010P11S-2UX		
	FRN010G11S-4UX	FRN010P11S-4UX		
15	FRN015G11S-2UX	FRN015P11S-2UX		
	FRN015G11S-4UX	FRN015P11S-4UX		
20	FRN020G11S-2UX	FRN020P11S-2UX		
	FRN020G11S-4UX	FRN020P11S-4UX		
25	FRN025G11S-2UX	FRN025P11S-2UX		
	FRN025G11S-4UX	FRN025P11S-4UX		
30	FRN030G11S-2UX	FRN030P11S-2UX		
	FRN030G11S-4UX	FRN030P11S-4UX		
40	FRN040G11S-2UX	FRN040P11S-2UX		
	FRN040G11S-4UX	FRN040P11S-4UX		
50	FRN050G11S-2UX	FRN050P11S-2UX		
	FRN050G11S-4UX	FRN050P11S-4UX		
60	FRN060G11S-2UX	FRN060P11S-2UX		
	FRN060G11S-4UX	FRN060P11S-4UX		
75	FRN075G11S-2UX	FRN075P11S-2UX		
	FRN075G11S-4UX	FRN075P11S-4UX		
100	FRN100G11S-2UX	FRN100P11S-2UX		
	FRN100G11S-4UX	FRN100P11S-4UX		
125	FRN125G11S-2UX	FRN125P11S-2UX		
	FRN125G11S-4UX	FRN125P11S-4UX		
150	–	FRN150P11S-2UX		
	FRN150G11S-4UX	FRN150P11S-4UX		
200	FRN200G11S-4UX	FRN200P11S-4UX		
250	FRN250G11S-4UX	FRN250P11S-4UX		
300	FRN300G11S-4UX	FRN300P11S-4UX		
350	FRN350G11S-4UX	FRN350P11S-4UX		
400	FRN400G11S-4UX	FRN400P11S-4UX		
450	FRN450G11S-4UX	FRN450P11S-4UX		
500	FRN500G11S-4UX	FRN500P11S-4UX		
600	FRN600G11S-4UX	FRN600P11S-4UX		
700	–	FRN700P11S-4UX		
800	–	FRN800P11S-4UX		

4. Terminal

■ **Terminal size**

M2.5:Common for all models

Operation

Contents

1. Frequency Control Operation

1.1 Types of frequency control signal

17 types of frequency setting method are available as shown on Table 2-1.

Table 2-1 List of Frequency setting method

No.	Frequency setting method	Description	Related Func. Code
			G11S, P11S
1	**KEYPAD operation (∧, ∨ keys)**	• While the ∧ key is pressed, the output frequency increases and while the ∨ key is pressed, it decreases.	F01
2	**External potentiometer**	• Connect a potentiometer (1 to 5kΩ) with three terminals to the terminals 13, 12, and 11 to perform frequency control. • At that time, +10Vdc is applied between terminals 13 and 11. Therefore, use a potentiometer of 1 to 5k. (The maximum allowable current between terminals is 10mA) • Potentiometer is sold separately.	F01
3	**0 to +10V voltage input**	• Input a 0 to +10Vdc signal between the terminals 12 and 11 to perform frequency control. (Input impedance = 22kΩ)	F01
4	**0 to +5V voltage input**	• By setting Function code F17 (Gain for frequency setting signal) at 200.0%, 0 to 5Vdc signal can be used for frequency setting. • Input a 0 to +5Vdc signal between the terminals 12 and 11 to perform frequency control. (Input impedance = 22kΩ)	F01
5	**4 to 20mA current input**	• Input a 4 to 20mAdc current signal between the terminals C1 and 11 to perform frequency control. (Input impedance = 250Ω)	F01
6	**Voltage input + current input**	• Use an added signal of voltage signal of 0 to 10Vdc (between terminals 12 and 11) + current signal of 4 to 20mAdc (between terminals C1 and 11) to perform frequency control.	F01
7	**0 to ±10V voltage input**	• Invert the polarity of the DC voltage signal, in addition to the control of item 3 above, to change the rotating direction.	F01
8	**+10 to 0V voltage input**	• Input a +10 to 0Vdc voltage signal between the terminals 12 and 11 (or V2 and 11) to perform frequency control in inverse mode.(Input impedance = 22k), (+10 to 0V / 0Hz to Max. freq.)	F01
9	**20 to 4mA current input**	• Input a 20 to 4mAdc current signal between the terminals C1 and 11 to perform frequency control in inverse mode.(Input impedance = 250), (20 to 4mA / 0Hz to Max. freq.)	F01
10	**UP/DOWN control**	• Set UP/DOWN control to the terminal function of digital input terminal. Output frequency increases while UP terminal is on; it decreases while DOWN terminal is on. • Output frequency at starting can be selected from either 0Hz or the value last set before stopping.	F01 E01 to E09
11	**Multistep speed operation**	• 15 kinds of output frequency can be stored in the inverter. Each output frequency can be selected by external signals (assigned to terminals X1 to X9) to perform multistep (max. 16) speed operation.	F01 E01 to E09
12	**Jogging operation**	• Jogging operation can be set by KEYPAD panel or external signal input.	F02 E01 to E09
13	**Pattern operation**	• An automatic timer operation can be performed according to the preset max. 7 stages. External setting from PLC is not required.	F01 C21 to C28
14	**D/I or pulse train**	• Highly precise speed control can be performed with 16-bit parallel signal using an option card (OPC-G11S-DIO). Either 16-bit binary signal or BCD 4-digit signal can be selected. • Speed control with pulse train input can be performed using an option card (OPC-G11S-PG☐). • Using an option card (OPC-G11S-SY) enables the position control with pulse train input and the synchronous operation between two motors (simultaneous-start-and-synchronization, proportional synchronization).	F01

No.	Frequency setting method	Description	Related Func. Code
			G11S, P11S
15	**RS-485 communication**	• Frequency setting can be made by means of communication with RS-485 as standard.	H30 to H39
16	**PID control**	• Optimum control is enabled, by controlling feedback signal in air-conditioning unit.	H20 to H25
17	**T-link**	• Highly precise speed control can be performed with 16-bit serial signal by connecting FUJI PLC “MICREX-F” via an option card (OPC-G11S-TL).	F01, H30
18	**LINK operation**	• Using the option cads (OPC-G11S-□□□) below enables several types of communications. • Profibus-DP, DeviceNet, Modbus Plus, Interbus-S, CAN open	

* In G11S series, output frequency can be selected out of 2 preset frequency signals by using external signal input (Function select of terminal X1 to X9).

1.2 Accuracy and resolution

Accuracy and resolution depend on the frequency setting type as follows:

Table 2-2 Accuracy of frequency setting

Type of setting	Accuracy	Remarks
Analog setting	±0.2% of Maximum frequency	25 ± 10°C (77 ± 50°F)
Digital setting	±0.01% of Maximum frequency	-10 to +50°C (14 to 122°F)

Table 2-3 Resolution of frequency setting

Type of setting	Resolution	Remarks
Analog setting	1/3000 of Maximum frequency	
KEYPAD panel setting	0.01Hz at 99.99Hz or lower 0.1Hz at 100.0Hz or higher	
LINK setting	1/20000 of Maximum frequency or 0.01Hz (Fixed)	Either one can be selected.

2. KEYPAD panel

LED monitor
In operation mode:
Displays the setting frequency, output current, voltage, motor speed, or line speed.
In trip mode:
Displays code indicating the cause of trip.

Up/Down keys
In operation mode :
Increases or decreases the frequency or speed.
In program mode :
Increases or decreases function code number and data set value.

Program key
Switches the display to a menu screen or to the initial screen for operation mode or alarm mode.

Shift key (Column shift)
In program mode :
Moves the cursor horizontally at data change. Pressing this key with the UP or DOWN key, the screen changes to the next function block.

Reset key
In program mode :
Cancels the current input data and shifts the screen.
In trip mode :
Releases the trip-stop state.

LCD monitor
In operation mode :
Displays various items of information such as operation condition and function data.
Operation guidance, which can be scrolled, is displayed at the bottom.
In program mode :
Displays functions and data.

Unit indication
Displays the unit for the information shown on the LED monitor.

FWD/REV keys
In operation mode :
Starts the inverter with forward or reverse operation command.
Pressing the FWD or REV key lights the RUN lamp.
Invalid when the function code F02 (Operation method) is set at 1 (External signal operation).

Stop key
In operation mode :
Stops the inverter.
Invalid when the function code F02 (Operation method) is set at 1 (External signal operation).

Function/Data Select key
In operation mode :
Changes the displayed values of LED monitor.
In program mode :
Selects the function code or stores the data.

■ KEYPAD panel Operation

Perform the wiring shown in the Basic wiring diagram in Section 3.2, Chapter 1. Turn on inverter power, and use the ∧ or ∨ key to set an output frequency. Press the FUNC DATA key, then press the FWD or REV key.
The inverter starts running using the factory setting function data.
Press the STOP key to stop the inverter.

• Procedure for selecting function codes and data codes

The following is a sample procedure for selecting a function code and changing the function data.

① Press the PRG key to switch the operation monitor screen to the program menu screen.

```
RUN                FWD
PRG →  PRG   MENU
F/D  →  LED   SHIFT
```

② Select "1. DATA SET" , and press the FUNC DATA key.

```
→   1. DATA SET
    2. DATA CHECK
    3. OPR MNTR
    4. I / O CHECK
```

③ Press the ∧ or ∨ key to select a target function code. To quickly scroll the function select screen, press SHIFT >> key and the ∧ or ∨ key at the same time. At the target function, press the FUNC DATA key.

```
F00   DATA PRTC
F01   FREQ CMD 1
F02   OPR METHOD
F03   MAX Hz-1
```

④ Use the ∧, ∨, and SHIFT >> keys to change the function data to the target value. (Use the SHIFT >> key to move the cursor when you want to enter a numerical value.)

```
F01   FREQ CMD 1

                    0
0 ~ 11
```

⑤ Press the FUNC DATA key to store the updated function data in memory. The screen shifts for the selection of the next function.

```
F02   OPR METHOD
F03   MAX Hz-1
F04   BASE Hz-1
F05   RATED V-1
```

⑥ Pressing the PRG key switches the screen to the operation monitor screen.

```
RUN                FWD
PRG →  PRG   MENU
F/D  →  LED   SHIFT
```

1) Setting a frequency

When the operation monitor screen is displayed, a frequency can be set by using the ∧ or ∨ key in both the operation and stop modes. When the target frequency is displayed, press the FUNC DATA key to enter the frequency in memory.

2) Switching a unit indication

During both operation and stop modes, each time the FUNC DATA key is pressed, the value displayed on the LED monitor changes, and the unit indication on the LCD monitor shifts from Hz to A, V, r/min, m/min, kW, and % in this order in accordance with the displayed value.

3. Function Explanation

• “⇨” means the related functions and the set value

3.1 Fundamental Functions

■ F00 Data protection

F00 DATA PRTC

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

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

[Setting procedure]

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

1 → 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 command 1

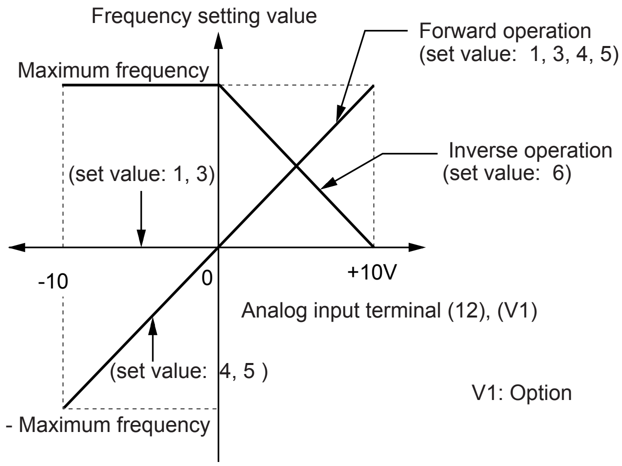
F01 FREQ CMD1

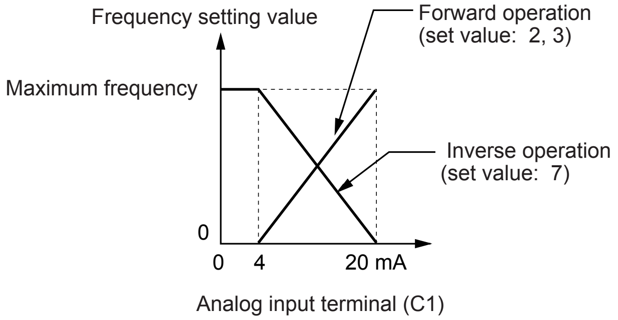
This function selects the frequency setting method.

⇨ E01 to E09

0: Setting by KEYPAD panel operation (∧, ∨ key).
1: Setting by voltage input (terminal 12) (0 to +10Vdc, 0 to 5Vdc).
2: Setting by current input (terminal C1) (4 to 20mAdc).
3: Setting by voltage input + current input (terminal 12 + terminal C1) (0 to +10V + 4 to 20mA).
The setting frequency is determined by adding inputs to terminals 12 and C1.
4: Reversible operation with polarized voltage input (terminal 12). (-10 to +10Vdc)
5: Reversible operation with polarized voltage input (terminal 12) + voltage command auxiliary input (optional terminal V1) (-10 to +10Vdc)
The setting frequency is determined by adding inputs to terminals 12 and V1.
* Polarized input allows operation in the direction opposite that of an operation command.
6: Inverse mode operation (terminal 12) (+10 to 0Vdc)
7: Inverse mode operation (terminal C1) (20 to 4mA)
8: Setting by UP/DOWN control mode 1 (initial value = 0) (terminals UP and DOWN)
⇨ E01 to E09
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.
10: Setting by PATTERN operation
⇨ C21 to C28
11: Setting by DI option or Pulse train input (Option)
For details, see the instruction manual on options.

• Forward and inverse operation





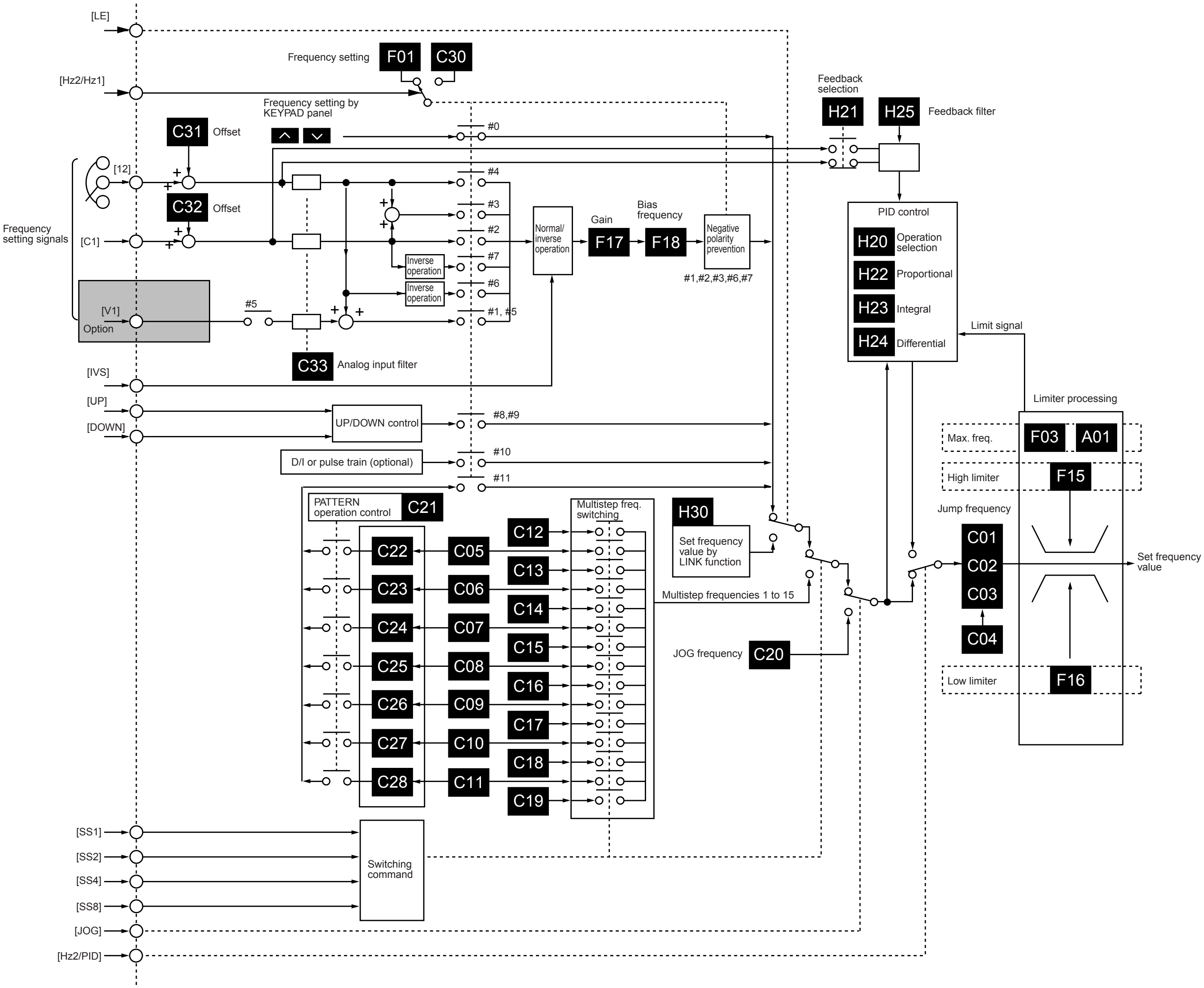
■ F02 Operation method

F02 OPR METHOD

This function sets the operation command input method.

- Set value 0: KEYPAD operation (FWD, REV, and STOP keys).
  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.



Frequency setting block diagram

■ F03 Maximum frequency 1

F03 MAX Hz-1

This function sets the maximum output frequency for motor 1.

- Setting range G11S: 50 to 400Hz
  P11S: 50 to 120Hz

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

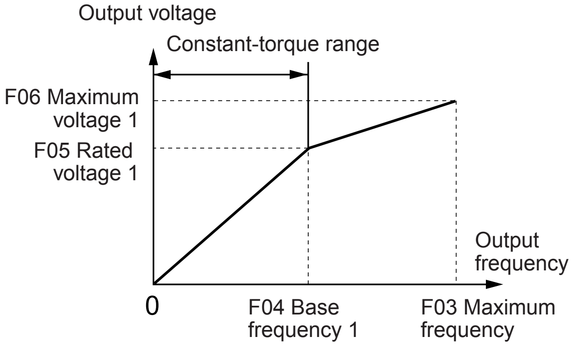
■ F04 Base frequency 1

F04 BASE Hz-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 this value with he rating of the motor.

- Setting range G11S: 25 to 400Hz
  P11S: 25 to 120Hz

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

F05 RATED V-1

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

- Setting range 230V: 0, 80 to 240V
  460V: 0, 320 to 480V

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 voltage 1

F06 MAX V-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.

- Setting range 230V: 80 to 240V
  460V: 320 to 480V

■ F07 Acceleration time 1
■ F08 Deceleration time 1

F07 ACC TIME1

F08 DEC TIME1

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.

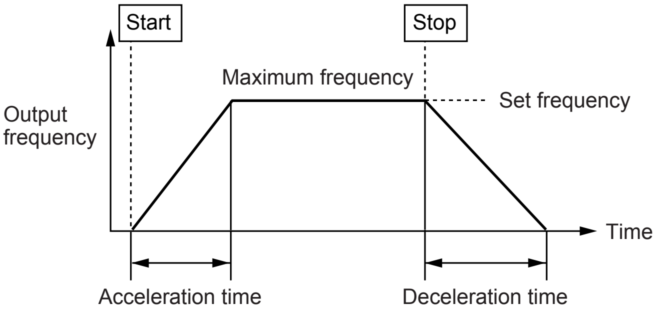
- Setting range Acceleration time 1: 0.01 to 3600s
  Deceleration time 1: 0.01 to 3600s

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

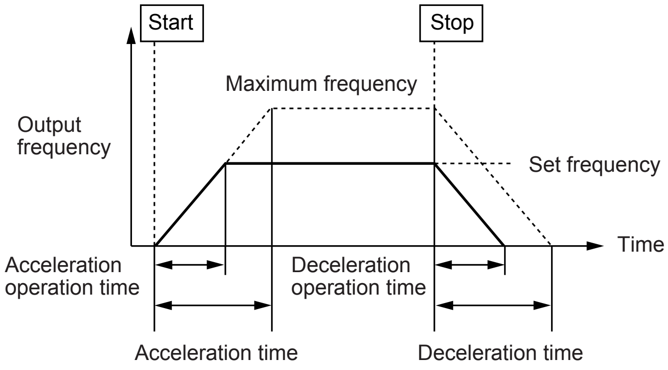
The actual operation time matches the set value.



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 is activated, thereby prolonging the operation time beyond that stated above.

■ F09 Torque boost 1

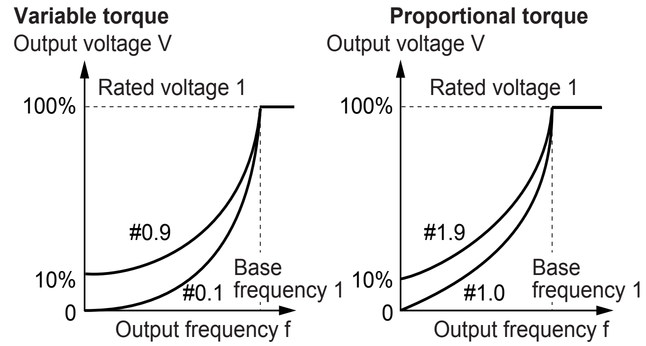
F09 TRQ BOOST1

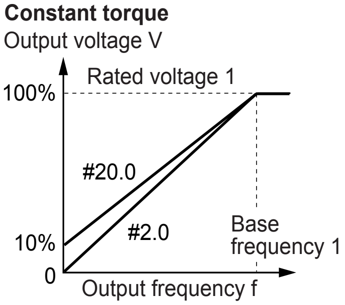
This is a motor 1 function. The following can be selected:

- Selection of load characteristics such as automatic torque boost, variable 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	Variable torque characteristics for fan and pump loads
1.0 to 1.9	Proportional torque for middle class loads between variable torque and constant torque (linear change)
2.0 to 20.0	Constant torque (linear change)

Torque characteristics





NOTE:
As a large torque boost value creates over-excitation 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 (Level)
■ F12 Electronic thermal O/L relay (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).

F10 ELCTRN OL1

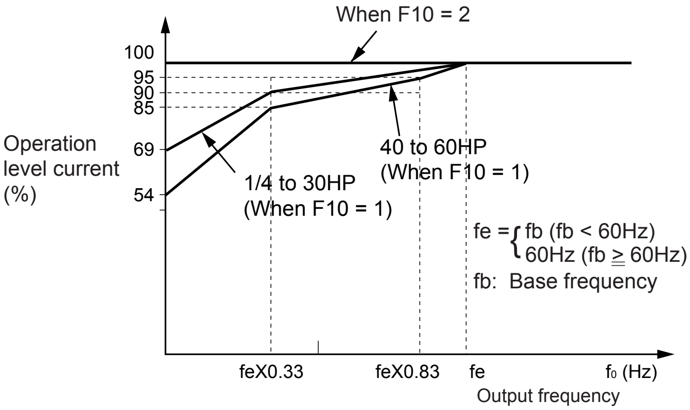
This function specifies whether to operate the electronic thermal O/L relay and selects the target motor. When a standard motor is selected, the operation level is lowered in the low speed range according to the cooling characteristics of the motor.

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

F11 OL LEVEL1

This function sets the operation level (current value) of the electronic thermal. Enter a value from 1 to 1.1 times the current rating value of the motor.
The setting range is 20 to 135% of the rated current of the inverter.

Operation level current and output current

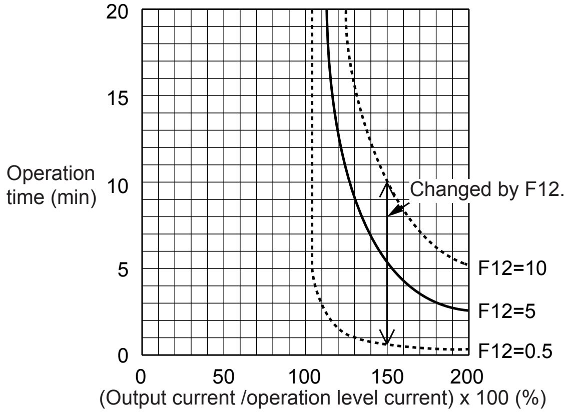


F12 TIME CNST 1

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

- Setting range : 0.5 to 75.0 min (in 0.1 min steps)

Current-operation time characteristics example



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

F13 DBR OL

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

Inverter capacity	Operation
G11S: 10HP or less	0: Inactive 1: Active (built-in braking resistor) 2: Active (external braking resistor)
P11S: 15HP or less	0: Inactive 2: Active (external braking resistor)
G11S: 15HP or more P11S: 20HP or more	0: Inactive

■ F14 Restart mode after momentary power failure (Select)

F14 RESTART

This function selects operation if 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.

- Setting range: 0 to 5

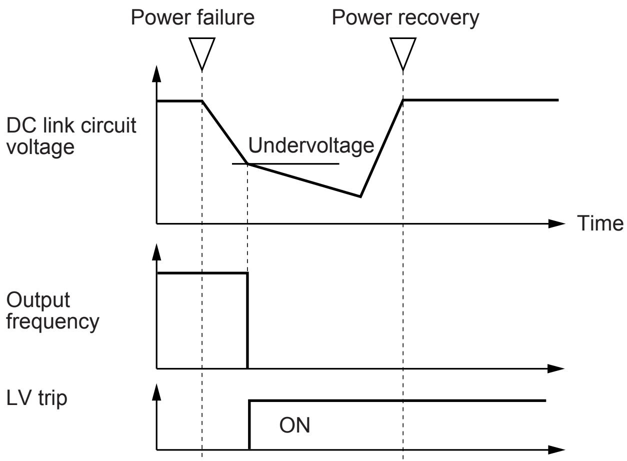
The following table lists the function details.

Operation after momentary power failure

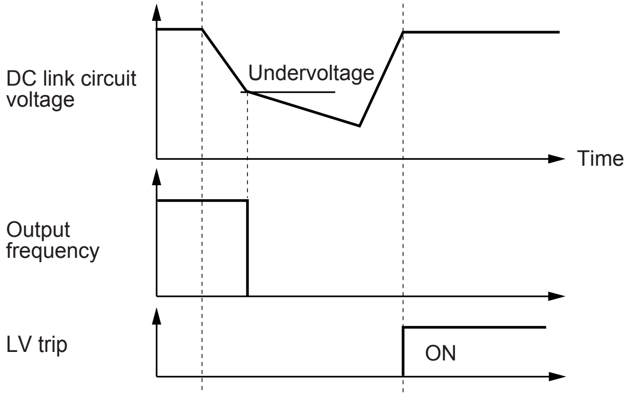
Set value G11S/P11S	Function name	Operation at power failure	Operation at power recovery	
0	Inactive (immediate inverter trip)	If undervoltage is detected, the protective function is activated and output stops.	Inverter is not restarted.	Inputting the protective function reset command and operation command restarts operation.
1	Inactive (inverter trip at recovery)	If undervoltage is detected, the protective function is not activated, but output stops.	The protective function is activated, but operation is not restarted.	
2	Inactive (inverter trip after deceleration to a stop at powerfailure)	When the operation continuation level (H15) is reached, deceleration to a stop occurs. The DC voltage of the main circuit sharpens the deceleration slope so that the undervoltage protective function is not activated. The inverter collects the inertia energy of the load and control the motor until it stops, then the undervoltage protective function is activated. If the amount of inertia energy from the load is small, and the undervoltage level is achieved during deceleration, the undervoltage protective function is then activated.	The protective function is activated, and operation is not restarted.	
3	Active (operation continued, for high-inertia loads)	When the operation continuation level is achieved, energy is collected from the inertia amount of the load to extend the operation continuation time. If undervoltage is detected, the protective function is not activated, but output stops.	Operation is automatically restarted. For power recovery during operation continuation, rotation accelerates directly to the original frequency. If undervoltage is detected, operation automatically restarts with the frequency at that time.	
4	Active (restart with the frequency at power failure)	If undervoltage is detected, the protective function is not activated and output stops.	Operation is automatically restarted with the frequency at power failure.	
5	Active (restart with the starting frequency, for low-inertia loads)	If undervoltage is detected, the protective function is not activated and 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 rotating motor 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 pick-up 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 120Hz. If the detected speed is outside this range, restart the motor using the regular restart function.

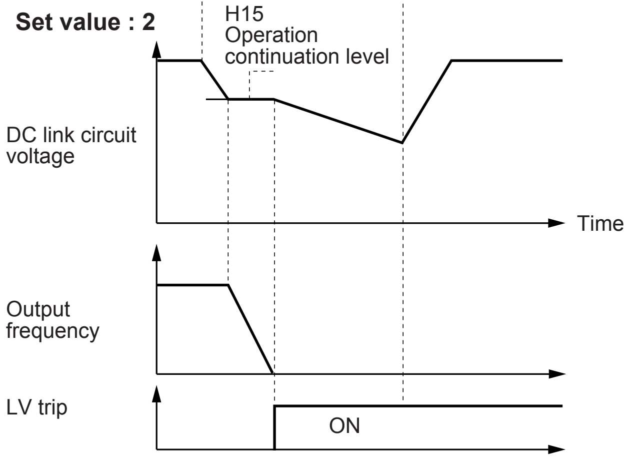
Set value : 0



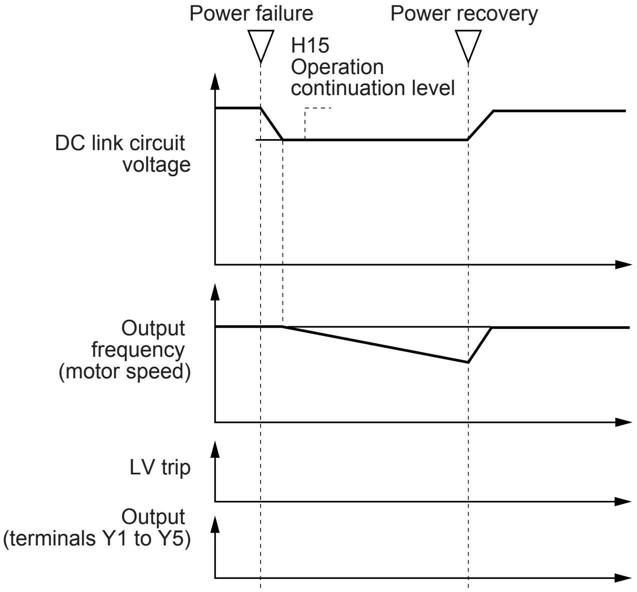
Set value : 1



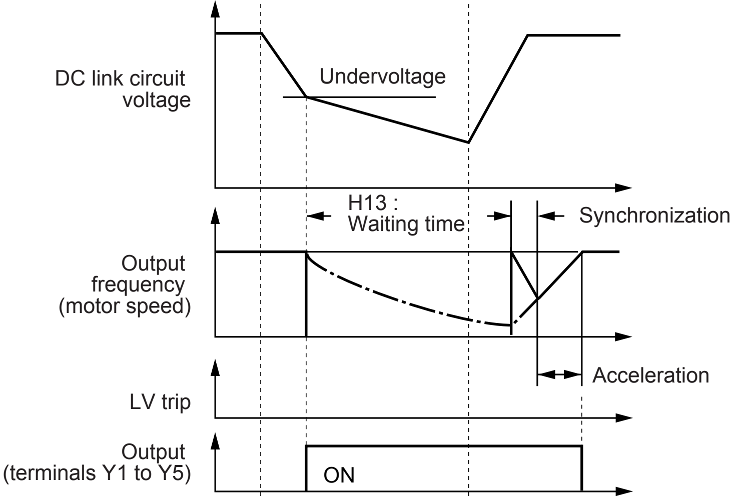
Set value : 2



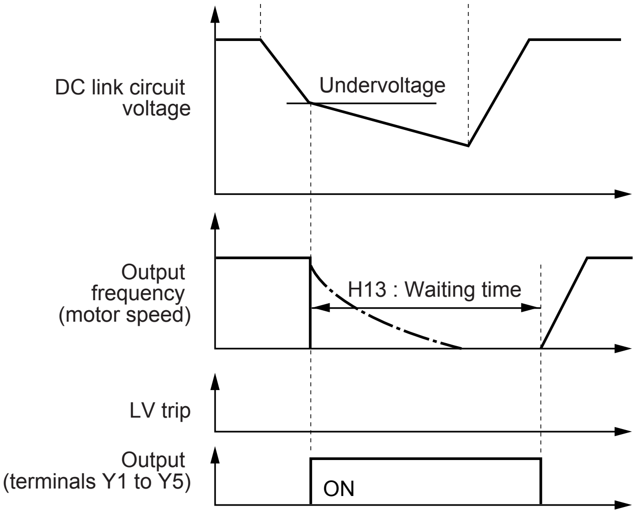
Set value : 3



Set value : 4



Set value : 5



NOTE : Dotted-dashed lines indicate motor speed.

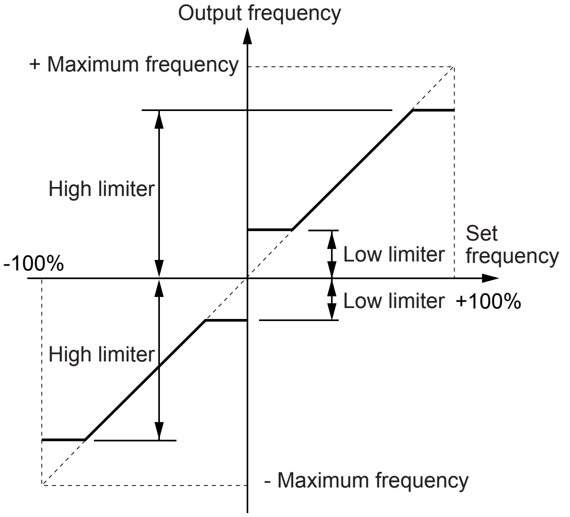
■ F15 Frequency limiter (High)
■ F16 Frequency limiter (Low)

F15 H LIMITER

F16 L LIMITER

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

- Set values: G11S: 0 to 400Hz
  P11S: 0 to 120Hz



* The inverter output starts with the starting frequency when operation begins, and stops with the stop frequency when operation ends.

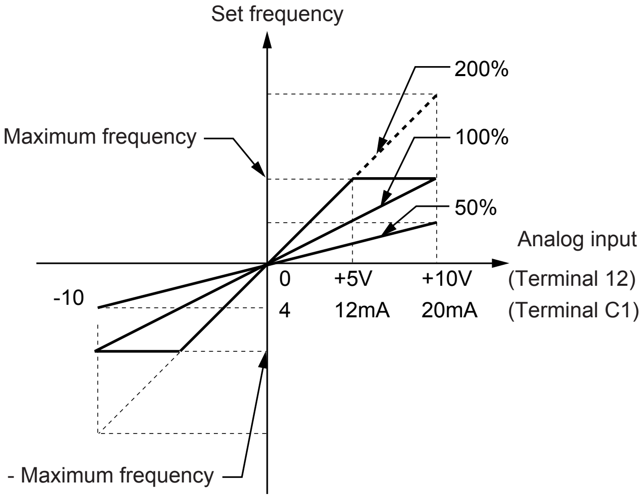
* If the upper limit value is less than the lower limit value, the upper limit value overrides the lower limit value.

■ F17 Gain (for frequency setting signal)

F17 FREQ GAIN

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

Operation follows the figure below.



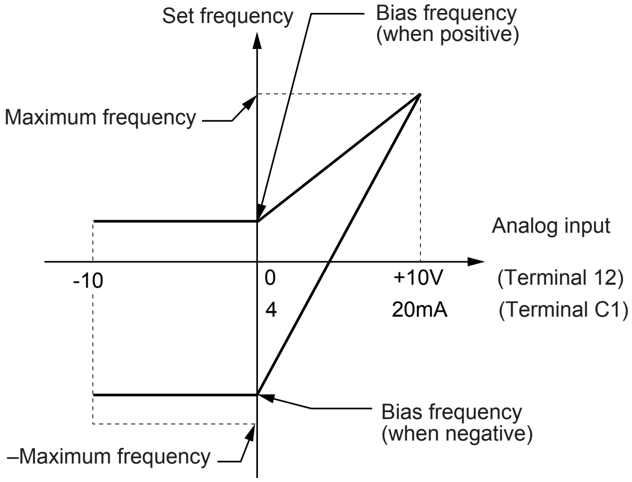
■ F18 Bias frequency

F18 FREQ BIAS

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

The operation follows the figure below.

When the bias frequency is higher than the maximum frequency or lower than the – (minus) maximum frequency, it is limited to the maximum or –maximum frequency.



■ F20 DC brake (Starting freq.)
■ F21 DC brake (Braking level)
■ F22 DC brake (Braking time)

F20 DC BRK Hz

Starting frequency: This function sets the frequency at which DC injection brake starts operation during deceleration, to decelerate the motor to a stop.

- Set values: 0.0 to 60.0Hz

F21 DC BRK LVL

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

- Set values: G11S: 0 to 100%
  P11S: 0 to 80%

F22 DC BRK t

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

- Set value 0.0: Inactive
  0.1 to 30.0s

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

■ F23 Starting frequency (Freq.)
■ 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.

F23 START Hz

Frequency: This function sets the frequency at startup.
- Set values: 0.1 to 60.0Hz

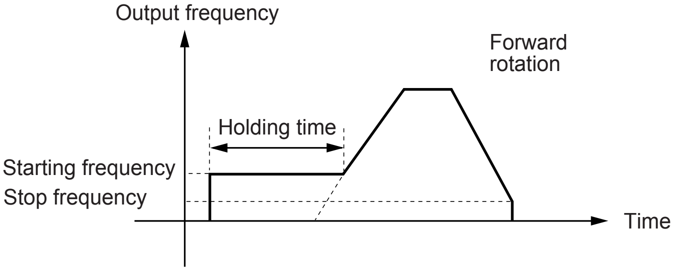
F24 HOLDING t

Holding time: This function sets the holding time during which the start frequency is sustained at startup.
- Set values: 0.1 to 10.0s

* 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.

F25 STOP Hz

This function sets the frequency at stop.
- Set values: 0.1 to 6.0Hz



The operation does not start when the starting frequency is less than the stop frequency or when the setting frequency is less than the stop frequency.

■ F26 Motor sound (Carrier freq.)

F26 MTR SOUND

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

Series	Nominal applied motor	Setting range
G11S	75HP or less	0.75 to 15kHz
	100HP or more	0.75 to 10kHz
P11S	30HP or less	0.75 to 15kHz
	40 to 100HP	0.75 to 10kHz
	125HP or more	0.75 to 6kHz

Carrier frequency	Low	High
Motor sound	High	Low
Output current waveform	Bad	Good
Leakage current	Small	Large
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 0.75kHz, reduce the motor torque by about 15%.
2. Increasing the set value increases inverter loss and raises inverter temperature.

■ F27 Motor sound (Sound tone)

F27 MTR TONE

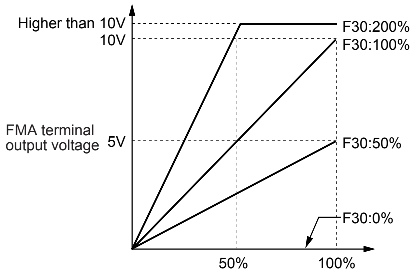
The tone of motor sound can be altered when the carrier frequency is 7kHz or lower. Use this function as required.
- Set values: 0, 1, 2, 3

■ 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.

F30 FMA V-ADJ

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.
- Set values: 0 to 200%



F31 FMA FUNC

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

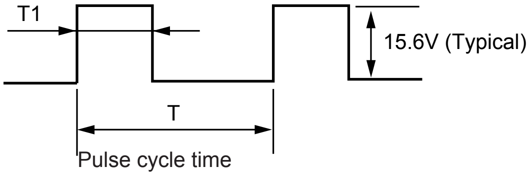
Set value	Monitor item	Definition of 100% monitor amount
0	Output frequency 1	Maximum output frequency (before slip compensation)
1	Output frequency 2	Maximum output frequency (after slip compensation)
2	Output current	Rated output current of inverter x 2
3	Output voltage	Maximum output voltage of inverter (230V: 250V, 460V: 500V)
4	Output torque	Rated torque of motor x 2
5	Load factor	Rated load of motor x 2
6	Input power	Rated output of inverter x 2
7	PID feedback value	Feedback value of 100%
8	PG feedback value	Synchronous speed at maximum frequency (only when option is installed)
9	DC link circuit voltage	230V: 500V 460V: 1000V
10	Universal AO	0 to 10V

■ F33 FMP terminal (Pulse rate)
■ F34 FMP terminal (Voltage adjust)
■ F35 FMP terminal (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).

F33 FMP PULSES

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



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

F34 FMP V-ADJ

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

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 2670 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.)

F35 FMP FUNC

This function selects the monitor item to be output to terminal FMP.
The set value and monitor items are the same as those of F31.

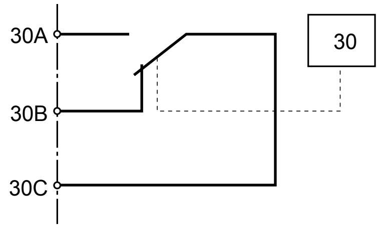
■ F36 30Ry operation mode

F36 30RY MODE

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

Set value	Operation	
0	Normal mode Trip mode	30A-30C : OFF, 30B-30C : ON 30A-30C : ON, 30B-30C : OFF
1	Normal mode Trip mode	30A-30C : ON, 30B-30C : OFF 30A-30C : OFF, 30B-30C : ON

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



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

F40 DRV TRQ 1

F41 BRK TRQ 1

- 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.

Function	Set value	Operation
Torque limit (Driving)	G11S: 20% to 200% P11S : 20% to 150%	The torque is limited to the set value.
	999	Torque limiting inactive
Torque limit (Braking)	G11S: 20% to 200% P11S : 20% to 150%	The torque is limited to the set value.
	0	Automatically prevents OU trip due to power regeneration effect.
	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

F42 TRQVECTOR1

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.

Set value	Operation
0	Inactive
1	Active

⇨ 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 boost).
2. "P09 Slip compensation control 1"
   Slip compensation is automatically activated.
   When 0.0 is set, the amount of slip compensation for the FUJI 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 ("P03 Rated current", "P06 No-load current", "P07 %R1 setting", and "P08 %X setting) of motor 1 must be correct.
   When the FUJI standard 3-phase motor is used, setting the capacity (function P02) ensures entry of the above data. A tuning operation should be performed for other motors.
3. 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).
4. To prevent leakage current and ensure accurate control, the length of the cable between the inverter and motor should not exceed 164ft (50m).
5. When a reactor is connected between the inverter and the motor, or the impedance of the wiring cannot be disregarded, use "P04 Tuning" to rewrite data.

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

3.2 Extension Terminal Functions

■ E01 X1 terminal function to ■ E09 X9 terminal function

E01	**X1 FUNC**
E02	**X2 FUNC**
E03	**X3 FUNC**
E04	**X4 FUNC**
E05	**X5 FUNC**
E06	**X6 FUNC**
E07	**X7 FUNC**
E08	**X8 FUNC**
E09	**X9 FUNC**

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

Set value	Function
0, 1, 2, 3	Multistep frequency selection (1 to 15 steps)
4, 5	Acceleration and deceleration time selection (3 steps)
6	3-wire operation stop command [HLD]
7	Coast-to-stop command [BX]
8	Alarm reset [RST]
9	Trip command (External fault) [THR]
10	Jogging operation [JOG)
11	Freq. set 2/Freq. set 1 [Hz2/Hz1]
12	Motor 2/motor 1 [M2/M1]
13	DC brake command [DCBRK]
14	Torque limiter 2/Torque limiter 1 [TL2/TL1]
15	Switching operation between line and inverter (50Hz) [SW50]
16	Switching operation between line and inverter (60Hz) [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 for 52-2 [IL]
23	Torque control cancel [Hz/TRQ]
24	Link enable (RS-485: standard, Bus: option) [LE]
25	Universal DI [U-DI]
26	Pick up start mode [STM]
27	SY-PG enable [PG/Hz]
28	Synchronization command [SYC]
29	Zero speed command [ZERO]
30	Forced stop command [STOP1]
31	Forced stop command with Deceleration time 4 [STOP2]
32	Pre-exciting command [EXITE]

NOTE:
Data numbers which are not set in the functions from E01 to E09 or E05, are assumed to be inactive.

Multistep frequency selection : 0, 1, 2, 3

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.

Multistep frequency selection

Combination of set value input signals				Frequency selected	
3 (SS8)	2 (SS4)	1 (SS2)	0 (SS1)		
off	off	off	on	C05 Multistep Hz1	⇨ C05 to C19 Setting range G11S: 0.00 to 400.00Hz P11S: 0.00 to 120.00Hz
off	off	on	off	C06 Multistep Hz2	
off	off	on	on	C07 Multistep Hz3	
off	on	off	off	C08 Multistep Hz4	
off	on	off	on	C09 Multistep Hz5	
off	on	on	off	C10 Multistep Hz6	
off	on	on	on	C11 Multistep Hz7	
on	off	off	off	C12 Multistep Hz8	
on	off	off	on	C13 Multistep Hz9	
on	off	on	off	C14 Multistep Hz10	
on	off	on	on	C15 Multistep Hz11	
on	on	off	off	C16 Multistep Hz12	
on	on	off	on	C17 Multistep Hz13	
on	on	on	off	C18 Multistep Hz14	
on	on	on	on	C19 Multistep Hz15	

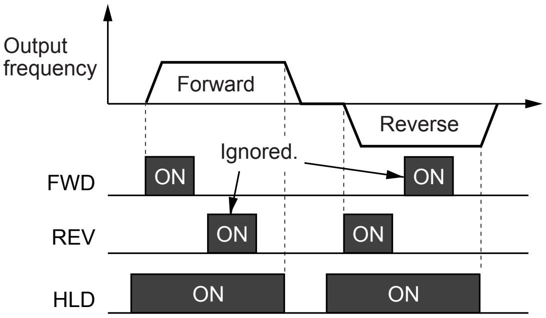
Acceleration and deceleration time selection :4,5

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	
5 (RT2)	4 (RT1)		
off	off	F07 Acceleration time 1 F08 Deceleration time 1	⇨ F07, F08 E10 to E15
off	on	E10 Acceleration time 2 E11 Deceleration time 2	
on	off	E12 Acceleration time 3 E13 Deceleration time 3	Setting range 0.01 to 3600s
on	on	E14 Acceleration time 4 E15 Deceleration time 4	

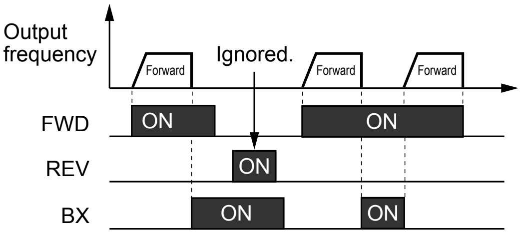
Three-wire operation stop command [HLD] : 6

This function 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 value **"6"** to the target digital input terminal.



Coast-to-stop command [BX] : 7

When BX and CM 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 CM are disconnected when the operation command (FWD or REV) is on, operation starts at the starting frequency. To use this BX terminal function, assign value **"7"** to the target digital input terminal.



Alarm reset [RST] : 8

When an inverter trip occurs, connecting RST and CM clears the alarm output (for any fault) ; disconnecting them clears trip indication and restarts operation. To use this RST terminal function, assign value **"8"** to the target digital input terminal.

Trip command (External fault) [THR] : 9

Disconnecting THR and CM 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.

Jogging operation [JOG] : 10

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

Freq. set 2/Freq. set 1 : 11

This function switches the frequency setting method set in function codes F01 and C30 by an external digital input signal.

Set value input signal 11	Frequency setting method selected
off	F01 Frequency command 1
on	C30 Frequency command 2

Motor 2/motor 1 : 12

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.

⇨ A01 to A19

Set value input signal 12	Motor selected
off	Motor 1
on	Motor 2

DC brake command : 13

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 or when both terminals FWD and REV go on or off at external signal 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.

Note that operation restarts when the operation command goes on.

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

Torque limiter 2/Torque limiter 1 : 14

This function switches the torque limit value set in function codes F40 and F41, and E16 and E17 by an external digital input signal.

⇨ F40, F41, E16, E17

Set value input signal 14	Torque limit value selected	
off	F40 DRV TRQ 1 F41 BRK TRQ 1	Setting range DRV: 20 to 200%, 999 BRK: 0, 20 to 200%, 999
on	E16 DRV TRQ 2 E17 BRK TRQ 2	

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

Motor operation can be switched from 50Hz 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	From inverter operation to line operation (50Hz)
on → off	From line operation to inverter operation (50Hz)

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

Motor operation can be switched from 60Hz 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	From inverter operation to line operation (60Hz)
on → off	From line operation to inverter operation (60Hz)

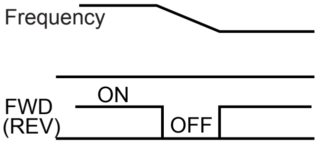
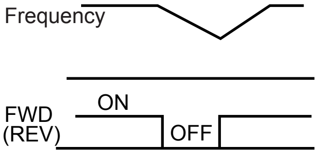
When the digital input signal goes off, 50 or 60 Hz is output according to the set value input signal after the restart waiting time following a momentary power failure (function code H13). The motor is then directed to inverter operation.

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

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 command (F01 or C30).

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

Write enable for KEYPAD (data change permission) [WE-KP] : 19

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 selected
19	
off	Data protected
on	Data change enable

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.

PID control cancel [Hz/PID] : 20

The PID control can be disabled by an external digital input signal.

⇨ H20 to H25

Set value input signal	Function selected
20	
off	Enable PID control.
on	Disable PID control (frequency setting from KEYPAD panel).

Inverse mode changeover [IVS] : 21

The analog input (terminals 12 and C1) can be switched between normal and inverse operations by an external digital input signal.

⇨ F01

Set value input signal	Function selected
21	
off	Normal mode setting → Normal operation Inverse mode setting → Inverse operation
on	Normal mode setting → Inverse operation Inverse mode setting → Normal operation

Interlock signal 52-2 [IL] : 22

When a magnetic 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 by digital input
on	Momentary power failure detection by digital input

Torque control cancel [Hz/TRQ] : 23

When function code "H18 Torque control" 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 active and inactive in this input signal state.

⇨ H18

Set value input signal	Function selected
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).

Link enable (RS-485: standard, Bus: option) [LE] : 24

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 Serial link". Assign value **"24"** to the target digital input terminal and switch between valid or invalid in this input signal state.

⇨ H30

Set value input signal	Function selected
24	
off	Link command invalid.
on	Link command valid

Universal DI [U-DI] : 25

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 RS-485 or optional BUS.
This input terminal is only used to check for an incoming input signal through communication and does not affect inverter operation.

Pick up start mode [STM] : 26

The start mode (rotating motor pick-up) 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.

⇨ H09

Set value input signal	Function selected
26	
off	Start mode disabled.
on	Start mode enabled.

SY-PG enable (Option) [PG/Hz] : 27

Synchronization command (Option) [SYC] : 28

Zero speed command with PG option [ZERO] : 29

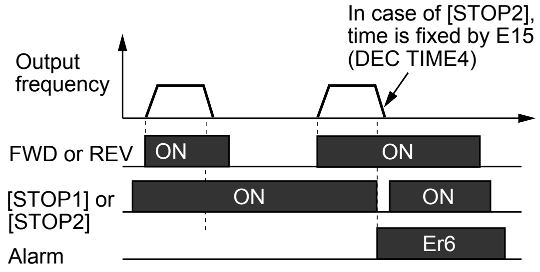
Pre-exciting command with PG option [EXITE] : 32

These functions are used for PG-Option or SY-Option card. Refor to each instruction manual.

Forced stop command with Deceleration [STOP1] : 30

Forced stop command with Deceleration time 4 [STOP2] :31

Normally this terminal should be "ON", when this terminal goes off durring motor running, the motor decelerates to stop, and outputs alarm "Er6".
In case of terminal [STOP2], the decelertion 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 freq. selection [SS1]
Terminal X2	1	Multistep freq. selection [SS2]
Terminal X3	2	Multistep freq. selection [SS4]
Terminal X4	3	Multistep freq. selection [SS8]
Terminal X5	4	ACC/DEC selection [RT1]
Terminal X6	5	ACC/DEC 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

E10 ACC TIME2

E11 DEC TIME2

E12 ACC TIME3

E13 DEC TIME3

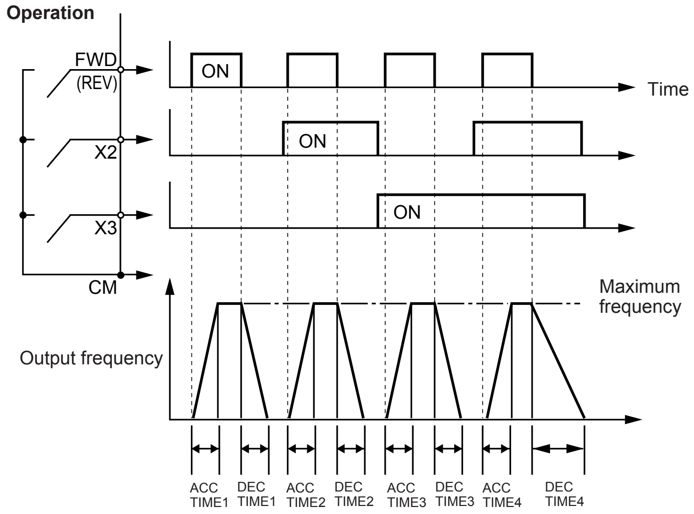
E14 ACC TIME4

E15 DEC TIME4

⇨ E01 to E09 : 4, 5

- Three other types of acceleration and deceleration time can be selected as well as Acceleration time 1 (F07) and deceleration time 1 (F08).
- 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.

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



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

E16 DRV TRQ 2

E17 BRK TRQ 2

- 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 limiter 2/Torque limiter 1 (value 14) in E01 to E09.

⇨ E01 to E09 : 14

■ E20 Y1 terminal function
to
■ E24 Y5A, Y5C terminal function

E20 Y1 FUNC

E21 Y2 FUNC

E22 Y3 FUNC

E23 Y4 FUNC

E24 Y5 FUNC

- Some control and monitor signals can be selected and output from terminals. Terminals Y1 to Y4 use transistor output; terminals Y5A and Y5C use relay contacts for G11S/P11S.

Set value	Output signal
0	Inverter running [RUN]
1	Frequency equivalence signal [FAR]
2	Frequency level detection [FDT1] ([FDT] for E11S)
3	Undervoltage detection signal [LU]
4	Torque polarity [B/D]
5	Torque limiting [TL]
6	Auto-restarting (IPF)
7	Overload early warning [OL1] ([OL] for E11S)
8	KEYPAD operation mode [KP]
9	Inverter stopping [STP]
10	Ready output [RDY]
11	Line/Inverter changeover for 88 [SW88]
12	Line/Inverter changeover for 52-2 [SW52-2]
13	Line/Inverter changeover for 52-1 [SW52-1]
14	Motor 2 / Motor 1 [SWM2]
15	Auxiliary terminal (for 52-1) [AX]
16	PATTERN operation time-up signal [TU]
17	PATTERN operation cycle completion signal [TO]
18	PATTERN operation stage No. indication 1 [STG1]
19	PATTERN operation stage No. indication 2 [STG2]
20	PATTERN operation stage No. indication 4 [STG4]
21	Alarm indication 1 [AL1]
22	Alarm indication 2 [AL2]
23	Alarm indication 4 [AL4]
24	Alarm indication 8 [AL8]
25	Fan operation signal [FAN]
26	Auto-resetting [TRY]
27	Universal DO [U-DO] *
28	Overheat early warning [OH]
29	Synchronization completion signal [SY] *
30	–
31	2nd Freq. level detection [FDT2]
32	2nd OL level early warning [OL2]
33	Terminal C1 off signal
34	Speed exstence signal [DNZS]

NOTE:
For output signals marked *, refer to instruction manuals for RS-485 communication and the synchronized operation card.

Inverter running [RUN] : 0

“Running” means that the inverter is outputting a frequency. “RUN” signal is output when there is output speed (frequency). When the DC injection brake function is active, this signal is not output.

Frequency equivalence signal [FAR] : 1

See the explanation of function code “E30 FAR function signal (Hysteresis)”.

Frequency level detection [FDT1] : 2

See the explanation of function codes “E31 and E32 FDT1 function signal”.

Undervoltage detection signal [LU] : 3

If the undervoltage protective function activates, i.e. when the DC link circuit 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 230V: 200V DC or less
460V: 400V DC or less

Torque polarity [B/D] : 4

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.

Torque limiting [TL] : 5

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 being limited or power regeneration is prevented.

Auto-restarting [IPF] : 6

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 0Hz 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 occurrence.

Overload early warning [OL1] : 7

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 OL1 function signal (Mode select)”, and “E34 OL1 function signal (Level).”
NOTE: This function is effective for motor 1 only.

KEYPAD operation mode [KP] : 8

An ON signal is output when operation command keys (FWD, REV, and STOP keys) on the KEYPAD panel can be used (i.e., 0 set in “F02 Operation method”) to issue operation and stop commands.

Inverter stopping [STP] : 9

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.

Ready output [RDY] : 10

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.

Line/Inverter changeover [SW88] [SW52-2][SW52-1] : 11, 12, 13

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 FRENIC5000G11S/P11S 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.

Motor 2 / Motor 1 [SWM2] : 14

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.

Auxiliary terminal (for 52-1) [AX] : 15

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.

PATTERN operation time-up signal [TU] : 16

When the pattern operation stage changes, this function outputs a one-shot (100ms) ON signal to report a stage change.

PATTERN operation cycle completion signal [TO] : 17

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

PATTERN operation stage No. indication [STG1] [STG2] [STG4] : 18, 19 20

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.

Alarm indication [AL1] [AL2] [AL4] [AL8] : 21 to 24

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, input phase loss	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
RS-485 communication error	on	off	on	on
Overspeed, PG disconnection	off	on	on	on

In normal operation, terminals do not output a signal.

Fan operation signal [FAN] : 25

When used with “H06 Fan stop operation,” this function outputs a signal while the cooling fan is operating.

Auto-resetting [TRY] : 26

When a value of 1 or larger is set to “H04 Auto-reset,” the signal is output while retry operation is activating when the inverter protective function is activated.

Universal DO [U-DO] : 27

Assigning value “27” to a transistor output terminal renders the terminal a universal DO terminal.
This function enables ON/OFF through the RS-485 and BUS option.
This function serves only to turn on and off the transistor output through communication and is not related to inverter operation.

Overheat early warning [OH] : 28

This function outputs an early warning signal when heat sink temperature is (overheat detection level - 10°C (50°F)) or higher.

Synchronization completion signal [SY] : 29

Outputs ON signal when syncoronization is completed. (only when an optional Synchronized Operation Card is used)

2nd Freq. level detection [FDT2] : 31

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

2nd OL level early warning [OL2] : 32

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

Terminal C1 off signal [C1OFF] : 33

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

Speed existence signal [DNZS] : 34

This function output an ON signal when the motor speed is detected. Only when using an optional card, OPC-G11S-PG/PG2 or OPC-G11S-SY.

Settings when shipped from the factory

Digital output	Factory setting	
	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	15	Auxiliary terminal (for 52-1) [AX]

■ E25 Y5 RY operation mode

E25 Y5RY MODE

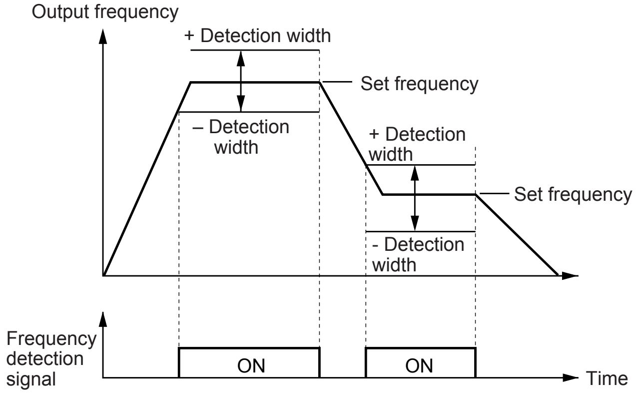
This function adetermaines the operation mode of Y5 relay.
- Set value 0: Inactive (Y5 relay excites at “ON signal” mode)
1: Active (Y5 relay excites at “OFF signal” mode)

■ E30 FAR function signal (Hysteresis)

E30 FAR HYSTR

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.
- E30 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.

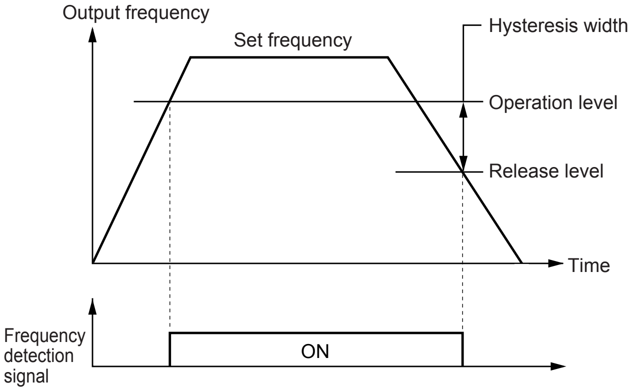


■ E31 FDT1 function signal (Level)
■ E32 FDT1 function signal (Hysteresis)

E31 FDT1 LEVEL

E32 FDT HYSTR

This function determines the operation (detection) level of the output frequency and hysteresis width for its operation release. When the output frequency exceeds the set operation level, an ON signal can be selected and output from terminals Y1 to Y5.
- Setting range Operation level : G11S: 0 to 400Hz
P11S: 0 to 120Hz
Hysteresis width : 0.0 to 30.0Hz



■ E33 OL1 function signal (Mode select)

E33 OL1 WARNING

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.
- 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)

E34 OL1 LEVEL

This function determines the operation level of the electronic thermal O/L relay or output current.
- Setting range G11S: 5 to 200% of inverter rated output current
  P11S: 5 to 150% of inverter rated output current

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

■ E35 OL1 function signal (Timer)

E35 OL TIMER

This function is used when 1 (output current) is set to “E33 OL1 function signal (Mode select).”
- Setting range: 0.0 to 60.0s

Set the time from when the operation level is attained until the overload early warning function is activated.

■ E36 FDT2 function (Level)

E36 FTD2 LEVEL

This function determines the operation (detection) level of the output frequency for motor 2, and operates the same as “E31 FDT1 function signal (Level)”.
For details, see the explanation for E31.

■ E37 OL2 function (Level)

E37 OL2 LEVEL

This function determines the operation level of the electronic thermal O/L relay, and operates the same as “E34 OL1 function signal (Level)”.
This overcurrent early warning can be output regardless of the setting of “E33 OL1 function signal (Mode select)” and “Motor 1 or 2”. For details, see the explanation for E34.

■ E40 Display coefficient A
■ E41 Display coefficient B

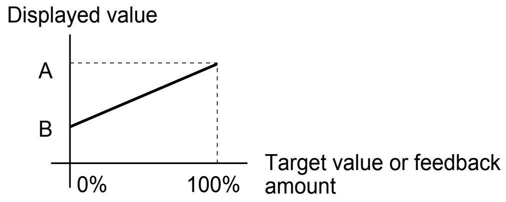
E40 COEF A

E41 COEF 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.
- 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 “E40 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

E42 DISPLAY FL

Among data in “E43 LED monitor (Function),” some data need not be displayed instantaneously when the data changes. For such data, a flickering suppression filter can be used.
- Setting range: 0.0 to 5.0 seconds

Monitored items in “E43 LED monitor (Function)”

Set value	Display item	Set value	Display item
3	Output current	8	Calculated torque value
4	Output voltage	9	Input power

■ E43 LED Monitor (Function)
■ E44 LED Monitor (Display at STOP mode)

E43 LED MNTR

E44 LED MNTR2

The data during inverter operation, during stopping, at frequency setting, and at PID setting is displayed on the LED monitor.

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.

NOTE:

Value set to E43	E44=0		E44=1	
	Stopping	Running	Stopping	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 shaft speed set value (r/min)	Load shaft speed (r/min)		
8	Calculated torque value (%)			
9	Input power (kW)			
10	PID reference value (Final value)			
11	PID reference value (remote)			
12	PID feedback amount			

For the values 10 to 12 set to E43, the data is displayed only when selected in "H20 PID control (Mode select)."

- **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 frequency value (Hz)
5	Synchronous speed set value (r/min)
6	Line speed set value (m/min.)
7	Load shaft speed set value (r/min)
8, 9	Set frequency value (Hz)
10, 11, 12	Set frequency value (Hz)

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

■ E45 LCD Monitor (Function)

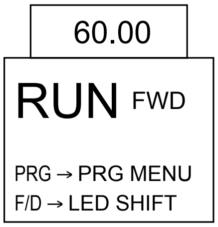
E45 LCD MNTR

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

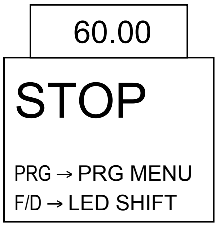
Set value	Display item
0	Operation status, rotating direction, operation guide
1	Output frequency (before slip compensation), output current, calculated torque value in bar graph

Set value: 0

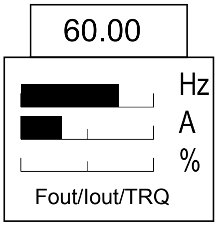
During running



When stopping



Set value: 1



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 Language

E46 LANGUAGE

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

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

■ E47 LCD monitor (Contrast)

E47 CONTRAST

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

Set value	0, 1, 2 .... 8, 9, 10
Screen	Soft ←——————→ Hard

3.3 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 0Hz.
- 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.

C01 JUMP Hz 1

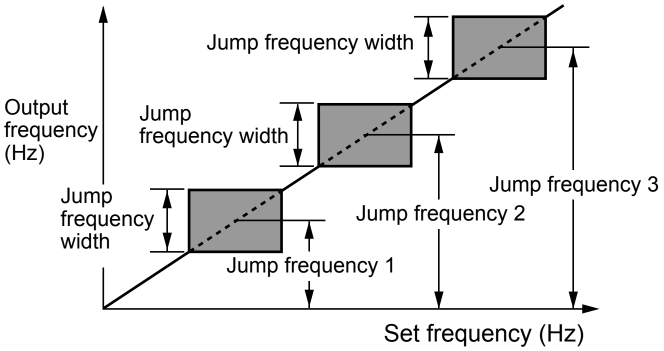
C02 JUMP Hz 2

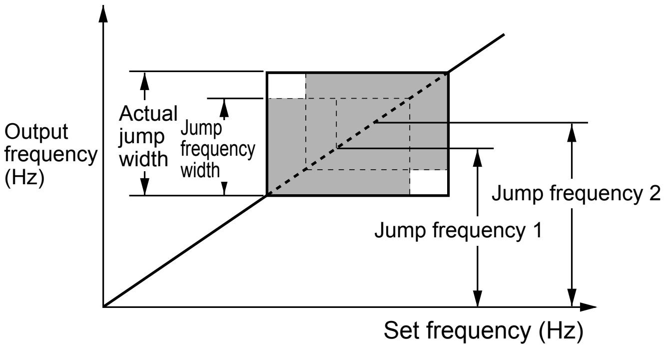
C03 JUMP Hz 3

- Set value G11S: 0 to 400Hz
P11S: 0 to 120Hz
In 1Hz steps (min.)

C04 JUMP HYSTR

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





■ C05 Multistep frequency setting 1
to
■ C19 Multistep frequency setting 15

C05 MULTI Hz-1

C06 MULTI Hz-2

C07 MULTI Hz-3

C08 MULTI Hz-4

C09 MULTI Hz-5

C10 MULTI Hz-6

C11 MULTI Hz-7

C12 MULTI Hz-8

C13 MULTI Hz-9

C14 MULTI Hz-10

C15 MULTI Hz-11

C16 MULTI Hz-12

C17 MULTI Hz-13

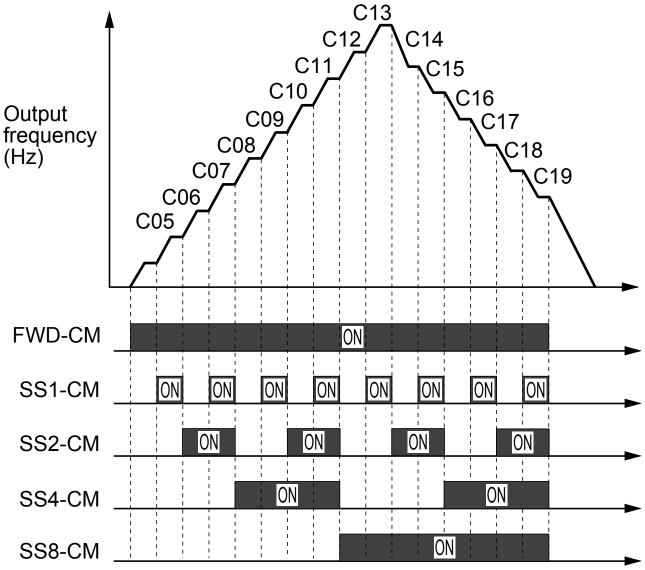
C18 MULTI Hz-14

C19 MULTI Hz-15

⇨ E01 to E09 : 0 to 3

- 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.

- Set value G11S: 0 to 400Hz
P11S: 0 to 120Hz
In 0.01Hz steps (min.)



■ C20 JOG frequency

C20 **JOG Hz**

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

- Setting range G11S: 0.00 to 400.00Hz
  P11S: 0.00 to 120.00Hz

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 X1 terminal function,” to “E09 X9 terminal function.”

■ C21 Pattern operation (Mode select)

C21 **PATTERN**

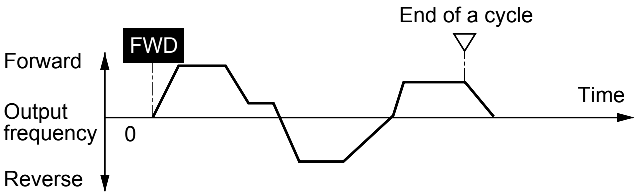
Pattern operation is an automatic operation according to preset operation time, direction of rotation, acceleration and deceleration time, and frequency.
When using this function, set 10 (pattern operation) at “F01 Frequency setting.”

⇨ F01, C30 : 10

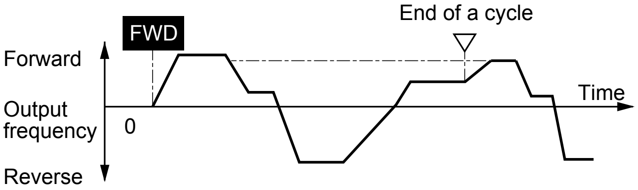
The following operation patterns can be selected:

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.

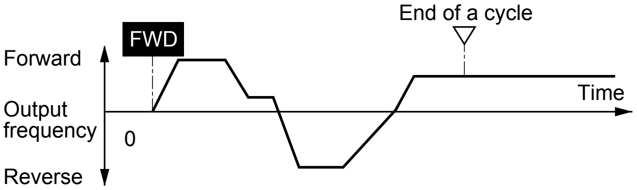
Set value : 0



Set value : 1



Set value : 2



■ C22 PATTERN operation (stage 1)
to
■ C28 PATTERN operation (stage 7)

C22 **STAGE 1**

C23 **STAGE 2**

C24 **STAGE 3**

C25 **STAGE 4**

C26 **STAGE 5**

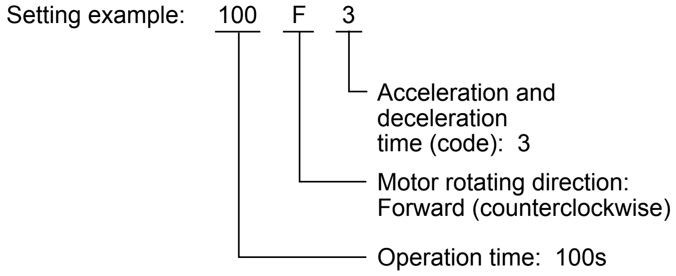
C27 **STAGE 6**

C28 **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, the rotating direction, and acceleration and deceleration time for each stage.

Set item	Setting range
Operation time	0.00 to 6000 s
Rotation direction	F: Forward (counterclockwise) R: Reverse (clockwise)
Acceleration and deceleration time	1: Accel. time 1 (F07), decel. time 1 (F08) 2: Accel. time 2 (E10), decel. time 2 (E11) 3: Accel. time 3 (E12), decel. time 3 (E13) 4: Accel. time 4 (E14), decel. 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.



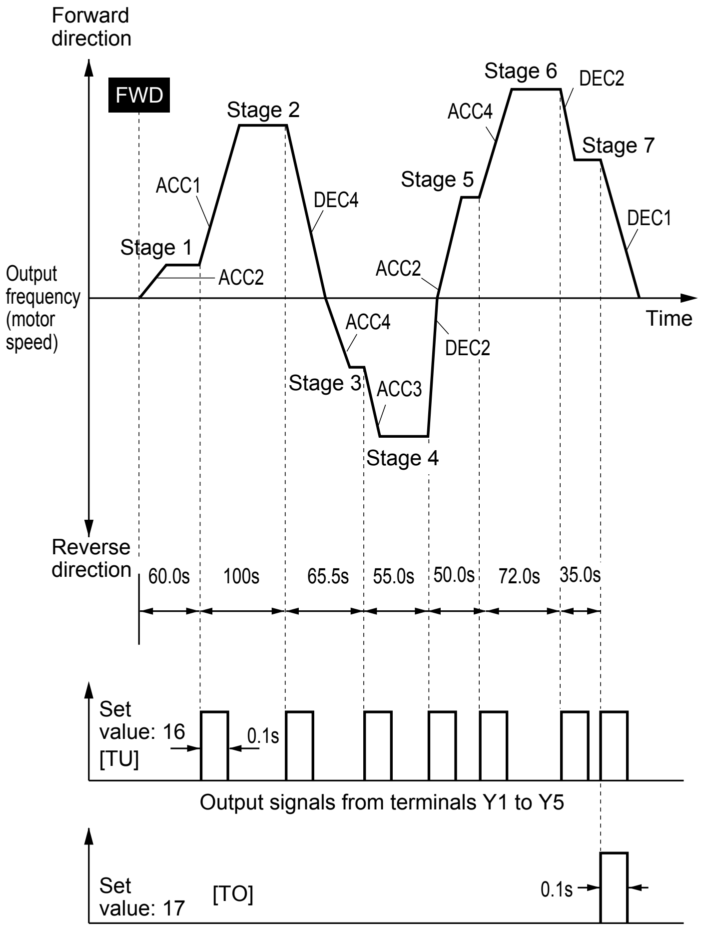
Set the operation time to 0.00 for stages not used, which are skipped in operation.
With regard to the set frequency value, the multistep frequency function is assigned as listed in the table below. Set frequencies to “C05 Multistep frequency setting (Freq. 1)”, to “C11 Multistep frequency setting (Freq.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

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

Pattern operation setting example

Function	Set value	Operation frequency to be set
C21 (Mode select)	1	–
C22 (stage 1)	60.0F2	Multistep frequency setting (Freq. 1)
C23 (stage 2)	100F1	Multistep frequency setting (Freq. 2)
C24 (stage 3)	65.5R4	Multistep frequency setting (Freq. 3)
C25 (stage 4)	55.0R3	Multistep frequency setting (Freq. 4)
C26 (stage 5)	50.0F2	Multistep frequency setting (Freq. 5)
C27 (stage 6)	72.0F4	Multistep frequency setting (Freq. 6)
C28 (stage 7)	35.0F2	Multistep frequency setting (Freq. 7)

The following diagram shows this pattern operation example.



Running and stopping are controlled by pressing the FWD and STOP keys or 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),” press the STOP key and press the RESET key.
If an alarm stop occurs, press the RESET key to release the protective function, then press the RESET key again.

NOTES:
- 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.
- 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

C30 FREQ CMD 2

⇨ E01 to E09 : 11; F01

This function selects the frequency setting method.

0: Setting by KEYPAD panel operation (∧, ∨ key).
1: Setting by voltage input (terminal 12) (0 to +10Vdc).
2: Setting by current input (terminal C1) (4 to 20 Adc).
3: Setting by voltage input + current input (terminal 12 + terminal C1) (0 to +10V + 4 to 20mA).
The setting frequency is determined by adding inputs to terminals 12 and C1.
4: Reversible operation with polarized voltage input (terminal 12). (-10 to +10Vdc)
5: Reversible operation with polarized voltage input (terminal 12) + voltage command auxiliary input (optional terminal V1) (-10 to +10Vdc)
The setting frequency is determined by adding inputs to terminals 12 and V1.
* Polarized input allows operation in the direction opposite that of an operation command.
6: Inverse mode operation (terminal 12) (+10 to 0Vdc)
⇨ E01 to E09 : 21
7: Inverse mode operation (terminal C1) (20 to 4mA)
8: Setting by UP/DOWN control mode 1 (initial value = 0) (terminals UP and DOWN)
⇨ E01 to E09 : 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.
10: Setting by PATTERN operation
See the function explanation C21 to C28 for details.
⇨ C21 to C28
11: Setting by DI option or Pulse train input (Option)
For details, see the instruction manual on options.

