FUJI ELECTRIC

Fuji Spindle Drive System for Machine Tools

FRENIC 5000MS5

Technical information

MHT256c (Engl.)

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Section 1 System Components

1.1 FRENIC5000MS5 series system components

FRENIC5000MS5 series consists of two series: The M5 series, which uses torque-vector control without sensors, and the high-performance V5 series, which uses vector control with sensors. Each of the series includes units and spindle motors.

[Unit]

(1) Converter unit

◆A converter unit supplies the main electric power to the drive units.

◆When using a converter unit, select either a dynamic braking converter unit which consumes braking energy in a braking resistor, or a regenerative braking converter unit which feeds the braking energy back to the power supply line.

◆One converter unit can supply the main power to two or more drive units if the total output of the drive units does not exceed the converter unit output rating.

(2) Drive unit

◆A drive unit receives the main electric power from a converter unit to drive the spindle motor.

◆When using a drive unit, select either an M5 drive unit or a V5 drive unit. The M5 drive unit performs torque-vector control without speed feedback, while the V5 drive unit uses a speed feedback for high-performance vector control.

(3) Package type drive unit

◆In this unit, the functions described in items (1) and (2) above are incorporated. When using this type, use either an M5 package type drive unit for torque-vector control without speed feedback, or a V5 package type drive unit for high-performance vector control using a speed feedback.

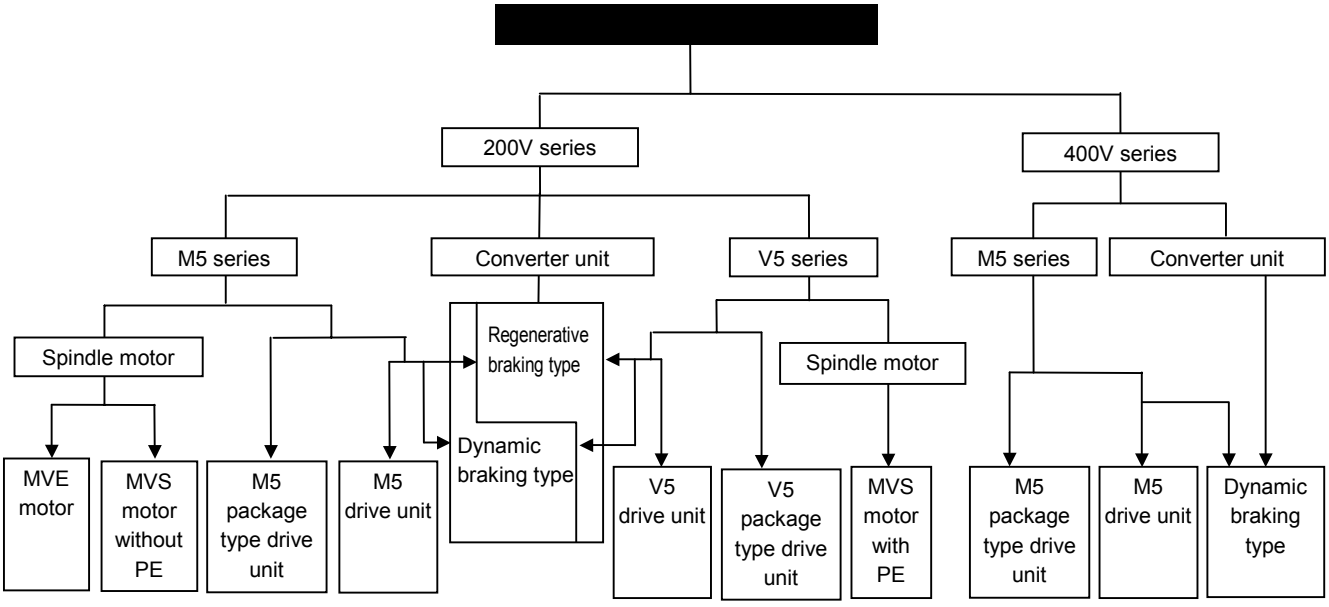
◆Only the dynamic braking type unit is available.

[Spindle motor]

◆Spindle motors are classified into MVS type and MVE type.

◆MVS type with a pulse encoder (PE) is for V5 series system and one without a PE is for M5 series system.

◆MVE type is for M5 series system.



1.2 Product line

50%ED rated output [kW]	1.1	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Continuous rated output [kW]	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45
Dynamic braking converter unit					FRN□□PD5-2								
					FRN□□PD5-4								
Regenerative braking converter unit							FRN□□PD5-2						
M5 package type drive unit	FRN□□M5-2												
				FRN5.5M5-4									
V5 package type drive unit		FRN□□V5-2											
M5 drive unit							FRN□□MC5-2						
					FRN□□MC5-4								
V5 drive unit							FRN□□VC5-2						
MVE motor	MVE□□M5-2A,G												
MVS motor with PE		MVS□□V5-2A,G											
MVS motor without PE		MVS□□M5-2A,G											

□in the product type indicates a 50%ED rated output.

1.3 Optional equipment

Name	Type	Description	
Braking resistor (10%ED)	DB□□□MS5-□1 (*1)	・Used together with the dynamic braking converter unit or package type drive unit to perform dynamic braking. ・For 200 [V] series, the type number suffix is 21 or 22. For 400 [V] series, the type number suffix is 41 or 42.	
Braking resistor (20%ED)	DB□□□MS5-□2 (*1)		
PE interface card	OPCⅡ-MS5-PE	・Receives signals from the pulse encoder on a machine spindle to make positioning of controlled axis (orientation with PE). ・Receives signals from the pulse encoder on a machine spindle to perform spindle speed feedback control with the signals. (*2) ・Performs I/O signal processing to switch over the motor windings from Δ to 人. ・Digital speed can be set.	
Synchronous operation card	OPCⅡ-MS5-SY	・Optional card having PE interface card with biaxial synchronous operation function. ・For the synchronous operation, this card is necessary for each drive unit.	
Magneto-sensor orientation card	OPCⅡ-MS5-MG	・Perform (one point) positioning of spindle together with magneto-sensor and detector.	
Program loading software connection cable	CB-MS5-PC	・Loader software for personal computer and a dedicated cable for connecting a PC and a drive unit	
Communication cable between units (*3)	CB-MS5-1	Cable for communicating between units	For detailed application, see section 3 Outline Dimensions.
	CB-MS5-2		
	CB-MS5-3		
DC connecting bar (*3) (*4)	DC-MS5-1	Connecting bar for DC busbar of each unit	For a unit 90mm wide (left) + a unit 90mm wide (right)
	DC-MS5-1R		For a unit 150mm wide (left) + a unit 90mm wide (right)
	DC-MS5-1L		For a unit 90mm wide (left) + a unit 150mm wide (right)
	DC-MS5-2		For a unit 150mm wide (left) + a unit 150mm wide (right)
	DC-MS5-2R2		For a unit 270mm wide (left) + a unit 150mm wide (right) x 2
	DC-MS5-3		For a unit 270mm wide (left) + a unit 270mm wide (right)

Notes: (*1) □in the product type indicates a rated output at 50%ED.

(*2) In the M5 series, in case the speed reduction ratio in motor/spindle is about five times or less when PE orientation or synchronous operation is executed, the control method can be assumed to be the spindle PE feedback control.
In the spindle PE feedback control, the speed of the machine spindle is detected by the signal from the pulse encoder installed in the machine spindle. In that case, when the speed reduction ratio between the motor shaft and the machine spindle is large, the speed in a low-speed range cannot be detected, and an enough performance might not be exhibited. For these reasons, when a machine having the large speed reduction ratio (about five times or more as the standard) is used, select the torque vector or V/f control which does not use the speed feedback from the spindle for control, or also select MVS (with PE) motor plus the V5 series (high-performance vector control).
When the spindle PE feedback control is executed, the performance of spindle PE feedback control may decrease when the tension of the belt is insufficient regarding the coupling of "machine spindle and pulse encoder shaft", or "machine spindle and motor shaft". In the worst case, the alarm occurrence might be caused. Note the rigidity of the machine system fully.

(*3) It is always necessary except when the package type drive unit is used solely. Select the equipment to be used according to the size and the installation method of the unit, or prepare the equivalent one on your side.

(*4) Inquire of our sales office when arranging or combining the bar other than described here.

(*5) Only one optional card can be packed per package type drive unit or per drive unit.

(*6) The following functions are available if the optional card is installed.

Optional card name	Function name (○: Enable)				
	PE orientation	Synchronous operation	Winding changeover	Digital speed setting	MG orientation
OPCⅡ-MS5-PE	○	—	○	○	—
OPCⅡ-MS5-SY	○	○	○	○	—
OPCⅡ-MS5-MG	—	—	—	—	○

Section 2 Specifications

2.1 Unit specifications

(1) 200V series unit standard specifications

Dynamic braking converter unit

Type [FRN□PD5-2]			7.5	11	15	18.5
Output rating	Cont. rated output	[kW]	5.5	7.5	11	15
	50%ED rated output (*1)	[kW]	7.5	11	15	18.5
	DC voltage		283 to 325 [V] DC			
Input power supply	Phases, voltage, frequency		3-phase 3-wire 200 [V]/50 [Hz], 200 to 230 [V]/60 [Hz]			
	Allowable variation		Voltage: +10 to –15%, Imbalance rate of power supply voltage: 2% or less (*3)			
	Required power supply capacity	[kVA]	12	17	22	28
Calorific power (heat loss) emanated inside panel during cont. rated operation (*4)		[W]	35 (45)	45 (55)	60 (100)	80 (150)
Braking	Braking method		Dynamic braking			
	Cyclic duration factor (*6)		10%ED or 20%ED (using optional braking resistor)			
	Overload capacity		50%ED rated output of applied drive unit x 120% for 1 [min]			
Approx. mass		[kg]	5	5	6	6

Regenerative braking converter unit

Type [FRN□PR5-2]			5.5	7.5	11	15	18.5	22	30	37	45	55
Output rating	Cont. rated output	[kW]	3.7	5.5	7.5	11	15	18.5	22	30	37	45
	50%ED rated output (*1)	[kW]	5.5	7.5	11	15	18.5	22	30	37	45	55
	30 [min] rated output (*2)	[kW]	–								45	55
	DC voltage		283 to 325 [V] DC									
Input power supply	Phases, voltage, frequency		3-phase 3-wire 200 [V]/50 [Hz], 200 to 230 [V]/60 [Hz]									
	Allowable variation		Voltage: +10 to –15%, Imbalance rate of power supply voltage: 2% or less (*3)									
	Required power supply capacity	[kVA]	9	12	17	22	28	34	45	55	67	82
Calorific power (heat loss) emanated inside panel during cont. rated operation (*7)		[W]	45 (60) {25}	60 (75) {30}	80 (100) {35}	115 (155) {45}	140 (190) {50}	170 (230) {50}	190 (290) {50}	250 (300) {70}	300 (450) {70}	350 (550) {90}
Braking	Braking method		Regenerative braking									
	Cyclic duration factor (*8)		30%ED at max. output, Cont. regenerative braking at cont. rated output									
	Overload capacity		50%ED rated output of applied drive unit x 120% for 1 [min]									
Approx. mass		[kg]	6	6	6	8	8	9	9	22	23	23

Notes: (*1) 50%ED rated output is the output obtained at the operating condition, ON for 5 [min] and OFF for 5 [min] per 10 [min] operation cycle.

(*2) 30 [min] rated output is the output obtained at the operating condition, ON for 30 [min] and OFF until the temperature of the units and motor lowers down to the ambient temperature. (45/37 [kW] to 55/45 [kW]).

(*3) Imbalance rate of power supply voltage [%] = (Max. voltage [V] – Min. voltage [V]) / 3-phase average voltage [V] x 67

(*4) Value in ( ) indicates the heat loss from the external cooling fin section (heat sink outside).

(*6) Cyclic duration factor 10%ED is the output obtained at the operating condition, ON for 10 [s] and OFF for 90 [s] per 100 [s] operation cycle. Cyclic duration factor 20%ED is the output obtained at the operating condition, ON for 20 [s] and OFF for 80 [s] per 100 [s] operation cycle.

(*7) Value in ( ) indicates the heat loss from the external cooling fin section (heat sink outside). Value in { } indicates the heat loss from the AC reactor (provided standard) for regenerative braking converter unit.

(*8) Cyclic duration factor 30%ED is the output obtained at the operating condition, ON for 30 [s] and OFF for 70 [s] per 100 [s] operation cycle.

Package type drive unit

Type	M5 series [FRN□M5-2]		1.1	2.2	3.7	5.5
	V5 series [FRN□V5-2]		–	2.2	3.7	5.5
Output rating	Cont. rating	Output [kW]	0.75	1.5	2.2	3.7
		Current [A]	5.3	11	17	22
	50%ED rating (*1)	Output [kW]	1.1	2.2	3.7	5.5
		Current [A]	7	14	24	28
	Overload capacity		50%ED rated output x 120% for 1 [min]			
Input power supply	Phases, voltage, frequency		3-phase 3-wire 200 [V]/50 [Hz], 200 to 230 [V]/60 [Hz]			
	Allowable variation		Voltage: +10 to –15%, Imbalance rate of power supply voltage: 2% or less (*3)			
	Momentary voltage dip capability		When the input voltage is 165 [V] AC or more, the unit can be operated continuously but the output may be reduced. When the input voltage drops below 165 [V] AC from the rated voltage, the unit can be operated for 15 [ms]. (*7)			
	Required power supply capacity [kVA]		2.5	4	7	9
Calorific power (heat loss) emanated inside panel during cont. rated operation (*4) [W]			50 (25)	70 (50)	90 (75)	110 (120)
Control range	Torque vector (V/f) control (*5) [Hz]		0.5 to 266			
	PE feedback control High-performance vector control (*5) [r/min]		30 to 8000			
Braking	Braking method		Dynamic braking			
	Braking torque		50%ED rated output x 120% for 1 [min]			
	Cyclic duration factor (*6)		10%ED or 20%ED (using optional braking resistor)			
Approx. mass [kg]			5.5	5.5	5.5	6

Notes: (*1) 50%ED rated output is the output obtained at the operating condition, ON for 5 [min] and OFF for 5 [min] per 10 [min] operation cycle.
(*3) Imbalance rate of power supply voltage [%] = (Max. voltage [V] – Min. voltage [V]) / 3-phase average voltage [V] x 67
(*4) Value in ( ) indicates the heat loss from the external cooling fin section (heat sink outside).
(*5) When the MVE spindle motor is driven by the unit, the max. speed depends on the motor specifications.
(*6) Cyclic duration factor 10%ED is the output obtained at the operating condition, ON for 10 [s] and OFF for 90 [s] per 100 [s] operation cycle. Cyclic duration factor 20%ED is the output obtained at the operating condition, ON for 20 [s] and OFF for 80 [s] per 100 [s] operation cycle.
(*7) Tested at standard load condition (85% load for a nominal applied motor) specified by a JEMA committee.

Drive unit

Type	M5 series [FRN□MC5-2]		5.5	7.5	11	15	18.5	22	30	–	–	–
	V5 series [FRN□VC5-2]		5.5	7.5	11	15	18.5	22	30	37	45	55
Output rating	Cont. rating	Output [kW]	3.7	5.5	7.5	11	15	18.5	22	30	37	45
		Current [A]	22	33	45	54	75	88	105	137	167	205
	50%ED rating (*1)	Output [kW]	5.5	7.5	11	15	18.5	22	30	37	45	55
		Current [A]	28	41	57	74	88	101	136	166	195	238
	30 [min] rating (*2)	Output [kW]	–								45	55
		Current [A]	–								195	238
	Overload capacity		50%ED rated output x 120% for 1 [min]									
Input power supply	Power supply method		DC input from MS5 series converter unit									
	Input voltage		283 to 325 [V] DC									
	Allowable variation		Voltage: +10 to –15%, Imbalance rate of power supply voltage: 2% or less (*3)									
	Momentary voltage dip capability		When the AC input voltage to the converter unit is 165 [V] AC or more, the unit can be operated continuously but the output may be reduced. When the input voltage drops below 165 [V] AC from the rated voltage, the unit can be operated for 15 [ms]. (*7)									
Calorific power (heat loss) emanated inside panel during cont. rated operation (*4) [W]			70 (105)	90 (145)	125 (195)	150 (250)	220 (330)	260 (390)	280 (440)	350 (600)	500 (850)	650 (1050)
Control method			【M5 series】 - Torque vector control or V/f control - Spindle PE feedback control (vector control) can be executed when a PE is attached to the spindle and a PE interface card is used. (speed reduction ratio: 5 or less) 【V5 series】 High-performance vector control									
Control range	Torque vector (V/f) control (*5) [Hz]		0.5 to 266									
	PE feedback control High-performance vector control (*5) [r/min]		30 to 8000			30 to 6000				30 to 4500		30 to 4000
Braking	Braking method		Dynamic braking and regenerative braking by MS5 series converter unit									
	Nominal applied converter unit (*9)	Dynamic braking [□PD5-2]	–	7.5	11	15	18.5	–	–	–	–	–
		Regenerative braking [□PR5-2]	5.5	7.5	11	15	18.5	22	30	37	45	55
Approx. mass [kg]			6	6	6	8	8	9	9	22	23	22

Notes: (*1) 50%ED rated output is the output obtained at the operating condition, ON for 5 [min] and OFF for 5 [min] per 10 [min] operation cycle.
(*2) 30 [min] rated output is the output obtained at the operating condition, ON for 30 [min] and OFF until the temperature of the units and motor lowers down to the ambient temperature. (45/37 [kW] to 55/45 [kW])
(*3) Imbalance rate of power supply voltage [%] = (Max. voltage [V] – Min. voltage [V]) / 3-phase average voltage [V] x 67
(*4) Value in ( ) indicates the heat loss from the external cooling fin section (heat sink outside).
(*5) When the MVE spindle motor is driven by the unit, the max. speed depends on the motor specifications.
(*7) Tested at standard load condition (85% load for a nominal applied motor) specified by a JEMA committee.
(*9) This is a standard combination where one drive unit is combined with one converter unit. In order to combine two drive units or more with one converter unit, select a converter unit having a higher output (Cont./50%ED rating) than the total output (Cont./50%ED rating) of the drive units to be used.

(2) 400V series unit standard specification

Dynamic braking converter unit

Type [FRN□PD5-4]			7.5	11	15	18.5
Output rating	Cont. rated output	[kW]	5.5	7.5	11	15
	50%ED rated output (*1)	[kW]	7.5	11	15	18.5
	DC voltage		537 to 679 [V] DC			
Input power supply	Phases, voltage, frequency		3-phase 3-wire 380 to 480 [V] 50/60 [Hz]			
	Allowable variation		Voltage: +10 to –15%, Imbalance rate of power supply voltage: 2% or less (*2)			
	Required power supply capacity	[kVA]	12	17	22	28
Calorific power (heat loss) emanated inside panel during cont. rated operation (*3)		[W]	( )	( )	( )	( )
Braking	Braking method		Dynamic braking			
	Cyclic duration factor (*4)		10%ED or 20%ED (using optional braking resistor)			
	Overload capacity		50%ED rated output of applied drive unit x 120% for 1 [min]			
Approx. mass		[kg]	5	5	6	6

Package type drive unit

Type	M5 series [FRN□M5-4]			5.5			
Output rating	Cont. rating	Output	[kW]	0.75	1.5	2.2	3.7
		Current	[A]	2.7	5.5	8.5	11
	50%ED rating (*1)	Output	[kW]	1.1	2.2	3.7	5.5
		Current	[A]	3.5	7.0	12	14
	Overload capacity			50%ED rated output x 120% for 1 [min]			
Input power supply	Phases, voltage, frequency			3-phase 3-wire 380 to 480 [V] 50/60 [Hz]			
	Allowable variation			Voltage: +10 to –15%, Imbalance rate of power supply voltage: 2% or less (*2)			
	Momentary voltage dip capability			When the input voltage is 310 [V] AC or more, the unit can be operated continuously but the output may be reduced. When the input voltage drops below 310 [V] AC from the rated voltage, the unit can be operated for 15 [ms]. (*6)			
Applicable motor			[kW]	0.75/1.1	1.5/2.2	2.2/3.7	3.7/5.5
Required power supply capacity			[kVA]	2.5	4	7	9
Calorific power (heat loss) emanated inside panel during cont. rated operation (*3)			[W]	( )	( )	( )	( )
Control method				Torque vector control or V/f control PE feedback control (vector control) can be executed when a dedicated motor and a PG or PE interface card is used.			
Control range	Torque vector (V/f) control		[Hz]	0.5 to 266			
	PE feedback control		[r/min]	30 to 6000			
Braking	Braking method			Dynamic braking			
	Braking torque			50%ED rated output x 120% for 1 [min]			
	Cyclic duration factor (*6)			10%ED or 20%ED (using optional braking resistor)			
Approx. mass			[kg]	6			

Notes: (*1) 50%ED rated output is the output obtained at the operating condition, ON for 5 [min] and OFF for 5 [min] per 10 [min] operation cycle.
(*2) Imbalance rate of power supply voltage [%] = (Max. voltage [V] – Min. voltage [V]) / 3-phase average voltage [V] x 67
(*3) Value in ( ) indicates the heat loss from the external cooling fin section (heat sink outside).
(*4) Cyclic duration factor 10%ED is the output obtained at the operating condition, ON for 10 [s] and OFF for 90 [s] per 100 [s] operation cycle. Cyclic duration factor 20%ED is the output obtained at the operating condition, ON for 20 [s] and OFF for 80 [s] per 100 [s] operation cycle.
(*6) Tested at standard load condition (85% load for a nominal applied motor) specified by a JEMA committee.

Drive unit

Type	M5 series [FRN□MC5-4]		7.5	11	15	18.5	–
Output rating	Cont. rating	Output [kW]	5.5	7.5	11	15	–
		Current [A]	17	23	27	38	–
	50%ED rating (*1)	Output [kW]	7.5	11	15	18.5	–
		Current [A]	21	29	37	44	–
	Overload capacity		50%ED rated output x 120% for 1 [min]				
Input power supply	Power supply method		DC input from MS5 series converter unit (400 [V] series)				
	Input voltage		537 to 679 [V] DC				
	Allowable variation		Voltage: +10 to –15%				
	Momentary voltage dip capability		When the AC input voltage to the converter unit is 310 [V] AC or more, the unit can be operated continuously but the output may be reduced. When the input voltage drops below 310 [V] AC from the rated voltage, the unit can be operated for 15 [ms]. (*4)				
Calorific power (heat loss) emanated inside panel during cont. rated operation (*2) [W]			( )	( )	( )	( )	–
Control method			Torque vector control or V/f control PE feedback control (vector control) can be executed when a dedicated motor and a PG or PE interface card is used.				
Control range	Torque vector (V/f) control [Hz]		0.5 to 266				
	PE feedback control [r/min]		30 to 8000				
Braking	Braking method		Dynamic braking by MS5 series converter unit				
	Nominal applied converter unit (*3)	Dynamic braking [□PD5-4]	7.5	11	15	18.5	–
Approx. mass [kg]			6	8	8	9	

Notes: (*1) 50%ED rated output is the output obtained at the operating condition, ON for 5 [min] and OFF for 5 [min] per 10 [min] operation cycle.

(*2) Value in ( ) indicates the heat loss from the external cooling fin section (heat sink outside).

(*3) This is a standard combination where one drive unit is combined with one converter unit. In order to combine two drive units or more with one converter unit, select a converter unit having a higher output (Cont./50%ED rating) than the total output (Cont./50%ED rating) of the drive units to be used.

(*4) Tested at standard load condition (85% load for a nominal applied motor) specified by a JEMA committee.

(3) Unit common specifications

Item			Specifications		
			M5 series	V5 series	
Control	Operation	Speed (frequency) setting signal	Analog signal : +10 [V] DC/Forward • reverse max. frequency (forward • reverse max. speed) Digital signal (optional) : 12 bit binary (with/without sign) 2-digit BCD, 3-digit BCD	Analog signal : +10 [V] DC/Forward • reverse max. speed : ±10 [V] DC/Forward • reverse max. speed (forward • reverse max. frequency) Digital signal (optional) : 12 bit binary (with/without sign) 2-digit BCD, 3-digit BCD	
		Override	± 0% to 50% of speed (frequency) setting signal (by 1% step)		
		Digital (contact) signal	Forward operation command, Reverse operation command, Coast-to-stop command, 2nd spindle motor changeover command, Torque limiting command, M gear signal, L gear signal, External fault, Alarm reset, Simplified orientation start command, Simplified orientation stop command	Forward operation command, Reverse operation command, Coast-to-stop command, 2nd spindle motor changeover command, Torque limiting command (H), M gear signal, L gear signal, External fault, Alarm reset, Rigid tap command, Torque limiting command (L)	
	Running status signal	Transistor output	Arbitrary speed (frequency) detection, Speed (frequency) arrival detection, Speed (frequency) zero detection, 2nd spindle motor changeover end, Batch alarm output (for any fault)	Arbitrary speed detection, Speed arrival detection, Speed zero detection, Under torque limiting, Torque detection, Batch alarm output (for any fault)	
		Analog output	Output for speedometer (frequency meter) [0 to +10 [V] DC], Output for load meter [0 to +10 [V] DC]		
	Acceleration/deceleration		Torque limiting accel./decel., Linear accel./decel., S-curve accel./decel., Polygonal line accel./decel.		
Indication	Running/stopped		Motor speed (output frequency), Output current, Spindle speed, Load meter output, etc.		
	Program mode		Indicates function codes and set data in 7-segment LED monitor.		
	Tripped (alarm)		Indicates cause of trip by code in 7-segment LED monitor.		
Protection	Overcurrent		Detects overcurrent on output side to stop the drive unit.		
	Overvoltage		Detects DC link circuit overvoltage 400 [V] DC (800 [V] DC for 400 [V] series) in braking mode to stop the drive unit.		
	Overspeed		Detects 120% or more of max. setting speed to stop the drive unit		For M5 series, valid only for spindle speed feedback with PE.
	Excess speed deviation		[Delayed start] Activated when torque limiting is valid and speed zero condition continues for 1 [s] or more.		
			[Excess speed deviation] Stops the drive unit when the deviation between the actual motor speed and the motor setting speed exceeds a specified value (P808) and continues for more than the preset time.		
	Undervoltage		Detects DC link circuit voltage drop to stop the drive unit.		
	Short-circuit		Detects overcurrent due to short-circuit on output side to protect the drive unit.		
	Fuse blown		Stops the drive unit when a fuse at DC link circuit blows.		
	Drive unit overload		Protects the unit with electronic thermal overload function and by detecting abnormal temperature rise inside the unit.		
	Drive unit overheating		Detects abnormal temperature rise inside to protect the unit.		
	Motor overheating		For a dedicated motor, stops the drive unit when motor overheating is detected by NTC thermistor. (with disconnection detection). For a general-purpose motor, protection by thermal overload relay etc. is necessary.		
	Internal fan fault		Stops the drive unit when fault of cooling fan for inside the unit is detected.		
	External fault (alarm)		Inputs external fault signal to stop the drive unit.		
	Current detection circuit fault		Protects the drive unit when fault of current detection circuit is detected at stoppage.		
	CPU error		Detects the CPU error with WDT (watchdog timer) to protect the drive unit.		
	Loader communication error		Stops the drive unit when a communication error occurs over personal computer loader under operation.		
	Memory error		Protects the drive unit when a fault occurs in the memory.		
	Synchronous communication error		Stops the drive units on master and slave shaft side when a serial communication error occurs over optional synchronous operation card.		
	Tuning error		Activated when automatic adjustment such as tuning action finishes improperly.		
	Regenerative braking error		Stops the drive unit when an alarm occurs at regenerative braking converter unit.		
	Incoming surge		4 [kV] (1.2 x 50 [μs])		
Cooling method			Natural cooling for up to 2.2/1.1 [kW] (200 [V] series only), Forced fan cooling for 3.7/2.2 [kW] or more		
Installation method			External cooling		
Applicable standards			IEC61800-2, TÜV approved (200 [V] series only)		
Environment	Installation location		Indoor, not more than 1000 [m] above the sea level. Free from corrosive gases, dusts, and direct sunlight. (install inside IP54 enclosure.)		
	Ambient temperature		–10 to +55°C (–10 to +40°C for cooling fun section (heat sink)		
	Humidity		5 to 85%RH during operating (no condensation)		
	Vibration		5.9 [m/s^2] or less		
	Storage		–25 to +55°C, 5 to 95%RH (no condensation)		

2.2 200V series spindle motor specifications

MVE Spindle motor

Type [MVE□M5-2A, G] (*1)			1.1	2.2	3.7	5.5	7.5	11	15	18.5	22	30
Output rating	Cont. rating	Output [kW]	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22
		Torque [N•m]	4.8	7.0	14.0	23.5	35.0	47.7	70.0	95.5	117.7	140.0
	50%ED rating	Output [kW]	1.1	2.2	3.7	5.5	7.5	11	15	18.5	22	30
		Torque [N•m]	9.5	14.0	23.5	35.0	47.7	70.0	95.5	117.7	140.0	190.9
Moment of inertia of rotor [kg•m^2]			0.002	0.007	0.0095	0.016	0.027	0.035	0.087	0.12	0.16	0.19
Base speed [r/min]			1500									
Max. speed [r/min]			6000								4500	
Output characteristic curve			Fig. A								Fig. B	
Mounting method			Foot mounted (IMB3, IMV5), Flange mounted (IMB5, IMV1)									
Cooling	Cooling method		Forced fan cooling (A cooling fan blows air over the motor toward the drive-end.)									
	Fan motor input power		1-phase, 40/50 [W], 2P			1-phase, 40/50 [W], 4P			3-phase, 85/110 [W], 4P			
Noise level			70 [dB](A)						75 [dB](A)			
Vibration			V5									
Finishing color			Munsell N5									

Note: (*1) □ in the type section indicates A for foot mounted, or G for flange mounted.

MVS Spindle motor

Type(*1)	With PE [MVS□V5-2A, G]		2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
	Without PE [MVS□M5-2A, G]		2.2	3.7	5.5	7.5	11	15	18.5	22	30	–	–	–
Output rating	Cont. rating	Output [kW]	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45
		Torque [N•m]	7.0	14.0	23.5	35.0	47.7	70.0	95.5	117.7	140.0	249.0	307.0	429.5
	50%ED rating	Output [kW]	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
		Torque [N•m]	14.0	23.5	35.0	47.7	70.0	95.5	117.7	140.0	190.9	307.0	373.5	525.0
	30 [min] rating	Output [kW]	–										45	55
		Torque [N•m]	–										373.5	525.0
Moment of inertia of rotor [kg•m^2]			0.008	0.008	0.014	0.019	0.026	0.047	0.058	0.083	0.083	0.33	0.42	0.78
Base speed [r/min]			1500									1150		1000
Max. speed [r/min]			8000					6000				4500		4000
Output characteristic curve			Fig. C		Fig. D			Fig. E				Fig. F		Fig. G
Mounting method			Foot mounted (IMB3, IMV5), Flange mounted (IMB5, IMV1)											
Cooling	Cooling method		Forced fan cooling (A cooling fan blows air over the motor toward the drive-end.)											
	Fan motor input power		1-phase, 40/50 [W], 2P			1-phase, 80/105 [W], 2P		3-phase, 60/80 [W], 2P				3-phase, 4P		
												150/210 [W]		200/300 [W]
Noise level			70 [dB](A)					75 [dB](A)				80 [dB](A)		
Vibration			V5											V10
Finishing color			Munsell N1.2, dull											

Note: (*1) □ in the type section indicates A for foot mounted, or G for flange mounted.

Spindle motor common specifications

Item		Specifications
Insulation class, No. of poles		Class F, 4 poles
Connection to load		Coupling or belted connection
Degree of protection		IP44 (Totally enclosed)
Applicable standards		IEC34-1
Environment	Installation location	Indoor, not more than 1000 [m] above the sea level.
	Ambient temperature	–10 to +40°C
	Humidity	0 to 90%RH

Output characteristic curves

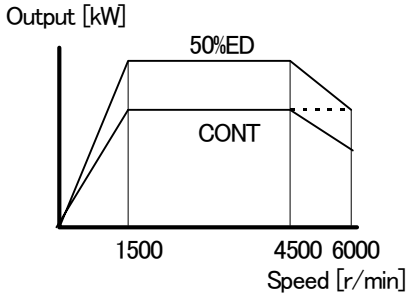


Fig. A

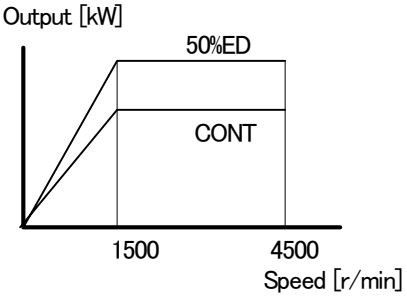


Fig. B

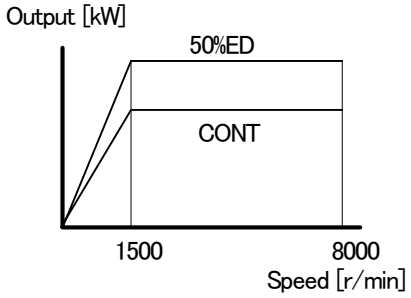


Fig. C

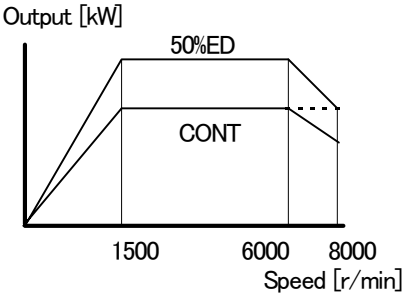


Fig. D

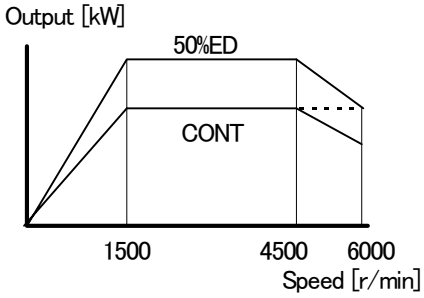


Fig. E

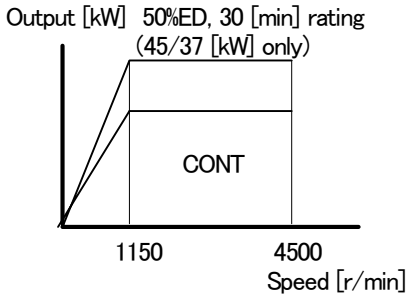


Fig. F

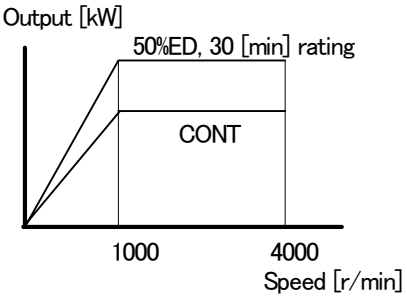


Fig. G

2.3 400V series spindle motor specifications

MVE Spindle motor

Type [MVE□M5-4A, G] (*1)			1.1	2.2	3.7	5.5	7.5	11	15	18.5
Output rating	Cont. rating	Output [kW]	0.75	1.5	2.2	3.7	5.5	7.5	11	15
		Torque [N•m]	4.8	7.0	14.0	23.5	35.0	47.7	70.0	95.5
	50%ED rating	Output [kW]	1.1	2.2	3.7	5.5	7.5	11	15	18.5
		Torque [N•m]	9.5	14.0	23.5	35.0	47.7	70.0	95.5	117.7
Moment of inertia of rotor [kg•m^2]			0.002	0.007	0.0095	0.016	0.027	0.035	0.087	0.12
Base speed [r/min]			1500							
Max. speed [r/min]			6000							
Output characteristic curve			Fig. A							
Mounting method			Foot mounted (IMB3, IMV5), Flange mounted (IMB5, IMV1)							
Cooling	Cooling method		Forced fan cooling (A cooling fan blows air over the motor toward the drive-end.)							
	Fan motor input power		1-phase, 40/50 [W], 2P			1-phase, 40/50 [W], 4P			3-phase, 85/110 [W], 4P	
Noise level			70 [dB](A)						75 [dB](A)	
Vibration			V5							
Finishing color			Munsell N5							

Note: (*1) □ in the type section indicates A for foot mounted, or G for flange mounted.

MVS Spindle motor

Type(*1)	With PE [MVS□V5-4A, G]		2.2	3.7	5.5	7.5	11	15	18.5
	Without PE [MVS□M5-4A, G]		2.2	3.7	5.5	7.5	11	15	18.5
Output rating	Cont. rating	Output [kW]	1.5	2.2	3.7	5.5	7.5	11	15
		Torque [N•m]	7.0	14.0	23.5	35.0	47.7	70.0	95.5
	50%ED rating	Output [kW]	2.2	3.7	5.5	7.5	11	15	18.5
		Torque [N•m]	14.0	23.5	35.0	47.7	70.0	95.5	117.7
	30 [min] rating	Output [kW]	–						
		Torque [N•m]	–						
Moment of inertia of rotor [kg•m^2]			0.008	0.008	0.014	0.019	0.026	0.047	0.058
Base speed [r/min]			1500						
Max. speed [r/min]			8000					6000	
Output characteristic curve			Fig. B		Fig. C			Fig. D	
Mounting method			Foot mounted (IMB3, IMV5), Flange mounted (IMB5, IMV1)						
Cooling	Cooling method		Forced fan cooling (A cooling fan blows air over the motor toward the drive-end.)						
	Fan motor input power		1-phase, 40/50 [W], 2P			1-phase, 80/105 [W], 2P		3-phase, 60/80 [W], 2P	
Noise level			70 [dB](A)					75 [dB](A)	
Vibration			V5						
Finishing color			Munsell N1.2, dull						

Note: (*1) □ in the type section indicates A for foot mounted, or G for flange mounted.

Spindle motor common specifications

Item		Specifications
Insulation class, No. of poles		Class F, 4 poles
Connection to load		Coupling or belted connection
Degree of protection		IP44 (Totally enclosed)
Applicable standards		IEC34-1
Environment	Installation location	Indoor, not more than 1000 [m] above the sea level.
	Ambient temperature	–10 to +40°C
	Humidity	0 to 90%RH

Output characteristic curves

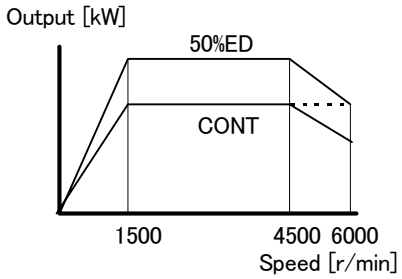


Fig. A

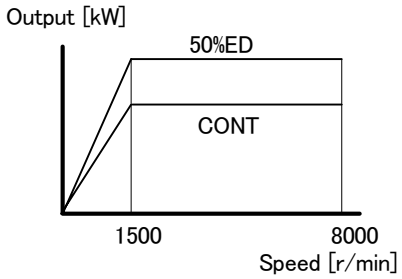


Fig. B

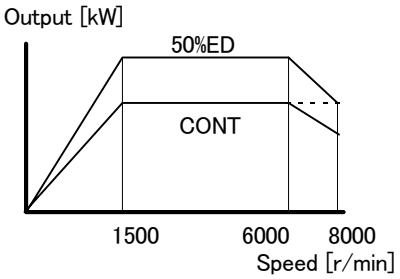


Fig. C

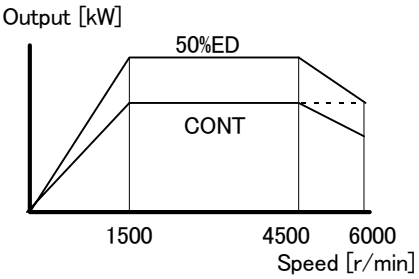


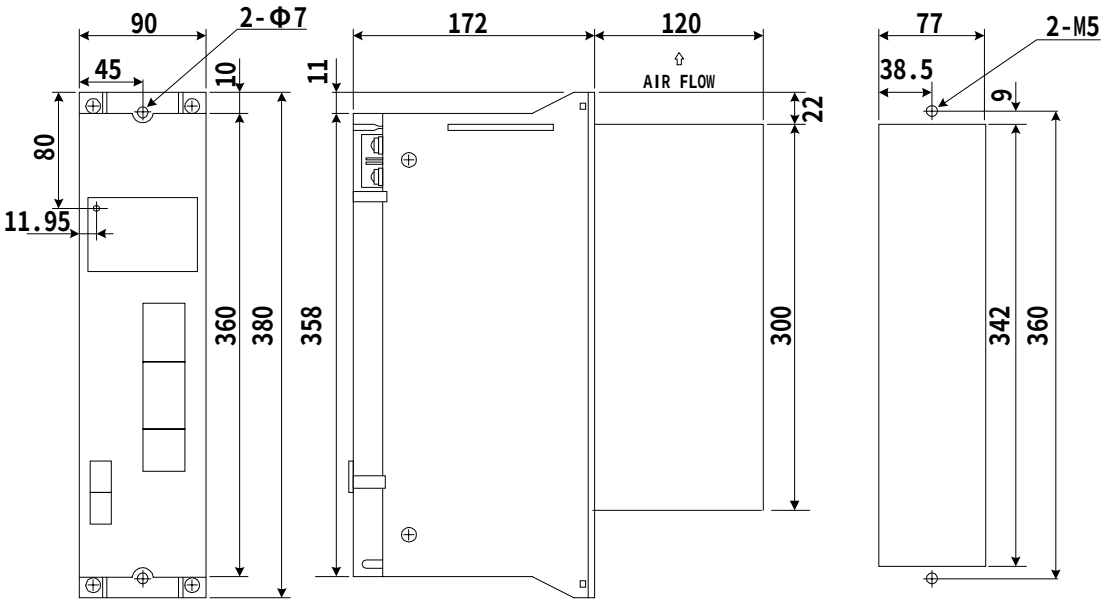
Fig. D

Section 3 External Dimensions

3.1 Unit

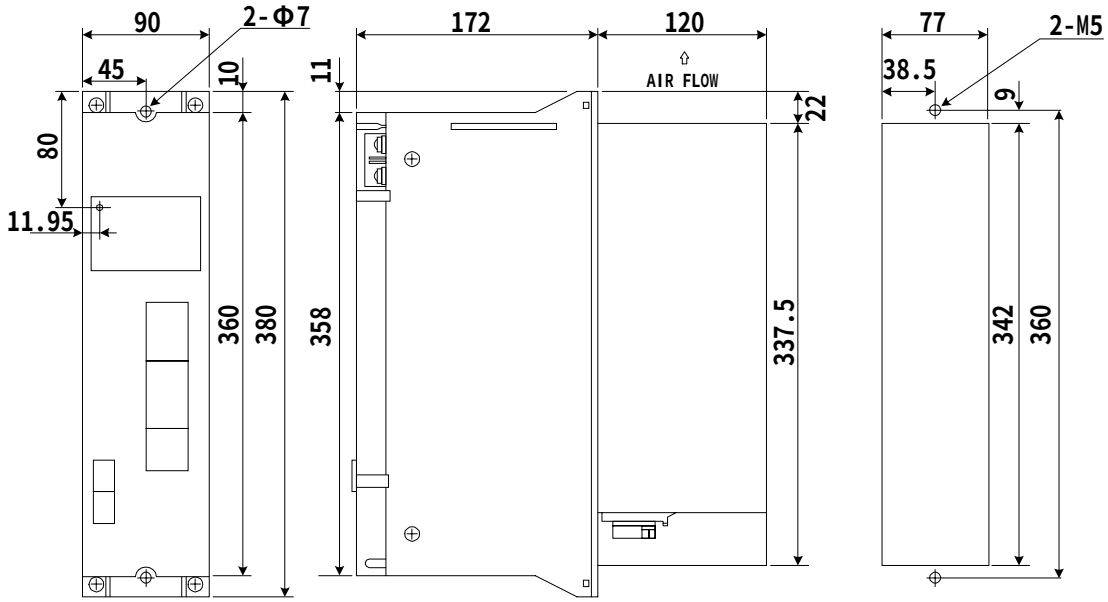
- FRN1.1M5-2 to FRN2.2M5-2
- FRN2.2V5-2
- FRN7.2PD5-2

[Unit: mm]



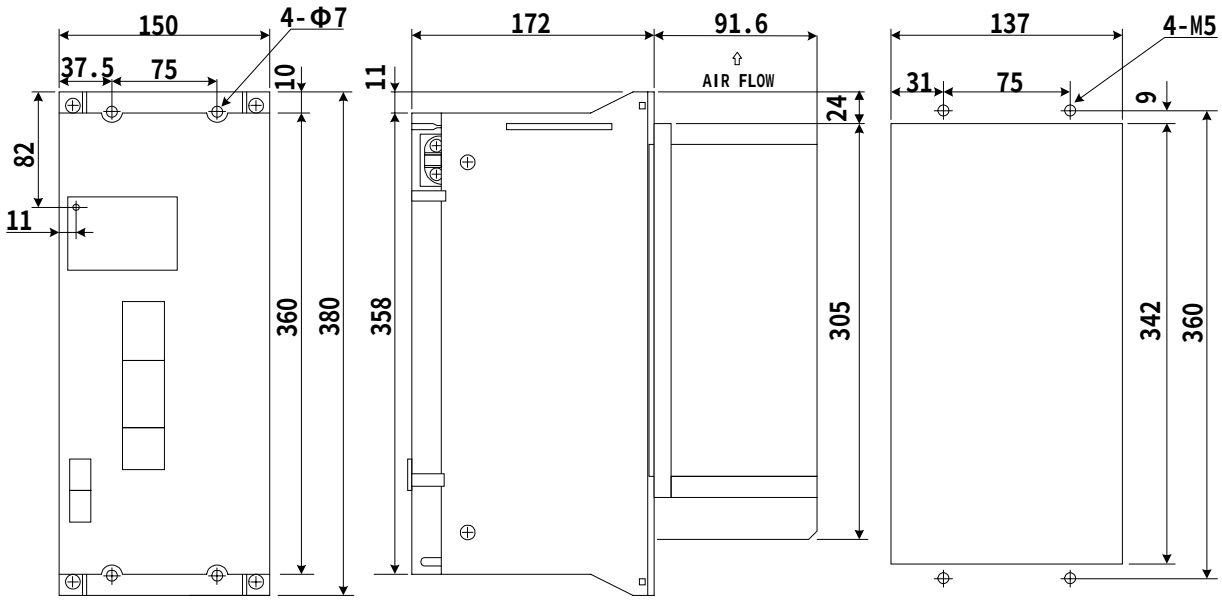
- FRN3.7M5-2 to FRN5.5M5-2, FRN5.5MC5-2 to FRN11MC5-2
- FRN5.5M5-4 , FRN7.5MC-4
- FRN3.7V5-2 to FRN5.5V5-2, FRN5.5VC5-2 to FRN11VC5-2
- FRN5.5PR5-2 to FRN11PR5-2
- FRN11PD5-2, FRN7.5PD5-4, FRN11PD5-4

[Unit: mm]



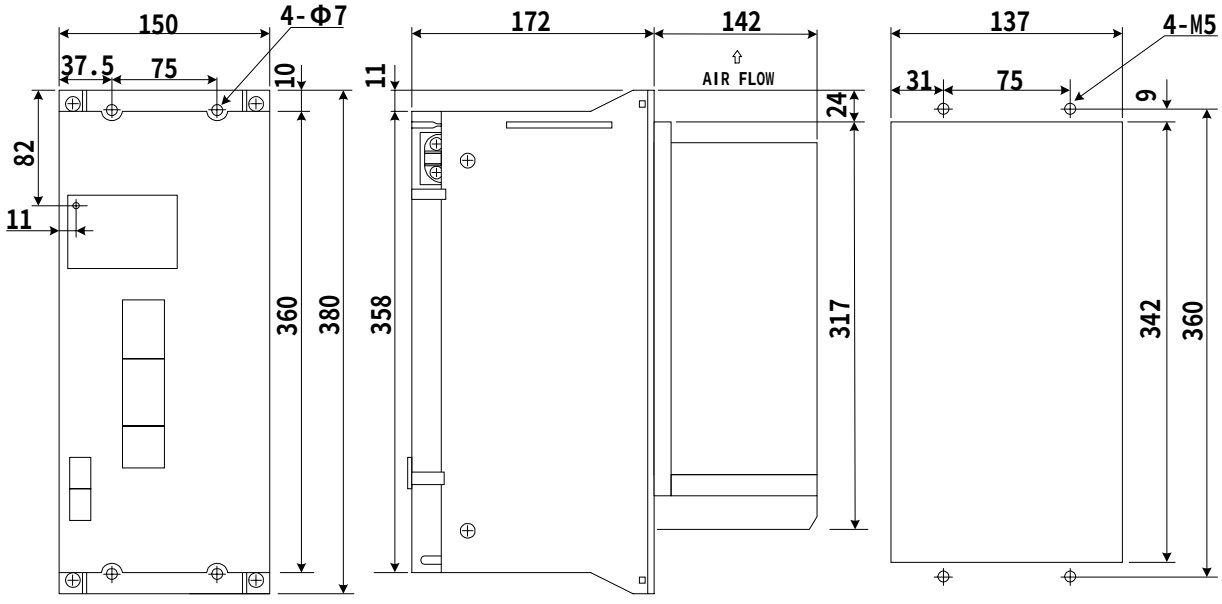
◆ FRN15MC5-2 to FRN18.5MC5-2, FRN11MC5-4 to FRN18.5MC5-4
◆ FRN15VC5-2 to FRN18.5VC5-2
◆ FRN15PD5-2 to FRN18.5PD5-2, FRN15PD5-4 to FRN18.5PD5-4
◆ FRN15PR5-2 to FRN30PR5-2

[Unit: mm]



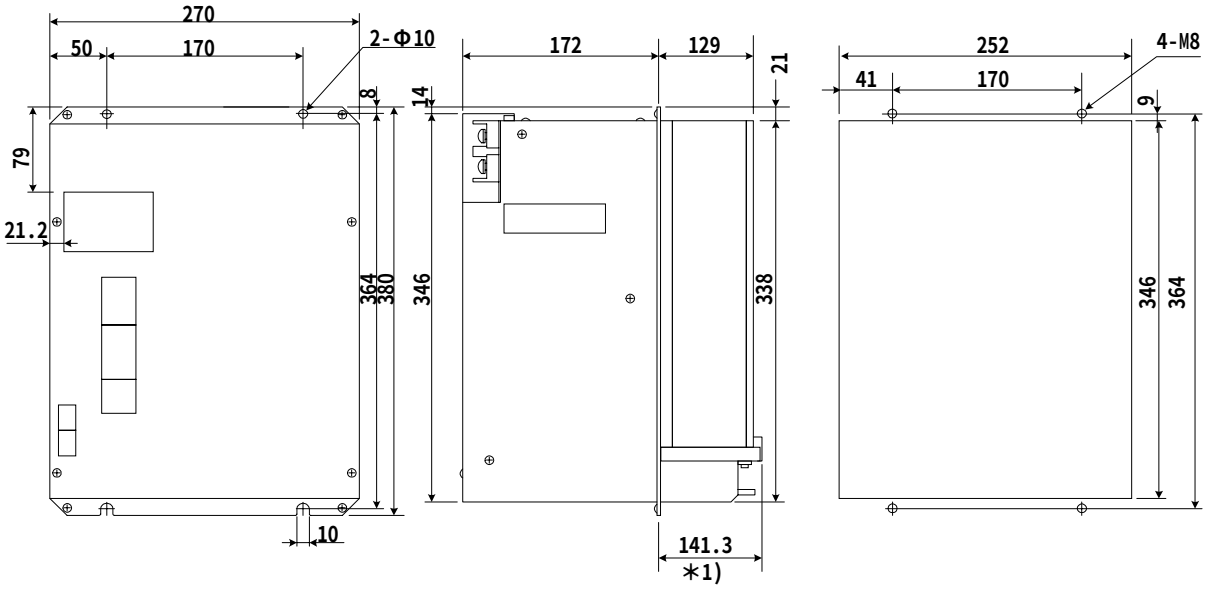
◆ FRN22MC5-2 to FRN30MC5-2
◆ FRN22VC5-2 to FRN30VC5-2

[Unit: mm]



◆ FRN37VC5-2, FRN45VC5-2
◆ FRN37PR5-2 to FRN55PR5-2

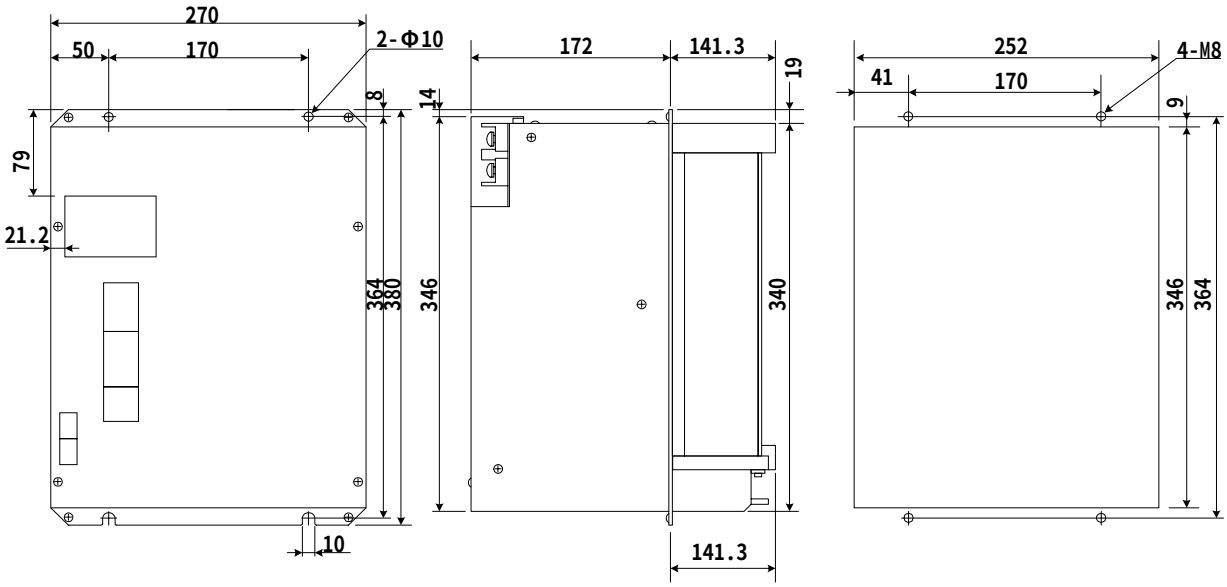
[Unit: mm]



(*1) FRN45VC5-2 only

◆ FRN55VC5-2

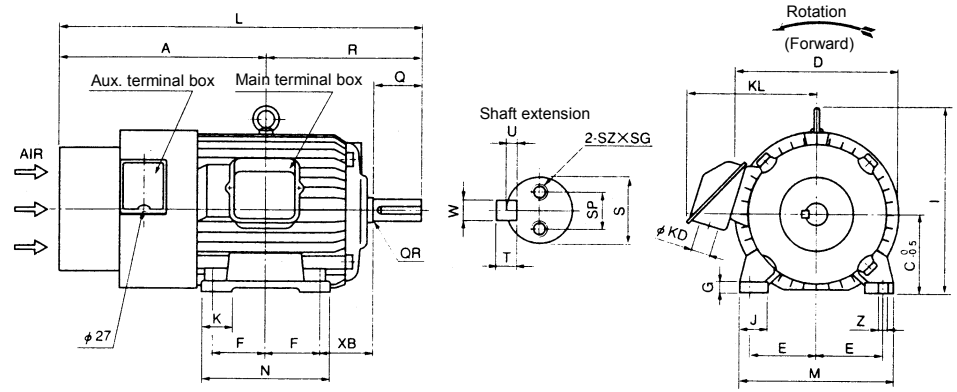
[Unit: mm]



3.2 Spindle motor

(1) MVE spindle motor

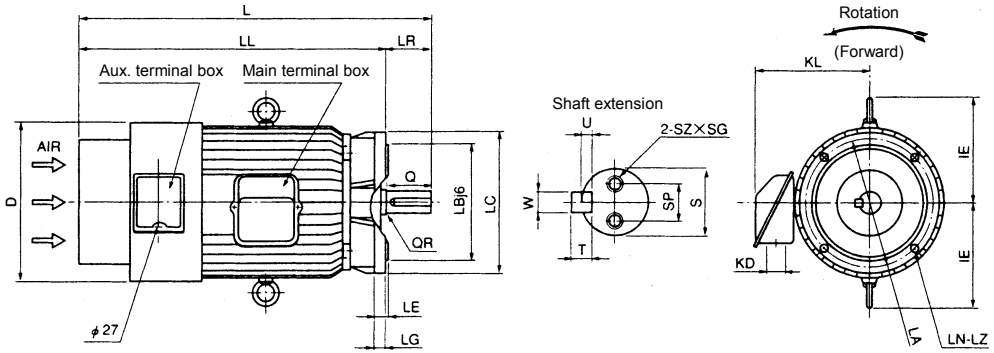
Fig. A



Foot mounted

Rated output [kW] (50%ED/Cont.)	Motor type	Fig.	Dimensions [mm]																	Shaft extension [mm]								Approx. mass [kg]
			A	C	D	E	F	G	I	J	K	KD	KL	L	M	N	R	XB	Z	Q	QR	S	T	U	W	SP	SZ	SG	
1.1/0.75	MVE1.1M5-2A	A	170	80	174	62.5	50	9	170	35.5	35.5	27	163	310	155	128	140	50	10	40	—	19j6	6	3.5	6	10	M4	8	18
2.2/1.5	MVE2.2M5-2A		197	90	202	70	62.5	10	195				177	365.5	170	150	168.5	56		50		24j6	7	4	8	16	M5	10	27
3.7/2.2	MVE3.7M5-2A		212	100		80	70	12.5	238	40	40			405	195	170	193	63	12	60		28j6					M6	12	34
5.5/3.7	MVE5.5M5-2A		245	112	236	95		14	270		50		197	445	224	175	200	70											47
7.5/5.5	MVE7.5M5-2A		253	132	273	108		17	311	45		34	212	492	250	180	239	89		80		38k6	8	5	10	25			66
11/7.5	MVE11M5-2A		272				89							530		212	258												77
15/11	MVE15M5-2A		342	160	321	127	105	18	376	50	63	48	272	665	300	250	323	108	14.5	110	0.5	42k6			12				131
18.5/15	MVE18.5M5-2A		364				127							709		300	345												161
22/18.5	MVE22M5-2A		386	180	376	139.5	120.5	20	428	75	75		305	737.5	350	292	351.5	121			1.5	48k6	9	5.5	14	31.5	M8	16	191
30/22	MVE30M5-2A		405				139.5					60		775.5		330	370.5					55m6	10	6	16				213

Fig. B

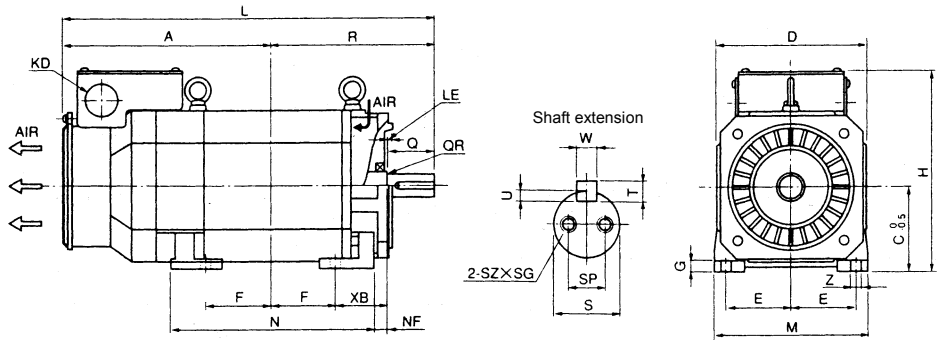


Flange mounted (□: M = without PE, V = with PE)

Rated output [kW] (50%ED/Cont.)	Motor type	Fig.	Dimensions [mm]														Shaft extension [mm]									Approx. mass [kg]
			D	L	LL	LR	KD	KL	LA	LB	IE	LC	LE	LG	LN	LZ	Q	QR	S	T	U	W	SP	SZ	SG	
1.1/0.75	MVE1.1M5-2G	B	174	340	300	40	27	158	165	130	—	200	3.5	12	4	12	40	—	19j6	6	3.5	6	10	M4	8	20
2.2/1.5	MVE2.2M5-2G		202	390	340	50		172			105						50		24j6	7	4	8	16	M5	10	30
3.7/2.2	MVE3.7M5-2G			429	369	60					138						60		28j6					M6	12	36
5.5/3.7	MVE5.5M5-2G		236	465	405			197	215	180	160	250	4	16		14.5										52
7.5/5.5	MVE7.5M5-2G		273	542	462	80	34	208			179			18			80		38k6	8	5	10	25			74
11/7.5	MVE11M5-2G			580	500																					87
15/11	MVE15M5-2G		321	703	593	110	48	261	300	250	216	350	5	20		18.5	110	0.5	42k6			12				136
18.5/15	MVE18.5M5-2G			747	637																					166
22/18.5	MVE22M5-2G		376	768	658			296	350	300	248	400						1.5	48k6	9	5.5	14	31.5	M8	16	201
30/22	MVE30M5-2G			806	696		60												55m6	10	6	16				223

(2) MVS spindle motor

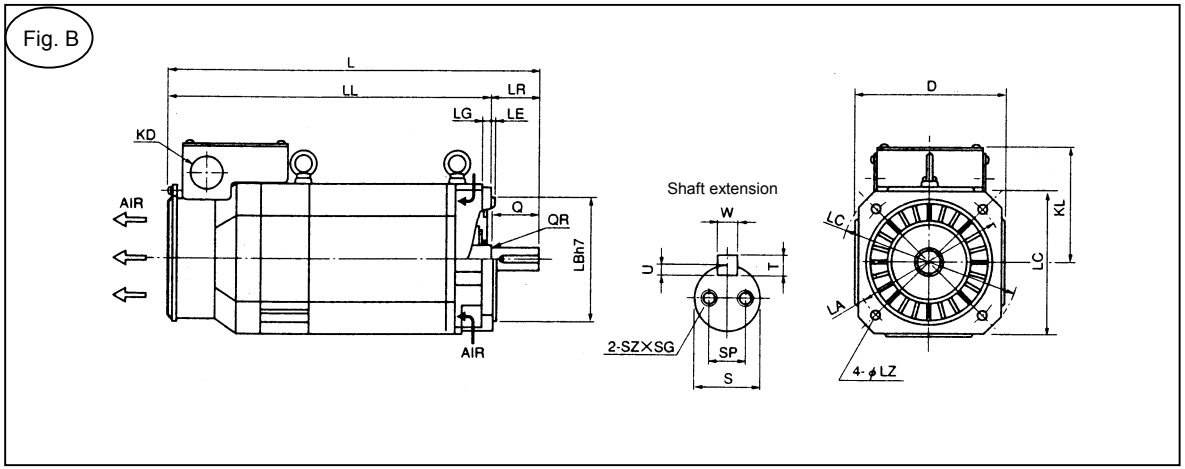
Fig. A



Foot mounted (□: M = without PE, V = with PE)

Rated output [kW] (50%ED/Cont.)	Motor type	Fig.	Dimensions [mm]																	Shaft extension [mm]							Approx. mass [kg]
			A	C	D	E	F	G	H	KD	L	M	N	NF	R	XB	Z	Q	QR	S	T	U	W	SP	SZ	SG	
2.2/1.5	MVS2.2□5-2A	A	217	100	180	80	50	12	240	34	380	188	172	22	163	63	12	50	2	22j6	6	3.5	6	13	M5	10	32
3.7/2.2	MVS3.7□5-2A										390				173			60	1	28j6	7	4	8	16	M6	12	32
5.5/3.7	MVS5.5□5-2A		267.5				79.5				470		252		202.5												50
7.5/5.5	MVS7.5□5-2A		295	112	210	95	70		267	43	515	218	232	31	220	70		80		32k6	8	5	10				63
11/7.5	MVS11□5-2A		331				89				600		287		269			110	—	48k6	9	5.5	14	31.5	M8	16	75
15/11	MVS15□5-2A		277	160	260	127	70	16	345	51	565	287	263	39	288	108	14.5		1								90
18.5/15	MVS18.5□5-2A		288				89				595		293		307												99
22/18.5	MVS22□5-2A		358							63	665		363							55m6	10	6	16				128
30/22	MVS30□5-2A		358																								128
37/30	MVS37□5-2A		443.5	200	390	178	133.5	24	475		850	420	360	86	406.5	133	18.5	140	0.5	60m6	11	7	18	40	M10	20	310
45/37	MVS45□5-2A																										350
55/45	MVS55□5-2A		530	225	438		143	34	526		962	436	366	109	432	149			1.5	65m6							435

