FANUC

GE Fanuc Automation

Computer Numerical Control Products

Built-in AC Spindle Motor

Descriptions Manual

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Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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CONTENTS

1. GENERAL

This manual explains the built-in AC spindle motor series and AC spindle servo units.
This manual handles all aspects of the built-in motors, and covers the models listed below.

Series	Model
FANUC BUILT-IN AC SPINDLE MOTOR series Standard series	B0.3, B0.5, B1, B1.5, B2, B6, B8, B15, B30, B40
FANUC BUILT-IN AC SPINDLE MOTOR series Speed range switching series	B2, B3, B8, B10, B17, B26, B28, B35, B45, B50

This manual is divided into the following chapters to explain the built-in motors and servo units:

Chapter I	Built-in AC spindle motor series
Chapter II	Reference assembly diagrams
Chapter III	Notes
Chapter IV	AC spindle servo unit serial interface S series
Chapter V	Load meter
Chapter VI	Signal conversion circuit
Chapter VII	High-resolution magnetic pulse coder
Chapter VIII	Speed range switching control
Chapter IX	Speed range switching unit
Chapter X	Thermal data
Chapter XI	Order specification drawing numbers for built-in motors
Chapter XII	Driving the spindle motors by the serial spindle amplifier without using the CNC
Chapter XIII	Troubleshooting and corrective action (serial interface series)
Chapter XIV	Serial interface parameter list
Chapter XV	Appendixes

2. SELECTING A MOTOR

The method of selecting a motor is explained below, using Model B2 as an example.

2.1 Selection Based on Output Characteristics

① Select a desired output characteristic (Fig. 1).
Here, the following are selected:
Model: B2
Output type: L120
The output type number is a unique drawing number assigned to the output characteristic, and matches the lower four digits of the parameter drawing number.

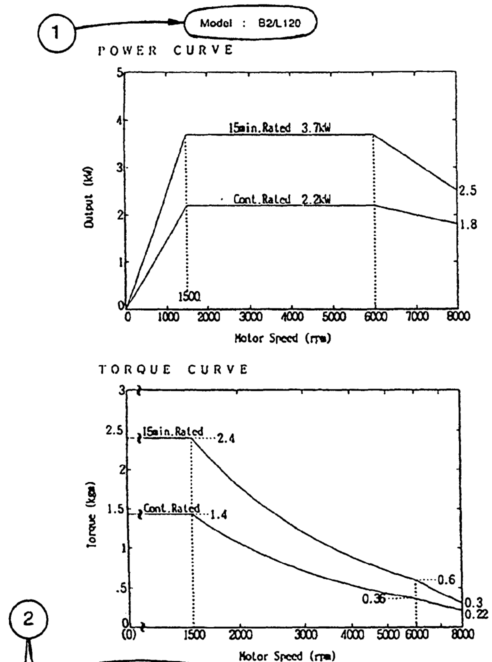
② Check the outside dimensions of the rotor and stator, then select those that can satisfy the required conditions.
Fig. 1 indicates that two types of rotors satisfy the output characteristic. Use the respective drawing numbers (Fig. 2) to determine which type of rotor to use. Select the rotor with a sleeve (A290-0922-T202). The drawing number of the stator is A290-0922-T113.

③ Determine the amplifier.
The amplifier can be determined from the model and output type. From Fig. 3, the drawing number of the amplifier is A06B-6064-H302#550.

④ Select a sensor.
A sensor is to be selected from the model with the rotor drawing number T202 and the output type L120 in Fig. 3. A sensor can be chosen from three types. In this example, a high-resolution magnetic pulse coder is selected (Fig. 3).

⑤ Determine the motor specification drawing number (ordering drawing number).
From ① to ④, the motor drawing number is determined to be A06B-0922-B341.

⑥ Thus, the selection is completed as follows:
Motor drawing number: A06B-0922-B341
Amplifier drawing number: A06B-6064-H302#H550
Parameter drawing number: A06B-6064-L120
These three drawing numbers are always required for ordering. For detailed information about ordering, see Chapter XI.