For the setting method, see the explanation for F01.

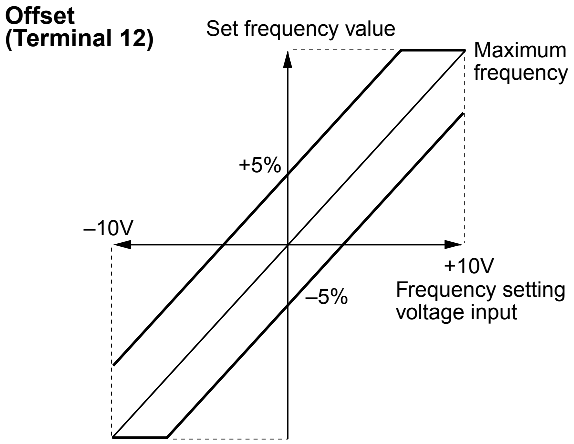
■ C31 Offset (Terminal 12)
■ C32 Offset (Terminal C1)

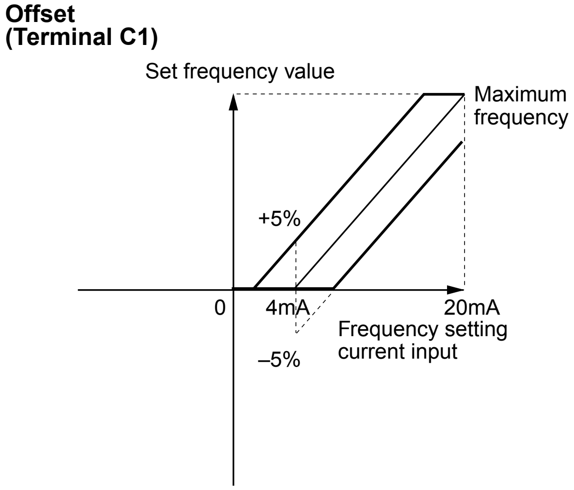
C31 OFFSET 12

C32 OFFSET C1

This function sets the offset of the analog input (terminals 12 and C1).
The setting range is -5.0 to +5.0% (in 0.1% steps) of the maximum output frequency.

■ P01 Number of motor 1 poles





■ C33 Analog setting signal filter

C33 REF 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.

- Setting range: 0.00 to 5.00s

A 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 unknown, 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 “H25 PID control (Feedback filter)” is used.

3.4 Motor Parameters

■ P01 Number of motor 1 poles

P01 M1 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.
- Set values: 2, 4, 6, 8, 10, 12, 14

■ P02 Motor 1 (Capacity)

P02 M1-CAP

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

- Set value:
  Models with nominal applied motor of 30HP or less: 0.01 to 45kW
  Models with nominal applied motor of 40HP or more: 0.01 to 500kW

- Set the nominal applied motor capacity listed in "Standard Specifications" in Chapter 1. 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 regarding related function data.
- When the setting of this function is changed, the values of the following related functions are automatically set to data of the FUJI 3-phase standard motor.
  P03 Motor 1 (Rated current)
  P06 Motor 1 (No-load current)
  P07 Motor 1 (% R1 setting)
  P08 Motor 1 (% X1 setting)

NOTE:
The set values for the FUJI standard 3-phase motor are 200V, 50Hz, 4 poles for the 230V; 400V, 50Hz, 4 poles for the 460V.

■ P03 Motor 1 (Rated current)

P03 M1-Ir

This function sets the rated current value of motor 1.
- Set value : 0.00 to 2000A

■ P04 Motor 1 (Tuning)

P04 M1 TUN1

This function measures and automatically writes motor data.

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.
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.

Perform "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. Tuning improves control and calculation accuracy.
- When a motor other than the FUJI standard 3-phase motor is used and accurate data is required for close control.
- 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 %R1 or %X is unknown as when a non-standard or special motor is used.

Tuning procedure

1. Adjust the voltage and frequency according to motor characteristics. Adjust functions "F03 Maximum frequency 1," "F04 Base frequency 1," "F05 Rated voltage 1," and "F06 Maximum voltage 1."
2. Enter untunable motor constants first. Set functions "P02 Capacity," "P03 Rated current," and "P06 No-load current," (input of no-load current is not required when P04=2, running the motor at tuning, is selected).
3. When tuning the no-load current, disconnect the motor from the load machine, and beware of motor rotation.
4. Set 1 (motor stop) or 2 (motor rotation) to function "P04 Tuning." Press the FUNC/DATA key to write the set value and press the FWD key or REV key, then start tuning simultaneously.
   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, the no-load current is tuned and decelerates according to the deceleration time, the total tuning time varies depending on set acceleration and deceleration times.)
5. Press the STOP key after the turning is completed.
6. End of procedure

NOTE:
Use function "A13 Motor 2 (Tuning)," to tune motor 2. In this case, functions described in 1. and 2. above are for the function (A01 -) of motor 2.

⚠ WARNING	**When the tuning value is set to 2, the motor rotates at a maximum of half the base frequency. Disconnect the motor from the load machine and beware of motor rotation.**

■ P05 Motor 1 (On-line Tuning)

P05 **M1 TUN2**

Long-time operation affects motor temperature and motor speed. On-line tuning minimizes speed variation when motor temperature changes.

Set value	Operation
0	Inactive
1	Active

■ P06 Motor 1 (No-load current)

P06 **M1-Io**

This function sets the no-load current (exciting current) of motor 1.
- Set value: 0.00 to 2000A

■ P07 Motor 1 (%R1 setting)
■ P08 Motor 1 (%X setting)

P07 **M1-%R1**

P08 **M1-%X**

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

Calculate %R1 using the following formula:

$$\%R1 = \frac{R1 + \text{Cable } R}{V/(\sqrt{3} \cdot I)} \times 100\ [\%]$$

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

Calculate %X using the following formula:

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

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

NOTE:
For reactance, use a value based on 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 values that can be ignored.

■ P09 Motor 1 (Slip compensation control 1)

P09 **SLIP COMP1**

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.
- Set value: 0.00 to 15.00Hz

Calculate the amount of slip compensation using the following formula:

Slip compensation amount =

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

Slippage = Synchronous speed – Rated speed

3.5 High Performance Functions

■ H03 Data initializing (Data reset)

H03 DATA INIT

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

- 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)

H04 AUTO-RESET

H05 RESET INT

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.

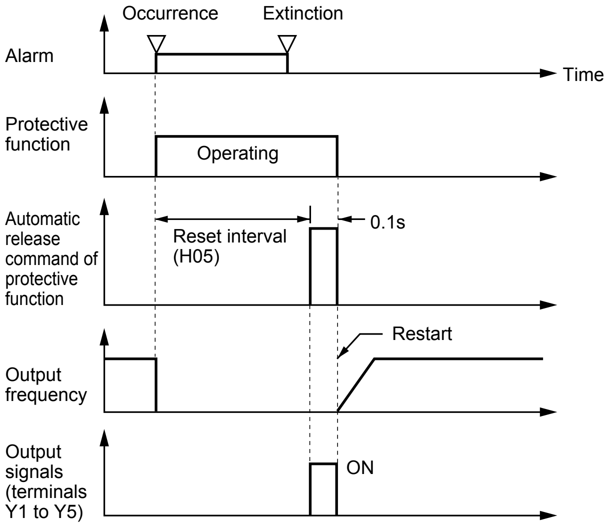
- Setting range (Times) : 0, 1 to 10
  (Reset interval) : 2 to 20s

Not to use the retry function, set 0 to “H04 Auto-reset (Times).”
• Inverter protective functions that can invoke retry function

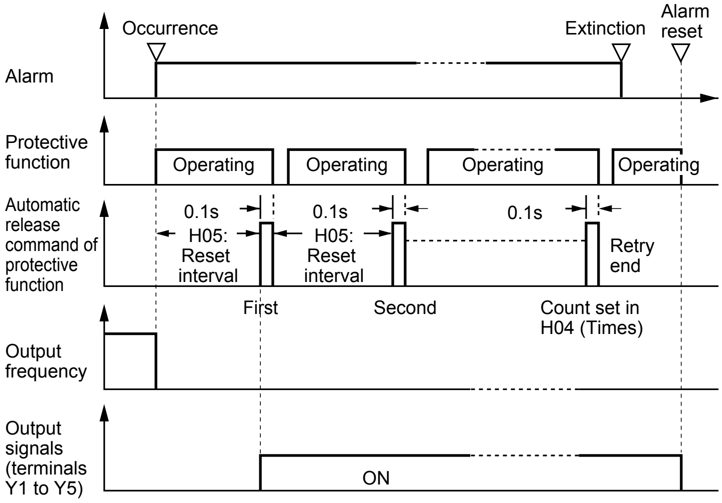
OC1, OC2, OC3: Overcurrent	dBH: Braking resistor overheating
OV1, OV2, OV3: Overvoltage	OL1: Motor 1 overload
OH1: Heat sink overheating	OL2: Motor 2 overload
OH3: Inverter inside overheating	OLU: Inverter overload

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),” after 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.

■ When retry succeeded



■ If retry failed



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.)**

■ H06 Fan stop operation

H06 FAN STOP

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 fan in the inverter and turns the fan on or off.
When this control is not selected, the cooling fan rotates continually.

- 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 pattern (Mode select)

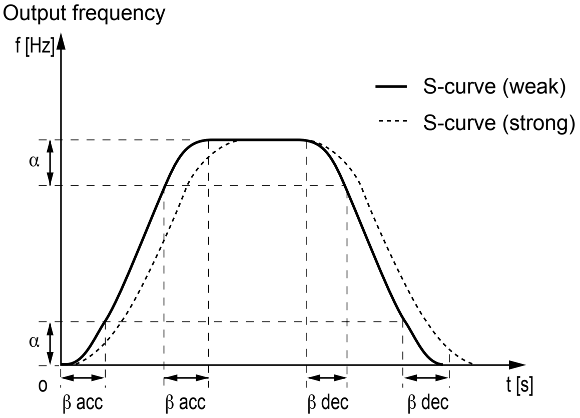
H07 ACC PTN

This function selects the acceleration and deceleration pattern.

- Set value 0: Inactive (linear acceleration and deceleration)
1: S-curve acceleration and deceleration (weak)
2: S-curve acceleration and deceleration (strong)
3: Non-linear (For variable torque load)

[S-curve acceleration and deceleration]

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



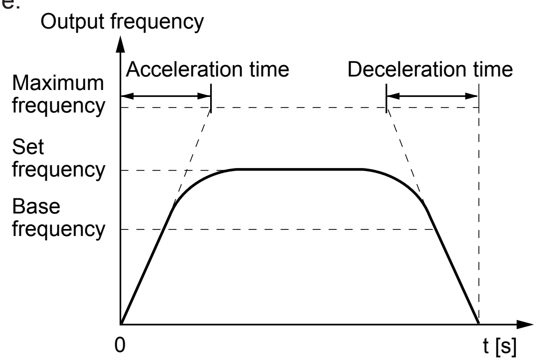
Pattern constants

	When H07=1 (S-curve weak)	When H07=2 (S-curve strong)
Range of S-curve (α)	0.05 x max. frequency (Hz)	0.10 x max. frequency (Hz)
Time for S-curve at acceleration (β acc)	0.10 x accel. time (s)	0.20 x accel. time (s)
Time for S-curve at deceleration (β dec)	0.10 x decel. time (s)	0.20 x decel. time (s)

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

[Non-linear acceleration and deceleration]

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



■ H08 Rev. phase sequence lock

H08 REV 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 CM terminals, inadvertent activation of the REV key, or negative analog input from terminal 12 or V1.

- Set value 0: Inactive
1: Active

■ H09 Start mode (Rotating motor pick up)

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. However, the normal startup method is used, when the coasting speed of the motor is 120Hz or more as an inverter frequency and when the value set to “F03 Maximum frequency 1”, exceeds the value set to “F15 Frequency limiter (High).”

- Set value: 0, 1, 2

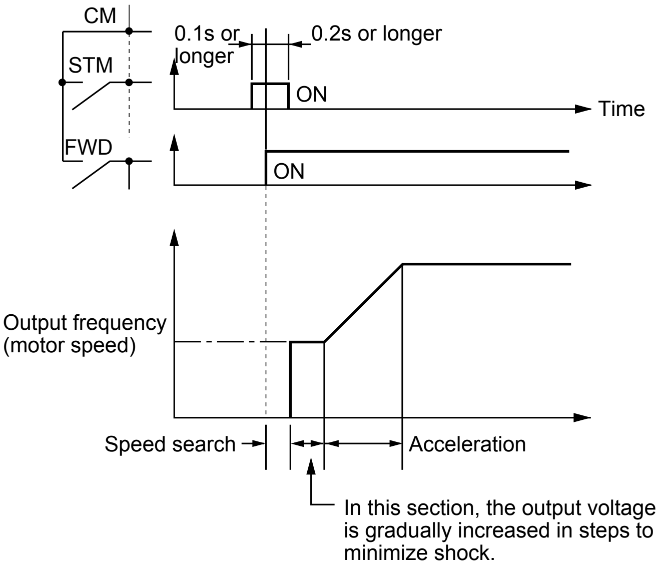
Set value	Normal startup	Restart after a momentary power failure	Line-to-inverter changeover
0	Inactive	Inactive	Inactive
1	Inactive	Active	Active
2	Active	Active	Active

Explanation of set values

1: This function is effective when 3, 4, or 5 is set to “F14 Restart mode after momentary power failure .”
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

H10 ENERGY SAV

When the output frequency is fixed (constant-speed operation) at light loads and value other than 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.

- Set value 0: Inactive
  1: Active

NOTES:
- Use this function for variable 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

H11 DEC MODE

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

- Set value 0: Deceleration-to-stop based on data set to “H07 ACC/DEC pattern”
  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

H12 INST CL

- 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.

- Set value 0: Inactive
  1: Active

■ H13 Auto-restart (Restart time)

H13 RESTART

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.

- Setting range: 0.1 to 10.0s

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 0.5s).

■ H14 Auto-restart (Frequency fall rate)

H14 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.

- Setting range: 0.00, 0.01 to 100.00Hz/s

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

NOTE:
A too large frequency fall 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)

H15 HOLD V

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 .” Either function starts a control operation if the DC link circuit voltage drops below the set operation continuation level.

- Setting range 230V: 200 to 300V
  460V: 400 to 600V

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 Fuji electric when changing the initial value.

■ H16 Auto-restart (OPR command self-hold time)

H16 SELFHOLD t

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.)

- Setting range: 0.0 to 30.0s, 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 DC link circuit voltage is about 0.

■ H18 Torque control

H18 TRQ CTRL

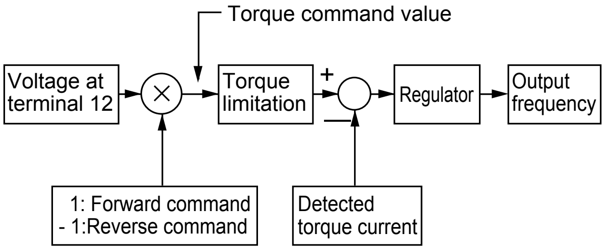
This function controls motor torque according to a command value.

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

⇨ E01 to E09 : 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 -10V.
2	Torque control active A -10 to +10V 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



- 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 (High) value, and 120Hz. 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

H19 AUTO RED

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.

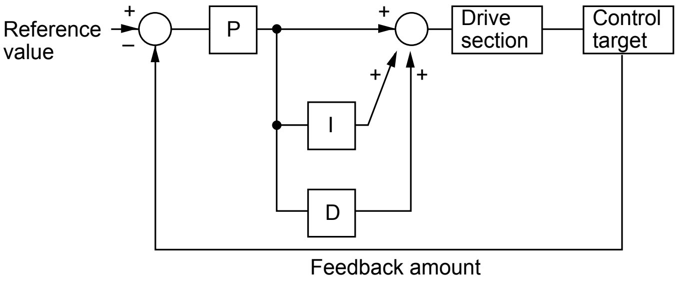
- Set value 0: Inactive
  1: Active

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

■ H20 PID control (Mode select)
to
■ 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 reference 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 reference value.

This function can be used for flow control, pressure control, temperature control, and other process controls.

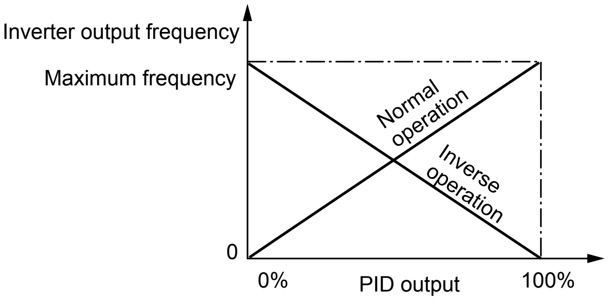


■ H20 PID control (Mode select)

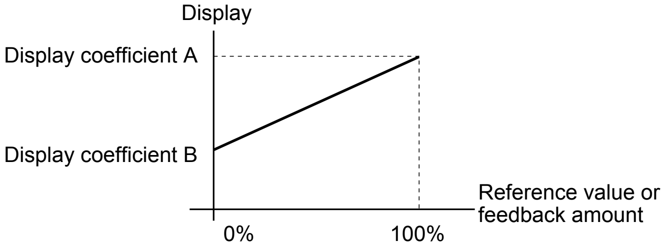
H20 PID MODE

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.

- Set value 0: No operation
  1: Normal operation
  2: Inverse operation



- The reference 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 command 1,” input an OFF signal to the selected terminal. For direct entry from the KEYPAD panel, turn on the selected terminal.
- For the reference 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.”

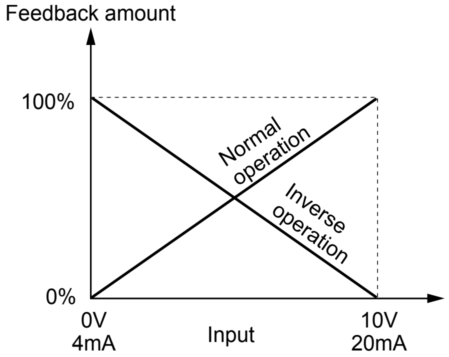


■ H21 PID control (Feedback signal)

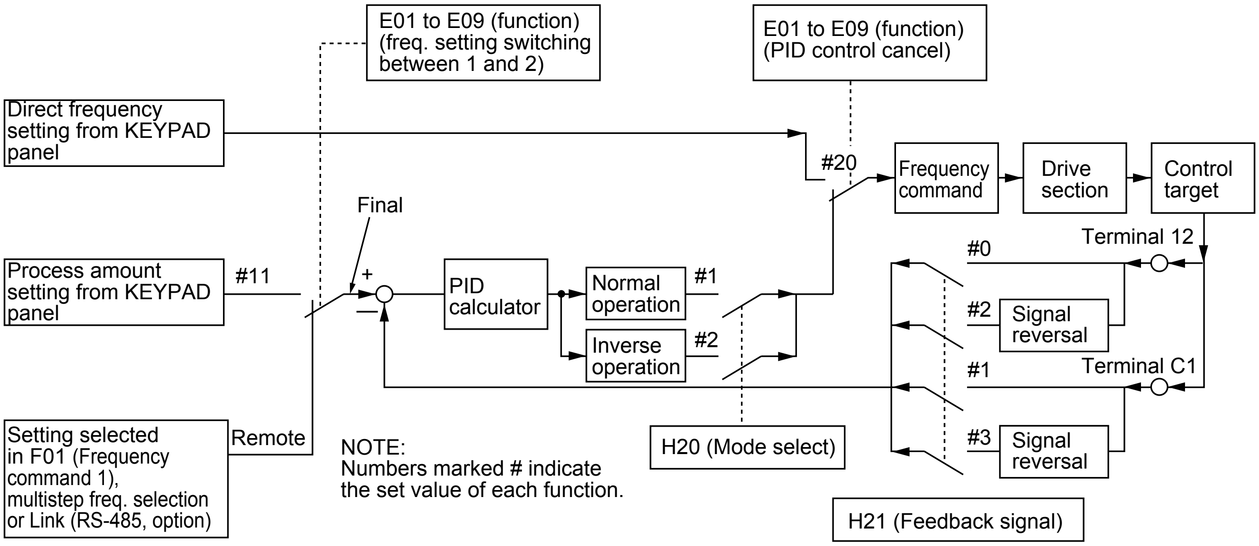
H21 FB SIGNAL

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.

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



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



NOTE:
Numbers marked # indicate the set value of each function.

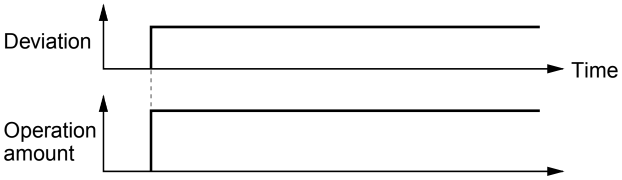
■ H22 PID control (P-gain)
■ H23 PID control (I-gain)
■ H24 PID control (D-gain)

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

• **P operation**

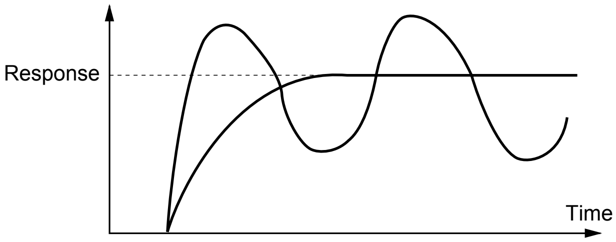
H22 P-GAIN

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.



- Setting range: 0.01 to 10.0 times

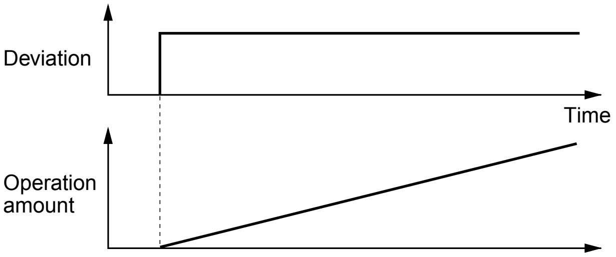
P gain is the parameter that determines the response level for the deviation of P operation. Although an increase in gain speeds up response, an excessive gain causes vibration, and a decrease in gain delays response.



• **I operation**

H23 I-GAIN

An operation where the change speed of the operation amount (output frequency) is proportional to the deviation is called I operation. 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 reference value (e.g., set frequency), though it deteriorates response for significant changes in deviation.



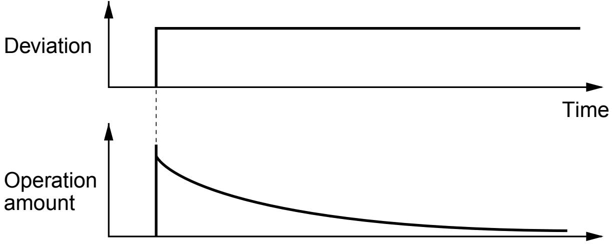
- Setting range: 0.0 (inactive), 0.1 to 9999s

"I: integration time" 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**

H24 D-GAIN

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



- Setting range: 0.00 (Inactive)
  0.01 to 10.0s

"D: differential time" is used as a parameter to determine the effect of a D operation. A longer differential time quickly attenuates vibration caused by P operation at the occurrence of deviation. Excessive differential time could cause vibration. Shortening the differential 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 reference 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.

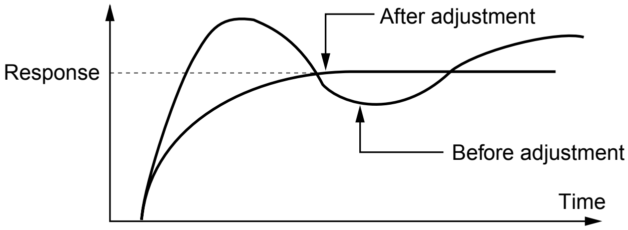
- **PID control**
  PID control combines the P operation, the I operation which removes deviation, and the D operation which suppresses vibration. This control achieves deviation-free, accurate, and stable responses.
  This control is effective for loads for which the time from deviation occurrence to response return is long.

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

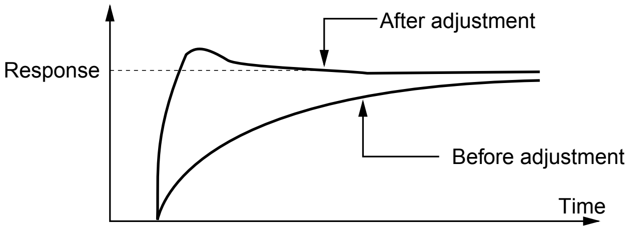
– Increase the value of "H22 (P-gain)" without generating vibration.
– Decrease the value of "H23 (I-gain)" without generating vibration.
– Increase the value of "H24 (D-gain)" without generating vibration.

Adjust the response waveform as follows:

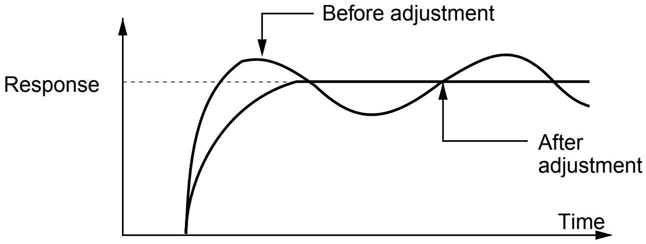
To remove the overshoot, increase the value of "H23 I-gain," then decrease the value of "H24 D-gain."



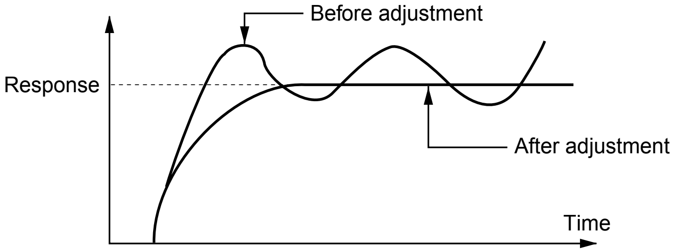
To stabilize response quickly (i.e., allowing for a little overshoot), decrease the value of "H23 I-gain," or increase the value of "H24 D-gain."



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)

H25 FB FILTER

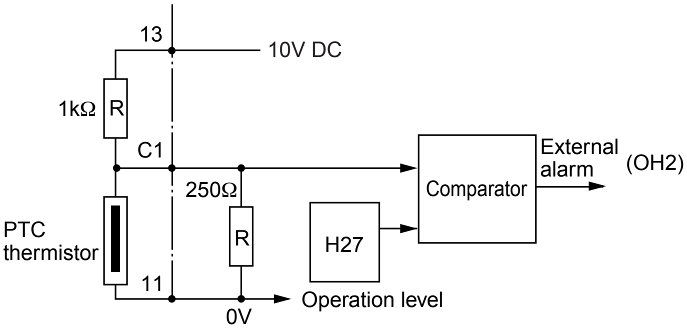
This filter is for feedback signal input from terminal 12 or C1.
This filter stabilizes operation of the PID control system. A set value that is too large, however, deteriorates response.
- Setting range: 0.0 to 60.0s

■ H26 PTC thermistor (Mode select)

H26 PTC MODE

Set this function active when the motor has a PTC thermistor for overheat protection.
- Set value 0: Inactive
  1: Active

Connect the PTC thermistor as shown in the figure below.
The protective function uses the external alarm input to terminals X1 to X9 when selected. The trip mode is activated by "OH2: External alarm input.



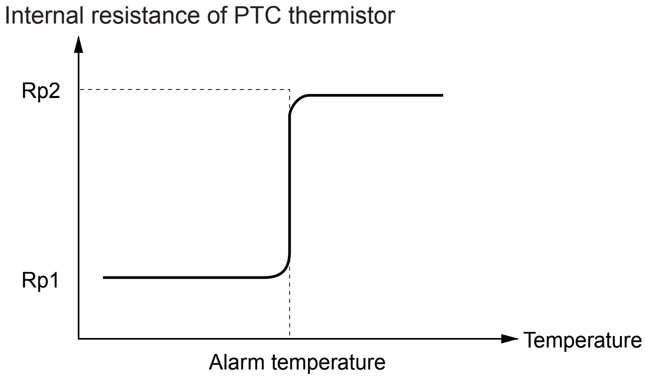
■ H27 PTC thermistor (Level)

H27 PTC LEVEL

The voltage input to terminal C1 is compared to the set voltage (operation level). When the input voltage is equal to or greater than the operation level, “H26 PTC thermistor (Mode select),” starts.

- Setting range: 0.00 to 5.00V

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 250Ω and the thermistor (resistance value Rp) are connected in parallel. Hence, voltage V_{C1} (operation level) at terminal C1 can be calculated by using the following formula.

$$Vc1= \frac{\frac{250\cdot Rp}{250 + Rp}}{1000 + \frac{250\cdot Rp}{250 + Rp}} \times 10\ [V]$$

The operation level can be set by bringing Rp in the Vc1 calculation formula into the following range.

$Rp1 < Rp < Rp2$

To obtain Rp easily, use the following formula.

$$Rp = \frac{Rp1 + Rp2}{2}\ [\Omega]$$

■ H28 Droop control

H28 DROOP

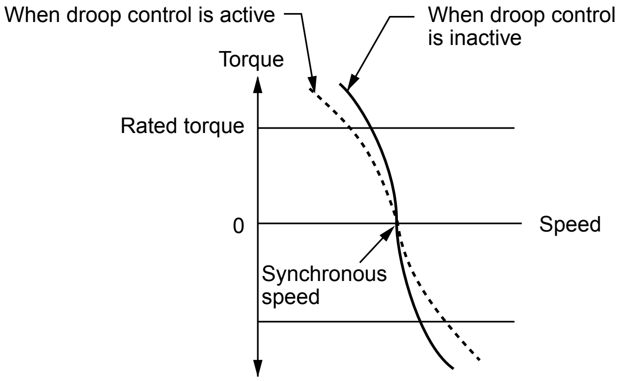
When two or more motors drive a single machine, a higher load is placed on the motor rotating the fastest. Droop control achieves a good load balance by applying drooping characteristics to speed against load variations.

Calculate the droop amount using the following formula:

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

- Set value : -9.9Hz to 0.0Hz

Characteristics of the motor



■ H30 Serial link (Function select)

H30 LINK FUNC

The link function (communication function) provides RS-485 (provided as standard) and various bus connections (optional).
The 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) Writing function data

- Setting range: 0 to 3

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

Set value	Frequency setting	Operation command
0	Inactive	Inactive
1	Active	Inactive
2	Inactive	Active
3	Active	Active

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 RS-485 interface is restricted to monitoring and writing function data. When the option is not installed, this setting selects the RS-485 function.

■ H31 RS-485 (Address)
to
■ H39 RS-485 (Response interval)

These functions set the conditions of RS-485 communication. Set the conditions according to the upstream device. Refer to 4. Communication Specification (RS-485) for the protocol.

■ H31 RS-485 (Address)

H31 485ADDRESS

This function sets the station address of RS-485.

- Setting range: 1 to 31

■ H32 RS-485 (Mode select on no response error)
■ H33 RS-485 (Timer)

H32 **MODE ON ER**

H33 **TIMER**

These function set processing at communication error and sets the error processing timer value.
- Setting range: 0 to 3

Set value	Processing at communication error
0	Immediate Er8 trip (forced stop)
1	Continue operation within timer time, Er8 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.

- Setting range: 0 to 60.0s

■ H34 RS-485 (Baud rate)

H34 **BAUD RATE**

This function sets the transmission speed.
- Setting range: 0 to 4

Set value	Transmission speed
0	19200bit/s
1	9600bit/s
2	4800bit/s
3	2400bit/s
4	1200bit/s

■ H35 RS-485 (Data length)

H35 **LENGTH**

This function sets data length.

Set value	Data length
0	8bit
1	7bit

■ H36 RS-485 (Parity check)

H36 **PARITY**

This function sets the parity bit.

Set value	Parity bit
0	None
1	Even
2	Odd

■ H37 RS-485 (Stop bits)

H37 **STOP BITS**

This function sets the stop bit.

Set value	Stop bit
0	2bit
1	1bit

■ H38 RS-485 (No response error detection time)

H38 **NO RES t**

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 Er8 trip.
- Setting range: 0 (no detection), 1 to 60 seconds

■ H39 (Response interval)

H39 **INTERVAL**

This function sets the time from when a request is issued from the upstream device to when a response is returned.
- Setting range: 0.00 to 1.00s

* Following functions are diagnostic functions. These data can be monitored at LCD on the Keypad panel.

■ H40 Maximum temperature of heat sink
■ H41 Maximum effective current
■ H42 Main circuit capacitor lifetime
■ H43 Cooling fan accumulated operation time
■ H44 Inverter ROM version
■ H45 Keypad panel ROM version
■ H46 Option ROM version

3.6 Alternative Motor Parameters

■ A01 Maximum frequency 2

A01 MAX Hz-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.

■ A02 Base frequency 2

A02 BASE Hz-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.

■ A03 Rated voltage 2 (at Base frequency 2)

A03 RATED V-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.

■ A04 Maximum voltage 2 (at Maximum frequency 2)

A04 MAX V-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.

■ A05 Torque boost 2

A05 TRQ BOOST2

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.

■ A06 Electronic thermal O/L relay for motor 2 (Select)

■ A07 Electronic thermal O/L relay for motor 2 (Level)

■ A08 Electronic thermal O/L relay for motor 2 (Thermal time constant)

A06 ELCTRN OL2

A07 OL LEVEL2

A08 TIME CNST2

This function sets the function of the electronic thermal O/L relay of motor 2. This function operates the same as F10 to F12, “Electronic thermal O/L relay for motor 1.” For details, see the explanations for F10 to F12.

■ A09 Torque vector control 2

A09 TRQVECTOR2

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.

■ A10 Number of motor 2 poles

A10 M2 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.

■ A11 Motor 2 (Capacity)

A11 M2-CAP

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).”

■ A12 Motor 2 (Rated current)

A12 M2-Ir

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.

■ A13 Motor 2 (Tuning)

A13 M2 TUN1

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

■ A14 Motor 2 (On-line tuning)

A14 M2 TUN2

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

■ A15 Motor 2 (No-load current)

A15 M2-Io

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.

■ A16 Motor 2 (%R1 setting)
■ A17 Motor 2 (%X setting)

A16 **M2-%R1**

A17 **M2-%X**

These functions set %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.

■ A18 Motor 2 (Slip compensation control)

A18 **SLIP COMP2**

This function sets the amount of slip compensation for motor 2. This function operates the same as “P09 Motor 1 (Slip compensation control 1).” For details, see the explanation for P09.

4. Standard RS-485 Interface

Foreword

This section describes the communication specification when the inverter FRENIC5000G11S/P11S series is controlled through serial transmission from a host unit such as personal computer or PLC. Read this section and the instruction manual of the inverter, understand the treatment method before use, and use this unit correctly. Misuse may result in abnormal operation or cause troubles and reduction of life.

Caution for safety instructions

Be sure to read carefully this section before installation, connection (wiring), operation, maintenance and inspection, and use correctly.

Use this unit after mastered all of the knowledge of the unit, information of safety and attentions.

In this section, the ranks of safety messages are classified as follows:

⚠ **Warning**	Denotes operating procedures and practices that may result in personal injury or loss of life if not correctly followed.

⚠ **CAUTION**	Denotes operating procedures and practices that, if not strictly observed, may result in damage to, or destruction of the equipment.

Even if the items in the caution, they may cause serious results under the circumstances. Since the items have important contents, be sure to follow to the cautions.

Wiring

⚠ **Warning**	- Be sure to wire after power supply off. **There is a fear of electric shock.**

⚠ **CAUTION**	- This cannot connect with RS-422A interface. (Since this can do only one way communication, the response cannot be received.) **There is a fear of damage.**

Operation

⚠ **Warning**	- Be sure to check no run command because of sudden start when valid/invalid communication is changed over, while a run command through RS-485 or external signal terminals is remained. **There is a fear of failure.** - Be sure to check no run command because of sudden restart when the alarm is reset while a run command through RS-485 is remained. **There is a fear of failure.** - There is possibility that stop command through RS-485 cannot be recognized when a communication error causes while operating through RS-485. Be sure that an emergency stop is made possible by using forced stop of the external signal terminal (BX). **There is a fear of failure.**

4.1 Outline

4.1.1 Features

- A host unit can be connected up to 31 inverters.
- Because a common protocol for FRENIC5000G11S/P11S series is adopted, the similar program in host unit can operate all inverters of the series. (The parameter specifications may differ for each unit type.)
- Because adopting the transmission frame of fixed length, the program on the host is facilitated.
- The optional transmission frame can shorten the communication time for the operation commands and setting frequency required high response.

4.1.2 Function overview

Function		Remarks
Operation command	- Forward command (FWD) and Reverse command (REV) - Digital input command (X1 – X9) - Reset command (RST)	By specific communication functions (S code)
Frequency setting	Can select 2 methods. - ± 20000/maximum frequency - Frequency (min. unit: 0.01Hz) .... Without polarity	
Operating condition monitor	- Setting frequency - Output frequency, torque calculation value, torque current, input power, output current and output voltage - Operation state and Y1 – Y5 condition	By specific communication functions (M code)
Maintenance data monitor	- Operation time and DC link circuit voltage - Life (main circuit capacitor, capacitors on control PCB and cooling fan) - Type code, capacity code and ROM version	
Alarm data monitor	- Alarm history (newest – former 3 times) monitor - Information monitor at occurring new alarm. Operation information (Output frequency, setting frequency, torque calculation value, torque current, input power, output current and output voltage) Operation state and universal output terminals Maintenance (integrated operation time, DC link circuit voltage, internal air temperature in inverter and fin temperature)	
Function data	- All function data can be monitored and changed. (However, the functions related to RS-485 communication cannot be changed.)	By standard functions

4.2 Transmission specification

Physical level	EIA RS-485 (A unit with an RS-232C interface reqires a converter)
Transmission distance	500 m max.
Recommended cable	24AWG shielded twisted-pair cable
Number of connectable units	Host: 1, Inverter: 31 (station address: 01–31, broadcast: 99)
Transmission speed	19200, 9600, 4800, 2400, 1200 [bits/s]
Synchronization method	Start - stop synchronization
Transmission mode	Half duplex
Transmission protocol	Polling/selecting, broadcast
Character code	7-bit ASCII
Data length	8 bits, 7 bits selectable
Stop bit length	1 bit, 2 bits selectable
Frame length	Standard frame: 16 bytes fixed, Option frame: 8 bytes, 12 bytes
Parity	Non, even parity, odd parity selectable
Error check	BCC (check sum), overrun error, frame error

4.3 Connection

4.3.1 Connection method

Use shielded wires (Recommended cable: Refer to 4.2. Transmission specification) and connect the wires between the control terminals (DXA, DXB and SD) of the inverter and the host unit so as to surely become drawing in one stroke.

⚠ **Warning**	Be sure to wire after power supply off. **There is a fear of electric shock.**

⚠ **CAUTION**	This cannot connect with RS-422A interface. (Because this can do only one way communication, the response cannot be received.) **There is a fear of damage.**

Note:

1) Shorten the wiring as possible to be hard against noise influence.
2) Connection with RS-232C units uses a communication level converter on the market.
(Refer to "4.11.1 Communication level converter").
3) Assign the different station address to the inverters.

Control terminals (only for communication)

Terminal marking	Terminal name	Function description
DXA	RS-485 communication data (+)	Input/output terminals for RS-485 communication. Max. 31 inverters can be connected by multi-drop connection.
DXB	RS-485 communication data (–)	
SD	For connection to communication cable sheath	Connecting shielded wire of cable. Electrically floating

Control terminal arrangement

In detail, refer to "Connection" of the instruction manual of inverter.

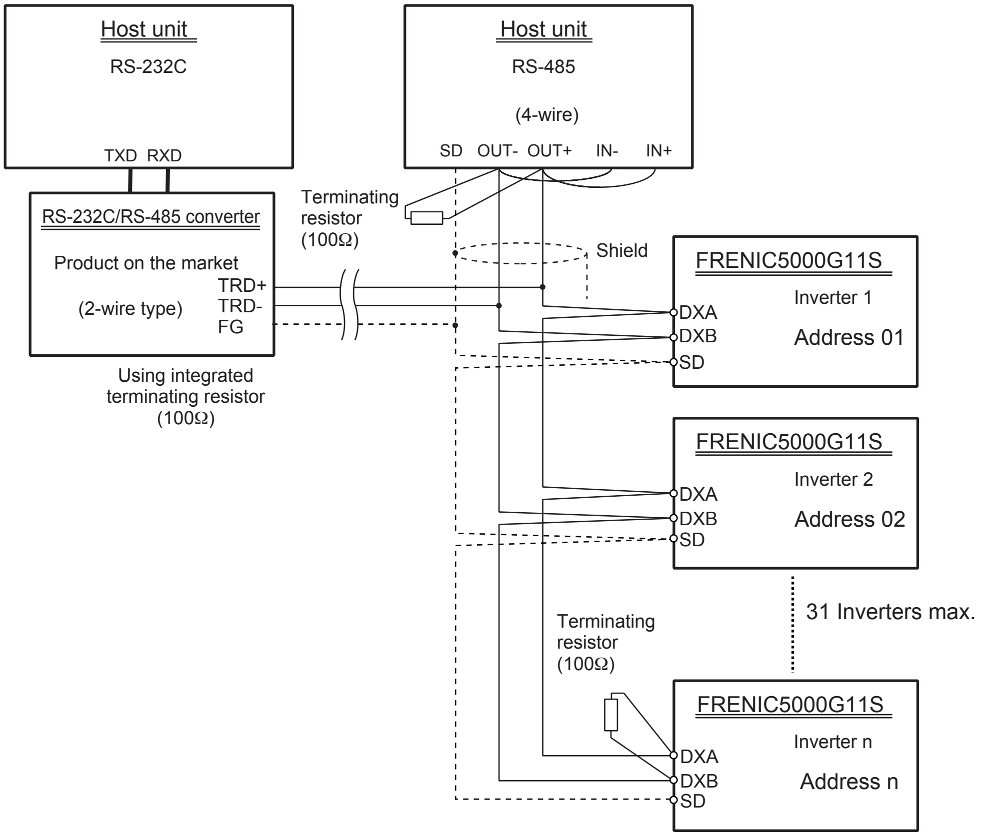
DXA	**DXB**	**SD**

4.3.2 RS-485

RS-485 interface is used when performing multi-drop bidirectional communication. The input/output terminals are provided for 2-wire and 4-wire connections. Either unit of the connections can be used (using as 2-wire connection).

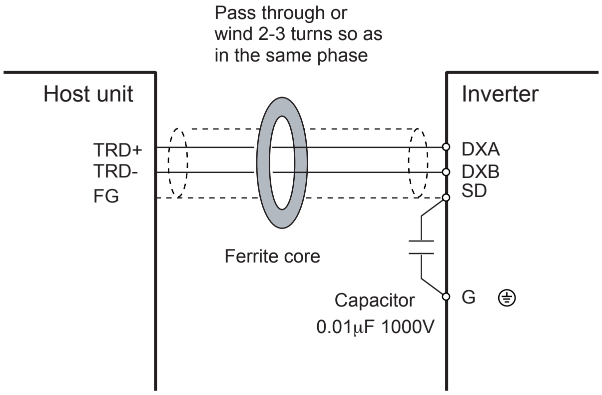
Type	Description	Example of terminals
2-wire connection	Input and output (driver and receiver) are internally connected.	TRD+ .. Differential input terminal (hot side) TRD- ... Differential output terminal (common side) FG .... Frame ground
4-wire connection	Input and output (driver and receiver) are separated.	IN+, IN- .... Differential input terminal OUT+, OUT- .. Differential output terminal SD .... Signal ground

4.3.3 Example of connection of FRENIC5000G11S/P11S series



4.3.4 Example of noise prevention

The malfunction such as communication error may be occured by the noise generated the inverter. In such case, connect ferrite core or capacitor.

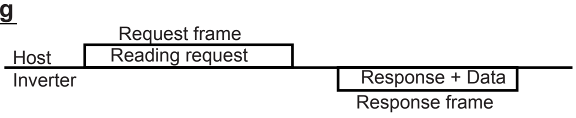


4.4 Transmission method

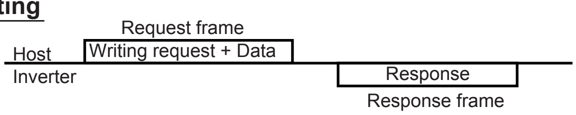
The polling/selecting system is applied to the response message feature. The inverter is always waiting the selecting (writing request) and polling (reading request) from the host unit.

When the inverter receives a request frame from the host during waiting state and judges for it to be a correct receiving, the inverter processes for the request and returns an affirm response frame (in a case of polling, returning the data together with the affirm response frame). If judging it not to be normally received, the inverter returns a negative response frame. Further, in a case of broadcast (selecting all terminals in a lump), the inverter does not return the response.

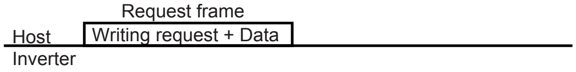
Polling



Selecting



Broadcast



Description) Broadcast (selecting one lump of all terminals)
A frame set with station address of 99 is treated by all inverters as broad cast. By using broadcast, operation commands and frequency command can be give all the inverters in a lump. (The writing of S01 - S06 ['W', 'E' commands] in the standard frame and 'a' - 'f' and 'm' commands in the option frame are only valid.)

4.4.1 Transmission frame

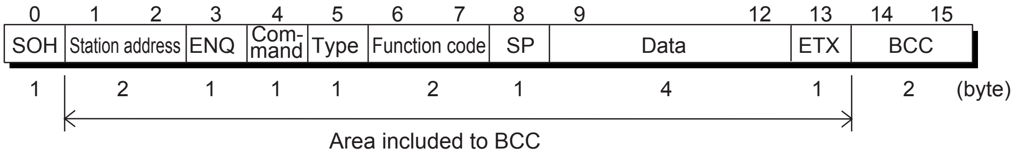
In the transmission frames, there are standard frames that can use all communication functions and option frames that are limited to the command and monitoring to inverter but can perform high-speed communication.

In both standard frame and option frame, all characters (including BCC) configuring the frame is expressed with ASCII code.
The lengths of transmission frames become shown in the following table.

Sort of frame			Frame length
Standard frame	**Selecting**	Request	16 bytes
		Response	16 bytes
	Polling	Request	16 bytes
		Response	16 bytes
Option frame	**Selecting**	Request	12 bytes
		Response	8 bytes
	Polling	Request	8 bytes
		Response	12 bytes

(1) Standard frame

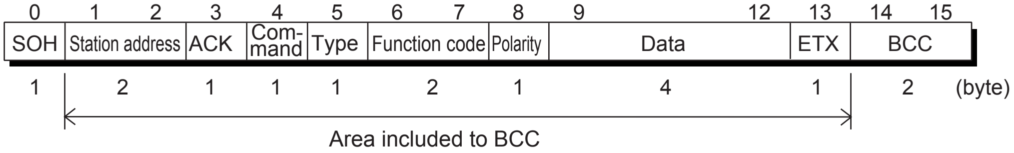
Request frame [Host ⇒ Inverter]



Byte	Field	Value		Description
		ASCII type	Hexadecimal	
0	SOH	SOH	01$_H$	Start of header
1	Station address	'0'-'3', '9'	30$_H$-33$_H$, 39$_H$	Station address of inverter (Decimal: x 10)
2		'0'-'9'	30$_H$-39$_H$	Station address of inverter (Decimal: x 1)
3	ENQ	ENQ	05$_H$	Transmission request
4	Command	 'R' 'W' 'A' 'E'	 52$_H$ 57$_H$ 41$_H$ 45$_H$	Request command Polling (reading) Selecting (writing) High-response selecting (writing)*1 Alarm reset
5	Type	 'F' 'E' 'C' 'P' 'H' 'A' 'o' 'S' 'M'	 46$_H$ 45$_H$ 43$_H$ 50$_H$ 48$_H$ 41$_H$ 6F$_H$ 53$_H$ 4D$_H$	Function type Fundamental Functions Extension Terminal Functions Control Functions of Frequency Motor Parameters High performance Functions Alternative Motor Parameters Optional Functions Setting data Functions Monitoring data Functions
6	Function code	'0'-'4'	30$_H$-34$_H$	Function code (Decimal: x 10)
7		'0-'9'	30$_H$-39$_H$	Function code (Decimal: x 1)
8	SP	' '	20$_H$	Not use (fixed space)
9	Data	'0'-'F'	30$_H$-3F$_H$	1st character of data (Hexadecimal: x 1000$_H$)
10		'0'-'F'	30$_H$-3F$_H$	2nd character of data (Hexadecimal: x 100$_H$)
11		'0'-'F'	30$_H$-3F$_H$	3rd character of data (Hexadecimal: x 10$_H$)
12		'0'-'F'	30$_H$-3F$_H$	4th character of data (Hexadecimal: x 1$_H$)
13	ETX	ETX	03$_H$	End of text
14	BCC	'0'-'F'	30$_H$-3F$_H$	Check sum 1 (Hexadecimal: x 10$_H$)
15		'0'-'F'	30$_H$-3F$_H$	Check sum 2 (Hexadecimal: x 1$_H$)

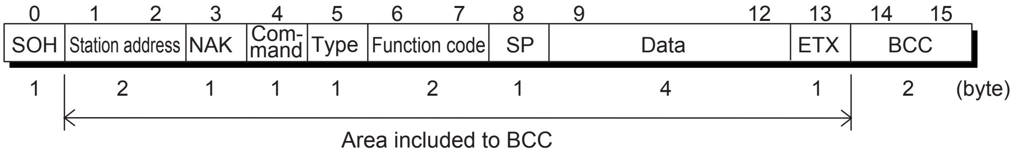
NOTE:
*1) This is used to read out the monitor during writing a function taking for long time (several seconds) (see time out list of "4.4.3 Procedure on host side"). The response of the inverter is not returned till finish of writing of the inverter by the normal writing command 'W', but, since the inverter immediately returns at the time point of receiving the writing request under the high speed response command 'A', the communication can continue even during writing. To judge the finish of writing, call BUSY flag during writing (M14: 15th bit). If trying to newly write during writing, NAK response (error during writing) is issued.

ACK response frame [Inverter ⇒ Host]



Byte	Field	Value		Description
		ASCII type	Hexadecimal	
0	SOH	SOH	01_H	Start of header
1	Station address	'0'-'3', '9'	30_H-33_H, 39_H	Station address of inverter (Decimal: x 10)
2		'0'-'9'	30_H-39_H	Station address of inverter (Decimal: x 1)
3	ACK	ACK	06_H	Transmission request Acknowledge: When there are no receiving error and logical error of the request
4	Command	 'R' 'W' 'A' 'E'	 52_H 57_H 41_H 45_H	Request command Polling (reading) Selecting (writing) High-response selecting (writing) Alarm reset
5	Type	 'F' 'E' 'C' 'P' 'H' 'A' 'o' 'S' 'M'	 46_H 45_H 43_H 50_H 48_H 41_H $6F_H$ 53_H $4D_H$	Function type Fundamental Functions Extension Terminal Functions Control Functions of Frequency Motor Parameters High performance Functions Alternative Motor Parameters Optional Functions Setting data Functions Monitoring data Functions
6	Function code	'0'-'4'	30_H-34_H	Function code (Decimal: x 10)
7		'0'-'9'	30_H-39_H	Function code (Decimal: x 1)
8	Polarity	 ' ' '-'	 20_H $2D_H$	Polarities of M09 and M35 data Positive data, normal data (except M09 and M35) negative data
9	Data	'0'-'F'	30_H-$3F_H$	1st character of data (Hexadecimal: x 1000_H)
10		'0'-'F'	30_H-$3F_H$	2nd character of data (Hexadecimal: x 100_H)
11		'0'-'F'	30_H-$3F_H$	3rd character of data (Hexadecimal: x 10_H)
12		'0'-'F'	30_H-$3F_H$	4th character of data (Hexadecimal: x 1_H)
13	ETX	ETX	03_H	End of text
14	BCC	'0'-'F'	30_H-$3F_H$	Check sum 1 (Hexadecimal: x 10_H)
15		'0'-'F'	30_H-$3F_H$	Check sum 2 (Hexadecimal: x 1_H)

NAK response frame [Inverter ⇒ Host]

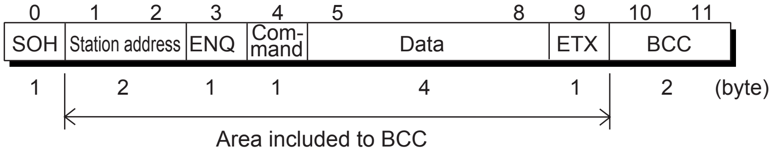


Byte	Field	Value		Description
		ASCII type	Hexadecimal	
0	SOH	SOH	01_H	Start of header
1	Station address	'0'-'3', '9'	30_H-33_H, 39_H	Station address of inverter (Decimal: x 10)
2		'0'-'9'	30_H-39_H	Station address of inverter (Decimal: x 1)
3	NAK	NAK	15_H	Transmission response Negative acknowledge: When there is a logical error in the request
4	Command*1			Answer back to request command
		'R'	52_H	Polling (reading)
		'W'	57_H	Selecting (writing)
		'A'	41_H	High-response selecting (writing)
		'E'	45_H	Alarm reset
5	Type*1			Function type
		'F'	46_H	Fundamental Functions
		'E'	45_H	Extension Terminal Functions
		'C'	43_H	Control Functions of Frequency
		'P'	50_H	Motor Parameters
		'H'	48_H	High performance Functions
		'A'	41_H	Alternative Motor Parameters
		'o'	$6F_H$	Optional Functions
		'S'	53_H	Setting data Functions
		'M'	$4D_H$	Monitoring data Functions
6	Function code*1	'0'-'4'	30_H-34_H	Function code (Decimal: x 10)
7		'0-'9'	30_H-39_H	Function code (Decimal: x 1)
8	SP	' '	20_H	Not use (fixed space)
9	Data	' '	20_H	Not use (fixed space)
10		' '	20_H	Not use (fixed space)
11		'4', '5'	34_H,35_H	Communication error code (Hexadecimal: x 10_H)
12		'0'-'F'	30_H-$3F_H$	Communication error code (Hexadecimal: x 1_H)
13	ETX	ETX	03_H	End of text
14	BCC	'0'-'F'	30_H-$3F_H$	Check sum 1 (Hexadecimal: x 10_H)
15		'0'-'F'	30_H-$3F_H$	Check sum 2 (Hexadecimal: x 1_H)

NOTE: *1) In case of the transmission format error and transmission command error, spaces (' '= 20_H) are set.

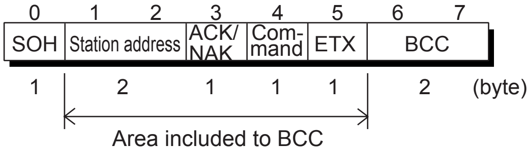
(2) Option frame

Selecting request frame [Host ⇒ Inverter]



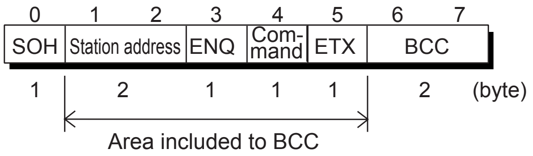
Byte	Field	Value		Description
		ASCII type	Hexadecimal	
0	SOH	SOH	01H	Start of header
1	Station address	'0'-'3', '9'	30H-33H, 39H	Station address of inverter (Decimal: x 10)
2		'0'-'9'	30H-39H	Station address of inverter (Decimal: x 1)
3	ENQ	ENQ	05H	Transmission request
4	Command	 'a' 'e' 'f' 'm'	 61H 65H 66H 6DH	Request command Frequency setting (p.u.) Frequency setting Operation command Alarm reset
5	Data	'0'-'F'	30H-3FH	1st character of data (Hexadecimal: x 1000H)
6		'0'-'F'	30H-3FH	2nd character of data (Hexadecimal: x 100H)
7		'0'-'F'	30H-3FH	3rd character of data (Hexadecimal: x 10H)
8		'0'-'F'	30H-3FH	4th character of data (Hexadecimal: x 1H)
9	ETX	ETX	03H	End of text
10	BCC	'0'-'F'	30H-3FH	Check sum 1 (Hexadecimal: x 10H)
11		'0'-'F'	30H-3FH	Check sum 2 (Hexadecimal: x 1H)

Selecting response frame [Inverter ⇒ Host]



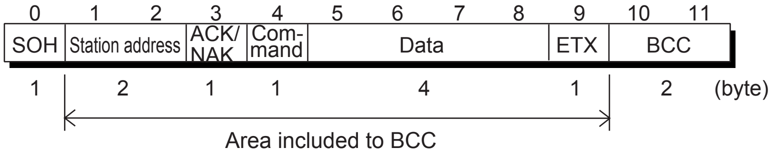
Byte	Field	Value		Description
		ASCII type	Hexadecimal	
0	SOH	SOH	01H	Start of header
1	Station address	'0'-'3', '9'	30H-33H, 39H	Station address of inverter (Decimal: x 10)
2		'0'-'9'	30H-39H	Station address of inverter (Decimal: x 1)
3	ACK/NAK	 ACK NAK	 06H 15H	Transmission response Acknowledge: When there are no receiving error and logical error Negative Acknowledge: When there is a logical error in the request
4	Command	 'a' 'e' 'f' 'm'	 61H 65H 66H 6DH	Request command Frequency setting (p.u.) Frequency setting Operation command Alarm reset
5	ETX	ETX	03H	End of text
6	BCC	'0'-'F'	30H-3FH	Check sum 1 (Hexadecimal: x 10H)
7		'0'-'F'	30H-3FH	Check sum 2 (Hexadecimal: x 1H)

Polling request frame [Host ⇒ Inverter]



Byte	Field	Value		Description
		ASCII type	Hexadecimal	
0	SOH	SOH	01_H	Start of header
1	Station address	'0'-'3', '9'	30_H-33_H, 39_H	Station address of inverter (Decimal: x 10)
2		'0'-'9'	30_H-39_H	Station address of inverter (Decimal: x 1)
3	ENQ	ENQ	05_H	Transmission request
4	Command	 'g' 'h' 'i' 'j' 'k'	 67_H 68_H 69_H $6A_H$ $6B_H$	Request command Output frequency (p.u.) Torque Torque current Output frequency Operation state monitor
5	ETX	ETX	03_H	End of text
6	BCC	'0'-'F'	30_H-$3F_H$	Check sum 1 (Hexadecimal: x 10_H)
7		'0'-'F'	30_H-$3F_H$	Check sum 2 (Hexadecimal: x 1_H)

Polling response frame [Inverter ⇒ Host]



Byte	Field	Value		Description
		ASCII type	Hexadecimal	
0	SOH	SOH	01_H	Start of header
1	Station address	'0'-'3', '9'	30_H-33_H, 39_H	Station address of inverter (Decimal: x 10)
2		'0'-'9'	30_H-39_H	Station address of inverter (Decimal: x 1)
3	ACK/NAK	 ACK NAK	 06_H 15_H	Transmission response Acknowledge: When there are no receiving error and logical error Negative Acknowledge: When there is a logical error in the request
4	Command	 'g' 'h' 'i' 'j' 'k'	 67_H 68_H 69_H $6A_H$ $6B_H$	Request command Output frequency (p.u.) Torque Torque current Output frequency Operation state monitor
5	Data	'0'-'F'	30_H-$3F_H$	1st character of data (Hexadecimal: x 1000_H)
6		'0'-'F'	30_H-$3F_H$	2nd character of data (Hexadecimal: x 100_H)
7		'0'-'F'	30_H-$3F_H$	3rd character of data (Hexadecimal: x 10_H)
8		'0'-'F'	30_H-$3F_H$	4th character of data (Hexadecimal: x 1_H)
9	ETX	ETX	03_H	End of text
10	BCC	'0'-'F'	30_H-$3F_H$	Check sum 1 (Hexadecimal: x 10_H)
11		'0'-'F'	30_H-$3F_H$	Check sum 2 (Hexadecimal: x 1_H)

(3) Negative response frame

As for a response frame changing its length depending on the command sort, it is made basic to respond with the frame length specified by the command if the command sort character is normally recognized.

No.	Frame/command sort	Cause of the error	Negative response frame	Error code (M26)
1	Standard frame Option frame	Could not detect ENQ at the specified position.	Standard frame (16 bytes length)	Format error [74]
2	Other than specified commands	Detected other than specified commands (R, W, A, E, a - k, m).	Standard frame (16 bytes length)	Command error [75]
3	Selecting command (a - f, m)	Could not detect ETX at the specified position.	Option frame (8 bytes length)	Format error [74]
4	Polling command (g - k)	Could not detect ETX at the specified position.	Option frame (12 bytes length)	Format error [74]

Note:
When returning the negative response of format error or command error in the standard frame as in No. 1 and 2, the contents of the command sort, function sort and function number field become indefinite.

4.4.2 Field description

(1) Data field

Standard frame

8	9	10	11	12
Special added data	1st character	2nd character	3rd character	4th character

Option frame

5	6	7	8
1st character	2nd character	3rd character	4th character

All data except partial special data are treated with 16 bits length. In the data field of communication frame, data use hexadecimal notation (0000_H - $FFFF_H$) and each figure is expressed with ASCII code. Further, in case of negative integer data (data with sign), minus data are produced by taking the two's complement.
In the standard frame, 1 byte of a special adding data is provided in addition to 4 bytes of the data field, and minus ('-') is set only when communicating negative data exceeding 16 bits length (output frequency of M09 and M35 in reverse rotation).

Notes:
- Make all A - F of hexadecimal capital letters.
- When polling, send with setting zero ('0') in all data field of the request frame.
- When selecting, the data field of the ACK response field becomes indefinite.

Example)
When setting 108.5Hz in the function S01 (frequency command) (maximum frequency: 120Hz).

1) Calculate setting value according to the data format of S01 (20,000/max. frequency)
   Data = 108.5Hz x ±20,000/120Hz
   (+in forward rotation, - in reverse rotation)
   = ±18083.3
   ≅ ±18083
2) Convert the data to hexadecimal (If the data is negative, take the two's complement).
   Data = 18083 .... (in forward rotation)
   = $46A3_H$
   Data =-18083 .... (in reverse rotation)
   = 0-18083 = 65536-18083 = 47453
   = $B95D_H$
3) Set data

Position	Setting value (Forward)	Setting value (Reverse)
1st character of data	ASCII ‘4’	ASCII ‘B’
2nd character of data	ASCII ‘6’	ASCII ‘9’
3rd character of data	ASCII ‘A’	ASCII ‘5’
4th character of data	ASCII ‘3’	ASCII ‘D’

(2) Check sum field

These data are to check for error in the communication frame when transmitting data. The calculation method is to express the data in ASCII code, which data are the lowest 1 byte of the sum of every 1 byte in the data field except SOH and check sum.

Example) When the added result is 0123_H

Position	Setting value
Check sum 1	ASCII '2'
Check sum 2	ASCII '3'

4.4.3 Procedure on the host side

As for the communication procedure of frames, follow the flow chart of each procedure.

Be sure to send next frame after recognizing the response in both writing and reading. If response from the inverter does not return exceeding a definite time, judge as time-out and execute retry. (When stating retry before time-out, the request frame cannot be normally received.)

Time-out

Command	Treatment	Time-out	Remarks
R	Reading all	0.1s	
W	Writing function data (S08 -S11)	1s	
	Writing function data	10s	Data initializing (H03) Auto-tuning (P04, A13)
		1s	Functions except above
	Other writing	1s	
A	Writing function data (S08 - S11)	1s	
	Writing function data		
E	Alarm reset	1s	
a-f, m	Selecting (option frame)	1s	
g-k	Polling (option frame)	0.1s	

Note: Since the time described above is not the guaranteed response time, but is surely the time of time-out for detecting abnormal, the response is returned earlier than that time.

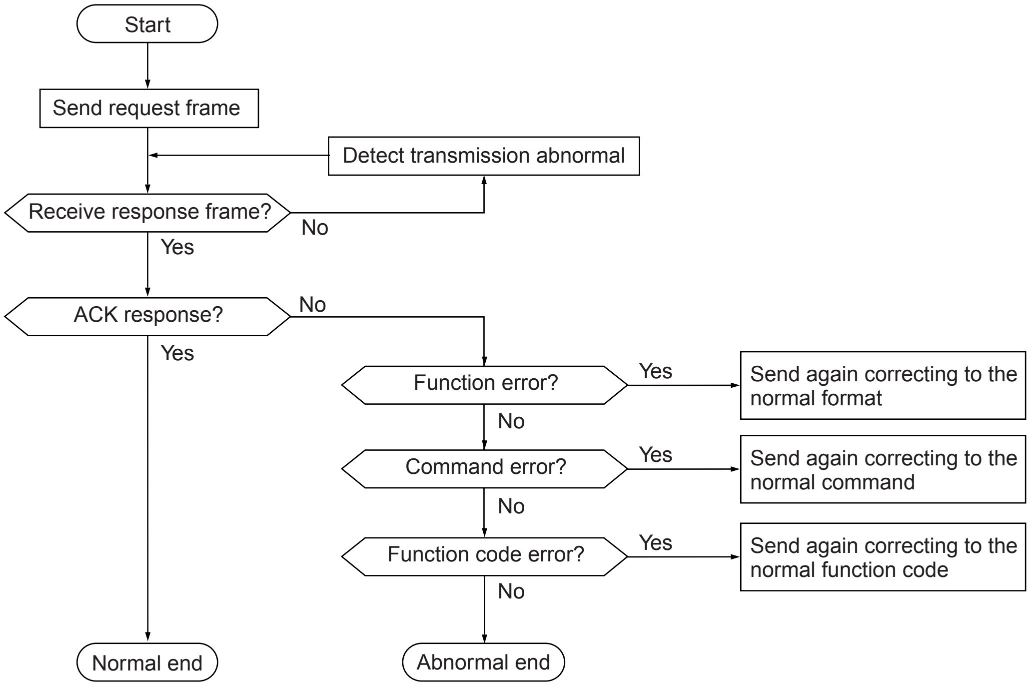
Description) Retry

In the retry treatment, it is confirmed either to send the former data before no response again or to obtain a normal response by polling (M26) for reading out the error content. (When confirming, it is necessary to judge time-out again or not.)

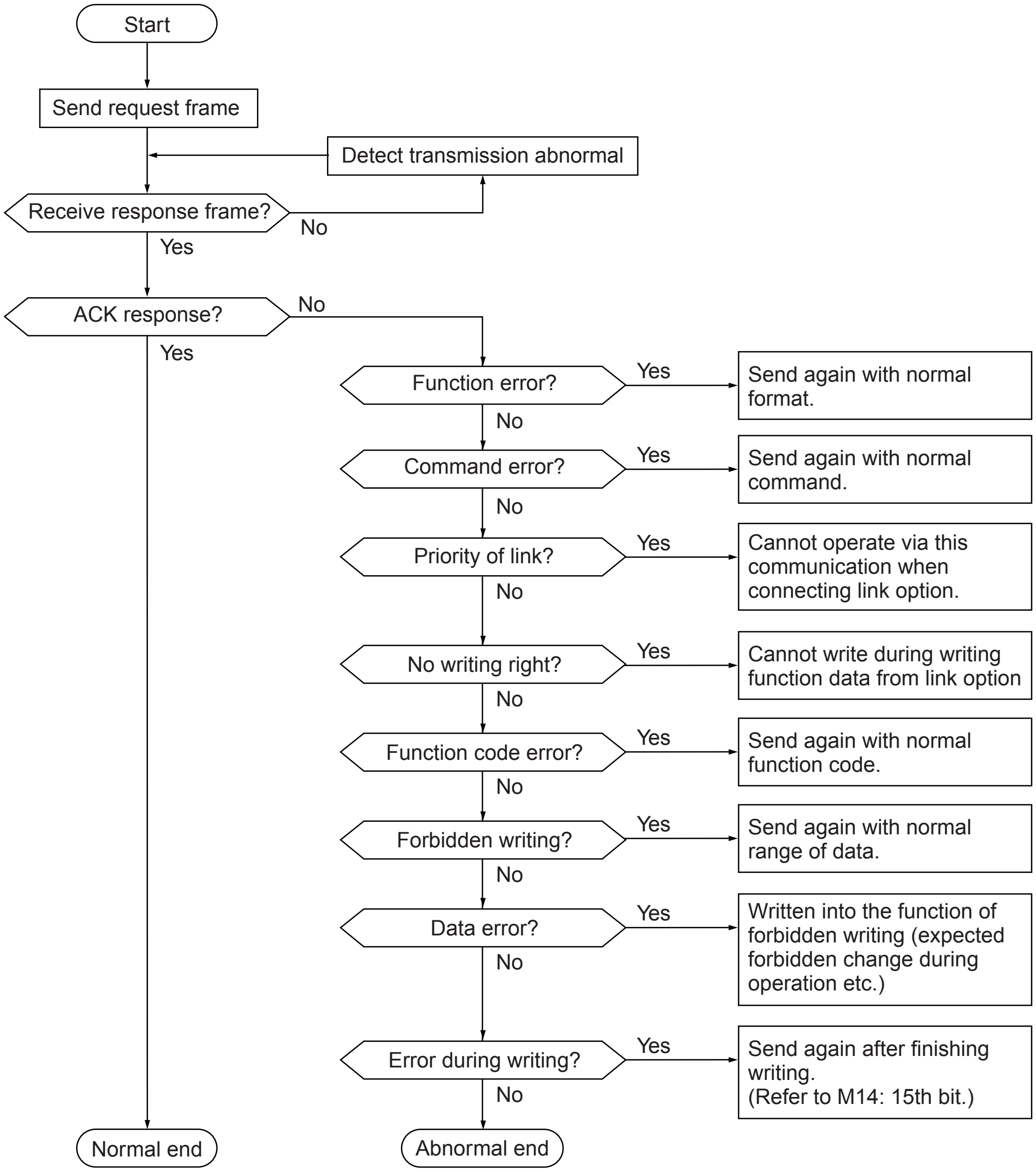
In a case of normal response, since this shows any transiently abnormal transmission by noise etc., the communication can be normally performed after this. (If this phenomena frequently occurs, investigation is necessary since there is a possibility of any abnormality.)

In a case of no response again, retry further. When the times of retrying exceed the pre-determined value (normally about 3 times), the problem in the hardware and the software of the upstream unit is expected. The investigation is necessary after abnormal ending as no response of the designated station.

(1) Polling procedure



(2) Selecting procedure



4.4.4 Example of communication

Typical examples of communication are shown as follows. (The station address are made 12.)

(1) Standard frame

[1] S05: Selecting frequency command (writing)

Request frame (host ⇒ inverter) .... 40.00 Hz command

SOH	1	2	ENQ	W	S	0	5	SP	0	F	A	0	ETX	8	1

ACK response frame (inverter ⇒ host)

SOH	1	2	ACK	W	S	0	5	SP	0	F	A	0	ETX	8	2

NAK response frame (inverter ⇒ host) ..... Priority of link error

SOH	1	2	NAK	W	S	0	5	SP	0	0	4	C	ETX	8	1

[2] M09: Polling output frequency (reading)

Request frame (host ⇒ inverter)

SOH	1	2	ENQ	R	M	0	9	SP	0	0	0	0	ETX	5	3

ACK response frame (inverter ⇒ host) 30.00Hz

SOH	1	2	ACK	R	M	0	9	SP	0	B	B	8	ETX	8	0

(2) Option frame

[1] Selection operation command (writing)

Request frame (host ⇒ inverter) .... FWD command

SOH	1	2	ENQ	f	0	0	0	1	ETX	9	2

ACK response frame (inverter ⇒ host)

SOH	1	2	ACK	f	ETX	D	2

NAK response frame (inverter ⇒ host) ..... Cause of error can be confirmed with
"M26: Transmission abnormal treatment code"

SOH	1	2	NAK	f	ETX	E	1

[2] Polling actual torque value (reading)

Request frame (host ⇒ inverter)

SOH	1	2	ENQ	h	ETX	D	3

ACK response frame (inverter ⇒ host) 85.00%

SOH	1	2	ACK	h	2	1	3	4	ETX	9	E

[3] Selecting operation command in broadcast (writing)

Request frame (host ⇒ inverter) .... REV command

SOH	9	9	ENQ	f	0	0	0	2	ETX	A	2

The response is not returned in broadcast,

4.4.5 Communication error

The errors detected by inverter as relating to communication are roughly categorized into transmission error, logic error and communication interrupt error, and the treatment at detecting error differs respectively.
At detecting the transmission error (error codes 71 - 73), the information using with a negative response frame is not performed. This is to avoid to be respond by plural inverters.
At detecting the logic error (error codes 74 - 81), the information using with a negative response frame is performed. Because the negative response informs the cause (content of the error), perform the treatment (see "4.4.3 Procedure on the host side") according to the content. However, in a case of the option frame, the cause is not informed because of a frame configuration of prior processing speed and having no frame to send the cause. If necessary to treat the error every cause, the cause can be confirmed by reading in M26 in the standard frame. (In M26, the newest communication error code is stored.)

(1) Communication error code

Error code	Error name	Description
71 (47_H)	Check sum error	Not matching check sum values in the frame for own station.
72 (48_H)	Parity error	Not matching the parities
73 (49_H)	Other error	Received error other than the above errors
74 ($4A_H$)	Format error	Incorrect transmission request character The characters of end of text are not in the specified position.
75 ($4B_H$)	Command error	Not existing command is sent.
76 ($4C_H$)	Priority of link error	Intending to write operation command in the state mounted a link option(If a link option has been mounted, the command data and operation command cannot be written through RS-485.)
77 ($4D_H$)	Error of no writing right	Intending to write new function data during writing from a link option
78 ($4E_H$)	Function code error	Requesting not existing function code
79 ($4F_H$)	Error of forbidden writing	Intending to write the function of forbidden writing or function of forbidden writing in operation during operation.
80 (50_H)	Data error	Writing data exceeded an available range of writing.
81 (51_H)	Error during writing	Intending to write new function data during writing a function.

(2) Action at communication error

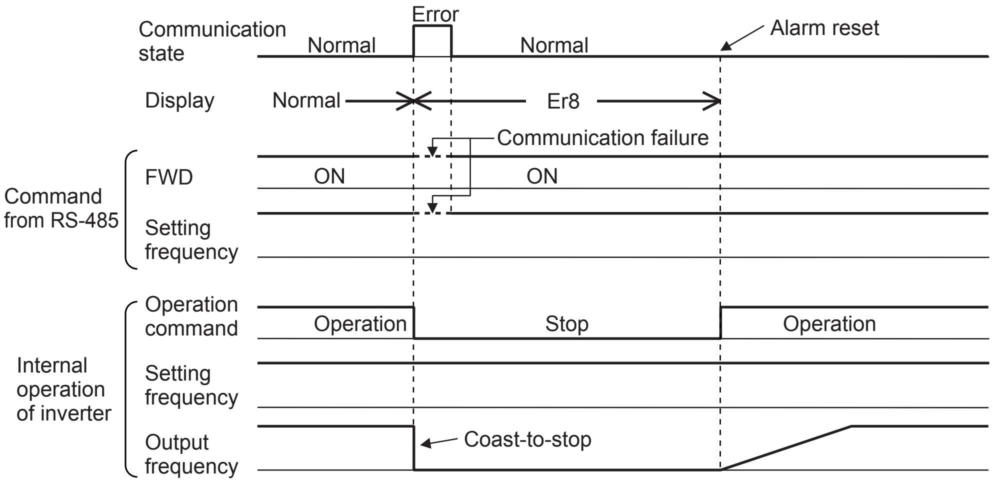
In case of occurring transmission errors (8 times continual) or transmission interruption error, the following actions can be selected. However, if not receiving the first SOH ((normal data) after switching on of inverter power supply or not operating by the communication (frequency command/ operation command), the error action is not performed.