Fig. B



Flange mounted (□: M = without PE, V = with PE)

Rated output [kW] (50%ED/Cont.)	Motor type	Fig.	Dimensions [mm]															Shaft extension [mm]							Approx. mass
			D	L	LL	LR	KD	KL	LA	LB	LC	LC'	LE	LG	LZ	Q	QR	S	T	U	W	SP	SZ	SG	[kg]
2.2/1.5	MVS2.2□5-2G	B	180	380	330	50	34	140	185	150	174	220	5	11	11	50	2	22j6	6	3.5	6	13	M5	10	31
3.7/2.2	MVS3.7□5-2G			390		60										60	1	28j6	7	4	8	16	M6	12	31
5.5/3.7	MVS5.5□5-2G			470	410	60																			46
7.5/5.5	MVS7.5□5-2G		210	515	435	80	43	155	215	180	204	250		15	14.5	80		32k6	8	5	10				62
11/7.5	MVS11□5-2G			600	490	110										110	—	48k6	9	5.5	14	31.5	M8	16	75
15/11	MVS15□5-2G		260	565	455		51	185	265	230	250	300		19			1								85
18.5/15	MVS18.5□5-2G			595	485																				98
22/18.5	MVS22□5-2G			665	555		63											55m6	10	6	16				125
30/22	MVS30□5-2G																								125
37/30	MVS37□5-2G		390	850	710	140		275	400	350	370	450		23	18.5	140	0.5	60m6	11	7	18	40	M10	20	310
45/37	MVS45□5-2G																								350
55/45	MVS55□5-2G		428	988	848			296	500	450	480	550		25	24		1.5	65m6							450

3.3 Accessories and options

AC reactor for regenerative braking converter unit (accessory)

[Unit: mm]

Applied converter unit	Reactor type	Mass [kg]	Fig.	A	B	C	D	E	F	G	H
FRN5.5PR5-2	ACL-5M	4	A	130±2	50±1	160±3	86±3	M4	120	135	−
FRN7.5PR5-2	ACL-7M	5				116±3	96±3	M5	140	135	
FRN11PR5-2	ACL-11M	5.5				121±3	101±3		150	135	
FRN15PR5-2	ACL-15M	4	B	170±2	150±1	70±3	50±2	M6	105	170	
FRN18.5PR5-2	ACL-18M	5		190±2	170±1					185	
FRN22PR5-2	ACL-22M	6				80±3	60±2		115	185	
FRN30PR5-2	ACL-30M	7				85±3	65±2	M8	130	195	
FRN37PR5-2	ACL-37M	10	C	200	120±1	120±3	90±3		140	200	200
FRN45,55PR5-2	ACL-55M	12				130±3	100±3	M10	180	225	−

Fig. A

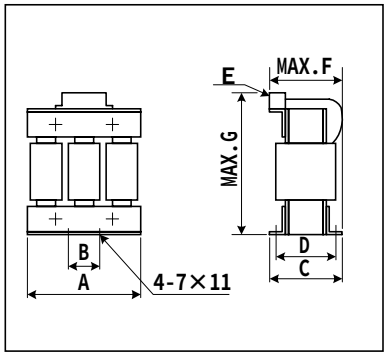


Fig. B

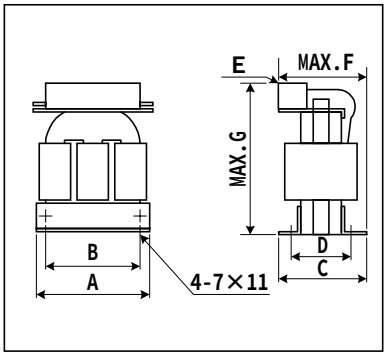
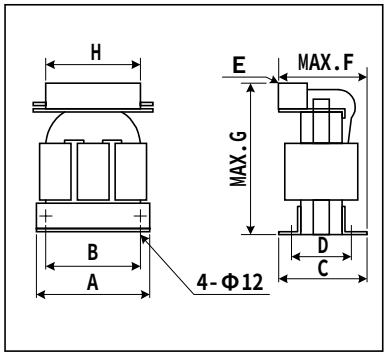
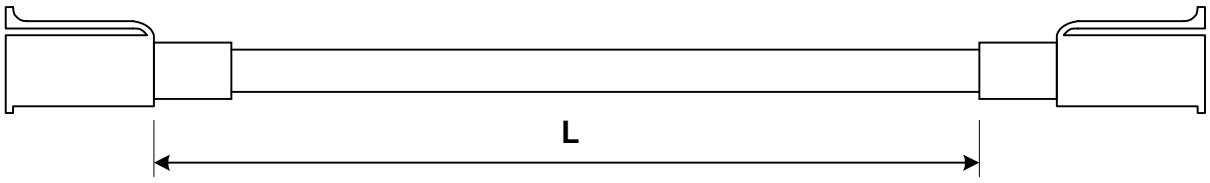


Fig. C



Communication cable between units (option)



[Unit: mm]

Type	Length L
CB-MS5-1	150
CB-MS5-2	250
CB-MS5-3	350

Applicable communication cable to unit combination

Unit on the left hand side \ Unit on the right hand side	90mm wide unit	150mm wide unit	270mm wide unit
90mm wide unit	CB-MS5-1	CB-MS5-1	CB-MS5-1
150mm wide unit	CB-MS5-2	CB-MS5-2	CB-MS5-2
270mm wide unit	CB-MS5-3	CB-MS5-3	CB-MS5-3

DC connecting bar (option)

Fig. A DC-MS5-1, 1R, 1L, 2, 3 [Unit: mm]

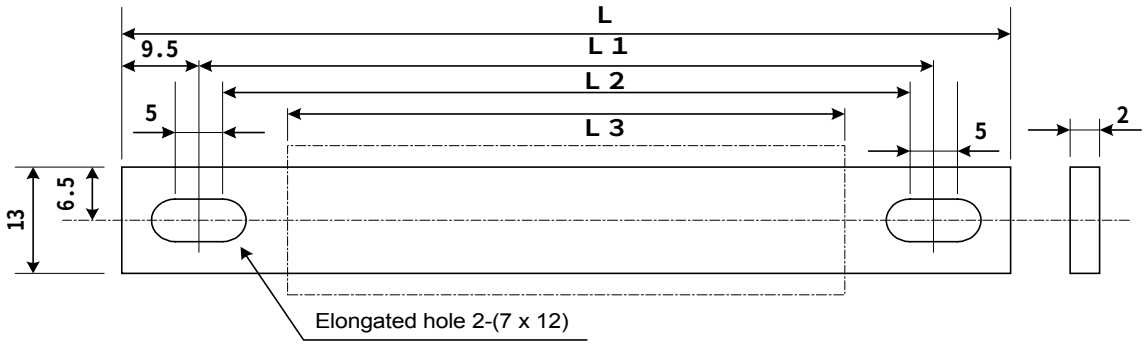
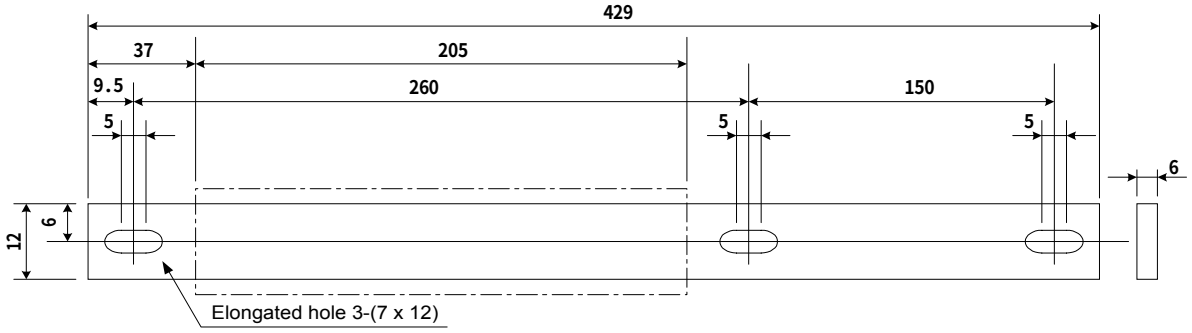


Fig. B DC-MS5-2R2 [Unit: mm]

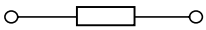
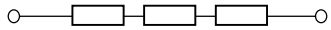
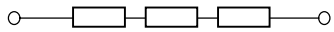
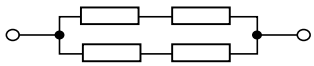
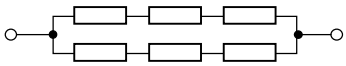
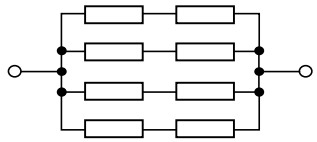


[Unit: mm]

Type	Application	Fig.	L	L1	L2	L3	D
DC-MS5-1	For a unit 90mm wide (left) + a unit 90mm wide (right)	A	109	90	85	—	2
DC-MS5-1R	For a unit 150mm wide (left) + a unit 90mm wide (right)	A	96	77	72	—	2
DC-MS5-1L	For a unit 90mm wide (left) + a unit 150mm wide (right)	A	182	163	158	—	2
DC-MS5-2	For a unit 150mm wide (left) + a unit 150mm wide (right)	A	169	150	145	—	2
DC-MS5-2R2	For a unit 270mm wide (left) + a unit 150mm wide (right) x 2	B	See Fig. B.				
DC-MS5-3	For a unit 270mm wide (left) + a unit 270mm wide (right)	A	289	270	265	215	6

Braking resistor (10%ED) (option)

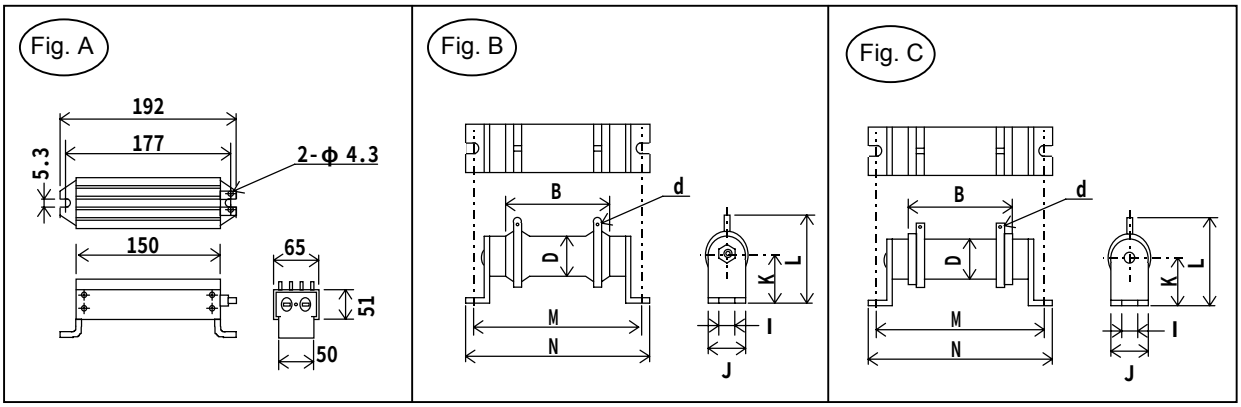
200V series

Unit type	Resistor specifications				Thermal O/L relay setting range (setting value)
	Type	Nos. to be used	Ohmic value & capacity per resistor	Connection	
FRN1.1M5-2	DB1.1MS5-21	1	119 [W] • 84 [Ω]		0.95 to 1.45 (1.2) [A]
FRN2.2M5-2 FRN2.2V5-2	DB2.2MS5-21	3	150 [W] • 15 [Ω]		2.2 to 3.4 (2.3) [A]
FRN3.7M5-2 FRN3.7V5-2	DB3.7MS5-21	2	600 [W] • 10 [Ω]		4 to 6 (4.5) [A]
FRN5.5M5-2 FRN5.5V5-2	DB5.5MS5-21	2	600 [W] • 8 [Ω]		5 to 8 (6.1) [A]
FRN7.5PD5-2	DB7.5MS5-21	3	600 [W] • 4 [Ω]		7 to 11 (8.3) [A]
FRN11PD5-2	DB11MS5-21	4	600 [W] • 8 [Ω]		9 to 13 (13) [A]
FRN15PD5-2	DB15MS5-21	6	600 [W] • 4 [Ω]		13 to 20 (17) [A]
FRN18.5PD5-2	DB18.5MS5-21	8	600 [W] • 10 [Ω]		13 to 20 (20) [A]

Notes : *1)DB□MS5-22 (20%ED) is custom-made. Contact Fuji.

*2) Be sure to connect a thermal O/L relay for the braking resistor.

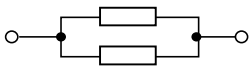
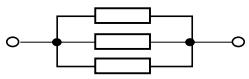
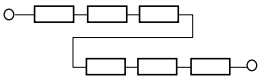
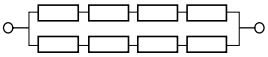
*3) Be sure to attach a protective cover (having open structure as expanded metal) because the surface of the braking resistor becomes hot. The protective cover should be kept at least 50 [mm] away from the braking resistor in the upper direction and 20 [mm] in the side direction.



[Unit: mm]

Braking resistor type	Fig.	Dimensions [mm]								
		N	M	B	D	J	I	L	K	d
DB1.1MS5-21	A	See Fig. A.								
DB2.2MS5-21	B	247	226	195	28	26	5	58	28	4.2
DB3.7MS5-21	C	410	380	330	46	40	9	86	43	5.5
DB5.5MS5-21										
DB7.5MS5-21										
DB11MS5-21										
DB15MS5-21										
DB18.5MS5-21										

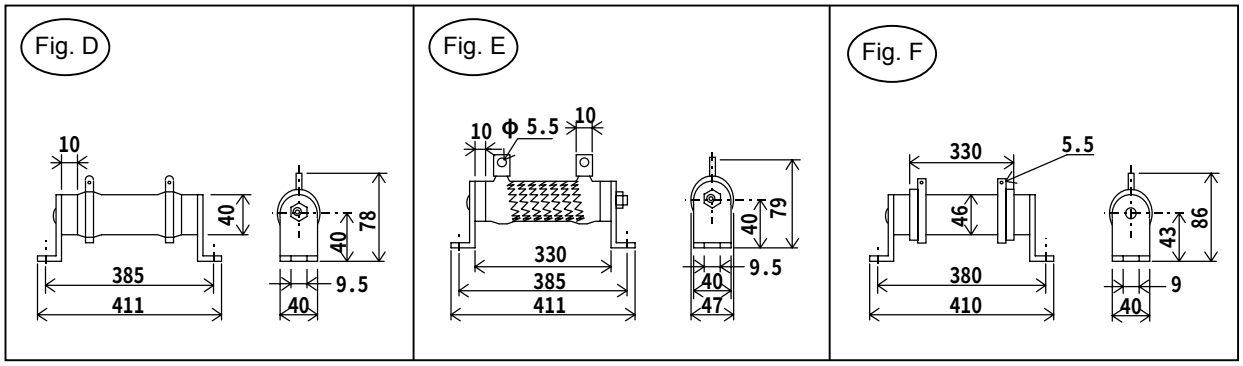
400V series

Unit type	Resistor specifications					Thermal O/L relay setting range (setting value)
	Type	Nos. to be used	Ohmic value & capacity per resistor	Connection	Fig.	
FRN5.5M5-4 (0.75/1.1kW)	DB1.1MS5-41	1	400 [W] • 192 [Ω]		**D**	0.64 to 0.96 (0.8) [A]
FRN5.5M5-4 (1.5/2.2kW)	DB3.7MS5-41	2	400 [W] • 192 [Ω]		**D**	1.4 to 2.2 (1.6) [A]
FRN5.5M5-4 (2.2/3.7kW)						1.4 to 2.2 (2.0) [A]
FRN5.5M5-4 (3.7/5.5kW)	DB5.5MS5-41	3	400 [W] • 192 [Ω]		**D**	2.2 to 3.4 (3.0) [A]
FRN7.5PD5-4 (5.5/7.5kW)	DB7.5MS5-41	3	600 [W] • 16 [Ω]		**E**	4 to 6 (4.1) [A]
FRN11PD5-4 (5.5/7.5kW)	DB11MS5-41	4	600 [W] • 8 [Ω]		**F**	5 to 8 (6.1) [A]
FRN15PD5-4 (11/15kW)	DB15MS5-41	6	600 [W] • 4 [Ω]		**F**	7 to 11 (8.2) [A]
FRN18.5PD5-4 (15/18.5kW)	DB18.5MS5-41	8	600 [W] • 10 [Ω]		**F**	7 to 11 (10) [A]

Notes : *1)DB□MS5-42 (20%ED) is custom-made. Contact Fuji.

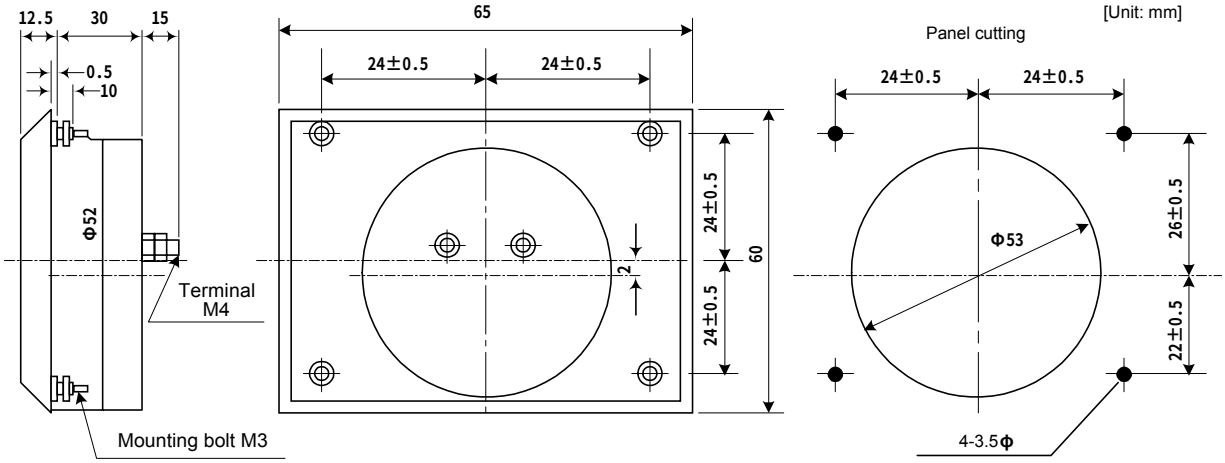
*2) Be sure to connect a thermal O/L relay for the braking resistor.

*3) Be sure to attach a protective cover (having open structure as expanded metal) because the surface of the braking resistor becomes hot. The protective cover should be kept at least 50 [mm] away from the braking resistor in the upper direction and 20 [mm] in the side direction.



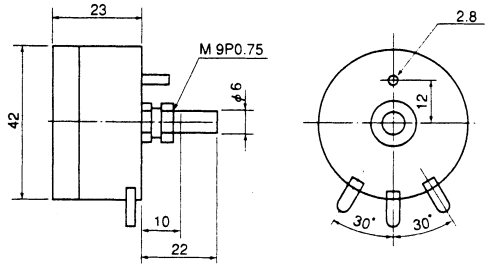
Frequency meter, Load meter (Ammeter) (option)

Type: DCF-6 (Toyo keiki make)

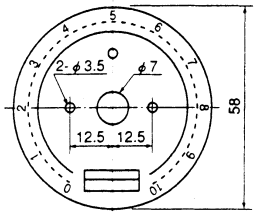


Speed setting POT, Override setting device (option)

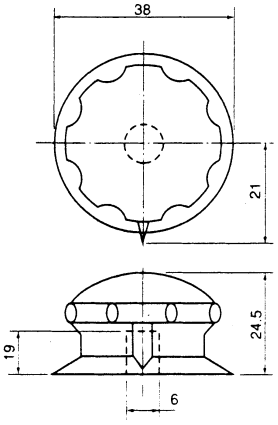
Type WAR3W



Legend plate 60P



Knob (black, 40N)



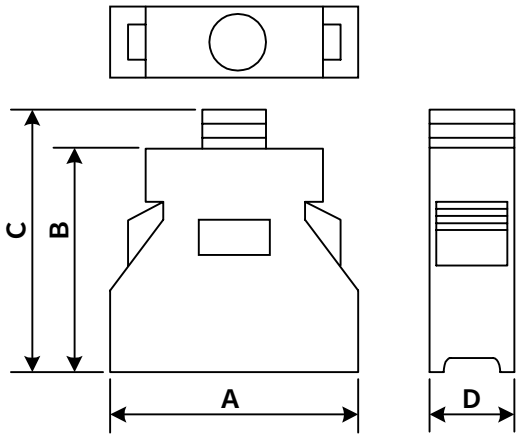
Connector for external connection (CN3 to CN10)

The connector for external connection is not supplied with FRENIC5000MS5 unit.

Prepare the connector on the machine manufacturer side. In case the connector is not available, ask Fuji.

Maker	Name	Type and product number	Remarks
Fujitsu	Cold welded plug	FCN-247R020-G/E	—
	Cover	FCN-240C020-A/S	One-touch lock type
3M	Soldered plug	10120-3000VE	—
	Cover	10320-52F0-008	With ground plate, one-touch lock type
HIROSE	Cold welded plug	DX30AM-20P	—
	Cover	DX30M-20-CV	One-touch lock type
	Soldered plug	DX40M-20P	—
	Cover	DX30M-20-CV	One-touch lock type

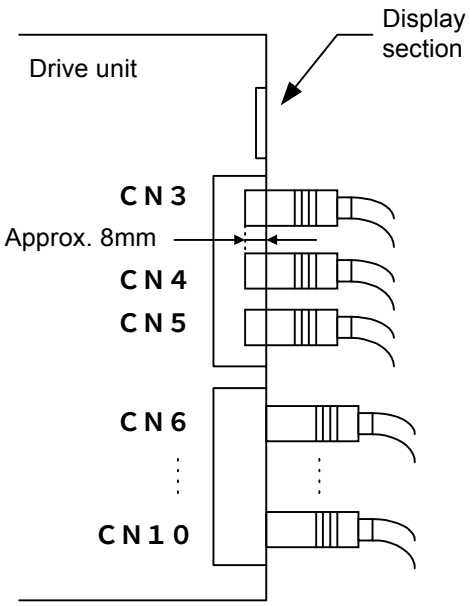
Outline dimensions of the connector cover



[Unit: mm]

Maker	A	B	C	D
Fujitsu	29.7	34.5	42.0	11.5
3M	33.3	39.0		14.0
HIROSE	29.6	32.0	42.0	11.5

* : For reference only. For details, refer to the drawings supplied by each manufacturer.



When the connector for external connection is connected to the drive unit, the CN3 to CN5 will be fixed at approximately 8 [mm] inside the drive unit cover.

Tthe CN6 to CN10 (connector for optional card) will be fixed at almost the same level as in the drive unit cover surface.

Program loading software connection cable (option)

Type	Description
CB-MS5-PC	A dedicated cable for connection a PC and a drive unit (A loader software designed for Windows95 or 98 is attached. This software does not run on Windows3.1 or NT.) The following functions are incorporated. • Read/write function data from/into the drive unit • Save/read files • Compare data, print lists • Monitor operating status

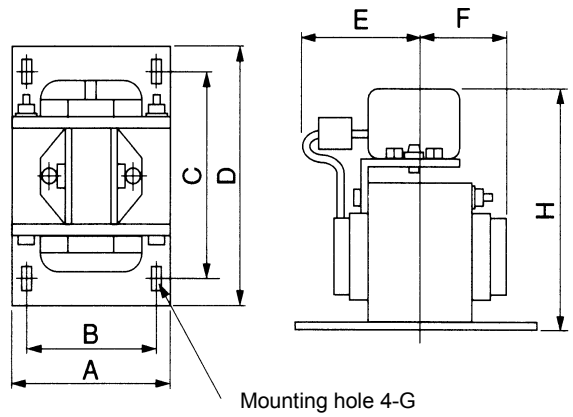
*) Windows is a registered trademark of Microsoft Corporation.

DC reactor for power-factor correcting (DCL) (option)

200V series

This reactor is mainly used for either normalizing the power supply or improving the power-factor (reducing harmonics).
When a regenerative braking converter unit is used, this reactor is not necessary.

Unit type	DC reactor for power-factor correcting					
	Type	Rated current [A]	Inductance [mH]	Coil resistance [mΩ]	Generated loss [W]	Mass [kg]
FRN1.1M5-2	DCR2-0.75	5.0	7.0	123	2.8	1.4
FRN2.2M5-2 FRN2.2V5-2	DCR2-1.5	8.0	4.0	57.5	4.6	1.6
FRN3.7M5-2 FRN3.7V5-2	DCR2-2.2	11	3.0	43	6.7	1.8
FRN5.5M5-2 FRN5.5V5-2	DCR2-3.7	18	1.7	21	8.8	2.6
FRN7.5PD5-2	DCR2-5.5	25	1.2	16	14	3.6
FRN11PD5-2	DCR2-7.5	34	0.8	9.7	16	3.8
FRN15PD5-2	DCR2-11	50	0.6	7.0	27	4.3
FRN18.5PD5-2	DCR2-15	67	0.4	4.3	27	5.9

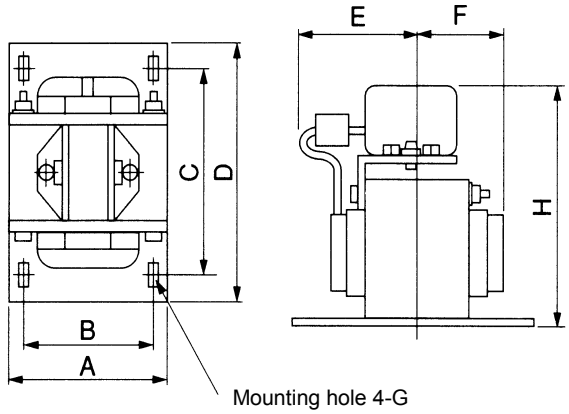


Reactor type	Dimensions [mm]								
	A	B	C	D	E	F	G	H	Terminal size
DCR2-0.75	66	56	72	90	65	40	5.2 × 8	94	M4
DCR2-1.5	66	56	72	90	65	45	5.2 × 8	94	M4
DCR2-2.2	86	71	80	100	60	40	6 × 11	110	M4
DCR2-3.7	86	71	80	100	70	50	6 × 11	110	M4
DCR2-5.5	111	95	80	100	70	55	7 × 11	130	M5
DCR2-7.5	111	95	80	100	75	55	7 × 11	130	M5
DCR2-11	111	95	80	100	75	60	7 × 11	137	M6
DCR2-15	146	124	96	120	75	60	7 × 11	171	M6

400V series

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

Unit type	Applied motor [kW]	DC reactor for power-factor correcting					
		Type	Rated current [A]	Inductance [mH]	Coil resistance [mΩ]	Generated loss [W]	Mass [kg]
FRN5.5M5-4	0.75/1.1	DCR4-0.75	2.5	30	440	2.5	
FRN5.5M5-4	1.5/2.2	DCR4-1.5	4.0	16	235	4.8	
FRN5.5M5-4	2.2/3.7	DCR4-2.2	5.5	12	172	6.8	
FRN5.5M5-4	3.7/5.5	DCR4-3.7	9.0	7.0	74.5	8.1	
FRN7.5PD5-2	5.5/7.5	DCR4-5.5	13	4.0	43	10	
FRN11PD5-2	7.5/11	DCR4-7.5	18	3.5	35.5	15	
FRN15PD5-2	11/15	DCR4-11	25	2.2	23.2	21	
FRN18.5PD5-2	15/18.5	DCR4-15	34	1.8	18.1	28	



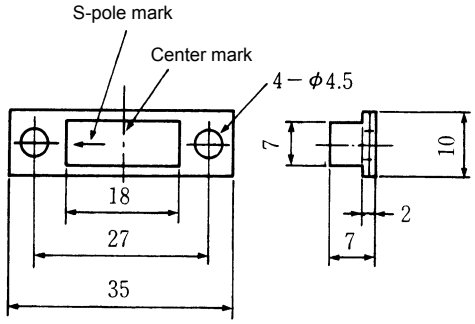
Reactor type	Dimensions [mm]								
	A	B	C	D	E	F	G	H	Terminal size
DCR4-0.75	66	56	72	90	65	40	5.2×8	94	M4
DCR4-1.5	66	56	72	90	65	45	5.2×8	94	M4
DCR4-2.2	86	71	80	100	65	45	6×9	110	M4
DCR4-3.7	86	71	80	100	70	50	6×9	110	M4
DCR4-5.5	86	71	80	100	70	50	6×9	110	M4
DCR4-7.5	111	95	80	100	75	60	7×11	130	M5
DCR4-11	111	95	80	100	75	60	7×11	130	M5
DCR4-15	146	124	96	120	75	60	7×11	171	M5

Magneto-sensor type orientation (magnet, magneto-sensor, detector) (option)

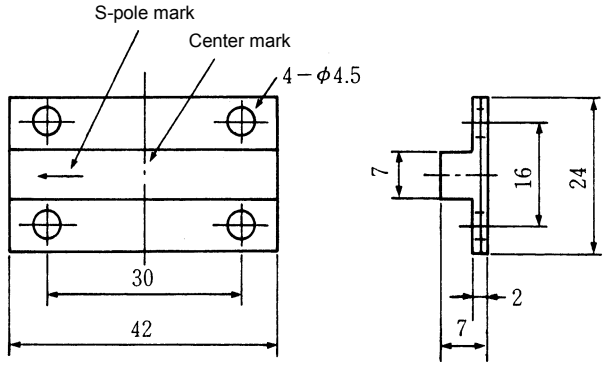
Dimensions

Magnet [Unit: mm]

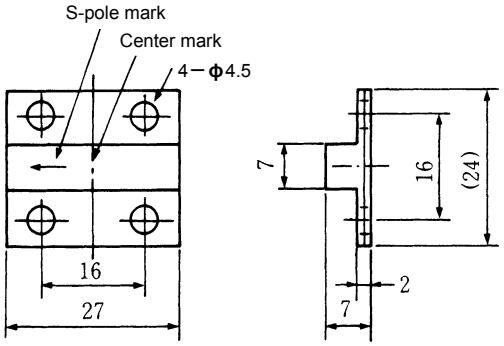
①M-16



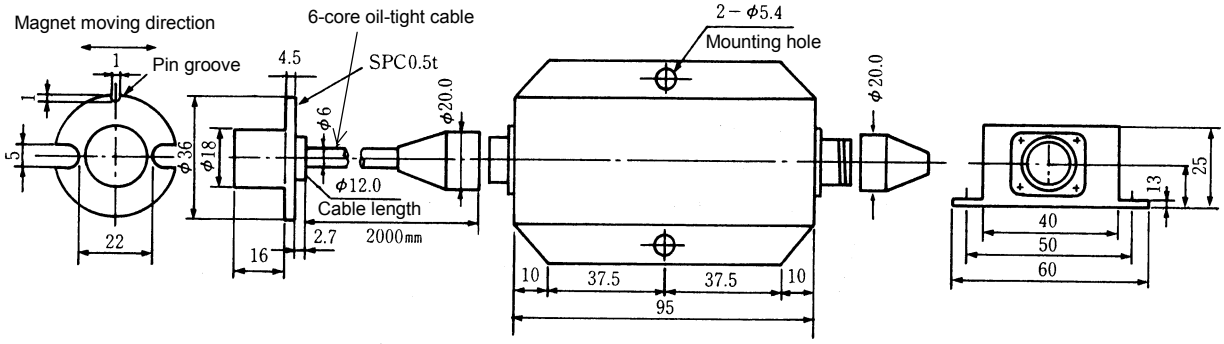
③M-40



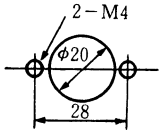
②M-25



Magneto-sensor, detector [Unit: mm]



Sensor mounting hole



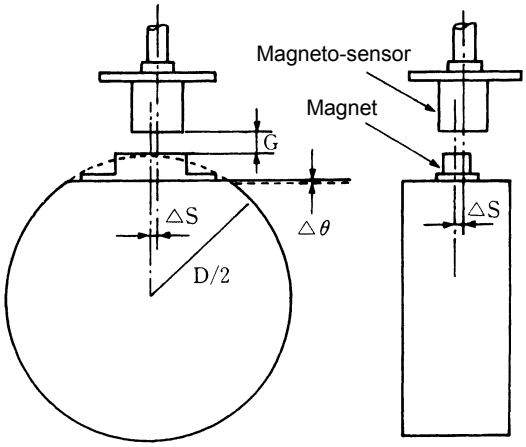
Connector interface

Attach a magnet and magneto-sensor

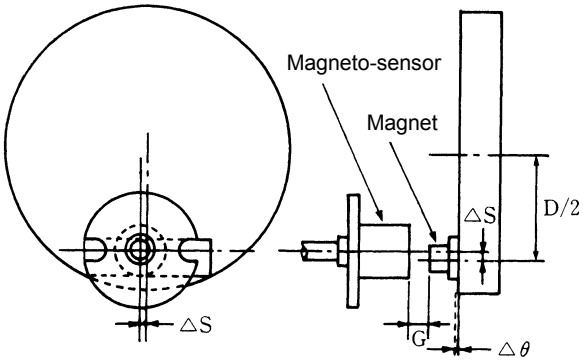
Attach a magnet and sensor properly as shown below. If they are attached mistakenly, such phenomena as hunting at near stopping position or repetitive positioning operation between forward and reverse will occur, so that exact positioning cannot be executed.

(1) Dimension to attach

① Attach at the outskirt of the rotor



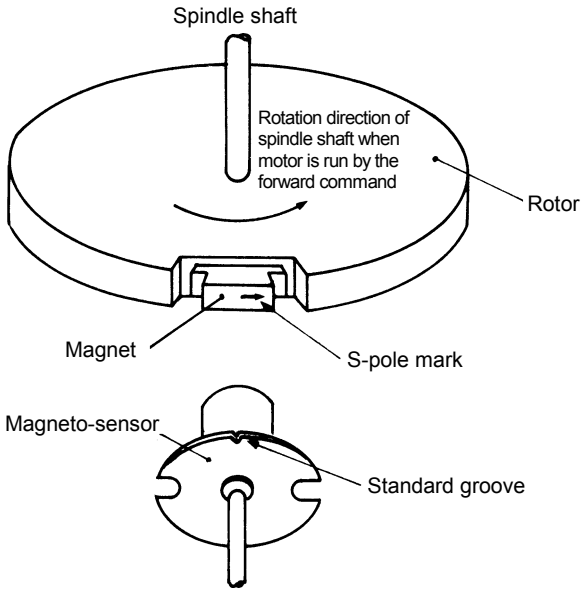
② Attach on the periphery of the rotor



Magnet type	Rotor diameter D [mm]	Gap G [mm]	Center deviation ΔS [mm]	Standard surface deviation Δθ [°]
M-16	Φ70 to Φ110	3.5±0.5	0.5	0.2
M-25	Φ110 to Φ170	4.5±0.5		
M-40	Φ170 to Φ250	5.5±0.5		

(2) Relationship of attaching position

The position relationship between the magnet standard groove and magneto-sensor is as shown on the right. Match the S-pole mark of the magnet with the forward direction of the spindle drive motor. Make sure that the attaching direction is correct by rotating the spindle shaft using the forward command [FWD: ON](setting speed of + polarity).



(3) Cautions on attaching

* The magneto-sensor part is of an excellent oiltight and watertight structure. Mold it with silicon adhesive if oil and water frequently splash to the push part.
* Wire and structure so that neither oil nor water splashes to the cable and the detector.
* Do not put magnetic substance like iron powder on the magnet.
* Do not put an article which generates magnetic field, especially solenoids, closer to the sensor and magneto-sensor.

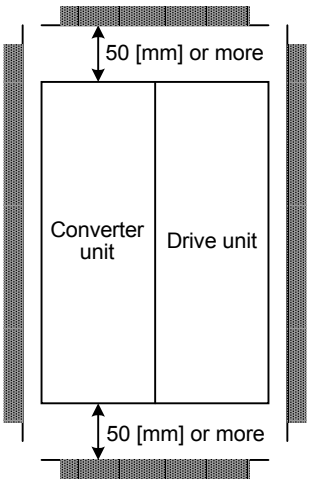
Section 4 Installation

4.1 Installation

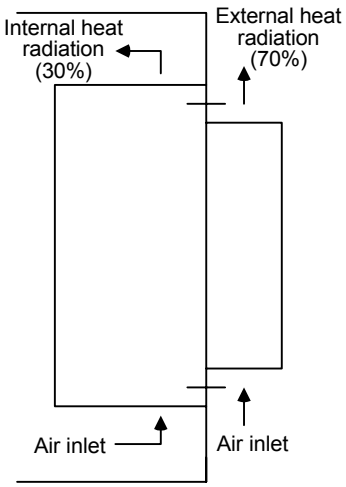
⚠Warning

There is fear of the electric shock when the unit is being energized, and until the charge lamp goes out after the power supply is turned off.
Do not remove the surface cover.
Do not use the products whose parts have been damaged or missing. There is fear of personal injury and damage to property.
Read "FRENIC5000MS5 Instruction Manual" thoroughly before using and use it properly.

Installation method greatly influences safety and the lifetime of the product. Note the undermentioned.
(1) Confirm that the ambient temperature, humidity, and vibration at the installation place are within the specification value of Section 2.
(2) Install the drive unit including the cooling fins for heat radiation outside at the place free from dust, oil mist, corrosive gases or the like.
(3) Install each unit vertically, directing the terminal section to the lower side properly, as shown in the figure below.
(4) Space out for maintenance of peripheral equipment on the upper and lower sides as shown in the figure below.
* In horizontal direction, no space is necessary except for special application.



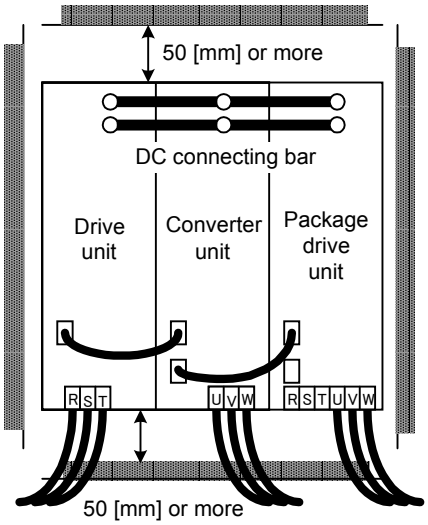
(Maintenance space)



(External cooling type)

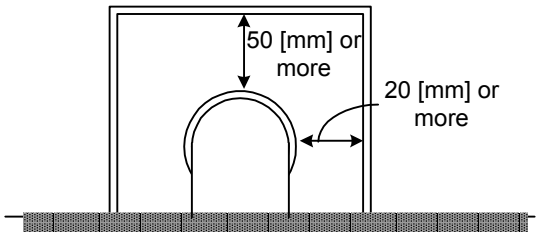
(5) Install each unit side-by-side, horizontally, as shown in the above figure.
Refer to item (6) when you combine a converter unit with two drive units or more.
(6) Install each unit side-by-side, horizontally as shown in the figure below, even when you combine a converter unit with two drive units or more.

Notes when two drive units or more are combined with one converter unit
1) Limit the total number of drive units to be combined with one converter unit to 12 or less.
However, because there might be a restriction in the number of drive units connected according to its capacity when three or more is connected; Inquire of our sales office.
2) Do not connect the three-phase AC power supply with the R/L1, S/L2, and T/L3 terminals of the package drive unit.
3) Detach the jumper connector CN1 or CN2 of the package drive unit.



(Maintenance space)

(7) An optional braking resistor is necessary for the dynamic braking converter unit and the package type drive unit.
Consider to install the braking resistor at a place above power equipment panels so as not to influence MS5 unit and other electric equipment because the braking resistor is a heating object.
Note the temperature rise in the panel and the ventilation of heat fully when you are forced to install the braking resistor inside power equipment panels.
Be sure to attach a protective cover (having open structure such as expanded metal) because the braking resistor's surface becomes hot. Attach the protective cover, 50 [mm] or more toward the upper side and 20 [mm] or more toward the side direction away from the braking resistor.



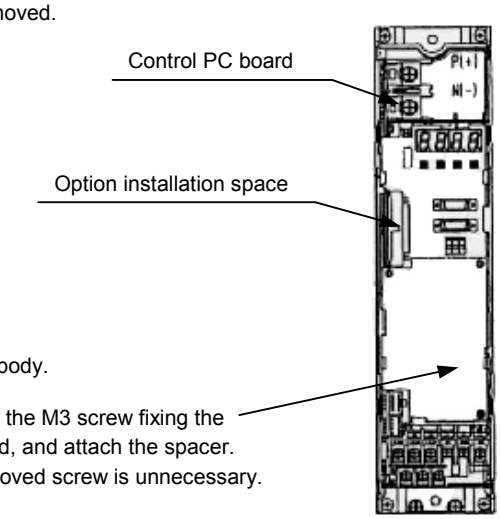
4.2 Optional card installation procedure

⚠Warning

There is fear of the electric shock when the unit is being energized, and until the charge lamp goes out after the power supply is turned off. Do not remove the surface cover.
Do not use the products whose parts have been damaged or missing. There is fear of personal injury and damage to property.

Install the optional card in the following procedures.

(1) Detach the front cover of (package type) drive unit
The control PC board is located in the front when the front cover is removed.



(2) Attach spacer
Attach the spacer (1 piece) appended to the optional card to the main body.

Spacer (TSB5, 5-8)

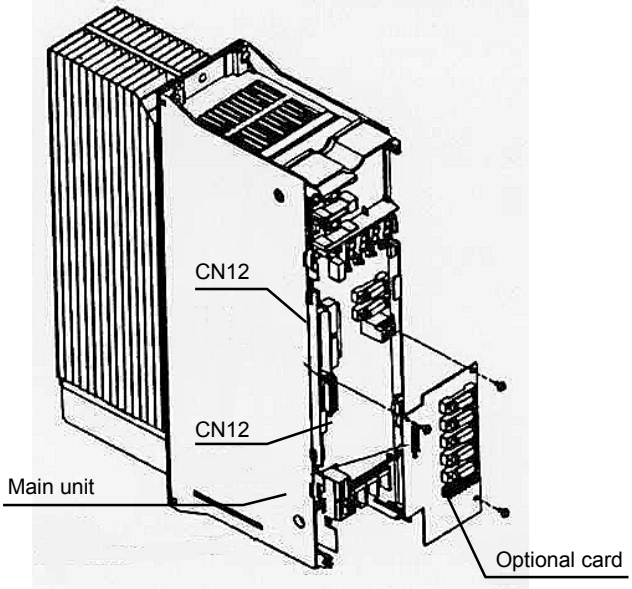
(3) Attach optional card
① Attach the optional card to the main unit

Align connector (CN12) of the main unit and optional card's connector (CN12), and push the optional card's connector.

Note : When pushing the connector, push it into the place with the click sound.

② Tighten the attached screws (3 pieces).

(4) Attach the front cover of (package type) drive unit



Section 5 Interface

5.1 Standard schematic diagram

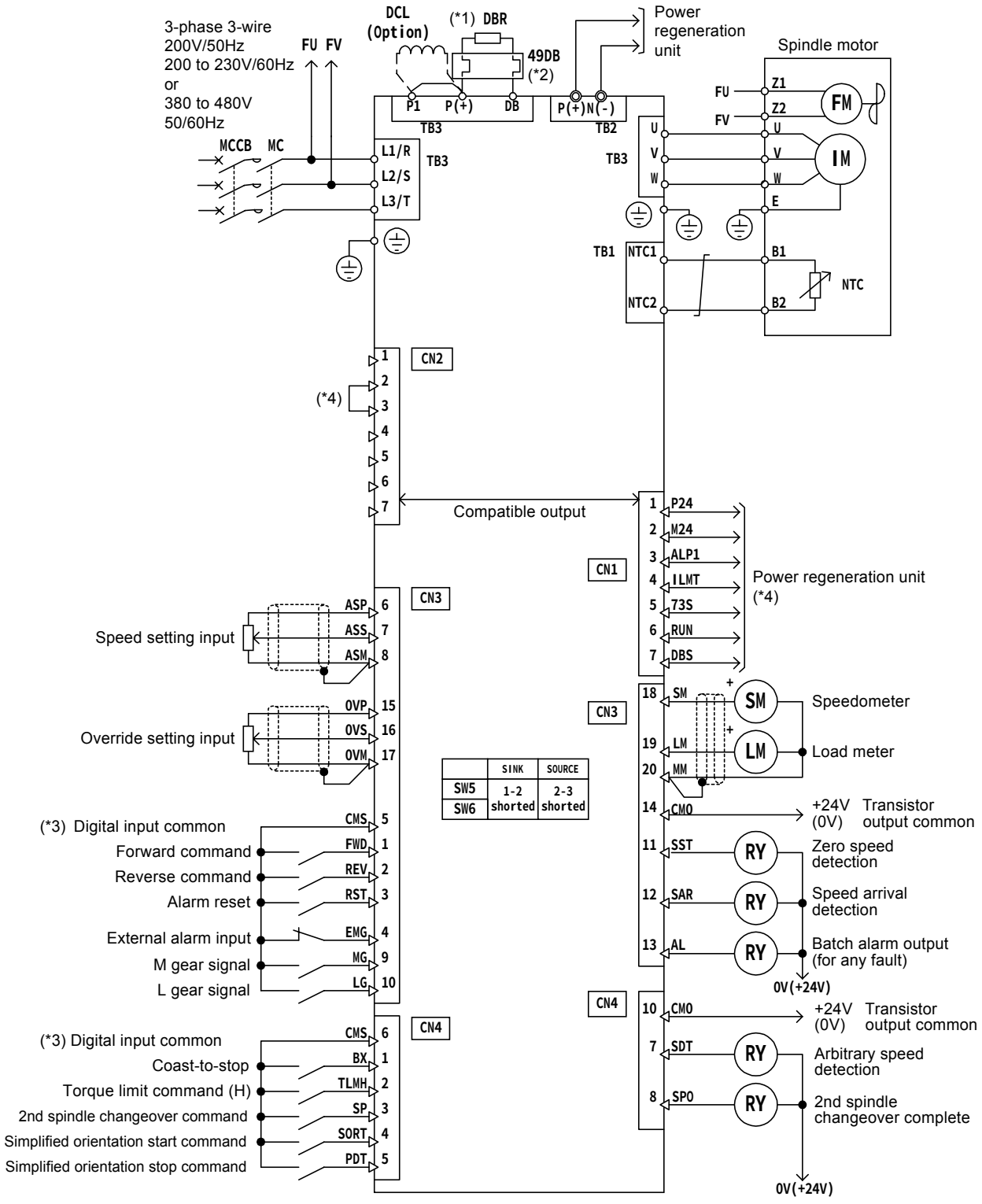
Table of Standard Schematic Diagram

Series	Converter unit type	Name of function	Page
(1) M5	Package type	Standard (without optional card)	5-2
	Dynamic braking converter unit	Standard (without optional card)	5-3
		PE orientation, digital speed setting	5-4
		Synchronous operation, digital speed setting	5-5
		Magneto-sensor type orientation	5-6
	Regenerative braking converter unit	Standard (without optional card)	5-7
		PE orientation, digital speed setting	5-8
		PE orientation, digital speed setting, winding changeover	5-9
		Synchronous operation, digital speed setting	5-10
		Magneto-sensor type orientation	5-11
(2) V5	Package type	Standard (without optional card)	5-12
	Dynamic braking converter unit	Standard (without optional card)	5-13
		PE orientation, digital speed setting	5-14
		Synchronous operation, digital speed setting	5-15
		Magneto-sensor type orientation	5-16
	Regenerative braking converter unit	Standard (without optional card)	5-17
		PE orientation, digital speed setting	5-18
		PE orientation, digital speed setting, winding changeover	5-19
		Synchronous operation, digital speed setting	5-20
		Magneto-sensor type orientation	5-21

(1) M5 series

① Dynamic braking

Without optional card (Package type)

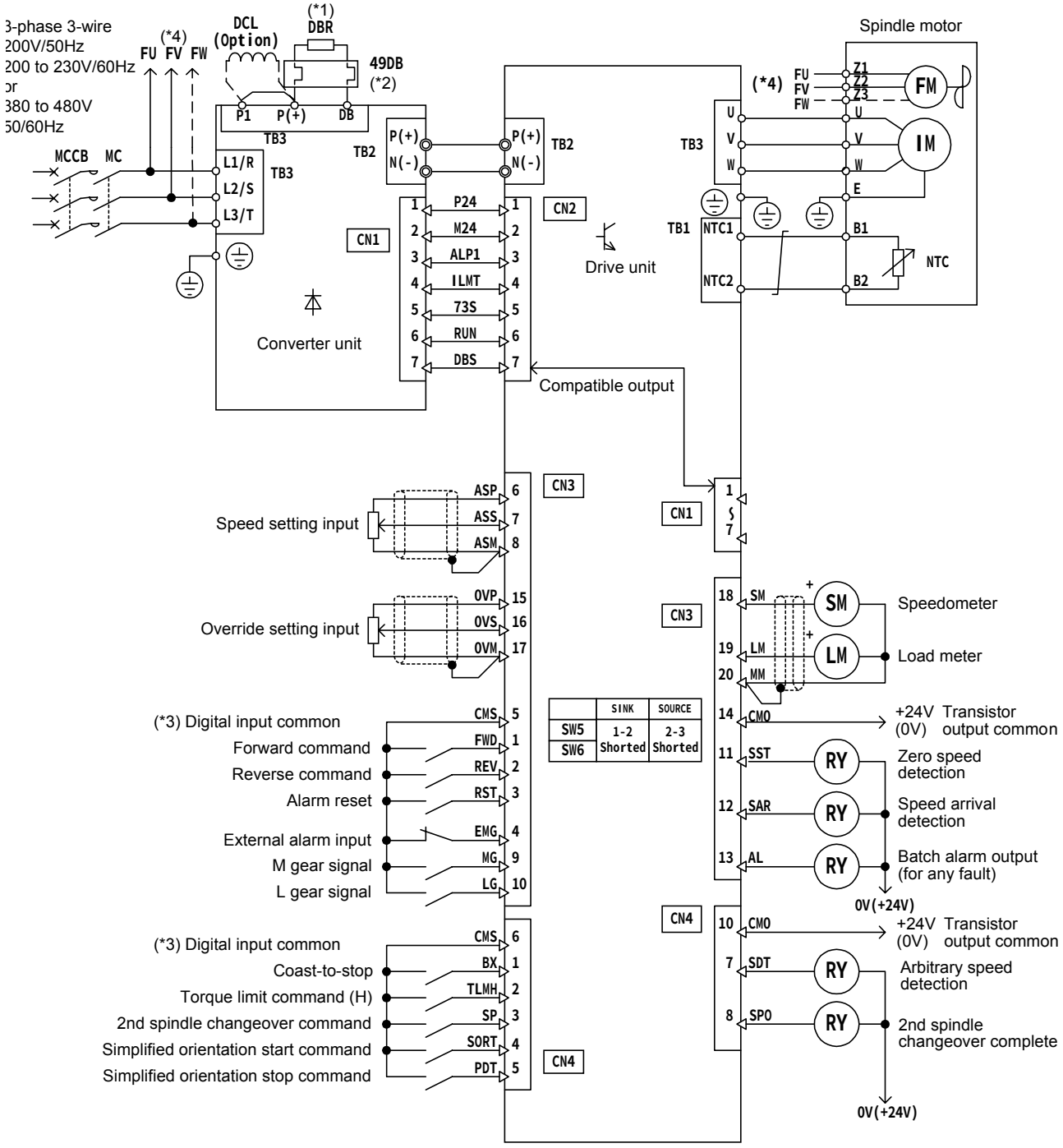


Notes: (*1) When a braking resistor (DBR) is used, be sure to connect a thermal overload relay to protect the resistor and use a protective cover.
(*2) Use the auxiliary contact (manual reset) of the thermal overload relay to trip the MCCB or MC.
(*3) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.
(*4) To connect with a converter unit, remove a jumper connector (accessory) of CN1 or CN2.

(1) M5 series

① Dynamic braking

Without optional card



Notes: (*1) When a braking resistor (DBR) is used, be sure to connect a thermal overload relay to protect the resistor and use a protective cover.

(*2) Use the auxiliary contact (manual reset) of the thermal overload relay to trip the MCCB or MC.

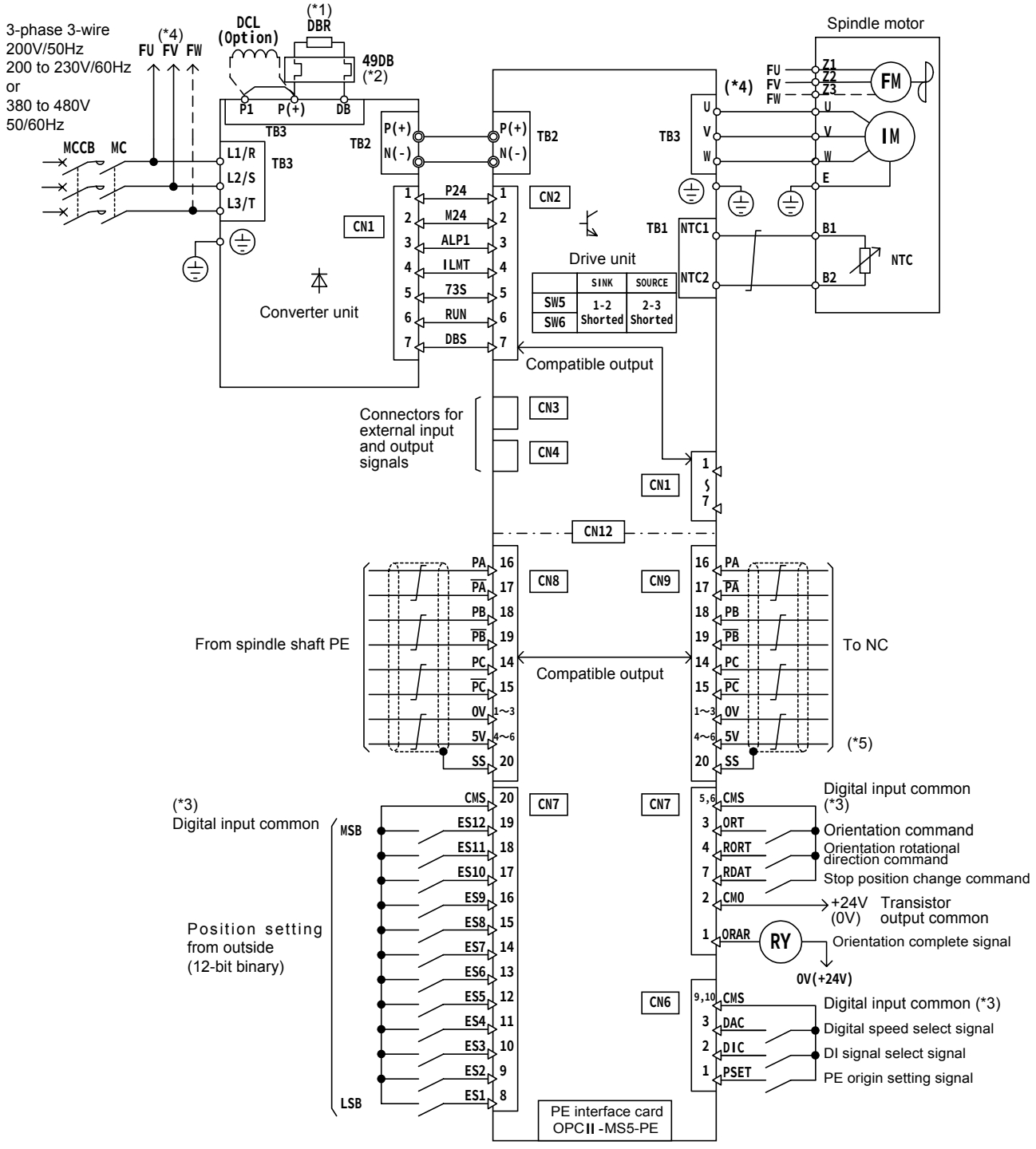
(*3) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

(*4) When the motor model type of MVE15M5-2, MVS15M5-2 or more is used, three-phase power supply is required for operating fan motor.

(1) M5 series

① Dynamic braking

With PE interface card

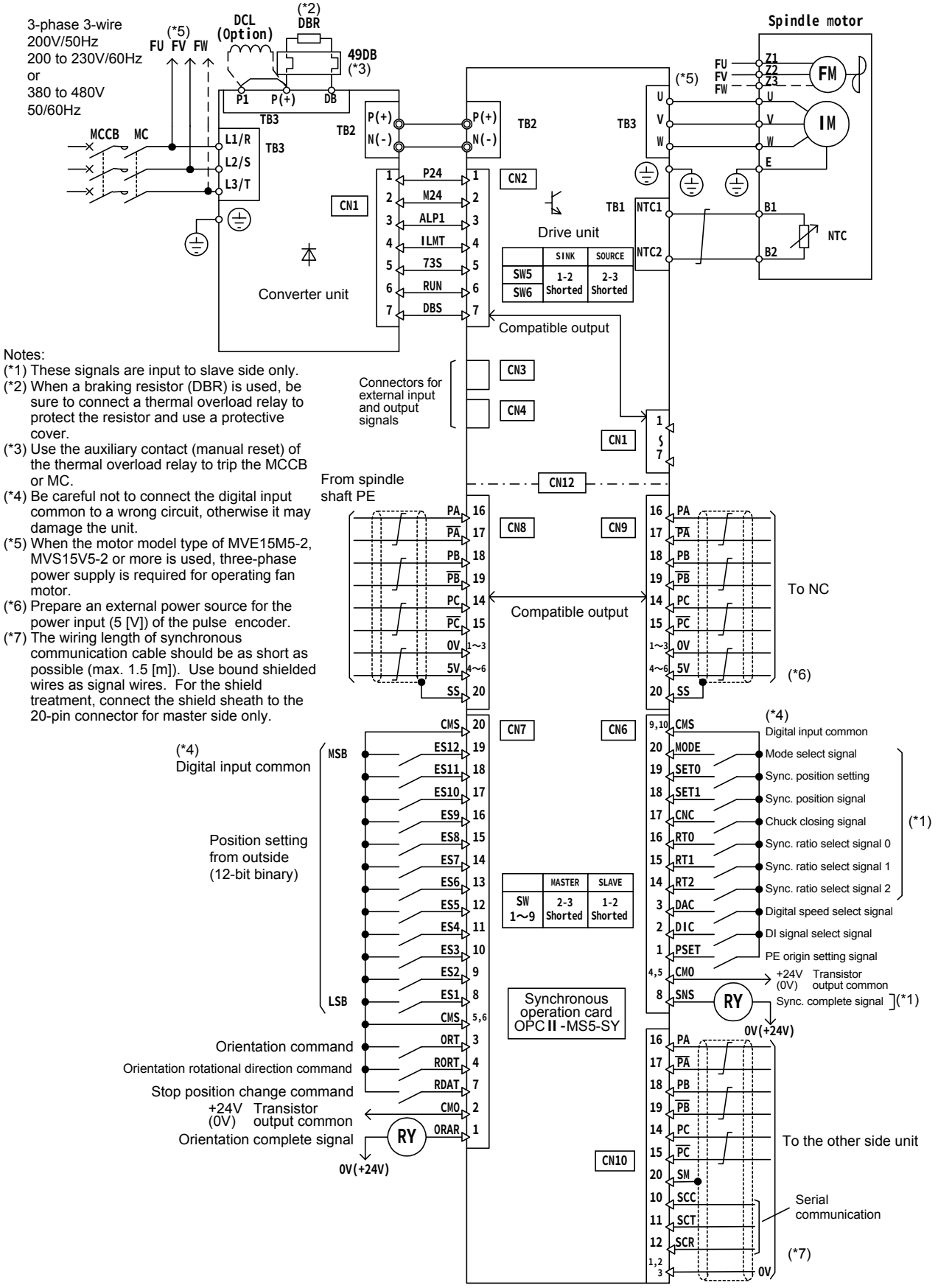


Notes: (*1) When a braking resistor (DBR) is used, be sure to connect a thermal overload relay to protect the resistor and use a protective cover.
(*2) Use the auxiliary contact (manual reset) of the thermal overload relay to trip the MCCB or MC.
(*3) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.
(*4) When the motor model type of MVE15M5-2, MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.
(*5) Prepare an external power source for the power input (5 [V]) of the pulse encoder.