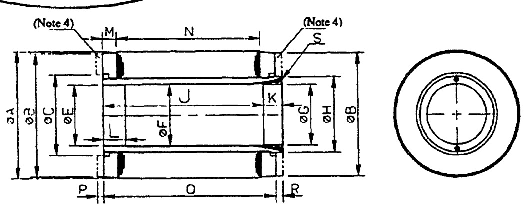


Corresponding rotor drawing No.
A290-0922-T202 A290-0922-T211

Corresponding stator drawing No.
A290-0922-T113

Fig. 1 Output Characteristics

Model: B2
Rotor No.: A290-0922-T202
Output type: L120, L515



Model	B2		
A (Note 1)	<100>		
B	96		
C	57		
D (Note 2)			
E (Note 2)	44.86 ± 0.05 (45.16 ± 0.008)		
F	46		
G (Note 2)	44.66 ± 0.05 (44.96 ± 0.008)		
H	61		
I		N	108
J	117.2 ± 0.2	P	8
K	17 ± 0.1	Q	134
L	17 ± 0.1	R	8
M	13	S	M4 × P0.5

Fig. 2 Rotor Dimensions

BUILT-IN MOTOR COMBINATIONS

Model	Motor specification drwaing No.(*4) A06B-	Output switching	Rotor		Stator drawing No.	Sensor(*3)								Amplifier specification drawing No. A06B-6064	Output type
			Draw-ing No.	Shape (*1)		Built-in				High-resolution magnetic					Parameter specification drawing No. (*2) A06B-6064
						1	2	3	4	1	2	3	4		
B0.3	0953-B612	—	T211	1	T113		○							H301#H550	L127
B0.5	0955-B612	—	T211	1	T113		○							H301#H550	L113
	0955-B612	—	T211	1	T113		○							H302#H550	L128
B1	0921-B312	—	T201	2	T113		○							H301#H550	L129
	0921-B612	—	T211	1	T113		○							H301#H550	L129
B1.5	0951-B312	—	T202	2	T113		○							H302#H550	L130
	0951-B612	—	T211	1	T113		○							H302#H550	Under development
B2	0922-B312	—	T202	2	T113		○							H302#H550	L120
	0922-B612	—	T211	1	T113		○							H302#H550	L120
	0922-B311	—	T202	2	T113	○								H302#H550	L120
	0922-B611	—	T211	1	T113	○								H302#H550	L120
	0922-B641	—	T211	1	T113					○				H302#H550	L120
	0922-B341	—	T202	2	T113					○				H302#H550	L120
	0922-B907	Provided	T202	2	T198									H306#H550	L516
B2(8)	0982-B611	Provided	T211	1	T113	○								H306#H550	L516
	0982-B642	Provided	T211	1	T113						○			H306#H550	L516
B3	0923-B311	Provided	T202	2	T113	○								H306#H550	L517
	0923-B312	Provided	T202	2	T113		○							H306#H550	L517
B6	0926-B311	—	T201	2	T113	○								H306#H550	L131
	0926-B311	—	T201	2	T113	○								H308#H550	L132
	0926-B711	—	T211	1	T113	○								H306#H55	L131
	0926-B711	—	T211	1											
	0926-B341	—													

3

Model L120

4

Selectable from 3 types

5

This model satisfies all the required conditions.

Fig. 3 Built-in Motor Combinations

2.2 Selection Based on Outside Dimensions

① Select a desired rotor and stator based on the outside dimensions.
A rotor and stator with the same output type can be combined with each other. A rotor with an output type cannot be combined with a stator with a different output type.
In this example, the following choice is made:
Model: B2
Rotor: A290-0922-T202 with an output type of L120
Stator: A290-0922-T113 with an output type of L120
(Fig. 1, Fig. 2)

② Check the output characteristic from the output type.
The figure showing the output characteristics can be found from the output type L120 (Fig. 3). The output type number is a unique drawing number assigned to the output characteristic, and matches the lower four digits of the parameter drawing number (Fig. 4).

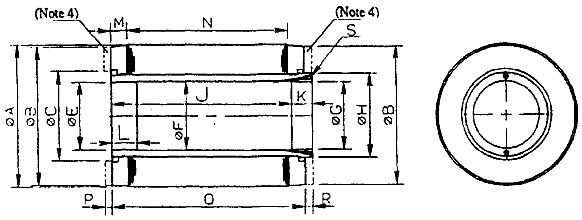
③ Determine the amplifier.
From the model and output type, the amplifier can be determined. From Fig. 2.2 (d), the drawing number of the amplifier is A06B-6064-H302#550.

④ Select a sensor.
A sensor is to be selected from the model with the rotor drawing number T202 and the output type L120 in Fig. 4. A sensor can be chosen from three types. In this example, a high-resolution magnetic pulse coder is selected.

