CHECKED: K. Ueki/NAKATO APPROVED: S. Taka. DATE: 2019/06/20

FRENIC - MEGA
Product Specifications
(Type :FRN□□□G1□-4E□)

Electronic Equipment Dept.
Suzuka Factory

	Date	Signature	Approved		Fuji Electric Systems Co., Ltd	a/
Drawn	12th-Feb-'08	T.Nakanishi	Y.Matsumoto			b/
Checked	12th-Feb-'08	Y.Hachisu			Drawing No. SI27- 4648 1/28	c

1. Standard specifications

1-1. Standard Models 1 (EMC filter built-in type)

1) Three-phase 400 V series

(0.4 to 55 kW) HD mode designed for heavy duty load applications

Item			Specifications																
Type (FRN□□□G1E-4E)			0.4	0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55		
Nominal applied motor*2 [kW]			0.4	0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55		
Output ratings	Rated capacity*3 [kVA]		1.1	1.9	2.8	4.1	6.8	10	14	18	24	29	34	45	57	69	85		
	Rated voltage*4 [V]		Three-phase, 380 to 480 V (with AVR function)																
	Rated current [A]		1.5	2.5	4	5.5	9	13.5	18.5	24.5	32	39	45	60	75	91	112		
	Overload capability		150% -1 min, 200% -3.0 s																
Input ratings	Voltage, frequency		Three-phase, 380 to 480 V, 50/60 Hz																
	Allowable voltage/frequency		Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *6, Frequency: +5 to -5%																
	Required capacity with DCR*7 [kVA]		0.6	1.2	2.1	3.2	5.2	7.4	10	15	20	25	30	40	48	58	71		
Braking	Torque*8 [%]		150%		100%					20%				10 to 15%					
	Braking transistor		Built-in											-					
	Built-in braking resister		Built-in							-									
		Braking time [s]	5 s							-									
		%ED	5	3	5	3	2	3	2	-									
EMC filter			Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)																
DC reactor (DCR)			Option																
KEY PAD			Option																
Applicable safety standards *10			UL508C, C22.2No.14, EN61800-5-1:2007 EN ISO 13849-1:2015 PL=d Cat.3, EN 61800-5-2:2007 SIL2																
Enclosure (IEC60529)			IP20, UL open type											IP00 UL open type					
Cooling method			Natural cooling			Fan cooling													
Weight/Mass [kg]			1.8	2.1	2.7	2.9	3.2	6.8	6.9	6.2	10.5	10.5	11.2	26	27	32	33		

(*2) Fuji 4-pole standard motor

(*3) Rated capacity is calculated by assuming the output rated voltage as 220 V for 200 V series and 440 V for 400 V series.

(*4) Output voltage cannot exceed the power supply voltage.

(*6) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V]×67(See IEC61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(*7) Required when a DC reactor (DCR) is used.

(*8) Average braking torque for the motor running alone. (It varies with the efficiency of the motor.)

(75 to 630 kW) HD mode designed for heavy duty load applications

Item		Specifications																
Type (FRN□□□G1E-4E)		75	90	110	132	160	200	220	280	315	355	400	500	630				
Nominal applied motor*2 [kW]		75	90	110	132	160	200	220	280	315	355	400	500	630				
Output ratings	Rated capacity*3 [kVA]	114	134	160	192	231	287	316	396	445	495	563	731	891				
	Rated voltage*4 [V]	Three-phase, 380 to 480 V (with AVR function)																
	Rated current [A]	150	176	210	253	304	377	415	520	585	650	740	960	1170				
	Overload capability	150%-1 min, 200% -3.0 s																
Input ratings	Voltage, frequency	Three-phase, 380 to 440 V, 50 Hz Three-phase, 380 to 480 V, 60 Hz																
	Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *6, Frequency: +5 to -5%																
	Required capacity with DCR*7 [kVA]	96	114	140	165	199	248	271	347	388	436	489	661	773				
Braking	Torque*8 [%]	10 to 15 %																
	Braking transistor	-																
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)																
DC reactor (DCR)		Option *9																
KEY PAD		Option																
Applicable safety standards *10		UL508C, C22.2No.14, EN61800-5-1:2007 EN ISO 13849-1:2015 PL=d Cat.3, EN 61800-5-2:2007 SIL2																
Enclosure (IEC60529)		IP00, UL open type																
Cooling method		Fan cooling																
Weight/Mass [kg]		42	62	64	94	**98**	**129**	**140**	**245**	**245**	**330**	**330**	**530**	**530**				

(*2) Fuji 4-pole standard motor

(*3) Rated capacity is calculated by assuming the output rated voltage as 220 V for 200 V series and 440 V for 400 V series.

(*4) Output voltage cannot exceed the power supply voltage.

(*6) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V]×67(See IEC61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(*7) Required when a DC reactor (DCR) is used.

(*8) Average braking torque for the motor running alone. (It varies with the efficiency of the motor.)

(*9) A DC reactor (DCR) is an option. However, inverters with a capacity of 75 kW or above require a DCR to be connected. Be sure to connect it to those inverters.

(*10) FRN160,200,220,355 and 400G1E-4 can not apply to the C22.2 No.14.

(90 to 400 kW) MD mode designed for middle duty load applications

Item		Specifications																
Type (FRN□□□G1E-4E)		90	110	132	160	200	220	280	315	355	400							
Nominal applied motor*2 [kW]		110	132	160	200	250	250	315	355	400	450							
Output ratings	Rated capacity*3 [kVA]	160	192	231	287	356	356	445	495	563	640							
	Rated voltage*4 [V]	Three-phase, 380 to 480 V (with AVR function)																
	Rated current [A]	210	253	304	377	468	468	585	650	740	840							
	Overload capability	150%-1 min																
Input ratings	Voltage, frequency	Three-phase, 380 to 440 V, 50 Hz Three-phase, 380 to 480 V, 60 Hz																
	Voltage, frequency variations	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *6, Frequency: +5 to -5%																
	Required capacity with DCR*7 [kVA]	140	165	199	248	271	308	388	436	489	547							
Braking	Torque*8 [%]	10 to 15 %																
	Braking transistor	-																
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)																
DC reactor (DCR)		Option *9																
KEY PAD		Option																
Applicable safety standards *10		UL508C, C22.2No.14, EN61800-5-1:2007 EN ISO 13849-1:2015 PL=d Cat.3, EN 61800-5-2:2007 SIL2																
Enclosure (IEC60529)		IP00, UL open type																
Cooling method		Fan cooling																
Weight/Mass [kg]		62	64	**94**	**98**	**129**	**140**	**245**	**245**	**330**	**330**							

(*2) Fuji 4-pole standard motor

(*3) Rated capacity is calculated by assuming the output rated voltage as 220 V for 200 V series and 440 V for 400 V series.

(*4) Output voltage cannot exceed the power supply voltage.

(*6) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V]×67(See IEC61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(*7) Required when a DC reactor (DCR) is used.

(*8) Average braking torque obtained by use of a motor. (Varies with the efficiency of the motor.)

(*9) A DC reactor (DCR) is an option. However, inverters with a capacity of 75 kW or above require a DCR to be connected. Be sure to connect it to those inverters.

(*10) FRN160,200,220,355 and 400G1E-4 can not apply to the C22.2 No.14.

(5.5 to 55 kW) LD mode designed for light duty load applications

Item			Specifications																
Type (FRN□□□G1E-4E)			0.4	0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55		
Nominal applied motor*2 [kW]			-	-	-	-	-	7.5	11	15	18.5	22	30	37	45	55	75		
Output ratings	Rated capacity*3 [kVA]		-	-	-	-	-	12	17	22	28	33	45	57	69	85	114		
	Rated voltage*4 [V]		-	-	-	-	-	Three-phase, 380 to 480 V (with AVR function)											
	Rated current [A]		-	-	-	-	-	16.5	23	30.5	37	45	60	75	91	112	150		
	Overload capability		-	-	-	-	-	120% -1 min											
Input ratings	Voltage, frequency		-	-	-	-	-	Three-phase, 380 to 480 V, 50/60 Hz											
	Voltage, frequency variations		-	-	-	-	-	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *6, Frequency: +5 to -5%											
	Required capacity with DCR*7 [kVA]		-	-	-	-	-	10	15	20	25	30	40	48	58	71	96		
Braking	Torque*8 [%]		-	-	-	-	-	70%		15%				7 to 12%					
	Braking transistor		-	-	-	-	-	Built-in						-					
	Built-in braking resister		-	-	-	-	-	Built-in		-									
		Braking time [s]	-	-	-	-	-	3.7s	3.4s	-									
		%ED	-	-	-	-	-	2.2	1.4	-									
EMC filter			-	-	-	-	-	Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)											
DC reactor (DCR)			-	-	-	-	-	Option *9											
KEY PAD								Option											
Applicable safety standards *10			-	-	-	-	-	UL508C, C22.2No.14, EN61800-5-1:2007 EN ISO 13849-1:2015 PL=d Cat.3, EN 61800-5-2:2007 SIL2											
Enclosure (IEC60529)			-	-	-	-	-	IP20, UL open type						IP00 UL open type					
Cooling method			-	-	-	-	-	Fan cooling											
Weight/Mass [kg]			-	-	-	-	-	6.8	6.9	6.2	10.5	10.5	11.2	26	27	32	33		

(*2) Fuji 4-pole standard motor

(*3) Rated capacity is calculated by assuming the output rated voltage as 220 V for 200 V series and 440 V for 400 V series.

(*4) Output voltage cannot exceed the power supply voltage.

(*6) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V]×67(See IEC61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(*7) Required when a DC reactor (DCR) is used.

(*8) Average braking torque obtained by use of a motor. (Varies with the efficiency of the motor.)

(*9) A DC reactor (DCR) is an option. However, inverters with a capacity of 55 kW or above require a DCR to be connected. Be sure to connect it to those inverters.

(75 to 630 kW) LD mode designed for light duty load applications

Item		Specifications																
Type (FRN□□□G1E-4E)		75	90	110	132	160	200	220	280	315	355	400	500	630				
Nominal applied motor*2 [kW]		90	110	132	160	200	220	250	315	400	450	500	630	710				
Output ratings	Rated capacity*3 [kVA]	134	160	192	231	287	316	356	445	563	640	731	891	1044				
	Rated voltage*4 [V]	Three-phase, 380 to 480 V (with AVR function)																
	Rated current [A]	176	210	253	304	377	415	468	585	740	840	960	1170	1370				
	Overload capability	120% -1 min																
Input ratings	Voltage, frequency	Three-phase, 380 to 440 V, 50 Hz Three-phase, 380 to 480 V, 60 Hz																
	Voltage, frequency variations	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *6, Frequency: +5 to -5%																
	Required capacity with DCR*7 [kVA]	114	140	165	199	248	271	312	436	489	547	611	773	871				
Braking	Torque*8 [%]	7 to 12%																
	Braking transistor	-																
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)																
DC reactor (DCR)		Option *9																
KEY PAD		Option																
Applicable safety standards *10		UL508C, C22.2No.14, EN61800-5-1:2007 EN ISO 13849-1:2015 PL=d Cat.3, EN 61800-5-2:2007 SIL2																
Enclosure (IEC60529)		IP00, UL open type																
Cooling method		Fan cooling																
Weight/Mass [kg]		42	62	64	**94**	**98**	**129**	**140**	**245**	**245**	**330**	**330**	**530**	**530**				

(*2) Fuji 4-pole standard motor

(*3) Rated capacity is calculated by assuming the output rated voltage as 220 V for 200 V series and 440 V for 400 V series.