(1) M5 series

① Dynamic braking

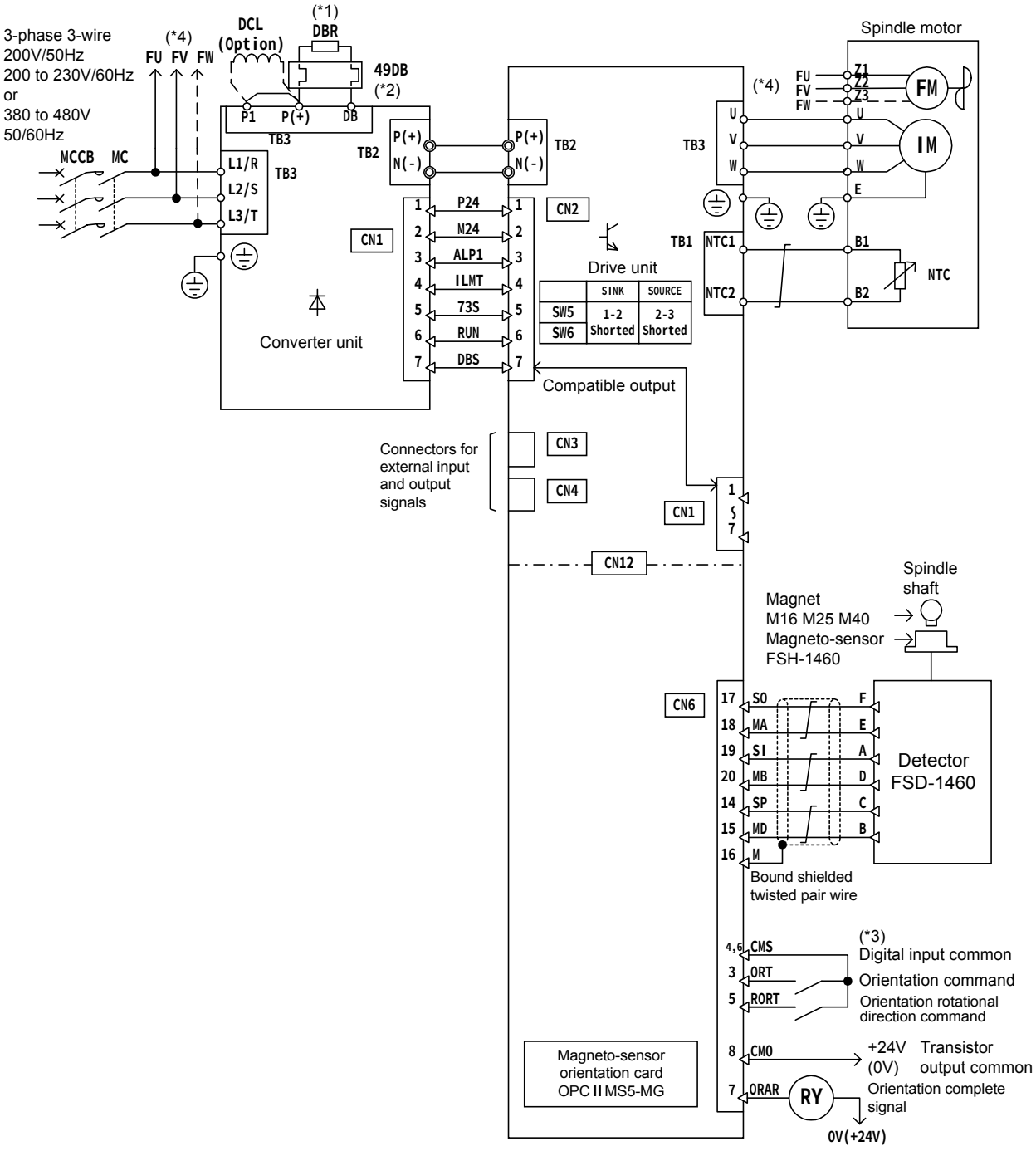
With synchronous operation card



(1) M5 series

① Dynamic braking

With magneto-sensor orientation card

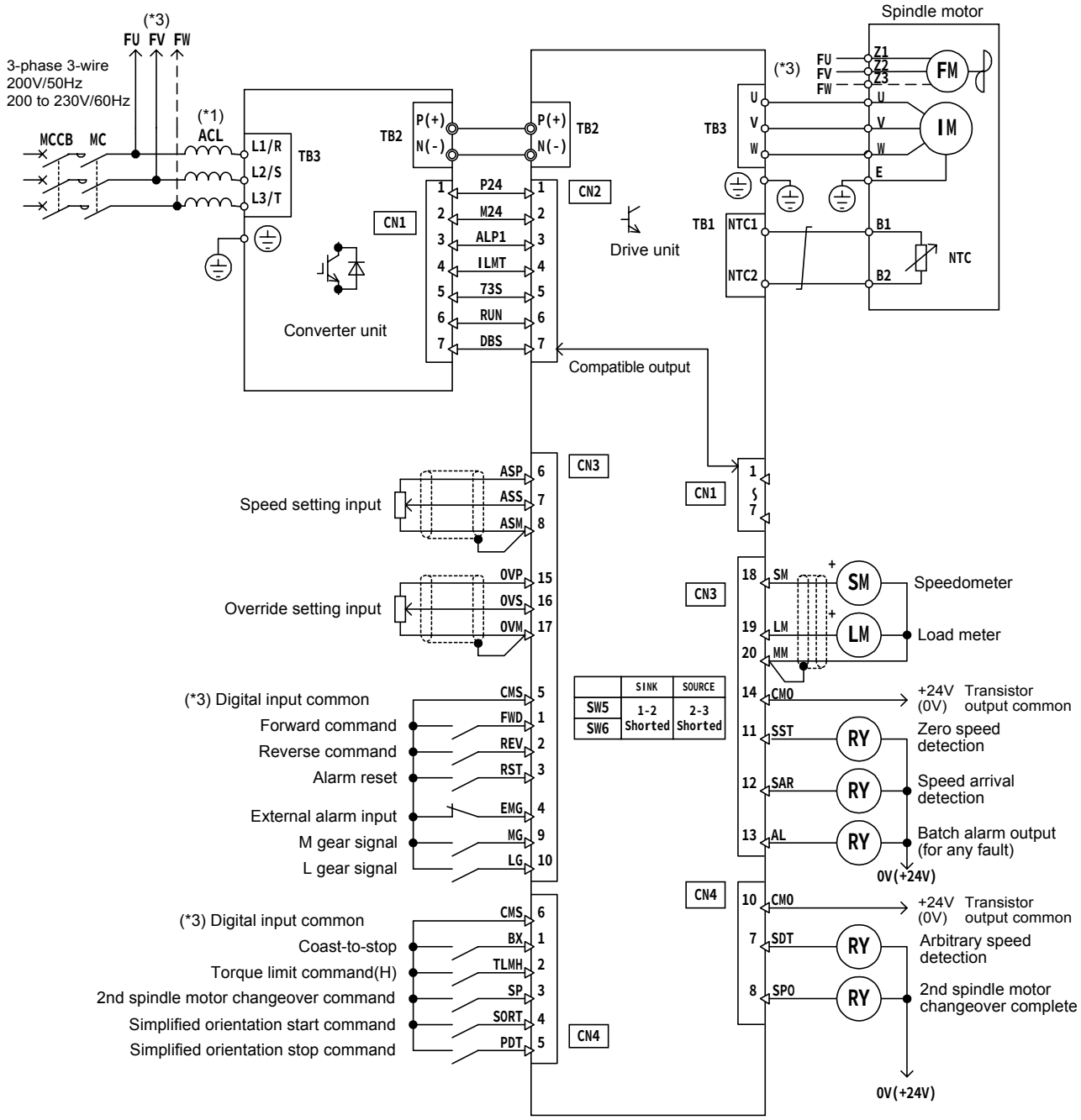


Notes: (*1) When a braking resistor (DBR) is used, be sure to connect a thermal overload relay to protect the resistor and use a protective cover.
(*2) Use the auxiliary contact (manual reset) of the thermal overload relay to trip the MCCB or MC.
(*3) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.
(*4) When the motor model type of MVE15M5-2, MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

(1) M5 series

② Regenerative braking

Without option card

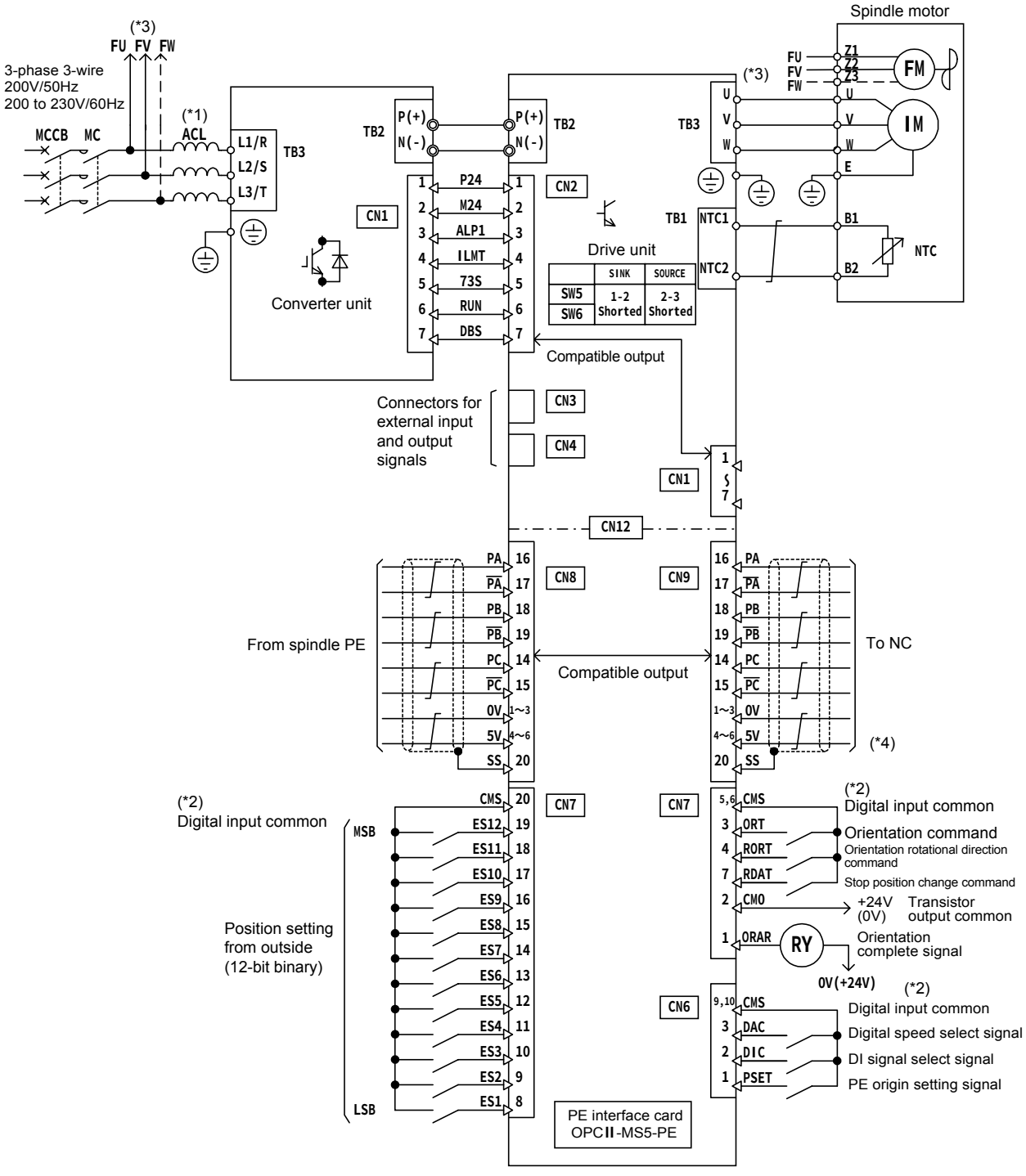


Notes: (*1) When a regenerative braking converter unit is used, be sure to connect the attached ACL to the power supply side.
(*2) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.
(*3) When the motor model type of MVE15M5-2, MVS15M5-2 or more is used, three-phase power supply is required for operating fan motor.

(1) M5 series

② Regenerative braking

With PE interface card



Notes: (*1) When a regenerative braking converter unit is used, be sure to connect the attached ACL to the power supply side.

(*2) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

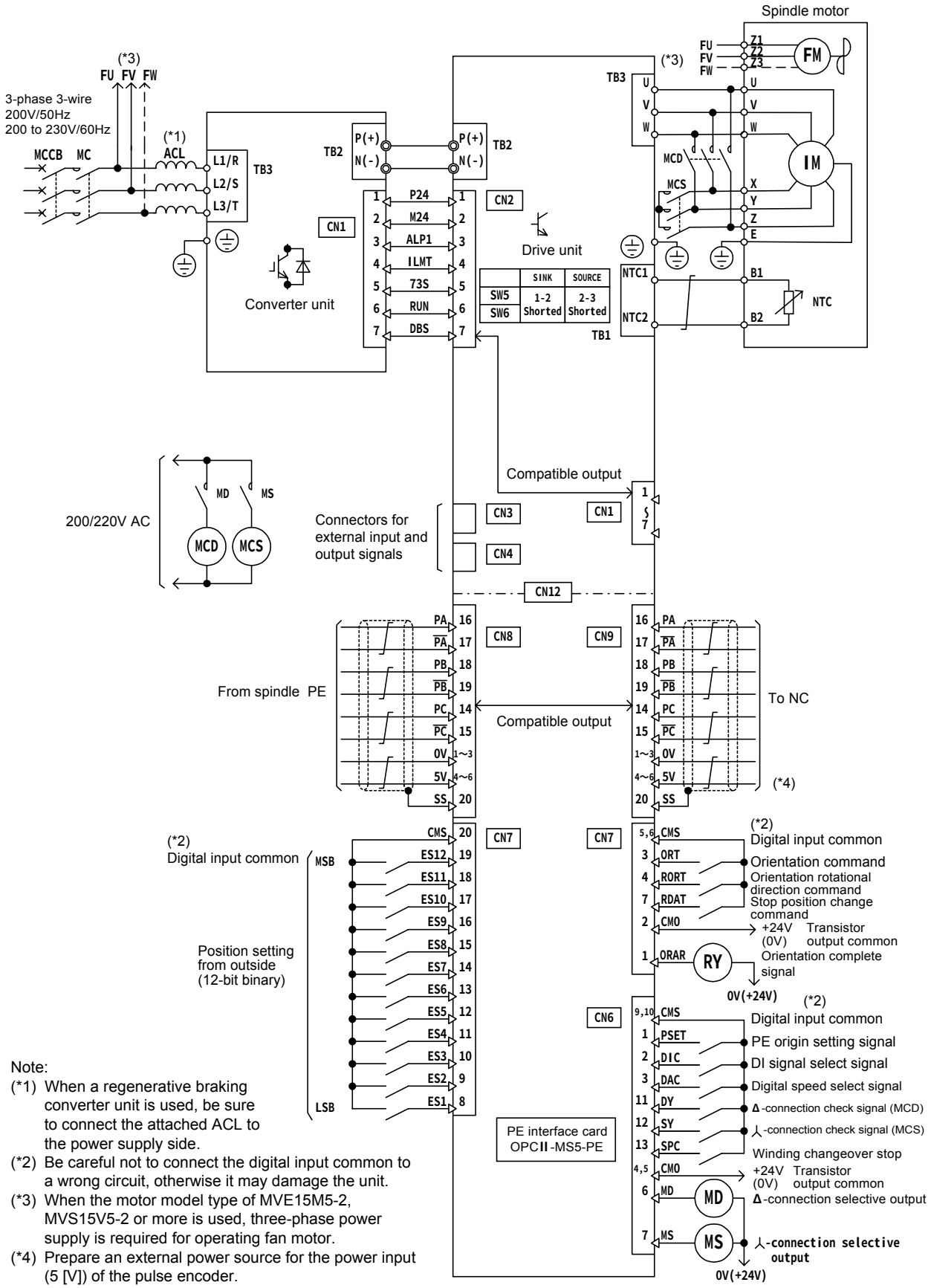
(*3) When the motor model type of MVE15M5-2, MVS15M5-2 or more is used, three-phase power supply is required for operating fan motor.

(*4) Prepare an external power source for the power input (5 [V]) of the pulse encoder.

(1) M5 series

② Regenerative braking

With PE interface card (when changing-over winding)



Note:

(*1) When a regenerative braking converter unit is used, be sure to connect the attached ACL to the power supply side.

(*2) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

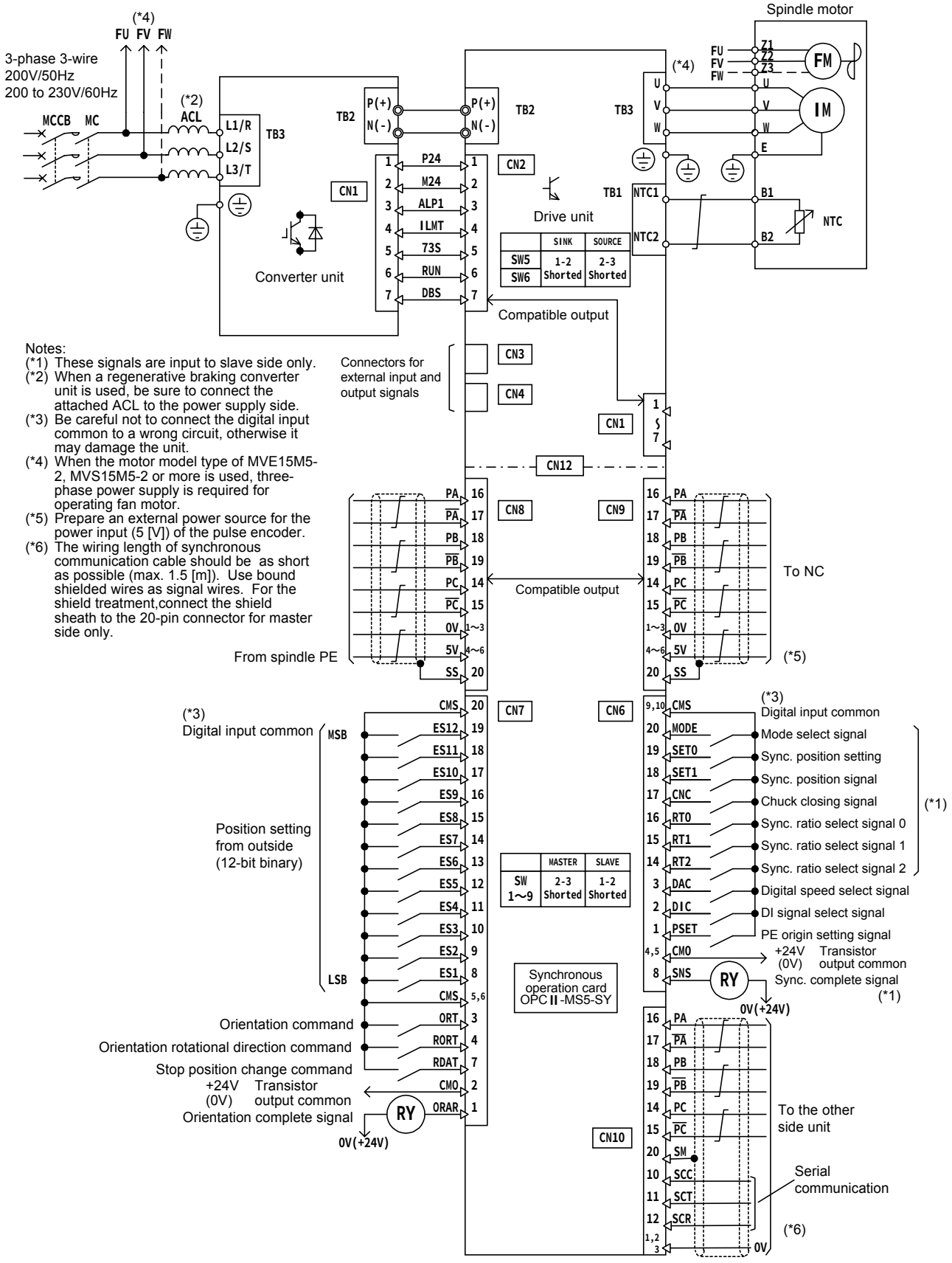
(*3) When the motor model type of MVE15M5-2, MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

(*4) Prepare an external power source for the power input (5 [V]) of the pulse encoder.

(1) M5 series

② Regenerative braking

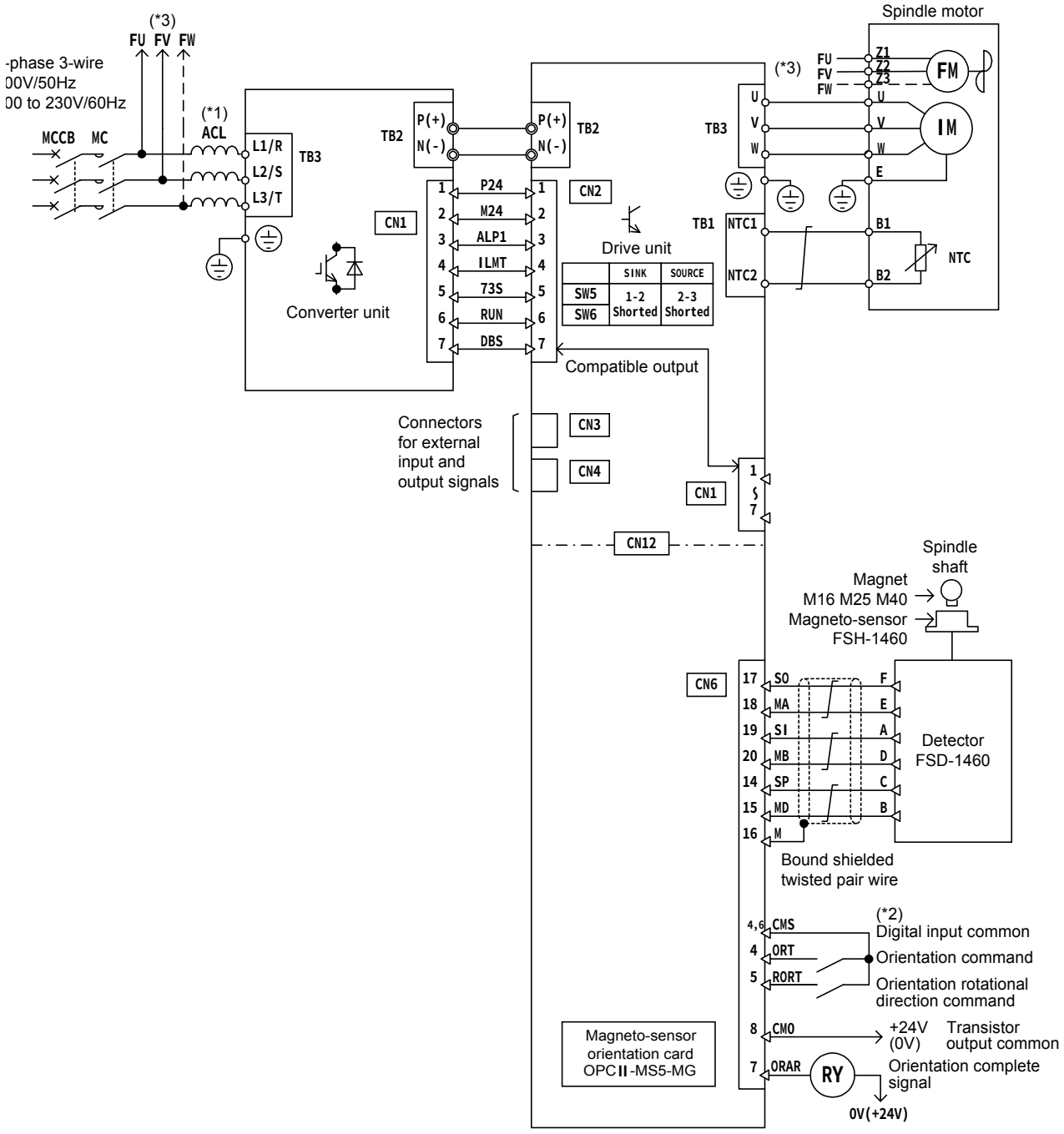
With synchronous operation card



(1) M5 series

② Regenerative braking

With magneto-sensor orientation card



Notes: (*1) When a regenerative braking converter unit is used, be sure to connect the attached ACL to the power supply side.

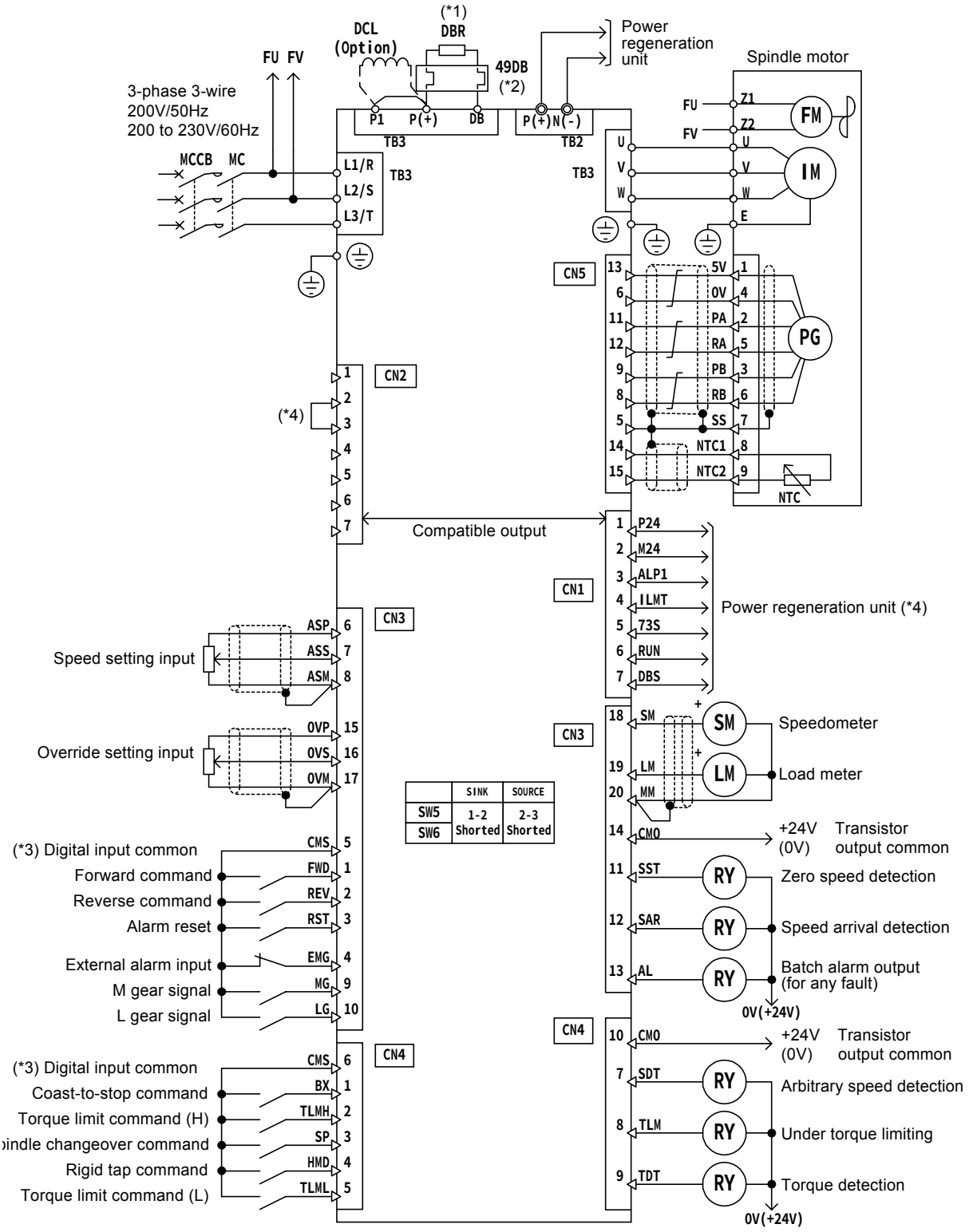
(*2) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

(*3) When the motor model type of MVE15M5-2, MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

(2) V5 series

① Dynamic braking

Without optional card (Package type)



Notes: (*1) When a braking resistor (DBR) is used, be sure to connect a thermal overload relay to protect the resistor and use a protective cover.

(*2) Use the auxiliary contact (manual reset) of the thermal overload relay to trip the MCCB or MC.

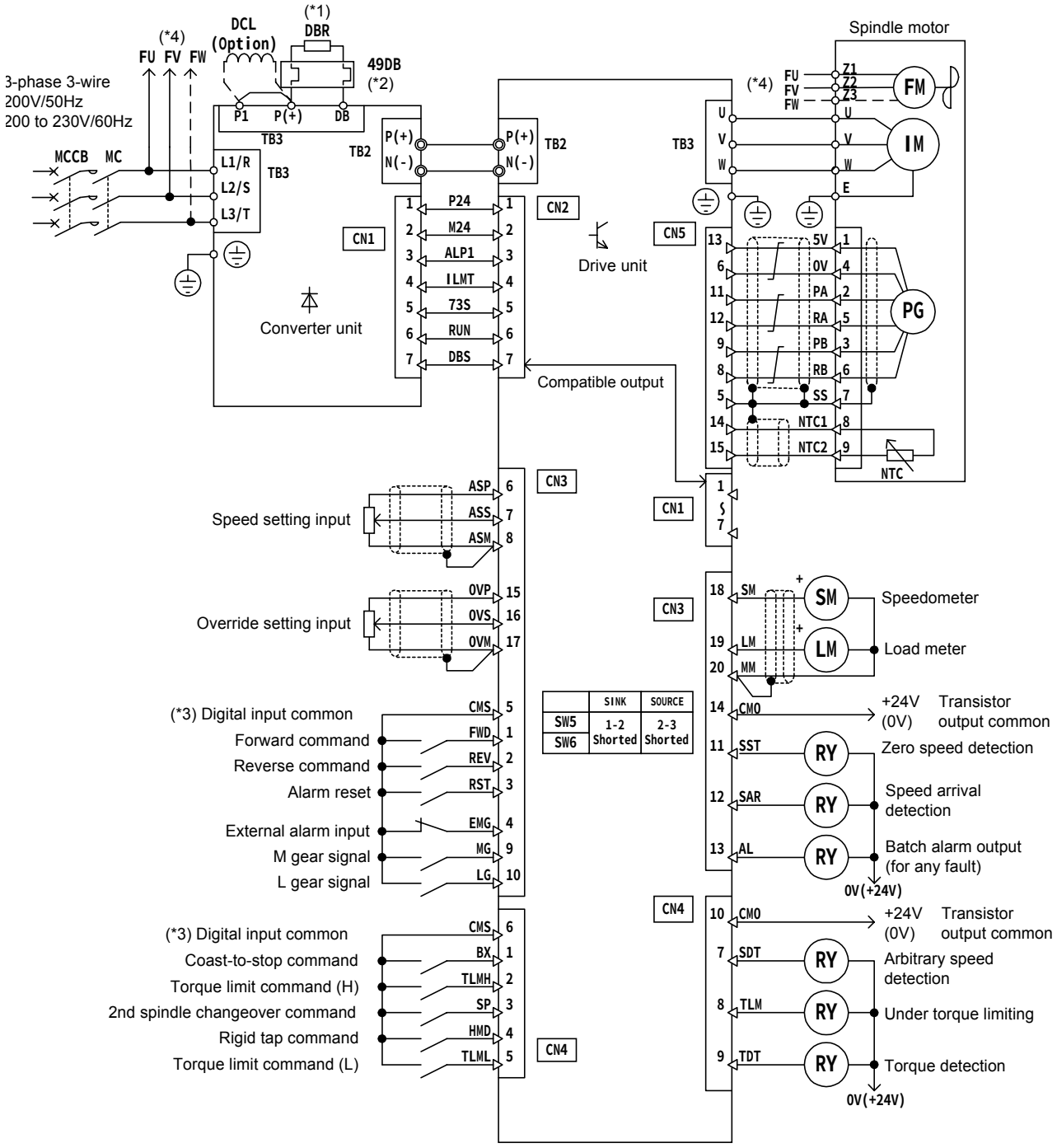
(*3) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

(*4) To connect with a converter unit, remove a jumper connector of CN1 or CN2 (accessory).

(2) V5 series

① Dynamic braking

Without optional card

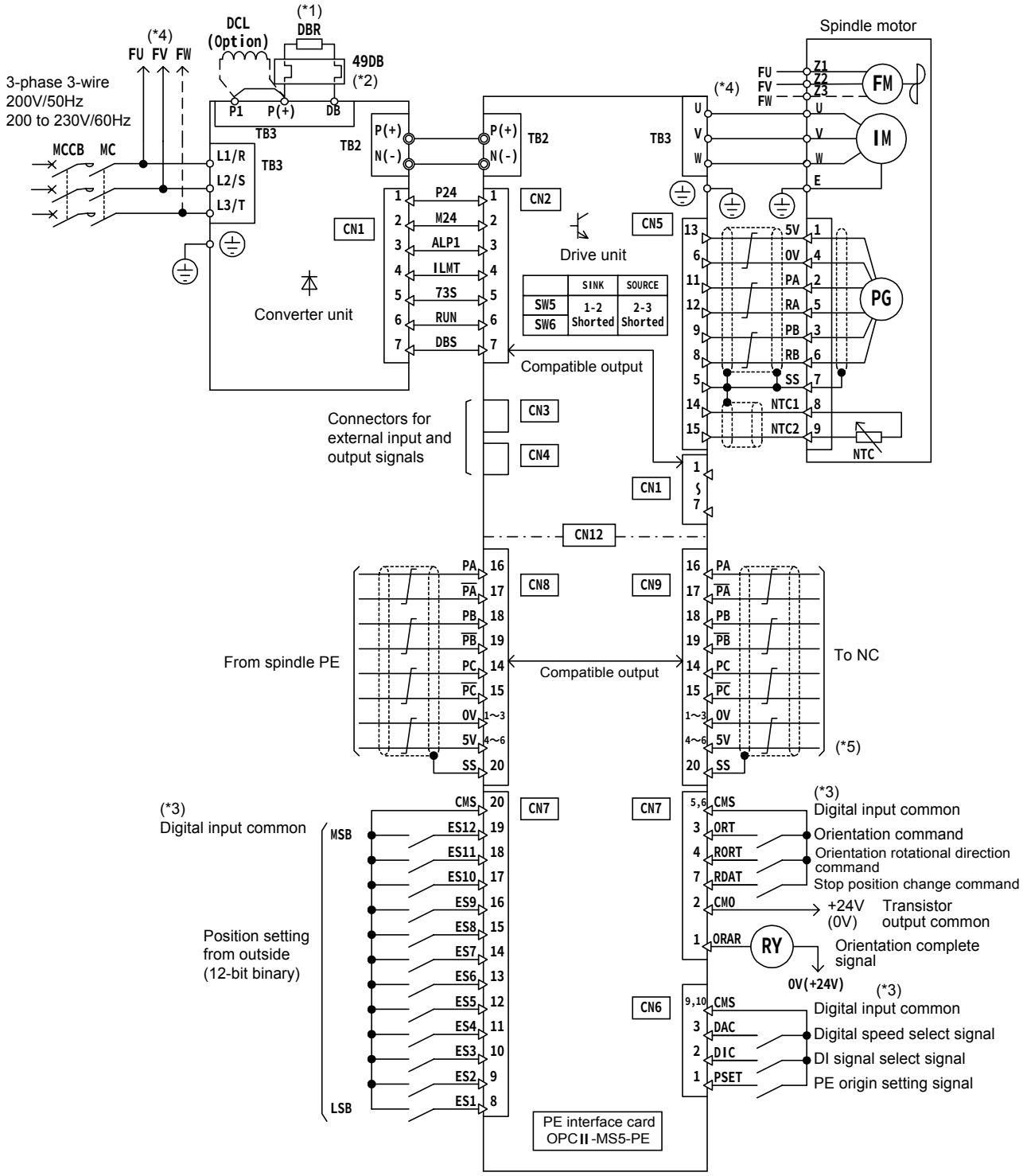


Notes: (*1) When a braking resistor (DBR) is used, be sure to connect a thermal overload relay to protect the resistor and use a protective cover.
(*2) Use the auxiliary contact (manual reset) of the thermal overload relay to trip the MCCB or MC.
(*3) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.
(*4) When the motor model type of MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

(2) V5 series

① Dynamic braking

With PE interface card

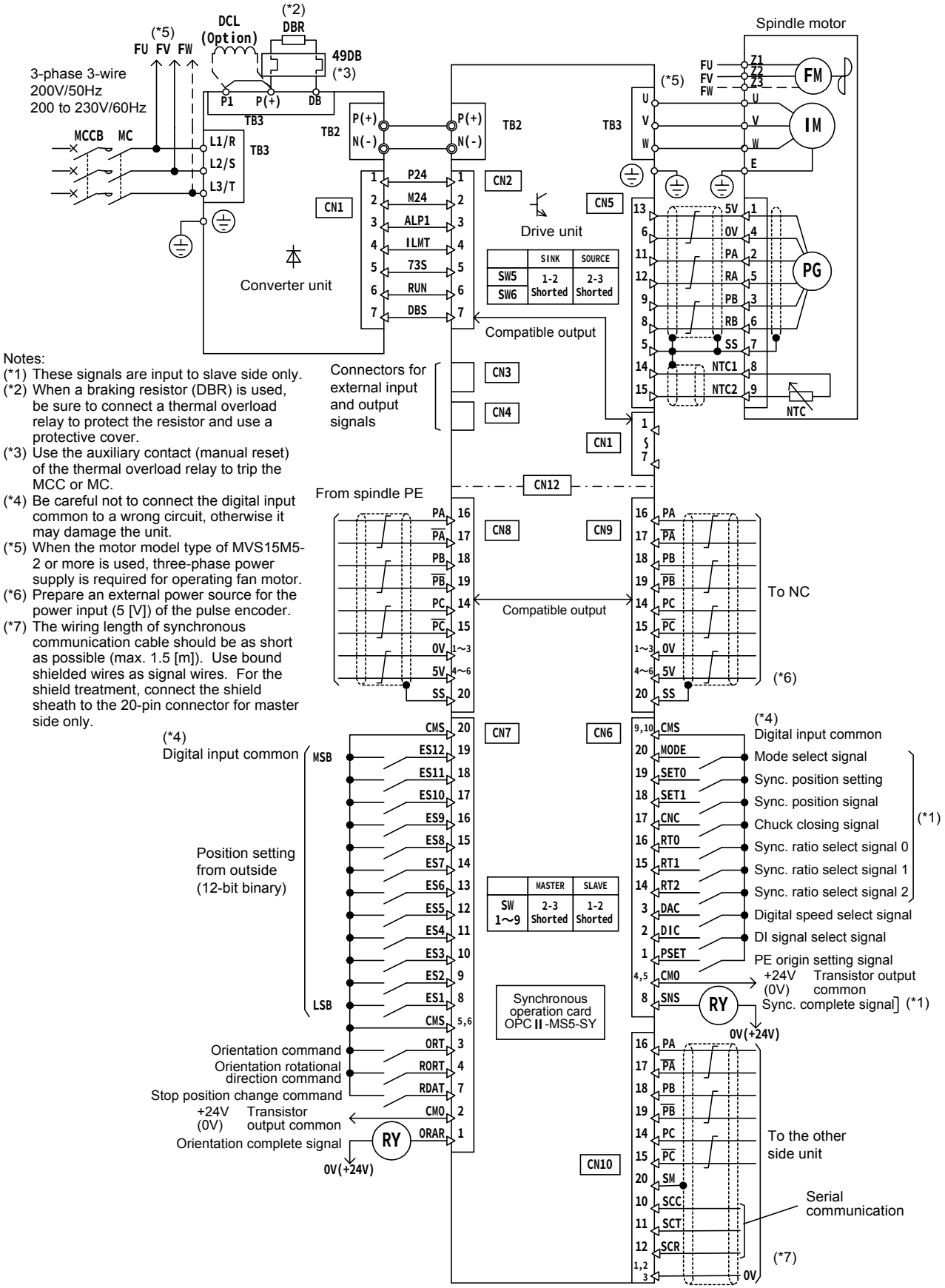


Notes: (*1) When a braking resistor (DBR) is used, be sure to connect a thermal overload relay to protect the resistor and use a protective cover.
(*2) Use the auxiliary contact (manual reset) of the thermal overload relay to trip the MCCB or MC.
(*3) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.
(*4) When the motor model type of MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.
(*5) Prepare an external power source for the power input (5 [V]) of the pulse encoder.

(2) V5 series

① Dynamic braking

With synchronous operation card



Notes:

(*1) These signals are input to slave side only.

(*2) When a braking resistor (DBR) is used, be sure to connect a thermal overload relay to protect the resistor and use a protective cover.

(*3) Use the auxiliary contact (manual reset) of the thermal overload relay to trip the MCC or MC.

(*4) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

(*5) When the motor model type of MVS15M5-2 or more is used, three-phase power supply is required for operating fan motor.

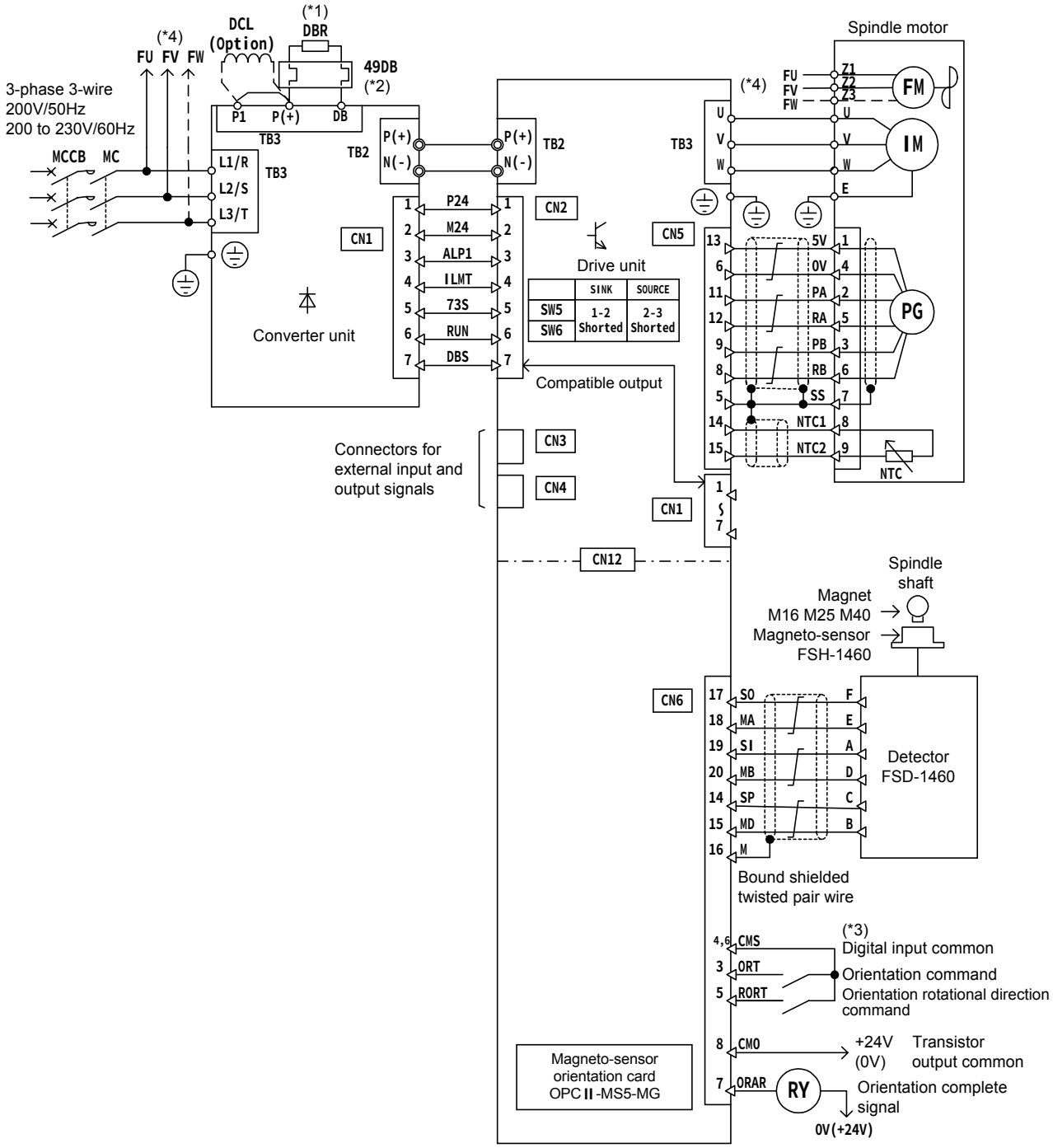
(*6) Prepare an external power source for the power input (5 [V]) of the pulse encoder.

(*7) The wiring length of synchronous communication cable should be as short as possible (max. 1.5 [m]). Use bound shielded wires as signal wires. For the shield treatment, connect the shield sheath to the 20-pin connector for master side only.

(2) V5 series

① Dynamic braking

With magneto-sensor orientation card

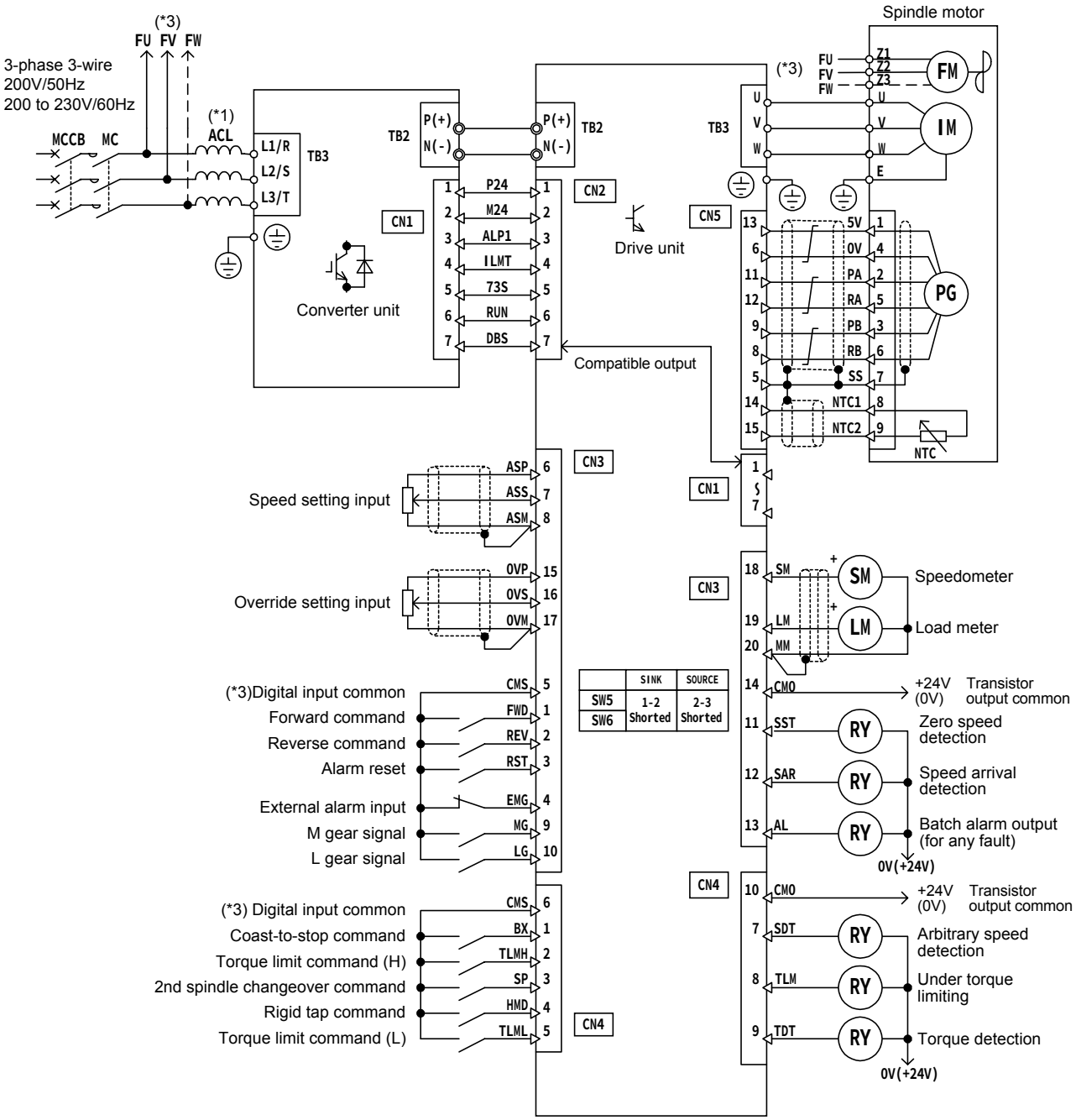


Notes: (*1) When a braking resistor (DBR) is used, be sure to connect a thermal overload relay to protect the resistor and use a protective cover.
(*2) Use the auxiliary contact (manual reset) of the thermal overload relay to trip the MCCB or MC.
(*3) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.
(*4) When the motor model type of MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

(2) V5 series

② Regenerative braking

Without optional card



Notes: (*1) When a regenerative braking converter unit is used, be sure to connect the attached ACL to the power supply side.

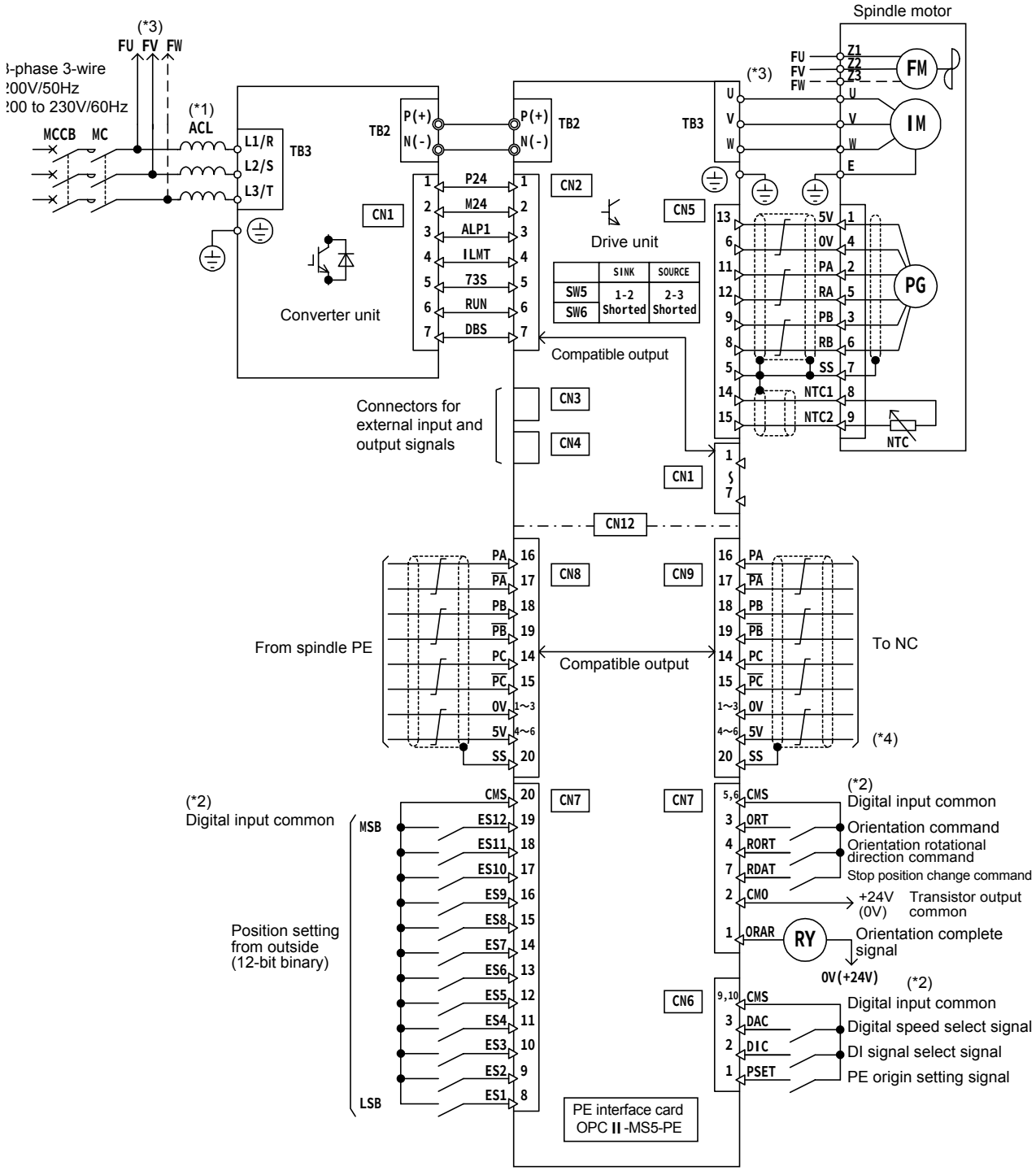
(*2) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

(*3) When the motor model type of MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

(2) V5 series

② Regenerative braking

With PE interface card



Notes: (*1) When a regenerative braking converter unit is used, be sure to connect the attached ACL to the power supply side.

(*2) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

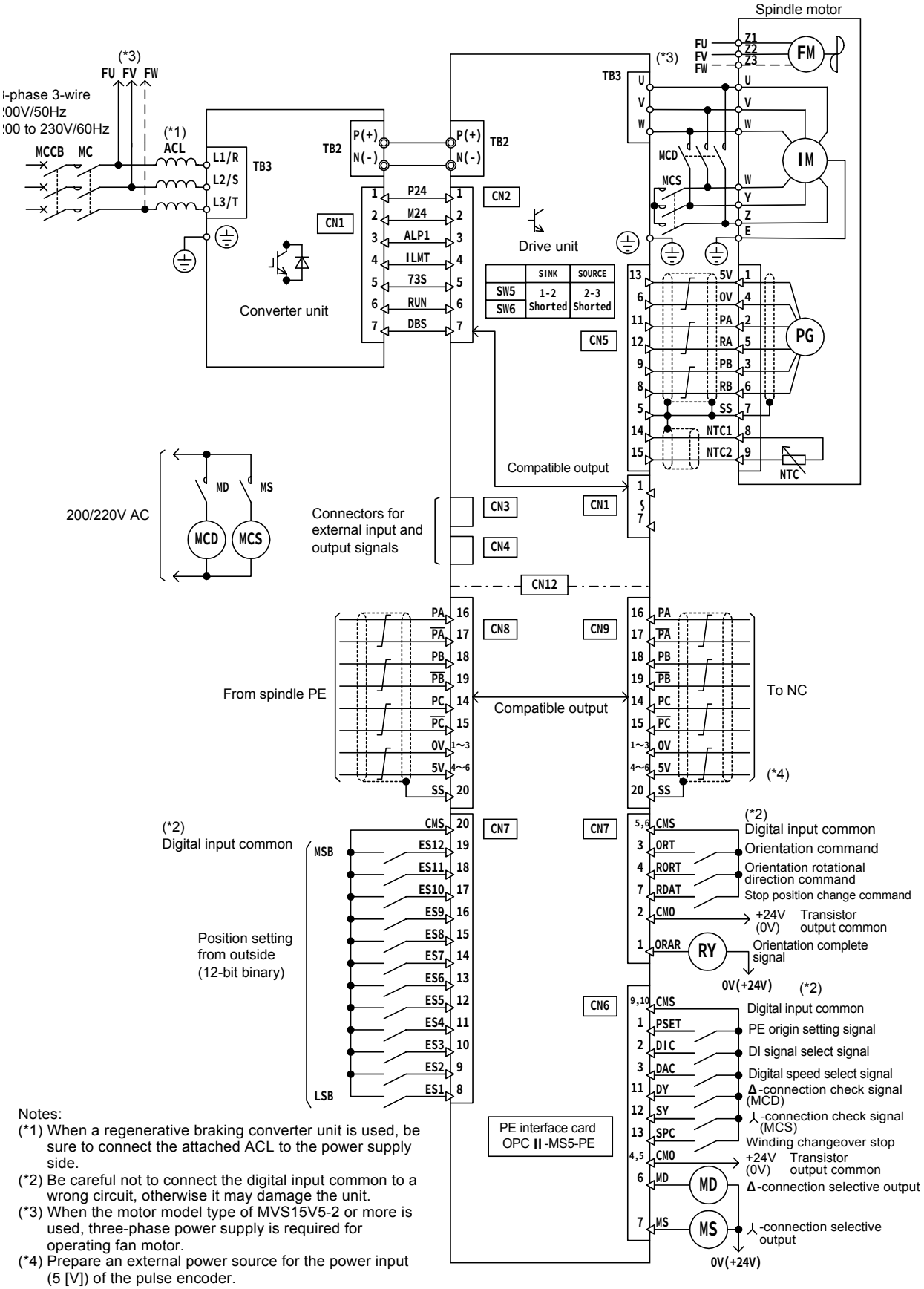
(*3) When the motor model type of MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

(*4) Prepare an external power source for the power input (5 [V]) of the pulse encoder.

(2) V5 series

② Regenerative braking

With PE interface card (when changing-over winding)



Notes:

(*1) When a regenerative braking converter unit is used, be sure to connect the attached ACL to the power supply side.

(*2) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

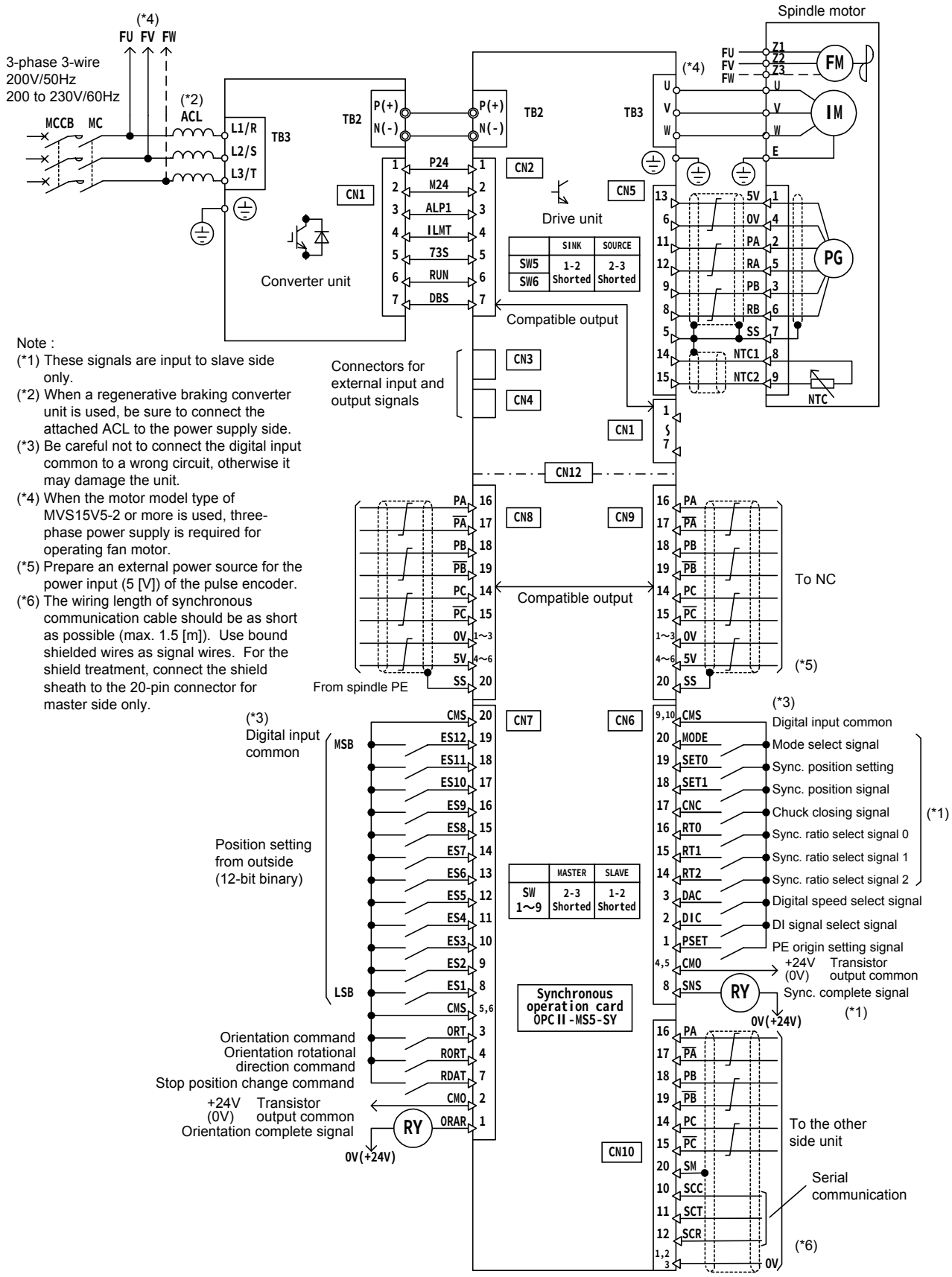
(*3) When the motor model type of MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

(*4) Prepare an external power source for the power input (5 [V]) of the pulse encoder.

(2) V5 series

② Regenerative braking

With synchronous operation card



Note :

(*1) These signals are input to slave side only.

(*2) When a regenerative braking converter unit is used, be sure to connect the attached ACL to the power supply side.

(*3) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

(*4) When the motor model type of MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

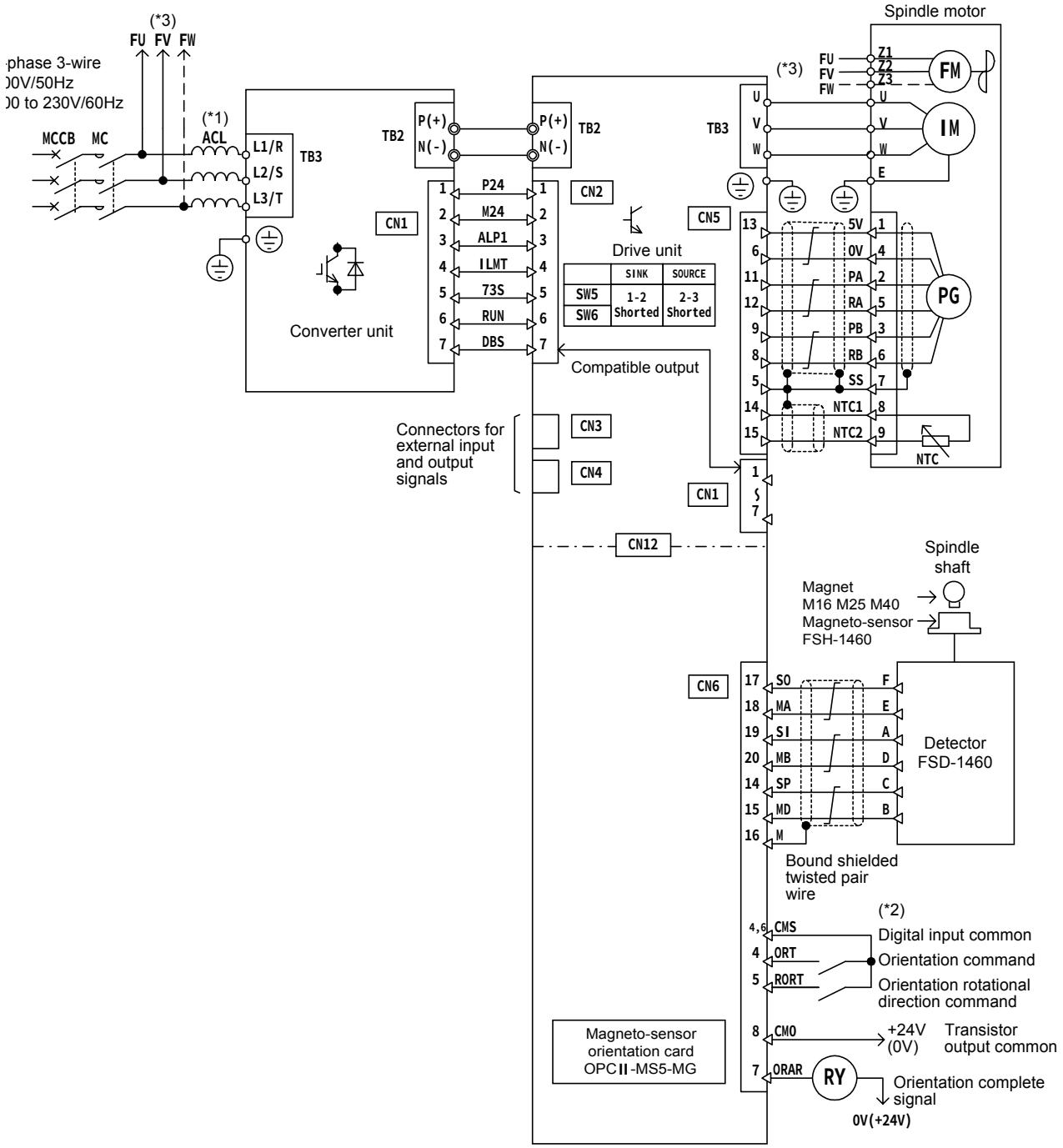
(*5) Prepare an external power source for the power input (5 [V]) of the pulse encoder.

(*6) The wiring length of synchronous communication cable should be as short as possible (max. 1.5 [m]). Use bound shielded wires as signal wires. For the shield treatment, connect the shield sheath to the 20-pin connector for master side only.

(2) V5 series

② Regenerative braking

With magneto-sensor orientation card



Notes: (*1) When a regenerative braking converter unit is used, be sure to connect the attached ACL to the power supply side.

(*2) Be careful not to connect the digital input common to a wrong circuit, otherwise it may damage the unit.

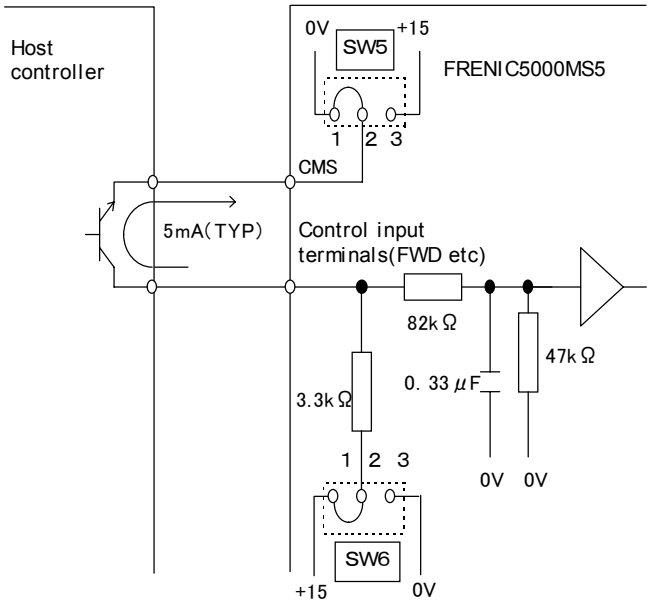
(*3) When the motor model type of MVS15V5-2 or more is used, three-phase power supply is required for operating fan motor.