⑤ Determine the motor specification drawing number (ordering drawing number).
From ① to ④, the motor drawing number is determined to be A06B-0922-B341.

⑥ Thus, the selection is completed as follows:
Motor drawing number: A06B-0922-B341
Amplifier drawing number: A06B-6064-H302#H550
Parameter drawing number: A06B-6064-L120
These three drawing numbers are always required for ordering. For detailed information about ordering, see Chapter XI.

Model: B2
Rotor No.: A290-0922-T202
Output type: L120, L515

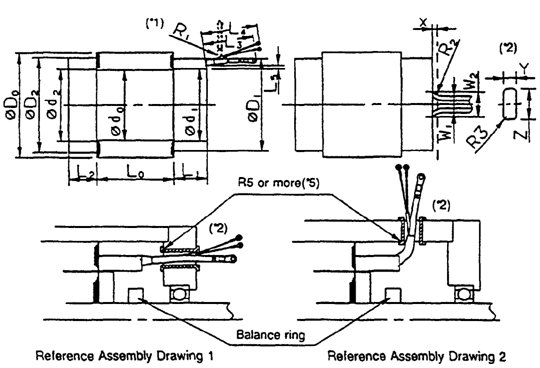


Model	B2		
A (Note 1)	<100>		
B	96		
C	57		
D (Note 2)			
E (Note 2)	44.86 ± 0.05 (45.16 ± 0.008)		
F	46		
G (Note 2)	44.66 ± 0.05 (44.96 ± 0.008)		
H	61		
I		N	108
J	117.2 ± 0.2	P	8
K	17 ± 0.1	Q	134
L	17 ± 0.1	R	8
M	13	S	M4 × P0.5

Fig. 1 Rotor Dimensions

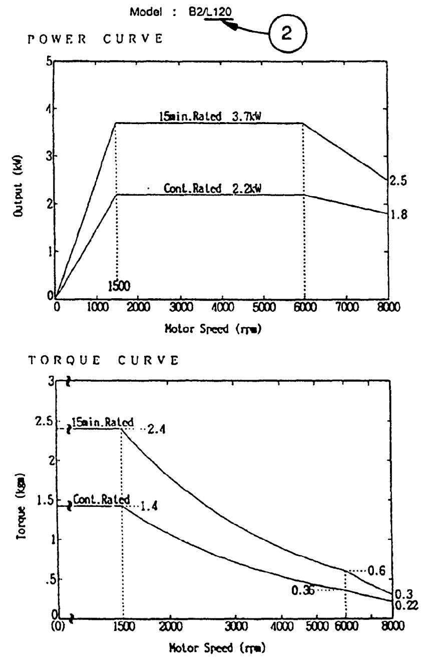
6. **STATOR EXTERNAL DIMENSIONS**

6.1 **Standard**



Model	B0.3	B0.5	B1	B1.5	B2	B6	B6	B8	B15
Stator drawing No. (A290-)	0953-T113	0955-T113	0921-T113	0951-T113	0922-[illegible]	0926-T113	0926-T114	0958-T113	0935-T113
Output type	L127	L113 L128	L129	L130	L120	L131 L132	L133	L134	L135
D_0(*3)	88±0.01	88±0.01	120±0.01	120±0.01	150±0.01	180±0.01	180±0.01	180±0.01	240±0.01
L_0	67	108	120	170	110	180	180	226	182
d_0	(49)	(49)	(75)	(75)	(100)	(115)	(115)	(115)	(160)
D_1	84 +0	84 +0	112 +0	112 +0	142 +0	167 +0	167 +0	167 +0	216 +0
D_2	84 +0	84 +0	112 +0	112 +0	142 +0	167 +0	167 +0	167 +0	216 +0
d_1	50 -0	50 -0	76 -0	76 -0	101 -0	118 -0	118 -0	118 -0	163 -0
d_2	50 -0	50 -0	76 -0	76 -0	101 -0	118 -0	118 -0	118 -0	163 -0
L_1	32 +0	34 +0	38 +0	38 +0	44 +0	57 +0	62 +0	57 +0	69 +0
L_2	25 +0	32 +0	35 +0	35 +0	42 +0	52 +0	52 +0	52 +0	58 +0
L_3, L_4(*4)	1000	1000	1000	2000	2000	2000	2000	2000	2000
Power line cross-sectional area (mm^2)	2.0	2.0	2.0	2.0	2.0	5.5	3.5	3.5	5.5