(*4) Output voltage cannot exceed the power supply voltage.

(*6) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V]×67(See IEC61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(*7) Required when a DC reactor (DCR) is used.

(*8) Average braking torque obtained by use of a motor. (Varies with the efficiency of the motor.)

(*9) A DC reactor (DCR) is an option. However, inverters with a capacity of 55 kW or above require a DCR to be connected. Be sure to connect it to those inverters.

(*10) FRN160,200,220,355 and 400G1E-4 can not apply to the C22.2 No.14.

1-2. Standard Models 2 (EMC filter and Braking transistor built-in type)

1) Three-phase 400 V series

(30 to 160 kW) HD mode designed for heavy duty load applications

Item		Specifications																
Type (FRN□□□G1E-4EBU)		30	37	45	55	75	90	110	132	160								
Nominal applied motor*2 [kW]		30	37	45	55	75	90	110	132	160								
Output ratings	Rated capacity*3 [kVA]	45	57	69	85	114	134	160	192	231								
	Rated voltage*4 [V]	Three-phase, 380 to 480 V (with AVR function)																
	Rated current [A]	60	75	91	112	150	176	210	253	304								
	Overload capability	150% -1 min, 200% -3.0 s																
Input ratings	Voltage, frequency	Three-phase, 380 to 480 V, 50/60 Hz				Three-phase, 380 to 440 V, 50 Hz Three-phase, 380 to 480 V, 60 Hz												
	Voltage, frequency variations	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *6, Frequency: +5 to -5%																
	Required capacity with DCR*7 [kVA]	40	48	58	71	96	114	140	165	199								
Braking	Braking transistor	Built-in																
	Allowable minimum resistor [Ω] Braking Torque*8 [%]	10 150%	9 150%	8 150%	6.5 150%	4.7 150%	3.9 150%	3.2 150%	2.6 150%	2.2 150%								
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)																
DC reactor (DCR)		Option *9																
KEY PAD		Option																
Applicable safety standards *10		UL508C, C22.2No.14, EN61800-5-1:2007 EN ISO 13849-1:2015 PL=d Cat.3, EN 61800-5-2:2007 SIL2																
Enclosure (IEC60529)		IP20, UL open type																
Cooling method		Fan cooling																
Weight/Mass [kg]		25	26	31	33	42	62	64	94	98								

(*2) Fuji 4-pole standard motor

(*3) Rated capacity is calculated by assuming the output rated voltage as 220 V for 200 V series and 440 V for 400 V series.

(*4) Output voltage cannot exceed the power supply voltage.

(*6) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V]×67(See IEC61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(*7) Required when a DC reactor (DCR) is used.

(*8) Average braking torque for the motor running alone. (It varies with the efficiency of the motor.)

(*9) A DC reactor (DCR) is an option. However, inverters with a capacity of 55 kW or above require a DCR to be connected. Be sure to connect it to those inverters.

(*10) FRN160,200,220,355 and 400G1E-4 can not apply to the C22.2 No.14.

(90 to 160 kW) MD mode designed for middle duty load applications

Item		Specifications																
Type (FRN□□□G1E-4EBU)		90	110	132	160													
Nominal applied motor*2 [kW]		110	132	160	200													
Output ratings	Rated capacity*3 [kVA]	160	192	231	287													
	Rated voltage*4 [V]	Three-phase, 380 to 480 V (with AVR function)																
	Rated current [A]	210	253	304	377													
	Overload capability	150% -1 min																
Input ratings	Voltage, frequency	Three-phase, 380 to 440 V, 50 Hz Three-phase, 380 to 480 V, 60 Hz																
	Voltage, frequency variations	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *6, Frequency: +5 to -5%																
	Required capacity with DCR*7 [kVA]	140	165	199	248													
Braking	Braking transistor	Built-in																
	Allowable minimum resistor [Ω] Braking [%] Torque*8	3.9 120%	3.2 120%	2.6 120%	2.2 120%													
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)																
DC reactor (DCR)		Option *9																
KEY PAD		Option																
Applicable safety standards *10		UL508C, C22.2No.14, EN61800-5-1:2007 EN ISO 13849-1:2015 PL=d Cat.3, EN 61800-5-2:2007 SIL2																
Enclosure (IEC60529)		IP00, UL open type																
Cooling method		Fan cooling																
Weight/Mass [kg]		62	64	94	98													

(*2) Fuji 4-pole standard motor

(*3) Rated capacity is calculated by assuming the output rated voltage as 220 V for 200 V series and 440 V for 400 V series.

(*4) Output voltage cannot exceed the power supply voltage.

(*6) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V]×67(See IEC61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(*7) Required when a DC reactor (DCR) is used.

(*8) Average braking torque obtained by use of a motor. (Varies with the efficiency of the motor.)

(*9) A DC reactor (DCR) is an option. However, inverters with a capacity of 75 kW or above require a DCR to be connected. Be sure to connect it to those inverters.

(*10) FRN160,200,220,355 and 400G1E-4 can not apply to the C22.2 No.14.

(30 to 160 kW) LD mode designed for light duty load applications

Item		Specifications																
Type (FRN□□□G1E-4EBU)		30	37	45	55	75	90	110	132	160								
Nominal applied motor*2 [kW]		37	45	55	75	90	110	132	160	200								
Output ratings	Rated capacity*3 [kVA]	57	69	85	114	134	160	192	231	287								
	Rated voltage*4 [V]	Three-phase, 380 to 480 V (with AVR function)																
	Rated current [A]	75	91	112	150	176	210	253	304	377								
	Overload capability	120% -1 min																
Input ratings	Voltage, frequency	Three-phase, 380 to 480 V, 50/60 Hz				Three-phase, 380 to 440 V, 50 Hz Three-phase, 380 to 480 V, 60 Hz												
	Voltage, frequency variations	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *6, Frequency: +5 to -5%																
	Required capacity with DCR*7 [kVA]	48	58	71	96	114	140	165	199	248								
Braking	Braking transistor	Built-in																
	Allowable minimum resistor [Ω] Braking Torque*8 [%]	10 120%	9 120%	8 120%	6.5 120%	4.7 120%	3.9 120%	3.2 120%	2.6 120%	2.2 120%								
EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)																
DC reactor (DCR)		Option *9																
KEY PAD		Option																
Applicable safety standards *10		UL508C, C22.2No.14, EN61800-5-1:2007 EN ISO 13849-1:2015 PL=d Cat.3, EN 61800-5-2:2007 SIL2																
Enclosure (IEC60529)		IP00, UL open type																
Cooling method		Fan cooling																
Weight/Mass [kg]		25	26	31	33	42	62	64	94	98								

(*2) Fuji 4-pole standard motor

(*3) Rated capacity is calculated by assuming the output rated voltage as 220 V for 200 V series and 440 V for 400 V series.

(*4) Output voltage cannot exceed the power supply voltage.

(*6) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V]×67(See IEC61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(*7) Required when a DC reactor (DCR) is used.

(*8) Average braking torque obtained by use of a motor. (Varies with the efficiency of the motor.)

(*9) A DC reactor (DCR) is an option. However, inverters with a capacity of 55 kW or above require a DCR to be connected. Be sure to connect it to those inverters.

(*10) FRN160,200,220,355 and 400G1E-4 can not apply to the C22.2 No.14.

2. Common specifications

Item			Specifications	Remarks
Output	Setting range	Maximum frequency	25 to 500 Hz（HD mode, V/f control *1,*2,*3) 25 to 200 Hz (HD mode, V/f control w/PG/vector control w/PG*4,*5,*7) 25 to 120 Hz (HD mode, sensorless vector control *6, LD and MD mode, various controls,*1 to 7)	
		Base frequency	25 to 500 Hz variable setting (LD and MD mode : 120Hz)	
		Starting frequency	0.1 to 60.0 Hz variable setting (sensorless vector contro*6/ vector control w/PG, 0.0 Hz for *7)	
		Carrier frequency	• 0.75 to 16 kHz variable setting (HD mode: 0.4 to 55 kW,LD mode:5.5 to 18.5 kW） • 0.75 to 10 kHz variable setting（HD mode: 75 to 400 kW, LD mode: 22 to 55 kW） • 0.75 to 6 kHz variable setting（HD mode: 500 to 630 kW, LD mode: 75 to 500 kW) • 0.75 to 4 kHz variable setting（ LD mode: 630 kW） • 0.75 to 2kHz variable setting（MD mode:90 to 400 kW） NOTE: Frequency drops automatically to protect the inverter depending on environmental temperature and output current. (This auto drop function can be canceled.)	
	Output frequency Accuracy (Stability)		• Analog setting: ±0.2% of max. frequency (at 25 ±10 °C)*1 • Digital setting: ±0.01% of max. frequency (at -10 to +50 °C)	
	Setting resolution		• Analog setting : Analog setting: 1/3000 of max. frequency (1/1500 with V2 input) • Keypad setting: 0.01Hz (99.99Hz or less), 0.1Hz (100.0 to 500Hz) • Link setting : 1/20000 of max. frequency or 0.01 Hz (fixed)	
	Speed control range		・Min. speed: Base speed 1:1500 (4P 1r/min to 1500r/min) *7 ・Min. speed: Base speed 1:200 (4P 7.5r/min to 1500r/min) *6 ・Min. speed: Base speed 1:100 1:200 (4P 15r/min to 1500r/min, 1024p/r) *4, *5 ・Min. speed: Base speed 1:4 *7 ・Min. speed: Base speed 1:2 *4 ,*5 ,*6	
	Speed control accuracy		・Analog setting: ±0.2% of max. frequency (at 25±10℃) *4,*5,*7 ・Digital setting: ±0.01% of max. frequency (at -10 to +50℃) ・Analog setting: ±0.5% or below of base speed (at 25±10℃) *6 ・Digital setting: ±0.5% or below of base speed (at -10 to +50℃)	
Functional safety	Category		・3 (EN ISO 13849-1:2015)	
	Performance level		・d (EN ISO 13849-1:2015)	
	DCave		・>=90%	
	Response time for the safety function		・<=50ms (delay time to "Safe torque off" from turning off either terminal [EN1] or [EN2]	
	MTTFd for each channel		・>=1000 years	
	Stop function		・Safe torque off (STO: acc.EN61800-5-2:2007)	
	SIL		・SIL 2 (Safety integrity level)	
	HFT		・1	
	SFF		・>=90%	
	PFH		・<1.04×E-10(0.010% of SIL2) (Probability of a dangerous random hardware failure per hour)	
Control	Control method		・V/f control *1 ・Dynamic torque vector control *2 ・V/f control, the slip compensation is available. *3 ・V/f control with speed sensor (with an optional PG interface card mounted) *4 ・Dynamic torque vector control with speed sensor (with an optional PG interface card mounted) *5 ・Vector control without speed sensor *6 ・Vector control with speed sensor (with an optional PG interface card mounted) *7	
	Voltage/freq. characteristic		・Base frequency and max. output frequency can be set to 160 to 500V in common. ・The AVR control ON/OFF can be selected. *1, *4 ・Non-linear V/f setting (3 points): Free voltage (0 to 500V) and frequency (0 to 500Hz) can be set. *1, *4	
	Torque boost		・ Auto torque boost (for constant torque load) *1 to *4 ・Manual torque boost: Desired torque boost (0.0 to 20.0%) can be set. *1,*4 ・Select application load with function code F37. (Variable torque load or constant torque load) *1,*4	
	Starting torque（HD mode)		・22kW or below: 200% or higher, 30kW or above: 180% or higher/set frequency: 0.3Hz *6 ・22kW or below: 200% or higher, 30kW or above: 180% or higher/set frequency: 0.3Hz :Base frequency 50Hz, slip compensation and auto torque boost operation *1 to*4	
	Start/stop operation		Keypad ・Remote keypad: Start and stop with RUN and STOP keys ・Multi-function keypad: Start and stop with FWD, REV, and STOP keys	*9
			External signals (digital inputs): Forward (Reverse) rotation, stop command (capable of 3-wire operation), coast-to-stop command, external alarm, alarm reset, etc.	
			Link operation: Operation through RS-485 or field bus (option) communications, or USB *9(provided in remote keypad)	
			Switching operation command: Remote/Local switching, link switching	