5.2 Input/output interface

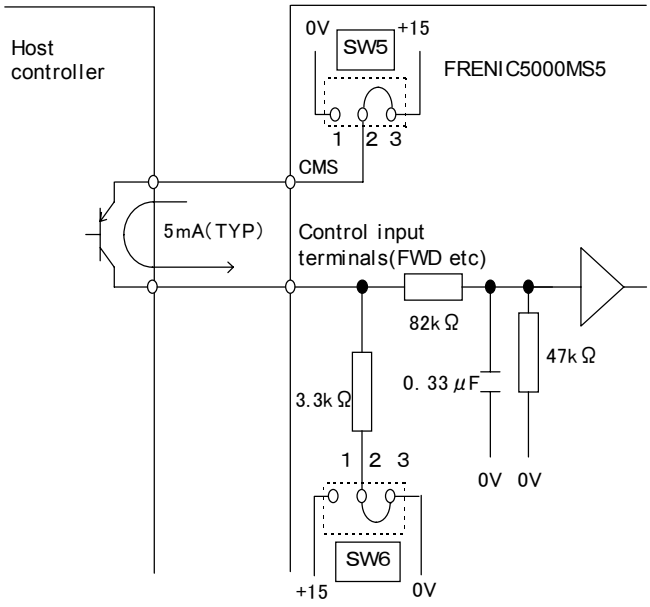
(1) Input interface (logic input)

- SINK or SOURCE of the input terminal can be selected with the changeover switches SW5, SW6 on the drive unit control PC board.
- SINK logic is factory set (pins 1 and 2 of both SW5 and SW6 are short-circuited) when the unit is shipped.
- To change over to the SOURCE logic, after confirming the charge lamp goes out (i.e. some time has elapsed since the main power source is turned off), short-circuit the pins 2 and 3 of both SW5 and SW6.
- Note that the host controller or the drive unit might be damaged when wiring has been made and the power supply is turned on, with the wrong SW5 and SW6 setting.

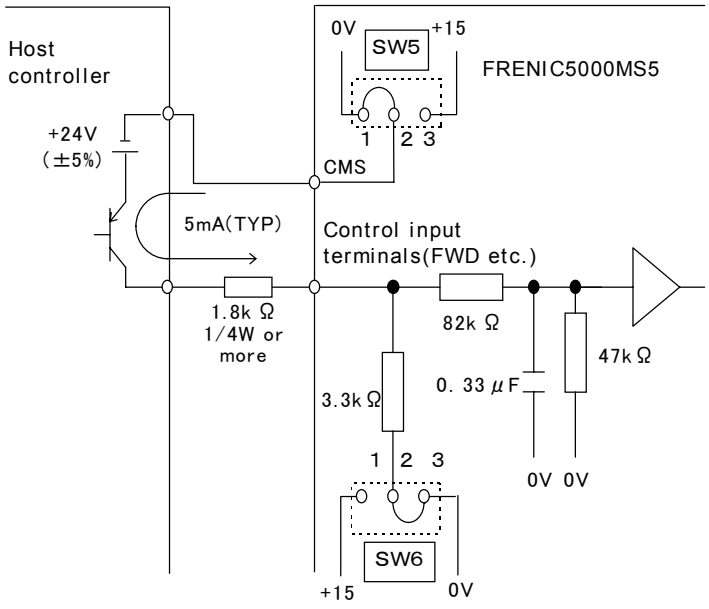
Control input interface at SINK logic



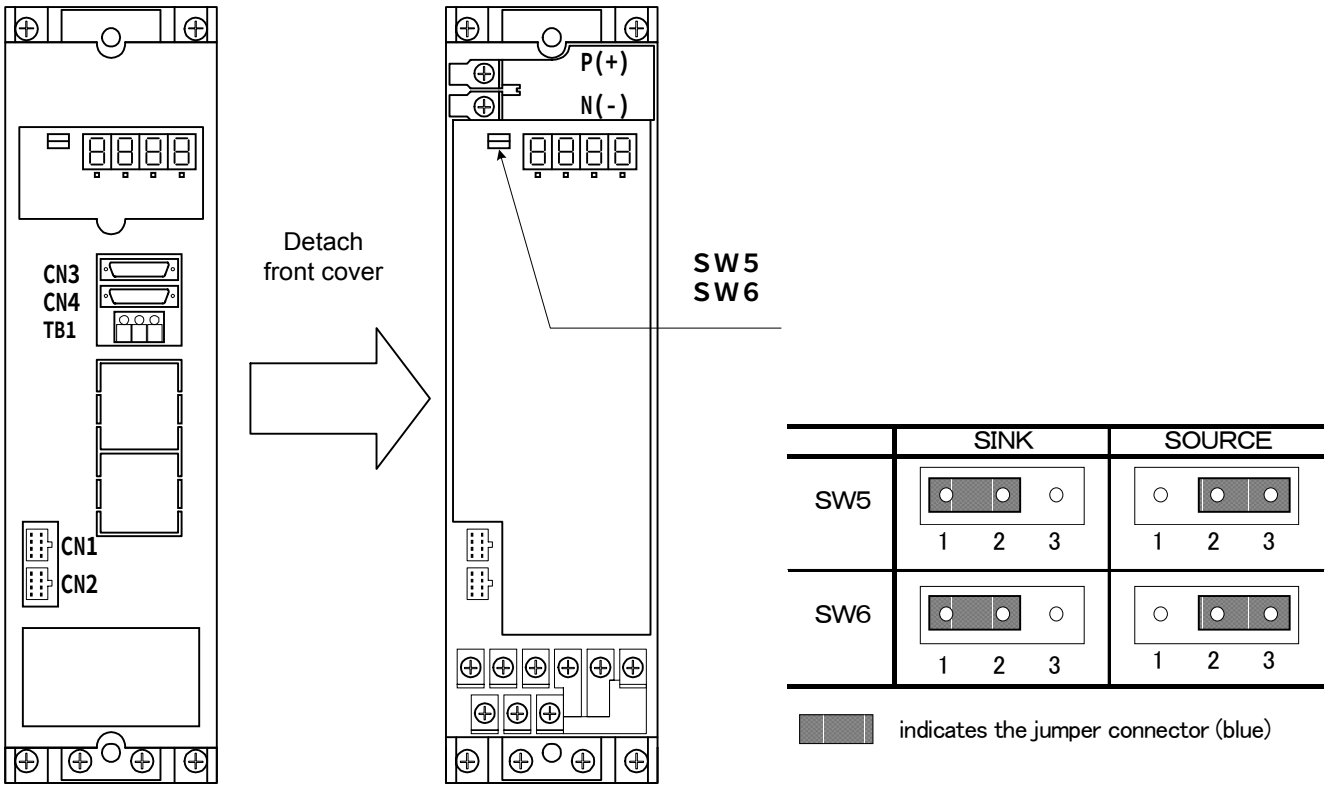
Control input interface at SOURCE logic



Interface when using external power supply (+24V)



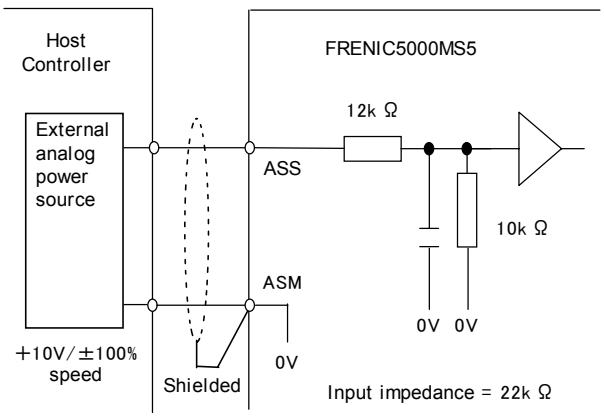
SINK/SOURCE changeover switches



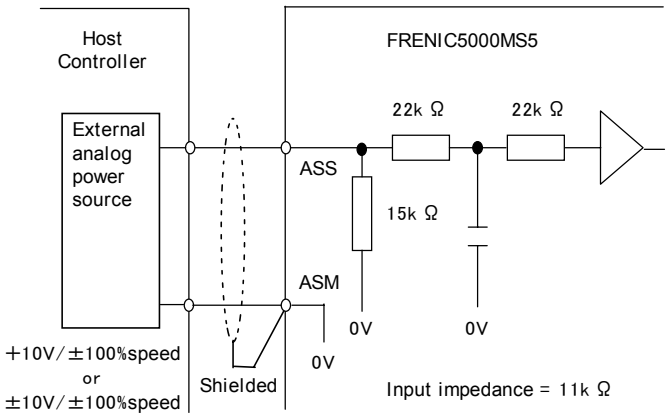
(2) Input interface (analog input)

External speed command [CN3: ASS, ASM]

M5 drive unit



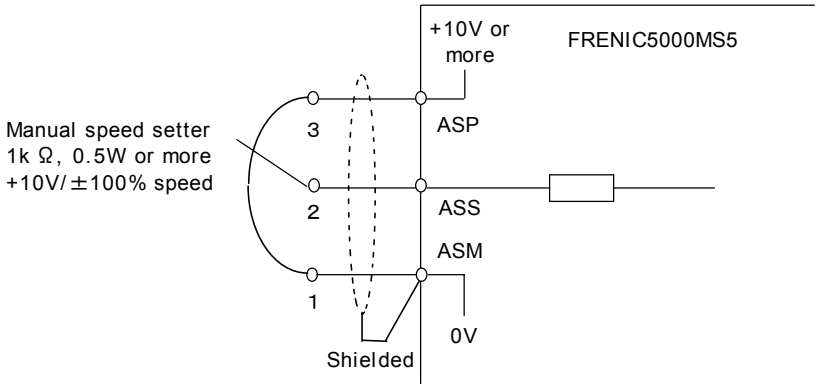
V5 drive unit



- Used when you give the speed setting using external analog power supply through the D/A converter etc. of the NC machine tool.
- For the V5 drive unit, the forward or reverse rotational direction can be changed by the polarity (+, -) of the speed setting voltage, and the forward command (FWD) and reverse command (REV) mentioned later.

Manual speed setting [CN3: ASP, ASS, ASM]

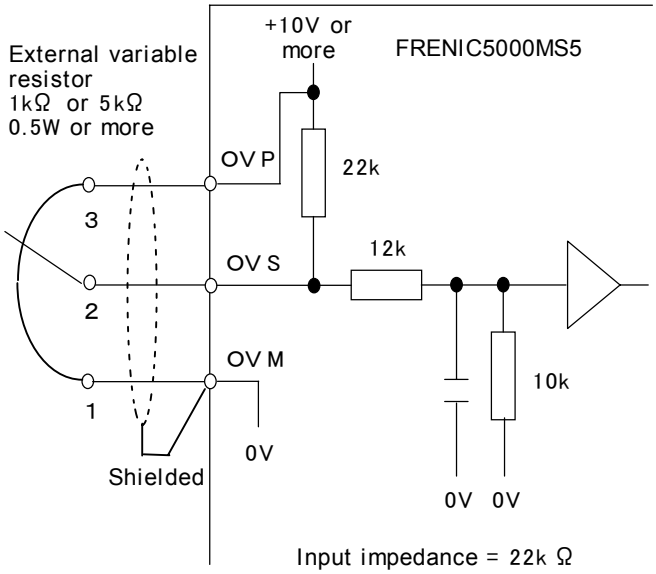
Common to M5 and V5 drive units



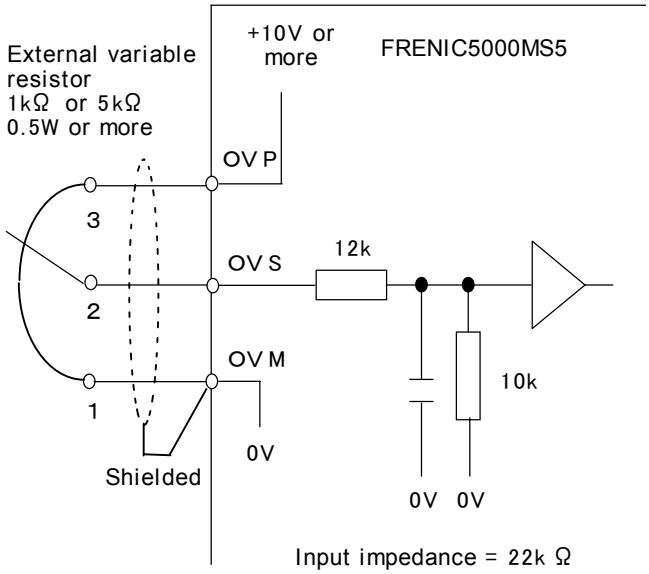
- Used when the speed setting is given by a manual variable resistor by using internal analog power supply (+10V) of the drive unit.
- Use the forward or reverse signal (FWD or REV) to give the forward or reverse rotational command.

Override setting input [CN3: OVP, OVS, OVM]

M5 drive unit



V5 drive unit

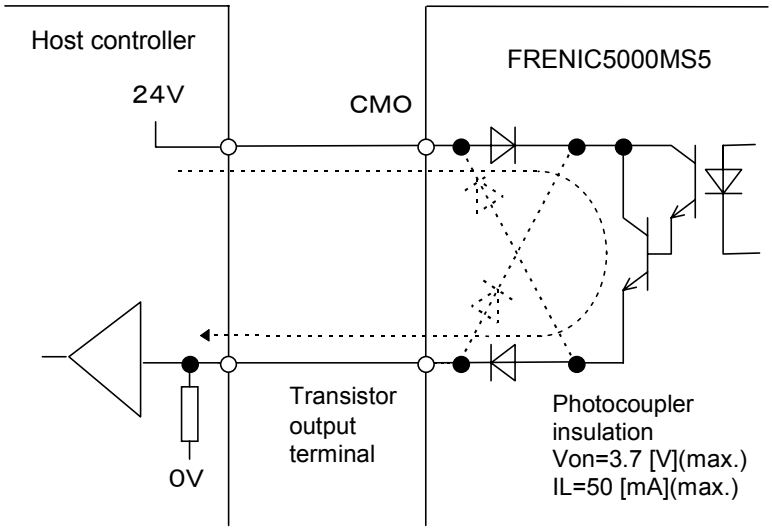


- In order to make the override input valid, set the function code P026 at the absolute value other than 0%.
- Note that when the external variable resistor is disconnected by a relay etc., approximate 0% (5 [V]) is set in the M5 drive unit, and the max. value of negative side (0 [V]) is set in the V5 drive unit. In the M5 drive unit, the resistor (22 [k**Ω**]) located between +10 [V] and OVS is mounted only on the PC board No. EP-3895B (stamped on right side of CN3) or subsequent.

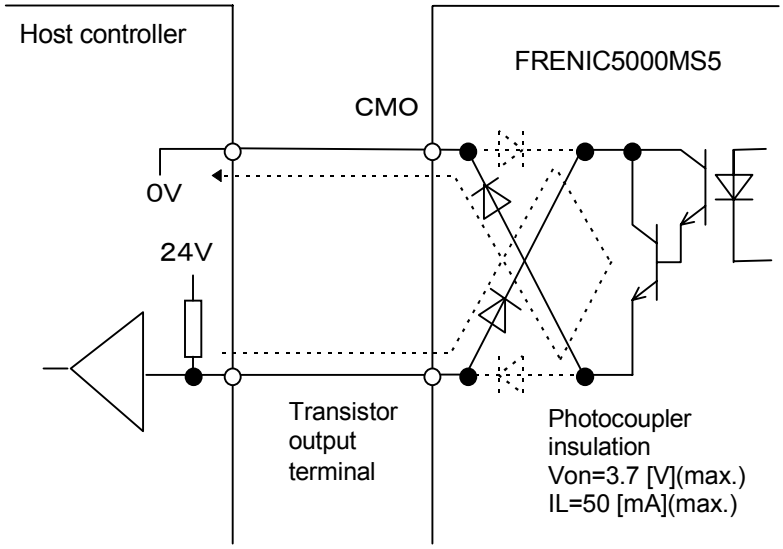
(3) Output interface (transistor output)

- The transistor output terminals are compatible with either SINK or SOURCE logic depending the external connection. (common to M5 and V5)

Transistor output interface at SINK logic



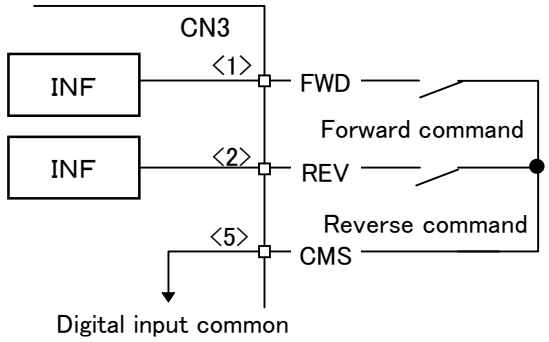
Transistor output interface at SOURCE logic



5.3 Description of input interface signal
(1) Input interface signal common to M5 and V5

Forward command [CN3: FWD]

Reverse command [CN3: REV]



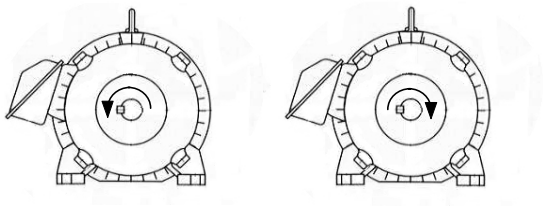
Analog speed setting with input of 0 to +10 [V];
(Common to M5 series and V5 series)

- When the forward command contact is ON (closed), the spindle motor rotates counterclockwise (CCW) when viewing from the drive side at a speed corresponding to the speed command value. When the reverse command is ON (closed), the spindle motor rotates clockwise (CW) as viewing the drive side at a speed corresponding to the speed command value.
- When both forward/reverse commands are OFF (open), the spindle motor decelerates to a stop (while braking applied).
- When the forward/reverse commands are input at the same time, it also decelerates to a stop (while braking applied).

Analog speed setting with input of 0 ±10 [V];
(V5 series only)

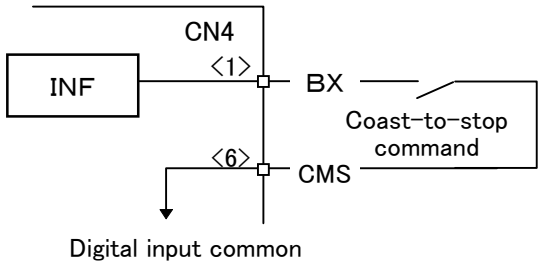
- When the forward command contact is ON (closed), the spindle motor rotates counterclockwise (CCW) at a speed corresponding to the speed command value with the speed setting input (+) polarity. With (-) polarity at the speed setting input, it rotates in the clockwise direction (CW) at a speed corresponding to the speed command value.
- When both forward/reverse commands are OFF (open), the spindle motor decelerates to a stop (while braking applied).
- When the forward/reverse commands are input at the same time, it also decelerates to a stop (while braking applied).

Definition of forward/reverse operation of spindle motor
(when viewed from shaft)



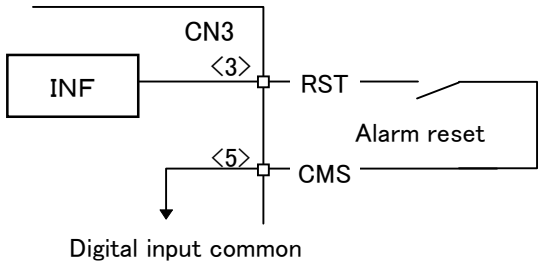
Forward (CCW) Reverse (CW)

Coast-to-stop command [CN4: BX]



- This coast-to-stop command is used to stop the motor in case of emergency.
- To decelerate the motor to a stop in an emergency, turn both the forward/reverse commands (FWD and REV) OFF.

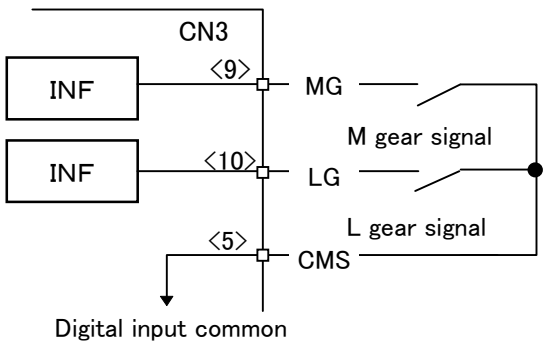
Alarm reset command [CN3: RST]



- If an error occurs, some protective circuit is energized to display and output an alarm. After the cause of the error has been removed, when the alarm reset signal is input, the alarm is canceled to allow the motor to return to a normal operating condition again.
- For the alarm reset switch, use a spring return pushbutton switch, etc. After resetting, set the switch to open the contact.
- Since the drive unit is also provided with the alarm reset switch (press the "MODE" and "SET" switches at the same time), it allows resetting from the inside or outside.

M gear signal [CN3: MG]

L gear signal [CN3: LG]



- If a reducer mechanism is provided between the spindle and motor, this gear selection signal allows selecting the speed control loop gain and accelerating/decelerating time corresponding to a gear ratio (H, M, L, and LL) for optimum speed control.
  The following gears are selected by the MG and LG signals.

MG	LG	Gear to be selected
OFF	OFF	H gear
ON	OFF	M gear
OFF	ON	L gear
ON	ON	LL gear

- A guideline of gear ratio is as follows:
  H gear : 0.5 to 2
  M gear : 2 to 6
  L gear : 6 to 20
  LL gear : 20 to 60

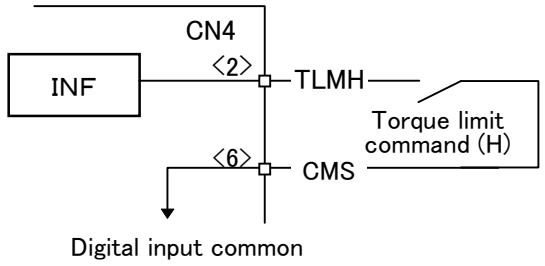
$$\left(\text{Gear ratio} = \frac{\text{Motor speed}}{\text{Spindle rotating speed}}\right)$$

- In the orientation control, this gear signal allows achieving optimum positioning control corresponding to the gear ratio. (The speed ratio of the spindle to the motor should be set with reference to function codes P080 to P083).
- Gear selection by the M gear signal and L gear signal is possible during operation.

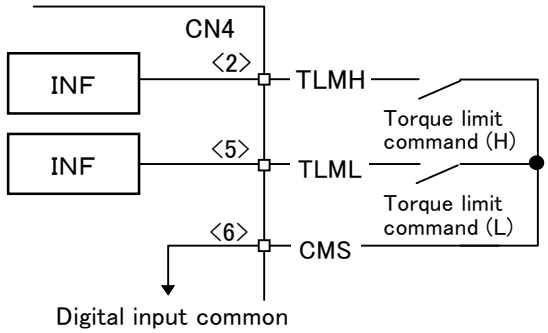
Torque limit command (H) [CN4: TLMH]

Torque limit command (L) [CN4: TLML]

M5 drive unit

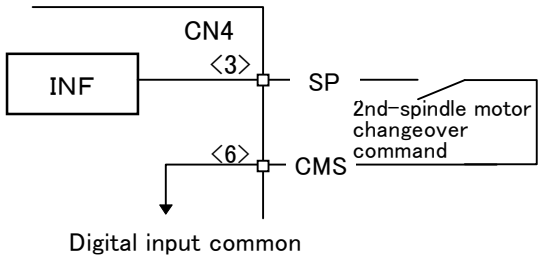


V5 drive unit



- Torque limiter value can be set from 20 to 200% with respect to 50% ED of the motor rated torque according to the function code set value.
- For the details of switching of torque limiter value, refer to Section 9.2, Detailed description of function code, P033 external torque limiter (H) and P034 external torque limiter (L).

2nd-spindle motor changeover command [CN4: SP]



- It is used for selecting the 2nd-spindle motor when a single drive unit drives either of 2 motors.
- When the 2nd-spindle motor changeover command contact is ON (closed), the function code for the 2nd-spindle motor is selected. It outputs 2nd-spindle motor changeover complete (SPO) when the function is ready for selection preparation complete (M5 drive unit only).

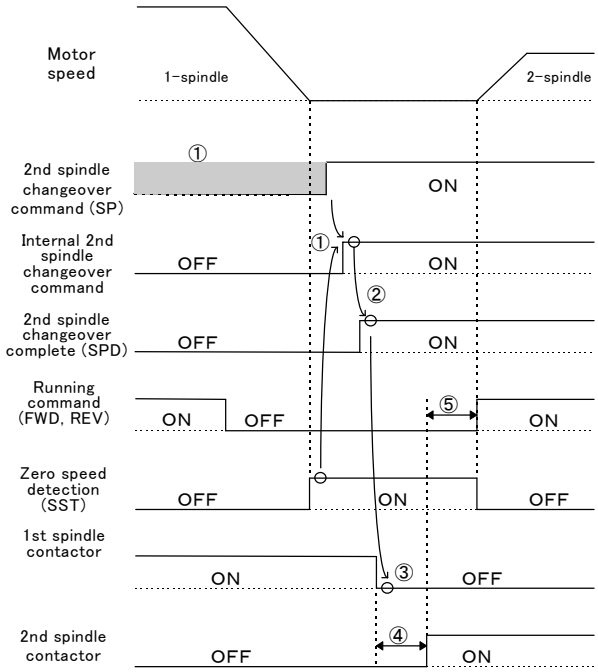
Note : This input signal is valid only when the drive unit is stopped (when forward/reverse commands are both OFF and zero speed detection is output). Even if the signal is input during operation, it cannot be accepted until the drive unit is stopped.

When the capacity of the drive unit versus the motor exceeds 10:1 in ratio, control may not be stabilized. In this case, prepare a dedicated drive unit for the 2nd-spindle motor.

Since V5 series does not outputs the 2nd-spindle motor changeover complete (SPO), provisions should be required for an external sequence.

The V5 series is under the torque vector or V/f control when the 2nd-spindle motor is selected.

A timing chart of motor changeover is shown below:



① The internal parameter changeover function is energized with the 2nd spindle changeover command and zero speed.

② After the internal data have been changed, the 2nd spindle changeover complete signal is output. However, as V5 series is not provided with the SPO terminal, it should be interlocked by a timer (0.1 [s] or more) externally.

③ When the SPO terminal is ON, the release command is output to the 1st spindle contactor.

④ Confirm that the 1st spindle contactor is completely released. If not released, wait until it is completely released. Then, issue the closing command to the 2nd spindle contactor. (Be sure to interlock it from an external unit).

⑤ Confirm that the 2nd spindle contactor is completely closed. If not closed, wait until it is completely closed. Then, issue the operation command. (Be sure to interlock it from an external unit).

Steps ① and ② are for the internal processing of the drive unit and steps ③, ④ and ⑤ are for the processing of the external circuit and host unit.

The selection sequence from 1st spindle to 2nd spindle is given, and sequence from 2nd spindle to 1st spindle is accomplished in the same procedures.

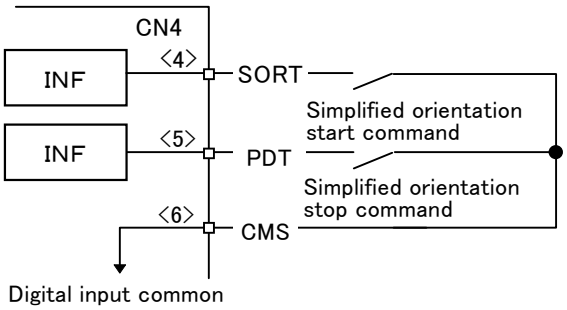
- When driving the 2nd-spindle motor, the functional limitation are as follows:

Function	Function code for 2nd spindle	Action
Maximum speed	P301	Settable individually
Accelerating/ decelerating time	P302, P303	Settable individually
S-curve acceleration/ deceleration	P304, P305	Settable individually, but limited to S-curve acceleration/ deceleration
Override	None	Same as 1st spindle
Torque boost	P306	Settable individually
Flux command level	P322	Settable individually
Torque limiter	P320, P321	Settable individually, but external torque limitations (H) and (L) are common to the 1st spindle.
DC braking	None	Same as 1st spindle
Spare excitation	None	Not operated
Simplified ORT	None	Same as 1st spindle
Arbitrary speed detection	None	Same as 1st spindle
Speed arrival	None	Same as 1st spindle
Zero speed detection	None	Same as 1st spindle
Torque detection	None	Not operated
Speedometer gain	P323	Settable individually
Ammeter/load meter gain	P324	Settable individually, Switching between ammeter and load meter is performed on the same side as on the 1st spindle.
Each motor constant	P307 to P319	Settable individually, excluding the number of motor poles
NTC thermistor	None	Motor overload detection function is available.
Excess speed deviation, excess speed alarm	None	Not operated
Auto-tuning	None	Same as 1st spindle
Braking resistor %ED monitor	None	Operated regardless of either 1st spindle or 2nd spindle
Gear selection	None	Same as 1st spindle
Magnetic type orientation	None	Same as 1st spindle
Synchronous operation, PE orientation	None	Not operated
Winding changeover	None	Not operated
Spindle PE feedback control	None	Not operated

(2) Input interface signal for M5 only

Simplified orientation start command [CN4: SORT]

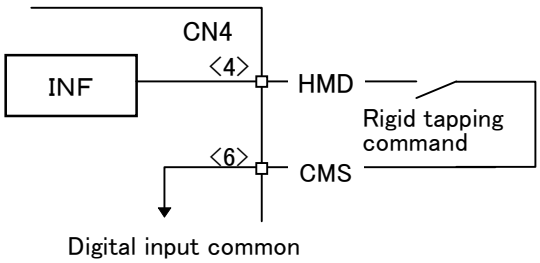
Simplified orientation stop command [CN4: PDT]



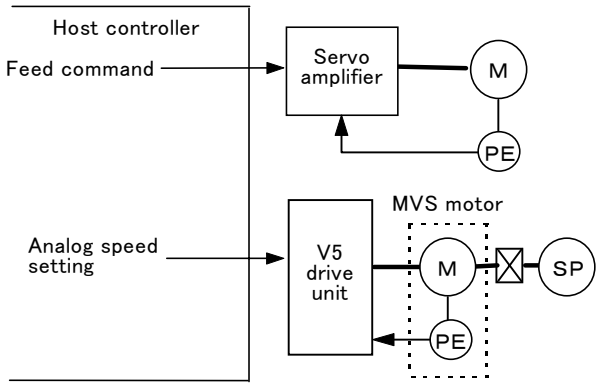
- This command is used when the simplified orientation is performed by using a proximity switch.
- By input of the simplified orientation start command (SORT), motor speed is reduced at the normal gradient down to a coasting speed set by the function code P050. After the motor reaches the slow-speed, and the time set by "the PDT read timer" of the function code P051 elapses, the next stop command signal (PDT) is read. Then, the motor is stopped by DC braking.
- Going into DC braking, the complete signal (zero speed detection output terminal SST) is ON (closed) after the time set by the "complete signal timer" of P052 elapses.
- For performance and specifications for the simplified orientation, refer to simplified ORT control in Section 9.2 Detailed description of function code.

(3) Input interface signal for V5 only

Rigid tapping command [CN4: HMD]



- This command is used when performing rigid tapping by controlling the feed shaft servo motor that travels the tapper (blade) used for tapping (thread) and the spindle motor that rotates the tapper and by synchronizing feeding and rotation of the tapper (1 pitch per rotation).
- When the rigid-tapping command contact is ON (closed), the rigid-tapping mode is selected and the soft start/stop (accelerating/decelerating time setting) and override functions are cancelled. Thus, motor speed response can be increased. For the switching of control constants in this mode, see Section 9.2, Detailed description of function code, ASR.
- This mode can set the maximum speed independently according to the function code P120 in order to enhance speed resolution.
- When each control constant for the drive unit is switched for rigid-tapping, the rigid-tapping mode changeover complete signal (TLM) is ON (closed).
- The rigid-tapping mode is switched by input of this signal even while the drive unit is running and the above function is made available. However, this signal is ignored during the PE and magnetic orientation, and synchronous operation.
- System configuration is shown below.

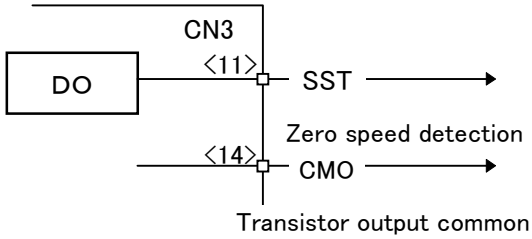


When performing orientation by using spindle PE

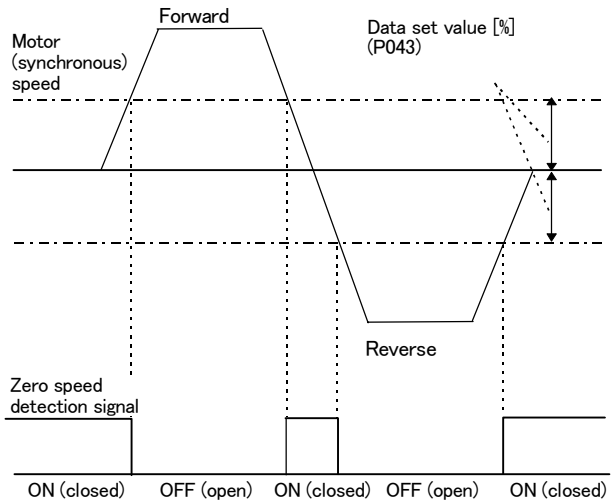
Note : In any case, position control should be performed on the host controller side.

5.4 Description of output interface signal
(1) Output interface signal common to M5 and V5

Zero speed detection [CN3: SST]

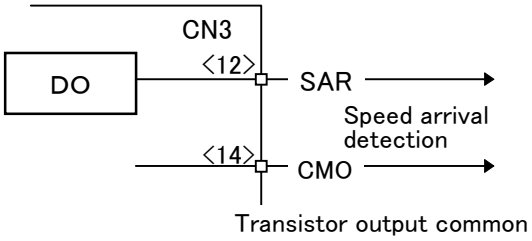


- When the motor synchronous speed (at frequency, torque vector and V/f control) or motor speed (at spindle PE feedback control and high performance vector control) is reduced below the zero speed detection range, an output is ON (closed).
- The detection range can be set within 0.2 to 2.0% of the max. speed (P001, P301) set value according to the zero speed detection level (P043).
- This signal is output in the above range regardless of the forward and reverse commands. When switching the rotating direction from forward to reverse or vice versa, the zero speed detection signal is temporarily output every time the motor speed becomes zero.
- When the coast-to-stop command is input and an alarm is output, the signal is not output.
- The signal works as the orientation complete signal with a simplified orientation. (valid only with M5 drive unit)

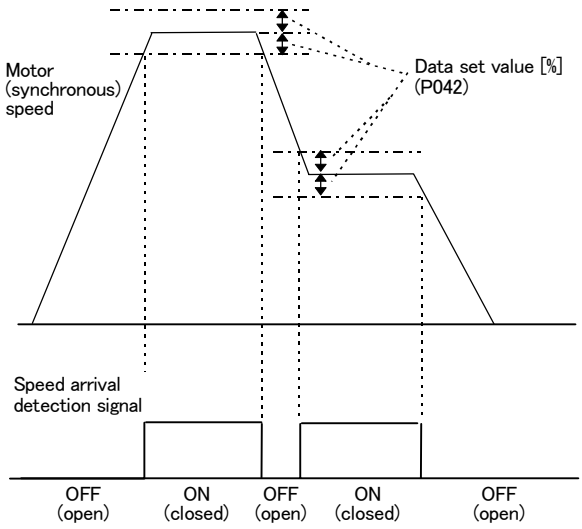


For hysteresis, see Section 9.2, Detailed description of function code, P043 Zero speed detection.

Speed arrival detection [CN3: SAR)

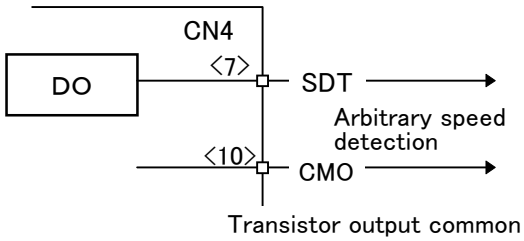


- When the motor synchronous speed (at frequency, torque vector and V/f control) or motor speed (spindle PE feedback control, high performance vector control) arrives in the set range relative to the command speed, an output is ON (closed).
- The detection range can be set by the speed arrival (P042) in the range of ±2 to 15% of the command speed.
- The signal is output only when either of forward/reverse signals (FWD and REV) is input. If both of them are OFF, it does not produce an output even in the command speed set range.
- If the motor speed is beyond the set range when the command speed varies or the speed is decreased due to overload, the speed arrival signal is OFF. When the motor speed returns to the set range, the signal is ON.
- The signal is not output in the zero speed detection range.

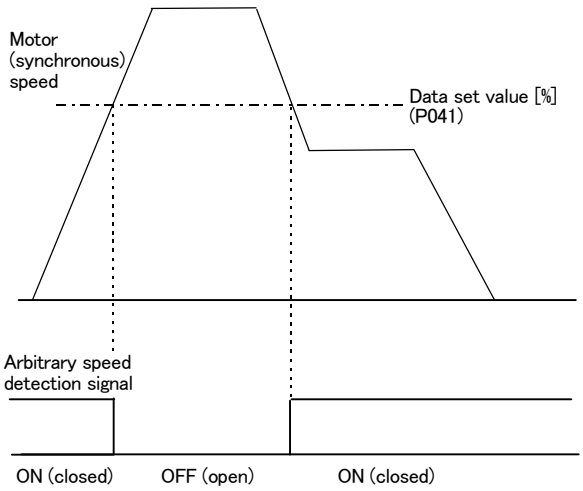


For hysteresis, see Section 9.2, Detailed description of function code, P043 Zero speed detection.

Arbitrary speed detection [CN4: SDT]

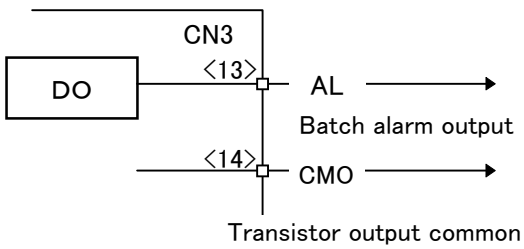


- This signal is used to confirm that the motor synchronous speed (at frequency, torque vector and V/f control) or motor speed (at spindle PE feedback control or high performance vector control) has lowered below a certain set speed.
- The detection level can be set by the speed detection level (P041) in the range of 1 to 100% of the max. speed (P001, P301) set value.
- This signal is output when it meets the above conditions, regardless of the forward and reverse commands (FWD and REV).



For hysteresis, see Section 9.2, Detailed description of function code, P043 Zero speed detection.

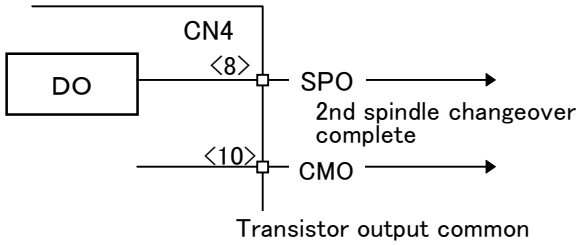
Batch alarm output [CN3: AL]



- If an error occurs to the drive unit or converter unit, a protective circuit is energized to allow coasting the motor to a stop and a batch alarm is output.
- A batch alarm output is ON (closed) in the normal operating condition, and if an alarm occurs, the alarm output is OFF (open). The 7-segment LED display at the drive unit or power regenerative converter unit indicates the contents in codes.
- This alarm output and alarm display remain held until the alarm is reset or power is turned OFF.

(2) Output interface signal for M5 only

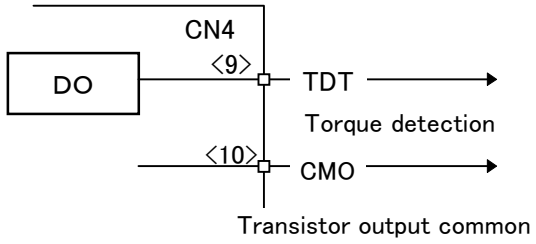
2nd spindle changeover complete [CN4: SPO]



- With the 2nd spindle changeover command contact ON (closed), the function code for the 2nd spindle motor is selected, and output is ON (closed) when the motor is in the selection preparation complete state.
- Before attempting to operate the motor, be sure to check the following; to run the 2nd spindle motor, the signal should be ON (closed), and then the signal should be OFF (open) to run the 1st spindle motor.
- Since V5 series do not output this signal, provide an interlock of at least 0.1 [s] before the motor is run after the 2nd spindle changeover command is switched.
- For details, refer to Section 5.3, (1) Input interface signal common to M5 and V5, 2nd-spindle motor changeover command.

(3) Output interface signal for V5 only

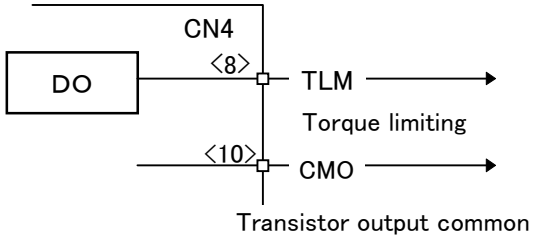
Torque detection [CN4: TDT]



- This signal is used for detection of load torque.
- If the load in excess of set torque is applied, an output is ON (closed).
- The detection level can be set to 0% to 150% of the motor rated torque 50% ED according to the torque detection (level) of the function code P044.

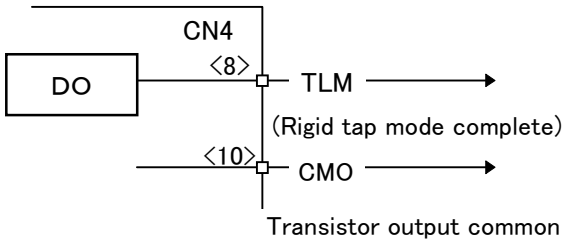
For hysteresis, refer to Section 9.2, Detailed description of function code, P044 Torque detection (level).

Torque limiting [CN4: TLM]



- When either the torque limit command (H) (TLMH) or (L) (TLML) is ON (closed), while the torque limit is activated, an output is ON (closed).
- When the rigid tapping command (HMD) is ON (closed), the output is used as the rigid tapping mode complete signal. It cannot be used for torque limiting.

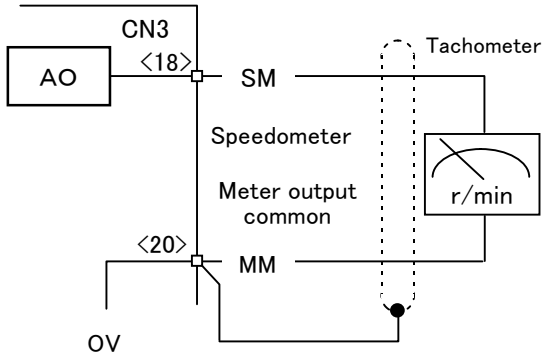
(Rigid tap mode complete) [CN4] TLM]



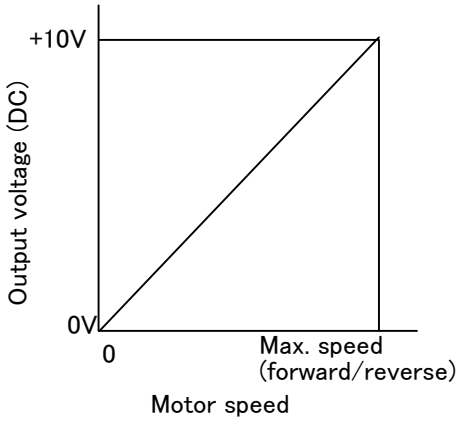
- When the rigid tapping command (HMD) is ON (closed) and the drive unit is in the rigid tapping preparation complete state, it is ON (closed).
- To start the rigid tap, check that the signal is ON (closed).

(4) Analog meter output interface

Speedometer [CN3: SM]

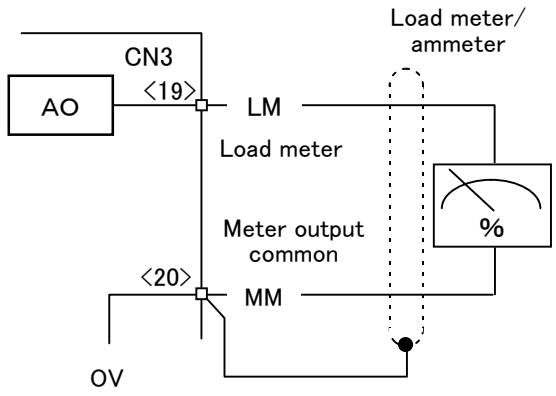


- The speedometer allows reading the speed of the spindle motor by connecting it externally.
- It outputs DC voltage proportional to the rotation speed, regardless of the forward/reverse operation of the motor.
- It outputs +10 [V] at the max. speed set by the function code P001 and P301.



- Gain of a speedometer can be changed by the speedometer gain given in the function code P046 and P323.
- For speedometer, use the following.
  (up to 2 speedometers are connectable).
  One-way deflection type DC voltmeter
  10 [V] DC of full scale
  Internal resistance of 10 [kΩ] or more
  (output current of 1 [mA], max.)
  (Example)
  Fuji Electric DC voltmeter FM-60
  Toyo Instrument DC voltmeter DCF-6 with accuracy of ±5%, max.)
- For details, refer to Section 9.2, Detailed description of function code, P046 Speedometer gain.

Load meter [CN3: LM]



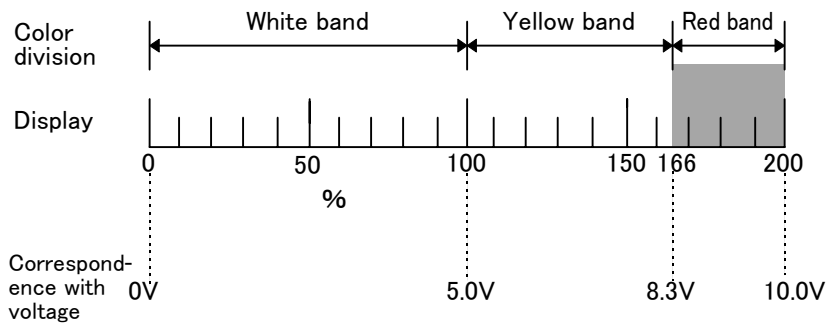
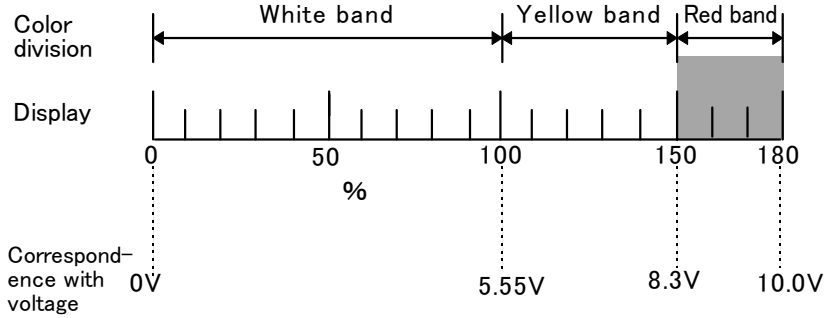
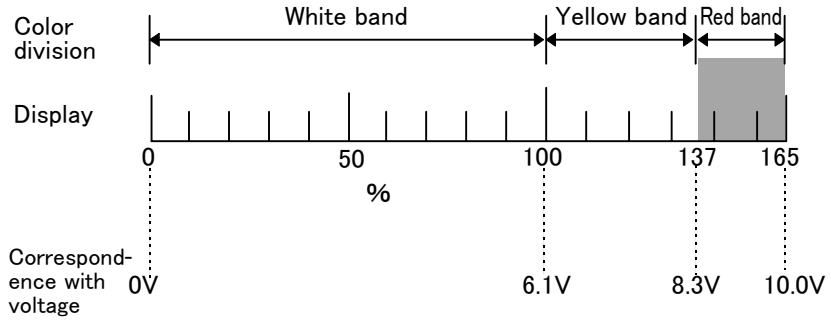
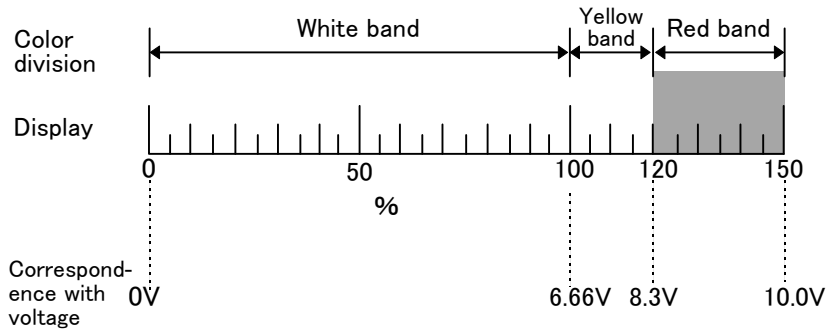
- Any of the load meter and ammeter can be used by the function code P045.
- Gain of the load meter and ammeter can be changed according to the ammeter/load meter gain given in the function code P047 and P324.
- For the load meter/ammeter, use the one having the same specifications as that of the speedometer. (up to 2 meters are connectable).

For details, refer to Section 9.2, Detailed description of function code, P047 Ammeter/load meter gain.

(Reference)
Table (a) Relation between spindle motor output versus load meter output voltage

Type of drive unit	Output [kW]	Load meter output [V]	Ratio (%) of continuous rating at 100%	Display example of load meter		
				Display type	Full scale	Output display
FRN1.1M5	0.75	5.7	100	B	180	102
	1.1	8.3	147			150
	1.32	10.0	176			180
FRN2.2M5 FRN2.2V5	1.5	5.7	100	B	180	102
	2.2	8.3	147			150
	2.64	10.0	176			180
FRN3.7M5 FRN3.7V5	2.2	5.0	100	A	200	99
	3.7	8.3	168			166
	4.44	10.0	202			200
FRN5.5M5、MC5 FRN5.5V5、VC5	3.7	5.6	100	B	180	101
	5.5	8.3	148			150
	6.6	10.0	178			180
FRN7.5MC5 FRN7.5VC5	5.5	6.1	100	C	165	101
	7.5	8.3	136			137
	9.0	10.0	164			165
FRN11MC5 FRN11VC5	7.5	5.7	100	B	180	103
	11.0	8.3	146			150
	13.2	10.0	175			180
FRN15MC5 FRN15VC5	11.0	6.1	100	C	165	101
	15.0	8.3	136			137
	18.0	10.0	164			165
FRN18.5MC5 FRN18.5VC5	15.0	6.7	100	D	150	101
	18.5	8.3	124			125
	22.2	10.0	149			150
FRN22MC5 FRN22VC5	18.5	7.0	100	D	150	105
	22.0	8.3	118			125
	26.4	10.0	143			150
FRN30MC5 FRN30VC5	22.0	6.1	100	C	165	101
	30.0	8.3	136			137
	36.0	10.0	164			165
FRN37VC5	30.0	6.7	100	D	150	106
	37.0	8.3	124			125
	44.4	10.0	149			150
FRN45VC5	37.0	6.8	100	D	150	103
	45.0	8.3	122			125
	54.0	10.0	146			150
FRN55VC5	45.0	6.8	100	D	150	102
	55.0	8.3	122			124
	66.0	10.0	147			150

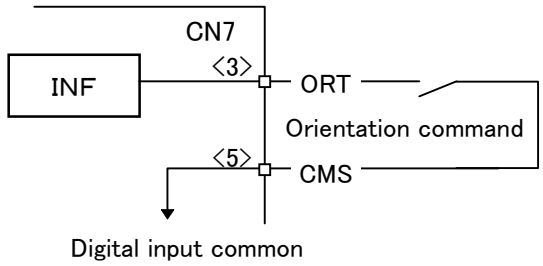
Table (b) Example of type of load meter

Display type	Display of load meter	Remarks
A		FRN3.7M5 FRN3.7V5
B		FRN1.1M5 FRN2.2M5 FRN2.2V5 FRN5.5M5 FRN5.5MC5 FRN5.5V5 FRN5.5VC5 FRN11MC5 FRN11VC5
C		FRN7.5MC5 FRN7.5VC5 FRN15MC5 FRN15VC5 FRN30MC5 FRN30VC5
D		FRN18.5MC5 FRN18.5VC5 FRN22MC5 FRN22VC5 FRN37VC5 FRN45VC5 FRN55VC5

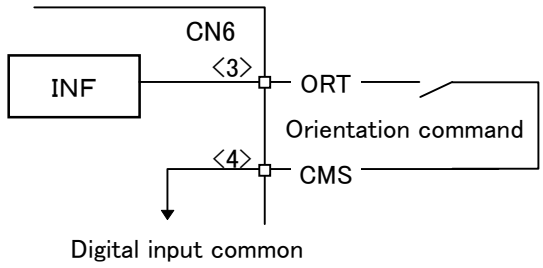
5.5 Description of optional input/output interface signal
(1) Orientation input/output interface signal
1) Input interface signal

Orientation command [CN6, CN7: ORT]

When the OPCII-MS5-PE or SY card is used:



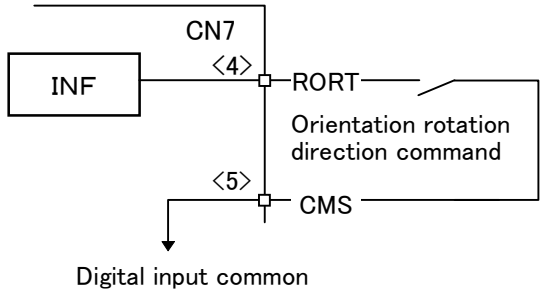
When the OPCII-MS5-MG card is used:



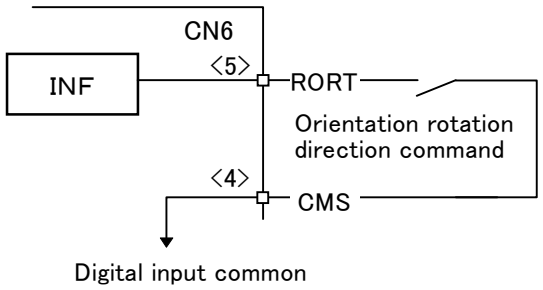
- This signal issues the electrically predetermined stop position control command.
- With the contact ON (closed), this signal automatically controls positioning at any speed. When the contact is OFF (open), the positioning control is released.

Orientation rotation direction command [CN6, CN7: ROPT]

When the OPCII-MS5-PE or SY card is used:



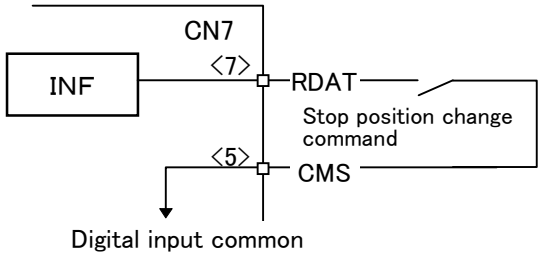
When the OPCII-MS5-MG card is used:



- To perform the predetermined stop position control in the reverse direction (motor shaft) from the spindle stop position, close the contact before the orientation is started.
- This command is invalid when the unit is running with the orientation command active.

Stop position change command [CN7: RDAT]

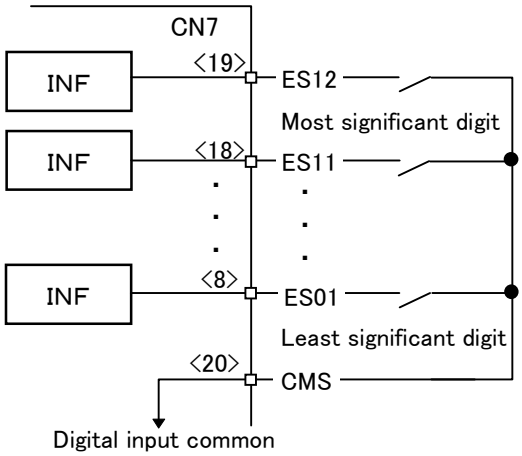
When the OPCII-MS5-PE or SY card is used:



- To perform continuous multi-point stop, close the contact and read the external stop position.
- By reading the external stop position with one-shot input when the orientation is completed, perform re-orientation action.
- For the input signal timing, refer to Section 9.3, Spindle orientation function, (4) Description of operation.

External stop position setting [CN7: ES12 to ES01]

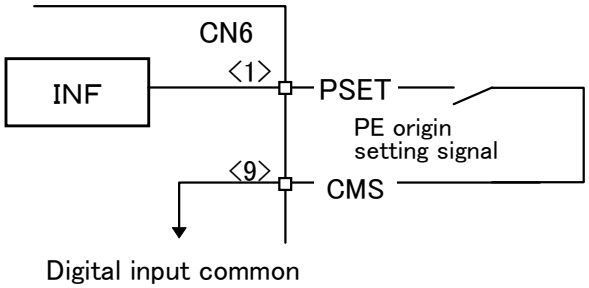
When the OPCII-MS5-PE or SY card is used:



- Set the PE-orientation position command or digital speed by the 12-bit digital signal.
- Read the position command data by the orientation command or stop position change command (in the timing of Open → Closed)
- For the digital speed setting timing, refer to Section 9.5.

PE origin setting signal [CN6: PSET]

(Valid when the OPCII-MS5-PE or SY card is used)

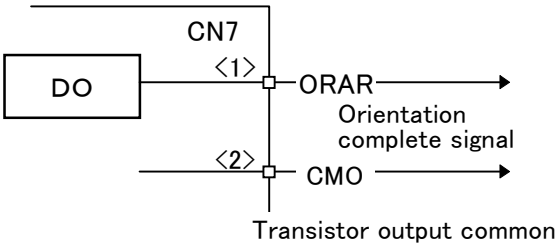


- This signal becomes valid by setting "1" to the function code P807.
- When the contact is ON (closed), this signal reads the current position of the pulse encoder as internal stop position.
- This action enables the data of the function code P205 to be rewritten.
- To rewrite the internal stop position by this signal, be sure to turn ON the drive unit and rotate the spindle 1-turn or more.

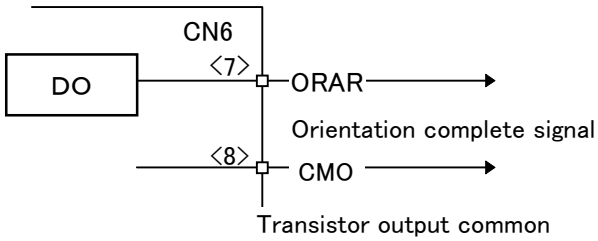
2) Output interface signal

Orientation complete signal [CN6, CN7: ORAR]

(Valid when the OPCII-MS5-PE or SY card is used)



(Valid when the OPCII-MS5-MG card is used)



- When the spindle stops in the vicinity of the specified stop position (orientation completion width) and the positioning control is completed, this signal is output.
- This signal is output with the contact ON (closed) when the following conditions are met.
  1) The orientation command is ON
  2) The spindle stops in the vicinity of the stop position (within orientation completion width).
- This signal may be OFF if the spindle is forcedly displaced by an external unit after the output of the signal. When the signal is OFF, create the sequence to suspend tool replacement.

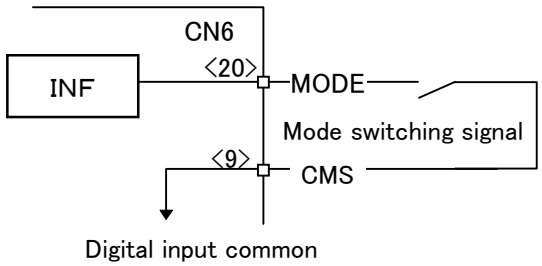
(2) Synchronous operation optional input/output interface signal

(Valid only for the slave shaft when the OPCII-MS5-SY card is used)

For details, refer to Instruction Manual [INR-HF51077-JE] for synchronous operation card.

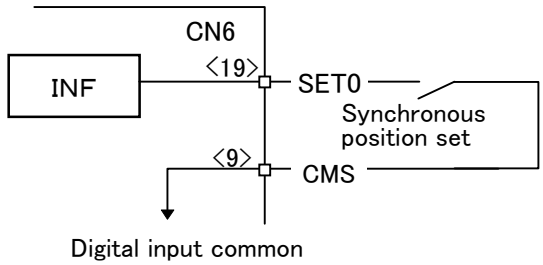
1) Input interface signal

Mode switching signal [CN6: MODE]



- When the contact is ON (closed), the signal is set in the synchronous operation mode.
- When the operation command (FWD or REV) is given to the slave shaft in this operation mode, the slave shaft will respond to the master shaft speed.

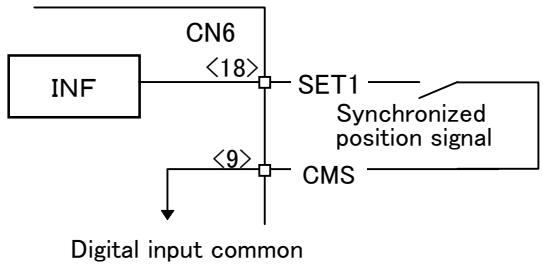
Synchronous position set [CN6: SETO]



- When the contact is ON (closed), this code memorizes the position relation (synchronization deviation) between the master and slave shafts.
- The one-shot input (in the open-to-close timing) clears the synchronized position deviation (CO11).
- A slight position deflection caused by chucking is corrected by the one-shot input of the signal after the work piece is chucked, and then this corrected position will be synchronized position. After the work piece has been chucked, be sure to input this signal or chuck closed signal (CNC).
- When the power is turned OFF or the SET1 signal is newly input, stored data will be cleared.
- When the function code P413 is set to "0" and this signal is input by the one-shot input (in the open-to-close timing), the synchronous control system will be set to the torque balanced control. If the synchronized control is completed, the system will be placed again under the position control.

* Since the slave shaft is run by the torque current command from the master shaft when the synchronous control system is under the torque balanced control, undue stress will not be applied to the work piece.

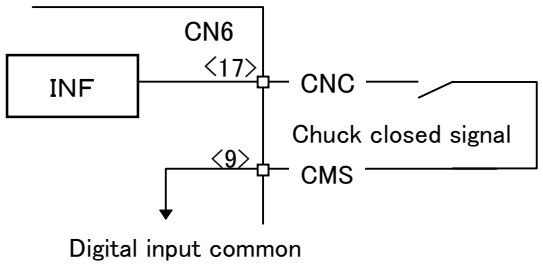
Synchronized position signal [CN6: SET1]



- When the contact is ON (closed), this signal allows reading the position relation (synchronization deviation) between the master shaft and slave shaft saved in the non-volatile memory of the drive unit. (When the synchronous control system returns to the saved synchronized position after the synchronized position is changed by the SET0 signal or when the first synchronized operation is started after the power is turned ON, the signal allows reading the position relation).
- When the contact is ON (closed) with the mode switching signal ON (closed), the signal allows saving the position relation (synchronization deviation) between the master and slave shaft in the non-volatile memory of the drive unit.
- When the orientation command to the slave shaft is ON (closed) with the signal ON (closed), the signal allows performing positioning at a synchronized position saved in the non-volatile memory of the drive unit.

* The non-volatile memory enables holding the data saved in the drive unit after the power of the drive unit is turned OFF.

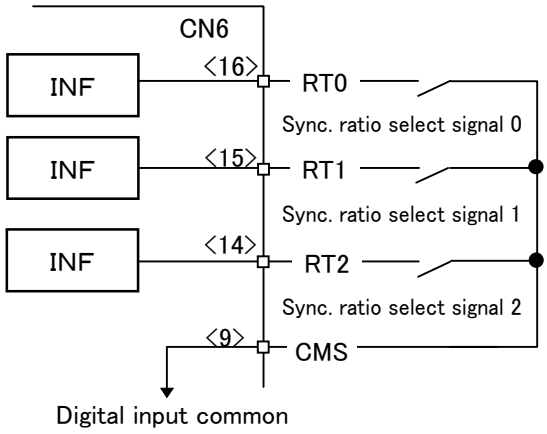
Chuck closed signal [CN6: CNC]



- When the function code P413 is set to "1" and the contact is ON (closed) during the synchronized operation, the synchronous control system will be set to the torque balanced control.
- After the work piece has been chucked, be sure to input this signal or synchronized position set (SET0).

* Since the slave shaft is run by the torque current command from the master shaft when the synchronized control system is under the torque balanced control, undue stress will not be applied to the work piece.

Synchronous ratio select signal [CN6: RT0, RT1, RT2]

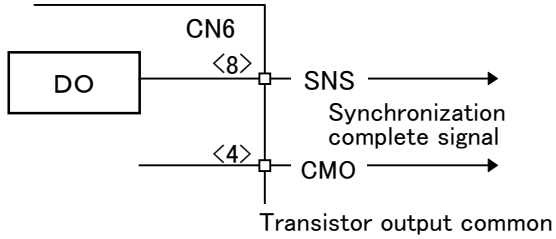


- This signal allows the speed ratio to be selected during the ratio synchronous operation.