Fig. 2 Stator Dimensions



Corresponding rotor drawing No.
A290-0922-T202 A290-0922-T211

Corresponding stator drawing No.
A290-0922-T113

Fig. 3 Output Characteristics

BUILT-IN MOTOR COMBINATIONS

3

Model	Motor specification drwaing No.(*4) A06B-	Output switching	Rotor Drawing No.	Rotor Shape (*1)	Stator drawing No.	Sensor(*3) Built-in 1	Built-in 2	Built-in 3	Built-in 4	High-resolution magnetic 1	High-resolution magnetic 2	High-resolution magnetic 3	High-resolution magnetic 4	Amplifier specification drawing No. A06B-6064	Output type: Parameter specification drawing No. (*2) A06B-6064
B0.3	0953-B612	—	T211	1	T113		○							H301#H550	L127
B0.5	0955-B612	—	T211	1	T113		○							H301#H550	L113
	0955-B612	—	T211	1	T113		○							H302#H550	L128
B1	0921-B312	—	T201	2	T113		○							H301#H550	L129
	0921-B612	—	T211	1	T113		○							H301#H550	L129
B1.5	0951-B312	—	T202	2	T113		○							H302#H550	L130
	0951-B612	—	T211	1	T113		○							H302#H550	Under development
B2	0922-B312	—	T202	2	T113		○							H302#H550	L120
	0922-B612	—	T211	1	T113		○							H302#H550	L120
	0922-B311	—	T202	2	T113	○								H302#H550	L120
	0922-B611	—	T211	1	T113	○								H302#H550	L120
	0922-B641	—	T211	1	T113					○				H302#H550	L120
	0922-B341	—	T202	2	T113					○				H302#H550	L120
	0922-B907	Provided	T202	2	T198									H306#H550	L515
B2(8)	0982-B611	Provided	T211	1	T113	○								H306#H550	L516
	0982-B642	Provided	T211	1	T113						○			H306#H550	L516
B3	0923-B311	Provided	T202	2	T113	○								H306#H550	L517
	0923-B312	Provided	T202	2	T113		○							H306#H550	L517
B6	0926-B311	—	T201	2	T113	○								H306#H550	L131
	0926-B311	—	T201	2	T113	○								H308#H550	L132
	0926-B711	—	T211	1	[illegible]										

5 4

Fig. 4 Built-in Motor Combinations

I. BUILT-IN AC SPINDLE MOTOR series

1. FEATURES

The FANUC Built-in AC Spindle Motor series has found many applications for machine use. Some of the superior features of this series, all based on technology accumulated by FANUC over the years, are as follows:

(1) For easy disassembling, the rotor is provided with a stepped sleeve. (This feature has been patented.)

(2) By employing a speed range switching system, sufficient power is output over a wide range without degrading the large torque needed in a low-speed area and without degrading the power needed in a high-speed area. (This feature has been patented.)

(3) By combining a motor and amplifier, the optimum torque/power is achieved.

(4) A wide variety of model configurations allow sizes and output characteristics to match any user requirements.

(5) A motor incorporated in the spindle has simplified the mechanical configuration to improve precision and reliability.

(6) Motors employing a high-resolution magnetic pulse coder are added to the lineup to match requirements for spindle synchronization, high-precision positioning, tapping, and C-axis contouring.

2. SPECIFICATIONS

2.1 Built-in Motors (Standard)

Item			Model	Standard series					
				B0.3	B0.5	B0.5	B1	B1.5	B2
Output type				L127	L113	L128	L129	L130	L120
Rated output (*1)	Low-speed winding	Continuous	kW						
		Short-time							
	High-speed winding	Continuous		0.55	0.65	1.1	1.5	1.1	2.2
		Short-time		0.75	1.10	1.5	2.2	3.7	3.7
Speed	Base speed (low-speed winding)	Continuous rating	min^{-1}	6000	3000	3000	3000	1500	1500
		Short-time rating							
		40% ED rating(*2)							
		25% ED rating							
	Switching speed								
	Maximum speed (high-speed winding)			6000	8000	12000	15000	8000	8000
Output torque Below the base speed	Low-speed winding	Continuous rating	Nm	0.88	2.07	3.50	4.78	7.00	14.0
		Short-time rating		1.19	3.50	4.78	6.96	23.5	23.5
		40% ED rating							
		25% ED rating							
	High-speed winding	Continuous rating							
		Short-time rating							
GD^2			kgm^2	0.0012	0.0019	0.0019	0.012	0.016	0.03
Rotor inertia			$kgcms^2$	0.0030	0.0048	0.0048	0.030	0.040	0.08
Weight	Rotor		kg	1	2	2	3	4	5
	Stator			2	4	4	6	9	11
Overload tolerance (1 minute)				120% of the short-time rating					
Insulation				Class F					
Ambient temperature				0 to 40°C					
Noise				75 dB					
Vibration (residual unbalance) (*3)			grcm	7					
Cooling capacity (*4)			kcal/h	Air-cooling at 30% of the short-time rating		750 (*6)	(*7) Air-cooling at 30% of the short-time rating		
Applicable spindle servo unit (serial)				1S	1S	2S	2S	2S	2S
30-minute rated power supply capacity			kVA	3	4	5	4	4	7
Maximum power supply capacity			kVA	4	5	6	5	5	9
Cs contour control option (*5)									○