	Item	Specifications	Remarks
Control	Enable input(Safe Torque Off (STO)	• Turning off the circuit between terminals [EN1] and [PLC] or terminals [EN2] and [PLC] stops the inverter's output transistor. (Safe Torque Off: STO)	
	Frequency setting	• Keypad : Can be set with UP and DOWN keys *9 • External Volume : Can be Set with external potentiometer (1 to 5kΩ 1/2W) • Analog input : 0 to ±10 VDC (±5 VDC)/0 to ±100% (Terminals [12] and [V2]) 0 to +10 VDC (+5 VDC)/0 to +100% (Terminals [12] and [V2]) +4 to +20 mA DC/0 to 100% (Terminal [C1]) 0 to +20 mA DC/0 to 100% (Terminal [C1]) *12 • UP/DOWN operation : Frequency can be increased or decreased while the digital input signal is ON. • Multi-frequency : Selectable from 16 steps (step 0 to 15) • Digital signal : 16bit parallel (binary, BCD) • Link operation : Frequency can be set througt RS-485 (Standard setting) • Switching frequency setting : Frequency setting can be switched (2 settings) with external signal (digital input). Remote/local switching, link switching • Auxiliary frequency setting : Terminal [12], [C1], or [V2] input can be selected respectively as an additional input. • Operation at a specified ratio : The ratio can be set by analog input signal. • Inverse operation : The setting "0 to +10V DC/0 to 100%" can be switched to "+10 to 0V DC/0 to 100%" by external command. : The setting "4 to +20mA DC/0 to 100%" or "0 to +20mA DC/0 to 100% (Terminal [C1])" can be switched to "+20 to 4mA DC/0 to 100%"or "+20 to 0mA DC/0 to 100% (Terminal [C1])" *12 • Pulse train input : Pulse input = X7 terminal, rotational direction = general terminal Complementary output: Max. 100kHz, Open collector output: Max. 30kHz • Pulse train inpu t : PG interface option CW/CCW pulse, pulse + rotational direction Complementary output: Max. 100kHz, Open collector output: Max. 25kHz	"DC+1 to +5V" can be adjusted with bias and analog input gain
	Acceleration/deceleration time	• Setting range: From 0.00 to 6000 s • Switch: The four types of accel./decel. time can be set or selected individually (switchable during operation). • Acceleration/deceleration pattern: Linear accel./decel., S-shape accel./decel. (weak, free, (strong)), curvilinear accel./decel. (accel./decel. max. capacity of constant output) • Deceleration mode (coast-to-stop): Coast-to-stop at the operation command OFF. • Forcible stop decel. time: Deceleration stop by the forcible stop (STOP)	
	Frequency limiter (Upper limit and lower limit frequencies)	• Both upper and lower limit frequencies can be variably set in hertz. • It is possible to choose the operation done when the set frequency drops below the lower limit from between continuous operation at lower limit frequency and operation stop.	
	Bias frequency	• Bias of set reference frequency and PID command can be independently set (setting range: 0 to ±100%).	
	Analog input	• Gain : Setting in the range from 0 to 200% • Off-set : Setting in the range from -5.0 to +5.0% • Filter : Setting in the range from 0.00s to 5.00s	
	Jump frequency	•Actuation points (3 points) and their common jump widths (0 to 30.0Hz) can be set.	
	Jogging operation	•Operation with RUN key（remote keypad）,FWD, or REV key（multifunction keypad）, or digital contact input ,FWD, or REV (Exclusive accel/decel time setting, exclusive frequency setting)	
	Auto-restart after momentary power failure	•Trip at power failure: The inverter trips immediately after power failure. •Trip at power recovery: Coast-to-stop at power failure and trip at power recovery •Deceleration stop: Deceleration stop at power failure, and trip after stoppage •Continuous operation: Operation is continued using the load inertia energy. •Start at the frequency selected before momentary stop: Coast-to-stop at power failure and start after power recovery at the frequency selected before momentary stop. *1 to *3 •Start at starting frequency: Coast-to-stop at power failure and start at the starting frequency after power recovery. *1 to *3	
	Current limit by hardware	•Limiting the current by hardware to prevent overcurrent trip due to sharp load change or momentary power failure which cannot be controlled by software current limit（This function can be cancelled.）	
	Operation by commercial power supply	•With commercial power selection command, the inverter outputs 50/60Hz (SW50, SW60). *1 to *3 •The inverter has the commercial power supply selection sequence.	
	Slip compensation	• Compensates for decrease in speed according to the load. *1 to *3	
	Droop control	• Decrease the speed according to the load torque.	
	Torque limiter	•Switchable between 1st or 2nd torque limit values •Torque limit, torque current limit, and power limit are set for each quadrant. *6, *7 •Analog torque limit input	
	Current control (software current limit)	•Automatically reduces the frequency so that the output current becomes lower than the preset operation level. *1 to *5	

Item		Specifications	Remarks
Control	PID control	・PID adjuster for process control and that for dancer control ・Switchable between forward and reverse operations ・Low liquid level stop function (pressurized operation possible before low liquid level stop)	
		・PID command: Keypad, analog input (from terminals [12], C1, V2), RS-485 communications ・PID feedback value: Analog input (from terminals [12], C1, V2) ・Alarm output (absolute value alarm, deviation alarm) ・PID output limiter ・Integration reset/ho	
	Auto search for idling motor speed	・Estimates the speed of the motor running under no load and starts the motor without stopping it. (Motor electric constant needs tuning: Offline tuning) *1 to * 3 and *6	
	Automatic deceleration	・If the DC link bus voltage or calculated torque exceeds the automatic deceleration level during deceleration, the inverter automatically prolongs the deceleration time to avoid overvoltage trip. (It is possible to select forcible deceleration actuated wh ・If the calculated torque exceeds automatic deceleration level during constant speed operation, the inverter avoids overvoltage trip by increasing the frequency.	
	Deceleration characteristic (improving braking ability)	・The motor loss is increased during deceleration to reduce the regenerative energy in the inverter to avoid overvoltage trip. *1, *4	
	Automatic energy saving operation	・The output voltage is controlled to minimize the total sum of the motor loss and inverter loss at a constant speed.	
	Overload prevention control	・If the ambient temperature or IGBT joint temperature increases due to overload, the inverter lowers the output frequency to avoid overload.	
	Off-line tuning	・Rotary type and non-rotary type are available for tuning the motor constant.	
	On-line tuning	・Performs tuning while the motor is rotating in order to cover the motor speed fluctuation caused by the temperature rise of the motor. *11	
	Cooling fan ON/OFF control	・Detects inverter internal temperature of the inverter and stops the cooling fan when the temperature is low. ・The fan control signal can be output to an external device.	
	Setting 2nd to 4th motors	・Switchable among the four motors ・Code data for four kinds of specific functions can be switched (even during operation). It is possible to set the base frequency, rated current, torque boost, and electronic thermal slip compensation as the data for 1st to 4th motors.	
	Universal DI	・The status of external digital signal connected with the universal digital input terminal is transferred to the host controller.	
	Universal DO	・Digital command signal from the host controller is output to the universal digital output terminal.	
	Universal AO	・The analog command signal from the host controller is output to the analog output terminal.	
	Speed control	・Notch filter for vibration control, *7	
	Constant peripheral speed control	・Constant peripheral speed control suppresses an increase in peripheral speed (line speed) resulting from the increasing radius of the take-up roll in a winder system. *4 *5	
	Syncronous operation	・Synchronous control drives two or more shafts of a conveyer while keeping their positions in synchronization. *4 *5 *7 *11	
	Preliminary excitation	・Excitation is carried out to create the motor flux before starting the motor. *6 and*7	
	Zero speed control	・The motor speed is held to zero by forcibly zeroing the speed command. *7	
	Servo lock	・Stops the inverter and holds the motor in stop position. *7	
	Torque control *6, *7	・Analog torque command input ・Speed limit function is provided to prevent the motor from becoming out of control.	
	Rotation direction control	・Preventing reverse rotation ・Preventing forward rotation	
	Preventing condensation in motor	・When the inverter is stopped, current is automatically supplied to the motor to keep the motor warm and avoid condensation.	
	Customizable logic interface	・Available in 10 steps with the functions of 2-input, 1-output, logical operation, and timer function	
	Battery Operation	・The battery operation enables the undervoltage inverter to run the elevator with a battery for moving the cage to the nearest floor.	
Display *9	Run/stop	Speed monitor (set frequency, output frequency, motor speed, load shaft speed, line speed, and speed indication with percent) Output current [A], output voltage [V], calculated torque, input power [kW], PID reference value, PID feedback value, PID output	
	Inverter life warning	・Life judgment of the main circuit capacitor, electrolytic capacitor on printed circuit board, and cooling fan ・Life warning information can be output to an external device. ・Ambient temperature: 40°C, Load rate: inverter rated current 100% (LD type: 80%)	
	Cumulative running hours	・Displays the inverter cumulative running hours, integrated power, cumulative motor running hours, and the number of operation start times (of each motor). ・Outputs the warning when the maintenance time or the number of start times has exceeded the preset	
	Trip mode	・Displays the cause of trip.	
	Light-alarm	・Shows the light-alarm display [L-AL].	
	Running or trip mode	・Trip history: Saves and displays the cause of the last four trips (with a code). ・Also saves and displays the detailed data recorded on occurrence of the last four trips.	