* The ratio synchronized operation means that the slave shaft performs synchronous control at a speed of an integral multiple of the master shaft rotation speed.

2) Output interface signal

Synchronization complete signal [CN6: SNS]

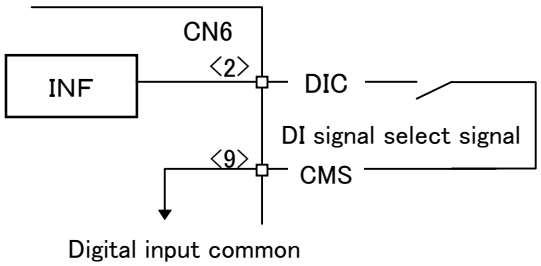


- When the synchronized position deviation between the master and slave shafts is within P419 Synchronization complete width, this signal is output.
- This signal is not output when the mode select signal and operation commands of the master and slave shafts are OFF (open).

(3) Input interface signal for digital speed setting function

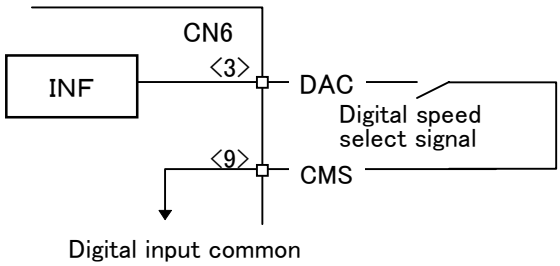
(Valid for use of OPCII-MS5-PE or SY card only)

DI signal select signal [CN6: DIC]



- Setting the function code P806 to "1" to "4" makes the signal valid.
- This signal is used so as not to read unstable data when 12-bit setting signal data varies.
- When the contact is ON (closed), the 12-bit setting signal can be read.
- For the digital speed setting timing, see Section 9.5.

Digital speed select signal [CN6: DAC]



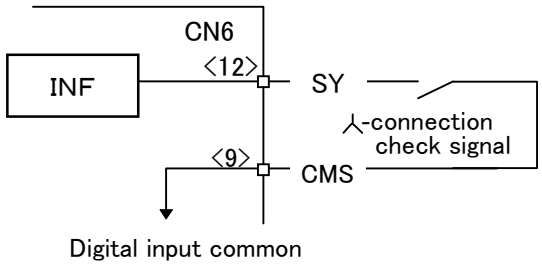
- Setting the function code P806 to "1" to "4" makes the signal valid.
- When the contact is ON (closed), the 12-bit setting signal is read for setting digital speed.
- When the contact is OFF (open), the 12-bit setting signal is read for setting the external stop position.
- For the digital speed setting timing, see Section 9.5.

(4) Winding changeover function input/output interface signal

(Valid for use of OPCII-MS5-PE or SY card only)

1) Input interface signal

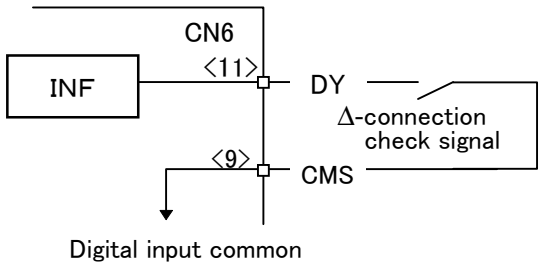
人-connection check signal [CN6: SY]



- Check signal for 人-winding (on the low-speed side)
- Close the contact when the 人-connection (on the low-speed side) is selected in the external sequence.
- For the winding changeover chart, refer to Section 9.6.

Note: If this check signal is not input within 2 [s] after 人-connection select output signal has been output from the drive unit, an external alarm (OH2) is output.

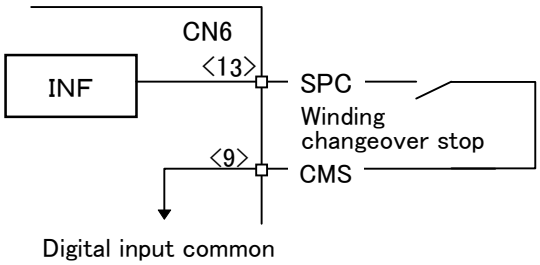
Δ-connection check signal [CN6: DY]



- Check signal for Δ-winding (on the high-speed side)
- Close the contact when the Δ-connection (on the low-speed side) is selected in the external sequence.
- For the winding changeover chart, refer to Section 9.6.

Note : If this check signal is not input within 2 [s] after Δ-connection select output signal has been output from the drive unit, an external alarm (OH2) is output.

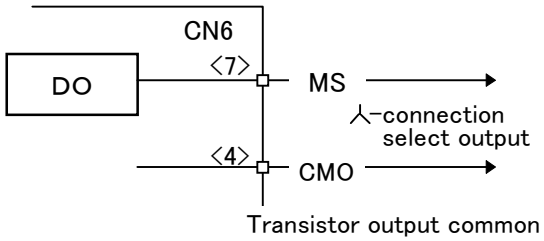
Winding changeover stop [CN6: SPC]



- Fix the windings to the present select windings with the contact ON (closed).
- However, if the motor speed reaches at least 120% of the winding changeover speed on the 人-winding (on the low-speed side), winding is automatically switched to Δ-winding (on the high-speed side), and then it is fixed to the Δ-winding (on the high-speed side).
- For the winding changeover chart, refer to Section 9.6.

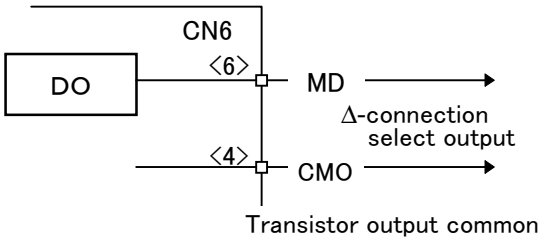
2) Output interface signal

人-connection select output [CN6: MS]



- This signal is output when the drive unit selects 人-winding (on the low-speed side).
- Switch the connection to 人-winding (on the low-speed side) according to the external sequence.
- For the winding changeover chart, refer to Section 9.6.

Δ-connection select output [CN6: MD]



- This signal is output when the drive unit selects Δ-winding (on the high-speed side).
- Switch the connection to Δ-winding (on the high-speed side) according to the external sequence.
- For the winding changeover chart, refer to Section 9.6.

Section 6 Connection

6.1 Main circuit terminal function

Package type drive unit

Division	Terminal symbol	Name of terminal	Description of function	Connector No.	Pin No.
Main circuit terminal	L1/R	Main power supply input	Connect 3-phase power.	TB3	-
	L2/S				-
	L3/T				-
	U	Unit output	Connect 3-phase motor.	TB3	-
	V				-
	W				-
	P(+)	For connection of DC common	Connect to the converter unit by a DC connecting bar (option).	TB2	-
	N(-)				-
	P1	For connection of DC reactor	Connect DC reactor (option). Short-circuit when the DC reactor is not used.	TB3	-
	P (+)				
	P (+)	For connection of braking resistor	Connect to a braking resistor (option).	TB3	-
	DB				
	⏚	Grounding terminal	Unit grounding terminal	-	-

Converter unit

Division	Terminal symbol	Name of terminal	Description of function		Connector No.	Pin No.
Main circuit terminal	L1/R	Main power supply input	Connect 3-phase power. For the regenera-tive braking converter unit, be sure to mount the supplied AC reactor between the power supply and converter unit.		TB3	-
	L2/S					-
	L3/T					-
	P (+)	For connection of DC common	Connect to the drive unit by a DC connecting bar (option).		TB2	-
	N (-)					-
	P 1	For connection of DC reactor	For the dynamic braking converter unit, connect a DC reactor (option). If the DC reactor is not connected, short-circuit it.	This terminal is not provided on the regenerative braking converter unit.	TB3	-
	P (+)					
	P (+)	For connection of braking resistor	For the dynamic braking converter unit, connect the braking resistor (option).		TB3	-
	DB					
	⏚	Grounding terminal	Unit grounding terminal		-	-

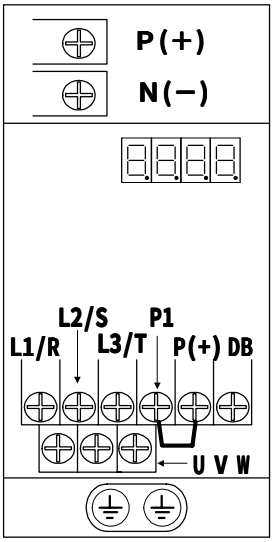
Drive unit

Division	Terminal symbol	Name of terminal	Description of function	Connector No.	Pin No.
Main circuit terminal	U	Unit output	Connect 3-phase motor.	TB3	-
	V				-
	W				-
	P (+)	For connection of DC common	Connect to the converter unit by a DC connecting bar (option)	TB2	-
	P (-)				-
	⏚	Grounding terminal	Unit grounding terminal	-	-

6.2 Main circuit terminal arrangement

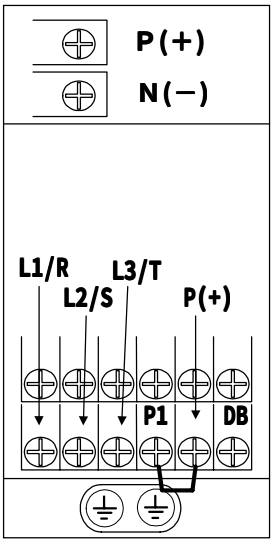
Package type drive unit

FRN1.1 to 5.5M5-2
FRN2.2 to 5.5V5-2
FRN5.5M5-4

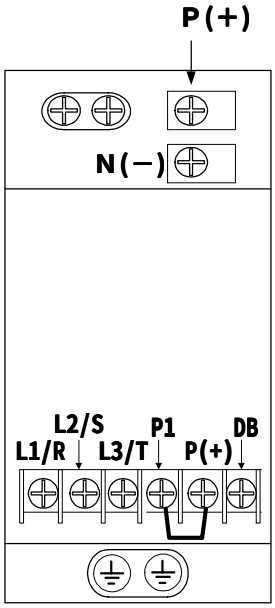


Dynamic braking converter unit

FRN7.5 to 11PD5-2
FRN7.5 to 11PD5-4

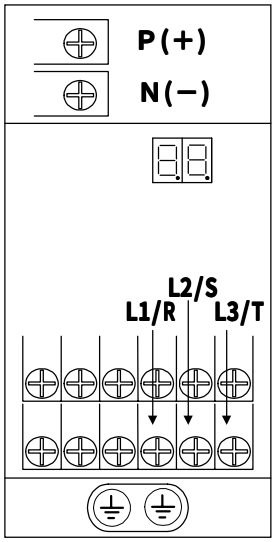


FRN15 to 18.5PD5-2
FRN15 to 18.5PD5-4

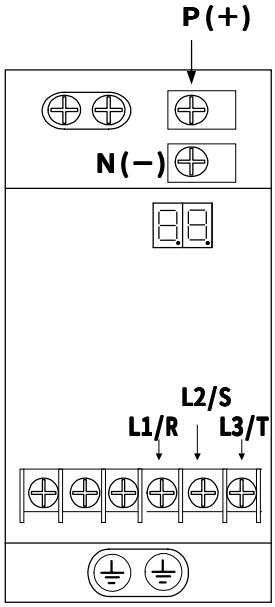


Regenerative braking converter unit

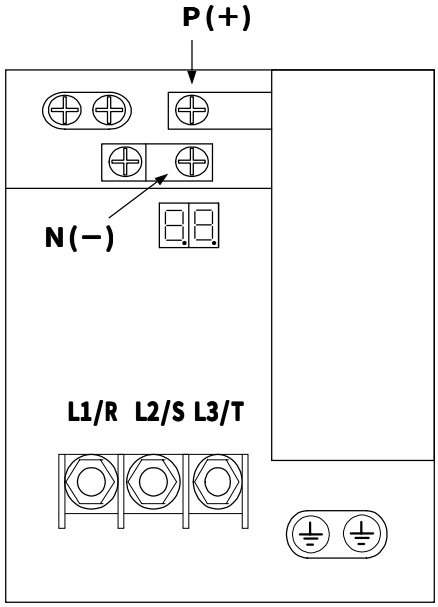
FRN5.5 to 11PR5-2



FRN15 to 30PR5-2

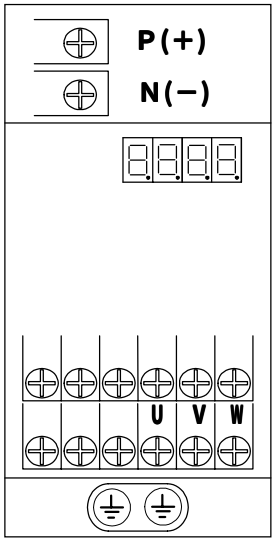


FRN37 to 55PR5-2

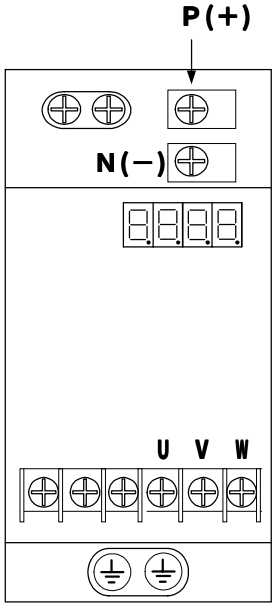


Drive unit

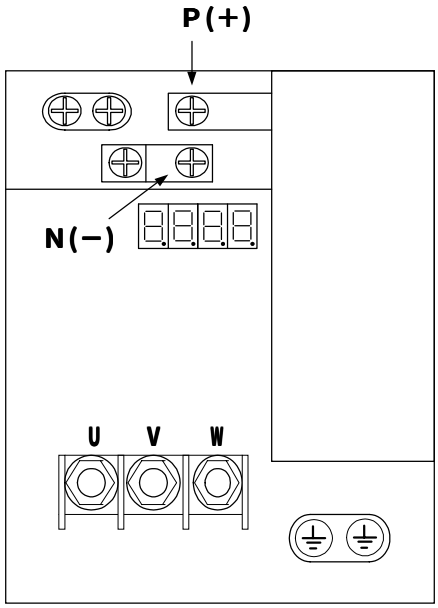
FRN5.5 to 11MC5-2
FRN7.5MC5-4
FRN5.5 to 11VC5-2



FRN15 to 30MC5-2
FRN11 to 18.5MC5-4
FRN15 to 30VC5-2



FRN37 to 55VC5-2



6.3 Control circuit terminal arrangement

Division	M5	V5	Terminal symbol	Name of terminal	Description of function	Connector No.	Pin No.
Connect between units	●	●	P24	Connecting terminal across unit	Connect a dedicated cable (option) between converter unit CN1 and drive unit CN1 (CN2). When a plurality of drive units or package type units are connected to a single converter unit, connect this cable between drive units.	CN1, CN2 (*2)	1
	●	●	M24				2
	●	●	ALP1				3
	●	●	ILMT				4
	●	●	73S				5
	●	●	RUN				6
	●	●	DBS				7
NTC terminal	●		NTC1	Thermistor signal	NTC thermistor connecting terminal built in the dedicated motor. Do not connect any article when unused.	TB1	1
	●		NTC2				3
	●		SS	Shield connection	Connect shielded cable for NTC thermistor. Shielded cable should be treated on the drive unit, and keep the cable end open on the motor side.		2
MVS motor PE connecting terminal		●	+5V	MVS motor PE signal	PE (pulse encoder) signal connecting terminal built in the dedicated motor.	CN5	13
		●	0V				6
		●	PA				11
		●	RA				12
		●	PB				9
		●	RB				8
		●	SS				5
		●	NTC1	Thermistor signal	NTC thermistor connecting terminal built in the dedicated motor. Do not connect any article when unused.		14
		●	NTC2				15
Contact input terminal (*3)	●	●	FWD	Forward command	For detailed function, refer to the sections relevant to I/O interface.	CN3	1
	●	●	REV	Reverse command			2
	●	●	RST	Alarm reset			3
	●	●	EMG	External alarm input			4
	●	●	MG	M gear signal			9
	●	●	LG	L gear signal			10
	●	●	BX	Coast-to-stop command		CN4	1
	●	●	TLMH	Torque limit command (H)			2
	●	●	SP	2nd-spindle motor changeover command			3
	●		SORT	Simplified orientation start command			4
	●		PDT	Simplified orientation stop command			5
		●	HMD	Rigid tapping command			4
		●	TLML	Torque limit command (L)			5
	●	●	CMS	Digital input common	Common terminal for contact input signal	CN3	5
						CN4	6

Division	M5	V5	Terminal symbol	Name of terminal	Description of function	Connector No.	Pin No.
Output terminal (*4)	●	●	SST	Zero speed detection	For detailed function, refer to the sections relevant to I/O interface.	CN3	11
	●	●	SAR	Speed arrival detection			12
	●	●	AL	Batch alarm output			13
	●	●	SDT	Arbitrary speed detection		CN4	7
	●		SPO	2nd spindle changeover complete			8
		●	TLM	Torque limiting			8
		●	TDT	Torque detection			9
	●		CMO	Transistor output common	Common terminal for output signal above	CN3	14
						CN4	10
Analog input (*5)	●	●	ASP	Speed setter power supply	For detailed function, refer to the sections relevant to I/O interface	CN3	6
	●	●	ASS	Speed setting input			7
	●	●	ASM	Speed set common			8
	●	●	OVP	Override setting power supply			15
	●	●	OVS	Override setting input			16
	●	●	OVM	Override setting common			17
Meter output	●	●	SM	Speedometer output	For detailed function, refer to the sections relevant to I/O interface	CN3	18
	●	●	LM	Load meter output			19
	●	●	**MM**	Meter output common			20

Notes: (*1) A mark of (●) in the box of M5 or V5 denotes “applicable to”.
(*2) The converter unit is not provided with CN2.
(*3) This terminal is not isolated from the drive unit control power. It is isolated from the main circuit power of drive unit. Use of a short-circuit switch on the printed circuit board allows sink and source to switch.
(*4) Transistor output. External wiring allows switching sink and source.
(*5) Since analog signal is sensitive at the analog input, it is easily affected by the noise generated from an external unit. Use a cable as short as possible (20 [m] or less) and use a shielded cable. Cable sheath should be connected to the ASM terminals.
When contacts are provided at the circuitry, use twin contacts which can handle feeble signals. Don’t use contact at the ASM terminal.

6.4 Control terminal function of optional card

PE interface card

Terminal symbol	Name of terminal	Description of function	Connector No.	Pin No.
PSET	PE origin set signal	For detailed function, refer to the sections relevant to I/O interface.	CN6	1
DIC	DI signal selection signal			2
DAC	Digital speed selection signal			3
CMO	Transistor output common			4
				5
MD	△-connection selection output			6
MS	人-connection selection output			7
CMS	Digital input common			9
				10

Terminal symbol	Name of terminal	Description of function	Connector No.	Pin No.
DY	△-connection check signal	For detailed function, refer to the sections of relevant to I/O interface.	CN6	11
SY	人-connection check signal			12
SPC	Winding changeover stop			13
ORT	Orientation command	For detailed function, refer to the sections of relevant to I/O interface.	CN7	3
RORT	Orientation rotation direction command			4
CMS	Digital input common			5
				6
				20
RDAT	Stop position change command			7
ORAR	Orientation complete signal			1
CMO	Transistor output common			2
ES1	External position setting (LSB)	Perform the external stop position/digital speed settings in the PE orientation.		8
ES2	External position setting			9
ES3	External position setting			10
ES4	External position setting			11
ES5	External position setting			12
ES6	External position setting			13
ES7	External position setting			14
ES8	External position setting			15
ES9	External position setting			16
ES10	External position setting			17
ES11	External position setting			18
ES12	External position setting (MSB)			19
0V	PE (encoder) common	Signal connecting terminal for PE (pulse encoder) mounted on the machine spindle. Compatible with CN9.	CN8	1
				2
				3
5V	5V power for PE			4
				5
				6
$\overline{PC}$	$\overline{C}$ signal for PE			14
PC	C signal for PE			15
$\overline{PA}$	$\overline{A}$ signal for PE			16
PA	A signal for PE			17
$\overline{PB}$	$\overline{B}$ signal for PE			18
PB	B signal for PE			19
SS	For connection of shielded cable sheath			20
0V	PE (encoder) common	Signal connecting terminal for PE (pulse encoder) mounted on the machine spindle. Compatible with CN8.	CN9	1
				2
				3
5V	5V power for PE			4
				5
				6
$\overline{PC}$	$\overline{C}$ signal for PE			14
PC	C signal for PE			15
$\overline{PA}$	$\overline{A}$ signal for PE			16
PA	A signal for PE			17
$\overline{PB}$	$\overline{B}$ signal for PE			18
PB	B signal for PE			19
SS	For connection of shielded cable sheath			20

Synchronous operation card

Terminal symbol	Name of terminal	Description of function	Connector No.	Pin No.
PSET	PE origin set signal	For detailed function, refer to the sections relevant to I/O interface.	CN6	1
DIC	DI signal selection signal			2
DAC	Digital speed selection signal			3
CMO	Transistor output common			4
				5
MD	△-connection selection output			6
MS	人-connection selection output			7
SNS	Synchronization complete signal			8
CMS	Digital input common			9
				10
DY	△-connection check signal			11
SY	人-connection check signal			12
SPC	Winding changeover stop			13
RT2	Synchronous ratio selection signal 2			14
RT1	Synchronous ratio selection signal 1			15
RT0	Synchronous ratio selection signal 0			16
CNC	Chuck close signal			17
SET1	Synchronous position signal			18
SET0	Synchronous position set			19
MODE	Mode selection signal			20
ORT	Orientation command	For detailed function, refer to the sections relevant to I/O interface.	CN7	3
RORT	Orientation rotation direction command			4
CMS	Digital input common			5
				6
				20
RDAT	Stop position change command			7
ORAR	Orientation complete signal			1
CMO	Transistor output common			2
ES1	External position setting (LSB)	Perform external stop position/digital speed settings in the PE orientation.		8
ES2	External position setting			9
ES3	External position setting			10
ES4	External position setting			11
ES5	External position setting			12
ES6	External position setting			13
ES7	External position setting			14
ES8	External position setting			15
ES9	External position setting			16
ES10	External position setting			17
ES11	External position setting			18
ES12	External position setting (MSB)			19

Terminal symbol	Name of terminal	Description of function	Connector No.	Pin No.
0V	PE (encoder) common	Signal connecting terminal for PE (pulse encoder) mounted on the machine spindle. Compatible with CN9.	CN8	1
				2
				3
5V	5V power supply for PE			4
				5
				6
PC	C signal for PE			14
$\overline{PC}$	$\overline{C}$ signal for PE			15
PA	A signal for PE			16
$\overline{PA}$	$\overline{A}$ signal for PE			17
PB	B signal for PE			18
$\overline{PB}$	$\overline{B}$ signal for PE			19
SS	For connecting shielded cable			20
0V	PE (encoder) common	Signal connecting terminal for PE (pulse encoder) mounted on the machine spindle. Compatible with CN8.	CN9	1
				2
				3
5V	5V power supply for PE			4
				5
				6
PC	C signal for PE			14
$\overline{PC}$	$\overline{C}$ signal for PE			15
PA	A signal for PE			16
$\overline{PA}$	$\overline{A}$ signal for PE			17
PB	B signal for PE			18
$\overline{PB}$	$\overline{B}$ signal for PE			19
SS	For connecting shielded cable			20
SCR	0V	Terminals for communication between master shaft and slave shaft for synchronous operation and signal connecting terminals for PE (pulse encoder).	CN10	1
				2
				3
SCC	Serial communication			10
SCT				11
SCR				12
PC	C signal for PE			14
$\overline{PC}$	$\overline{C}$ signal for PE			15
PA	A signal for PE			16
$\overline{PA}$	$\overline{A}$ signal for PE			17
PB	B signal for PE			18
$\overline{PB}$	$\overline{B}$ signal for PE			19
SM	For connecting shielded cable			20

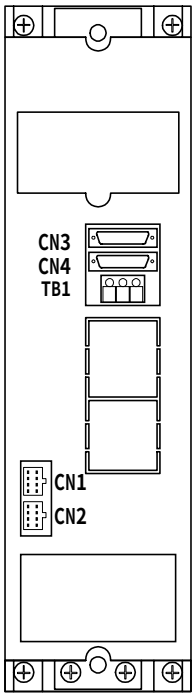
Magneto-sensor orientation card

Terminal symbol	Name of terminal	Description of function	Connector No.	Pin No.
ORT	Orientation command	For detailed function, refer to the sections relevant to input/output interface.	CN6	3
CMS	Digital input common			4
RORT	Orientation rotation direction command			5
CMS	Digital input common			6
ORAR	Orientation complete signal			7
CMO	Transistor output common			8
SP	+12V power supply	Is supplied from the drive unit to detectors.		14
MD	0V common	For connecting the detector (FSD-1460) * For details, refer to the connection diagram.		15
M	For connecting shielded cable			16
SO	A-phase sensor signal			17
MA	A-phase reference signal			18
SI	B-phase sensor signal			19
MB	B-phase reference signal			20

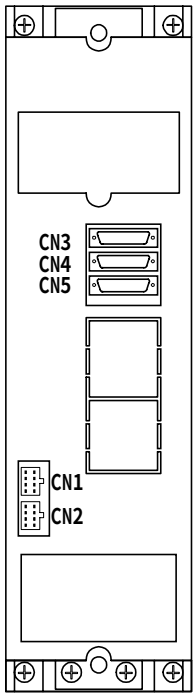
6.5 Connector arrangement

Connector arrangement for units

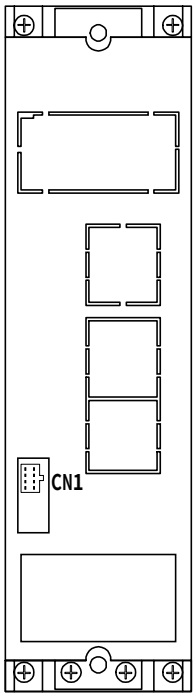
M5 package type drive unit & M5 drive unit



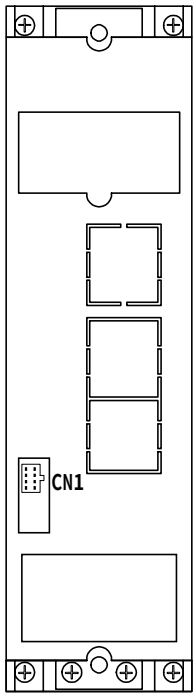
V package type drive unit & V5 drive unit



Dynamic braking converter unit

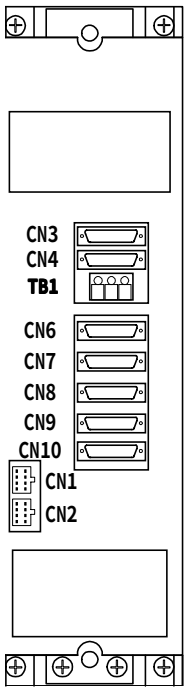


Regenerative braking converter unit

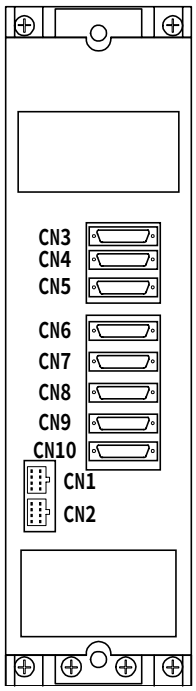


Connector arrangement with optional card mounted

M5 package type drive unit & M5 drive unit



V5 package type drive unit & V5 drive unit

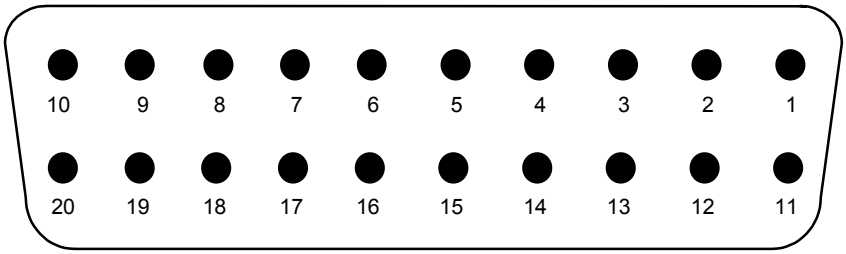


CN6 to CN10 are connectors mounted on optional cards, and are classified into three types, depending on the card.

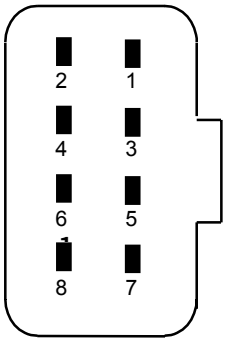
- PE interface card
  [OPCII-MS5-PE]: CN6 to CN9
- Synchronous operation card
  [OPCII-MS5-SY]: CN6 to CN10
- Magneto-sensor type orientation card
  [OPCII-MS5-MG]: CN6

Connector pin arrangement

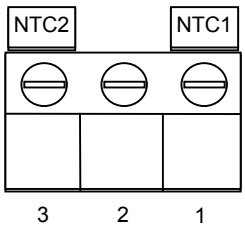
【CN3 to CN10】



【CN1,CN2】



【TB1】



Note) Pin arrangements as viewed from the front of the unit

6.6 Main circuit terminal size

[200V series]

Unit rated output, 50%ED [kW]	Terminal size					
	L1/R, L2/S, L3/T AC power input	U, V, W Motor output	P1, P(+) For connecting DC reactor	P(+), DB For connecting braking resistor	P (+), N (-) DC power input	Grounding terminal
1.5	M4	M4	M4	M4	M6	M5
2.2						
3.7						
5.5						
7.5						
11						
15	M6	M6	M6	M6		M6
18.5						
22			-	-		
30						
37	M10	M10				M8
45						
55						

[400V series]

Unit rated output, 50%ED [kW]	Terminal size					
	L1/R, L2/S, L3/T AC power input	U, V, W Motor output	P1, P(+) For connecting DC reactor	P(+), DB For connecting braking resistor	P (+), N (-) DC power input	Grounding terminal
5.5	M4	M4	M4	M4	M6	M5
7.5						
11(PD5)						
11(MC5)	M6	M6	M6	M6		M6
15						
18.5						

6.7 Cautions on wiring

(1) For details on terminals, refer to Section 6.1 Main circuit terminal function, 6.2 Main circuit terminal arrangement.

(2) For electrical equipment (MCCB, MC, etc.), sequence relay, speedometer, load meter, and other instruments, use recommended ones or equivalent.

(3) When using an ELCB (earth leakage circuit breaker), a one having means for inverter should be taken. [Example: FUJI SG series and EG-A series]

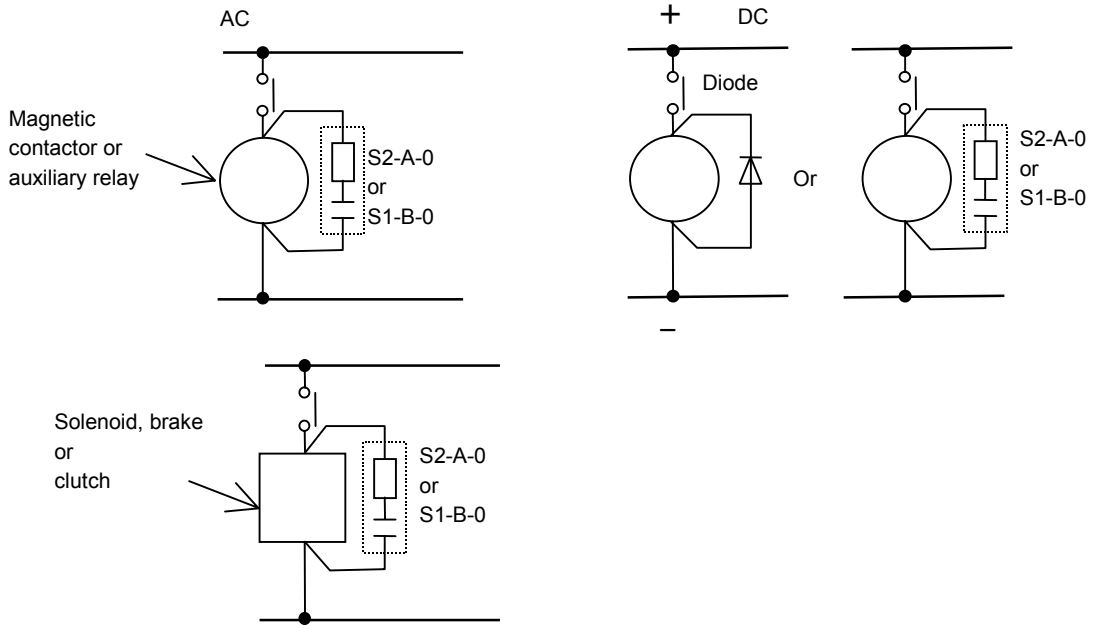
(4) For protection of MC (magnetic contactor) and relay coils from noise, connect CR filters (AC operation circuit) and diodes (DC operation circuit) in parallel with coils.

(a) Application of CR filter and diode to circuit (circuit voltage: 250V or less)

Applicable device		CR filter or diode
Magnetic contactor (for main circuit)	AC	S2-A-0 or equivalent
	DC	Diode or S2-A-0
Auxiliary relay	AC	S1-B-0 or equivalent
	DC	Diode or S1-B-0
Solenoid brake clutch	AC	S2-A-0
	DC	Diode

- Capacity of CR filter
  S2-A-0 C : 0.2 [μF], 500 [V] DC
  R : 500 [Ω]
  (Okatani Sangyo make)
  S1-B-0 C : 0.1 [μF], 500 [V] DC
  R : 200 [Ω]
  (Okatani Sangyo make)
- Capacity of diode (Operating coil current : 0.1 [A] or less)
  ERB24-06C 600 [V] 1 [A] (Fuji Electric make)
  (Surge current: 45 [A]/10 [ms])

(b) Example of wiring



(5) For the unit and spindle motor, be sure to ground the E (G) terminal for prevention of electric shock. Never ground other parts and terminals.

(6) Don't insert the CR filter between the unit output terminals.

(7) When using the regenerative braking converter unit, be sure to connect an AC reactor (provided standard) to the power supply side.

(8) Don't install a phase advance capacitor in the output terminals (U, V, W) of the drive unit and package type drive unit.

(9) Don't connect the power supply to the output terminals (U, V, W) of the drive unit and package type drive unit.

(10) The forward direction of the spindle motor is counterclockwise viewed from the spindle shaft end. To change the direction, use the operation signal (forward command or reverse command).

(11) Install the power cable such as motor and power lines apart from the control cable as far as possible. When they must be forcedly crossed, install them so that they be crossed at a right angle.

(12) Wiring distance should be within the following values.
Between spindle motor and drive unit/package type drive unit : Max. 50 [m]
Between operation unit and drive unit/package type drive unit : Max. 20 [m]

(13) To connect P and N terminals between the converter unit and drive unit, be sure to use an optional DC connecting bar.
If the optional DC connecting bar cannot be used due to limitations of the unit arrangement, contact Fuji Electric.

(14) After wiring is completed, check that wiring is properly installed. Failure to wire properly may result in malfunction and damage to the unit.

Section 7 Preparation for Operation

After installation and wiring have been completed, proper settings, adjustment and check should be carried out before attempting to perform operation. The minimum function codes required for the settings are enumerated below. For detailes of each function code, refer to Section 9. Failure to perform proper settings or adjustments may result in affecting motor operation.

Before supplying feeds the power to the unit and trial operation, check the following:

- Wiring between them is properly connected.
- Connectors and terminals are tightened or not missing.
- The settings of the SINK/SOURCE selector switch (SW5 and SW6) are correct.
- The input voltage is as specifications.
- There is no problem if the motor rotates.

7.1 Common items

[P001, P301: Setting of maximum motor speed]
Set the maximum motor speed by the maximum speed (frequency) command value from an external unit.

[P022, P023, P024: Speed set offset/adjustment of speed set gain]
See Section 9.2 and start the adjustment. For P024, adjustment is required only when V5 series is used and minus(-) polarity input is used.

[P025: Adjustment of override offset]
See Section 9.2 and start the adjustment. If the override function is not used, adjustment is not required to start.

7.2 When standard motor (MVE and MVS series including other motor with different capacity) is combined

M5 series (without option)

[P053: Settings of motor code (type and capacity)]
See Section 9.2 and set the motor code. The motor code is factory-set in combination with the MVE motor (torque vector control / V/f control) of the same capacity as the drive unit.

V5 series (without option)

[P053: settings of motor code (type and capacity)]
See Section 9.2 and set the motor code. The motor code is factory-set in combination with the MVS motor (high performance vector control) of the same capacity as the drive unit.

[P073: Adjustment of motor speed (at low-speed)]
See Section 9.2 and start the adjustment. When the motor is running at a low speed, adjust offset and gain together to prevent it from hunting.

[P101 to P104: ASR P gain]
See Section 9.2 and adjust ASR P gain. If hunting occurs when the motor is running, adjust ASR P gain so that the value may be decreased.

M5 series (PE orientation, synchronous operation, spindle PE feedback control)

In M5 series, when the PE orientation and synchronous operation functions are used with the option (OPC II-MS5-PE or OPCII-MS5-SY) mounted, it allows spindle PE feedback control.
For the following items, perform proper settings.
However, If the ratio of spindle speed versus motor speed (reduction ratio) is as large as 5 to 10 times, spindle PE feedback control cannot be performed.

[P078: Setting of PE feedback control]
Setting the function code at “1” switches to the PE vector (PE feedback) control system.

[P053: Setting of motor code (type and capacity)]
See Section 9.2 and set the motor code. The motor code is factory-set in combination with the MVE motor (torque vector control and V/f control) of the same capacity as the drive unit.
[P080 to P083: Setting of speed ratio of spindle versus motor]
See Section 9.2 and set the speed ratio.

[P101 to P109: ASR P gain]
See Section 9.2 and adjust ASR P gain. If hunting occurs when the motor is running, adjust ASR P gain so that the value may be decreased.

[P201 to P203: Setting of pulse encoder]
See Section 9.2 and set the pulse encoder.

In addition, slow speed and APR gain adjustments are required. For details, see Section 9.2, Instruction Manual (INR-HF51076-JE) for PE Interface Card OPCII-MS5-PE or Instruction Manual (INR-HF51077-JE) for Synchronous Operation Card OPC II-MS5-SY.

On M5 series, if the reduction speed ratio of motor versus spindle is as low as 5 times in achieving the PE orientation function and synchronous operation function, the control system allows performing spindle PE feedback control.
In the spindle PE feedback control, speed of the machine spindle can be detected by signals from a pulse encoder mounted on the machine spindle. In this case, if the transmission gear ratio (reduction ratio) of the machine spindle to the motor shaft becomes larger, it is difficult to achieve speed detection at a low speed rotation, thus optimum performance cannot be obtained. Accordingly, for a machine with a large reduction ratio (about 5 times or more as a target value), torque vector or V/f control that does not use speed feedback from the spindle for control should be selected, or MVS (with PE) motor and V5 series (high performance vector control) should be selected.
If the spindle feedback control is not performed since the reduction ratio is larger, set P078 to "0" and P053 to torque vector or V/f control selection.

For spindle PE feedback control, if the coupling is provided between the machine spindle and pulse encoder shaft or between machine spindle and motor shaft and belt tension is not sufficient to maintain, spindle PE feedback control may be deteriorated, resulting in alarming or the like in the worst case. Be careful about machine rigidity.

V5 series (PE orientation, synchronous operation)

[P053: Setting of motor code (type and capacity)]
See Section 9.2 and set the motor code. The motor code is factory-set in combination with the MVS motor (high performance vector control) of the same capacity as the drive unit.

[P073: Adjustment of motor speed (at low speed)]
See Section 9.2 and start the adjustment. Failure to adjust the offset and gain properly may result in motor hunting or orientation stop may not be able to be achieved successfully at low speed.

[P080 to P083: Setting the speed ratio of spindle to motor]
See Section 9.2 and set the speed ratio.

[P101 to P109: ASR P gain]
See Section 9.2 and adjust ASR P gain. If hunting occurs when the motor is running, adjust ASR P gain so that the value may be decreased.
[P201 to P203: Setting of pulse encoder]
See Section 9.2 and set the pulse encoder.
Slow speed and APR gain adjustments are required. For details, see Section 9.2, Instruction Manual (INR-HF51076-JE) for PE Interface Card OPCII-MS5-PE or Instruction Manual (INR-HF51077-JE) for Synchronous Operation Card OPC II-MS5-SY.

M5 series (Magneto-sensor type orientation)

[P053: Settings of motor code (type and capacity)]
See Section 9.2 and set the motor code.
Torque vector and V/f control are performed when the magneto-sensor type orientation is specified. Before shipment, the motor code is set with the MVE motor (torque vector control or V/f control) of the same capacity as the drive unit.

[P080 to P083: Setting of speed ratio of spindle to motor]
See Section 9.2 and set the speed ratio.

In addition, magneto-sensor mounting orientation check, sensor waveform peak check, slow speed and APR gain adjustments, etc. are required. For details, see Instruction Manual (INR-HF51131-JE) for Magneto-Sensor type Orientation Card OPC II-MS5-MG.

V5 series (Magneto-sensor type orientation)

[P053: Settings of motor code (type and capacity)]
See Section 9.2 and set the motor code. Before shipment, the motor code is set with the MVS motor (high performance vector control selection) of the same capacity as the drive unit.

[P073: Motor speed adjustment (for low speed)]
See Section 9.2 and start the adjustment. Failure to adjust the offset and gain properly may result in motor hunting or orientation stop may not be able to be achieved successfully at low speed.

[P080 to P083: Setting of speed ratio of spindle to motor]
See Section 9.2 and set the speed ratio.

[P101 to P109: ASR P gain]
See Section 9.2 and adjust the ASR P gain. If motor hunting occurs, adjust the ASR P gain so that the value may be decreased.

In addition, Magneto-sensor mounting orientation check, sensor waveform peak check, slow speed and APR gain adjustments, etc. are required. For details, see Instruction Manual (INR-HF51131-JE) for Magneto-Sensor type Orientation Card OPC II-MS5-MG.

7.3 Combination with other motors except standard motors

The following settings should be performed in addition to the function codes given in Section 7.1.

[P079: Setting of NTC thermistor]
When operating the motor in combination with special motors without connecting NTC thermistor, rb (thermistor disconnection detection) alarm occurs. If the NTC thermistor is not connected, set the function code to "0".

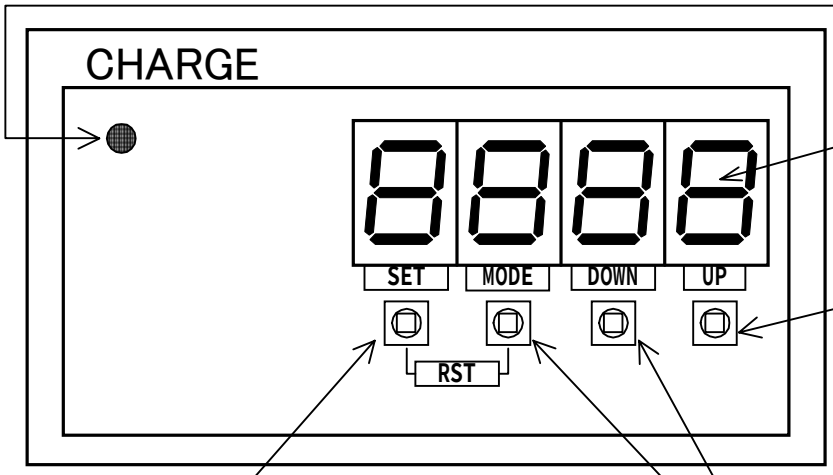
Note : If the NTC thermistor is not used, thermal relays or other protective means should be installed externally since thermal protection is not provided for the motor.

Section 8 Data Display and Operation Procedure

(1) Appearance of data display/set unit, and function of each part

The data display/set unit consists of digital indicators and operation keys on the control printed circuit board, which can be viewed through the display window of the cover.
Note that the data display/set unit is not provided with the dynamic braking converter unit.

Data display/set unit for package type drive unit and drive unit



Charge lamp

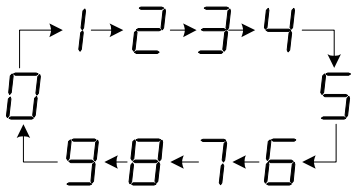
Lit when the smoothing capacitor for the DC power supply unit is in charged condition.

Digital display

Displays the function code or data given in the function code list.

UP key

A figure circulates as shown by an arrow.



When a figure changes from 9 to 0 (changes from F to 0 with the hexadecimal code), a figure above a digit increases by one.

SET key

- To hold changed data after power OFF, press this key.
- When protective function for the unit is activated, remove the cause and then press the SET and MODE key simultaneously. The protective function can be released.

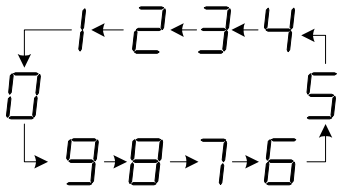
MODE key

To display the function code, press this key. When selecting data code or alarm data, press the UP or DOWN key together.

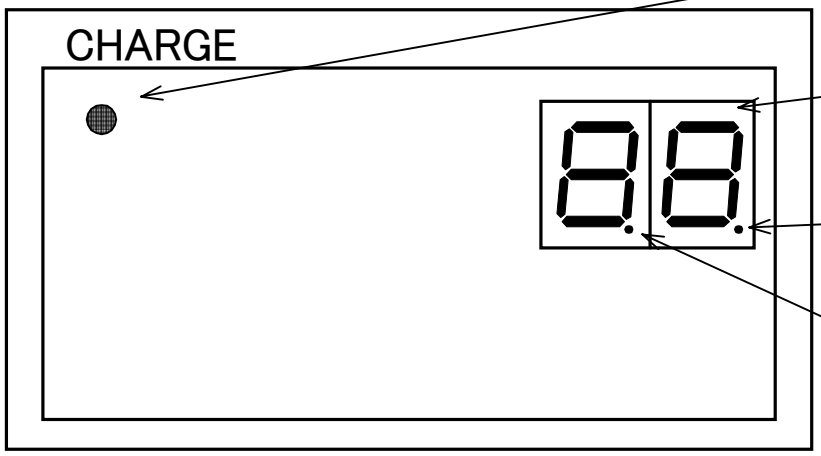
DOWN key

A figure circulates as shown by an arrow.

When a figure changes from 0 to 9 (changes from 0 to F with the hexadecimal code), a figure above a digit decreases by one.



Data display/set unit for regenerative braking converter unit



CHARGE lamp

Lit when the smoothing capacitor for the DC power supply unit is in charged condition.

DIGITAL display

Displays an alarm code when the protective function is energized.

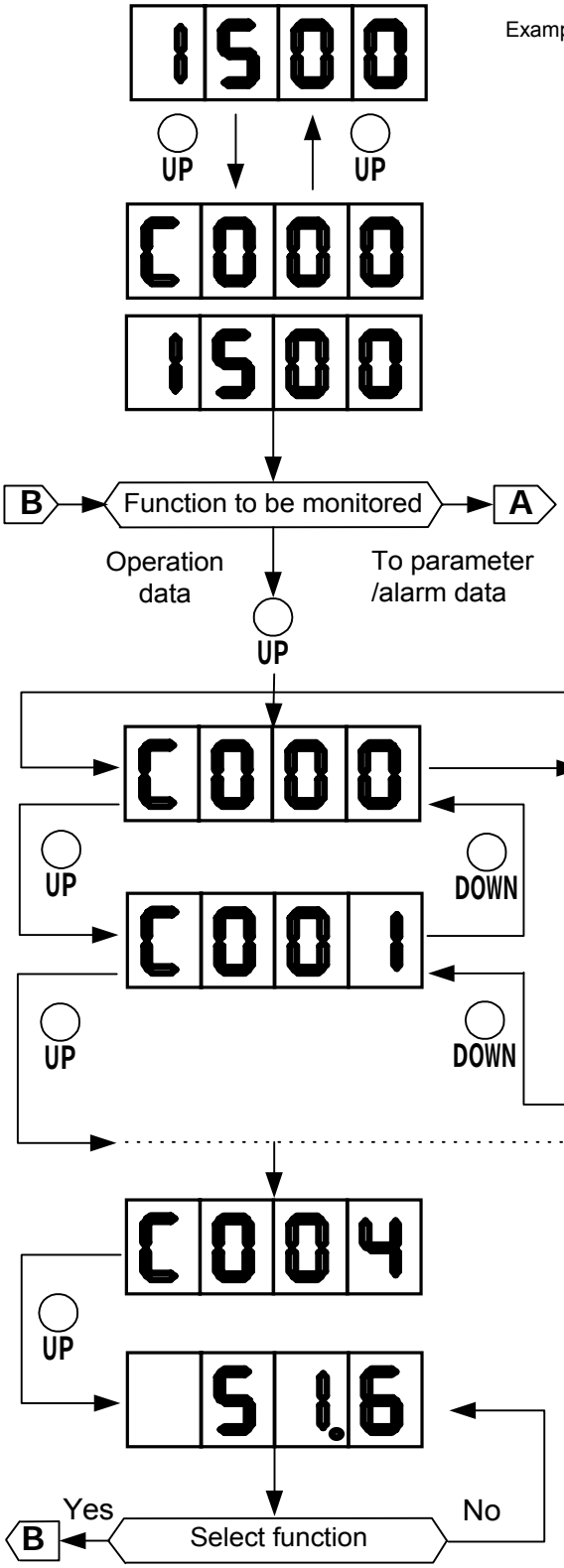
CONTROL POWER lamp

Lit when the converter unit control power is established.

OPERATION DISPLAY lamp

Lit when the forward or reverse command is input.

(2) Data monitoring
Operation data (C000 to C013)



Example of display: Motor speed is 1500 [r/min] when C000 is monitored

To display the function code to be monitored.	Press UP or DOWN once. The display indicates a currently-monitored data code.
To return to the data display	Release UP or DOWN. The display indicates a currently-monitored function data in a second.

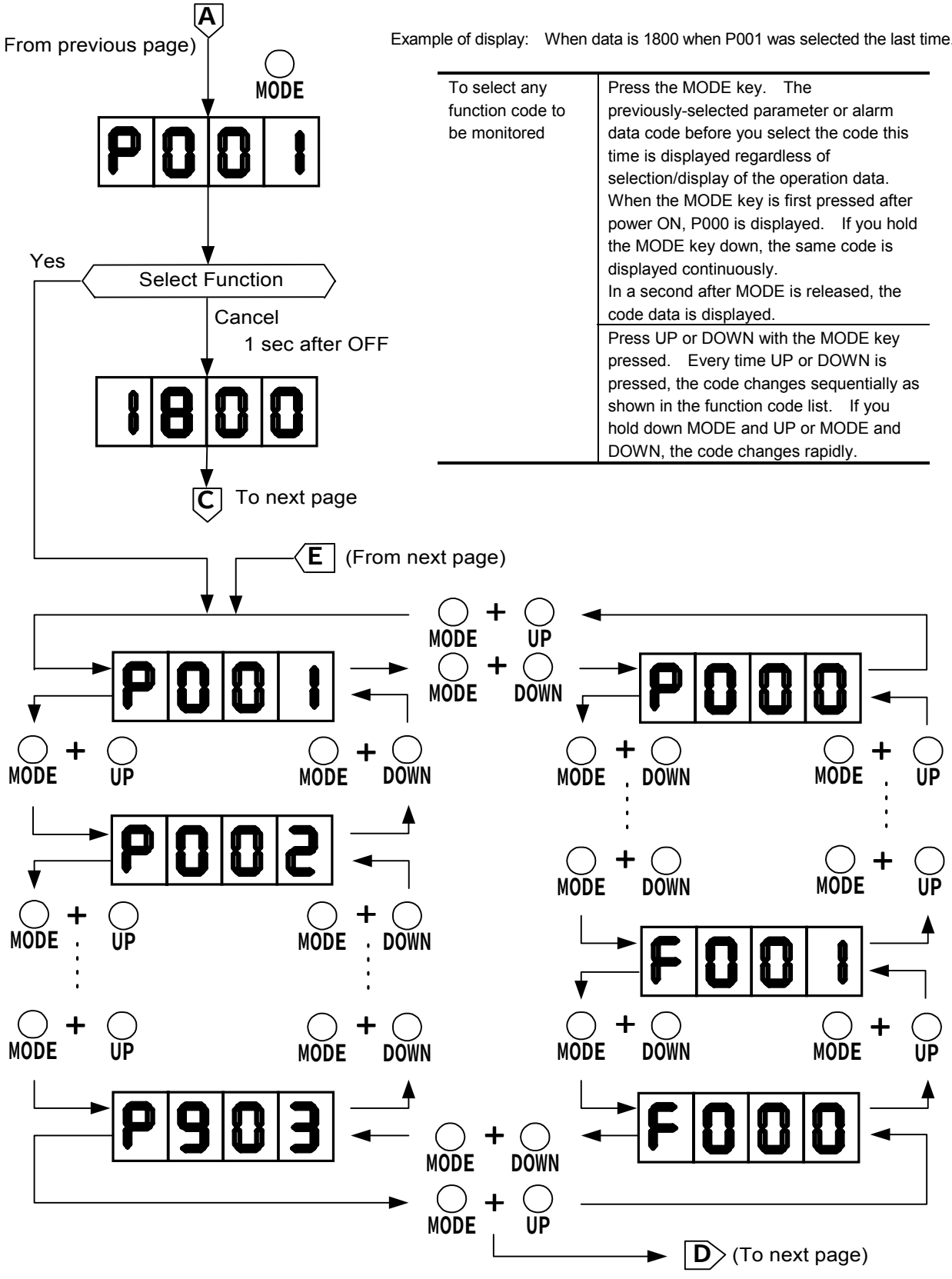
To select the code to be monitored	Press UP or DOWN. Every time the key is pressed, the code changes and the function code is selected. When either of the keys is held down, the code changes quickly.

Note : Any code without function is not displayed.

To display data	When the code to be monitored is displayed, release UP or DOWN.
	In a second after either of the switches is released, the function data to be selected is displayed. The displayed data is displayed continuously until a new function is selected or a protective function of the unit is activated.

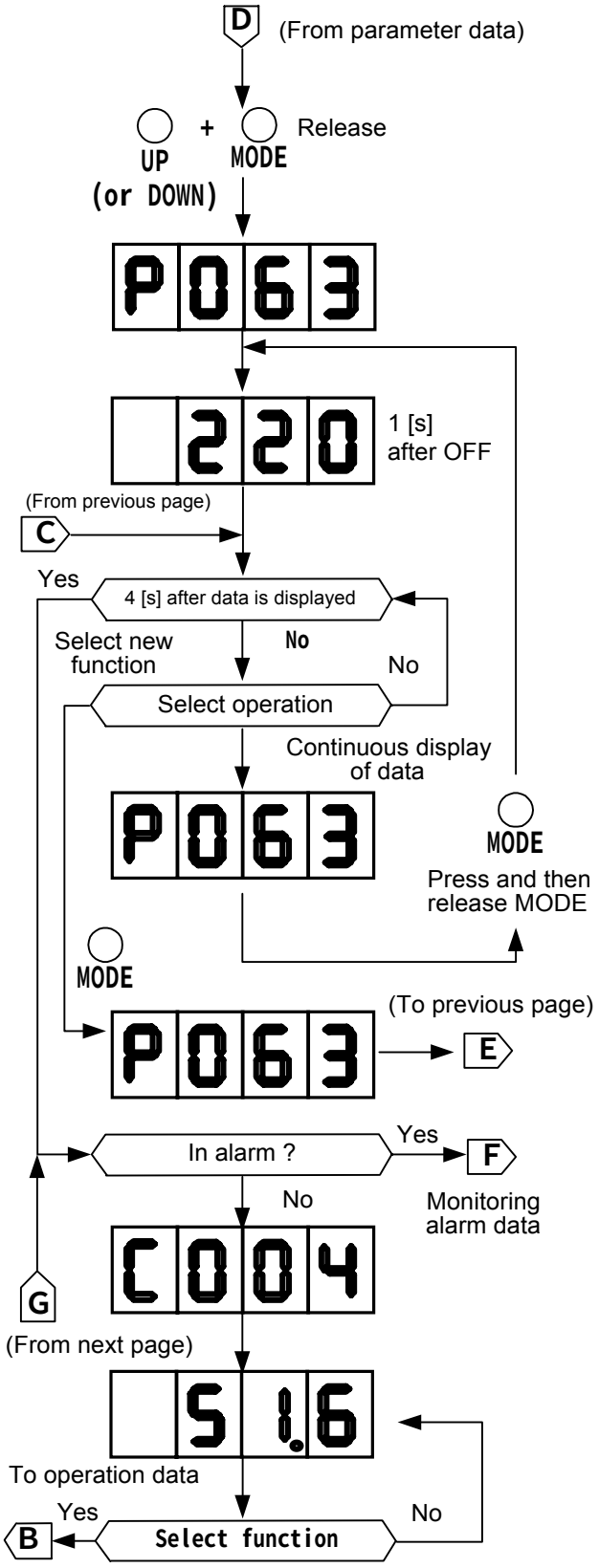
Example of display: An output current is 51.6 [A] when C004 is selected:

Parameter/alarm data (P001 to P903, F000 to F012)



Example of display: When data is 1800 when P001 was selected the last time.

To select any function code to be monitored	Press the MODE key. The previously-selected parameter or alarm data code before you select the code this time is displayed regardless of selection/display of the operation data. When the MODE key is first pressed after power ON, P000 is displayed. If you hold the MODE key down, the same code is displayed continuously. In a second after MODE is released, the code data is displayed.
	Press UP or DOWN with the MODE key pressed. Every time UP or DOWN is pressed, the code changes sequentially as shown in the function code list. If you hold down MODE and UP or MODE and DOWN, the code changes rapidly.



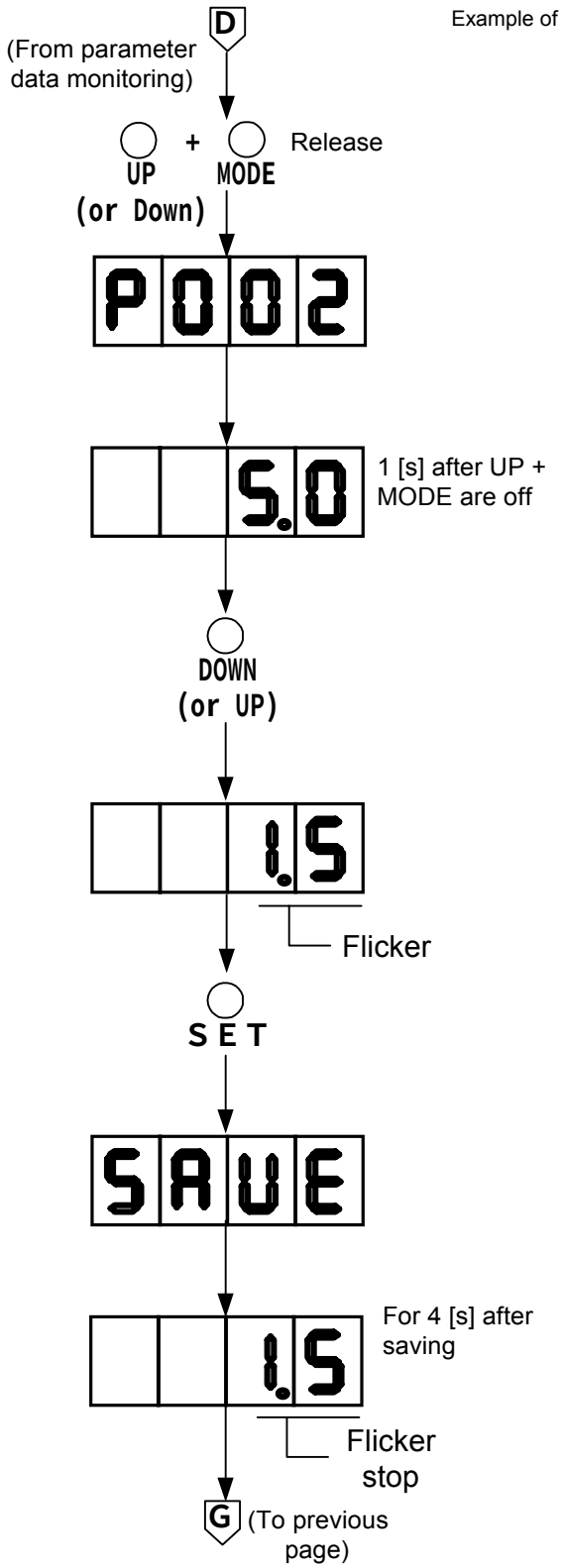
	When the monitor code is displayed, release UP or DOWN together with MODE. Example : When data is 220 [V] with P063.
To display data	Selected code data is displayed in 1 [s] after the key is released. Data is displayed for 4 [s].

Note : When the code data of P100, P200, P300, P400, P500 and P800 are "0" (no display), the function in each block is not displayed.

	To monitor data continuously or select a new function, follow steps within 4 [s] after data is displayed.
To continue data display	After the code to be selected is displayed by pressing MODE, release MODE.
To select a new function	Press MODE to display selected code.

To return to display of operation data	Four [s] later, the code monitored for 5 [s] or more before the function of parameter/alarm data was selected will be displayed. The display does not change to the function of operation data which was passed (less than 5 [s]) by the select operation. One [s] later, the data of displayed code will be displayed. This display will continue until a new function is selected or a protective function of the unit is activated.

(3) Data setting
Parameter data (P001 to P903)



Example of display: When setting accelerating time P002 to 1.5 [s]:

To select the function code whose setting you want to change.	When the monitor code is displayed, release UP or DOWN together with MODE. Example of display: When data is 5.0 [s] (at default) with P002. The selected code data is displayed in 1 [s] after the key is released. The data is displayed for 4 [s].

Note : When the code data of P100, P200, P300, P400, P500 and P800 are "0" (no display), the function in each block is not displayed.

To change the data	After the function code data whose setting you want to change is displayed, change the data within 4 [s].
To save the data	After the data has been set, press the SET key within 4 [s] to save the data.
	After the data has been saved, the set data is displayed for 4 [s].

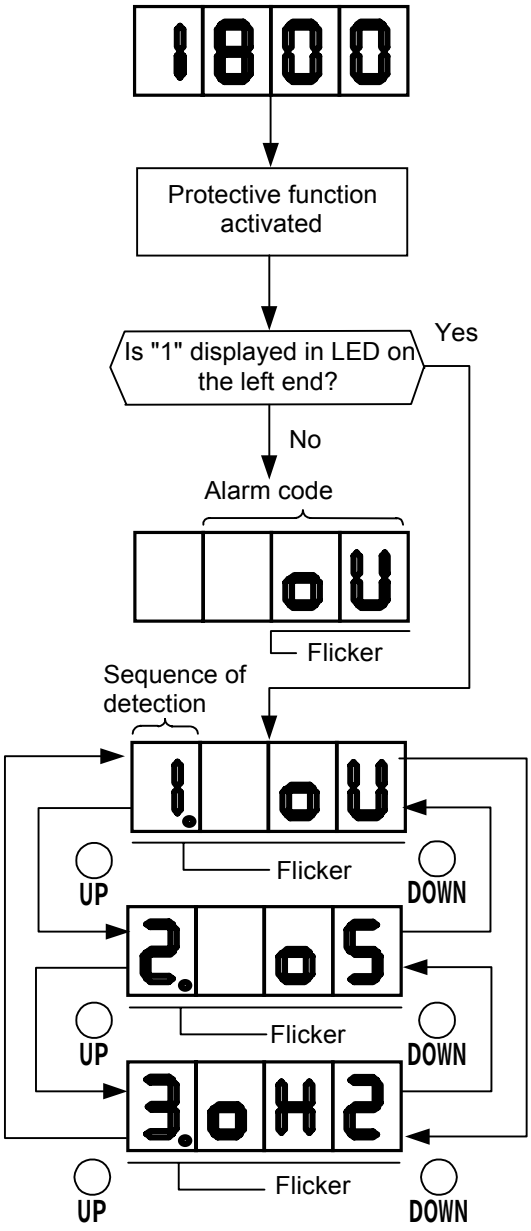
Note : When the code P000 is set at "1" (data protection), data change cannot be carried out. Some data cannot be changed during operation depending on the function code. Be sure to press the SET key after changing the data because of the following. If the data is changed and the SET key is not pressed, the unit operates on the changed data until the power supply of the drive unit is turned off. The changed data returns to the previous data once its power supply is turned off.