1) Selecting action when occurring error (H32)

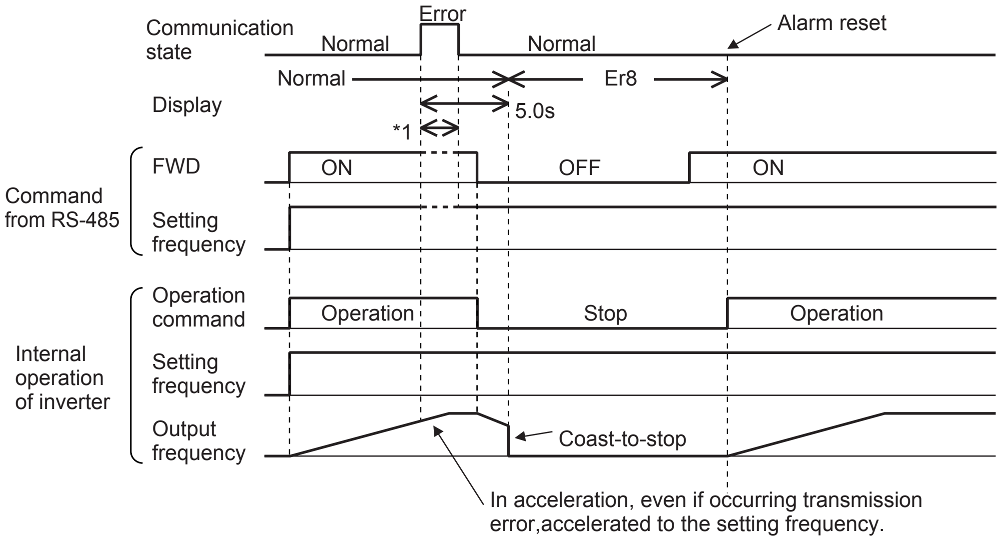
H32	Action at occurring error		Remarks
0	Immediate forced stop	Er8	
1	Continue operation within H33 time and stop	Er8	Keep the command just before the error within H33 time, but when restoring, operate following to the designation of communication.
2	Continue operation till restoration of the communication, and follow to designation of communication. However, when not restoring after H33 time, immediate forced stop	Er8	
3	Continue operation till restoration of the communication, and after the restoration, follow to designation of communication.	Automatic restoration after restoring communication	

2) Setting time of timer at occurring error (H33)
0.0 - 60.0s

In a case of H32=0 (Mode of immediate forced stop at occurring communication error)

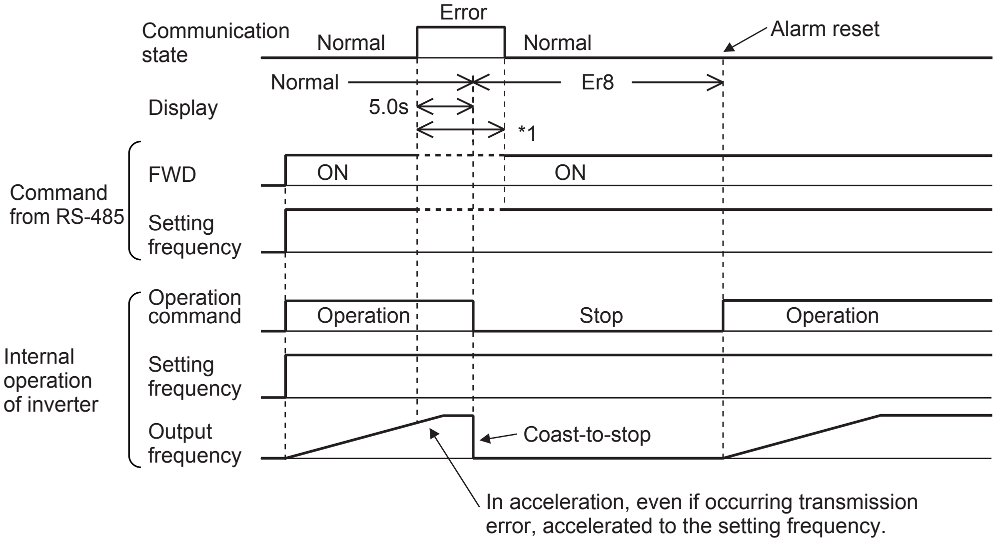


In a case of H32=1, H33=5.0s (Mode of immediate forced stop after 5s at occurring communication error)

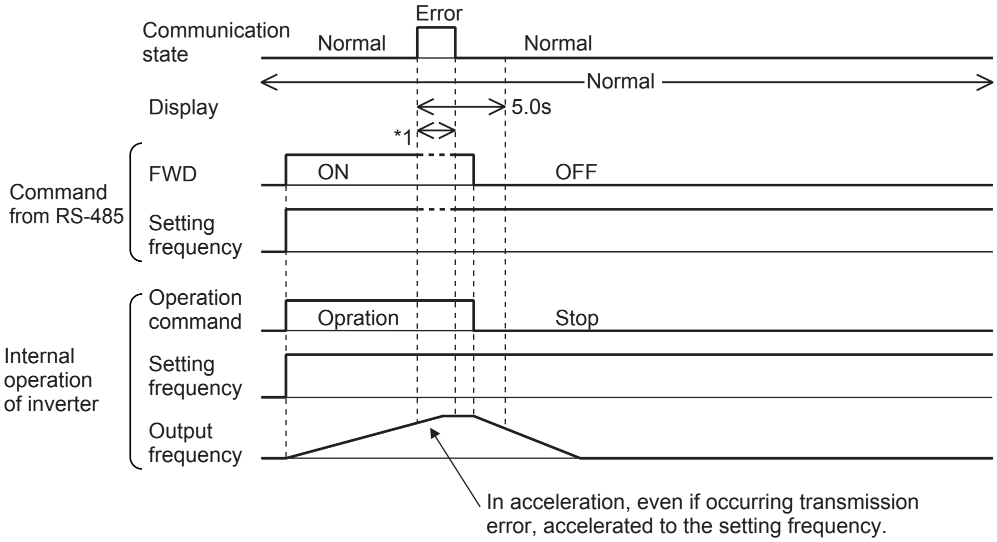


NOTE:
*1) In a period until restoring the communication, the commands (command data and operation data) just before the error are kept.

In a case of H32=2, H33=5.0s (The communication does not restore after elapsing 5s from occurring error, and inverter trips Er8.)

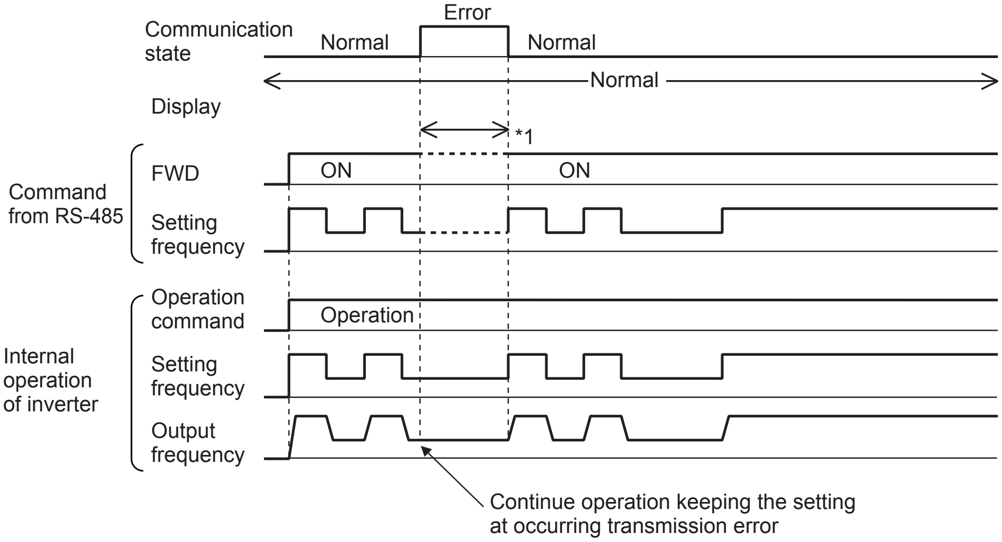


In a case of H32=2, H33=5.0s (A communication error occurs, but restored within 5s.)



NOTE:
*1) In a period until restoring the communication, the commands (command data and operation data) just before the error are kept.

In a case of H32=3 (When a communication error occurs, the operation continues)



⚠ **Warning**	There is possibility that stop command through RS-485 cannot be recognized when a communication error causes while operating through RS-485. Be sure that an emergency stop is made possible by using emergency stop of the external signal terminal (BX). **There is a fear of failure.**

[1] Transmission error

In case of occurring transmission errors (communication error codes 71 - 73) 8 times continually, error action is performed as communication error.

1) Increment conditions of transmission error counter
   - When a frame for own station
     ...... Communication error code 71
   - When a receiving error (parity, framing, over run) occurs
     ...... Communication error codes 72, 73

     (Because error receiving is limited to once per frame, the errors occurring after errors of 15 times are not counted till receiving next SOH)
2) Clearing condition of transmission error counter
   When a check sum check of the frame for own or other station was normal

[2] Communication interruption error

When the communication by this protocol stops, error action is performed as communication error.

1) Setting time of communication interruption detection (H38)
   0s (no detection), 1 - 60s
2) Clearing condition of communication interruption detection
   When a check sum check of the frame for own or other station was normal

NOTE:

*1) In a period until restoring the communication, the commands (command data and operation data) just before the error are kept.

4.5 Functions specific for communication

To operate the inverters or to monitor the state via communication, the following functions are specifically available for communication in addition to the functions for parameter change of the inverters. These functions adopted the common data format applicable to the types on and after G11/P11 series, so that it is possible to access to the different type by the same program on the host side.

4.5.1 Command data

Code	Name	Unit	Variable range	Min. unit	Read/write
S01	Setting frequency (p.u.)	-	-20000 to +20000 (Maximum frequency at ±20000)	1	R/W
S05	Setting frequency	Hz	0.00 to 400.00 (P11S: 0.00 to 120.00)	0.01	R/W

Note:
1) If both S01 and S05 are set (Data writing except 0), command of S01 becomes valid.
2) The data writing exceeding the setting range is possible, but the actual action will be restricted within the inverter.
3) When the command data shown here are read, it is not the command data of actual action but the command data communicated before (the final command data can be obtained by reading of the monitoring data described later).

4.5.2 Operation command data

Code	Name	Unit	Variable range	Min. unit	Read/write
S06	Operation command	-	Refer to the data format [14]	-	R/W
S07	Universal Do	-	Refer to the data format [15]	-	R/W
S12	Universal Ao	-	-20000 to +20000 (100% output at ±20000)	1	R/W

⚠ **Warning**	Be sure to check no run command because of sudden start when the alarm is reset while a run command through RS-485 is remained. **There is a fear of failure.**

Note:
1) Since X1-X9 are multi-function inputs, it is necessary to set the functions with E01-E09.
2) The alarm reset is executed, when RST signal changes from ON to OFF even there are no alarming factors.
3) Universal Do is a function utilizing inverter's Do via transmission. (In detail, refer to the detail descriptions E20-E24 in "Function Explanation" in the instruction manual of inverter).
4) The data writing exceeding the setting range is possible, but the actual action will be restricted within the inverter.
5) When the operation command is instructed through the communication, the relation to the inverter terminal commands becomes as follows.

Function				Command	
Classification		Symbol	Name	Transmission	Terminal block
Operation command		FWD/REV	FWD/REV command	Valid	Invalid
Multi-function command	0-3	SS1, 2, 4, 8	Multistep freq. selection		
	4, 5	RT1, RT2	ACC/DEC time selection		
	6	HLD	3-wire operation stop command	Invalid	
	7	BX	Coast-to-stop command	Valid	
	8	RST	Alarm reset		
	9	THR	Trip command (External fault)	Invalid	Valid
	10	JOG	Jogging operation	Invalid	
	11	Hz2/Hz1	Freq. set. 2 / Freq. set. 1	Valid	Invalid
	12	M2/M1	Motor 2 / Motor 1		
	13	DCBRK	DC brake command		
	14	TL2/TL1	Torque limiter 2 / Torque limiter 1		
	15, 16	SW50, SW60	Switching operation between line and inverter (50, 60Hz)		
	17, 18	UP, DOWN	UP, DOWN command	Invalid	Valid
	19	WE-KP	Write enable for KEYPAD	Valid	Invalid
	20	Hz/PID	PID control cancel		
	21	IVS	Inverse mode changeover (terminals 12 and C1)		
	22	IL	Interlock signal for 52-2	Invalid	Valid
	23	Hz/TRQ	TRQ control cancel	Valid	Invalid
	24	LE	Link enable (Bus, RS-485)	Invalid	Valid
	25	U-DI	Universal DI		
	26	STM	Pick up start mode	Valid	
	27	PG/Hz	SY-PG enable	Valid	Invalid
	28	SYC	Synchronization command		
	29	ZERO	Zero speed command		
	30	STOP1	Forced stop command	Invalid	Valid
	31	STOP2	Forced stop command with Deceleration time 4		
	32	EXITE	Pre-exciting command	Valid	

4.5.3 Function data

Code	Name	Unit	Variable range	Min. unit	Read/write
S08	Acceleration time F07	s	0.1-3600.0	0.1	R/W
S09	Deceleration time F08	s	0.1-3600.0	0.1	R/W
S10	Torque limit level 1 (Driving) F40	%	20.00-200.00(P11S, 20.00-150.00), 999	1.00	R/W
S11	Torque limit level 2 (Braking) F41	%	0.00, 20.00-200.00 (P11S, 20.00-150.00), 999	1.00	R/W

Note:
1) The writing to out of the range is treated as out of range error.
2) The acceleration and deceleration time S08 and S09 are assigned to "F07: Acceleration time 1" and "F08: Deceleration time 1" respectively.
3) The torque limit level 1 and 2 of S10 and S11 are assigned to "F40: Torque limit 1 (Driving)" and "F41: Torque limit 1 (Braking)" respectively.

4.5.4 Monitoring data

Code	Description	Unit	Range	Min. unit	Read/Write
M01	Setting frequency (Final data)	-	-20000 to +20000 (Maximum frequency at ±20000)	1	R
M05	Setting frequency (Final data)	Hz	0-400.00 (P11S: 0.00-120.00)	0.01	R
M06	Output frequency 1	-	-20000 to +20000 (Maximum frequency at ±20000)	1	R
M07	Torque calculation value	%	-200.00 to +200.00	0.01	R
M08	Torque current	%	-200.00 to +200.00	0.01	R
M09	Output frequency 1	Hz	0.00-400.00 (P11S: 0.00-120.00)	0.01	R
M10	Input power	%	0.00-200.00	0.01	R
M11	Output current	%	0.00-200.00 (Inverter rating at 100.00)	0.01	R
M12	Output voltage	V	0.0-600.0	1.0	R
M13	Operation command (Final data)	-	Refer to the data format [14]	-	R
M14	Operating state	-	Refer to the data format [16]	-	R
M15	Y1-Y5 output terminal data	-	Refer to the data format [15]	-	R
M16	Fault memory 0	-	Refer to the data format [10]	-	R
M17	Fault memory (1st prior)	-			
M18	Fault memory (2nd prior)	-			
M19	Fault memory (3rd prior)	-			
M20	Operating time	h	0-65535	1	R
M21	DC link circuit voltage	V	0-1000	1	R
M23	Type code	-	Refer to the data format [17]	-	R
M24	Capacity code	-	Refer to the data format [11]	-	R
M25	ROM version	-	0-64999	1	R
M26	Transmission error code	-	Refer to the data format [10]	-	R
M27	Setting frequency at alarming (Final data)	-	-20000 to +20000 (Maximum frequency at 20000)	1	R
M31	Setting Frequency at alarming (Final data)	Hz	0-400.00 (P11S: 0.00-120.00)	0.01	R
M32	Output frequency at alarming	-	-20000 to +20000 (Maximum frequency at ±20000)	1	R
M33	Torque calculation value at alarming	%	-200.00 to +200.00	0.01	R
M34	Torque current at alarming	%	-200.00 to +200.00	0.01	R
M35	Output frequency 1 at alarming	Hz	-400.00 to +400.00 (P11S: -120.00 to +120.00)	0.01	R
M36	Input power at alarming	%	0.00-200.00	0.01	R
M37	Output current at alarming	%	0.00-200.00 (Inverter rating at 100.00)	0.01	R
M38	Output voltage at alarming	V	0.0-600.0	1.0	R
M39	Operation command at alarming	-	Refer to the data format [14]	-	R
M40	Operating state at alarming	-	Refer to the data format [16]	-	R
M41	Y1-Y5 output terminal data at alarming	-	Refer to the data format [15]	-	R
M42	Operation time at alarming	h	0-65535	1	R
M43	DC link circuit voltage at alarming	V	0-1000	1	R
M44	Inverter internal air temp. at alarming	°C	0-120	1	R
M45	Cooling fin temp. at alarming	°C	0-120	1	R
M46	Life of main circuit capacitor	%	0.0-100.0	0.1	R
M47	Life of printed circuit board capacitor	h	0-65535	1	R
M48	Life of cooling fan	h	0-65535	1	R

Note :
1) The output frequency 1 is before slip compensation.
2) The output frequency 1 with speed regulator (using option OPC-G11S-PG) is treated as the synchronous frequency.

4.6 Function data format

The data formats for various function data of the inverters are defined here. The data shall be prepared according to the following data format specifications. The instruction manual of inverter shall be referred to for the range and unit of data.

4.6.1 List of function data format

Code	Name	Data format	Code	Name	Data format
F00	Data protection	[1]	E01	X1 terminal function	[1]
F01	Frequency command 1	[1]	E02	X2 terminal function	[1]
F02	Operation method	[1]	E03	X3 terminal function	[1]
F03	Maximum output frequency 1	[1]	E04	X4 terminal function	[1]
F04	Base frequency 1	[1]	E05	X5 terminal function	[1]
F05	Rated voltage 1	[1]	E06	X6 terminal function	[1]
F06	Maximum output voltage 1	[1]	E07	X7 terminal function	[1]
F07	Acceleration time 1	[12]	E08	X8 terminal function	[1]
F08	Deceleration time 1	[12]	E09	X9 terminal function	[1]
F09	Torque boost 1	[3]	E10	Acceleration time 2	[12]
F10	Electronic thermal overload relay 1 (Selection)	[1]	E11	Deceleration time 2	[12]
F11	Electronic thermal overload relay 1 (Level)	[12]	E12	Acceleration time 3	[12]
F12	Electronic thermal overload relay 1 (Thermal time constant)	[3]	E13	Deceleration time 3	[12]
			E14	Acceleration time 4	[12]
F13	Electronic thermal overload relay (Braking resistor)	[1]	E15	Deceleration time 4	[12]
F14	Restart after momentary power failure (Selection)	[1]	E16	Torque limiter 2 (Driving)	[1]
F15	Frequency limiter (High)	[1]	E17	Torque limiter 2 (Braking)	[1]
F16	Frequency limiter (Low)	[1]	E20	Y1 terminal function	[1]
F17	Gain (for frequency setting signal)	[3]	E21	Y2 terminal function	[1]
F18	Bias frequency	[4]	E22	Y3 terminal function	[1]
F20	DC brake (Starting frequency)	[3]	E23	Y4 terminal function	[1]
F21	DC brake (Braking level)	[1]	E24	Y5A, Y5C terminal functions	[1]
F22	DC brake (Braking time)	[3]	E25	Y5 logical reverse functiom	[1]
F23	Starting frequency	[3]	E30	Frequency arrival (FAR) (Detecting width)	[3]
F24	Starting frequency (Holding time)	[3]	E31	Frequency detection 1 (FDT) (level)	[1]
F25	Stop frequency	[3]	E32	Frequency detection (FDT) (Hysteresis width)	[3]
F26	Motor sound (Carrier frequency)	[1] *1	E33	Overload early warning (Mode selection)	[1]
F27	Motor sound (Sound tone)	[1]	E34	Overload early warning 1 (level)	[12]
F30	FMA terminal (Voltage adjust)	[1]	E35	Overload early warning (Timer time)	[3]
F31	FMA terminal (Function selection)	[1]	E36	Frequency detection 2 (FDT) (level)	[1]
F33	FMP terminal (Pulse rate multiplier)	[1]	E37	Overload early warning 2 (level)	[12]
F34	FMP terminal (Voltage adjust)	[1]	E40	Display coefficient A	[12]
F35	FMP terminal (Function selection)	[1]	E41	Display coefficient B	[12]
F36	30Ry operation mode	[1]	E42	Display filter	[3]
F40	Torque limit 1 (Driving)	[1]	E43	LED monitor (Display selection)	[1]
F41	Torque limit 1 (Braking)	[1]	E44	LED monitor (Display at STP mode)	[1]
F42	Torque vector control 1	[1]	E45	LCD monitor (Display selection)	[1]
			E46	LCD monitor (Language)	[1]
			E47	LCD monitor (Contrast adjustment)	[1]

NOTE:
*1) 0.75 kHz is treated as 0000H.

Code	Name	Data format
C01	Jump frequency 1	[1]
C02	Jump frequency 2	[1]
C03	Jump frequency 3	[1]
C04	Jump frequency (Width)	[1]
C05	Multi-step frequency 1	[5]
C06	Multi-step frequency 2	[5]
C07	Multi-step frequency 3	[5]
C08	Multi-step frequency 4	[5]
C09	Multi-step frequency 5	[5]
C10	Multi-step frequency 6	[5]
C11	Multi-step frequency 7	[5]
C12	Multi-step frequency 8	[5]
C13	Multi-step frequency 9	[5]
C14	Multi-step frequency 10	[5]
C15	Multi-step frequency 11	[5]
C16	Multi-step frequency 12	[5]
C17	Multi-step frequency 13	[5]
C18	Multi-step frequency 14	[5]
C19	Multi-step frequency 15	[5]
C20	Jogging frequency	[5]
C21	Pattern operation	[1]
C22	Stage 1	[13]
C23	Stage 2	[13]
C24	Stage 3	[13]
C25	Stage 4	[13]
C26	Stage 5	[13]
C27	Stage 6	[13]
C28	Stage 7	[13]
C30	Frequency setting	[1]
C31	Analog input offset (terminal 12) / Analog input bias (terminal 12)	[4]
C32	Analog input offset (terminal C1) / Analog input gain (terminal 12)	[4]
C33	Analog filter	[5]
P01	Motor 1 (Number of poles)	[9]
P02	Motor 1 (Capacity)	[5]
P03	Motor 1 (Rated current)	[12]
P04	Motor 1 (Auto-tuning)	[1]
P05	Motor 1 (On-line tuning)	[1]
P06	Motor 1 (No-load current)	[12]
P07	Motor 1 (%R1)	[5]
P08	Motor 1 (%X)	[5]
P09	Motor 1 (Slip compensation control)	[5]

Code	Name	Data format
H03	Data initializing	[1] *3
H04	Auto-reset (Times)	[1]
H05	Auto-reset(Reset interval)	[1]
H06	Fan stop operation	[1]
H07	ACC/DEC pattern (Mode selection)	[1]
H08	Reverse phase sequence lock	[1]
H09	Start mode (Pick-up mode)	[1]
H10	Energy-saving operation	[1]
H11	Deceleration mode	[1]
H12	Instantaneous overcurrent limiting	[1]
H13	Auto-restart (Restart time)	[3]
H14	Auto-restart (Frequency fall rate)	[5]
H15	Auto-restart (Holding DC voltage)	[1]
H16	Auto-restart (OPR command selfhold time)	[3] *1
H18	Torque control (Mode selection)	[1]
H19	Active drive	[1]
H20	PID control (Mode selection)	[1]
H21	PID control (Feedback signal)	[1]
H22	PID control (P-Gain)	[5]
H23	PID control (I-time)	[3]
H24	PID control (D-time)	[5]
H25	PID control (Feedback filter)	[3]
H26	PTC thermistor (Mode selection)	[1]
H27	PTC thermistor (Level)	[5]
H28	Droop operation	[4]
H30	Serial link (Function selection)	[1]
H31	RS-485 (Address)	[1] *2
H32	RS-485 (Mode selection on error)	[1] *2
H33	RS-485 (Timer time)	[3] *2
H34	RS-485 (Baud rate)	[1] *2
H35	RS-485 (Data length)	[1] *2
H36	RS-485 (Parity check)	[1] *2
H37	RS-485 (Stop bits)	[1] *2
H38	RS-485 (No response detection time)	[1] *2
H39	RS-485 (Response interval)	[5] *2
A01	Maximum frequency 2	[1]
A02	Base frequency 2	[1]
A03	Rated voltage 2 (at base speed)	[1]
A04	Maximum output voltage 2	[1]
A05	Torque boost 2	[3]
A06	Electronic thermal 2 (Selection)	[1]
A07	Electronic thermal 2 (Level)	[12]
A08	Electronic thermal 2 (Thermal time constant)	[3]
A09	Torque vector control 2	[1]
A10	Motor 2 (Number of motor-2 poles)	[9]
A11	Motor 2 (Capacity)	[5]
A12	Motor 2 (Rated current)	[12]
A13	Motor 2 (Auto-tuning)	[1]
A14	Motor 2 (On-line tuning)	[1]
A15	Motor 2 (No-load current	[12]
A16	Motor 2 (%R1 setting)	[5]
A17	Motor 2 (%X setting)	[5]
A18	Motor 2 (Slip compensation control 2)	[5]

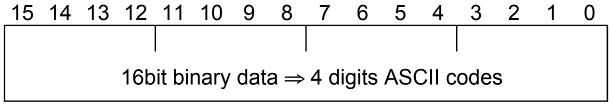
NOTE:
*1) 999 is treated as 03E7H (99.9).
*2) Read-only from communication.
*3) The communication might not be able to be continued by writing (data 1).

Code	Name	Data format	Code	Name	Data format
o01	Speed command system / automatic speed control system	[18]	M01	Setting frequency (Final data)	[2]
o02	Time constant of PG vector and speed command filter	[7]	M05	Setting frequency (Final data)	[5]
o03	Number of feedback PG pulses	[1]	M06	Output frequency 1	[2]
o04	Constant P of feedback speed controller	[5]	M07	Torque calculation value	[6]
o05	Constant I of feedback speed controller	[7]	M08	Torque current	[6]
o06	Time constant of feedback speed detection filter	[7]	M09	Output frequency 1	[19]
o07	Feedback pulse correction coefficient 1	[1]	M10	Input power	[5]
o08	Feedback pulse correction coefficient 2	[1]	M11	Output current	[5]
o09	Base side number of encoder pulses	[1]	M12	Output voltage	[3]
o10	Time constant of pulse train input filter	[7]	M13	Operation command (Final data)	[14]
o11	Command pulse compensation coefficient 1	[1]	M14	Operating state	[16]
o12	Command pulse compensation coefficient 2	[1]	M15	Y1-Y5 output terminal data	[15]
o13	Main speed regulator gain	[3]	M16	Fault memory 0	[10]
o14	APR P gain	[5]	M17	Fault memory (1st prior)	[10]
o15	Z phase matching gain	[3]	M18	Fault memory (2nd prior)	[10]
o16	Offset angle	[1]	M19	Fault memory (3rd prior)	[10]
o17	Detecting angle width for completion of synchronizing	[1]	M20	Operating time	[1]
o18	Too mach deviation	[1]	M21	DC link circuit voltage	[1]
o19	Di function selection	[1]	M23	Type code	[17]
o20	Di input mode selection	[1]	M24	Capacity code	[11]
o21	Do function selection	[1]	M25	ROM version	[1]
o22	Ai function selection	[18]	M26	Transmission error processing code	[10]
o23	Ao function selection	[18]	M27	Setting frequency at alarming (Final data)	[2]
o24	Ao1 voltage adjust	[3]	M31	Setting frequency at alarming (Final data)	[5]
o25	Ao2 voltage adjust	[3]	M32	Output frequency at alarming	[2]
o26	Dedicated function for manufacturer	–	M33	Torque calculation value at alarming	[6]
o27	Mode selection on error	[1]	M34	Torque current at alarming	[6]
o28	Timer time setting	[3]	M35	Output frequency 1 at alarming	[19]
o29	Transmission format selection	[1]	M36	Input power at alarming	[5]
			M37	Output current at alarming	[5]
			M38	Output voltage at alarming	[3]
			M39	Operation command at alarming	[14]
S01	Setting frequency (p.u.)	[2]	M40	Operating state at alarming	[16]
S05	Setting frequency	[5]	M41	Y1-Y5 output terminal data at alarming	[15]
S06	Operation command	[14]	M42	Operating time at alarming	[1]
S07	Universal Do	[15]	M43	DC link circuit voltage at alarming	[1]
S08	Acceleration time	[3]	M44	Inverter internal air temp. at alarming	[1]
S09	Deceleration time	[3]	M45	Cooling fin temp. at alarming	[1]
S10	Torque limit level 1	[5] *1	M46	Life of main circuit capacitor	[3]
S11	Torque limit level 1	[5] *1	M47	Life of printed circuit board capacitor	[1]
S12	Universal Ao	[2]	M48	Life of cooling fan	[1]

NOTE:
*1) 999 is treated as 03E7H (99.9)

4.6.2 Data format specification

All data within the data field of the communication frame except data format [19] shall be represented by ASCII code of 4 digits converted from 16 bits binary data length.



Data format [1] **Interger data (Positive): Min. unit 1**

Example) If "F15:Frequency limiter (high)" = 60 Hz,
Since 60 = 003C$_H$

⇨ 0 0 3 C

Data format [2] **Integer data (Positive, negative): Min. unit 1**

Example) If being -20,
Since -20 = FFEC$_H$

⇨ F F E C

Data format [3] **Decimal data (Positive): Min. unit 0.1**

Example) If "F17:Gain (for frequency setting signal)" = 100.0%,
Since 100.0 x 10 = 1000 = 03E8$_H$

⇨ 0 3 E 8

Data format [4] **Decimal data (Positive, negative): Min. unit 0.1**

Example) If "C31:Analog input offset (terminal 12)" = -5.0%,
Since -5.0 x 10 = -50 = FFCE$_H$

⇨ F F C E

Data format [5] **Decimal data (Positive): Min. unit 0.01**

Example) If "C05:Multi-step frequency 1" = 50.25 Hz,
Since 50.25 x 100 = 5025 = 13A1$_H$

⇨ 1 3 A 1

Data format [6] **Decimal data (Positive, negative): Min. unit 0.01**

Example) If "M07:Actual torque value" = -85.38%,
Since -85.38 x 100 = -8538 = DEA6$_H$

⇨ D E A 6

Data format [7] **Decimal data (Positive): Min. unit 0.001**

Example) If "o05:Constant I of feedback speed controller" = 0.105 s,
Since 0.105 x 1000 = 105 = 0069H

⇨ 0 0 6 9

Data format [8] **Decimal data (Positive, negative): Min. unit 0.001**

Example) If being -1.234,
Since -1.234 x 1000 = -1234 = FB2E$_H$

⇨ F B 2 E

Data format [9] **Integer data (Positive): Min. unit 2**

Example) If "P01:Motor 1 (number of poles)" = 2 poles,
Since 2 = 0002$_H$

⇨ 0 0 0 2

Data format [10] **Alarm code**

Code	Description	
0	No alarm	---
1	Overcurrent (During acceleration)	OC1
2	Overcurrent (During deceleration)	OC2
3	Overcurrent (While running at constant speed)	OC3
5	Ground fault	EF
6	Overvoltage (During acceleration)	OU1
7	Overvoltage (During deceleration)	OU2
8	Overvoltage (While running at constant speed)	OU3
10	Undervoltage	LU
11	Input phase lose	Lin
14	Fuse blown	FUS
16	Output wiring error	Er7
17	Overheat of heat sink in inverter	OH1
18	External alarm input	OH2
19	Overheat of unit internal temp.	OH3
22	Overheat of DB resistance	dbH
23	Electronic thermal overload relay (Motor 1)	OL1
24	Electronic thermal overload relay (Motor 2)	OL2
25	Electronic thermal overload relay (Inverter)	OLU
27	Overspeed	OS
28	PG error	Pg
31	Memory error	Er1
32	KEYPAD panel communication error	Er2
33	CPU error	Er3
34	Option communication error	Er4
35	Option error	Er5
36	Operating proc. error	Er6
37	Output phase loss error	Er7
38	RS-485 communication error	Er8
71	Check sum error	
72	Parity error	
73	Other errors	
74	Format error	
75	Command error	
76	Priority of link	
77	No writing right for error	
78	Function code error	
79	Forbidden writing error	
80	Data error	
81	Error during writing	

Example) If overvoltage during acceleration (OU1)
Since 6 = 0006$_H$

⇨ 0 0 0 6

Data format [11] Capacity code

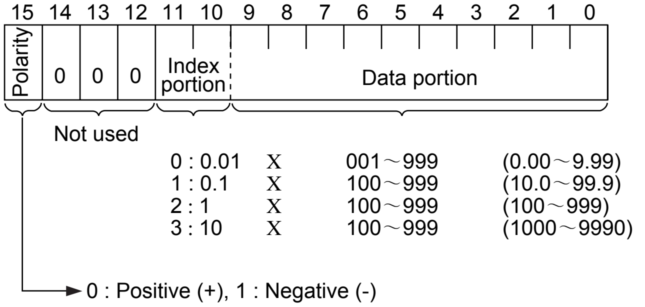
Code	Capacity (kW)	Code	Capacity (kW)
5	0.05	3700	37
10	0.1	4500	45
20	0.2	5500	55
40	0.4	7500	75
75	0.75	9000	90
150	1.5	11000	110
220	2.2	13200	132
370	3.7	16000	160
550	5.5	20000	200
750	7.5	22000	220
1100	11	25000	250
1500	15	28000	280
1850	18.5	31500	315
2200	22	35500	355
3000	30	40000	400

Example) If 30kW

Since 30 x 100 = 3000 = $0BB8_H$

⇨ 0 B B 8

Data format [12] Exponential data (ACC/DEC time, current value, display coefficient)

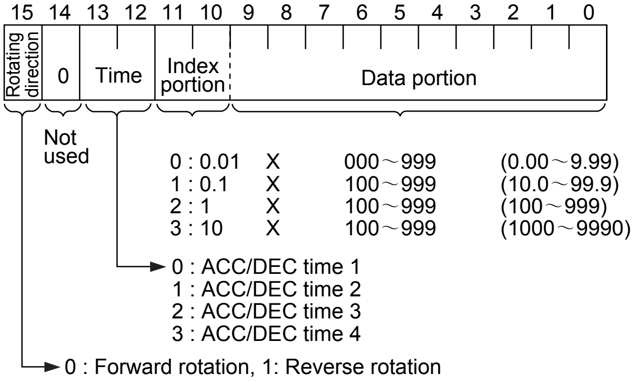


Example) If "F07:Acceleration time 1" = 20.0s,

20.0 = 0.1 x 200 ⇒ 0400_H + $00C8_H$ = $04C8_H$

⇨ 0 4 C 8

Data format [13] Pattern operation

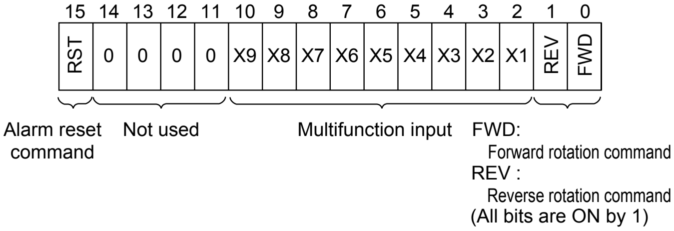


Example) If "C22:Stage1" = 10.0s R2 (10s, reverse rotation, acceleration time 2/deceleration time 2),

10.0 = 0.1 x 100 ⇒ 9000_H + 0400_H + 0064_H = 9464_H

⇨ 9 4 6 4

Data format [14] Operation command

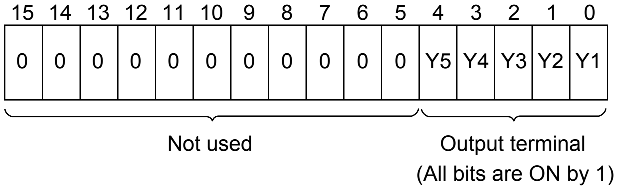


Example) If "S06:Operation command" = FWD, X1, X5 = ON

0000 0000 0100 0101_b = 0045_H

⇨ 0 0 4 5

Data format [15] Y1-Y5 output terminal

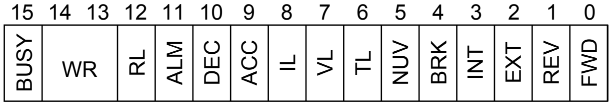


Example) If "M15:Y1-Y5 output terminal" = Y1, Y5 = ON

0000 0000 0001 0001_b.= 0011_H

⇨ 0 0 1 1

Data format [16] Operating status



(All bits are ON or active by 1)

FWD: In forward operation
REV: In reverse operation
EXT: In DC braking (or in pre-excitation)
INT: Inverter trip
BRK: In braking
NUV: DC link voltage establishment (undervoltage at 0)
TL: In torque limiting
VL: In voltage limiting
IL: In current limiting
ACC: In acceleration
DEC: In deceleration
ALM: Alarm
RL: Transmission valid
WR: Function writing right
  0: Keypad panel
  1: RS-485
  2: Link (option)
BUSY: In data writing (processing)

Example) Monitoring method is similar as in the formats [14] and [15].

Data format [17] **Type code**

15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
Unit type	Generation	Series	Voltage series

Code	Type	Generation	Series	Voltage series
1	VG	11th series	For Japan	100V single phase
2	G	-	For Asia	200V single phase
3	P	-	For China	200V three phase
4	E	-	For Europe	400V three phase
5	C	-	For USA	575V three phase
6	S	-	-	-

Data format [18] **Code setting (1 - 4 figures)**

15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
Data 4	Data 3	Data 2	Data 1

Example) If "o22:Ai function selection" = 123,
Since 123 = 0123_H

⇨ 0 1 2 3

Data format [19] **Polarity + decimal (positive): Min. unit 0.01**

19 18 17 16	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Polarity (' ', '-')	16-bit binary data ⇒ ASCII of 4 figures

Example)
If "M09:Output frequency" = 60.00 Hz (forward rotation)
Since 60.00 x 100 = 6000 = 1770_H,
(Same as in the data format [5] when being positive data)

⇨ 1 7 7 0

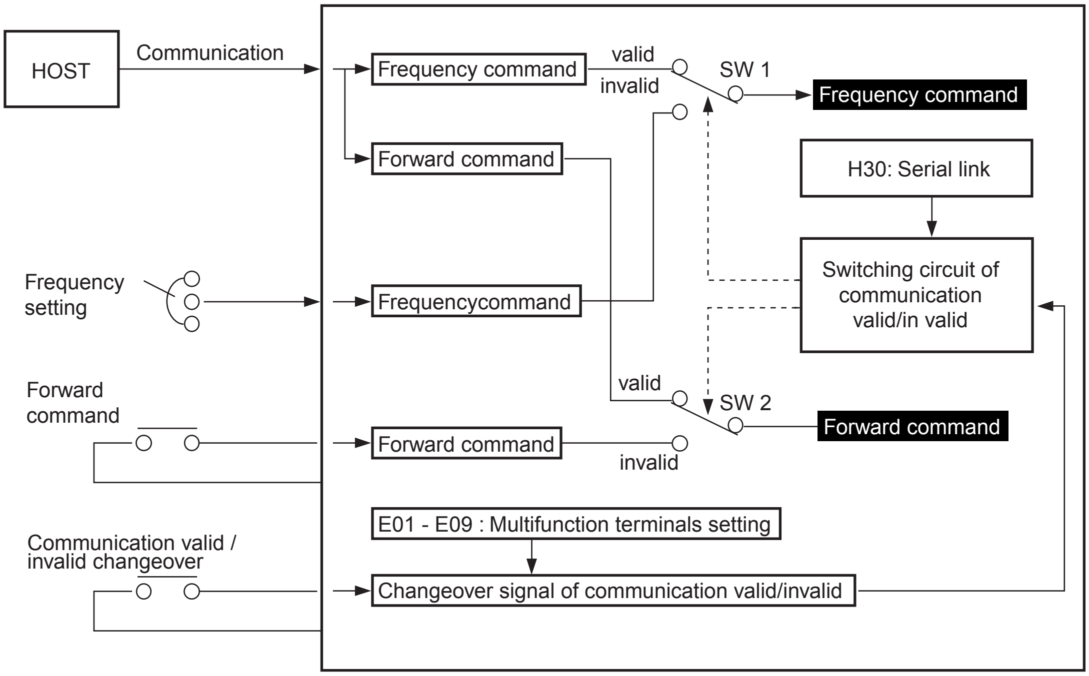
If "M09:Output frequency" = -60.00 Hz (reverse rotation)
60.00 x 100 = 6000 = 1770H
Minus is added into special additional data.

⇨ – 1 7 7 0

4.7 Changeover of communications

In order to perform the inverter operation through the communication (by command data and operation data), the communication should be made valid under the condition that 1-3 of "H30: Serial link (Function selection)" has been selected. (The reading and writing of function data and functions are possible in any time regardless the communication valid or invalid).

⚠ **Warning**	Be sure to check no run command because of sudden start when valid/invalid communication is changed over, while a run command through RS-485 or external signal terminals is remained. **There is a fear of failure.**



4.7.1 Changeover method for communication valid/ invalid

The changeover of the communication valid/invalid can be performed by the multi-function command terminals (terminals X1-X9) on the inverter. However, it is necessary to set the inverter's multi-function command input terminals (E01 - E09: X1-X9 terminals function) to the link operation selection (Data 24). If the multi-function command terminals have not been set to the link operation selection, the communication becomes valid automatically.

Input terminals	State
OFF	Communication invalid mode
ON	Communication valid mode

Note:
1) Since all memories are initialized at switching power supply on, the command data and operation data must be write again from the upstream units.
2) Even when the communication is invalid, the writing of command data and operation data is valid, but it is not reflected by SW1·SW2.The changeover without shock is possible by the way where the data are set previously during the communication invalid mode at first, then the mode is changed over to the communication valid mode.

4.7.2 Link function (operation selection)

The setting (valid/invalid) for command data and operation data during the communication valid period is possible individually by the setting of " H30: Serial link (Function selection)". (By making the communication always valid without setting at the multi-function terminals, changeover for the H30 data valid/invalid can change over the communication valid/invalid, similar to the changeover with multi-function command terminals.)

Link function H30	During communication is valid		During communication is invalid
	SW1 (Command data)	SW2 (Operation data)	SW1, SW2
0	Invalid	Invalid	Invalid
1	Valid	Invalid	
2	Invalid	Valid	
3	Valid	Valid	

4.7.3 Coexistence of link (option) and RS-485 communication

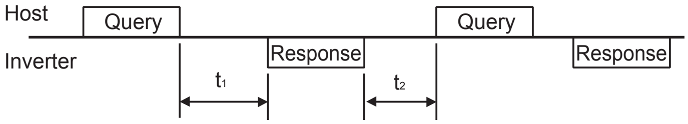
When the link options (such as T link, field bus, etc.) are mounted on the inverter, the communication is positioned as described below and the functions are restricted.

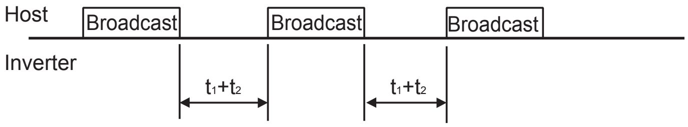
Link : The operation through the communication (either one of command data and operation data or both), the operation monitoring, and the reading and changing of functions are possible.

The communication
: The operation monitoring and the reading and changing of functions as loader are possible (Operation through the communication is impossible).

Note:
1) The communication valid bit of M14: Operating state becomes the state signal of link option and not of RS-485.
2) When the command data and operation data are accessed from RS-485, NAK is returned.
3) If the writing of functions is performed through this communication during the writing of functions by the link, NAK (no writing right error) is returned.

4.8 Response Time





4.8.1 Response interval time

The time till start of response sending after receiving a query from the host such as PLC and PC can be set. By means of the response interval time setting, it is possible to match the sending timing even with the host having slow processing speed.

- Response interval time (t_1)
  t_1: Response interval time setting (H39) + t_d
  t_d: Processing time of inverter

$t_d \leq 10ms$

Frame	Processing		Command
Standard frame	Polling		R, E
	Selecting	s01 - s07	W, A
		s08 - s11	A
		Function data	A
Option frame	Polling		g, h, i, j, k
	Selecting		a, e, f, m

$t_d \leq 100ms$

Frame	Processing		Command
Standard frame	Selecting	s08 - s11	W
		Function data	W

$t_d \leq 5s$

Frame	Processing		Command
Standard frame	Selecting	H03	W

Note:
1) In case of the broadcast, the setting of response interval is invalid (0s) because the inverter does not return the response, but it is necessary to keep t_d even in this case. (The all data received during t_d become neglected.)
2) If auto-tuning of P04 and A13 is written by single/continuous functions, no response returns till completion of the tuning or occurring of Er7. If tuning starting is commanded by the terminal blocks or FWD/REV on the keypad panel during the invalid state of communication, take care that the waiting state continues till receiving of the starting command).

4.8.2 Time of receiving preparation completion

This defines the time from returning the response to completing receiving preparation of the input port in the inverter.

t_2: Time of receiving preparation completion ≤ 0.1 ms

4.9 Function

■ H30 Serial link (Function select)

H30 LINK FUNC

The link function (communication function) can connect RS-485 (provided as standard) to various bus connections (option).
The link function includes:

1) Monitoring (various data monitoring and function data check)
2) Frequency setting
3) Operation commands
(Commands such as FWD and REV set at the digital inputs)
4) Writing function data

Setting link function when communication is valid

Setting value	Frequency setting	Operation command
0	Invalid	Invalid
1	Valid	Invalid
2	Invalid	Valid
3	Valid	Valid

Monitoring function and writing function data function are always valid. If making the communication of digital input invalid, the state becomes similar to 0 of the setting value. When option related to busses is provided, this setting in the function becomes the function selecting of the option, and the function of RS-485 is restricted only to monitoring and writing function data. When not providing option, this setting becomes function selecting of RS-485.

■ H31 RS-485 (Address)
to
■ H39 RS-485 (Response interval)

These set various conditions of the communication through RS-485. Set these so as to match with upstream devices. For the protocols, refer to the technical manual.

H31 485ADDRESS

Setting the station address of RS-485
- Setting range: 1 - 31

H32 MODE ON ER

H33 TIMER

Setting action when occurring error and value of timer for the action

Setting value	Processing at communication error
0	Immediate Er8 alarm (forced stop)
1	Continue operation within timer time,after timer time, Er8 alarm
2	Continue operation within timer time, and retry operation. After timer time, Er8 alarm if communication error, or continue operation if no error.
3	Continue operation

H34 BAUD RATE

Setting transmission speed

Setting value	Transmission speed
0	19200 bits/s
1	9600 bits/s
2	4800 bits/s
3	2400 bits/s
4	1200 bits/s

H35 LENGTH

Setting data length

Setting value	Data length
0	8 bits
1	7 bits

H36 PARITY

Setting parity bits

Setting value	Parity bit
0	None
1	Even number
2	Odd number

H37 STOP BITS

Setting stop bits

Setting value	Stop bit
0	2 bits
1	1 bit

H38 NO RES t

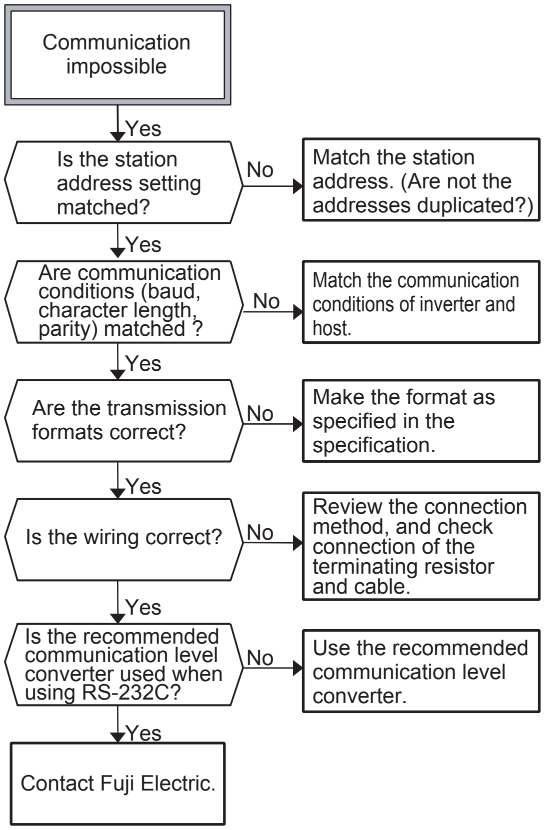
In a system where the local station is always surely accessed within a specific time, this function detects that access was stopped due to an open-circuit or other fault and invoke an Er8 trip.

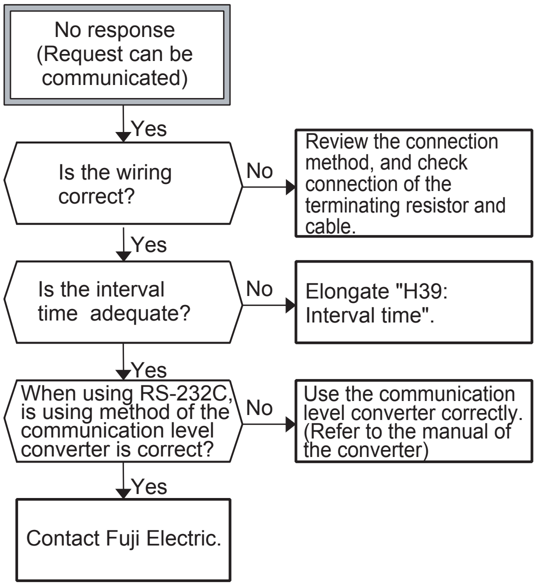
Setting range: 0: No detection
1 to 60s

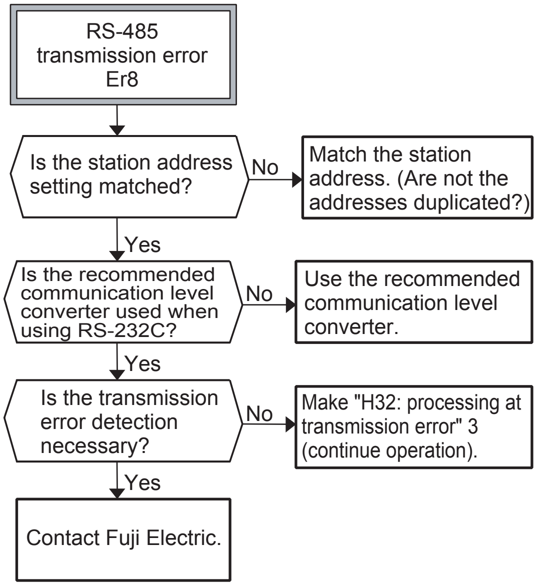
H39 INTERVAL

This function sets the time from being issued a request from the upstream device to a response starting to return.
Setting range: 0.00 to 1.00s

4.10 Troubleshooting







4.11 Appendix

4.11.1 Communication level converter

A communication level converter of product on the market is necessary for connection with a device provided RS-232C as a serial interface. To correctly use, be sure to use the converter fulfilling the following specification.

- Specification of the recommended communication level converter
  - Changeover method of sending/receiving .... Automatic changeover by monitoring the sending data on the host (RS-232C) side
  - Isolation .... The device shall be electrically isolated from RS-485
  - Fail safe .... With fail safe function
  - Others .... Excellent noise- proof characteristics

4.11.2 ASCII code list

	00H	**10H**	**20H**	**30H**	**40H**	**50H**	**60H**	**70H**
0H	NUL	DLE	SP	0	@	P	`	p
1H	SOH	DC1	!	1	A	Q	a	q
2H	STX	DC2	"	2	B	R	b	r
3H	ETX	DC3	#	3	C	S	c	s
4H	EOT	DC4	$	4	D	T	d	t
5H	ENQ	NAK	%	5	E	U	e	u
6H	ACK	SYN	&	6	F	V	f	v
7H	BEL	ETB	'	7	G	W	g	w
8H	BS	CAN	(	8	H	X	h	x
9H	HT	EM	)	9	I	Y	i	y
AH	LF	SUB	*	:	J	Z	j	z
BH	VT	ESC	+	;	K	[	k	{
CH	FF	FS	,	<	L	/	l	|
DH	CR	GS	-	=	M	]	m	}
EH	SO	RS	.	>	N	^	n	~
FH	SI	US	/	?	O	_	o	DEL

Netted codes are used in this communication.

4.11.3 Example of a control program

Sample program of QBasic (for MS-DOS) for reading/writing "F03: Maximum frequency 1" is shown as follows.
[QBasic is in ¥Other¥Oldmsdos¥ in the CD-ROM of Microsoft Windows 95.]

```
100  'SAMPLE PROGRAM(MS-DOS QBasic)
110  OPEN "COM1:9600,N,8,2" FOR RANDOM AS #1                    '8BITS,2BITS,NONE
120  SOH$  = CHR$(&H1)                                           'ASCII SET
130  ETX$  = CHR$(&H3)
140  ENQ$  = CHR$(&H5)
150  ACK$ = CHR$(&H6)
160  NAK$ = CHR$(&H15)
170  ESC$  = CHR$(&H1B)
180  CLS
1000  PRINT "SELECT OPERATION 1:READ,2:WRITE"
1010  KEY$ = INKEY$: IF KEY$ = "" THEN 1010
1020  IF KEY$ = "2" THEN 3000
1030  '
2000  '==== READ(F03) ====
2010  CMD$ = SOH$                                               'SOH
2020  CMD$ = CMD$ + "01"                                        'ADDRESS(01 - 31)
2030  CMD$ = CMD$ + ENQ$                                        'ENQ
2040  CMD$ = CMD$ + "R"                                         'COMMAND(R,W,A,E)
2050  CMD$ = CMD$ + "F03"                                       'CODE(F00...)
2060  CMD$ = CMD$ + " 0000"                                     'DATA(0000 - FFFF)
2070  CMD$ = CMD$ + ETX$                                        'ETX
2080  GOTO 4000
2090  '
3000  '==== WRITE(F03:50Hz) ====
3010  CMD$ = SOH$                                               'SOH
3020  CMD$ = CMD$ + "01"                                        'ADDRESS(01 - 31)
3030  CMD$ = CMD$ + ENQ$                                        'ENQ
3040  CMD$ = CMD$ + "W"                                         'COMMAND(R,W,A,E)
3050  CMD$ = CMD$ + "F03"                                       'CODE(F00...)
3060  CMD$ = CMD$ + " 0032"                                     'DATA(0000 - FFFF)
3070  CMD$ = CMD$ + ETX$                                        'ETX
3080  '
4000  '==== SEND ====
4010  BUF$ = CMD$
4020  GOSUB CALCBCC
4030  CMD$ = CMD$ + BCC$                                        'BCC
4040  '
4050  PRINT #1, CMD$                                            'SEND
4060  '
4100  '==== RECV ====
4110  RECV$ = INPUT$(1, #1)                                     'RECV
4120  IF RECV$ = SOH$ THEN ANSWER$ = ""
4130  ANSWER$ = ANSWER$ + RECV$
4140  IF RECV$ <> ETX$ THEN 4110
4150  ANSWER$ = ANSWER$ + INPUT$(2, #1)
4160  PRINT "RECEIVED DATA:"; ANSWER$
4170  '
4180  PRINT "HIT ANY KEY (ESC -> END)"
4190  KEY$ = INKEY$: IF KEY$ = "" THEN 4190
4200  IF KEY$ <> ESC$ THEN 1000
4210  CLOSE #1
4220  END
4230  '
5000  CALCBCC:
5010  B = 0: C = 2
5020  CHAR$ = MID$(BUF$, C, 1)
5030  B = B + ASC(CHAR$)                                        'ADD
5040  C = C + 1
5050  IF CHAR$ <> ETX$ THEN 5020
5060  B = B AND &HFF
5070  BIN = INT(B / 16): GOSUB BINTOASC: BCC$ = ASCII$          'BCC1
5080  BIN = B MOD 16: GOSUB BINTOASC: BCC$ = BCC$ + ASCII$      'BCC2
5090  RETURN
5100  '
5110  BINTOASC:
5120  IF BIN < 10 THEN ASCII$ = CHR$(ASC("0") + BIN) ELSE ASCII$ = CHR$(ASC("A") + BIN - 10)
5130  RETURN
```

5. Using Lifetime Forecast Functions

■ Equipping lifetime forecast functions as standard

- The inverter itself manages average lives of the parts having lives, and outputs a lifetime forecast alarm signal. Then, the customer can be presented information on periodical parts exchange without previously arranging a spare inverter.

5.1 Contents of lifetime forecast functions

Lifetime forecast function
Monitoring the lifetime information
Regardless of running or stopping of inverter, you can see the information of each part having lifetime on the KEYPAD panel.
Outputs lifetime forecast
A warning signal can be output when the conditions of each part having life become under the standard lives.

Parts having lives in inverter	Life as standard
Main circuit smoothing capacitor	
The capacitance of the capacitor is measured when turning off power supply to the inverter.	The capacitance of the capacitor is 85% or less of the initial value.
Capacitor on the control PC board	
The accumulated energized time under consideration of temperature inside the inverter is measured.	The accumulated energized time is 61,000 hours or more.
Cooling fan	
The accumulated operation time of the cooling fan is measured.	The accumulated operation time of the fan is; 40,000 hours [5HP or less] 25,000 hours [7.5HP or more]

5.2 How to check lifetime forecast information

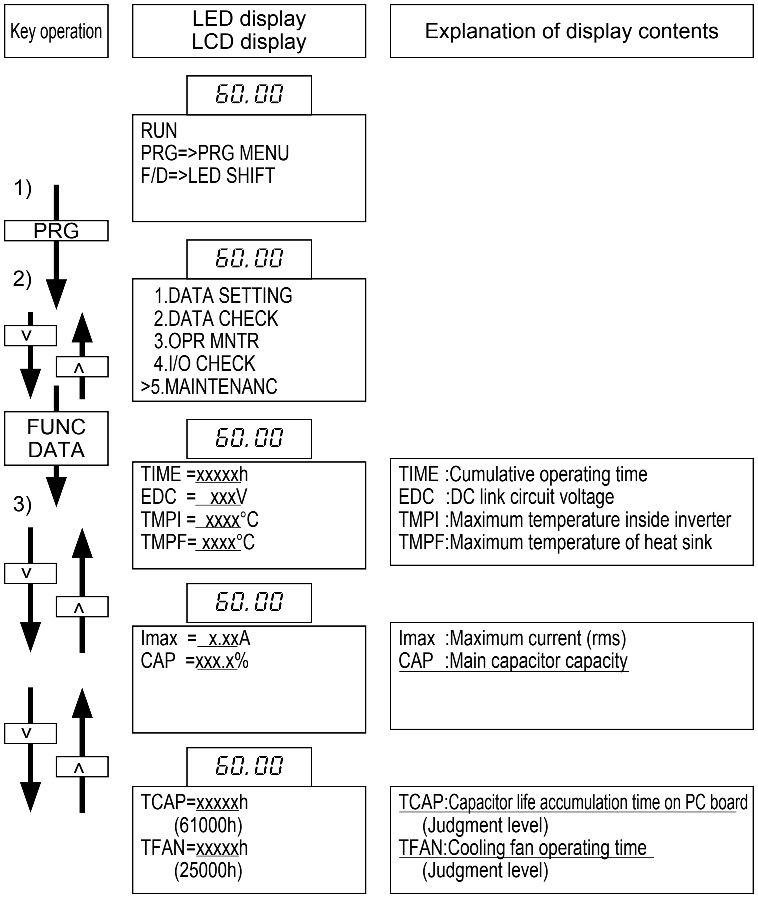
This information can be checked with maintenance information screen on the KEYPAD panel regardless of running or stopping of the inverter.

• Confirmable items

- Reduction ratio of the capacitance of the main circuit smoothing capacitor
- Life accumulation time of the capacitor on the PC board
- Accumulated operation time of the cooling fan

• How to check

1) Move from the operation mode screen to the program menu screen.
2) On the program menu screen, select "5. Maintenance" with ∨ and ∧ keys.
3) On the maintenance screen, the capacitance of main capacitors, etc. can be checked.



Key operation	LED display LCD display	Explanation of display contents
	60.00 RUN PRG=>PRG MENU F/D=>LED SHIFT	
1) PRG 2)	60.00 1.DATA SETTING 2.DATA CHECK 3.OPR MNTR 4.I/O CHECK >5.MAINTENANC	
∨ ∧ FUNC DATA 3)	60.00 TIME =xxxxxh EDC = xxxV TMPI = xxxx°C TMPF= xxxx°C	TIME :Cumulative operating time EDC :DC link circuit voltage TMPI :Maximum temperature inside inverter TMPF:Maximum temperature of heat sink
∨ ∧	60.00 Imax = x.xxA CAP =xxx.x%	Imax :Maximum current (rms) CAP :Main capacitor capacity
∨ ∧	60.00 TCAP=xxxxxh (61000h) TFAN=xxxxxh (25000h)	TCAP:Capacitor life accumulation time on PC board (Judgment level) TFAN:Cooling fan operating time (Judgment level)

5.3 Measuring conditions of lifetime

• Main circuit smoothing capacitor
(Standard life: 85% of the initial value)
Measure the capacitance after setting an initial condition to keep the load of main circuit capacitor of the inverter constant. The initial condition is that the cooling fan is in operation (for the inverters of 2HP or more), the inverter is stopped, and the power supply is switched off. Then, the capacitance of the main circuit capacitor is measured.

The correct measurement cannot be performed in the following operation condition:
- When using an option card.
- When supplying the power from the auxiliary control power supply terminal.
- When communicating through RS485.
- When sending or receiving the power through a DC bus with other inverters.

<To use the lifetime forecast function under these conditions, contact Fuji Electric.>

• Capacitor on control PC board
(Standard life: 61,000 hrs)
Instead of measuring the capacitance of the PC board capacitor as in the case of the main circuit capacitor, it is shown as the life accumulation time (*) that the supplied time of the control power supply is multiplied by life coefficient depending on the ambient temperature of the PC board.

• Cooling fan
Standard life : 40,000 hours [inverters of 5HP or less]
: 25,000 hours [inverters of 7.5HP or more]
The cooling fan is simply shown with the accumulation of its operation time(*).

(*) The accumulated time is counted in one-hour units and does not include time less than one hour.

• Output setting of lifetime forecast
When any of the three standard lives described above is reached, a lifetime forecast signal can be output. However, for the cooling fan, the signal is output at 25,000 hours as a standard life, regardless of inverter capacity. Since there is no specific terminal, 4 transistor output terminals (Y1 to Y4) for which many functions are selectable or one relay output terminal (Y5) can be used by setting this function.

[Example of setting]
- When outputting the signal from Y1 terminal (transistor output), a function code "E20" is set at "30:[LIFE]".
- When outputting the signal from Y5A or Y5C terminal (Relay terminal), a function code "E24" is set at "30:[LIFE]".

Chapter 3

Peripheral Equipment

Contents

1. Inverter Input Current

■ This section describes selecting peripheral devices and cables.

Table 3.1 Various current value through inverter

		50Hz, 200V (400V, 100V)					60Hz, 220V (440V)				
Power supply voltage	Nominal applied motor [HP]	Input effective value current [A]		DC link circuit current [A]	Braking resistor curcuit current [A]		Input effective value current [A]		DC link circuit current [A]	Braking resistor circuit current [A]	
		With DCR	Without reactor		G11S series	P11S series	With DCR	Without reactor		G11S series	P11S series
Three-phase 230V	1/4	0.94	1.8	1.1	1.2	–	0.84	1.7	1.0	1.2	–
	1/2	1.6	3.4	2.0	1.2		1.4	3.2	1.7	1.2	
	1	3.1	6.4	3.8	1.6		2.7	6.2	3.3	1.6	
	2	5.7	11.1	7.0	3.6		5.1	10.6	6.2	3.6	
	3	8.3	16.1	10	3.5		7.5	15.5	9.2	3.5	
	5	14.0	25.5	17	4.1		12.5	24.2	15	4.1	
	7.5	19.7	40.8	24	6.4	3.5	16.9	36.2	21	6.4	3.5
	10	26.9	52.6	33	6.1	5.3	24.0	46.6	29	6.1	5.3
	15	39.0	76.9	48	9.1	5.1	34.7	67.7	42	9.1	5.1
	20	54	98	66	11	7.2	48	87	59	11	7.2
	25	66	117	81	14	9.3	59	104	72	14	9.3
	30	78	136	96	15	11	70	123	86	15	11
	40	109	168	133	19	19	99	149	121	19	19
	50	135	204	165	25	19	122	181	149	25	19
	60	163	243	200	30	25	148	217	181	30	25
	75	199	291	244	37	30	182	262	223	37	30
	100	272	–	333	48	37	247	–	303	48	37
	125	327		400	61	48	296		363	61	48
	150	400		490	–	61	364		446	–	61
Three-phase 460V	1/2	0.82	1.8	1.0	0.8	–	0.73	1.7	0.9	0.8	–
	1	1.5	3.5	1.8	1.1		1.4	3.4	1.7	1.1	
	2	2.9	6.2	3.6	1.8		2.6	6.1	3.2	1.8	
	3	4.2	9.2	5.1	1.8		3.8	9.0	4.7	1.8	
	5	7.1	14.9	8.7	2.1		6.3	14.2	7.7	2.1	
	7.5	10.0	21.5	12	3.2	1.8	8.3	19.0	10	3.2	1.8
	10	13.5	27.9	17	3.1	2.7	12.1	24.6	15	3.1	2.7
	15	19.8	39.1	24	4.5	2.5	17.7	34.5	22	4.5	2.5
	20	26.8	50.5	32	5.7	3.6	24	44	29	5.7	3.6
	25	33.2	59.9	40	7.2	4.6	29	53	36	7.2	4.6
	30	39.3	69.3	48	7.7	5.7	35	62	43	7.7	5.7
	40	54	86	66	10	10	49	76	60	10	10
	50	67	104	82	12	10	61	92	75	12	10
	60	81	124	99	15	12	74	111	91	15	12
	75	100	150	122	19	15	91	134	111	19	15
	100	134	–	164	24	19	122	–	149	24	19
	125	160		196	31	24	146		179	31	24
	150	196		240	34	31	178		218	34	31
	200	232		284	41	34	211		258	41	34
	250	282		345	50	41	256		314	50	41
	300	352		431	62	50	320		392	62	50
	350	385		472	71	62	350		429	71	62
	400	491		601	100	71	446		546	100	71
	450	552		676	100	100	502		615	100	100
	500	624		764	124	100	567		694	124	100
	600	704		862	124	124	640		784	124	124
	700	792		970	–	124	720		882	–	124
	800	880		1078	–	124	800		980	–	124

NOTE:
- The inverter efficiency is calculated using individual value by capacity. The input effective value current is obtained for following conditions:
  [30HP or smaller]
  - Power source capacity : 500kVA   Power source impedance : 2.5%

  [40HP or larger]
  - Power source capacity and impedance are calculated using values corresponding to Fuji's recommended capacity.
- For different power voltages such as 230V or 380V, input current is in inverse proportion to the power voltage.

2. Circuit Breakers and Magnetic Contactors

Table 3.2 Circuit breakers and Magnetic contactors

Power supply voltage	Nominal applied motor [HP]	Inverter type		MCCB, GFCI Rated current [A]		MC1 (for input circuit)		MC2 (for output circuit)	
		G11S series	P11S series	With DCR	Without reactor	With DCR	Without reactor	G11S series	P11S series
Three-phase 230V	1/4	FRNF25G11S-2UX	–	5	5	SC-05	SC-05	SC-05	–
	1/2	FRNF50G11S-2UX							
	1	FRN001G11S-2UX			10				
	2	FRN002G11S-2UX		10	15				
	3	FRN003G11S-2UX			20				
	5	FRN005G11S-2UX		20	30		SC-5-1		
	7.5	FRN007G11S-2UX	FRN007P11S-2UX	30	50		SC-N1	SC-4-0	SC-4-0
	10	FRN010G11S-2UX	FRN010P11S-2UX	40	75	SC-5-1	SC-N2	SC-N1	SC-5-1
	15	FRN015G11S-2UX	FRN015P11S-2UX	50	100	SC-N1	SC-N2S		SC-N1
	20	FRN020G11S-2UX	FRN020P11S-2UX	75	125	SC-N2	SC-N3	SC-N2	SC-N2
	25	FRN025G11S-2UX	FRN025P11S-2UX	100	150	SC-N2S	SC-N4	SC-N2S	SC-N2S
	30	FRN030G11S-2UX	FRN030P11S-2UX		175		SC-N5	SC-N3	
	40	FRN040G11S-2UX	FRN040P11S-2UX	150	200	SC-N4	SC-N7	SC-N4	SC-N4
	50	FRN050G11S-2UX	FRN050P11S-2UX	175	250	SC-N5	SC-N8	SC-N5	SC-N5
	60	FRN060G11S-2UX	FRN060P11S-2UX	200	300	SC-N7		SC-N7	SC-N7
	75	FRN075G11S-2UX	FRN075P11S-2UX	250	350	SC-N8	SC-N11	SC-N8	SC-N8
	100	FRN100G11S-2UX	FRN100P11S-2UX	350	–	SC-N11	–	SC-N10	SC-N10
	125	FRN125G11S-2UX	FRN125P11S-2UX	400				SC-N11	SC-N11
	150	–	FRN150P11S-2UX	500		SC-N12		–	SC-N12
Three-phase 460V	1/2	FRNF50G11S-4UX	–	5	5	SC-05	SC-05	SC-05	–
	1	FRN001G11S-4UX							
	2	FRN002G11S-4UX			10				
	3	FRN003G11S-4UX			15				
	5	FRN005G11S-4UX		10	20				
	7.5	FRN007G11S-4UX	FRN007P11S-4UX	15	30		SC-4-0		SC-05
	10	FRN010G11S-4UX	FRN010P11S-4UX	20	40		SC-5-1		
	15	FRN015G11S-4UX	FRN015P11S-4UX	30	50		SC-N1	SC-4-0	SC-4-0
	20	FRN020G11S-4UX	FRN020P11S-4UX	40	60	SC-5-1		SC-5-1	SC-5-1
	25	FRN025G11S-4UX	FRN025P11S-4UX		75	SC-N1	SC-N2	SC-N1	SC-N1
	30	FRN030G11S-4UX	FRN030P11S-4UX	50	100		SC-N2S		
	40	FRN040G11S-4UX	FRN040P11S-4UX	75	125	SC-N2	SC-N3	SC-N2	SC-N2
	50	FRN050G11S-4UX	FRN050P11S-4UX	100		SC-N2S	SC-N4	SC-N2S	SC-N2S
	60	FRN060G11S-4UX	FRN060P11S-4UX		150	SC-N3		SC-N3	SC-N3
	75	FRN075G11S-4UX	FRN075P11S-4UX	125	200		SC-N5	SC-N4	SC-N4
	100	FRN100G11S-4UX	FRN100P11S-4UX	175	–	SC-N4	–	SC-N5	SC-N5
	125	FRN125G11S-4UX	FRN125P11S-4UX	200		SC-N7		SC-N7	SC-N7
	150	FRN150G11S-4UX	FRN150P11S-4UX	250				SC-N8	SC-N8
	200	FRN200G11S-4UX	FRN200P11S-4UX	300		SC-N8			
	250	FRN250G11S-4UX	FRN250P11S-4UX	350		SC-N11		SC-N11	SC-N11
	300	FRN300G11S-4UX	FRN300P11S-4UX	500		SC-N12		SC-N12	SC-N12
	350	FRN350G11S-4UX	FRN350P11S-4UX	500					
	400	FRN400G11S-4UX	FRN400P11S-4UX	600		SC-N14		SC-N14	SC-N14
	450	FRN450G11S-4UX	FRN450P11S-4UX	800					
	500	FRN500G11S-4UX	FRN500P11S-4UX						
	600	FRN600G11S-4UX	FRN600P11S-4UX	1200		SC-N16		SC-N16	SC-N16
	700	–	FRN700P11S-4UX					–	
	800		FRN800P11S-4UX						

NOTES: For the MCCB and GFCI types, the rated current values recommended for 50°C (122°F) or lower panel inside temperature are shown. Select an actual type according to the facility short-circuit interrupting capacity.

3. Wire Size

3.1 FRENIC5000G11S/P11S Series

(a) Under the 50°C (122°F) or lower panel inside temperature

Table 3.3 (a) Wire size (50°C (122°F))

Power supply voltage	Nominal applied motor [HP]	Inverter type		Recommended wire size [mm²]											
				Input circuit [L1/R, L2/S, L3/T]								Output circuit [U, V, W]			
				With DCR				Without reactor				G11S series			
		G11S series	P11S series	Allowable temp.*1)			Current [A]	Allowable temp.*1)			Current [A]	Allowable temp.*1)			Current [A]
				60°C (140°F)	75°C (167°F)	90°C (194°F)		60°C (140°F)	75°C (167°F)	90°C (194°F)		60°C (140°F)	75°C (167°F)	90°C (194°F)	
Three-phase 230V	1/4	FRNF25G11S-2UX	–	2.0	2.0	2.0	0.94	2.0	2.0	2.0	1.8	2.0	2.0	2.0	1.5
	1/2	FRNF50G11S-2UX					1.6				3.4				3
	1	FRN001G11S-2UX					3.1				6.4				5
	2	FRN002G11S-2UX					5.7				11.1				8
	3	FRN003G11S-2UX					8.3	3.5			16.1				11
	5	FRN005G11S-2UX					14	5.5	3.5		25.5	3.5			17
	7.5	FRN007G11S-2UX	FRN007P11S-2UX	3.5			19.7	14	5.5	3.5	40.8	5.5	3.5		25
	10	FRN010G11S-2UX	FRN010P11S-2UX	5.5	3.5		26.9	–	8	5.5	52.6	8	3.5	3.5	33
	15	FRN015G11S-2UX	FRN015P11S-2UX	14	5.5	3.5	39	–	14	14	76.9	14	8	5.5	46
	20	FRN020G11S-2UX	FRN020P11S-2UX	22	8	5.5	54	–	22	14	98.5	22	8	8	59
	25	FRN025G11S-2UX	FRN025P11S-2UX	–	14	8	66.2	–	38	22	117	–	14	14	74
	30	FRN030G11S-2UX	FRN030P11S-2UX	–	14	14	78.8	–	38	38	136	–	14	14	87
	40	FRN040G11S-2UX	FRN040P11S-2UX	60	38	22	109	–	60	38	168	60	38	22	115
	50	–	FRN050P11S-2UX	–	38	38	135	–	60	60	204	100	38	38	145
		FRN050G11S-2UX	–	100					100						
	60	FRN060G11S-2UX	FRN060P11S-2UX	–	60	38	163	–	100	60	243	–	60	38	180
	75	FRN075G11S-2UX	FRN075P11S-2UX	–	100	60	199	–	100	100	291	–	100	60	215
	100	–	FRN100P11S-2UX	–	100	100	272	–				–	150	100	283
		FRN100G11S-2UX	–	–	150										
	125	FRN125G11S-2UX	FRN125P11S-2UX	–	150	100	327					–	150	150	346
	150	–	FRN150P11S-2UX	–	200	150	400					–	–	–	–
Three-phase 460V	1/2	FRNF50G11S-4UX	–	2.0	2.0	2.0	0.82	2.0	2.0	2.0	1.8	2.0	2.0	2.0	1.5
	1	FRN001G11S-4UX					1.5				3.5				2.5
	2	FRN002G11S-4UX					2.9				6.2				3.7
	3	FRN003G11S-4UX					4.2				9.2				5.5
	5	FRN005G11S-4UX					7.1				14.9				9
	7.5	FRN007G11S-4UX	FRN007P11S-4UX				10	5.5			21.5				13
	10	FRN010G11S-4UX	FRN010P11S-4UX				13.5	5.5	3.5		27.9	3.5			18
	15	FRN015G11S-4UX	FRN015P11S-4UX	3.5			19.8	14	5.5	3.5	39.1	5.5			24
	20	FRN020G11S-4UX	FRN020P11S-4UX	5.5	3.5		26.8	14	8	5.5	50.3	8	3.5		30
	25	FRN025G11S-4UX	FRN025P11S-4UX	8	5.5	3.5	33.2	22	14	8	59.9	14	5.5	3.5	39
	30	FRN030G11S-4UX	FRN030P11S-4UX	14	5.5	3.5	39.3	–	14	8	69.3	14	8	5.5	45
	40	FRN040G11S-4UX	FRN040P11S-4UX	22	8	5.5	54	–	22	14	86	22	14	8	60
	50	FRN050G11S-4UX	FRN050P11S-4UX	38	14	8	67	60	22	22	104	38	14	14	75
	60	FRN060G11S-4UX	FRN060P11S-4UX	38	22	14	81	60	38	22	124	38	22	14	91
	75	FRN075G11S-4UX	FRN075P11S-4UX	60	22	14	100	–	60	38	150	60	38	22	112
	100	–	FRN100P11S-4UX	–	38	38	134	–				100	60	38	150
		FRN100G11S-4UX	–	100											
	125	FRN125G11S-4UX	FRN125P11S-4UX	100	60	38	160					–	60	38	176
	150	FRN150G11S-4UX	FRN150P11S-4UX	–	60	60	196					–	100	60	210
	200	FRN200G11S-4UX	FRN200P11S-4UX	–	100	60	232					–	100	100	253
	250	FRN250G11S-4UX	FRN250P11S-4UX	–	150	100	282					–	150	100	304
	300	FRN300G11S-4UX	FRN300P11S-4UX	–	150	150	352					–	200	150	377
	350	FRN350G11S-4UX	FRN350P11S-4UX	–	200	150	385					–	200	150	415
	400	FRN400G11S-4UX	FRN400P11S-4UX	–	250	200	491					–	2×150	200	520
	450	FRN450G11S-4UX	FRN450P11S-4UX	–	2×150	250	552					–	2×150	250	585
	500	FRN500G11S-4UX	FRN500P11S-4UX	–	2×200	250	624					–	2×200	325	650
	600	FRN600G11S-4UX	FRN600P11S-4UX	–	2×200	325	704					–	2×250	325	740
	700	–	FRN700P11S-4UX	–	2×250	2×200	792					–			
	800		FRN800P11S-4UX	–	2×325	2×200	880								

* Select an appropriate wire size referring to Table 3.1 and Table 3.2 if conditions such as ambient temperature or power voltage are different.

