

# MITSUBISHI

**AC SPINDLE DRIVE  
FREQROL-SGJ  
STANDARD SPECIFICATION  
M0600 - ES**

ADVANCED AND EVER ADVANCING  
**MITSUBISHI ELECTRIC**

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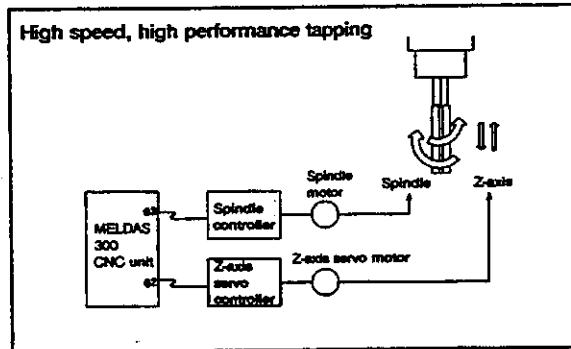
**CHAPTER 1    OUTLINE OF THE FR-SGJ SERIES  
AC SPINDLE DRIVE**

## 1. Outline of the FR-SGJ Series AC Spindle Drive

### 1.1 Features

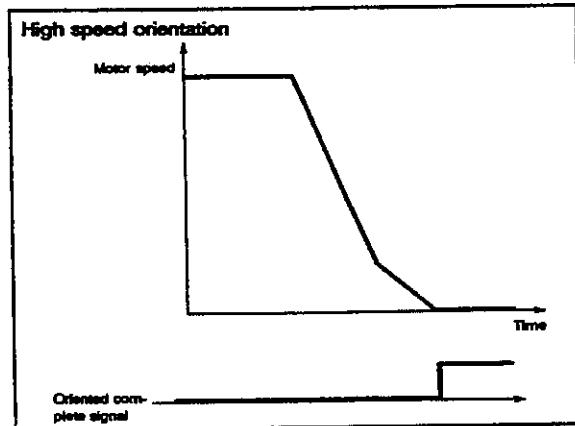
#### [Responds to the spindle servo]

- Through bus line connection with the NC unit, the spindle can be used as a servo and direct high speed, high performance tapping can be realized without the floating tap chuck.
- Re-clasping of a rotating work, chucking of special shapes and cutting-off machining of long material is possible.



#### [Upgrade of basic performance]

- By using a high speed orient that allows direct orientation from high speed rotation, smooth operations and a shortening in the orientation time have been realized.
- The cutting performance has been further upgraded with an upgrade in the impact load response with advanced control.



#### [Responds to machinery combinations]

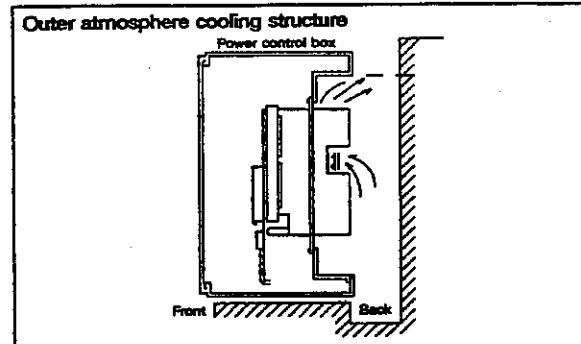
- Switch-over 1 amp 2 motor from the spindle motor and the general-purpose motor (without a detector) has been made possible.

#### [Realization of easy use]

- Operability has been upgraded by allowing parameter settings (motor maximum speed, speed loop gain etc.) with the built-in key switches, and allowing parameter setting with the CRT screen on the NC.
- Diagnosis information of the alarm contents is displayed on the NC CRT screen.
- Reliability has been upgraded by using a LSI and a printed circuit board in the power section.

[Responds to outer atmosphere cooling structure]

- An outer cooling structure has been prepared for the unit structure in addition to the panel installation type.



[Various products available]

- A capacity range between 0.75 to 7.5 kW has been prepared.
- A 71 frame motor has been added to the 112 frame and 90 frame motor frame numbers.

[Responds to the high speed spindle]

- The 0.75 to 5.5 kW maximum speed has been increased to 10000 rpm.

## 1.2 Cautions for use

- (1) The rated motor output is guaranteed to the controller rated input voltage (AC200/220/230V). When the input voltage decreases to below this, the rated output may not be output at times.
- (2) As a highly harmonic chopper voltage that is PWM controlled is applied to the motor, a highly harmonic leakage voltage will flow during operation of the motor. When the universal leakage breaker is used, malfunctions may occur because of this high voltage, so please use the leakage breaker for inverter use.
- (3) The highly harmonic leakage voltage above flows through the earth wire between the motor and controller. If the earth wire and the NC CRT screen come in contact, the CRT screen may malfunction from the leakage voltage magnetic forces. Please keep the earth wire and NC CRT screen apart if possible.
- (4) Noise may become a problem in AM radio frequencies due to the magnetic wave noise emitted from the motor and controller. Please keep radios away from the motor and controller when possible. A filter to prevent radio noise has been prepared as an option, so please use it when necessary.
- (5) You may get burned if the resistivity unit is touched when hot. Please use a protective cover or use consideration when installation so that people will not touch the unit.
- (6) Do not turn off the power immediately after the motor operation has stopped. The power must be left on for a minimum of ten minutes to cool the resistivity unit. When the power is cut off immediately after load operation, the cooling fan will stop and the resistivity unit temperature may rise, emit smoke or be damaged from the remaining heat.

**Chapter 1 OUTLINE OF THE FR-SGJ SERIES  
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### 1.3 Model Designation

Motor	<p>SJ - N 5.5 A M</p> <p>AC spindle motor series name</p> <p>15 min. or 30 min. rated output (kW)</p> <p>Basic speed A: 1500 rpm X: Special speed</p> <p>M: With Z-phase</p>									
	<p>FR-SGJ - 2 - 5.5 K</p> <p>Prefix for AC spindle inverter</p> <p>Output (kW)</p> <p>Power supply (200V class)</p> <table border="1"> <tr> <th>Symbol</th> <th>Series</th> </tr> <tr> <td>A</td> <td>Standard series</td> </tr> </table> <table border="1"> <tr> <th>Symbol</th> <th>Name</th> </tr> <tr> <td>NOSIGN</td> <td>Panel installation type</td> </tr> <tr> <td>C</td> <td>Middle panel type</td> </tr> </table>	Symbol	Series	A	Standard series	Symbol	Name	NOSIGN	Panel installation type	C
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Controller (Analog speed command and digital I/O type)	<table border="1"> <thead> <tr> <th>Symbol</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>NO SIGN</td> <td> <ul style="list-style-type: none"> <li>○ S-analog ±10/Top speed</li> <li>○ "Machine operation ready" input</li> <li>○ "Fwd/rev." command input</li> <li>○ "Emergency stop" input</li> <li>□ "Torque limit" command input</li> <li>□ "Alarm reset" input</li> <li>□ "Motor selection" 1, 2 input</li> <li>□ "Speed selection" 1, 2, 3 input</li> <li>○ "Speed meter" output</li> <li>○ "Load meter" output</li> <li>○ "Zero speed" output signal</li> <li>○ "Up-to-speed" output signal</li> <li>○ "Spindle failure" output signal</li> <li>△ "Speed detect" output signal</li> <li>△ "Current detect" output signal</li> <li>△ "Emergency stop" output signal</li> <li>△ "Torque limit ON" output signal</li> <li>△ "Ready-ON" output signal</li> <li>△ "Motor fwd.run/rev.run" output signal</li> <li>△ "Alarm" output signal</li> <li>△ "Motor selection" 1, 2 output signal</li> <li>○ "Emergency stop alarm" output signal, ON/OFF selection</li> <li>○ Acceleration/deceleration time constant setting</li> </ul> </td> </tr> <tr> <td>R SGJ-OR card</td> <td> <ul style="list-style-type: none"> <li>○ Magnesensor orientation</li> <li>○ Encoder multipoint orientation</li> <li>○ Encoder multipoint Index orientation</li> <li>○ Motor built-in encoder multipoint orientation</li> <li>○ Motor built-in encoder index orientation</li> <li>○ Motor built-in encoder <ul style="list-style-type: none"> <li>• Spindle speed display</li> <li>• Sync. feed signal</li> </ul> </li> <li>○ Oriented command input</li> <li>○ "Oriented complete" output signal</li> <li>○ S-analog high speed tap</li> </ul> </td> </tr> <tr> <td>D SGJ-DA card</td> <td> <ul style="list-style-type: none"> <li>Digital speed command <ul style="list-style-type: none"> <li>○ BINARY 12-bit</li> <li>○ BCD 2-digit</li> <li>○ BCD 3-digit</li> </ul> </li> </ul> </td> </tr> </tbody> </table>	Symbol	Function	NO SIGN	<ul style="list-style-type: none"> <li>○ S-analog ±10/Top speed</li> <li>○ "Machine operation ready" input</li> <li>○ "Fwd/rev." command input</li> <li>○ "Emergency stop" input</li> <li>□ "Torque limit" command input</li> <li>□ "Alarm reset" input</li> <li>□ "Motor selection" 1, 2 input</li> <li>□ "Speed selection" 1, 2, 3 input</li> <li>○ "Speed meter" output</li> <li>○ "Load meter" output</li> <li>○ "Zero speed" output signal</li> <li>○ "Up-to-speed" output signal</li> <li>○ "Spindle failure" output signal</li> <li>△ "Speed detect" output signal</li> <li>△ "Current detect" output signal</li> <li>△ "Emergency stop" output signal</li> <li>△ "Torque limit ON" output signal</li> <li>△ "Ready-ON" output signal</li> <li>△ "Motor fwd.run/rev.run" output signal</li> <li>△ "Alarm" output signal</li> <li>△ "Motor selection" 1, 2 output signal</li> <li>○ "Emergency stop alarm" output signal, ON/OFF selection</li> <li>○ Acceleration/deceleration time constant setting</li> </ul>	R SGJ-OR card	<ul style="list-style-type: none"> <li>○ Magnesensor orientation</li> <li>○ Encoder multipoint orientation</li> <li>○ Encoder multipoint Index orientation</li> <li>○ Motor built-in encoder multipoint orientation</li> <li>○ Motor built-in encoder index orientation</li> <li>○ Motor built-in encoder <ul style="list-style-type: none"> <li>• Spindle speed display</li> <li>• Sync. feed signal</li> </ul> </li> <li>○ Oriented command input</li> <li>○ "Oriented complete" output signal</li> <li>○ S-analog high speed tap</li> </ul>	D SGJ-DA card	<ul style="list-style-type: none"> <li>Digital speed command <ul style="list-style-type: none"> <li>○ BINARY 12-bit</li> <li>○ BCD 2-digit</li> <li>○ BCD 3-digit</li> </ul> </li> </ul>	
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Note:  
**NO SIGN:**  
NO SIGN is selected when the R and D additional specifications are not required.

R: Includes the NO SIGN function.  
D: When connected to NC units other than the M300, M3/L3 and the digital speed command is necessary, D is used.  
Includes the NO SIGN and R functions.

**Chapter 1 OUTLINE OF THE FR-SGJ SERIES  
AC SPINDLE DRIVE**

Controller (Bus-line connection type)	<table border="1"> <tr> <td>Symbol</td> <td>Series</td> </tr> <tr> <td>B</td> <td>Standard series</td> </tr> </table> <table border="1"> <tr> <td>Symbol</td> <td>Name</td> </tr> <tr> <td>NOSIGN</td> <td>Panel installation type</td> </tr> <tr> <td>C</td> <td>Middle panel type</td> </tr> </table>		Symbol	Series	B	Standard series	Symbol	Name	NOSIGN	Panel installation type	C	Middle panel type
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## **1.4 NC to Spindle Connection Specification**

Spindle model Type of CNC	<b>FR-SGJ-2-□K-</b>				
	(*) A	AR	AD	(*) B	BR
Conventional CNC	(I)	(I)	(I), (II)	—	—
M300, M3/L3	(I)	(I)	(I), (II)	(III)	(III)
CNC for other manufacturer	(I)	(I)	(I), (II)	—	—

(\*) } without option card  
 (\*)

**Specification:**

- (I) : Analog speed command + Digital I/O
- (II) : Digital speed command + Digital I/O (Binary 12-bit, BCD 2-digit, BCD 3-digit)
- (III) : Bus-line connection (RS485)

## 1.5 Input/Output Signal, Optional Function List

### 1.5.1 Analog speed command and digital I/O type

Function	Reference		Controller Model FR-SGJ-Z- <sup>1</sup> /K-A [See below]		
	General	Details	Option symbol		
			—	R	D
Basic input/output	S-analog command voltage input ±10V/top speed	Page 3-1	○	○	○
	Machine ready input	Page 2-11	Page 3-1	○	○
	Fwd.run/rev.run command input	Page 2-11	Page 3-2	○	○
	Zero speed output	Page 2-10	Page 3-9	○	○
	Up-to-speed output	Page 2-10	Page 3-10	○	○
	Speed meter output	Page 2-10	Page 3-13	○	○
	Load meter output	Page 2-10	Page 3-14	○	○
	Spindle failure output (alarm)	Page 2-10	Page 3-11	○	○
Auxiliary input/output	Orient command input	Page 2-11	Page 3-3	—	○
	Gear selection L, M input	Page 2-11	Page 3-4	—	□□
	Emergency stop input	Page 2-11	Page 3-4	□	□
	Torque limit H, L input	Page 2-11	Page 3-4	□□	□□
	Index fwd.run/rev.run input	Page 2-11	Page 3-5	—	□□
	External reset input	Page 2-11	Page 3-5	□	□
	Motor selection 1, 2 input (1 amp 2 motor)	Page 2-11	Page 3-5	□□	□□
	Speed selection 1, 2, 3 input	Page 2-11	Page 3-5	□□□	□□□
	Digital speed selection input	Page 2-12	Page 3-6	—	—
	S-analog high speed tap input	Page 2-12	Page 3-6	—	□
	Oriented complete output	Page 2-10	Page 3-11	—	△
	Speed detect output	Page 2-10	Page 3-12	△	△
	Current detect output	Page 2-10	Page 3-12	△	△
	Emergency stop output	Page 2-10	Page 3-12	△	△
	Torque limit ON output	Page 2-10	Page 3-12	△	△
	Ready-ON output	Page 2-10	Page 3-12	△	△
	Motor fwd.run/rev.run output	Page 2-10	Page 3-12	△△	△△
	Alarm output	Page 2-10	Page 3-12	△	△
	Motor selection 1, 2 output (1 amp 2 motor)	Page 2-11	Page 3-13	△△	△△
	Emergency stop alarm signal output, ON/OFF selection	Page 2-12	Page 3-13	○	○
	Acceleration/deceleration time constant setting	Page 2-12	Page 3-13	○	○

Continued on the next page.

**Chapter 1 OUTLINE OF THE FR-SGJ SERIES  
AC SPINDLE DRIVE**

Function		Reference		Controller Model FR-SGJ-Z-□;K-A [See below]			
		General	Details	Option symbol			
				—	R	D	
Optional functions	Magnesensor use	Magnesensor orient	Page 7-9	—	○	○	
		Spindle speed display, synchronous feed signal		—	○	○	
		Magnesensor S-analog high speed tap	Page 9-1	—	○	○	
	1024P rev	Encoder (4096 point) orient	Page 7-9	—	○	○	
		Encoder (4096 points) index function	Page 9-1	—	○	○	
		Encoder S-analog high speed tap	Page 9-1	—	○	○	
	With Z-phase Motor built-in encoder use	Spindle speed display, synchronous feed signal		—	○	○	
		Motor built-in encoder orient	Page 7-9	—	○	○	
		Motor built-in encoder index function	Page 9-1	—	○	○	
		Motor built-in encoder S-analog high speed tap	Page 9-1	—	○	○	
Digital speed command 12-bit binary, BCD 3-digit, BCD 2-digit selection			Page 3-8	—	—	○	
1 amp 2 motor function		Page 9-1		○	○	○	

Note) Up to 5 can be selected and used from the output signals marked with a "□".  
(With option symbol D, up to 8 can be selected.)

Up to 3 can be selected and used from the input signals marked with a "△".  
(With option symbol D, up to 4 can be selected.)

**Chapter 1 OUTLINE OF THE FR-SGJ SERIES  
AC SPINDLE DRIVE**

**1.5.2 Bus-line connection type**

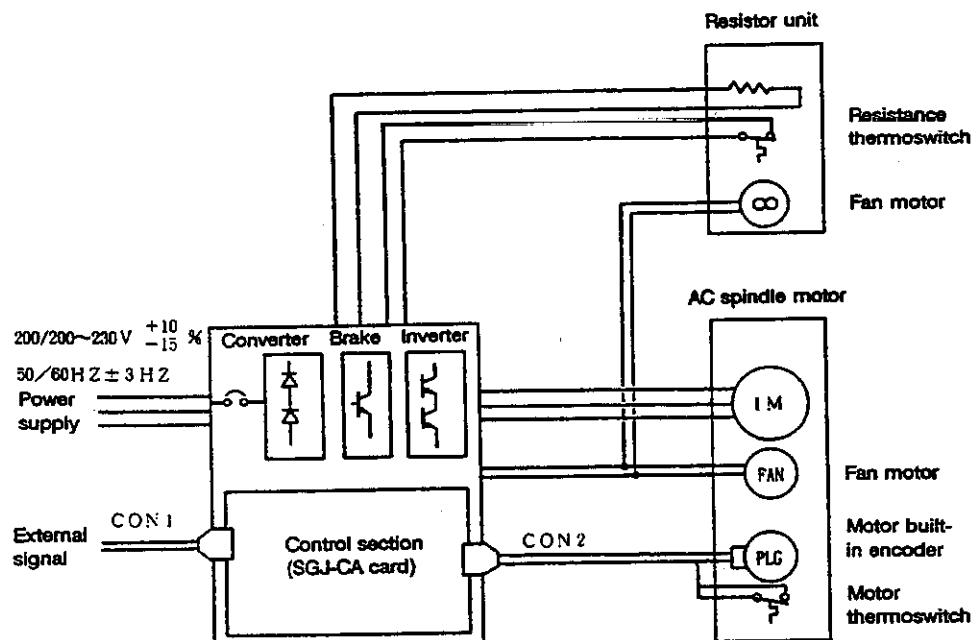
Function		Reference		Controller Model FR-SGJ-Z [JK-B [See below]	
		General	Details	Option symbol	
				—	R
Digital Input	Machine ready input	Page 2-11	Page 3-1	○	○
	Emergency stop input	Page 2-11	Page 3-4	○	○
	Speed command input			○	○
	Ready-ON input			○	○
	Fwd.run/rev.run command input	Page 2-11	Page 3-2	○	○
	Orient command input	Page 2-11	Page 3-3	—	○
	Gear selection L, M input	Page 2-11	Page 3-4	—	○
	Torque limit H, L input	Page 2-11	Page 3-4	○	○
	Index fwd.run/rev.run input	Page 2-11	Page 3-5	—	○
	NC reset input			○	○
	Motor selection 1, 2 input (1 amp 2 motor)	Page 2-11	Page 3-5	○	○
	Speed selection 1, 2, 3 input	Page 2-11	Page 3-5	○	○
	Zero speed output	Page 2-10	Page 3-9	○	○
	Up-to-speed output	Page 2-10	Page 3-10	○	○
	Oriented complete output	Page 2-10	Page 3-11	—	○
	Speed detect output	Page 2-10	Page 3-12	○	○
	Current detect output	Page 2-10	Page 3-12	○	○
	Emergency stop output	Page 2-10	Page 3-12	○	○
	Torque limit output	Page 2-10	Page 3-12	○	○
	Ready-ON output			○	○
Input/output through bus interface	Motor fwd.run/rev.run output	Page 2-10	Page 3-12	○	○
	Alarm output	Page 2-10	Page 3-12	○	○
	Motor selection 1, 2 output (1 amp 2 motor)	Page 2-10	Page 3-13	○	○
	Speed meter output			○	○
	Load meter output			○	○
	Emergency stop alarm signal output, ON/OFF selection	Page 2-12	Page 3-13	○	○
	Acceleration/deceleration time constant setting	Page 2-12	Page 3-13	○	○
	Magnesensor orient	Page 7-9		—	○
	Spindle speed display, synchronous feed signal			—	○
	Magnesensor high speed synchronous tap	Page 8-1		—	○
	Magnesensor spindle synchronous	Page 9-1		—	○
	1024P rev	Encoder (4096 point) orient	Page 7-9	—	○
	Encoder use	Encoder (4096 point) index function	Page 9-1	—	○
	With Z-phase Motor built-in encoder use	Encoder high speed synchronous tap	Page 8-1	—	○
	With Z-phase Motor built-in encoder use	Encoder spindle synchronous	Page 9-1	—	○
	With Z-phase Motor built-in encoder use	Spindle speed display, synchronous feed signal		—	○
	With Z-phase Motor built-in encoder use	Motor built-in encoder orient	Page 7-9	—	○
	With Z-phase Motor built-in encoder use	Motor built-in encoder index function	Page 9-1	—	○
	With Z-phase Motor built-in encoder use	Motor built-in encoder high speed synchronous tap	Page 8-1	—	○
	With Z-phase Motor built-in encoder use	Motor built-in encoder spindle synchronous	Page 9-1	—	○
	1 amp 2 motor function		Page 9-1	○	○

## 1.6 Composition

### 1.6.1 Analog speed command and digital I/O type

#### 1.6.1.1 Basic composition (standard) for analog speed command and digital I/O

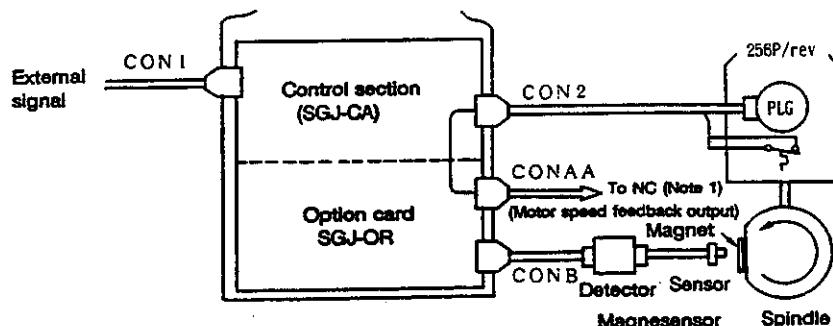
FR-SGJ-2-□K-A



### 1.6.1.2 Analog speed command and digital I/O

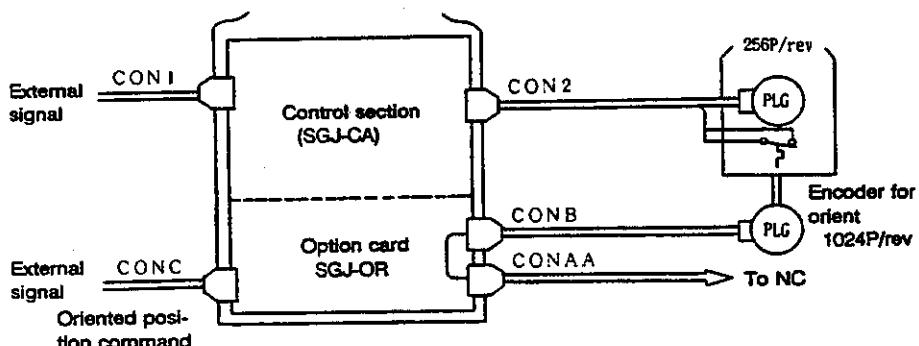
With oriented function (Option SGJ-OR card used) FR-SGJ-2-□K-AR

- (1) Magnesensor oriented (1 point) specification + Motor speed feedback output (for spindle speed display/sync. feed signal)

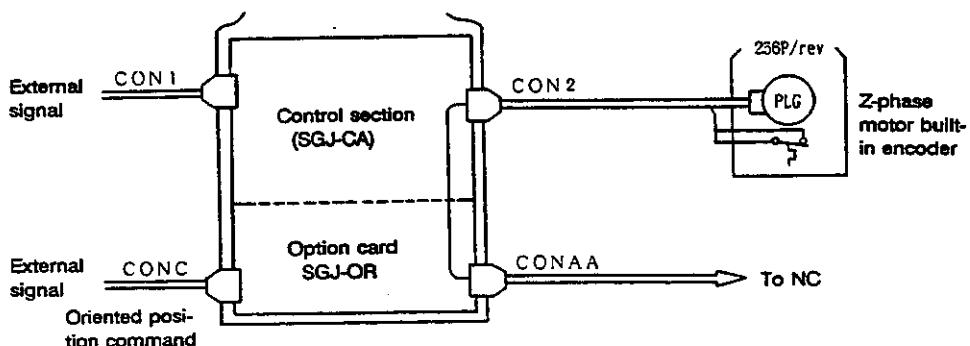


(Note) Number of output pulses depends on "spindle to motor reduction ratio".

- (2) Encoder oriented (4096 points) specification/index function

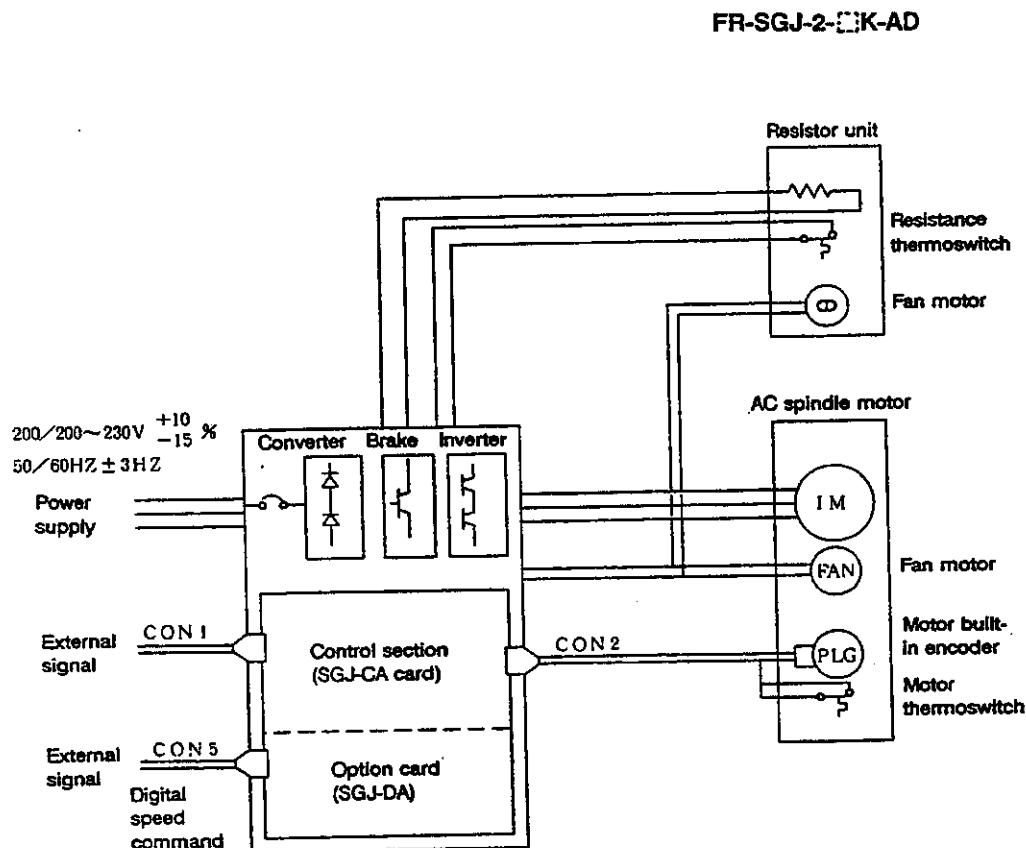


- (3) Z-phase motor built-in encoder oriented (4096 points) specification/index function



(Note) Multipoint orient using the Z-phase motor built-in encoder is applicable only when spindle to motor reduction ratio is 1:1.

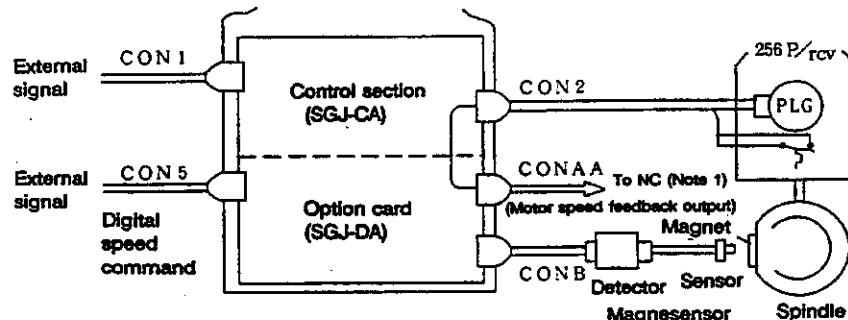
**1.6.1.3 Basic composition (standard) for digital speed command and digital I/O  
(Option SGJ-DA card used)**



#### 1.6.1.4 Digital speed command and digital I/O

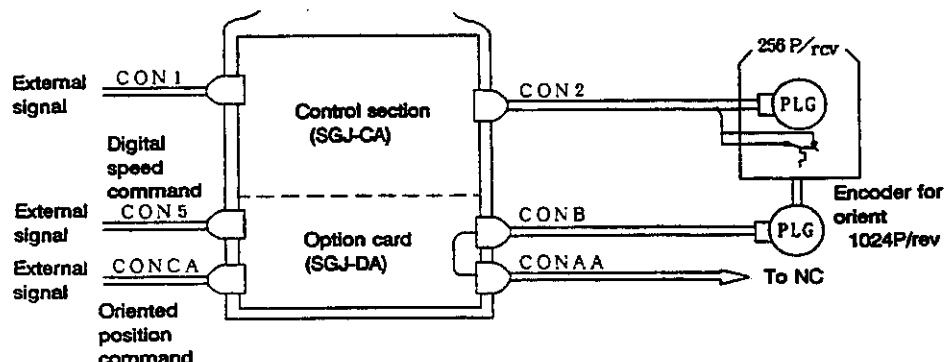
With oriented function (Option SGJ-DA card used) FR-SGJ-200K-AD

- (1) Magnesensor oriented (1 point) specification + Motor speed feedback output  
(for spindle speed display/sync. feed signal)

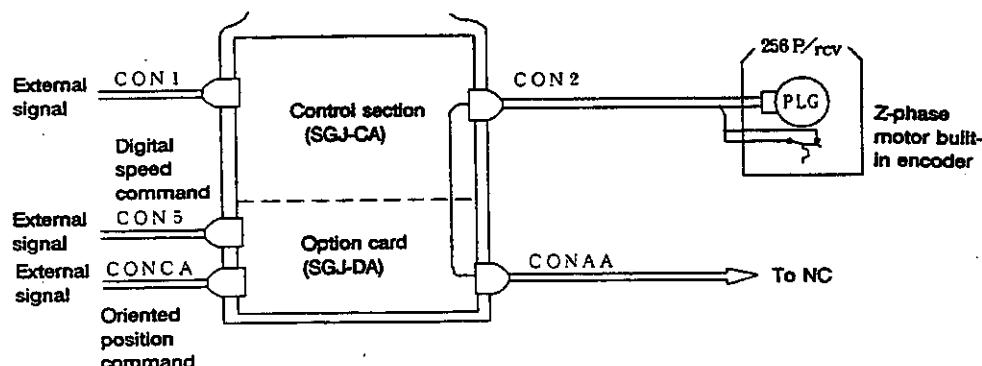


(Note) Number of output pulses depends on "spindle to motor reduction ratio".

- (2) Encoder oriented (4096 points) specification/index function



- (3) Z-phase motor built-in encoder oriented (4096 points) specification/index function

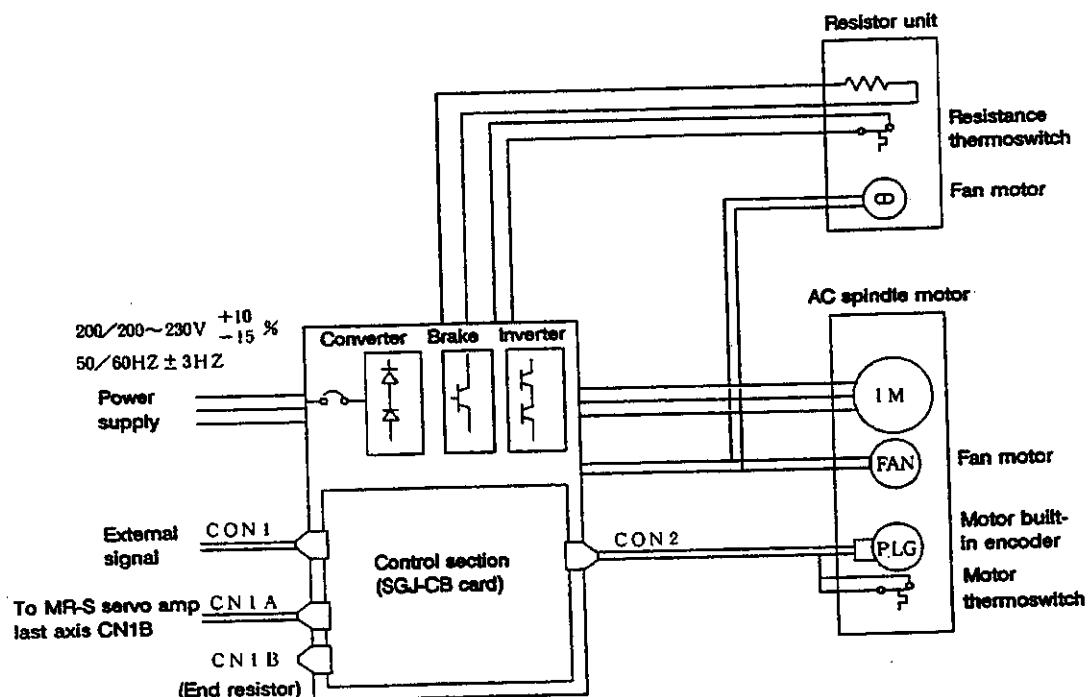


(Note) Multipoint orient using the Z-phase motor built-in encoder is applicable only when spindle to motor reduction ratio is 1:1.

### 1.6.2 Bus-line connection type

#### 1.6.2.1 Basic composition (standard) for bus-line connection with M300, M3/L3

FR-SGJ-2-□ K-B

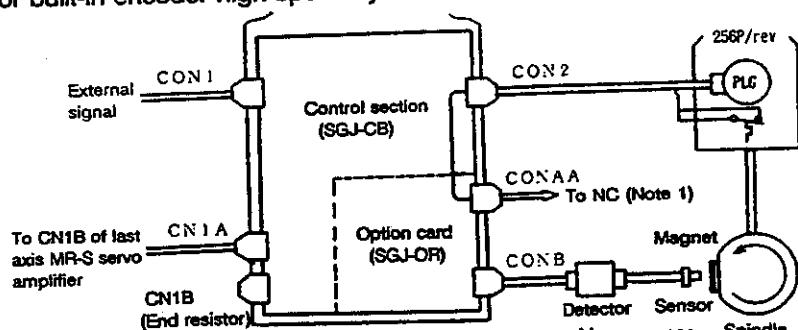


FR-SGJ-2-[]K-BR

### 1.6.2.2 Bus-line connection to M300, M3/L3

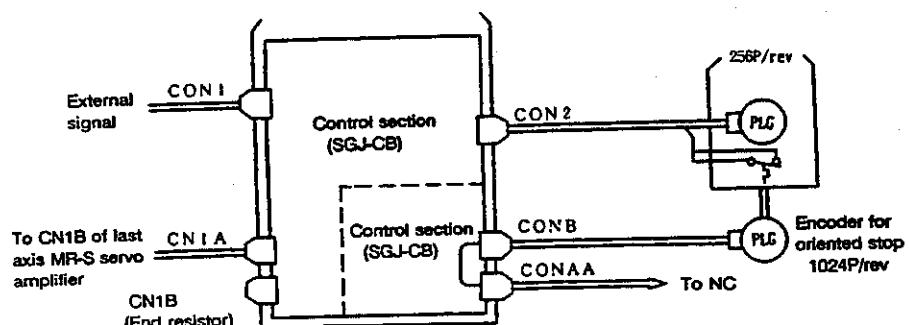
With high speed sync. TAP oriented function (Option SGJ-OR card used)

- (1) Motor built-in encoder high speed sync. TAP/magnesensor oriented (1 point) specification

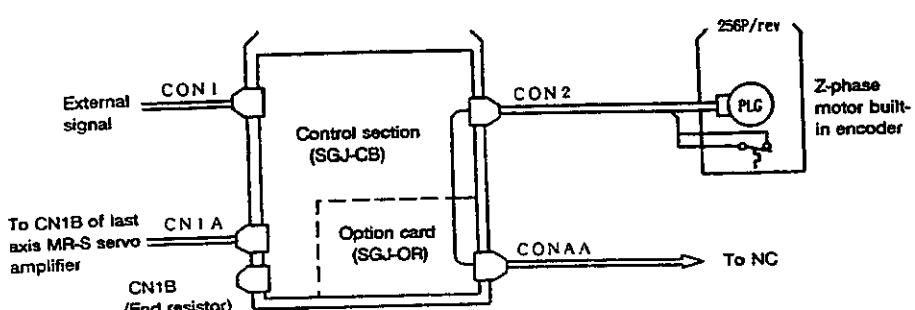


(Note) Number of output pulses depends on "spindle to motor reduction ratio".

- (2) Encoder high speed sync. TAP oriented (4096 points) specification/index function



- (3) Z-phase built-in encoder high speed sync. TAP oriented (4096 points) specification/index function



(Note) Multipoint orient using the Z-phase motor built-in encoder is applicable only when spindle to motor reduction ratio is 1:1.

## **CHAPTER 2    SPECIFICATIONS**

## 2. Specifications

### 2.1 AC Spindle Motor • Controller Specifications

	Item	Series	Standard series								
			SJ-N								
AC spindle motor	Model		0.75A	1.5A	2.2X	2.2A	3.7A	5.5AP	5.5A	7.5A	
	Output	Cont. rating (kW)	0.4	0.75	1.1	1.5	2.2	3.0	3.7	5.5	
		30% rating or 50% ED rating (kW)	0.75 15 min	1.5 15 min	2.2 15 min	2.2 15 min	3.7 15 min	5.5 15 min	5.5 15 min	7.5 15 min	
	Speed	Basic speed (rpm)	1500	3000			1500				
		Max. speed (rpm)			10000			8000			
	Frame No.		71		90			112			
	Cont. rated torque (kg-m)	0.26	0.48	0.36	0.97	1.43	2.4	2.4	3.57		
	GD <sup>2</sup> (kg-m <sup>2</sup> )	0.0045	0.0086	0.0086	0.017	0.021	0.045	0.058	0.071		
	Weight (kg)	15	20	20	33	37	45	63	74		
	Permissible radial load (kg)		50		100		150	200			
	Cooling fan (W)		20		40	55		35			
	Vibration			V5							
	Sound level (db)(A)			75							
	Installation		The output shaft is horizontal or vertical down.								
	Overload margin		30 min./15 min. rated output 120% for one minute.								
	Ambient temperature (°C)			0 ~ 40							
	Insulation class				F						
	Paint color			Munsell 5.27G 2.46/21							
	Accessories			Pulse generator and overheat detector							
	Lubrication of bearings			Grease							
Controller	Model		0.75K	1.5K	2.2K	2.2K	3.7K	5.5K	5.5K	7.5K	
	Power capacity (kVA)	2	3	4	4	7	9	9	12		
	Total heat generated (W)	140	160	180	180	210	290	290	380		
	Power supply		200/200 ~ 230V +10% -15%, 50/60Hz ±3Hz								
	Main circuit		Transistor sinusoidal wave PWM inverter								
	Control method		High speed return, digital closed loop control, vector control with pulse generator								
	Braking		Regenerative braking (resistor is used to disperse regenerative energy)								
	Speed control range			35 ~ 10000			35 ~ 8000				
	Speed regulation		Max. 0.2% of maximum speed (under load varying from 10% to 100%)								
	Speed command		Max. ±10V analog command/bus connection								
	Ambient temperature/humidity			-5 ~ 55°C/45 ~ 85%							
	Atmosphere		To be free from detrimental gas and dust (to conform with "grade C" specified by JEM1103)								
	Vibration			Max. 0.5G							
	Applicable standard				IEC						

(Note 1) The rated output is guaranteed for the rated input power supply (AC200/220/230V). If power supply regulation is not within the specified range, the rated output may not be obtained.