(4) Display and operation when alarm occurs

When the unit protective function is activated, the display indicates the alarm code immediately even when monitoring data. If there are 2 or more causes, it indicates the number of causes.

When the protective function is being activated, the alarm data and parameter can be monitored, but operation data cannot be monitored.

1) Check of alarm contents



When the number of causes is 1, the display indicates the alarm code only.

To check the alarm code.	Check the alarm code. The alarm code flickers when protective function is activated.
Example of display :	Overvoltage protection function is activated when monitoring "C000 motor speed" (1800 [r/min]).

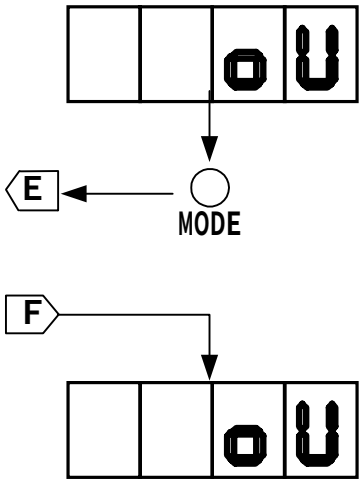
When the number of causes is more than one, the display indicates sequence of detection and alarm code.

To check the alarm code	Check the alarm code. The display indicates the sequence of detection "1" and the alarm code which was detected first. The sequence of detection and alarm code flicker when the protective function is activated.
To search for the alarm contents	Press the UP key. Check the alarm code to be detected as sequence of detection is 2. Every time UP is pressed, the sequence of detection changes from 2 to 3. The display indicates the alarm code based on the sequence. When the all of causes have been displayed, the display returns to the first sequence of detection and alarm code. When DOWN is pressed, the sequence changes in order of 1 → 3 → 2 → 1 in the reverse order of UP.

Example of display

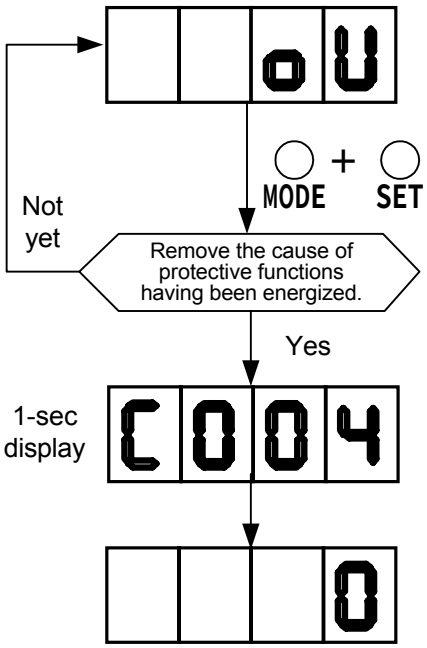
Sequence of detection	Name of alarm
1	Overvoltage
2	Overspeed
3	External alarm

2) Parameter/alarm data monitoring



Parameters and alarm data functions given in the function list can be monitored. How to monitor is the same as the one given in (2) Data monitoring.

3) Resetting



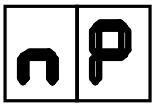
After the alarm code has been checked and the cause of action of the protective function has been removed, hold down SET, and then press MODE at the same time.
When the protective function in action is released, it returns to anormal operating condition. In the display, the operation data monitored before the action of protective function is displayed again. In addition, the protective function for the converter unit is released at this time.

Note : Press the SET first, and then MODE. If you press MODE earlier than SET, parameter/alarm data will be displayed.

When performing the resetting the operation without removing the cause of action of the protective function, the action of the protective function cannot be released. So, the display indicates the alarm code continuously.

Converter unit

1) Alarm



Example of display

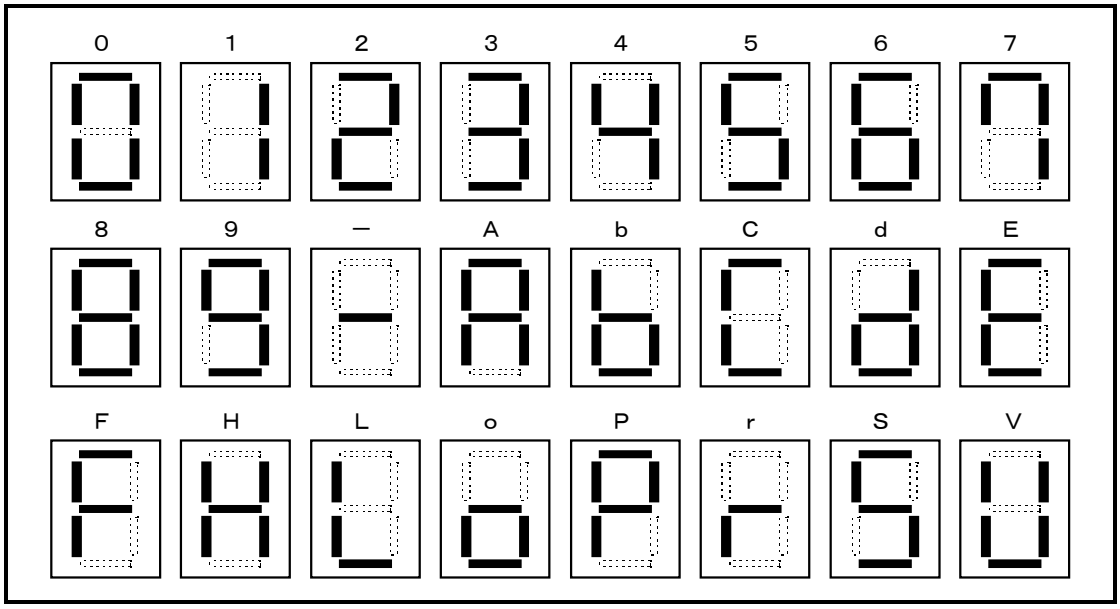
An alarm code that is first detected is only displayed. For the alarm code, refer to the alarm list for the regenerative braking converter unit given in Section 10.2.

2) Reset

Resetting should be performed from the drive unit. Observe step (3) Resetting as shown above. The alarm code indicated in the display is cleared after reset. Operation data will not be displayed like the drive unit.

(5) LED display

- In FRENIC 5000MS5, the LED displays the function code and alarm in 7 segments.
- An sample of LED display and character is shown below.



* The figure 5 and character S are drawn in the same shape.

9.1 Function code list

Division	Code	Name	Setting/Display range	Minimum unit	Factory setting	Detailed description
Monitor	C000	Motor speed	0 to 20000 [r/min] (*1)	(*1)	-	P. 9-7
	C001	Motor speed (set value)	0 to 20000 [r/min] (*1)	(*1)		
	C002	Spindle speed	0 to 20000 [r/min] (*1)	(*1)		
	C003	Load meter output	0 to 255%	1		
	C004	Output current	0 to 255%	1		
	C005	Input signal check (Control)	Corresponding LED lit	-		
	C006	(Option)				
	C007	Output signal check				
	C008	Stop position set value	0000 to 1FFF	1		
	C009	0° reference spindle position	0000 to 1FFF			P. 9-8
	C010	Position deviation	0000 to 1FFF			
	C011	Synchronized position deviation	0000 to 1FFF			
	C012	Braking resistor %ED	0 to 100%	1		
	C013	ROM version	0.00 to 99.99	0.01		
Protection	P000	Data protection	0: Release, 1: Protection	1	1	
Max. speed	P001	Maximum speed	0 to 20000 [r/min] (*1)	(*1)	4500 [r/min]	
Acceleration/ deceleration	P002	Acceleration time	0.1 to 120.0 [s]	0.1	5.0 [s]	
	P003	Deceleration time				
	P004	Accel./decel. mode selection (Mode selection)	0: Step response 1: S-curve acceleration/deceleration 2: Non-linear acceleration/deceleration	1	1	
	P005	S-curve accel./decel. (S-curve width) (At acceleration)	0 to 50%	1	10%	P. 9-9
	P006	(At deceleration)				
	P007	Non-linear speed N1	1 to 99%	1	5	
	P008	N2			50	
	P009	N3			75	
	P010	N4			80	
	P011	N5			90	
	P012	Non-linear ratio K1	1 to 99%	1	10	
	P013	K2			20	
	P014	K3			40	
	P015	K4			50	
	P016	K5			70	
	P017	Accel./decel. ratio (M gear)	1.0 to 9.9	0.1	2.0	
	P018	(L gear)			4.0	
	P019	(LL gear)			4.0	
Boost	P020	Torque boost	0: Auto torque boost 1 to 150: Manual	1	0	P. 9-10
Speed setting override	P021	Analog input filter	1 to 1000 [ms]	1	200 [ms]	
	P022	Speed setting offset (Selection of operation)	0: Inactive 1: Active (auto adjustment)	1	0	
	P023	Speed setting gain (+ polarity)	0.00 to 11.00 [V]	0.01	10.00	
	P024	(- polarity)			10.00	
	P025	Override offset (Selection of operation)	0: Inactive 1: Active (auto adjustment)	1	0	P. 9-11
	P026	Override setting width	0 to 50%	1	0%	
Magnetic flux command	P027	Magnetic flux command level (At constant speed)	10 to 100%	1	50%(25%)	
	P028	(Stronger time constant at decel.)	0 to 250 [ms]	1	100 [ms]	
	P029	(At ORT)	10 to 100%	1	50%	P. 9-29
	P030	(At rigidity)	10 to 100%		100%	P. 9-11
Torque limit	P031	Torque limiter (Driving)	0 to 200%	1	By capacity	
	P032	(Braking)				
	P033	External torque limiter (H)			120%	
	P034	(L)			50%	
	P035	Output limiter pattern	0 to 5	1	0	P. 9-12
	P036	Output limiter value	0 to 150%	1	120%	

Division	Code	Name	Setting/Display range	Minimum unit	Factory setting	Detailed description
DC braking	P037	DC injection braking (Voltage)	0 to 100%	1	20%	P. 9-12
	P038	(Time)	0.0 to 30.0 [s]	0.1	1.0 [s]	
Pre-excitation	P039	Pre-excitation (Level)	50 to 200%	1	100%	P. 9-13
	P040	(Time)	0.0 to 5.0 [s]	0.1	0.0 [s]	
DC setting	P041	Speed detection (Level)	1 to 100%	1	75%	
	P042	Speed arrival (Detection width)	2 to 15%	1	5%	
	P043	Zero speed detection (Level)	0.2 to 2.0%	0.1	0.3%	
	P044	Torque detection (Level)	0 to 150%	1	100%	P. 9-14
AO setting	P045	Ammeter/load meter changeover	0: Ammeter 1: Standard load meter 2: Special load meter	1	1	
	P046	Speedometer gain	50 to 150%	1	100%	
	P047	Ammeter/load meter gain	50 to 200%	1	100%	
	P048	Analog meter test	0: Inactive 1: Active	1	0	P. 9-15
	P049	Ammeter/load meter filter time constant	10 to 1000 [ms]	10	100 [ms]	
Simplified ORT	P050	Slow-speed	15 to 300 [r/min]	1	30 [r/min]	
	P051	PDT read timer	0 to 1000 [ms]	10	500 [ms]	
	P052	Complete signal timer	0 to 1000 [ms]	10	100 [ms]	
Motor 1	P053	Motor code (Type and capacity)	Code by capacity	-	By capacity	P. 9-16
	P054	Base speed	100 to 20000 [r/min] (*1)	(*1)		
	P055	Rated voltage	120 to 480 [V]	1, 2		
	P056	Rated current (Continuous)	0.1 to 500.0 [A]	0.1		
	P057	Rated torque current (Continuous)				P. 9-17
	P058	Exciting current				
	P059	%R1	0.00 to 50.00%	0.01		
	P060	%L σ	0.00 to 50.00%	0.01		
	P061	No. of motorpoles	2, 4, 6, 8, 10, 12	2		
	P062	Maximum speed	100 to 20000 [r/min] (*1)	(*1)		
	P063	Maximum output voltage	120 to 480 [V]	1, 2		
	P064	Differential calculation constant	0000 to FFFF	1		
	P065	Slip frequency (Driving)	0.00 to 5.00 [Hz]	0.01		P. 9-18
	P066	(Braking)				
	P067	Calculation coefficient 1	0000 to FFFF	1		
	P068	Calculation coefficient 2				
	P069	Calculation coefficient 3				
	P070	Calculation coefficient 4				
	P071	Calculation coefficient 5				
	P072	Auto tuning (%R1, %L σ, Io)	0 to 2	1	0	
Hardware adjustment	P073	Motor speed adjustment (Selection of action) (at low-speed)	0: Inactive 1: Gain adjustment 2: Offset adjustment	1	0	
	P074	Tuning (Current detection)	0: Inactive 1: Active	1	0	P. 9-19
	P075	(Voltage detection)	0: Inactive 1: Active		0	
Definition	P076	Capacity of drive unit	Code by capacity	-	By capacity	
	P077	Excess speed deviation alarm (Selection of operation)	0: Inactive 1: Active	1	1	
	P078	PE feedback control (Selection of operation)	0: Inactive 1: Active	1	0	
	P079	NTC thermister (Selection of operation)	0: Inactive 1: Active	1	1	P. 9-20
Spindle/motor speed ratio	P080	Spindle/motor speed ratio (H gear)	0000 to FFFF	1	0800	
	P081	(M gear)				
	P082	(L gear)				
	P083	(LL gear)				

Division	Code	Name	Setting/Display range	Minimum unit	Factory setting	Detailed description
ASR rigidity	P100	Selection of function block (P101 to P126) <ASR>	0: Non-display 1: Display	1	0 (1)	P. 9-20
	P101	ASR P gain (H gear)	0 to 150 times	1	20 times	
	P102	(M gear)				
	P103	(L gear)				
	P104	(LL gear)				
	P105	(Rigid)				
	P106	(ORT H gear)			40 times	
	P107	(ORT M gear)				
	P108	(ORT L gear)				
	P109	(ORT LL gear)				
	P110	ASR integral time (H gear)	0 to 200 [ms]	1	20 [ms]	P. 9-21
	P111	(M gear)				
	P112	(L gear)				
	P113	(LL gear)				
	P114	(Rigid)				
	P115	(ORT H gear)			100(20) [ms]	
	P116	(ORT M gear)				
	P117	(ORT L gear)				
	P118	(ORT LL gear)				
	P119	ASR input filter	1 to 1000 [ms]	1	20 [ms]	
	P120	Maximum speed (Rigid)	100 to 20000 [r/min] (*1)	(*1)	4500 [r/min]	
	P121	Analog input filter (Rigid)	1 to 1000 [ms]	1	1 [ms]	
	P122	ASR input filter (Rigid)	1 to 1000 [ms]			
	P123	Speed detection filter (H gear)	1 to 50 [ms]	1	10(5) [ms]	
	P124	(M, L, and LL gears, rigid)				
	P125	(ORT H gear)				
	P126	(ORT M, L, LL gear)				
ORT	P200	Selection of function block (P201 to P228) <ORT>	0: Non-display 1: Display	1	0	P. 9-20
	P201	Pulse encoder (Ratio to spindle)	1: 1:1 2: 2:1	1	1	P. 9-26
	P202	(Selection of phase A or B)	0: Phase A lead with forward 1: Phase B lead with reverse	1	0	
	P203	(No. of pulses)	0: 1024 1: 2048	1	0	
	P204	Accel./decel. mode (Selection of mode)	0: Inactive 1: Active	1	0	
	P205	Internal stop position	0000 to 1FFF	1	000	
	P206	Automatic reading of internal stop position	0: Inactive 1: Active	1	0	
	P207	Torque boost	0: Automatic torque boost 1 to 150: Manual	1	0	P. 9-27
	P208	ASR input filter	1 to 1000 [ms]	1	1 [ms]	
	P209	1st slow-speed (ORT H gear)	0 to 3000 [r/min]	1	500 [r/min]	
	P210	(ORT M gear)			600 [r/min]	
	P211	(ORT L gear)			750 [r/min]	
	P212	(ORT LL gear)			250 [r/min]	
	P213	2nd slow-speed (MGORT H gear)	0 to 1200 [r/min]	1	100 [r/min]	
	P214	(MGORT M gear)			120 [r/min]	
	P215	(MGORT L gear)			150 [r/min]	
	P216	(MGORT LL gear)			50 [r/min]	
	P217	APR P gain (ORT H gear)	0 to 255 times	1	20 times	
	P218	(ORT M gear)			40 times	
	P219	(ORT L gear)			80 times	
	P220	(ORT LL gear)			100 times	
	P221	Complete width (Width)	0 to 127	1	5	
	P222	(Increment after stop)			0	
	P223	Complete signal (ON-delay timer)	0 to 1000 [ms]	10	100 [ms]	P. 9-28
	P224	(OFF-delay timer)				

Division	Code	Name	Setting/Display range	Minimum unit	Factory setting	Detailed description
ORT	P225	Re-ORT mode (Selection of mode)	0: Instant APR 1: After 1-turn	1	0	P. 9-28
	P226	ORT stop mode (Selection of mode)	0: No increased speed 1: Increased speed	1	1	
	P227	ORT rotational direction (Selection of mode)	0: Shortcut 1: Direction command	1	1	
	P228	2nd slow-speed changover angle (MGORT)	0 to 180 °	1	45 °	
Motor 2	P300	Selection of function block (P301 to P324) <Motor 2>	0: Non-display 1: Display	1	0	P. 9-20
	P301	Maximum speed	100 to 20000 [r/min] (*1)	(*1)	4500 [r/min]	P. 9-8
	P302	Acceleration time	0.1 to 120.0 [s]	0.1	5.0 [s]	
	P303	Deceleration time				
	P304	S-curve accel./decel. (At acceleration)	0 to 50%	1	10%	P. 9-9
	P305	(S-curve width) (At deceleration)				
	P306	Torque boost	0: Automatic torque boost 1 to 150: Manual	1	0	P. 9-10
	P307	Motor code (Type and capacity)	Code by capacity		By capacity	P. 9-16
	P308	Base speed	100 to 20000 [r/min] (*1)	(*1)		
	P309	Rated voltage	120 to 480 [V]	1, 2		
	P310	Rated current (Continuous)	0.1 to 500.0 [A]	0.1		
	P311	Exciting current				P. 9-17
	P312	%R1	0.00 to 50.00%	0.01		
	P313	%L **σ**				
	P314	Maximum speed	100 to 20000 [r/min] (*1)	(*1)		
	P315	Maximum output voltage	120 to 480 [V]	1, 2		
	P316	Slip frequency (Driving/braking)	0.00 to 5.00 [Hz]	0.01		P. 9-18
	P317	Calculation coefficient 1	0000 to FFFF	1		
	P318	Calculation coefficient 2				
	P319	Calculation coefficient 3				
	P320	Torque limiter (Driving)	0 to 200%	1		P. 9-11
	P321	(Braking)				
	P322	Magnetic flux command level	10 to 100%	1	50%	
	P323	Speedometer gain	50 to 150%	1	100%	P. 9-14
	P324	Ammeter/load meter gain	50 to 200%	1	100%	
Synchronous operation	P400	Selection of function block (P401 to P430) <Synchronous operation>	0: Non-display 1: Display	1	0	P. 9-20
	P401	Acceleration time	0.1 to 120.0 [s]	0.1	5.0 [s]	P. 9-33
	P402	Deceleration time				
	P403	S-curve accel./decel. (At acceleration)	0 to 50%	1	10%	
	P404	(At deceleration)				
	P405	APR P gain (H gear)	0.0 to 200.0 times	0.1	30.0 times	
	P406	(M gear)				
	P407	(L gear)				
	P408	(LL gear)				
	P409	APR integral time (H gear)	0.00 to 3.00 [s]	0.01	0.50 [s]	
	P410	(M gear)				
	P411	(L gear)				
	P412	(LL gear)				
	P413	Sequence selection of torque balance control (Selection of operation)	0: SET0 1: CNC	1	0(1)	
	P414	APR output filter	0 to 1000 [ms]	1	0 [ms]	
	P415	Synchronized position control start speed deviation	0 to 50%	1	0%	
	P416	Pre-synchronous 3	0000 to FFFF	1	0000	-
	P417	Pre-synchronous 4	0 to 255	1	0	
	P418	Chuck ON timer	0 to 1000 [ms]	10	100 [ms]	P. 9-34
	P419	Complete width	0 to 100 [pulse]	1	10 [pulses]	
	P420	Complete signal (ON-delay timer)	0 to 1000 [ms]	10	100 [ms]	
	P421	(OFF-delay timer)				
	P422	PE rotation direction (Selection of operation)	0: Same phase 1: Negative phase	1	0	

Division	Code	Name	Setting/Display range	Minimum unit	Factory setting	Detailed description
Synchronous operation	P423	Synchronous ratio 1	1 to 99	1	1	P. 9-34
	P424	Synchronous ratio 2			2	
	P425	Synchronous ratio 3			3	
	P426	Synchronous ratio 4			4	
	P427	Synchronous ratio 5			5	
	P428	Synchronous ratio 6			6	
	P429	Synchronous ratio 7			7	
	P430	Synchronous ratio 8			8	
Winding changeover	P500	Selection of function block (P501 to P521) <Winding changeover>	0: Non-display 1: Display	1	0	P. 9-36
	P501	Winding changeover speed	0 to 20000 [r/min] (*1)	(*1)	By capacity	
	P502	Winding changeover speed hysteresis width	0 to 1000 [r/min]	10	30 [r/min]	
Low-speed winding	P503	Maximum speed	0 to 20000 [r/min] (*1)	(*1)	1500 [r/min]	P. 9-8
	P504	Torque boost	0: Automatic torque boost 1 to 150: Manual	1	0	-
	P505	Base speed	0 to 20000 [r/min] (*1)	(*1)	By capacity	P. 9-16
	P506	Rated voltage	120 to 480 [V]	1, 2		
	P507	Rated current	0.1 to 500.0 [A]	0.1		
	P508	Rated torque current				P. 9-17
	P509	Exciting current				
	P510	%R1	0.00 to 50.00%	0.01		
	P511	%Lσ		0.01		
	P512	Maximum speed	100 to 20000 [r/min] (*1)	(*1)		
	P513	Maximum output voltage	120 to 480 [V]	1, 2		
	P514	Differential calculation constant	0000 to FFFF	1		
	P515	Slip frequency (Driving)	0.00 to 5.00 [Hz]	0.01		P. 9-18
	P516	(Braking)				
	P517	Calculation coefficient 1	0000 to FFFF	1		
	P518	Calculation coefficient 2				
	P519	Calculation coefficient 3				
	P520	Calculation coefficient 4				
	P521	Calculation coefficient 5				
For maker	P800	Selection of function block (P801 to P810) (for maker)	0: Non-display 1: Display	1	0	P. 9-20
	P801	Data 1 for maker	0000 to FFFF	1	By capacity	P. 9-21
	P802	Data 2 for maker				
	P803	Selection of current/voltage limit operation	0000 to FFFF	1	0000	
	P804	ORT boost addition value	0 to 150	1	0	P. 9-28
	P805	No. of PE speed detection sampling	0000 to FFFF	1	0000	P. 9-29
	P806	Digital speed/position command changeover	00 to 04	1	0	P. 9-35
	P807	Selection of PE origin signal	0: Invalid 1: Valid	1	0	P. 9-29
	P808	Excess speed deviation detection	0: Invalid 1: 1 to 100%	1	0	P. 9-22
	P809	Data 9 for maker	0 to 255	1	By capacity	P. 9-21
	P810	Data 10 for maker				
Function management	P900	Speed display (Selection of range)	0 : 0 to 9999 1 : 0 to 16000	1	0	P. 9-22
	P901	Data initialization	0: Manual setting value 1: Initialization (default value)	1	0	
	P902	Alarm history clear	0: Inactive 1: Action	1	0	P. 9-23
	P903	Data batch setting	0: Inactive 1: Batch setting	1	0	

Division	Code	Name	Setting/Display range	Minimum unit	Factory setting	Detailed description
Alarm (monitor only)	F000	Alarm (Latest)	Code display	-	-	P. 9-23
	F001	Data at alarm (Speed/speed detection value)	0 to 20000 [r/min] (*1)	(*1)		
	F002	(Speed set value)				
	F003	(Output current/output torque current)	0 to 255%	1		
	F004	(Torque current command value)				
	F005	(Exciting current detection value)				
	F006	(Exciting current command value)				
	F007	Input signal (Control)	Displayed on corresponding LED	-		P. 9-24
	F008	(Option)	Displayed on corresponding LED			
	F009	Output signal	Displayed on corresponding LED			
	F010	Alarm history (Previous)	Code display	-		P. 9-23
	F011	(2 times before)				
	F012	(3 times before)				

Notes: (*1) The setting range of speed setting parameters varies depending on the P900: speed display (selection of range) values.
P900: 0 → 0 to 9999 [r/min], P900: 1 → 0 to 20000 [r/min] (However, a decimal is displayed at the lowest significant position of 1/10.
(Example) 1200. at 12000 [r/min] setting

(*2) Parameters whose name is shaded can be changed during operation or with the operation command on.

(*3) An expression of "*** speed" in some parameter names denotes synchronous speed at the torque-vector and V/f control.

(*4) The figure in the parentheses of factory setting values denotes a factory-set value of V5 series before shipment.

9.2 Detailed description of function code
(1) Monitor code (C000 to C013)

C000	Motor speed

◆ Displays the motor shaft speed.

Indication value: 0 to 20000 [r/min]

The indication depends on the control system, as follows.
At torque-vector and V/f control for M5 series and 2nd spindle for V5 series: Synchronious speed
At spindle PE feedback control for M5 series:
Calculated values from spindle speed
At high-performance vector control:
Measured value:

Note: Since synchronous speed is equal to output frequency x 120 divided by the number of poles, it may be different from actual motor speed.

C001	Motor speed (set value)

◆ The set value of the motor shaft speed is indicated.

Indication value: 0 to 20000 [r/min]

C002	Spindle speed

◆ The spindle speed is indicated.

Indication value: 0 to 20000 [r/min]
The spindle speed calculated by C000/(P080 to P083) is indicated.

C003	Load meter output

◆ The present output level with respect to the 50%ED rated output of the motor is indicated by %.
Indication value: 0 to 255%

C004	Output current

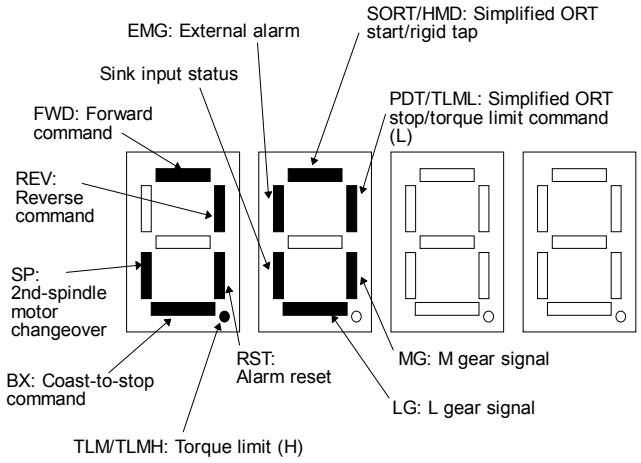
◆ The present output current level with respect to the rated output current of the drive unit is indicated by %.

Indication value: 0 to 255%

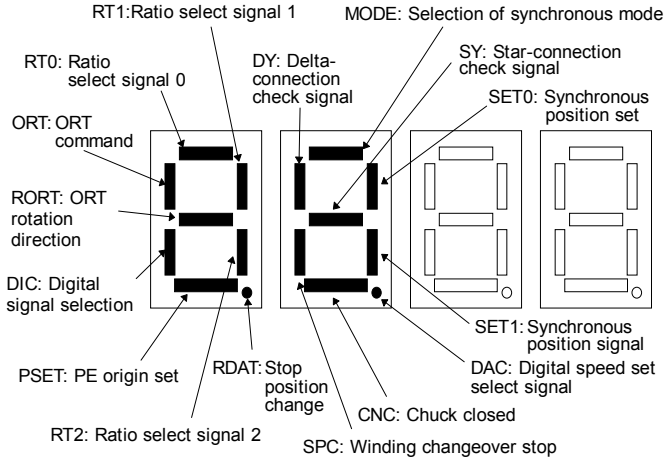
C005	Input signal check (Control)
C006	Input signal check (Option)
C007	Output signal check

◆ The status of contact input signal and transistor output signal is displayed in LED. C005 displays an input signal for the control PC board, C006 an input signal for the optional PC board, and C007 an output signal. The black-displayed portions are lighted with each signal ON.

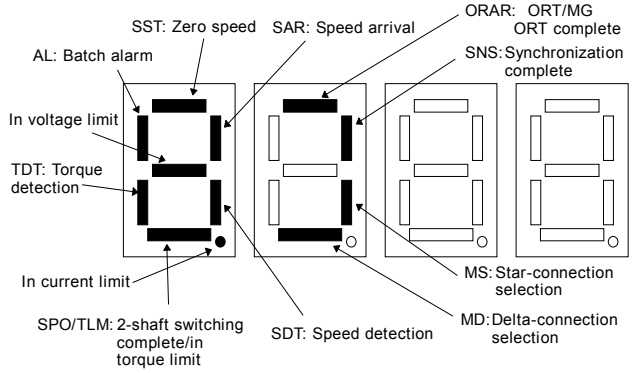
C005



C006



C007



C008	Stop position set value

◆ Stop position command value (external command ES12-ES01) for PE orientation is indicated in hexadecimal.

Indication value: 000 to 1FFF

C009	0° reference spindle position

◆ This position is counted based on the spindle origin (value adding internal stop position to the position of C pulse (1-turn signal) of a pulse encoder.

Indication value: 000 to 1FFF

C010	Position deviation

◆ Position deviation from the stop position of PE or PG orientation stop

Indication value: 000 to 1FFF

C011	Synchronized position deviation

◆ Synchronized position deviation between 2 spindles during synchronous operation is indicated.

Indication value: 000 to 1FFF

C012	Braking resistor %ED

◆ When setting the reference time at 100 [s], operation frequencies of a braking resistor is indicated in %ED.

Indicated value: 0 to 100%

C013	ROM version

◆ ROM version for the drive unit is indicated in 4-digit code.

Indicated value: 0.00 to 99.99

(2) Function code (P000 to P903)

P000	Data protection

◆ When the function code is set at "1: Protection", it is impossible to rewrite function codes expressed in P□□□.

Setting range: 0: Release, 1: Protection

Note: The function code is set at "1" before shipment. To change the function code, set the P000 to "0" (release).

P001	Maximum speed
P301	(Motor 2) Maximum speed
P503	Maximum speed (Low-speed winding)

◆ The maximum speed is set to allow controlling the drive unit.

Setting range: 100 to 20000 [r/min]

Note: The following upper limit is set for the drive unit, depending on the number of motor poles.
2 poles: 20000 [r/min], 4 poles: 10000 [r/min]
6 poles: 6666 [r/min], 8 poles: 5000 [r/min]
12 poles: 3333 [r/min]

If the speed is set over the allowable value for driven units, the motor or other machine may be damaged. Set the speeds so as not to exceed the motor 1 speed within the maximum speed (P062) and the motor 2 speed within (P314) described in specification, respectively.

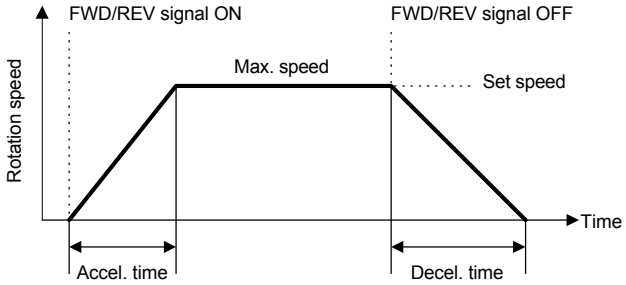
P002	Acceleration time
P003	Deceleration time
P302	(Motor 2) Acceleration time
P303	(Motor 2) Deceleration time

◆ The acceleration time to be taken until the speed command value reaches from 0 to maximum speed (P001/P301) and deceleration time until the speed command value reaches from maximum speed (P001/P301) to 0 are set, respectively.

Setting range: 0.1 to 120.0 [s]

Set speed = maximum speed

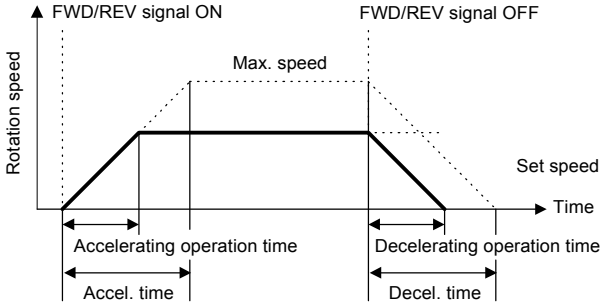
The set value agrees with actual operation time.



Set speed<maximum speed

The set value differs from actual operation time.

Accel./decel. operation time = set value x (set speed / max. speed)



Note : If the accel./decel. time is set shorter than the required despite large repulsion torque and moment of inertia, the torque limit function or the stall prevention function is activated and it may be longer than the previously-set operation time.

P004	Accel./decel. mode selection (Mode selection)

◆ Set the accel./decel. operation mode.

Setting range: 0: Step response, 1: S-curve accel./decel.
2: Non-linear accel./decel.

Step response

This drive system accelerates and decelerates at the maximum output torque regardless of the accel/decel time. Do not set this code at torque vector or V/f control.

S-curve acceleration/deceleration

Slow speed change can be made at the beginning of acceleration/deceleration and at the arrival to the set speed. Thus, smooth and shockless acceleration/deceleration is possible.

Select S-curve acceleration/deceleration and set the width of S-curve at 0% for linear acceleration/deceleration.

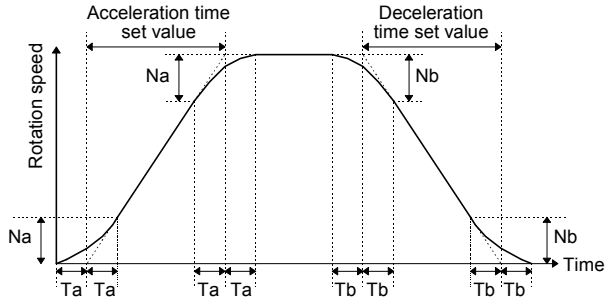
Non-linear acceleration/deceleration

Set the rotation speed during acceleration/deceleration and the accel/decel time at 5 points arbitrarily for non-linear acceleration/deceleration.

P005	S-curve accel./decel. (S-curve width) (At accel.)
P006	S-curve accel./decel. (S-curve width) (At decel.)
P304	(Motor 2) S-curve accel./decel. (S-curve width) (At accel.)
P305	(Motor 2) S-curve accel./decel. (S-curve width) (At decel.)

◆ Set the amount of S-curve in percentages (%) of the accleration/decelration time when selecting the S-curve acceleration/deceleration by the P004 code.

Setting range : 0 to 50%



Ta = Accel. time set value [s] x Set amount of S-curve (accel.) (%) →Set % by P005.

Tb = Decel. time set value [s] x Set amount of S-curve (decel.) (%) →Set % by P006.

Na = Max. speed [r/min] x Set amount of S-curve (accel.) (%) →Set % by P005.

Nb = Max. speed [r/min] x Set amount of S-curve (decel.) (%) →Set % by P006.

Note: Setting P005 and P006 at 0% will change from the S-curve acceleration/deceleration pattern to the linear acceleration/deceleration pattern automatically. When changing the speed setting continuously such as constant circumferential speed control, do not set larger S-curve pattern than required, or follow-up of the motor speed will be affected. So, the motor speed cannot be controlled properly.

In such a case, set the width of S-curve pattern to 0% or reduce the width of S-curve to a level that problems will be cleared.

If the S-curve acceleration/deceleration patterns meet the following conditions, it automatically changes to the linear acceleration/deceleration pattern.

$$\frac{\text{Set value B}}{\text{Set value A}} \geq 82 \text{ or}$$

$$\frac{(\text{Set value A})^2 \times (\text{Set value C})}{\text{Set value B}} \geq 26214$$

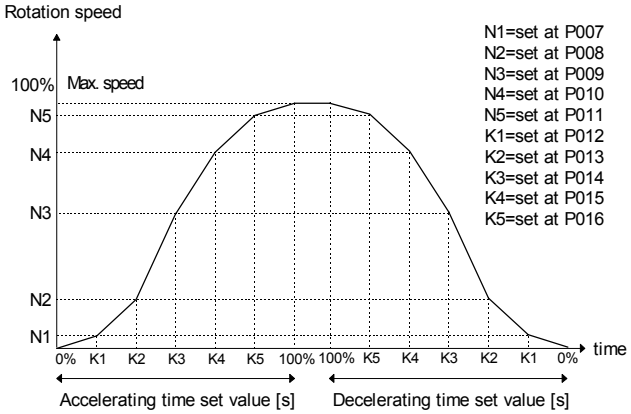
Operation mode		Set value		
		A	B	C
Acceleration	H gear	P002	1	P005
	M gear		P017	
	L gear		P018	
	LL gear		P019	
Deceleration	H gear	P003	1	P006
	M gear		P017	
	L gear		P018	
	LL gear		P019	

The same conditions as in the motor 2

P007	Non-linear speed N1
⟆	⟆
P011	Non-linear speed N5
P012	Non-linear ratio K1
⟆	⟆
P016	Non-linear ratio K5

◆ Set the non-linear acceleration/deceleration pattern.

Setting range: 1 to 99%



However, if the following conditions are not satisfied, the non-linear accel./decel. pattern is changed to the linear accel./decel. pattern automatically.

K1<K2<K3<K4<K5 and N1<N2<N3<N4<N5…….

P017	Accel./decel. ratio (M gear)
P018	Accel./decel. ratio (L gear)
P019	Accel./decel. ratio (LL gear)

◆ When a transmission gear is provided between the motor and

machine spindle, set the gear ratio of M gear, L gear and LL gear versus H gear (maximum speed spindle gear) as an accel./decel. ratio. Set the accel./decel. ratio according to the function code. Acceleration / deceleration is determined by the accel./decel. time given below by input of the switching signal to each of the M, L and LL gears.

MG	LG	Acceleration time	Deceleration time
OFF	OFF	P002	P003
ON	OFF	P002/P017	P003/P017
OFF	ON	P002/P018	P003/P018
ON	ON	P002/P019	P003/P019

For example, when P002 (acceleration time) is 10.0 [s], and P017 (accel./decel. ratio (M gear)) is 4.0 [s], external signal MG is ON, and external signal LG is OFF, the acceleration time is 2.5 [s].
When the 2nd-spindle motor is selected, P002 changes to P302, and P003 to P303.

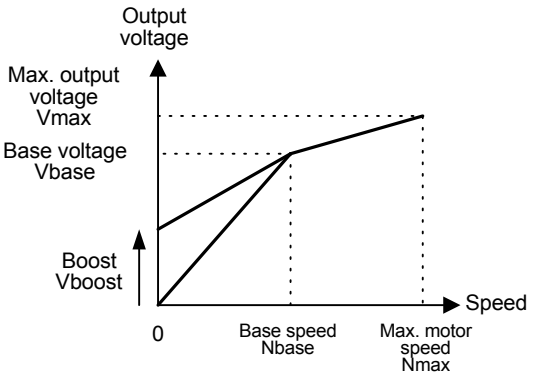
P020 Torque boost
P306 (Motor 2) Torque boost

◆ This function allows selecting the following actions.

Auto torque boost:
When the auto torque boost is selected on condition that motor constant parameters are correctly set, this function calculates an optimum voltage automatically for loads for outputs.

Manual boost:
This function compensates at a constant ratio for the shortage of motor magnetic flux caused by voltage drop in a low frequency area and corrects the shortage of torque during operation at low speed.
If the motor constant is unknown, select the manual boost.

Setting range
0: Auto torque boost
1 to 150: Manual boost



$$Vboost = Vbase \times \frac{\text{Manual boost (P020)}}{1024} \quad [V]$$

Note: If a value is increased by the manual boost, the motor gets in over-excitation at the low speed area. If the motor operation is continued in such condition, it may result in overheating to the motor. Adjust the value to the performance of the motor to drive.
This function is valid only for torque-vector and V/f control.

P021 Analog input filter

◆ This function sets time constants for speed setting (analog input) input filters to protect the analog command from noise.

Setting range: 1 to 1000 [ms]

Note: This function is valid only for torque-vector and V/f control. If the set value is large, response to the speed setting is degraded.

P022 Speed setting offset (Selection of operation)

◆ This function performs automatic adjustment of reference voltage (equivalent to 0 [V]) offset of speed setting (analog input).

Setting range:
0: Inactive
1: Active (auto adjustment)

Input the reference voltage (equivalent to 0 [V]) in the speed setting (analog input), and set the P022 data at "1". When "SAVE" is displayed, automatic adjustment is carried out, and the P022 data display returns to "0" after adjustment.

Note: If the speed command value fluctuates due to noise, etc, adjustment of offset may be impossible.

P023 Speed setting gain (+ polarity)

◆ This function performs automatic adjustment of speed setting (analog input) gain.

Setting range: 0.00 to 11.00 [V]

Input the maximum voltage (+10.00 [V] or equivalent) in the speed setting (analog input) and set the P023 data at "10.00". When "SAVE" is displayed, automatic adjustment is carried out and the P023 data display returns to "10.00" after adjustment. In case of the manual adjustment, set data at "9.00" with respect to +10.00 [V] input, 10% gain is decreased. If the data is set at "11.00", 10% gain is increased.

Note: Adjustable range of the parameter is within ±10%.
This function is only used for fine adjustment.
The speed command value fluctuates due to noise, no adjustment can be made.

P024 Speed setting gain (- polarity)

◆ This function performs automatic adjustment of speed setting (analog input) gain.

Setting range: 0.00 to 11.00 [V]

Input the maximum voltage (–10.00 [V] or equivalent) in the speed setting (analog input) and set P024 data at "10.00". Automatic adjustment is carried out when "SAVE" is displayed, P024 data display returns to "10.00" after adjustment is completed.
If a voltage of –10.00 [V] is input and data is set at "9.00" in the manual adjustment mode, 10% gain is decreased. When data is set at "11.00", 10% gain is increased.

Note: Since this parameter is adjustable in the range of ± 10%, it can only be used for fine adjustment of –10 [V]. If the speed command value fluctuates due to noise, etc, it may not be able to be adjusted. This parameter should be adjusted only when –(minus) polarity input is used for V5 series.

P025	Override offset (Selection of operation)
P026	Override setting width

◆ Set when override is applied to the main speed setting by an external variable resistor. Final speed command value by overriding is as shown below.

$$\text{Speed command value} = \text{Motor maximum speed (P001 set value)} \times \frac{\text{Speed (frequency) set voltage [V]}}{10\ [\text{V}]} \times \left[\text{[100\% + Override setting width (P026 set value)]} \times \frac{\text{Override set voltage [V]} - 5\ [\text{V}]}{5\ [\text{V}]} \right]$$

◆ P025 allows performing automatic adjustment of a reference voltage offset (5 [V] or equivalent) for the override setting (analog input).

Setting range
0: Inactive
1: Active (auto adjustment)

Set a reference voltage of +5 [V] or equivalent to the override setting (analog input) or set an external variable resistor at the center (±0%), and set the P025 data to "1". Automatic adjustment is carried out when "SAVE" is displayed, P025 data display returns to "0" after adjustment is completed.

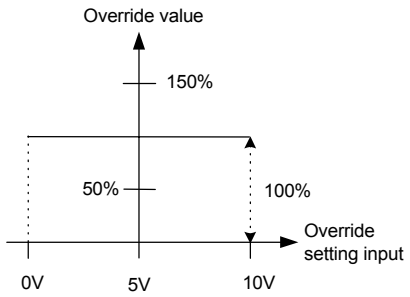
Note: If the override setting input fluctuates due to noise, etc, it may not be able to be adjusted.

◆ P026 allows setting the override setting width .

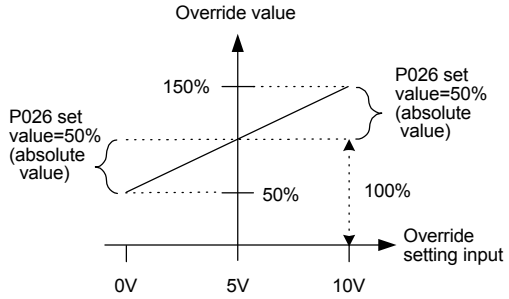
Setting range: 0 to 50%

An example of override setting to speed setting is shown on the right.

Standard factory set value (P026=0%)



Override setting width 50% (P026=50%)



P027	Magnetic flux command level (At constant speed)
P028	Magnetic flux command level (Stronger time constant at decel.)
P030	Magnetic flux command level (At rigidity)
P322	(Motor 2) Magnetic flux command level

◆ These codes allow reducing motor electromagnetic noise by weakening the magnetic flux command level with the speed constant at light load. It boosts the magnetic flux automatically if the amount of a load is increased.

Setting range: 10 to 100%

Note: If the motor speed is decreased, the electromagnetic noise is reduced. However, response to impact load will be degraded.

◆ P028 allows setting the time constant that returns the magnetic flux command level from weak condition to 100% level at the start of acceleration/deceleration.

Setting range: 0 to 250 [ms]

Note: If the time constant is shortened, response is upgraded. However, if it is too much shortened, it may result in overcurrent alarm.

P031	Torque limiter (Driving)
P032	Torque limiter (Braking)
P033	External torque limiter (H)
P034	External torque limiter (L)
P320	(Motor 2) Torque limiter (Driving)
P321	(Motor 2) Torque limiter (Braking)

◆ These codes allow setting limiter values for the torque limiting

operation.

These codes allows controlling the torque limiting action, so that torque calculation value may not exceed each limiter value at torque-vector and V/f control, and torque command value may not exceed each limiter value at the spindle PE feedback control and high-performance vector control.

The torque limit values are selected by combination of inputs of the contact input signals (TLMH, TLML, and SP) as shown below.

Setting range: 0 to 200%

However, 50%ED rated torque for the motor is 100%.

Contact input signal			Selective torque limit value	
TLMH	TLML	SP	Driving	Braking
OFF	OFF	OFF	P031	P032
ON	OFF	OFF	P031/ P033	P032/ P033
OFF	ON	OFF	P031/ P034	P032/ P034
ON	ON	OFF	P031/ P033/ P034	P032/ P033/ P034
OFF	OFF	ON	P320	P321
ON	OFF	ON	P320/ P033	P321/ P033
OFF	ON	ON	P320/ P034	P321/ P034
ON	ON	ON	P320/ P033/ P034	P321/ P033/ P034

Note: In case 3 selective torque limit values or more are filled in the above table, the smallest value of the column is selected.
Toque limiter value should be set according to the specifications of motors and machine.

P035	Output limiter pattern
P036	Output limiter value

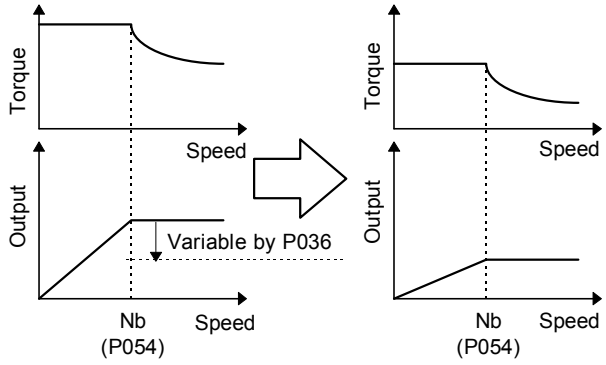
◆ These codes are set when reducing the motor output under mechanical limitations.

When P035 and P036 are used, the pattern is as follows:

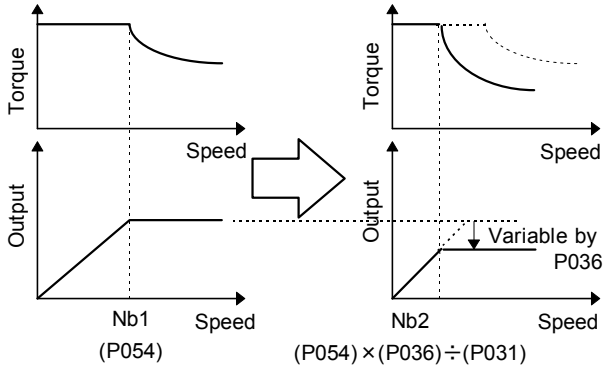
Setting range:
P035: 0 to 5
P036: 0 to 150%
However, 50% ED rated torque for the motor is 100%.

P035	Pattern (see figure on the right above)	Conditions where output limitations are valid
0	-	Invalid for the whole range
1	(1)	Valid only during acceleration/deceleration
2	(2)	
3	(1)	Valid only at constant speed
4	(2)	
5	(2)	Valid at all times

Pattern (1): Limits output by torque limitations.



Pattern (2): Limits output by reducing the base speed.



Note: When the limiter value of an external torque selected is smaller than that set in this function, the external torque limit value becomes valid.

P037	DC injection braking (Voltage)
P038	DC injection braking (Time)

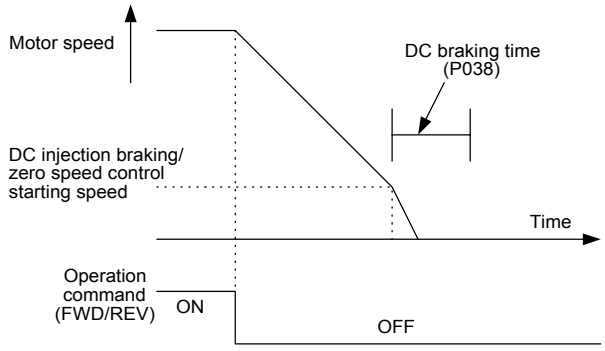
◆ P037 sets the DC voltage level at DC injection braking. This function allows setting the voltage to 100% in 1% step, which flows 1/2 or equivalent of the current set by the continuous rated torque current parameter for the motor.

Setting range: 0 to 100%

Note: The larger the DC voltage level is at the torque-vector and V/f control, the larger braking torque is. But, it may lead to overcurrent alarm or overload alarm. If the P037 value changes at the spindle PE feedback and high-performance vector control, operation will not be changed.

◆ P038 sets the operation time at DC injection braking. This function performs zero speed control, not DC injection braking, at spindle PE feedback control and high-performance vector control.

Setting range: 0.0 to 30.0 [s]



DC injection braking starting speed at the torque-vector and V/f control is about 15 [r/min]. Zero speed control starting speed at the spindle PE feedback control and high-performance vector control is 6 [r/min] (both values are fixed.)

Note: The larger the value is, the longer the braking time at DC injection braking and zero speed control is, but it may lead to overload alarm.

P039	Pre-excitation (Level)
P040	Pre-excitation (Time)

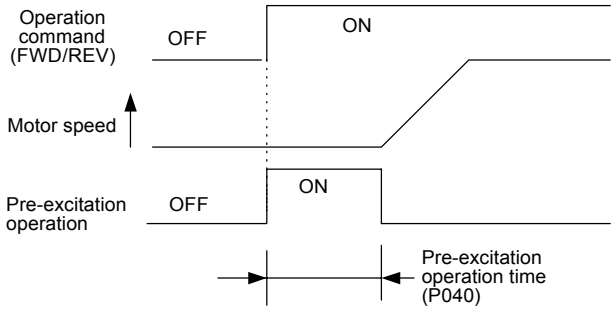
◆ These codes are set when performing pre-excitation for the purpose of improving a torque response at the start of the motor. The exciting current can be supplied at a level set by P039. It can be set in 1% step with the rated exciting current of the motor at 100%.

Setting range: 50 to 200%

◆ The operation time for pre-excitation is set in P040.

Setting range: 0.0 to 5.0 [s]

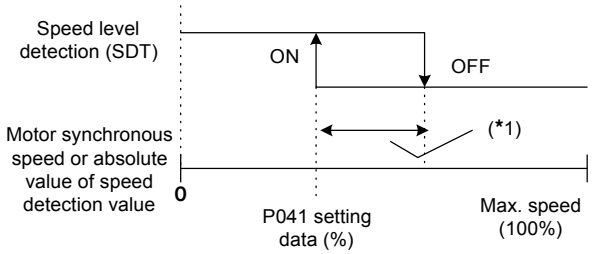
Note: The pre-excitation function is invalid at the torque-vector and V/f control.



P041	Speed detection (Level)

◆ If the motor synchronous speed (output frequency) and speed detection value are below the setting level, the speed level detection signal (SDT) can be output. It allows setting the speed in 1% step with the maximum speed (P001/P301) at 100%.

Setting range: 1 to 100%



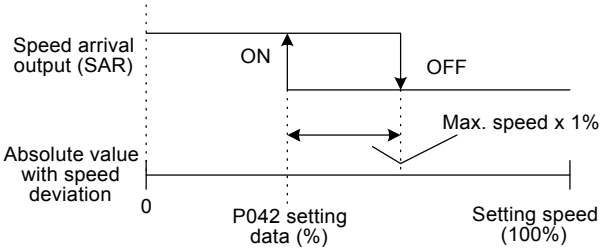
(*1) Hysteresis width
Setting data ＞ 20%: Max. speed x setting data x 5%
Setting data ≤ 20%: Max. speed x 1%

P042	Speed arrival (Detection width)

◆ When the speed arrives at the setting range where the synchronous speed (output frequency) of the motor and speed detection value are set to the command speed, the speed arrival signal can be output.

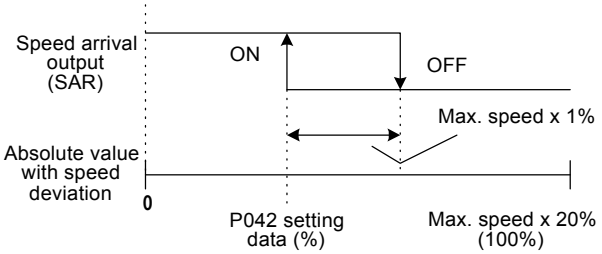
Setting range: 2 to 15%

Speed setting value ＞ max. speed x 20%



Speed arrival is set in 1% step with the setting speed at 100%.

Speed setting value ≤ max. speed x 20%



The speed arrival is set in 1% step in the range of 20% of max. speed (100%).

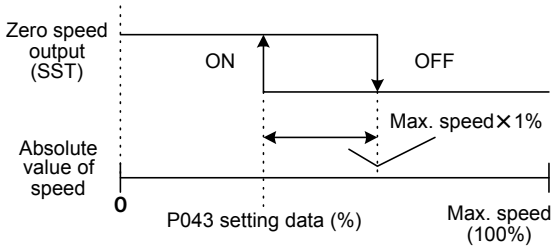
Note: This function does not output the speed arrival signal when either of operation commands (FWD, REV) is off or in the range of zero-speed detection.

P043	Zero speed detection (Level)

◆ In case synchronous speed (output frequency) of the motor and speed detection value are below the setting level, frequency/zero speed signals can be output.

It allows setting the zero speed in 0.1% step with the

maximum speed (P001/P301) (100%).
Setting range: 0.2 to 2.0%

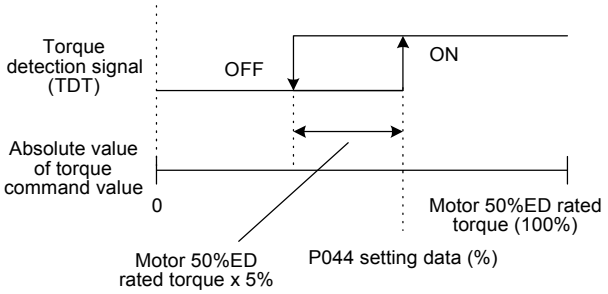


Note: This signal is not turned on (closed) with the coast-to-stop command (BX) on and alarm output.

P044	Torque detection (Level)

◆ When the torque command value exceeds the setting level, this function outputs a torque detection signal. The signal can be set in 1% step with the motor 50%ED rated torque at 100%.

Setting range: 0 to 150%



Note: This function is valid only for the first motor of V5 series in driving.

P045	Ammeter/load meter changeover

◆ This function allows selecting whether the output terminal of the load meter (LM) is connected to either ammeter output or load meter output.

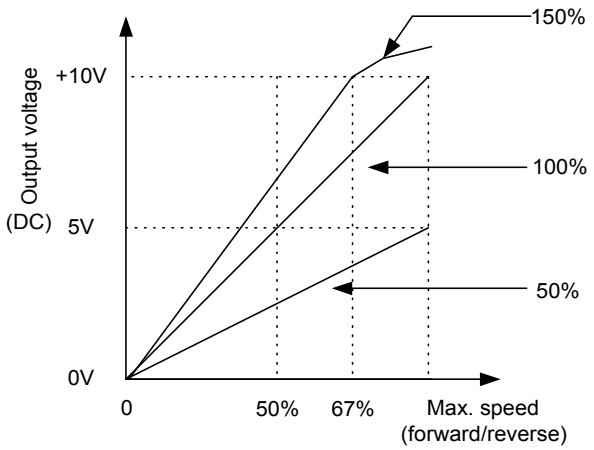
Setting range
0: Ammeter
1: Load meter
2: Special use

Note: It should not be set to 2.

P046	Speedometer gain
P323	(Motor 2) Speedometer gain

◆ This function allows adjustment of output gain for speedometer (SM) output terminals. When the maximum speed set by the motor maximum speed (P001/P301) is set at 100% (maximum output), the motor synchronous speed is output at torque-vector and V/f control and the motor speed is output at spindle PE feedback control and high-performance vector control, and the gain can be changed by this parameter.

Setting range: 50 to 150%



Note: If gain is set at 100% or more, the speed meter outputs up to about 12 [V], but non-linear performance is indicated if it exceeds 10 [V].

P047	Ammeter/load meter gain
P324	(Motor 2) Ammeter/load meter gain

◆ This function allows adjustment of output gain for load meter (LM) terminals.

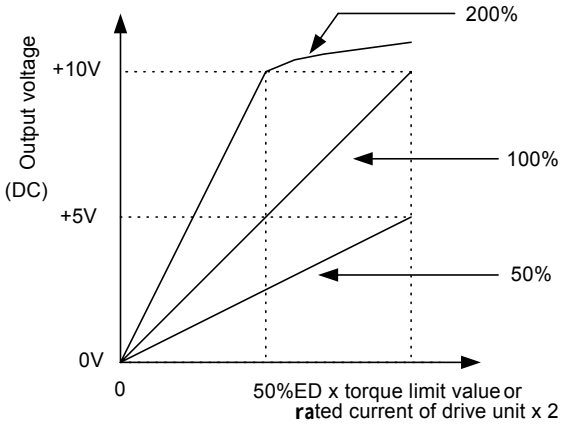
When selecting ammeter:

200% of the rated current for the drive unit is output as 100% (maximum output). Gain can be changed by this parameter.

When selecting load meter:

The sum of 50%ED rated output of the motor x torque limiter setting value (See Note) is output as the maximum output. Gain can be changed by this parameter.

Setting range: 50 to 200%



Note: If the load meter is set to full scale, torque limit value is selected as whichever P031 (driving) or P032 (braking) is larger when the motor 1 is running. When the motor 2 is running, the torque limit value is whichever P320 (driving) or P321 (braking) is larger.

Load meter output is defined as follows:

At torque-vector and V/f control:

Below base speed: motor torque calculation value

Above base speed: (motor torque calculation value x motor synchronous speed) / base speed

At spindle PE feedback and high-performance vector control:

Below base speed: motor torque command value

Above base speed: (motor torque command value x motor speed) / base speed

If gain is set at 100% or more, the speed meter outputs up to about 12 [V], but non-linear performance is indicated if it exceeds 10 [V].

P048	Analog meter test

◆ When this setting is at "1: Active" during adjustment of the analog meter, the speed meter (SM) and ammeter/load meter (LM) output a full scale (10 [V]).

Setting range:

0: Inactive

1: Active

Note: After adjustment has been completed, return the setting to "0".

P049	Ammeter/load meter filter time constant

◆ This function allows setting a time constant of filter to the ammeter/load meter output (LM terminal).

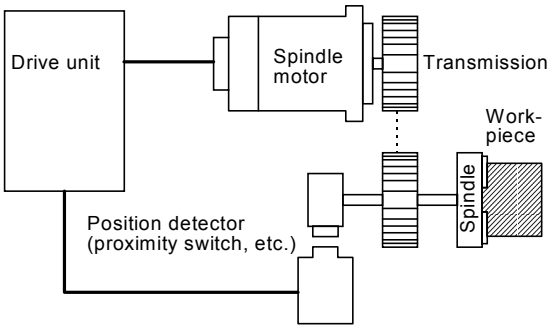
Setting range: 10 to 1000 [ms]

Simplified ORT control

Simplified ORT (positioning) control is a fixed position stop control which allows signals from an external position detector (proximity switch, etc.) to change from slow-speed to DC braking control.

It is valid for M5 series only.

System configuration



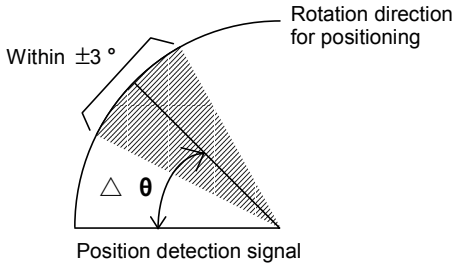
Specifications

Control system	DC braking system
Repeat positioning accuracy	Within $\pm 3^{\circ}$ as based on motor shaft
Repulsion torque	No (Mechanical lock is required if external force is applied after stop. MS5 series motors are not provided with brakes.)
Position detector (provide separately)	Proximity switch, etc. (Detector is provided with contacts or an open collector with output circuit of 15 [V] DC and 5 [mA], max)

Repeat positioning accuracy

The angle $\Delta\theta$ from the position detection signal received to the stop position depends on the moment of inertia of mechanical system, slow-speed, DC braking voltage, DC braking time setting. To stop the motor at a target position, the position detector signal should be output by $\Delta\theta$ in advance as shown below.

Range of stop position



P050	Slow-speed
P051	PDT read timer
P052	Complete signal timer

◆ P050 allows setting the slow-speed.

Setting range: 15 to 300 [r/min]

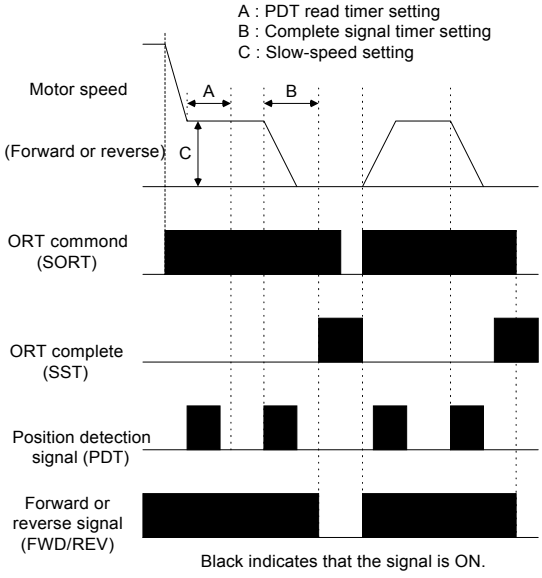
Note: The positioning time is shortened as the slow-speed is increased. The stop position may fluctuate too much.

◆ The PDT read timer should be set by P051 (until reading the effective edge of the stop detection signal is started at slow-speed). If load inertia is larger, the timer should be set to longer period.

Setting range: 0 to 1000 [ms]

◆ The complete signal timer should be set by P052 (the time to be taken from detection of position detection signal to output of complete signal).

Setting range: 0 to 1000 [ms]



Note: The position detection signal is read as the simplified orientation stop command. A complete signal is

output to the zero speed signal (SST). The complete signal is output when DC braking action is started and the setting time of this timer is out. As a matter of fact, whether positioning of the spindle and motor shafts is completed is not directly confirmed.