NOTES: *1) Allowable temperature 60°C (140°F) means using “IV wire”; 75°C (167°F) means “600V HIV insulation wire”; and 90°C (194°F) means “600V cross-linking polyethylene insulation wire”.

Table 3.3 (a) Wire size (50°C (122°F)) (cont'd)

Recommended wire size [mm²]																								
Output circuit [U, V, W]				DC link circuit				Braking circuit [P(+), DB, N(–)]								Control circuit			Auxiliary control			Grounding		
P11S series				[P1, P(+)]				G11S series				P11S series							power supply [R0, T0]			[⏚ G]		
Allowable temp.*1)			Current	Allowable temp.*1)			Current	Allowable temp.*1)			Current	Allowable temp.*1)			Current	Allowable temp.*1)			Allowable temp.*1)			Allowable temp.*1)		
60°C (140°F)	75°C (167°F)	90°C (194°F)	[A]	60°C (140°F)	75°C (167°F)	90°C (194°F)	[A]	60°C (140°F)	75°C (167°F)	90°C (194°F)	[A]	60°C (140°F)	75°C (167°F)	90°C (194°F)	[A]	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)
–	–	–	–	2.0	2.0	2.0	1.1	2.0	2.0	2.0	1.2	–	–	–	–	1.25	1.25	1.25	2.0	2.0	2.0	2.0	2.0	2.0
							2.0				1.2													
							3.8				1.6													
							7.0				3.6													
							10				3.5													
				3.5			17				4.1													
5.5	2.0	2.0	22	5.5			24				6.4	2.0	2.0	2.0	3.5							3.5		
8.0	3.5	2.0	29	8.0	3.5	3.5	33				6.1				5.3							5.5	3.5	
14	5.5	3.5	42	14	8.0	5.5	48				9.1				5.1							14	5.5	3.5
22	8.0	5.5	55	22	14	8.0	66				11				7.2							22	8.0	5.5
–	14	8.0	67	–	22	14	81				14				9.3							–	14	8.0
–	14	14	78	–	22	14	96				15				11							–	14	14
–	38	22	115	–	38	38	133	3.5			19	3.5			19							–	38	22
–	38	38	145	–	60	38	165	5.5	3.5		25				19							– –	38	38
–	60	38	180	–	60	60	200	8.0			30	5.5	3.5		25							–	60	38
–	100	60	215	–	100	60	244	14	5.5	3.5	37	8.0			30							–	100	60
–	100	100	283	–	150	100	333	14	8.0	5.5	45	14	5.5	3.5	37							–	100 150	100
–	150	150	346	–	200	150	400	22	14	8.0	61	14	8.0	5.5	48							–	150	100
–	200	150	415	–	250	200	490	–	–	–	–	22	14	8.0	61							–	200	150
–	–	–	–	2.0	2.0	2.0	1.0	2.0	2.0	2.0	0.8	–	–	–	–	1.25	1.25	1.25	2.0	2.0	2.0	2.0	2.0	2.0
							1.8				1.1													
							3.6				1.8													
							5.1				1.8													
							8.7				2.1													
2.0	2.0	2.0	12.5				12				3.2	2.0	2.0	2.0	1.8									
3.5			16.5	3.5			17				3.1				2.7									
5.5			23	5.5			24				4.5				2.5							3.5		
8.0	3.5		30	8.0	5.5	3.5	32				5.7				3.6							5.5	3.5	
14	5.5	3.5	37	14	5.5	3.5	40				7.2				4.6							8.0	5.5	3.5
14	5.5	5.5	44	14	8.0	5.5	48				7.7				5.7							14	5.5	3.5
22	14	8.0	60	22	14	8.0	66				10				10							22	8.0	5.5
38	14	14	75	38	22	14	82				12				10							38	14	8.0
38	22	14	91	60	22	14	99				15				12							38	22	14
60	38	22	112	60	38	22	122	3.5			19				15							60	22	14
100	60	38	150	100	60	38	164	5.5			24	3.5			19							– 100	38	38
–	60	38	176	–	60	60	196	8.0	3.5		31	5.5			24							100	60	38
–	100	60	210	–	100	60	240	8.0	5.5	3.5	34	8.0	3.5		31							–	60	60
–	100	100	253	–	150	100	284	14	5.5	3.5	41	8.0	5.5	3.5	34							–	100	60
–	150	100	304	–	150	150	345	14	8.0	5.5	50	14	5.5	3.5	41							–	150	100
–	200	150	377	–	250	150	431	22	14	8.0	62	14	8.0	5.5	50							–	150	150
–	200	150	415	–	250	200	472	38	14	14	71	22	14	8.0	62							–	200	150
–	2×150	200	520	–	2×200	250	601	60	22	14	100	38	14	14	71							–	250	200
–	2×150	250	585	–	2×200	2×150	676	60	22	14	100	60	22	14	100							–	325	250
–	2×200	2×150	650	–	2×250	2×200	764	60	38	22	124	60	22	14	100							–	400	250
–	2×250	325	740	–	2×325	2×200	862	60	38	22	124	60	38	22	124							–	500	325
–	2×250	2×200	840	–	2×325	2×250	970	–				60	38	22	124							–	–	400
–	2×325	2×250	960	–	2×325	2×325	1078					60	38	22	124							–	–	500

(b) Under the 40°C (104°F) or lower panel inside temperature

Table 3.3 (b) Wire size (40°C (104°F))

Power supply voltage	Nominal applied motor [HP]	Inverter type		Recommended wire size [mm²]											
				Input circuit [L1/R, L2/S, L3/T]								Output circuit [U, V, W]			
		G11S series	P11S series	With DCR				Without reactor				G11S series			
				Allowable temp.*1)			Current [A]	Allowable temp.*1)			Current [A]	Allowable temp.*1)			Current [A]
				60°C (140°F)	75°C (167°F)	90°C (194°F)		60°C (140°F)	75°C (167°F)	90°C (194°F)		60°C (140°F)	75°C (167°F)	90°C (194°F)	
Three-phase 230V	1/4	FRNF25G11S-2UX	–	2.0	2.0	2.0	0.9	2.0	2.0	2.0	1.8	2.0	2.0	2.0	1.5
	1/2	FRNF50G11S-2UX					1.6				3.4				3
	1	FRN001G11S-2UX					3.1				6.4				5
	2	FRN002G11S-2UX					5.7				11.1				8
	3	FRN003G11S-2UX					8.3				16.1				11
	5	FRN005G11S-2UX					14	3.5			25.5				17
	7.5	FRN007G11S-2UX	FRN007P11S-2UX				19.7	8	5.5	3.5	40.8	3.5			25
	10	FRN010G11S-2UX	FRN010P11S-2UX	3.5			26.9	14	8	5.5	52.6	5.5	3.5		33
	15	FRN015G11S-2UX	FRN015P11S-2UX	5.5	5.5	3.5	39	22	14	8	76.9	8	5.5	3.5	46
	20	FRN020G11S-2UX	FRN020P11S-2UX	14	8	5.5	54	–	22	14	98.5	14	8	5.5	59
	25	FRN025G11S-2UX	FRN025P11S-2UX	14	14	8	66.2	–	22	22	117	22	14	8	74
	30	FRN030G11S-2UX	FRN030P11S-2UX	22	14	14	78.8	–	38	22	136	22	14	14	87
	40	FRN040G11S-2UX	FRN040P11S-2UX	38	22	14	109	60	38	38	168	–	22	22	115
	50	–	FRN050P11S-2UX	60	38	22	135	–	60	38	204	60	38	22	145
		FRN050G11S-2UX	–					100							
	60	FRN060G11S-2UX	FRN060P11S-2UX	60	38	38	163	100	100	60	243	100	60	38	180
	75	FRN075G11S-2UX	FRN075P11S-2UX	100	60	38	199	–	100	100	291	100	60	60	215
	100	–	FRN100P11S-2UX	–	100	60	272	–				150	100	100	283
		FRN100G11S-2UX	–	150											
	125	FRN125G11S-2UX	FRN125P11S-2UX	200	150	100	327					200	150	100	346
	150	–	FRN150P11S-2UX	250	150	150	400					–	–	–	–
Three-phase 460V	1/2	FRNF50G11S-4UX	–	2.0	2.0	2.0	0.82	2.0	2.0	2.0	1.8	2.0	2.0	2.0	1.5
	1	FRN001G11S-4UX					1.5				3.5				2.5
	2	FRN002G11S-4UX					2.9				6.2				3.7
	3	FRN003G11S-4UX					4.2				9.2				5.5
	5	FRN005G11S-4UX					7.1				14.9				9
	7.5	FRN007G11S-4UX	FRN007P11S-4UX				10				21.5				13
	10	FRN010G11S-4UX	FRN010P11S-4UX				13.5	3.5			27.9				18
	15	FRN015G11S-4UX	FRN015P11S-4UX				19.8	5.5	5.5	3.5	39.1	3.5			24
	20	FRN020G11S-4UX	FRN020P11S-4UX	3.5			26.8	14	5.5	5.5	50.3	3.5	3.5		30
	25	FRN025G11S-4UX	FRN025P11S-4UX	5.5	3.5		33.2	14	8	5.5	59.9	5.5	3.5	3.5	39
	30	FRN030G11S-4UX	FRN030P11S-4UX	5.5	5.5	3.5	39.3	14	14	8	69.3	8	5.5	3.5	45
	40	FRN040G11S-4UX	FRN040P11S-4UX	14	8	5.5	54	22	14	14	86	14	8	5.5	60
	50	FRN050G11S-4UX	FRN050P11S-4UX	14	14	8	67	38	22	14	104	22	14	8	75
	60	FRN060G11S-4UX	FRN060P11S-4UX	22	14	14	81	38	22	22	124	22	14	14	91
	75	FRN075G11S-4UX	FRN075P11S-4UX	38	22	14	100	60	38	38	150	38	22	14	112
	100	–	FRN100P11S-4UX	60	38	22	134	–				60	38	38	150
		FRN100G11S-4UX	–												
	125	FRN125G11S-4UX	FRN125P11S-4UX	60	38	38	160					60	60	38	176
	150	FRN150G11S-4UX	FRN150P11S-4UX	100	60	38	196					100	60	60	210
	200	FRN200G11S-4UX	FRN200P11S-4UX	100	60	60	232					150	100	60	253
	250	FRN250G11S-4UX	FRN250P11S-4UX	150	100	100	282					150	100	100	304
	300	FRN300G11S-4UX	FRN300P11S-4UX	200	150	100	352					200	150	100	377
	350	FRN350G11S-4UX	FRN350P11S-4UX	250	150	150	385					250	150	150	415
	400	FRN400G11S-4UX	FRN400P11S-4UX	–	200	150	491					–	250	200	520
	450	FRN450G11S-4UX	FRN450P11S-4UX	–	250	200	552					–	250	200	585
	500	FRN500G11S-4UX	FRN500P11S-4UX	–	2×150	250	624					–	325	250	650
	600	FRN600G11S-4UX	FRN600P11S-4UX	–	2×150	250	704					–	2×200	325	740
	700	–	FRN700P11S-4UX	–	2×200	2×150	792					–			
	800		FRN800P11S-4UX	–	2×250	2×200	880								

* Select an appropriate wire size referring to Table 3.1 and Table 3.2 if conditions such as ambient temperature or power voltage are different.

NOTES: *1) Allowable temperature 60°C (140°F) means using "IV wire"; 75°C (167°F) means "600V HIV insulation wire"; and 90°C (194°F) means "600V cross-linking polyethylene insulation wire".

Table 3.3 (b) Wire size (40°C (104°F)) (cont'd)

Recommended wire size [mm^2]																								
Output circuit [U, V, W]				DC link circuit				Braking circuit [P(+), DB, N(–)]								Control circuit			Auxiliary control			Grounding		
P11S series				[P1, P(+)]				G11S series				P11S series							power supply [R0, T0]			[⏚ G]		
Allowable temp.*1)			Current	Allowable temp.*1)			Current	Allowable temp.*1)			Current	Allowable temp.*1)			Current	Allowable temp.*1)			Allowable temp.*1)			Allowable temp.*1)		
60°C (140°F)	75°C (167°F)	90°C (194°F)	[A]	60°C (140°F)	75°C (167°F)	90°C (194°F)	[A]	60°C (140°F)	75°C (167°F)	90°C (194°F)	[A]	60°C (140°F)	75°C (167°F)	90°C (194°F)	[A]	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)
–	–	–	–	2.0	2.0	2.0	1.1	2.0	2.0	2.0	1.2	–	–	–	–	1.25	1.25	1.25	2.0	2.0	2.0	2.0	2.0	2.0
							2.0				1.2													
							3.8				1.6													
							7.0				3.6													
							10				3.5													
							17				4.1													
2.0	2.0	2.0	22	3.5			24				6.4	2.0	2.0	2.0	3.5									
3.5			29	5.5	3.5		33				6.1				5.3							3.5		
8.0	5.5	3.5	42	8.0	5.5	5.5	48				9.1				5.1							5.5	5.5	3.5
14	8.0	5.5	55	14	14	8.0	66				11				7.2							14	8.0	5.5
14	14	8.0	67	22	14	14	81				14				9.3							14	14	8.0
22	14	8.0	78	–	22	14	96				15				11							22	14	14
38	22	22	115	60	38	22	133				19				19							38	22	14
60	38	22	145	60	38	38	165	3.5			25				19							60	38	22
100	60	38	180	100	60	38	200	3.5	3.5		30	3.5			25							60	38	38
100	60	60	215	100	100	60	244	5.5	3.5	3.5	37	3.5	3.5		30							100	60	38
–	100	100	283	–	150	100	333	8.0	5.5	5.5	48	5.5	3.5	3.5	37							– 150	100	60
–	150	100	346	–	150	150	400	14	8.0	5.5	61	8.0	5.5	5.5	48							200	150	100
–	150	150	415	–	200	150	490	–	–	–	–	14	8.0	5.5	61							250	150	150
–	–	–	–	2.0	2.0	2.0	1.0	2.0	2.0	2.0	0.8	–	–	–	–	1.25	1.25	1.25	2.0	2.0	2.0	2.0	2.0	2.0
							1.8				1.1													
							3.6				1.8													
							5.1				1.8													
							8.7				2.1													
2.0	2.0	2.0	12.5				12				3.2	2.0	2.0	2.0	1.8									
			16.5				17				3.1				2.7									
3.5			23	3.5			24				4.5				2.5									
3.5	3.5		30	5.5	3.5		32				5.7				3.6							3.5		
5.5	3.5	3.5	37	5.5	5.5	3.5	40				7.2				4.6							5.5	3.5	
8.0	5.5	3.5	44	8.0	5.5	5.5	48				7.7				5.7							5.5	5.5	3.5
14	8.0	5.5	60	14	14	8.0	66				10				10							14	8.0	5.5
22	14	8.0	75	22	14	14	82				12				10							14	14	8.0
22	14	14	91	38	22	14	99				15				12							22	14	14
38	22	14	112	38	22	22	122				19				15							38	22	14
60	38	38	150	60	38	38	164	3.5			24				19							60	38	22
60	60	38	176	100	60	38	196	5.5	3.5		31	3.5			24							60	38	38
100	60	60	210	100	100	60	240	5.5	3.5		34	5.5	3.5		31							100	60	38
150	100	60	253	150	100	100	284	8.0	5.5	3.5	41	5.5	3.5		34							100	60	60
150	100	100	304	200	150	100	345	8.0	5.5	5.5	50	8.0	5.5	3.5	41							150	100	150
200	150	100	377	250	200	150	431	14	8.0	5.5	62	8.0	5.5	5.5	50							200	150	150
250	150	150	415	325	200	150	472	14	14	8.0	71	14	8.0	5.5	62							250	150	150
325	250	200	520	–	2×150	200	601	38	22	14	100	14	14	8.0	71							–	200	150
–	250	200	585	–	2×150	250	676	38	22	14	100	38	22	14	100							–	250	200
–	2×150	250	650	–	2×200	2×150	764	38	22	22	124	38	22	14	100							–	2×150	250
–	2×200	325	740	–	2×200	2×200	862	38	22	22	124	38	22	22	124							–	2×150	250
–	2×200	2×150	840	–	2×250	2×200	970	–				38	22	22	124							–	2×200	2×150
–	2×250	2×200	960	–	2×325	2×250	1078					38	22	22	124							–	2×250	2×200

3.2 Allowable current of insulation wire

■ IV wire (Maximum allowable temperature : 60°C (140°F))

Table 3.5 (a) Allowable current of insulation wire

Wire size [mm^2]	Allowable current reference value (up to 30°C (86°F)) I_0 [A]	Wiring outside duct					Wiring in the duct (Max. 3 wires in one duct)			
		35°C (95°F) (I_0x0.91) [A]	40°C (104°F) (I_0x0.82) [A]	45°C (113°F) (I_0x0.71) [A]	50°C (122°F) (I_0x0.58) [A]	55°C (131°F) (I_0x0.41) [A]	35°C (95°F) (I_0x0.63) [A]	40°C (104°F) (I_0x0.57) [A]	45°C (113°F) (I_0x0.49) [A]	50°C (122°F) (I_0x0.40) [A]
2	27	24	22	19	15	11	17	15	13	10
3.5	37	33	30	26	21	15	23	21	18	14
5.5	49	44	40	34	28	20	30	27	24	19
8	61	55	50	43	35	25	38	34	29	24
14	88	80	72	62	51	36	55	50	43	35
22	115	104	94	81	66	47	72	65	56	46
38	162	147	132	115	93	66	102	92	79	64
60	217	197	177	154	125	88	136	123	106	86
100	298	271	244	211	172	122	187	169	146	119
150	395	359	323	280	229	161	248	225	193	158
200	469	426	384	332	272	192	295	267	229	187
250	556	505	455	394	322	227	350	316	272	222
325	650	591	533	461	377	266	409	370	318	260
400	745	677	610	528	432	305	469	424	365	298
500	842	766	690	597	488	345	530	479	412	336
2 x 100	497	452	407	352	288	203	313	283	243	198
2 x 150	658	598	539	467	381	269	414	375	322	263
2 x 200	782	711	641	555	453	320	492	445	383	312
2 x 250	927	843	760	658	537	380	584	528	454	370
2 x 325	1083	985	888	768	628	444	682	617	530	433
2 x 400	1242	1130	1018	881	720	509	782	707	608	496
2 x 500	1403	1276	1150	996	813	575	883	799	687	561

■ HIV wire (Maximum allowable temperature : 75°C (167°F))

Table 3.5 (b) Allowable current of insulation wire

Wire size [mm^2]	Allowable current reference value (up to 30°C (86°F)) I_0 x 1.22 [A]	Wiring outside duct					Wiring in the duct (Max. 3 wires in one duct)			
		35°C (95°F) (I_0x1.15) [A]	40°C (104°F) (I_0x1.08) [A]	45°C (113°F) (I_0x1.00) [A]	50°C (122°F) (I_0x0.91) [A]	55°C (131°F) (I_0x0.82) [A]	35°C (95°F) (I_0x0.80) [A]	40°C (104°F) (I_0x0.75) [A]	45°C (113°F) (I_0x0.70) [A]	50°C (122°F) (I_0x0.63) [A]
2	32	31	29	27	24	22	21	20	18	17
3.5	45	42	39	37	33	30	29	27	25	23
5.5	59	56	52	49	44	40	39	36	34	30
8	74	70	65	61	55	50	48	45	42	38
14	107	101	95	88	80	72	70	66	61	55
22	140	132	124	115	104	94	92	86	80	72
38	197	186	174	162	147	132	129	121	113	102
60	264	249	234	217	197	177	173	162	151	136
100	363	342	321	298	271	244	238	223	208	187
150	481	454	426	395	359	323	316	296	276	248
200	572	539	506	469	426	384	375	351	328	295
250	678	639	600	556	505	455	444	417	389	350
325	793	747	702	650	591	533	520	487	455	409
400	908	856	804	745	677	610	596	558	521	469
500	1027	968	909	842	766	690	673	631	589	530
2 x 100	606	571	536	497	452	407	397	372	347	313
2 x 150	802	756	710	658	598	539	526	493	460	414
2 x 200	954	899	844	782	711	641	625	586	547	492
2 x 250	1130	1066	1001	927	843	760	741	695	648	584
2 x 325	1321	1245	1169	1083	985	888	866	812	758	682
2 x 400	1515	1428	1341	1242	1130	1018	993	931	869	782
2 x 500	1711	1613	1515	1403	1276	1150	1122	1052	982	883

■ 600V cross-linking polyethylene insulation wire (Maximum allowable temperature: 90°C (194°F))

Table 3.5 (c) Allowable current of insulation wire

Wire size [mm^2]	Allowable current reference value (up to 30°C (86°F)) I_0 x 1.41[A]	Wiring outside duct					Wiring in the duct (Max. 3 wires in one duct)			
		35°C (95°F) (I_0x1.35) [A]	40°C (104°F) (I_0x1.29) [A]	45°C (113°F) (I_0x1.22) [A]	50°C (122°F) (I_0x1.15) [A]	55°C (131°F) (I_0x1.08) [A]	35°C (95°F) (I_0x0.94) [A]	40°C (104°F) (I_0x0.90) [A]	45°C (113°F) (I_0x0.85) [A]	50°C (122°F) (I_0x0.80) [A]
2	38	36	34	32	31	29	25	24	22	21
3.5	52	49	47	45	42	39	34	33	31	29
5.5	69	66	63	59	56	52	46	44	41	39
8	86	82	78	74	70	65	57	54	51	48
14	124	118	113	107	101	95	82	79	74	70
22	162	155	148	140	132	124	108	103	97	92
38	228	218	208	197	186	174	152	145	137	129
60	305	292	279	264	249	234	203	195	184	173
100	420	402	384	363	342	321	280	268	253	238
150	556	533	509	481	454	426	371	355	335	316
200	661	633	605	572	539	506	440	422	398	375
250	783	750	717	678	639	600	522	500	472	444
325	916	877	838	793	747	702	611	585	552	520
400	1050	1005	961	908	856	804	700	670	633	596
500	1187	1136	1086	1027	968	909	791	757	715	673
2 x 100	700	670	641	606	571	536	467	447	422	397
2 x 150	927	888	848	802	756	710	618	592	559	526
2 x 200	1102	1055	1008	954	899	844	735	703	664	625
2 x 250	1307	1251	1195	1130	1066	1001	871	834	787	741
2 x 325	1527	1462	1397	1321	1245	1169	1018	974	920	866
2 x 400	1751	1676	1602	1515	1428	1341	1167	1117	1055	993
2 x 500	1978	1894	1809	1711	1613	1515	1318	1262	1192	1122

4. Braking Unit and Braking Resistor

■ 230V

Table 3.6 Braking unit and braking resistor (G11S-2 series)

Power supply voltage	Inverter type	Option					Maximum braking torque [%]			Cont. braking (100% torque conversion value)		Repetitive braking (100s or less cycle)	
		Braking unit		Braking resistor				50Hz [lb-in (N·m)]	60Hz [lb-in (N·m)]				
		Type	Q'ty	Type	Q'ty	Total ohmic value [Ω]		[N·m]	[N·m]	Dis-charging capability [kWs]	Brak-ing time [s]	Aver-age loss [kW]	Duty cycle [%]
Three-phase 230V	FRNF25G11S-2UX	–	–	DB0.75-2	1	100	150	17.6(1.99)	14.6(1.65)	9	90	0.037	37
	FRNF50G11S-2UX							35.6(4.02)	29.4(3.32)	9	45	0.044	22
	FRN001G11S-2UX							67(7.57)	55.3(6.25)	17	45	0.068	18
	FRN002G11S-2UX			DB2.2-2	1	40		133(15.0)	110(12.4)	34	45	0.075	10
	FRN003G11S-2UX							195(22.0)	161(18.2)	33	30	0.077	7
	FRN005G11S-2UX			DB3.7-2	1	33		328(37.1)	270(30.5)	37	20	0.093	5
	FRN007G11S-2UX			DB5.5-2	1	20		481(54.3)	398(45.0)	55	20	0.138	5
	FRN010G11S-2UX			DB7.5-2	1	15		651(73.6)	545(61.6)	37	10	0.188	5
	FRN015G11S-2UX	BU3-185-2	1	DB11-2	1	10		956(108)	792(89.5)	55	10	0.275	5
	FRN020G11S-2UX		1	DB15-2	1	8.6		1301(147)	1080(122)	75	10	0.375	5
	FRN025G11S-2UX		1	DB18.5-2	1	6.8		1611(182)	1336(151)	92	10	0.463	5
	FRN030G11S-2UX	BU3-220-2	1	DB22-2	1	5.8		1912(216)	1584(179)	88	8	0.550	5
	FRN040G11S-2UX	BU37-2C	1	DB30-2C	1	4.0	100	1726(195)	1434(162)	150	10	1.50	10
	FRN050G11S-2UX		1	DB37-2C	1	3.0		2124(240)	1770(200)	185	10	1.85	10
	FRN060G11S-2UX	BU55-2C	1	DB45-2C	1	2.5		2584(292)	2151(243)	225	10	2.25	10
	FRN075G11S-2UX		1	DB55-2C	1	2.0		3177(359)	2638(298)	275	10	2.75	10
	FRN100G11S-2UX	BU90-2C	1	DB75-2C	1	1.5		4310(487)	3585(405)	375	10	3.75	10
	FRN125G11S-2UX		1	DB90-2C	1	1.2		5178(585)	4301(486)	450	10	4.50	10

NOTE: • Refer to Selection procedure and Notes on Selection.
• Maximum braking torque is based on the rated torque run by a commercial power supply.

Table 3.7 Braking unit and braking resistor (P11S-2 series)

Power supply voltage	Inverter type	Option					Maximum braking torque [%]			Cont. braking (100% torque conversion value)		Repetitive braking (100s or less cycle)	
		Braking unit		Braking resistor				50Hz [lb-in (N·m)]	60Hz [lb-in (N·m)]				
		Type	Q'ty	Type	Q'ty	Total ohmic value [Ω]		[N·m]	[N·m]	Dis-charging capability [kWs]	Brak-ing time [s]	Aver-age loss [kW]	Duty cycle [%]
Three-phase 230V	FRN007P11S-2UX	–	–	DB3.7-2	1	33	100	320(36.2)	266(30.0)	37	15	0.093	3.5
	FRN010P11S-2UX			DB5.5-2	1	20		435(49.1)	363(41.0)	55	15	0.138	3.5
	FRN015P11S-2UX			DB7.5-2	1	15		637(72.0)	528(59.7)	37	7	0.188	3.5
	FRN020P11S-2UX	BU3-185-2	1	DB11-2	1	10		868(98.1)	720(81.4)	55	7	0.275	3.5
	FRN025P11S-2UX		1	DB15-2	1	8.6		1071(121)	885(100)	75	8	0.375	4
	FRN030P11S-2UX		1	DB18.5-2	1	6.8		1275(144)	1053(119)	92	8	0.463	4
	FRN040P11S-2UX	BU37-2C	1	DB30-2C	1	4.0		1292(146)	1434(162)	88	6	0.55	3.5
	FRN050P11S-2UX		1	DB30-2C	1	4.0	75	1593(180)	1328(150)	150	8	1.50	8
	FRN060P11S-2UX		1	DB37-2C	1	3.0		1938(219)	1611(182)	185	8	1.85	8
	FRN075P11S-2UX	BU55-2C	1	DB45-2C	1	2.5		2381(269)	1974(223)	225	8	2.25	8
	FRN100P11S-2UX		1	DB55-2C	1	2.0		3231(365)	2682(303)	275	7	2.75	7
	FRN125P11S-2UX	BU90-2C	1	DB75-2C	1	1.5		3877(438)	3222(364)	375	8	3.75	8
	FRN150P11S-2UX		1	DB90-2C	1	1.2		4726(534)	3930(444)	450	8	4.50	8

NOTE: • Refer to Selection procedure and Notes on Selection.
• Maximum braking torque is based on the rated torque run by a commercial power supply.

■ 460V

Table 3.8 Braking unit and braking resistor (G11S-4 series)

Power supply voltage	Inverter type	Option					Maximum braking torque [%]			Cont. braking (100% torque conversion value)		Repetitive braking (100s or less cycle)	
		Braking unit		Braking resistor				50Hz [lb-in (N·m)]	60Hz [lb-in (N·m)]				
		Type	Q'ty	Type	Q'ty	Total ohmic value [Ω]		[N·m]	[N·m]	Discharging capability [kWs]	Braking time [s]	Average loss [kW]	Duty cycle (%)
Three-phase 460V	FRNF50G11S-4UX	–	–	DB0.75-4	1	200	150	35.6(4.02)	29.4(3.32)	9	45	0.044	22
	FRN001G11S-4UX							67.0(7.57)	55.3(6.25)	17	45	0.068	18
	FRN002G11S-4UX			DB2.2-4	1	160		133(15.0)	110(12.4)	34	45	0.075	10
	FRN003G11S-4UX							195(22.0)	161(18.2)	33	30	0.077	7
	FRN005G11S-4UX			DB3.7-4	1	130		328(37.1)	270(30.5)	37	20	0.093	5
	FRN007G11S-4UX			DB5.5-4	1	80		482(54.5)	399(45.1)	55	20	0.138	5
	FRN010G11S-4UX			DB7.5-4	1	60		658(74.3)	545(61.6)	38	10	0.188	5
	FRN015G11S-4UX	BU3-220-4	1	DB11-4	1	40		956(108)	792(89.5)	55	10	0.275	5
	FRN020G11S-4UX		1	DB15-4	1	34.4		1301(147)	1080(122)	75	10	0.375	5
	FRN025G11S-4UX		1	DB18.5-4	1	27		1611(182)	1336(151)	93	10	0.463	5
	FRN030G11S-4UX		1	DB22-4	1	22		1912(216)	1584(179)	88	8	0.550	5
	FRN040G11S-4UX	BU37-4C	1	DB30-4C	1	15	100	1726(195)	1434(162)	150	10	1.50	10
	FRN050G11S-4UX		1	DB37-4C	1	12		2124(240)	1770(200)	185	10	1.85	10
	FRN060G11S-4UX	BU55-4C	1	DB45-4C	1	10		2584(292)	2151(243)	225	10	2.25	10
	FRN075G11S-4UX		1	DB55-4C	1	7.5		3177(359)	2638(298)	275	10	2.75	10
	FRN100G11S-4UX	BU90-4C	1	DB75-4C	1	6.5		4310(487)	3585(405)	375	10	3.75	10
	FRN125G11S-4UX		1	DB110-4C	1	4.7		5178(585)	4301(486)	450	10	4.5	10
	FRN150G11S-4UX	BU132-4C	1	DB110-4C	1	4.7		6302(712)	5240(592)	550	10	5.5	10
	FRN200G11S-4UX		1	DB132-4C	1	3.9		7567(855)	6284(710)	665	10	6.65	10
	FRN250G11S-4UX	BU220-4C	1	DB160-4C	1	3.2		9169(1036)	7620(861)	800	10	8.0	10
	FRN300G11S-4UX		1	DB200-4C	1	2.6		11462(1295)	9523(1076)	1000	10	10.0	10
	FRN350G11S-4UX		1	DB220-4C	1	2.2		12603(1424)	10479(1184)	1100	10	11.0	10
	FRN400G11S-4UX		2	DB160-4C	2	1.6		16046(1813)	13329(1506)	1600	11	16.0	11
	FRN450G11S-4UX		2	DB160-4C	2	1.6		18047(2039)	15002(1695)	1600	10	16.0	10
	FRN500G11S-4UX		2	DB200-4C	2	1.3		20339(2298)	16905(1910)	2000	11	20.0	11
	FRN600G11S-4UX		2	DB200-4C	2	1.3		22923(2590)	19047(2152)	2000	10	20.0	10

NOTE: • Refer to Selection procedure and Notes on Selection.
• Maximum braking torque is based on the rated torque run by a commercial power supply.

Table 3.9 Braking unit and braking resistor (P11S-4 series)

Power supply voltage	Inverter type	Option					Maximum braking torque [%]			Cont. braking (100% torque conversion value)		Repetitive braking (100s or less cycle)	
		Braking unit		Braking resistor				50Hz [lb-in (N·m)]	60Hz [lb-in (N·m)]				
		Type	Q'ty	Type	Q'ty	Total ohmic value [Ω]		[N·m]	[N·m]	Discharging capability [kWs]	Braking time [s]	Average loss [kW]	Duty cycle (%)
Three-phase 460V	FRN007P11S-4UX	–	–	DB3.7-4	1	130	100	321(36.3)	266(30.1)	37	15	0.093	3.5
	FRN010P11S-4UX			DB5.5-4	1	80		439(49.6)	363(41.0)	55	15	0.138	3.5
	FRN015P11S-4UX			DB7.5-4	1	60		636(71.9)	528(59.7)	38	7	0.188	3.5
	FRN020P11S-4UX	BU3-220-4	1	DB11-4	1	40		868(98.1)	720(81.4)	55	7	0.275	3.5
	FRN025P11S-4UX		1	DB15-4	1	34.4		1071(121)	885(100)	75	8	0.375	4
	FRN030P11S-4UX		1	DB18.5-4	1	27		1275(144)	1053(119)	93	8	0.463	4
	FRN040P11S-4UX	BU37-4C	1	DB30-4C	1	15		1593(180)	1328(150)	88	6	0.55	3
	FRN050P11S-4UX		1	DB30-4C	1	15	75	1593(180)	1328(150)	150	8	1.50	8
	FRN060P11S-4UX		1	DB37-4C	1	12		1938(219)	1611(182)	185	8	1.85	8
	FRN075P11S-4UX	BU55-4C	1	DB45-4C	1	10		2381(269)	1974(223)	225	8	2.25	8
	FRN100P11S-4UX		1	DB55-4C	1	7.5		3231(365)	2682(303)	275	7	2.75	7
	FRN125P11S-4UX	BU90-4C	1	DB75-4C	1	6.5		3877(438)	3222(364)	375	8	3.75	8
	FRN150P11S-1UX		1	DB110-4C	1	4.7		4726(534)	3930(444)	450	8	4.5	8
	FRN200P11S-4UX	BU132-4C	1	DB110-4C	1	4.7		5673(641)	4717(533)	550	8	5.5	8
	FRN250P11S-4UX		1	DB132-4C	1	3.9		6877(777)	5718(646)	665	8	6.65	8
	FRN300P11S-4UX	BU220-4C	1	DB160-4C	1	3.2		8594(971)	7143(807)	800	8	8.0	8
	FRN350P11S-4UX		1	DB200-4C	1	2.6		9453(1068)	7859(888)	1000	9	10.0	9
	FRN400P11S-4UX		1	DB220-4C	1	2.2		12037(1360)	10001(1130)	1100	8	11.0	8
	FRN450P11S-4UX		2	DB160-4C	2	1.6		13542(1530)	11249(1271)	1600	10	16.0	10
	FRN500P11S-4UX		2	DB160-4C	2	1.6		15259(1724)	12674(1432)	1600	9	16.0	9
	FRN600P11S-4UX		2	DB200-4C	2	1.3		17188(1942)	14285(1614)	2000	10	20.0	10
	FRN700P11S-4UX		2	DB200-4C	2	1.3		19339(2185)	16073(1816)	2000	9	20.0	9
	FRN800P11S-4UX		2	DB200-4C	2	1.3		21489(2428)	17852(2017)	2000	8	20.0	8

NOTE: • Refer to Selection procedure and Notes on Selection.
• Maximum braking torque is based on the rated torque run by a commercial power supply.

5. Braking Unit and Braking Resistor (10% ED)

[230V]

■FRN □□□ G11S-2 series, FRN □□□ P11S-2 series

Table 3.11 Braking unit and braking resistor (G11S 200V)

Power supply voltage	Inverter type	Option					Maximum braking torque [%]			Cont. braking (100% torque conversion value)		Repetitive braking (100s or less cycle)	
		Braking unit		Braking resistor				50Hz [lb-in (N·m)]	60Hz [lb-in (N·m)]				
		Type	Q'ty	Type	Q'ty	Total ohmic value [Ω]		[N·m]	[N·m]	Discharging capability [kWs]	Braking time [s]	Average loss [kW]	Duty cycle (%)
Three-phase 230V	FRNF25G11S-2UX	–	–	DB0.75-2C	1	100	150	17.6(1.99)	14.6(1.65)	9	90	0.01	10
	FRNF50G11S-2UX							35.6(4.02)	29.4(3.32)	9	45	0.02	10
	FRN001G11S-2UX							67.0(7.57)	55.3(6.25)	17	45	0.0375	10
	FRN002G11S-2UX			DB2.2-2C	1	40		133(15.0)	110(12.4)	34	45	0.075	10
	FRN003G11S-2UX							195(22.0)	161(18.2)	33	30	0.11	10
	FRN005G11S-2UX			DB3.7-2C	1	33		328(37.1)	270(30.5)	37	20	0.185	10
	FRN007G11S-2UX			DB5.5-2C	1	20		481(54.3)	398(45.0)	55	20	0.275	10
	FRN010G11S-2UX			DB7.5-2C	1	15		659(74.4)	545(61.6)	37	10	0.375	10
	FRN015G11S-2UX	BU3-220-2	1	DB11-2C	1	10		956(108)	792(89.5)	55	10	0.55	10
	FRN020G11S-2UX		1	DB15-2C	1	8.6		1301(147)	1080(122)	75	10	0.75	10
	FRN025G11S-2UX	BU37-2C	1	DB22-2C	1	5.8		1611(182)	1337(151)	92	10	0.925	10
	FRN030G11S-2UX		1		1			1912(216)	1584(179)	110	10	1.1	10
	FRN007P11S-2UX	–	–	DB3.7-2C	1	33	100	320(36.2)	266(30.0)	37	15	0.185	10
	FRN010P11S-2UX			DB5.5-2C	1	20		439(49.6)	363(41.0)	55	15	0.275	10
	FRN015P11S-2UX			DB7.5-2C	1	15		637(72.0)	528(59.7)	37	7	0.375	10
	FRN020P11S-2UX	BU3-220-2	1	DB11-2C	1	10		868(98.1)	720(81.4)	55	7	0.55	10
	FRN025P11S-2UX		1	DB15-2C	1	8.6		1071(121)	885(100)	75	7	0.75	7
	FRN030P11S-2UX	BU37-2C	1	DB22-2C		5.8		1275(144)	1053(119)	93	7	0.925	7

NOTE: • Refer to Selection procedure and Notes on Selection.
• Maximum braking torque is based on the rated torque run by a commercial power supply.

[460V]

■FRN □□□ G11S-4 series, FRN □□□ P11S-4 series

Table 3.12 Braking unit and braking resistor (G11S 400V)

Power supply voltage	Inverter type	Option					Maximum braking torque [%]			Cont. braking (100% torque conversion value)		Repetitive braking (100s or less cycle)	
		Braking unit		Braking resistor				50Hz [lb-in (N·m)]	60Hz [lb-in (N·m)]				
		Type	Q'ty	Type	Q'ty	Total ohmic value [Ω]		[N·m]	[N·m]	Discharging capability [kWs]	Braking time [s]	Average loss [kW]	Duty cycle (%)
Three-phase 460V	FRNF50G11S-4UX	–	–	DB0.75-4C	1	200	150	35.6(4.02)	29.4(3.32)	9	45	0.02	10
	FRN001G11S-4UX							67.0(7.57)	55.3(6.25)	17	45	0.0375	10
	FRN002G11S-4UX			DB2.2-4C	1	160		133(15.0)	110(12.4)	34	45	0.075	10
	FRN003G11S-4UX							195(22.0)	161(18.2)	33	30	0.11	10
	FRN005G11S-4UX			DB3.7-4C	1	130		328(37.1)	270(30.5)	37	20	0.185	10
	FRN007G11S-4UX			DB5.5-4C	1	80		481(54.3)	398(45.0)	55	20	0.275	10
	FRN010G11S-4UX			DB7.5-4C	1	60		659(74.4)	545(61.6)	38	10	0.375	10
	FRN015G11S-4UX	BU3-220-4	1	DB11-4C	1	40		956(108)	792(89.5)	55	10	0.55	10
	FRN020G11S-4UX		1	DB15-4C	1	34.4		1301(147)	1080(122)	75	10	0.75	10
	FRN025G11S-4UX	BU37-4C	1	DB22-4C	1	22		1611(182)	1337(151)	92	10	0.925	10
	FRN030G11S-4UX		1		1			1912(216)	1584(179)	110	10	1.1	10
	FRN007P11S-4UX	–		DB3.7-4C	1	130	100	320(36.2)	266(30.0)	37	15	0.185	10
	FRN010P11S-4UX		–	DB5.5-4C	1	80		439(49.6)	363(41.0)	55	15	0.275	10
	FRN015P11S-4UX			DB7.5-4C	1	60		637(72.0)	528(59.7)	38	7	0.375	10
	FRN020P11S-4UX	BU3-220-4	1	DB11-4C	1	40		868(98.1)	720(81.4)	55	7	0.55	10
	FRN025P11S-4UX		1	DB15-4C	1	34.4		1071(121)	885(100)	75	7	0.75	7
	FRN030P11S-4UX	BU37-4C	1	DB22-4C		22		1275(144)	1053(119)	93	7	0.925	7

NOTE: • Refer to Selection procedure and Notes on Selection.
• Maximum braking torque is based on the rated torque run by a commercial power supply.

■Dimensions, inch (mm)

- Braking resistor (10% ED)
  DB0.75-2C to DB22-2C
  DB0.75-4C to DB22-4C

Fig. A

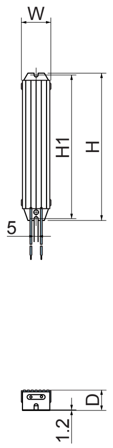


Fig. B

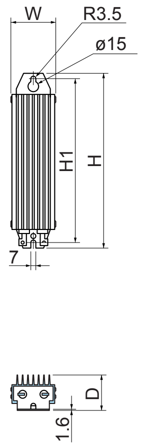


Fig. C

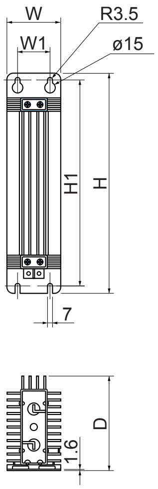
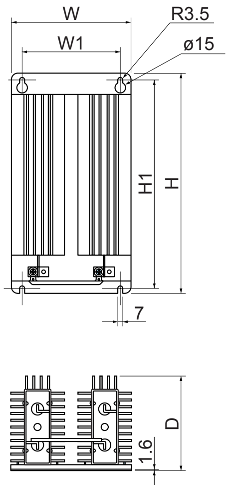


Fig. D



Braking resistor type		Fig.	Dimensions [inch (mm)]				
230V	460V		W	W1	H	H1	D
DB0.75-2C	DB0.75-4C	A	1.69(43)	–	8.7(221)	8.46(215)	1.2(30.5)
DB2.2-2C	DB2.2-4C	B	2.64(67)		7.4(188)	6.77(172)	2.17(55)
DB3.7-2C	DB3.7-4C				12.91(328)	12.28(312)	
DB5.5-2C	DB5.5-4C		3.15(80)		14.88(378)	14.25(362)	3.07(78)
DB7.5-2C	DB7.5-4C				16.46(418)	15.83(402)	
DB11-2C	DB11-4C	C		1.97(50)	18.11(460)	17.32(440)	5.51(140)
DB15-2C	DB15-4C				22.83(580)	22.05(560)	
DB22-2C	DB22-4C	D	7.09(180)	5.67(144)	15.75(400)	15.08(383)	5.71(145)

6. Rated Sensitive Current of GFCI

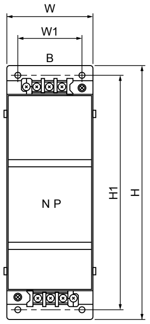
Table 3.14 Rated sensitive current of GFCI

Power supply voltage	Nominal applied motor [HP]	Inverter type		Rated current of nominal applied motor [A]	Wiring length and sensitive current					
		G11S series	P11S series		10m	30m	50m	100m	200m	300m
Three-phase 230V	1/4	FRNF25G11S-2UX	–	1.4						
	1/2	FRNF50G11S-2UX		2.3						
	1	FRN001G11S-2UX		3.6						
	2	FRN002G11S-2UX		6.5						
	3	FRN003G11S-2UX		9.2		30mA				
	5	FRN005G11S-2UX		15						
	7.5	FRN007G11S-2UX	FRN007P11S-2UX	22						
	10	FRN010G11S-2UX	FRN010P11S-2UX	29				100mA		
	15	FRN015G11S-2UX	FRN015P11S-2UX	42						
	20	FRN020G11S-2UX	FRN020P11S-2UX	55						
	25	FRN025G11S-2UX	FRN025P11S-2UX	67					200mA	
	30	FRN030G11S-2UX	FRN030P11S-2UX	78						
	40	FRN040G11S-2UX	FRN040P11S-2UX	107						
	50	FRN050G11S-2UX	FRN050P11S-2UX	130						
	60	FRN060G11S-2UX	FRN060P11S-2UX	156						
	75	FRN075G11S-2UX	FRN075P11S-2UX	198						
	100	FRN100G11S-2UX	FRN100P11S-2UX	271						500mA
	125	FRN125G11S-2UX	FRN125P11S-2UX	315						
	150	–	FRN150P11S-2UX	383						
Three-phase 460V	1/2	FRNF50G11S-4UX	–	1.2						
	1	FRN001G11S-4UX		1.8						
	2	FRN002G11S-4UX		3.3						
	3	FRN003G11S-4UX		4.6						
	5	FRN005G11S-4UX		7.5	30mA					
	7.5	FRN007G11S-4UX	FRN007P11S-4UX	11						
	10	FRN010G11S-4UX	FRN010P11S-4UX	14.5						
	15	FRN015G11S-4UX	FRN015P11S-4UX	21			100mA			
	20	FRN020G11S-4UX	FRN020P11S-4UX	27.5						
	25	FRN025G11S-4UX	FRN025P11S-4UX	34						
	30	FRN030G11S-4UX	FRN030P11S-4UX	39				200mA		
	40	FRN040G11S-4UX	FRN040P11S-4UX	54						
	50	FRN050G11S-4UX	FRN050P11S-4UX	65						
	60	FRN060G11S-4UX	FRN060P11S-4UX	78					500mA	
	75	FRN075G11S-4UX	FRN075P11S-4UX	99						
	100	FRN100G11S-4UX	FRN100P11S-4UX	135						
	125	FRN125G11S-4UX	FRN125P11S-4UX	160						
	150	FRN150G11S-4UX	FRN150P11S-4UX	192						
	200	FRN200G11S-4UX	FRN200P11S-4UX	226						1000mA
	250	FRN250G11S-4UX	FRN250P11S-4UX	265						(Non standard)
	300	FRN300G11S-4UX	FRN300P11S-4UX	336						
	350	FRN350G11S-4UX	FRN350P11S-4UX	396						
	400	FRN400G11S-4UX	FRN400P11S-4UX	500						
	450	FRN450G11S-4UX	FRN450P11S-4UX	Contact Fuji						
	500	FRN500G11S-4UX	FRN500P11S-4UX							
	600	FRN600G11S-4UX	FRN600P11S-4UX							
	700	–	FRN700P11S-4UX							
	800		FRN800P11S-4UX							

NOTE: Rated current of nominal applied motor is based on the value of Fuji standard motor (4 pole, 230V, 50Hz).

7. Input Circuit Noise Filter (EMC Compliance Filter)

• Filter



• Core

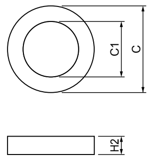


Table 3.15 Input circuit noise filter (EMC Compliance Filter, 230V)

Power supply voltage	Nominal applied motor [HP]	Inverter type		Filter				Core		Filter						Core		
		G11S series	P11S series	Type	Rated voltage [V]	Rated current [A]	Leakage current [mA]	Type	Q'ty	Dimensions [inch(mm)]					Weight [lbs(kg)]	Dimensions [inch(mm)]		
										W	W1	H	H1	D		C	C1	H2
Three-phase 230V	1/4	FRNF25G11S-2UX	–	EFL-0.75SP-2	200 to 230	6	4.2	OF1	1	3.35 (85)	2.32 (59)	9.57 (243)	8.98 (228)	3.66 (93)	3.3 (1.5)	2.01 (51)	0.98 (25)	0.67 (17)
	1/2	FRNF50G11S-2UX																
	1	FRN001G11S-2UX																
	2	FRN002G11S-2UX		EFL-3.7SP-2		25		OF2		4.13 (105)	3.15 (80)	9.17 (233)	8.46 (215)	5.35 (136)	5.5 (2.5)	2.72 (69)	1.69 (43)	0.63 (16)
	3	FRN003G11S-2UX																
	5	FRN005G11S-2UX																
	7.5	FRN007G11S-2UX	FRN007P11S-2UX	EFL-7.5SP-2		50	9			4.72 (120)	3.74 (95)	10.75 (273)	10.00 (254)	6.22 (158)	11 (5.0)			
	10	FRN010G11S-2UX	FRN010P11S-2UX															
	15	FRN015G11S-2UX	FRN015P11S-2UX	EFL-15SP-2		100	23	OF3		8.07 (205)	6.30 (160)	20.20 (513)	19.17 (487)	7.60 (193)	44 (20)	3.82 (97)	2.95 (75)	0.98 (25)
	20	FRN020G11S-2UX	FRN020P11S-2UX															
	25	FRN025G11S-2UX	FRN025P11S-2UX	EFL-22SP-2		150												
	30	FRN030G11S-2UX	FRN030P11S-2UX															

Fig. A

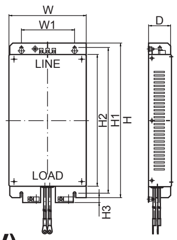


Fig. B

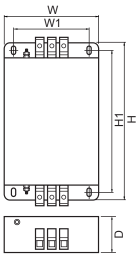


Fig. C

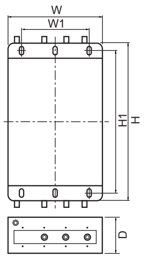


Table 3.16 Input circuit noise filter (EMC Compliance Filter, 460V)

Power supply voltage	Nominal applied motor [HP]	Inverter type		EMC filter Type	Rated voltage [V]	Rated current [A]	Leakage current [mA]	Fig	Dimensions [inch (mm)]							
		G11S series	P11S series						W	W1	H	H1	H2	H3	D	Mtg, screw
Three-phase 460V	1/2	FRNF50G11S-4UX	–	EFL-0.75G11-4	380 to 480	5	72	A	4.57 (116)	3.54 (90)	12.20 (310)	11.54 (293)	10.43 (265)	0.39 (10)	1.65 (42)	M5
	1	FRN001G11S-4UX														
	2	FRN002G11S-4UX		EFL-4.0G11-4		12	105		6.10 (155)	4.13 (105)	12.20 (310)	11.54 (293)	10.43 (265)	0.39 (10)	1.77 (45)	M5
	3	FRN003G11S-4UX														
	5	FRN005G11S-4UX														
	7.5	FRN007G11S-4UX	FRN007P11S-4UX	EFL-7.5G11-4		35	105		8.86 (225)	6.57 (167)	13.03 (331)	12.24 (311)	10.24 (260)	0.39 (10)	1.87 (47.5)	M8
	10	FRN010G11S-4UX	FRN010P11S-4UX													
	15	FRN015G11S-4UX	FRN015P11S-4UX	EFL-15G11-4		50	158		9.84 (250)	7.28 (185)	18.90 (480)	17.68 (449)	15.75 (400)	0.79 (20)	2.76 (70)	M8
	20	FRN020G11S-4UX	FRN020P11S-4UX													
	25	FRN025G11S-4UX	FRN025P11S-4UX	EFL-22G11-4		72	105		9.84 (250)	7.28 (185)	18.90 (480)	17.68 (449)	15.75 (400)	0.79 (20)	2.76 (70)	M8
	30	FRN030G11S-4UX	FRN030P11S-4UX													
	40	FRN040G11S-4UX	FRN040P11S-4UX	RF-3100-F11	380 to 480	100	130	B	7.87 (200)	6.54 (166)	17.13 (435)	16.06 (408)	–	–	5.12 (130)	M6
	50	FRN050G11S-4UX	FRN050P11S-4UX	RF-3180-F11		180			7.87 (200)	6.54 (166)	19.49 (495)	18.43 (468)	–	–	6.30 (160)	M6
	60	FRN060G11S-4UX	FRN060P11S-4UX													
	75	FRN075G11S-4UX	FRN075P11S-4UX													
	100	FRN100G11S-4UX	FRN100P11S-4UX													
	125	FRN125G11S-4UX	FRN125P11S-4UX													
	150	FRN150G11S-4UX	FRN150P11S-4UX	RF-3280-F11		280	270	C	9.84 (250)	6.69 (170)	23.11 (587)	22.05 (560)	–	–	8.07 (205)	M6
	200	FRN200G11S-4UX	FRN200P11S-4UX													
	250	FRN250G11S-4UX	FRN250P11S-4UX	RF-3400-F11		400			9.84 (250)	6.69 (170)	23.11 (587)	22.05 (560)	–	–	8.07 (205)	M6
	300	FRN300G11S-4UX	FRN300P11S-4UX													
	350	FRN350G11S-4UX	FRN350P11S-4UX													
	400	FRN400G11S-4UX	FRN400P11S-4UX	RF-3880-F11		880			14.33 (364)	11.81 (300)	27.09 (688)	25.51 (648)	–	–	7.09 (180)	M8
	450	FRN450G11S-4UX	FRN450P11S-4UX													
	500	FRN500G11S-4UX	FRN500P11S-4UX	Contact Fuji												
	600	FRN600G11S-4UX	FRN600P11S-4UX													
	700	–	FRN700P11S-4UX													
	800		FRN800P11S-4UX													

8. Output Circuit Noise Filter (OFL-□□-2/4)

Table 3.18 Output circuit noise filter (OFL-□□-2/4)

Power supply voltage	Nominal applied motor [HP]	Inverter type		Filter type	Rated current [A]	Overload capability	Inverter power input voltage	Maximum frequency	Carrier frequency allowable range *4)	Approx. Weight [lbs (kg)]
		G11S series	P11S series							
Three-phase 230V	1/4	FRNF25G11S-2UX	–	OFL-0.4-2	3	150% for 60s, 200% for 0.5s	3-phase 200 to 230V 50/60Hz	400Hz	8 to 15kHz	15(7)
	1/2	FRNF50G11S-2UX								
	1	FRN001G11S-2UX		OFL-1.5-2	8					21(9.5)
	2	FRN002G11S-2UX								
	3	FRN003G11S-2UX		OFL-3.7-2	17					33(15)
	5	FRN005G11S-2UX								
	7.5	FRN007G11S-2UX	FRN007P11S-2UX	OFL-7.5-2	33					51(23)
	10	FRN010G11S-2UX	FRN010P11S-2UX							
	15	FRN015G11S-2UX	FRN015P11S-2UX	OFL-15-2	59					84(38)
	20	FRN020G11S-2UX	FRN020P11S-2UX							
	25	FRN025G11S-2UX	FRN025P11S-2UX	OFL-22-2	87					101(46)
	30	FRN030G11S-2UX	FRN030P11S-2UX							
	40	FRN040G11S-2UX	FRN040P11S-2UX	OFL-30-2	115	150% for 60s, 180% for 0.5s		120Hz	6kHz or higher	84(38)
	50	FRN050G11S-2UX	FRN050P11S-2UX	OFL-37-2	145					97(44)
	60	FRN060G11S-2UX	FRN060P11S-2UX	OFL-45-2	180					106(48)
	75	FRN075G11S-2UX	FRN075P11S-2UX	OFL-55-2	215					146(66)
	100	FRN100G11S-2UX	FRN100P11S-2UX	OFL-75-2	285					192(78)
	125	FRN125G11S-2UX	FRN125P11S-2UX	OFL-90-2	Contact Fuji					
	150	–	FRN150P11S-2UX	OFL-110-2						
Three-phase 460V	1/2	FRNF50G11S-4UX	–	OFL-0.4-4	1.5	150% for 60s, 200% for 0.5s	3-phase 380 to 460V 50/60Hz	400Hz	8 to 15kHz	15(7)
	1	FRN001G11S-4UX		OFL-1.5-4	3.7					15(7)
	2	FRN002G11S-4UX								
	3	FRN003G11S-4UX		OFL-3.7-4	9					26(12)
	5	FRN005G11S-4UX								
	7.5	FRN007G11S-4UX	FRN007P11S-4UX	OFL-7.5-4	18					42(19)
	10	FRN010G11S-4UX	FRN010P11S-4UX							
	15	FRN015G11S-4UX	FRN015P11S-4UX	OFL-15-4	30					73(33)
	20	FRN020G11S-4UX	FRN020P11S-4UX							
	25	FRN025G11S-4UX	FRN025P11S-4UX	OFL-22-4	45					95(43)
	30	FRN030G11S-4UX	FRN030P11S-4UX							
	40	FRN040G11S-4UX	FRN040P11S-4UX	OFL-30-4	60	150% for 60s, 180% for 0.5s		120Hz	6kHz or higher	84(38)
	50	FRN050G11S-4UX	FRN050P11S-4UX	OFL-37-4	75					101(46)
	60	FRN060G11S-4UX	FRN060P11S-4UX	OFL-45-4	91					121(55)
	75	FRN075G11S-4UX	FRN075P11S-4UX	OFL-55-4	112					150(68)
	100	FRN100G11S-4UX	FRN100P11S-4UX	OFL-75-4	150					176(80)
	125	FRN125G11S-4UX	FRN125P11S-4UX	OFL-90-4	176					216(98)
	150	FRN150G11S-4UX	FRN150P11S-4UX	OFL-110-4	210					254(115)
	200	FRN200G11S-4UX	FRN200P11S-4UX	OFL-132-4	253					287(130)
	250	FRN250G11S-4UX	FRN250P11S-4UX	OFL-160-4	304					342(155)
	300	FRN300G11S-4UX	FRN300P11S-4UX	OFL-200-4	377					408(185)
	350	FRN350G11S-4UX	FRN350P11S-4UX	OFL-220-4	415					441(200)
	400	FRN400G11S-4UX	FRN400P11S-4UX	OFL-280-4	Contact Fuji					
	450	FRN450G11S-4UX	FRN450P11S-4UX	OFL-315-4						
	500	FRN500G11S-4UX	FRN500P11S-4UX	OFL-355-4						
	600	FRN600G11S-4UX	FRN600P11S-4UX	OFL-400-4						
	700	–	FRN450P11S-4UX	OFL-450-4						
	800	–	FRN800P11S-4UX	OFL-500-4						

NOTES:
- For the model of 40HP or larger, capacitor will be installed separately.
- This filter should be used within the carrier frequency allowable range.

8. Output Circuit Noise Filter (OFL-☐☐-2/4)

■ Dimensions, mm

- **Filter**

Fig.A

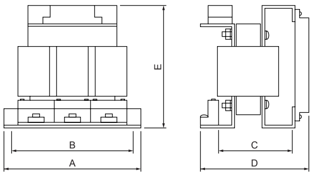
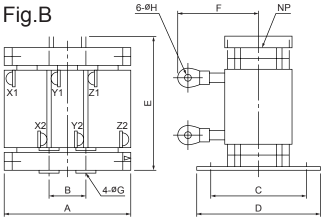


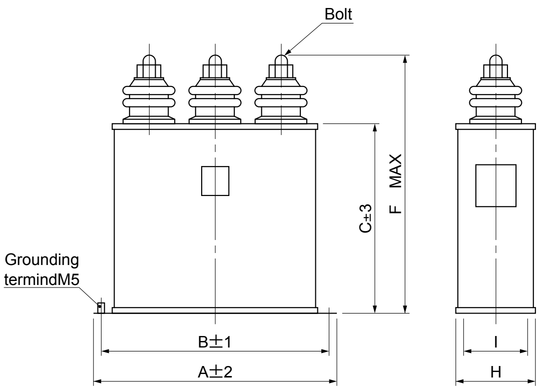
Fig.B



Power supply voltage	type	Fig.	A	B	C	D	E	F	Earth terminal	Terminal screw H	Mounting screw G	Approx. Weight [lbs(kg)]
Three-phase 230V	OFL-0.4-2	A	8.66(220)	7.87(200)	3.74(95)	6.69(170)	7.68(195)	—	M4	M4	M5	15(7)
	OFL-1.5-2				4.13(105)		8.46(215)					21(9.5)
	OFL-3.7-2				5.31(135)	7.87(200)						33(15)
	OFL-7.5-2		11.02(280)	9.84(250)	6.3(160)	9.84(250)	9.06(230)		M5	M6	M6	51(23)
	OFL-15-2		11.81(300)	10.63(270)	6.69(170)	10.63(270)	12.60(320)		M6		M8	84(38)
	OFL-22-2				7.09(180)	11.81(300)	12.99(330)			M8		101(46)
	OFL-30-2	B	11.02(280)	3.74(95)	7.87(200)	9.06(230)	13.58(345)	6.30(160)	—	0.25(6.4)	0.39(10)	84(38)
	OFL-37-2				8.27(210)	9.45(240)		6.69(170)		0.33(8.4)		97(44)
	OFL-45-2		12.99(330)	4.33(110)	7.87(200)		15.75(400)				0.47(12)	106(48)
	OFL-55-2				8.46(215)	10.04(255)	16.54(420)	7.09(180)		0.41(10.5)		146(66)
	OFL-75-2				9.45(240)	11.02(280)	16.93(430)	7.48(190)				172(78)
Three-phase 460V	OFL-0.4-4	A	8.66(220)	7.87(200)	3.74(95)	6.69(170)	7.68(195)	—	M4	M4	M5	15(7)
	OFL-1.5-4											15(7)
	OFL-3.7-4				4.53(115)	7.48(190)	8.86(225)					26(12)
	OFL-7.5-4		11.42(290)	10.24(260)	5.51(140)	9.06(230)	9.06(230)		M5	M5	M6	42(19)
	OFL-15-4		12.99(330)	11.81(300)	5.71(145)	10.04(255)	12.20(310)		M6	M6	M8	73(33)
	OFL-22-4				6.69(170)	11.42(290)	12.99(330)					95(43)
	OFL-30-4	B	11.02(280)	3.74(95)	7.87(200)	9.06(230)	13.58(345)	5.91(150)	—	0.25(6.4)	0.39(10)	84(38)
	OFL-37-4				8.46(215)	9.65(245)	13.98(355)	6.69(170)				101(46)
	OFL-45-4		12.99(330)	4.33(110)	7.87(200)	9.45(240)	15.75(400)				0.47(12)	121(55)
	OFL-55-4				8.46(215)	10.04(255)	16.54(420)	7.09(180)		0.33(8.4)		150(68)
	OFL-75-4				9.06(230)	10.63(270)	16.93(430)	7.48(190)				176(80)
	OFL-90-4		14.17(360)	4.72(120)	10.24(260)	11.81(300)	18.90(480)			0.41(10.5)	0.59(15)	216(98)
	OFL-110-4				10.83(275)	12.40(315)						254(115)
	OFL-132-4				11.61(295)	13.19(335)	19.29(490)	7.87(200)		0.51(13)		287(130)
	OFL-160-4		15.35(390)	5.12(130)	11.22(285)	12.80(325)	21.65(550)	8.27(210)				342(155)
	OFL-200-4				12.01(305)	13.58(345)	22.44(570)	9.06(230)				408(185)
	OFL-220-4		16.54(420)	5.51(140)	12.2(310)	14.17(360)	22.83(580)	9.45(240)				441(200)

- **Capacitor**

The capacitor for the filter OFL-30-☐ or larger has to be installed separatery.
(The capacitor mass is not included in the filter mass on the above table.)



Power supply voltage	Filter type	Capacitor dimensions [inch(mm)]						
		A	B	C	F	H	I	Bolt
Three-phase 230V	OFL-30-2	6.50(165)	5.91(150)	4.72(120)	5.91(150)	2.76(70)	1.57(40)	M5
	OFL-37-2			5.91(150)	7.28(185)			
	OFL-45-2	8.07(205)	7.48(190)	5.91(150)	7.87(200)			M6
	OFL-55-2							
	OFL-75-2	11.02(280)	10.43(265)	7.09(180)	10.63(270)	0.41(10.5)	2.17(55)	M12
Three-phase 460V	OFL-30-4	6.50(165)	5.91(150)	3.94(100)	5.31(135)	2.76(70)	1.57(40)	M5
	OFL-37-4							
	OFL-45-4			4.72(120)	6.10(155)			
	OFL-55-4							
	OFL-75-4			5.91(150)	7.28(185)			M6
	OFL-90-4	8.07(205)	7.48(190)		7.87(200)			
	OFL-110-4							M12
	OFL-132-4	11.02(280)	10.43(265)	7.09(180)	10.63(270)	3.54(90)	2.17(55)	
	OFL-160-4							
	OFL-200-4			7.87(200)	11.42(290)			
	OFL-220-4			9.06(230)	12.60(320)			

9. Output Circuit Noise Filter (OFL-□□-4A)

Table 3.19 Output circuit noise filter (OFL-□□-4A)

Power supply voltage	Nominal applied motor [HP]	Inverter type		Filter type	Rated current [A]	Overload capability	Inverter power input voltage	Carrier frequency allowable range	Maximum frequency
		G11S series	P11S series						
Three-phase 460V	1/2	FRNF50G11S-4UX	–	OFL-0.4-4A	1.5	150%-1min, 200%-0.5s	Three-phase 380 to 480V 50/60HZ	0.75 to 15kHz	400Hz
	1	FRN001G11S-4UX		OFL-1.5-4A	3.7				
	2	FRN002G11S-4UX							
	3	FRN003G11S-4UX		OFL-3.7-4A	9				
	5	FRN005G11S-4UX							
	7.5	FRN007G11S-4UX	FRN007P11S-4UX	OFL-7.5-4A	18				
	10	FRN010G11S-4UX	FRN010P11S-4UX						
	15	FRN015G11S-4UX	FRN015P11S-4UX	OFL-15-4A	30				
	20	FRN020G11S-4UX	FRN020P11S-4UX						
	25	FRN025G11S-4UX	FRN025P11S-4UX	OFL-22-4A	45				
	30	FRN030G11S-4UX	FRN030P11S-4UX						
	40	FRN040G11S-4UX	FRN040P11S-4UX	OFL-30-4A	60	150%-1min, 180%-0.5s			
	50	FRN050G11S-4UX	FRN050P11S-4UX	OFL-37-4A	75				
	60	FRN060G11S-4UX	FRN060P11S-4UX	OFL-45-4A	91			0.75 to 10kHz	
	75	FRN075G11S-4UX	FRN075P11S-4UX	OFL-55-4A	112				
	100	FRN100G11S-4UX	FRN100P11S-4UX	OFL-75-4A	150				
	125	FRN125G11S-4UX	FRN125P11S-4UX	OFL-90-4A	176				
	150	FRN150G11S-4UX	FRN150P11S-4UX	OFL-110-4A	210				
	200	FRN200G11S-4UX	FRN200P11S-4UX	OFL-132-4A	253				
	250	FRN250G11S-4UX	FRN250P11S-4UX	OFL-160-4A	304				
	300	FRN300G11S-4UX	FRN300P11S-4UX	OFL200-4A	377				
	350	FRN350G11S-4UX	FRN350P11S-4UX	OFL-220-4A	415				
	400	FRN400G11S-4UX	FRN400P11S-4UX	OFL-280-4A	520				
	450	FRN450G11S-4UX	FRN450P11S-4UX	OFL-315-4A	Contact Fuji				
	500	FRN500G11S-4UX	FRN500P11S-4UX	OFL-355-4A					
	600	FRN600G11S-4UX	FRN600P11S-4UX	OFL-400-4A					
	700	–	FRN700P11S-4UX	OFL-450-4A					
	800		FRN800P11S-4UX	OFL-500-4A					

NOTES: The capacitor for the filter OFL-30-4A or larger has to be installed separately. (The capacitor mass is not included in the filter mass on the table below.)

■ Dimensions, inch(mm)

• Filter

Fig.A

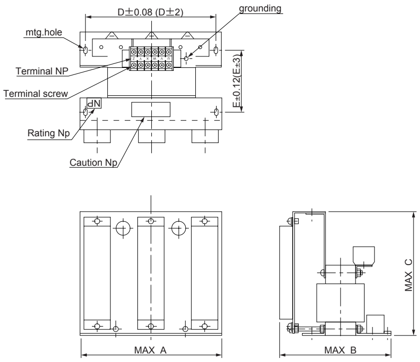


Fig.B

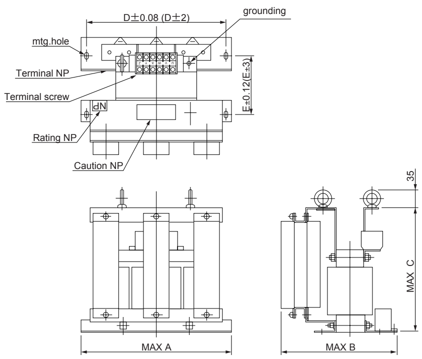


Fig.C

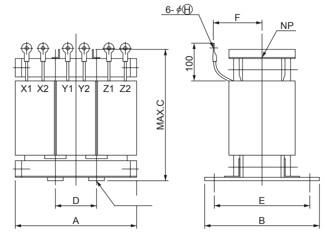


Fig.D

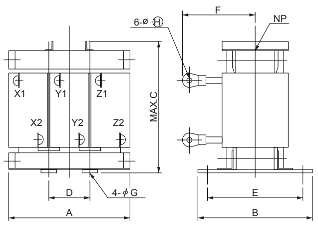
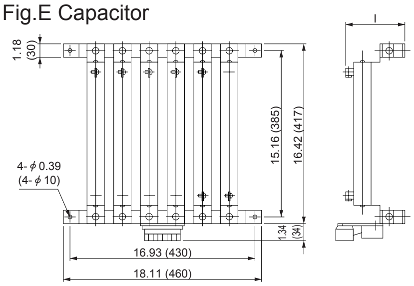


Fig.E Capacitor



The capacitor for the filter OFL-30-4A or larger has to be installed separately. (The capacitor mass is not included in the filter mass on the table below.)

Power supply voltage	Filter type	Fig.	Dimensions [inch(mm)]										Approx. Weight [lbs(kg)]
			A	B	C	D	E	F	I	Ground terminal	Terminal screw H	Mounting screw G	
Three-phase 460V	OFL-0.4-4A	A	8.66(220)	6.89(175)	7.68(195)	7.87(200)	3.74(95)	–	–	M4	M4	M5	15(7)
	OFL-1.5-4A												15(7)
	OFL-3.7-4A			8.86(225)	8.66(220)		4.53(115)						31(14)
	OFL-7.5-4A		11.42(290)	11.42(290)	9.06(230)	10.24(260)	6.30(160)			M5	M5	M6	49(22)
	OFL-15-4A	B	12.99(330)	10.83(275)	12.20(310)	11.81(300)	5.71(145)			M6	M6	M8	77(35)
	OFL-22-4A			11.81(300)	12.99(330)		6.69(170)						99(45)
	OFL-30-4A	C	8.27(210)	6.89(175)	8.27(210)	2.76(70)	5.51(140)	3.54(90)	6.30(160)	–	0.25(6.4)	0.31(8)	26(12)
	OFL-37-4A		8.66(220)	7.48(190)	8.66(220)	2.95(75)	5.91(150)	3.74(95)					33(15)
	OFL-45-4A	D • E		7.68(195)	10.43(265)	2.76(70)	6.10(155)	5.51(140)			0.33(8.4)	0.39(10)	37(17)
	OFL-55-4A		10.24(260)	7.87(200)	10.83(275)	3.35(85)	6.30(160)	5.91(150)					49(22)
	OFL-75-4A			8.27(210)	11.42(290)		6.69(170)		9.17(233)		0.41(10.5)	0.47(12)	55(25)
	OFL-90-4A							6.10(155)					62(28)
	OFL-110-4A		11.81(300)	9.06(230)	12.99(330)	3.94(100)	7.48(190)	6.69(170)					84(38)
	OFL-132-4A			9.45(240)	13.39(340)		7.87(200)				0.51(13)		93(42)
	OFL-160-4A							7.09(180)					106(48)
	OFL-200-4A		12.60(320)	10.63(270)	13.78(350)	4.13(105)	8.66(220)	7.48(190)	13.11(333)			0.59(15)	132(60)
	OFL-220-4A		13.39(340)	11.81(300)	15.35(390)	4.53(115)	9.84(250)						154(70)
	OFL-280-4A		13.78(350)		16.93(430)			7.87(200)					172(78)

10. DC REACTOR (DCR)

■This REACTOR is mainly used for normalizing the power supply or improving power-factor (reducing harmonics).

Table 3.20 DC REACTOR (DCR), G11S/P11S series

Power Power supply	Nominal applied motor [HP]	Inverter type		DC REACTOR (DCR)			
		G11S series	P11S series	Type	Rated current [A]	Inductance [mH]	Generated loss [W]
Three-phase 230V	1/4	FRNF25G11S-2UX	–	DCR2-0.2	1.5	20	1.2
	1/2	FRNF50G11S-2UX		DCR2-0.4	3.0	12	1.7
	1	FRN001G11S-2UX		DCR2-0.75	5.0	7.0	2.7
	2	FRN002G11S-2UX		DCR2-1.5	8.0	4.0	4.2
	3	FRN003G11S-2UX		DCR2-2.2	11	3.0	6.5
	5	FRN005G11S-2UX		DCR2-3.7	18	1.7	9.1
	7.5	FRN007G11S-2UX	FRN007P11S-2UX	DCR2-5.5	25	1.2	14
	10	FRN010G11S-2UX	FRN010P11S-2UX	DCR2-7.5	34	0.8	16
	15	FRN015G11S-2UX	FRN015P11S-2UX	DCR2-11	50	0.6	24
	20	FRN020G11S-2UX	FRN020P11S-2UX	DCR2-15	67	0.4	28
	25	FRN025G11S-2UX	FRN025P11S-2UX	DCR2-18.5	81	0.35	31
	30	FRN030G11S-2UX	FRN030P11S-2UX	DCR2-22A	98	0.3	37
	40	FRN040G11S-2UX	FRN040P11S-2UX	DCR2-30B	136	0.23	37
	50	FRN050G11S-2UX	FRN050P11S-2UX	DCR2-37B	167	0.19	47
	60	FRN060G11S-2UX	FRN060P11S-2UX	DCR2-45B	203	0.16	52
	75	FRN075G11S-2UX	FRN075P11S-2UX	DCR2-55B	244	0.13	55
	100	FRN100G11S-2UX	FRN100P11S-2UX	DCR2-75B	341	0.080	55
	125	FRN125G11S-2UX	FRN125P11S-2UX	DCR2-90B	410	0.067	57
	150	–	FRN150P11S-2UX	DCR2-110B	526	0.055	67
Three-phase 460V	1/2	FRNF50G11S-4UX	–	DCR4-0.4	1.5	50	1.5
	1	FRN001G11S-4UX		DCR4-0.75	2.5	30	2.1
	2	FRN002G11S-4UX		DCR4-1.5	4.0	16	4.6
	3	FRN003G11S-4UX		DCR4-2.2	5.5	12	6.7
	5	FRN005G11S-4UX		DCR4-3.7	9.0	7.0	8.5
	7.5	FRN007G11S-4UX	FRN007P11S-4UX	DCR4-5.5	13	4.0	9.3
	10	FRN010G11S-4UX	FRN010P11S-4UX	DCR4-7.5	18	3.5	15
	15	FRN015G11S-4UX	FRN015P11S-4UX	DCR4-11	25	2.2	20
	20	FRN020G11S-4UX	FRN020P11S-4UX	DCR4-15	34	1.8	28
	25	FRN025G11S-4UX	FRN025P11S-4UX	DCR4-18.5	41	1.4	29
	30	FRN030G11S-4UX	FRN030P11S-4UX	DCR4-22A	49	1.2	35
	40	FRN040G11S-4UX	FRN040P11S-4UX	DCR4-30B	71	0.86	35
	50	FRN050G11S-4UX	FRN050P11S-4UX	DCR4-37B	88	0.70	40
	60	FRN060G11S-4UX	FRN060P11S-4UX	DCR4-45B	107	0.58	44
	75	FRN075G11S-4UX	FRN075P11S-4UX	DCR4-55B	131	0.47	55
	100	FRN100G11S-4UX	FRN100P11S-4UX	DCR4-75B	178	0.335	58
	125	FRN125G11S-4UX	FRN125P11S-4UX	DCR4-90B	214	0.29	64
	150	FRN150G11S-4UX	FRN150P11S-4UX	DCR4-110B	261	0.24	73
	200	FRN200G11S-4UX	FRN200P11S-4UX	DCR4-132B	313	0.215	84
	250	FRN250G11S-4UX	FRN250P11S-4UX	DCR4-160B	380	0.177	90
	300	FRN300G11S-4UX	FRN300P11S-4UX	DCR4-200B	475	0.142	126
	350	FRN350G11S-4UX	FRN350P11S-4UX	DCR4-220B	524	0.126	131
	400	FRN400G11S-4UX	FRN400P11S-4UX	DCR4-280B	649	0.100	150
	450	FRN450G11S-4UX	FRN450P11S-4UX	DCR4-315B	739	0.089	190
	500	FRN500G11S-4UX	FRN500P11S-4UX	DCR4-355B	833	0.079	205
	600	FRN600G11S-4UX	FRN600P11S-4UX	DCR4-400B	938	0.070	215
	700	–	FRN700P11S-4UX	DCR4-450B	1056	0.063	272
	800		FRN800P11S-4UX	DCR4-500B	1173	0.057	292

NOTE: The generated loss is an approximate value calculated by the following conditions:

- Power supply voltage is 230V or 460V, 50Hz. Voltage unbalance is 0(zero) %.
- Power transformer capacity is 500kVA, or 10 times of inverter rated capacity; which is larger one is adopted.
- The load motor is 4 pole standard motor with 100% load.
- No AC reactor (ACR) is connected.
- For the model of 100HP or larger, provided with DC REACTOR (DCR) as standard.