Standard series						
B6	B6	B6	B8	B15	B40	B40
L131	L132	L133	L134	L135	Under development	L138
3.7	5.5	11	7.5	15	30	37
5.5	7.5	15	11	18.5	37	45
1100	1500	2500	1500	1020	1500	1500
10000	10000	15000	10000	6000	3000	3000
32.1	32.1	42.0	47.8	140	191	236
47.7	47.7	57.3	70.1	173	236	286
0.08	0.08	0.08	0.11	0.34	1.07	1.07
0.21	0.21	0.21	0.28	0.88	2.73	2.73
11	11	11	15	22	47	47
20	20	20	26	38	120	120
120% of the short-time rating						
Class F						
0 to 40°C						
75 dB						
7					10	
(*7) Air-cooling at 30% of the short-time rating		3000 (*6)	(*7) Air-cooling at 30% of the short-time rating		5000 (*6)	
6S	8S	22S	12S	22S	Under development	40S
9	12	22	17	26	54	63
12	21	29	22	32	65	76
O	O				O	O

*1 The rated output is guaranteed when a rated input voltage (200/220/230 VAC) is applied.
If an input power supply voltage fluctuates, the rated output may not be produced even if the fluctuation is within its allowable range.
For detailed information about the short-time rating, see the output characteristics of each model.

*2 The cycle time is 10 minutes. At 50% ED, the ON time is 5 minutes, and the OFF time is 5 minutes.

*3 A balance correction is made for a rotor with a sleeve. No balance correction is made for a rotor without a sleeve. See Section III.2.(4) for additional information.

*4 The motors are not equipped with a fan motor to cool the air.

*5 For the motors marked with O, additional models incorporating the optional Cs contour control are available.

*6 These motors must be liquid-cooled.

*7 These motors must be air-cooled.
For each motor, a cooling capacity of 30% or more of the short-time rating is required.
For information about a fan motor to cool the air, see Section II.1.1.

Note) For selecting a built-in sensor (for speed/position feedback) and high-speed magnetic pulse coder, see the table of built-in motor combinations given in this chapter.