P053	(Motor 1) Motor code (Type and capacity)
P307	(Motor 2) Motor code (Type and capacity)

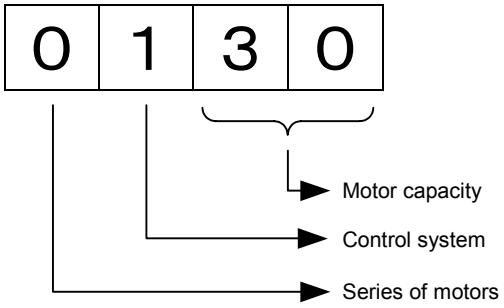
Constant settings for motor 1 and motor 2

P053 to P071, P301 to P319, and P501 to P521 are function codes which set low-speed winding constants of motor 1, motor 2 and winding changeover motor, respectively and these codes should be set correctly according to the motor type, control system and motor capacity. When using dedicated motors (MVE, MVS) and Fuji general-purpose motors (MLA, MLH motors), since values of each code are automatically set to optimum values only by matching motor codes (P053 and P307), there is no need to change individual values. When using other motors, perform proper settings for P054 to P063, P065 and P066. Or it may result in improper motor operation. Even if P901 data initialization is started, the codes related to the motor constants are not changed.

◆ Set the type and capacity of motors to be connected.

Motor constants are automatically written by setting the next motor code in P053 (motor 1) and P307 (motor 2).

Setting range



Series of motors

Series	Code	Contents
200 [V]	0	MVE motor (M5) and M3 series motor (MPF5***)
	1	MVS motor
	2	V3 series motor (MPF *** V3)
	3	Fuji general-purpose motor (MLA, MLH)
	4	Winding changeover motor (for special use)
	5 to 7	Not assigned (non-display)
400 [V]	8	MVE motor
	A	MVS motor
	B	Not assigned (non-display)
	C	CMVE series
	D	Fuji general-purpose motor (MLA, MLH)
	E , F	Not assigned (non-display)

Control system

Code	Contents
0	Torque-vector and V/f control (open-loop control)
1	Spindle PE feedback control High-performance vector control

Motor capacity

Code	Capacity [kW] (50%ED/Continuous)	Code	Capacity [kW] (50%ED/Continuous)
01	1.1/0.75	18	18.5/15
02	2.2/1.5	22	22/18.5
03	3.7/2.2	30	30/22
05	5.5/3.7	37	37/30
07	7.5/5.5	45	45/37
11	11/7.5	55	55/45
15	15/11		

Note: For the spindle PE feedback and high-performance vector control, a combination test may be needed depending on applicable motors. Contact Fuji Electric.
In choosing Fuji general-purpose motor (MLA and MLH series), set the motor code with the same continuous rating as given in the table above.
(Example) In case of 200 [V] MLA6165 (continuous rating: 11kW) motor, select “3015”.

If P053 is changed after the setting data of P031, P032, P054 to P071, P501, P504 to P521, P801, P802, P809, and P810 have been set, and P307 is changed after P308 to P321 have been set, be carefull since individual set values are rewritten.

P054	Base speed
P308	(Motor 2) Base speed
P505	(Low-speed winding) Base speed

◆ This function sets the base speed of the motor. Set the base speed to the rating of the motor.

Set range: 100 to 20000 [r/min]

P055	Rated voltage
P309	(Motor 2) Rated voltage
P506	(Low-speed winding) Rated voltage

◆ Set the rated voltage of the motor. Set the rated voltage to the rating of the motor. However, voltage in excess of the power supply (input) voltage cannot be set.

Setting range: 120 to 480 [V]

P056	Rated current (Continuous)
P310	(Motor 2) Rated current (Continuous)
P507	(Low-speed winding) Rated current

◆ Set the rated current of the motor. Set the rated current to the rating of the motor.

Setting range: 0.1 to 500.0 [A]

P057	Rated torque current (Continuous)
P508	(Low-speed winding) Rated torque current

◆ Set the rated torque current of motor 1.
Set them according to the rating of the motor.
Torque current can be obtained from the following equation.

$$\text{Torque current} = \sqrt{(\text{Rated current})^2 - (\text{Exciting current})^2}$$

Setting range: 0.1 to 500.0 [A]

P058	Exciting current
P311	(Motor 2) Exciting current
P509	(Low-speed winding) Exciting current

◆ Set the exciting current (no-load current) of the motor. Set the exciting current to the rating of the motor.

Setting range: 0.1 to 500.0 [A]

Note: This setting is also enable by the auto tuning (P072) function.

P059	%R1
P060	%Lσ
P312	(Motor 2) %R1
P313	(Motor 2) %Lσ
P510	(Low-speed winding) %R1
P511	(Low-speed winding) %Lσ

◆ This function allows setting %R1 and %Lσ obtained from motor primary resistance, resistance value between the drive unit and motor, and leakage reactance at the base speed.

Setting range: 0.00 to 50.00%

%R1 is obtained from the following equation.

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

Where,
R1: Motor primary coil resistance [Ω]
Cable R: Output cable resistance value [Ω]
V: Rated voltage [V],
I: Motor rated current [A]

%Lσ is obtained from the following equation.

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

Where,
X1: Motor primary leakage reactance [Ω]
X2: Motor secondary leakage reactance [Ω]
XM: Motor exciting reactance [Ω]
Cable X: Reactance of output cable [Ω]
V: Rated voltage [V]
I: Rated current of motor [A]

Note: This setting is also enable by the auto tuning (P072) function.

P061	Number of motor poles

◆ This function sets the number of motor poles.

Setting range: 2, 4, 6, 8, 10, and 12

Note: For the torque-vector control and V/f control, set correct values, or speed display and parameter setting values may differ from actual values.

P062	Maximum speed
P314	(Motor 2) Maximum speed
P512	(Low-speed winding) Maximum speed

◆ This function sets the maximum speed to the specifications of the motor. Set the maximum speed to the rating of the motor.

Setting range: 100 to 20000 [r/min]

Note: This setting is required for determining V/f pattern. Be sure to set the maximum speed.

P063	Maximum output voltage
P315	(Motor 2) Maximum output voltage
P513	(Low-speed winding) Maximum output voltage

◆ This function sets the maximum output voltage to the specifications of the motor. Set the maximum output voltage to the rating of the motor.

Setting range: 120 to 480 [V]

Note This setting is required for determining V/f pattern. Be sure to set the maximum output voltage. But, voltage exceeding the power supply (input) voltage can not be output.

P064	Differential calculation constant
P514	(Low-speed winding) Differential calculation constant

◆ These constants are needed for control.

Setting range: 0000 to FFFF

Note: Unless otherwise requested, do not change function values.

P065	Slip frequency (Driving)
P066	Slip frequency (Braking)
P316	(Motor 2) Slip frequency (Driving and braking)
P515	(Low-speed winding) Slip frequency (Driving)
P516	(Low-speed winding) Slip frequency (Braking)

◆ These functions allow performing slip compensation control by using parameter setting values at the torque-vector and V/f control (open loop). Slip compensation control reduces motor speed variations caused by change in torque by adding the frequency proportional to the motor torque to the inverter output frequency. Slip compensation control will not be performed with the setting value at 0.

Note: At the torque-vector and V/f control (open loop), do not set the slip frequency setting value larger than needed, or hunting phenomena may occur to the motor.

◆ In case of spindle PE feedback control and high-performance vector control, the slip amount of the motor is calculated to perform vector control by using the parameter setting value.

Note: Set the slip frequency setting value correctly at the PE feedback control and high-performance vector control, or reduction in the motor torque may result.

Setting range: 0.00 to 5.00 [Hz]

P067	Calculation coefficient 1
∫	∫
P071	Calculation coefficient 5
P317	(Motor 2) Calculation coefficient 1
∫	∫
P319	(Motor 2) Calculation coefficient 3
P517	(Low-speed winding) Calculation coefficient 1
∫	∫
P521	(Low-speed winding) Calculation coefficient 5

◆ These data are required for control.

Setting range: 0000 to FFFF

Note: Do not change function values unless otherwise requested.

P072	Auto tuning (%R1, %Lσ, Io)

The auto tuning function measures motor constants (%R1, %Lσ, and Io) required for control by the drive unit and writes the measured data automatically.

Note: When dedicated motors for MVE and MVS are used, do not perform auto tuning.

Code	Operation status
0	Inactive
1	Perform auto tuning of %R1 and %Lσ with the motor stopped.
2	Perform auto tuning of exciting current (no-load current Io) with the motor running.

◆ Auto tuning procedure

<u>To start tuning of %R1 and %Lσ</u>

1. Disconnect the motor from a load. If the motor cannot be disconnected from the load, limit the load to a minimum.
2. Set the motor capacity code, base speed [r/min], rated voltage [V], rated current [A], number of motor poles, maximum output voltage [V] according to the motor ratings.
3. Set the acceleration/deceleration time longer to avoid an alarm occurrence during acceration/deceleration.
4. Set this function code at "1". Tuning starts when the "SAVE" is displayed. A few seconds will be taken to perform tuning and it completes when "0" is automatically displayed after turning is ended.

Note: When turning is started, motor shaft slightly turns.

<u>To start tuning of Io</u>

5. When this function code is set at "2", and "SAVE" is displayed, the tuning mode is set.
6. Set the speed setting at about 1/3 to 1/2 (arbitrarily) of the base speed and turn the operation command (FWD, REV) ON. When the motor rotates and it arrives at the command speed, tuning is started.
   A few seconds will be taken to perform tuning, and it completes when "0" is automatically displayed after turning is ended. After tuning, turn the operation command off to stop the motor.

Note: This tuning is only valid only when the torque-vector or V/f control mode is selected. Be sure to start the turning with the 100's digits of the motor code (P053) set to 0 and with PE feedback control (P078) at 0, respectively.

When tuning the motor 2, input the 2nd-spindle changeover command and start the auto tuning.

As the motor turns at a high speed in the auto tuning of Io (exciting current), start auto tuning with care about the high speed rotation. If the tuning is not properly performed, "Er 5" is displayed with the alarm.

P073	Motor speed adjustment (at low-speed)

◆ This function performs an automatic adjustment of a speed detector circuit when the MVS motor is used for V5 series.

Setting range:
0: Inactive
1: Gain adjustment
2: Offset adjustment

Note: In case of V5 series, be sure to perform this speed adjustment. However, in case of M5 series and when the MVS motor is not used, do not start this adjustment.

◆ Procedure of automatic adjustment

To start the offset adjustment

Set the function code at "2" when the motor is completely stopped, and this function starts tuning immediately when "SAVE" is displayed.
A few seconds will be taken to perform the tuning and it completes when "0" is automatically displayed after turning is ended.

To start gain adjustment

Set the function code at "1" when the motor is running at 50 [r/min] forward or in reverse direction, and this function starts tuning when "SAVE" is displayed.
A few seconds will be taken to perform the tuning and it completes when "0" is automatically displayed after turning is ended.

Note: If hunting occurs to the motor running at a low speed, carry out this adjustment again.

Be sure to set the speed of the motor shaft at 50 [r/min] before starting the gain adjustment. If hunting may occur to the motor during adjustment, decrease the ASR gain to a small value to assure a smooth rotation and then start the adjustment.

P074 Tuning (Current detection)

◆ This function performs automatic adjustment of gain balance in the detection of current.

Setting range:
0: Inactive
1: Active

Note: Unless otherwise described, there is no need to start this function.

P075 Tuning (Voltage detection)

◆ This function performs automatic adjustment of offset/gain in the detection of voltage.

Setting range:
0: Inactive
1: Active

Note: Tuning adjustment should be carried out only when printed circuit boards are replaced during maintenance. Unless otherwise described, do not perform this adjustment.

If this adjustment is forced to be performed, stop the motor completely and set this function code at "1" with the motor cable disconnected from the drive unit. When "SAVE" is displayed, the tuning adjustment starts up.

A few seconds will be taken to perform the tuning, and it completes when "0" is automatically displayed after turning is ended.

This adjustment is not required for the spindle PE feedback control and high-performance vector control.

P076 Capacity of drive unit

◆ This function sets the capacity of the drive unit.

Setting range: Code by capacity
The code of the drive unit by the capacity is given below:

[200V series]

Code	Capacity [kW] (50%ED/Cont.)	Code	Capacity [kW] (50%ED/Cont.)
01	1.1/0.75	18	18.5/15
02	2.2/1.5	22	22/18.5
03	3.7/2.2	30	30/22
05	5.5/3.7	37	37/30
07	7.5/5.5	45	45/37
11	11/7.5	55	55/45
15	15/11		

[400V series]

Code	Capacity [kW] (50%ED/Cont.)	Code	Capacity [kW] (50%ED/Cont.)
401	-	418	18.5/15
402	-	422	-
403	-	430	-
405	-	437	-
407	7.5/5.5	445	-
411	11/7.5	455	-
415	15/11		

Note: This code is strictly factory-set before shipment. Do not manipulate the value.

When printed circuit boards are replaced during the maintenance, different values may be set. Set the correct value.

Note that the drive unit capacity code will not vary even when data initialization P901 is started.

P077 Excess speed deviation alarm (Selection of operation)

◆ Of the speed deviation excess alarm, this function allows selection of the start delay detection operation. For definition of speed deviation excess alarm (start delay) detection, Section 10. Alarm function.

Setting range:
0: Inactive
1: Active

Note: Selection of operation mode is valid only for spindle PE feedback control of M5 series and high performance vector control of V5 series.

P078 PE feedback control (Selection of operation)

◆ This function is set when performing PE feedback control by using signals from the pulse encoder (1024 or 2048 [P/R] line driver output type) mounted in the spindle or motor with the optional card (OPCII-MS5-PE or OPCII-MS5-SY) inserted into M5 series.

Setting range:
0: Inactive
1: Active

Note: V5 series:
When using V5 series in combination with the standard MVS series motor, set the function code to "0: Inactive". When 1024 or 2048 [P/R] line driver output type encoder is only installed on the motors with the optional card (OPCII-MS5-PE or OPCII-MS5-SY) for special application, set the function code to "1: Active".
M5 series:
Unless the optional card (OPCII-MS5-PE or OPCII-MS5-SY) is inserted in M5 series, PE feedback control is not activated even with set at "1".

P079	NTC thermistor (Selection of operation)

◆ This function allows selection of operation about the NTC thermistor for temperature detection built in dedicated motors (MVS, MVE series).

Setting range:
0: Inactive
1: Active

Note: When the code is set to "0: Inactive", be sure to install a protective circuit for motor overheating in external units.

P080	Spindle/motor speed ratio (H gear)
P081	Spindle/motor speed ratio (M gear)
P082	Spindle/motor speed ratio (L gear)
P083	Spindle/motor speed ratio (LL gear)

◆ If a transmission mechanism such as pulleys or gears between spindle and motor shaft where the encoder is installed is provided, set the ratio in hexadecimal according to the following equation.

$$\text{Spindle/motor speed ratio} = \frac{\text{Motor max. speed [r/min]} \times 2048}{\text{Spindle max. speed [r/min]}}$$

(Example) In case the spindle max. speed is 4000 [r/min], and motor max. speed is 5000 [r/min],
(5000 x 2048) /4000 =2560
When performing decimal-to-hexadecimal conversion of 2560, it is A00. Set the ratio to 0A00.

Note: When installing the optional card (OPCII-MS5-PE, OPCII-MS5-SY or OPCII-MS5-MG), be sure to set the ratio to correct value for each gear, or orientation operation time may become longer, thus degraded control accuracy of the synchronous operation may result, hunting may occur during operation and the worst alarm may occur.

P100	Selection of function block (P101 to P126)
P200	Selection of function block (P201 to P228)
P300	Selection of function block (P301 to P324)
P400	Selection of function block (P401 to P430)
P800	Selection of function block (P801 to P810)

◆ The function selects whether the function code in parentheses is displayed in each function block or not.

Setting range:
0: Non-display
1: Display

Note: The function codes which are set at "non-display" by the selection can be still used for control.

ASR (Automatic Speed Regulator)

This function is valid only for spindle PE feedback control and high-performance vector control.

Caution

If a high gain or improper data is input for the functions related to ASR, hunting may occur to motors, thus damage to the motor and other devices result.

Do not increase the ASR P gain (P101 to P109) data abruptly. Do not decrease the ASR integral time (P110 to P118) data abruptly.

The functions related to the ASR are as follows:
- ASR P gain
- ASR integral time
- ASR input filter
- Speed detection filter

P101	ASR P gain (H gear)
≀	≀
P109	ASR P gain (ORT LL gear)

◆ This function sets P-gain for the automatic speed regulator. When the setting value is raised, response to the speed control enhances. However, if the setting value is increased too much, hunting may occur to motors.

Setting range: 0 to 150 times

Note: For the changeover, see the table given below.

P110	ASR integral time (H gear)
≀	≀
P118	ASR integral time (ORT LL gear)

◆ This function sets integral time for the automatic speed regulator. When the setting value is lowered, response to the speed control enhances. However, if the setting value is decreased too much, hunting may occur to motors.

Setting range: 0 to 200 [ms]

Note: For the changeover, see the table given below.

(Reference)

Speed deviation ΔN→ASR→Torque command τ*

The transmission function of ASR system is expressed in the following equation.

$\tau^* = Kp\left(1 + \frac{1}{STi}\right) \times \Delta N$ Kp: P constant Ti: Integration constant

Definition of 1.0 time P constant

The gain is 1 on condition that torque command, τ* is assumed to be equal to 100% (continuous rated torque) when speed deviation ΔN is equal to 100% (base speed).

P119	ASR input filter
P122	ASR input filter (Rigid)

◆ It is used when a response to speed command requires some delay, or analog speed set voltage is unstable. If made too big, response to speed setting drops. In rigid tap mode, a small value is set to enhance response.

Setting range: 1 to 1000 [ms]

Note: For the changeover, refer to the table below.

P123	Speed detection filter (H gear)
≀	
P126	Speed detection filter (ORTM, L, LL gear)

◆ In case the ripple of speed detection signal is big, a bigger set value is used. If too big, response to speed control drops. If a bigger set value is used, control may become unstable on the contrary. In this case, lower ASR gain.

Setting range: 1 to 50 [ms]

Note: For the changeover, refer to the table below.

P120	Maximum speed (Rigid)
P121	Analog input filter (Rigid)

◆ When the rigid tap command (HMD) is on to raise speed setting resolution in the rigid tap mode, the maximum speed is switched to the value given by P120. For the operation of rigid tap mode, see items of the rigid tap command given in Section 5.3.

Setting range: 100 to 20000 [r/min]

Note: P121 analog input filters (rigid) is invalid in any case.

P801	Data 1 for maker
P802	Data 2 for maker
P809	Data 9 for maker
P810	Data 10 for maker

◆ Codes for maker (by the capacity)

Setting range: 0000 to FFFF, 0 to 255

Note: Unless otherwise described, do not manipulate values.

P803	Selection of current/voltage limit operation

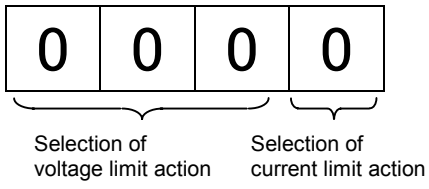
◆ This function allows selection of the current and voltage limit action by monitoring output current and DC link circuit voltage during operation to prevent overcurrent and overvoltage alarms from occurring.

Setting range: 0000 to FFFF

Note: Unless otherwise described, do not manipulate values.

(Reference)

Top three digits of the setting data are for selection of the voltage limit action, and the remaining digit is for selection of current limit action.

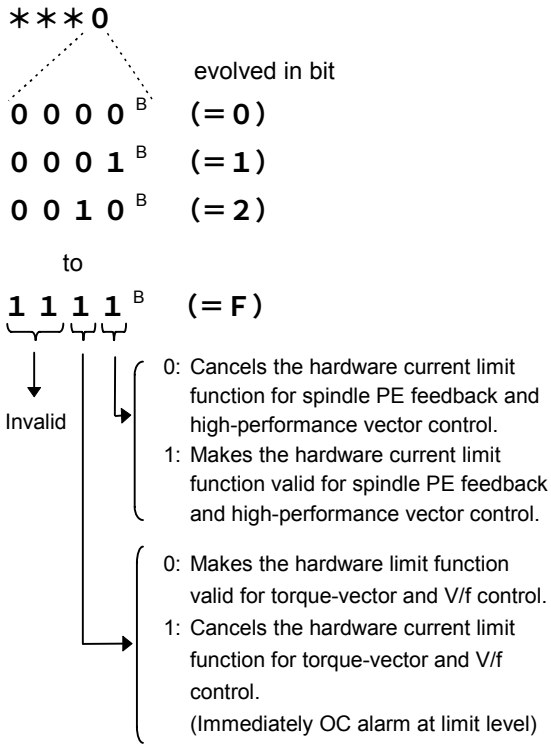


List of codes selected in each operation mode

External input				Operation mode	ASR P-gain	ASR integral time	Speed detection filter	Analog input filter	Magnetic flux command level	Maximum speed
ORT	MG	LG	HMD							
OFF	OFF	OFF	OFF	Normal H gear	P101	P110	P123	P119	P027	P001
OFF	ON	OFF	OFF	Normal M gear	P102	P111	P124			
OFF	OFF	ON	OFF	Normal L gear	P103	P112				
OFF	ON	ON	OFF	Normal LL gear	P104	P113				
ON	OFF	OFF	Arbitrary	ORTH gear	P106	P115	P125	P208	P029	
ON	ON	OFF	Arbitrary	ORTM gear	P107	P116				
ON	OFF	ON	Arbitrary	ORTL gear	P108	P117	P126			
ON	ON	ON	Arbitrary	ORTLL gear	P109	P118				
Arbitrary			ON	Rigid tap	P105	P114	P124	Invalid	P030	P120

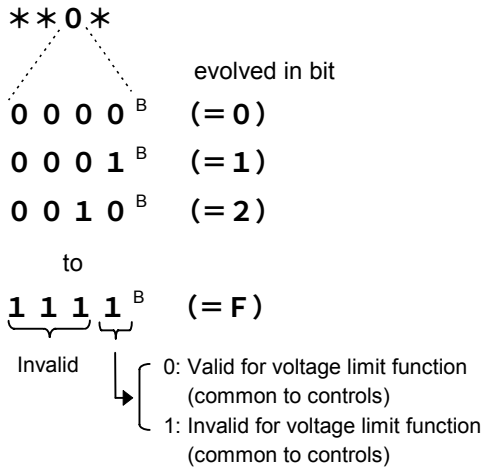
Selection of current limit operation

The least significant digit (the one place) is further evolved in bit.



Selection of voltage limit operation

The least significant 2nd digit (the place of 10) is further evolved in bit.



(Torque-vector and V/f control)

When the DC link circuit voltage reaches the voltage limit level during the reduction in the motor speed when the voltage limit action is valid, stop the motor speed reduction temporarily and wail until the DC voltage reduces below the limit level.

(Spindle PE feedback and high-performance vector control)

If the voltage limit action is valid, DC link circuit voltage reaches the voltage limit level, regenerative current of the regenerative braking converter unit arrives at the limit level, turn the torque command off once and wail until the voltage and current are lowered below the limit level. The torque current return time constants can be set to the most significant 2 digits (the places of 1000 and 100) to return the current from the limit level.

For example, if 32^{H} (= 50^{d}), the constant is 50 [ms]. If 64^{H} (= 100^{d}), the time constant is 100 [ms]. Also, the time constant is 100 [ms] with 00^{H}.

P808 Excess speed deviation detection

◆ This function allows selection of excess speed deviation detection action. For the definition of the excess speed deviation alarm detection, see Section 10. Alarm function.

Setting range:
- 0: Invalid
- 1 to 100: Valid

Note: The mode selection is valid only for M5 series spindle PE feedback control and V5 series high-performance vector control.

P900 Speed display (Selection of range)

◆ The setting range of the function code which sets and displays the speed depends on the settings of this function. When the function code is set at "0", the display indicates values in the range from "0 to 9999", which means the speed. When the code is set at "1", the display indicates values in the range from "0. to 20000.", which means 1/10 of actual values.

For example, if the display indicates "1200.", the actual value is 12000 [r/min].

Setting range:
- 0: 0 to 9999 [r/min]
- 1: 0 to 20000 [r/min]

Note: In an attempt to change the setting value of this code from 1 to 0, the setting of this code cannot be changed with the setting value in the code related to the speed setting set at 10000 [r/min] ("1000." Is displayed) or more. In this case, change the setting value to 10000 [r/min] or less, and then change the setting of this code.

P901 Data initializeation

◆ This function allows customized data to return to the default value. To initialize setting value of all functions automatically, set the this function at "1" and save it. When initialization is completed, the setting value of this function returns to "0" automatically.

Setting range:
- 0: Manual setting value

1: Initialization

Caution

If data is initialized under this code, all of the codes, such as maximum speed, acceleration/deceleration time, ASR constants except for some codes return to factory-set values. So, after initialization has been completed, set the values according to the specifications for the machine and then put the machine into operation.

Since the following codes are not initialized, perform resetting of data individually if required.

Capacity of drive unit (P076)
Motor constants (P031, P032, P053 to P071, P307 to P321, P501, P505 to P521, P801, P802, P809, P810)
Adjustment of speed setting gain (P023, P024)
Speed display (selection of range) (P900)

P902	Alarm history clear

◆ This function clears all of alarm histories from the latest to 3rd occurrence in the past.

To clear the alarm history, set the setting value at "1" and save it. After the history clear is completed, the setting value of this function returns to "0" automatically.

Setting range:
0: Inactive
1: Active

Note: History clear cannot be achieved when the alarm is activated.

P903	Data batch setting

◆ When the number of data settings is 2 or more, this function eliminates the need to repeat the "save" operation by pressing the SET key every time each setting is completed. After you change all of the data of the function code to be set, set the function code to "1" and save it, and all of the data changed are saved at the same time.

Setting range:
0: Inactive
1: Data batch setting

(3) Alarm code (F000 to F012)

F000	Alarm (Latest)
F010	Alarm history (Previous)
∫	∫
F012	Alarm history (3 times before)

◆ The latest alarm to the alarm that occurred in the 3 times before are displayed. If an alarm occurs, the display indicates "F000" automatically.

Display value: by code display

Note: If the alarm history is cleared under the function code P902, displays are all cleared.

F001	Data at alarm (Speed/speed detection value)

◆ This function displays the motor speed (data equivalent to C000) at the occurrence of the latest alarm.

Display value: 0 to 20000 [r/min]

F002	Data at alarm (Speed set value)

◆ The function displays the speed setting value at the occurrence of the latest alarm.

Display value: 0 to 20000 [r/min]

F003	Data at alarm (Output current/output torque current)

◆ This function displays the output current at the occurrence of the latest alarm. It displays the output torque current at the spindle PE feedback and high-performance vector control.

Display value: 0 to 255%

F004	Data at alarm (Torque current command value)

◆ This function displays the torque current command value at the occurrence of the latest alarm.

Display value: 0 to 255%

Note: This function displays the same value as in F003 at the torque-vector and V/f control.

F005	Data at alarm (Exciting current detection value)

◆ This function displays the detection value of exciting current at the occurrence of the latest alarm.

Display value: 0 to 255%

Note: This function displays the same value as in F003 at the torque-vector and V/f control.

F006	Data at alarm (Exciting current command value)

◆ This function displays the command value of exciting current at the occurrence of the latest alarm.

Display value: 0 to 255%

Note: This function displays the same value as in F003 at the torque-vector and V/f control.

F007	Input signal (Control)

◆ This function allows the status of contact input signal (control signal) to be displayed on LED at the occurrence of the latest alarm. The display position and signal name are the same as in C005. See the code, C005.

F008	Input signal (Option)

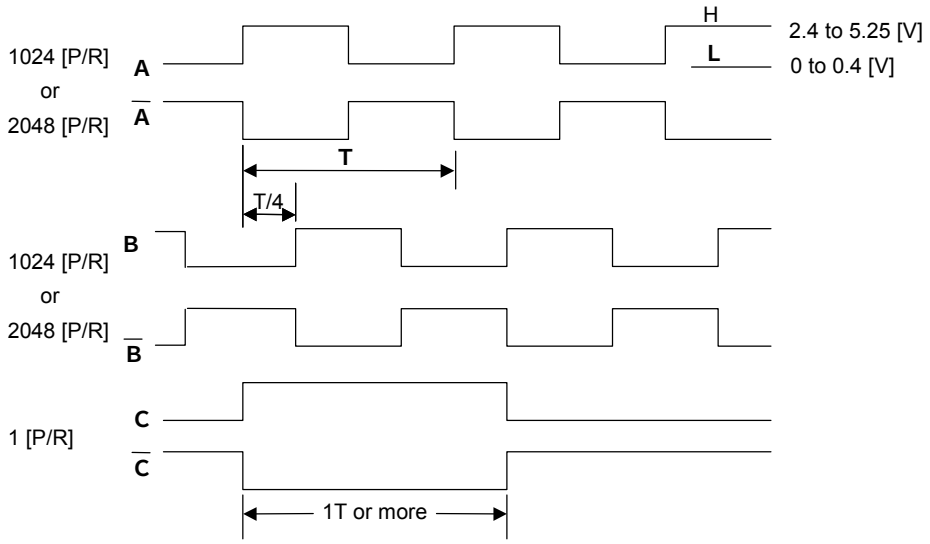
◆ This function allows the status of contact input signal (option card) to be displayed on LED at the occurrence of the latest alarm. The display position and signal name are the same as in C006. See the code, C006.

F009	Output signal

◆ This function allows the status of contact output signal to be displayed on LED at the occurrence of the latest alarm. The display position and signal name are the same as in C007. See the code, C007.

9.3 Spindle orientation function (option)

(1) Standard specifications

Item		Magneto-sensor (MG) system	Pulse encoder (PE) system
Stop position		• Stops at center mark position of magnet and magneto-sensor.	• Internal setting method: Function code • External setting method: 12-bit binary
Repetitive positioning accuracy	M5 series	• ±0.5° or less, ±0.5 [mm] or less with respect to magnet mounting diameter of 100 [mm].	• ±0.3° or less (PE feedback control) • ±0.5° or less (torque-vector control)
	V5 series	• ±0.1° or less, ±0.1 [mm] or less with respect to magnet mounting diameter of 100 [mm].	±0.1° or less
Detection position		-	• 0.088°/pulse (when using pulse encoder of 1024 [P/R]) • 0.044°/pulse (when using pulse encoder of 2048 [P/R])
Range of stop position adjustment		-	• Enable by internal setting
Repulsion toque		• None (M5 series) • Spindle motor max. value (V5 series) • Transient displacement becomes large against instantaneous load torque.	• Spindle motor max. value ※No repulsion torque exists at torque-vector control of M5 series. • Transient displacement becomes large against instantaneous load torque.
Mechanical conditions		• Spindle maximum speed : 8000 [r/min] or less • No. of transmission gear steps: 4 steps, max. • Transmission gear ratio: 0.5 to 32 (motor shaft/spindle) (*1)	
Type of optional card built in drive unit		OPCII-MS5-MG	OPCII-MS5-PE or SY
Position detector		• Type of magnet: M-16 (Mass: 5±0.3 [g]) M-25 (Mass: 9±0.5 [g]) M-40 (Mass: 14.5±0.5 [g]) • Sensor type: FSH-1460 • Detector type: FSD-1460	• LED type pulse encoder (*2) A, $\overline{A}$ signal: 1024 or 2048 [P/R] B, $\overline{B}$ signal: 1024 or 2048 [P/R] C, $\overline{C}$ signal: 1 [P/R] • Output circuit type: Line driver Balance transmission type equivalent to SN75113
Pulse encoder output specifications			

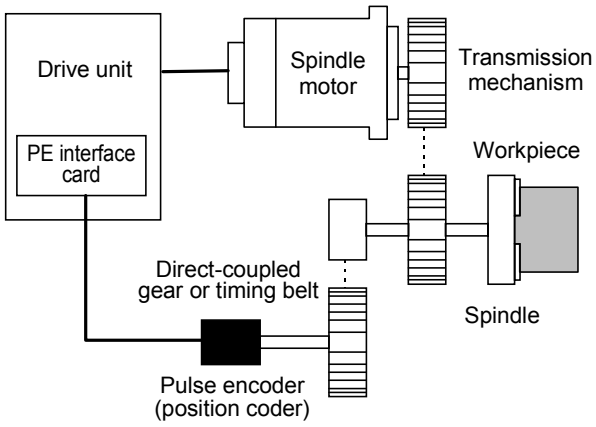
Notes:

(*1) In M series, when the reduction ratio of motor versus spindle is large (5 times or more) for the pulse encoder type orientation, select torque-vector control. Spindle PE feedback control is not available.

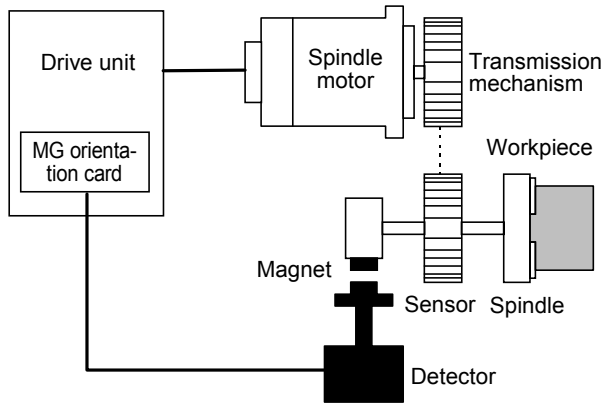
(*2) The customer is reguested to arrange for the pulse encoder.
Since the power of Fuji drive unit (optional card) is not supplied to the pulse encoder, the power should be supplied from an external unit. Current consumption of the optional printed circuit board above is 3 [mA], max.

(2) System configuration

Pulse encoder system



Magneto-sensor type



(3) Description of function code

P201	Pulse encoder (Ratio to spindle)

◆ This function sets the rotation ratio of spindle versus the pulse encoder mounted on the spindle.

Setting range
- 1: Spindle : Pulse encoder = 1 : 1
- 2: Spindle : Pulse encoder = 2 : 1

Note: Do not set any ratio other than the above ratios.

P202	Pulse encoder (Selection of phase A or B)

◆ This function sets the definition of output pulse phase sequence for the pulse encoder mounted on the spindle and the rotational direction of the motor.

Setting range:
- 0: Phase A lead with motor in forward direction
- 1: Phase B lead with motor in forward direction

The setting procedure is as follows:
1. Turn the motor slowly by the forward command (FWD).
2. Make sure that the data of the function code C010 (position deviation) vary in the decrement direction. If the data changes in the increment direction, stop the motor once. Change the setting from 0 to 1 (or from 1 to 0) and then check the code C010 again.
   In case the C010 data cannot be read since the indication changes too fast, reduce the motor speed.

P203	Pulse encoder (No. of pulses)

◆ This function sets the number of pulses of the pulse encoder mounted on the spindle.

Setting range:
- 0: 1024
- 1: 2048

P204	Accel./decel. mode for ORT (Selection of mode)

◆ This function allows the setting to determine whether the soft start/stop mode at orientation is valid or not.

Setting range:
- 0: Inactive
- 1: Active

When the code is set at "0", the motor accelerates/decelerates depending on the maximum capacity (step response) of the drive unit.
When the code is set at "1", the motor accelerates/decelerates according to the pattern set by the P004 accel./decel. mode.

Note: In case the code is set at "0", the orientation time is shortened, but the change rate at the start and stop is large and mechanical shock may occur.

P205	Internal stop position

◆ This function sets the deviation between origin (C pulse position) of the pulse encoder and origin of machine spindle (orientation origin).

Setting range: 0000 to 1FFFF

The setting can be achieved by starting automatic reading of P206 internal stop position and automatic writing by external contact input PSET, and changing this code directly.

P206	Automatic reading of internal stop position

◆ This function allows a current spindle stop position to be saved automatically in the code P205 as an internal stop position by writing "1" in the code.

Setting range:
- 0: Inactive
- 1: Active

Match the spindle position with the origin of the machine spindle. Adjustment of origin can be automatically achieved by writing "1" in this code.

Note: After the power is turned on, be sure to rotate the spindle by one turn or more and start this code. Before the start, make sure that the power of the pulse encoder is turned on.

P207	(ORT) Torque boost

◆ This function sets the amount of torque boost at the orientation. It enables the following mode to be selected.

Automatic torque boost:
An optimum voltage can be automatically calculated for a load when selecting the selecting the automatic torque boost on condition that the motor parameters are correctly set.

Manual boost:
The shortage of the motor magnetic flux due to voltage drop in the low frequency area can be corrected at a constant ratio to compensate for the shortage of torque at the low speed operation.
If motor constants are unknown, set the manual boost.

Setting range:
0: Automatic torque boost
1 to 150: Manual boost

Note: This setting is only required for the magneto-sensor type orientation of M5 series, and for the pulse encoder type orientation at the torque-vector and V/f control of M5 series. The operation will not change even when the setting is changed at the spindle PE feedback control or high-performance vector control.

P208	(ORT) ASR input filter

◆ This function is used to allow response to the orientation action to be delayed.

Setting range: 1 to 1000 [ms]

P209	1st slow-speed (ORT H gear)
P210	1st slow-speed (ORT M gear)
P211	1st slow-speed (ORT L gear)
P212	1st slow-speed (ORT LL gear)

◆ These functions set the first slow-speed of the motor shaft.

Setting range: 0 to 3000 [r/min]

For the action, see the charts in Section 9.3(4)

Note: If the 1st slow-speed is set at a high level, the orientation stop time will shorten. However, if too high, overshooting may occur.

P213	2nd slow-speed (MGORT H gear)
P214	2nd slow-speed (MGORT M gear)
P215	2nd slow-speed (MGORT L gear)
P216	2nd slow-speed (MGORT LL gear)

◆ These functions set the 2nd slow-speed of the motor shaft.

These functions set the motor shaft speed to front angle of 11° from the switching angle of the 2nd slow-speed (Speed adjustment just before the orientation stop is achieved).

Setting range: 0 to 1200 [r/min]

For the action, refer to the chart given later. This code is only valid for magneto-sensor type orientation.

Note: If the 2nd slow-speed is set at a high level, the orientation stop time will shorten. However, if too high, overshooting may occur.

P217	APR P gain (ORT H gear)
P218	APR P gain (ORT M gear)
P219	APR P gain (ORT L gear)
P220	APR P gain (ORT LL gear)

◆ These functions set a proportional gain to the position controller (APR).

Setting range: 0 to 255 times

Position deviation $\Delta\theta$ → [APR] → Speed command N*

P controller

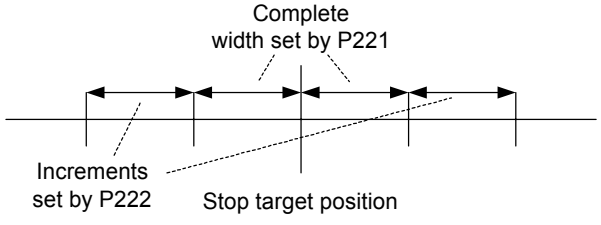
The weighing of a gain will vary with the spindle/motor speed ratio.
0000 to 27FF: No change
2800 to 4FFF: Multiply the gain setting value by 4 internally
5000 to FFFF: Multiply the gain setting value by 8 internally

Note: If the gain is set at a high level, the orientation stop time will shorten. However, if too high, hunting may occur.

P221	(ORT) Complete width (Width)
P222	(ORT) Complete width (Increment after stop)

◆ These functions set the complete allowable width to output orientation complete signals.

Setting range: 0 to 127



For example, when 5 is set by P221, positioning is completed within the range of ±5 [pulse] from the stop target position, this function outputs the orientation complete signal. Once the complete signal is output, the sum of values set by P221 and P222 is the complete width as given above.

Note: If the setting value of complete width is too small, complete signal will cause chattering, nor turn on.

P223	(ORT) Complete signal (ON-delay timer)
P224	(ORT) Complete signal (OFF-delay timer)

◆ The function is set when ON-delay timer or OFF-delay timer is set to the orientation complete signal.

Setting range: 1 to 1000 [ms]

P223 ON-delay timer

If the positioning stop can be continuously performed within the period in the complete width (P221) set by P223, turn on the complete signal. Once the stop position is deviated from the complete width during the timer operation, the timer restarts. When the stop position is stabilized after positioning is completed, this function sets to allow the complete signal to produce an output

P224 OFF-delay timer

If the positioning stop is continuously deviated from the complete width (P221 + P222) for the period set by P224, turn off the complete signal. Once the stop position is placed in the complete width during the timer operation, the timer restarts. This function sets to disable the complete signal to turn off for a certain period after the output of the complete signal.

P225	Re-ORT mode (Selection of mode)

◆ This function allows the mode to be selected when performing orientation in the positioning control zone (±11°).

Setting range
0: Instant APR
1: APR after 1-turn

When the code is set at "0", positioning is carried out again by the stroke within an angle of 11°. When the code is set at "1", positioning is carried out again after one-turn.
See the chart given later.

P226	ORT stop mode (Selection of mode)

◆ This function allows the selection of mode when performing an orientation during the stop or running at the 1st slow-speed or below.

Setting range:
0: No increased speed
1: Increased speed

When the code is set at "0", the function performs positioning without accelerating to the 2nd slow-speed or over.

When the code is set at "1", positioning is carried out in the shortest period.
See the chart given later.

Note: The 2nd solw-speed is defined as follows.
In case of the pulse encoder type orientation, it means the speed determined by the following equation.
(APR P gain setting value x 0.36) [r/min]
In case of the magneto-sensor type orientation, it means the speed set by P213 to P216.

P227	ORT rotational direction (Selection of mode)

◆ The function sets the rotational direction when performing orientation at the stop.

Setting range:
0: Shortcut
1: Direction command

When the code is set at "0", this function stops orientation in the shortest way. When the code is set at "1", the function allows the rotational direction to follow the direction command RORT from the external unit.
See the chart given later.

Note: When the orientation is carried out in the control zone (±11°) with the instant APR selected in the Re-ORT mode P225, the shortest way is selected even when the code is set at "1".

P228	2nd slow-speed changeover angle (MGORT)

◆ For the magneto-sensor type orientation, this function sets an angle (from the stop position) so that the motor shaft may arrive at the 2nd slow-speed.

Setting range: 0 to 180°

If overshooting may occur or the motor continues running when the motor should be stopped by orientation, the 2nd slow-speed changeover angle can be widened. In case of pulse encoder type orientation, the operation will not vary even when this code setting is changed.

P804	ORT boost addition value

◆ This function sets an addition amount of boost to the automatic torque boost when orientation is performed at the torque-vector and V/f control. With the automatic toque boost, the amount of addition of boost is set when the torque is insufficient to reach the stop position.

Setting range: 0 to 150

Note: Do not increase the set value too much, or an overcurrent or overload alarm may occur.

P805	No. of PE speed detection sampling

◆ This function sets the pulse encoder type orientation control system with the most significant 2 digits and a lower limit of speed detection at spindle PE feedback control with the least significant 2 digits.

Setting range: 0000 to FFFF

∗∗□□: A lower limit value of speed detection is set by the HEX code at the spindle PE feedback control with the least significant 2 digits. The figures in the table is the speed converted to the motor shaft.

Setting value	Lower limit value of speed detection
00, 05	2.93 [r/min]
01, 02	7.32 [r/min]
03	4.88 [r/min]
04	3.66 [r/min]
≀	≀
14 or more	0.73 [r/min]

The stop accuracy may be enhanced with a higher setting value.

□□∗∗: If 01 is set at the most significant 2 digits with 0 (PE feedback control invalid) set in P078, the function switches the pulse encoder type orientation to the spindle PE feedback control. When starting the orientation during rotation, be sure to turn off the operation commands (FWD, REV). (The ORT command can be input in any timing). Immediately after the stop at a normal decelerating speed, this function allows the orientation to stop within one be sure to turn. In this case, the orientation rotational direction is determined by the setting of the ORT rotational direction (P227).

P807	Selection of PE origin signal

◆ This function defines whether the internal stop position setting (P205) rewritten by the external contact input PSET is valid or not.

Setting range:
0: Invalid
1: Valid

To prevent the signal from an error due to noise, etc., set the code at "0: Invalid".

P029	Magnetic flux command level (At ORT)

◆ This function sets the magnetic flux command level at orientation. In this case, this command level should be set at a higher value to enhance a torque response.

Setting range: 10 to 100%

(4) Description of operation

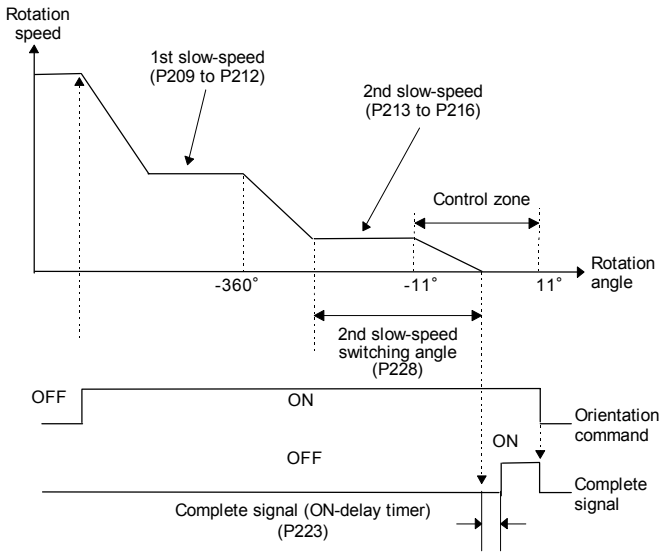
[Magneto-sensor type orientation]

The definition of the term is given below.

Item	Description
1st slow-speed N1	Motor speed set by the function codes P209 to P212
2nd slow-coast speed N2	Motor speed set by the function codes P213 to P216
2nd slow-coast speed switching angle	Timing for reaching the 2nd slow-speed is set by the function code P228 as an angle from the stop target point
Control zone	Positioning control is performed in the range of ±11° with respect to the stop target point.

Orientation during rotation

1) Orientation starting from 1st slow-speed or above



2) Orientation starting from 1st slow-speed or below

• M5 series

Regardless of the presence/absence of an increased speed in the ORT stop mode of P226, the mode of M5 series is as follows:

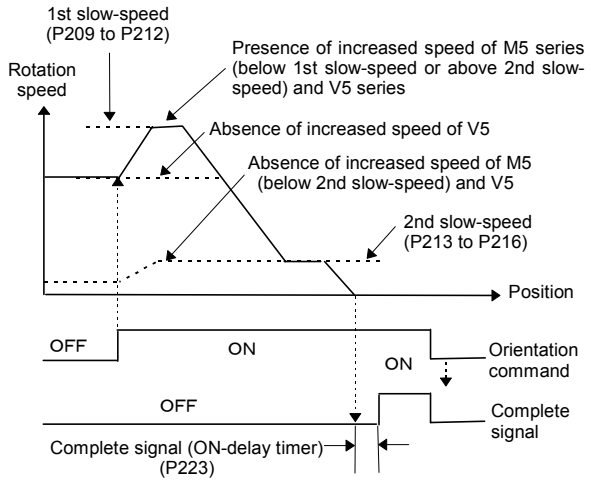
1) When the speed at the input of the ORT command is less than the 1st slow-speed and the 2nd slow-speed or above, it is increased up to the 1st slow-speed.
2) When the speed at the input of the ORT command is less than the 2nd slow-speed, it is increased up to the 2nd slow-speed.

• V5 series

In case of presence of increased speed in the ORT stop mode of P226, the speed may be increased up to the 1st slow-speed to stop an orientation in a shortest time.

In case of absence of an increased speed in the ORT stop

mode of P226, the speed at the input of the ORT command is maintained to perform the orientation stop.



Note: The rotational direction of orientation is the same as that given by the orientation command.

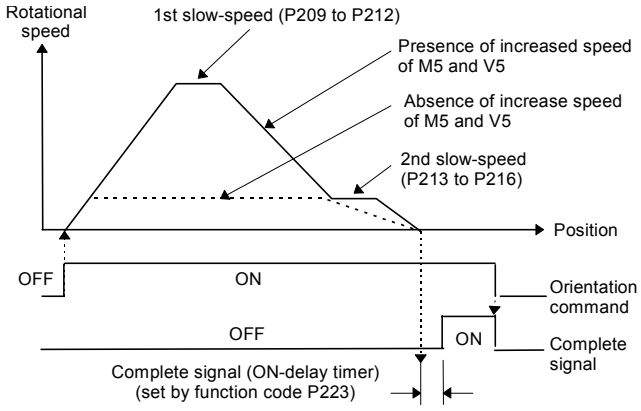
3) Orientation starting from stop

- M5 series

  In case of presence of increased speed at the ORT stop mode of P226, the speed is increased up to the 1st slow-speed, and then the orientation stop is performed.
  In case of absence of increased speed at the ORT stop mode of P226, the speed is increased to the 2nd slow-speed, and then the orientation stop is performed.

- V5 series

  In case of presence of an increased speed in the ORT stop mode of P226, the speed may be increased up to the 1st slow-speed to stop an orientation in a shortest time.
  In case of absence of an increased speed in the ORT stop mode of P226, the speed is increased up to the 2nd slow-speed to stop the orientation.



Note: It turns in the forward direction of the spindle motor. To reverse the direction, the rotational direction command (input by the RORT terminal) is given to it from an external unit.

In V5 series, the shortest way mode can be selected by the ORT rotational direction given by function code P227.

Immediately after the power ON, the orientation rotates at the 2nd slow-speed in a predetermined direction, pass through a magnet once to stop by one-turn.

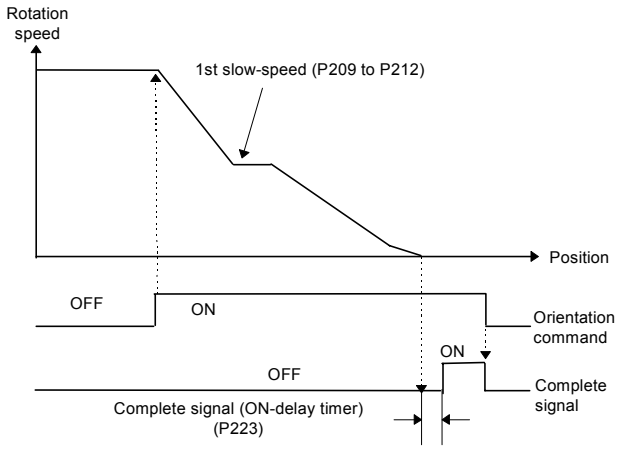
[Pulse encoder type orientation]

The definition of the terms is given below.

Item	Description
1st slow-speed N1	Motor speed set by the function codes P209 to P212
2nd slow-speed N2	Motor speed given by (APR P gain setting value x 0.36) [r/min]
Control zone	Positioning control is performed in the range of ± 11° with respect to the stop target point.

Orientation during rotation

1) Orientation starting from 1st slow-speed or above

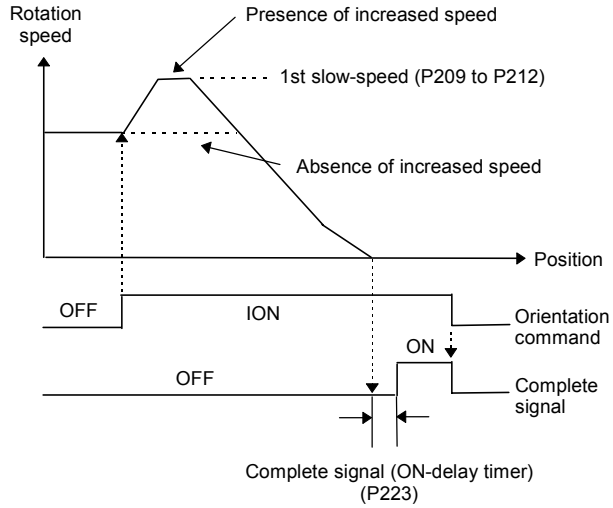


2) Orientation starting from 1st slow-speed or below

- M5 and V series, in common

  In case of presence of an increased speed in the ORT stop mode of P226, the speed may be increased up to the 1st slow-speed to perform the orientation stop in a shortest time.

  In case of absence of an increased speed in the ORT stop mode of P226, the speed at the input of the ORT command is maintained to perform the orientation stop.

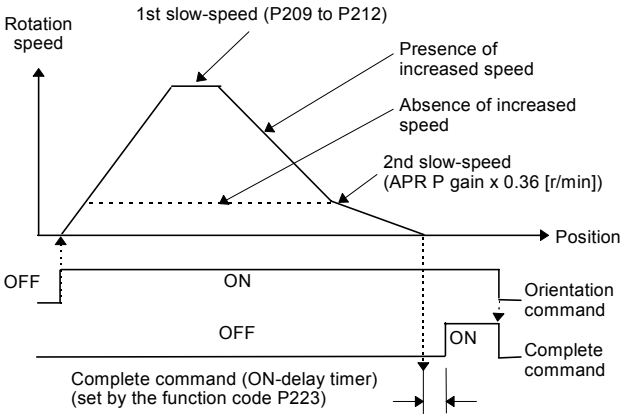


Note: The rotational direction of orientation is the same as that given by the orientation command.

3) Orientation starting from stop

- M5 and V series, in common

In case of presence of an increased speed in the ORT stop mode of P226, the speed may be increased up to the 1st slow-speed to perform the orientation stop in a shortest time. In case of absence of an increased speed in the ORT stop mode of P226, the speed is increased to the 2nd slow-speed to perform the orientation stop.



Note: It turns in the forward direction of the spindle motor. To reverse the direction, the rotational direction command (input by the RORT terminal) is given to it from an external unit.
The shortest way mode can be selected by the ORT rotational direction given by function code P227.

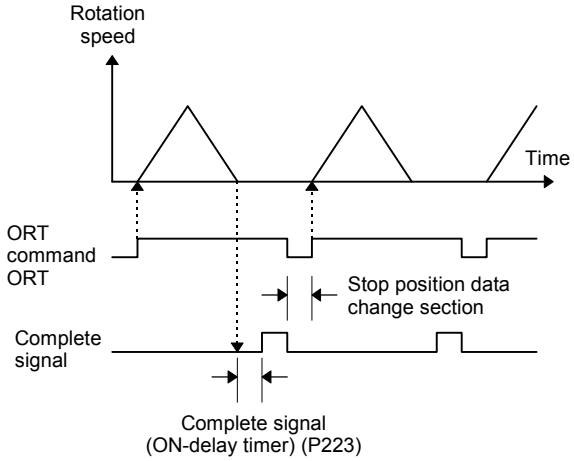
4) Orientation operation just after power ON

The motor rotates at the 1st slow-speed in the direction determined by the external command RORT, and pass through the origin (C-pulse) of the pulse encoder once to stop at the setting position.

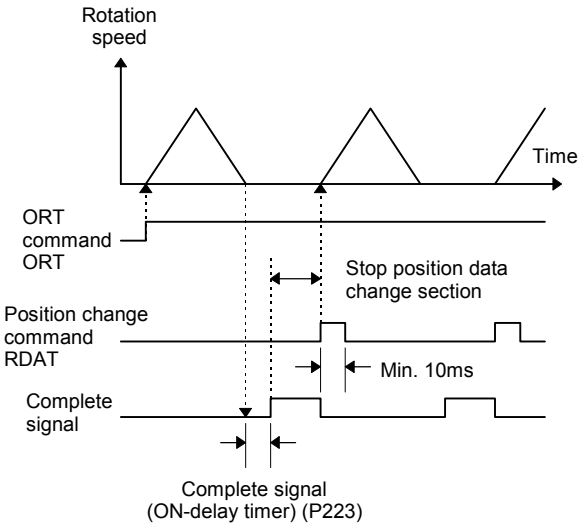
5) Orientation at continuous multi-point stop positions

When performing orientation by the external stop position command using a pulse encoder, the orientation stop can be performed at continuous multi-point stop positions while the machine spindle rotates one turn.
The method is available in the following 2 types:

<u>When ORT command is once OFF:</u>

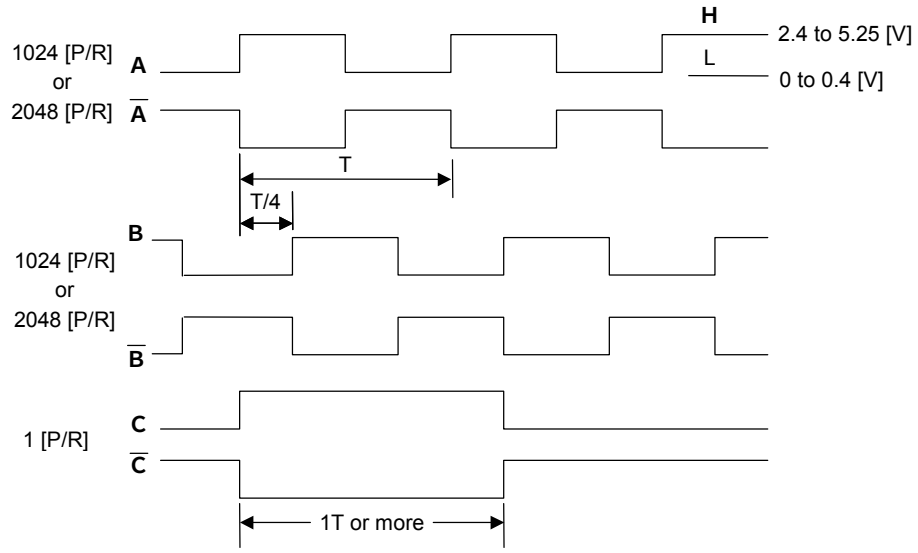


<u>When using the position change command</u>



9.4 Synchronous operation function (option)

(1) Standard specifications

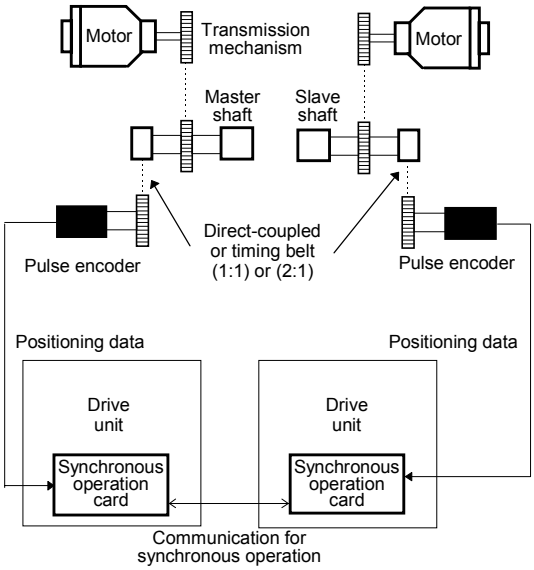
Item		Specifications	
Orientation control	Stop position setting	Internal	• Parameter P206 (automatic reading of internal stop position) • PE origin set signal
		External	12-bit binary
		Adjustment can be made by parameter P206 (automatic reading of internal stop position)	
	Repetitive positioning accuracy	V5 series	±0.1° or less
		M5 series	• ±0.3° or less (spindle PE feedback control) • ±0.5° or less (torque-vector control)
	Repulsion torque at positioning control	50%ED x 120%	
		Deviation is transiently increased with respect to instantaneous load torque.	
Synchronous control	Synchronous accuracy (in constant speed, no-load operation)	V5 series	• ±0.5° or less (Within ±0.5 pulse)
		M5 series	• ±0.5° or less (Within ±0.5 pulse) – Spindle PE feed back control • ±0.1° or less (Within ±10 pulse) – Torque-vector control
Mechanical condition		Spindle max. rotation speed: 8000 [r/min] or less No. of transmission gear steps: 4 steps, max Transmission gear ratio: 0.5 to 32 (motor shaft to spindle) (*1)	
Position detector		• LED type pulse encoder (*2) A, $\overline{A}$ signal: 1024 or 2048 [P/R] B, $\overline{B}$ signal: 1024 or 2048 [P/R] C, $\overline{C}$ signal: 1 [P/R] • Output circuit type: Line driver (equivalent to SN75113) balanced transmission type	
Pulse encoder output specifications			

Notes:

(*1) For the pulse encoder type orientation for M5 series, if the deceleration ratio of motor versus spindle is large (more than 5 times), spindle PE feedback control cannot be performed. So, select torque-vector control.

(*2) The customer is requested to arrange for a pulse encoder.
Since the power of Fuji drive unit (optional card) is not supplied to the pulse encoder, the power should be supplied from an external unit. Current consumption of the optional printed circuit board above is 3mA, max.

(2) System configuration



(3) Description of function code

P401	Acceleration time
P402	Deceleration time

◆ These functions set the acceleration and deceleration time of the master shaft in the synchronous mode (MODE signal is ON).

◆ The acceleration/deceleration time is set in the master shaft unit.

◆ For detailed setting, refer to the function codes, P001 and P002.

Setting range: 0.1 to 120.0 [s]

P403	S-curve accel./decel. (At acceleration)
P404	S-curve accel./decel. (At deceleration)

◆ These functions set the S-curve acceleration/deceleration width of the master shaft in the synchronous mode (MODE signal is ON).

◆ The S-shape acceleration/deceleration width is set in the master shaft unit.

◆ For detailed setting, refer to the function codes, P005 and P006.

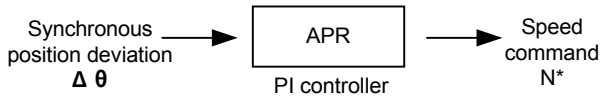
Setting range: 0 to 50%

P405	APR P gain (H gear)
P406	APR P gain (M gear)
P407	APR P gain (L gear)
P408	APR P gain (LL gear)

◆ These functions set the proportional gain to the positioning controller (APR) on the slave shaft for the synchronous operation.

◆ The proportional gain is set at the slave shaft unit.

Setting range: 0 to 255 times



Note: If the proportional gain is set at a high level, the synchronization complete time will shorten. However, if too high, hunting may occur.

P409	APR integral time (H gear)
P410	APR integral time (M gear)
P411	APR integral time (L gear)
P412	APR integral time (LL gear)

◆ These functions set the integral time for the positioning controller (APR) on the slave shaft for the synchronous operation.

◆ The integral time is set in the slave shaft unit.

Setting range: 0.00 to 3.00 [s]

Note: If the integral time is set at a short value, the synchronous complete time will shorten. However, if too short, hunting may occur.

P413	Sequence selection of torque balance control

◆ This function selects an input signal to shift to the torque balance control.

Setting range:
0: Torque balance with SETO signal
1: Torque balance with CNC signal

◆ Torque balance control is started by selecting the SETO signal from OFF (open) to ON (close). If the torque balance control is out of the synchronous complete, it will be reset.

◆ Torque balance control is continued with the CNC signal ON.

P414	APR output filter

◆ In case of follow-up synchronous operation of the slave shaft, the setting is set at a larger level to prevent shock just before starting synchronous positioning control.

Setting range: 0 to 1000 [ms]

Note: If the setting is too large, a longer time may be taken until the synchronization completion is performed or synchronous completion may not be ended.

P415	Synchronized position control start speed deviation

◆ This function sets deviation in speed of the slave shaft from the master shaft when the speed control is switched to the synchronous position control.

◆ If a shock may occur just before synchronous positioning control starts due to follow-up synchronization of the slave shaft, a shock can be reduced by decreasing the setting.

Setting range: 0 to 50%

It is set at a rate of the slave shaft versus the maximum speed given in P001.
If the code is set at 0%, the slave shaft is turned at a ratio of 10%.

Note: If the ratio is too small, synchronous positioning control cannot be continued at a constant speed.

P418 Chuck ON timer

◆ This function sets a time from the input of the chuck ON (closed) signal (SETO, CNC signals) to the shift of torque balance control.

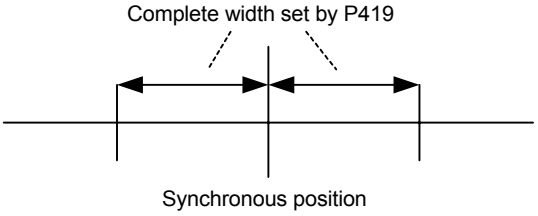
◆ This function compensates for delayed time when a machine performs chucking of a workpiece actually.

Setting range: 0 to 1000 [ms]

P419 Complete width

◆ This function sets the complete allowable width where synchronization complete signal is output at the synchronous position in absolute values.

Setting range: 0 to 100 [pulses]



Note: If the setting value of the complete width is small, chattering may occur to the complete signal.

P420 Complete signal (ON-delay timer)
P421 Complete signal (OFF-delay timer)

◆ This function allows ON-delay or OFF-delay to be applied to the synchronization complete signal.

Setting range: 0 to 1000 [ms]

P420 ON-delay timer

Turn on the complete signal when it can be continuously synchronized for a given time set by P420 in the complete width (P419).
Once the complete signal is deviated from the complete width during the timer operation, the timer will restart.
After synchronized control has been stabilized, this function is used to output the complete signal.