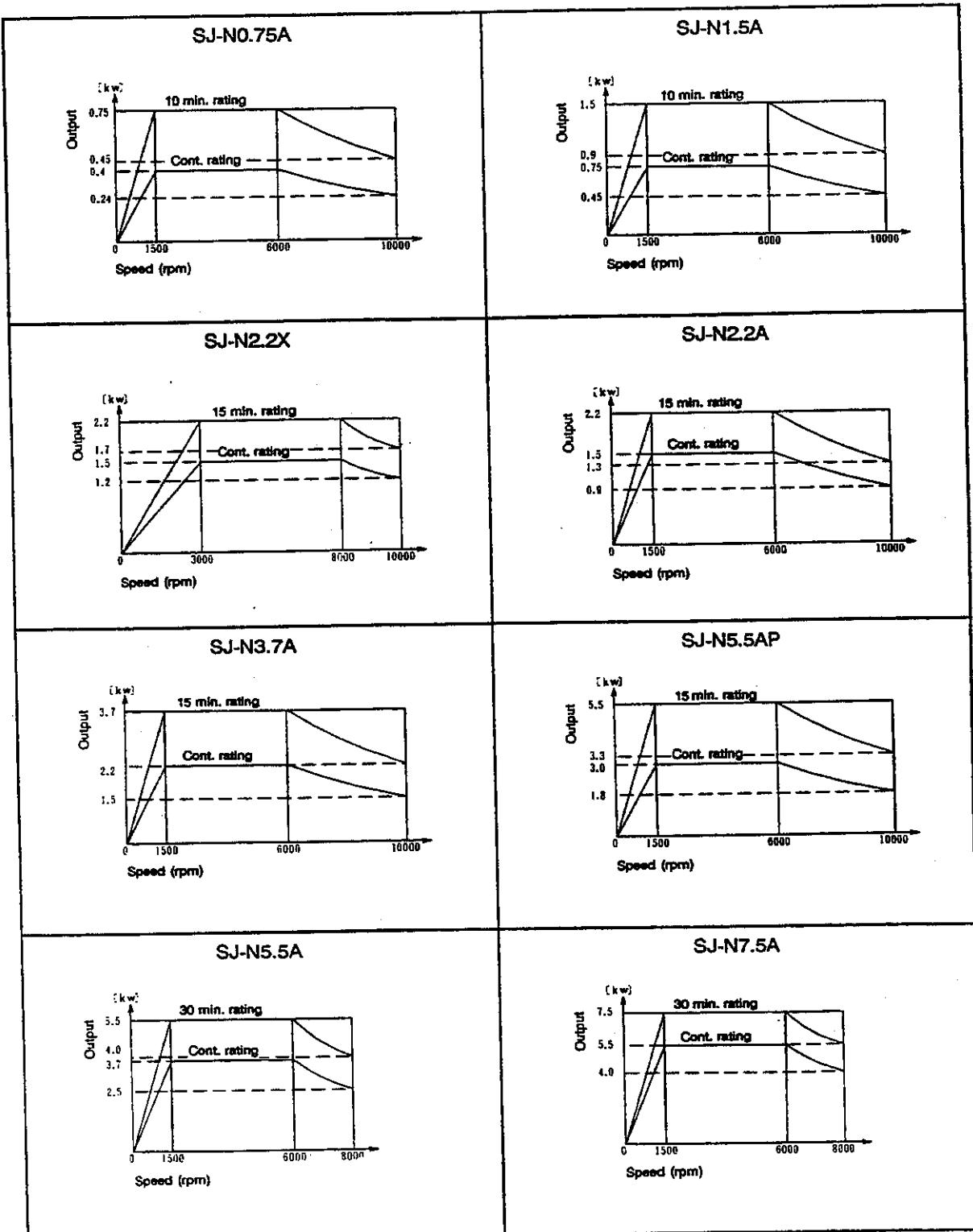
(Note 2) For speed faster than 6000 rpm, the output is equal to [Rated output ×  $\frac{6000}{\text{Speed}}$ ]

(Note 3) If the specified input power supply is not available, use an appropriate transformer.

(Note 4) The total heat generated is the value for continuous rated output. In the middle panel type, the generated heat outside the panel will be approximately  $(\text{total heat generated} - 30) \times 0.5 [\text{W}]$ .

(Note 5) The 50% ED rating is ON for five minutes and OFF for 5 minutes within the 10-minute cycle time.

## 2.2 Output Characteristics



### 2.3 Permissible Frequency of Controller Acceleration/Deceleration Operation

The permissible frequency of controller acceleration/deceleration operation (cycles per minute) depends on motor speed and  $GD^2$  (converted into motor shaft load), and can be determined from the formula shown below.

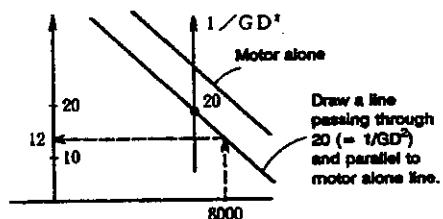
Since permissible frequency is governed by acceleration/deceleration time that in turn depends on controller output (see the Appendix), select the lower frequency in actual operation.

Ex.) For FR-SGJ-2-2.2K

Speed : 8000 rpm  
 $GD_L^2$  converted into motor shaft load: 0.033 kgm<sup>2</sup>

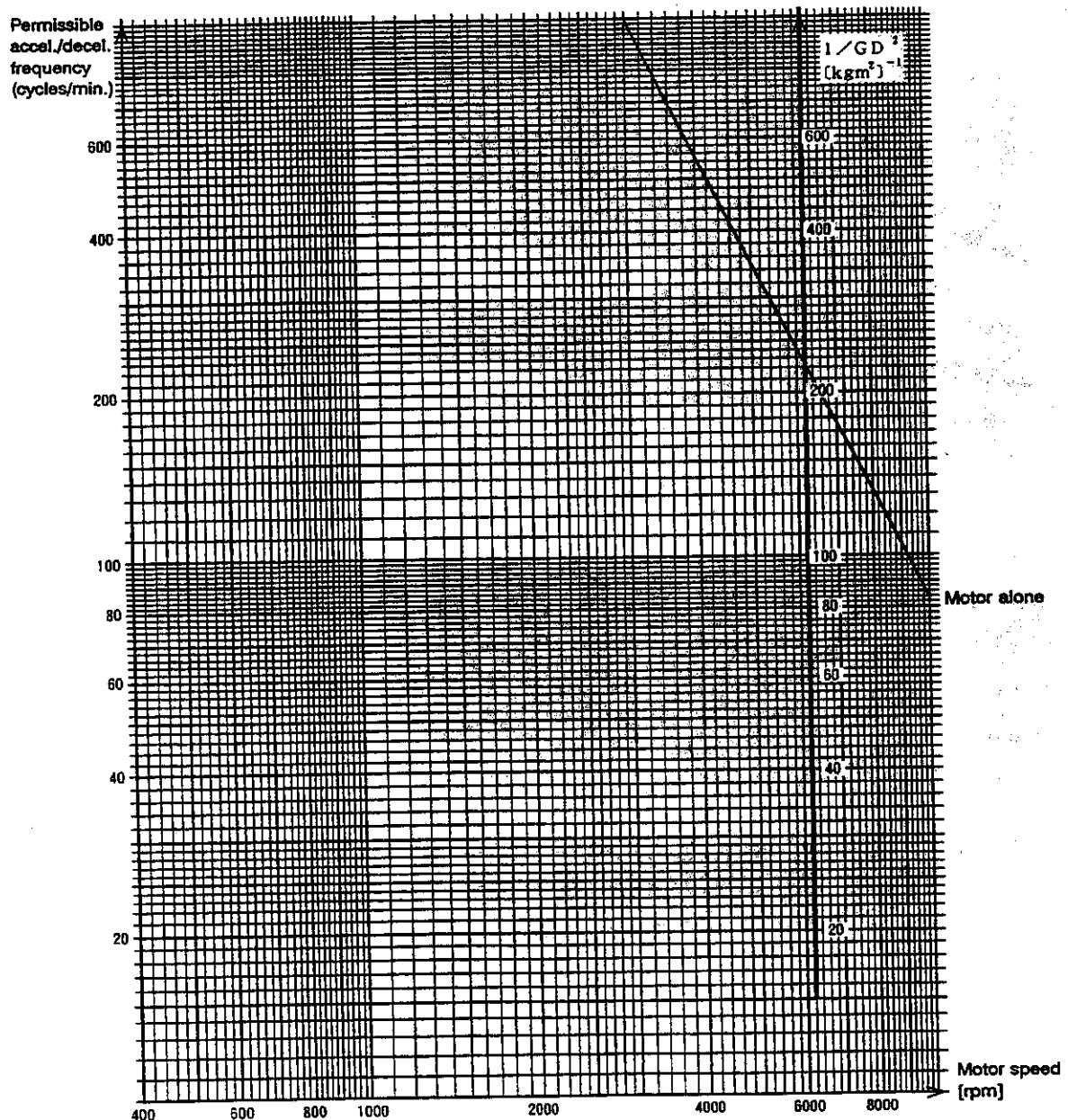
$$\begin{aligned} \text{Total } GD^2 \text{ converted into motor shaft load} \\ = GD_L^2 + GD_M^2 = 0.033 + 0.017 = 0.05 \end{aligned}$$

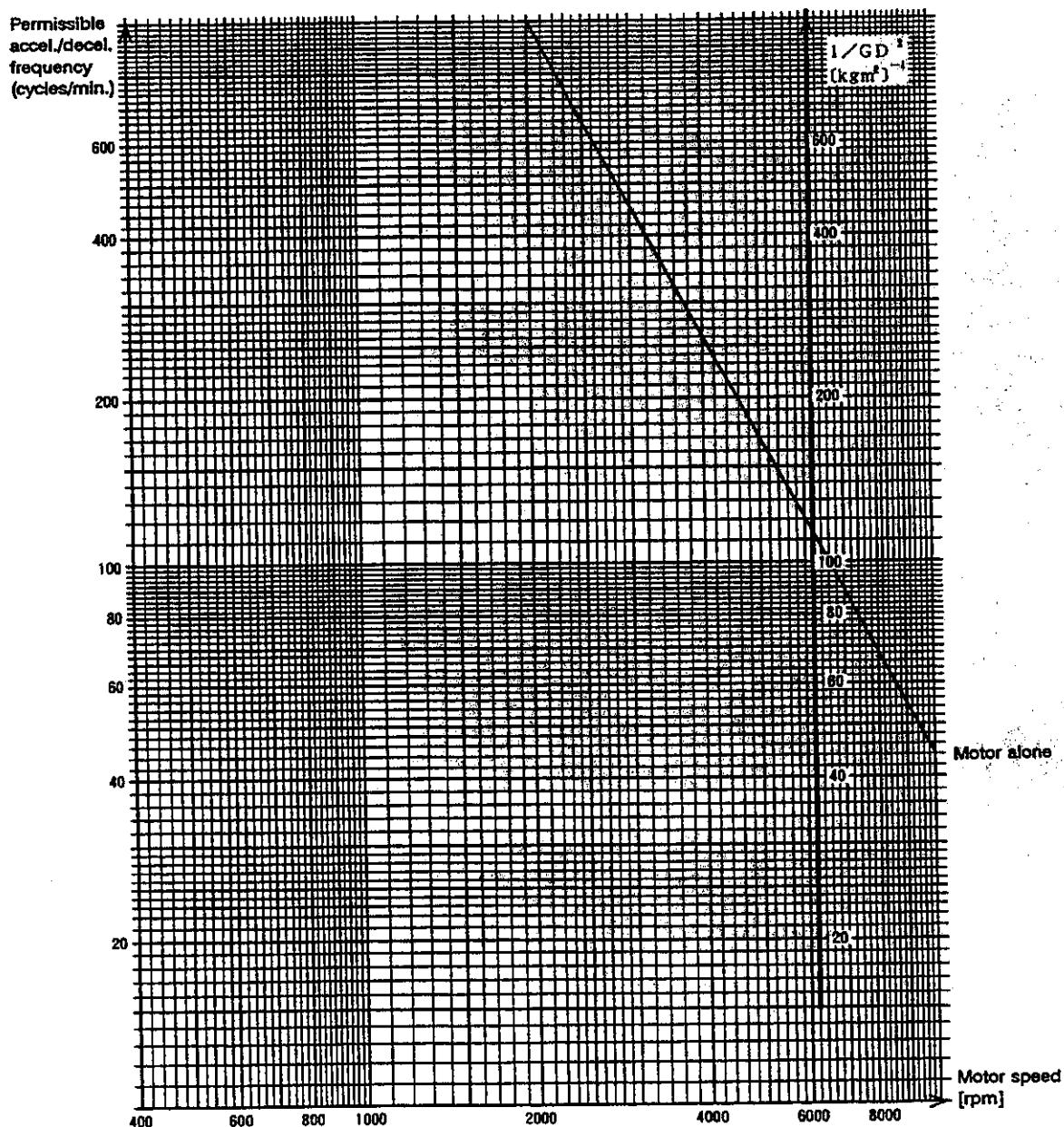
$$\text{Therefore, } 1/GD^2 = 1/0.05 = 20$$

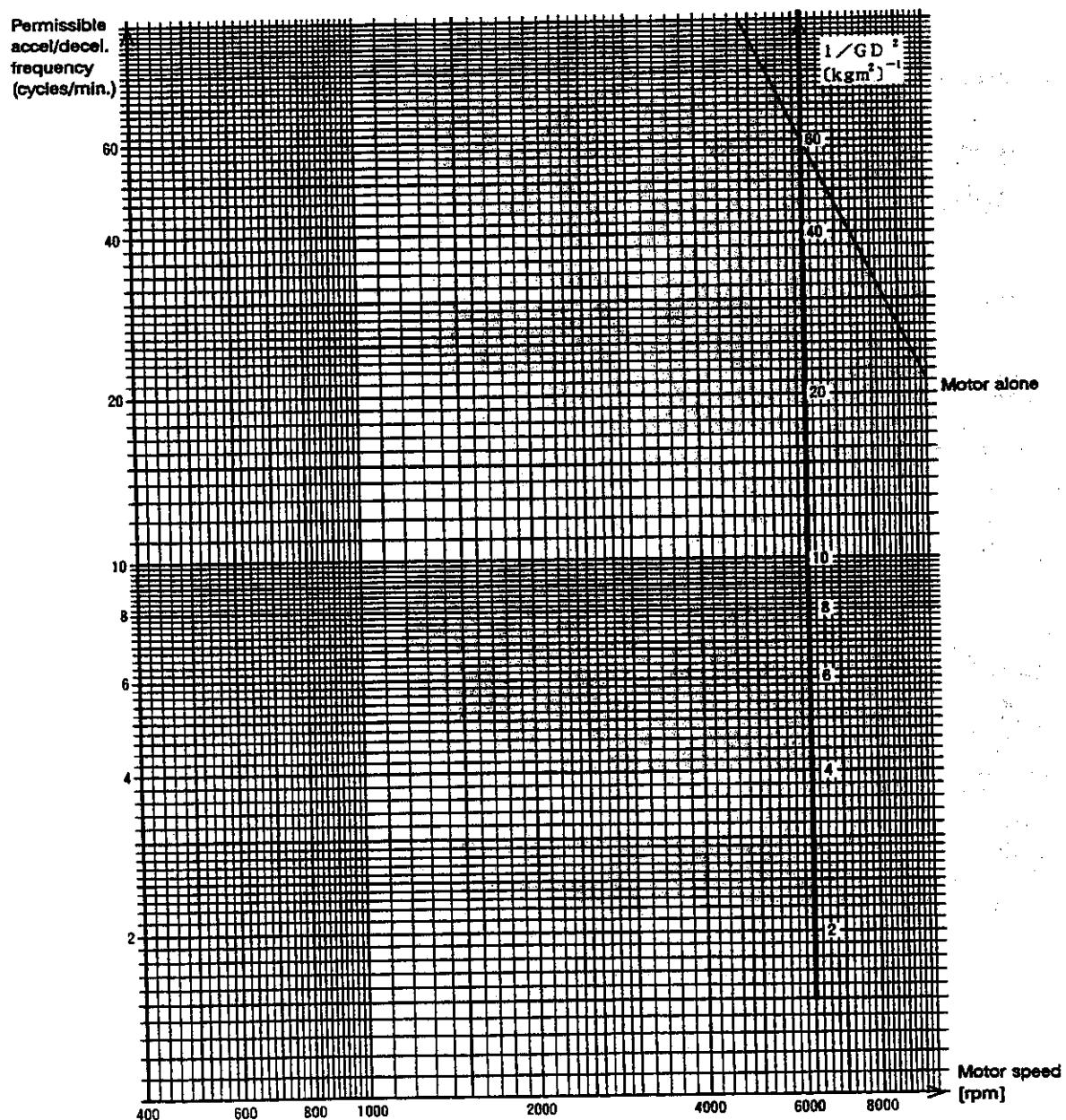


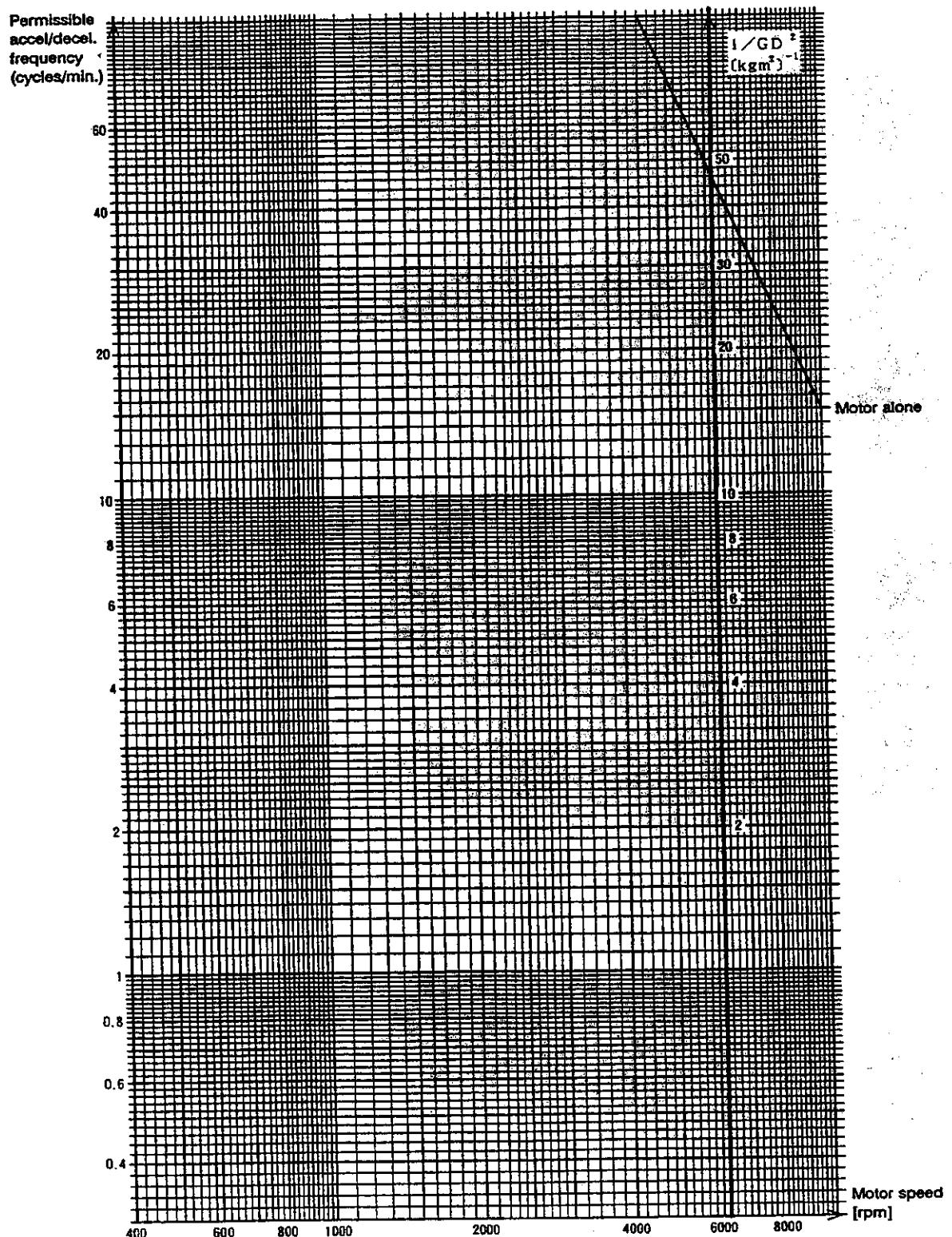
This means that the permissible acceleration/deceleration frequency should be 12 cycles/min. (maximum).

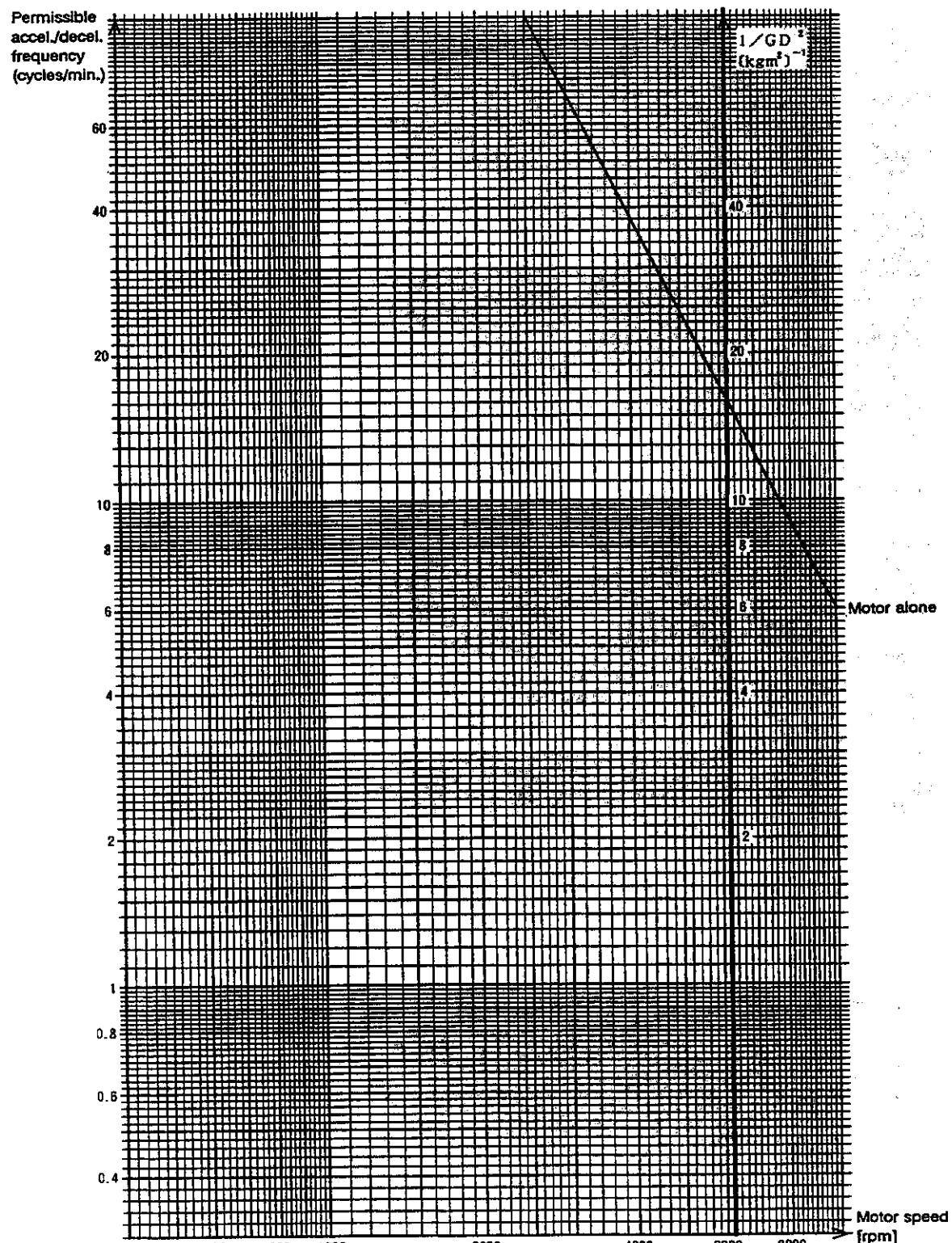
(For motor  $GD_M^2$ , refer to the specifications in the item 2.1.)

**2.3.1 FR-SGJ-2-0.75K permissible acceleration/deceleration frequency**

**2.3.2 FR-SGJ-2-1.5K permissible acceleration/deceleration frequency**

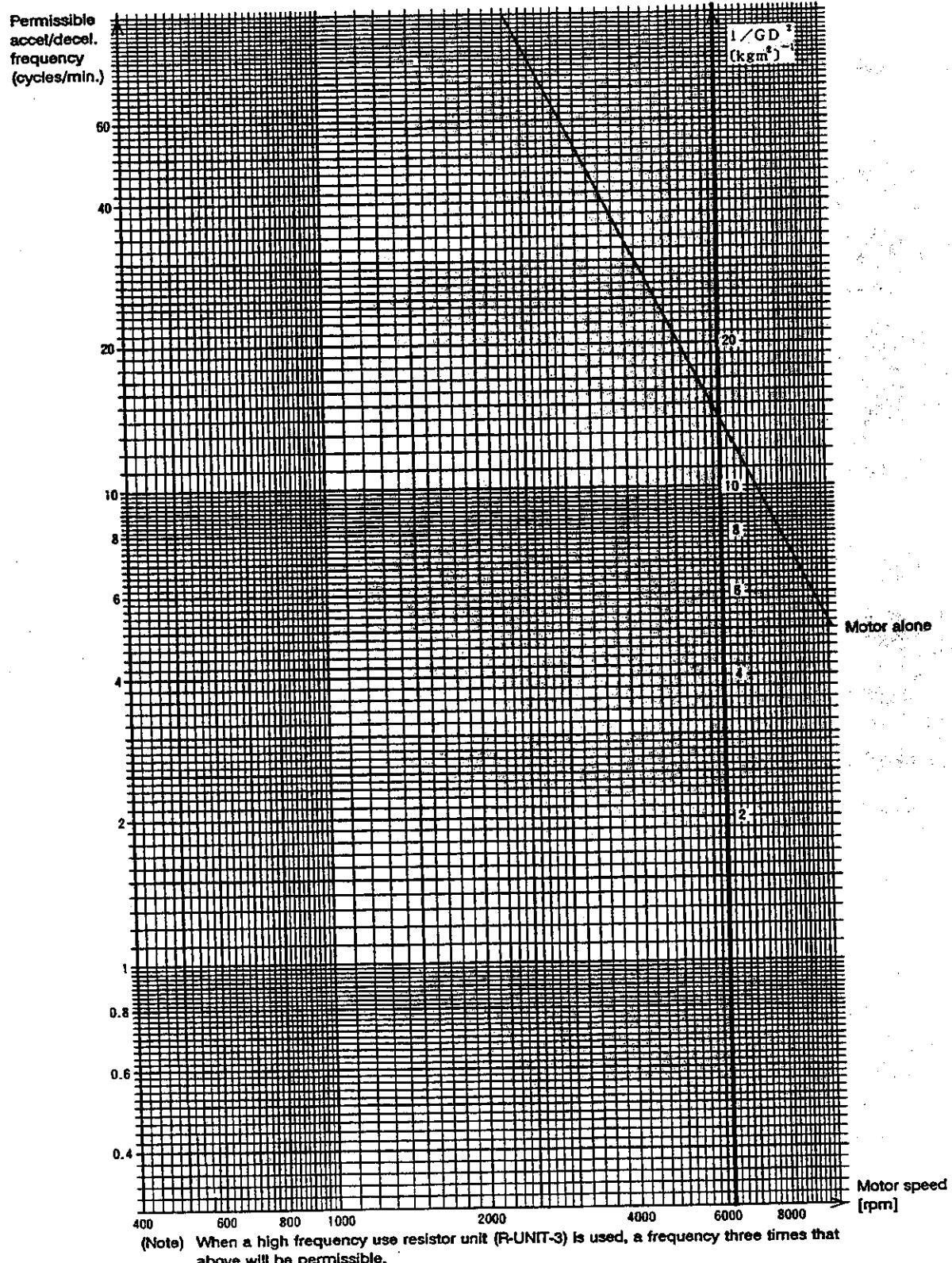
**2.3.3 FR-SGJ-2-2.2K permissible acceleration/deceleration frequency**

**2.3.4 FR-SGJ-2-3.7K permissible acceleration/deceleration frequency**

**2.3.5 FR-SGJ-2-5.5K permissible acceleration/deceleration frequency**

(Note) When a high frequency use resistor unit (R-UNIT-3) is used, a frequency three times that above will be permissible.

### 2.3.6 FR-SGJ-2-7.5K permissible acceleration/deceleration frequency



(Note) When a high frequency use resistor unit (R-UNIT-3) is used, a frequency three times that above will be permissible.

## 2.4 Input/Output Signals

\* The explanation for the input/output signals is for the FR-SGJ-2-[]K-A[] type  
(analog speed command and digital I/O type).

Function	Application	Description	Refer to (para.)	Internal parameter setting range	IO
Zero speed output signal	Machine interlock	With this signal, output transistors turn on when motor speed is slower than the preset minimum speed.	Page 3-9	1 ~ 1000 rpm Standard: 50 rpm Semi-standard: 25 rpm	Open emitter output or open collector output
Up-to-speed output signal	Answer back to NC	Output transistors turn on when motor speed reaches $\pm 15\%$ of preset speed.	Page 3-10	—	Open emitter output or open collector output
Speed meter output	Speed meter display	10VDC is output for full scale at maximum speed.	Page 3-13	—	DC voltage output
Load meter output	Load meter display	3VDC or 10VDC (either one is selected by parameter setting ... standard 10VDC) is output for full scale at 120% load of 30 (15) min. rated output.	Page 3-14	10VDC or 3VDC for full scale	DC voltage output
Spindle failure output signal (alarm)	Spindle failure	Signal for contact that opens when trouble occurs with spindle.	Page 3-11	—	Contact output
△ Orient completed output signal	Orientation	Output transistors turn on when within the set inposition range.	Page 3-11	Mag.: 0 ~ 39° Encoder: 0 ~ 360°	Open emitter output or open collector output
△ Speed detect output signal		Output transistors turn on when motor speed is below the preset speed.	Page 3-12	1 ~ 120% of maximum speed Standard: 10%	Open emitter output or open collector output
△ Current detect output signal	Prevention of cutter eat-in	Output transistors turn on when output is over 110%.	Page 3-12	—	Open emitter output or open collector output
△ Emergency stop output signal		Output transistors turn on during emergency stop.	Page 3-12	—	Open emitter output or open collector output
△ Torque limit ON output signal		Output transistors turn on for restriction of motor torque.	Page 3-12	—	Open emitter output or open collector output
△ Ready-ON output signal		Output transistors turn on when machine preparation is completed.	Page 3-12	—	Open emitter output or open collector output
△ Motor fwd.run/rev.run output signal		Judges whether the motor is rotating forward or reverse and turns on output transistors.	Page 3-12	—	Open emitter output or open collector output
△ Alarm output signal	Spindle failure	Output transistors turn on when spindle fails.	Page 3-13	—	Open emitter output or open collector output

Continued on the next page.

Those marked with a "△" can be selected with parameters and used.  
(Refer to "Auxiliary Output Signals" for details.)

Function	Application	Description	Refer to (para.)	Internal parameter setting range	IO
△ Motor selection 1, 2 output signal	1 amp 2 motor	Output transistors turn on when motor switch-over preparation is completed.	Page 3-1	—	Open emitter output or open collector output
□ Machine operation ready input	Verification of machine status	Machine ready signal. Completed when shut, incomplete when open.	Page 3-1	—	External input
□ Fwd.run/rev.run command input	Motor operation	Fwd.run/rev.run command signal. Motor operation when closed, motor free when open.	Page 3-2	—	External input
□ Orient command input	Orientation	Auxiliary input signals selected with parameters. Orientation when closed, orientation released when open.	Page 3-3	—	External input
□ Gear selection L, M input	Orientation	Auxiliary input signals selected with parameters. Gear selection when closed.	Page 3-4	—	External input
□ Emergency stop input	Emergency stop	Decelerates and stops the motor with regeneration operations and stops the base. Auxiliary input signals selected with parameters. Normal when shut, operating when closed.	Page 3-4	—	External input
□ Torque limit H, L input	Temporarily decreases the torque and rotates the motor when the gear is being shifted etc.	Auxiliary input signals selected with parameters. H: The set value torque limit is operated when closed. L: The torque is limited and operated at 1/2 of the set value when closed.	Page 3-4	0 ~ 100% of maximum torque Standard: 10%	External input
□ Index fwd.run/rev.run input	Index	Auxiliary input signals selected with parameters. Index operations when closed.	Page 3-5	—	External input
□ External reset input	Resetting of irregular flags in the controller.	Auxiliary input signals selected with parameters. Alarm is reset when closed and opened.	Page 3-5	—	External input
□ Motor selection 1, 2 input	1 amp 2 motor	Auxiliary input signals selected with parameters. 1: Switches to motor 2 when closed. 2: Switches to motor 3 when closed.	Page 3-5	—	External input

Continued on the next page.

Those marked with a "△" can be selected with parameters and used.  
(Refer to "Auxiliary Output Signals" for details.)

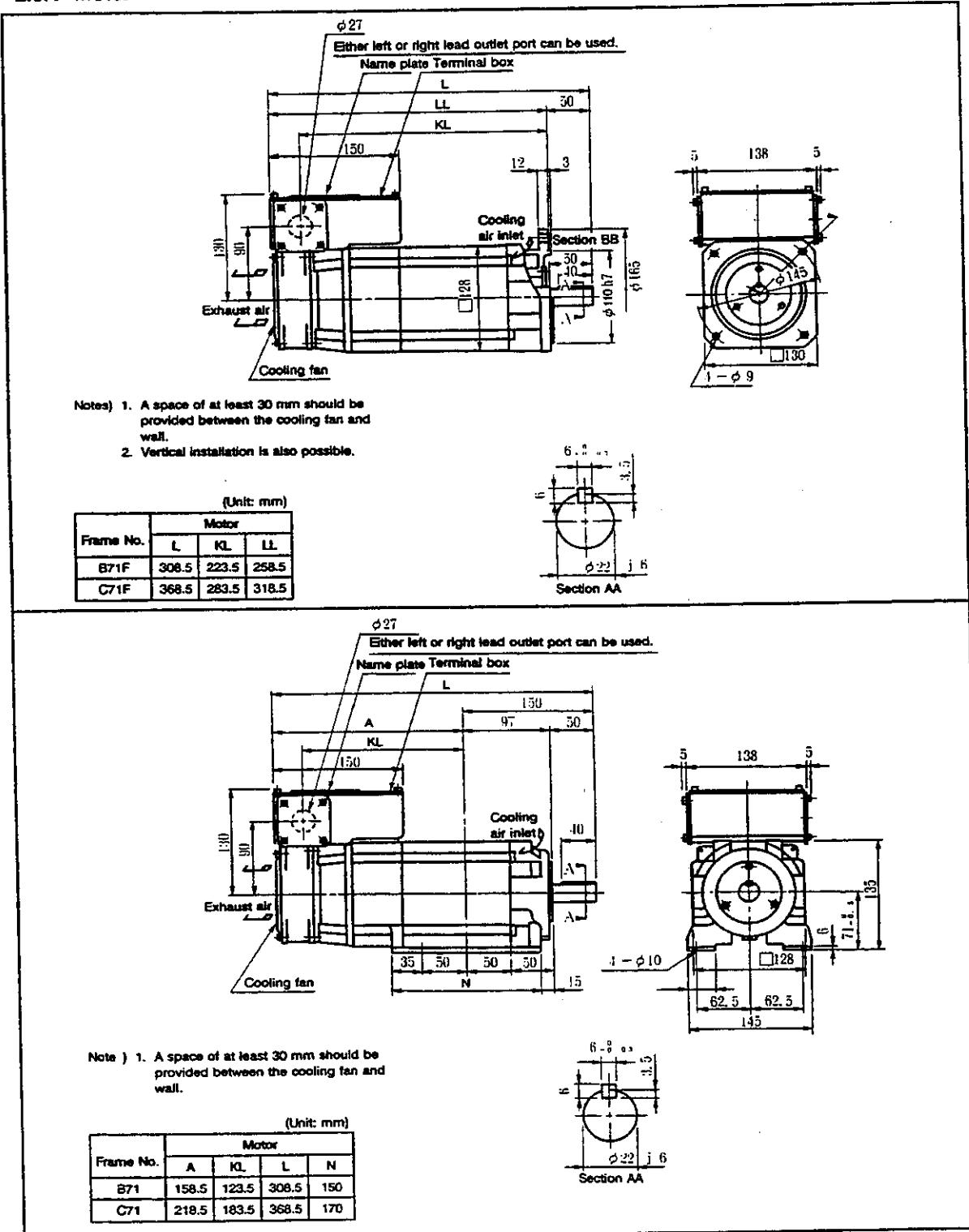
Those marked with a "□" can be selected with the parameters and used.  
(Refer to "Auxiliary Input Signals" for details.)