Item			Specifications	Remarks
Protective function	Overcurrent protection		・The inverter is stopped for protection against overcurrent.	OC1,OC2,OC3
	Short-circuit protection		・The inverter is stopped for protection against overcurrent caused by a short circuit in the output circuit.	
	Ground fault protection		・ The inverter is stopped for protection against overcurrent caused by a grounding fault in the output circuit. (400 V 22 kW or less)	
			・Detecting zero-phase current of output current, the inverter is stopped for protection against overcurrent caused by a grounding fault in the output circuit. (200V 30kW, 400V 30kW or above)	EF
	Overvoltage protection		・ An excessive voltage (200V series: 400V DC, 400V series: 800V DC) in the DC link circuit is detected and the inverter is stopped. If an excessive voltage is applied by mistake, the protection can not be guaranteed.	OU1,OU2,OU3
	Undervoltage protection		・ The voltage drop (200V series: 200V DC, 400V series: 400V DC) in the DC link circuit is detected to stop the inverter. However, the alarm will not be issued when the re-starting after instantaneous stop is selected.	LU
	Input phase loss protection		・The input phase loss is detected to shut off the inverter output. This function protects the inverter. ・When the load to be connected is small or DC REACTOR is connected a phase loss is not detected.	Lin
	Output phase loss detection		Detects breaks in inverter output wiring at the start of running and during running, stopping the inverter output.	OPL
	Overheat protection		・Stop the inverter output detecting excess cooling fan temperature in case of a cooling fan fault or overload.	OH1
			・Stop the inverter output detecting a fault of inner agitating fan. (200V 45kW, 400V 75kW or above)	
			・Stop the inverter output detecting inner temperature of the inverter unit for a cooling fan fault or overload.	OH3
			・Protect the braking resistor from over heat by setting the braking resistor electronic thermal function.	dbH
	Overload protection		・Stop the inverter output detecting a cooling unit temperature of the inverter cooling fan and a switching element temperature calculated with the output current.	OLU
	External alarm input		・ With the digital input signal (THR) opened, the inverter is stopped with an alarm.	OH2
	Fuse breaking		・Stop the inverter output detecting the fuse breaking of the main circuit in the inverter. (400V 90kW or above)	FUS
	Charging circuit abnormality		・Stop the inverter output detecting the charge circuit abnormality in the inverter. (400V 75kW or above)	PbF
	Brake transistor abnormality		・Stop the inverter detecting the brake transistor abnormality. (DB transistor built-in type only)	dbA
	Over-speed protection *4 to *7		・Stop the inverter when the detected speed exceeds (max. output frequency) × (d32 data or d33 data) × 120% in the case of d35 = 999 *4～*7 ・Stop the inverter when the detected speed exceeds (max. output frequency)×(d35 data) in the case of d35≠999 *6 ・Stop the inverter when the detected speed exceeds 120Hz × 120% *6 ・Stop the inverter when the detected speed exceeds 200Hz × 120% *7	OS
	PG breakwire *4 *5 *7		・Stop the inverter detecting the PG breaking.	Pg
	Motor protection	Electronic thermal	・The inverter is stopped with an electronic thermal function set to protect the motor. Protects the general-purpose motor inverter over all frequency range.(The running level and thermal time constant (0.5 to 75.0 min) can be set.)	OL1 to OL4
		PTC thermistor	・A PTC thermistor input stops the inverter to protect the motor. Connect a PTC thermistor between terminal V2 and 11 and set the switch on control print board and the function code.	OH4
		NTC thermistor	・The NTC thermistor detects a motor temperature. Connect a NTC thermistor between terminal V2 and 11 and set the switch on control print board and the function code.	
		NTC thermistor broken	・Stop the inverter output detecting the built-in motor NTC breaking.	nrb
		Overload early warning	・ Warning signal(OL) is output at the predetermined level before stopping the inverter with electronic thermal function.	-
	Memory error		・ Data is checked upon power-on and data writing to detect any fault in the memory and to stop the inverter if any.	Er1
	Keypad communications error detection		・ The keypad is used to detect a communication fault between the keypad and inverter main body during operation and to stop the inverter.	Er2
	CPU error		・ Stop the invert detecting a CPU error or LSI error caused by noise.	Er3
	Option communications error		・ When each option is used, a fault of communication with the inverter main body is detected to stop the inverter.	Er4
	Option error		・ When each option is used, the option detects a fault to stop the inverter.	Er5
	Operation error		・STOP key priority Pressing the STOP key on the keypad or entering the digital input signal will forcibly decelerate and stop the motor even if the operation command through signal input or communication is selected. Er6 will be displayed after the stop. ・Start check: If the running command is being ordered when switching the running command method from power-on, alarm reset, or the linked operation, the operation starts suddenly. This function bans running and displays Er6.	Er6
	Tuning error		・ Stop the inverter output when tuning failure, interruption, or any fault as a result of tuning is detected during tuning for motor constant.	Er7
	RS-485 communicationserror (port1)		・ When the connection port of the keypad connected via RS485 communication port to detect a communication error, the inverter is stopped and displays an error.	Er8
	Speed deviation excess *4 to *7		・Stop the inverter output when the speed deviation excesses the specified value (difference between speed command and feedback).	ErE
	Data save error upon undervoltage		・When the undervoltage protection function works, an alarm is displayed if the data is not properly saved.	ErF
	Positioning Control Error		・Stop the inverter output when an excessive positioning deviation has occurred. *4 *5 *7 *11	Ero
	RS-485 communicationserror (port2)		・Stop the inverter output detecting the communication error between the inverter main unit and a mate when the RS-485 connection port of the touch panel is used to configure the network.	ErP
	Hardware error		・Stop the inverter output detecting the communication error between the inverter main unit and a mate when the RS-485 connection port of the touch panel is used to configure the network..	ErH
	Simulation error		・Simulated alarm is output by the keypad operation.	Err
	EN Circuit Error *12		・The circuit to detect EN terminal status is broken (Single fault)	ECF

Item		Specifications	Remarks
Protective function	PID feedback breaking detection	・Stop the inverter output detecting a breaking when the input current is allocated to the PID control feedback. (Select valid/invalid.)	CoF
	Alarm relay output (for any fault)	• The inverter outputs a relay contact signal when the inverter issues an alarm and stops the inverter output. • The alarm stop state is reset by pressing the PRG/RESET key or by the digital input signal RST.	
	Alarm relay output (for any fault)	・The relay signal is output when the inverter stops upon an alarm. ・PRG/RESET key is used to reset the alarm stop state.	
	Light-alarm (warning)	Below items can be registered as minor errors Alarm detection: Overheating of the heatsink (OH1), External alarm (OH2), Inverter overheat (OH3), Overheating of braking resistor (dbH), Motor overload (OL1 to OL4), Optional communication error (Er4), Option error (Er5), RS-485(port1) communication error (Er8), Inconsistent speed (excessive speed deviation) (ErE), Positioning Control Error(Ero), RS-485 (port2) communication error (ErP), Warning output: DC fan lock detected, Overload early warning (for motor), heatsink overheat early warning, Life early warning (DC link bus capacitor, electrolytic capacitor on printed circuit board, cooling fan), Reference command loss detected, PID warning output, Low torque detected, Thermistor detection (PTC), Machine life (cumulative motor run time error), Machine life (number of startups error),	L-AL
	Stall prevention	・Operates when the inverter output goes beyond the instantaneous overcurrent limiting level, and avoids tripping, during acceleration and constant speed operation.	
	Retry function	・When the motor is tripped and stopped, this function automatically resets the tripping state and restarts operation.	
	Surge protection	・The inverter is protected against surge voltage intruding between the main circuit power line and ground.	
	Command loss detected	・ A loss (breaking, etc.) of the frequency command is detected to output an alarm and the operation is continued at the preset frequency (set at a ratio to the frequency before detection).	
	Momentary power failure protection	・ A protective function (inverter stoppage) is activated upon a momentary power failure for 15ms or longer. ・ If restart upon momentary power failure is selected, the inverter restarts upon recovery of the voltage within the set time.	
Environment	Installation location	・ Shall be free from corrosive gases, flammable gases, oil mist, dusts, direct sunlight.(Pollution degree 2 (IEC60664-1)). Indoor use only.	
	Ambient temperature	・ -10 to +50℃ (-10 to +40℃ when installed side-by-side without clearance (22kW or below))	
	Ambient humidity	・ 5 to 95% RH (without condensation)	
	Altitude	・Lower than 1,000m	
	Vibration	200 V 55 kW, 400 V 75 kW or below 3 mm: 2 to less than 9 Hz, 9.8 m/s2: 9 to less than 20 Hz, 2 m/s2: 20 to less than 55 Hz, 200 V 75 kW, 400 V 90 kW or above 3 mm: 2 to less than 9 Hz 2 m/s2: 9 to less than 55 Hz 1 m/s2 : 55	
	Storage temperature	-25 to +65°C	
	Storange humidity	・ 5 to 95% RH (without condensation)	
	Measures against sulfide gases	Coating specification: Wider area will be coated than current models. (TBD) Full coating is available by BTO.	

*1 Effective function in V/f control

*2 Effective function in dynamic torque vector control

*3 Effective function when the slip compensation is made active under V/f control

*4 Effective function under the V/f control with speed sensor (PG option is necessary.)

*5 Effective function in dynamic torque vector control with speed sensor. (PG option is necessary.)

*6 Effective function in vector control without speed sensor

*7 Effective function in vector control with speed sensor (PG option is necessary.)

*8 Function not incorporated in the inverters of initial version

*9 These function can be used by using keypad(option).

*10 This specification does not gurantee that all single fault cases are surely detected (EN ISO 13849-1, Cat.3)

*11 These function can be supported by the inverters having a ROM version 3000 or later

*12 These function can be supported by the inverters having a ROM version 3600 or later

3. Terminal functions

Classification	Symbol	Name	Functions	Remarks
Main circuit terminals	L1/R, L2/S L3/T	Main circuit power inputs	Connect the three-phase input power lines.	
	R0, T0	Auxiliary power input for the control circuit	Connect AC power lines.	
	R1,T1	Auxiliary power input for the fans	Normally, no need to use these terminals. Use these terminals for an auxiliary power input of the fans in a power system using a power regenerative PWM converter.	（400 V 75 kW or above）
	U,V,W	Inverter outputs	Connect a three-phase motor.	
	P(+),P1	DC reactor connection	Connect a DC reactor (DCR).	
	P(+),N(-)	DC link bus	Terminal for DC bus link system.	
	P(+),DB	Braking resistor	Connect an external braking resistor (option).	(22kW or below, Braking transistor built-in type)
	⊕ G	Grounding for inverter	Grounding terminals for the inverter.	
Analog intput	[13]	Power supply for the potentiometer	Power supply (+10 VDC) for frequency command potentiometer (Variable resistor: 1 to 5kW) The potentiometer of 1/2 W rating or more should be connected. (10 VDC, 10 mADC max.)	
	[12]	Analog setting voltage input	• External input voltage to be used as a frequency command. 0 to +10 VDC/ 0% to 100% (0 to +5 VDC/ 0% to 100%) 0 to ±10 VDC/ 0% to ±100% (0 to ±5 VDC/ 0% to ±100%)	Input impedance: 22kΩ Maximum input ±15 VDC
		(Inverse operation)	• +10 to 0 VDC/ 0 to100%	
		(PID control)	Used as PID command value or PID feedback signal.	Gain: 200%
		(Auxiliary frequency setting)	• Used as additional auxiliary setting to various frequency settings.	Offset: ±5%
		(Gain setting)	• Used as gain for the frequency command. 0% to 100% for 0 to 10 V	Setting filter: 5 s
		(Torque limit value)	• Analog torque limit value	
		(Torque command/ torque current command)	• Analog torque command value/ Torque current command *6*7	
		(Speed limit value of FWD)	• Analog torque limit value of FWD *12	
		(Speed limit value of REV)	• Analog torque limit value of REV *12	
		（Analog input monitor）	• Enables peripheral analog signals to be displayed on the keypad. (Display coefficient valid)	
	[C1]	Analog setting current input	• External input voltage to be used as a frequency command. 4 to 20 mADC/ 0% to 100% or 0 to 20 mADC/ 0% to 100% *11	Input impedance: 250Ω Maximum input 30 mADC
		(Inverse operation)	• 20 to 4 mADC/ 0% to 100% or 20 to 0 mADC/ 0% to 100% *11	
		(PID control)	Used as PID command value or PID feedback signal.	Gain: 200%
		(PTC/NTC thermistor connection)	• Connect a PTC/NTC thermistor for motor protection. (Switchable)	Offset: ±5%
		(Auxiliary frequency setting)	• Used as additional auxiliary setting to various frequency settings.	Setting filter: 5 s
		(Gain setting)	• Used as gain for the frequency command. 0% to 100% for 4 to 20 mA or 0% to 100% for 0 to 20 mA *11	
		(Torque limit value)	• Analog torque limit value	
		(Torque command/ torque current command)	• Analog torque command value/Torque current command *6*7	
		(Speed limit value of FWD)	• Analog torque limit value of FWD *12	
		(Speed limit value of REV)	• Analog torque limit value of REV *12	
		（Analog input monitor）	• Enables peripheral analog signals to be displayed on the keypad. (Display coefficient valid)	
	[V2]	Analog setting voltage input	• External input voltage to be used as a frequency command. 0 to +10 VDC/ 0 to 100% (0 to +5 VDC/ 0 to100%) 0 to ±10 VDC/ 0 to ±100% (0 to ±5 VDC/ 0 to ±100%)	Input impedance: 22kΩ Maximum input ±15 VDC
		(Inverse operation)	• +10 to 0 VDC/ 0 to100%	
		(PID control)	Used as PID command value or PID feedback signal.	Gain: 200%
		(Auxiliary frequency setting)	• Used as additional auxiliary setting to various frequency settings.	Offset: ±5%
		(Gain setting)	• Used as gain for the frequency command. 0% to 100% for 0 to 10 V	Setting filter: 5 s
		(Torque limit value)	• Analog torque limit value	
		(Torque command/ torque current command)	• Analog torque command value/Torque current command *6*7	
		(Speed limit value of FWD)	• Analog torque limit value of FWD *12	
		(Speed limit value of REV)	• Analog torque limit value of REV *12	
		（Analog input monitor）	• Enables peripheral analog signals to be displayed on the keypad. (Display coefficient valid)	
	[11] (2 terminals)	Analog common	Common terminals for frequency command signals (12, 13, C1, V2, FM1,FM2).	These terminals are electrically isolated from terminals [CM]s and [CMY]s.
Digital input	[X1]	Digital input 1	• The following functions can be assigned to terminals [X1] to [X7], [FWD], and [REV]. <Common functions> • SINK/SOURCE is changeable by using the internal slide switch. • These function codes may also switch the logic system between normal and negative to define how the inverter logic interprets either ON or OFF status of each terminal.	Operation current at ON Source current: 2.5 to 5 mA Source current: 9.7 to 16 mA （terminal [X7]） Voltage level: 2 V Operation current at OFF Allowable leakage current: 0.5 mA or less Voltage: 22 to 27 V
	[X2]	Digital input 2		
	[X3]	Digital input 3		
	[X4]	Digital input 4		
	[X5]	Digital input 5		
	[X6]	Digital input 6		
	[X7]	Digital input 7	Terminal [X7] can receive a pulse rate input. (Using the SY disables [X7].)	
	[FWD]	Run forward commands		
	[REV]	Run reverse commands		