P224 OFF-delay timer

If the complete signal is continuously deviated from the complete width (P419) for a time set by P421, turn off the complete signal. Once the complete signal is input in the complete width during the timer operation, the timer will restart.
After the output of the complete signal, this function is used in order that the complete signal may not be turned off for a certain time.

P422 PE rotational direction

◆ This function allows the motor rotational direction on the slave shaft in the reverse direction (reverse phase) to the command.

Setting range:
0: Same
1: Reverse phase

Note: The rotational direction is reversed with a single operation except in the synchronous mode.

Operation command		P422=0		P422=1	
Master	Slave	Single mode	Synchro-nous mode	Single mode	Synchro-nous mode
FWD	FWD	Forward	Forward	Reverse	Reverse
FWD	REV	Reverse	Forward	Forward	Reverse
REV	FWD	Forward	Reverse	Reverse	Forward
REV	REV	Reverse	Reverse	Forward	Forward

FWD: Forward command REV: Reverse command
Forward: Counterclockwise direction as viewed from the motor shaft
Reverse: Clockwise direction as viewed from the motor shaft

P423 Synchronous ratio 1
⟆ ⟆
P430 Synchronous ratio 8

◆ This function sets the speed ratio of the slave shaft for the ratio synchronous operation.

Setting range: 1 to 99

Each function code is selected with the ratio synchronous selection signals (RT0, RT1, RT2) in combination.

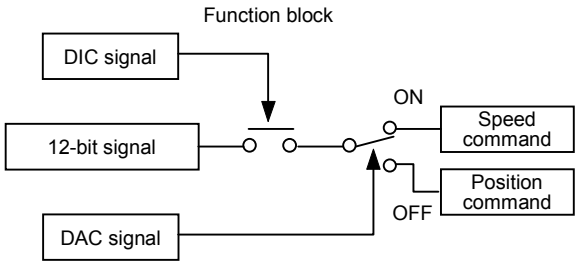
Function code to be selected	RT0	RT1	RT2
P423	OFF	OFF	OFF
P424	ON	OFF	OFF
P425	OFF	ON	OFF
P426	ON	ON	OFF
P427	OFF	OFF	ON
P428	ON	OFF	ON
P429	OFF	ON	ON
P430	ON	ON	ON

Note: When performing the ratio synchronous operation, synchronous accuracy is degraded in proportional to the speed ratio. If the set value is too large, synchronous control is disabled.

9.5 Digital speed setting function (option)

(1) Outline of function

- This function allows the PE interface card or synchronous operation card to set digital speeds by switching the 12-bit digital signal (ES01 to ES12) to an external stop position such as orientation and speed command.
- The analog speed setting is invalid when selecting the digital speed setting by the function code, P806.



(2) Description of function code

P806	Digital speed/position command changeover

◆ This function allows the optional card (OPCII-MS5-PE or OPCII-MS5-SY) to set digital speeds.

This function selects whether the 12-bit digital signal input in ES01 to ES12 of the optional card CN7 is read as either external stop position command or digital speed setting.

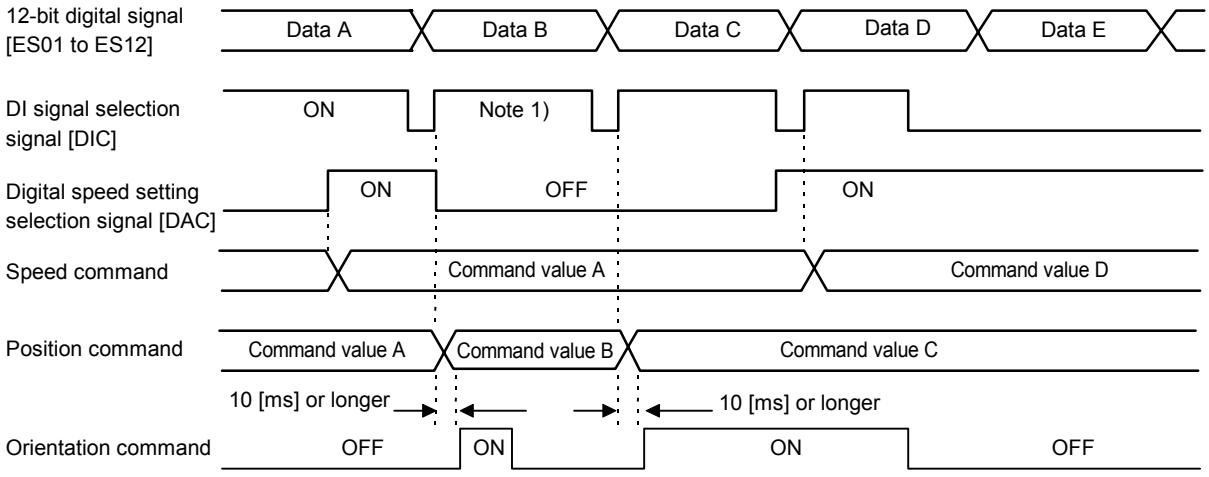
Setting range: 00 to 04

The operation for each set value is given as follows:

Set Value	Operation
00	A 12-bit digital signal is read as the position command. DIC and DAC signals are ignored.
01	When both DIC signal and DAC signal are ON, 12-bit digital signal is activated as binary speed command (± 12 bits) without polarity. 000: 0, FFF: Command equivalent to +maximum speed
02	When both DIC signal and DAC signal are ON, 12-bit digital signal is activated as binary speed command (± 11 bits) with polarity. 7FF: +maximum rotation speed command 800: -maximum rotation speed command
03	When both DIC signal and DAC signal are ON, 12-bit digital signal is activated as BCD 3-digit speed command. 000: 0, 999: Command equivalent to +maximum speed
04	When both DIC signal and DAC signal are ON, 12-bit digital signal is activated as BCD 2-digit speed command. 000: 0, 099: Command equivalent to +maximum speed (valid for low-order 8 bit)

Note: Setting of a numerical value exceeding "9" is regarded as "9" in BCD. When the 12-bit digital signal is only used as a speed command, set the DIC (DI signal selected) and DAC (digital speed setting selected) signals to ON at all times.

(3) Timing chart for switching between digital speed setting and external stop postion setting



Note 1) Turn OFF the DIC signal once before changing the 12-bit digital signal, or the 12-bit digital signal may work as speed command or positioning command at a value in the process where it varies.

9.6 Winding changeover function (option)

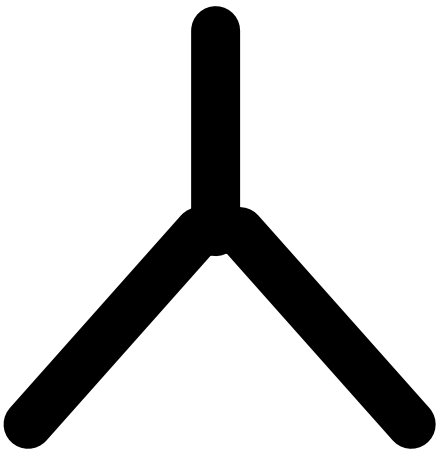
Use of a winding-changeover motor allows the constant output range to be widened by switching low-speed winding and high-speed winding without using a mechanical transmission mechanism. The motor can be driven by the same capacity of the drive unit as in the low speed range by switching windings to 人-connection in low speed range and △-connection in high speed range.

(1) Outline of function

- PE feedback control (by using PE interface card or synchronous operation card) for V5 series or M5 series allows automatic selection of low-speed winding and high-speed winding of winding-changeover motors.
- A contactor should be operated from an external unit by the selection signal for switching between the low-speed and high-speed winding which are output from the drive unit, thus switching motor windings.
- The motor winding can be fixed to a present selected winding by the input of the winding changeover stop signal in the drive unit. However, if the motor speed arrives at 120% or more of the winding changeover speed in the low-speed winding, the low-speed winding is automatically switched to the high-speed winding, which is then fixed at the high-speed winding.
- While switching the winding (200 [ms] or less), the drive unit shuts down the output (motor coasting to a stop).

(2) Example of motor output performance

An example of motor output performance is shown below. For details of the winding-changeover motor, contact Fuji electric.



(3) Description of function code

P500	Function block (P501 to P521)

◆ This function selects whether the function codes of P501 to P521 are displayed or not, or winding changeover function is used or not.

Setting range:
0: Non-display (Inactive)
1: Display (Active)

Note: When using the winding changeover function, be sure to set the function code at “1”. If the code remains at “0”, the function does not become valid.

P501	Winding changeover speed
P502	Winding changeover speed hysteresis width

◆ This function sets the speed for switching between 人-winding and △-winding at P501 and its hysteresis width at P502.

Setting range
P501: 0 to 20000 [r/min]
P502: 0 to 1000 [r/min]

Set the value so that the following equation may be satisfied.
• (Set value in P501 ＋ (Set value in P502 : 2)
≦ (Max. speed of low-speed winding)
• (Set value in P501 － (Set value in P502 : 2)
≧ (Base speed of high-speed winding)

Note: The code P501, “winding switching speed” is automatically re-written with the change of the P053, “motor code”.

If the set value of P502 is too small, contactors may cause chattering when switching from low-speed winding to high-speed winding. If switching is not carried out at the standard value, increase the value. However, keep in mind that actual switching of the winding is achieved at a speed that is deviated by 1/2 of the setting value given in P502 from the set speed in P501. So, if the set value is raised too much, switching is performed at a speed over the switching range, which may not result in good constant output performance.

Just after the power supply is turned on, the drive unit outputs low-speed winding selection signal. If the drive unit has been turned off with the external contactor switched to the high-speed winding, switch the contactor once immediately after the power supply is turned on.

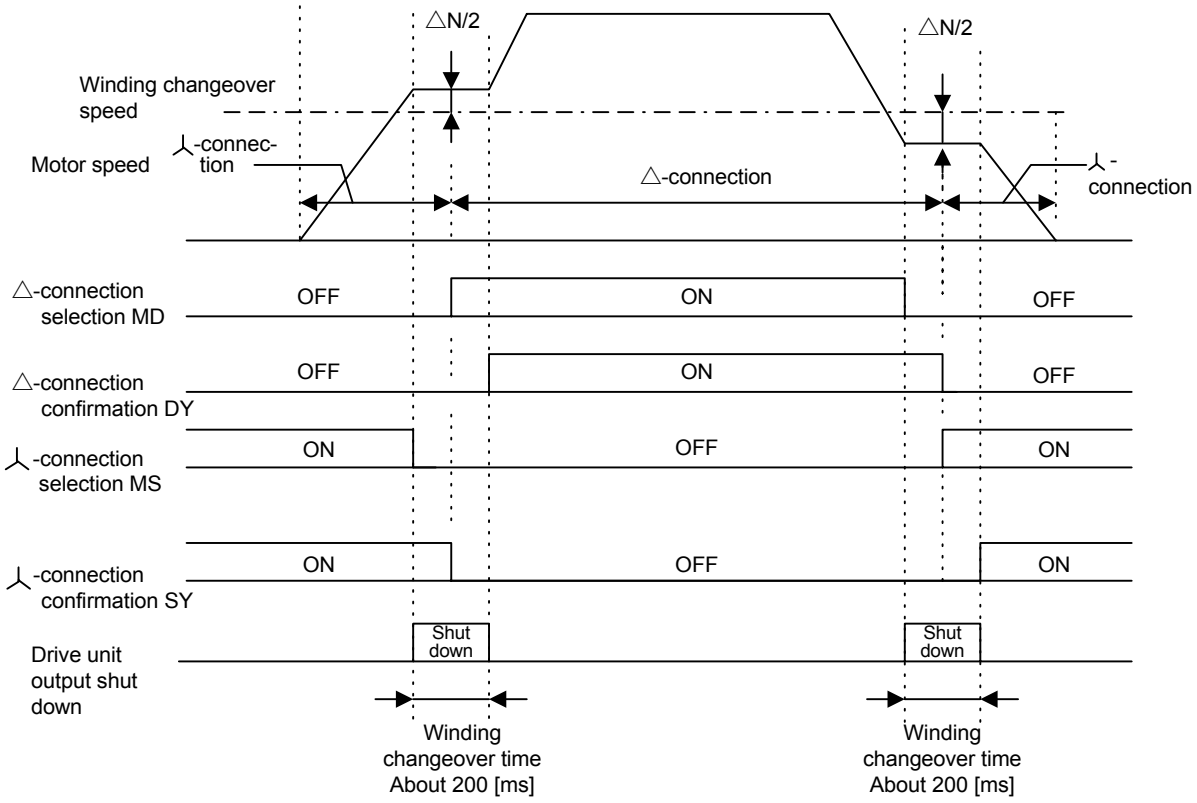
After the connection selection signal for 人- or △-winding is output from the drive unit, a confirmation signal to the selection output is input in the drive unit within 2 seconds. Otherwise, an external alarm (OH2) may occur. In case both confirmation signals for 人- and △-windings have been input at the same time for 2 [s] or longer, the external alarm (OH2) will occur. When the external alarm (OH2) occurs, check these signals.

(4) Operation chart

1) Automatic winding changeover operation (SPC: winding changeover stop signal OFF)

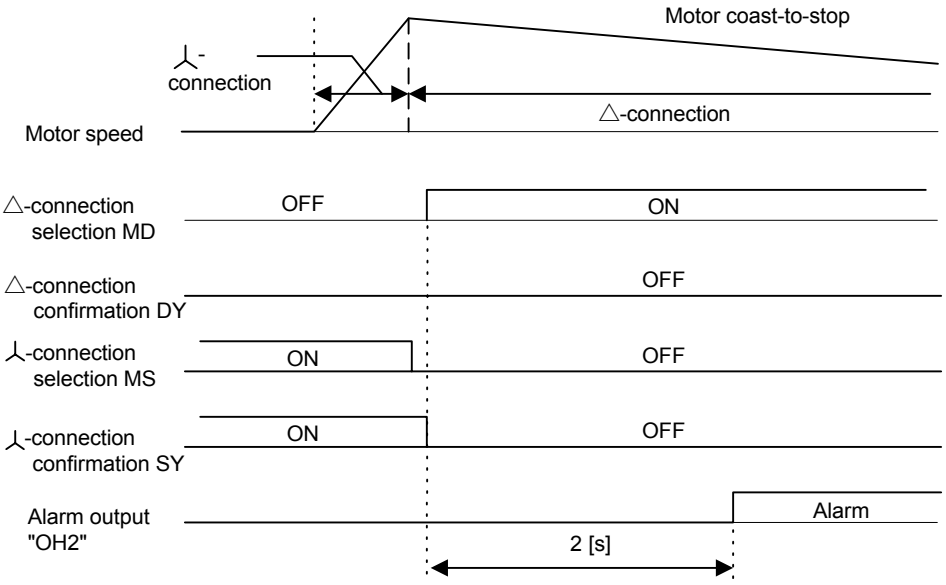
The winding changeover speed (set by function code P501) allows windings automatically to switch by motor actual speed.

Normal operation timing chart for automatic winding changeover



(Depending on operation time of contactor and relay)

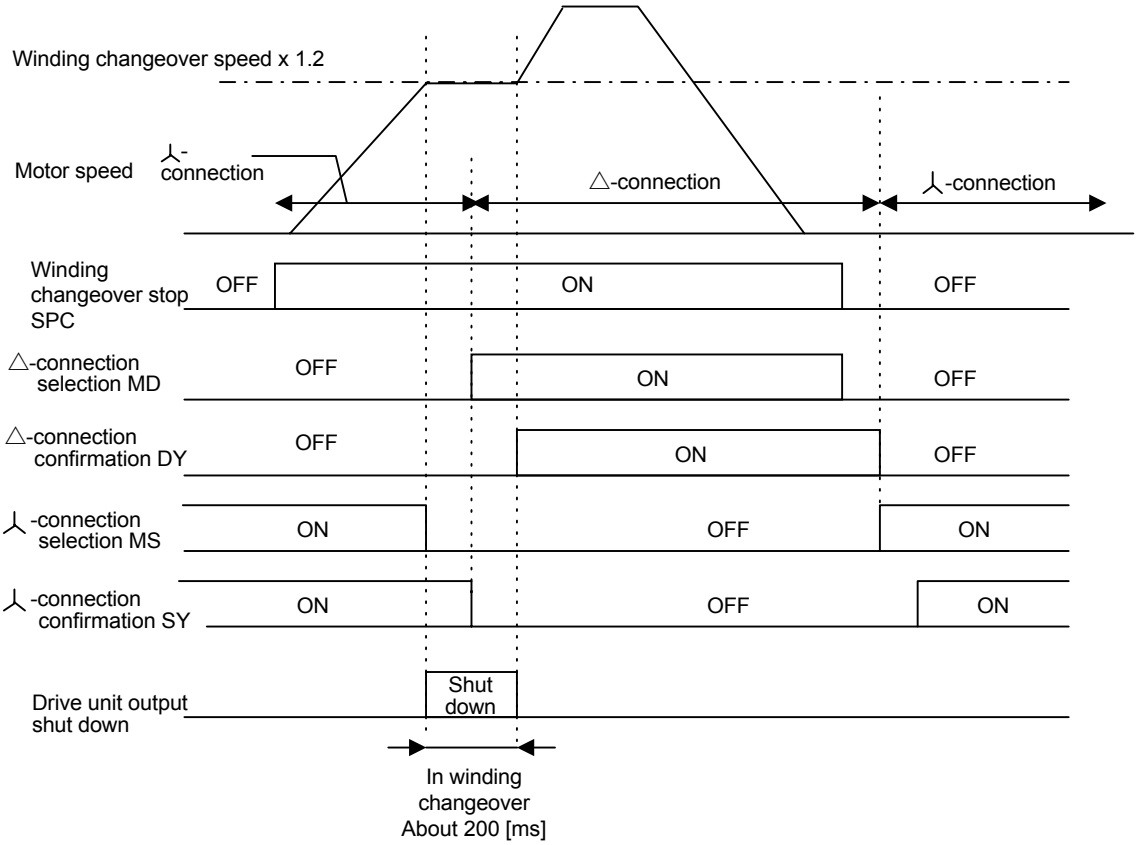
Timing chart at no-input of confirmation signal



2) Winding changeover stop operation (SPC: winding changeover stop signal ON)

Winding is fixed to either of sides by turning on the winding changeover stop signal (SPC).
For 人-connection, if the motor speed exceeds 120% of the winding changeover speed given in P501, the 人-connection is automatically switched to △-connection. To return △-connection to 人-connection, reduce the motor speed below the winding changeover speed and turn off the winding changeover stop signal (SPC).
Winding is set to 人-connection just after the power is turned on. To fix the △-connection, increase the motor speed to 120% or more of the winding changeover speed, and then switch 人-connection to △-connection.

Normal operation timing chart of winding changeover stop



(Depending on the operation time of contactor and relay)

Section 10 Alarm Function

(1) Alarm list of package type drive unit and drive unit

Name of alarm	Code	Contents of operation	
Overcurrent	oC	If the unit output circuit is short-circuited or ground fault occurs, or an instantaneous value of the output current exceeds an overcurrent level, it will be activated.	
Fuse blown	dCF	If fuse blown to the unit DC power circuit is detected, it will be activated.	
Overvoltage	oV	If the DC power voltage exceeds an overvoltage level where the AC power supply voltage is increased or regenerative current is increased with braking action (the braking energy exceeds the braking capacity), it will be activated. However, when excessive voltage (for example, high voltage) is applied, it will not be activated. "Overvoltage detection level: 400 [V] DC (200 [V] series), 800 [V] DC (400 [V] series)"	
Undervoltage	LV	If the DC power supply voltage is decreased below the undervoltage detection level, due to AC power supply voltage drop, it will be activated. "Undervoltage detection level: 186 [V] DC (200 [V] series), 372 [V] DC (400 [V] series)"	
Drive unit overheat	oH1	If unit and cooling fin temperatures are increased due to stop of a cooling fan, it will be activated.	
External alarm input	oH2	When alarm contacts for an external unit such as braking resistor and thermal relay are connected to the control connector "CN3, terminals 4 – 5), it will be activated depending on the contact signal condition (OFF between terminals 4 – 5).	
Drive unit overload	oL1	When the motor current exceeds an overload level of inverse time characteristics, it will be activated. "Overload level: 50%ED rated output current x 120%, 1 [min]"	
Motor overheating	oL2	When the temperature detection NTC thermistor mounted on the motor exceeds 150 °C, it will be activated	To prevent activation, set P079 - function code data at "0".
Temperature detection circuit disconnection	rb	When motor temperature detection NTC thermistor circuit is disconnected, or motor temperature is below -20°C, it will be activated.	
Overspeed (V5 series)	oS	When the function code C000 exceeds 120% of the set value of the function code P001, it will be activated.	
Excess speed deviation (V5 series)	SF	Start delay • If torque limit and zero speed condition are continued for 1 [s] or more, it will be activated. • If the function code data of P077 is set at "0", it will not be activated.	When performing spindle PE feedback control using the PE interface card, M5 series acts in the same way as in V5 series. It will not activate without using the PE interface card.
		Excess speed deviation • When deviation between the speed command value and speed detection value exceeds the ratio [%] set by the function code P808 as compared with the set value given in the function code P001 and continues for 1 [s] or more, it will be activated. • It will be activated with the P077 function code data set at "0".	
Error to current detection circuit	CF	If an error is detected in the current detection circuit for the control section when the unit is operating, it will be activated.	
Error to converter unit	rF	When the protective function for the converter unit is energized, transfer of the operation signal to the drive unit allows the protective function for the drive unit to be energized.	
Error to internal fan	FAL	When an error occurs to an internal ventilation fan in the drive unit, it will be activated.	
Memory error	Er1	When an error to data writing occurs, it will be activated.	
Loader communication error	Er2	When a communication error occurs to a personal computer loader, it will be activated.	
CPU error	Er3	When an error occurs to CPU, it will be activated.	
Synchronous communication error	Er4	When an error to serial communication with an optional synchronous operation card occurs, it will be activated.	
Improper tuning	Er5	(1) When the drive unit output circuit is disconnected or impedance is excessively large after auto tuning (%R1, %Lσ) of the function code P072 has been made, it will be activated. (2) When adjustment values are improper after the motor speed adjustment (at low-speed) of the function code P073 (valid for V5 series only) has been made, it will be activated. (3) When adjustment values are improper after the tuning for voltage detection of the function code P074 has been made, it will be activated. (4) When the following causes occurs during the voltage detection tuning given in the function code P075, 1) The motor is connected. 2) The operation command and coast-to-stop command BX are ON. 3) PE feedback control is selected for M5 series. 4) 2nd-spindle motor changeover signal is not selected for V5 series. 5) Adjustment values are improper.	

Note) If control voltage is lowered until the unit control circuit operation cannot be maintained, all of the protective functions are automatically reset.

(2) Alarm list of regenerative braking converter unit

Name of alarm	Code	Contents of operation
Error to power phase sequence	nP	When the power supply is applied to the AC power terminals of the regenerative braking converter unit with different phase sequence, it will be activated.
Regenerative braking overcurrent	oC	When an instantaneous value of the regenerative braking current to the power supply exceeds the overcurrent level, it will be activated.
Converter overheating	oH	When the cooling fan is stopped during operation and temperature on cooling fins is increased, it will be activated.

Appendix

A.1 Recommended main circuit devices

[200V series]

Package type drive unit Type	Nominal applied motor [kW]	At continuous rating		At 50%ED rating		Required power capacity [kVA]	Peripheral devices			
		Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]	Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]		Molded-case circuit breaker (MCCB) Earth-leakage circuit breaker (ELCB) (*4)	Magnetic contactor (MC) (*5)		Thermal relay and set value for braking resistor
								Input circuit	Output circuit	
FRN1.1M5-2	0.75/1.1	2.9	6.6	4.3	9.4	2.5	15	SC-05	SC-05	TR-1SN 1.2 [A]
FRN2.2M5-2 FRN2.2V5-2	1.5/2.2	5.5	11.1	8.1	15.9	4.0	20			TR-1SN 2.3 [A]
FRN3.7M5-2 FRN3.7V5-2	2.2/3.7	8.0	15.2	13.4	24.6	7.0	30			TR-1SN 4.5 [A]
FRN5.5M5-2 FRN5.5V5-2	3.7/5.5	13.1	23.3	19.5	33.5	9.0	40	SC-5-1	SC-5-1	TR-1SN 6.1 [A]

Dynamic braking converter unit Type	Nominal applied motor [kW]	At continuous rating		At 50%ED rating		Required power capacity [kVA]	Peripheral devices			
		Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]	Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]		Molded-case circuit breaker (MCCB) Earth-leakage circuit breaker (ELCB) (*4)	Magnetic contactor (MC) (*5)		Thermal relay and set value for braking resistor
								Input circuit	Output circuit	
FRN7.5PD5-2	5.5/7.5	19.5	32.9	26.5	43.7	12	50	SC-N1	-	TR-1SN 8.3 [A]
FRN11PD5-2	7.5/11	25.6	41.2	37.6	58.4	17	60			TR-1SN 13 [A]
FRN15PD5-2	11/15	37.2	57.5	50.7	76.4	22	75	SC-N2S	-	TR-1SN 17 [A]
FRN18.5PD5-2	15/18.5	50.1	74.8	61.8	90.6	28	100	SC-N3	-	TR-1SN 20 [A]

Regenerative braking converter unit Type	Nominal applied motor [kW]	At continuous rating		At 50%ED rating		Required power capacity [kVA]	Peripheral devices (*3)		
		Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]	Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]		Molded-case circuit breaker (MCCB) Earth-leakage circuit breaker (ELCB) (*4)	Magnetic contactor (MC) (*5)	
								Input circuit	Output circuit
FRN5.5PR5-2	3.7/5.5	13.1	15.4	19.5	21.8	9	30	SC-05	-
FRN7.5PR5-2	5.5/7.5	19.5	23.1	26.5	29.8	12	40	SC-5-1	-
FRN11PR5-2	7.5/11	25.6	30.5	37.6	42.0	17	60	SC-N1	-
FRN15PR5-2	11/15	37.2	43.8	50.7	57.1	22	60	SC-N2	-
FRN18.5PR5-2	15/18.5	50.1	60.1	61.8	70.0	28	75	SC-N2S	-
FRN22PR5-2	18.5/22	61.8	73.0	73.5	83.3	34	100	SC-N3	-
FRN30PR5-2	22/30	73.5	87.6	100	113	45	125	SC-N4	-
FRN37PR5-2	30/37	100	118	124	143	55	150	SC-N5	-
FRN45PR5-2	37/45	124	147	151	180	67	250	SC-N8	-
FRN55PR5-2	45/55	151	180	184	213	82	300		

Drive unit Type	Nominal applied motor [kW]	Peripheral devices
		Magnetic contactor (MC) (*5)
		Output circuit
FRN5.5MC5-2 FRN5.5VC5-2	3.7/5.5	SC-5-1
FRN7.5MC5-2 FRN7.5VC5-2	5.5/7.5	SC-N1
FRN11MC5-2 FRN11VC5-2	7.5/11	SC-N2
FRN15MC5-2 FRN15VC5-2	11/15	SC-N2S
FRN18.5MC5-2 FRN18.5VC5-2	15/18.5	SC-N3
FRN22MC5-2 FRN22VC5-2	18.5/22	SC-N4
FRN30MC5-2 FRN30VC5-2	22/30	SC-N5
FRN37VC5-2	30/37	SC-N7
FRN45VC5-2	37/45	SC-N8
FRN55VC5-2	45/55	SC-N10

Notes:

(*1) For the power supply, select a version of 50 [Hz] and 200 [V].

(*2) An ambient temperature is set at 55°C.

(*3) Peripheral devices are selected based on current values when standard provided AC reactor (ACR) is connected.

(*4) Since the required rated sensitive current varies depending upon the power conditions of equipment to be installed, the rated current value [A] is only given.

(*5) Fuji Electric's of magnetic contactors

[400 series]

Package type drive unit Type	Nominal applied motor [kW]	At continuous rating		At 50%ED rating		Required power capacity [kVA]	Peripheral devices			
		Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]	Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]		Molded-case circuit breaker (MCCB) Earth leakage circuit breaker (ELCB) (*4)	Magnetic contactor (MC) (*5)		Thermal relay and set value for braking resistor
FRN5.5M5-4	0.75/1.1	1.5	3.6	2.2	5.3	2.5	10	SC-05	SC-05	TR-1SN 0.8 [A]
FRN5.5M5-4	1.5/2.2	2.9	6.6	4.2	9.7	4	15	SC-05	SC-05	TR-1SN 1.6 [A]
FRN5.5M5-4	2.2/3.7	4.2	9.1	7.1	15.3	7	20	SC-05	SC-05	TR-1SN 2.0 [A]
FRN5.5M5-4	3.7/5.5	6.9	14.4	10.2	21.3	9	30	SC-05	SC-05	TR-1SN 3.0 [A]

Dynamic braking converter unit Type	Nominal applied motor [kW]	At continuous rating		At 50%ED rating		Required power capacity [kVA]	Peripheral devices			
		Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]	Input fundamental wave current I1 [A]	Input r.m.s current Ieff [A]		Molded-case circuit breaker (MCCB) Earth leakage circuit breaker (ELCB) (*4)	Magnetic contactor (MC) (*5)		Thermal relay and set value for braking resistor
FRN7.5PD5-4	5.5/7.5	10.2	19.7	14.0	26.9	12	10	SC-5-1	SC-5-1	TR-1SN 4.1 [A]
FRN11PD5-4	7.5/11	13.5	25.0	19.8	36.6	17	15	SC-5-1	SC-5-1	TR-1SN 6.1 [A]
FRN15PD5-4	11/15	19.6	34.3	26.7	46.8	22	20	SC-N1	SC-N1	TR-1SN 8.2 [A]
FRN18.5PD5-4	15/18.5	26.4	44.0	32.5	54.2	28	30	SC-N2	SC-N2	TR-1SN 10 [A]

Drive unit Type	Nominal applied motor [kW]	Peripheral devices
		Magnetic contactor (MC) (*5)
		Output circuit
FRN5.5M5-4	0.75/1.1	SC-05
FRN5.5M5-4	1.5/2.2	SC-05
FRN5.5M5-4	2.2/3.7	SC-05
FRN5.5M5-4	3.7/5.5	SC-05
FRN7.5MC5-4	5.5/7.5	SC-05
FRN11MC5-4	7.5/11	SC-5-1
FRN15MC5-4	11/15	SC-5-1
FRN18.5MC5-4	15/18.5	SC-N1

Notes:

(*1) For the power supply, select a version of 50 [Hz] and 380 [V].

(*2) An ambient temperature is set at 55°C.

(*4) Since the required rated sensitive current varies depending upon the power conditions of equipment to be installed, the rated current value [A] is only given.

(*5) Fuji Electric's magnetic contactors

A.2 Applicable cable size

Package type drive unit

[200 V series]

Cable size [mm^2]

Unit capacity [Cont./50%ED]	L1/R, L2/S, L3/T		U, V, W	P1, P(+)	P(+), DB	CN3, 4 CN6, 7	CN5 CN8 to 10	TB1	⏚
	75℃	90℃	75℃, 90℃	75℃, 90℃	75℃, 90℃				75℃, 90℃
0.75/1.1	2.0	2.0	2.0	2.0	2.0	0.2	0.3	0.5 to 1.5	10
1.5/2.2									
2.2/3.7									
3.7/5.5	3.5								

[400 V series]

Cable size [mm^2]

Unit capacity [Cont./50%ED]	L1/R, L2/S, L3/T		U, V, W	P1, P(+)	P(+), DB	CN3, 4 CN6, 7	CN5 CN8 to 10	TB1	⏚
	75℃	90℃	75℃, 90℃	75℃, 90℃	75℃, 90℃				75℃, 90℃
3.7/5.5	2.0	2.0	2.0	2.0	2.0	0.2	0.3	0.5 to 1.5	10

Dynamic braking converter unit

[200 V series]

Cable size [mm^2]

Unit capacity [Cont./50%ED]	L1/R, L2/S, L3/T		P(+), N(-)		P1, P(+)		P(+), DB		⏚	
	75℃	90℃	75℃	90℃	75℃	90℃	75℃	90℃	75℃	90℃
5.5/7.5	5.5	3.5	Use recommended connecting bar		3.5	2.0	2.0	2.0	10	10
7.5/11		5.5			5.5	3.5				
11/15	14	8.0			14	5.5			14	
15/18.5	22	14				14	3.5			14

[400 V series]

Cable size [mm^2]

Unit capacity [Cont./50%ED]	L1/R, L2/S, L3/T		P(+), N(-)		P1, P(+)		P(+), DB		⏚	
	75℃	90℃	75℃	90℃	75℃	90℃	75℃	90℃	75℃	90℃
5.5/7.5	2.0	2.0	Use recommended connecting bar		3.5	2.0	2.0	2.0	10	10
7.5/11	3.5				5.5	3.5				
11/15	5.5	3.5			8.0	5.5				
15/18.5	8.0	5.5			14	8.0			14	

Regenerative braking converter unit

Cable size [mm^2]

Unit capacity [Cont./50%ED]	L1/R, L2/S, L3/T		P(+), N(-)		⏚	
	75℃	90℃	75℃	90℃	75℃	90℃
3.7/5.5	2.0	2.0	Use recommended connecting bar		10	10
5.5/7.5	3.5					
7.5/11	5.5	3.5				
11/15	8	5.5				
15/18.5	14	8			14	
18.5/22	22	14			16	14
22/30						
30/37	38	22			22	16
37/45	100	60			60	38
45/55	*1					

Notes:
- CN3: Bound shielded PVC cable
  However, analog circuit (speed setting, overriding) should be shielded-wired independently of the contact I/O signal.
- CN4: Bound shielded PVC cable
- CN5: 5 sets of twisted pair shielded cable
- CN6: Bound shielded PVC cable
- CN7: Bound shielded PVC cable
- CN8 to 10: 5 sets of twisted pair shielded cable

Drive unit

[200 V series]

Cable size [mm^2]

Unit capacity [Cont./50%ED]	P(+), N(-)		U, V, W		CN3, 4 CN6, 7	CN5 CN8 to 10	TB1	⏚	
	75℃	90℃	75℃	90℃				75℃	90℃
3.7/5.5	Use recommended connecting bar		2.0	2.0	0.2	0.3	0.5 to 1.5	10	10
5.5/7.5			5.5	3.5					
7.5/11				5.5					
11/15			14	8				14	
15/18.5			22	14				16	14
18.5/22									
22/30			14×2 (*2)	22					16
30/37			60	38				38	22
37/45			80	60				60	38
45/55			—	80				-	60

[400 V series]

Cable size [mm^2]

Unit capacity [Cont./50%ED]	P(+), N(-)		U, V, W		CN3, 4 CN6, 7	CN5 CN8 to 10	TB1	⏚	
	75℃	90℃	75℃	90℃				75℃	90℃
5.5/7.5	Use recommended connecting bar		2.0	2.0	0.2	0.3	0.5 to 1.5	10	10
7.5/11			3.5						
11/15									
15/18.5			5.5	3.5					

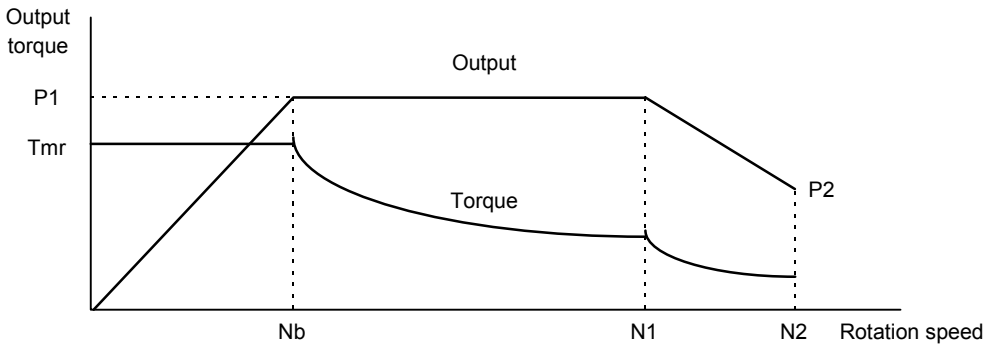
Note 1) Cable size is selected by the allowable temperature (by the type of cable).
Allowable temperature: 75°C/90°C → 600V HIV insulated cable/600V cross-linked polyethylene insulated cable

∗1 Selected based on 50%ED current value

∗2 Use of solderless terminal 38-S6 of Japan Solderless Terminal Manufacturing Co., Ltd. (JSD) make enables a single 38 [mm^2] cable to be used.

A.3 How to find acceleration/deceleration time

(1) Spindle motor output characteristic



Where,

P1 = Rated output [kW]
P2 = Rated output at max. speed [kW]
Tmr = Rated torque [N・m]
Nb = Base rotation speed [r/min]
N1 = Output decrease start speed [r/min]
N2 = Max. speed [r/min]

A general equation expressing the relation of output, torque and rotational speed is as follows.

$$P = \frac{T \times N}{974 \times 9.80665} \quad [kW]$$

(2) Calculation of acceleration and deceleration time

A general equation is as follows.

$$t = \frac{4J}{375} \int_{n1}^{n2} \frac{1 \times 9.80665}{Tm \pm Tl} dn \quad [s] \quad \left(\begin{array}{l} \text{- : at acceleration} \\ \text{+: at deceleration} \end{array} \right)$$

Where,

J = all J [kg・m^2]
Tm = Max. torque of motor [N・m]
T1 = Load torque [N・m]

When load torque T1 is equal to 0, the acceleration time (deceleration time) is calculated as follows:

(1) t1 〔0→Nb [r/min]〕

$$t1 = \frac{4J \times Nb \times 9.80665}{375 \times Tm} \quad [s]$$

(2) t2 〔Nb→N1 [r/min]〕

$$t2 = \frac{4J \times (N1^2 - Nb^2) \times 9.80665}{375 \times Tm \times 2 \times Nb} \quad [s]$$

(3) t3 〔N1→N2 [r/min]〕

$$t3 = \frac{4J \times (N2^2 - N1^2) \times 9.80665}{375 \times Tm' \times 2 \times N1} \quad [s]$$

Therefore, the acceleration time (deceleration time) to be taken from 0 to N2 is
t = t1 + t2 + t3 [s]
However,

Where, $Tm = \alpha \times \frac{P1 \times 974 \times 9.80665}{N1}$ [N・m]

$$Tm' = \alpha \times \frac{P0' \times 974 \times 9.80665}{N1} \quad [N・m]$$

$$P' = \frac{P1 + P2}{2} \quad [kW]$$

α = 1.2 (1.1/0.75 to 55/45 [kW])
P1 and P2: 50%ED rated output of motor [kW]

A.4 Calculation of orientation control

(1) How to obtain set value of orientation slow-speed

1) Magneto sensor method

1)–1) How to obtain the 2nd slow-speed set value

$$N2 \leqq \sqrt{\frac{1375 \times Tmr \times k}{4 \Sigma J}}$$

Where,

N1 : 1st slow-speed set value [r/min]

N2 : 2nd slow-speed set value [r/min]

Tmr : Continuous rated torque [N・m]

k : Gear ratio $= \dfrac{\text{Spindle rotational speed}}{\text{Motor shaft rotational speed}}$

ΣJ : All J converted into motor shaft [kg・m^2]

1)–2) How to obtain set value of the 1st slow-speed

$$N1 \leqq \sqrt{\frac{33750 \times Tmr \times k}{4 \Sigma J \times 9.80665} + N2^2}$$

2) Pulse encoder method

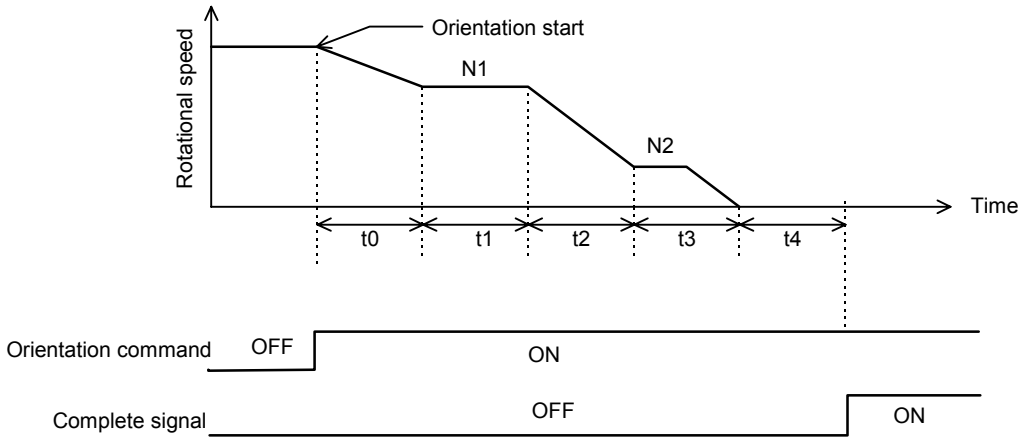
2)–1) How to find the 1st slow-speed set value

$$N1 \leqq \sqrt{\frac{45000 \times Tmr \times k}{4 \Sigma J \times 9.80665}}$$

(2) How to obtain orientation time

How to obtain the orientation time about magneto-sensor method and pulse encoder method is given below:

1) Magneto-sensor method



a) t0: Obtained from equation of the normal deceleration time

b) t1: Between this section, the spindle performs a maximum of one-turn.

$$t1max = \frac{60 \times k}{N1} \text{ [s]}$$

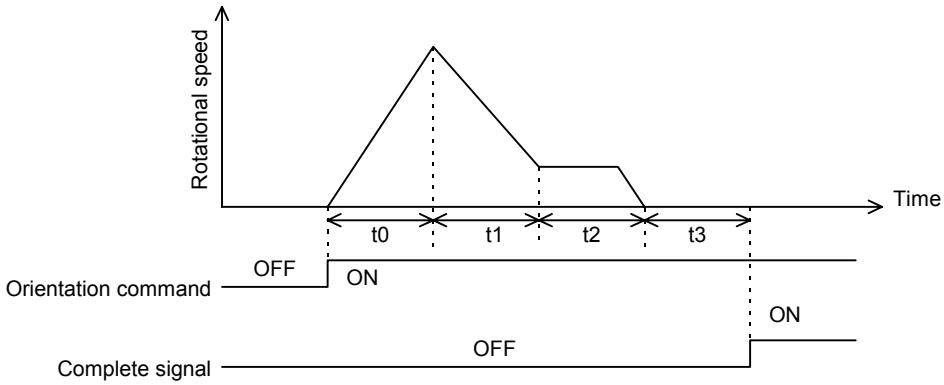
c) t2: $t2 = \dfrac{90 \times k}{N1 + N2}$ [s]

k: gear ratio $= \dfrac{\text{Spindle rotational speed}}{\text{Motor shaft rotational speed}}$

d) t3: $t3 = \dfrac{17 \times k}{N2}$ [s]

e) t4: time of a timer from orientation completion to output of complete signal. Standard set value before shipment is 0.1 [s].

1)-2 How to obtain orientation time starting at stop



a) $t0 : t0 = \dfrac{4\Sigma J \times N1 \times 9.80665}{375 \times Tm} \times \sqrt{\dfrac{Tm}{Tm \times Tmr}} + 0.3$ [s]

b) $t1 : t1 = \dfrac{90 \times k}{N1 + N2} \times \dfrac{N1 \times \sqrt{\dfrac{Tm}{Tm + Tmr}} - N2}{N1 - N2}$ [s]

c) $t2 : t2 = \dfrac{17 \times k}{N2}$ [s]

d) t3 : time of a timer from orientation completion to output of complete signal. Standard set value before shipment is 0.1 [s].

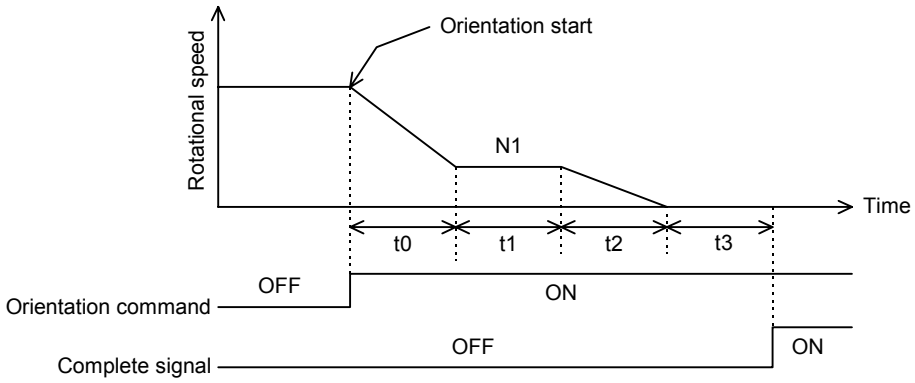
where, N1 : 1st slow-speed set value [r/min]
N2 : 2nd slow-speed set value [r/min]
Tmr : Continuous rated torque [N・m]
Tm : 50%ED rated torque $\times \alpha$ [N・m] $\alpha = 1.2$

k : Gear ratio $k = \dfrac{\text{Spindle rotational speed}}{\text{Motor shaft rotational speed}}$

ΣJ : All J converted into motor shaft [$kg \cdot m^2$]

2) Pulse encoder method

2)-1 How to obtain orientation time during rotation



a) t0 : Obtained from equation of the normal deceleration time

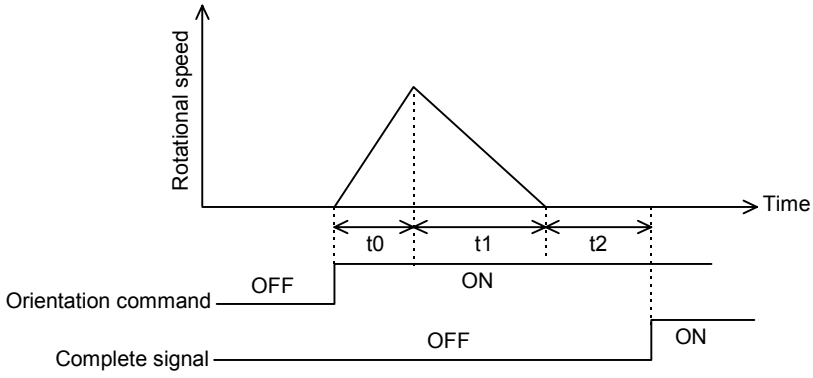
b) t1 : Between this section, the spindle performs a maximum of one-turn.

$t1max = \dfrac{60 \times k}{N1}$ [s]

c) t2 : $t2 = \dfrac{120 \times k}{N1}$ [s]

d) t3 : time of a timer from orientation completion to output of complete signal. Standard set value before shipment is 0.1 [s].

2)-2 How to obtain orientation time during stop



a) $t0 : t0 = \dfrac{4\Sigma J \times N1 \times 9.80665}{375 \times Tm} \times \sqrt{\dfrac{Tm}{Tm+Tmr}} + 0.3$ [s]

b) $t1 : t1 = \dfrac{120 \times k}{N1} \times \sqrt{\dfrac{Tm}{Tm+Tmr}}$ [s]

c) t2 : time of a timer from orientation completion to output of complete signal. Standard set value before shipment is 0.1 [s].

N1 : 1st slow-speed [r/min]
Tmr : Continuous rated torque [N・m]
Tm : 50%ED rated torque $\times \alpha$ [N・m] $\alpha = 1.2$

k : Gear ratio $k = \dfrac{\text{Spindle rotational speed}}{\text{Motor shaft rotational speed}}$

ΣJ : All J converted into motor shaft [$kg \cdot m^2$]

A.5 Rated sensitive current of earth-leakage circuit breaker

(1) Application of earth-leakage circuit breaker

For the FRENIC5000MS5 series (the drive unit and package type drive unit), sinusoidal wave PWM type inverter constitutes the main circuit. High frequency leakage current flows due to the stray capacitance to ground of the main circuit wiring, motor winding, and drive unit.

Malfunction may occur in the earth-leakage circuit breaker and earth-leakage relay installed in the power circuit due to the high frequency leakage current. It is recommended that you use Fuji earth-leakage circuit breaker provided for protection against high frequency leakage current.

(2) Leakage current of MS5 series

Commercial frequency components of leakage current for FRENIC5000MS5 series (drive unit and package type drive unit) is 4 to 5 [mA] in case the power supply is of a single grounding cable type (S-phase grounding).

A general leak tester may sometimes indicate a large value. This is because high frequency leakage current is included in the measured value by the frequency characteristics of the measuring device.

For the FRENIC5000MS5 series (drive unit and package type drive unit), the indication may differ depending upon the capacity of the drive unit, and the main circuit cable length from the drive unit and package type drive unit to the motor. When the wiring length is less than 10 [m], there is no practical problem if a leakage current per unit is assumed to be up to 10 to 15 [mA].

Rated sensitive current of earth-leakage circuit breaker

Motor output [kW] (50%ED rating)	Wiring length and applicable sensitive current			
	10 [m]	30 [m]	50 [m]	100 [m]
1.1	30 [mA]	30 [mA]	30 [mA]	100 [mA]
2.2	〃	〃	〃	〃
3.7	〃	〃	〃	〃
5.5	〃	〃	〃	〃
7.5	〃	〃	100 [mA]	〃
11	〃	〃	〃	〃
15	〃	〃	〃	〃
18.5	〃	〃	〃	〃
22	〃	〃	〃	〃
30	〃	〃	〃	〃
37	〃	100 [mA]	〃	〃
45	〃	〃	〃	200 [mA]
55	〃	〃	〃	〃

A.6 Transformer for different voltage power supply

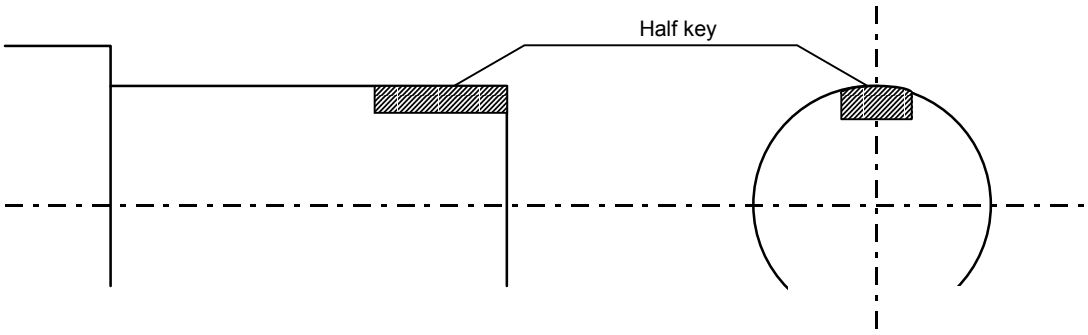
If the rated AC power supply of a transformer connected to FRENIC5000MS5 series is different from 200/200 to 230 [V], 50/60 [Hz], prepare a transformer for different voltage power supply as shown below.

Package type drive unit output [kW]		1.1/ 0.75	2.2/ 1.5	3.7/ 2.2	5.5/ 3.7	—	—	—	—	—	—	—	—	—
Converter unit output [kW]		—	—	—	5.5/ 3.7	7.5/ 5.5	11/ 7.5	15/ 11	18.5/ 15	22/ 18.5	30/ 22	37/ 30	45/ 37	55/ 45
Capacity [kVA]	Continuous rating	2	3	4	7	9	12	17	22	28	34	45	55	67
	50%ED	3	4	7	9	12	17	22	28	34	45	55	67	82
Secondary rated voltage [V]		210 [V], 50/60 [Hz]												
50%ED rated secondary current [A]		8.3	11	20	24	32	46	60	76	102	124	151	185	226
% impedance		Less tham 5%												
Connection method		△—△ connection												

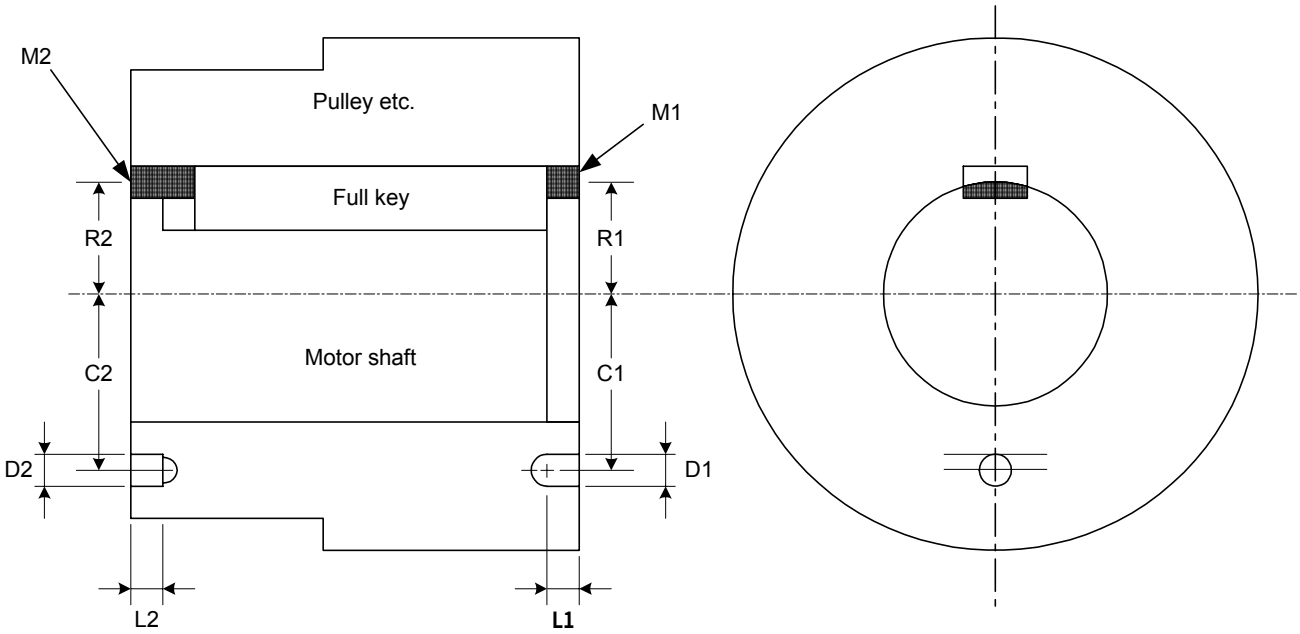
A.7 Cautions on use of spindle motor

(1) Motor dynamic balance (common to MVE and MVS motor)

The motor rotor is dynamically balanced by using all balancing machines with a half key on the shaft end key groove as shown below. This motor rotates very quickly so that a slight unbalance may generate a large vibration. Take much care that unbalance may not occur at gear and pulley attached to the motor shaft and other high speed rotational shaft.



Motor balancing



$$M1 \times R1 = \frac{\pi}{4} \times (D1)^2 \times L1 \times C1 \times \gamma$$

$$M2 \times R2 = \frac{\pi}{4} \times (D2)^2 \times L2 \times C2 \times \gamma$$

M1, M2 : Mass

γ : Specific gravity

Example of correction of unbalanced pulley

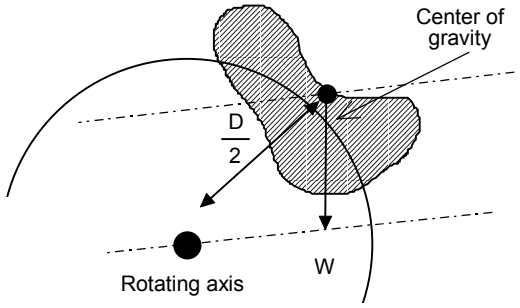
A.8 How to obtain moment of inertia of rotor

(1) Rotating motor element

Workpiece handled by lathe is almost a rotating element and its rotating shaft is aligned with a central shaft of the rotating element.

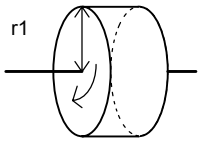
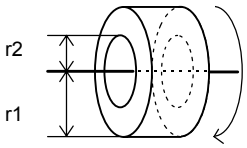
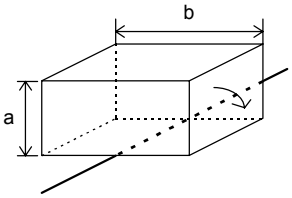
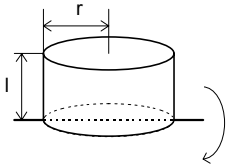
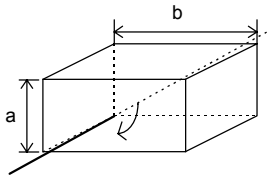
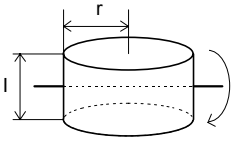
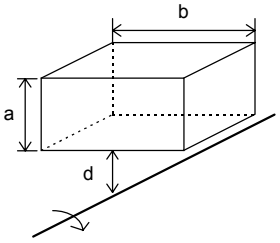
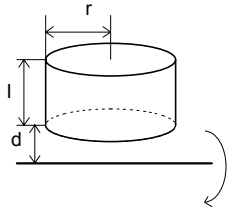
The moment of inertia J of the rotating element is expressed as follows, when diameter and mass of the rotating element are D [m] and W [kg],

$$J = \frac{W \cdot D^2}{4} \quad [kg \cdot m^2]$$



D : Rotating diameter [m]
W : Mass [kg]

Diameter D of various rotating elements is given as follows:

Rotating axis on the same central shaft of cylinder		Rotating axis on an end of rotating element	
 $D=\sqrt{2}\ r1$	 $D=\sqrt{2\,(r1^2+r2^2)}$	 $D=\sqrt{\frac{4a^2+b^2}{3}}$	 $D=\sqrt{\frac{4}{3}l^2+r^2}$
Rotating axis passing through the center of gravity		**Rotating axis out of rotating element**	
 $D=\sqrt{\frac{a^2+b^2}{3}}$	 $D=\sqrt{\frac{1}{3}l^2+r^2}$	 $D=\sqrt{\frac{4a^2+b^2}{3}+4\,(ad+d^2)}$	 $D=\sqrt{\frac{4}{3}l^2+r^2+4\,(dl+d^2)}$

A motor is connected to a rotating element or load not only directly, but via a reduction mechanism such as a pulley. In such a case, the load shaft Jl is required to be converted into the motor shaft J. The conversion equation is as follows.

$$Jm = Jl \cdot \left(\frac{nl}{nm}\right)^2 = Jl \cdot a^2$$

Where,

Jm : Motor shaft conversion J [kg・m^2]
Jl : Load shaft J [kg・m^2]
nl : Load shaft speed [r/min]
nm : Motor shaft rotational speed [r/min]

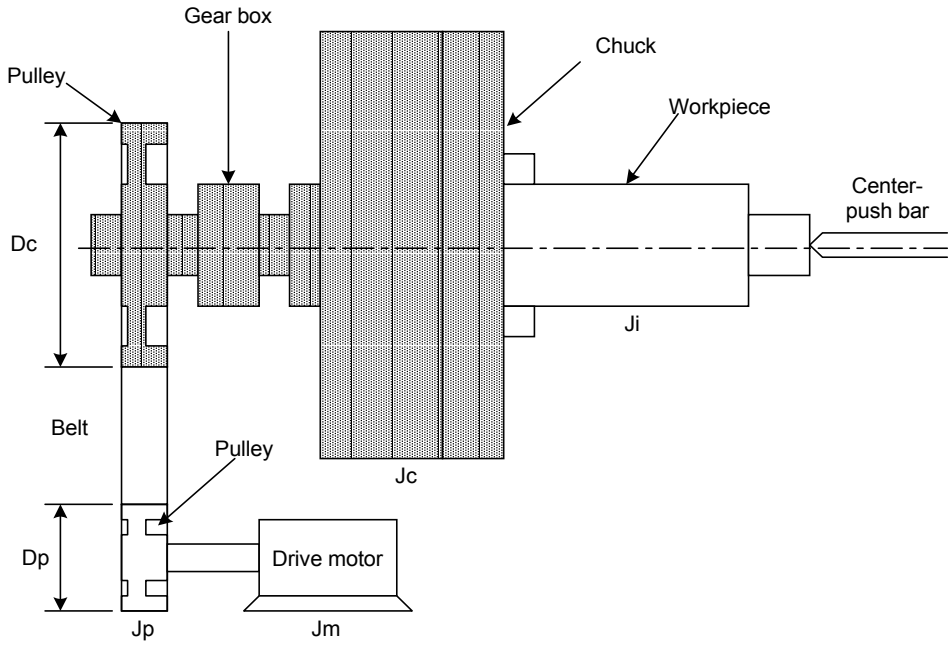
Example

Converted value of each part J into motor shaft by calculating all J converted into motor shaft of a reduction gear driven by belt as shown in the figure is as follows:

$J=Jm+Jp+(Ji+Jc)\cdot a^2$ [kg·m^2]

Where,

$$a=\frac{nl}{nm}=\frac{Dp}{Dc}$$



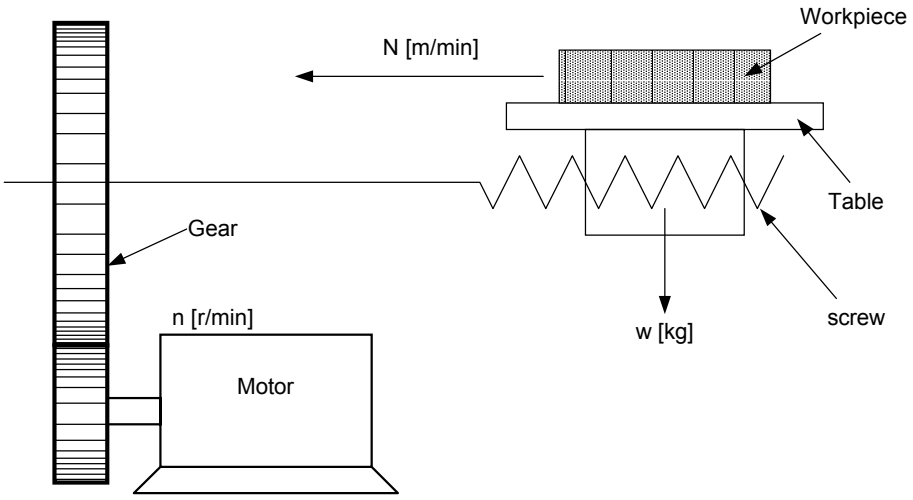
(2) Linear motion element

Like the planer table drive, the motor shaft Jm for linear motion is expressed as follows:

$$Jm=\frac{(Ww+Wt)\,N^2}{4\,\pi^2 n^2}\ [kg\cdot m^2]$$

Ww : Mass of workpiece [kg]
Wt : Mass of table [kg]
N : Table speed [m/min]
N : Motor rotational speed to N [r/min]

However, for actual Jm, take the gear and coupling J into consideration.



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Block 5000 Ang Mo Kio Ave. 5 #02-03 SINGAPORE 569870
Phone : 481-5079
Facsimile : 481-5476

Contracted Service Companies

Asia and Oceania

●CNC and Robotic Automated Services
20 Hackett Terrace Marryatville, S.A. 5068 AUSTRALIA
Phone : 08-8378-6081
Facsimile : 08-8364-4021

●Fuji-Electric Technology and Service (Shenzhen) Co., Ltd.
Room 209 Liming Bldg. No.144, Zhongxing Rd., Luohu Ku. Shenzhen City, CHINA
Phone : 0755-220-2745
Facsimile : 0755-218-5812

●Fuji Electric (Asia) Co., Ltd.
Room 1001, 10th Fl., Tsimshatsui Center 66 Mody Rd., Tsimshatsui East Kowloon, HONG KONG
Phone : 2311-8282
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●Autonum Controls Pvt. Ltd.
17, Adukia Apartment, S. Mody Rd., Kandivli (West), Mumbai-400 067, INDIA
Phone : 022-8658136
Facsimile : 022-8073246

●Donghai Corporation
Donghai Bldg., 1056-28, Namhyun-dong, Kwanak-ku, Seoul, R.O. KOREA
Phone : 02-586-0058
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●Gaius Industries Co., Ltd.
2nd Fl., Young Shin Bldg., 954-4, Dogok-dong, Kangnam-gu, Seoul, 135-270, R.O. KOREA
Phone : 02-554-0766
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●Taiwan Optical Measuring Instrument Co., Ltd.
6th Fl.-3, No.190, Sec. 2, Chung Hsing Rd., Hsin Tien City, Taipei Hsien, TAIWAN R.O.C.
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  Phone : 847-233-9412
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- Los Angeles Office
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  Phone : 503-520-5044
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South East Asia

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