Unit conversion (to the SI unit)
1 W = 8.600 × 10^{-1} kcal/h

2.2 Built-in Motors (Output Switching)

Item \ Model				Output switching series							
Item				B2(8)	B2	B3	B8	B8	B8	B10	B10
Output type				L516	L515	L517	L511	L519	L520	L521	L522
Rated output (*1)	Low-speed winding	Continuous	kW	2.2	2.2	3.7	5.5	5.5	15	5.5	5.5
		Short-time		3.7	3.7	5.5	7.5	9.0	18.5	7.5	7.5
	High-speed winding	Continuous		2.2	2.2	3.7	5.5	5.5	18.5	5.5	5.5
		Short-time		3.7	3.7	5.5	7.5	9.0	22	7.5	7.5
Speed	Base speed (low-speed winding)	Continuous rating	min^{-1}	1200	1200	1500	680	680	1500	520	450
		Short-time rating		1800	1200	1500	680		1500	520	520
		40% ED rating(*2)		1200	1000		530				450
		25% ED rating			850			500	1060		350
	Switching speed			1800	1500	4000	1600	1600	3500	1000	1000
	Maximum speed (high-speed winding)			4500	6000	15000	10000	12000	12000	8000	10000
Output torque Below the base speed	Low-speed winding	Continuous rating	Nm	17.5	17.5	23.6	77.4	77.4	95.5	101	117
		Short-time rating		19.6	29.4	35.0	106		118	138	138
		40% ED rating		35.3	35.3		135				159
		25% ED rating			41,5			172	167		205
	High-speed winding	Continuous rating		11.6	14.0	8.8	35.0	35.0	50.5	52.5	52.5
		Short-time rating		19.6	23.6	13.1	47.8	53.7	60.0	71.6	71.6
GD^2			kgm^2	0.03	0,03	0.06	0.11	0.11	0.11	0.14	0.14
Rotor inertia			$kgcms^2$	0.08	0.08	0.15	0.28	0.28	0.28	0.35	0.35
Weight	Rotor		kg	5	5	10	15	15	15	18	18
	Stator			11	11	21	26	26	26	31	31
Overload tolerance (1 minute)				120% of the short-time rating							
Insulation				Class F							
Ambient temperature				0 to 40°C							
Noise				75 dB							
Vibration (residual unbalance) (*3)			grcm	7							
Cooling capacity (*4)			kcal/h	3000	3000	4000	4000	4000	5000	4000	4000
Applicable spindle servo unit (serial)				6S	6S	6S	12S	15S	Small 30S	12S	15S
30-minute rated power supply capacity			kVA	7	9	9	12	12		12	12
Maximum power supply capacity			kVA	9	12	12	16	16		16	20
Cs contour control option (*5)				O							

Speed range switching series												
B12	B12	B17	B26	B26	B26	B26	B28	B28	B28	B35	B45	B50
L523	L524	L525	L526	L527	L528	L535	L529	L530	L531	L532	L533	L534
5.5	11	5.5	7.5	7.5	7.5	11	7.5	11	11	18.5	11	22
7.5	15	7.5	11	11	11	15	11	15	15	22	15	26
5.5	26	5.5	7.5	7.5	7,5	11	7.5	11	11	18.5	11	26
7.5	30	7.5	11	11	11	15	11	15	15	22	15	30
450	1000	330	550	360	360	630	430	400	400	420	300	300
450	1000	330	550	450	450	630	430	500	500	420	300	300
				360	360	520		400	400	370		260
350									320	350		139
1000	4000	1500	1400	1000	1000	1400	1000	900	2000	1100	900	800
6000	10000	10000	4500	10000	10000	4500	4500	6000	6000	6000	3500	8000
117	105	159	130	199	199	167	167	263	263	421	350	7000
159	143	218	191	233	233	227	244	287	287	500	478	828
				292	292	275		358	358	568		955
205									448	601		1102
52,5	24.8	35.0	51.2	71.6	71.6	75.0	71.6	79.6	52.5	161	117	310
71.6	35.8	47.8	75.0	105	105	102	105	117	71.6	191	159	358
0.34	0.34	0.19	0.52	0.52	0.52	0.52	0.76	0.76	0.76	1.23	1.78	2.44
0.88	0.88	0.49	1.32	1.32	1.32	1.32	1.94	1.94	1.94	3.13	4.53	6.22
22	22	17	32	32	32	32	38	38	38	61	57	90
38	38	61	52	52	52	52	65	65	65	111	115	200
120% of the short-time rating												
Class F												
0 to 40°C												
75 dB												
7							10					
4000	4000	4000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
15S	26S	12S	12S	15S	18S	15S	12S	26S	26S	26S	26S	40S
15		12	17	17	17	17	17	22	22	32	21	54
		22	24	29	33	29	20	29	37	37	31	63
		O		O	O				O		O	

*1 The rated output is guaranteed when a rated input voltage (200/220/230 VAC) is applied.
If an input power supply voltage fluctuates, the rated output may not be produced even if the fluctuation is within its allowable range.
For detailed information about the short-time rating, see the output characteristics of each model.

*2 The cycle time is 10 minutes. At 50% ED, the ON time is 5 minutes, and the OFF time is 5 minutes.

*3 A balance correction is made for a rotor with a sleeve. No balance correction is made for a rotor without a sleeve. See Section III.2.(5) for additional infor-mation.

*4 These motors must be liquid-cooled.
For information about the temperature increase of each motor when the cooling capability is changed, see Chapter X.

*5 For the motors marked with O, additional models incorporating the optional Cs contour control are available.

Note) For selecting a built-in sensor (for speed/position feedback) and high-speed magnetic pulse coder, see the table of built-in motor combinations given in this chapter.