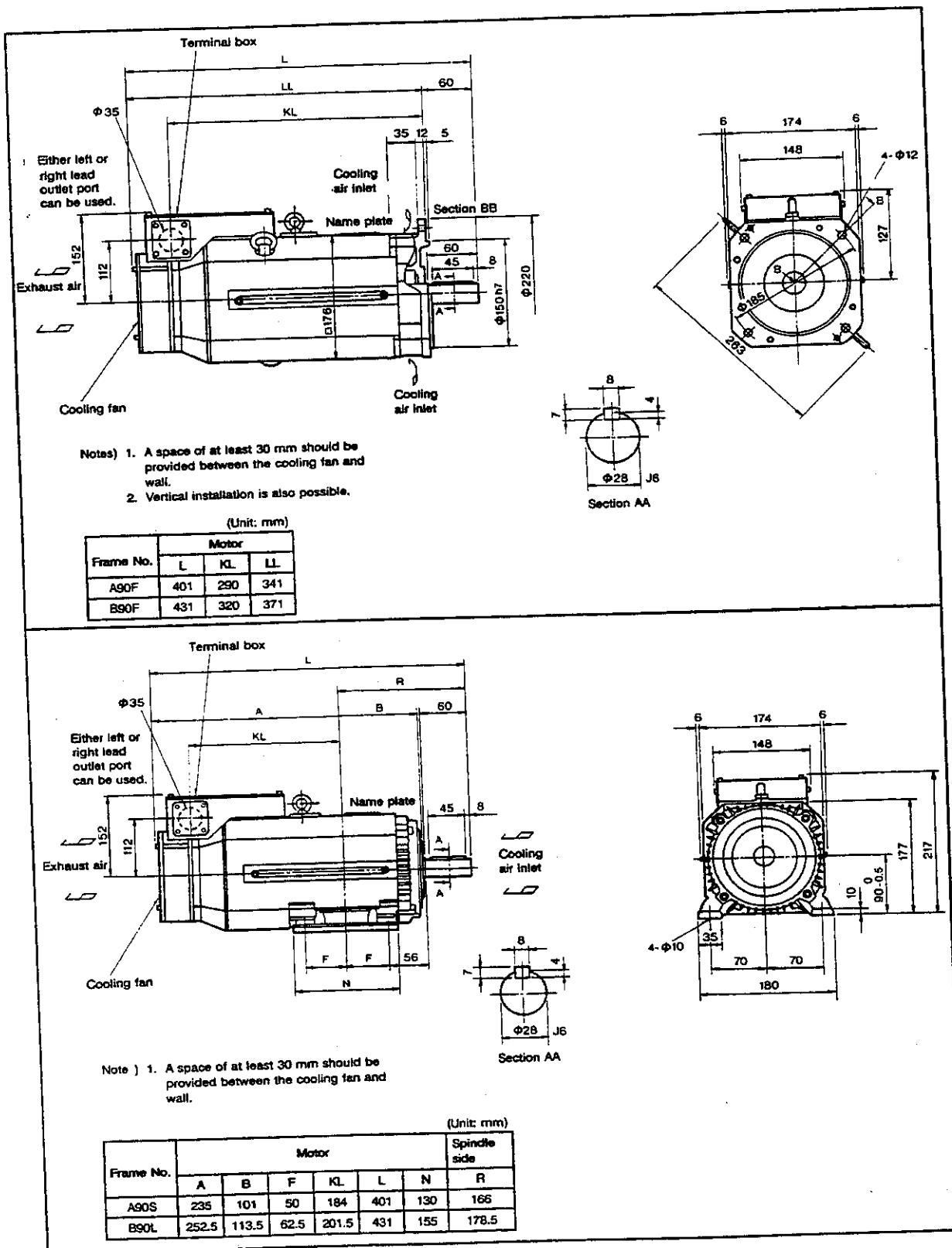
Function	Application	Description	Refer to (para.)	Internal para- meter setting range	I/O
□ Speed selection 1, 2, 3 input		Auxiliary input signals selected with parameters. Speed command is switched with combinations of open and close.	Page 3-5	—	External input
□ Digital speed selection input	Selection of digital speed command	Auxiliary input signals selected with parameters. Digital input when closed. Analog input when open.	Page 3-6	—	External input
□ S-analog high speed tap input	S-analog synchronous tap	Auxiliary input signals selected with parameters. S-analog tap when closed. Normal when open.	Page 3-6	—	External input
Alarm signal output at emergency stop input	Selects ON/OFF of the alarm signal at emergency stop	When ON is selected: Alarm signal output at emergency stop. When OFF is selected: Alarm signal not output at emergency stop.		Provided • Not provided Standard: Not provided	Contact output
Acceleration/ deceleration time constant setting	Regulates the acceleration and deceleration of the speed command	The command time constant is set within the controller. Differs from the actual operation time with the load $GD^2$ .		20 ~ 32767 msec. Standard: 0.3 sec.	Internal setting

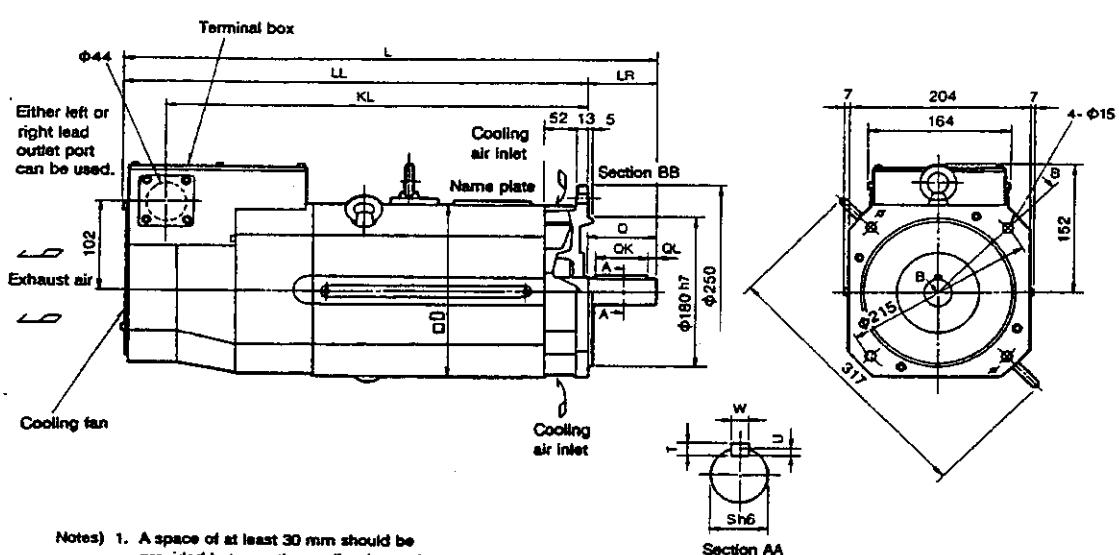
Those marked with a "□" can be selected with the parameters and used.  
(Refer to "Auxiliary Input Signals" for details.)

## 2.5 Outside Views and Dimensions

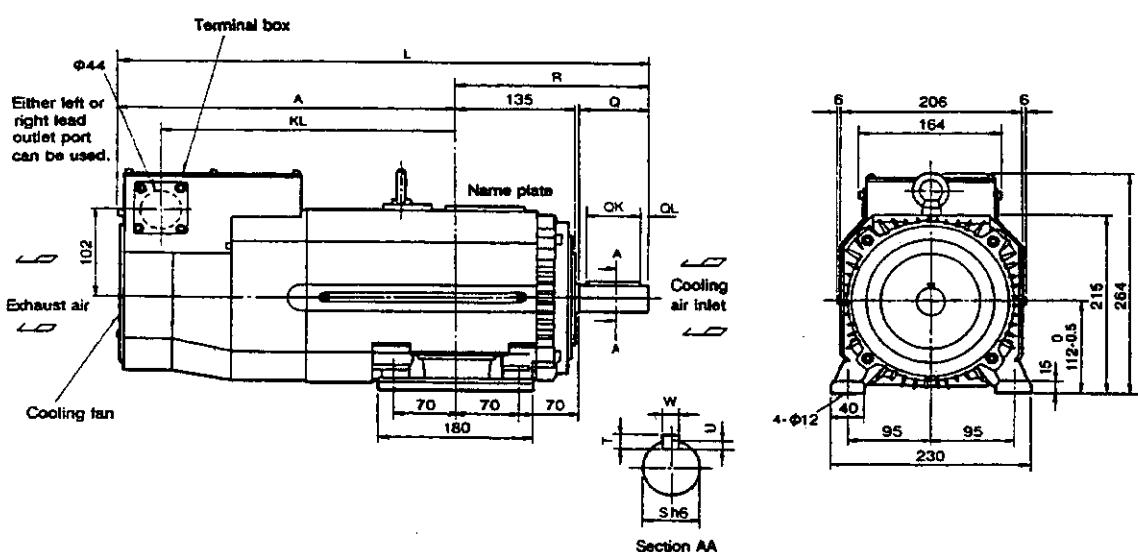
### 2.5.1 Motor





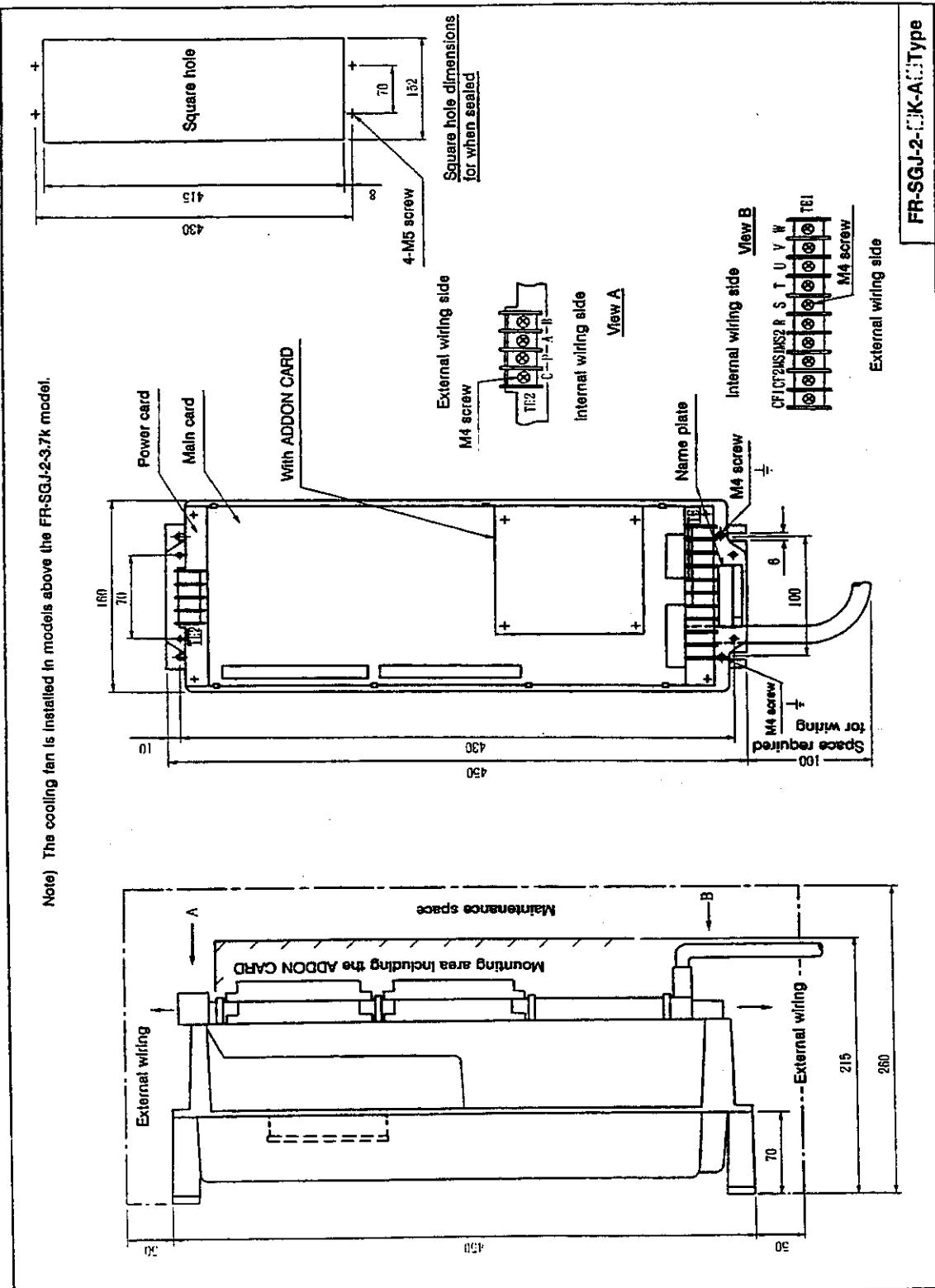


Frame No.	Motor			Spindle side							
	L	KL	LL	LR	Q	OK	S	T	U	W	QL
A112F	549	438	489	60	60	45	28	7	4	7	7.5
B112F	614	483	534	80	80	63	32	8	5	10	8

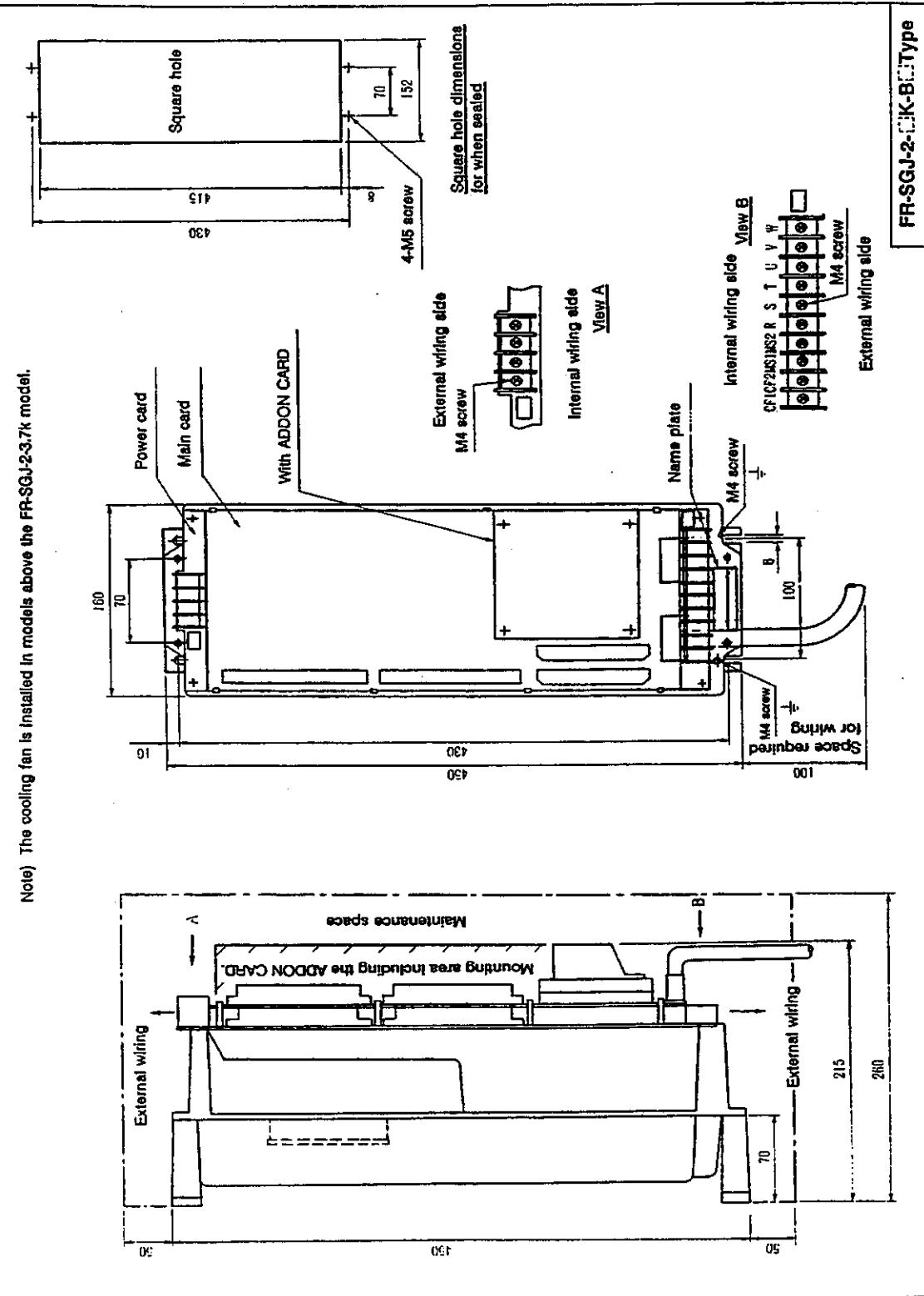


Frame No.	Motor			Spindle side							
	A	KL	L	Q	OK	R	S	T	U	W	QL
A112M	349	298	549	60	45	200	28	7	4	7	7.5
B112M	394	343	614	80	63	220	32	8	5	10	8

## 2.5.2 Controller



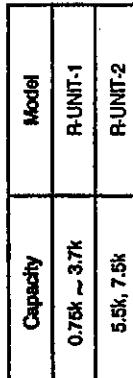
Note) The cooling fan is installed in models above the FR-SGJ-23.7k model.



### 2.5.3 Resistor unit

Capacity	Model
0.75k ~ 3.7k	R-UNIT-1
5.5k ~ 7.5k	R-UNIT-2

**(1) R-UNIT-1, R-UNIT 2 ... For FR-SGJ-2-0.75 k to 7.5k.**

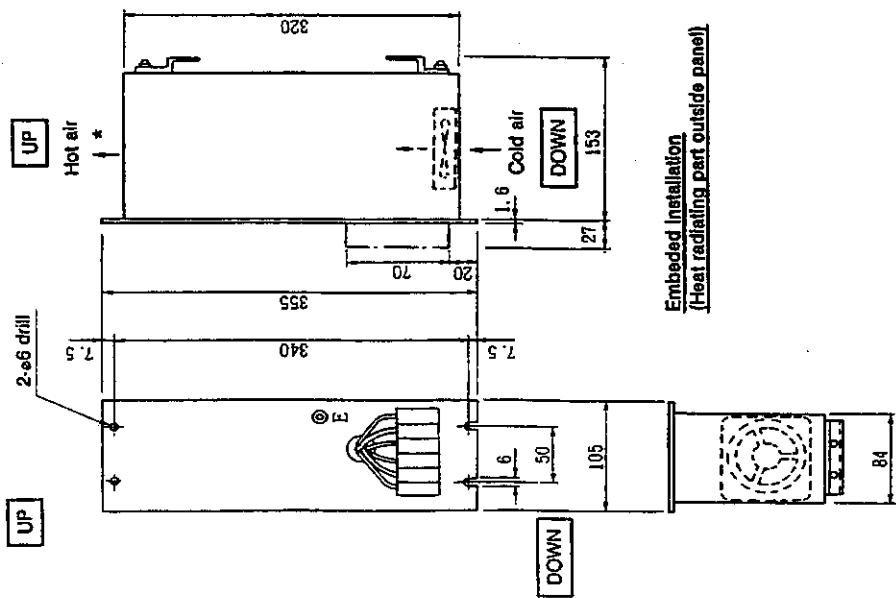
Terminal arrangement  


Terminal screw size  
M4 × 0.7 screw

Appropriate solderless terminal  
Up to bare round shape 5.5-4.

Note 1) The parts with a "\*" emit very hot air so do not place wires or other equipment on them.  
Note 2) Install this resistivity unit with the [UP] up and the [DOWN] down.  
Note 3) You may get burned if you touch this resistor unit when it is hot. Use protective covers or make considerations when installing so that people will not touch the unit.  
Note 4) The amount of generated heat from the resistor unit will differ depending on factors such as the acceleration/deceleration frequency, number of used rotations and the load GD<sup>2</sup>. Always install the unit so that the hot air is emitted outside the panel.

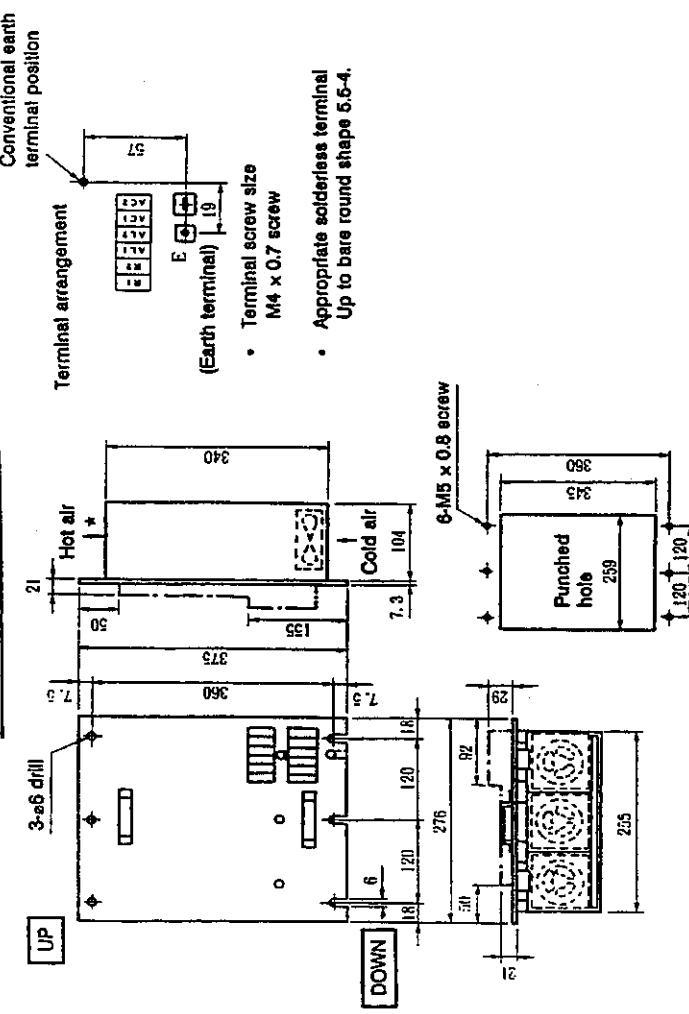
**Embedded Installation  
[Heat radiating part outside panel]**



**R-UNIT-1, R-UNIT-2**

(2) R-UNIT-3 ... For FP-SGJ-2-5.5k, 7.5k high frequency use.

Embedded Installation  
[Heat radiating part outside panel]

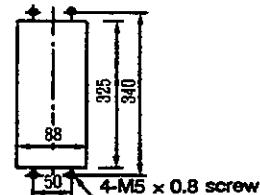
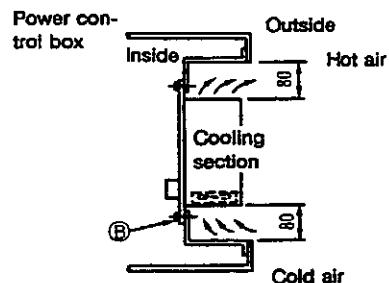


Embedded Installation,  
Installation hole dimension

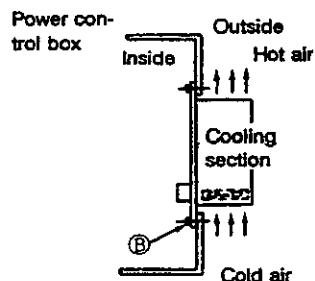
R-UNIT-3

Examples of discharge resistor unit installation

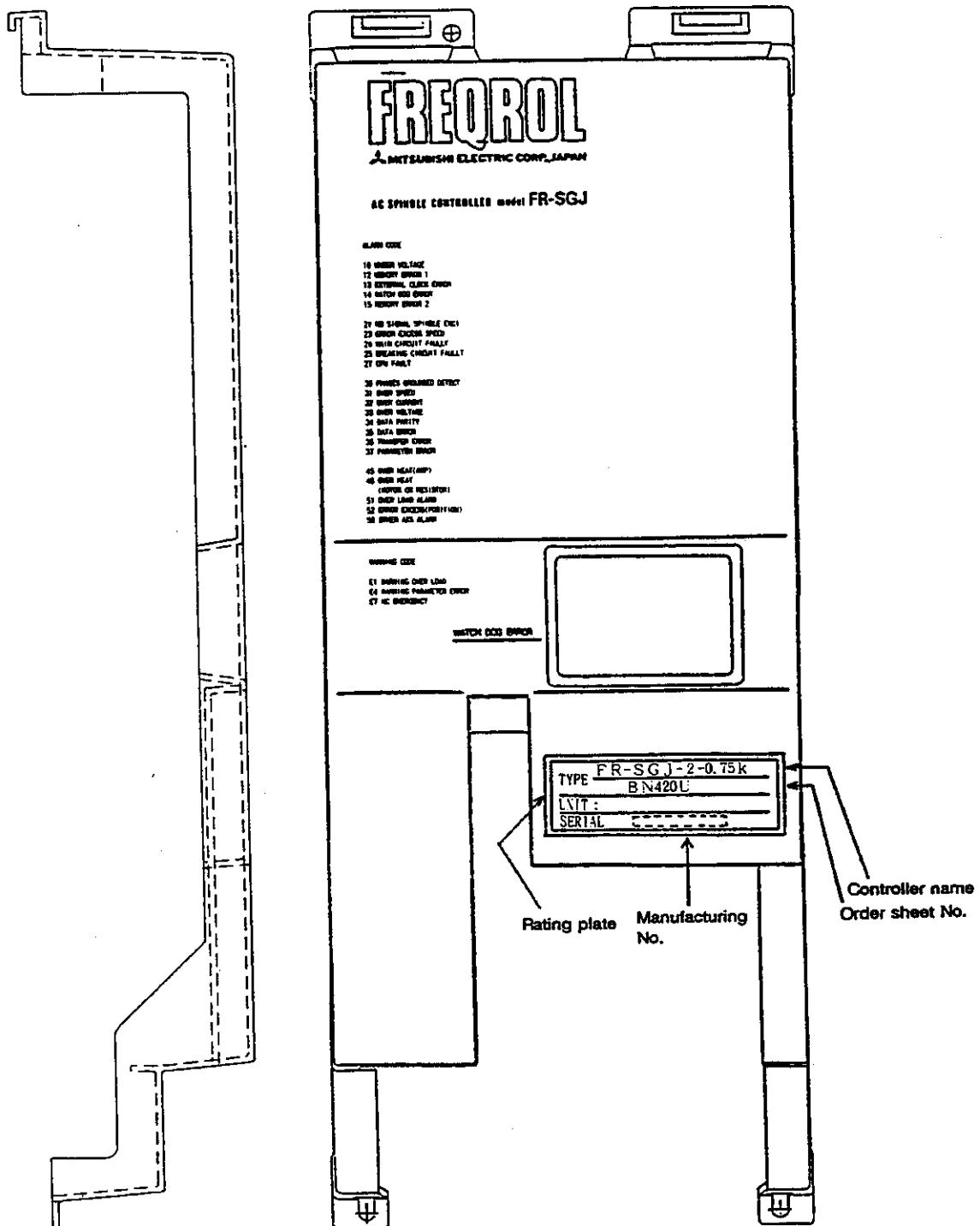
Ex.1: The cooling section is inside the power control box.



Ex.2: The cooling section is outside the power control box.



#### 2.5.4 Decoration panel



## **CHAPTER 3   FUNCTIONS**

### 3. Functions

#### 3.1 Input Signals

##### 3.1.1 Control input signals

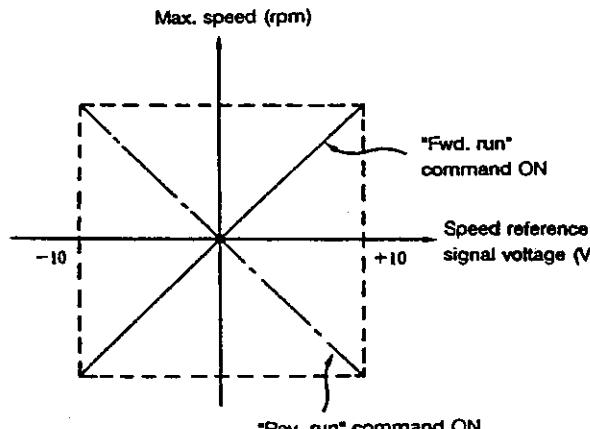
This section describes the control input signals used in DIO connection (Digital Input/Output signal connection).

When the controller is connected to the M300, M3/L3 series CNC with bus line, the DIO signals are ignored. However, the "machine operation ready" signal and "emergency stop" signal can be made valid by setting the corresponding parameter (BSL).

The spindle signal names used in PLC of CNC system correspond to those used in this section.

(1) Analog speed command voltage input (SE1, SE2)

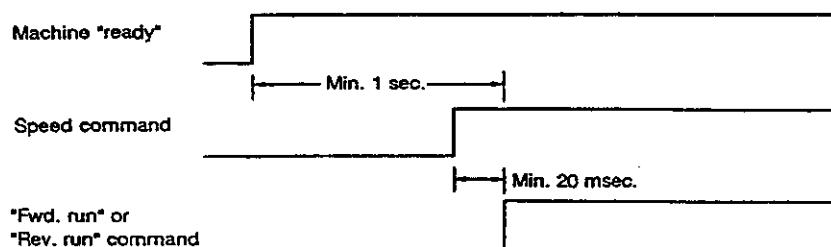
(For analog interface, refer to 3.4.)



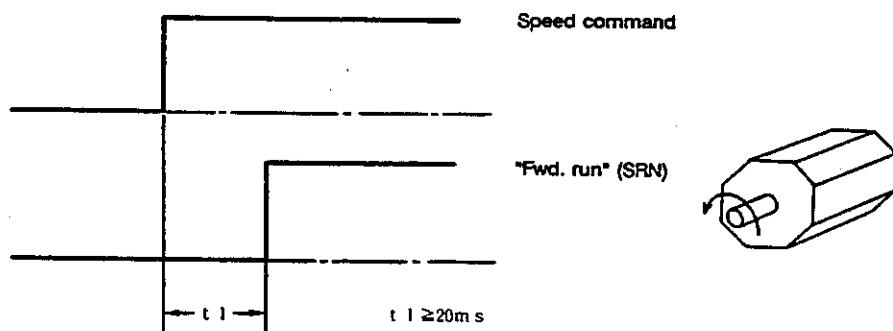
- 1) Motor rotates in forward direction when command voltage is positive, and rotates in reverse direction when command voltage is negative. (Will not rotate with only the command voltage.)
- 2) Depending on offset setting, etc., motor may not stop completely with speed command voltage set at 0V (not failure).
- 3) To stop motor completely, "forward run" or "reverse run" command signal should be turned off.
- 4) The maximum speed can be set with parameter.
- 5) External input signal is used to validate the digital speed command.  
(Refer to the description about auxiliary input signals.)

(2) Machine ready input (SET)

- 1) When this signal turns on, the power transistor base current is shut off and the main circuit contactor is closed.
- 2) When the signal turns off, motor stops after coasting.
- 3) When machine operator must touch the spindle for removal or setting up of workpiece or tool, this signal should be turned off for safety. Do not turn the signal on and off too frequently (more than several hundred cycles/day).



- (3) Forward run command input signal (SRN)
  - 1) While signal SRN is on, spindle motor runs counterclockwise (CCW), as viewed from the shaft side (when analog speed command signal is positive).
  - 2) When signal SRN turns off, motor stops after deceleration (power transistor base current is shut off).
  - 3) If "oriented spindle stop" command signal is given at the same time as signal SRN turns off, priority is given to the former signal.



- (4) Reverse run command input (SRI)
  - 1) While the signal is on, the spindle motor runs clockwise (CW), as viewed from the shaft side (when analog speed command signal is positive).
  - 2) When signal SRI turns off, motor stops after deceleration (power transistor base current is shut off).
  - 3) If the forward run command and reverse run command turn on simultaneously, the spindle motor will stop.
  - 4) If "orientation" command signal is given as signal SRI turns off, priority is given to the former signal.

### 3.1.2 Auxiliary input signal

Auxiliary input 1 (IN4), Auxiliary input 2 (IN5), Auxiliary input 3 (IN6), Auxiliary input 4 (IN7), Auxiliary input 5 (IN8)

- (1) Five of these signals can be selected freely from the input signal chart below and used.
- (2) Auxiliary input 1 (IN4) .... Parameter HI1  
 Auxiliary input 2 (IN5) .... Parameter HI2  
 Auxiliary input 3 (IN6) .... Parameter HI3  
 Auxiliary input 4 (IN7) .... Parameter HI4  
 Auxiliary input 5 (IN8) .... Parameter HI5

Parameter setting No.	Input signal name
0 = Invalid	
1 = Orient start	(ORC)
2 = Gear selection L	(CTL)
3 = Gear selection M	(CTM)
4 = Emergency stop	(EMG)
5 = Torque limit H	(TL2)
6 = Torque limit L	(TL1)
7 = Forward index	(WRN)
8 = Reverse index	(WRI)
9 = External reset	(RST)
10 = Motor selection 1	(MSL1)
11 = Motor selection 2	(MSL2)
12 = Speed selection 1	(SSL1)
13 = Speed selection 2	(SSL2)
14 = Speed selection 3	(SSL3)
15 = Digital speed selection	(DEG)
16 = S-analog high speed tap	(HSP)

- \* (3) By adding on the optional SGJ-DA card, auxiliary input 6 (IN9), auxiliary input 7 (IN10), and auxiliary input 8 (IN11) can be used.

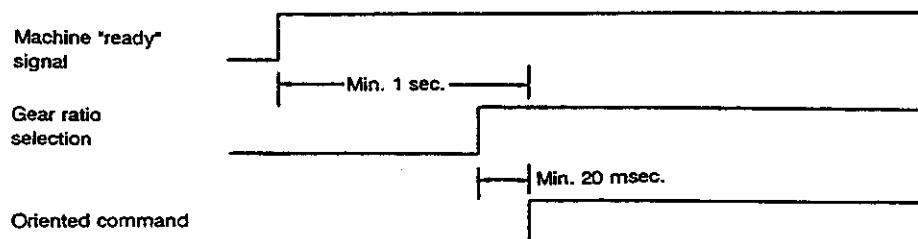
Here, the desired signals can be selected with parameter HI6, HI7 and HI8 as done above.

[0] Auxiliary input invalid

The auxiliary input signal is ignored.

[1] Oriented command input (ORC)

- 1) This signal starts orientation. When this signal turns on, orient operation will start regardless of run commands (SRN, SRI).
- 2) When signal SRN (forward run) or signal SRI (reverse run) is on at the time signal ORC is turned off, spindle motor starts running again.
- 3) If machine operation ready signal is turned off and on again while orient operation is in suspension with this signal held turned on, the orient operation restarts.



## [2, 3] Gear select input (CTL) (CTM)

Spindle speed can be changed for orient operation, etc. by using these signals.

Signal combinations for gear selection are listed below.

Do not change signal status while oriented command signal is on.

Gear ratio selection	CTM signal	CTL signal	Parameter for gear ratio setting
Gear 00 (High speed H)	OFF	OFF	GRA1, GRB1
Gear 01 (Low speed L)	OFF	ON	GRA2, GRB2
Gear 10 (Medium speed M)	ON	OFF	GRA3, GRB3
Gear 11 (Low-medium speed ML)	ON	ON	GRA4, GRB4

For 2-speed gears (H and L), use CTL

## [4] Emergency stop input (EMG)

- When emergency stop signal contact is opened, motor stops after deceleration and the power transistor base current is shut off.

Whether alarm signal is output or not can be determined by parameter (BSL) setting.

- When emergency stop signal contact is closed again, the motor is ready to run (when the signal is not used as "failure" signal).

The motor immediately starts rotating when run command signal is turned on.

Thus, a circuit that resets "forward run" or "reverse run" command should be provided externally.

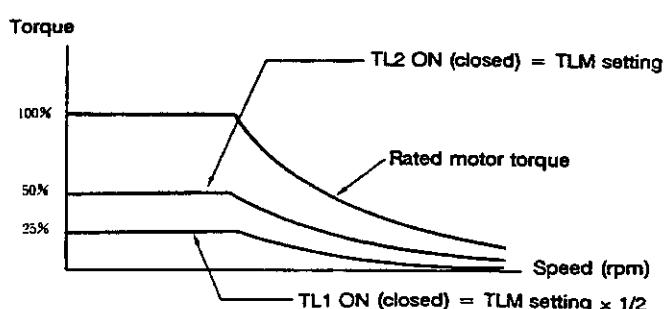
## [5, 6] Torque limit command input (TL2) (TL1)

Torque limit temporarily reduces spindle motor output torque for mechanical spindle orientation, gear shift, etc., and rotates the spindle motor.

To set torque limit level, parameter TLM is used.

Note that accuracy is not guaranteed for this setting (%).

(Ex.) TLM = 50



**[7, 8] Index input (WRN) (WRI)**

Command for forward index (WRN) or reverse index (WRI) is input for encoder type multipoint orientation.

Spindle rotates counter-clockwise, as viewed from the motor shaft end, in forward index, and rotates clockwise in reverse index.

For details, refer to "FR-SGJ spindle index function option specification (BNP-A2956-23)".

**[9] External reset input (RST)**

This will reset (return to initial state) the FR-SGJ micro computer and error flags. The reset PB on the printed circuit board will also reset the micro computer and error flags.

**[10, 11] Motor selection 1, 2 (MSL1) (MSL2)**

This command input will select the sub-motor 1 (sub-motor 2) when carrying out 1 amp 2 motor (3 motor) runs. For details, refer to "FR-SFJ 1 amp 2 motor switch-over function specifications (BNP-A2956-23)".

**[12, 13, 14] Speed selection 1, 2, 3 (SSL1) (SSL2) (SSL3)**

This command input runs the motor at the speed set in parameters SS0 to SS7.

With a three-bit combination eight different speeds can be set. When this signal is input, the analog speed command and digital speed command will be ignored.

Speed selection signal			Selection parameter
3	2	1	
0	0	0	SS0
0	0	1	SS1
0	1	0	SS2
0	1	1	SS3
1	0	0	SS4
1	0	1	SS5
1	1	0	SS6
1	1	1	SS7

0 : Contact open

1 : Contact closed

**[15] Digital speed selection (DEG)**

When the input contact is turned on (closed), the digital speed selection command becomes valid, and when the input contact is turned off (opened) the analog speed selection command becomes valid.

The following digital signals can be selected through parameter (DSR) setting.

Binary 12-bit, signed binary 12-bit, BCD 2-digit and BCD 3-digit.

Note) The digital speed command is input with the SGJ-DA card (option). When you do not have an optional card or when the SGJ-OR card is used, turn the speed command to zero with this signal input and the motor will stop. Use this to completely stop the motor. This cannot be used when bus-line connection to the M300 and M3/L3 are used.

**[16] S-analog high speed tap input (HSP)**

The input contact is turned on when synchronous tap is to be carried out with the analog speed command.

However, a program to synchronize the spindle and Z-axis on the NC side will be required. For details refer to "FR-SGJ S-analog high speed tap function option specifications (BNP-A2956-24)".

**3.1.3 Command input signals****(1) Multipoint oriented position command input (01H ~ 12H)**

(Option card SGJ-OR or SGJ-DA is used)

FR-SGJ-2-[]K-AR or AD

- 1) With encoder orientation, spindle can be exactly stopped in position with increment units of 360/4096 (deg.) when this 12-bit input signal is used.

Stop position is determined in reference to the zero point set by parameter PST, and its error on position encoder is X (deg.) (motor runs counterclockwise).

$$X \text{ (deg.)} =$$

$$\frac{360}{4096} [1 + (02H) + (03H) + (04H) + (05H) + (06H) + (07H) + (08H) + (09H) + (10H) + (11H) + (12H)]$$

01H to 12H will turn on at 1 and off at 0.