11. AC Reactor (ACR)

■This reactor is unnecessary unless an especially stable power supply such as DC-bus connection operation (PN-connection operation) is required. Use a DC REACTOR (DCR) for reducing harmonics.

Table 3.22 AC reactor (ACR)

Power supply voltage	Nominal applied motor [HP]	Inverter type		AC REACTOR (ACR)					
		G11S series	P11S series	Type	Rated current [A]	Reactance [mΩ/phase]		Coil resistance [mΩ]	Generated loss [W] *1)
						50Hz	60Hz		
Three-phase 230V	1/4	FRNF25G11S-2UX	–	ACR2-0.4A	3	917	1100	–	5
	1/2	FRNF50G11S-2UX							10
	1	FRN001G11S-2UX		ACR2-0.75A	5	493	592		12
	2	FRN002G11S-2UX		ACR2-1.5A	8	295	354		14
	3	FRN003G11S-2UX		ACR2-2.2A	11	213	256		16
	5	FRN005G11S-2UX		ACR2-3.7A	17	218	153		23
	7.5	FRN007G11S-2UX	FRN007P11S-2UX	ACR2-5.5A	25	87.7	105		27
	10	FRN010G11S-2UX	FRN010P11S-2UX	ACR2-7.5A	33	65.0	78.0		30
	15	FRN015G11S-2UX	FRN015P11S-2UX	ACR2-11A	46	45.5	54.7		37
	20	FRN020G11S-2UX	FRN020P11S-2UX	ACR2-15A	59	34.8	41.8		43
	25	FRN025G11S-2UX	FRN025P11S-2UX	ACR2-18.5A	74	28.6	34.3		51
	30	FRN030G11S-2UX	FRN030P11S-2UX	ACR2-22A	87	24.0	28.8		57
	40	FRN040G11S-2UX	FRN040P11S-2UX	ACR2-37	200	10.8	13.0	0.5	28.6
	50	FRN050G11S-2UX	FRN050P11S-2UX						40.8
	60	FRN060G11S-2UX	FRN060P11S-2UX	ACR2-55	270	7.50	9.00	0.375	47.1
	75	FRN075G11S-2UX	FRN075P11S-2UX						66.1
	100	FRN100G11S-2UX	FRN100P11S-2UX	ACR2-75	390	5.45	6.54	0.250	55.1
	125	FRN125G11S-2UX	FRN125P11S-2UX	ACR2-90	450	4.73	5.67	0.198	61.5
	150	–	FRN150P11S-2UX	ACR2-110	500	4.25	5.10	0.180	83.4
Three-phase 460V	1/2	FRNF50G11S-4UX	–	ACR4-0.75A	2.5	1920	2300	–	5
	1	FRN001G11S-4UX							10
	2	FRN002G11S-4UX		ACR4-1.5A	3.7	1160	1390		11
	3	FRN003G11S-4UX		ACR4-2.2A	5.5	851	1020		14
	5	FRN005G11S-4UX		ACR4-3.7A	9	512	615		17
	7.5	FRN007G11S-4UX	FRN007P11S-4UX	ACR4-5.5A	13	349	418		22
	10	FRN010G11S-4UX	FRN010P11S-4UX	ACR4-7.5A	18	256	307		27
	15	FRN015G11S-4UX	FRN015P11S-4UX	ACR4-11A	24	183	219		40
	20	FRN020G11S-4UX	FRN020P11S-4UX	ACR4-15A	30	139	167		46
	25	FRN025G11S-4UX	FRN025P11S-4UX	ACR4-18.5A	39	114	137		57
	30	FRN030G11S-4UX	FRN030P11S-4UX	ACR4-22A	45	95.8	115		62
	40	FRN040G11S-4UX	FRN040P11S-4UX	ACR4-37	100	41.7	50	2.73	38.9
	50	FRN050G11S-4UX	FRN050P11S-4UX						55.7
	60	FRN060G11S-4UX	FRN060P11S-4UX	ACR4-55	135	30.8	37	1.61	50.2
	75	FRN075G11S-4UX	FRN075P11S-4UX						70.7
	100	FRN100G11S-4UX	FRN100P11S-4UX	ACR4-75	160	25.8	31	1.16	65.3
	125	FRN125G11S-4UX	FRN125P11S-4UX	ACR4-110	250	16.7	20	0.523	42.2
	150	FRN150G11S-4UX	FRN150P11S-4UX						60.3
	200	FRN200G11S-4UX	FRN200P11S-4UX	ACR4-132	270	20.8	25	0.741	119
	250	FRN250G11S-4UX	FRN250P11S-4UX	ACR4-220 *2)	561	10.0	12	0.236	56.4
	300	FRN300G11S-4UX	FRN300P11S-4UX						90.4
	350	FRN350G11S-4UX	FRN350P11S-4UX						107
	400	FRN400G11S-4UX	FRN400P11S-4UX	ACR4-280	825	6.67	8	0.144	108
	450	FRN450G11S-4UX	FRN450P11S-4UX	Contact Fuji					
	500	FRN500G11S-4UX	FRN500P11S-4UX						
	600	FRN600G11S-4UX	FRN600P11S-4UX						
	700	–	FRN700P11S-4UX						
	800		FRN800P11S-4UX						

NOTE: *1) The generated loss is an approximate value calculated by the following conditions:
*2) Fan cooling is required. (3m/s or over).
- Power supply voltage is 230V or 460V, 50Hz. Voltage unbalance is 0(zero) %.
- Power transformer capacity is 500kVA, or 10 times of inverter rated capacity; which is larger one is adopted.
- The load motor is 4 pole standard motor with 100% load.

11. AC Reactor (ACR)

■ Dimensions of AC reactor (ACR)

Fig A

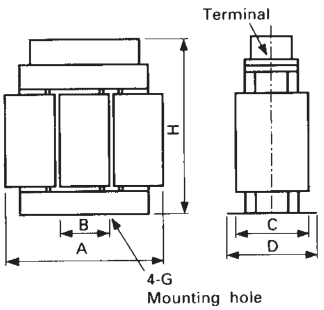


Fig.B

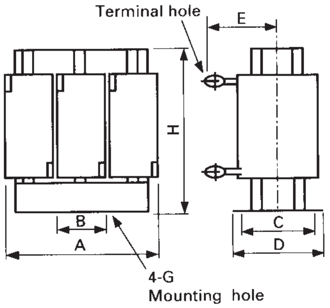
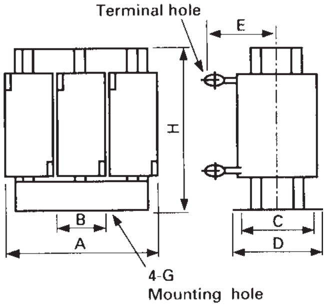


Fig.C



NOTE: Selected wire is supposed to be for three-phase.

Power supply voltage	ACR type	Fig.	Dimensions [inch(mm)]							Terminal size	Weight [lbs(kg)]
			A	B	C	D	E	G	H		
Three-phase 230V	ACR2-0.4A	A	4.72(120)	1.57(40)	2.56(65)	3.54(90)	–	0.24x0.39 (6x10)	4.92(125)	M4	3.3(1.5)
	ACR2-0.75A				2.95(75)	3.94(100)					
	ACR2-1.5A										5.5(2.5)
	ACR2-2.2A										
	ACR2-3.7A		4.92(125)								
	ACR2-5.5A				3.54(90)	4.53(115)					6.8(3.1)
	ACR2-7.5A	B					3.54(90)		3.74(95)	M5	
	ACR2-11A				3.94(100)	4.92(125)				M6	8.2(3.7)
	ACR2-15A		7.09(180)	2.36(60)	3.35(85)	4.33(110)		0.28x0.43 (7x11)	4.53(115)		11(4.8)
	ACR2-18.5A										12(5.5)
	ACR2-22A										
	ACR2-37		7.48(190)	2.36(60)	3.54(90)	4.72(120)	6.69(170)	0.28x0.43(7x11)	7.48(190)	0.33(8.4)	24(11)
	ACR2-55	C					7.87(200)	0.28x0.39(7x10)		0.51(13)	26(12)
	ACR2-75		9.84(250)	3.94(100)	3.54(90)	4.72(120)		0.35x0.55(9x14)	9.84(250)		55(25)
	ACR2-90		11.22(285)	7.48(190)	4.72(120)	6.22(158)	7.48(190)	0.47x0.79(12x20)	8.27(210)		57(26)
	ACR2-110		11.02(280)	5.91(150)	4.33(110)	5.43(138)	7.87(200)	0.39x0.79(10x20)	10.63(270)		66(30)
Three-phase 460V	ACR4-0.75A	B	4.72(120)	1.57(40)	2.56(65)	3.54(90)	3.54(90)	0.24x0.39 (6x10)	3.74(95)	M4	2.4(1.1)
	ACR4-1.5A		4.92(125)		2.95(75)	3.94(100)					4.2(1.9)
	ACR4-2.2A										4.9(2.2)
	ACR4-3.7A										5.3(2.4)
	ACR4-5.5A				3.54(90)	4.53(115)				M5	6.8(3.1)
	ACR4-7.5A										8.2(3.7)
	ACR4-11A		7.09(180)	2.36(60)	3.35(85)	4.33(110)		0.28x0.43 (7x11)	4.53(115)	M6	9.5(4.3)
	ACR4-15A								5.39(137)		12(5.4)
	ACR4-18.5A										13(5.7)
	ACR4-22A										13(5.9)
	ACR4-37		7.48(190)		3.54(90)	4.72(120)	6.69(170)	0.28x0.39 (7x10)	7.48 (190)	0.33(8.4)	24(11)
	ACR4-55	C					7.87(200)			0.41(10.5)	26(12)
	ACR4-75					4.96(126)	7.76(197)			0.43(11)	
	ACR4-110		9.84(250)	3.94(100)	4.13(105)	5.35(136)	7.95(202)	0.37x0.71 (9.5x18)	9.65(245)	0.51(13)	53(24)
	ACR4-132				4.53(115)	5.75(146)	8.27(210)		9.84(250)		71(32)
	ACR4-220		12.60(320)	4.72(120)	4.33(110)	5.91(150)	9.45(240)	0.47x0.79 (12x20)	11.81(300)		88(40)
	ACR4-280		14.96(380)	5.12(130)			10.24(260)				115(52)

12. Ferrite Ring for Reducing Radio Noise (ACL)

■The applicable wire size depends on the inner diameter and installation condition of the ferrite ring for reducing radio noise (ACL).

Table 3.18 Ferrite ring for reducing radio noise (ACL)

Ferrite ring type	Q'ty	No. of turns	Recommended wire size [mm^2]
ACL-40B	1	4	2.0, 3.5, 5.5
	2	2	8, 14
ACL-74B	1	4	8, 14
	2	2	22, 38, 60, 5.5 x 2, 8 x 2, 14 x 2, 22 x 2
	4	1	100, 150, 200, 250, 325, 38 x 2, 60 x 2, 100 x 2, 150 x 2

NOTE: Selecterd wire is supposed to be for three-phase.

13. Power Regenerative PWM Converter (RHC)

Combining the FRENIC5000G11S/P11S series inverter with the RHC series power regenerative PWM converter enables power regenerative braking to be easily performed. In this section, specifications, wiring diagram, standard capacity application list, dimensions, and optional parts are described.

The power regenerative PWM converter regenerates a large energy genarated at the time of braking due to lifted and lowered load or large inertia centrifugal separator back to the AC power supply efficeintly.

Features
- Raising the braking performance
- Energy-saving
- Space-saving
- Increasing the capacity by parallel wiring

■ Standard specifications

- 230V series

Type		RHC7.5-2A	RHC15-2A	RHC22-2A	RHC37-2A	RHC55-2A
Applicable inverter capacity		7.5, 10	15, 20	25, 30	40, 50	60, 75
Output ratings	Rated capacity [HP]	8.5	17	25.2	41	62
	Rated voltage [V]	340				
	Rated current [A]	25	50	74	120	182
Input ratings	Overload capability	150% for 1min.				
	Phases, Voltage, Frequency	Three-phase 200-220V 50/60Hz				
	Voltage /frequency variations	Voltage: +10 to -15% (Voltage unbalance: 3% or less) Frequency: +5 to -5%				
	Required power supply capacity [kVA]	10	20	29	47	69
Regenerative braking	Cont. rating	100% of rated current, Continuous				
	Short-time rating	150% of rated current for 1min.				
Enclosure		IP40			IP00	
Cooling method		Forced fan cooling				
Weight [lbs(kg)]		26 (12.0)			62 (28.0)	97 (44.0)

- 460V series

Type		RHC7.5-4A	RHC15-4A	RHC22-4A	RHC37-4A	RHC55-4A	RHC75-4A	RHC110-4A	RHC160-4A	RHC220-4A
Applicable inverter capacity		7.5, 10	15, 20	25, 30	40, 50	60, 75	100	125, 150	200, 250	300, 350
Output ratings	Rated capacity [HP]	8.8	17	25.2	41	62	83	124	181	249
	Rated voltage [V]	680								
	Rated current [A]	13	25	37	60	91	122	182	266	366
Input ratings	Overload capability	150% for 1min.								
	Phases, Voltage, Frequency	Three-phase 400-440V 50/60Hz *1)								
	Voltage /frequency variations	Voltage: +10 to -15% (Voltage unbalance: 3% or less) Frequency: +5 to -5%								
	Required power supply capacity [kVA]	10	20	29	47	69	97	144	211	291
Regenerative braking	Cont. rating	100% of rated current, Continuous								
	Short-time rating	150% of rated current for 1min.								
Enclosure		IP40			IP00					
Cooling method		Forced fan cooling								
Weight [lbs(kg)]		26 (12.0)			62 (28.0)	73 (33.0)	132 (60.0)	187 (85.0)	265 (120.0)	386 (175.0)

*1) If 380V is applied, the rated capacity reduces.

Chapter 3

13. Power Regenerative PWM Converter (RHC)

■ Common specifications

Control	Control method	Sinusoidal wave input current control
	Operation method	Operation starts at power-on after wiring completed Input signal: Run command, Stop command, Reset input
	Operation status signal	Ready to operate
	Input power-factor	0.95 or higher (at 100% load)
	Input harmonic current	Conversion coefficient Ki=0 (based on "Guideline for Harmonic Current Suppression" by MITI "Ministry of International Trade and Industry")
	Restart after momentary power failure	Automatically restarts the converter at power recovery
	Current limiting control	Controls current under the preset current limiting level.
Indication	Running, stopping	Input current, Input voltage, Input power, Output voltage (by 7-segment LED display)
	Program mode	Displays function codes and data
	Trip mode	Displays cause of the trip by code (by 7-segment LED display). LD1 (LED) is on when CPU error occurs.
Protection	Overcurrent	Detects AC overcurrent to stop the operation of the unit. (OC)
	Overvoltage	Detects DC overvoltage to stop the operation of the unit. (OV)
	Overload	Stops operation of the unit by electronic thermal function and detection of temperature inside (OL)
	Overheating	Stops operation of the unit by detecting heat sink overheating. (OH)
	AC fuse blown	Stops operation of the unit by detecting AC fuse blown. (AFUS) *1)
	DC fuse blown	Stops operation of the unit by detecting DC fuse blown. (DFUS) *1)
	Abnormal frequency	Stops operation of the unit by detecting frequency of AC input power at power-on. (FRE)
	DC link circuit undervoltage	Stops operation of the unit when the DC voltage drops below the undervoltage level (165V or less in 230V seires, 365V or less in 460V seires). (Auto-reset is selectable by function setting.) (LU)
	AC circuit undervoltage	Stops operation of the unit when the AC voltage drops below the undervoltage level (165V or less in 230V seires, 365V or less in 460V seires). (Auto-reset only, No alarm indication)
Condition (Installation and operation)	Installation location	Indoor use only. Altitude: 3300ft (1000m) or less. Free from corrosive gases, flammable gases, dusts, and direct sunlight.
	Ambient temperature	-20 to +50°C (-4 to 122°F)
	Ambient humidity	20 to 90%RH (non-condensing)
	Vibration	5.9m/s2 or less
Storage condition		-20 to +65°C (-4 to 149°F)

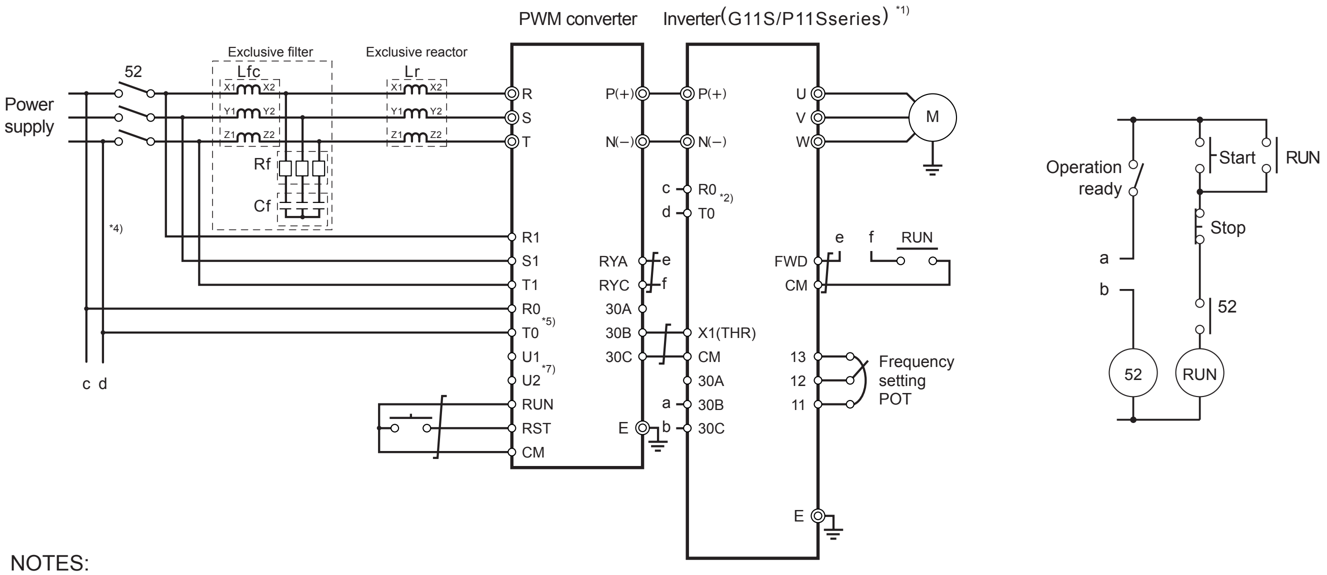
*1) Not provided with RHC22-□ or smaller model.

■ Terminal function

	Symbol	Terminal name	Function	
Main circuit	R,S,T	Power input	Connect a 3-phase power supply via an exclusive reactor.	
	P(+),N(—)	Converter output	Connect the power input terminals P(+), N(-) of inverter.	
	E(G)	Grounding	Grounding terminal for converter chassis (housing).	
	R0,T0	Auxiliary control power supply	Connect the same AC power supply as that of the main circuit to back up the control circuit power supply.	50HP or larger model only
	U1,U2	Auxiliary power supply	Connect the power supply transformer used for cooling fans and magnetic contactor for charging resistor by－pass. Change of wiring inside the converter is necessary when the main circuit voltage is 380V.	50HP or larger model in 460V series only
Voltage detection	R1,S1,T1	Synchronous power input	Used for detecting for converter control. Connect to the power supply side of exclusive reactor and exclusive filter	
Control input	RUN	Operation command	RUN-CM: ON - The converter runs; OFF - The converter stops.	
	RST	Alarm reset	When RST-CM is on after the cause of trip is removed during alarm stop, the active protective function (converter is in trip state) is reset and the converter restarts operation.	
	X1	Function extension	Not in use at normal use	
	CM	Common for input signal	Common terminal for contact input signal.	
Analog I/O	AI	Function extension	Not in use at normal use	
	AO	Function extension	Not in use at normal use	
	M	Analog I/O common	Common terminal for analog I/O signal.	
Transistor output	Y1	Overload early warning	Outputs overload early warning ON signal before overload protective function is activated. (Warning level can be preset by Function F07.)	Allowable output of transistor: 27V DC, 50mA max.
	Y2	Overcurrent early warning	Outputs ON signal when load level (F08 x F10, or F09 x F10) is 100 or over. (For F08, F09, F10, see next page)	
	CME	Common (transistor output)	Common for transistor output signal.	
Relay output	RYA,RYC	Ready output	Outputs ON signal when the converter is ready for operation. (Initial charge and voltage step-up completed)	
	30A,30B,30C	Alarm relay output	Outputs a contact signal when a protective function is activated and converter stops by an alarm. (1SPDT contact, 30A-30C: ON - At trip mode)	Contact rating: 250V AC, 0.3A (cos ø=0.3)

■ Basic wiring diagram

The following diagram is one of the simplest operation sequence using PWM converter.



NOTES:

- Design the sequence so that inverter operation comannd can be input after PWM converter is ready to operate.

*1) For the applicable inverter models, refer to the combination table on page 3-26.

*2) The power supply for cooling fans and magnetic contactors inside inverter may be required. (When a converter has to be connected to an inverter of 40HP or larger, change-over the connector CNRXTX in the inverter.

*3) When the actual power supply capacity is insufficient compared to the required capacity, the PWM converter may be damaged.

*4) An insulation transformer may be necessary for some models. For detalis, see the instruction manual.

*5) Provided with 50HP model or larger.

*6) Be sure to connect the exclusive filter to the primary side (power supply side) of the exclusive reactor.

*7) When the main circuit voltage is 380V, connection inside the converter has to be changed.

13. Power Regenerative PWM Converter (RHC)

■ Function setting

	Function		Setting range	Min. unit	Factory setting
	Code	Name			
Operation monitor	F00	DC link circuit voltage	Detection level	1V	-
	F01	Input voltage		1V	-
	F02	Input current		1A	-
	F03	Input power		1kW	-
Basic functions	F04	LED monitor selection	0: F00 DC link circuit voltage 1: F01 Input voltage 2: F02 Input current 3: F03 Input power	-	0
	F05	LV cancel	0: Active 1: Inactive	-	0
	F06	Filter capacitor	0: Connect 1: Disconnect	-	1
	F07	Overload early warning level	50 to 105%	1%	80%
	F08	Input current limiter (Driving)	0 to 150%	1%	150%
	F09	Input current limiter (Braking)	-150 to 0%	1%	-150%
	F10	Current limiter output (Ratio)	50 to 100%	1%	100%
Alarm monitor	E00	Alarm data (Latest)	Alarm code	-	-
	E01	Alarm data (the last)		-	-
	E02	Alarm data (the last but one)		-	-
	E03	Alarm data (the last but two)		-	-
	E04	Alarm history clear	0: Inactive 1: Active	-	0

■ Protective functions

Function	Description	LED monitor
Overcurrent	Stops the converter operation immediately when the converter input current reaches overcurrent protection level.	OC
DC undervoltage	- Stops the converter operation immediately when the main circuit DC voltage drops below undervoltage level, and retains the trip state. - The trip state is automatically reset when the power failure time becomes long and the control circuit cannot be held.	LU
AC undervoltage	- Stops the converter operation immediately when the power supply voltage drops below undervoltage level. - The trip state is automatically reset when the power failure time becomes long and the control circuit power cannot be held.	
Overvoltage	Stops the converter operation immediately when the main circuit DC voltage reaches overvoltage protection level.	OU
Overload	Stops the converter operation immediately when the load connected to the cnverter becomes excessive.	OL
Converter overheating	Stops the converter operation immediately when it detects excess heat sink temperature or an abnormal rise in temperature inside the converter.	OH
Power supply abnormal frequency	Stops the converter operation immediately when the power supply exceeds the frequency range of 50±4Hz or 60±4Hz. (Detected only when power-on)	FrE
NVRAM fault	Stops the converter operation immediately when nonvolatile memory on the control PC board in the converter is faulty.	Err1
CPU error	Stops the converter operation immediately when it detects CPU error on the PC board in the converter.	LD1 on

NOTE:
When the control power voltage is reduced until the operation of converter control circuit cannot be maintained, all the protective functions are automatically reset.

Table 3.23 Combination of inverter and converter

Power supply voltage	Inverter type		PWM converter main unit type	Exclusive reactor type	Exclusive filter		
	G11S series	P11S series			Filter (Reactor type)	Filter (Capacitor type)	Filter (Resistor type)
Three-phase 230V	FRN007G11S-2UX	FRN007P11S-2UX	RHC7.5-2A	LR2-7.5	LFC2-7.5	CF2-7.5	RF2-7.5
	FRN010G11S-2UX	FRN010P11S-2UX					
	FRN015G11S-2UX	FRN015P11S-2UX	RHC15-2A	LR2-15	LFC2-15	CF2-15	RF2-15
	FRN020G11S-2UX	FRN020P11S-2UX					
	FRN025G11S-2UX	FRN025P11S-2UX	RHC22-2A	LR2-22	LFC2-22	CF2-22	RF2-22
	FRN030G11S-2UX	FRN030P11S-2UX					
	FRN040G11S-2UX	FRN040P11S-2UX	RHC37-2A	LR2-37L	LFC2-37	CF2-37	GRZG400-1Ω
	FRN050G11S-2UX	FRN050P11S-2UX					
	FRN060G11S-2UX	FRN060P11S-2UX	RHC55-2A	LR2-55L	LFC2-55	CF2-55	GRZG400-0.6Ω
	FRN075G11S-2UX	FRN075P11S-2UX					
	FRN100G11S-2UX	FRN100P11S-2UX	Contact Fuji				
	FRN125G11S-2UX	FRN125P11S-2UX					
	–	FRN150P11S-2UX					
Three-phase 460V	FRN007G11S-4UX	FRN007P11S-4UX	RHC7.5-4A	LR4-7.5	LFC4-7.5	CF4-7.5	RF4-7.5
	FRN010G11S-4UX	FRN010P11S-4UX					
	FRN015G11S-4UX	FRN015P11S-4UX	RHC15-4A	LR4-15	LFC4-15	CF4-15	RF4-15
	FRN020G11S-4UX	FRN020P11S-4UX					
	FRN025G11S-4UX	FRN025P11S-4UX	RHC22-4A	LR4-22	LFC4-22	CF4-22	RF4-22
	FRN030G11S-4UX	FRN030P11S-4UX					
	FRN040G11S-4UX	FRN040P11S-4UX	RHC37-4A	LR4-37L	LFC4-37	CF4-37	GRZG400-4Ω
	FRN050G11S-4UX	FRN050P11S-4UX					
	FRN060G11S-4UX	FRN060P11S-4UX	RHC55-4A	LR4-55L	LFC4-55	CF4-55	GRZG400-2.4Ω
	FRN075G11S-4UX	FRN075P11S-4UX					
	FRN100G11S-4UX	FRN100P11S-4UX	RHC75-4A	LR4-75L	LFC4-75	CF4-75	RF4-75
	FRN125G11S-4UX	FRN125P11S-4UX	RHC7.5-4A	LR4-110L	LFC4-110	CF4-110	RF4-110
	FRN150G11S-4UX	FRN150P11S-4UX					
	FRN200G11S-4UX	FRN200P11S-4UX	RHC160-4A	LR4-160L	LFC4-160	CF4-160	RF4-160
	FRN250G11S-4UX	FRN250P11S-4UX					
	FRN300G11S-4UX	FRN300P11S-4UX	RHC220-4A	LR4-220L	LFC4-220	CF4-220	RF4-220
	FRN350G11S-4UX	FRN350P11S-4UX					
	FRN400G11S-4UX	FRN400P11S-4UX	Contact Fuji				
	FRN450G11S-4UX	FRN450P11S-4UX					
	FRN500G11S-4UX	FRN500P11S-4UX					
	FRN600G11S-4UX	FRN600P11S-4UX					
	–	FRN700P11S-4UX					
		FRN800P11S-4UX					

NOTES:
- When using an exclusive filter, use a reactor type filter, a capactor type one, and resistor type one at the same time.
- More than one inverters can be connected to one converter if the converter capacity is not exceeded.

13. Power Regenerative PWM Converter (RHC)

■ Dimensions

• PWM converter main unit

unit: inch (mm)

• 30HP or smaller

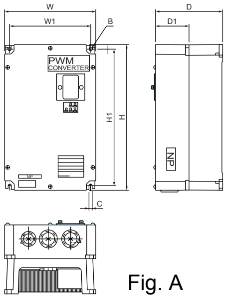


Fig. A

• 40 to 250HP

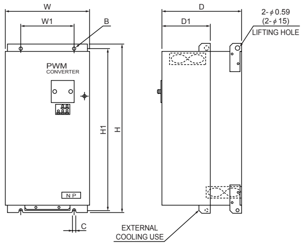


Fig. B

• 300HP or larger

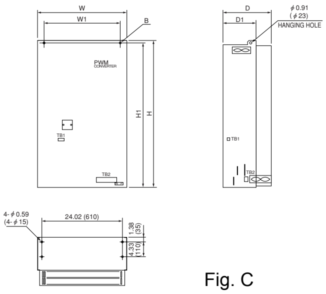
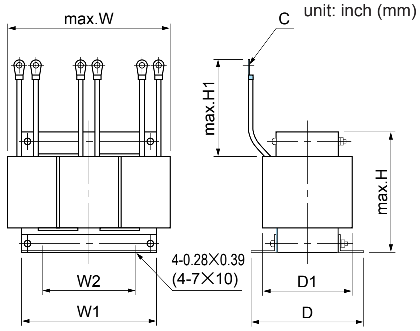


Fig. C

Power supply voltage	PWM converter main unit type	Fig.No	Dimensions [inch(mm)]								Weight [lbs(kg)]
			W	W1	H	H1	D	D1	B	C	
Three-phase 230V	RHC7.5-2A	A	10.04 (255)	8.90 (226)	15.79 (401)	14.88 (378)	7.44 (189)	3.68 (93.5)	ø0.39 (ø10)	0.39 (10)	26(12)
	RHC15-2A										
	RHC22-2A										
	RHC37-2A	B	11.02(280)	7.09(180)	24.21(615)	23.43(595)	10.83(275)	6.69(170)			62(28)
	RHC55-2A		13.39(340)	9.45(240)	29.53(750)	28.74(730)	11.02(280)	6.50(165)			97(44)
Three-phase 460V	RHC7.5-4A	A	10.04 (255)	8.90 (226)	15.79 (401)	14.88 (378)	7.44 (189)	3.68 (93.5)	ø0.39 (ø10)	0.39 (10)	26(12)
	RHC15-4A										
	RHC22-4A										
	RHC37-4A	B	11.02 (280)	7.09 (180)	21.65(550)	20.87(530)	10.43(265)	6.30(160)			57(26)
	RHC55-4A				26.57(675)	25.79(655)	10.83(275)	6.69(170)			73(33)
	RHC75-4A		20.87 (530)	16.93 (430)	33.07 (840)	31.89 (810)	10.63(270)	5.91(150)	ø0.59 (ø15)	0.59 (15)	132(60)
	RHC110-4A						12.40(315)	7.48(190)			187(85)
	RHC160-4A				43.31 (1100)	42.13(1070)	14.17 (360)	8.66(220)			265(120)
	RHC220-4A	C	26.77(680)	22.83(580)		42.52(1080)		9.65(245)		—	386(175)

• RHC series exclusive reactor

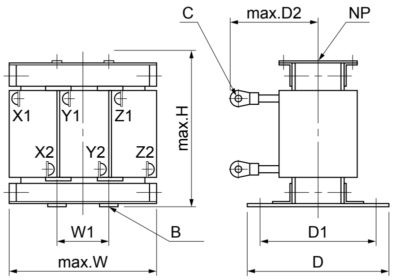
• 30HP or smaller



unit: inch (mm)

Power supply voltage	Exclusive reactor type	Dimensions [inch(mm)]								Weight [lbs(kg)]
		W	W1	W2	H	H1	D	D1	C	
230V	LR2-7.5	8.27(210)	6.69(170)	4.72(120)	5.91(150)	4.72(120)	5.75(146)	4.57(116)	0.25(6.4)	40(18)
	LR2-15				7.48(190)	5.51(140)	6.54(166)	5.35(136)	0.33(8.4)	57(26)
	LR2-22	10.63(270)	8.66(220)		8.27(210)	4.72(120)	6.93(176)			88(40)
460V	LR4-7.5	8.27(210)	6.69(170)		5.91(150)	3.94(100)	5.75(146)	4.57(116)	0.21(5.4)	40(18)
	LR4-15				7.48(190)	4.72(120)	6.54(166)	5.35(136)	0.25(6.4)	57(26)
	LR4-22	10.63(270)	8.66(220)		8.27(210)		6.89(175)			88(40)

• 40HP or larger



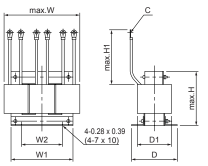
Power supply voltage	Exclusive reactor type	Dimensions [inch(mm)]								Weight [lbs(kg)]
		W	W1	H	D	D1	D2	B	C	
230V	LR2-37L	11.81(300)	7.87(200)	10.83(275)	5.35(136)	4.33(110)	6.50(165)	0.35(9)	0.33(8.4)	77(35)
	LR2-55L	12.99(330)	8.66(220)	12.80(325)	6.38(162)	4.72(120)	6.69(170)		0.41(10.5)	108(49)
460V	LR4-37L	11.81(300)	7.87(200)	10.83(275)	5.35(136)	4.33(110)	5.91(150)		0.25(6.4)	77(35)
	LR4-55L	12.99(330)	8.66(220)	12.80(325)	6.38(162)	4.72(120)	6.50(165)		0.33(8.4)	108(49)
	LR4-75L	13.78(350)	4.33(110)	15.35(390)	10.04(255)	8.46(215)	6.69(170)	0.47(12)	0.41(10.5)	143(65)
	LR4-110L	13.39(340)		15.94(405)	10.83(275)	9.25(235)	7.28(185)	0.59(15)		187(85)
	LR4-160L	15.35(390)	5.12(130)	18.11(460)	11.81(300)	10.24(260)	8.46(215)		0.51(13.0)	254(115)
	LR4-220L			19.29(490)	12.60(320)	10.83(275)	8.86(225)			320(145)

• RHC series exclusive filter

• Filter (Reactor type)

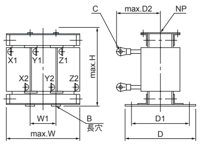
• 30HP or smaller

unit: inch (mm)



Power supply voltage	Filter (Reactor type)	Dimensions [inch(mm)]								Weight [lbs(kg)]
		W	W1	W2	H	H1	D	D1	C	
230V	LFC2-7.5	6.69(170)	5.31(135)	3.54(90)	4.72(120)	4.72(120)	3.98(101)	2.99(76)	ø0.25(ø6.4)	17(7.5)
	LFC2-15				5.51(140)	5.51(140)	4.76(121)	3.78(96)	ø0.33(ø8.4)	24(11)
	LFC2-22	7.09(180)	5.91(150)		6.50(165)	4.72(120)	4.17(106)	4.17(106)		29(13)
460V	LFC4-7.5	6.69(170)	5.31(135)		4.72(120)	3.15(80)	3.98(101)	2.99(76)	ø0.21(ø5.3)	17(7.5)
	LFC4-15				5.51(140)	3.94(100)	4.76(121)	3.78(96)	ø0.25(ø6.4)	24(11)
	LFC4-22	7.09(180)	5.91(150)		6.50(165)	4.33(110)	5.35(136)	4.17(106)		29(13)

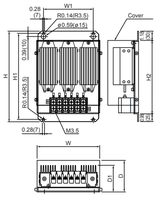
• 40HP or larger



Power supply voltage	Filter (Reactor type)	Dimensions [inch(mm)]								Weight [lbs(kg)]
		W	W1	H	D	D1	D2	B	C	
230V	LFC2-37	10.04(255)	6.69(170)	7.68(195)	4.76(121)	3.74(95)	5.71(145)	0.28(7)	ø0.33(ø8.4)	42(19)
	LFC2-55				5.16(131)	4.13(105)	6.30(160)		ø0.41(ø10.5)	49(22)
460V	LFC4-37	10.04(255)	6.69(170)	7.68(195)	4.76(121)	3.74(95)	5.31(135)	0.28(7)	ø0.25(ø6.4)	40(18)
	LFC4-55				5.16(131)	4.13(105)	5.91(150)		ø0.33(ø8.4)	46(21)
	LFC4-75	12.60(320)	4.13(105)	11.61(295)	8.27(210)	6.69(170)		0.39(10)		66(30)
	LFC4-110			12.60(320)	8.66(220)	6.89(175)				77(35)
	LFC4-160	13.78(350)	4.53(115)	14.57(370)	9.06(230)	7.48(190)	6.30(160)	0.47(12)	ø0.41(ø10.5)	110(50)
	LFC4-220	14.57(370)	4.72(120)	15.35(390)	9.65(245)	8.46(215)	7.87(200)		ø0.51(ø13)	154(70)

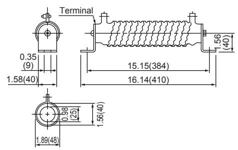
• Filter (Resistor type)

• 30HP or smaller



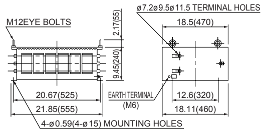
Power supply voltage	Filter (Resistor type)	Dimensions [inch(mm)]							Weight [lbs(kg)]
		W	W1	H	H1	H2	D	D1	
230V	RF2-7.5	7.87(200)	6.3(160)	11.42(290)	10.87(276)	9.25(235)	3.94(100)	3.27(83)	7.9(3.6)
	RF2-15			16.14(410)	15.59(396)	13.98(355)			13(6.0)
	RF2-22	9.84(250)		15.55(395)	15.00(381)	13.39(340)		3.74(95)	15(6.8)
460V	RF4-7.5	7.87(200)		11.42(290)	10.87(276)	9.25(235)		3.27(83)	7.9(3.6)
	RF4-15			16.14(410)	15.59(396)	13.98(355)			13(6.0)
	RF4-22	9.84(250)		15.55(395)	15.00(381)	13.39(340)		3.74(95)	15(6.8)

• 50HP, 75HP



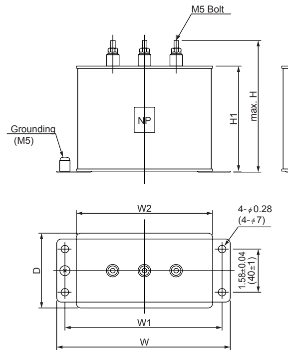
Power supply voltage	Filter (Resistor type)	Weight [lbs(kg)]
230V	GRZG400-1Ω	1.9(0.85)
	GRZG400-0.6Ω	
460V	GRZG400-4.0Ω	
	GRZG400-2.4Ω	

• 100HP or larger



Power supply voltage	Filter (Resistor type)	Weight [lbs(kg)]
460V	RF4-75	44(20)
	RF4-110	44(20)
	RF4-160	51(23)
	RF4-220	55(25)

• Filter (Capacitor type)



Power supply voltage	Filter (Capacitor type)	Dimensions [inch(mm)]							Weight [lbs(kg)]
		W	W1	W2	H	H1	D	D1	
230V	CF2-7.5	6.50(165)	5.91(150)	5.12(130)	5.31(135)	3.94(100)	2.76(70)	1.57(40)	2.9(1.3)
	CF2-15				7.28(185)	5.91(150)			4.2(1.9)
	CF2-22				8.46(215)	7.09(180)			5.1(2.3)
	CF2-35				7.28(185)	5.91(150)			5.5(2.5)
	CF2-55	8.07(205)	7.48(190)	6.81(173)					8.8(4.0)
460V	CF4-7.5	6.50(165)	5.91(150)	5.12(130)	4.53(115)	3.15(80)			2.2(1.0)
	CF4-15				5.31(135)	3.94(100)			2.9(1.3)
	CF4-22				6.10(155)	4.72(120)			3.3(1.5)
	CF4-37								4.2(1.9)
	CF4-55				7.28(185)	5.91(150)			5.1(2.3)
	CF4-75	8.07(205)	7.48(190)	6.81(173)	8.07(205)	6.69(170)			6.4(2.9)
	CF4-110				9.65(245)	8.27(210)			8.8(4.0)
	CF4-160	11.02(280)	10.43(265)	9.45(240)	9.06(230)	7.09(180)	3.54(90)	2.17(55)	12.1(5.5)
	CF4-220				11.02(280)	9.06(230)			15.4(7.0)

Chapter 4

Optimal Type Selection

Contents

1. Inverter and Motor Selection

When selecting a general-purpose inverter, select a motor first and next inverter.

(1) To select a motor, determine what kind of load machine is used, calculate the moment of inertia, and then select an appropriate motor capacity.
(2) To select an inverter, consider in what operating conditions (acceleration time, deceleration time, or frequency in operation) the mechanical system is used for the motor capacity selected in (1), and calculate acceleration torque, deceleration torque, and braking torque.

Here, the selection procedure for the above (1) and (2) is described. First, explained is the output torque obtained by using the inverter FRENIC5000G11S/P11S.

◆ **Motor output torque characteristics (See Section 1.1)**
Torque characteristics (continuous output torque, output torque in a short time, braking torque) obtained when frequency control is made by inverter, are described for the whole range of speed control using figures.

◆ **Selection procedure (See Section 1.2 and 1.3)**
1 Selection procedure: Explained using a flowchart.
2 Selection calculation expressions: Calculation method shown in the selection flowchart is explained with calculation expressions.

1.1 Motor output torque characteristics

Fig. 4.1 and 4.2 show the output torque characteristics individually according to 50Hz and 60Hz base for the rated output frequency.

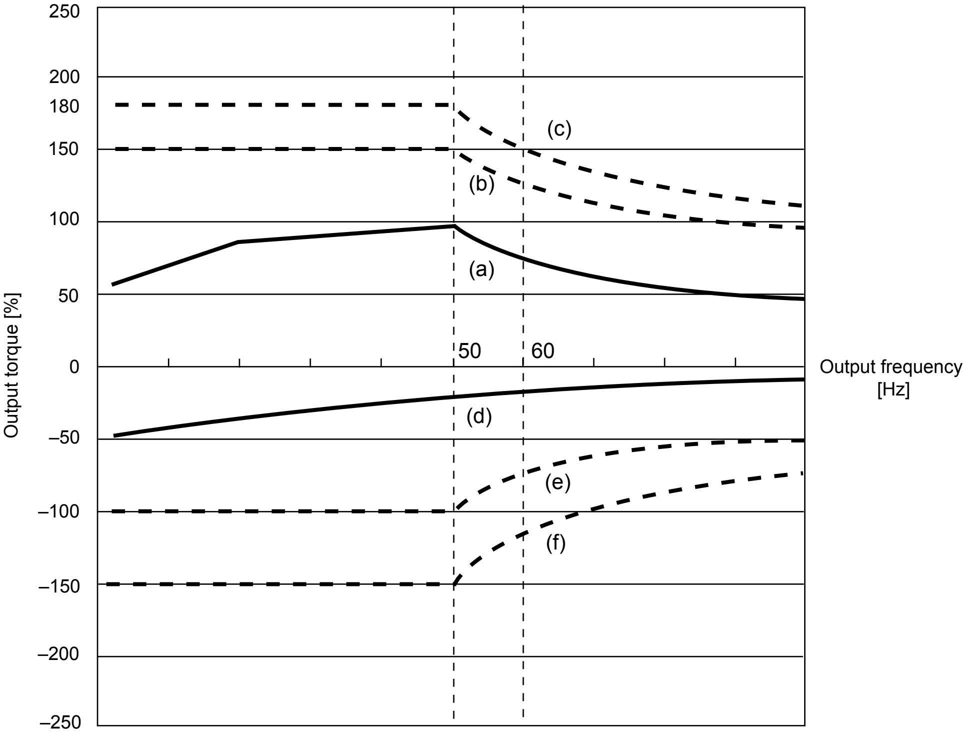


Fig. 4.1 Output torque characteristics (50Hz base)

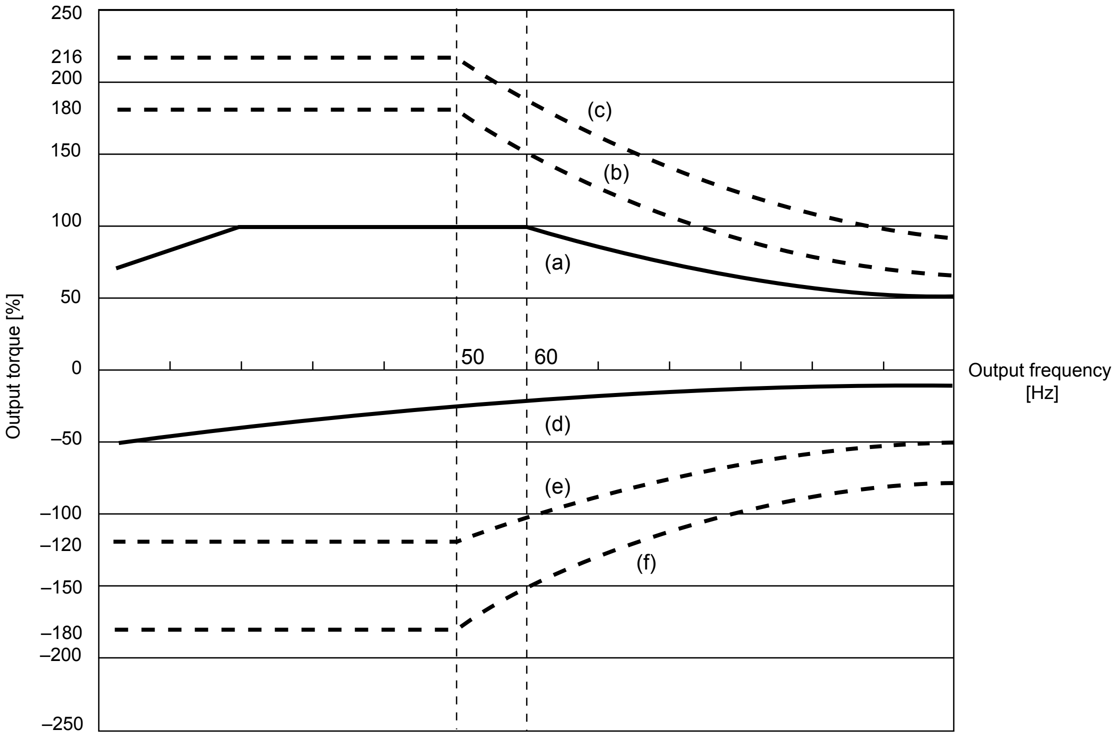


Fig. 4.2 Output torque characteristics (60Hz base)

(1) Continuous allowable driving torque (Fig. 4.1 and 4.2, curve (a))

Curve (a) is the torque that can be obtained in a range of the inverter continuous rated current. This value can be obtained continuously by observing the motor cooling characteristic. In 60Hz running, 100% output torque is obtained, but in 50Hz running, output torque is a somewhat reduced compared with that during commercial running, and it is further reduced during low speed running. Reduction of output in 50Hz running is due to increased loss by inverter driving, and that in low speed running is mainly due to air flow reduction of motor cooling fan.

(2) Maximum driving torque in a short time (Fig. 4.1 and 4.2, curves (b) and (C))

Curve (b) is the torque that can be obtained in a range of the inverter rated current in short time (150% for one minute) when torque vector control is selected. At that time, the motor cooling characteristics have little effect to the output torque.

Curve (c) is an example of output torque when one size larger capacity inverter is used to increase the short time maximum torque. At that time, short time torque is 20 to 30% greater than that when standard capacity inverter is applied.

(3) Starting torque (around speed 0 in Fig. 4.1 and 4.2)

Maximum torque in a short time is starting torque as it is.

(4) Braking torque (Fig. 4.1 and 4.2, curves (d), (e), and (f))

n braking mode, mechanical energy is converted to electrical energy and regenerated to the smoothing capacitor in the inverter. A large braking torque, as shown in curve (e), can be obtained by discharging this electrical energy to the braking resistor. If a braking resistor is not provided, only the motor and inverter losses consume the regenerated braking energy, so the torque becomes smaller, as shown in curve (d). A 10HP or smaller capacity inverter unit incorporates a small braking resistor, so a large braking torque can be obtained even if optional resistor is not used. For further information, see Chapter 1, Specifications.

Braking torque when a braking resistor is used is allowable only for a short time. Its time ratings are mainly determined by the braking resistor ratings. In this manual and associated catalogues, the allowable value [HP] obtained from average discharging loss and allowable value [kWs] obtained from discharging capability that can be discharged at one time are shown.

The torque % value varies according to the inverter capacity.

For a 15HP or larger capacity inverter unit, a discharging transistor unit (braking unit) is necessary, in addition to the braking resistor. So, selecting an optimum braking unit enables a braking torque value to be selected comparatively freely in a range below short time maximum torque in driving mode, as shown in curve (f).

For torque values and other allowable values of standard selection of braking unit and resistor, see Chapter 3, Section 4.

1.2 Selection procedure

Fig. 4.3 shows the general selection procedure for optimal inverter selection. Inverter capacity can be easily selected if there are no limitation regarding acceleration and deceleration time. The cases such as “Lifting or lowering a load”, “Acceleration and deceleration time is restricted”, or “Highly frequent acceleration and deceleration” make the selection procedure a little bit complex.

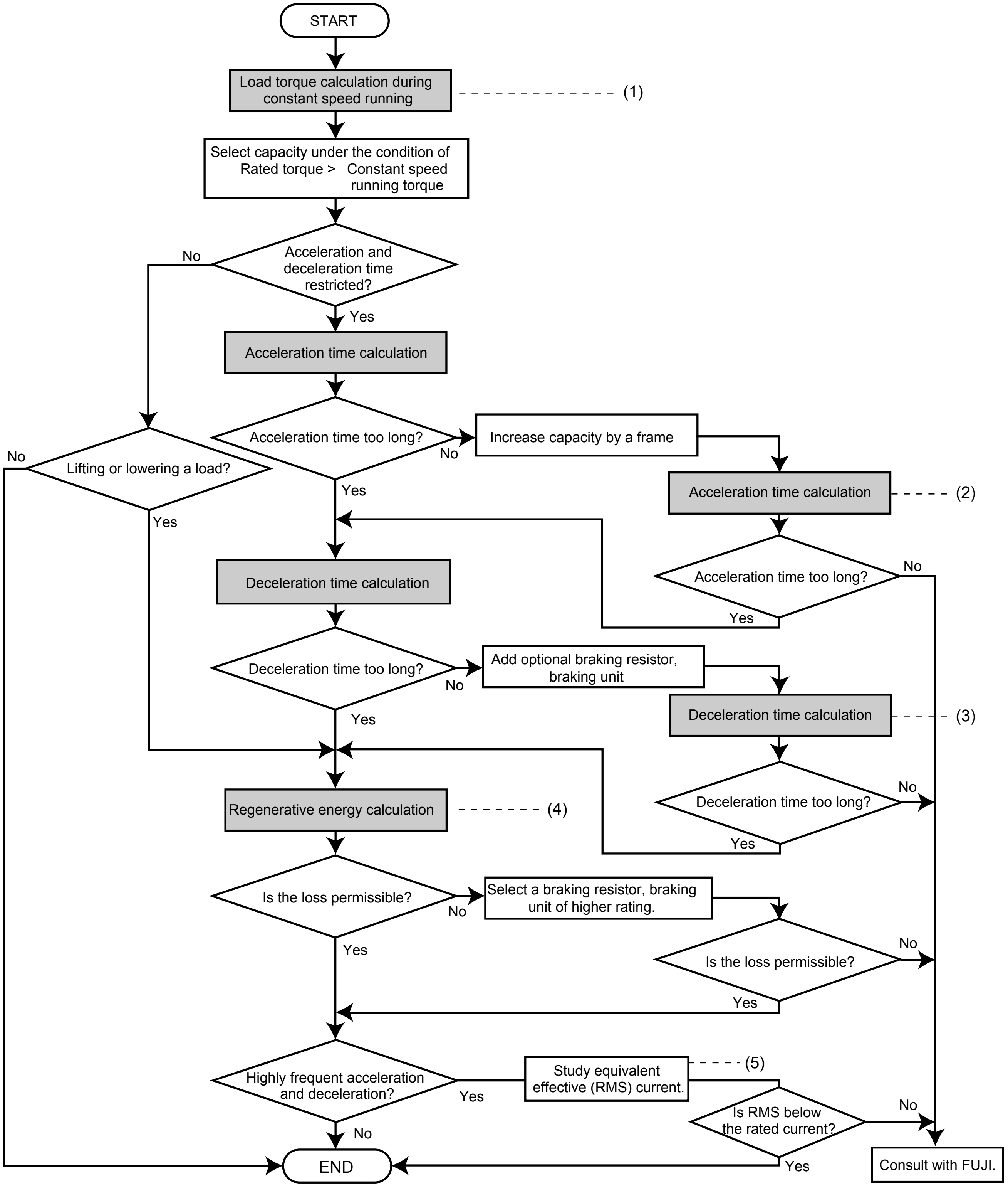


Fig. 4.3 Selection procedure

(1) Calculation of load torque during constant speed running (For detailed calculation, see Section 1.3.1)

This step is necessary for capacity selection for all loads. Determine the rated torque of the motor during constant speed running higher than that of the load torque, and select a tentative capacity. To perform capacity selection efficiently, it is necessary to match the rated speeds (base speeds) of the motor and load.

To do this, select an appropriate reduction-gear (mechanical transmission) ratio and number of motor poles. If acceleration/deceleration time is not limited and the system is not a lifting machine, capacity selection is completed as it is.

(2) Acceleration time
(For detailed calculation, see Section 1.3.2)

When there are specified requirements for the acceleration time, calculate it using the following procedure:

① **Calculate moment of inertia for the load and motor.**
Calculate moment of inertia for the load by referring to Section1.3.2.

② **Calculate minimum acceleration torque. (See Fig. 4.4)**
The acceleration torque is the difference between motor short time output torque (60s rating) explained in Section 1.1 and load torque (τ_L/η_G) during constant speed running calculated in the above ① . Calculate minimum acceleration torque for the whole range of speed.

③ **Calculate the acceleration time.**
Assign the value calculated above to the expression (4.15) in Section 1.3.2 to calculate the acceleration time. If the calculated acceleration time is longer than the requested time, select one size larger capacity inverter and motor and calculate it again.

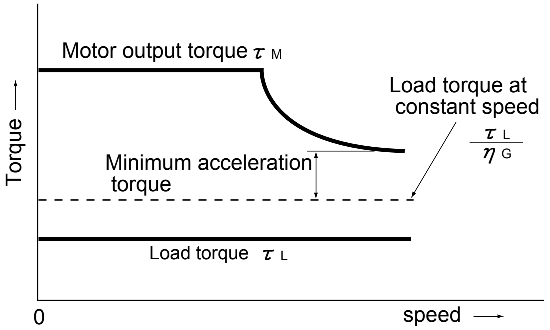


Fig. 4.4 Example study of minimum acceleration torque

(3) Deceleration time
(For detailed calculation, see Section 1.3.2)

To calculate the deceleration time, check the motor deceleration torque characteristics for the whole range of speed in the same way as for the acceleration time.

① **Calculate moment of inertia for the load and motor.**
Same as for acceleration time.

② **Calculate minimum deceleration torque.**
(See Fig. 4.5)
Same as for deceleration time.

③ **Calculate the deceleration time.**
Assign the value calculated above to the expression (4.16) in Section 1.3.2 to calculate the deceleration time. If the calculated deceleration time is longer than the requested time, select one size larger capacity and calculate it again.

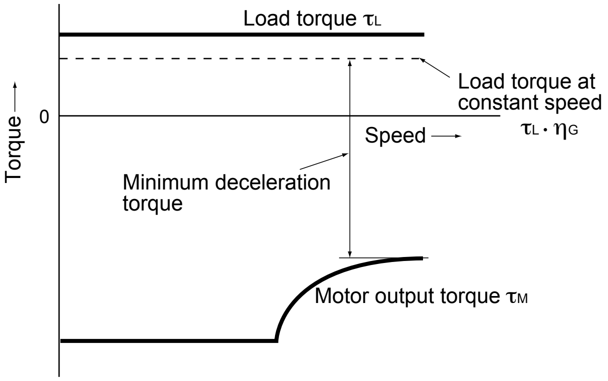


Fig. 4.5 Example study of minimum deceleration torque (1)

However, note that minimum deceleration torque becomes smaller due to regenerative operation when lifting or lowering a load. (See Fig. 4.6)

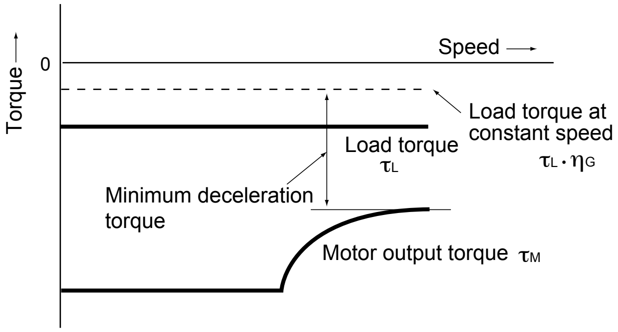


Fig. 4.6 Example study of minimum deceleration torque (2)

(4) Braking resistor rating
(For detailed calculation, see Section 1.3.3)

Braking resistor rating is divided into two types according to the braking periodic duty cycle:

① **When periodic duty cycle is 100s or less:**
Calculate average loss to determine rated values.

② **When periodic duty cycle is 100s or more:**
Allowable braking energy depends on maximum braking power. Allowable values are listed in Chapter 3, Section 4.

(5) Motor RMS current

In metal processing machine and carriage machinery requiring positioning control, highly frequent running with short time rating is performed. In this case, calculate an equivalent RMS current value not to exceed the allowable value for the motor.

1.3 Selection calculation expressions

1.3.1 Load torque during constant speed running

1. General expression

The frictional force acting on a horizontally moved load must be calculated. For loads lifted or lowered vertically or along a slope, the gravity acting on the load must be calculated. Calculation for driving a load along a straight line with the motor is shown below.

Where the force to move a load linearly at constant speed υ [m/s] is F[N] and the motor speed for driving this is N_M [r/min], the required motor output torque τ_M [N·m] is as follows:

$$\tau_M = \frac{60\upsilon}{2\pi \cdot N_M} \cdot \frac{F}{\eta_G} \quad [N\cdot m] \quad \ldots\ldots (4.1)$$

Where, η_G: Reduction-gear efficiency

When the motor is in braking mode, efficiency works inversely, so the required motor torque should be calculated as follows:

$$\tau_M = \frac{60\upsilon}{2\pi \cdot N_M} \cdot F \cdot \eta_G \quad [N\cdot m] \quad \ldots\ldots (4.2)$$

$(60\upsilon)/(2\pi \cdot N_M)$ in the above expression is an equivalent rotation radius corresponding to speed υ around the motor shaft.

The value F in the above expressions changes according to the load type.

2. Obtaining the required force F

(1) Moving a load horizontally

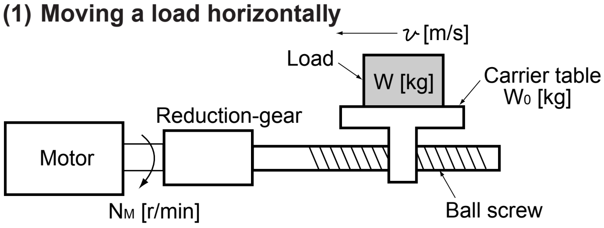


Fig. 4.7 Moving a load horizontally

As shown in Fig. 4.7, where the carrier table weight is W_0 [kg], load is W [kg], and friction coefficient of the ball screw is μ, friction force F [N] is expressed as follows:

$$F = (W_0 + W) \cdot g \cdot \mu \quad [N] \quad \ldots\ldots (4.3)$$

Where, g : Gravity acceleration (≒ 9.8 m/s²)

Then, required driving torque around the motor shaft is expressed as follows:

$$\tau_M = \frac{60\upsilon}{2\pi \cdot N_M} \cdot \frac{(W_0 + W) \cdot g \cdot \mu}{\eta_G} \quad [N\cdot m] \quad \ldots\ldots (4.4)$$

(2) Moving a load vertically

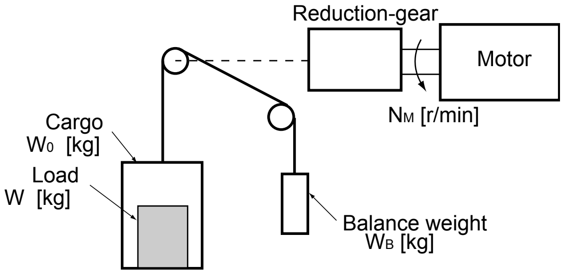


Fig. 4.8 Moving a load vertically

As shown in Fig. 4.8, where a cage weight, load weight, and balance-mass weight are W_0, W, and W_B [kg], the force of gravity F [N] is as follows:

(Lifting)

$$F = (W_0 + W - W_B) \cdot g \quad [N] \quad \ldots\ldots (4.5)$$

(Lowering)

$$F = (W_B + W - W_0) \cdot g \quad [N] \quad \ldots\ldots (4.6)$$

Where maximum load is W_{max}, generally W_B equals to $(W_o + W_{max}) / 2$. So, F may become a negative force to brake both lifting and lowering movements depending on the load weight.

Calculate the required torque τ around the motor shaft in the driving mode by expression (4.1) and that in the braking mode by expression (4.2). That is, if F is positive, use expression (4.1); if it is negative, use expression (4.2).

(3) Moving a load along a slope

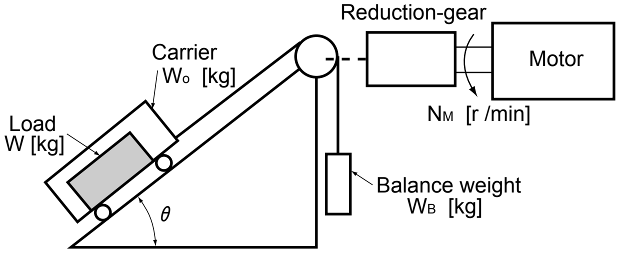


Fig. 4.9 Moving a load along a slope

Lifting and lowering a load along a slope may seem to be like lifting and lowering a load vertically, but friction force between the load and the slope cannot be ignored in lifting and lowering along a slope. Therefore, the expression for lifting a load is a little different from that for lowering a load. Where slope angle is θ and friction coefficient is μ, as shown in Fig. 4.9, driving force F [N] is as follows:

(Lifting)

$$F = ((W_0 + W)(\sin\theta + \mu \cdot \cos\theta) - W_B) \cdot g \quad [N] \quad \ldots\ldots (4.7)$$

(Lowering)

$$F = (W_B - (W_0 + W)(\sin\theta - \mu \cdot \cos\theta)) \cdot g \quad [N] \quad \ldots\ldots (4.8)$$

The force of gravity F may become a negative force to brake both lifting and lowering movements, depending on the load weight. This is the same as for vertical lifting and lowering. Required torque around the motor shaft can be also calculated similarly. That is, when F is positive, use expression (4.1); when it is negative, use expression (4.2).

1.3.2 Acceleration and deceleration time calculation

When an object whose moment of inertia is J [kg·m^2] rotates at the speed N [r/min], it has the following kinetic energy:

$$E = \frac{J}{2} \left(\frac{2\pi \cdot N}{60}\right)^2 \quad [J] \quad \text{.........} \quad (4.9)$$

To accelerate the above rotation, kinetic energy will be increased; to decelerate, kinetic energy must be discharged.

The torque required for acceleration and deceleration can be expressed as follows:

$$\tau = J \cdot \frac{2\pi}{60} \left(\frac{dN}{dt}\right) \quad [N \cdot m] \quad \text{.........} \quad (4.10)$$

In this way, the mechanical moment of inertia is an important element in acceleration and deceleration. First, calculation method of moment of inertia is described, then that for acceleration and deceleration time are explained.

1. Calculation of moment of inertia

For an object that rotates around the rotation axis, vertually divide the object into small segments and square the distance from the rotation axis to each segment. Then, sum the squares of the distances and the masses of the segments to calculate the moment of inertia.

$$\text{Moment of inertia } J = \sum (W_i \cdot r_i^2) \quad [kg \cdot m^2] \quad \text{.........} \quad (4.11)$$

① Hollow cylinder and solid cylinder

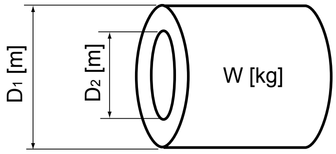


Fig. 4.10 Hollow cylinder

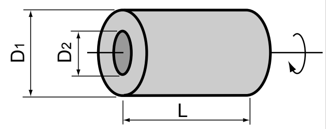
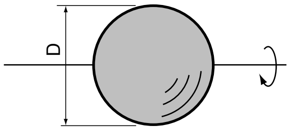
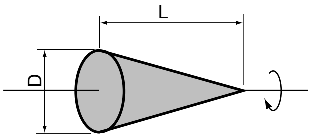
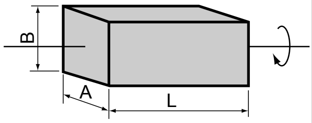
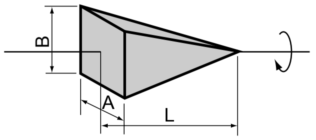
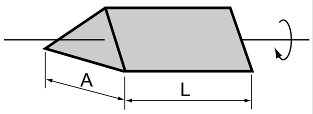
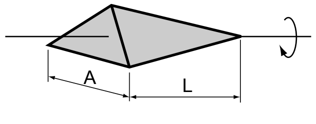
The common shape of a rotating body is hollow cylinder. The moment of inertia around the hollow cylinder center axis can be calculated as follows, where the outer and inner diameters are D_1 and D_2 [m] and total weight is W [kg] in Fig. 4.10.

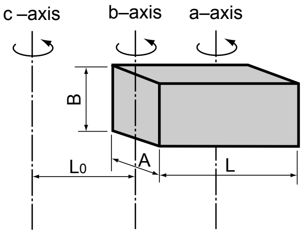
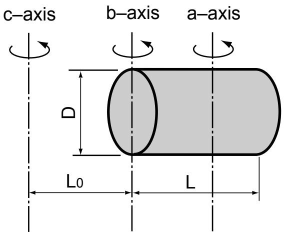
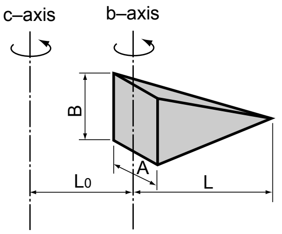
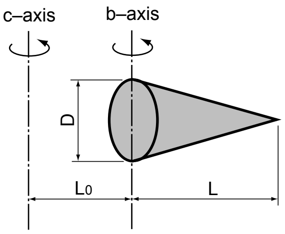
$$J = \frac{W \cdot (D_1^2 + D_2^2)}{8} \quad [kg \cdot m^2] \quad \text{.........} \quad (4.12)$$

For a similar shape, a solid cylinder, calculate the moment of inertia as D_2 is 0.

② **For a general rotating body**
Table 4.1 lists the calculation expressions of moment of inertia of various rotating bodies including the above cylindrical rotating body.

Table 4.1 Moment of inertia of various rotating bodies

Shape	Mass :W [kg]	Moment of inertia :J [kg·m²]
Hollow cylinder 	$W = \frac{\pi}{4}(D_1^2 - D_2^2)\cdot L\cdot\rho$	$J = \frac{1}{8}\cdot W\cdot(D_1^2 + D_2^2)$
Sphere 	$W = \frac{\pi}{6}D^3\cdot\rho$	$J = \frac{1}{10}\cdot W\cdot D^2$
Cone 	$W = \frac{\pi}{12}D^2\cdot L\cdot\rho$	$J = \frac{3}{40}\cdot W\cdot D^2$
Rectangular prism 	$W = A\cdot B\cdot L\cdot\rho$	$J = \frac{1}{12}\cdot W\cdot(A^2 + B^2)$
Pyramid, rectangular base 	$W = \frac{1}{3}A\cdot B\cdot L\cdot\rho$	$J = \frac{1}{20}\cdot W\cdot(A^2 + B^2)$
Triangular prism 	$W = \frac{\sqrt{3}}{4}\cdot A^2\cdot L\cdot\rho$	$J = \frac{1}{3}\cdot W\cdot A^2$
Tetrahedron with an equilateral triangular base 	$W = \frac{\sqrt{3}}{12}\cdot A^2\cdot L\cdot\rho$	$J = \frac{1}{5}\cdot W\cdot A^2$

Shape	Mass :W [kg]	Moment of inertia :J [kg·m²]
	$W = A\cdot B\cdot L\cdot\rho$	$J_a = \frac{1}{12}\cdot W\cdot(L^2 + A^2)$ $J_b = \frac{1}{12}\cdot W\cdot(L^2 + \frac{1}{4}\cdot A^2)$ $J_c \fallingdotseq W\cdot(L_0^2 + L_0\cdot L + \frac{1}{3}\cdot L^2)$
	$W = \frac{\pi}{4}D^2\cdot L\cdot\rho$	$J_a = \frac{1}{12}\cdot W\cdot(L^2 + \frac{3}{4}\cdot D^2)$ $J_b = \frac{1}{3}\cdot W\cdot(L^2 + \frac{3}{16}\cdot D^2)$ $J_c \fallingdotseq W\cdot(L_0^2 + L_0\cdot L + \frac{1}{3}\cdot L^2)$
	$W = \frac{1}{3}A\cdot B\cdot L\cdot\rho$	$J_b = \frac{1}{10}\cdot W\cdot(L^2 + \frac{1}{4}\cdot A^2)$ $J_c \fallingdotseq W\cdot(L_0^2 + \frac{3}{2}L_0\cdot L + \frac{3}{5}\cdot L^2)$
	$W = \frac{\pi}{12}\cdot D^2\cdot L\cdot\rho$	$J_b = \frac{1}{10}\cdot W\cdot(L^2 + \frac{3}{8}\cdot D^2)$ $J_c \fallingdotseq W\cdot(L_0^2 + \frac{3}{2}L_0\cdot L + \frac{3}{5}\cdot L^2)$

Main metal density (at 20°C) ρ [kg/m³] Iron : 7860, Copper : 8940, Aluminum : 2700

③ For a load running horizontally

As shown in Fig. 4.7, a carrier table can be driven by a motor. If the table speed is υ [m/s] when the motor rotation speed is N_M [r/min], an equivalent distance from the rotation axis is $60\upsilon/(2\pi\cdot N_M)$ [m]. Then, the moment of inertia of table and load to the rotation axis is calculated as follows:

$J = \left(\frac{60\upsilon}{2\pi \cdot N_M}\right)^2 \cdot (W_0 + W)$ [kg · m²] .... (4.13)

④ For lifting and lowering load

As shown in Figures 4.8 and 4.9, two loads tied with the rope move in different directions. The moment of inertia can be calculated by obtaining the sum of the moving object's weight as follows:

$J = \left(\frac{60\upsilon}{2\pi \cdot N_M}\right)^2 \cdot (W_0 + W + W_B)$ [kg · m²] .... (4.14)

2. Calculation of the acceleration time

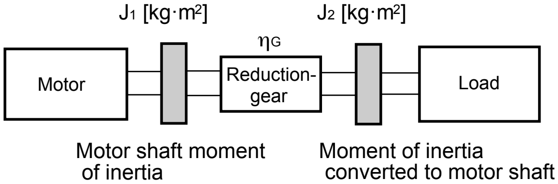


Fig. 4.10 Load model including reduction-gear

Fig.4.10 shows a general load model. Here, the load is tied via a reduction-gear with efficiency η_G.
The time required to accelerate this load to a speed of N_M [r/min] is calculated with the following expression:

$t_{ACC} = \frac{J_1 + J_2/\eta_G}{\tau_M - \tau_L/\eta_G} \cdot \frac{2\pi \cdot (N_M - 0)}{60}$ [s] .... (4.15)

Where,
J_1: Motor shaft moment of inertia [kg·m²]
J_2: Load shaft moment of inertia converted to motor shaft [kg·m²]
τ_M: Minimum motor output torque in driving mode [N·m]
τ_L: Maximum load torque converted to motor shaft [N·m]
η_G: Reduction-gear efficiency

As clarified in the above expression, equivalent moment of inertia becomes (J_1+J_2/η_G) considering the reduction gear efficiency.

3. Calculation of the deceleration time

In Fig. 4.10, the time required to stop the motor rotating at a speed of N_M [r/min] is calculated with the following expression:

$t_{DEC} = \frac{J_1 + J_2 \cdot \eta_G}{\tau_M - \tau_L \cdot \eta_G} \cdot \frac{2\pi \cdot (0 - N_M)}{60}$ [s] .... (4.16)

Where,
J_1: Motor shaft moment of inertia [kg·m²]
J_2: Load shaft moment of inertia converted to motor shaft [kg·m²]
τ_M: Minimum motor output torque in braking (deceleration) mode [N·m]
τ_L: Maximum load torque converted to motor shaft [N·m]
η_G: Reduction-gear efficiency

In the above expression, generally output torque τ_M is negative and load torque τ_L is positive. So, deceleration time becomes shorter. However, in a lifted and lowered load, τ_L may become a negative value in braking mode. In this case, the deceleration time becomes longer.

* For lifting or lowering load
In inverter and motor capacity selection for lifted and lowered load, the deceleration time must be calculated by using the maximum value that makes the load torque negative.

1.3.3 Heat energy calculation of braking resistor

Braking by an inverter causes mechanical energy to be regenerated in the inverter circuit.
This regenerative energy is often discharged to the resistor. In this section, braking resistor rating is explained.

Calculation of regenerative energy

Regenerative energy generated in the inverter operation consists of kinetic energy of a moving object and its potential energy.

① Kinetic energy of a moving object

When an object with moment of inertia J [kg·m²] rotates at a speed N_2 [r/min], its kinetic energy is as follows:

$E = \frac{J}{2} \cdot \left(\frac{2\pi \cdot N_2}{60}\right)^2$ [J] .... (4.17)

$\fallingdotseq \frac{1}{182.4} \cdot J \cdot N_2^2$ [J = kWs] .... (4.17)'

The output energy when this object is decelerated to a speed N_1 [r/min] is as follows:

$E = \frac{J}{2} \cdot \left[\left(\frac{2\pi \cdot N_2}{60}\right)^2 - \left(\frac{2\pi \cdot N_1}{60}\right)^2\right]$ [J] .... (4.18)

$\fallingdotseq \frac{1}{182.4} \cdot J \cdot (N_2^2 - N_1^2)$ [J] .... (4.18)'

The energy regenerated to the inverter as shown in Fig. 4.10 is calculated by considering the reduction-gear efficiency η_G and motor efficiency η_M as follows:

$E \fallingdotseq \frac{1}{182.4} \cdot (J_1+J_2 \cdot \eta_G) \cdot \eta_M \cdot (N_2^2 - N_1^2)$ [J] .... (4.19)

② Potential energy of an object

When an object of W [kg] is lowered from height h_2 [m] to h_1 [m], the output potential energy is expressed as follows:

$E = W \cdot g \cdot (h_2 - h_1)$ [J] .... (4.20)

Where, $g \fallingdotseq 9.8065$ [m/s²]

Regenerative energy to the inverter circuit is calculated by considering the reduction-gear efficiency η_G and motor efficiency η_M as follows:

$E = W \cdot g \cdot (h_2 - h_1) \cdot \eta_G \cdot \eta_M$ [J] .... (4.21)

1.3.4 Appendix (calculation for other than in SI Unit)

All the expressions in this document are based on SI units (International System of Units). In this section, how to convert expressions to other units is explained.