Classification	Symbol	Name	Functions	Remarks
Digital input	[EN1]	Enable Input 1	• Turning off the circuit between terminals [EN1] and [PLC] or terminals [EN2] and [PLC] stops the inverter's output transistor. (Safe Torque Off: STO) • These terminals are exclusively used for the source mode input and cannot be switched to the sink mode. • If either one of these input terminals is kept OFF for 50 ms or more, the inverter interprets it as a discrepancy, causing an alarm ecf. This alarm state can be cleared only by turning the inverter off and on.	Compliance with EN ISO13849-1;2008 Cat.3 Source current at Turn-on : 5-10mA Threshold voltage between [PLC] - [EN] : 2V (Turn off) : 22V (Turn on) leakage current : 0.5mA or less
	[EN2]	Enable Input 2		
	[CM]	Digital input common	Common terminals for digital input signals.	This terminal is electrically isolated from terminals [CM] and [11]s.
	[PLC] (2 terminals)	PLC signal power	Connect to PLC output signal power supply. This terminal also serves as 24 V power supply.	+24 V (22 to 27 V), Max. 100 mA
	(FWD)	Run forward	Turning the (FWD) ON runs the motor in the forward direction; turning it OFF decelerates it to a stop.	These terminal commands can be assigned only to terminals [FWD] and [REV]. The negative logic system never applies to those terminals.
	(REV)	Run reverse	Turning the (REV) ON runs the motor in the reverse direction; turning it OFF decelerates it to a stop.	Same as above.
	(SS1)	Select multi-frequency	The combination of the ON/OFF states of digital input signals (SS1), (SS2), (SS4) and (SS8) provides 16 different frequency choices.	
	(SS2)			
	(SS4)			
	(SS8)			
	(RT1)	Select ACC/DEC time (2 steps)	The combination of the ON/OFF states of (RT1) and (RT2) provides four choices of acceleration/deceleration settings.	
	(RT2)	Select ACC/DEC time (4 steps)		
	(HLD)	Enable 3-wire operation	Used as a self-hold signal for 3-wire inverter operation. Turning the (HLD) ON self-holds the (FWD) or (REV) command; turning it OFF releases the self-holding.	
	(BX)	Coast to a stop	Turning the (BX) ON immediately shuts down the inverter output so that the motor coasts to a stop without issuing any alarms.	
	(RST)	Reset alarm	Turning the (RST) ON clears the alarm state.	Signal of 0.1 s or more
	(THR)	Enable external alarm trip	Turning the (THR) OFF immediately shuts down the inverter output so that the motor coasts to a stop, issuing OH2 if (ALM) is enabled.	
	(JOG)	Ready for jogging	Turning the (JOG) ON readies the inverter for jogging. Turning the (FWD) or (REV) ON starts jogging in the rotation direction specified by the jogging frequency.	
	(Hz2/Hz1)	Select frequency command 2/1	Turning the (Hz2/Hz1) ON selects Frequency command 2. (If the PID control is enabled, this terminal command switches the PID command.)	
	(M2)	Select motor 2	The combination of the ON/OFF states of (M2), (M3) and (M4) provides four choices of Motors 1 to 4. (Setting all of (M2), (M3) and (M4) OFF selects Motor 1.)	
	(M3)	Select motor 3		
	(M4)	Select motor 4		
	(DCBRK)	Enable DC braking	Turning the (DCBRK) ON activates DC braking.	
	(TL2/TL1)	Select torque limiter level	The (TL2/TL1) switches between torque limiters 1 and 2.	
	(SW50)	Switch to commercial power (50 Hz)	Turning the (SW50) OFF switches to commercial power, 50 Hz. *1~*3	
	(SW60)	Switch to commercial power (60 Hz)	Turning the (SW60) OFF switches to commercial power, 60 Hz. *1~*3	
	(UP)	UP (Increase output frequency)	While the (UP) is ON, the output frequency increases.	
	(DOWN)	DOWN (Decrease output frequency)	While the (UP) is ON, the output frequency decreases.	
	(WE-KP)	Enable data change with keypad	Only when the (WE-KP) is ON, function code data can be changed with the keypad.	
	(Hz/PID)	Cancel PID control	Turning the (Hz/PID) ON disables the PID control so that the inverter runs the motor with a reference frequency specified by any of the multi-frequency, keypad, analog input, etc.	
	(IVS)	Switch normal/inverse operation	The (INV) switches the output frequency control between normal (proportional to the input value) and inverse in PID process control and manual frequency command. Turning the (INV) ON selects the inverse operation.	
	(IL)	Interlock	In a configuration where a magnetic contactor (MC) is inserted between the inverter and motor, connecting the auxiliary contact to this terminal enables the input of the (IL) when a power failure occurs, activating the momentary power failure detection fu	
	(Hz/TRQ)	Cancel torque control *6*7	Turning Hz/TRQ ON swiches torque control to speed control .	
	(LE)	Enable communications link via RS-485 or field bus	Turning the (LE) ON gives priority to commands received via the RS-485 communications link or the field bus option.	
	(U-DI)	Universal DI	Using the (U-DI) enables the inverter to monitor arbitrary digital input signals sent from the peripheral equipment, telling the signal status to the host controller.	
	(STM)	Enable auto search for idling motor speed at starting	The (STM) enables auto search for idling motor speed at the start of operation.	
	(STOP)	Force to stop	Turning the (STOP) OFF causes the motor to decelerate to a stop forcedly in accordance with the specified deceleration time.	

Classification	Symbol	Name	Functions	Remarks
Digital input	(PID-RST)	Reset PID integral and differential components	Turning the (PID-RST) ON resets PID integral and differential components.	
	(PID-HLD)	Hold PID integral component	Turning this terminal command ON holds the integral components of the PID processor.	
	(Hz/LSC)	Cancel constant peripheral speed control	Turning the (Hz/LSC) ON cancels constant peripheral speed control. *4*5	
	(LSC-HLD)	Hold the constant peripheral speed control frequency in the memory	If LSC-HLD is ON under constant peripheral speed control, stopping the inverter or turning OFF Hz/LSC saves the current frequency command compensating for a take-up roll getting bigger, in the memory. *4 *5	
	(EXITE)	Pre-excitation	When this (EXITE)signal comes ON, preliminary excitation starts. *6*7	
	(LOC)	Select local (keypad) operation	Turning the (LOC) ON gives priority to run/frequency commands entered from the keypad.	
	(DWP)	Protect motor from dew condensation	Turning the (DWP) ON supplies a DC current to the motor that is on halt, in order to generate heat, preventing dew condensation.	
	(ISW50)	Enable integrated sequence to switch to commercial power (50 Hz)	Turning the (ISW50) OFF switches inverter operation to commercial-power operation in accordance with the inverter internal switching sequence (for 50 Hz).	
	(ISW60)	Enable integrated sequence to switch to commercial power (60 Hz)	Turning the (ISW50) OFF switches inverter operation to commercial-power operation in accordance with the inverter internal switching sequence (for 60 Hz).	
	(LOCK)	Servo-lock command	Turning the (LOCK) ON makes the motor servo-locked state *7	
	(PIN)	Pulse train input	Frequency command by pulse rate input.	Available only on terminal [X7] (E07)
	(SIGN)	Pulse train sign	Rotational direction command for pulse rate input. OFF: Forward, ON: Reverse	Available only on terminal [X7] (E07)
	(CRUN-M1)	Count the run time of commercial power-driven motor 1	Turning the (CRUN-M1) ON accumulates the run time of motor 1 in commercial-power operation. (independent of run/stop and motor selected)	
	(CRUN-M2)	Count the run time of commercial power-driven motor 2	Turning the (CRUN-M2) ON accumulates the run time of motor 2 in commercial-power operation. (independent of run/stop and motor selected)	
	(CRUN-M3)	Count the run time of commercial power-driven motor 3	Turning the (CRUN-M3) ON accumulates the run time of motor 3 in commercial-power operation. (independent of run/stop and motor selected)	
	(CRUN-M4)	Count the run time of commercial power-driven motor 4	Turning the (CRUN-M4) ON accumulates the run time of motor 4 in commercial-power operation. (independent of run/stop and motor selected)	
	(DROOP)	Select droop control	Turning the(DROOP) ON enables the droop control.	
	(PG-CCL)	Cancel PG alarm	Turning the(PG-CCL) ON cancels PG alarm. *4*5*7	
	(CLC)	Cancel customizable logic	Turning the (CLC) ON cancel customizable logic	
	(CLTC)	Clear all customizable logic timers	Turning the (CLTC) ON clear all customizable logic timers	
	(BATRY)	Enable battery operation	Turning the (BATRY) ON Enable battery operation *12	
	(NONE)	No function	No function assigned. Can be used as a temporary input of the customized logic interface.	
Transistor output	(PLC)	Transistor output power	Transistor output load power. (24 VDC, 100 mA DC max.) (Note: Shared by the digital input PLC terminal.)	Short-circuit terminals [CM] and [CMY].
	[Y1]	Transistor output 1	Out of the following signals, the selected one will be issued. • These function codes may also switch the logic system between normal and negative to define how the inverter logic interprets either ON or OFF status of each terminal.	Maximum voltage 27 VDC Maximum current 50 mADC
	[Y2]	Transistor output 2	Applicable to SINK and SOURCE. (No switching is required.)	Leakage current
	[Y3]	Transistor output 3		0.1 mA or less
	[Y4]	Transistor output 4		ON voltage: Max. 2V (50 mA)
	[CMY]	Transistor output common	Common terminal for transistor output signal terminals.	This terminal is electrically isolated from terminals [CM] and [11]s.
	(RUN)	Inverter running	This signal is ON when the inverter is running with the starting frequency or higher.	
	(RUN2)	Inverter output on	This signal is ON when the inverter is running with the starting frequency or higher or when the DC braking is activated.	
	(DNZS)	Speed valid	This signal is turned ON when the speed command/actual speed exceeds the stop frequency; it is turned OFF when it is below the stop frequency. (Speed command and actual speed selectable.)	