- 2) Either the open collector or open emitter signal can be used for the signal form. (A parameter setting for selection is not required for either the open collector or open emitter signals.)

(2) Digital speed command input (use optional SGJ-DA card) FR-SGJ-2-[]K-AD

- 1) For the digital speed input, switch-over of the following can be possible in parameter DSR.

BCD code 2-digit (S2-digit)	8-bit
BCD code 3-digit (S3-digit)	12-bit
Binary notation (binary)	12-bit
Binary notation with sign	12-bit

- 2) Either the open collector or open emitter signal can be used for the signal form. (A parameter setting for selection is not required for either the open collector or open emitter signals.)

Ex.: BCD code 2-digit (S2-digit) 8-bit

BCD code	Motor speed (6000 rpm)	Motor speed (4500 rpm)
00	0 rpm	0 rpm
01	61 rpm	45 rpm
02	121 rpm	91 rpm
•	•	•
•	•	•
•	•	•
•	•	•
98	5939 rpm	4455 rpm
99	6000 rpm	4500 rpm

When BCD code is "99", for example, status of each bit is as follows ("1" for contact closed, "0" for contact opened):

9				9					
1	0	0	1	1	0	0	1		
R08	R07	R06	R05	R04	R03	R02	R01	Input terminal	

Ex.: BCD code 3-digit (S3 digit) 12-bit

BCD code	Motor speed (6000 rpm)	Motor speed (4500 rpm)
000	0 rpm	0 rpm
001	6 rpm	4.5 rpm
002	12 rpm	9.0 rpm
..	..	..
..	..	..
..	..	..
..	..	..
998	5994 rpm	4495.5 rpm
999	6000 rpm	4500 rpm

When BCD code is "999", for example, status of each bit is as follows ("1" for contact closed, "0" for contact opened):

9				9					9				
1	0	0	1	1	0	0	1	1	0	0	1	1	0
R12	R11	R10	R9	R08	R07	R06	R05	R04	R03	R02	R01	Input terminal	

Ex.: Binary 12-bit

BINARY code	Motor speed (6000 rpm)	Motor speed (4500 rpm)
(000)H	0	0
..	..	..
..	..	..
..	..	..
..	..	..
..	..	..
(800)H	3001 rpm	2251 rpm
..	..	..
..	..	..
..	..	..
(FFF)H	6000 rpm	4500 rpm

When BINARY code is "FFF", for example, status of each bit is as follows:

(4095) D = (FFF) H							
1	1	1	1	1	1	1	1
R12	R11	R10	R09	R08	R07	R06	R05

Note: ( )H is for hexadecimal value, and ( )D for decimal value.  
("1" for contact closed, "0" for contact opened)

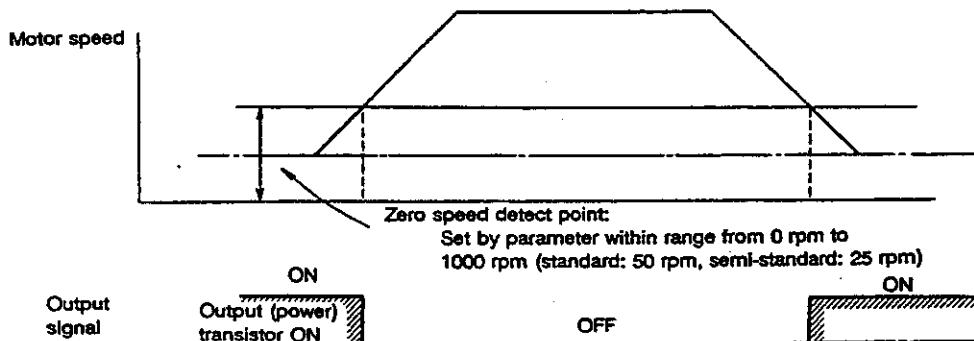
## 3.2 Output Signals

### 3.2.1 Control output signals

The signals used in DIO connection (Digital Input/Output connection) are described here. The same signals are output when the controller is connected to the M300, M3/L3 series CNC with bus line.

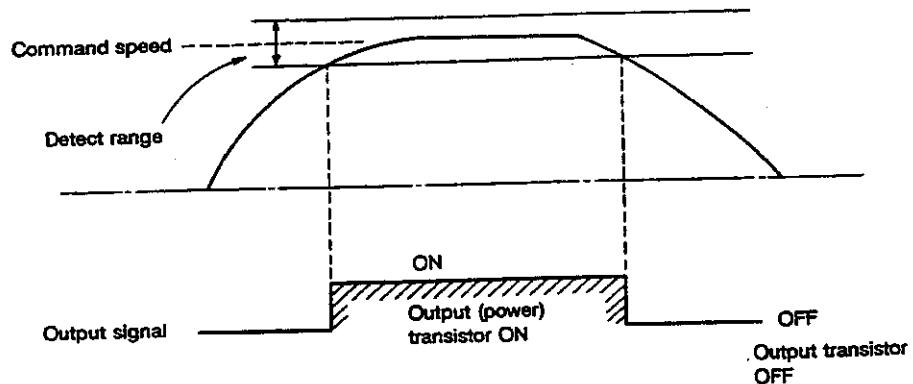
The spindle signal names used in PLC of CNC system correspond to those used in this section.

- (1) Zero speed output signal (ZS) (open emitter or open collector output)
  - 1) The output transistors turn on if actual spindle speed decreases to the preset "zero speed detect" level.

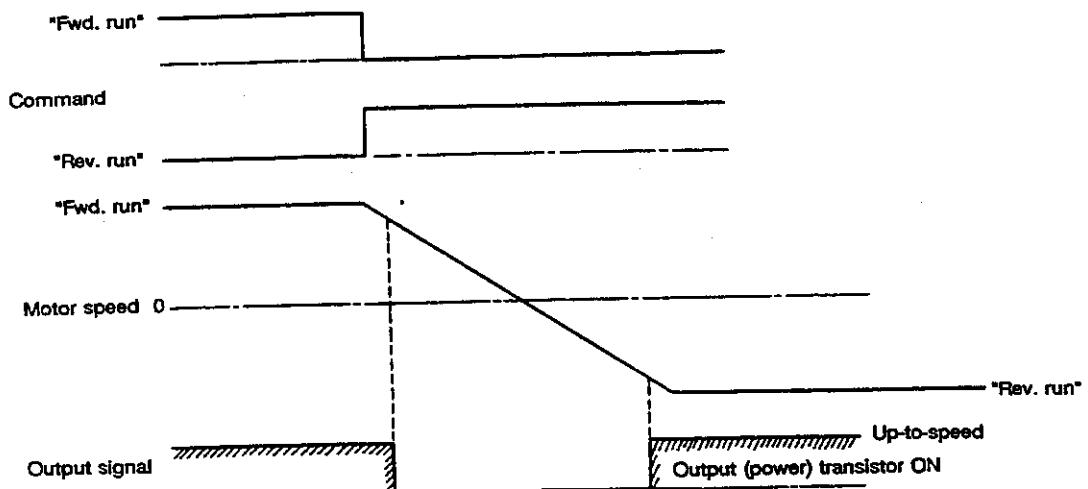


- 2) The signal is output whether or not run command signal is SRN (forward run) or SRI (reverse run).
- 3) The minimum output pulse width is about 200 ms.
- 4) Zero speed detect level can be set within the range of 1 rpm and 1000 rpm with parameter ZSP.
- 5) When run or start command signal (SRN, SRI, ORC) turns off while motor is running at speed slower than the preset zero speed detect level, the transistor base current is shut off and motor stops after coasting.

- (2) Up-to-speed output signal (US) (open emitter or open collector output)
- 1) This signal is output when actual motor speed reaches  $\pm 15\%$  of the command speed, and turns on the output transistors.



- 2) This signal is not output unless either SRN or SRI turns on. The signal is not output when orientation is completed.
- 3) The signal can be used to verify implementation of "forward run (M03)" or "reverse run (M04)" command.
- 4) When reverse run command signal turns on, the motor starts decelerating until the up-to-speed signal turns off. Then the reverse run command is completed when the up-to-speed signal turns on again.



- (3) Spindle failure output signal (FA, FC) (relay contact)
  - 1) Relay contact opens if failure occurs.
  - 2) The signal is output for about 1 sec. after the power is turned on (until the power is stabilized).

### 3.2.2 Auxiliary output signal

Auxiliary output 1 (OUT3), Auxiliary output 2 (OUT4), Auxiliary output 3 (OUT5)

- (1) Three of these signals can be selected freely from the output signal chart below.
- (2) Auxiliary output 1 (OUT3) .... Parameter H01  
 Auxiliary output 2 (OUT4) .... Parameter H02  
 Auxiliary output 3 (OUT5) .... Parameter H03

Parameter setting No.	Output signal name
0 = Invalid	
1 = Orient completed	(ORA)
2 = Speed detect	(SDO)
3 = Current detect	(CDO)
4 = Emergency stop	(EMO)
5 = Torque limit	(TLO)
6 = Ready-ON	(RDO)
7 = Motor forward run	(MPO)
8 = Motor reverse run	(MNO)
9 = Alarm	(ALO)
10 = Motor selection output 1	(MSE1)
11 = Motor selection output 2	(MSE2)

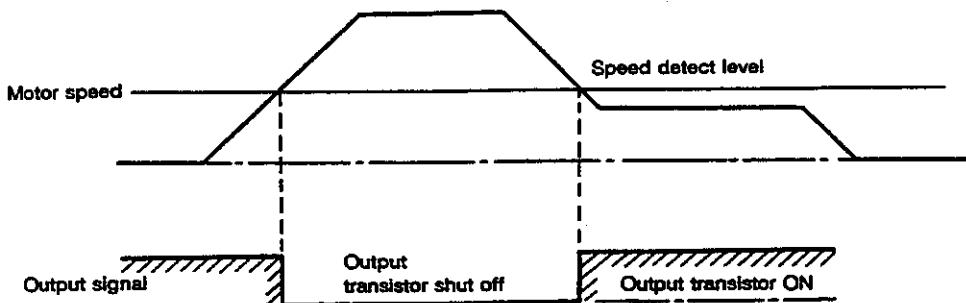
- (3) When the conditions are satisfied, the output transistor will turn on (open emitter or open collector output).

- \* (4) By adding on the optional SGJ-DA card, auxiliary output 4 (OUT6) can be used. Here, the random signals can be selected with parameter H04 as done above (in this case only for open emitter output).

- [0] Auxiliary output invalid  
 The auxiliary output signal is ignored.
- [1] Orient completed output signal (ORA)  
 Refer to orient operation.

[2] Speed detect output signal

- 1) The output transistors turn on when motor speed decreases to the level set by parameter SDT.



- 2) Speed detect range can be set by parameter SDT.

3) This signal is output, whether or not the run command signal is SRN or SRI, whenever motor speed reaches the preset speed level.

[3] Current detect output signal (CDO)

The output transistor will turn on when the current value is more than 110% output which is near the current limit value (120% output).

[4] Emergency stop output signal (EMO)

This signal is output and the output transistors are on when emergency stop signal is input.

[5] Torque limit output signal (TLO)

Torque limit signal (TL1, TL2) is input, and this signal is output to conduct the output transistors turned on.

This signal is output when the torque limit signal is output.

[6] Ready-ON output signal (RDO)

When machine ready input signal is on and card FR-SGJ becomes ready for operation, this signal is output to turn on the output transistors.

When run or start command signal (SRN, SRI, ORC) is turned on with this signal turned on, the motor starts running.

[7] Motor forward run output signal (MPO)

- 1) This signal is output and the output transistors are on while motor is running counterclockwise, as viewed from the motor shaft side.
- 2) The signal should be output when motor runs at a speed faster than 10 rpm. For motor stop, the signal should turn off.

## [8] Motor reverse run output signal (MNO)

- 1) This signal is output and the output transistors are on while motor is running clockwise, as viewed from the motor shaft side.
- 2) The signal should be output when motor runs at a speed faster than 10 rpm. For motor stop, the signal should turn off.

## [9] Alarm output signal

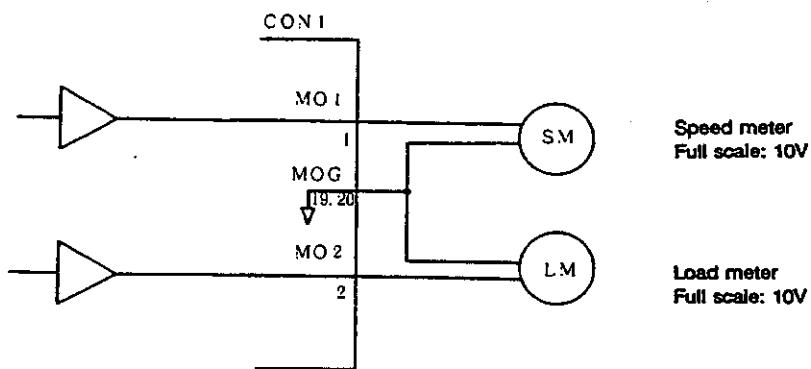
In case of FR-SGJ operation failure (alarm), this signal is output and the output transistors are turned on.

## [10, 11] Motor selection output 1, 2 (MSE1) (MSE2)

The output transistor will turn on when the sub-motor 1 (sub-motor 3) has been selected for carrying out 1 amp 2 motor (3 motor) operation.

For details, refer to "FR-SGJ 1 amp 2 motor switch-over function option specifications (BNP-A2956-23)".

### 3.3 Meter Outputs

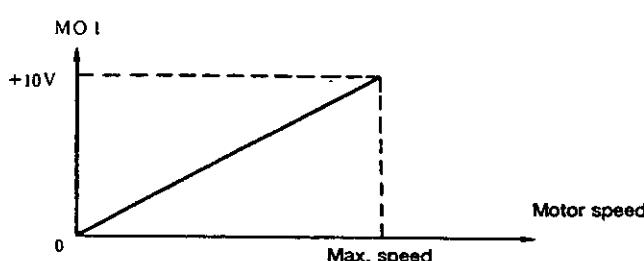


## (1) Speed meter output

- (a) The following meter is recommended for speed meter.

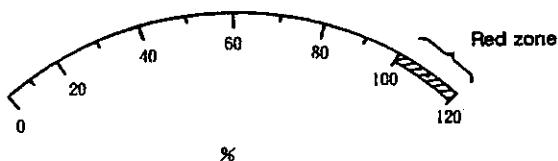
- 1) Model : YM-8G DC voltmeter (Mitsubishi)
- 2) Rating : 10VDC full scale
- 3) Internal impedance: About 10 kΩ

- (b) When motor runs at the full speed, +10VDC is output, no matter of direction of rotation.

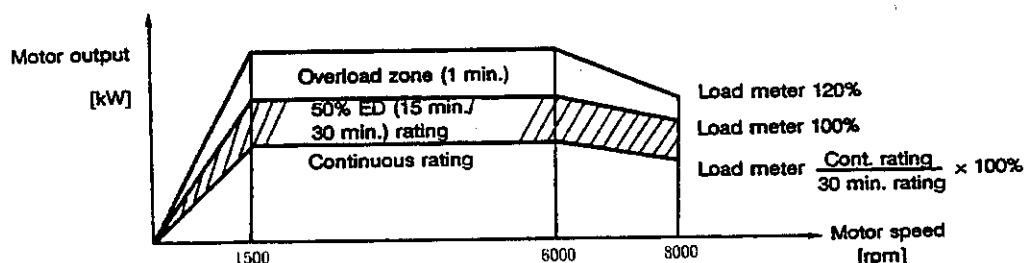


## (2) Load meter output

- (a) The following meter is recommended for load meter.
- 1) Model : YM-8G DC voltmeter (Mitsubishi)
  - 2) Rating : 10VDC full scale
  - 3) Internal impedance: About 10 kΩ
  - 4) Scale



- (b) Reading of load meter is percent (%) of load to the rated motor output. The relationship between motor kW and load meter reading is as follows:



### 3.4 Interface Electrical Specifications (for digital I/O (DIO))

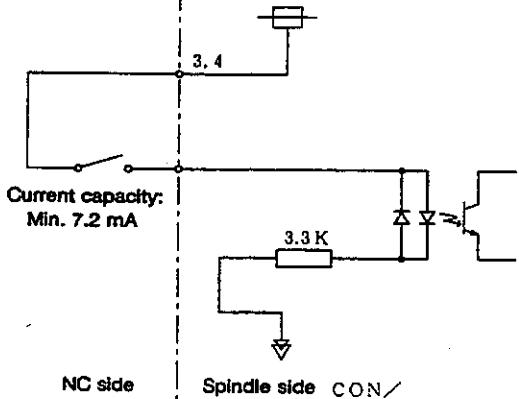
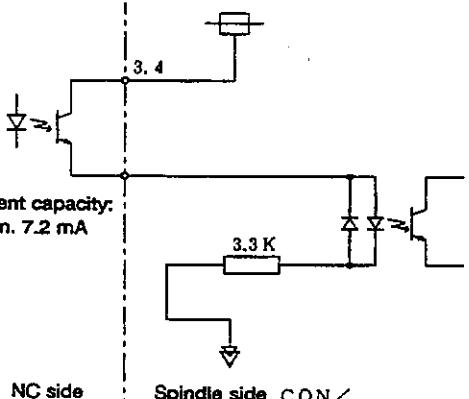
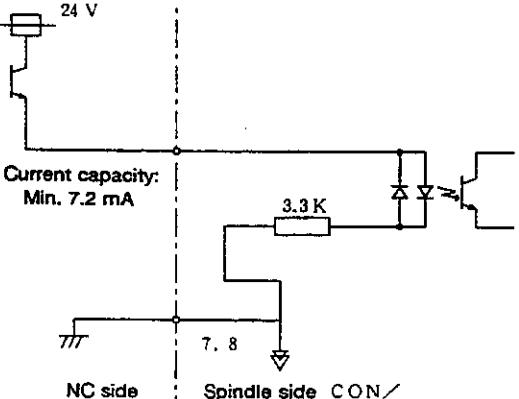
#### 3.4.1 Digital input interface

(1) CON1 input circuit (SGJ-CA card)

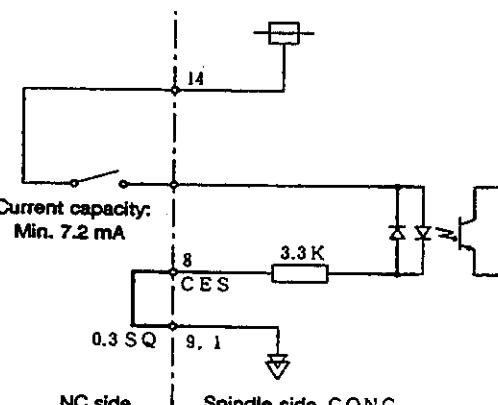
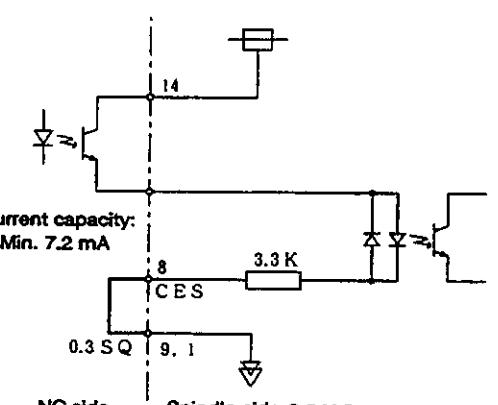
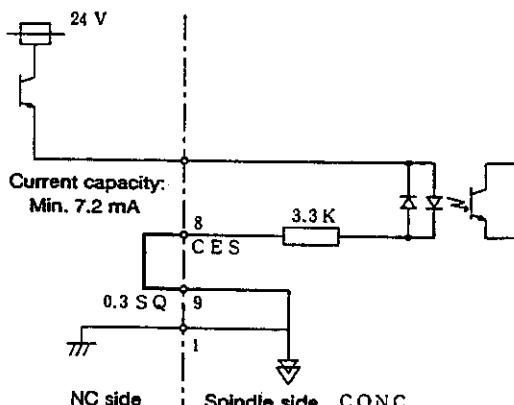
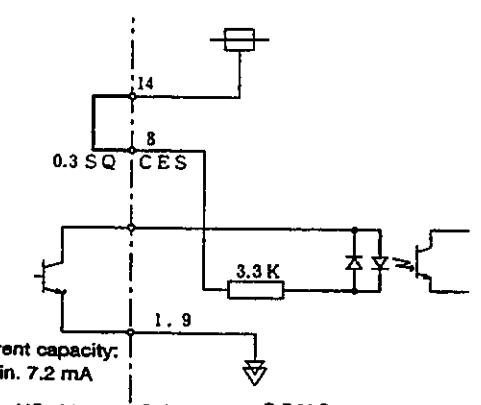
For input circuit interface, select the best one from those shown below.

a) Connection at contact	b) Connection with photo-coupler
<p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CON/</p> <p>Short circuit pins 23, 22</p> <p>Delay caused by input filter is 5 to 15 ms.</p>	<p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CON/</p> <p>Short circuit pins 23, 22</p> <p>Delay caused by input filter is 5 to 15 ms.</p>
c) Connection with open emitter	d) Connection with open collector
<p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CON/</p> <p>Short circuit pins 23, 22</p> <p>Delay caused by input filter is 5 to 15 ms.</p>	<p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CON/</p> <p>Short circuit pins 23, 6</p> <p>Delay cause by input filter is 5 to 15 ms.</p>

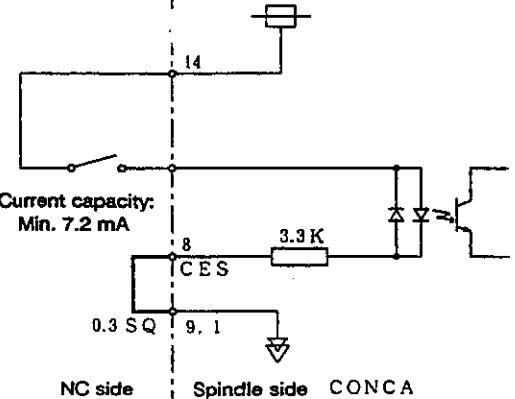
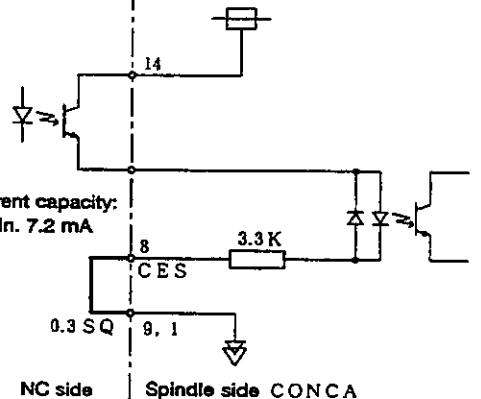
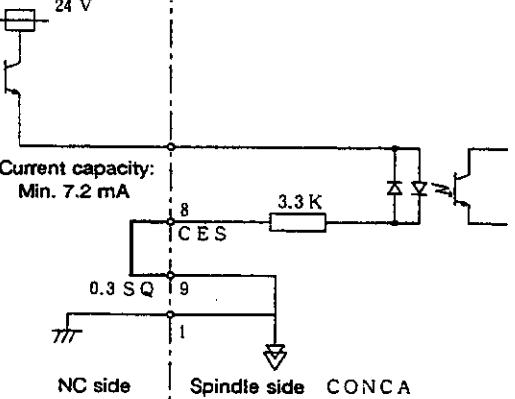
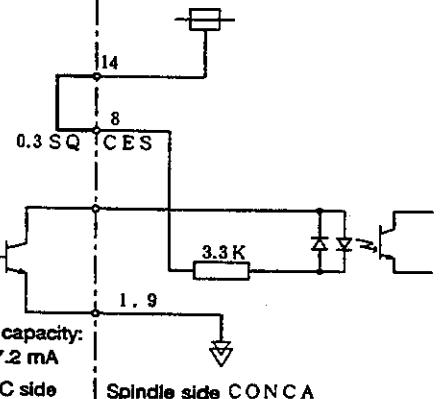
- (2) CON1 input circuit (SGJ-CB card)  
Select the input circuit interface from below.

a) Connection at contact	b) Connection with photo-coupler
 <p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CON/</p>	 <p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CON/</p>
<p>Delay caused by input filter is 5 to 15 ms.</p>	<p>Delay caused by input filter is 5 to 15 ms.</p>
c) Connection with open emitter	d) Connection with open collector
 <p>Current capacity: Min. 7.2 mA</p> <p>7//7      7, 8</p> <p>NC side      Spindle side CON/</p>	<p>Not connectable</p>
<p>Delay caused by input filter is 5 to 15 ms.</p>	

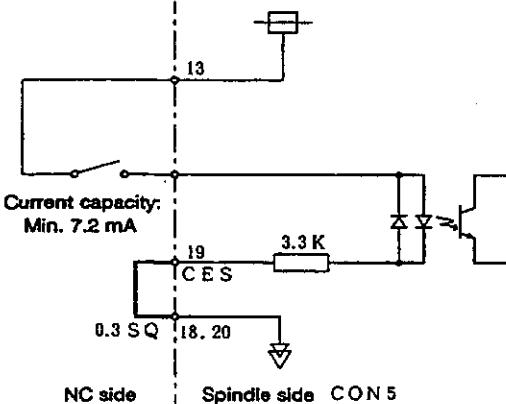
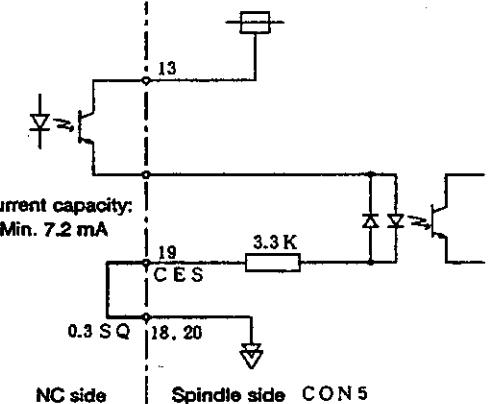
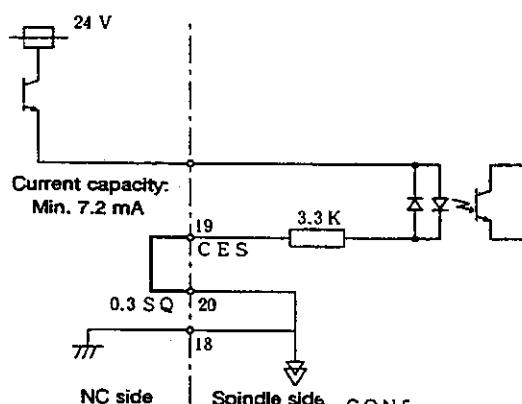
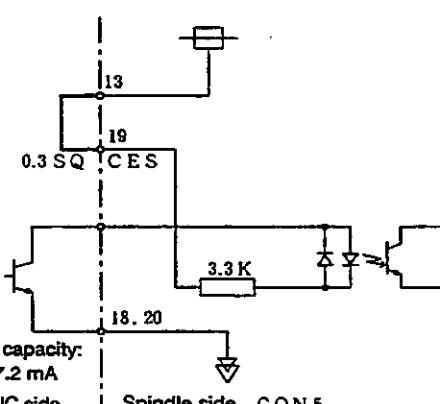
- (3) CONC orient position command input circuit (SGJ-OR card)  
 Select the input circuit interface from below.

a) Connection at contact	b) Connection with photo-coupler
 <p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CONC</p> <p>Short circuit pins 8, 9 Delay caused by input filter is 5 to 15 ms.</p>	 <p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CONC</p> <p>Short circuit pins 8, 9 Delay caused by input filter is 5 to 15 ms.</p>
c) Connection with open emitter	d) Connection with open collector
 <p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CONC</p> <p>Short circuit pins 8, 9 Delay caused by input filter is 5 to 15 ms.</p>	 <p>Current capacity: Min. 7.2 mA</p> <p>NC side      Spindle side CONC</p> <p>Short circuit pins 8, 14 Delay cause by input filter is 5 to 15 ms.</p>

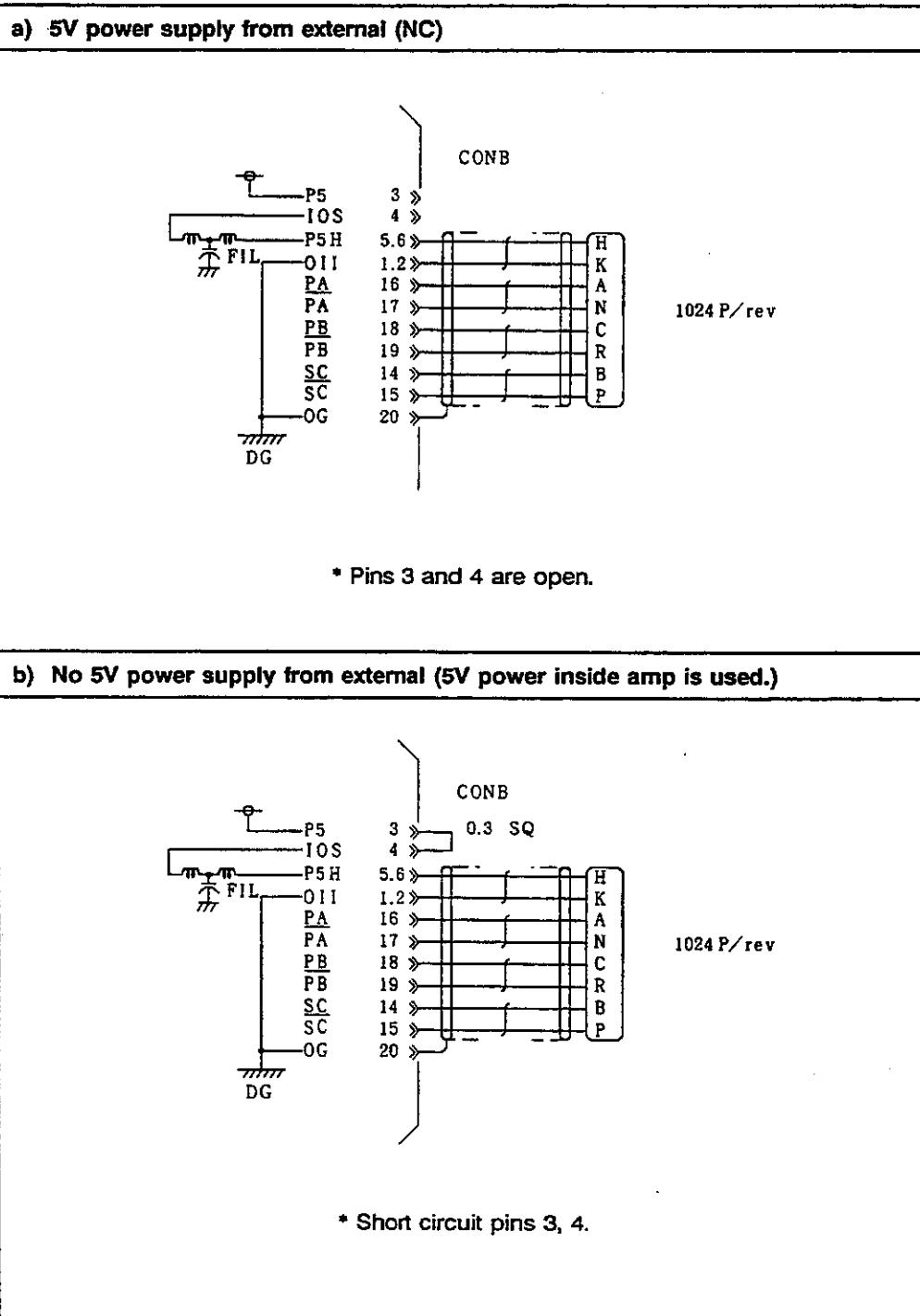
- (4) CONCA orient position command input circuit and auxiliary input circuit (SGJ-DA card)  
 Select the input circuit interface from below.

a) Connection at contact	b) Connection with photo-coupler
 <p>Current capacity: Min. 7.2 mA</p> <p>0.3 SQ 9, 1</p> <p>NC side Spindle side CONCA</p> <p>Short circuit pins 8, 9</p> <p>Delay caused by input filter is 5 to 15 ms.</p>	 <p>Current capacity: Min. 7.2 mA</p> <p>0.3 SQ 9, 1</p> <p>NC side Spindle side CONCA</p> <p>Short circuit pins 8, 9</p> <p>Delay caused by input filter is 5 to 15 ms.</p>
c) Connection with open emitter	d) Connection with open collector
 <p>Current capacity: Min. 7.2 mA</p> <p>0.3 SQ 9</p> <p>747</p> <p>NC side Spindle side CONCA</p> <p>Short circuit pins 8, 9</p> <p>Delay caused by input filter is 5 to 15 ms.</p>	 <p>Current capacity: Min. 7.2 mA</p> <p>1, 9</p> <p>NC side Spindle side CONCA</p> <p>Short circuit pins 8, 14</p> <p>Delay cause by input filter is 5 to 15 ms.</p>

- (5) CON5 digital speed command input circuit (SGJ-DA card)  
 Select the input circuit interface from below.

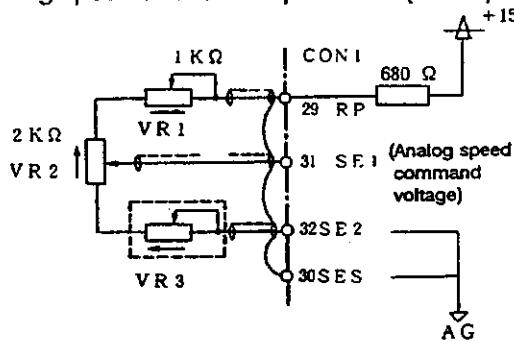
a) Connection at contact	b) Connection with photo-coupler
 <p>Current capacity: Min. 7.2 mA</p> <p>0.3 SQ 18. 20</p> <p>NC side      Spindle side CON 5</p>	 <p>Current capacity: Min. 7.2 mA</p> <p>0.3 SQ 18. 20</p> <p>NC side      Spindle side CON 5</p>
<p>Short circuit pins 19, 20</p> <p>Delay caused by input filter is 5 to 15 ms.</p>	<p>Short circuit pins 19, 20</p> <p>Delay caused by input filter is 5 to 15 ms.</p>
c) Connection with open emitter	d) Connection with open collector
 <p>Current capacity: Min. 7.2 mA</p> <p>0.3 SQ 20</p> <p>7f 18</p> <p>NC side      Spindle side CON 5</p>	 <p>Current capacity: Min. 7.2 mA</p> <p>0.3 SQ 19</p> <p>18. 20</p> <p>NC side      Spindle side CON 5</p>
<p>Short circuit pins 19, 20</p> <p>Delay caused by input filter is 5 to 15 ms.</p>	<p>Short circuit pins 13, 19</p> <p>Delay cause by input filter is 5 to 15 ms.</p>

- (6) Connection for using the encoder (1024 P/rev.) (SGJ-OR card, SGJ-DA card)  
Select the external connection according to the encoder power supply method.



### 3.4.2 Analog Input interface

#### (1) Analog speed command input circuit (for unipolarity)



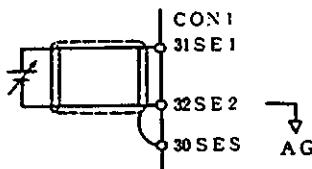
VR1 : Max. speed setting  
VR2 : Analog speed setting  
(max. speed at +10V)  
(VR3 : Min. speed setting)

SE1 input impedance: 10 to 20 kΩ

Signal from RP is derived from +15V supply and output through resistor.

Speed is maximum when voltage across SE1 and SE2 is 10V.  
The maximum speed and minimum speed can be changed by VR1 and VR3 respectively.

When another analog speed command power supply exists, the circuit should be as shown to the right.



### 3.4.3 Output interface

#### (1) External contact output circuit

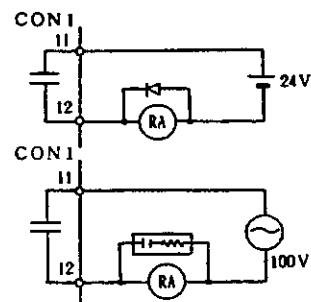
Spindle failure output signal (FA, FC)

It is recommended that the ratings of external output relay contact are as follows:

DC 24V : Less than 0.3A

AC 100V : Less than 0.1A

Chattering : Less than 5 msec.



As a small relay is used, so when connecting the inductive load for the relay, it is recommended to use a miniature DC relay together with a flywheel diode connected in parallel with the relay coil.

When an AC relay must be used, connect it together with CR surge absorber connected in parallel with the relay coil.

When a lamp is connected, its inrush current should be restricted to 1A by using a resistor.

#### (2) Open emitter output circuit

SGJ-CA (CON1)

Up-to-speed (US)

Zero speed (ZS)

Aux. output 1 (OUT3)

Aux. output 2 (OUT4)

Aux. output 3 (OUT5)

SGJ-DA (CONCA)

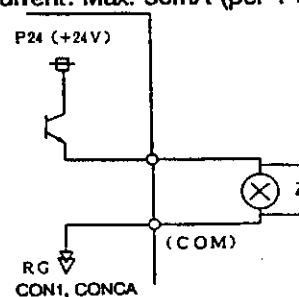
Aux. output 4 (OUT6)

Output transistor ratings:

M54630P Transistor array

Permissible voltage: Max. DC24V

Permissible current: Max. 50mA (per 1 output)



(3) Open collector output circuit

SGJ-CA (CON1)

Up-to-speed (USC)

Zero speed (ZSC)

Aux. output 1 (OUT3C)

Aux. output 2 (OUT4C)

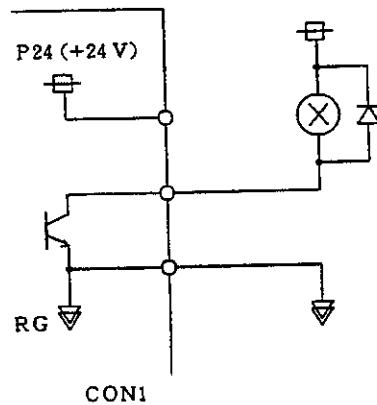
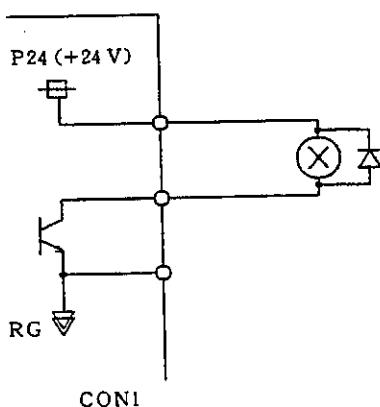
Aux. output 3 (OUT5C)

Output transistor rating:

M54523P Transistor array

Permissible voltage: Max. DC24V

Permissible current: Max. 50mA (per 1 output)



Note) When a direct current relay is used externally, connect the flywheel diode in parallel with the coil.