1. Conversion of unit

(1)Force

- 1[kgf] ≒ 9.8[N]
- 1[N] ≒ 0.102[kgf]

(2)Torque

- 1[kgf · m] ≒ 9.8[N · m]
- 1[N · m] ≒ 0.102[kgf · m]

(3)Work and energy

- 1[kgf · m] ≒ 9.8[N · m] = 9.8[J] = 9.8[W · s]

(4)Power

- 1[kgf · m/s] ≒ 9.8[N · m/s] = 9.8[J/s] = 9.8[W]
- 1[N · m/s] ≒ 1[J/s] = 1[W] = 0.102[kgf · m/s]

(5)Rotation speed

- $1[\text{r/min}] = \frac{2\pi}{60}[\text{rad/s}] \fallingdotseq 0.1047[\text{rad/s}]$
- $1[\text{rad/s}] = \frac{60}{2\pi}[\text{r/min}] \fallingdotseq 9.549[\text{r/min}]$

(6)Inertia constant

- $J[\text{kg} \cdot \text{m}^2]$: moment of inertia
- $GD^2[\text{kg} \cdot \text{m}^2]$: flywheel effect
- $GD^2 = 4J$
- $J = \frac{GD^2}{4}$

(7)Pressure and stress

- $1[\text{mmAq}] \fallingdotseq 9.8[\text{Pa}] \fallingdotseq 9.8[\text{N/m}^2]$
- $1[\text{Pa}] \fallingdotseq 1[\text{N/m}^2] \fallingdotseq 0.102[\text{mmAq}]$
- $1[\text{bar}] \fallingdotseq 100000[\text{Pa}] \fallingdotseq 1.02[\text{kg} \cdot \text{cm}^2]$
- $1[\text{kg} \cdot \text{cm}^2] \fallingdotseq 98000[\text{Pa}] \fallingdotseq 980[\text{mbar}]$
- 1 atmospheric pressure =1013[mbar] = 760[mmHg]
  = $101300[\text{Pa}] \fallingdotseq 1.033[\text{kg/cm}^2]$

2. Calculation formula

(1)Torque, power and rotation speed

- $P[\text{W}] \fallingdotseq \frac{2\pi}{60} \cdot N[\text{r/min}] \cdot \tau\,[\text{N} \cdot \text{m}]$
- $P[\text{W}] \fallingdotseq 1.026 \cdot N[\text{r/min}] \cdot T[\text{kgf} \cdot \text{m}]$
- $\tau\,[\text{N} \cdot \text{m}] \fallingdotseq 9.55 \cdot \frac{P[\text{W}]}{N[\text{r/min}]}$
- $T[\text{kgf} \cdot \text{m}] \fallingdotseq 0.974 \cdot \frac{P[\text{W}]}{N[\text{r/min}]}$

(2)Kinetic energy

- $E[\text{J}] \fallingdotseq \frac{1}{182.4} \cdot J[\text{kg} \cdot \text{m}^2] \cdot N^2[(\text{r/min})^2]$
- $E[\text{J}] \fallingdotseq \frac{1}{730} \cdot GD^2[\text{kg} \cdot \text{m}^2] \cdot N^2[(\text{r/min})^2]$

(3) Torque of linear moving load

[Driving mode]

- $\tau[\text{N} \cdot \text{m}] \fallingdotseq 0.159 \frac{V[\text{m/min}]}{N_M[\text{r/min}] \cdot \eta_G} \cdot F[\text{N}]$
- $T[\text{kgf} \cdot \text{m}] \fallingdotseq 0.159 \frac{V[\text{m/min}]}{N_M[\text{r/min}] \cdot \eta_G} \cdot F[\text{kgf}]$

[Braking mode]

- $\tau[\text{N} \cdot \text{m}] \fallingdotseq 0.159 \frac{V[\text{m/min}]}{N_M[\text{r/min}] \cdot \eta_G} \cdot F[\text{N}]$
- $T[\text{kgf} \cdot \text{m}] \fallingdotseq 0.159 \frac{V[\text{m/min}]}{N_M[\text{r/min}] \cdot \eta_G} \cdot F[\text{kgf}]$

(4) Acceleration torque

[Driving mode]

- $\tau[\text{N} \cdot \text{m}] \fallingdotseq \frac{J[\text{kg}\cdot\text{m}^2]}{9.55} \cdot \frac{\Delta N[\text{r/min}]}{\Delta t[\text{s}] \cdot \eta_G}$
- $T[\text{kgf} \cdot \text{m}] \fallingdotseq \frac{GD^2[\text{kg}\cdot\text{m}^2]}{375} \cdot \frac{\Delta N[\text{r/min}]}{\Delta t[\text{s}] \cdot \eta_G}$

[Braking mode]

- $\tau[\text{N} \cdot \text{m}] \fallingdotseq \frac{J[\text{kg}\cdot\text{m}^2]}{9.55} \cdot \frac{\Delta N[\text{r/min}] \cdot \eta_G}{\Delta t[\text{s}]}$
- $T[\text{kgf} \cdot \text{m}] \fallingdotseq \frac{GD^2[\text{kg}\cdot\text{m}^2]}{375} \cdot \frac{\Delta N[\text{r/min}] \cdot \eta_G}{\Delta t[\text{s}]}$

(5)Acceleration time

- $t_{ACC}[\text{s}] \fallingdotseq \frac{J_1+J_2/\eta_G[\text{kg}\cdot\text{m}^2]}{\tau_M-\tau_L/\eta_G[\text{N}\cdot\text{m}]} \cdot \frac{\Delta N[\text{r/min}]}{9.55}$
- $t_{ACC}[\text{s}] \fallingdotseq \frac{GD_1^2+GD_2^2/\eta_G[\text{kg}\cdot\text{m}^2]}{T_M-T_L/\eta_G[\text{kgf}\cdot\text{m}]} \cdot \frac{\Delta N[\text{r/min}]}{375}$

(6)Deceleration time

- $t_{DEC}[\text{s}] \fallingdotseq \frac{J_1+J_2 \cdot \eta_G[\text{kg}\cdot\text{m}^2]}{\tau_M-\tau_L \cdot \eta_G[\text{N}\cdot\text{m}]} \cdot \frac{\Delta N[\text{r/min}]}{9.55}$
- $t_{DEC}[\text{s}] \fallingdotseq \frac{GD_1^2+GD_2^2 \cdot \eta_G[\text{kg}\cdot\text{m}^2]}{T_M-T_L \cdot \eta_G[\text{kgf}\cdot\text{m}]} \cdot \frac{\Delta N[\text{r/min}]}{375}$

2. Braking Unit and Braking Resistor Selection

2.1 Selection Procedure

The following three requirements must be satisfied simultaneously:

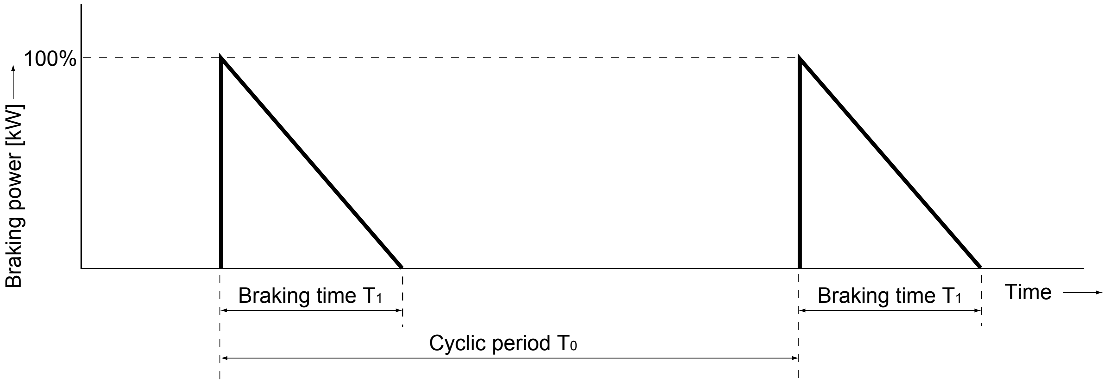
1) Maximum braking torque must not exceed values listed in Tables 3.1 and 3.2 in Chapter 3.
   To use maximum braking torque exceeding values in the above tables, select one size larger capacity braking unit and resistor.

2) Discharge energy for a single braking action must not exceed discharging capability [kWs] listed in the Table.
   For detailed calculation, see Section 1.3.3 Heat Energy Calculation of Braking Resistor.

3) Average loss obtained by dividing discharge energy by cyclic period must not exceed average loss [kW] listed in the Tables 3.1 and 3.2 in Chapter 3.

2.2 Notes on Selection

- The P11S series uses one size smaller capacity braking unit and resistor than those of the G11S series.
- Braking time and duty cycle are converted under deceleration braking conditions based on the rated torque as shown below. However, these value need not be considered when selecting braking unit and resistor capacity.



Duty cycle (%) = $\frac{T_1}{T_0}$ x 100

Fig. 4.11 Duty cycle

2.3 Optional fan unit

The standard duty cycle of the optional braking unit of 30kW or larger is 10%. The braking capacity can be increased up to 30% duty cycle by adding an optional fan unit (BU-F).

Chapter 5

Option

Contents

1. Options

1.1 Optional control cards

The following control cards built in inverter (for FRENIC5000G11S Series) are provided as options.

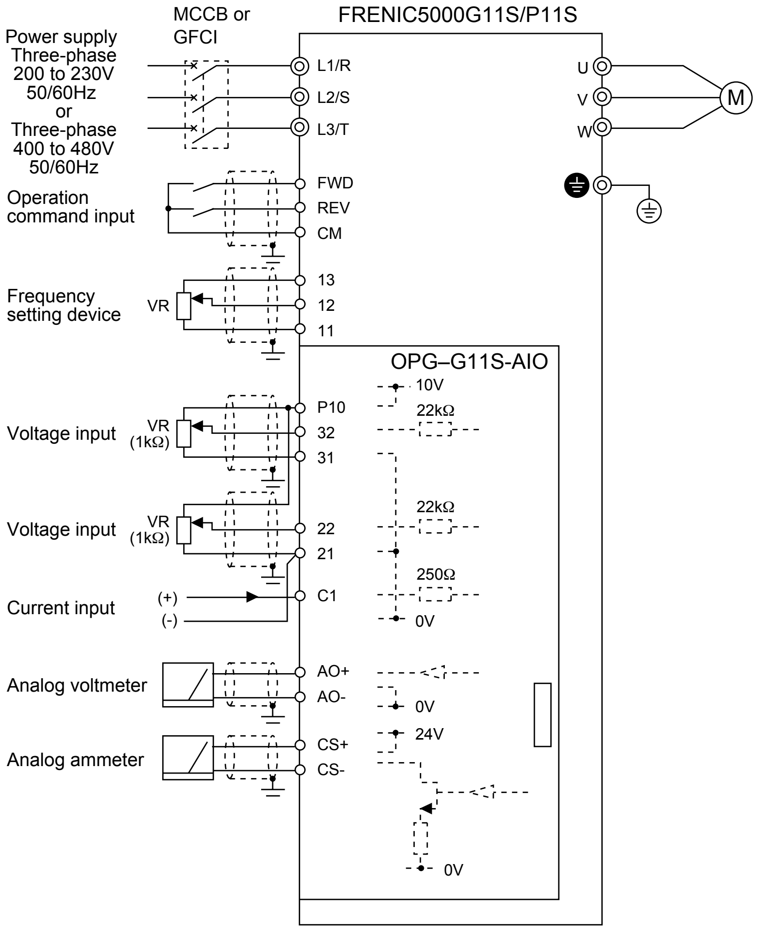
■ List of option cards

Name	Type	Function
Analog I/O interface card	OPC-G11S-AIO	• Auxiliary input for analog frequency setting (0 to ± 10V, 4 to 20mA) • Analog monitoring of inverter output frequency, output current, and torque.
Digital I/O interface card	OPC-G11S-DIO	• For setting frequency using a binary code • For monitoring frequency, output voltage, output current using a binary code (8 bit)
PG feedback card	OPC-G11S-PG	• For performing quick response torque-vector control using feedback signals from a pulse generator. • For 12V or 15V dc.
	OPC-G11S-PG2	• For performing quick response torque-vector control using feedback signals from a pulse generator. • For 5V dc.
	OPC-G11S-PGA	• For performing quick response torque-vector control using feedback signals from a pulse generator. • The frequency dividing output can be made.
Synchronized operation card	OPC-G11S-SY	• For synchronized operation of two motors
Relay output card	OPC-G11S-RY	• Includes four relay output circuits. • Converts transistor output signals from inverter control output terminals Y1 to Y4 to relay (1SPDT) output signals.

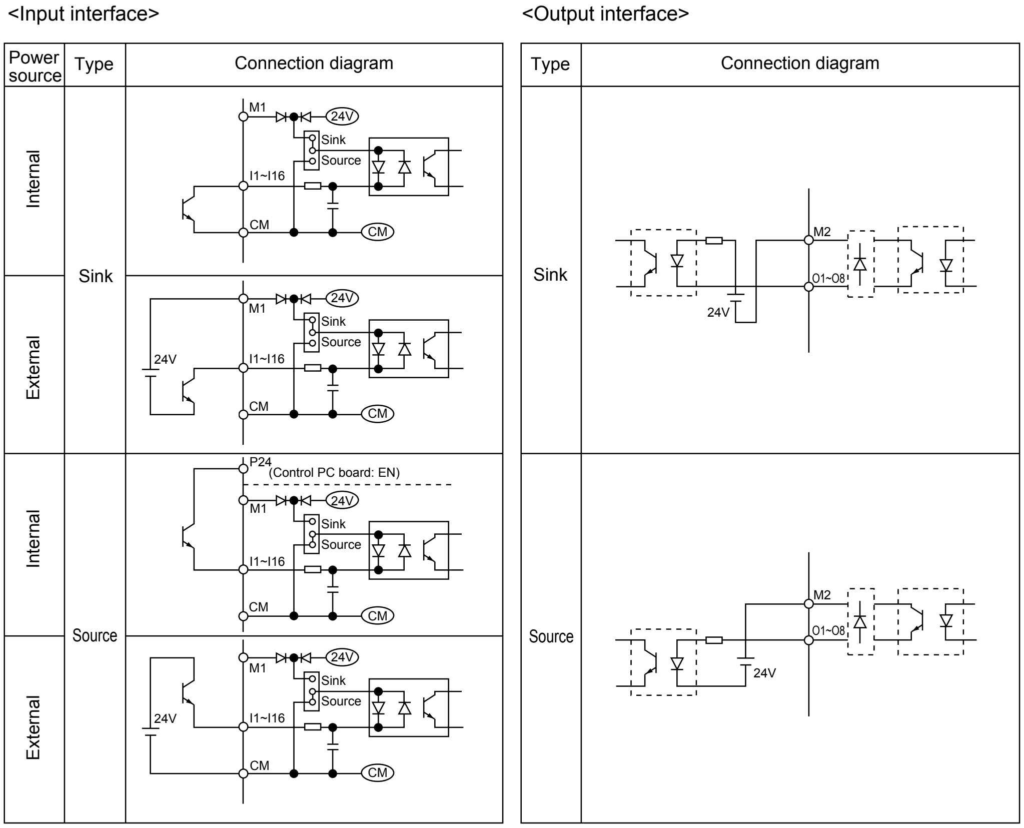
1.2 Other exclusive options

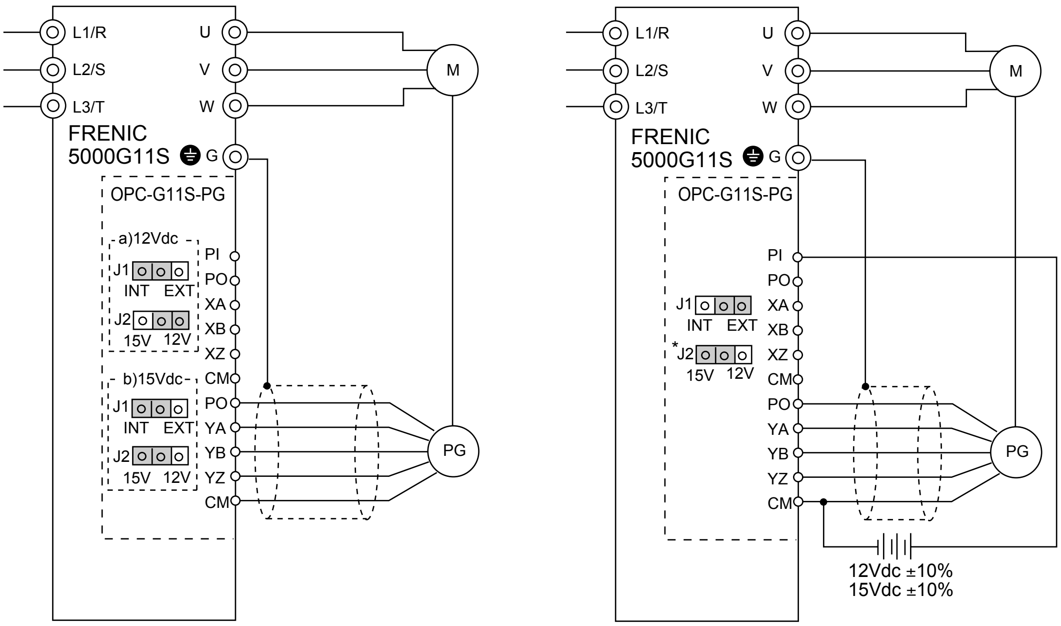
Name	Type	Function
Extension cable for keypad panel	CBIII-10R-□□	Connects the keypad panel to an inverter unit. Three cable types are available: straight 6.6ft (2m), curled 3.3ft (1m), and curled 6.6ft (2m). The curled 3.3ft (1m) cable can be externded up to 16ft (5m), and the curled 6.6ft (2m) cable up to 33ft (10m). Note: Cables once extended to the maximum length do not return to their original length.
IP20 enclosure adapter	P20G11-□□	• Used to put 40HP or larger model to change its enclosure of IP00 into that of IP20.
Mounting adapter for external cooling	PBG11-□□	• Used to put the cooling fan section of the inverter outside the panel. • Only applicable to 30HP and below inverters. (40HP and above inverters can be modified to external cooling type by replacing the mounting bracket, as standard.)
Panel-mount adapter	MAG9-□□	Used to put an FRN-G11S inverter to be mounted in panel holes that were used to mount an FVR-G7S inverter.

1.3 Detailed specifications

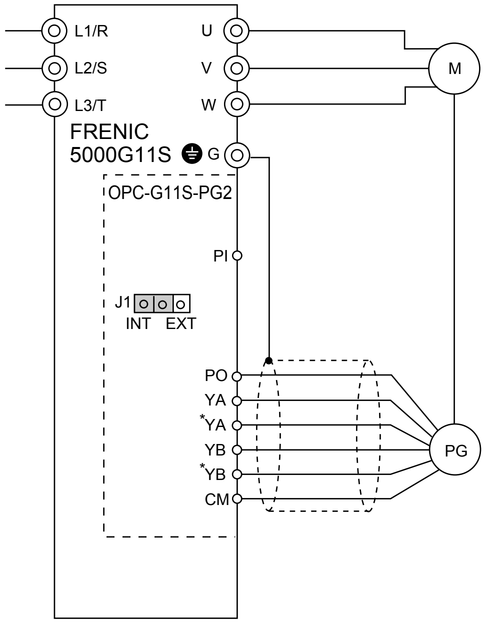
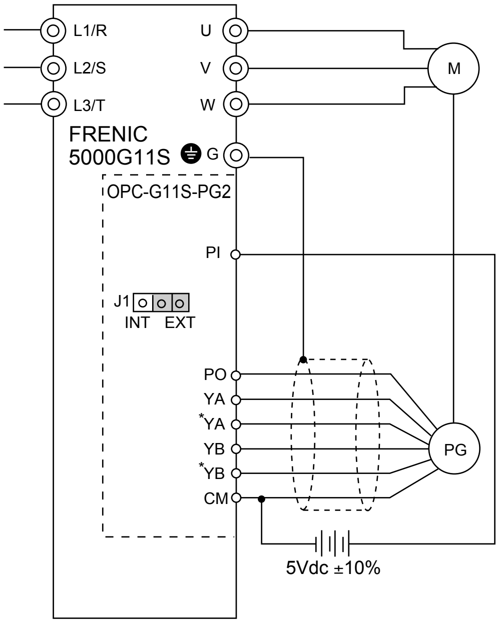
Name		Analog I/O interface card
Type	**Card-type**	OPC-G11S-AIO
	Unit-type	–
Function		3 analog inputs (2 voltage inputs and 1 current input): Torque limiting value (Driving, braking), frequency setting, ratio setting can be input respectively. 2 analog outputs (1 voltage output and 1 current output): 11 types of data can be output.
Specifications	**Input**	Analog signal input (3 points) by short-circuiting terminals between 32, 22, C2-21, and 31. Terminal 32: Voltage input (both side) : 0 to ±10Vdc / 0 to ±100%, input impedance: 22kΩ Terminal 22: Voltage input (single side) : 0 to +10Vdc / 0 to +100%, input impedance: 22kΩ Terminal C2: Current input : 4 to 20mAdc / 0 to +100%, input impedance: 250Ω For voltage input, power supply terminal for variable resistor (P10) should be connected. Related function code: o22
	Output	Analog signal output (2 points) by short-circuiting terminals between AO+, AO-, CS+, and CS-. Terminal AO+ : Voltage output : 0 to ±10Vdc, for max. 2 voltmerters, input impedance: 10kΩ Terminal AO- : Voltage output common Terminal CS+ : Current output : 4 to 20mAdc, max. 500Ω Terminal CS- : Current output common (Terminal CS- is isolated from terminal 21, 31, and AO-.) Related function code: o23
	Power source	Power supply terminal for variable resistor: P10 +10Vdc (10mA)
Connection diagram		
Remarks		

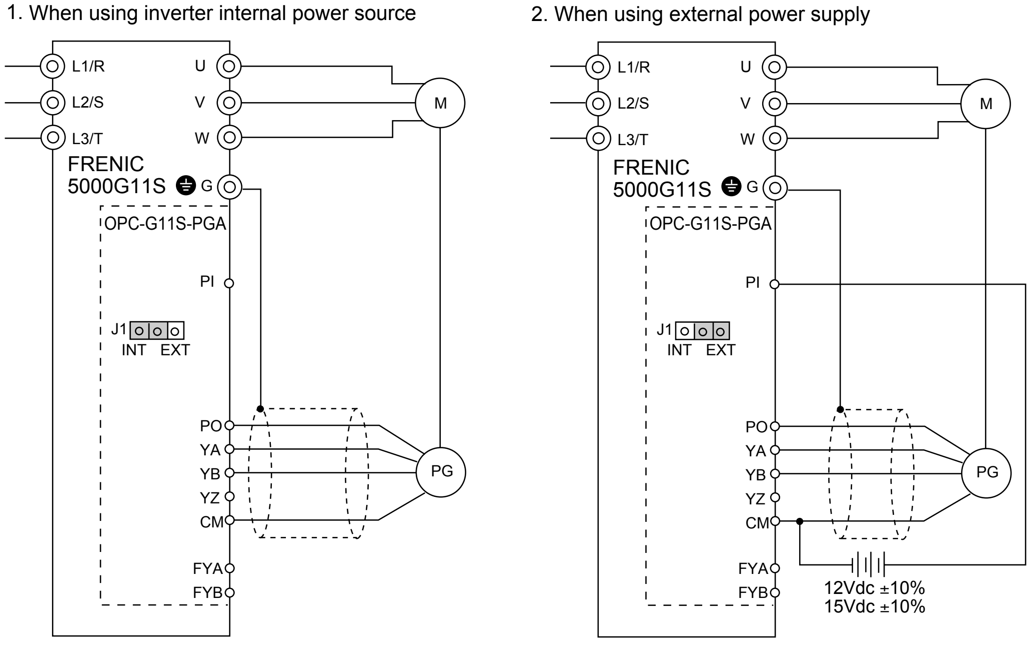
1. Options

Name		**Digital I/O interface card**
Type	**Card-type**	OPC-G11S-DIO
	Unit-type	–
Function		4 digital inputs : Binary code input of max. 16 bits or four-digit BCD input (Sink/Source changeable) 3 digital outputs : Binary code output of max. 8 bits.
Specifica-tions	**Input**	Digital signal input (4 points) by short-circuiting terminals between I1, I16, and M1 <Sink> ON operation current : 4.5mA max. OFF operation voltage : 27V max. <Source> ON operation current : 4.5mA max. OFF operation voltage : 27V max. Related function code : o19, o22
	Output	Digital signal output (3 points) by short-circuiting terminals between O1 to O6, and M2. <Sink> ON operation current : 50mA max. OFF operation voltage : 27V max. <Source> ON operation current : -50mA max. OFF operation voltage : 27V max. Related function code : o21
	Power source	+24Vdc (3.2mA x 8 = 25.6mA)
Connection diagram		
Remarks		

Name		PG feedback card	
Type	**Card-type**	OPC-G11S-PG	
	Unit-type	–	
Function		To perform speed control by detecting motor rotating speed using a pulse generator.	
Specifications	**Control**	**Speed control range**	1:1200 (3 to 3600r/min)
		Maximum speed	3600r/min (120Hz)
		Speed control accuracy	± 0.02%
		Speed control response	40Hz
	Applicable encoder (generator)	• No. of output pulse: 100 to 3000P/R A/B phase (incremental) • Maximum response frequency: 100kHz • Pulse output method: Totem pole / open collector, Output current: 7mA or more	
	Input terminal	**YA, YB, CM**	Connect A- and B-phase output signal from pulse generator on feedback side
		YZ, CM	Connect Z-phase output signal from pulse generator on feedback side. When the pulse generator does not have Z-phase, these terminals need not be connected.
	Output	None	
	Power source	• Internal power source: +15Vdc ±10%/120mA, +12Vdc ±10%/120mA (Changeable on PC board) *1) (Terminal: PO, CM) • External power source: +12Vdc (-10%) to +15Vdc (+10%)/300mA or less *2) (Terminal: PI, CM) *1) Use external power source when more than one PG feedback cards are used and the total input current exceeds 120mA. *2) Take note of the power source matches the specifications of the applied pulse generator.	
Connection diagram		1. When using inverter internal power source 2. When using external power supply  * Pin J2 can be connected to both 12V side and 15V side.	
Remarks		Terminals XA, XB, and XZ are not in use.	

*) OPC-G11S-PG2 for 5Vdc power source is available.

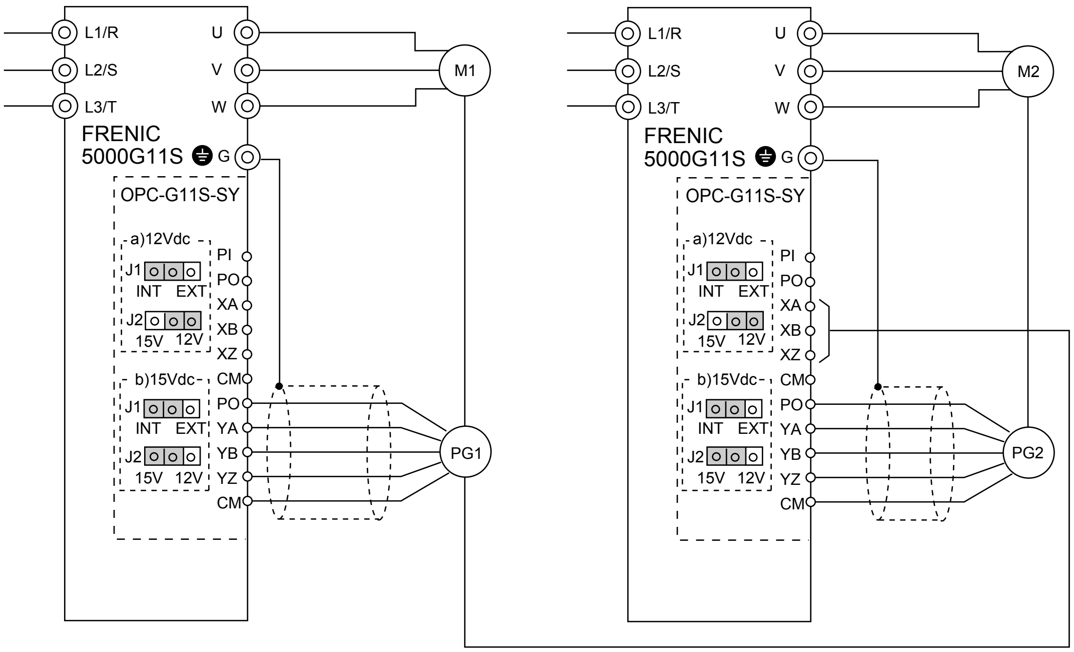
Name		**PG feedback card (PG power input : +5V)**		
Type	**Card-type**	OPC-G11S-PG2		
	Unit-type	–		
Function		To perform speed control by detecting motor rotating speed using a pulse generator.		
Specifica-tions	**Control**	**Speed control range**	1:1200 (3 to 3600r/min)	For the applicable motor, see the combination list of inverter and dedicated motor with PG.
		Maximum speed	3600r/min (120Hz)	
		Speed control accuracy	± 0.02%	
		Speed control response	40Hz	
	Applicable pulse generator	• No. of output pulse: 20 to 3000P/R A/B phase (incremental) • Maximum response frequency: 100kHz • Pulse output method: Line driver		
	Input terminal	**YA, YB, CM**	Connect A- and B-phase output signal from pulse generator on feedback side	
		YZ, CM	Connect Z-phase output signal from pulse generator on feedback side. When the pulse generator does not have Z-phase, these terminals need not be connected.	
	Output	None		
	Power source	• Internal power source: +15Vdc ±10%/200mA, (Terminal: PO, CM)*1) • External power source: +5Vdc (±10%) to +15Vdc (+10%)/300mA or less *2) (Terminal: PI, CM) *1) Use external power source when more than one PG feedback cards are used and the total input current exceeds 200mA. *2) Take note of the power source matches the specifications of the applied pulse generator.		
Connection diagram		1. When using inverter internal power source 	2. When using external power supply  * Pin J2 can be connected to both 12V side and 15V side.	
Remarks		Terminals XA, XB, and XZ are not in use.		

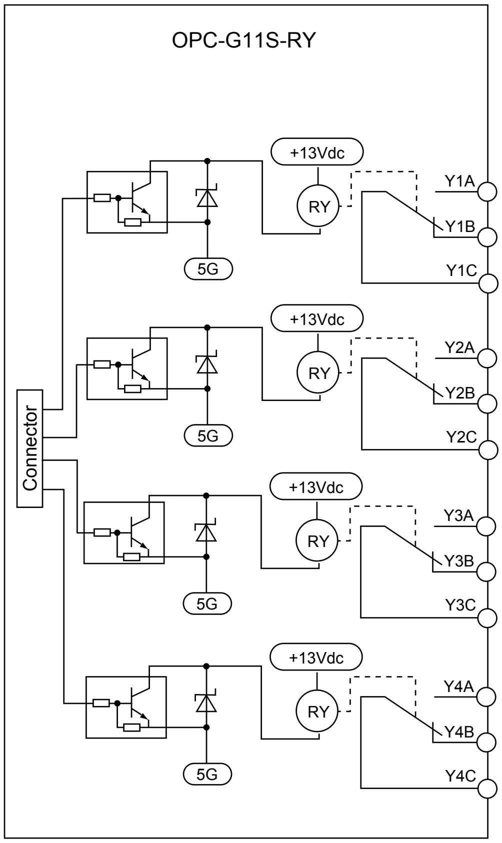
Name		PG feedback card (Frequency dividing output)		
Type	**Card-type**	OPC-G11S-PGA		
	Unit-type	–		
Function		To perform speed control by detecting motor rotating speed using a pulse generator. To perform the specified frequency dividing output of input pulses from the pulse generator.		
Specifica-tions	**Control**	**Speed control range**	1:1200 (3 to 3600r/min)	For the applicable motor, see the combination list of inverter and dedicated motor with PG.
		Maximum speed	3600r/min	
		Speed control accuracy	± 0.02%	
		Speed control response	40Hz	
	Applicable pulse generator	• No. of output pulse: 20 to 3000P/R A/B phase (incremental) • Maximum response frequency: 100kHz (Totem pole) / 25kHz (Open collector) • Total wiring length : 100m (Totem pole) / 20m (Open collector) • Pulse output method: Line driver		
	Input terminal	**YA, YB, CM**	Connect A- and B-phase output signal from pulse generator on feedback side	
		YZ, CM	Connect Z-phase output signal from pulse generator on feedback side. When the pulse generator does not have Z-phase, these terminals need not be connected.	
	Output	FYA, FYB : A-phase, B-phase frequency dividing output terminal Frequency dividing ratio: 1/1 to 1/64 Rating: 27Vdc max., 50mA max.		
	Power source	• Internal power source: +15Vdc ±5%/120mA *1), +12Vdc ±5%/120%mA *1) (Terminal: PO, CM) • External power source: +5Vdc (±10%) to +15Vdc (+10%)/300mA or less *2) (Terminal: PI, CM) *1) Use external power source when more than one PG feedback cards are used and the total input current exceeds 200mA. *2) Take note of the power source matches the specifications of the applied pulse generator.		
Connection diagram		 1. When using inverter internal power source 2. When using external power supply * Pin J2 can be connected to both 12V side and 15V side.		
Remarks		Terminals XA, XB, and XZ are not in use.		

Combination list of inverter and dedicated motor with PG

Power supply voltage	Inverter		Dedicated motor with PG			Remarks
	Type	Rated output current [A]	Type	Rated output current [A]	Maximum speed [r/min]	
Three-phase 230V	FRNF25G11S-2UX	1.5	–	–	–	*3)
	FRNF50G11S-2UX	3				
	FRN001G11S-2UX	5	MVK6096A–C	4.8	3600	
	FRN002G11S-2UX	8	MVK6097A–C	7		
	FRN003G11S-2UX	11	MVK6107A–C	11		
	FRN005G11S-2UX	17	MVK6115A–C	18		*1)
	FRN007G11S-2UX	25	MVK6133A–C	27		*2)
	FRN010G11S-2UX	33	MVK6135A–C	37		
	FRN015G11S-2UX	46	MVK6165A–C	49		
	FRN020G11S-2UX	59	MVK6167A–C	63		
	FRN025G11S-2UX	74	MVK6184A–C	74		
	FRN030G11S-2UX	87	MVK6185A–C	90		*1)
	FRN040G11S-2UX	115	MVK6206A–C	116	3000	*2)
	FRN050G11S-2UX	145	MVK6207A–C	143		
	FRN060G11S-2UX	180	MVK6208A–C	170		*4)
			MVK9221A–C	180	2400	
	FRN075G11S-2UX	215	MVK9250A–C	211		
	FRN100G11S-2UX	283	MVK9252A–C	280		
	FRN125G11S-2UX	346	MVK9280A–C	328	2000	
Three-phase 460V	FRNF50G11S-4UX	1.5	–	–	–	*3)
	FRN001G11S-4UX	2.5				
	FRN002G11S-4UX	3.7				
	FRN003G11S-4UX	5.5				
	FRN005G11S-4UX	9	MVK6115A–C	9	3600	
	FRN007G11S-4UX	13	MVK6133A–C	13.5		*2)
	FRN010G11S-4UX	18	MVK6135A–C	18.5		
	FRN015G11S-4UX	24	MVK6165A–C	24.5		
	FRN020G11S-4UX	30	MVK6167A–C	32		
	FRN025G11S-4UX	39	MVK6184A–C	37		
	FRN030G11S-4UX	45	MVK6185A–C	45		
	FRN040G11S-4UX	60	MVK6206A–C	58	3000	
	FRN050G11S-4UX	75	MVK6207A–C	71		
	FRN060G11S-4UX	91	MVK6208A–C	85		*4)
			MVK9221A–C	87	2400	
	FRN075G11S-4UX	112	MVK9250A–C	103		
	FRN100G11S-4UX	150	MVK9252A–C	140		
	FRN125G11S-4UX	176	MVK9280A–C	164	2000	
	FRN150G11S-4UX	210	MVK9282A–C	196		
	FRN200G11S-4UX	253	MVK9310A–C	236		
	FRN250G11S-4UX	304	MVK9312A–C	283		
	FRN300G11S-4UX	377	MVK9316A–C	351		
	FRN350G11S-4UX	415	MVK9318A–C	389		
	FRN400G11S-4UX	520	Contact Fuji			
	FRN450G11S-4UX	585				
	FRN500G11S-4UX	650				
	FRN600G11S-4UX	740				

*1) The inverter rated output current is larger than the motor rated current and the motor thermal characteristics has limitation. Use the equipment at ambient temperature 40℃ (104°F) or below.
*2) Though the inverter rated output current is larger than the motor rated current. There is no problem in use.
*3) The combination should be studied for each product. Contact Fuji.
*4) You can select an appropriate motor out of two types motors.

Name			Synchronized operation card
Type	**Card-type**		OPC-G11S-SY
	Unit-type		–
Function			To perform position control by pulse train input, synchronized operation of 2 motors (simultaneous-start-and-synchronize operation and proportional speed ratio operation)
Specifications	**Control**	**Speed control range**	1:1200 (3 to 3600r/min)
		Maximum speed	3600r/min (120Hz)
		Speed control accuracy	± 0.02%
		Speed control response	40Hz
	Applicable encoder (generator)		• No. of output pulse: 20 to 3000P/R A/B phase (incremental) • Maximum response frequency: 100kHz (Totem pole) / 25kHz (Open collector) • Wiring length: 328ft (100m) (Totem pole) / 66ft (20m) (Open collector) • Pulse output method: Totem pole / Open collector, Output current: 7mA or more
	Input	**Terminal**	**Function**
		XA, XB, CM	Connect A- and B-phase output signal of master rotary encoder.
		XZ, CM	Connect Z-phase output signal of master rotary encoder.
		YA, YB, CM	Connect A- and B-phase output signal of feedback or master rotary encoder.
		YZ, CM	Connect Z-phase output signal of feedback or master rotary encoder.
	Output		None
	Power source		• Internal power source: +15Vdc ±10% / 120mA, +12Vdc ±10% / 120mA (Changeable on PC board)*1) (Terminal: PO, CM) • External power source: +12Vdc (-12%) to +15Vdc (+10%) / 300mA or less *2) (Terminal: PI, CM) *1) Use external power source when more than one synchronized operation cards are used and the total input current exceeds 120mA. *2) Take note of the power source matches the specifications of the applied rotary encoder.
Connection diagram			1. <Master side> <Slave side>  The above diagrams are used for when inverter internal power source is used. When using external power source, perform connection similar to the above connection, by referring to “2. When using external power supply" of PG feedback card (page 5-5)
Remarks			

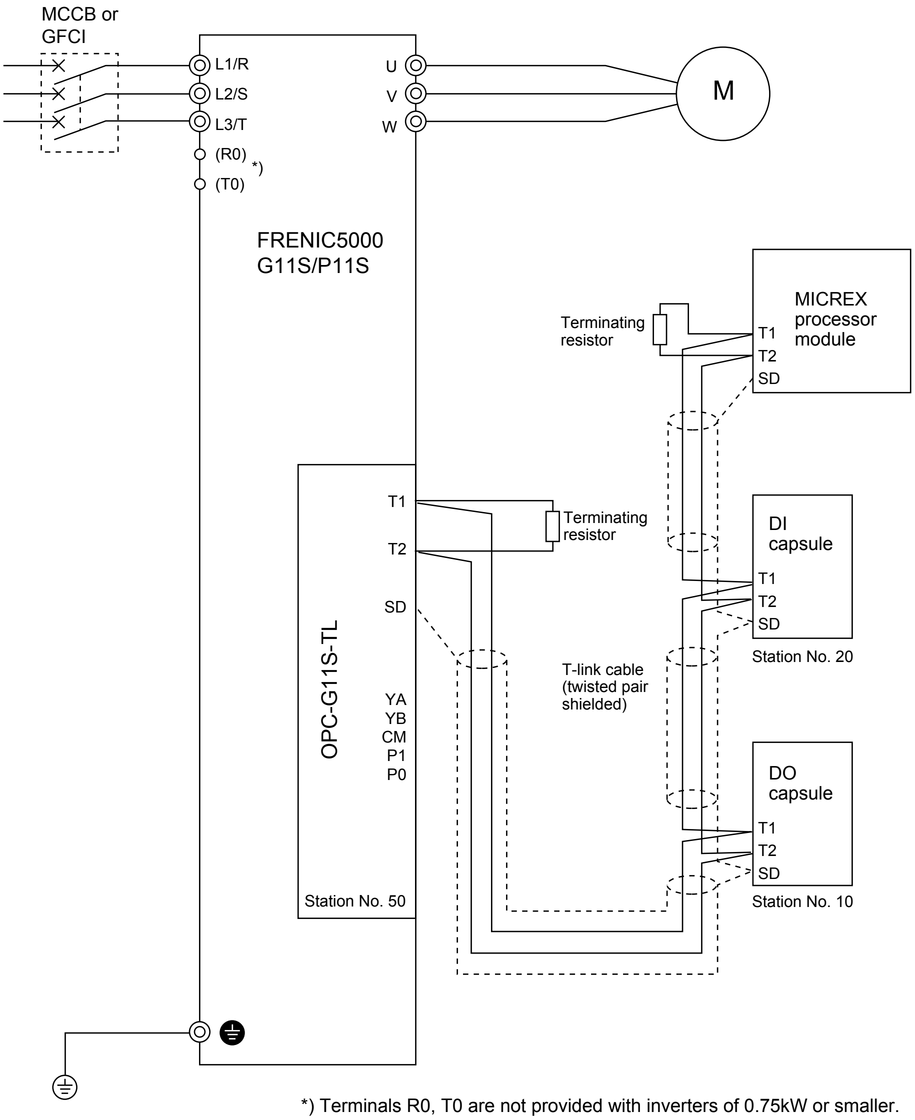
Name		**Relay output card**	
Type	**Card-type**	OPC-G11S-RY	*)
	Unit-type	–	–
Function		• Includes four relay output circuits. • Converts transistor output signals from inverter control output terminals Y1 to Y4 to relay (1SPDT) output signals.	In addition to the relay output function, PG vector control can be performed with the feedback signal from pulse generator.
Specifications	**Input**	None	Connect the pulse generator A-phase, B-phase output signal.
	Output	Four-channel contact (12 terminals from Y1A to Y4C) 250Vac, 0.3A, cos ø = 0.3	None
	Power source	The power source to drive the relay card is supplied from inverter.	• Internal power source: +15Vdc ±10%/120mA, +12Vdc ±10%/120mA (Changeable on PC board) *1) • External power source: +12Vdc (-10%) to +15Vdc (+10%)/300mA or less *2) *1) Use external power source when more than one relay output cards are used and the total input current exceeds 120mA. *2) Take note of the power source matches the specifications of the applied pulse generator.
Connection diagram			Refer to the connection diagram of PG feedback card.
Remarks			*) When the relay output card has to be used together with the PG feedback card, the card will be made-to-order. Contact Fuji.

Optional communication card

The following optional communication card are available for FRENIC5000G11S series inverter.

Name	Type	Function
T-link card	OPC-G11S-TL	• Setting of operation frequency • Setting of operation command (FWD, REV, RST, etc.) • Setting and reading out of function code and data code • Monitoring of operating status • Reading out of inverter trip data
Open-bus card	OPC-G11S-PDP	• Conforming to Profibus
	OPC-G11S-DEV	• Conforming to DeviceNet
	OPC-G11S-MBP	• Conforming to Modbus Plus
	OPC-G11S-IBS	• Conforming to Interbus-S
	OPC-G11S-COP	• Conforming to CAN-open

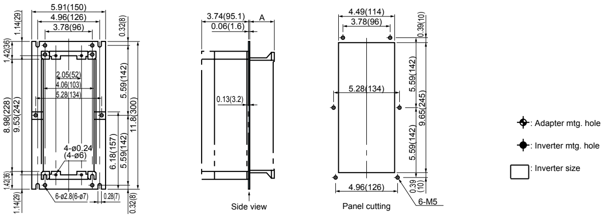
For details of open-bus cards, see individual instruction manual.

Name		T-link interface card
Type	**Card-type**	OPC-G11S-TL
	Unit-type	–
Function		To connect inverter to FUJI MICREX series PLC to control inverter from PLC. Setting and monitoring function data for function codes can be made.
Specifications	**Transmission specification**	T-link slave I/O transmission
	No. of words used	8 words: MICREX → Inverter: 4 words Inverter → MICREX: 4 words
	Terminal	Terminal T1, T2, SD: T-link cable connection terminal (Use general-purpose cable described in instruction manual.)
	Relative function code	o27, o28, o29
	Power source	None
Connection diagram		 *) Terminals R0, T0 are not provided with inverters of 0.75kW or smaller.
Remarks		

■ Exclusive option specifications

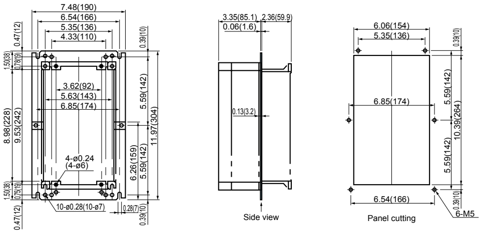
• Mounting adapter for external cooling (PGB11-□□)

Used to put the cooling fan section of the inverter outside the panel.
Only applicable to 30HP or smaller inverter. (40HP or larger inverter can be modified to external cooling type by replacing the mounting bracket, as standard.)

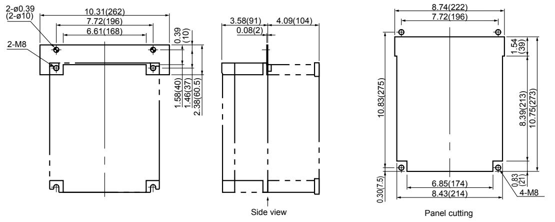


unit: inch (mm)

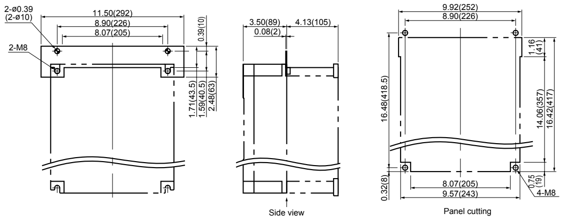
Option type	Applicable inverter	A
PBG11-0.75	FRNF25G11S-2UX to FRN001G11S-2UX FRNF50G11S-4UX	1.37 (34.9)
	FRN001G11S-4UX	1.97(49.9)



Option type	Applicable inverter
PBG11-3.7	FRN002G11S-2UX to FRN005G11S-2UX FRN002G11S-4UX to FRN005G11S-4UX



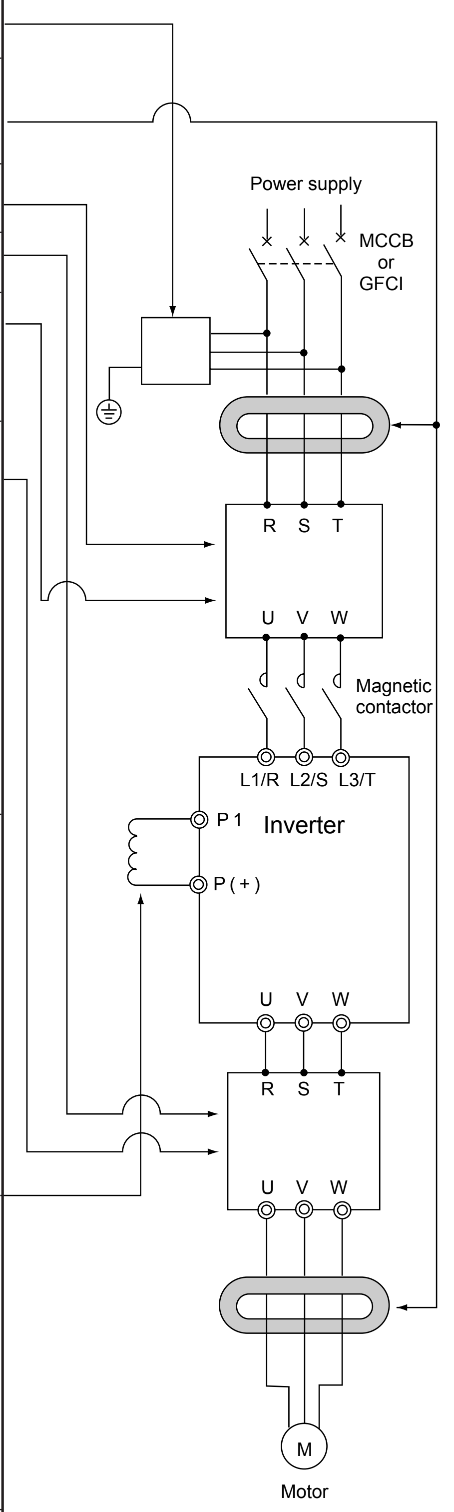
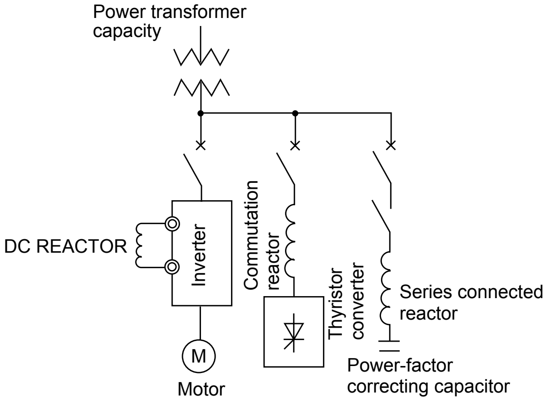
Option type	Applicable inverter
PBG11-7.5	FRN007G11S-2UX to FRN010G11S-2UX FRN007G11S-4UX to FRN010G11S-4UX FRN007P11S-2UX to FRN015P11S-2UX FRN007P11S-4UX to FRN015P11S-4UX



Option type	Applicable inverter
PBG11-22	FRN015G11S-2UX to FRN030G11S-2UX FRN015G11S-4UX to FRN030G11S-4UX FRN020P11S-2UX to FRN030P11S-2UX FRN020P11S-4UX to FRN030P11S-4UX

2. Optional Peripheral Equipment

2.1 Optional peripheral equipment

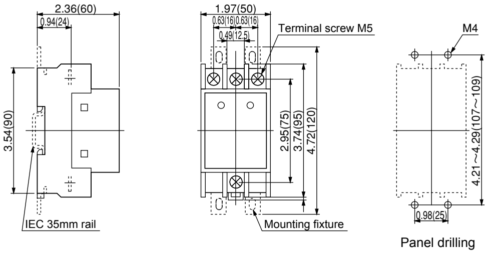
Name (Type)	Function	Mounting position
Arrester (CN23232) (CN2324E)	Suppresses induced lightning surges from power source, thus protecting all equipment connected from the power source.	
Ferrite ring for reducing radio noise (ACL-40B) (ACL-74B)	Reduces radio frequency noise. If the wiring between motor and inverter is shorter than 66ft (20m), use the ferrite ring in the power supply side. If longer than 66ft (20m), use it in the output side.	
Power filter (FHF-TA/□□/250) (FHF-TA/□□/500) (FHF-TB/□□/250) (FHF-TB/□□/500)	Prevents the noise generated from the inverter. Supresses radiation noise and induction noise generated from the output side wiring.	
EMC compliance filter (EFL-□□□SP-2) (EFL-□□□G11-4) (RF3□□□-F11)	This is a special filter which complies with the European EMC (Emission) Directive. This filter should be used together with a ferrite core. Note: Other prerequisites must be fulfilled to ensure compliance with EMC Directives. Refer to this filters operation manual for details.	
Output circuit filter (OFL-□□□-□) (OFL-□□□-4A)	Connected to the output circuit of inverters under low-noise operation with carrier frequency from 8 to 15kHz; 6kHz or higher for 40HP or larger inverters (OFL-□□□-□),0.75 to 15kHz; 0.75 to 10kHz for 100HP or larger inverters (OFL-□□□-4A). This filter has the following functions: ① Suppressing fluctuation of motor terminal voltage. Protects the motor insulation from being damaged by surge voltage. (460V) ② Suppressing leakage current from output side wiring. (OFL-□□□-□ only) Reduces the leakage current caused when several motors are operated in parallel or connected with long wiring. * Total wiring length should be less than 1300ft (400m). ③ Suppressing radial noise or inductive noise from output side wiring. Effective noise suppression device for long wiring applications such as plant. Note: When connecting OFL-□□□ -□ ,be sure to set the carrier frequency F26 at 8kHz or over.	
DC REACTOR(DCR) (DCR4-□□□) (DCR2-□□□)	[Use the DCR to normalize the power supply in the following cases.] ① The power transformer capacity is 500kVA or over and exceeds the inverter rated capacity by 10 times. ② The inverter and a thyristor converter are connected with the same transformer. * Check if the thyristor converter uses a commutation reactor. If not, AC reactor must be connected to the power supply side. ③ Overvoltage trip occurs due to open/close of the phase-advancing capacitor for the power supply lines. ④ The voltage unbalance exceeds 2%. $\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage [V]} - \text{Min. Voltage [V]}}{\text{Three-phase average voltage [V]}} \times 67$  [For improving input power-factor, reducing harmonics] • Used to reduce input harmonic current (correcting power-factor)	
Surge absorber (Surge suppressor) (S2-A-O)(S1-B-O)	S2-A-O: for magnetic contactor S1-B-O: for mini control relay, or timer	
Frequency meter (TRM-45) (FM-60)	Analog frequency meter TRM-45: 1.77inch (45mm) square FM-60: 2.36inch (60mm) square	
Frequency setting device (RJ-13) (WAR3W-1kΩ)	Frequency setting potentiometer (mounted externally)	

*) For the detailed selection, refer to Chapter 3, Peripheral Equipment.

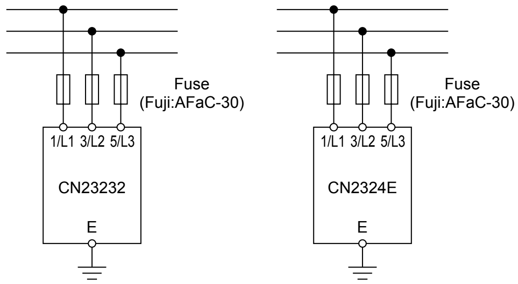
2.2 Specifications and dimensions

unit: inch (mm)

• Arrester (CN23232, CN2324E)

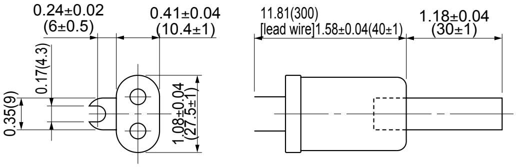


• Three-Phase 220V AC • Three-Phase 440V AC

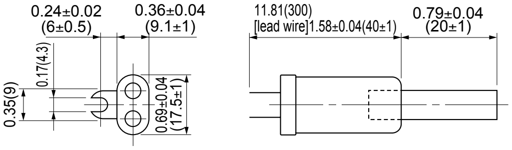


• Surge absorber (S2-A-O, S1-B-O)

S2-A-O (for magnetic contactor)

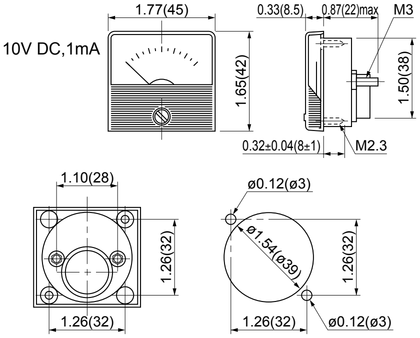


S1-B-O (for mini contorol relay or timer)

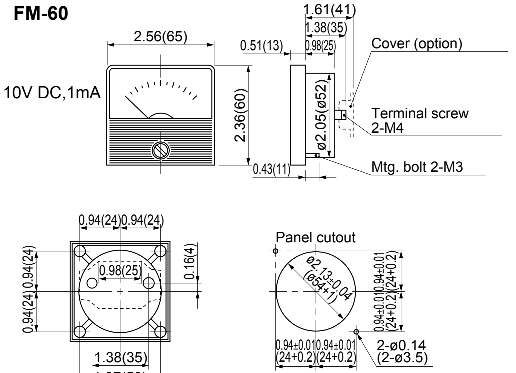


• Frequency meter (TRM-45, FM-60)

TRM 45



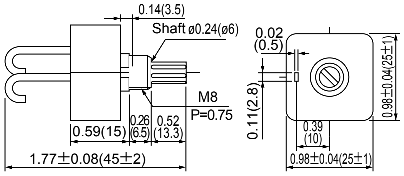
FM-60



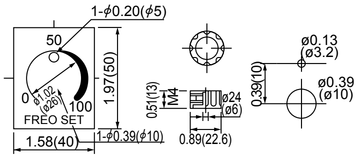
Approx. Mass: 0.15lbs (70g)

• Frequency setting device (RJ-13, WAR3W-1kΩ)

RJ-13 BA-2B Characteristic 1kΩ

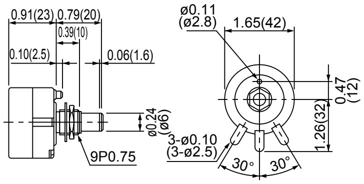


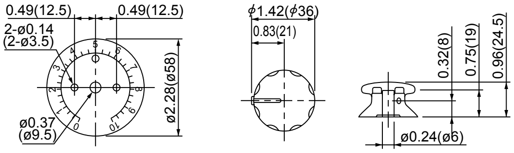
Legend plate(YS549810-0) Knob(MSS-2SB)



The legend plate and knob must be ordered as a separate item.

WAR3W-1kΩ (3W) B characteristic





The legend plate and knob are shipped together with the setting device.

Chapter 6

Application Idea

Contents

Chapter 6

1. Setting Items and Applications

The FRENIC5000G11S/P11S provides highest performance when parameters are set optimally for each application and the suitable options are used. Parameter settings for various type of load and option applications are described bellow.
Section 1 gives a list of setting items and applications and Section 2 and later sections describe how to make setting and choose the best values.

1. Setting Items and Applications

◎ : Important Item
○: Reference Item
▲: Unusable Item

◎ +: Use with positive value
◎ –: Use with negative value

	Application Function		Common	Pump	Fan and blower	Horizontal carrier	Lift	Extruder	Agitator	Washing machine	Centrifugal separator	High frequency motor	Tap water or water immersed cooling motor	Two motors switching	Pressing machine	Group operation	Load balance control
Basic function	F01	Frequency command 1	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	F02	Operation method	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	F03	Maximum frequency 1	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	F04	Base frequency 1	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	F05	Rated voltage 1	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	F07, F08	Acceleration/Deceleration time 1	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	F09	Torque boost 1	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	F10 to F12	Electronic thermal overload relay (for motor1)	◎	◎	◎	◎	◎	◎	◎	◎	◎	▲	▲	○	◎	▲	◎
	F13	Electronic thermal overload relay (for braking ressister)				◎	◎		◎	◎	◎	◎		◎			
	F14	Restart after momentary power failure	◎	◎	◎	◎	◎	◎	◎	◎	◎	○	○	○	◎	◎	◎
	F15, F16	Frequency limiter		◎	◎						○	○	○	○			
	F17	Gain for frequency setting signal															
	F18	Bias frequency		◎	◎												
	F20 to F22	DC brake			◎	◎				◎	◎	◎		◎			
	F40, F41	Torque limiter 1					◎	◎	◎	◎	◎				◎		◎
	F42, A09	Torque vector control 1, 2				◎	◎	◎	◎	◎	◎	◎	◎		◎		
	C05 to C19	Multistep frequency setting				◎	◎		◎	◎				◎			
	P01, A10	Number of motor poles 1, 2															
	P09, A18	Slip compensation control 1, 2				◎ +	◎ +	◎ +	◎ +	◎ +					◎ –		◎ –
Input terminal fnction	E01 to E09	X1-X9 terminal function selection				◎	◎		◎	◎	◎						
	E10 to E15	Acceleration/Deceleration time 2 to 4				◎								◎			
2nd Torque boost	A05	Torque boost 2				◎								◎			
FM terminal function	F30, F31	FMA terminal															
	F33 to F35	FMP terminal															
Output terminal function	E20 to E24	Y1-Y5 terminal function													◎		
	E20 to E24	FAR function signal															
	E20 to E24	FDT function signal															
	E20 to E24	OL function signal									◎	◎	◎	◎			
Frequency control	F23, F24	Starting frequency															
	C01 to C04	Jump frequency			◎												
	C33	Frequency setting signal filter															
LED and LCD monitor	E40, E41	Coefficient for machine speed and line speed				◎	◎				◎	◎					
	E43, E44	LED monitor															
	E45 to E47	LCD monitor															

	Application Function		Common	Pump	Fan and blower	Horizontal carrier	Lift	Extruder	Agitator	Washing machine	Centrifugal separator	High frequency motor	Tap water or water immersed cooling motor	Two motors switching	Pressing machine	Group operation	Load balance control
Pattern operation	C21 to C28	Pattern operation							◎	◎	◎						
	H07	ACC/DEC pattern			○					◎	◎						
Special functions	F26	Motor sound (carrier frequency)		◎	◎				◎								
	E46	Language	◎														
	E47	LCD monitor (brightness)															
	H03	Data initializing															
	H04, H05	Auto-reset	◎														
	H08	Rev. phase sequence lock															
	H10	Energy-saving operation		◎	◎												
Motor characteristics	P02 to P08	Motor 1 rating / impedance				◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
	A11 to A17	Motor 2 rating / impedance												◎			
Other inspection items	Option for braking					◎	◎			◎	◎			◎			
	Motor protection											◎	◎	◎		◎	
Recommended inverter application		G11S				◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
		P11S	◎	◎	◎												
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2. FRENIC5000G11S/P11S Series

2.1 Using with Aeration Tank Blowers

■ Advantages

1. Features a built-in PID control function.

- Excess blower airflow can be eliminated constantly maintaining a fixed amount of dissolved oxygen in the aeration tank. This results in energy savings.
- The use of a built-in PID control function makes conventional controllers unnecessary. Controlling the amount of dissolved oxygen can easily be achieved simply by installing a sensor (4 to 20mA) that detects dissolved oxygen.

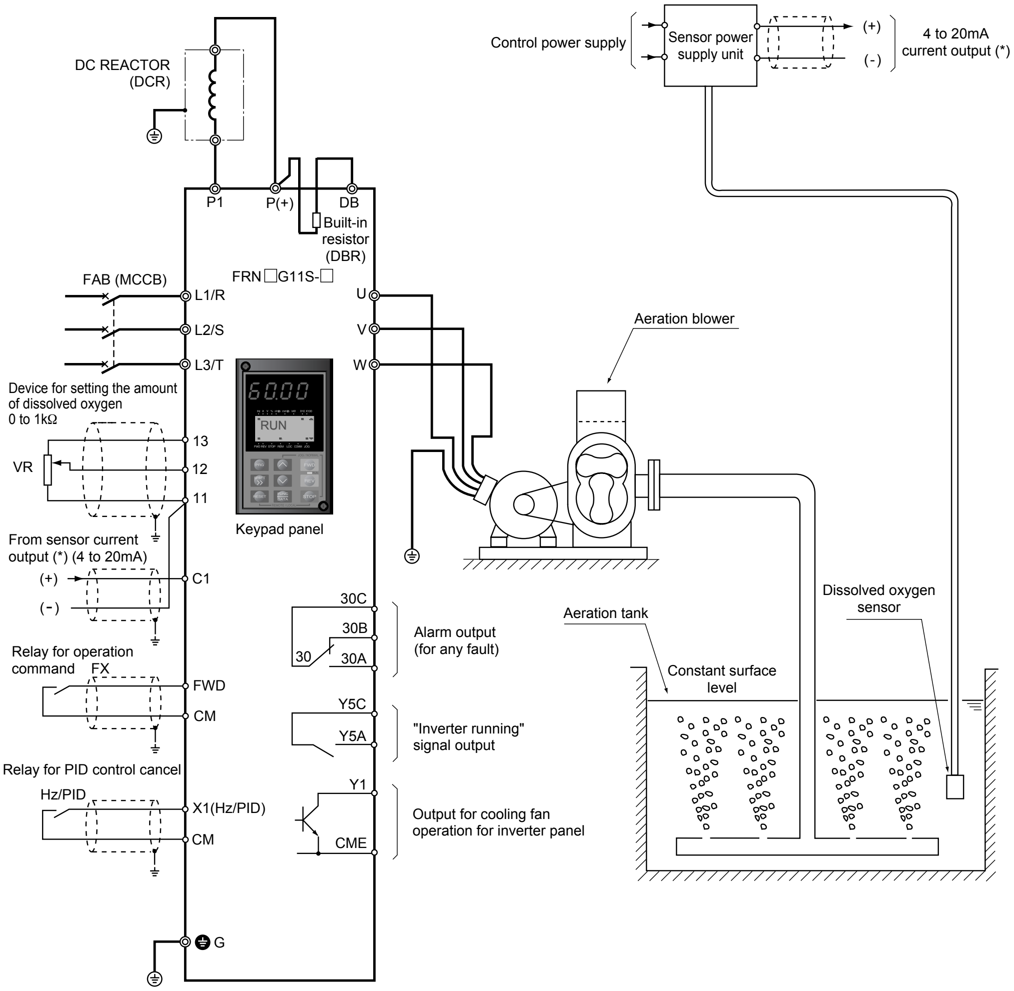
2. Greater energy savings realized with the automatic energy saving operation function.

- The energy saving effect is not as impressive for aeration tank blowers compared with the results achieved with other types of blowers. However, energy savings are significantly enhanced once the automatic energy saving operation is activated, when the system has sufficient treatment capacity.

3. Unnecessary to resort to any special soundproofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant motor sound that usually comes from the motor which is driven by the inverter. The inverter, whose sound levels are comparable to those of commercial power sources.

■ Wiring diagram/System configuration



Caution The information described in this catalog is for the purpose of selecting the appropriate products. Before actually using this product, be sure to read the instruction manual carefully to ensure proper operation.

■ Function setting value (Recommended: G11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
H20	PID control (Mode select)	0: Inactive	0: Inactive	Operation without PID function is selected.
			1: Active	
H21	(Feedback signal)	1: Terminal C1 (4 to 20mA) input	1: Terminal C1 (4 to 20mA) input	
H22	(P-gain)	0.01: 0.01 times	0.01 times (= 1%) to 10 times (= 1000%)	Set the functions according to individual system.
H23	(I-gain)	0.0: Inactive	0.1 to 3600s	
H24	(D-gain)	0.00: Inactive	0.1 to 10.00s	
H25	(Feedback filter)	0.0: No filter	0.0: No filter	
E01	X1 terminal (Function select)	0: Multistep freq. selection	20: PID control cancel	Manual operation when input signal is ON. (Frequency setting with Keypad panel)
F09	Torque boost 1	0.0: For constant torque load	0.0: For constant torque load	
H10	Energy-saving operation		1: Active	
H06	Fan stop operation	0: Inactive	1: Active	
E20	Y1 terminal (Function select)	0: Inverter running	25: Fan control signal	Used to control the inverter panel cooling fans for inverters of 40HP or larger. Also available with Functions E1 to E23 (Y2 to Y4 terminal functions).
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	3: Active (Continuous operation; heavy inertia load, or general load)	Set H13 to H16 also, if necessary.
F26	Motor sound (Carrier freq.)	2: 2kHz	15: 15kHz	For 75HP or smaller inverter.
			10: 10kHz	For 100HP or larger inverter.
E24	Y5A,Y5C terminal function (Relay output)	15: Auxiliary terminal for 52-1 [AX]	0: Inverter running (RUN)	Relay output (Y5A, Y5C). On when inverter output is present. (Set if necessary.)
F41	Torque limiter 1 (Braking)	999: No limit	0: Automatic deceleration control	Setting recommended when braking resistor is not used.
C01 to C03	Jump frequency 1 to 3	0: No jump frequency	0 to 400Hz	Set the value in accordance with the equipment to be combined.
C04	(Hysteresis)	3: 3Hz	0 to 30Hz	

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. G11S series for the aeration tank blower

- Because the load characteristics of the aeration tank blower (route blower) are nearly the constant torque load characteristics, apply FRENIC5000G11S series.

2. PID control setting values

- The optimum setting values depend on the system due to various combinations such as the blower characteristics and water depth of the aeration tank. Therefore, use empirical values in advance and then reset the values to the optimum values during test operation.

3. Energy saving operation selection considering operation condition

- Great energy saving effect can be realized if the system has enough treatment capacity. Set the energy saving operation (H10) active, and continue operation unless trouble occurs.

4. Precautions on radio interference

- As many measurement circuits are installed around the aeration tank, precautions need to be taken for radio noise interference.
- FRENIC5000G11S series incorporates measures against radio interference noise generation and a function for switching to a low carrier frequency. However, we recommend that you take the following action:

1) Install an isolation transformer for the power supply for the instruments.
2) Use shielded wires for the control signals.
3) Connect Power filter (FHF-☐/☐/☐) on the inverter power supply side.
4) Install a ferrite ring for reducing radio noise (ACL-40B or ACL-74B) on the inverter power supply side.
5) Perform complete wiring separation or electromagnetic shielding (use metal conduits) for the wiring on the inverter output side.

5. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR☐-☐☐☐) to reduce harmonics on power supply side.

6. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on. No measures have to be taken to handle inrush current in particular.

2.2 Using with Multi-storied Automated Warehouses

■ Advantages

1. Optimum, individuall control of two motors that have different capacities and characteristics using the motor 2/motor 1 selection function

- In multi-storied automated warehouses, one inverter is often used to control the traversing motor and the hoisting motor individually. In this case, the capacity of the hoisting motor is usually larger than that of the traversing motor.
- In the above case, the characteristics constants of motor 1 and that of motor 2 can be set in advance and tuned. The motor 2/motor 1 selection function can be set at any one of the terminal functions (E01 to E09)
- When the terminal set to the motor 2/motor 1 selection function is off, the setting value of motor 1 is enabled. When the terminal is on, the setting value of motor 2 is enabled. Therefore, even if the two motor capacities and characteristics are different, each motor can run under the optimum conditions relative to individual characteristics.

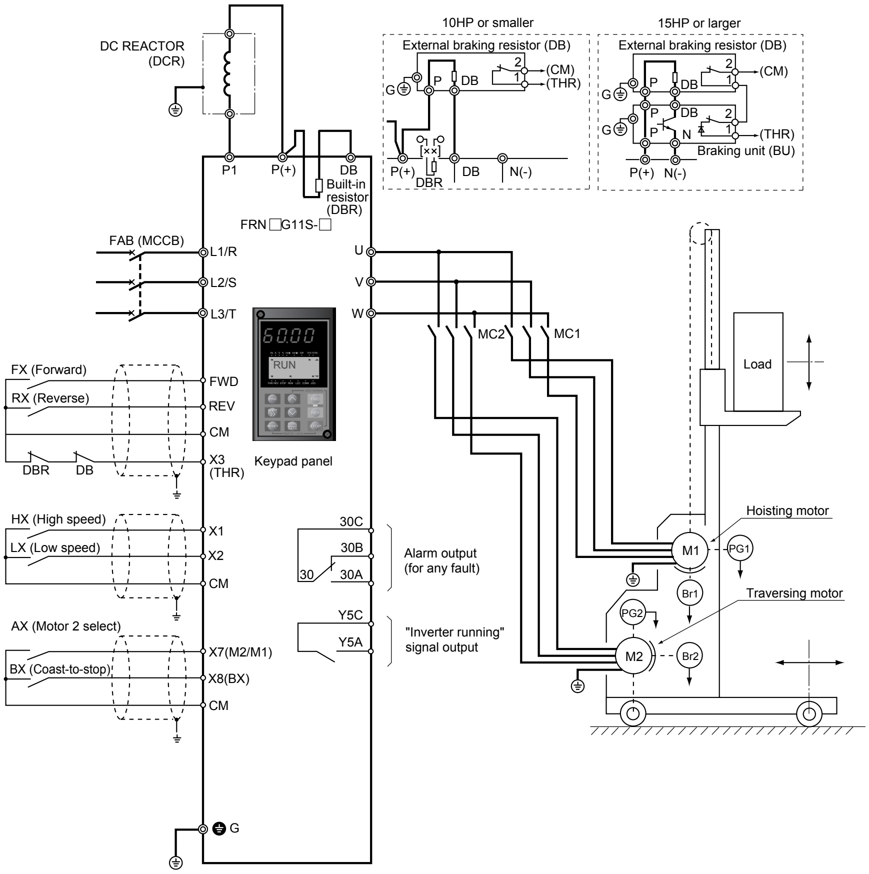
2. Improved the stopping accuracy for conveyed items using the slip compensation control function

- The slip compensation control function can be set to maintain stable rotating speed even if the size of the load changes. To improve the stopping accuracy, the conveyance speed is first reduced, then the conveyed item is brought to a standstill at the designated position. The stopping accuracy can be more improved because this function reduces the slip amount in this low speed range.

3. Unnecessary to resort to any special soundproofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant noise that usually comes from the motor which is driven by the inverter. The inverter, whose sound levels are comparable to those of commercial power sources, contributes to a comfortable working environment.

■ Wiring diagram/System configuration



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■ Function setting value (Recommended: G11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
F10	Electronic thermal relay for motor 1 (Select)	1: Active (Standard motor)	1: Active (Standard motor)	
F11	(Level)	100% of motor rated current	100% rated current of motor used	
F12	(Thermal time constant)	5.0min (30HP or smaller) 10.0min (40HP or larger)	5.0min (30HP or smaller) 10.0min (40HP or larger)	Set if necessary.
F42	Torque vector control 1	0: Inactive	1: Active	
P01	Motor 1 (No. of poles)	4: 4-pole	2 to 14: 2- to 14-pole	Set according to the motor used.
P02	(Capacity)	Capacity of motor used	1/8 to 60HP: 30HP or smaller 1/8 to 800HP: 40HP or larger	
P03	(Rated current)	Fuji's standard value	0.00 to 2000A	Set according to be motor used before tuning.
P04	(Tuning)	0: Inactive	1: Active	Set P04 first, and then P05.
P05	(On-line tuning)	0: Inactive	1: Active	
P06	(No-load current)	Fuji's standard value	0.00 to 2000A	Values are detected and written automatically during tuning.
P07	(%R1 setting)	Fuji's standard value	0.00 to 50.00%	
P08	(%X setting)	Fuji's standard value	0.00 to 50.00%	
P09	(Slip compensation control)	Fuji's standard value	0.00 to 5.00Hz	Set the value in accordance with the equipment to be combined.
A06	Electronic thermal relay for motor 2 (Select)	1: Active (Standard motor)	1: Active (Standard motor)	
A07	(Level)	100% of motor rated current	100% rated current of motor used	
A08	(Thermal time constant)	5.0min (30HP or smaller) 10.0min (40HP or larger)	5.0min (30HP or smaller) 10.0min (40HP or larger)	Set if necessary.
A09	Torque vector control 2	0: Inactive	1: Active	
A10	Motor 2 (No. of poles)	4: 4-pole	2 to 14: 2- to 14-pole	Set according to the motor used.
A11	(Capacity)	Capacity of motor used	1/8 to 60HP: 30HP or smaller 1/8 to 800HP: 40HP or larger	
A12	(Rated current)	Fuji's standard value	0.00 to 2000A	Set according to be motor used before tuning.
A13	(Tuning)	0: Inactive	1: Active	Set A13 first, and then A14.
A14	(On-line tuning)	0: Inactive	1: Active	
A15	(No-load current)	Fuji's standard value	0.00 to 2000A	Values are detected and written automatically during tuning.
A16	(%R1 setting)	Fuji's standard value	0.00 to 50.00%	
A17	(%X setting)	Fuji's standard value	0.00 to 50.00%	
A18	(Slip compensation control)	Fuji's standard value	0.00 to 5.00Hz	Set the value in accordance with the equipment to be combined.
E07	X7 terminal (Function select)	6: 3-wire operation stop command	12: motor2/motor1	
H06	Fan stop operation	0: Inactive	1: Active	
F26	Motor sound (Carrier freq.)	2: 2kHz	15: 15kHz	For 75HP or smaller inverter.
			10: 10kHz	For 100HP or larger inverter.
F14	Restart mode after momentary power failure (Mode select)	0: Inactive (Trip and alarm when power failure occurs.)	0: Inactive (Trip and alarm when power failure occurs.)	Set H13 to H16 also, if necessary.

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. High torque in the low speed range

- The starting time can be reduced and the stopping accuracy can be improved by reduced motor wow and high torque output in the low speed range.

2. Improved response

- The starting time can be reduced and the stopping accuracy can be improved by reduced motor wow and high torque output in the low speed range.
- Because the response level has been improved, more precise conveyance can be carried out even for highly frequent operations.

3. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard.
- Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

4. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on. No measures have to be taken to handle inrush current in particular.

5. Different motor capacities

- Please inquire if the difference in the capacities of motors 1 and 2 exceeds three frames.

2.3 Using with Automated Parking Garages

■ Advantages

1. Optimum, individual control of two motors that have different capacities and characteristics using the motor 2 /motor 1 selection function.

- In automated parking garages, one inverter is often used to control the traversing motor and the hoisting motor individually. In this case, the capacity of the hoisting motor is usually larger than that of the traversing motor.
- In the above case, the characteristics constants of motor 1 and that of motor 2 can be set in advance and tuned. Even if the motor capacities and characteristics are different, each motor can be run under the optimum conditions relative to individual characteristics.

2. Reduced time required to park and unload cars by the shortest acceleration and deceleration time setting.

- A dynamic torque-vector control system is used to achieve the shortest, smoothest acceleration and deceleration times to match the load condition. As a result, compact cars or cars without any loads can be parked in or out more quickly, which shortens the customers' waiting time.
- Till recently, the acceleration and deceleration times have been set taking into consideration the maximum capacity (size of moment of inertia). However, by adopting the dynamic torque-vector control system, once you set the acceleration and deceleration times for light loads, such as compact cars or cars without any loads in advance, the inverter automatically determines the condition of the cars conveyed and adjusts the acceleration and deceleration times.

3. Overcurrent tripping prevention with the torque limiting function

- When an automated parking garage is used outdoors, small clouds of dust can get inside the guides and rails. This can cause overcurrent tripping during operation. In this case, setting the torque limiting function can avoid overcurrent tripping and continue operation.