Classification	Symbol	Name	Functions	Remarks
Transistor output	(FRUN)	Running forward	ON-signal is generated at forward rotation.	
	(RRUN)	Running reverse	ON-sigal is generated at reverse rotation	
	(FAR)	Frequency (speed) arrival signal	ON-signal is generated when frequeny / speed reaches at set-value.	
	(FAR3)	Frequency (speed) arrival signal 3	ON-signal is generated when frequency / speed reaches at set-value. When the run command is OFF, the frequency command is interpreted as zeo and frequency arrival is judged under the premise.	
	(FDT)	Frequency (speed) detected	This output signal comes ON when the output frequency exceeds the frequency detection level , and it goes OFF when the output frequency drops below the "Frequency detection level - Hysteresis width."	
	(FDT2)	Frequency (speed) detected 2		
	(FDT3)	Frequency (speed) detected 3		
	(LU)	Undervoltage detected (Inverter stopped)	This signal is ON when the undervoltage protection function is activated so that the motor is in an abnormal stop state.	
	(B/D)	Torque polarity detected	This signal comes ON when the inverter is driving the motor; it comes OFF when the inverter is braking the motor or on halt.	
	(IOL)	Inverter output limiting	This signal comes ON when the inverter is activating the current limiter, torque limiter, or anti-regenerative control (automatic deceleration).	
	(IOL2)	Inverter output limiting with delay	This signal comes ON when the inverter has been activated the current limiter, torque limiter, or anti-regenerative control (automatic deceleration) for at least 20 ms.	
	(IPF)	Auto-restarting after momentary power failure	This signal is kept ON during the period from when the inverter shuts down its output due to a momentary power failure until the restart is completed.	
	(OL)	Motor overload early warning	This signal comes ON when the value calculated by the electronic thermal overload protection exceeds the predetermined detection level. (applicable to Motor 1 only)	
	(KP)	Keypad operation enabled	This signal is ON when the inverter is in keypad operation.	
	(RDY)	Inverter ready to run	This signal comes ON when the inverter is ready to run.	
	(SW88)	Switch motor drive source between commercial power and inverter output (For MC on commercial line)	This controls the magnetic contactor located at the commercial power line side, for switching the motor drive source from the commercial power line to inverter output.	
	(SW52-2)	Switch motor drive source between commercial power and inverter output (For secondary side)	This controls the magnetic contactor located at the inverter output side (secondary side), for switching the motor drive source from the commercial power line to inverter output.	
	(SW52-1)	Switch motor drive source between commercial power and inverter output (For primary side)	This controls the magnetic contactor located at the inverter input side (primary side), for switching the motor drive source from the commercial power line to inverter output.	
	(SWM1)	Motor 1 selected	This signal comes ON when motor 1 is selected.	
	(SWM2)	Motor 2 selected	This signal comes ON when motor 2 is selected.	
	(SWM3)	Motor 3 selected	This signal comes ON when motor 3 is selected.	
	(SWM4)	Motor 4 selected	This signal comes ON when motor 4 is selected.	
	(AX)	Select AX terminal function (For MC on primary side)	This signal controls the magnetic contactor located at the inverter input side (primary side).	
	(FAN)	Cooling fan in operation	This signal tells the ON/OFF state of the cooling fan.	
	(TRY)	Auto-resetting	This output signal comes ON when auto-resetting is in progress.	
	(U-DO)	Universal DO	This signal commands a peripheral apparatus according to signal sent from the host controller.	
	(ID)	Current detected	This signal comes ON when the output current of the inverter has exceeded the detection level for the time longer than the specified timer period.	
	(ID2)	Current detected 2		
	(ID3)	Current detected 3		
	(TD1)	Torque detected 1	This signal comes ON when the output torque of the inverter has exceeded the detection level for the time longer than the specified timer period.	
	(TD2)	Torque detected 2		
	(OH)	Heat sink overheat early warning	This outputs a heat sink overheat early warning before an overheat trip actually happens. It is also used to detect an internal air circulation fan failure. (Applicable to inverters with 400V 75 kW, or above)	

Classification	Symbol	Name	Functions	Remarks
Transistor output	(SY)	Synchronization completed	This signal comes ON when the control target comes inside the synchronization completion detection angle in synchronous running. *4*5*7*11	
	(LIFE)	Lifetime alarm	This outputs a service lifetime alarm according to the internal lifetime criteria. It is also used to detect an internal air circulation fan failure. (Applicable to inverters with 400V 75 kW, or above)	
	(PID-ALM)	PID alarm	This outputs an absolute-value alarm and deviation alarm when the PID control is enabled.	
	(PID-CTL)	Under PID control	This signal comes ON when the PID control is enabled.	
	(PID-STP)	Motor stopped due to slow flowrate under PID control	This signal is ON when the inverter is in a stopped state by the slow flowrate stopping function under the PID control. (The inverter is stopped even if a run command is entered.)	
	(REF OFF)	Reference loss detected	This signal comes ON when an analog frequency command is missed due to wire breaks.	
	(IDL)	Low current detected	This signal comes ON when the current has been below the preset current detection level for the time longer than the specified timer period.	
	(U-TL)	Low output torque detected	This signal comes ON when the torque value has been below the preset detection level for the time longer than the specified timer period.	
	(OLP)	Overload prevention control	This output signal comes ON when the overload prevention control is activated.	
	(RMT)	In remote operation	This signal comes ON when the inverter is in the remote mode.	
	(BRKS)	Brake signal	Signal for Brake Control. Turn ON when the brake is released.	
	(MNT)	Maintenance timer	Alarm signal is generated when time passes or start-up exceeds over the preset value	
	(THM)	Motor overheat detected by thermistor	This signal comes ON when the motor overheat is detected with the PTC/NTC thermistor.	
	(C1OFF)	Terminal [C1] wire break	When Input current to C1 terminal become less than 2mA, this is interpreted as wire brake and then ON-singal is generated.	
	(DSAG)	Speed agreement	This output signal comes ON when the difference between the detected speed and the commanded speed (frequency) has been within the specified range for the time specified by the agreement timer.	
	(PG-ERR)	PG error detected	Speed Deflection is greater than the certain value, ON-signal is generated.	
	(DECF)	Enable circuit failure detected	When the failure of an enable circuit is detected(*8)(*9), the turning on signal is output(*10).	
	(ENOFF)	Enable input OFF	When both of terminal EN1 and terminal EN2 input are turned off, the turning on signal is output.	
	(DBAL)	Braking transistor broken	This signal comes ON when the DBTr defective is detected.	
	(PSET)	Positioning completion signal	This signal comes ON when the inverter has been servo-locked so that the motor is held within the positioning completion range.	
	(L-ALM)	Light alarm	When Alarm or warning, which is set as "light failure", is generated, inverter indicates "Light failure"on the display and generates this light failure signal.	
	(ALM)	Alarm output (for any alarm)	This is an alarm relay output as a transistor output.	
	(CLO1) to (CLO5)	Customizable logic output signal	These are customizable logic output signals as transistor output signals.	
Relay output	[Y5A], [Y5C]	General purpose relay output	・As a general-purpose relay output, the same functions as Y1 to Y4 can be assigned. ・The logic value is switchable between "[Y5A] and [Y5C] are excited" and "non-excited."	Contact rating: 250 VAC, 0.3 A cosφ=0.3
	[30A], [30B], [30C]	Alarm relay output (for any error)	・This outputs a non-voltage contact signal (1c) when the inverter is stopped with the protective function. ・As a general-purpose relay output, the same functions as Y1 to Y4 can be assigned. ・The logic value is switchable between "[Y5A] and [Y5C] are excited" and "non-excited."	48 VDC, 0.5A

Classification	Symbol	Name	Functions	Remarks
Analog output	[FM1] [FM2]	Analog monitor 1 Analog monitor 2	The output can be either analog DC voltage (0 to 10 V) or analog DC current (4 to 20 mA or 0 to 20 mA). Any one of the following items can be output with the selected analog form. • Output frequency （before slip compensation, after slip compensation） • Output current • Output voltage • Output torque • Load factor • Input power • PID feedback amount • DC link bus voltage • Universal AO • Motor output • Analog output test • PID command • PID output • Speed detection （PG feedback value） • Positional deviation in synchronous running *11 *When the terminal is outputting 0 to 10 VDC, it is capable of driving up to two meters with 10kΩ impedance. *When the terminal is outputting current, it is capable of connecting a maximum of 500Ω to the meter. Adjustable gain range: 0% to 300%	
	[11]	Analog common		
Communication	RJ-45 connector for the keypad	RS-485 communications port 1	Out of the following protocols, the desired one can be selected. • Modbus RTU • Fuji general-purpose inverter protocol • FRENIC Loader protocol (SX)	With power supply to the keypad
	[DX+]/[DX-]/[SD]	RS-485 communications port 2(Terminalson control PCB)	• Modbus RTU • Fuji general-purpose inverter protocol	
	USB connector	USB port (On the keypad)	A USB port connector (Mini-B) that connects an inverter to a personal computer. FRENIC Loader.	Mounted on Remote Keypad (option)

*1 Effective function in V/f control

*2 Effective function in dynamic torque vector control

*3 Effective function when the slip compensation is made active under V/f control

*4 Effective function under the V/f control with speed sensor (PG option is necessary.)

*5 Effective function in dynamic torque vector control with speed sensor. (PG option is necessary.)

*6 Effective function in vector control without speed sensor

*7 Effective function in vector control with speed sensor (PG option is necessary.)