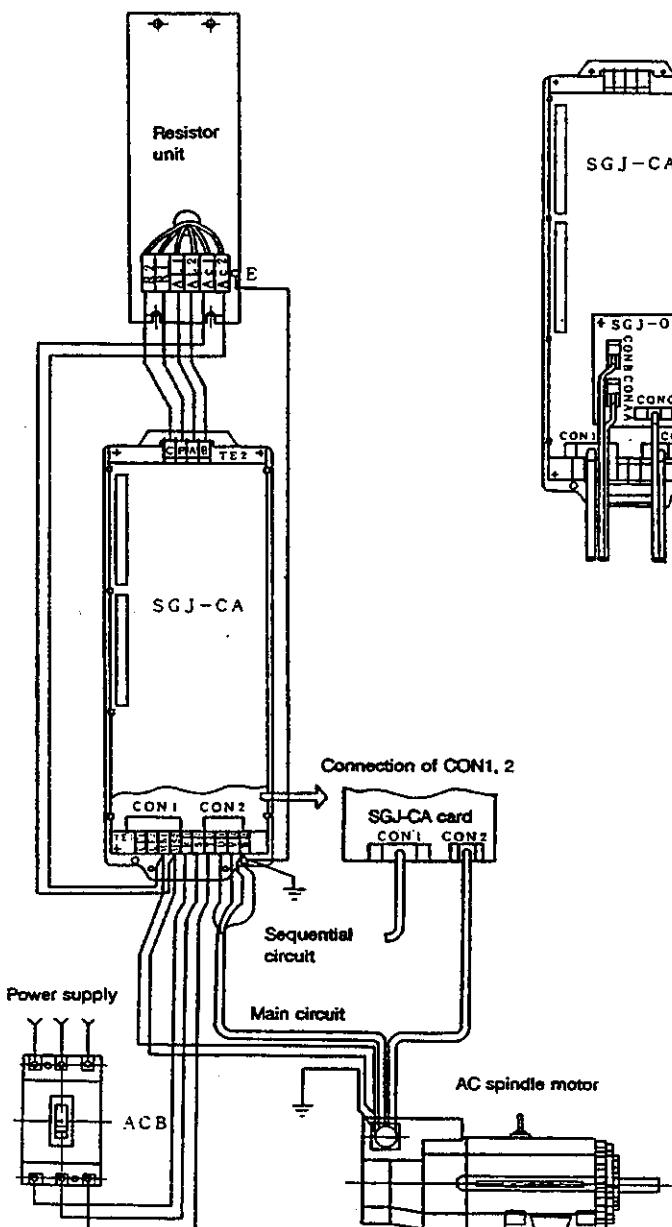
## **CHAPTER 4    INSTALLATION**

## 4. Installation

### 4.1 Installation of the Analog Speed Command and Digital I/O Type

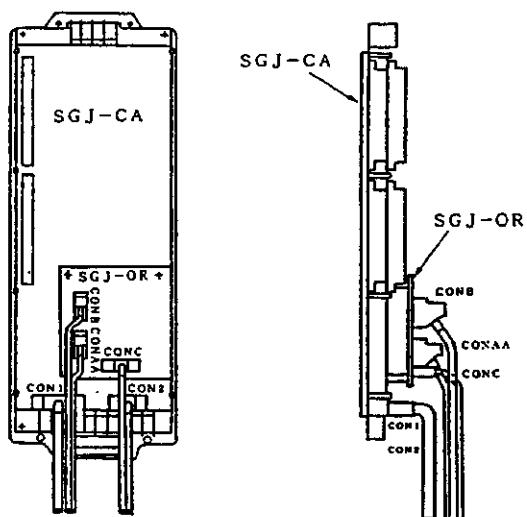
FR-SGJ-2-□K-A

Fig. 1



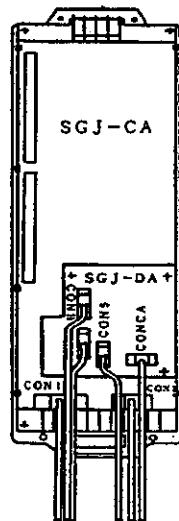
FR-SGJ-2-□K-AR

Fig. 2



RF-SGJ-2-□K-AD

Fig. 3



(Note) Fig. 2, 3 show the wiring for use of option card(s).

Fig. 1 shows the standard wiring (the controller is not equipped with option card).

## 4.2 Installation of the Bus-Line Connection type

**FR-SGJ-2-□K-B**

Fig. 1

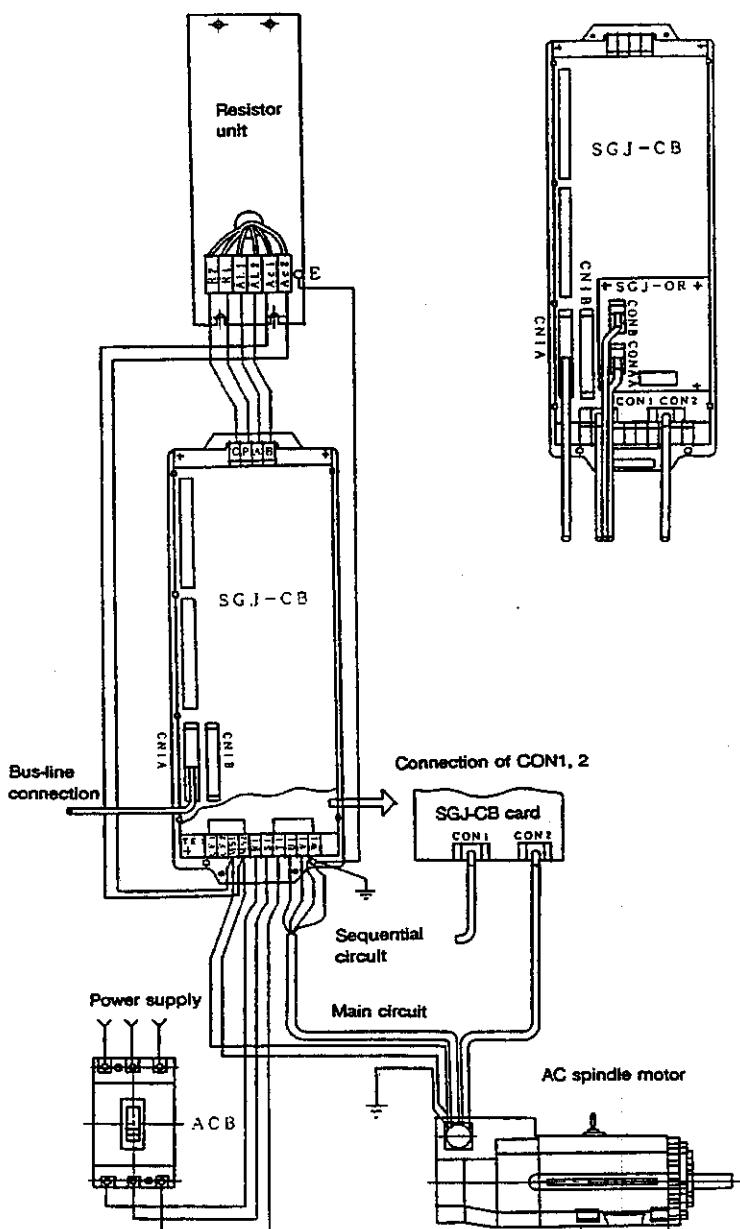
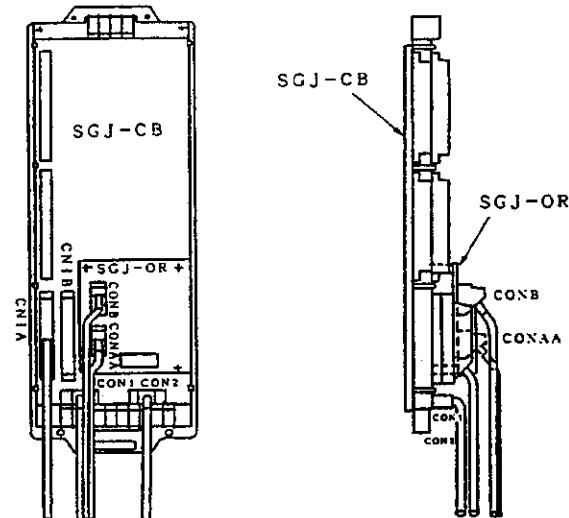
**FR-SGJ-2-□K-BR**

Fig. 2



(Note) Fig. 2 shows the wiring for use of option card(s).

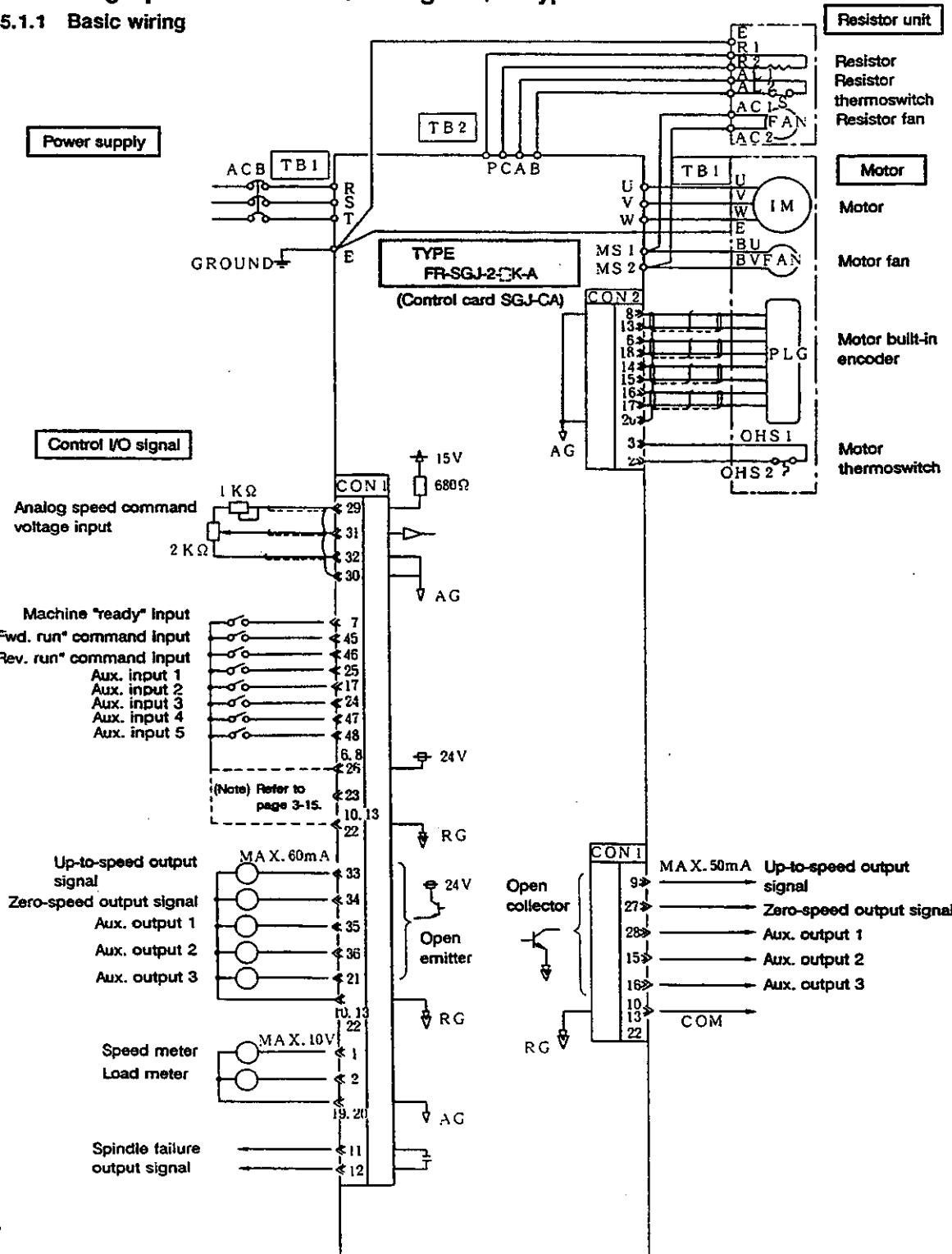
Fig. 1 shows the standard wiring (the controller is not equipped with option card).

**CHAPTER 5 CONNECTION**

## 5. Connection

### 5.1 Analog Speed Command and Digital I/O Type

#### 5.1.1 Basic wiring



## 5.1.2 Analog speed command and digital I/O/

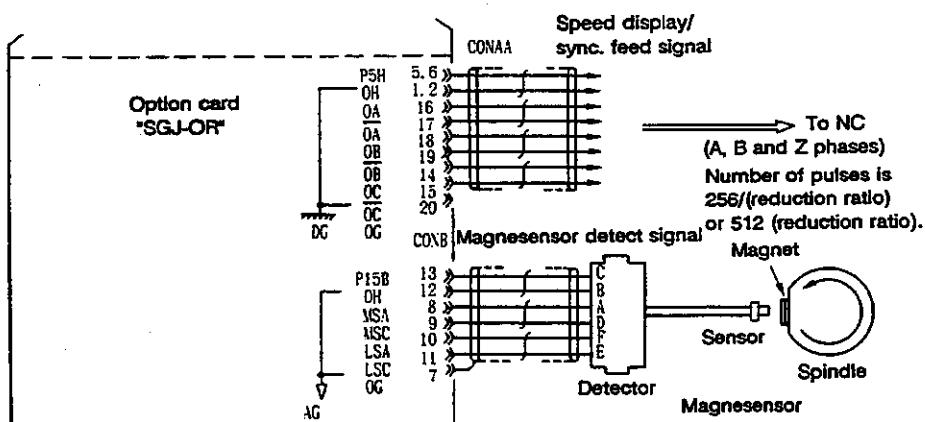
With oriented function (Option SGJ-OR card used)

The wiring shown below is added to the basic wiring.

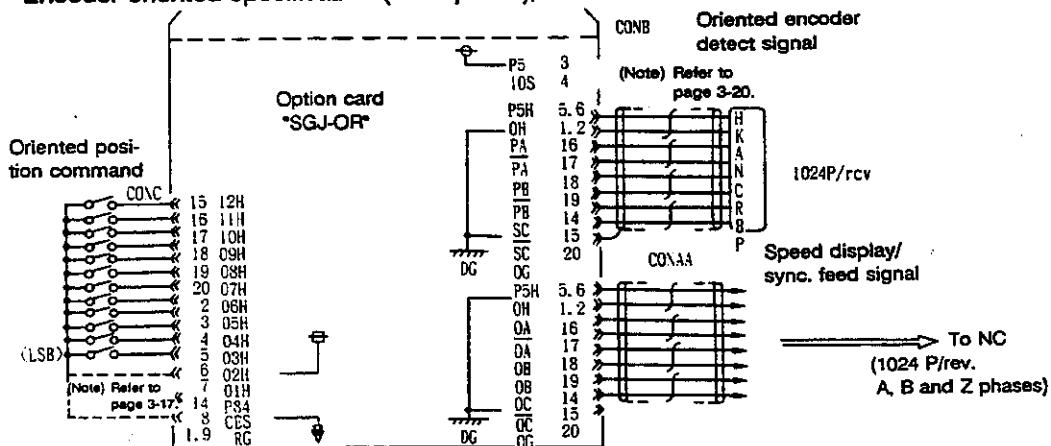
FR-SGJ-2- DK-AR

## (1) Magnesensor oriented (1 point) specification

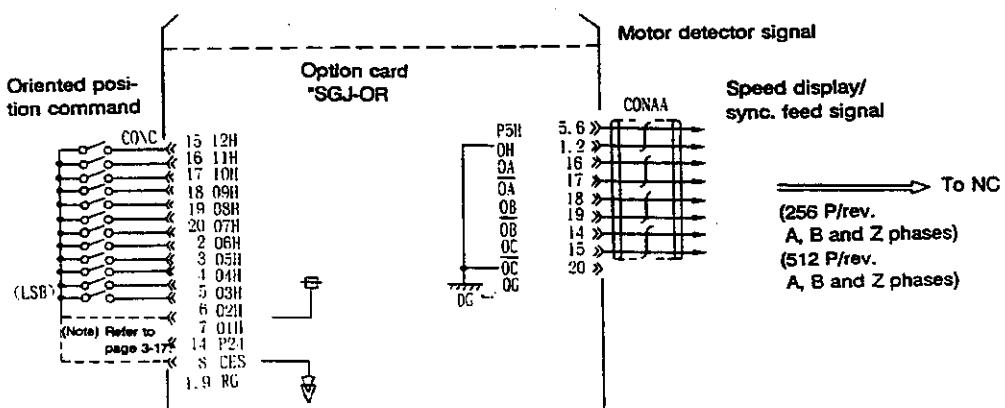
(with motor speed feedback output ... for spindle speed display and sync. feed signal)



## (2) Encoder oriented specification (4096 points)/index function



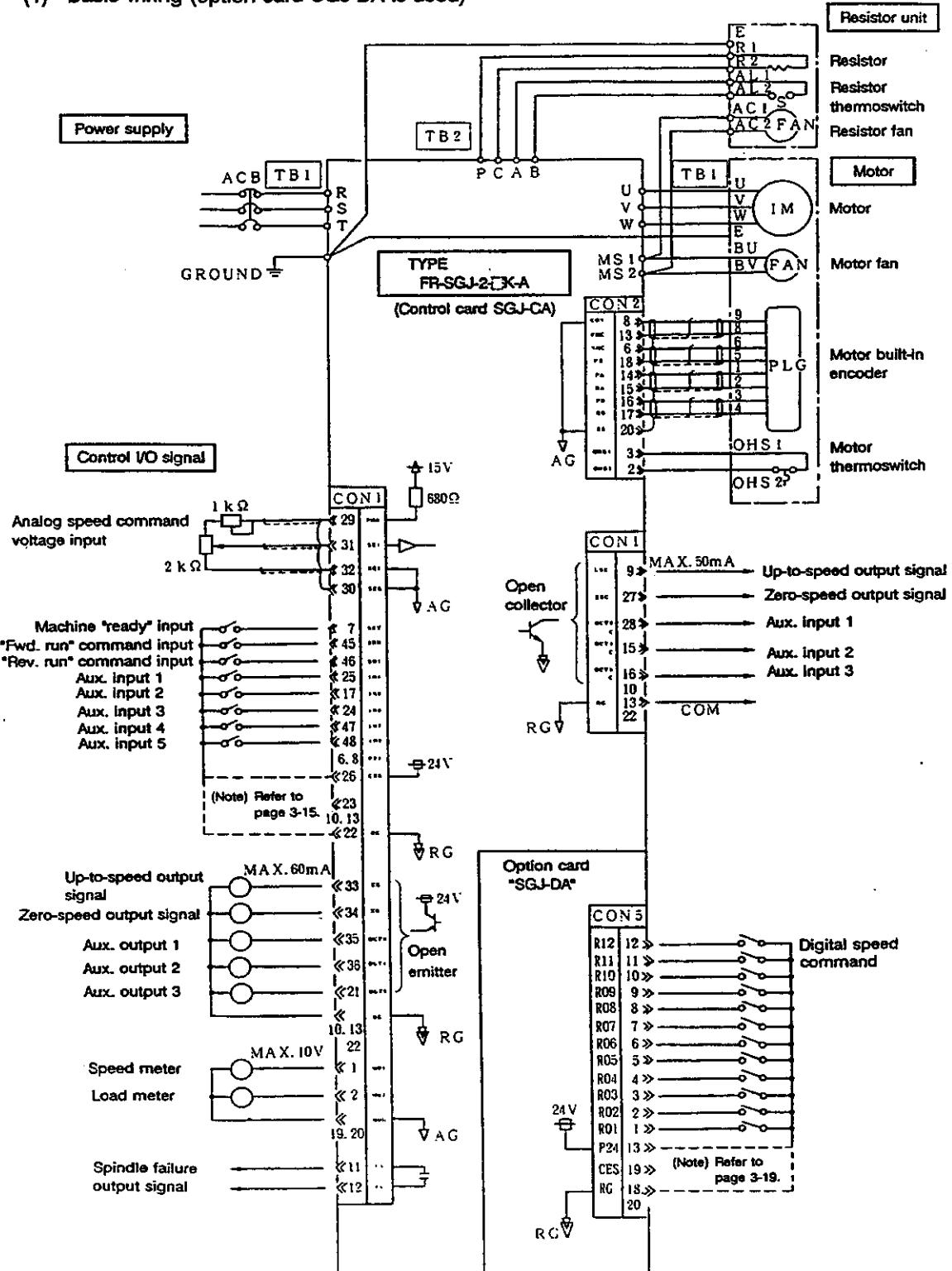
## (3) Z-phase motor built-in encoder oriented specification (4096 points)/index function



### 5.1.3 Digital speed command and digital I/O

FR-SGJ-2-**K-AD**

#### (1) Basic wiring (option card SGJ-DA is used)



#### 5.1.4 Digital speed command and digital I/O

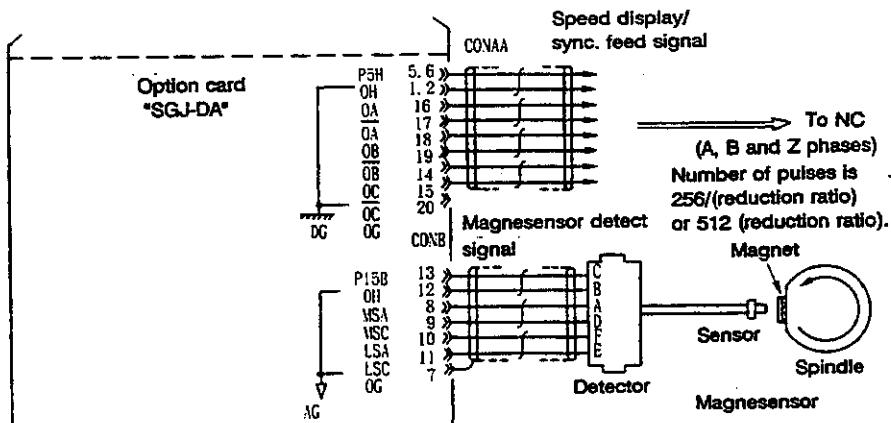
With oriented function (Option SGJ-DA card used)

The wiring shown below is added to the basic wiring.

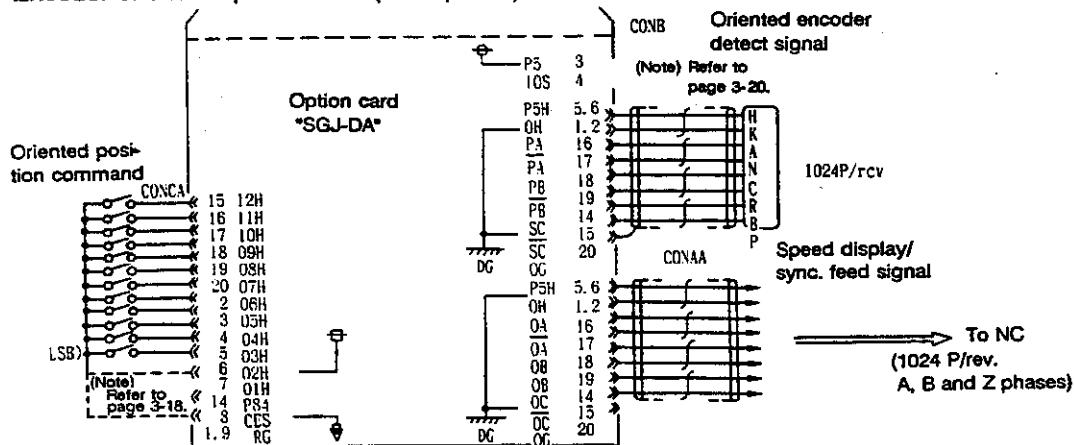
FR-SGJ-2-[]K-AD

##### (1) Magnesensor oriented specification (1 point)

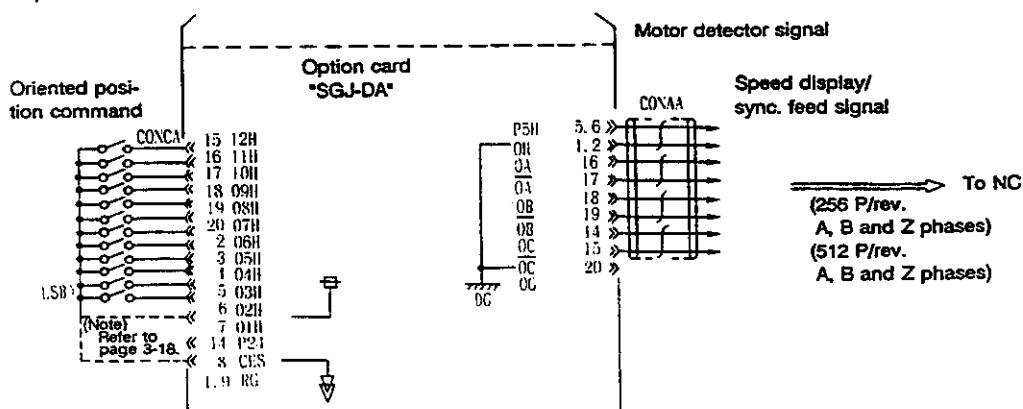
(with motor speed feedback output ... for spindle speed display and sync. feed signal)



##### (2) Encoder oriented specification (4096 points)/index function



##### (3) Z-phase motor built-in encoder oriented specification (4096 points)/index function

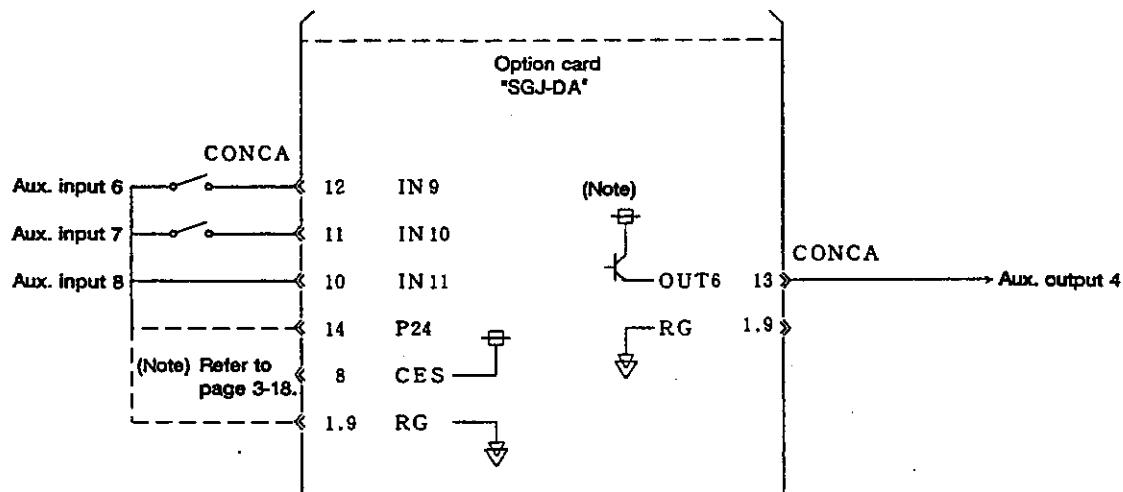


**5.1.5 Digital speed command and digital I/O**

With the additional auxiliary input output (Option SGJ-DA card used)

FR-SGJ-2-□K-AD

The wiring shown below is added to the basic wiring.

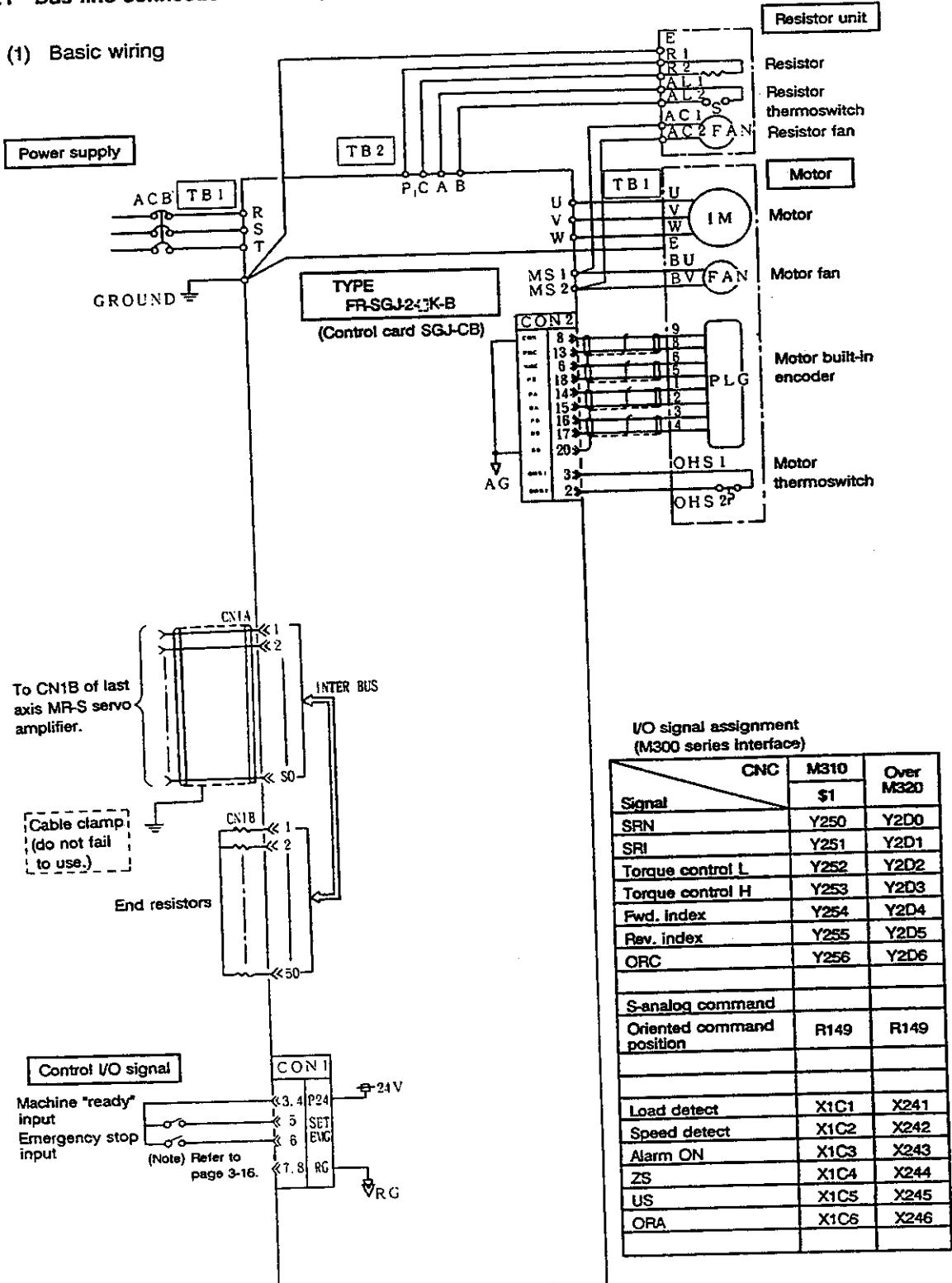


(Note) The auxiliary output 4 with the SGJ-DA card is open emitter output, and open collector output will not be possible.  
 Refer to page 3-21 for output interfaces.

## 5.2 Bus-Line Connection Type

### 5.2.1 Bus-line connection to M300, M3/L3

#### (1) Basic wiring



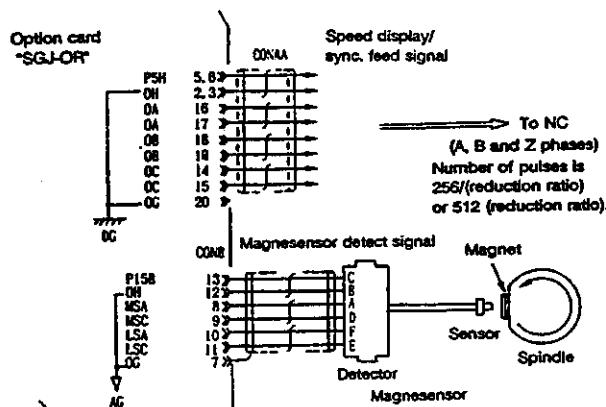
### 5.2.2 Bus-line connection to M300, M3/L3

With high speed synchronous tap and orient functions (Option SGJ-OR card used)

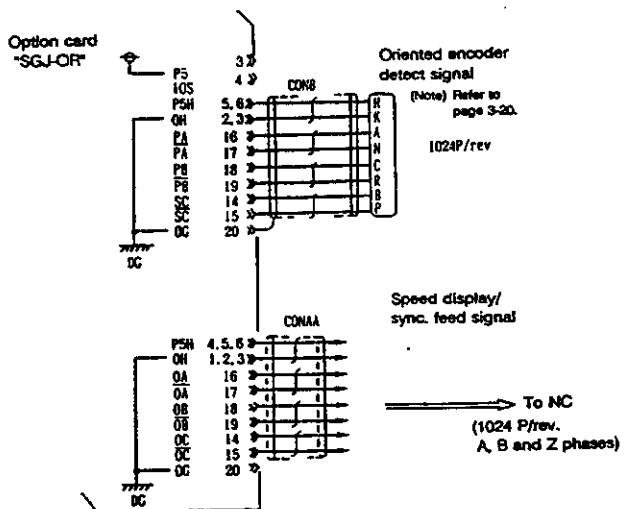
The following wiring is added to the basic wiring.

FR-SGJ-2-□K-BR

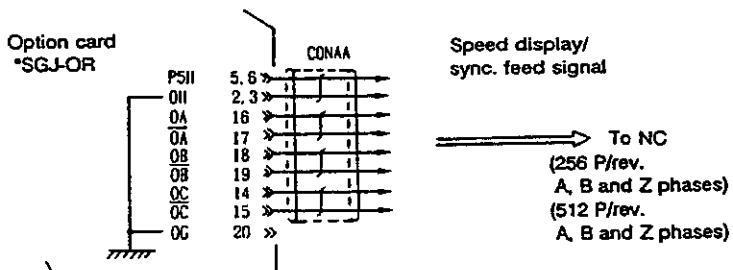
- (1) Motor built-in encoder high speed sync. TAP/magnesensor oriented specification (1 point)



- (2) Encoder high speed sync. TAP oriented specification (4096 points)/index function



- (3) Z-phase motor built-in encoder high speed sync. TAP multipoint oriented specification/index function



### 5.3 Cables and Breakers used in Main Circuit

Power cable, motor cable and breaker (ACB) used in the main circuit should be selected from the list shown below.

Application	Controller	FR-SGJ-2-0.75k	FR-SGJ-2-1.5k	FR-SGJ-2-2.2k	FR-SGJ-2-3.7k	FR-SGJ-2-5.5k	FR-SGJ-2-7.5k
Power cable (R,S,T,E)	IV2SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV8SQ
Motor cable (U,V,W,E)	IV2SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV5.5SQ
Resistor unit (R1,R2,E)	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ	IV3.5SQ
Breaker (ACB)	Model NF30CB3P10A01	NF30CB3P15A01	NF30CB3P20A01	NF30CB3P30A01	NF50CS3P40A01	NF50CS3P40A01	NF50CS3P40A01
Figure	Fig. 5.3-1	Fig. 5.3-1	Fig. 5.3-1	Fig. 5.3-1	Fig. 5.3-2	Fig. 5.3-2	Fig. 5.3-2

\*1: The power cable should be that rated for ambient temperature of 30°C, and meet the power capacity (30 (15) min. load rating).

\*2: The motor cable should be that rated for ambient temperature of 30°C, and meet the continuous-rated load current.

\*3: The cables should be determined, with the ambient temperature, cable materials and wiring conditions taken into consideration.

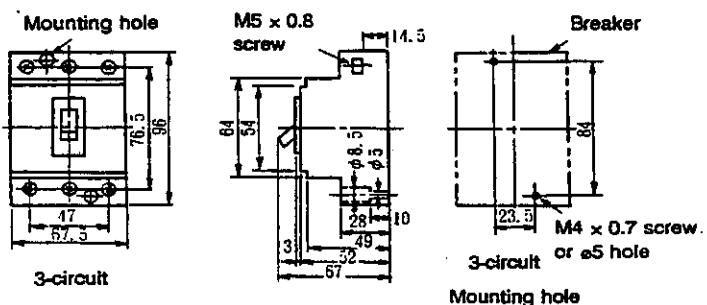


Fig. 5.3-1

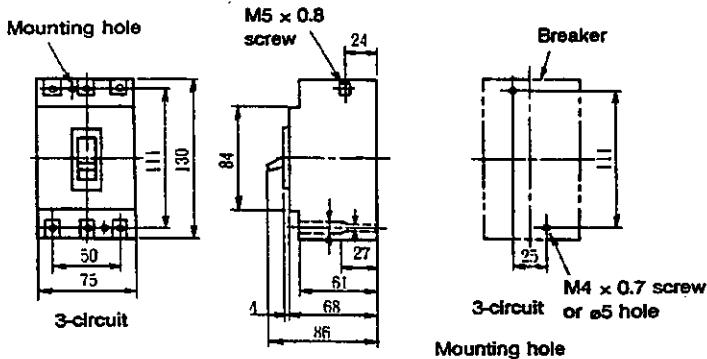


Fig. 5.3-2

## 5.4 Control Circuit Cables

### 5.4.1 Connectors

(1) Motor detector signal (motor side) pin arrangement

For connector of motor detector cable side (AMP-350720-1), use the furnished one (accessory).

3 PB	2 RA	1 PA
6 N15C	AG or PZ	4 RB
9 COM	8 P15C	7

Crimping tool  
(723705-1)

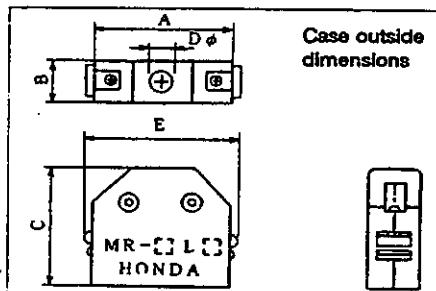
(2) Outside dimensions of controller connectors

The connectors on the controller cable side are to be prepared by user.