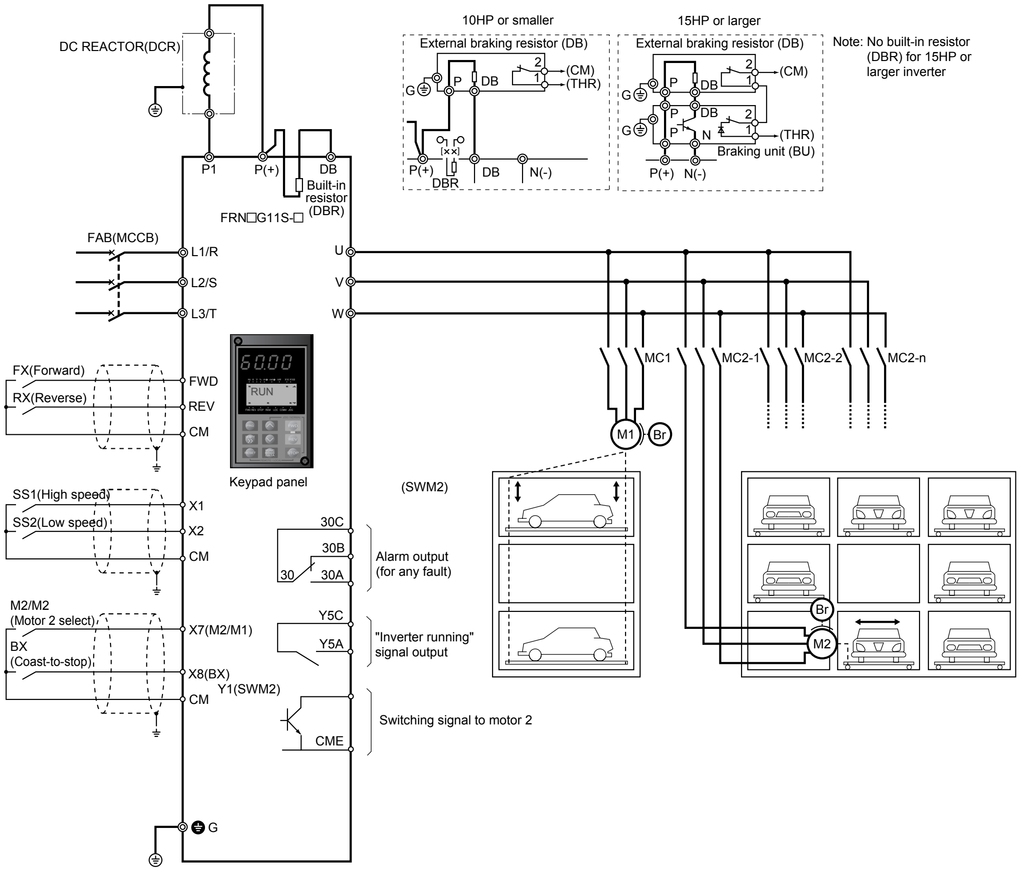
4. Communication functions equipped as standard

- Communication function (RS-485) is equipped as standard. Integration with a PLC or a personal computer achieves a high grade control.

5. Unnecessary to resort to any special sound-proofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant noise that usually comes from the motor which is driven by the inverter. The sound levels are comparable to those of commercial power sources. The inverter operation won't be a nuisance to adjacent homes in residential areas.

■ Wiring diagram/System configuration



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■ Function setting value (Recommended: G11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
F10	Electronic thermal relay for motor 1	1: Active (Standard motor)	1: Active (Standard motor)	
F11	(Select)	100% of motor rated current	100% rated current of motor used	
F12	(Level) (Thermal time constant)	5.0min (30HP or smaller) 10.0min (40HP or larger)	5.0min (30HP or smaller) 10.0min (40HP or larger)	Set if necessary.
F42	Torque vector control 1	0: Inactive	1: Active	
P01	Motor 1 (No. of poles)	4: 4-pole	2 to 14: 2- to 14-pole	Set according to the motor used.
P02	(Capacity)	Capacity of motor used	1/8 to 60HP: 30HP or smaller 1/8 to 800HP: 40HP or larger	
P03	(Rated current)	Fuji's standard value	0.00 to 2000A	Set according to be motor used before tuning.
P04	(Tuning)	0: Inactive	1: Active	Set P04 first, and then P05.
P05	(On-line tuning)	0: Inactive	1: Active	
P06	(No-load current)	Fuji's standard value	0.00 to 2000A	Values are detected and written automatically during tuning.
P07	(%R1 setting)	Fuji's standard value	0.00 to 50.00%	
P08	(%X setting)	Fuji's standard value	0.00 to 50.00%	
P09	(Slip compensation control)	Fuji's standard value	0.00 to 5.00Hz	Set the value in accordance with the equipment to be combined .
A06	Electronic thermal relay for motor 2 (Select)	1: Active (Standard motor)	1: Active (Standard motor)	
A07	(Level)	100% of motor rated current	100% rated current of motor used	
A08	(Thermal time constant)	5.0min (30HP or smaller) 10.0min (40HP or larger)	5.0min (30HP or smaller) 10.0min (40HP or larger)	Set if necessary.
A09	Torque vector control 2	0: Inactive	1: Active	
A10	Motor 2 (No. of poles)	4: 4-pole	2 to 14: 2- to 14-pole	Set according to the motor used.
A11	(Capacity)	Capacity of motor used	1/8 to 60HP: 30HP or smaller 1/8 to 800HP: 40HP or larger	
A12	(Rated current)	Fuji's standard value	0.00 to 2000A	Set according to be motor used before tuning.
A13	(Tuning)	0: Inactive	1: Active	Set A13 first, and then A14.
A14	(On-line tuning)	0: Inactive	1: Active	
A15	(No-load current)	Fuji's standard value	0.00 to 2000A	Values are detected and written automatically during tuning.
A16	(%R1 setting)	Fuji's standard value	0.00 to 50.00%	
A17	(%X setting)	Fuji's standard value	0.00 to 50.00%	
A18	(Slip compensation control)	Fuji's standard value	0.00 to 5.00Hz	Set the value in accordance with the equipment to be combined.
E07	X7 terminal (Function select)	6: 3-wire operation stop command	12: motor2/motor1	
H06	Fan stop operation	0: Inactive	1: Active	
F26	Motor sound	2: 2kHz	15: 15kHz	For 75HPor smaller inverter.
	(Carrier freq.)		10: 10kHz	For 100HP or larger inverter.
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	0: Inactive (Trip and alarm when power failure occurs.)	Set H13 to H16 also, if necessary.

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. Setting the base frequency to 50Hz

- Setting the base frequency to 50Hz gets the maximum performance out of the standard motor, thereby allowing you to reduce the required acceleration time.

2. Preparing external braking resistor

- For G11 inverter of 10HP or smaller, a braking resistor is built into the inverter. However, depending on conditions such as the level of frequent operation or the load amount, an external resistor (DB□-□) having a greater capacity may have to be connected. For 15HP or larger inverter, a braking unit (BU□-□) is required also.
- When the braking resistor is connected externally, be sure to disconnect the jumper wire (P(+), DB) of the built-in braking resistor which has been connected at shipping. In addition, be sure to insulate the disconnected portion.

3. Measures for reducing radio noise

- At locations where radio waves are weak, radio noise can occur due to the effect of the wiring on the load side. We recommend that you install a ferrite ring for reducing radio noise (ACL-40B or ACL-75B) to reduce radio noise, use metal conduits for wiring, and ground the control panel, motor, and conduits using lower resistance values.

4. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

5. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on.

6. Keypad panel designed with six foreign languages as standard

1) Standard products : English, German, French, Spanish, Italian, and Japanese
2) Manufactured on request : Chinese, English, and Japanese

2.4 Using with Vertical Circulation type Parking Facility

■ Advantages

1. Reduced customer waiting time by high-speed operation for lighter loads using the output torque monitor function

- The output torque monitor function can switch to high-speed operation upon detecting light carrying loads to reduce the customers' waiting time, thereby boosting the utilization rate of the parking facility.

2. Reduced time required to park and unload cars by the shortest acceleration and deceleration time setting

- A dynamic torque-vector control system is used to achieve the shortest, smoothest acceleration and deceleration times to match the load condition. As a result, compact cars or cars without any loads can be parked in or out more quickly, which shortens the customers' waiting time.
- Till recently, the acceleration and deceleration times have been set taking into consideration the maximum capacity (size of moment of inertia). However, once you set the acceleration and deceleration times for light loads, such as compact cars or cars without any loads in advance, the inverter automatically determines the condition of the cars conveyed and adjusts the acceleration and deceleration times.

3. Rolling and deflection prevention of car loads possible by S-shaped acceleration and deceleration

- Short acceleration and deceleration can be set to reduce the time required to convey cars in and out of the parking facility. However, in linear acceleration and deceleration, acceleration and deceleration can quickly change at starting and stopping, which can result in the crumpling of the car loads. By setting S-shaped acceleration and deceleration, acceleration and deceleration is changed smoothly, thus preventing the crumpling of them.

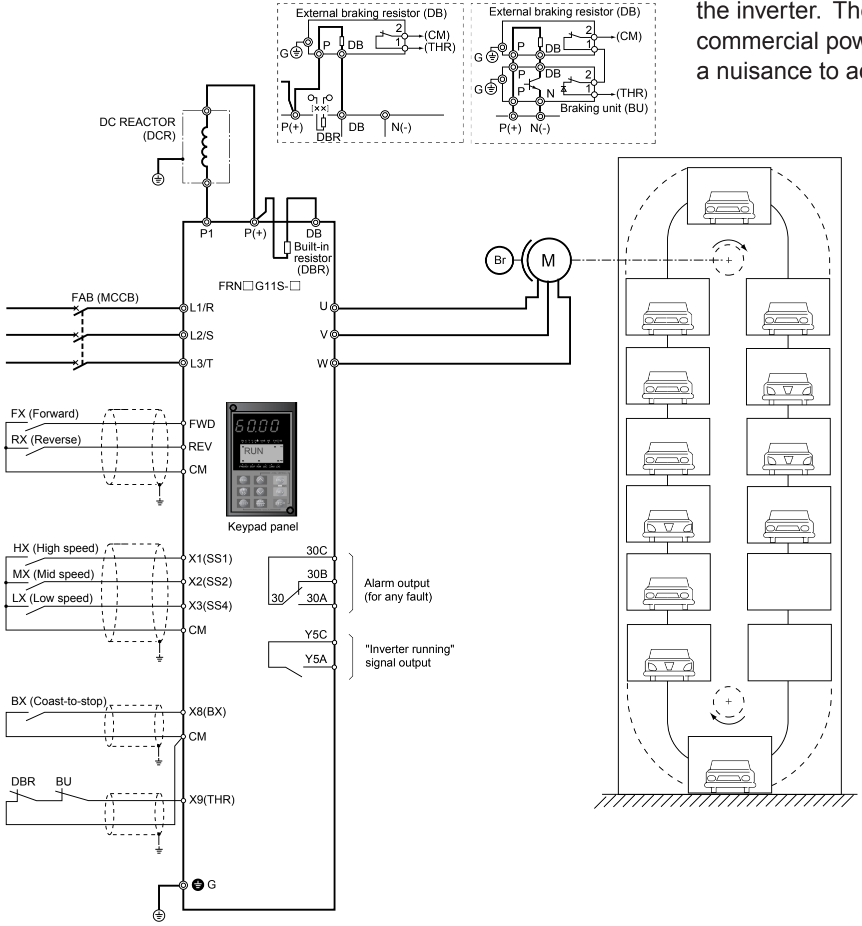
4. Serial communication functions equipped as standard.

- Serial communication function (RS-485) is equipped as standard. Integration with a PLC or a personal computer achieves a high grade control.

5. Unnecessary to resort to any special sound-proofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant noise that usually comes from the motor which is driven by the inverter. The sound levels are comparable to those of commercial power sources. The inverter operation won't be a nuisance to adjacent homes in residential areas.

■ Wiring diagram/System configuration



■ Function setting value (Recommended: G11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
F10	Electronic thermal relay for motor 1 (Select)	1: Active (Standard motor)	1: Active (Standard motor)	
F11	(Level)	100% of motor rated current	100% rated current of motor used	
F12	(Thermal time constant)	5.0min (30HP or smaller) 10.0min (40HP or larger)	5.0min (30HP or smaller) 10.0min (40HP or larger)	Set if necessary.
F42	Torque vector control 1	0: Inactive	1: Active	
P01	Motor 1 (No. of poles)	4: 4-pole	2 to 14: 2- to 14-pole	Set according to the motor used.
P02	(Capacity)	Capacity of motor used	1/8 to 60HP: 30HP or smaller 1/8 to 800HP: 40HP or larger	
P03	(Rated current)	Fuji's standard value	0.00 to 2000A	Set according to be motor used before tuning.
P04	(Tuning)	0: Inactive	1: Active	Set P04 first, and then P05.
P05	(On-line tuning)	0: Inactive	1: Active	
P06	(No-load current)	Fuji's standard value	0.00 to 2000A	Values are detected and written automatically during tuning.
P07	(%R1 setting)	Fuji's standard value	0.00 to 50.00%	
P08	(%X setting)	Fuji's standard value	0.00 to 50.00%	
P09	(Slip compensation control)	Fuji's standard value	0.00 to 5.00Hz	Set the value in accordance with the equipment to be combined.
E01	X1 terminal(Function select)	0: Multistep freq. select (1 to 4 bits) [SS1]	0: Multistep freq. select (1 to 4 bits) [SS1]	
E02	X2 terminal	1: Multistep freq. select (1 to 4 bits) [SS2]	1: Multistep freq. select (1 to 4 bits) [SS2]	
E03	X3 terminal	2: Multistep freq. select (1 to 4 bits) [SS4]	2: Multistep freq. select (1 to 4 bits) [SS4]	
E08	X8 terminal	7: Coast-to-stop command [BX]	7: Coast-to-stop command [BX]	
E09	X9 terminal	8: Alarm reset [RST]	9: Trip command (External fault) [THR]	For protecting the external braking resistor, when it is used.
F31	FMA (Function select)	0: Output frequency 1 (Before slip compensation)	4: Output torque	
F35	FMP (Function select)	0: Output frequency 1 (Before slip compensation)	4: Output torque	
H06	Fan stop operation	0: Inactive	1: Active	
H07	ACC/DEC pattern (Mode select)	0: Inactive (Linear)	1: S-curve(weak) 2: S-curve(strong)	Set the function in accordance with the load condition of equipment .
F26	Motor sound (Carrier freq.)	2: 2kHz	15:15kHz	For 75HP or smaller inverter.
			10:10kHz	For 100HP or larger inverter.
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	0: Inactive (Trip and alarm when power failure occurs.)	Set H13 to H16 also, if necessary.

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. Setting the base frequency to 50Hz

- Setting the base frequency to 50Hz gets the maximum performance out of the standard motor, thereby allowing you to reduce the required acceleration time.
- When the load (=car+carried goods) is light, set the operation frequency higher than the base frequency, then the time required to unload cars can be reduced.

2. "Inverter running" (RUN) signal output matching the brake timing

- The brake timing can be adjusted by the setting of operation command self-hold time (H16) during momentary power failure.

3. Preparing external braking resistor

- For G11S inverter of 10HP or smaller, a braking resistor is built into the inverter. However, depending on conditions such as the level of frequent operation or the load amount, an external resistor (DB□-□) having a greater capacity may have to be connected. For 15HP or larger inverter, a braking unit (BU□-□) is required also.
- When the braking resistor is connected externally, be sure to disconnect the jumper wire (P(+), DB) of the built-in braking resistor which has been connected at shipping. In addition, be sure to insulate the disconnected portion.

4. Measures for reducing radio noise

- This low-noise inverter switches its main circuits at high speed. At locations where radio waves are weak, therefore, radio noise can occur due to the effect of the wiring on the load side. We recommend that you install a ferrite ring for reducing radio noise (ACL-40B or ACL-75B) to reduce radio noise, use metal conduits for wiring, and ground the control panel, motor, and conduits using lower resistance values.

5. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

6. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on. No measures have to be taken to handle inrush current in particular.

2.5 Using with Bread Dough Mixers

■ Advantages

1. Constant speed control of the bread dough mixers using slip compensation control

- By setting the slip compensation amount, constant speed mixing of bread dough can be maintained even if the load amount changes while the dough is being mixed. In addition, the dynamic torque-vector control enables powerful operation even at low speed. Bread dough with good gluten elasticity can be realized for softer, more delicious bread.

2. Serial communication functions equipped as standard

- Serial communication function (RS-485) is equipped as standard. Integration with a PLC or a personal computer achieves a high grade control.

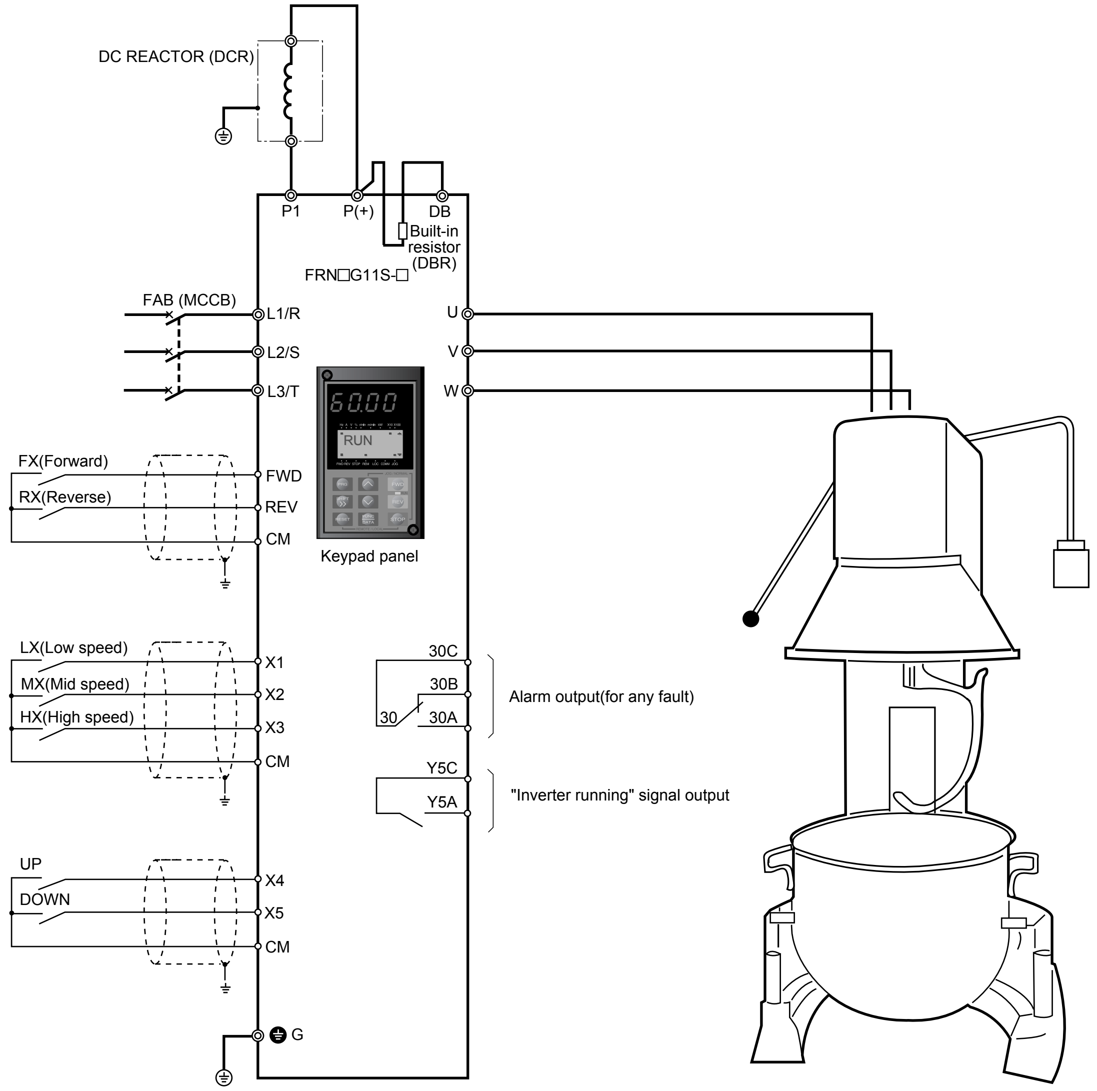
3. Superior construction for use in severe environments

- This inverter has a fully enclosed structure IP40 (up to 30HP) as standard. Also available are a water-proof structure IP65 (up to 10HP) and IP54 (15 to 30HP) as a separate series (available soon). You can select the inverter that matches your working environment.

4. Unnecessary to resort to any special sound-proofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant motor sound that usually comes from the motor which is driven by the inverter. The inverter, whose sound levels are comparable to those of commercial power sources, contributes to a comfortable working environment.

■ Wiring diagram/System configuration



Caution The information described in this catalog is for the purpose of selecting the appropriate products. Before actually using this product, be sure to read the instruction manual carefully to ensure proper operation.

■ Function setting value (Recommended: G11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
F10	Electronic thermal relay for motor 1	1: Active (Standard motor)	1: Active (Standard motor)	
F11	(Select)	100% of motor rated current	100% rated current of motor used	
F12	(Level) (Thermal time constant)	5.0min (30HP or smaller) 10.0min (40HP or larger)	5.0min (30HP or smaller) 10.0min (40HP or larger)	Set, if necessary.
F42	Torque vector control 1	0: Inactive	1: Active	
E01	X1 terminal (Function select)	0:Multistep freq. select (1 to 4 bits) [SS1]	0: Multistep freq. select (1 to 4 bits) [SS1]	Setting is also available with E06 to E09.
E02	X2 terminal	1:Multistep freq. select (1 to 4 bits) [SS2]	1: Multistep freq. select (1 to 4 bits) [SS2]	
E03	X3 terminal	2:Multistep freq. select (1 to 4 bits) [SS4]	2: Multistep freq. select (1 to 4 bits) [SS4]	
E04	X4 terminal	3:Multistep freq. select (1 to 4 bits) [SS8]	17: UP command [UP]	
E05	X5 terminal	4:ACC/DEC time selection (1 to 4 bits) [RT1]	18: DOWN command [DOWN]	
P09	Motor 1 (Slip compensation control)	Fuji's standard value	0.00 to 5.00Hz	Set the value in accordance with the equipment to be combined.
H31	RS-485 (Address)	0	1 to 31	Set the value according to your communication specifications.
H32	(Mode select on no response error)	0: Trip and alarm (Er8)	0: Trip and alarm (Er8) 1: Operation for H33 timer, and alarm (Er8) 2: Operation for H33 timer, and retry to communicate. If the retry fails, then the inverter trips ("Er8") 3: Continuous operation	
H33	(Timer)	2.0s	0.0 to 60.0s	
H34	(Baud rate)	1: 9600 [bit/s]	0 to 4: 19200 to 1200 [bit/s]	
H35	(Data length)	0: 8bit	0: 8bit 1: 7bit	
H36	(Parity check)	0: No checking	0: No checking 1: Even parity 2: Odd parity	
H37	(Stop bits)	0: 2bit	0: 2bit 1: 1bit	
H38	(No response error detection time)	0: (No detection)	0.1 to 60s	
H39	(Response interval)	0.01s	0.00 to 1.00s	
H06	Fan stop operation	0: Inactive	1: Active	
F26	Motor sound	2: 2kHz	15: 15kHz	For 75HP or smaller inverter.
	(Carrier freq.)		10: 10kHz	For 100HP or larger inverter.
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	0: Inactive (Trip and alarm when the power failure occurs.)	Set H13 to H16 also, if necessary.

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. Remote control using the UP/DOWN functions

- By assigning the UP/DOWN function to the arbitrary two terminals among the control terminals (X1 to X9) in advance, the rotating speed of the mixer can be adjusted using the ▲ and ▼ keys on the operator panel of the mixer in much the same way that you use a television remote control (volume adjustment).

2. PATTERN operation enabled

- PATTERN operation can be set in seven stages (stages 1 to 7). The operating time (0.00 to 6000 seconds) for each stage, rotating direction (forward or reverse), acceleration and deceleration times, and multistep frequencies (steps 1 to 7) can be set. If the operation pattern has been decided, this function greatly simplifies the configurations of the external circuits and devices.

3. Displays the rotating speed of the beaters digitally on the operator panel of the mixer

- A pulse in proportion to the operating frequency is output from the external output terminal (FMP terminal). Because the pulse count per this frequency can be set to an arbitrary value (300 p/s to 6000 p/s), a value approximating the rotating speed of the beaters can be displayed in combination with the exclusive frequency counter. In addition, by setting the slip compensation amount, the value further approaches the rotating speed of the beaters.

4. Measures for reducing radio noise

- This low-noise inverter switches its main circuits at high speed. At locations where radio waves are weak, therefore, radio noise can occur due to the effect of the wiring on the load side. We recommend that you install a ferrite ring for reducing radio noise (ACL-40B or ACL-75B) to reduce radio noise, use metal conduits for wiring, and ground the control panel, motor, and conduits using lower resistance values.

5. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

6. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on.

7. Keypad panel designed with six foreign languages as standard

3) Standard products : English, German, French, Spanish, Italian, and Japanese
4) Manufactured on request : Chinese, English, and Japanese

2.6 Using with Commercial-use Washing Machines

■ Advantages

1. Greatly reduced motor wow of washing machine tubs

- With our unique, new control method, motor wow at low speed has been reduced by more than one half (as compared with a conventional Fuji Inverter).

2. Stable rotating speed with slip compensation control function

- By setting the slip compensation amount, stable rotating speed can be maintained so that both heavy and light washing loads can drop from the topmost section.

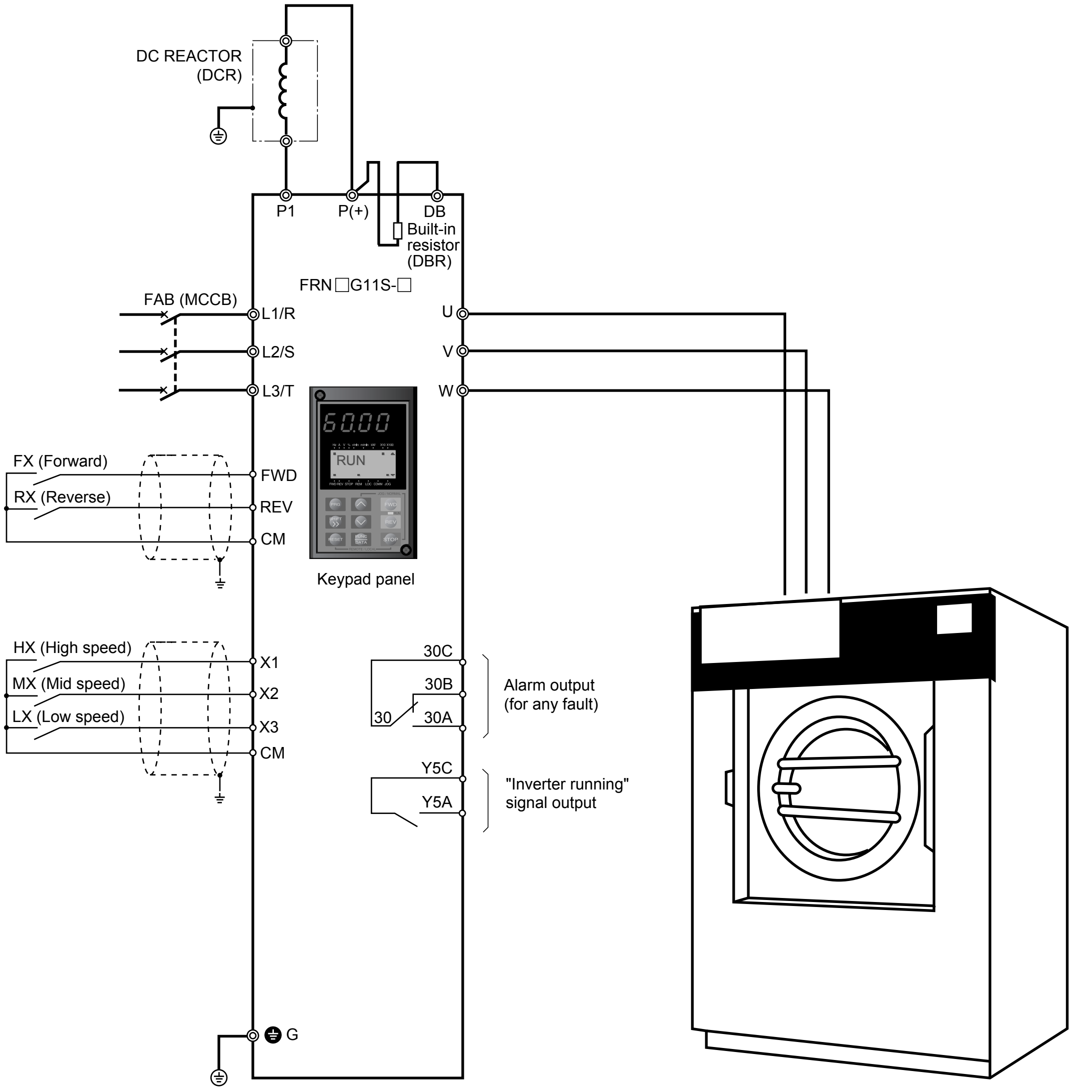
3. Smooth starts using a high starting torque of 200%

- Dynamic torque-vector control incorporating leading technologies enables a high starting torque of 200% (at 0.5 Hz).

4. Unnecessary to resort to any special soundproofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant motor sound that usually comes from the motor which is driven by the inverter. The sound levels are comparable to those of commercial power sources. The inverter meets strict restrictions for motor sound.

■ Wiring diagram/System configuration



⚠ **Caution**	The information described in this catalog is for the purpose of selecting the appropriate products. Before actually using this product, be sure to read the instruction manual carefully to ensure proper operation.

■ Function setting value (Recommended: G11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
E01	X1 terminal(Function select)	0: Multistep freq. select (1 to 4 bits) [SS1]	0: Multistep freq. select (1 to 4 bits) [SS1]	Setting is also available with E06 to E09.
E02	X2 terminal	1: Multistep freq. select (1 to 4 bits) [SS2]	1: Multistep freq. select (1 to 4 bits) [SS2]	
E03	X3 terminal	2: Multistep freq. select (1 to 4 bits) [SS4]	2: Multistep freq. select (1 to 4 bits) [SS4]	
E04	X4 terminal	3: Multistep freq. select (1 to 4 bits) [SS8]	17: UP command [UP]	
E05	X5 terminal	4: ACC/DEC time selection (1 to 4 bits) [RT1]	18: DOWN command [DOWN]	
F42	Torque vector control 1	0: Inactive	1: Active	
F09	Torque boost 1	0.0: Automatic torque boost	0.0: Automatic torque boost	
H06	Fan stop operation	0: Inactive	1: Active	
E20	Y1 terminal(Function select)	0: Inverter running	25: Fan operation signal	Used to control the inverter panel cooling fans for inverters of 40HP or larger. Also available with Functions E21 to E23 (Y2 to Y4 terminal functions).
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	3: Active (Continuous operation; heavy inertia load, or general load)	Set H13 to H16 also, if necessary.
F26	Motor sound (Carrier freq.)	2: 2kHz	15: 15kHz	For 75HP or smaller inverter.
			10: 10kHz	For 100HP or larger inverter.
E24	Y5A,Y5C terminal function (Relay output)	15: Auxiliary terminal AX (for 52-1)	0: Inverter running (RUN)	Relay output (Y5A, Y5C). On when inverter output is present. (Set if necessary.)
F41	Torque limiter 1 (Braking)	999: No limit	0: Automatic deceleration control	Setting recommended when braking resistor is not used.
C01 to C03	Jump frequency 1 to 3 (Hysteresis)	0: No jump frequency	0 to 120Hz	Set the value in accordance with the equipment to be combined.
C04		3: 3Hz	0 to 30Hz	

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. PATTERN operation enabled

- PATTERN operation can be set in seven stages (stages 1 to 7). The operating time (0.00 to 6000 seconds) for each stage, rotating direction (forward or reverse), acceleration and deceleration times, and multistep frequencies (steps 1 to 7) can be set. If the operation pattern has been decided, this function greatly simplifies the configurations of the external circuits and devices.

2. Measures for reducing radio noise

- This low-noise inverter switches its main circuits at high speed. At locations where radio waves are weak, therefore, radio noise can occur due to the effect of the wiring on the load side. We recommend that you install a ferrite ring for reducing radio noise (ACL-40B or ACL-75B) to reduce radio noise, use metal conduits for wiring, and ground the control panel, motor, and conduits using lower resistance values.

3. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

4. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on.

5. Keypad panel designed with six foreign languages as standard

1) Standard products: English, German, French, Spanish, Italian, and Japanese
2) Manufactured on request: Chinese, English, and Japanese

2.7 Using with Belt Conveyors

■ Advantages

1. Smooth starts using a high starting torque of 200%.

- Dynamic torque-vector control incorporating leading technologies enables a high starting torque of 200% (at 0.5 Hz).
- Operation can be started using a high starting torque of 200% even if large-sized item is being loaded. Even if there is a change in the type of item being conveyed, dynamic torque-vector control quickly and flexibly accommodates such change. Consequently, more efficient and continuous operation can be realized without causing a tripping.

2. Droop operation function enabling balanced load operation using two motors for long distance conveyors

- Long distance conveyors transporting heavy items usually have two motors at each end of the conveyor. Smooth operation is difficult due to the unbalance of the load being conveyed. To eliminate this problem, an inverter is installed for each motor and droop operation is set, enabling optimal operation by maintaining a good load balance between the motors.

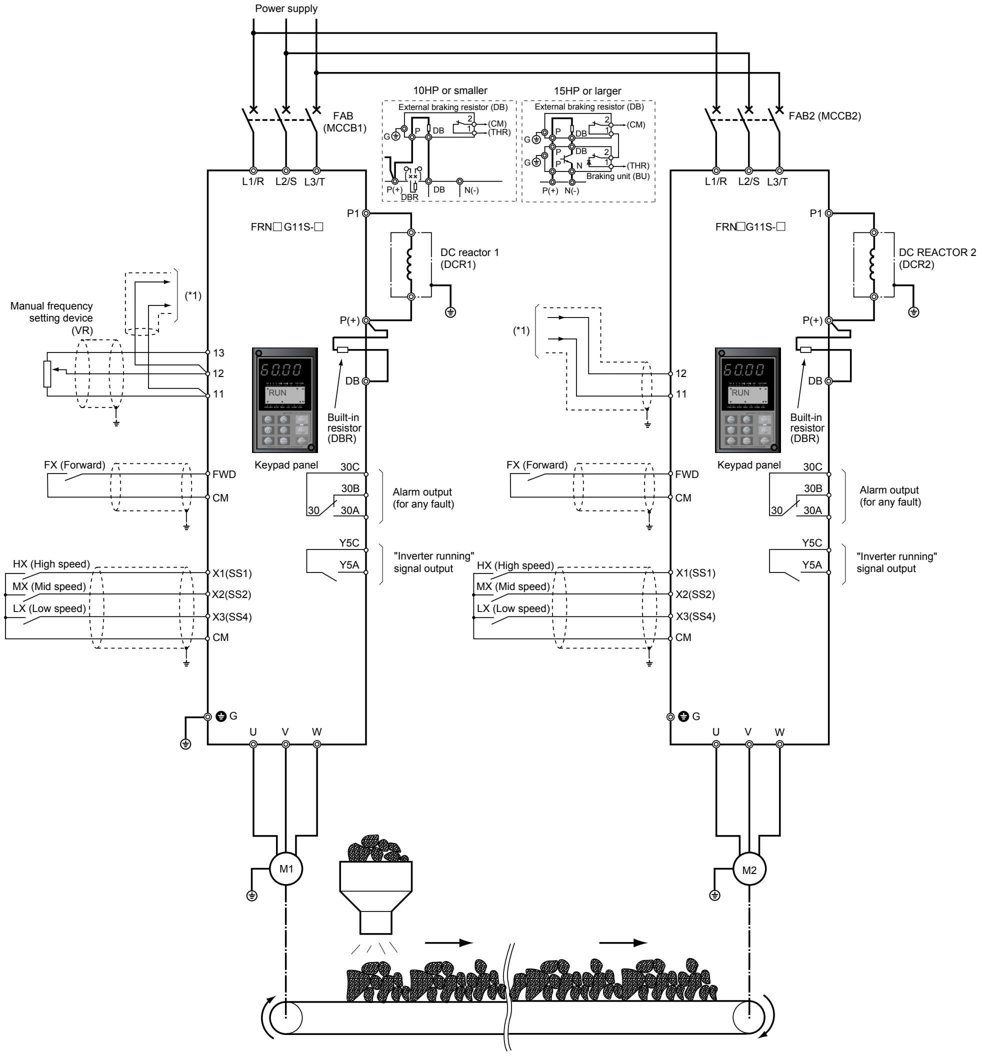
3. Highly efficient operation using multistep frequency operation

- Even if the carrying amount varies, the operating frequency can be easily changed using the multistep frequency function. The carrying items can be transported smoothly without stopping the conveyor.

4. Unnecessary to resort to any special soundproofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant motor sound that usually comes from the motor which is driven by the inverter. The sound levels are comparable to those of commercial power sources. The inverter meets strict restrictions for motor sound.

■ Wiring diagram/System configuration



⚠ **Caution**	The information described in this catalog is for the purpose of selecting the appropriate products. Before actually using this product, be sure to read the instruction manual carefully to ensure proper operation.

■ Function setting value (Recommended: G11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
F10	Electronic thermal relay for motor 1 (Select)	1: Active (Standard motor)	1: Active (Standard motor)	
F11	(Level)	100% of motor rated current	100% rated current of motor used	
F12	(Thermal time constant)	5.0min (30HP or smaller) 10.0min (40HP or larger)	5.0min (30HP or smaller) 10.0min (40HP or larger)	Set if necessary.
F42	Torque vector control 1	0: Inactive	1: Active	
P01	Motor 1 (No. of poles)	4: 4-pole	2 to 14: 2- to 14-pole	Set according to the motor used.
P02	(Capacity)	Capacity of motor used	1/8 to 60HP: 30HP or smaller 1/8 to 800HP: 40HP or larger	
P03	(Rated current)	Fuji’s standard value	0.00 to 2000A	Set according to be motor used before tuning.
P04	(Tuning)	0: Inactive	1: Active	Set P04 first, and then P05.
P05	(On-line tuning)	0: Inactive	1: Active	
P06	(No-load current)	Fuji’s standard value	0.00 to 2000A	Values are detected and written automatically during turning.
P07	(%R1 setting)	Fuji’s standard value	0.00 to 50.00%	
P08	(%X setting)	Fuji’s standard value	0.00 to 50.00%	
P09	(Slip compensation control)	Fuji’s standard value	0.00 to 5.00Hz	Set the value in accordance with the equipment to be combined.
E01	X1 terminal(Function select)	0: Multistep freq. select (1 to 4 bits) [SS1]	0: Multistep freq. select (1 to 4 bits) [SS1]	
E02	X2 terminal	1: Multistep freq. select (1 to 4 bits) [SS2]	1: Multistep freq. select (1 to 4 bits) [SS2]	
E03	X3 terminal	2: Multistep freq. select (1 to 4 bits) [SS4]	2: Multistep freq. select (1 to 4 bits) [SS4]	
E08	X8 terminal	7: Coast-to-stop command [BX]	7: Coast-to-stop command [BX]	
E09	X9 terminal	8: Alarm reset [RST]	9: Trip command (External fault) [THR]	For protecting the external braking resistor, when it is used.
F31	FMA (Function select)	0: Output frequency 1 (Before slip compensation)	4: Output torque	
F35	FMP (Function select)	0: Output frequency 1 (Before slip compensation)	4: Output torque	
H06	Fan stop operation	0: Inactive	1: Active	
H07	ACC/DEC pattern (Mode select)	0: Inactive (Linear)	1: S-curve(weak) 2: S-curve(strong)	Set the function in accordance with the load condition of equipment.
H28	Droop control	-9.9 to 0.0Hz	-9.9 to 0.0Hz	Set at the slave inverter according to the condition of the load to be combined.
F26	Motor sound (Carrier freq.)	2: 2kHz	15:15kHz	For 75HP or smaller inverter.
			10:10kHz	For 100HP or larger inverter.
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	1: Inactive (Trip and alarm when power recovers.)	Set H13 to H16 also, if necessary.

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. Setting the base frequency to 50Hz

- Setting the base frequency to 50Hz gets the maximum performance out of the standard motor, thereby allowing you to reduce the required acceleration time.

2. Preparing external braking resistor

- For G11S inverter of 10HP or smaller, a braking resistor is built into the inverter. However, depending on conditions such as the level of frequent operation or the load amount, an external resistor (DB□-□) having a greater capacity may have to be connected. For 15HP or larger inverter, a braking unit (BU□-□) is required also.
- When the braking resistor is connected externally, be sure to disconnect the jumper wire (P(+), DB) of the built-in braking resistor which has been connected at shipping. In addition, be sure to insulate the disconnected portion.

3. Measures for reducing radio noise

- This low-noise inverter switches its main circuits at high speed. At locations where radio waves are weak, therefore, radio noise can occur due to the effect of the wiring on the load side. We recommend that you install a ferrite ring for reducing radio noise (ACL-40B or ACL-75B) to reduce radio noise, use metal conduits for wiring, and ground the control panel, motor, and conduits using lower resistance values.

4. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

5. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on. No measures have to be taken to handle inrush current in particular.

6. Keypad panel designed with six foreign languages as standard

1) Standard products : English, German, French, Spanish, Italian, and Japanese
2) Manufactured on request : Chinese, English, and Japanese

2.8 Using with Grinding Machines

■ Advantages

1. Greatly reduced motor wow

- With our unique, new control method, motor wow at low speed has been reduced by more than one half (as compared with a conventional Fuji Inverter).

2. Slip compensation control function enabling constant speed operation of grinders

- By setting the slip compensation amount, constant grinder rotating speed can be maintained irrespective of whether the grinding amount is large or small.

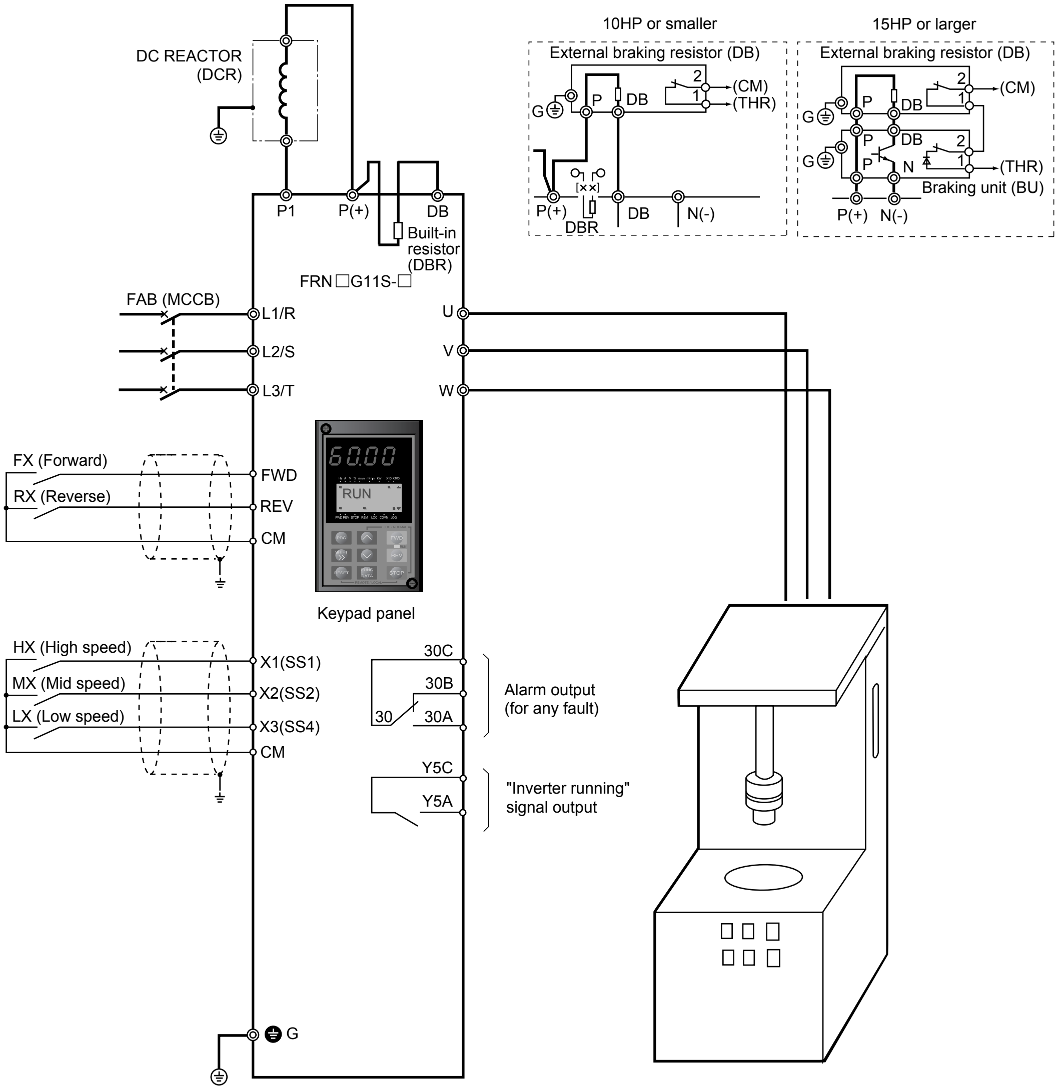
3. Smooth starts using a high starting torque of 200%

- Dynamic torque-vector control incorporating leading technologies enables a high starting torque of 200% (at 0.5 Hz).

4. Unnecessary to resort to any special soundproofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant motor sound that usually comes from the motor which is driven by the inverter.
  The sound levels are comparable to those of commercial power sources.
  The inverter meets strict restrictions for motor sound.

■ Wiring diagram/System configuration



■ Function setting value (Recommended: G11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
E01	X1 terminal(Function select)	0: Multistep freq. select (1 to 4 bits) [SS1]	0: Multistep freq. select (1 to 4 bits) [SS1]	Setting is also available with E06 to E09.
E02	X2 terminal	1: Multistep freq. select (1 to 4 bits) [SS2]	1: Multistep freq. select (1 to 4 bits) [SS2]	
E03	X3 terminal	2: Multistep freq. select (1 to 4 bits) [SS4]	2: Multistep freq. select (1 to 4 bits) [SS4]	
E04	X4 terminal	3: Multistep freq. select (1 to 4 bits) [SS8]	17: UP command [UP]	
E05	X5 terminal	4: ACC/DEC time selection (1 to 4 bits) [RT1]	18: DOWN command [DOWN]	
F42	Torque vector control 1	0: Inactive	1: Active	
F09	Torque boost 1	0.0: Automatic torque boost	0.0: Automatic torque boost	
H06	Fan stop operation	0: Inactive	1: Active	
E20	Y1 terminal(Function select)	0: Inverter running	25: Fan operation signal	Used to control the inverter panel cooling fans for inverters of 40HP or larger. Also available with Functions E21 to E23 (Y2 to Y4 terminal functions).
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	3: Active (Continuous operation; heavy inertia load, or general load)	Set H13 to H16 also, if necessary.
F26	Motor sound (Carrier freq.)	2: 2kHz	15: 15kHz	For 75HP or smaller inverter.
			10: 10kHz	For 100HP or larger inverter.
E24	Y5A,Y5C terminal function (Relay output)	15: Auxiliary terminal for 52-1 [AX]	0: Inverter running (RUN)	Relay output (Y5A, Y5C). On when inverter output is present. (Set if necessary.)
F41	Torque limiter 1 (Braking)	999: No limit	0: Automatic deceleration control	Setting recommended when braking resistor is not used.
C01 to C03	Jump frequency 1 to 3 (Hysteresis)	0: No jump frequency	0 to 120Hz	Set the value in accordance with the equipment to be combined.
C04		3: 3Hz	0 to 30Hz	

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. PATTERN operation enabled

- PATTERN operation can be set in seven stages (stages 1 to 7). The operating time (0.00 to 6000 seconds) for each stage, rotating direction (forward or reverse), acceleration and deceleration times, and multistep frequencies (steps 1 to 7) can be set. If the operation pattern has been decided, this function greatly simplifies the configurations of the external circuits and devices.

2. Measures for reducing radio noise

- This low-noise inverter switches its main circuits at high speed. At locations where radio waves are weak, therefore, radio noise can occur due to the effect of the wiring on the load side. We recommend that you install a ferrite ring for reducing radio noise (ACL-40B or ACL-75B) to reduce radio noise, use metal conduits for wiring, and ground the control panel, motor, and conduits using lower resistance values.

3. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR☐-☐☐☐) to reduce harmonics on power supply side.

4. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on. No measures have to be taken to handle inrush current in particular.

5. Keypad panel designed with six foreign languages as standard

1) Standard products : English, German, French, Spanish, Italian, and Japanese
2) Manufactured on request : Chinese, English, and Japanese

2.9 Using with Fans for Air Conditioning Unit (1)

■ Advantages

1. A Solution to growing demand for energy savings: Automatic energy saving operation

- Under the energy saving mode, conditions can be set automatically to ensure that the motor runs at peak efficiency. This approach takes into consideration the axial force of fans which frequently changes. This results in minimized power consumption, and satisfies the increasing demand for the greater energy savings.

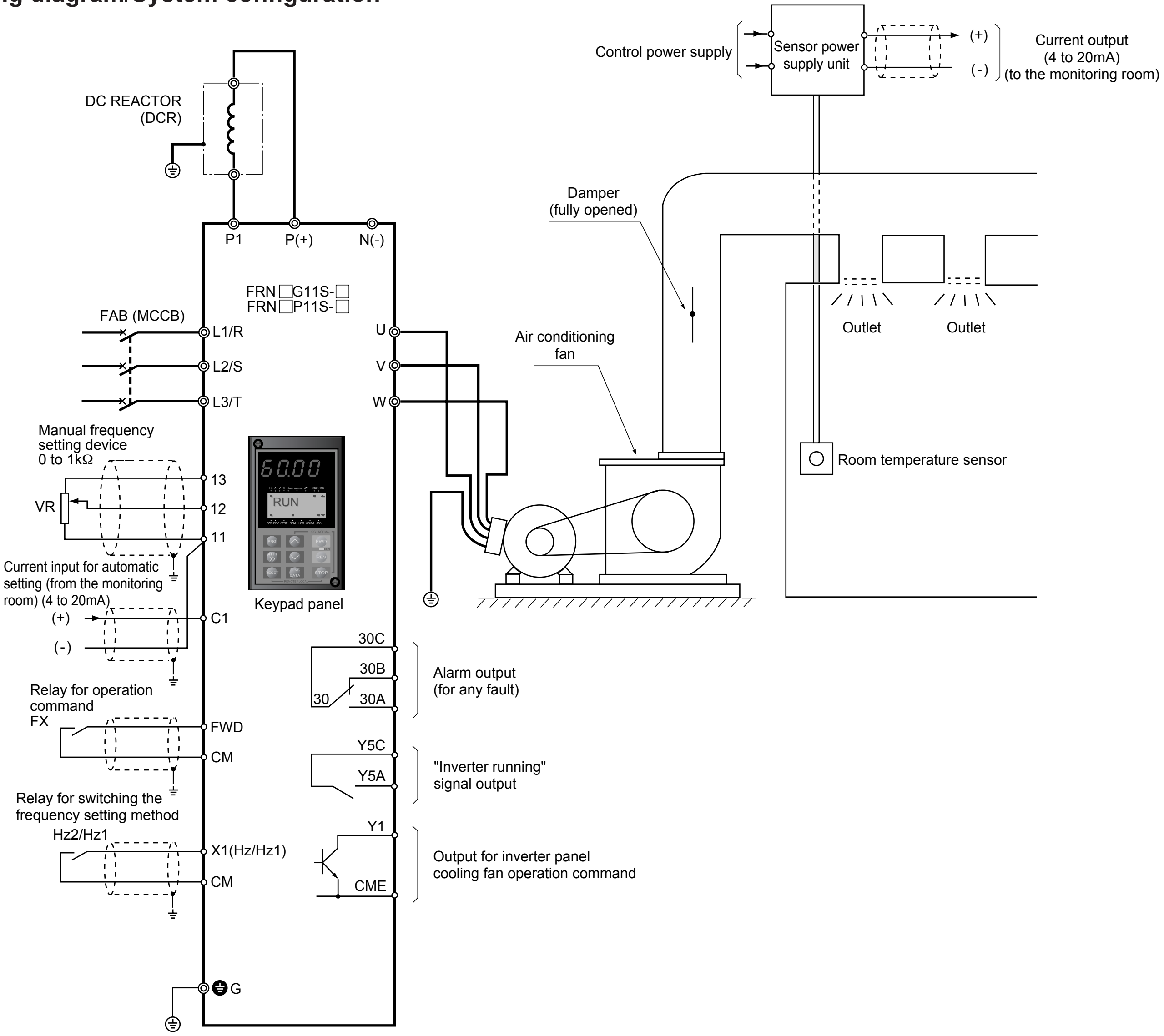
2. Automatic stopping of the inverter cooling fan while air conditioning system is not in operation

- By selecting cooling fan stop operation, the inverter cooling fan can be stopped when the temperature of the inverter cooling fan becomes low while the inverter operation command is off.
- Although energy savings may appear minimal from the point of view of the air conditioning unit itself, the total saving effect that can be realized by the whole air conditioning system is significant. Furthermore, the cooling fan stop operation contributes to a more quiet operation, as the cooling fan operation sound may be a nuisance at night.

3. Unnecessary to resort to any special soundproofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant motor sound that usually comes from the motor which is driven by the inverter.
  The sound levels are comparable to those of commercial power sources.

■ Wiring diagram/System configuration



⚠ **Caution**	The information described in this catalog is for the purpose of selecting the appropriate products. Before actually using this product, be sure to read the instruction manual carefully to ensure proper operation.

■ Function setting value (Recommended: G11S/P11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
F01	Frequency command 1	0: Keypad panel	2: Current input (terminal C1) (4 to 20mA DC)	Under normal operation
C30	Frequency command 2	0: Keypad panel	0: Keypad panel 1: Voltage input	Under manual operation
E01	X1 terminal (Function select)	0: Multistep freq. select	11: Freq. set. 2 /Freq. set. 1	Also available with Functions E02 to E09 (X2 to X9 terminal functions).
F09	Torque boost 1	0.1: For variable torque load (P11) 0.0: For constant torque load (G11)	0.1: For variable torque load	
H10	Energy-saving operation	0: Active (P11) 1: Inactive (G11)	1: Active	
H06	Fan stop operation	0: Inactive	1: Active	
E20	Y1 terminal(Function select)	0: Inverter running	25: Fan operation signal	Used to control the inverter panel cooling fans for inverters of 40HP or larger. Also available with Functions E21 to E23 (Y2 to Y4 terminal functions).
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	3: Active (Continuous operation; heavy inertia load, or general load)	Set H13 to H16 also, if necessary.
F26	Motor sound (Carrier freq.)	2: 2kHz	15: 15kHz	For 75HPor smaller inverter.
			10: 10kHz	For 100HP or larger inverter.
E24	Y5A,Y5C terminal function (Relay output)	15: Auxiliary terminal for 52-1 [AX]	0: Inverter running (RUN)	Relay output (Y5A, Y5C). On when inverter output is present. (Set if necessary.)
F41	Torque limiter 1 (Braking)	999: No limit	0: Automatic deceleration control	Setting recommended when braking resistor is not used.
C01 to C03	Jump frequency 1 to 3	0: No jump frequency	0 to 120Hz	Set the value in accordance with the equipment to be combined.
C04	(Hysteresis)	3: 3Hz	0 to 30Hz	

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. Automatic energy saving operation: Ideal for fans and pumps

- You can look forward to significant energy savings simply by using the automatic energy saving operation for loads such as fans and pumps.

2. Automatic on/off operation for the inverter panel cooling fan

- For inverter of 40HP or larger, the on/off signal of the cooling fan can be output externally. This signal can be used to automatically run and stop the cooling fan on the inverter panel. As a result, you can look forward to greater energy savings.

3. "Inverter running" signal output using relay output

- E24 (Y5A, Y5C terminal functions) can be used to set the output of the "Inverter running" signal using the relay output.

4. Easy switching between automatic and manual setting of the frequency setting signal

- Remote frequency setting (4 to 20mA) and manual frequency setting (setting using the frequency setting POT or Keypad panel) can be switched with ease. This function is useful for the operation confirmation at the installation site if required.
- One arbitrary terminal among the control input terminals X1 to X9 is used for switching. Switching is performed by turning the connected contact on and off. Use E01 (in case of control input terminal X1) to enable this function. When the contact is off, the frequency setting specified by F01 is enabled. When the contact is on, the frequency setting specified by C30 is enabled.

5. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

6. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S/P11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on. No measures have to be taken to handle inrush current in particular.

2.10 Using with Fans for Air Conditioning Unit (2)

■ Advantages

1. PID control functions built in as standard

- Till recently, a temperature controller has been required. However, because PID control functions are built in, the room temperature can easily be controlled uniformly by only installing a sensor (4 to 20mA) for detecting the room temperature.

2. A Solution to growing demand for energy savings: Automatic energy saving operation

- Under the energy saving mode, conditions can be set automatically to ensure that the motor runs at peak efficiency. This approach takes into consideration the axial force of fans which frequently changes. This results in minimized power consumption, and satisfies the increasing demand for the greater energy-savings.

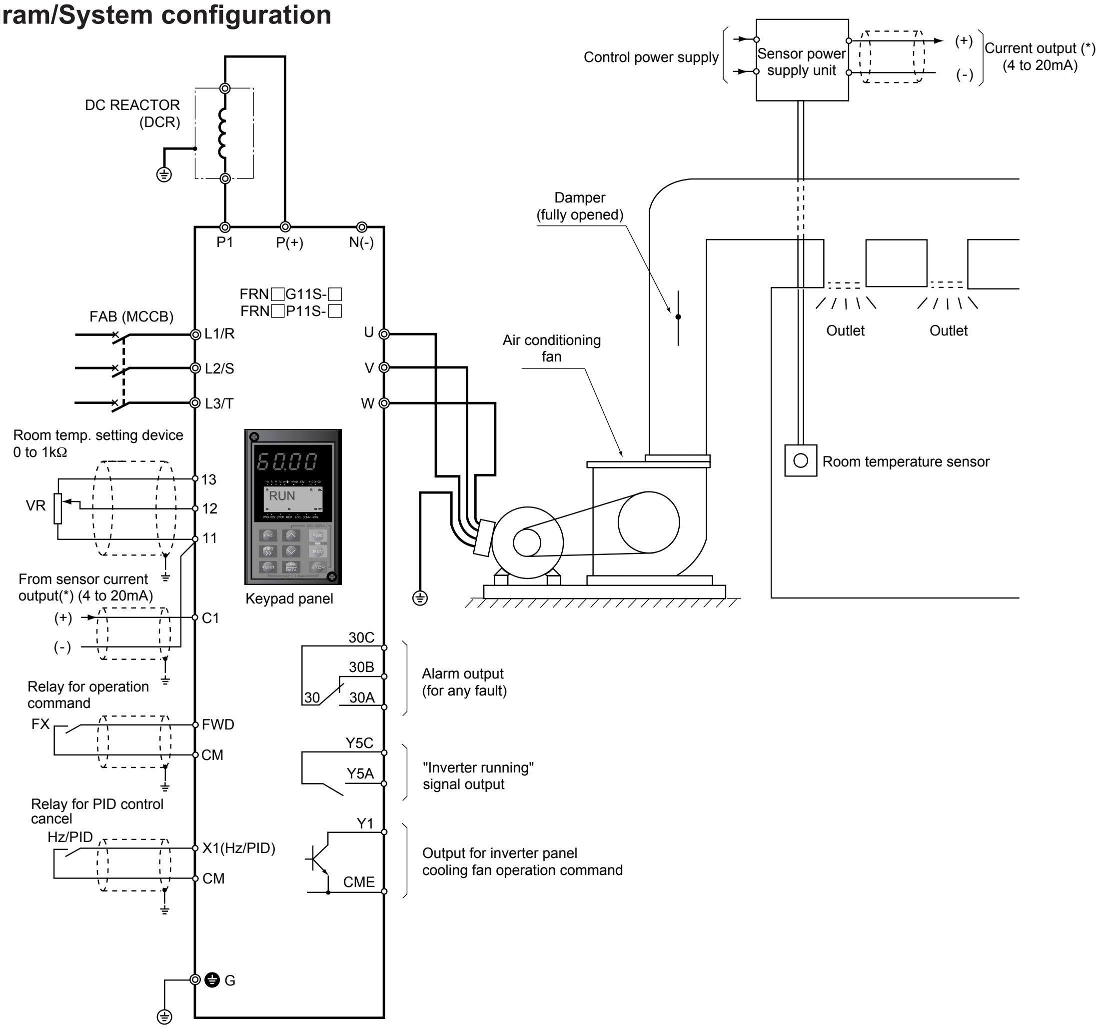
3. Automatic stopping of the inverter cooling fan while air conditioning system is not in operation

- By selecting cooling fan stop operation, the inverter cooling fan can be stopped when the temperature of the inverter cooling fan becomes low while the inverter operation command is off.
- Although energy savings may appear minimal from the point of view of the air conditioning unit itself, the total saving effect that can be realized by the whole air conditioning system is significant. Furthermore, the cooling fan stop operation contributes to a more quiet operation, as the cooling fan operation sound may be a nuisance at night.

4. Unnecessary to resort to any special sound-proofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant motor sound that usually comes from the motor which is driven by the inverter. The sound levels are comparable to those of commercial power sources.

■ Wiring diagram/System configuration



Caution	The information described in this catalog is for the purpose of selecting the appropriate products. Before actually using this product, be sure to read the instruction manual carefully to ensure proper operation.

■ Function setting value (Recommended: G11S/P11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
H20	PID control (Mode select)	0: Inactive	0: Inactive	Operation without PID function is selected.
			1: Active	
H21	(Feedback signal)	1: Terminal C1 (4 to 20mA) input	1: Terminal C1 (4 to 20mA) input	
H22	(P-gain)	0.01: 0.01 times	0.01 times (= 1%) to 10 times (= 1000%)	Set the functions according to individual system.
H23	(I-gain)	0.0: Inactive	0.1 to 3600s	
H24	(D-gain)	0.00: Inactive	0.01 to 10.00s	
H25	(Feedback filter)	0.0: No filter	0.0: No filter	
E01	X1 terminal (Function select)	0: Multistep freq. selection	20: PID control cancel	Manual operation when input signal is ON. (Frequency setting with Keypad panel)
F09	Torque boost 1	0.1: For variable torque load (P11) 0.0: For constant torque load (G11)	0.1: For variable torque load	
H10	Energy-saving operation	0: Active (P11) 1: Inactive (G11)	1: Active	
H06	Fan stop operation	0: Inactive	1: Active	
E20	Y1 terminal(Function select)	0: Inverter running	25: Fan operation signal	Used to control the inverter panel cooling fans for inverters of 40HP or larger. Also available with Functions E21 to E23 (Y2 to Y4 terminal functions).
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	3: Active (Continuous operation; heavy inertia load, or general load)	Set H13 to H16 also, if necessary.
F26	Motor sound (Carrier freq.)	2: 2kHz	15: 15kHz	For 75HP or smaller inverter.
			10: 10kHz	For 100HP or larger inverter.
E24	Y5A,Y5C terminal function (Relay output)	15: Auxiliary terminal for 52-1 [AX]	0: Inverter running (RUN)	Relay output (Y5A, Y5C). On when inverter output is present. (Set if necessary.)
F41	Torque limiter 1 (Braking)	999: No limit	0: Automatic deceleration control	Setting recommended when braking resistor is not used.
C01 to C03	Jump frequency 1 to 3	0: No jump frequency	0 to 120Hz	Set the value in accordance with the equipment to be combined.
C04	(Hysteresis)	3: 3Hz	0 to 30Hz	

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. PID control setting values

- The optimum setting values depend on the system configuration being used. It varies according to combination of different factors such as the area size to be air conditioned, adiabatic status, and the capacity of the air conditioning equipment. Therefore, use empirical values to set values in advance and then reset the values to the optimum values during test operation.

2. Automatic energy saving operation: Ideal for fans and pumps

- You can look forward to significant energy savings simply by using the automatic energy-saving operation for loads such as fans and pumps.

3. Automatic on/off operation for the inverter panel cooling fan

- For inverters of 40HP or larger, the on/off signal of the cooling fan can be output externally. This signal can be used to automatically run and stop the cooling fan on the inverter panel. As a result, you can look forward to greater energy savings.

4. "Inverter running" signal output using relay output

- E24 (Y5A, Y5C terminal functions) can be used to set the output of the "Inverter running" signal using the relay output.

5. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

6. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S/P11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on. No measures have to be taken to handle inrush current in particular.

2.11 Using with Cold/Warm Water Pumps

■ Advantages

1. PID control functions built in as standard

- By controlling the cold/warm water temperature of the air handling unit uniformly, the energy savings can be realized in accordance with the reduced amount of pump flow that accommodates changes in the room temperature.
- Till recently, a temperature controller has been required. However, because PID control functions are built in as inverter functions, the water temperature can be controlled uniformly simply by installing a temperature sensor (4 to 20mA) at the pump outlet.

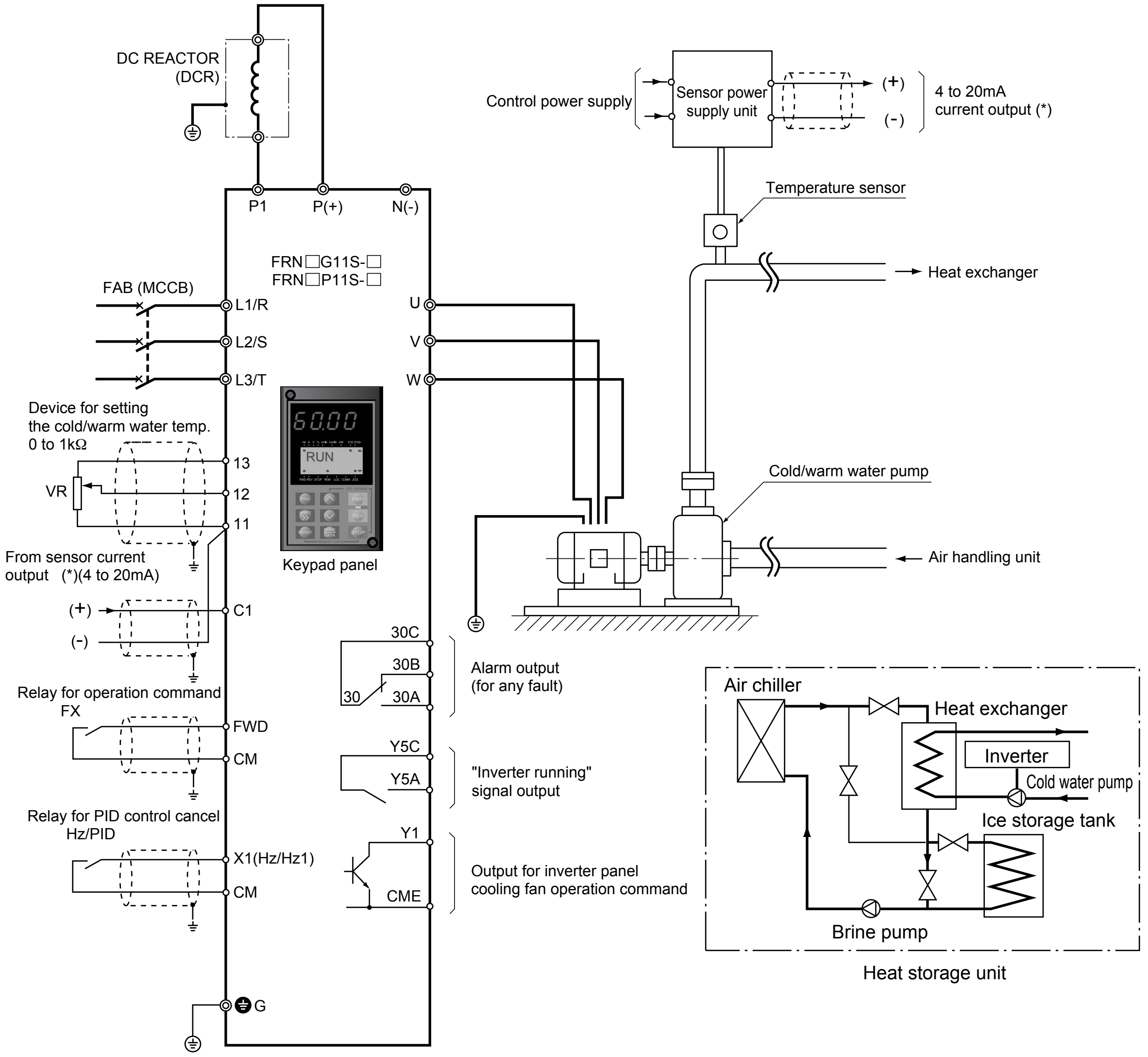
2. Greater energy saving effect obtainable combined with automatic energy saving operation function

- Normally, the cold/warm water pump has the variable torque characteristics. The axial force of the pump is directly proportional to the rotating speed cubed. If the rotating speed (amount of flow) drops to 80%, the axial force will be approximately 50%. As a result, compared with the amount of flow when the flow is restricted by the valve, significant energy savings can be expected.
- Moreover, you can anticipate greater energy savings by setting the automatic energy-saving operation function (Function code: H10) to 1 (Active).

3. Unnecessary to resort to any special sound-proofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant motor sound that usually comes from the motor which is driven by the inverter.
  The sound levels are comparable to those of commercial power sources.

■ Wiring diagram/System configuration



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■ Function setting value (Recommended: G11S/P11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
F04	Base frequency 1	50Hz	50Hz 60Hz *)1	Change from 50Hz to 60Hz in 60Hz district.
H20	PID control (Mode select)	0: Inactive	0: Inactive	Operation without PID function is selected.
			1: Active	
H21	(Feedback signal)	1: Terminal C1 (4 to 20mA) input	1: Terminal C1 (4 to 20mA) input	
H22	(P-gain)	0.01: 0.01 times	0.01 times (= 1%) to 10 times (= 1000%)	Set the functions according to individual system.
H23	(I-gain)	0.0: Inactive	0.1 to 3600s	
H24	(D-gain)	0.00: Inactive	0.01 to 10.00s	
H25	(Feedback filter)	0.0: No filter	0.0: No filter	
E01	X1 terminal (Function select)	0: Multistep freq. selection	20: PID control cancel	Manual operation when input signal is ON. (Frequency setting with Keypad panel)
F09	Torque boost 1	0.1: For variable torque load (P11) 0.0: For constant torque load (G11)	0.1: For variable torque load	
H10	Energy-saving operation	0: Active (P11) 1: Inactive (G11)	1: Active	
H06	Fan stop operation	0: Inactive	1: Active	
E20	Y1 terminal(Function select)	0: Inverter running	25: Fan operation signal	Used to control the inverter panel cooling fans for inverters of 40HP or larger. Also available with Functions E21 to E23 (Y2 to Y4 terminal functions).
F14	Restart mode after momentary power failure (Mode select)	1: Inactive	3: Active (Continuous operation; heavy inertia load, or general load)	Set H13 to H16 also, if necessary.
F26	Motor sound (Carrier freq.)	2: 2kHz	15: 15kHz	For 75HP or smaller inverter.
			10: 10kHz	For 100HP.
			6: 6kHz	For 125 to 400HP inverter.
E24	Y5A,Y5C terminal function (Relay output)	15: Auxiliary terminal for 52-1 [AX]	0: Inverter running (RUN)	Relay output (Y5A, Y5C). On when inverter output is present. (Set if necessary.)
F41	Torque limiter 1 (Braking)	999: No limit	0: Automatic deceleration control	Setting recommended when braking resistor is not used.
C01 to C03	Jump frequency 1 to 3	0: No jump frequency	0 to 120Hz	Set the value in accordance with the equipment to be combined.
C04	(Hysteresis)	3: 3Hz	0 to 30Hz	

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. PID control setting values

- The optimum setting values depend on the system configuration being used, due to various combinations such as the characteristics of the cold/warm water pump and air conditioning equipment. Therefore, use empirical values to set values in advance and then reset the values to the optimum values during test operation.

2. Energy saving operation selection considering operation condition

- Great energy saving effect can be realized if the system has enough treatment capacity.

3. Precautions on radio interference

- As many measurement circuits are installed around the aeration tank, precautions need to be taken for radio noise interference.
- FRENIC5000G11S series incorporates measures against radio interference noise generation and a function for switching to a low carrier frequency. However, we recommend that you take the following action:

1) Install an isolation transformer for the power supply for the instruments.
2) Use shielded wires for the control signals.
3) Connect Power filter (FHF-□/□/□) on the inverter power supply side.
4) Install a ferrite ring for reducing radio noise (ACL-40B or ACL-74B) on the inverter power supply side.
5) Perform complete wiring separation or electromagnetic shielding (use metal conduits) for the wiring on the inverter output side.

4. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

5. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S/P11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on.

2.12 Using with Line/Inverter Changeover Operation

■ Advantages

1. Switching from line operation to inverter operation enabled without stopping the motor

- When switching from line operation to inverter operation, the inverter outputs a frequency equivalent to the rotating speed of the motor. Then the operation can be automatically and smoothly changed to the desired frequency.

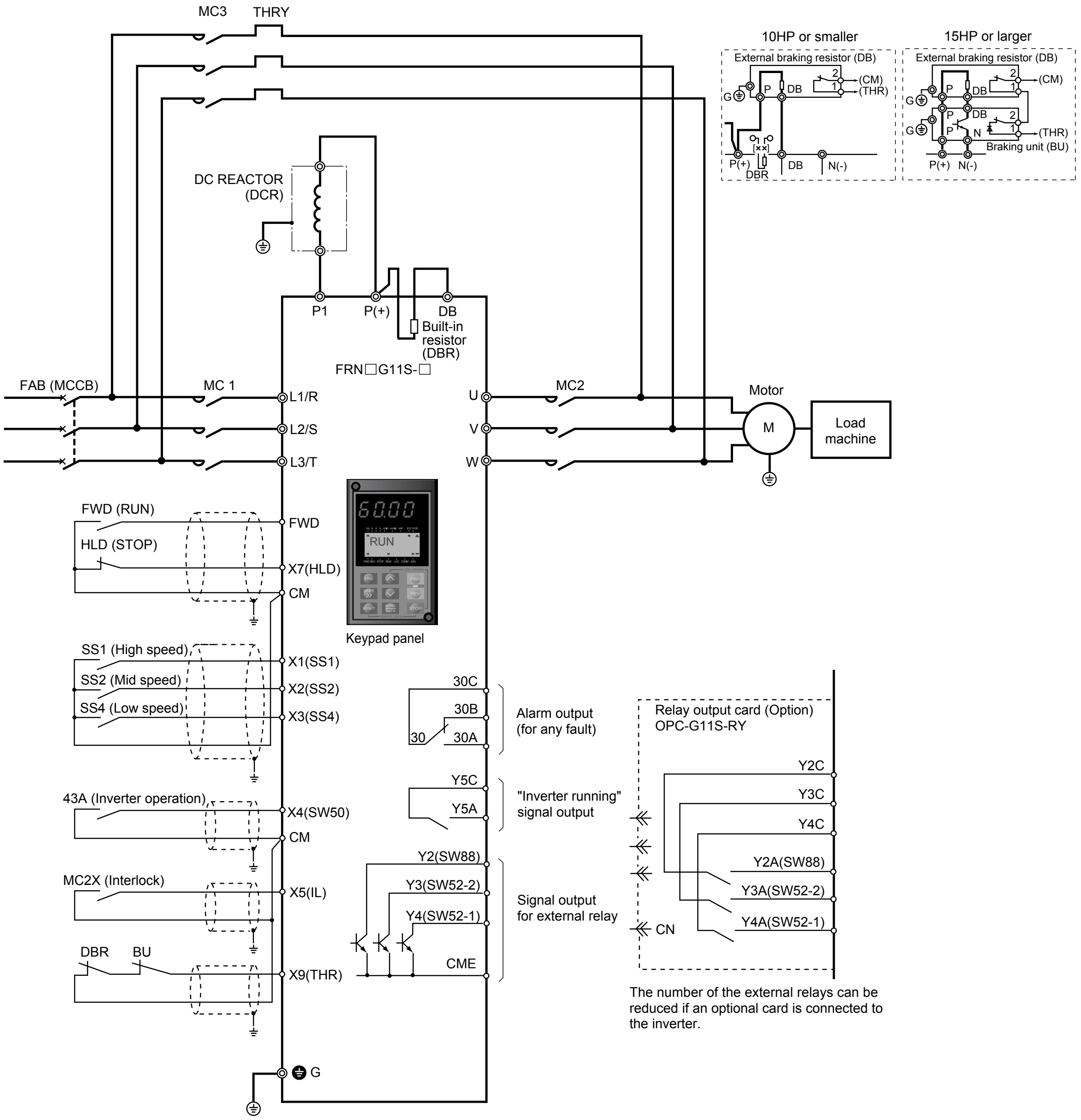
2. A built-in timing relay for switching command to the inverter operation circuit

- Proper timing for breaking/closing the magnetic contactor for main circuit switching from line to inverter operation had to be set externally. However, by a switching command relay being built-in the inverter, the circuits can be easily configured including interlock circuits.