*8 Function not incorporated in the inverters of initial version

4. Enable input operation logic diagram

Main power input L1/R,L2/S,L3/T	Enable input		Transistor output or Alarm relay output (for any error) *		Output
	EN1-PLC	EN2-PLC	DECF	ENOFF	
OFF	x	x	OFF	OFF	Shut down (Safe Torque Off (STO) **)
ON	OFF	OFF	OFF	ON	Shut down (Safe Torque Off (STO) **)
	ON	ON	OFF	OFF	Wait for a run command
	ON	OFF	ON ***	OFF	Shut down (Safe Torque Off (STO) **)
	OFF	ON	ON ***	OFF	Shut down (Safe Torque Off (STO) **)

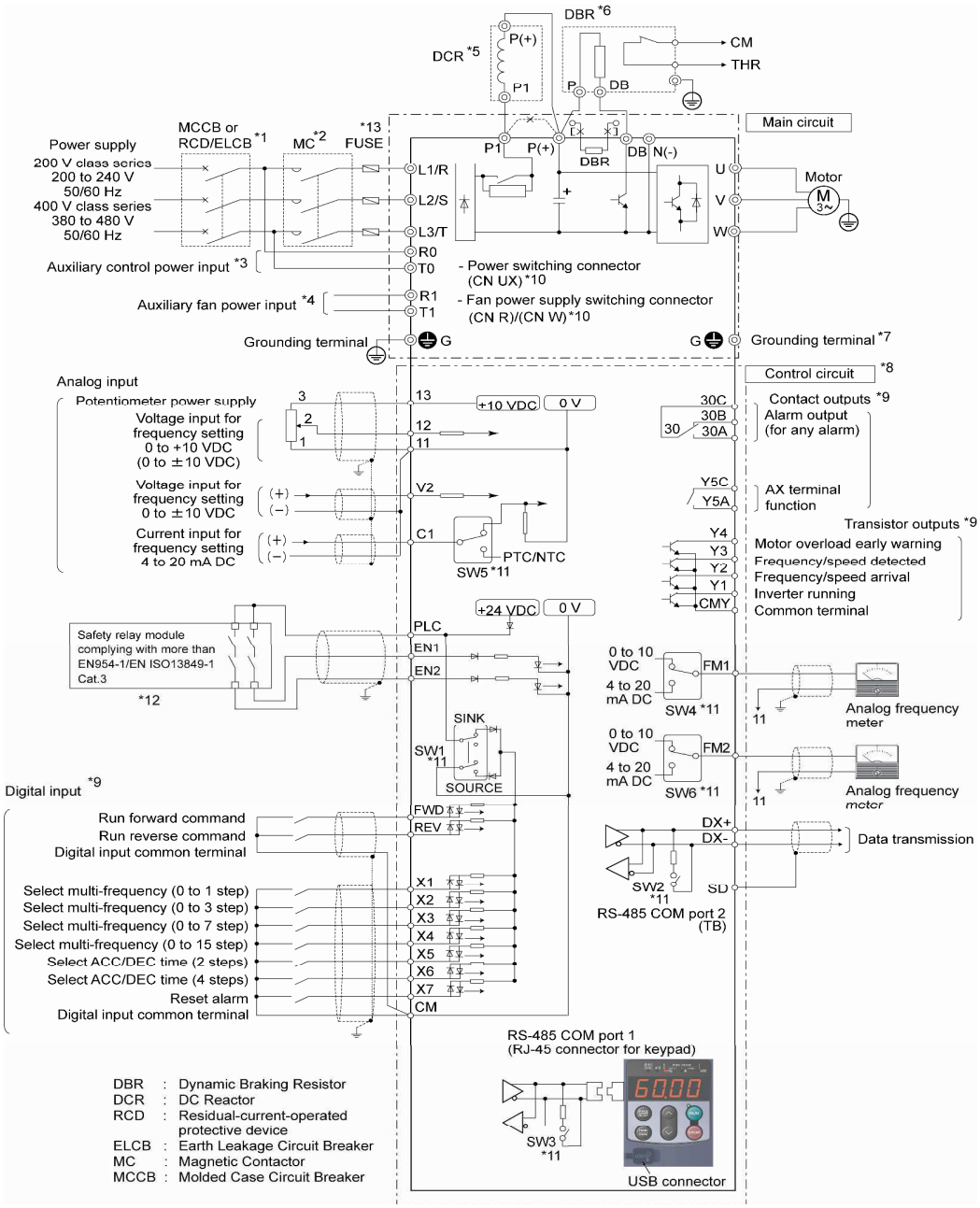
x : Independent of this state, the output is determined.

* : To use these functions, it is necessary to assign DECF/EN OFF to digital output terminals (function codes E20 to E24 and E27, data = 101/102 or 1101/1102 (negative logic)).

** : Output shutdown (Safe Torque Off) prescribed in EN61800-5-2.

*** : If either one of [EN1] and [EN2] terminals is kept OFF for 50 ms or more, the inverter interprets it as a discrepancy, causing an alarm ECF. This alarm state can be cleared only by turning the inverter off and on.

5. Wiring of main circuit terminals



*1 Install a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection function) in the primary circuit of the inverter to protect wiring. Ensure that the circuit breaker capacity is equivalent to or lower than the recommended capacity.

*2 Install a magnetic contactor (MC) for each inverter to separate the inverter from the power supply, apart from the MCCB or RCD/ELCB, when necessary.
Connect a surge absorber in parallel when installing a coil such as the MC or solenoid near the inverter.

*3 The R0 and T0 terminals are provided for inverters with a capacity of 1.5 kW or above.
To retain an alarm output signal ALM issued on inverter's programmable output terminals by the protective function or to keep the keypad alive even if the main power has shut down, connect these terminals to the power supply lines. Without power supply to these terminals, the inverter can run.

*4 Normally no need to be connected. Use these terminals when the inverter is equipped with a high power-factor, regenerative PWM converter (RHC series).

*5 When connecting an optional DC reactor (DCR), remove the jumper bar from the terminals P1 and P(+).
Inverters with a capacity of 55 kW in LD mode and inverters with 75 kW or above require a DCR to be connected. Be sure to connect it to those inverters.
Use a DCR when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity, or when there are thyristor-driven loads in the same power supply line.

*6 Inverters with a capacity of 7.5 kW or below have a built-in braking resistor (DBR) between the terminals P(+) and DB.
When connecting an external braking resistor (DBR), be sure to disconnect the built-in one.

*7 A grounding terminal for a motor. Use this terminal if needed.

*8 For control signal wires, use twisted or shielded-twisted wires. When using shielded-twisted wires, connect the shield of them to the common terminals of the control circuit. To prevent malfunction due to noise, keep the control circuit wiring away from the main circuit wiring as far as possible (recommended: 10 cm or more). Never install them in the same wire duct. When crossing the control circuit wiring with the main circuit wiring, set them at right angles.

*9 The connection diagram shows factory default functions assigned to digital input terminals [X1] to [X7], [FWD] and [REV], transistor output terminals [Y1] to [Y4], and relay contact output terminals [Y5A/C] and [30A/B/C].

*10 Switching connectors in the main circuits. For details, refer to "Instruction manual for FRENIC-MEGA Section 2.3.4 ⑥ Switching connectors" later in this section.

*11 Slide switches on the control printed circuit board (control PCB). Use these switches to customize the inverter operations. For details, refer to Instruction manual for FRENIC-MEGA Section 2.3.6 "Setting up the slide switches."

*12 When the Enable input function is not to be used, keep terminals [EN1]-[PLC] and terminals [EN2]-[PLC] short-circuited using jumper wires. For opening and closing the hardware circuit between terminals [EN1] and [PLC] and between [EN2] and [PLC], use safety components such as safety relays and safety switches that comply with EN ISO13849-1 Category 3 or higher.

*13 To bring the inverter into compliance with the European Standard, Low Voltage Directive EN61800-5-1, be sure to insert the specified fuse (see the Chapter 6) in the primary circuit of the inverter.

6. Input fuse rating list

Three-phase 400 V

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ LD mode	Fuse rating (A)
Three-phase 400 V	0.4	FRN0.4G1□-4E	HD	3(IEC60269-2)
	0.75	FRN0.75G□-4E		6(IEC60269-2)
	1.5	FRN1.5G1□-4E		10(IEC60269-2)
	2.2	FRN2.2G1□-4E		15(IEC60269-2)
	3.7	FRN3.7G1□-4E		20(IEC60269-2)
	5.5	FRN5.5G1□-4E	HD	80(IEC60269-4)
	7.5		LD	
		FRN7.5G1□-4E	HD	
	11		LD	
		FRN11G1□-4E	HD	125(IEC60269-4)
	15		LD	
		FRN15G1□-4E	HD	
	18.5		LD	
		FRN18.5G□-4E	HD	160(IEC60269-4)
	22		LD	
		FRN22G1□-4E	HD	
	30		LD	
		FRN30G1□-4E	HD	250(IEC60269-4)
	37		LD	
		FRN37G1□-4E	HD	315(IEC60269-4)
	45		LD	
		FRN45G1□-4E	HD	
	55		LD	
		FRN55G1□-4E	HD	350(IEC60269-4)
	75		LD	
		FRN75G1□-4E	HD	
	90		LD	
		FRN90G1□-4E	HD	
	110		MD/L	
		FRN110G1□-4E	HD	400(IEC60269-4)
	132		MD/L	
		FRN132G1□-4E	HD	450(IEC60269-4)
	160		MD/L	
		FRN160G1□-4E	HD	500(IEC60269-4)
	200		MD/L	
		FRN200G1□-4E	HD	550(IEC60269-4)
	220		MD/L	
		FRN220G1□-4E	HD	630(IEC60269-4)
	250		MD	
	280		LD	
		FRN280G1□-4E	HD	900(IEC60269-4)
	315		MD	
	355		LD	
	315	FRN315G1□-4E	HD	
	355		MD	
	400		LD	
	355	FRN355G1□-4E	HD	1200(IEC60269-4)
	400		MD	
	450		LD	
	400	FRN400G1□-4E	HD	
	450		MD	
	500		LD	
		FRN500G1□-4E	HD	2000(IEC60269-4)
	630		LD	
		FRN630G1□-4E	HD	
	710		MD	

7. Compliance with Functional Safety Standard

7.1 Compliance with Functional Safety Standard

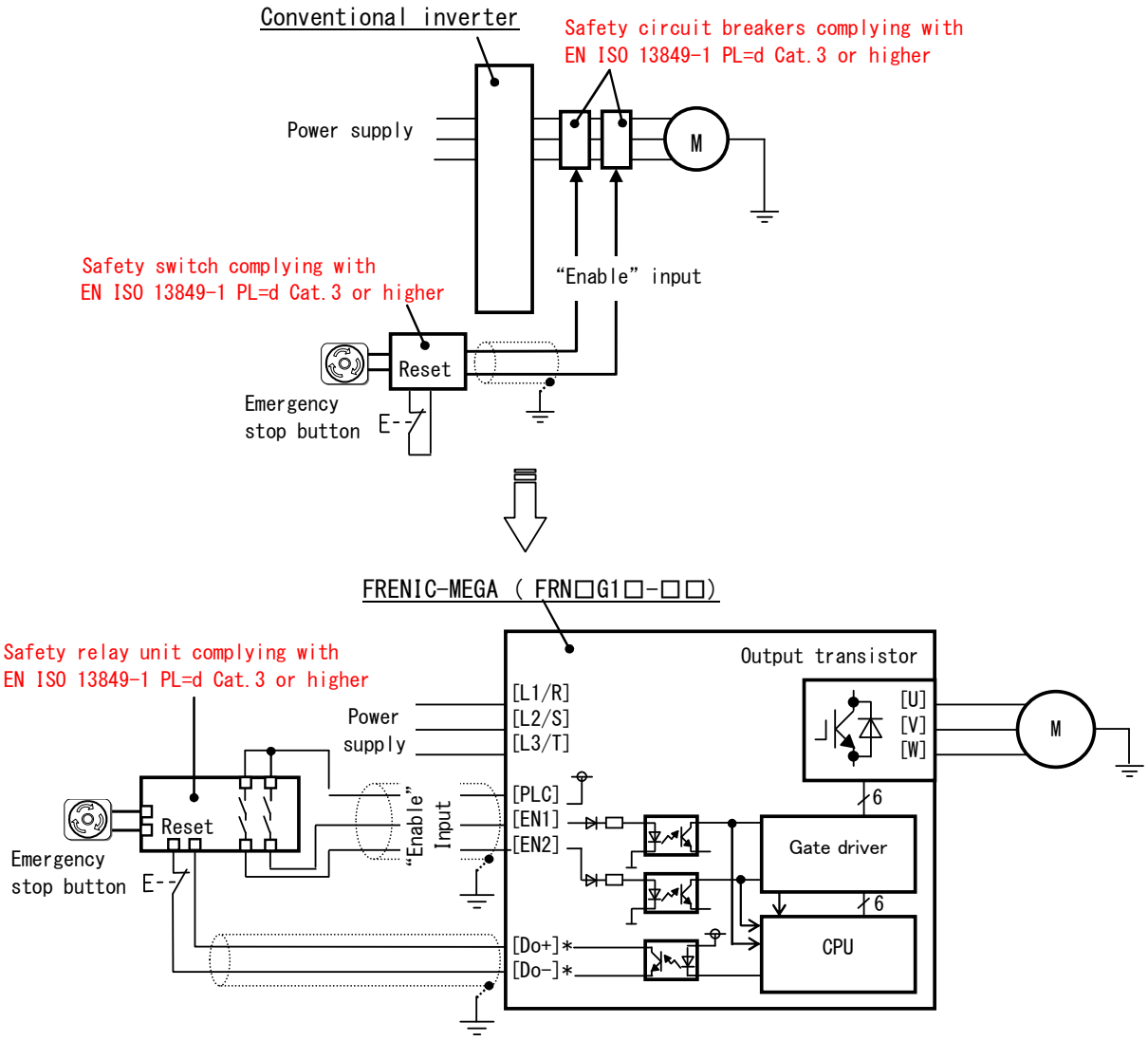
In FRENIC-MEGA series of inverters, opening the hardware circuit between terminals [EN1]-[PLC] or between terminals [EN2]-[PLC] stops the output transistor, coasting the motor to a stop. (EN1: Enable input 1, EN2: Enable input 2) This is the Safe Torque Off (STO) function prescribed in EN60204-1, Category 0 (Uncontrolled stop) and compliant with Functional Safety Standard.