Manufacturer: HONDA TSUSHIN

Model : MR-[ ] L[ ]

Circuits	Model	Dimensions		Unit: mm	
		A	B	C	D <sub>a</sub>
50	MR-50L	67.9	18	44.8	16
20	MR-20L	39.3	18	39.8	11 (44.9)



(3) Connector CON1 pin arrangement

CON1  
MR-20LM Input/output signals (SGJ-CB card)

20	19	18	17	16	15	14
	13	12	11	10	9	8
7	6	5	4	3	2	1
RG	EMG	SET	P24	P24		

CON1  
MR-50LF Input/output signals (SGJ-CA card)

50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	
		IN8	IN7	SRI	SRN										OUT4	OUT3	ZS	US
		32	31	30	29	28	27	26	25	24	23	22	21	20	19			
		SE2	SE1	SES	P15A	OUT3C	2SC	P24	IN4	IN6	CES	RG	OUT5	MOG	MOG			
18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
		IN5	OUT5C	OUT4C		RG	FC	FA	RG	USC	P24	SET	P24			M02	M01	

## (4) Connector CON2 pin arrangement

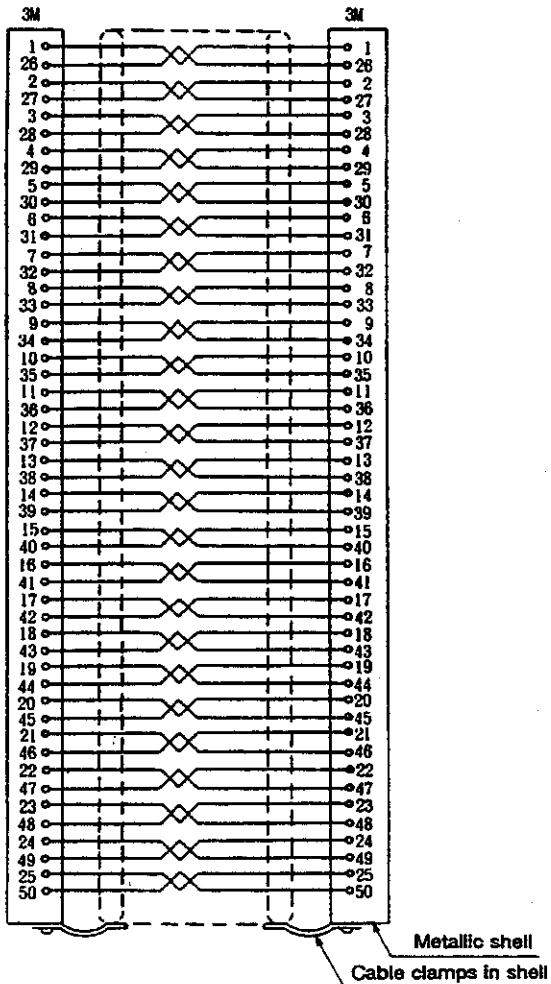
**CON2** Motor detector signal  
**MR-20LF** Motor thermoswitch signal

20	19	18	17	16	15	14
SS		PZ	RB	PB	RA	PA
	13	12	11	10	9	8
	P15C					COM
7	6	5	4	3	2	1
	N15C			OHS1	OHS2	AG

## (5) Connector CN1A, CN1B pin arrangement

Connector for bus-line connection

Cable specification



## (6) Option card SGJ-OR connector pin arrangement

FR-SGJ-2-□K-□R

CONB Magnesensor detect signal/oriented  
MR-20LF encoder detect signal

20	19	18	17	16	15	14
OG	PB	PB	PA	PA	SC	SC
	13	12	11	10	9	8
	P15B	OH	LSC	LSA	MSC	MSA
7	6	5	4	3	2	1
OG	P5H	P5H	IOS	P5	OH	OH

CONAA Speed display/sync. feed signal  
MR-20LF

20	19	18	17	16	15	14
OG	OB	OB	OA	OA	OC	OC
	13	12	11	10	9	8
7	6	5	4	3	2	1
	P5H	P5H			OH	OH

CONC Oriented position command  
MR-20LM

14	15	16	17	18	19	20
P24	12H	11H	10H	09H	08H	07H
	8	9	10	11	12	13
	CES	RG				
1	2	3	4	5	6	7
RG	06H	05H	04H	03H	02H	01H

## (7) Option card SGJ-DA connector pin arrangement

FR-SGJ-2-[]K-AD

CON5 Magnesensor detect signal (usually CONB is used)  
MR-20LF Digital speed command

20	19	18	17	16	15	14
RG	CES	RG				
	13	12	11	10	9	8
	P24	R12	R11	R10	R09	R08
7	6	5	4	3	2	1
RG	R07	R06	R05	R04	R03	R02

CONB Magnesensor detect signal/oriented encoder detect  
MR-20LF signal

20	19	18	17	16	15	14
OG	PB	PB	PA	PA	SC	SC
	13	12	11	10	9	8
	P15B	OH	LSC	LSA	MSC	MSA
7	6	5	4	3	2	1
OG	P5H	P5H	I0S	P5	OH	OH

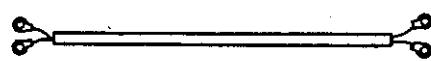
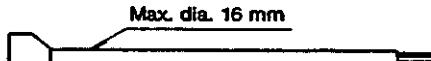
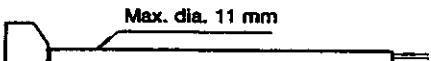
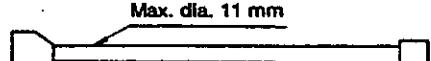
CONAA Speed display/sync. feed signal  
MR-20LF

20	19	18	17	16	15	14
OG	OB	OB	OA	OA	OC	OC
	13	12	11	10	9	8
7	6	5	4	3	2	1

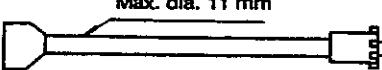
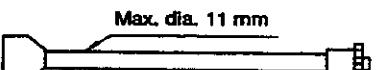
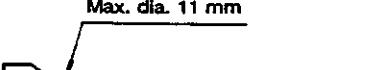
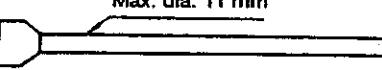
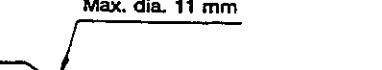
CONCA Oriented position command/aux. I/O signal  
MR-20LM

14	15	16	17	18	19	20
P24	I2H	I1H	I0H	O9H	O8H	O7H
	8	9	10	11	12	13
	CES	RG	IN11	IN10	IN9	OUT6
1	2	3	4	5	6	7
RG	06H	05H	04H	03H	02H	01H

## 5.4.2 Control circuit cable list

Applica- tion	Symbol	Unit		Cable assembly	Unit	
		Part model	Supply		Part	Supply
		Manufacturer			Manufacturer	
Motor cooling fan	TB1	Controller		Vinyl cabtyre cable 2 sq., 2-circuit, except for one shown below		Motor (lead terminal)
		Solderless terminal 2SQ-4 2 pcs. (3 pcs.)	Not sup- plied		Solderless terminal 2SQ-4 2 pcs. (3 pcs.)	Not sup- plied
		—	—		—	—
I/O signal	CON1 (SGJ-CB card)	Controller		Vinyl cable 0.3 sq., 20-circuit	Signal input/output	
		MR-20LM	Not sup- plied	 Max. dia. 16 mm	—	—
		HONDA	Not sup- plied	Cable length is to be less than 7 m.	—	—
I/O signal	CON1 (SGJ-CA card)	Controller		Shielded vinyl cable 0.2 sq., 50-circuit	Signal input/output	
		MR-50LF	Not sup- plied	 Max. dia. 11 mm	—	—
		HONDA	Not sup- plied	Cable length is to be less than 7 m.	—	—
Motor detector signal/ motor thermo- switch signal	CON2	Controller		5 twisted pair shield cable 0.3 sq.	Motor (connector) Motor (lead terminal)	
		MR-20LF	Not sup- plied	 Max. dia. 11 mm	Connector AMP-350720-1 Pin AMP-350689-1	Motor acces- ories
		HONDA	Not sup- plied	Cable length is to be less than 20 m.	NIPPON AMP	

**Chapter 5 CONNECTION**

Application	Symbol	Unit		Cable assembly	Unit	
		Part model	Supply		Part	Supply
		Manufacturer			Manufacturer	
Orientation magnesensor detect signal	CONB	Controller		3 twisted pair cable 0.3 sq.	Magnesensor amplifier	
		MR-20LF	Not supplied	 Max. dia. 11 mm	TRC116-12A10-7F10.5	Attached to magnesensor amplifier
		HONDA		Cable length is to be less than 20 m.	TAJIMI	
Orientation encoder detect signal	CONB	Controller		4 shielded, twisted pair cable 0.3 sq.	Encoder	
		MR-20LF	Not supplied	 Max. dia. 11 mm	MS3106A20-29S	Attached to encoder
		HONDA		Cable length is to be less than 20 m.	CANNON	
Speed display/sync. feed signal	CONAA	Controller		4 shielded, twisted pair cable 0.3 sq.	Signal input	
		MR-20LF	Not supplied	 Max. dia. 11 mm	—	—
		HONDA		Cable length is to be less than 20 m.	—	
Oriented position command	CONC	Controller		Vinyl cable 0.3 sq., 20-circuit	Signal output	
		MR-20LM	Not supplied	 Max. dia. 11 mm	—	—
		HONDA		Cable length is to be less than 7 m.	—	
Aux. input/output signal/oriented position command	CONCA	Controller		Vinyl cable 0.3 sq., 20-circuit	Signal output	
		MR-20LM	Not supplied	 Max. dia. 11 mm	—	—
		HONDA		Cable length is to be less than 7 m.	—	

Application	Symbol	Unit		Cable assembly	Unit	
		Part model	Manufacturer		Part	Manufacturer
Digital speed command /orientation magnesensor detect signal	CON5	Controller		<p>3 shielded, twisted pair cable 0.3 sq. (magnesensor) Vinyl cable 0.3 sq., 12-circuit (command)</p>	<p>Magnesensor amplifier Digital speed reference</p> <p>TRC116 -12A10 -7F 10.5</p> <p>TAJIMI</p>	Attached to magnesensor amplifier
		MR-20LF	Not supplied			
		HONDA				
Bus-linkage to M300, M3/L3	CN1A (CN1B)	Controller - Servo amp. - CNC				
		CAM11	Not supplied (provided on CNC side)			
		MITSUBISHI				
End resistor for bus-linkage to M300, M3/L3 (to be connected to CN1B)	CN1B	Controller				
		CABLE END	Not supplied (provided on CNC side)			
		MITSUBISHI				

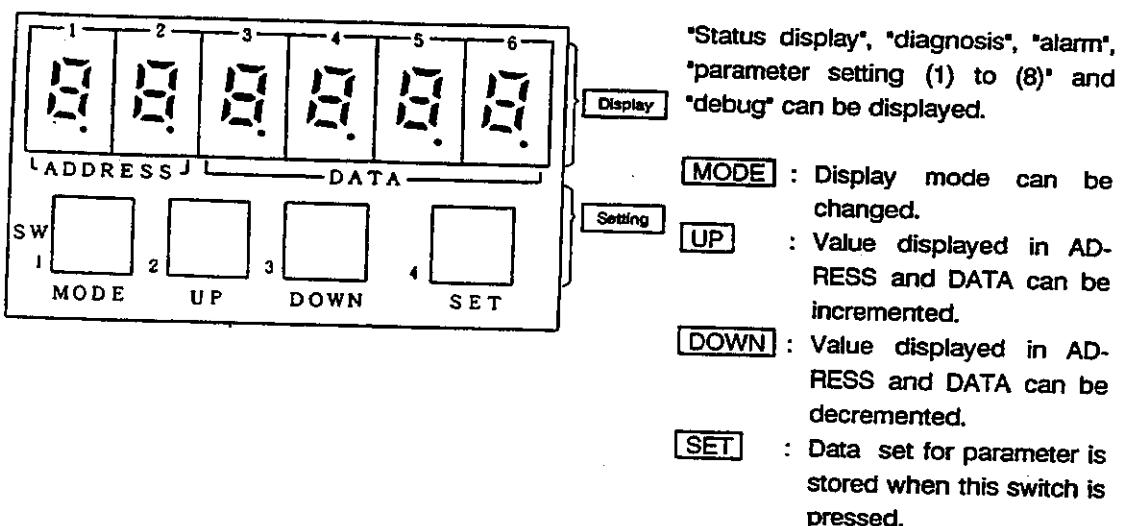
**CHAPTER 6 STATUS DISPLAY AND  
PARAMETER SETTINGS**

## 6. Status Display and Parameter Settings

### 6.1 FR-SGJ Display

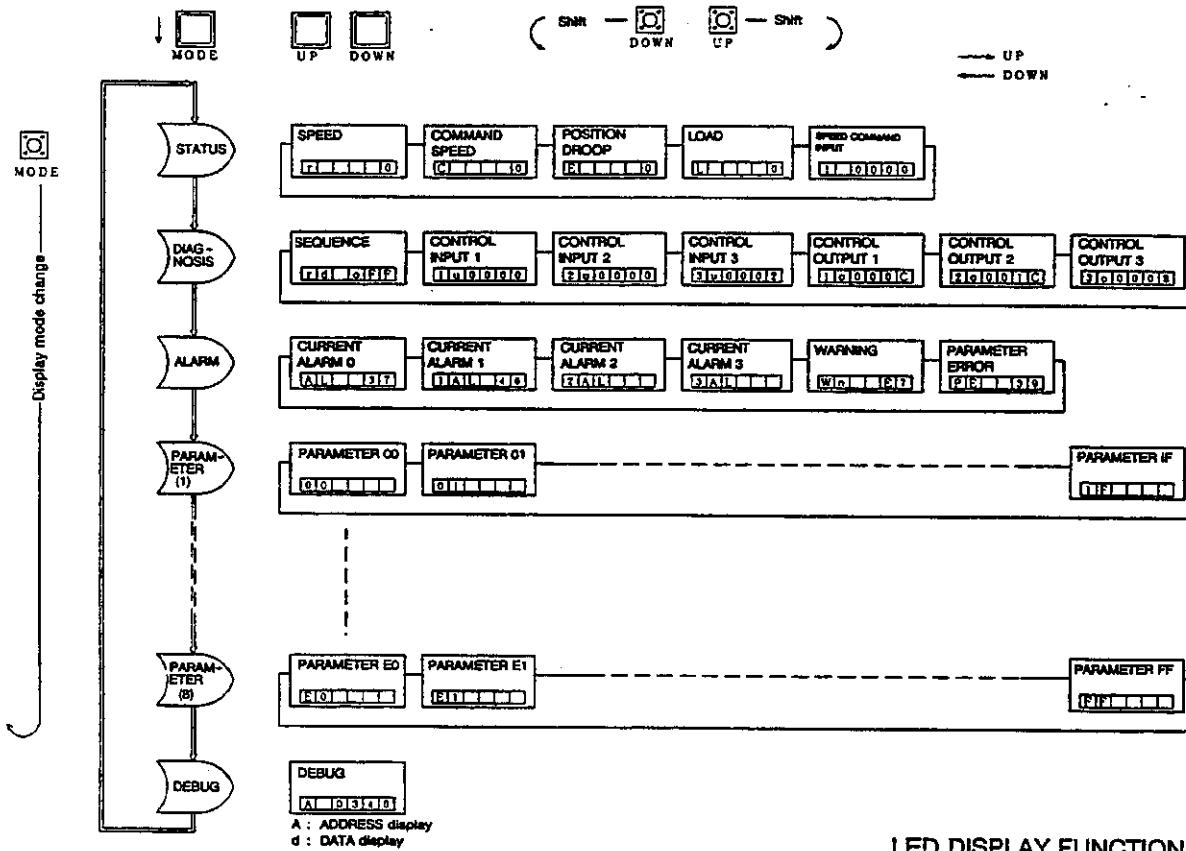
For status display and parameter setting, the display and switches of the SGJ-CA, CB card are used. When the controller is connected to the M300, M3/L3 series with bus line, part of the parameters can be set by the NC display unit ..... for details, refer to 6.2.

#### 6.1.1 Display and setting switches (on SGJ-CA, CB card)



- a) There are 12 display modes, namely, "status display", "diagnosis", "alarm", "parameter setting (1) to (8)" and "debug".
- b) After turning on the power, "Speed" is displayed in status mode unless alarm occurs.
- c) In case of alarm, the alarm code is displayed in error alarm mode.
- d) Display mode can be changed by pressing [MODE] switch.
- e) For display mode sequence and display content, refer to 6.1.2 "LED display mode".

### 6.1.2 LED display mode



- Display mode change, "status display", "status display", "diagnosis", "alarm", "parameter setting (1)" can be selected by pressing **MODE** switch.
- Display content can be changed in the same display mode by pressing **UP** or **DOWN** switch.

### 6.1.3 Display of status mode

The following descriptions are explained in the display of state mode.

Name	Symbol	Unit	Description
Speed	r	rpm	Displays the motor speed.
Command speed	C	rpm	Displays command speed in motor.
Position droop	E	pulse	Displays absolute value of pulses collected in deflection counter.
Load	L	%	The load state is displayed with the 30 minute rated output at 100%.
Speed command input	I	HEX	The speed command value (HEX) data received from the NC is displayed.

### 6.1.4 Diagnosis display mode

In the diagnosis display mode, the description of the sequence, external signal, warning No., parameter error No. and alarm No. is displayed.

#### (1) Sequence

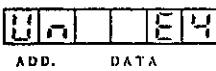
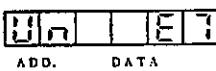
Name	Display	Description
Sequence		Means the preparation is completed.
		Means the preparation is not completed.

## (2) External signal

These have the following meanings in response to the displayed bit, and the input/output signal can be confirmed.

Name		CTM1	CTM2	CTM3	STS1	STS2	STS3
		ADD (Input signal)	ADD (Input signal)	ADD (Input signal)	ADD (Output signal)	ADD (Output signal)	ADD (Output signal)
Display • Description	F						
	E	CTM Gear selection					
	D	CTL Gear selection					
	C						
	B						
	A						
	9	SYNC Spindle synchro-nized				Reverse run	
	8	TAP Tapping	PCHG Parameter change		Parameter being changed	Forward run	
	7		DFIN Data set completed		Torque limit		
	6	ORC Orientation command			Inposition	OFIN Orientation completed	
	5	Reverse run index			Z-phase passed	UTS Up-to-speed	
	4	Forward run index	N.RST NC reset			ZS Zero speed	
	3	TL2 Torque limit H			Alarm	ALM Alarm	
	2	TL1 Torque limit L			Emergency stop	SD Speed detect	Gate ON
	1	SRI Reverse run	SVON Servo ON	RDY External ready	Servo ON	CD Current detect	Contact 2 ON
	0	SRN Forward run	RDY Ready ON	EMG External emergency stop	Ready ON	Spindle synchro-nous speed match	Contact 1 ON

**(3) Warning No.**

Name	Display	Description
Warning No.	 ADD. DATA	Parameter error warning
	 ADD. DATA	Emergency stop, warning

**(4) Parameter error No.**

Name	Display	Description
Parameter error No.	 ADD. DATA	Parameter error No. display

**(5) Alarm display mode**

**Alarm No.**

Name	Display	Description
Alarm No.	 ADD. DATA	Alarm No. display

**Alarm display**

**AL      15**

The alarm number is displayed.  
For details on the alarm numbers, refer  
to page 6-26 "Alarm, Warning List".

Alarms that occur simultaneously will be  
displayed as: AL → 1AL → 2AL → 3AL.

## 6.1.5 Parameter settings

To specify parameter, set "SET1" and "SET2" (machine ready for operation) to "OFF".

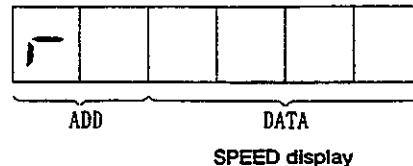
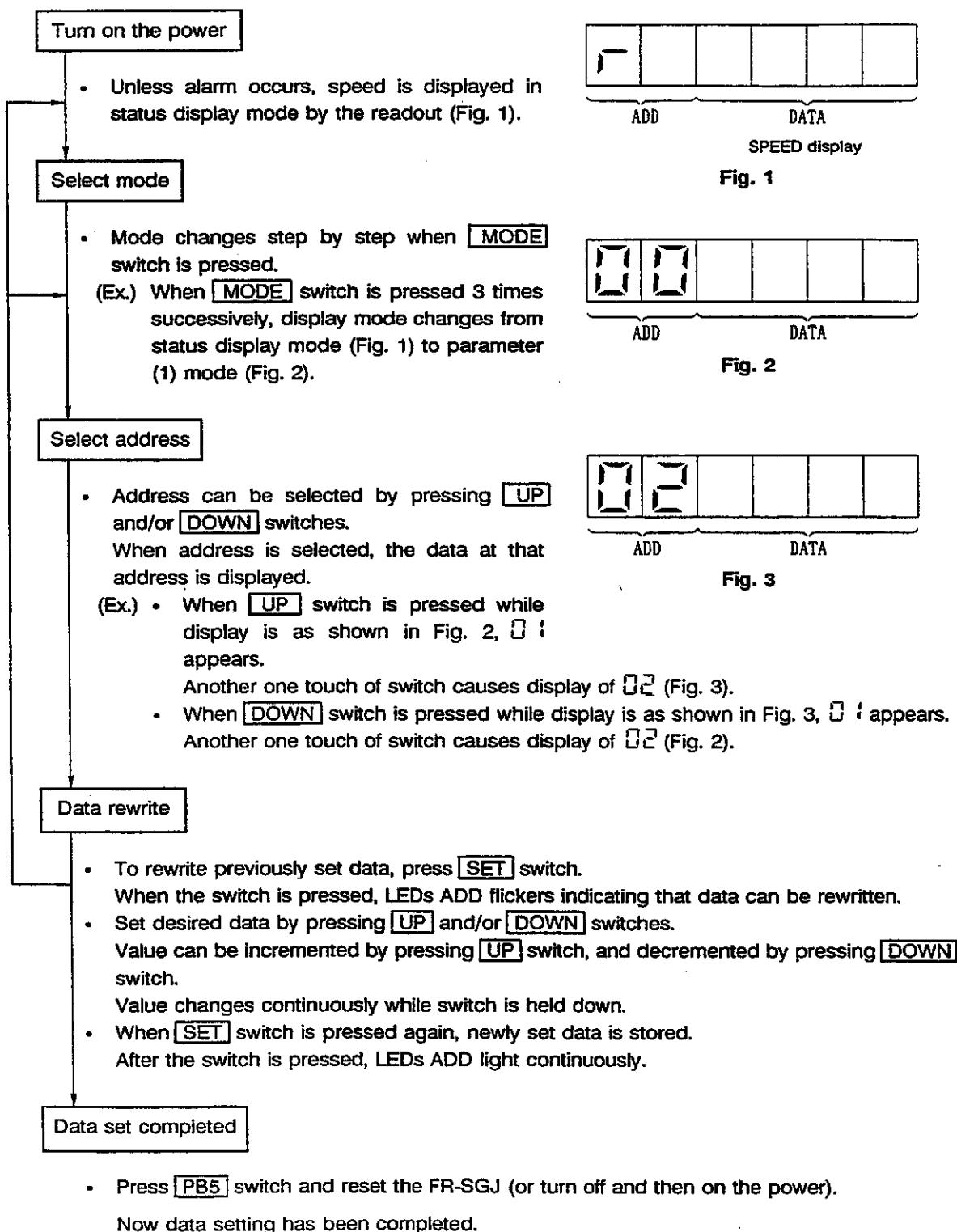


Fig. 1

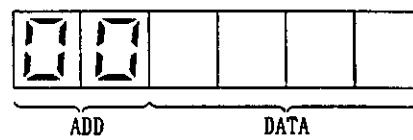


Fig. 2

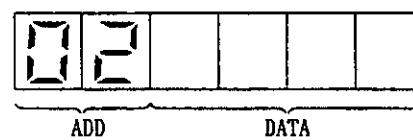


Fig. 3

## Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS

### 6.1.6 Parameter list

#	Parameter		Description	Setting range (unit)
01	NOX	Motor type	<p>bit0=0 Standard   =1 Set range constant output valid</p> <p>bit1=0 Standard   =1 Special motor constant (E2ROM)</p> <p>bit2=0 Standard   =1 Base slide valid</p> <p>(When the motor constant is standard, select with MSL.)</p>	Hexadecimal notation
02	MSL	Motor selection	<p>&lt;256PLG&gt;</p> <ul style="list-style-type: none"> <li>1 = SJ-N0.75A (10000 rpm)</li> <li>2 = SJ-N1.5A (10000 rpm)</li> <li>3 = SJ-N2.2X (10000 rpm)</li> <li>4 = SJ-N2.2A (10000 rpm)</li> <li>5 = SJ-N3.7A (10000 rpm)</li> <li>6 = SJ-N5.5AP (10000 rpm)</li> <li>7 = SJ-N5.5A (8000 rpm)</li> <li>8 = SJ-N7.5A (8000 rpm)</li> </ul> <p>&lt;128PLG&gt;</p> <ul style="list-style-type: none"> <li>17 = (Spare)</li> <li>18 = (Spare)</li> <li>19 = SJ-J2.2X (10000 rpm)</li> <li>20 = SJ-J2.2A (10000 rpm)</li> <li>21 = SJ-J3.7A (10000 rpm)</li> <li>22 = (Spare)</li> <li>23 = SJ-J5.5A (8000 rpm)</li> <li>24 = SJ-J7.5A (8000 rpm)</li> </ul> <p>* The SJ-J motor can be selected also.</p>	Decimal notation
03	PLG	Position loop encoder type	Setting is made for number of encoder pulses. 0: 1024 pulses (encoder orientation, sync. TAP)	Decimal notation
04	MOD	External Interface mode selection	Setting depends on interface with NC. 0: Digital I/O (CON1 signal is used for operation) 2: Bus-line connection to M300	Decimal notation
05	DSR	Digital speed command type	Type of digital speed command input is selected. This parameter is valid when MOD (#04) is set "0". 0: 12-bit binary 1: Signed 12-bit binary 2: BCD (2-digit) 3: BCD (3-digit)	Decimal notation
06	MON	Output monitor selection	The details of the load meter output (CON1 M02 output) are set. 0: Load meter 2: Load meter (with primary delay filter)	Decimal notation
07			Not used. Set "0".	
08			Not used. Set "0".	
09			Not used. Set "0".	
0A			Not used. Set "0".	

Continued on the next page.

**Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS**

#	Parameter		Description	Setting range (unit)
0B	VOP	Speed command offset adjustment	When analog speed command is used, offset value is set. Standard setting: 0	Signed decimal notation -999 ~ +999
0C	VON	Speed command clamp value	Set "0".	-999 ≤ ≤ +999
0D	VGP	Speed command gain adjustment	Gain for speed command is set. Actual speed command is product obtained by multiplying speed command from external signal source by this setting (1 multiplier = 1000). Standard setting: 1000	Decimal notation 0 ~ 1150
0E			Not used. Set "0".	
0F	CSN2	2nd cushion (slow-start) time constant	Set "0".	Decimal notation
10	DTYP	Data type	Whether data of parameters #11 ~ #20 are valid or invalid depends on this setting. 0: Invalid 1: Valid When "1" is selected, data set for parameters #11 ~ #20 become valid for input signal to connector CONC of SGJ-OR card.	Decimal notation
11	DT01	Data 1	These data are valid when "1" is set for #10 parameter (data type).	Decimal notation
12	DT02	Data 2		
13	DT03	Data 3		
14	DT04	Data 4		
15	DT05	Data 5		
16	DT06	Data 6		
17	DT07	Data 7		
18	DT08	Data 8		
19	DT09	Data 9		
1A	DT10	Data 10		
1B	DT11	Data 11		
1C	DT12	Data 12		
1D	DT13		Not used. Set "0".	
1E	DT14		Not used. Set "0".	
1F	DT15		Not used. Set "0".	
20			Not used. Set "0".	

Continued on the next page.

## Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS

#	Parameter	Description	Setting range (unit)	
21	PG1	Magnesensor oriented position loop gain  The larger the setting, shorter time taken for orientation, and the higher is the servo stiffness. Larger setting, however, may cause more intense vibration overshoot.  Standard setting: See Appendix table 1.	0 ~ 360 (1/10 rad/s)	
22	PG2	Encoder oriented position loop gain  Same as above  Standard setting: See Appendix table 1.	0 ~ 360 (1/10 rad/s)	
23	PGC	Sync. TAP position loop gain  Spindle position loop gain in sync. TAP is set.  Standard setting: 40 (NC display standard setting: 10.00)	1 ~ 512 (1/4 rad/s) For NC display parameter, 0.25 ~ 128.00 (rad/s)	
24	ZRZ	Oriented in-position range  Positioning range within which "orientation complete" signal is output is set.  Standard setting: 16 (NC display standard setting: 1.00)	Encoder  1 ~ 5760 (1/16 deg.)	Magnesensor  1 ~ 512 (1/16 deg.)  For parameter on NC display  0 ~ 359 deg.   0 ~ 39 deg.
25	OSP	Not used. Set "0".		
26	CSP	Creep speed  Time taken for orientation is reduced by increasing this setting.  Standard setting: See Appendix table 1.	1 ~ 1000	
27	PST	Position shift  Oriented stop position is set. Encoder: Stop position is set within 360 deg. with increment of 360/4096. Magnesensor: Stop position is set within range from -5 deg. to +5 deg. with increment 10/1024 (2048 for 0 deg.).  Standard setting: 2048	Encoder  0 ~ 4095 (pulses)	Magnesensor  1536 ~ 2560 (about 1/100 deg.)
28	BRC	Not used. Set "0".		
29	PGT	Position loop gain during synchronous tap  When combining the synchronous spindle function and synchronous tap function set the position loop gain for during synchronous tapping. Here the PGC will become invalid.  Standard setting: 40 (NC display standard setting: 10.00)	1 ~ 512 (1/4 rad/s) The NC display parameters will be 0.25 ~ 128.00 (rad/s)	
2A	PGS	Position loop gain during synchronous spindle  Set the position loop gain for the spindle during synchronous spindle.  Standard setting: 40 (NC display standard setting: 10.00)	1 ~ 512 (1/4 rad/s) The NC display parameters will be 0.25 ~ 128.00 (rad/s)	

Continued on the next page.

Parameters marked with \* are set on the NC side when the controller is connected to M300, M3/L3 series with bus line.

#	Parameter	Description	Setting range (unit)																																															
2B	ORTS	<p>Synchronous tap, synchronous spindle control selection</p> <p>During synchronous spindle or when the synchronous spindle function and synchronous tap function are used together, set the control method for the synchronous tap. Here the ORS2 position loop related parameters will become invalid.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td> </tr> <tr> <td colspan="5">For synchronous spindle</td><td colspan="11">For synchronous tap</td> </tr> <tr> <td>Exitation Close</td><td></td><td></td><td></td><td></td><td>Strong excitation</td><td>Semi-close</td><td>Normal command drive</td><td>Zero point return</td><td></td><td></td><td></td><td>Strong excitation</td><td></td><td>ORTS valid</td> </tr> </table> <p>0: (+) direction 1: (-) direction</p> <p>0: Movable excitation 1: Strong excitation</p> <p>0: (-) direction 1: (+) direction</p> <p>0: Close 1: Semi-close</p> <p>0: Movable excitation 1: Strong excitation</p> <p>0: ORTS invalid 1: ORTS valid (The setting for ORS2 setting is used.)</p> <ul style="list-style-type: none"> <li>• Bits 0, 9, A, E are used for both the synchronous tap and synchronous spindle.</li> </ul>	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	For synchronous spindle					For synchronous tap											Exitation Close					Strong excitation	Semi-close	Normal command drive	Zero point return				Strong excitation		ORTS valid	Hexadecimal notation
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0																																			
For synchronous spindle					For synchronous tap																																													
Exitation Close					Strong excitation	Semi-close	Normal command drive	Zero point return				Strong excitation		ORTS valid																																				
2C		Not used. Set "0".																																																
2D		Not used. Set "0".																																																
2E		Not used. Set "0".																																																

Continued on the next page.

Parameters marked with \* are set on the NC side when the controller is connected to M300, M3/L3 series with bus line.

Appendix table 1 Parameter standard setting value for orientation

Parameter \ Application	For small load GD <sup>2</sup> (Machining center, etc.)	For large load GD <sup>2</sup> (Lathe, etc.)
PG1	100	50
PG2	100	50
CSP	20	8
ORS1	4400	4400

## Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS

#	Parameter	Description	Setting range (unit)
2F	ORS1	Orient stop control 1	<p style="text-align: center;">   <b>4-bit combination 0: 0.6 [magnification]</b>            0: 0.6 [magnification]            1: 0.7            2: 0.8            3: 0.9            4: 1.0            5: 1.2            6: 1.4            7: 1.6            8: 1.8            9: 2.0            A: 2.2            B: 2.4            C: 2.6            D: 2.8            E: 3.0            F: 3.2         </p> <p style="text-align: center;"> <b>4-bit combination 0: 0.6 [magnification]</b>            0: 0.6 [magnification]            1: 0.7            2: 0.8            3: 0.9            4: 1.0            5: 1.2            6: 1.4            7: 1.6            8: 1.8            9: 2.0            A: 2.2            B: 2.4            C: 2.6            D: 2.8            E: 3.0            F: 3.2         </p> <p style="text-align: center;"> <b>4-bit combination 0: Delay/advance</b>            0: Delay/advance            1: PI         </p> <p style="text-align: center;"> <b>4-bit combination 0: 0.55 [rad/s]</b>            0: 0.55 [rad/s]            1: 1.1            2: 1.65            3: 2.2            4: 2.75            5: 3.3            6: 3.85            7: 4.4            8: 4.95            9: 5.5            A: 6.05            B: 6.6            C: 7.15            D: 7.7            E: 8.25            F: 8.8         </p> <p style="text-align: center;"><b>Standard setting:</b> Refer to Appendix table 1.</p>
30	ORS2	Orient stop control 2	<p style="text-align: center;">   <b>Position loop direction</b>            0: Position loop direction            1: Position loop direction         </p> <p style="text-align: center;"> <b>Position loop stop</b>            0: Position loop stop            1: Position loop stop         </p> <p style="text-align: center;"> <b>Orient rotation direction</b>            0: (+) direction            1: (-) direction         </p> <p style="text-align: center;"> <b>2-bit combination 0: PRE</b>            0: PRE            1: Forward            2: Reverse            3: Prohibit         </p> <p style="text-align: center;"> <b>Normal PRE</b>            PRE is the forward/reverse command and same direction until the last time.         </p>

Continued on the next page.

Parameters marked with \* are set on the NC side when the controller is connected to M300, M3/L3 series with bus line.

**Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS**

#	Parameter	Description	Setting range (unit)
* 31	TSP	Motor maximum speed	The maximum speed of motor depends on this setting. 1 ~ 3276 (10 rpm) 10 ~ 32760 (rpm) for parameter setting on NC display
* 32	ZSP	Zero speed	Speed at which "zero speed" is output is set. Standard setting: 50 1 ~ 1000 (rpm)
* 33	CSN	Acceleration time constant	Time for acceleration to maximum speed from zero speed is set (invalid for position loop control). Standard setting: 30 (300 for parameter setting on NC display) 2 ~ 3276 (10 msec) 20 ~ 32760 (msec) for parameter setting on NC display
* 34	SDT	Speed detection ratio	Speed at which "speed detect" signal is output is set in terms of percentage to motor maximum speed. Standard setting: 10 1 ~ 100 (%)
* 35	TLM	Torque limit	Torque limit is set in terms of percentage for torque limit. Standard setting: 10 1 ~ 120 (%)
* 36	VKP	Speed loop proportional gain	Proportional gain is set for speed loop. The larger the setting (100 ~ 150), the faster is the response, but the larger is the noise and vibration. Standard setting: 63 1 ~ 1000 (rad/s)
* 37	VKI	Speed loop integral gain	Integral gain is set for speed loop. It should be set so that its ratio to proportional gain VKP is almost constant. Standard setting: 60 0 ~ 1000 (1/10 rad/s)
* 38	TYP	Position loop "IN" type	Setting is made for transition from "speed loop" to "position loop". 0: Position loop "IN" after orientation 1: Position loop "IN" after the stop with creep speed. Set "0" when initialization (zero return) is required, otherwise set "1". Standard setting: 0 Decimal notation

Continued on the next page.

Parameters marked with \* are set on the NC side when the controller is connected to M300, M3/L3 series with bus line.

## Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS

#	Parameter	Description	Setting range (unit)
• 39	GRA1	Number of gear teeth on spindle side (Driven side)	Number of gear teeth for gear 00 is converted into hexadecimal value, and set. Parameters necessary for oriented stop 64 ~ 7FFF (HEX) The NC display is a 100 ~ 32767 (decimal), and does not need to be changed to a hexadecimal. When the following equation is used, set (GRA1 ~ GRA4) and (GRB1 ~ GRB4) to the smallest integer within the setting range.
• 3A	GRA2		Number of gear teeth for gear 01 is converted into hexadecimal value, and set.
• 3B	GRA3		Number of gear teeth for gear 10 is converted into hexadecimal value, and set.
• 3C	GRA4		Number of gear teeth for gear 11 is converted into hexadecimal value, and set.
• 3D	GRB1	Number of gear teeth on motor side (Drive side)	Number of gear teeth for gear 00 is converted into hexadecimal value, and set.
• 3E	GRB2		Number of gear teeth for gear 01 is converted into hexadecimal value, and set.
• 3F	GRB3		Number of gear teeth for gear 10 is converted into hexadecimal value, and set.
• 40	GRB4		Number of gear teeth for gear 11 is converted into hexadecimal value, and set. Spindle speed × number of gear teeth on spindle side (GRA1~4) number of gear teeth on motor side (GRB1~4) = motor speed. (Note 1)

Continued on the next page.

Parameters marked with \* are set on the NC side when the controller is connected to M300, M3/L3 series with bus line.

Note 1) When the GRA and GRB value is smaller than  $64_{H}$  ( $100_D$  with a decimal), multiply GRA and GRB with the same constant and change it so that it will be a value larger than  $100_D$ .  
(Ex. When  $GRA1=31$ ,  $GRB1=29$ , multiply both by 4, and set  $GRA1=124_D=7C_{H}$  and  $GRB1=116_D=74_{H}$ )

**Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS**

#	Parameter		Description	Setting range (unit)																															
41	OSL	Orientation type	Type of orientation is set. 0: Motor built-in encoder 1: Encoder 2: Magnesensor	Hexadecimal notation																															
42	BSL	Bit assignment	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td> </tr> <tr> <td colspan="15" style="height: 100px;"></td> </tr> </table> <p>Bit assignments:</p> <ul style="list-style-type: none"> <li>Bit 0: Load meter output 0: Load meter output 10V 1: Load meter output 3V</li> <li>Bits 1-4: Emergency stop "Alarm code" output 0: Not output 1: Output</li> <li>Bit 5: NC mode external emergency stop 0: Invalid 1: Valid</li> <li>Bit 6: NC mode machine "ready" signal 0: Invalid 1: Valid</li> <li>Bits 7-15: Unlabeled</li> </ul>	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0																Hexadecimal notation
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0																				
43	SPC	For general-purpose motor, meter output is valid/invalid	This parameter is set when using 1 amp 2 motor function. For details refer to option specifications BNP-A2956-23.	Hexadecimal notation																															
44			Not used. Set "0".																																
45			Not used. Set "0".																																

Continued on the next page.

## Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS

#	Parameter	Description	Setting range (unit)		
46	HSP	S-analog high speed tap selection			
47	HSPI	$K_p, K_i$ magnification for S-analog high speed tap <p>The <math>K_p, K_i</math> magnification is set in addition to orient for the S-analog high speed tap.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td><math>K_i</math> magnification for S-analog high speed tap</td> <td><math>K_p</math> magnification for S-analog high speed tap</td> </tr> </table> <p>The <math>K_i</math> and <math>K_p</math> magnifications can be set between 1/16 ~ 15 times with <math>10_{16}</math> (16<sub>10</sub>) as 1 time. When the magnification is raised, the response to the impact load is increased, and the noise of the gears will increase. Set at 1 ~ 2 times (<math>1010_{16}</math> ~ <math>2020_{16}</math>). Normally the <math>K_i</math> and <math>K_p</math> magnifications are set to the same value.</p>	$K_i$ magnification for S-analog high speed tap	$K_p$ magnification for S-analog high speed tap	Hexadecimal notation  Setting example When setting both $K_i$ and $K_p$ to 1.5 times: $CPI = \frac{18}{K_i} \quad \frac{18}{K_p}$
$K_i$ magnification for S-analog high speed tap	$K_p$ magnification for S-analog high speed tap				
48	DAM	PLG magnification	When optional SGJ-OR or SGJ-DA cards are added-on, the pulse number magnification of the PLG (motor built-in encoder) output from CONAA is set. 0H: x1 (256PPR) 100H: x2 (512PPR)		
49		Not used. Set "0".			
4A		Not used. Set "0".			
4B		Not used. Set "0".			
4C		Not used. Set "0".			
4D		Not used. Set "0".			
4E		Not used. Set "0".			
4F		Not used. Set "0".			
50		Not used. Set "0".			
51		Not used. Set "0".			

Continued on the next page.

**Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS**

#	Parameter	Description	Setting range (unit)
52	SETM	This is a fixed parameter set by Mitsubishi. Please take care not to change it.	Decimal notation
53	ZSTM		Decimal notation
54		Not used. Set "0".	
55	STOD	This is a fixed parameter set by Mitsubishi. Please take care not to change it.	Decimal notation
56		Not used. Set "0".	
57		Not used. Set "0".	
58	CVHS	This is a fixed parameter set by Mitsubishi. Please take care not to change it.	Decimal notation
59		Not used. Set "0".	
5A		Not used. Set "0".	
5B		Not used. Set "0".	
5C		Not used. Set "0".	
5D		Not used. Set "0".	
5E		Not used. Set "0".	
5F	PYX	Variable excitation  The variable excitation ratio is set. When the gear noise is loud, select a small value. A large value is effective in responding to the impact load. (When setting value = 0, the excitation ratio is 50%.)  Standard setting: 0	0 ~ 100 (%)

Continued on the next page.

## Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS

#	Parameter		Description	Setting range (unit)
60	HI1	Auxiliary input 1 selection	Meaning of each input For details refer to the auxiliary input signal section.  0 = Invalid 1 = Orient start 2 = Gear selection L 3 = Gear selection M 4 = Emergency stop 5 = Torque limit H 6 = Torque limit L 7 = Forward index 8 = Reverse index 9 = External reset 10 = Motor selection 1 11 = Motor selection 2 12 = Speed selection 1 13 = Speed selection 2 14 = Speed selection 3 15 = Digital speed selection 16 = S-analog high speed tap	Decimal notation 0 ~ 16
61	HI2	Auxiliary input 2 selection		
62	HI3	Auxiliary input 3 selection		
63	HI4	Auxiliary input 4 selection		
64	HI5	Auxiliary input 5 selection		
65	HO1	Auxiliary out- put 1 selection	Meaning of each output For details refer to the auxiliary output signal section.  0 = Invalid 1 = Orient completed 2 = Speed detect 3 = Current detect 4 = Emergency stop 5 = Torque limit 6 = Ready-ON 7 = Motor forward run 8 = Motor reverse run 9 = Alarm 10 = Motor selection output 1 11 = Motor selection output 2	Decimal notation 0 ~ 11
66	HO2	Auxiliary out- put 2 selection		
67	HO3	Auxiliary out- put 3 selection		
68	SS0	Speed setting 0	Speed selection with a combination of 1, 2, 3	Decimal notation 0 ~ 9999 (rpm)
69	SS1	Speed setting 1		
6A	SS2	Speed setting 2		
6B	SS3	Speed setting 3		
6C	SS4	Speed setting 4		
6D	SS5	Speed setting 5		
6E	SS6	Speed setting 6		
6F	SS7	Speed setting 7		

Speed selection			Selection
3	2	1	
0	0	0	SS0
0	0	1	SS1
0	1	0	SS2
0	1	1	SS3
1	0	0	SS4
1	0	1	SS5
1	1	0	SS6
1	1	1	SS7

0: Contact open  
1: Contact closed

Continued on the next page.

#	Parameter		Description	Setting range (unit)
70	HI6	Auxiliary input 6 selection	Selection is possible by adding on the optional SGJ-DA card. The meaning of each input is the same as HI1 ~ HI5.	Decimal notation 0 ~ 16
71	HI7	Auxiliary input 7 selection		
72	HI8	Auxiliary input 8 selection		
73	HO4	Auxiliary output 4 selection	Selection is possible by adding on the optional SGJ-DA card. The meaning of the output is the same as HO1 ~ HO3.	Decimal notation 0 ~ 11
74			Not used. Set "0".	
75			Not used. Set "0".	
76			Not used. Set "0".	
77			Not used. Set "0".	
78			Not used. Set "0".	
79			Not used. Set "0".	
7A			Not used. Set "0".	
7B			Not used. Set "0".	
7C			Not used. Set "0".	
7D	HSPT	Maximum speed during S-analog high speed tap	When carrying out S-analog high speed tap, the maximum motor speed is set for when S-analog $\pm 10V$ is input. When the set value is 0, it will be the same value as TSP.	Decimal notation 0 ~ 3276 (10 rpm)
7E	DION		This is a fixed parameter set by Mitsubishi. Please take care not to change it.	Decimal notation
7F	SMO	Maximum speed for speed meter	The speed to output 10V to the speed meter is set. When the set value is 0, it will be the same value as TSP.	Decimal notation
80 AF	TOUT BSD		This is a fixed parameter set by Mitsubishi. Please take care not to change it.	Hexadecimal notation
B0			Not used. Set "0".	
B1			Not used. Set "0".	
B2			Not used. Set "0".	

Continued on the next page.

**Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS**

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#	Parameter		Description	Setting range (unit)
B3			Not used. Set "0".	
B4			Not used. Set "0".	
B5			Not used. Set "0".	
B6			Not used. Set "0".	
B7			Not used. Set "0".	
B8			Not used. Set "0".	
B9			Not used. Set "0".	
BA			Not used. Set "0".	
BB			Not used. Set "0".	
BC			Not used. Set "0".	
BD			Not used. Set "0".	
BE			Not used. Set "0".	
BF			Not used. Set "0".	
CO ↓ C9	MT20 ↓ MT29	General-purpose sub-motor 1 constant	This parameter is set when the 1 amp 2 motor function is used. For details refer to option specifications (BNP-A2956-23).	Decimal notation
CA			Not used. Set "0".	
CB			Not used. Set "0".	
CC			Not used. Set "0".	
CD			Not used. Set "0".	
CE			Not used. Set "0".	
CF			Not used. Set "0".	

Continued on the next page.

**Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS**

#	Parameter	Description	Setting range (unit)																		
D0 D9	MT30 MT39	General-purpose sub-motor 2 constant  This parameter is set when the 1 amp 3 motor function is used. For details refer to option specifications (BNP-A2956-23).	Decimal notation																		
DA		Not used. Set "0".																			
DB		Not used. Set "0".																			
DC		Not used. Set "0".																			
DD		Not used. Set "0".																			
DE		Not used. Set "0".																			
DF		Not used. Set "0".																			
E0		Not used. Set "0".																			
E1	SYNV	Matched synchronized speeds  This parameter is set when the synchronized spindle function is used. This sets the judged speed difference that occurs when speed control is switched to position control.	Decimal notation																		
E2	SPI	K <sub>p</sub> , K <sub>i</sub> magnification for synchronized spindles  This is valid when #E3 SWT bit 8 is set to 1. The K <sub>p</sub> , K <sub>i</sub> magnifications are set in addition to orient for synchronized spindles.	Hexadecimal notation <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <table border="1" style="width: 100%; text-align: center;"> <tr> <td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td> </tr> </table> <table border="1" style="width: 50%; margin-top: 10px;"> <tr> <td style="padding: 5px;">K<sub>i</sub> magnification for synchronized spindles</td> <td style="padding: 5px;">K<sub>p</sub> magnification for synchronized spindles</td> </tr> </table> </div> The K <sub>i</sub> and K <sub>p</sub> magnifications can be set between 1/16 ~ 15 times with 10 <sub>H</sub> (16 <sub>D</sub> ) as 1 time. When the magnification is raised, the response to the impact load is increased, and the noise of the gears will increase. Set at 1 ~ 2 times (1010 <sub>H</sub> ~ 2020 <sub>H</sub> ). Normally the K <sub>i</sub> and K <sub>p</sub> magnifications are set to the same value.	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	K <sub>i</sub> magnification for synchronized spindles	K <sub>p</sub> magnification for synchronized spindles
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0						
K <sub>i</sub> magnification for synchronized spindles	K <sub>p</sub> magnification for synchronized spindles																				
			Setting example When setting both K <sub>i</sub> and K <sub>p</sub> to 1.5 times: $CPI = \frac{18}{K_i} \frac{18}{K_p}$																		

Continued on the next page.

## Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS

#	Parameter	Description	Setting range (unit)																																																
E3	SWT	<p>Setting of <math>K_p</math>, <math>K_i</math>, <math>\omega_T</math> control methods for synchronized spindles. Valid/invalid selection.</p> <p><math>\omega_T</math> selection for synchronized spindles. (rad/s)</p> <p>Control method during synchronized spindle</p> <table border="0"> <tr> <td>0: Delay/advance</td> <td>5: 3.3</td> <td>10: 9.4</td> </tr> <tr> <td>1: PI</td> <td>6: 3.85</td> <td>11: 10.0</td> </tr> <tr> <td></td> <td>7: 4.4</td> <td>12: 10.55</td> </tr> <tr> <td></td> <td>8: 4.95</td> <td>13: 11.10</td> </tr> <tr> <td></td> <td>9: 5.5</td> <td>14: 11.65</td> </tr> <tr> <td></td> <td>A: 6.05</td> <td>15: 12.2</td> </tr> <tr> <td></td> <td>B: 6.6</td> <td>16: 12.8</td> </tr> <tr> <td></td> <td>C: 7.15</td> <td>17: 13.35</td> </tr> <tr> <td></td> <td>D: 7.7</td> <td>18: 13.9</td> </tr> <tr> <td></td> <td>E: 8.25</td> <td>19: 14.45</td> </tr> <tr> <td></td> <td>F: 8.85</td> <td>1A: 15.05</td> </tr> <tr> <td></td> <td></td> <td>1B: 15.6</td> </tr> <tr> <td></td> <td></td> <td>1C: 16.15</td> </tr> <tr> <td></td> <td></td> <td>1D: 16.75</td> </tr> <tr> <td></td> <td></td> <td>1E: 17.3</td> </tr> <tr> <td></td> <td></td> <td>1F: 17.85</td> </tr> </table> <p>Valid/invalid selection of #E2 and #E3 parameters.</p> <p>0: Invalid 1: Valid</p> <p>The <math>K_p</math>, <math>K_i</math> and <math>\omega_T</math> control method will be the value set in #2F ORS1.</p> <p>t: Valid</p> <p>The <math>K_p</math>, <math>K_i</math> and <math>\omega_T</math> control method during position loop will be the value set in #E2 and E3.</p>	0: Delay/advance	5: 3.3	10: 9.4	1: PI	6: 3.85	11: 10.0		7: 4.4	12: 10.55		8: 4.95	13: 11.10		9: 5.5	14: 11.65		A: 6.05	15: 12.2		B: 6.6	16: 12.8		C: 7.15	17: 13.35		D: 7.7	18: 13.9		E: 8.25	19: 14.45		F: 8.85	1A: 15.05			1B: 15.6			1C: 16.15			1D: 16.75			1E: 17.3			1F: 17.85	Hexadecimal notation
0: Delay/advance	5: 3.3	10: 9.4																																																	
1: PI	6: 3.85	11: 10.0																																																	
	7: 4.4	12: 10.55																																																	
	8: 4.95	13: 11.10																																																	
	9: 5.5	14: 11.65																																																	
	A: 6.05	15: 12.2																																																	
	B: 6.6	16: 12.8																																																	
	C: 7.15	17: 13.35																																																	
	D: 7.7	18: 13.9																																																	
	E: 8.25	19: 14.45																																																	
	F: 8.85	1A: 15.05																																																	
		1B: 15.6																																																	
		1C: 16.15																																																	
		1D: 16.75																																																	
		1E: 17.3																																																	
		1F: 17.85																																																	
E4	TPI	<p>This is valid when #E5WT bit 8 is set to 1. The <math>K_p</math>, <math>K_i</math> magnification is set in addition to the orient for synchronous tap.</p> <p><math>K_i</math> magnification for synchronous tap      <math>K_p</math> magnification for synchronous tap</p> <p>The <math>K_i</math> and <math>K_p</math> magnifications can be set between 1/16 ~ 15 times with <math>10_{10}</math> (<math>16_{10}</math>) as 1 time. When the magnification is raised, the response to the impact load is increased, and the noise of the gears will increase. Set at 1 ~ 2 times (<math>1010_{10}</math> ~ <math>2020_{10}</math>). Normally the <math>K_i</math> and <math>K_p</math> magnifications are set to the same value.</p>	<p>Hexadecimal notation</p> <p>Setting example When setting both <math>K_i</math> and <math>K_p</math> to 1.5 times:</p> $CPI = \frac{18}{K_i} \frac{18}{K_p}$																																																

Continued on the next page.

## Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS

#	Parameter	Description	Setting range (unit)																																
E5	TWT	<p>Setting of <math>K_p</math>, <math>K_i</math>, <math>\omega_T</math> control methods for synchronous tap. Valid, invalid selection.</p> <p>Valid/invalid selection of #E4 and #E5 parameters. 0: Invalid The <math>K_p</math>, <math>K_i</math> and <math>\omega_T</math> control method will be the value set in #2F ORS1. 1: Valid The <math>K_p</math>, <math>K_i</math> and <math>\omega_T</math> control method during position loop will be the value set in #E4 and E5.</p> <p>Control method during synchronous tap 0: Delay/advance 1: PI</p> <p>5-bit combination</p> <table> <tbody> <tr><td>0: 0.55</td><td>10: 9.4</td></tr> <tr><td>1: 1.1</td><td>11: 10.0</td></tr> <tr><td>2: 1.65</td><td>12: 10.55</td></tr> <tr><td>3: 2.2</td><td>13: 11.10</td></tr> <tr><td>4: 2.75</td><td>14: 11.65</td></tr> <tr><td>5: 3.3</td><td>15: 12.2</td></tr> <tr><td>6: 3.85</td><td>16: 12.8</td></tr> <tr><td>7: 4.4</td><td>17: 13.35</td></tr> <tr><td>8: 4.95</td><td>18: 13.9</td></tr> <tr><td>9: 5.5</td><td>19: 14.45</td></tr> <tr><td>A: 6.05</td><td>1A: 15.05</td></tr> <tr><td>B: 6.6</td><td>1B: 15.6</td></tr> <tr><td>C: 7.15</td><td>1C: 16.15</td></tr> <tr><td>D: 7.7</td><td>1D: 16.75</td></tr> <tr><td>E: 8.25</td><td>1E: 17.3</td></tr> <tr><td>F: 8.85</td><td>1F: 17.85</td></tr> </tbody> </table>	0: 0.55	10: 9.4	1: 1.1	11: 10.0	2: 1.65	12: 10.55	3: 2.2	13: 11.10	4: 2.75	14: 11.65	5: 3.3	15: 12.2	6: 3.85	16: 12.8	7: 4.4	17: 13.35	8: 4.95	18: 13.9	9: 5.5	19: 14.45	A: 6.05	1A: 15.05	B: 6.6	1B: 15.6	C: 7.15	1C: 16.15	D: 7.7	1D: 16.75	E: 8.25	1E: 17.3	F: 8.85	1F: 17.85	Hexadecimal notation
0: 0.55	10: 9.4																																		
1: 1.1	11: 10.0																																		
2: 1.65	12: 10.55																																		
3: 2.2	13: 11.10																																		
4: 2.75	14: 11.65																																		
5: 3.3	15: 12.2																																		
6: 3.85	16: 12.8																																		
7: 4.4	17: 13.35																																		
8: 4.95	18: 13.9																																		
9: 5.5	19: 14.45																																		
A: 6.05	1A: 15.05																																		
B: 6.6	1B: 15.6																																		
C: 7.15	1C: 16.15																																		
D: 7.7	1D: 16.75																																		
E: 8.25	1E: 17.3																																		
F: 8.85	1F: 17.85																																		
E6		Not used. Set "0".																																	
E7		Not used. Set "0".																																	
E8		Not used. Set "0".																																	
E9		Not used. Set "0".																																	
EA		Not used. Set "0".																																	
EB		Not used. Set "0".																																	
EC		Not used. Set "0".																																	
ED		Not used. Set "0".																																	
EE		Not used. Set "0".																																	
EF		Not used. Set "0".																																	

Continued on the next page.

## Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS

#	Parameter		Description															Setting range (unit)																	
F0	FNK	Option function selection	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 6.666666666666667%;">F</td><td style="width: 6.666666666666667%;">E</td><td style="width: 6.666666666666667%;">D</td><td style="width: 6.666666666666667%;">C</td><td style="width: 6.666666666666667%;">B</td><td style="width: 6.666666666666667%;">A</td><td style="width: 6.666666666666667%;">9</td><td style="width: 6.666666666666667%;">8</td><td style="width: 6.666666666666667%;">7</td><td style="width: 6.666666666666667%;">6</td><td style="width: 6.666666666666667%;">5</td><td style="width: 6.666666666666667%;">4</td><td style="width: 6.666666666666667%;">3</td><td style="width: 6.666666666666667%;">2</td><td style="width: 6.666666666666667%;">1</td><td style="width: 6.666666666666667%;">0</td></tr> </table> <p style="margin-left: 10px;">         Starting high speed tap          1 amp 2 motor          Synchronous tap          Synchronous spindle          Index       </p>																F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	Hexadecimal notation
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0																				
			<p style="margin-left: 10px;">         { 0: Function valid          { 1: Function invalid       </p> <ul style="list-style-type: none"> <li>• When the corresponding option function bit is not set to 1, the function will not run and the option error will show "AL 57" when command is input. This parameter can be set only when shipped from the factory, and cannot be changed by the user.</li> </ul>																																
F1			Not used. Set "0".																																
F2			Not used. Set "0".																																
F3			Not used. Set "0".																																
F4			Not used. Set "0".																																
F5			Not used. Set "0".																																
F6			Not used. Set "0".																																
F7			Not used. Set "0".																																
F8	OLL		This is a fixed parameter set by Mitsubishi. Please take care not to change the settings.															Decimal notation																	
FF	? ENCP																																		

## 6.2 NC Display

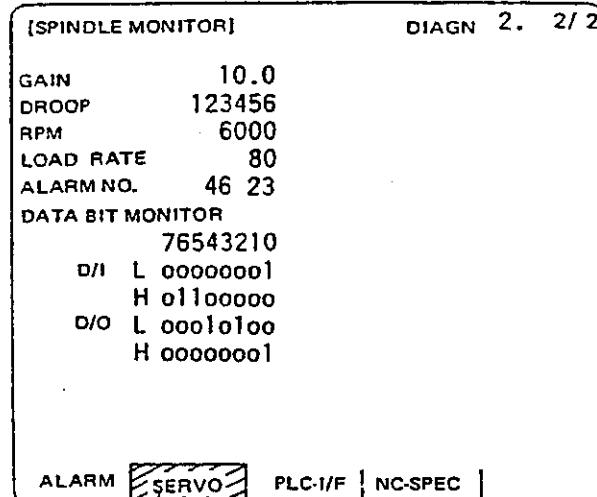
Since display (format, content, etc.) and setting method differ from NC to NC, refer to the instruction manual for your NC system.

Typical examples of NC display are described here.

### 6.2.1 Status display

For status display, "SPINDLE MONITOR" is selected from the menu.

For use of this display function, FR-SGJ should be connected to NC with bus line.



Display	Description
GAIN	Position loop gain is displayed. When position loop is not used, "0" is displayed. The standard position loop gain is, $\frac{\text{Motor speed (rad/s)}}{\text{Response delay (rad/s)}}$ = 10
DROOP	Error in true spindle angle from commanded spindle angle is called "droop". Droop is expressed in number of pulses. When position loop is not used, "0" is displayed.
RPM	Means autual speed of motor expressed in rpm.
LOAD RATE	Load is displayed in ratio (%) to motor rated output (capacity). The output rated for 30 min. is 100%. Range of display is from 0 to 120%.
ALARM NO.	When an error occurs in the spindle amp, the descriptions of the last alarm that occurred (left display) and the other alarms (right display) will be displayed with alarm codes. For alarm contents, refer to Appendix table 2.

Continued on the next page.

Display	Description																																																																
D/I	<p>Signal input to spindle amplifier is displayed by bit.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="8" style="text-align: center;">Control input H</th> <th colspan="8" style="text-align: center;">Control input L</th> </tr> <tr> <th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th> <th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th> </tr> </thead> <tbody> <tr> <td colspan="8" style="text-align: center; vertical-align: top;">           Gear select            00: GEAR 00            01: GEAR 01            10: GEAR 10            11: GEAR 11         </td> <td colspan="8" style="text-align: center; vertical-align: top;">           Oriented command            Reverse run index            Forward run  <b>H</b> Torque limit H  <b>L</b> Torque limit L  <b>SRI</b> Reverse run  <b>SRN</b> Forward run         </td> </tr> <tr> <td colspan="8" style="text-align: center; vertical-align: top;">           Synchronized spindles            Tapping         </td> <td colspan="8" style="text-align: center; vertical-align: top;"></td> </tr> </tbody> </table>	Control input H								Control input L								7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	Gear select 00: GEAR 00 01: GEAR 01 10: GEAR 10 11: GEAR 11								Oriented command Reverse run index Forward run <b>H</b> Torque limit H <b>L</b> Torque limit L <b>SRI</b> Reverse run <b>SRN</b> Forward run								Synchronized spindles Tapping															
Control input H								Control input L																																																									
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0																																																		
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Synchronized spindles Tapping																																																																	
D/O	<p>Signal output from spindle amplifier is displayed by bit.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="8" style="text-align: center;">Control output H</th> <th colspan="8" style="text-align: center;">Control output L</th> </tr> <tr> <th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th> <th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th> </tr> </thead> <tbody> <tr> <td colspan="8" style="text-align: center; vertical-align: top;">           CW Reverse run            CCW Forward run         </td> <td colspan="8" style="text-align: center; vertical-align: top;">           Oriented completed            Up-to-speed            Zero speed            Alarm            Speed detect            Current detect            Synchronized spindle speed match         </td> </tr> </tbody> </table>	Control output H								Control output L								7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	CW Reverse run CCW Forward run								Oriented completed Up-to-speed Zero speed Alarm Speed detect Current detect Synchronized spindle speed match																							
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7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0																																																		
CW Reverse run CCW Forward run								Oriented completed Up-to-speed Zero speed Alarm Speed detect Current detect Synchronized spindle speed match																																																									

Appendix Table 2 Spindle alarm list

FR-SGJ <u>Alarm, Warning List</u>						
No.	Description			No.	Description	
10	UV	Under voltage	PR	40		
11				41		
12	ME1	Memory error 1	AR	42		
13	CE	External clock error	PR	43		
14	WD	Watch dog alarm	AR	44		
15	ME2	Memory error 2	PR	45	OHF	Overheat (Controller)
16				46	OHM	Overheat (Motor or resistor)
17				47		
20				50		
21	NS	No signal (Spindle ENC.)	PR	51	OL	Overload alarm
22				52	OD	Error excessive
23	OSE	Speed deflection excessive	PR	53		
24	CB	Main circuit fault	PR	54		
25	BK	Braking circuit fault	PR	55	EMA	External emergency stop alarm
26				56	OA	Other axis error
27	CPUE	CPU error (Calculation error)	PR	57	OPE	Option error
30	GF	Grounding detection	PR	E0		
31	OS	Overspeed	PR	E1	WOL	Overload warning
32	OC	Over current	PR	E2		
33	OV	Over voltage	PR	E3		
34	DP	Data parity	PR	E4	WPE	Parameter error warning
35	DE	Data error	PR	E5		
36	TE	Transfer error	PR	E6		
37	PE	Parameter error	PR	E7	NCE	NC emergency stop warning

PR : Reset by turning off NC power supply

AR : Reset by turning off spindle amplifier power supply

NR : NC reset

\* : Warning (Reset by removing conditions)

### 6.2.2 Parameter setting

When "SPINDLE PARAMETER" is selected from the display menu, the list of spindle parameters is displayed. There are two types of spindle parameters; one is those used on the NC side, and the other is those sent to FR-SGJ when FR-SGJ is connected to NC through bus line.

#### (1) Parameters used on NC side

[SPINDLE SPEC.]			M-PARAM 7. 1 / 2					
#			1	1000	13	stap	1	527
1	slimt 1		2	790	14	2	2	2640
2			3	4000	15	3		
3			4	1000	16	4		
4			5	smax1	17	smini		
			6	2	18		1	
			7	4000	19			
			8	1000	20			
			9	ssift 1	21	sori	0	
			10	2	22	sgear	0	
			11	3	23			
			12	4	24			
#( ) DATA( )								
MC-ERR		MACRO		SPINDLE		PLC		MENU

#### Spindle parameter list (1/2)

#	Parameter	Description	Setting range (unit)
1	slimt 1	Speed limit	For GEAR 00 GEAR 01 GEAR 10 GEAR 11 } spindle speed with motor at maximum speed is set.
2	2		
3	3		
4	4		
5	smax1	Max. speed	For GEAR 00 GEAR 01 GEAR 10 GEAR 11 } maximum spindle speed is set. S limit ≥ t S max.
6	2		
7	3		
8	4		
9	ssift 1	Shift speed	For GEAR 00 GEAR 01 GEAR 10 GEAR 11 } spindle speed for gear shift is set.
10	2		
11	3		
12	4		
13	stap 1	Tap speed	For GEAR 00 GEAR 01 GEAR 10 GEAR 11 } maximum spindle speed during tap cycle is set.
14	2		
15	3		
16	4		
17	smini	Min. speed	Minimum spindle speed is set. Spindle runs at this speed even when speed specified by S command is lower than this speed.
21	sori		Not used. Set "0".
22	sgear	Encoder gear ratio	Gear ratio between spindle gear and encoder gear is set.
			0: 1/1 1: 1/2 2: 1/4 3: 1/8

## (2) Parameters sent to FR-SGJ from NC

These parameters are sent from FR-SGJ to NC when FR-SGJ is connected to NC through bus line. Although FR-SGJ itself has the same parameters, the parameters appearing on the NC display are valid when FR-SGJ is connected to NC.

Note) Parameters on the NC display can be made invalid by setting DSW-1 switch of card SGJ-CB to "ON".

In this case, the parameters stored in FR-SGJ are all valid.

[SPINDLE SPEC.]			M-PARAM 7.2 / 2				
#							
1	PG1	100	13		25	GRA1	100
2	PG2	100	14		26		2 100
3	PGC	10.00	15	ORS1	4400	27	3 100
4	ZRZ	1.00	16	ORS2	0	28	4 100
5	OSP	0	17	TSP	4500	29	GRB1 100
6	CSP	20	18	ZSP	50	30	2 100
7	PST	2048	19	CSN	300	31	3 100
8	BRC	0	20	SDT	10	32	4 100
9			21	TLM	10	33	
10			22	VKP	63	34	
11			23	VKI	60	35	
12			24	TYP	0	36	

#( ) DATA( )

MC-ERR | MACRO | SPINDLE | PLC | MENU

## Spindle parameter list (2/2)

#	Parameter	Description	Setting range (unit)	
1	PG1	Magnesensor oriented position loop gain  The larger the setting, the shorter is the time taken for orientation, and the higher is the servo stiffness. Larger setting, however, may cause more intense vibration overshoot.  Standard setting: See Appendix table 1 (page 6-10).	0 ~ 360 (1/10 rad/s)	
2	PG2	Encoder oriented position loop gain  Same as above  Standard setting: See Appendix table 1 (page 6-10).	0 ~ 360 (1/10 rad/s)	
3	PGC	Sync. TAP position loop gain  Spindle position loop gain in sync. TAP is set.  Standard setting: 10.00	0.01 ~ 999.99 (rad/s)	
4	ZRZ	Oriented in-position range  Positioning error range within which "orientation complete" signal is output is set.  Standard setting: 1.00	Encoder  0 ~ 359 deg.	Magnesensor  0 ~ 39 deg.
5	OSP		Not used. Set "0".	
6	CSP	Creep speed  Time taken for orientation is reduced by increasing this setting.  Standard setting: See Appendix table 1 (page 6-10)	0 ~ 1000	
7	PST	Position shift  Oriented stop position is set. Encoder : Stop position is set within 360 deg. with increment of 360/4096. Magnesensor: Stop position is set within range from -5 deg. to +5 deg. with increment 10/1024 (2048 for 0 deg.).  Standard setting: 2048	Encoder  0 ~ 4095 (pulses)	Magnesensor  1536 ~ 2560 (about 1/100 deg.)
8	BRC	Not used. Set "0".		
15	ORS1	Oriented stop control 1  See page 6-30.	Hexadecimal notation 0 ~ FFFF	
16	ORS2	Oriented stop control 2  See page 6-30.		

Continued on the next page.

**Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS**

#	Parameter		Description	Setting range (unit)
17	TSP	Motor maximum speed	The maximum speed of motor depends on this setting.	10 ~ 32760 (10 rpm)
18	ZSP	Motor zero speed	Speed at which "zero speed" is output is set. Standard setting: 50	1 ~ 1000 (rpm)
19	CSN	Acceleration time constant	Time for acceleration to maximum speed from zero speed is set (invalid for position loop). Standard setting: 300	20 ~ 32760 (msec)
20	SDT	Speed detection ratio	Speed at which "speed detect" signal is output is set in terms of percentage to motor maximum speed. Standard setting: 10	1 ~ 100 (%)
21	TLM	Torque limit	Torque limit is set in terms of percentage for torque limit signal H. (The torque limit signal L will be a limit ratio that is one-half of this.) Standard setting: 10	1 ~ 120 (%)
22	VKP	Speed loop proportional gain	Proportional gain is set for speed control loop. The larger the setting (100 ~ 150), the faster is the response, but the larger is the noise and vibration. Standard setting: 63	1 ~ 1000 (rad/s)
23	VKI	Speed loop integral gain	Integral gain is set for speed control loop. It should be set so that its ratio to proportional gain VKP is almost constant. Standard setting: 60	0 ~ 1000 (1/10 rad/s)
24	TYP	Position loop "IN" type	Setting is made for transition from "speed loop" to "position loop". 0: Position control loop "IN" after spindle orientation 1: Position control loop "IN" after the stop with creep speed. Set "0" when initialization (zero return) is required, otherwise set "1". Standard setting: 0	Decimal notation
25	GRA1	Number of gear teeth on spindle side (Driven side)	Number of gear teeth for gear 00 is converted into hexadecimal value, and set.	Note) 100 ~ 32767
26	GRA2		Number of gear teeth for gear 01 is converted into hexadecimal value, and set.	
27	GRA3		Number of gear teeth for gear 10 is converted into hexadecimal value, and set.	
28	GRA4		Number of gear teeth for gear 11 is converted into hexadecimal value, and set.	
29	GRB1	Number of gear teeth on motor side (Drive side)	Number of gear teeth for gear 00 is converted into hexadecimal value, and set.	Note) 100 ~ 32767
30	GRB2		Number of gear teeth for gear 01 is converted into hexadecimal value, and set.	
31	GRB3		Number of gear teeth for gear 10 is converted into hexadecimal value, and set.	
32	GRB4		Number of gear teeth for gear 11 is converted into hexadecimal value, and set.	

(Note) If setting of GRA1 ~ GRB4 is smaller than 100, multiply the same factor to GRA and GRB to make the value larger than 100.

Ex.: When GRA1 = 31 and GRB1 = 29, they are multiplied by 4.

Settings: GRA1 = 124 GRB1 = 116



**Chapter 6 STATUS DISPLAY AND PARAMETER SETTINGS**

Parameter	Description	Setting range (unit)																																
ORS1	Oriented stop control 1	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">F</td> <td>E</td> <td>D</td> <td>C</td> <td>B</td> <td>A</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> <td>D</td> </tr> <tr> <td colspan="4">Spindle orient, <math>K_1</math> magnification</td> <td colspan="4">Spindle orient, <math>K_2</math> magnification</td> <td colspan="4">Servo lock control</td> <td colspan="4"><math>\omega_T</math> select [rad/s]</td> </tr> </table> <p>4-bit combination 0: 0.6[Magnification] 1: 0.7 2: 0.8 3: 0.9 4: 1 5: 1.2 6: 1.3 7: 1.6 8: 1.8 9: 2 A: 2.2 B: 2.4 C: 2.6 D: 2.8 E: 3 F: 3.2</p> <p>4-bit combination 0: 0.6[Magnification] 1: 0.7 2: 0.8 3: 0.9 4: 1 5: 1.2 6: 1.4 7: 1.6 8: 1.8 9: 2 A: 2.2 B: 2.4 C: 2.6 D: 2.8 E: 3 F: 3.2</p> <p>4-bit combination 0: Delay/advanc 1: PI</p> <p>4-bit combination 0: 0.55 [rad/s] 1: 1.1 2: 1.65 3: 2.2 4: 2.75 5: 3.3 6: 3.85 7: 4.4 8: 4.95 9: 5.5 A: 6.05 B: 6.6 C: 7.15 D: 7.7 E: 8.25 F: 8.8</p>	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	D	Spindle orient, $K_1$ magnification				Spindle orient, $K_2$ magnification				Servo lock control				$\omega_T$ select [rad/s]			
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	D																			
Spindle orient, $K_1$ magnification				Spindle orient, $K_2$ magnification				Servo lock control				$\omega_T$ select [rad/s]																						
ORS2	Oriented stop control 2	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">F</td> <td>E</td> <td>D</td> <td>C</td> <td>B</td> <td>A</td> <td>9</td> <td>8</td> <td>7</td> <td>6</td> <td>5</td> <td>4</td> <td>3</td> <td>2</td> <td>1</td> <td>0</td> </tr> <tr> <td colspan="4">Position loop detector orientation</td> <td colspan="4">Position loop strong excitation</td> <td colspan="4">Position loop close/semiclose</td> <td colspan="4">Position loop motor rotating direction</td> </tr> </table> <p>0: (+) direction 1: (-) direction</p> <p>0: (+) direction 1: (-) direction</p> <p>0: Close 1: Semi-close</p> <p>0: Weak excitation 1: Strong excitation</p> <p>0: (+) direction 1: (-) direction</p> <p>Detector direction for orient</p> <p>Direction of orient rotation</p> <p>Combination of 2-bit 0: PRE 1: Fwd. 2: Rev. 3: Prohibit</p> <p>"PRE" ... Direction is same as previous direction.</p> <p>Usually "PRE" is selected.</p>	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	Position loop detector orientation				Position loop strong excitation				Position loop close/semiclose				Position loop motor rotating direction			
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0																			
Position loop detector orientation				Position loop strong excitation				Position loop close/semiclose				Position loop motor rotating direction																						

**CHAPTER 7 ORIENTATION FUNCTION (OPTION)**

## 7. Orientation Function (Option)

Three types of orientation function are available.

1. 1-point orientation function, using magnesensor
2. Multipoint (4096 points) orientation function, using encoder
3. Multipoint (4096 points) orientation function, using motor built-in encoder

For use of orientation function, option card SGJ-OR or SGJ-DA is required.

### 7.1 Magnesensor Type 1-point Orientation Function

#### 7.1.1 Connection

For connection of magnesensor to the spindle controller, refer to "5. Connection".

#### 7.1.2 Orientation of magnet and sensor head

Magnet : Install to the radius position shown in Table 7-1 and 7-2.

It can be installed in either one of two ways (**CASE 1** and **CASE 2**).

If radius (R) is small, accuracy in positioning may decrease.

On the contrary, if radius (R) is large, overshoot or intense vibration may occur.

Sensor : Install the sensor head with gap between the sensor head and the magnet, specified in Table 7-1 and Table 7-2.

If the gap is small, overshoot and intense vibration may occur.

On the contrary, if the gap is large, positioning accuracy decreases.

- (1) Install the magnet and the sensor head so that the reference hole of magnet and the reference notch of sensor head come on the same side.