3. Unnecessary to resort to any special sound-proofing measures; Fuji inverter drives a motor with silent motor sound.

- We have succeeded in eliminating most of the unpleasant motor sound that usually comes from the motor which is driven by the inverter. The sound levels are comparable to those of commercial power sources.

■ Wiring diagram/System configuration



The number of the external relays can be reduced if an optional card is connected to the inverter.

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■ Function setting value (Recommended: G11S/P11S)

Function code	Name	Factory setting	Recommended setting value	Remarks
E01	X1 terminal(Function select)	0: Multistep freq. select (1 to 4 bits) [SS1]	0: Multistep freq. select (1 to 4 bits) [SS1]	
E02	X2 terminal	1: Multistep freq. select (1 to 4 bits) [SS2]	1: Multistep freq. select (1 to 4 bits) [SS2]	
E03	X3 terminal	2: Multistep freq. select (1 to 4 bits) [SS4]	2: Multistep freq. select (1 to 4 bits) [SS4]	
E04	X4 terminal	3: Multistep freq. select (1 to 4 bits) [SS8]	15: Line/Inverter changeover operation (50Hz) [SW50]	
E05	X5 terminal	4: ACC/DEC time selection (1 to 4 bits) [RT1]	22: Interlock signal for 52-2 [IL]	
E07	X7 terminal	6: 3-wire operation stop command [HLD]	6: 3-wire operation stop command [HLD]	
E09	X9 terminal	8: Alarm reset [RST]	9: Trip command (External fault) [THR]	For protecting the external braking resistor, when it is used.
E21	Y2 terminal(Function select)	1: Frequency equivalence signal [FAR]	11: Line/Inv changeover (for 88) [SW88]	
E22	Y3 terminal	2: Frequency level detection [FDT]	12: Line/Inv changeover (for 52-2) [SW52-2]	
E23	Y4 terminal	7: Overload early warning [OL]	13: Line/Inv changeover (for 52-1) [SW52-1]	
E24	Y5A,Y5C terminal	15: Auxiliary terminal for 52-1 [AX]	0: Inverter running	
F14	Restart mode after momentary power failure (Mode select)	0: Inactive	0: Inactive (Trip and alarm when power failure occurs.)	Set H13 to H16 also, if necessary.
H13	Auto-restart(Restart time)	0.5s	0.1 to 10.0s	Set the functions according to individual system.
H14	(Freq. fall rate)	10.00Hz/s	0.00 to 100.00Hz/s	
H15	(Holding DC voltage)	460V: 470V 230V: 235V	460V: 400 to 600V 230V: 200 to 300V	
H16	(OPR command selfhold time)	999: Automatic (Max. time)	0 to 30.0s 999: Automatic (Max. time)	
H06	Fan stop operation	0: Inactive	1: Active	
H07	ACC/DEC pattern (Mode select)	0: Inactive (Linear)	1: S-curve(weak) 2: S-curve(strong)	Set the function in accordance with the load condition of the equipment.
H09	Start mode(Rotating motor pick up)	0: Inactive	2: Active	
F26	Motor sound (Carrier freq.)	2: 2kHz	15: 15kHz	For 75HP or smaller inverter.
			10: 10kHz	For 100HP.
			6: 6kHz	For 125 to 400HP inverter.

Other than the above functions, some of the basic functions such as base frequency, maximum frequency, acceleration/deceleration time, and motor characteristics parameters should be set.

■ Tips

1. Refer to the basic wiring diagram for the line/inverter changeover operation circuits.

- We have prepared a basic wiring diagram of the line/inverter changeover operation circuits in addition to the system configuration diagram. Refer to the basic wiring diagram when configuring the control circuits.
- To incorporate a line/inverter changeover operation circuit using the switching command timing relay built-in the inverter, the function code and data must be set taking into consideration the function setting value (recommended value) set in advance.
- Reverse operation using the inverter is not possible.

2. Inspection of a forced line operation circuit

- If a fatal fault occurs in the inverter, commands issued by the inverter circuit may not succeed in switching the system to line operation. To execute line operation even in such a condition, we recommend that you prepare a forced line operation circuit separately.
- Please inquire separately for details about a forced line operation circuit.

3. Adjusting the restart waiting time and other items

- Depending on the size of moment of inertia of the load machine, factors such as the restart waiting time and restart frequency fall rate may have to be adjusted.

4. Preparing external braking resistor

- For G11S inverter of 10HP or smaller, a braking resistor is built into the inverter. However, depending on conditions such as the level of frequent operation or the load amount, an external resistor (DB□-□) having a greater capacity may have to be connected. For 15HP or larger inverter, a braking unit (BU□-□) is required also.
- When the braking resistor is connected externally, be sure to disconnect the jumper wire (P(+), DB) of the built-in braking resistor which has been connected at shipping. In addition, be sure to insulate the disconnected portion.

5. Measures for reducing radio noise

- This low-noise inverter switches its main circuits at high speed. At locations where radio waves are weak, therefore, radio noise can occur due to the effect of the wiring on the load side. We recommend that you install a ferrite ring for reducing radio noise (ACL-40B or ACL-75B) to reduce radio noise, use metal conduits for wiring, and ground the control panel, motor, and conduits using lower resistance values.

6. Full preparation to suppress harmonics with a DC REACTOR

- An exclusive terminal (P1, P(+)) for connecting a DC REACTOR is equipped as standard. Connect the optional DC REACTOR (DCR□-□□□) to reduce harmonics on power supply side.

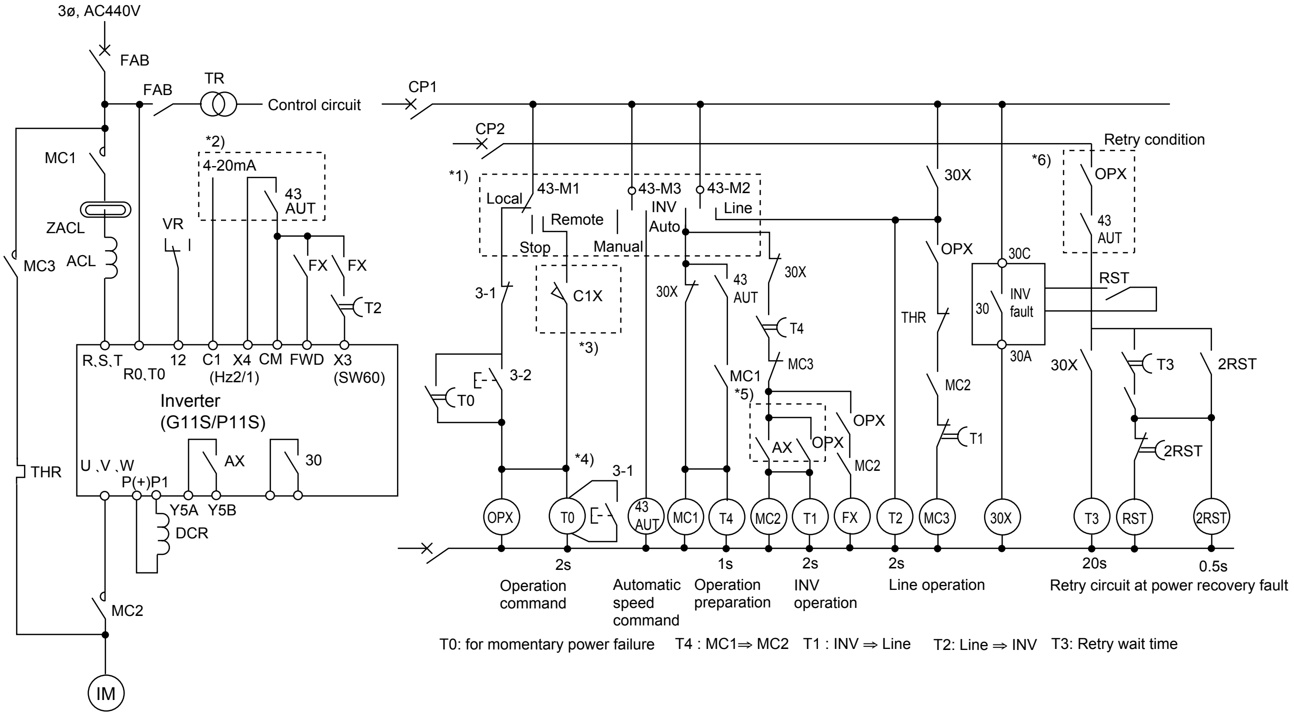
7. Suppression of inrush current when the power supply is turned on

- FRENIC5000G11S/P11S series inverters have a built-in circuit that suppresses inrush current that are generated when the power supply is turned on.

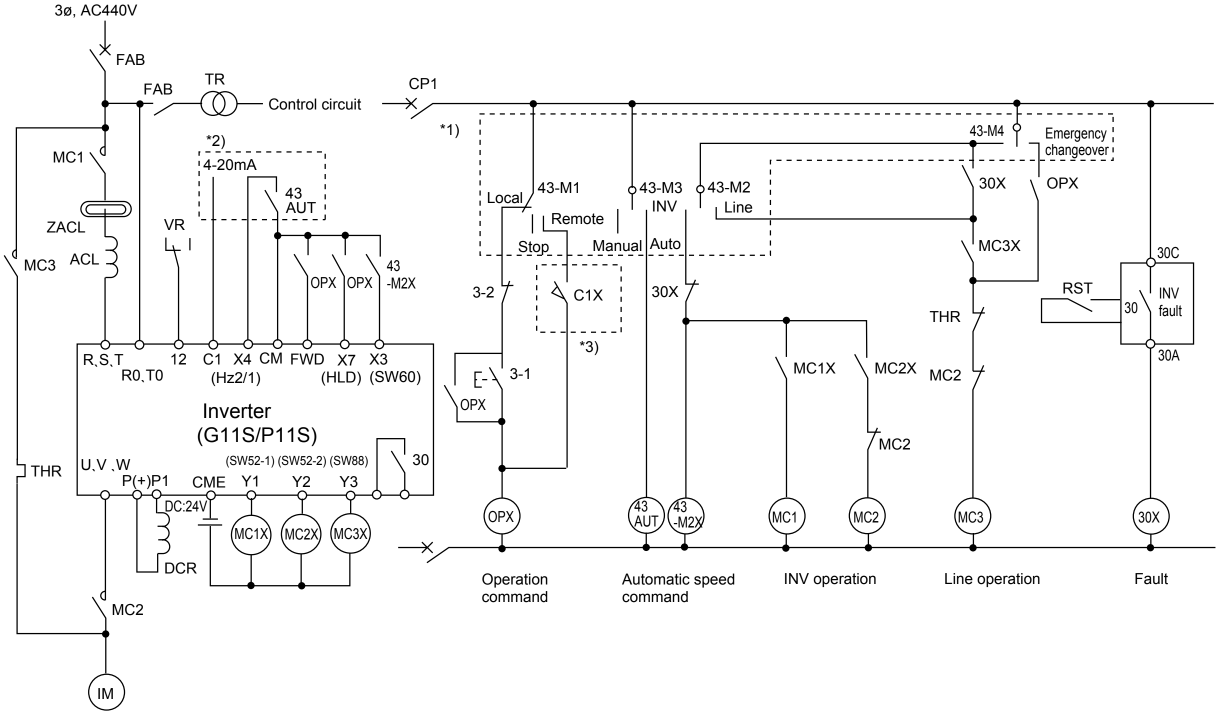
Line/Inverter changeover sequence

G11S/P11S series inverter is provided with a part of control sequence to changeover between line operation and inverter operation, as standard. This means that external sequence circuit can be more simplified compared with the conventional G9S series. The sequence diagrams below are a conventional G9 compatible sequence and a new sequence utilizing the G11S built-in sequence.

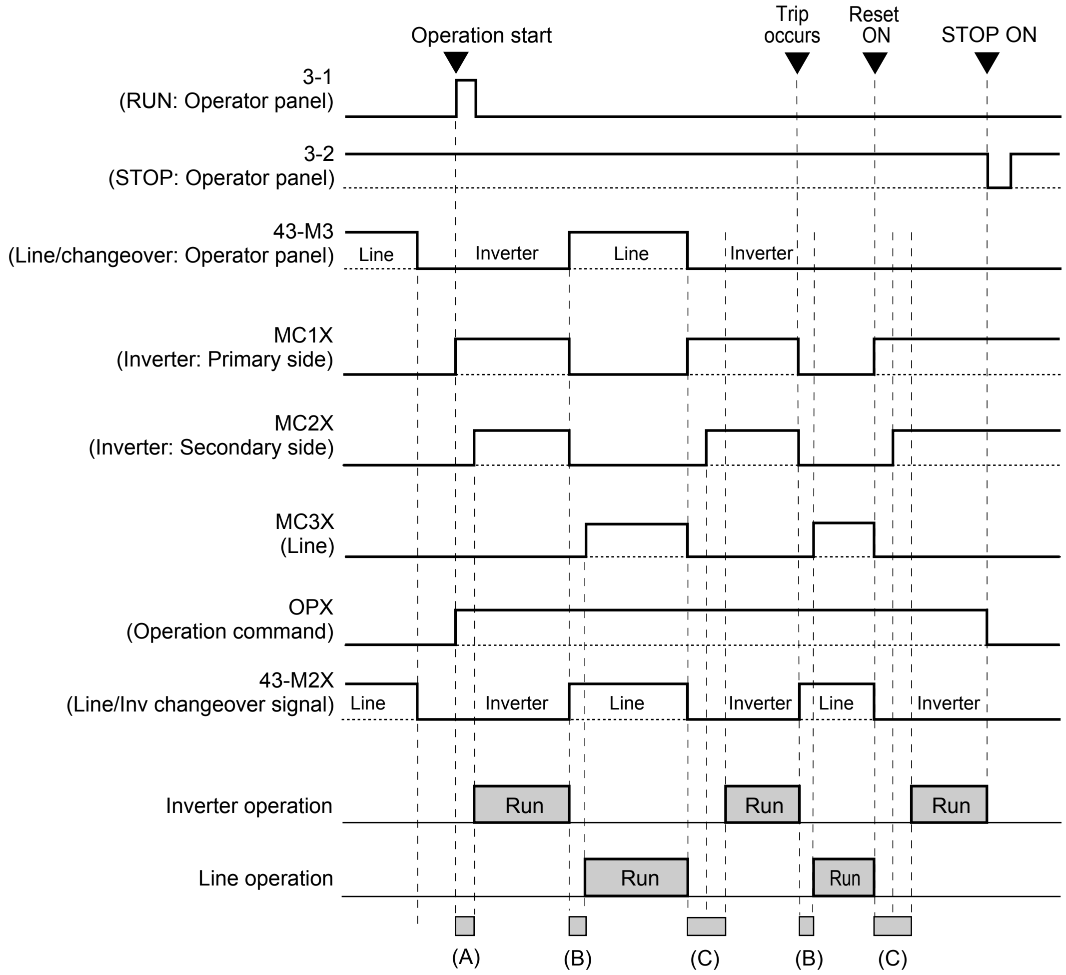
Inverter retry and restart sequence after momentary power failure and power recovery (Example 1)
(Inverter → Commercial power → Inverter, Automatic changeover sequence: G9S compatible sequence)



Inverter retry and restart sequence after momentary power failure and power recovery (Example 2)
(Inverter → Commercial power → Inverter, Automatic changeover sequence: Using inverter built-in sequence)



Basic operation example using built-in Line/Inverter changeover sequence



(A) Main circuit chatging time + Contactor closing delay timer (0.2s fixed)
(B) Restart time after momentary power failure (H13) + Contactor closing delay timer (0.2s fixed)
(C) Main circuit charging time + Restart time after momentary power failure (H13) + Contactor closing delay timer (0.2s fixed)

Related functions

X1- X9 terminal (Digital input terminal function)
■ E01 X1 terminal function
to
■ E09 X9 terminal function

Set value	Function
6	3-wire operation stop command [HLD]
15	Switching operation between line and inverter (50Hz) [SW50]
16	Switching operation between line and inverter (60Hz) [SW60]

Y1 -Y5C terminal (Transistor output function)
■ E20 Y1 terminal function (Function select)
to
■ E24 Y5A,Y5C terminal function (Function select)

Set value	Function
11	Line/Inv changeover (for 88) [SW88]
12	Line/Inv changeover (for 52-2) [SW52-2]
13	Line/Inv changeover (for 52-1) [SW52-1]

■ H13 Auto-restart (Restart time)

H13 RESTART

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.
- Setting range: 0.1 to 5.0s

NOTE: *1) Operation switch on control panel
*2) Use “X4” when current input is used.
*3) Take countermeasures against momentary power failure for a signal from “REMOTE”.
*4) T0 is an electronic timer with reset terminal.
*5) AX terminal function is used to make MC2 OFF after deceleration to a stop.
*6) Retry condition is determined depending on electric facility. The cut-off switch CP2 should be prepared in this circuit.

Chapter 7

Glossary

Contents

This part contains the definitions of the terms used in this engineering documentation.

1. Standard Specifications

• Nominal applied motor
The rated output of a general-purpose motor, stated in kW, that is used as a standard motor.

• Rated capacity
The rating of an output capacity, or the apparent power that is represented by the rated output voltage times the rated output current, which is calculated by solving the following equation and is stated in kVA:

$$\text{Rated capacity [kVA]} = \sqrt{3} \times \text{Rated output voltage [V]} \times \text{Rated output current [A]} \times 10^{-3}$$

The rated output voltage is assumed to be 220V for 230V-class equipment and 440V for 460V-class equipment.

• Rated output voltage
A fundamental wave rms equivalent of the voltage that is generated across the output terminal when the AC input voltage (supply voltage) and frequency meet their rated conditions and the output frequency of the inverter equals the base frequency.

• Rated output current
A total rms equivalent of the current that flows through the output terminal under the rated input and output conditions (the output voltage, current, frequency, and load factor meet their rated conditions). Essentially, equipment rated at 200V covers the current of a 50Hz 6-pole motor and equipment rated at 400V covers the current of a 50Hz 4-pole motor.

• Overload capability
The overload current that an inverter can tolerate, expressed as a percentage of the rated output current and also as a permissible energization time.

• Voltage / frequency variations
Variations in the input voltage or frequency within permissible limits. Variations outside these limits might cause an inverter or motor failure.

• Voltage unbalance
A condition of an AC input voltage (supply voltage) that states the voltage balance of each phase in an expression as:

$$\text{Voltage unbalance [\%]} = \frac{\text{Maximum voltage [V] - Minimum voltage [V]}}{\text{Three-phase average voltage [V]}} \times 67$$

(Conforming EN61800-3 (5.2.3))

• Required power supply capacity
The capacity required of a power supply for an inverter. This is calculated by solving either of the following equations and is stated in kVA:

$$\text{Required power supply capacity [kVA]} = \sqrt{3} \times 200 \times \text{Input rms current (200V, 50Hz)}$$

$$\text{or} = \sqrt{3} \times 220 \times \text{Input rms current (220V, 60Hz)}$$

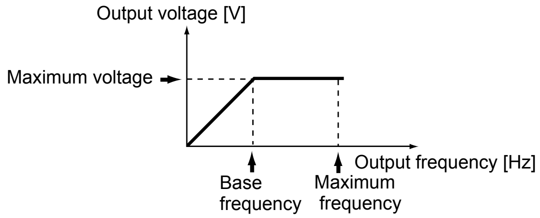
$$\text{Required power supply capacity [kVA]} = \sqrt{3} \times 400 \times \text{Input rms current (400V, 50Hz)}$$

$$\text{or} = \sqrt{3} \times 440 \times \text{Input rms current (440V, 60 Hz)}$$

• Momentary voltage dip capability
The minimum voltage [V] and time [ms] that permit continued rotation after a momentary voltage drop (instantaneous power failure).

• Maximum output frequency
The output frequency in the wake of the input of the maximum value of a frequency setup signal (for example, 10V for a voltage input range of 0 to 10V or 20mA for a current input range of 4 to 20mA).

• Base frequency
The frequency at which an inverter delivers a constant voltage in the output V/F pattern.



• Starting frequency
The minimum frequency at which an inverter starts its output (not the frequency at which a motor starts rotating).

• Carrier frequency
The frequency used to modulate a modulated frequency to establish a pulse width under the PWM control system. The higher the carrier frequency, the closer the inverter output current approaches a sinusoidal waveform and the quieter the motor becomes.

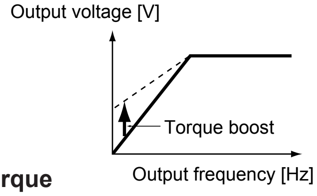
• Frequency accuracy (stability)
The percentage of variations in output frequency to a pre-defined maximum frequency, which is primarily influenced by ambient temperature.

• Frequency resolution
The minimum step, or increment, in which output frequency is varied, rather than continuously.

• Voltage/frequency characteristic
A characteristic representative of the variations in output voltage (V), and relative to variations in output frequency (f). To achieve efficient motor rotation, the voltage/frequency characteristic helps produce a motor torque matching the torque characteristics of a load.

• AVR control
A facility that keeps an output voltage constant regardless of variations in the input supply voltage or load.

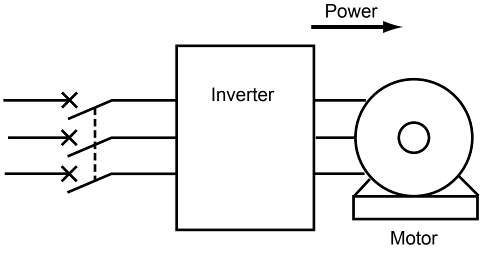
• Torque boost
If a general-purpose motor is run with an inverter, voltage drops would have a pronounced effect in a low-frequency region, reducing the motor output torque to a level significantly lower than that available if the motor would be run from a commercial power supply. In a low-frequency range, therefore, to minimize the loss of the motor output torque, it is necessary to increase the voltage to compensate for voltage drops. This process of voltage compensation is called torque boost.



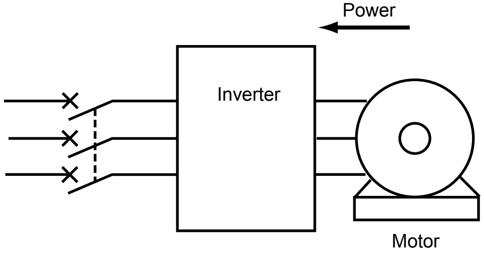
• Starting torque
The torque that a motor produces when it starts (or the power with which the motor can run a load).

• Braking torque
Torque that works in a direction that will stop a motor from rotating (or the power that is required to stop the motor).

[During accelerating or running at constant speed]



[During decelerating]



If the time for decelerating an inverter is set shorter than the natural stopping time for a load machine, the motor works as a generator when it decelerates, causing the kinetic energy of the load to be converted to electric energy that is returned to the inverter from the motor. If this power (regenerative power) is consumed by the inverter, the motor generates a braking force called "braking torque."

• DC injection braking
An inverter cuts its output at an output frequency of 0.2 Hz when the motor decelerates. If a load having a large moment of inertia is stopped or the motor is decelerated abruptly, however, the speed of the motor might not be fully reduced when the inverter reaches the output frequency of 0.2 Hz. Rather, inertial force would keep the motor rotating even after the inverter output has been cut. If the motor must be stopped completely, DC injection braking should be selected to cause DC current to flow through the motor to stop it completely.

• Protective structures
Protective structures of inverters as defined in IEC60529 "Degrees of protection provided by enclosures (IP Code)."

2. Common Specifications

• V/f control

The rotating speed N of a motor can be stated in an expression as

$$N = \frac{120f}{p}(1-s) \quad [r/min]$$

f: Input frequency
p: Number of poles
s: Slippage

On the basis of this expression, varying the input frequency varies the speed of the motor. However, simply varying the input frequency (f) would result in an overheated motor or would not allow the motor to demonstrate its optimum utility if the input voltage (V) remains constant. For this reason, the input voltage (V) must be varied with the input frequency (f) by using an inverter. This scheme of control is called V/f control.

• Dynamic torque-vector control

Calculation of the output matched to the status of a load at high speed to maximize the torque of the motor so as to optimize the current and voltage vectors. Dynamic torque-vector control calculates faster than previous methods of torque-vector control, providing a greater degree of control.

• Vector control with PG

Used to achieve positioning with greater accuracy.

• KEYPAD operation

To use a keypad panel to run an inverter.

• External potentiometer

A variable resistor (optional) that is used to set frequencies.

• Analog input

Used to set frequencies with external current and voltage input.

• Reversible operation

An inverter can be made to go forward or in reverse according to the polarity of an externally supplied voltage.

Polarity	FWD	REV
+	Forward	Reverse
–	Reverse	Forward

• Inverse operation

To invert an analog input signal.
Example:
0 to +10Vdc/0 to max. output frequency [Hz]
→ +10 to 0Vdc/0 to max. output frequency [Hz]
4 to 20mAdc/0 to max. output frequency [Hz]
→ 20 to 4mAdc/0 to max. output frequency [Hz]

• Multistep frequency selection

To preset frequencies (up to 16 stages), then select them at some later time.

• 12-bit parallel signals (12-bit binary)

A variation of inverter control signals.

• T-link

Fuji Electric's exclusive in-house linkage system used to control inverters by way of communications.

• Open bus

The following are some of the communications protocols used outside Japan.
- Profibus-DP
- Interbus-S
- Devicenet
- Modbus Plus

• JPCN1

This is a communications protocol used in Japan.

• Pattern operation

An operation consisting of iterative cycles of running seven different stages (stages 1 to 7) in sequence.

• Jogging operation

An extraordinary mode of operation in which a motor is made to go forward or in reverse at a frequency lower than usually.

• Transistor output

A control signal that generates predefined data from within an inverter via a transistor (open collector).

• Relay output
• Relay output multipurpose signal

A signal that is output via NO contact. The same data item as a transistor output can be generated.

• Batch alarm output/Alarm output (for any fault)

A no-voltage contact signal (1SPDT) that is generated by an inverter when it is halted by an alarm.

• Analog output

See the definition of terminal functions.

• Pulse output

See the definition of terminal functions.

• Bias frequency

The frequency set with an analog input frequency plus a bias frequency are combined to produce an output frequency.

• Gain (for frequency setting)

A frequency setting gain enables varying the slope of the output of the frequency set with an analog input frequency.

• Jump frequencies

Normally, the frequency of inverter output is continuous. However, output can become discontinuous within certain frequency ranges, called jump frequencies.

• Pick-up operation
An operation that smoothly initiates an inverter operation sequence without shutting down the motor even though the fan or other component is rotating under the influence of natural phenomena such as wind.

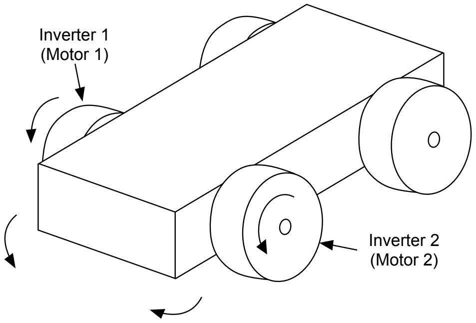
• Line/Inverter switching operation
A built-in circuit in an inverter that switches between commercial and inverter operations.

• Slip compensation control
A mode of control in which the output frequency of an inverter plus an amount of slip compensation is used as an actual output frequency to compensate for motor slippage.

• Torque limiting
A mode of control in which a limit value is set for the torque so the frequency is varied to hold the torque within that value.

• Droop control
A mode of control in which a balance is maintained between two motors used to drive a single load by using a negative amount of slip compensation.

Two concurrently running motors never have identical load factors because they have their own specific mechanical variations. The difference in load factors produces motor slippage, causing them to run at different speeds in an unbalanced manner.
As a result, either a motor could have a greater load than the other or could run erratically.
To control this phenomenon, the speed of either motor (for example, motor 1) is set higher than the other motor (motor 2), and inverter 1 is set to provide a negative amount of slip compensation (droop).
Whichever motor having the higher rpm (motor 1) will slip because it has a greater load factor than the other. Further, the negative amount of slip compensation adds to the slow-down of the motor, so that motor 1 will ultimately run at an rpm that is well-balanced with motor 2, in terms of load.



• PID control
The scheme of control that brings controlled objects to a desired value quickly and accurately, and which consists of three categories of action: proportional, integral and derivative.
Proportional action: Minimizes errors from a set point.
Integral action: Resets errors from a desired value to 0.

• Automatic deceleration
A mode of control in which deceleration time is automatically extended to prevent the inverter from tripping due to an overvoltage where a braking resistor is not used.

• Fan stop operation
A mode of control in which the cooling fan is shut down (where inverter is shut down) if the internal temperature in the inverter is low when no operation command is issued.

• Motor synchronous speed
Number of revolutions per minute [r/min] of a motor is stated in an expression as:

$$N = \frac{120f}{p} \quad [r/min]$$

f: Inverter output frequency [Hz]
p: Number of poles of the motor (4 at factory setting)

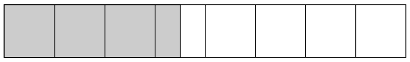
• Line speed
Number of revolutions per minute [r/min] of a line load, such as a conveyor.

• Load shaft speed
Number of revolutions per minute [r/min] of a rotating load, such as a fan.

• Trip
In response to an overvoltage, overcurrent, or any other unusual condition, actuation of an inverter's protective circuit to cut off the inverter output.

• Alarm
On an inverter, a coded indication of the cause of an interruption in the inverter output (inverter shut-down caused by a trip).

• Bar graph
A graphic representation of the output frequency, output current, and output torque of an inverter on its LCD screen.



• Electronic thermal overload relay
To safeguard a motor, calculations made within an inverter based on internal data about the characteristics of the motor.

• PTC thermistor
Type of thermistor designed to safeguard a motor.

• Stall
Although expected to stop, an inverter fails to produce the required torque due to a trip, such as one caused by overcurrent.

2. Common Specifications

• Tuning
A facility for implementing optimized control of a motor manufactured by other than Fuji Electric. Tuning deserves special notice for situations where there is a difference of three or more frames between the inverter and the motor.

• On-line tuning
Constant detection and calculation of motor constants to provide optimized control.

• Stopping frequency
The output frequency at which an inverter cuts its output.

• S-curve acceleration/deceleration (weak)
See Function H07 ACC/DEC pattern in Sections 3, Chapter 2.

• S-curve acceleration/deceleration (strong)
See Function H07 ACC/DEC pattern in Sections 3, Chapter 2.

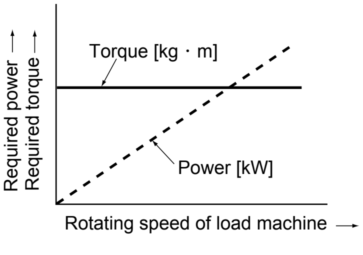
• Curved acceleration/deceleration (squared torque)
See Function H07 ACC/DEC pattern in Sections 3, Chapter 2.

• Reverse phase sequence lock
Function to prevent a motor from accidentally reversing as a result of an unintended KEYPAD operation or external input.

• Coast-to-stop
If inverter output is cut while a motor is rotating, the motor continues rotating due to inertial force. This state is called coast-to-stop.

• Thermal time constant
A detailed electronic thermal setting adjusted to meet the characteristics of a motor not manufactured by Fuji Electric.

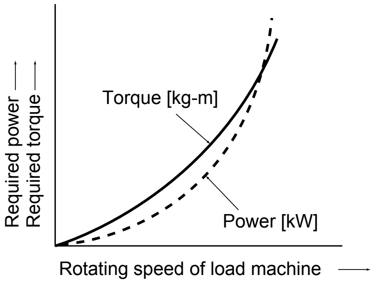
• Constant torque load
A constant torque load is characterized by:
① A requirement for an essentially constant torque, regardless of changes in the number of revolutions per minute.
② A power requirement that decreases in proportion to decreases in the number of revolutions per minute.
Examples: Conveyors, elevators, transport machines



• Squared torque load (Square law speed torque load)
A squared torque load is characterized by:
① A change in the required torque in proportion to the square of the number of revolutions per minute.
② A power requirement that decreases in proportion to the cube of decreases in the number of revolutions per minute.

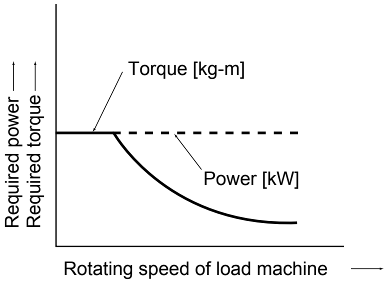
$$\text{Required power [kW]} = \frac{\text{Rotating speed [r/min] x Torque [N·m]}}{9.55}$$

Examples: Fans, pumps



• Constant output load
A constant output load is characterized by:
① An increase in the required torque in inverse proportion to a decrease in the number of revolutions per minute
② An essentially constant power requirement

Example: Machine tool spindle



Chapter 8
Appendix

Contents

Excerpt from Technical Document of
the Japan Electrical Manufacturers'
Association (JEMA) (April, 1994)

Appendix 1. Advantageous Use of Inverters (with regard to Electrical Noise)

1.1 Effect of inverters on other devices

This paper describes the effect that inverters, for which the field of applications is expanding, have on electronic devices already installed and on devices installed in the same system as the inverters. Measures to counter these effects are also introduced. (Refer to 1.3.3 Specific examples for further details.)

1.1.1 Effect on AM radios

(1) When operating an inverter, nearby AM radios may pickup noise from the inverter. (The inverter has almost no effect on FM radios or televisions)
(2) It is considered that radios receive noise radiated from the inverter.
(3) Measures to provide a noise filter on the power supply side of the inverter are effective.

1.1.2 Effect on telephones

(1) When operating an inverter, telephones may pickup noise during a conversation, making it difficult to hear.
(2) It is considered that a high-frequency leakage current radiated from the inverter and motors enters shielded telephone cables.
(3) It is effective to commonly connect the grounding terminals of the motors and return the common grounding line to the grounding terminal of the inverter.

1.1.3 Effect on proximity limit switches

(1) When operating an inverter, proximity limit switches (capacitance-type) may malfunction.
(2) It is considered that malfunction occurs because the capacitance-type proximity limit switches have inferior noise immunity.
(3) Connecting a filter to the input terminals of the inverter or changing the power supply treatment of the proximity limit switches is effective. In addition, the proximity limit switches can be changed to superior noise immunity types such as the magnetic type.

1.1.4 Effect on pressure sensors

(1) When operating an inverter, pressure sensors may malfunction.
(2) It is considered that malfunction occurs because noise penetrates through a grounding wire into the signal line.
(3) It is effective to install a noise filter on the power supply side of the inverter or to change the wiring.

1.1.5 Effect on position detectors (pulse generators; PGs, or pulse encoders)

(1) When operating an inverter, erroneous pulses from pulse converters may shift the stop position of a machine.
(2) Erroneous pulses are liable to occur when the signal lines of the PG and power lines are bundled together.
(3) The influence of induction noise and radiation noise can be reduced by separating the signal lines of the PG and power lines. Providing noise filters at the input and output terminals is also an effective measure.

1.2 Noise

A summary of the noise generated in inverters and its effect on devices susceptible to noise is described below.

1.2.1 Inverter noise

Figure 1 shows an outline of the inverter configuration. The inverter converts AC to DC (rectification) in a converter unit, and converts DC to AC (inversion) with 3-phase variable voltage and variable frequency. The conversion (inversion) is performed by PWM implemented by switching 6 transistors, and is used for variable speed motor control.

Switching noise is generated by the high-speed on/off switching of the 6 transistors. Noise current (i) is emitted and at each high-speed on/off switching the noise current flows through stray capacitance (C) of the inverter, cable and motor to the ground. The amount of the noise current,

$$I = C \cdot dv/dt$$

is related to the stray capacitance (C) and dv/dt (switching speed of the transistors). Further, this noise current is related to the carrier frequency since the noise current flows each time the transistors are switched on/off.

The frequency band of this noise is less than approximately 30 to 40MHz. Therefore, devices such as AM radios that use the low frequency band are affected by the noise, but FM radios and television using higher frequency than this frequency band are virtually unaffected.

Appendix 1. Advantageous Use of Inverters (with regard to Electrical Noise)

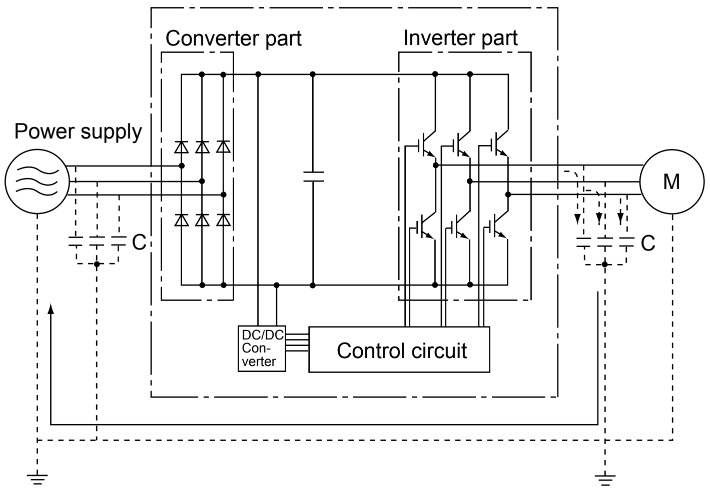


Fig. 1 Outline of inverter configuration

1.2.2 Types of noise

The noise generated in the inverter is propagated through the main circuit wiring to the power supply and the motor, and effects a wide range from the power supply transformer to the motor.
The various propagation routes are shown in Fig. 2, but these are roughly classified into 3 routes of conduction noise, induction noise and radiation noise.

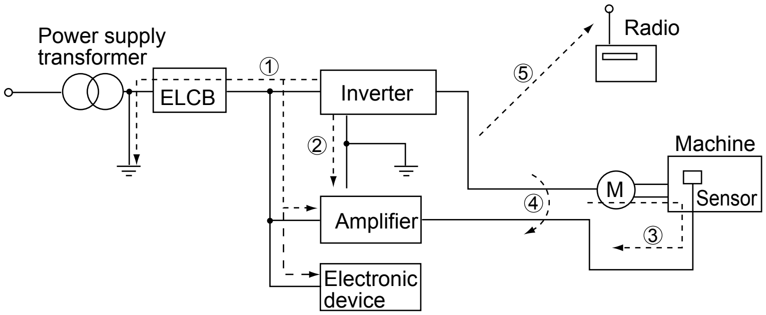


Fig. 2 Noise propagation routes

(1) Conduction noise

Conduction noise is generated in the inverter, propagates through the conductor and power supply, and effects peripheral devices of the inverter (Fig. 3) Some conduction noise ① propagates through the main circuit. If the ground lines are connected with a common connection, there is conduction through route ②. There is also noise ③ through the signal line and shielded wire.

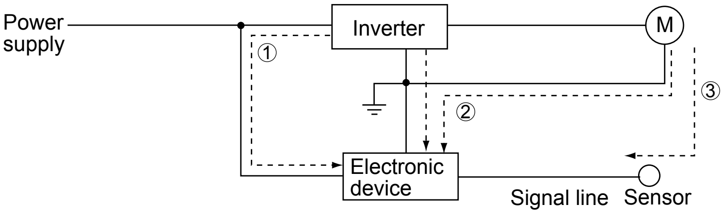


Fig. 3 Conduction noise

(2) Induction noise

When the wire and signal lines of peripheral devices are brought close to the wires on the input and output sides of the inverter, noise is induced in the wire and signal lines of the devices by electromagnetic induction (Fig. 4) and electrostatic induction (Fig. 5). This is induction noise ④.

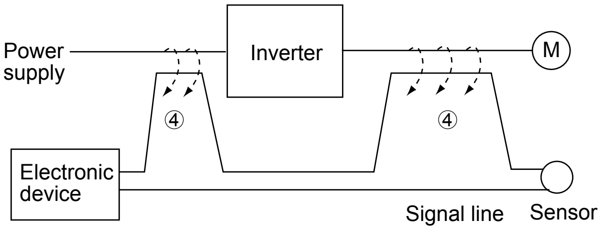


Fig. 4 Electromagnetic noise

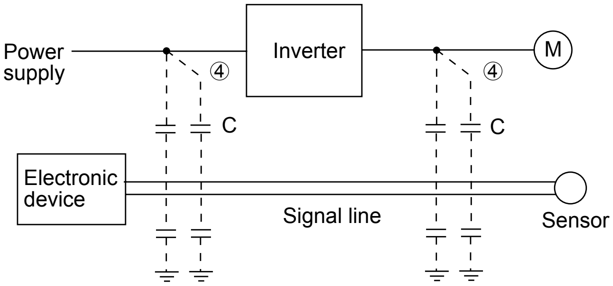


Fig. 5 Electrostatic noise

(3) Radiation noise

Noise generated in the inverter is radiated through the air from antennas consisting of wires at the input and output sides of the inverter. This noise is radiation noise ⑤ (Fig. 6). The antennas that emit radiation noise are not limited only to wires, the motor frame and panel containing the inverter may also act as antennas.

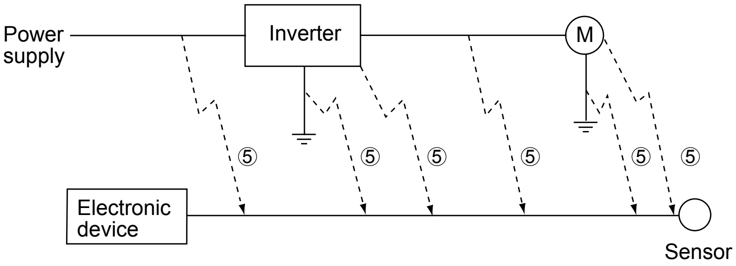


Fig. 6 Radiation noise

1.3 Noise prevention measures

As noise prevention measures are strengthened, they become more effective. With the use of appropriate measures, noise problems may be resolved simply. Therefore, it is necessary to implement economical noise prevention measures according to the noise level and the equipment condition.

1.3.1 Noise prevention treatments prior to installation

Before inserting an inverter in a control panel or installing an inverter panel, it is necessary to consider the noise. Once noise problems occur, great expenditures of apparatuses, materials and time are required.
Noise prevention treatments prior to installation are listed below.
① Separation of the wiring of the main circuit and control circuit
② Insertion of the main circuit wiring into a metal pipe (conduit pipe)
③ Use of shielded wire or twisted shielded wire in the control circuit.
④ Implementation of appropriate grounding work and grounding wiring.
These treatments can avoid most noise problems.

1.3.2 Implementation of noise prevention measures

There are two types of noise prevention measures, those that correspond to the propagation route and those that counteract the effect of noise on the receiving side (side that is adversely affected by the noise).
The basic measure to lessen the effect of noise on the receiving side is to:
① Separate the main circuit wiring from the control circuit wiring, making it more difficult to receive noise.
The basic measures to lessen the effect of noise on the generating side are to:
② Install a noise filter to reduce the noise level.
③ Apply a metal conduit pipe or metal control panel to confine the noise level, and
④ Apply an insulated transformer for the power supply to cut off the noise propagation route.

Table 1 lists the methods for preventing the noise problems, their goals and the propagation routes.
Next, noise prevention measures are presented for the inverter drive configuration.

(1) Wiring and grounding
Separating the main circuit and control circuit as much as possible, both inside and outside the control panel, and the use of shielded wire and twisted shielded wire, makes it more difficult to receive noise and allows wiring distances to be minimized (refer to Fig. 7). Take notice that the wiring of the main circuit and control circuit does not become bundled or parallel wiring.

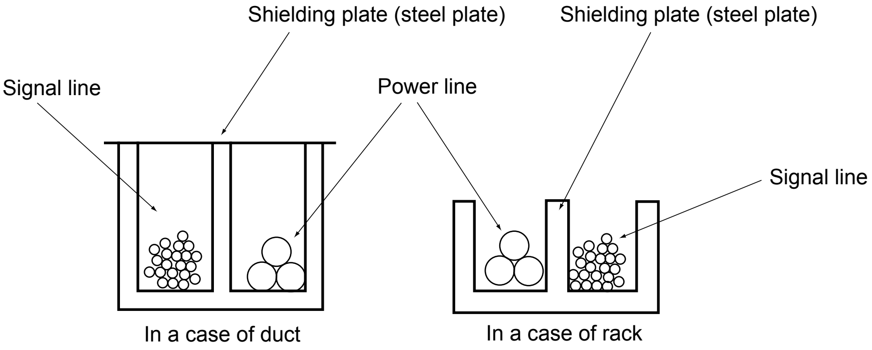


Fig. 7 Method of separating wiring

For the main circuit wiring, a metal conduit pipe is used and grounded through a grounding wiring to prevent noise propagation (refer to Fig. 8).
The shield (braided wire) of the shielded wire is securely connected to the base (common) side of the signal line at only one point to avoid the loop formation resulting from a multi-point connection (refer to Fig. 9).
The grounding is effective to not only to reduce the risk of electric shocks, but also to block noise penetration and radiation.
Corresponding to the main circuit voltage, the grounding work should be No. 3 grounding work (300V AC or less) and special No. 3 grounding work (300 to 600V AC). Each ground wire is to be provided with its own ground or separately wired to a grounding point.

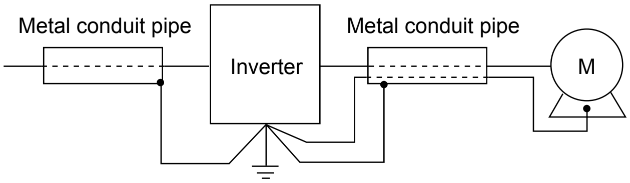


Fig. 8 Grounding of metal conduit pipe

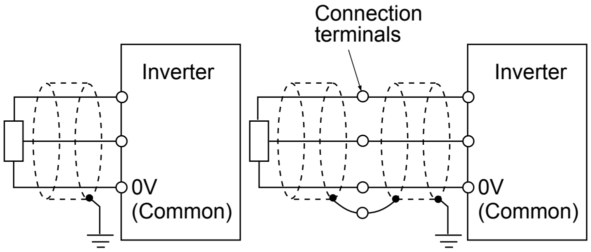


Fig. 9 Treatment of braided wire of shielded wire

Table 1 Noise prevention methods

Noise prevention method		Goal of noise prevention measure				Conduction route		
		Make it more difficult to receive noise	Cutoff noise conduction	Confine noise	Reduce noise level	Conduction noise	Induction noise	Radiation noise
Wiring and installation	Separate main circuit and control circuit	○					○	
	Minimum wiring distance	○			○		○	○
	Avoid parallel and bundled wiring	○					○	
	Use appropriate grounding	○			○	○	○	
	Use shielded wire and twisted shielded wire	○					○	○
	Use shielded cable in main circuit			○			○	○
	Use metal conduit pipe			○			○	○
Control panel	Appropriate arrangement of devices in panel	○					○	○
	Metal control panel			○			○	○
Anti-noise device	Line filter	○			○	○		○
	Insulation transformer		○			○		○
Treatment on the noise receiving side	Use passing capacitor	○					○	○
	Use ferrite core for control circuit	○			○		○	○
	Line filter	○		○		○		
Others	Separate power supply systems		○			○		
	Lower the carrier frequency				△	○	○	○

(2) Control panel

The control panel containing the inverter is generally made of metal, and this metal box can shield noise radiated from the inverter itself.

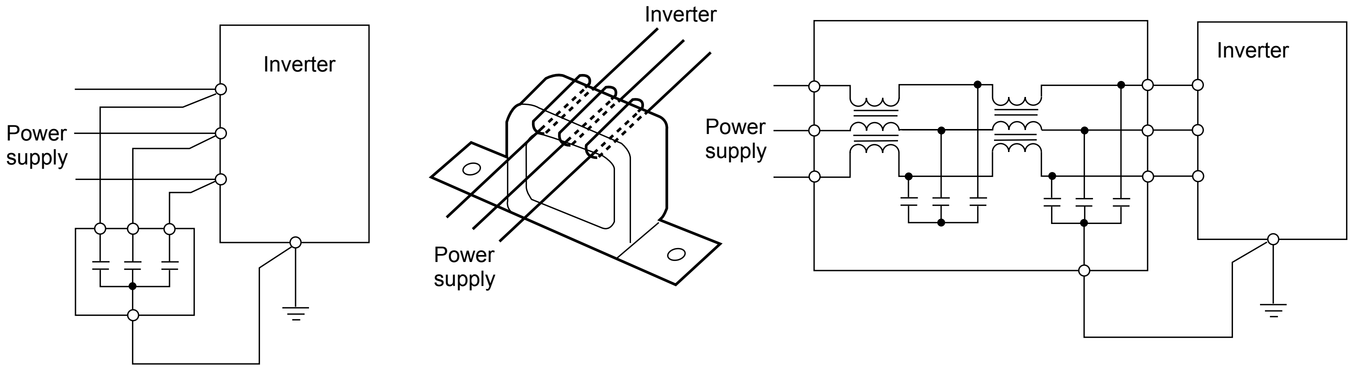
Further, when installing other electronic devices such as a programmable logic controller in the same control panel, attention should be paid to the arrangement of each device. When necessary, a noise prevention measure should be implemented, such as installing a shielding plate between the inverter and peripheral devices.

(3) Anti-noise devices

To reduce the noise propagated through the electrical circuits and the noise radiated from the main circuit wiring to the air, a line filter and power supply transformer are utilized (refer to Fig 10).

Among line filters, there are the simple type filters, such as a capacitive filter connected in parallel to the power supply line and an inductive filter connected in series to the power supply line, as well as orthodox filters (LC filters). These filters are used according to the targeted effect for reducing noise. In power supply transformers, there are common insulated transformers, shielded transformers, noise-cut transformers, etc. These transformers have different effectiveness in blocking noise propagation.

(4) Noise prevention measures on the receiving side



(a) Capacitive filter (b) Inductive filter (zero-phase reactor or ferrite ring)) (c) LC filter

Fig. 10 Various filters and their connection methods

It is important to strengthen the noise immunity of those electronic devices installed in the same control panel as the inverter and/or located near the inverter.
Line filters and shielded or twisted shielded wire is used to block the penetration of noise in the signal lines of these devices.
The following treatments are also implemented.

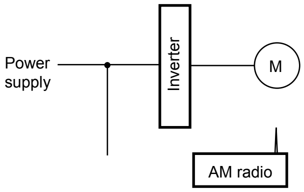
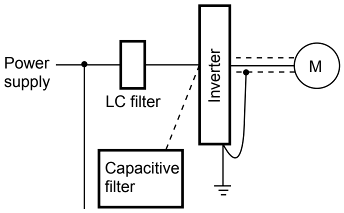
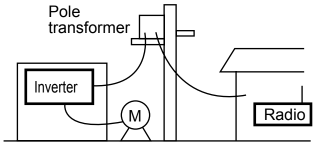
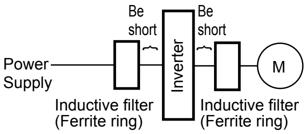
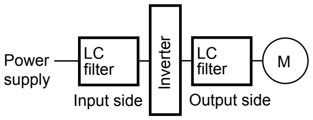
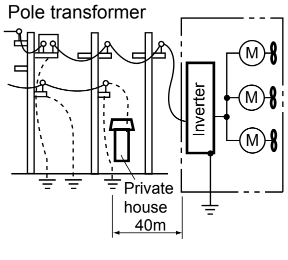
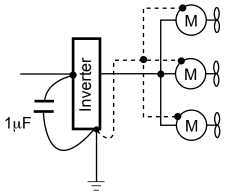
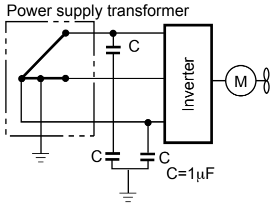
① The circuit impedance is lowered by connecting capacitors or resistors to the input and output terminals of the signal circuit in parallel.
② The circuit impedance for noise is increased by inserting choke coils in series in the signal circuit, or, passing the signal through ferrite core beads.
It is also effective to widen the signal base line (0 V line) or grounding line.

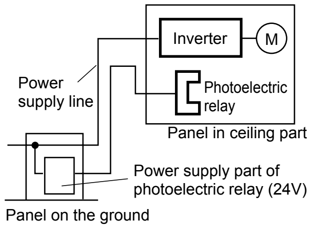
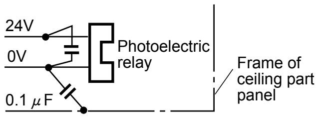
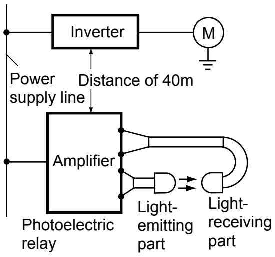
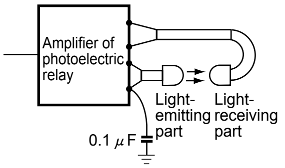
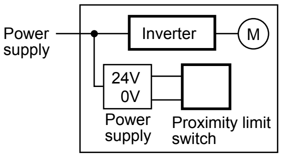
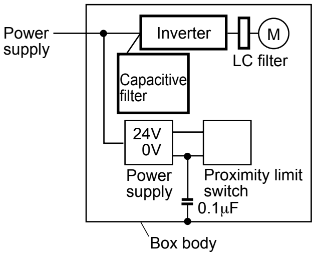
(5) Other
The generating (propagating) level of noise changes with the carrier frequency of the inverter, the higher the carrier frequency, the higher the generated level of noise.
In the case of an inverter for which the carrier frequency can be changed, lowering the carrier frequency can reduce the generation of electrical noise and result in a good balance with the audible noise of the motor under driving conditions.

1.3.3 Specific examples

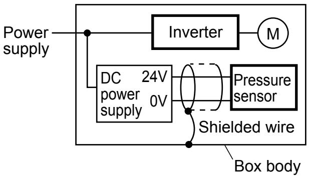
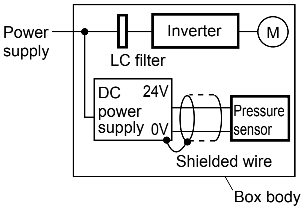
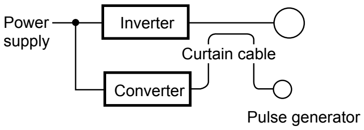
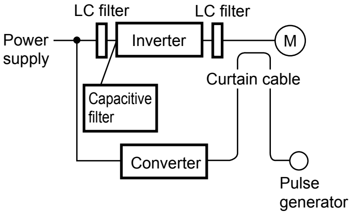
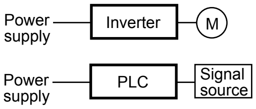
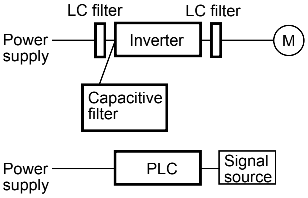
Table 2 lists specific examples of the measures to prevent noise generated by operation of the inverter.

Table 2 Specific examples of noise prevention measures

No.	Target device	Phenomena	Noise prevention measures	Notes
1	MAradio	When operating an inverter, noise entered into AM radio broadcast (500 to 1500kHz).  <Estimated cause> It is considered that the AM radio receives noise radiated from wires at the power supply and output sides of the inverter.	①Install an LC filter on the power supply side of the inverter. (A simple method is to install a capacitive filter. ②Install a metal conduit wiring between the motor and inverter.  Note: Minimize the distance between the LC filter and inverter as much as possible (within 3ft (1m)).	①The radiation noise of the wiring is reduced. ② The conduction noise to the power supply side is reduced. Further, shielded wiring is used. Note: Sufficient improvement may not be expected in narrow regions such as between mountains.
2	AM radio	When operating an inverter, noise entered into AM radio broadcast (500 to 1500kHz).  <Estimated cause> It is considered that the AM radio receives noise radiated from the power line at the power supply side of the inverter.	①Install inductive filters at the input and output sides of the inverter.  The number of turns of the zero-phase reactor (or ferrite ring) should be as large as possible. Further, wiring between the inverter and the zero-phase reactor (or ferrite ring) should be short as possible. (within 3ft (1m)) ②When further improvement is necessary, install LC filters.  	①The radiation noise of the wiring is reduced.
3	Telephone (in a common private residence at a distance of 130ft (40m))	When driving a ventilation fan with an inverter, noise entered a telephone in a private residence at a distance of 130ft (40m).  <Estimated cause> A high-frequency leakage current from the inverter and motor flowed to grounded part of the telephone cable shield. During the current's return trip, it flowed through a grounded pole transformer, and noise entered the telephone by electrostatic induction.	①Connect the ground terminals of the motors in a common connection. Return to the inverter panel, and insert a 1μF capacitor between the input terminal of the inverter and ground.  	①The effect of the inductive filter and LC filter may not be expected because of sound frequency component. ②In the case of a V–connection power supply transformer in a 230V system, it is necessary to connect capacitors as shown in the following figure, because of different potentials to the ground. 

No.	Target device	Phenomena	Noise prevention measures	Notes
4	Photoelectric relay	A photoelectric relay malfunctioned when the inverter was operated. [The inverter and motor are installed in the same place (for overhead traveling)]  <Estimated cause> It is considered that induction noise entered the photoelectric relay since the inverter's input power supply line and the photoelectric relay's wiring are in parallel separated by approximately 0.98inch (25mm) over a distance of 98 to 131ft (30 to 40m). Due to conditions of the installation, these lines cannot be separated.	①As a temporary measure, insert a 0.1μF capacitor between the 0 V terminal of the power supply circuit in the detection unit of the overhead photoelectric relay and a frame of the overhead panel.  ②As a permanent measure, move the 24V power supply from the ground to the overhead unit so that signals are sent to the ground side with relay contacts in the ceiling part.	①The wiring is separated. (by more than 11.81inch (30cm).) ②When separation is impossible, signals can be received and sent with dry contacts etc. ③Do not wire weak-current signal lines and power lines in parallel.
5	Photoelectric relay	A photoelectric relay malfunctioned when the inverter was operated.  <Estimated cause> Although the inverter and photoelectric relay are separated by a sufficient distance, since the power supplies share a common connection, it is considered that conduction noise entered through the power supply line into the photoelectric relay.	①Insert a 0.1μF capacitor between the output common terminal of the amplifier of the photoelectric relay and a frame. 	①If a weak-current circuit on the malfunctioning side is observed, the countermeasures may be simple and economical.
6	Proximity limit switch (electrostatic type)	A proximity limit switch malfunctioned.  <Estimated cause> It is considered that the capacitance type proximity limit switch is susceptible to conduction and radiation noise because of its low noise immunity.	①Install an LC filter on the output side of the inverter. ②Install a capacitive filter on the input side of the inverter. ③Ground the 0 V (common) line of the DC power supply of the proximity limit switch through a capacitor to the box body of the machine. 	①Noise generated in the inverter is reduced. ②The switch is superseded by a proximity limit switch of superior noise immunity (such as a magnetic type) .

Appendix 1. Advantageous Use of Inverters (with regard to Electrical Noise)

No.	Target device	Phenomena	Noise prevention measures	Notes
7	Pressure sensor	A pressure sensor malfunctioned.  <Estimated cause> It is considered that the pressure sensor signal malfunction was due to noise that came from the box body and traveled through the shield of the shielded wire.	①Install an LC filter on the input side of the inverter. ②Connect the shield of the shielded wire of the pressure sensor to the 0 V line (common) of the pressure sensor, changing the original connection. 	①The shielded parts of shield wire for sensor signals are connected to a common point in the system. ②Conduction noise from the inverter is reduced.
8	Position detector (pulse generator: PG)	Erroneous-pulse outputs from a pulse converter caused a shift in the stop position of a crane.  <Estimated cause> It is considered that erroneous pulses are output by induction noise since the power line of the motor and the signal line of the PG are bundled in a lump.	①Install an LC filter and a capacitive filter on the input side of the inverter. ②Install an LC filter on the output side of the inverter. 	①This is an example of a measure where the power line and signal line cannot be separated. ② Induction noise and radiation noise on the output side of the inverter are reduced.
9	Programmable logic controller (PLC)	The PLC program sometimes malfunctions.  <Estimated cause> Since the power supply system is the same for the PLC and inverter, it is considered that noise enters the PLC through the power supply.	①Install a capacitive filter and an LC filter on the input side of the inverter. ②Install an LC filter on the output side of the inverter. ③Lower the carrier frequency of the inverter. 	①Total conduction noise and induction noise in the electric line are reduced.

Excerpt from Technical Document of
the Japan Electrical Manufacturers'
Association (JEMA) (March, 1995)

Appendix 2. Effect on Insulation of General-purpose Motor Driven with 460V Class Inverter

Introduction

When an inverter drives a motor, surge voltages generated by switching the inverter elements are superimposed on the inverter output voltage and applied to the motor terminals. If the surge voltages are too high they may have an effect on the motor insulation and some cases have resulted in damage.

For preventing such cases this document describes the generating mechanism of the surge voltages and countermeasures against them.

2.1 Operating principle of inverter

2.1.1 Main circuit configuration of inverter

The main circuit of an inverter is configured with a converter part and an inverter part. The former part rectifies a commercial power source voltage and eliminates resulting ripple components, and the latter part converts DC voltage to AC voltage through a 3-phase bridge circuit composed of switching elements like transistors. (Refer to Fig. 1)

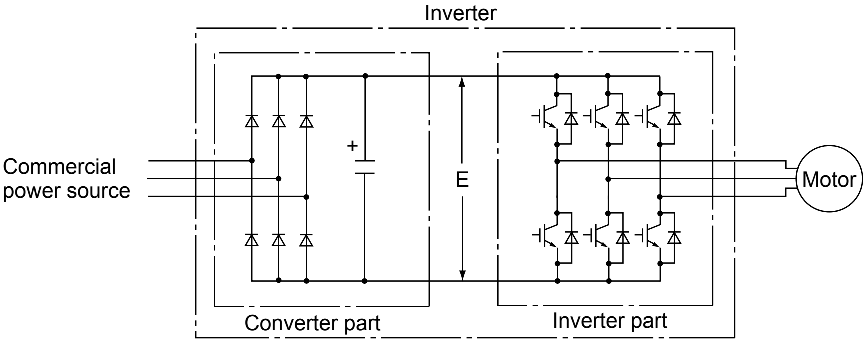


Fig. 1 Main circuit configuration of inverter

2.1.2 Control method of inverter

The PWM (Pulse Width Modulation) control is commonly adopted in general-purpose inverters. This method generates multiple switching pulses in one output cycle because both the output voltage and frequency are simultaneously controlled in the inverter part. The output voltage control is carried out by varying the pulse width while the pulse magnitude is kept constant.

The number of switching pulses generated in one second is designated as a carrier frequency and is normally high up to 0.7 to 16kHz. So transistors capable of high-speed switching (IGBT, etc.) are used for inverter elements.

2.2 Generating mechanism of surge voltages

As the inverter rectifies a commercial power source voltage and smoothes into a DC voltage, the magnitude E of the DC voltage becomes about $\sqrt{2}$ times of that of the source voltage (about 620V in case of an input voltage of 440V AC). The peak value of the output voltage is usually close to this DC voltage value.

But, as there exists inductance (L) and stray capacitance (C) in wiring between the inverter and the motor, the voltage variation due to switching the inverter elements causes a surge voltage originating in LC resonance and results in the addition of a high voltage to the motor terminals. (Refer to Fig.2)

This voltage sometimes reaches up to about twice of the inverter DC voltage (620V x 2 = about 1,200V) depending on a switching speed of the inverter elements and a wiring condition.

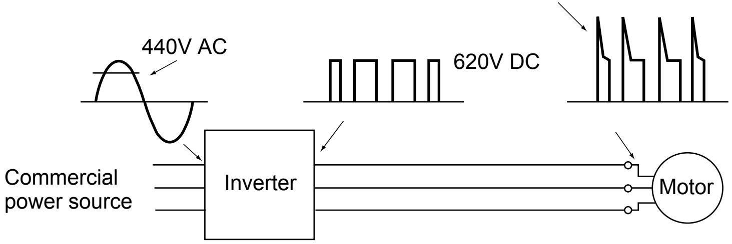
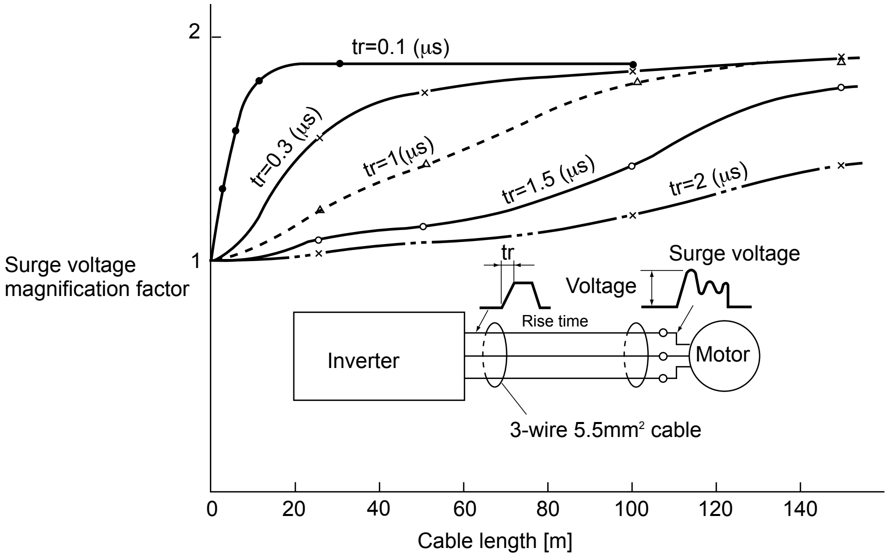


Fig. 2 Voltage wave shapes of individual positions

A measured example in Fig. 3 illustrates relation of a peak value of the motor terminal voltage with a wiring length between the inverter and the motor.
From this it can be confirmed that the peak value of the motor terminal voltage ascends as the wiring length increases and becomes saturated at about twice of the inverter DC voltage.
Besides the shorter a pulse rise time becomes, the higher the motor terminal voltage rises even in case of a short wiring length.



IGBT corresponds to
tr = 0.1 to 0.3μs.
Bipolar transistor corresponds to
tr = 0.3 to 1μs.
The case when an output reactor and/or a filter are inserted corresponds to
tr > 1μ s.
Surge voltage magnification factor :
Magnification factor against DC voltage E

Excerpt from [J. IEE Japan, Vol. 107, No. 7, 1987]

Fig. 3 Measured example of wiring length and peak value of motor terminal voltage

2.3 Effect of surge voltages

The surge voltages originating in LC resonance of wiring may be applied to the motor input terminals and depending on their magnitude sometimes cause damage to the motor insulation.
When the motor is driven with a 230V class inverter, as for dielectric strength of the insulation it is no problem that the peak value at the motor terminal voltage increases twice due to the surge voltages, since the DC voltage is only about 300V.
But in case of a 400V class inverter the DC voltage becomes about 600V and depending on wiring length the surge voltages may highly rise and sometimes result in damage to the insulation.

2.4 Countermeasures against surge voltages

The following methods are countermeasures against damage to the motor insulation by the surge voltages in case of a motor driven with a 460V class inverter.

2.4.1 Method to use motors with enhanced insulation

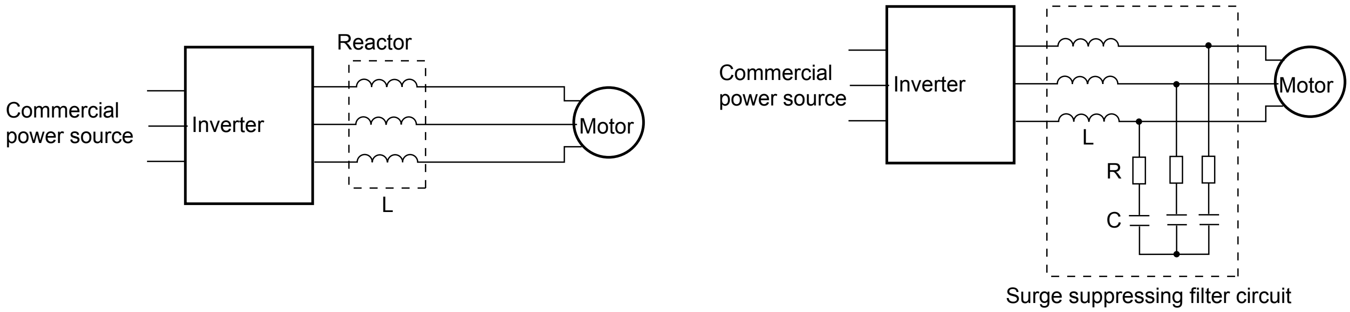
Enhanced insulation of a motor winding allows its surge proof strength to be improved.

2.4.2 Method to suppress surge voltages

There are two methods for suppressing the surge voltages, one is to reduce the voltage rising and another is to reduce the voltage peak value.

(1) Output reactor
If wiring length is relatively short the surge voltages can be suppressed by reducing the voltage rising (dv/dt) with installation of an AC reactor on the output side of the inverter. (Refer to Fig. 4 (1)) However, if the wiring length becomes long, suppressing the peak voltage due to surge voltage may be difficult.

(2) Output filter
Installing a filter on the output side of the inverter allows a peak value of the motor terminal voltage to be reduced. (Refer to Fig. 4 (2))



(1) Output reactor **(2) Output filter**

Fig. 4 Method to suppress surge voltage

2.5 Regarding existing equipment

2.5.1 In case of motor being driven with 400V class inverter

The last five years survey on motor insulation damage due to the surge voltages originating from switching of inverter elements shows that the damage incidence is 0.013% under the surge voltage condition of over 1,100V and most of the damage occurs in several months after commissioning of the inverter. Therefore there seems to be little probability of occurrence of motor insulation damage after a lapse of several months of commissioning.

2.5.2 In case of existing motor driven newly with 400V class inverter

We recommend to suppress the surge voltages with the method of 2.4.2.

Appendix 3. Example Calculation of Energy Savings

The energy saving that results from use of an inverter is calculated based on a specific calculation result (in the case of a fan and pump). The Q-P characteristic curve corresponding to damper use in Fig. 1 changes depending on the motor capacity and manufacturer. Therefore, characteristic curves should be obtained individually when performing a detailed calculation.

2.1 Calculating condition

[Use]

- Fan for air conditioning

[Usage period]

- 250 days / year (24 hours / day)

[Reduced rate of air flow with damper]

- In accordance with general output characteristics (Q-P curve) in Fig.1

[Reducing rate of air flow with an inverter (frequency)]

- 60Hz → 40Hz

[Electric power at maximum air flow rate :P_0 [kW]]

- P_0 = Applied motor [kW] x 1 / Motor efficiency → P_0
  = Applied motor [kW] x 1/0.9

<In a case of a motor of 37kW>

- P_0 = 37 x 1/0.9
  = 41.1 kW

[Power rate per 1 kWh : M_2 [US$]]

- Suppose US$0.04/kWh

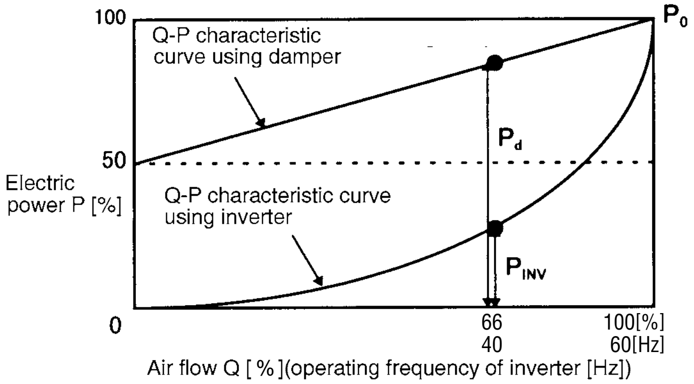


Fig.1 Q-P characteristic curve

2.2 Calculation of shaft driving power

[Shaft driving power with damper control : Pd]

Pd = ((50+50 x (40/60))/100 x P_0
= 0.833 P_0 [kW]

[Shaft driving power with inverter control : P_{INV}]

P_{INV} = $(40/60)^3$ x P_0
= 0.296 x P_0 [kW]

2.3 Calculation of energy savings

A specific example of the energy savings is calculated with the following formula.

<Formula>

- M_1 = (Pd - P_{INV}) x T x M_2 [US$/year]

where M_2 : Electricity bill of the energy saving [US$/year]
T : Operating time per year [h]
M_2 : Power rate per 1 kWh [US$]

■ Calculation example

- M_1 = (Pd - P_{INV}) x T x M_2 [US$/year]
  = (0.833-0.296) x P_0 x T x M_2
  = 0.537 x 41.1 x (250 x 24) x 0.04
  = 5,297 [US$/year]

Therefore, energy savings of approximately US$18,500/year are obtained.

Appendix 4. Inverter Generating Loss

Inverter generating loss

Power supply voltage	Nominal applied motor [HP]	Inverter type		Generating loss [W]			
		G11S series	P11S series	G11S series Carrier frequency (fc)		P11S series Carrier frequency (fc)	
				Low (2kHz)	High (15kHz)	Low (2kHz)	High (15kHz)
Three-phase 230V	1/4	FRNF25G11S-2UX	-	25	30	-	-
	1/2	FRNF50G11S-2UX		35	45		
	1	FRN001G11S-2UX		50	60		
	2	FRN002G11S-2UX		80	110		
	3	FRN003G11S-2UX		110	140		
	5	FRN005G11S-2UX		170	210		
	7.5	FRN007G11S-2UX	FRN007P11S-2UX	240	320	210	280
	10	FRN010G11S-2UX	FRN010P11S-2UX	300	415	290	370
	15	FRN015G11S-2UX	FRN015P11S-2UX	450	620	410	550
	20	FRN020G11S-2UX	FRN020P11S-2UX	540	720	500	670
	25	FRN025G11S-2UX	FRN025P11S-2UX	670	890	630	840
	30	FRN030G11S-2UX	FRN030P11S-2UX	880	1160	770	1030
	40	FRN040G11S-2UX	FRN040P11S-2UX	1150	1400	1250	1400 *1)
	50	FRN050G11S-2UX	FRN050P11S-2UX	1400	1750	1550	1700 *1)
	60	FRN060G11S-2UX	FRN060P11S-2UX	1700	2050	1800	2050 *1)
	75	FRN075G11S-2UX	FRN075P11S-2UX	1950	2400	2100	2350 *1)
	100	FRN100G11S-2UX	FRN100P11S-2UX	2750	3100 *1)	2800	3100 *1)
	125	FRN125G11S-2UX	FRN125P11S-2UX	3250	3650 *1)	3350	3500 *2)
	150	-	FRN150P11S-2UX	-	-	3950	4150 *2)
Three-phase 460V	1/2	FRNF50G11S-4UX	-	35	60	-	-
	1	FRN001G11S-4UX		45	85		
	2	FRN002G11S-4UX		60	110		
	3	FRN003G11S-4UX		80	150		
	5	FRN005G11S-4UX		130	230		
	7.5	FRN007G11S-4UX	FRN007P11S-4UX	170	300	160	290
	10	FRN010G11S-4UX	FRN010P11S-4UX	230	400	210	370
	15	FRN015G11S-4UX	FRN015P11S-4UX	300	520	300	520
	20	FRN020G11S-4UX	FRN020P11S-4UX	360	610	360	610
	25	FRN025G11S-4UX	FRN025P11S-4UX	460	770	460	770
	30	FRN030G11S-4UX	FRN030P11S-4UX	550	900	530	870
	40	FRN040G11S-4UX	FRN040P11S-4UX	900	1400	1100	1400 *1)
	50	FRN050G11S-4UX	FRN050P11S-4UX	1000	1700	1300	1600 *1)
	60	FRN060G11S-4UX	FRN060P11S-4UX	1150	1950	1450	1900 *1)
	75	FRN075G11S-4UX	FRN075P11S-4UX	1400	2300	1700	2200 *1)
	100	FRN100G11S-4UX	FRN100P11S-4UX	2000	2800 *1)	2050	2700 *1)
	125	FRN125G11S-4UX	FRN125P11S-4UX	2350	3250 *1)	2650	2950 *2)
	150	FRN150G11S-4UX	FRN150P11S-4UX	2600	3600 *1)	2950	3300 *2)
	200	FRN200G11S-4UX	FRN200P11S-4UX	2950	4150 *1)	3300	3750 *2)
	250	FRN250G11S-4UX	FRN250P11S-4UX	3450	4900 *1)	3900	4450 *2)
	300	FRN300G11S-4UX	FRN300P11S-4UX	3950	5750 *1)	4450	5150 *2)
	350	FRN350G11S-4UX	FRN350P11S-4UX	4400	6350 *1)	4950	5700 *2)
	400	FRN400G11S-4UX	FRN400P11S-4UX	5550	8050 *1)	5800	6700 *2)
	450	FRN450G11S-4UX	FRN450P11S-4UX	6250	9000 *1)	6500	7550 *2)
	500	FRN500G11S-4UX	FRN500P11S-4UX	6950	10200 *1)	7250	8450 *2)
	600	FRN600G11S-4UX	FRN600P11S-4UX	7850	11400 *1)	8250	9550 *2)
	700	-	FRN700P11S-4UX	-	-	9200	10700 *2)
	800		FRN800P11S-4UX			10400	12100 *2)

NOTES: *1) fc=10kHz
*2) fc=6kHz

MEMO

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Printed in Japan 2007-8 (H07/H07) CM 5 FIS