caution: The output shutdown function of this inverter uses the Safe Torque Off (STO) function prescribed in EN61800-5-2 so that it does not completely shut off the power supply to the motor electrically. Depending upon applications, therefore, additional measures are necessary for safety of end-users, e.g., brake function that locks the machinery and motor terminal protection that prevents possible electrical hazard(s).

reference: European Standard EN ISO13849-1 PL=d (Safety of machinery–Safety related parts of control systems) prescribes the basic safety requirements for machinery categorized according to the requirement level. Category 3 represents the requirements that the machinery shall be designed with redundancy so that a single fault does not lead to the loss of the safety function.

Using the Safe Torque Off (STO) function eliminates the need of external safety circuit breakers while conventional inverters need those breakers to configure the Functional Safety Standard compliant safety system.

Enable terminals and peripheral circuit, and internal circuit configuration



*Transistor output terminals (e.g., [Y1]-[CMY], DECF(Function code data=1101))

7.2 Notes for compliance to Functional Safety Standard

1) Wiring for terminals [EN1] (Enable input 1) and [EN2] (Enable input 2)

- [EN1]/[EN2] and [PLC] are terminals prepared for connection of safety related wires; therefore, careful wiring should be performed to ensure that no short-circuit(s) can occur to these terminals.
- For opening and closing the hardware circuit between terminals [EN1]/[EN2] and [PLC], use safety approved components such as safety relays that comply with EN ISO13849-1 PL=d Cat. 3 or higher to ensure a complete shutoff.
- It is the responsibility of the machinery manufacturer to guarantee that a short-circuiting or other fault does not occur in wiring of external safety components between terminals [EN1]/[EN2] and [PLC].

  Fault examples:
  • Terminals [EN1]/[EN2] and [PLC] are short-circuited due to the wiring being caught in the door of the control panel so that a current continues to flow in terminal [EN1]/[EN2] although the safety component is OFF and therefore the safety function may NOT operate
  • The wiring is in contact with any other wire so that a current continues to flow in terminal [EN1]/[EN2] and therefore the safety function may NOT operate

2) Note for Safe Torque Off (STO)

- When configuring the product safety system with this Safe Torque Off (STO) function, make a risk assessment of not only the external equipment and wiring connected to terminals [EN1] and [EN2] (Enable input 1 and Enable input 2) but also the whole system including other equipment, devices and wiring against the product safety system required by the machinery manufacturer under the manufacturer's responsibility in order to confirm that the whole system conforms to the product safety system required by the machinery manufacturer.
  In addition, as preventive maintenance, the machinery manufacturer must perform periodical inspections to check that the product safety system properly functions.
- To bring the inverter into compliance with Functional Safety Standard, it is necessary to install the inverter on a control panel with the enclosure rating of IP54 or above.
- To bring the inverter into compliance with Functional Safety Standard, it is necessary to bring it into compliance with European Standards EN61800-5-1 and EN61800-3.
- This Safe Torque Off (STO) function coasts the motor to a stop. When a mechanical brake is used to stop or hold the motor for the sake of the product safety system of whole system, do not use the inverter's control signals such as output from terminal [Y]. (Using control signals does not satisfy the safety standards because of software intervention.) Use safety relay units complying with EN ISO13849-1 PL=d Cat. 3 or higher to activate mechanical brakes.
- The safety shutdown circuit between terminal [EN1] and [EN2] input sections and inverter's output shutdown section is dual-configured (redundant circuit) so that an occurrence of a single fault does not detract the Safe Torque Off (STO).If a single fault is detected in the safety shutdown circuit, the inverter coasts the motor to a stop even with the [EN1]-[PLC] and [EN2]-[PLC] states being ON, as well as outputting an alarm to external equipment. (Note that the alarm output function is not guaranteed to all of single faults. It is compliant with EN ISO13849-1 PL=d Cat. 3.)
- The Safe Torque Off (STO) function does not completely shut off the power supply to the motor electrically. Before starting wiring or maintenance jobs, be sure to disconnect the input power to the inverter and wait at least 5 minutes.

(3) A test of Safe Torque Off (STO)
In application where no regular activation of the Safe Torque Off (STO) function is guaranteed, check at least once a year that the Safe Torque Off (STO) function works correctly.

CHECKED:K. Ueki/NAKATO APPROVED:S. Taka. DATE:2019/06/20

Revision	Date	Drawn	Checked	Approved	Contents
a	July 10th, '08	T.Yoshida	M.Mochizuki	Y.Matsumoto	■Top Cover
					Change company name.
					■Chapter 1. Standard specifications
					Add : braking transistor built-in type instead of Basic type etc.
					Expand capacity to 200V 90kW/400V 630kW
b	Mar. 11th, '11	K.Ueki L.Zhang T.Migaki	N.Itoigawa	T.Ichihara	**■Top Cover**
					Change companyname
					■Chapter 1. Standard specifications
					Add :
					・ Title
					・applicable standard No.
					・160 to 400kW inverters can not apply C22.2 No.14
					■Chapter 2. Common specifications
					・Output
					Correct the instruction of Analog setting resolution
					Delete the remarks of Speed control range
					・Functional safety
					Add : functional safety specifications
					・Control
					Add :
					・[Enable input(Safe Torque Off (STO))] : "Turning off the circuit between terminals [EN2] and [PLC]" input mode
					・ [Frequency setting] / [Analog input] : 0 to +20 mA DC/0 to 100% (Terminal [C1])
					・ [Frequency setting] / [Inverse operation] : +20 to 0mA DC/0 to 100% (Terminal [C1])
					・ On-line tuning
					・ constant peripheral speed control
					・ synchronous operation
					・ Battery operation
					Correct from "(Safety stop function)" to "(Safe Torque Off (STO))"
					Delete the remarks of Torque limiter
					Correct the instruction of Automatic energy saving operation
					Correct the remarks of Switching Motor Parameter
					Correct the remarks of Torque Control
					Correct the [Customized logic interface] to [Customizable logic interface] and delete the remarks
					・Protective function
					Add :
					・ Positioning control error
					・ [Light-alarm (warning)] : Positioning Control Error(Ero)
					Delete the remarks of[Control method] / V/f control with speed sensor
					Correct the instruction of Fuse breaking (Delete 200V 75kW)
					Correct the instruction of Charging circuit abnormality (Delete 200V 75kW)
					Correct the remarks of Brake transistor abnormality from [dbAL] to [dbA]
					Correct the instruction of Over-speed protection
					Correct the instruction of [Motor Protection] / [Overload early warning] from"Warning signal" to "Warning signal(OL)"
					・Others
					Reviewing :
					・ Delete ASR-auto tuning in speed control
					・ Delete analog resolution(Correct Setting Resolution)
					・ Delete Auto tuning by shortest accel./decel. mode
					・ Delete Automatic energy saving operation with digital input
					・ Delete Overload stop function
					・ Delete [vibration suppressing observer] for Speed control
					Add :
					・a Software Version Mark [*11] to each function which can be supported by the inverters having a ROM version 3000 or later
					・a Software Version Mark [*12] to each function which can be supported by the inverters having a ROM version 3600 or later

CHECKED:K. Ueki/NAKATO APPROVED:S. Taka. DATE:2019/06/20

b	Mar. 11th, '11	K.Ueki L.Zhang T.Migaki	N.Itoigawa	T.Ichihara	**■Chapter 3. Terminal functions**
					・Analog input
					Add ：
					・ [Analog intput] / [12]& [C1]&[V2] / [Torque command] ： Torque current command
					・ [Analog intput] / [12]& [C1]&[V2] / [Torque command] ： Speed limit value of FWD
					・ [Analog intput] / [12]& [C1]&[V2] / [Torque command] ： Speed limit value of REV
					・ [Analog intput] / [C1] / [Gain setting] ： 0% to 100% for 0 to 20 mA
					Delete the remarks of[Analog intput] / [12]& [C1]&[V2] / [Torque command/Torque current command]
					・Digital input
					Add ：
					・(Hz/TRQ)：Cancel torque control
					・(Hz/LSC)：Cancel constant peripheral speed control
					・(LSC-HLD)：Hold the constant peripheral speed control frequency in the memory
					・(LOCK)：Servo-lock command
					・(CLC)：Cancel customizable logic
					・(CLTC)：Clear all customizable logic timers
					・(BATRY)：Enable battery operation
					Correct the Remarks of Digital input from 11 to 16 mA （terminal [X7]) to 9.7 to 16 mA （terminal [X7)
					Change terminal [EN] to terminal [EN1] and [EN2]
					・Transistor output
					Add ：
					・ (SY) ： Synchronization completed
					・ (CLO1) to (CLO5) ： Customizable logic output signal
					Correct the instruction of (DECF) ： Enable circuit failure detected
					Correct the instruction of (ENOFF) ： Enable input OFF
					・Analog output
					Add ：
					・ [Analog output] / [FM1]&[FM2] ： 0 to 20 mA
					・ [Analog output] / [FM1]&[FM2] ： Positional deviation in synchronous running
					・Others
					Reviewing ： Delete Enable/disable overload stop function
					■Chapter4, 5, 6 and 7
					Add ： chapter 4, 5, 6 and 7
c	2019/5/9	K.Nakamura	K.Ueki	S.Takamoto	**Functional safety standard update（Control PCB：EP4950C, ROM:4200～）**
					■Top Cover
					Change department name
					■Chapter 1. Standard specifications
					Applicable safety standards number update
					■Chapter 2. Common specifications
					Functional safety update
					・Category
					・Performance level
					・DCave
					・Response time for the safety function
					・MTTFd for each channel
					・HFT
					・SFF
					・PFH
					■Chapter4. Enable input operation logic diagram
					■Chapter5. Wiring of main circuit terminals
					■Chapter 7. Compliance with Functional Safety Standard
					Safety standard Number deleted
					・EN954-1
					Safety standard Number changed
					・EN 61800-5-2：2007