**CASE 1** Magnet is installed on the circumferential surface of rotating disk.

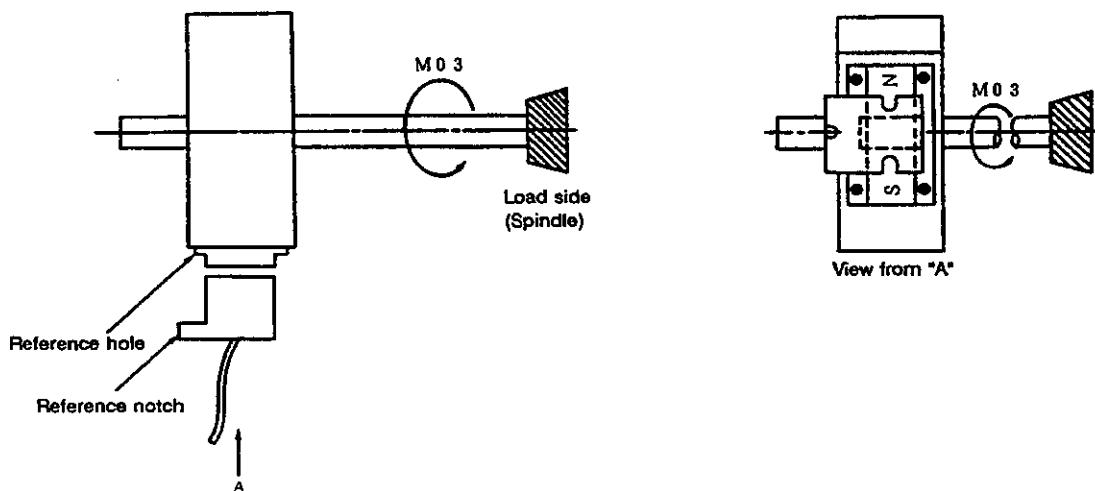


Fig. 7-1 Magnet installed on circumferential surface of rotating disk on shaft

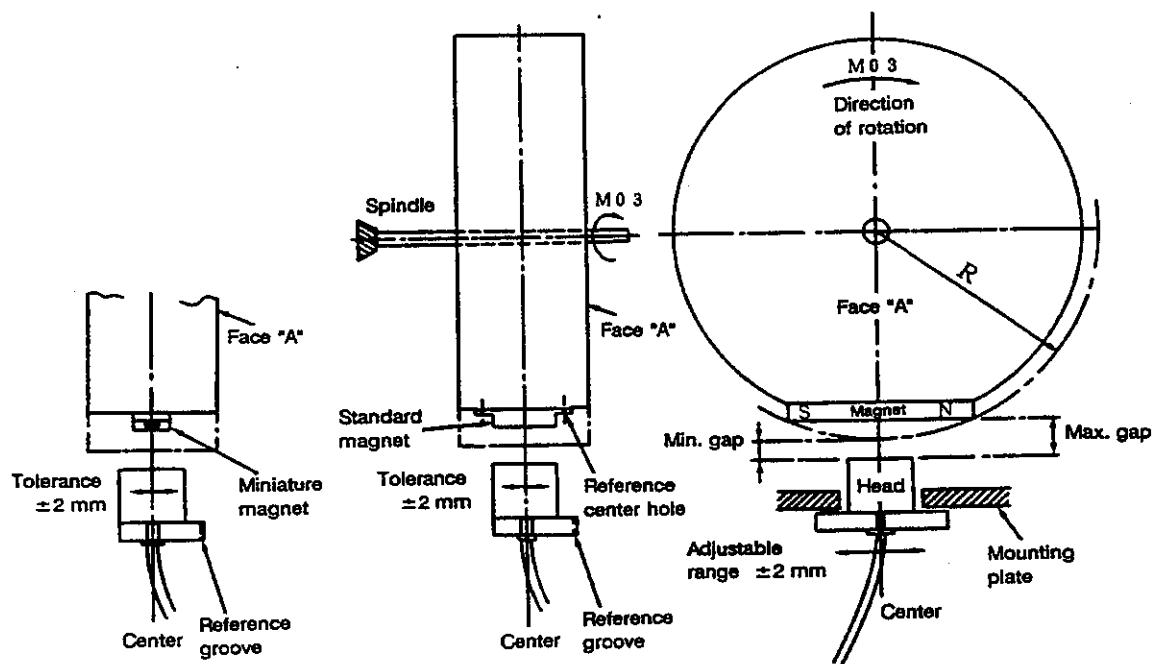
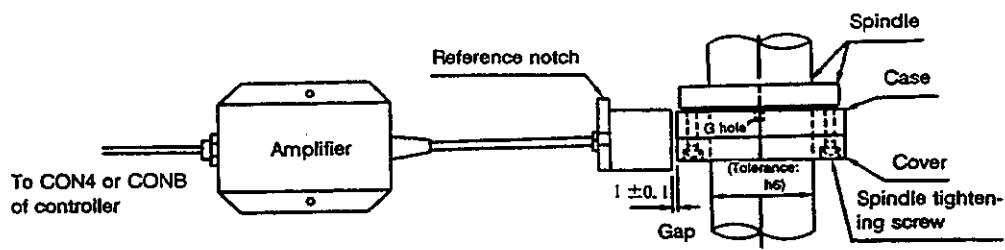


Fig. 7-2 Installation of detector

Table 7-1

Amplifier model	BKO-C1810 H01		BKO-C1730 H01			
Sensor model	BKO-C1810 H02		BKO-C1730 H02			
Magnet model	BKO-C1810 H03		BKO-C1730 H06		BKO-C1730 H09	
Max. speed	6000 rpm		12000 rpm		12000 rpm	
Radius R (mm)	Max. gap (mm)	Min. gap (mm)	Max. gap (mm)	Min. gap (mm)	Max. gap (mm)	Min. gap (mm)
40	11.5 ± 0.5	2.7 ± 0.5	10 ± 0.5	1.22 ± 0.5	6.25 ± 0.5	3.3 ± 0.5
50	9.5 ± 0.5	2.8 ± 0.5	8 ± 0.5	1.31 ± 0.5	6.0 ± 0.5	3.7 ± 0.5
60	8.5 ± 0.5	3.0 ± 0.5	7 ± 0.5	1.5 ± 0.5	5.75 ± 0.5	3.85 ± 0.5
70	8.0 ± 0.5	3.4 ± 0.5	7 ± 0.5	2.38 ± 0.5	5.5 ± 0.5	3.87 ± 0.5



For ring magnet BKO-C1730 H11, H12, H13 and H14, the gap should be 1 mm.

**CASE 2** Magnet is installed on the front or back flat surface of rotating disk.

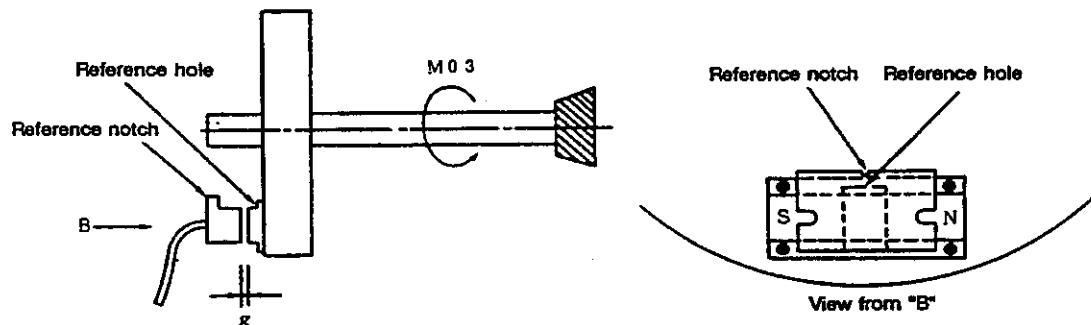


Fig. 7-3

Table 7-2

Amplifier model	BKO-C1810 H01	BKO-C1730 H01	
Sensor model	BKO-C1810 H02	BKO-C1730 H02	
Magnet model	BKO-C1810 H03	BKO-C1730 H06	
Max. speed	6000 rpm	12000 rpm	
Radius R (mm)	Gap g (mm)	Gap g (mm)	
40	$6 \pm 0.5$	$5 \pm 0.5$	
50			
60			

### 7.1.3 Caution on installation of magnet

When the magnet is installed to the spindle, pay attention to the following:

- (1) Do not place an intense magnetic source near the magnet.
- (2) Carefully handle the magnet, avoiding mechanical shock to the magnet.
- (3) Secure the magnet to the spindle with M4 screws.
- (4) After the magnet is installed, balance the entire spindle.
- (5) Align the center of the magnet with the center line of the rotating disk on the spindle.
- (6) Keep the magnet and its peripheral clean and free from iron particles (iron particles may cause malfunction).
- (7) Apply lock paint, or other suitable means, to prevent mounting screws from becoming loose.
- (8) If the magnet is installed on a ground rotating disk, demagnetize the disk.
- (9) Diameter of rotating disk on which the magnet is installed should be within the range from 80 mm to 120 mm.  
When spindle speed is low, use a rotating disk of larger diameter.
- (10) If speed of the spindle exceeds 6000 rpm, use a high-speed type magnet (applicable up to 12000 rpm of speed). If speed exceeds 12000 rpm, use a ring type magnet.

### 7.1.4 Caution on installation of sensor

When the sensor is installed, pay attention to the following:

- (1) Install the sensor head so that its reference notch and the reference hole of magnet come on the same side.  
For miniature magnet and ring type magnet, N and S should be positioned as shown in Fig. 7-1 and 7-3.
- (2) The center line of sensor head should be in line with the center of magnet (Fig. 7-2).
- (3) Gap between the magnet and the sensor head should be as indicated in Table 7-1 for **CASE 1** (Fig. 7-1), and as indicated in Table 7-2 for **CASE 2** (Fig. 7-3).  
\* It is recommended that a jig be fabricated for mass production.
- (4) Connector used in amplifier  
BKO-C1810 ..... Oil proof-type  
BKO-C1730 ..... Not oil proof-type  
Install both in a position where as little oil as possible will get on them.
- (5) The cable between the amplifier and the controller should be laid down apart from high-voltage cables.
- (6) Check the connector wiring, securely engage the connector and tighten connector lock screws.

### 7.1.5 Types and outside dimensions of magnesensor

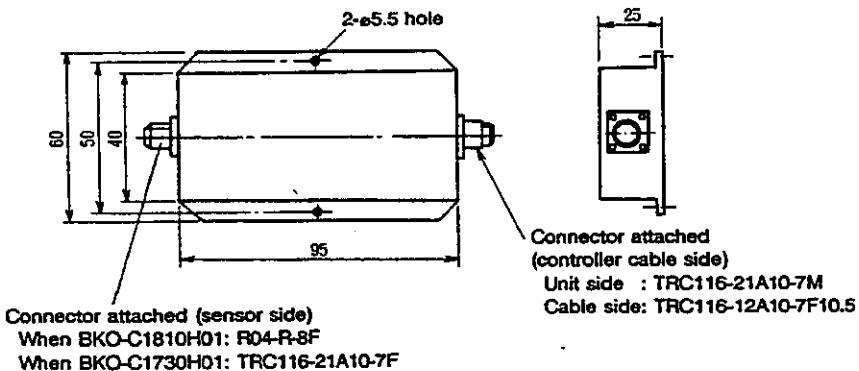
For orientation, the following combinations of amplifier, sensor and magnet are available.

Type	Permissible speed [rpm]	Model	Combination		
			Amplifier	Sensor head	Magnet
Standard	0 ~ 6000	MAGNESENSOR BKO-C1810H01-3	H01	H02	H03
High speed standard	0 ~ 12000	MAGNESENSOR BKO-C1730H01.2.6	H01	H02	H06
High speed miniature	0 ~ 12000	MAGNESENSOR BKO-C1730H01.2.9	H01	H02	H09
High speed ring	0 ~ 25000	MAGNESENSOR BKO-C1730H01.2.11	H01	H02	H11
High speed ring	0 ~ 30000	MAGNESENSOR BKO-C1730H01.2.12	H01	H02	H12
High speed ring	0 ~ 30000	MAGNESENSOR BKO-C1730H01.2.13	H01	H02	H13
High speed ring	0 ~ 30000	MAGNESENSOR BKO-C1730H01.2.14	H01	H02	H14

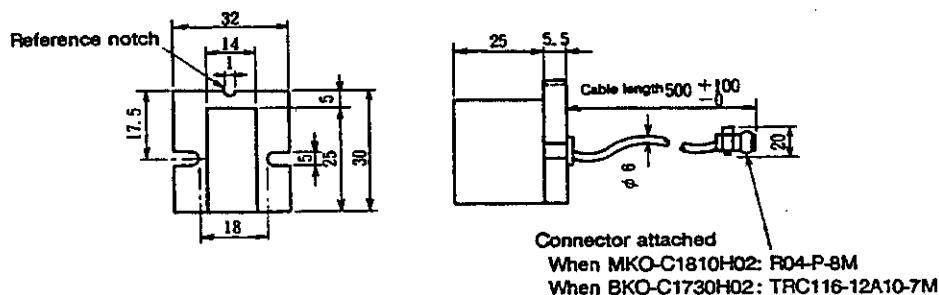
(Note) Combination of amplifier, sensor and magnet is possible within the same model group (C1810 or C1730).

#### Outside dimensions:

- Amplifier H01



- Sensor H02



## • Magnet

Part No.	Permissible speed [rpm]	Outside view											
H03	0 ~ 6000												
H06	0 ~ 12000												
H09	0 ~ 12000												
H11	0 ~ 25000												
H12	0 ~ 25000												
H13	0 ~ 30000												
H14	0 ~ 30000												

**Dimensions**

Magnet	A	B	C	D	E	F	G	H	J x X	L	Weight(g)
BKO-C1730 H11	105	70H7 <sup>+0.030</sup> <sub>-0</sub>	90	28	19	M6 x 1.0	5	90	70 x 79	1	1024 ± 4
BKO-C1730 H12	94	60H7 <sup>+0.030</sup> <sub>-0</sub>	79	25	17	M5 x 0.8	5	79	60 x 68	1	768 ± 4
BKO-C1730 H13	78	50H7 <sup>+0.025</sup> <sub>-0</sub>	66	23	15	M5 x 0.8	5	66	50 x 57	1	478 ± 4
BKO-C1730 H14	66	40H7 <sup>+0.025</sup> <sub>-0</sub>	54	20	13	M4 x 0.7	5	54	40 x 45	1	322 ± 4

Unit: mm

**Caution on Installation of H11 ~ H14**

- 1. Tolerance to shaft dimension should be  $\text{H}8^{\circ}$ .
- 2. 2-eG holes can be used for positioning of spindle and magnet.
- 3. Magnet shall be installed as shown to the left.
- 4. Misalignment between sensor head and magnet center line shall be within  $\pm 2 \text{ mm}$ .
- 5. The NS display is on the side of the cover. Reference notch of sensor head shall come on the case side.

**Installation of magnet**

## 7.2 Encoder Type 4096-point Orientation

### 7.2.1 Connection

For connection of the encoder to the spindle controller, refer to "5. Connection".

### 7.2.2 Installation

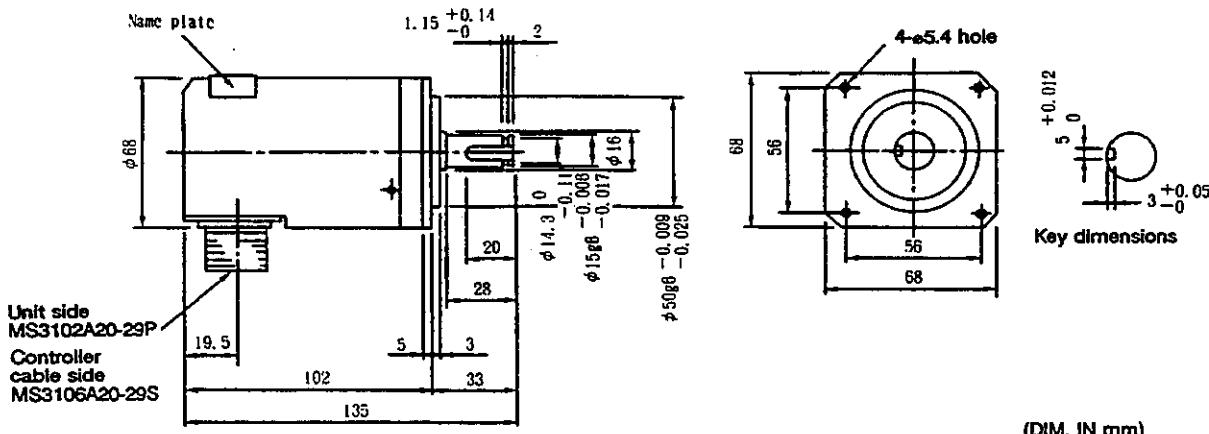
The encoder should be used in the environment under the conditions listed below.

Conditions	
Ambient temperature	-5°C to 55°C
Ambient humidity	
Permissible load (Axial)	Max. 5 kg
(Radial)	Max. 10 kg
Permissible speed	Max. 6000 rpm

### 7.2.3 Components (options)

#### Encoder (1024 P/rev)

Encoder model	Permissible speed (rpm)
RFH-1024-22-1M-68	6000
RFH-1024-22-1M-68-8	8000



(DIM. IN mm)

A	1chA	K	OV
B	2chZ	L	
C	1chB	M	
D		N	1chA
E	Case earth	P	2chZ
F		R	1chB
G		S	
H	+5V	T	
J			

### 7.3 Motor Built-in Encoder Type 4096-point Orientation Function

Z-phase controlled motor built-in encoder is required (refer to 1.2)

This type of orientation function is applicable to a motor directly coupled to spindle (1:1 timing belt connection is permissible).

#### 7.3.1 Connection

For connection, refer to "5. Connection".

#### 7.3.2 Installation

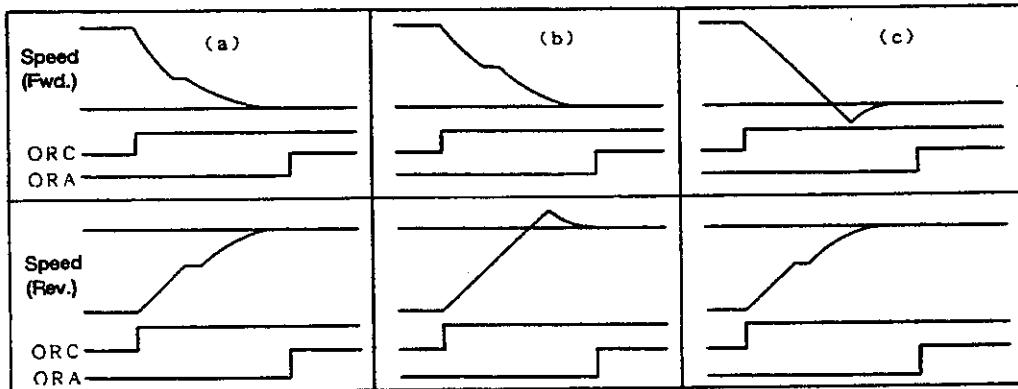
Since encoder is built in to the motor, installation of position detector is not required.

## 7.4 Operation of Orientation Function

### 7.4.1 Operation modes

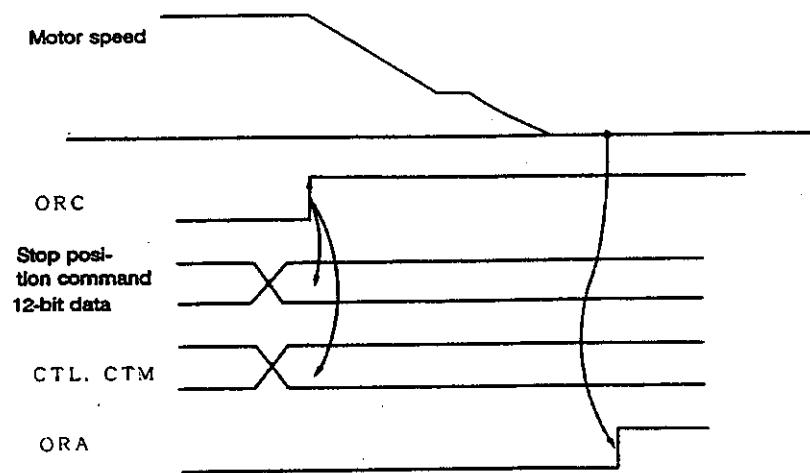
There are three modes of orientation stop. The desired mode can be selected by setting parameter ORS2.

1. PRE : (a) Spindle approaches the stop position in the direction of on-going rotation.
2. Forward orientation : (b) Spindle approaches the stop position in forward direction of rotation, regardless of on-going rotation direction.
3. Reverse orientation : (c) Spindle approaches the stop position in the reverse direction of rotation, regardless of on-going rotation direction.



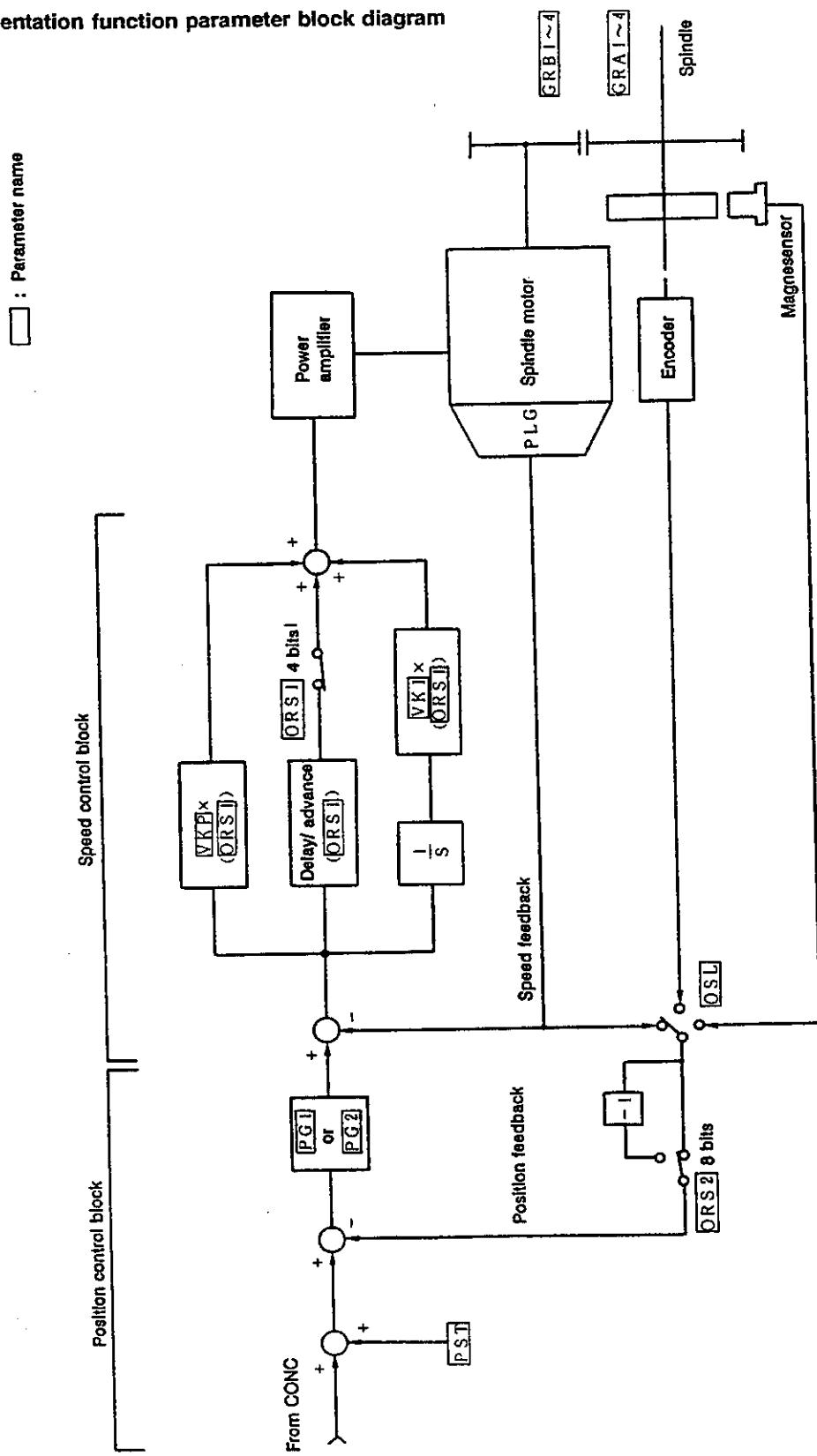
### 7.4.2 Operation sequence

- (1) When oriented command ORC is given, motor speed changes from the steady run speed to "positioning speed" and at the same time the specified spindle stop position is read.
- (2) When motor speed reaches the specified positioning speed, control mode changes from speed control to positioning control (position control loop gain parameter<sup>Note 1)</sup>).  
(Positioning speed is automatically set when position loop gain is specified by parameter.)
- (3) When control mode changes, distance to the stop position is calculated and the motor is decelerated in the pattern (specified by parameter CSP).
- (4) When the spindle enters the in-position range (set by parameter ZRZ), "oriented complete (in-position)" ORA turns on.
- (5) The stop position can be shifted by setting parameter PST.
- (6) When oriented command (ORC) is removed, the motor is accelerated to the previously specified steady run speed.



(Note 1) PG1 is used for magnesensor, and PG2 used for motor built-in encoder.

7.4.3 Orientation function parameter block diagram



## **CHAPTER 8    SYNC. TAP FUNCTION (OPTION)**

## 8. Sync. TAP Function (Option)

The sync. TAP function can be used by connecting spindle controller FR-SGJ (to be equipped with option card SGJ-OR) to the M300, M3/L3 series CNC.

There are two types of sync. TAP

1. Closed type sync. TAP
2. Semi-closed type sync. TAP

### 8.1 Closed type sync. TAP

A closed control loop can be made with position signal from an encoder installed on spindle.

#### 8.1.1 Connection

For connection of encoder to the spindle controller, refer to "5. Connection".

#### 8.1.2 Installation of encoder

For installation of encoder, refer to the description related to encoder type oriented function.

### 8.2 Semi-closed Type Sync. TAP

A position loop can be made with signal from motor built-in encoder (no special position detector is required).

This type of sync. TAP is applicable only when the spindle is coupled to the motor shaft directly or through gears.

(When V-belt or timing belt connection is used, closed type sync. TAP is applicable.)

It is also applicable to standard motor having no Z-phase control.

#### 8.2.1 Connection

No additional connection is required for sync. TAP function.

### 8.3 Operation of Sync. TAP Function

One of sync. TAP operation modes can be selected by parameter TYP.

- (1) Sync. TAP starts after return to the zero position (parameter TYP is set to "0").
- (2) Sync. TAP starts after deceleration and stop (parameter TYP is set to "1").

The operation of sync. TAP function is conditioned as shown below.

O ... Available    x ... Not available

	Without orientation	Magnesensor orientation	Encoder orientation	Motor built-in encoder orientation
Sync. TAP after zero return	x	O	O	O
Sync. TAP after decel. and stop.	O	O	O	O

## **CHAPTER 9 OTHER OPTION SPECIFICATIONS**

## 9. Other Option Specifications

Please refer to the option specifications listed for each machine below for details on option specifications not described in this manual.

	Option specifications title	Specifications No.
①	FR-SGJ Spindle index function option specifications	BNP-A2956-21
②	FR-SGJ Synchronous spindle function option specifications	BNP-A2956-22
③	FR-SGJ 1 amp 2 motor selection function option specifications	BNP-A2956-23
④	FR-SGJ S-analog high speed tap function option specifications	BNP-A2956-24

## **CHAPTER 10 DISCRETE COMPONENTS AND DEVICES**

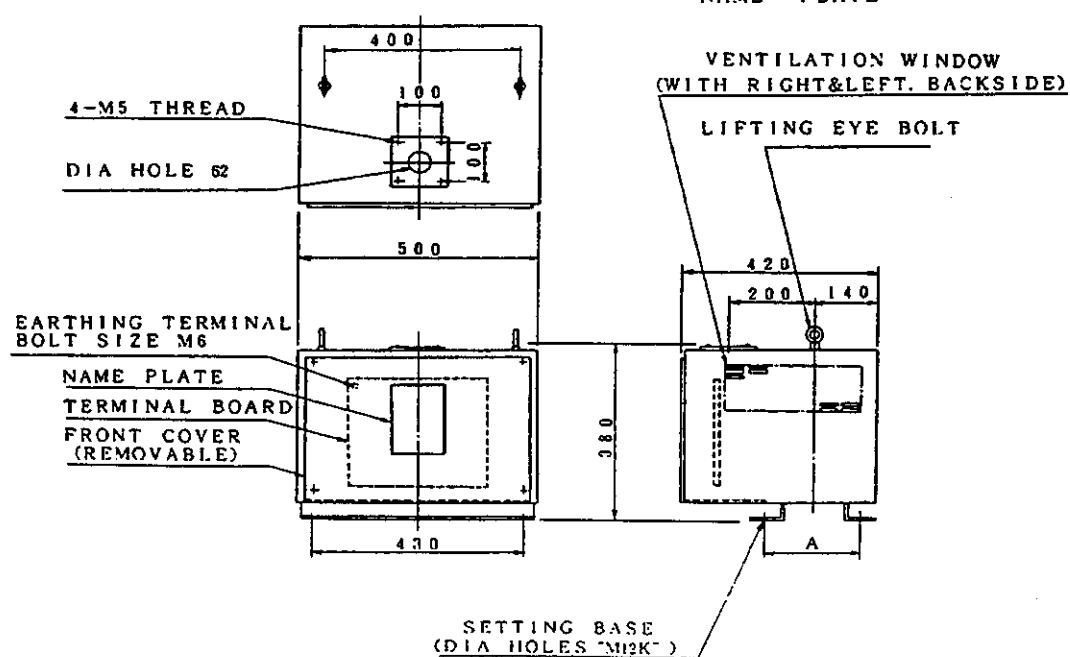
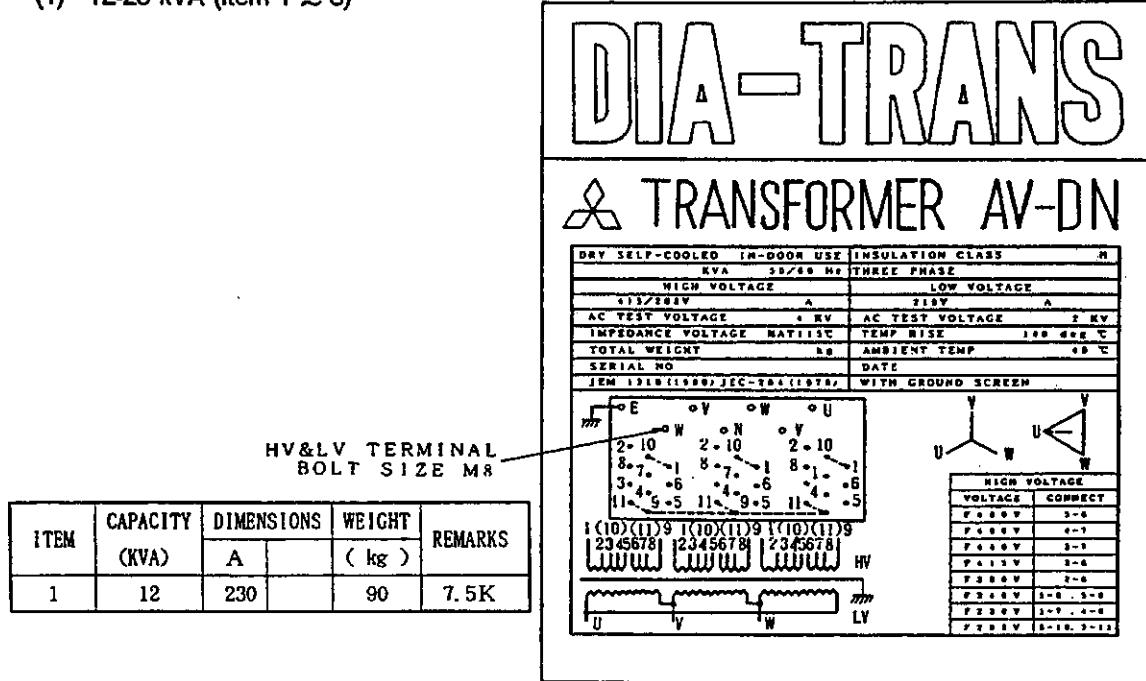
## 10. Discrete Components and Devices

### 10.1 Options

#### 10.1.1 Power transformer

When available power supply is 400V, use this optional transformer.

(1) 12-23 kVA (Item 1 ~ 3)



### 10.1.2 Noise filter

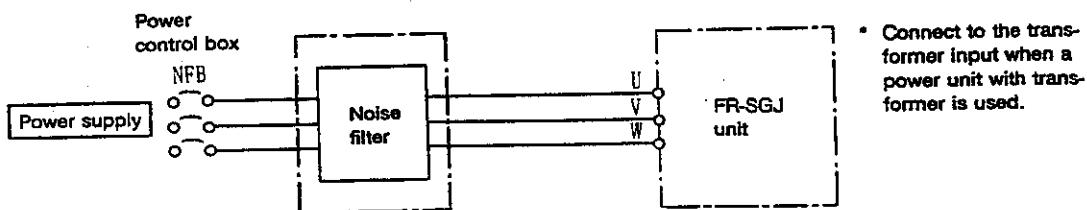
#### (1) Selection

When radio noise needs to be decreased select a noise filter from the chart below according to the unit type.

FR-SFJ-2-	Noise filter model (made by Tohoku Metal)
0.75K	LF-310
1.5K	LF-315
2.2K	LF-320
3.7K	LF-330
5.5K	LF-340
7.5K	LF-350

#### (2) Noise filter installation position

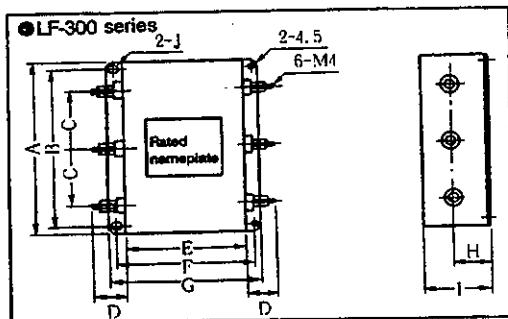
Insert into the unit input.



#### (3) Specifications

Part name	Rated voltage AC, DC (V)	Rated current AC, DC (A)	Test voltage AC 1 minute (V) between case terminal	Insulated resistance (MΩ) 500 VDC	Leakage current (mA) 250V 60Hz	Application temperature (°C)
LF-310	250	10	1500	> 300	< 1	-20 ~ + 55
LF-315	250	15	1500	> 300	< 1	-20 ~ + 55
LF-320	250	20	1500	> 300	< 1	-20 ~ + 55
LF-330	250	30	1500	> 300	< 1	-20 ~ + 55
LF-340	250	40	1500	> 300	< 1	-20 ~ + 45
LF-350	250	50	1500	> 300	< 1	-20 ~ + 45

**(4) Outline drawing/dimensions**



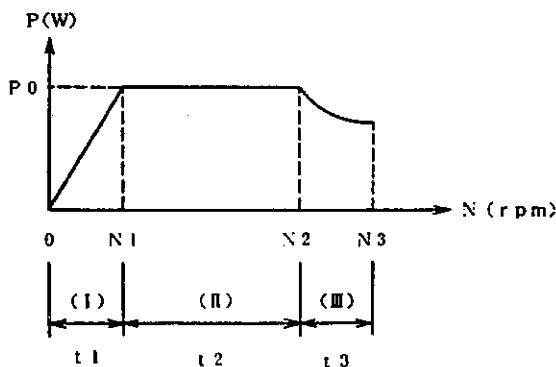
Part name	A	B	C	D	E	F	G	H	I	J
LF-310	180	170	60	25	120	135	150	35	65	4.5 x 7
LF-315	180	170	60	25	120	135	150	35	65	4.5 x 7
LF-320	180	170	60	29	120	135	150	35	65	6.5 x 9
LF-330	180	170	60	29	120	135	150	35	65	6.5 x 9
LF-340	180	160	50	30	200	220	240	40	80	6.5 x 9
LF-350	180	160	50	30	200	220	240	40	80	6.5 x 9

**APPENDIX THEORETICAL ACCELERATION AND  
DECELERATION TIMES**

## APPENDIX Theoretical Acceleration and Deceleration Times

In the calculation described below, the load torque is assumed to be zero. Therefore, acceleration and deceleration times determined here somewhat differ from actual acceleration and deceleration times.

### (1) Definition



(Notes) 1. "Po" is (Rated power  $\times$  1.2).

Ex.: For spindle of 2.2/3.7kW,

$$Po = 3700 \times 1.2 = 4440(\text{W})$$

2.  $GD^2 = (\text{Motor } GD_M^2) + (\text{GD}_L^2 \text{ converted into load to motor shaft})(\text{kg}\cdot\text{m}^2)$

### (2) Acceleration/deceleration time "t"

#### 1) Constant torque zone

$$t_1 = \frac{1.03 \times GD^2 \times N_1^2}{375 \times Po} \text{ (sec)}$$

#### 2) Constant output (power) zone

$$t_2 = \frac{1.03 \times GD^2 \times (N_2^2 - N_1^2)}{2 \times 375 \times Po} \text{ (sec)}$$

#### 3) Step-down output zone

$$t_3 = \frac{1.03 \times GD^2 \times (N_3^3 - N_2^3)}{3 \times 375 \times Po \times N_2} \text{ (sec)}$$

Therefore accel/decel. time (0  $\rightarrow$  N<sub>3</sub>) is,  $t = t_1 + t_2 + t_3$  (sec)

Ex.:  $GD_L^2 = 0.123 \text{ kgm}^2$ , motor SJ-J3.7A

From specification  $GD_M^2 = 0.021 \text{ kgm}^2$  thus,  $GD^2 = 0.021 + 0.123 = 0.144 \text{ kgm}^2$

$$t_1 = \frac{1.03 \times 0.144 \times 1500^2}{375 \times 3700 \times 1.2} = 0.200 \text{ (sec)}$$

$$t_2 = \frac{1.03 \times 0.144 \times (6000^2 - 1500^2)}{2 \times 375 \times 3700 \times 1.2} = 1.503 \text{ (sec)}$$

$$t_3 = \frac{1.03 \times 0.144 \times (8000^3 - 6000^3)}{3 \times 375 \times 3700 \times 1.2 \times 6000} = 1.465$$

Accel./decel. time for 0  $\rightarrow$  8000 rpm  $t = 0.200 + 1.503 + 1.465 = 3.168 \text{ (sec)}$

**Appendix THEORETICAL ACCELERATION AND  
DECELERATION TIMES**

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Unit conversion

- Forth : 1 kgf = 9.8N  
Torque : 1 kgm = 9.8Nm =  $10^2$ kgcm  
Speed : 1 rpm =  $\frac{2\pi}{60}$  rad/s  
Output (power) : 1 kW = 1/1.3596 HP

Formula:

$$P = \omega T_o = (2\pi \frac{N}{60}) \times 9.8T$$

- Where P : Output [W]  
 $\omega$  : Angular velocity [rad/s]  
 $T_o$  : Torque [N-m]  
N : Speed [rpm]  
T : Torque [kgm]

**MITSUBISHI**  
AC SPINDLE DRIVE  
**FREQUOR-SGJ**

### Order list

1. Order Article	
Item	Name
01	Comis
02	Resis
03	Mag
03	Encor
05	Moto
06	Sparre
07	Tecmabrate

**Cautions for filling up order list**

1. For detailed specifications of each item refer to the right hand "Standard specifications" table.
2. Make entries according to the functions for each unit.
3. Enter data into area specified for each data item. Lines X, math., number or symbol for recesses.
4. The items must be filled up for the initial value.
5. When no data are entered, the standard specifications of our company (indicated by a bold line) are applied.
6. The items other than those entered will be treated as standard specifications. Therefore, specify them in item 10 "Special items".

Order Article

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**Cautions for filling up order list**

1. For detailed specifications of each item refer to the right hand "Standard specifications" table
2. Make entries according to the functions for each unit
3. Enter data into area specified for each date item later X must, number or symbol for necessary
4. The items marked with an asterisk items 1, 2, 4 & 5 must be filled up for the initial order.
5. When no date is entered, the standard specifications of our company indicated by a bold frame
6. The items other than those entered will be treated as standard specifications. Therefore, for

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Torque limit		Speed limit		Emergency Stop limit		Emergency Stop limit	
Specified	%	Specified	%	Specified	%	Specified	%
Specified range (% of max speed)	2%	Specified range (% of max torque)	30%	Specified range (% of max torque)	10%	Specified range (% of max torque)	50%
Emergency Stop limit range (% of max speed)	5%	Emergency Stop limit range (% of max torque)	40%	Emergency Stop limit range (% of max torque)	20%	Emergency Stop limit range (% of max torque)	50%
Emergency Stop limit range (% of max torque)	5%	Emergency Stop limit range (% of max torque)	40%	Emergency Stop limit range (% of max torque)	20%	Emergency Stop limit range (% of max torque)	50%

\* Option

M&G sensor orientation (1 point)

Encoder (1024-pulse) multipoint orientation

Encoder (1024-pulse) multipoint indexing orientation

Encoder built into motor/multipoint orientation

Encoder built into motor/multipoint indexing orientation

Encoder built into motor.

F	S	SPW/rev
F	S	SPW/rev

F: Forward, S: Reverse (with the two series totaling to sum 1)

Direction & Enhancement & Power IC & Position instruction

M300, M32/L3 Baseline connection

M300, M32/L3 Baseline connection (100% pulse speed step by step)

M300, M32/L3 Baseline connection (100% pulse speed step by step)

For other specifications, please refer to item 10 Spec of Features