Unit conversion (to the SI unit)
1 W = 8.600×10^{-1} kcal/h

3. BUILT-IN MOTOR COMBINATIONS (ALL MODELS)

Model	Motor specification drwaing No.(*4) A06B-	Speed range switching	Rotor		Stator drawing No.	Sensor(*3)								Amplifier specification drawing No. A06B-6064	Output type
			Draw-ing No.	Shape (*1)		Built-in				High-resolution magnetic					Parameter specification drawing No. (*2) A06B-6064
						1	2	3	4	1	2	3	4		
B0.3	0953-B612	—	T211	1	T113		○							H301#H550	L127
B0.5	0955-B612	—	T211	1	T113		○							H301#H550	L113
	0955-B612	—	T211	1	T113		○							H302#H550	L128
B1	0921-B312	—	T201	2	T113		○							H301#H550	L129
	0921-B612	—	T211	1	T113		○							H301#H550	L129
B1.5	0951-B312	—	T202	2	T113		○							H302#H550	L130
	0951-B612	—	T211	1	T113		○							H302#H550	Under development
B2	0922-B312	—	T202	2	T113		○							H302#H550	L120
	0922-B612	—	T211	1	T113		○							H302#H550	L120
	0922-B311	—	T202	2	T113	○								H302#H550	L120
	0922-B611	—	T211	1	T113	○								H302#H550	L120
	0922-B641	—	T211	1	T113					○				H302#H550	L120
	0922-B341	—	T202	2	T113					○				H302#H550	L120
	0922-B907	Provided	T202	2	T198		○							H306#H550	L515
B2(8)	0982-B611	Provided	T211	1	T113	○								H306#H550	L516
	0982-B642	Provided	T211	1	T113						○			H306#H550	L516
B3	0923-B311	Provided	T201	2	T113	○								H306#H550	L517
	0923-B312	Provided	T201	2	T113		○							H306#H550	L517
B6	0926-B311	—	T201	2	T113	○								H306#H550	L131
	0926-B311	—	T201	2	T113	○								H308#H550	L132
	0926-B711	—	T211	1	T113	○								H306#H550	L131
	0926-B711	—	T211	1	T113	○								H308#H550	L132
	0926-B341	—	T201	2	T113					○				H306#H550	L131
	0926-B341	—	T201	2	T113					○				H308#H550	L132
	0926-B344	—	T201	2	T113								○	H306#H550	L131
	0926-B344	—	T201	2	T113								○	H308#H550	L132
	0926-B741	—	T211	1	T113					○				H306#H550	L131
	0926-B741	—	T211	1	T113					○				H308#H550	L132
	0926-B611	—	T211	1	T114	○								H322#H550	L133
B8	0958-B311	—	T201	2	T113	○								H312#H550	L134
	0958-B111	Provided	T201	2	T111	○								H312#H550	L511
	0958-B611	Provided	T213	1	T111	○								H312#H550	L511
	0958-B111	Provided	T201	2	T111	○								H315#H550	L519
	0958-B511	Provided	T201	2	T115	○								H327#H550	L520
	0958-B711	Provided	T213	1	T115	○								H327#H550	L520
B10	0930-B111	Provided	T201	2	T111	○								H312#H550	L521
	0930-B111	Provided	T201	2	T111	○								H315#H550	L522
	0930-B611	Provided	T211	1	T111	○								H312#H550	L521
	0930-B611	Provided	T211	1	T111	○								H315#H550	L522

*1 The shape of a rotor is indicated as follows:

No.	1	2	3	4	5
Shape	Without a sleeve	Stepped sleeve	Locking assembly sleeve	Special rotor 1	Special rotor 2

*2 Among the parameters, the sensor-related parameters depend on the sensor used. For detailed information about the setting parameters, see Chapter XIV. The parameter specification drawing numbers are given according to the drawing number system indicated below.

Model	Drawing number system
Standard model (without speed range switching)	A06B-6064-L100~L499
Model with speed range switching	A06B-6064-L500~L799

*3 The sensors include the built-in sensors and high-resolution magnetic pulse coders indicated below. For detailed information, see Chapters VI and VII.

No.	1	2	3	4
Built-in sensor A860-0392-	T011	T012	T013	T014
High-resolution magnetic A860-0382-	T141	T142	T143	T144

*4 A motor specification drawing number determines which rotor, stator, and sensor to order.

*5 When using a model with speed range switching, closely check the method of power line connection indicated in the tables of Section 6 to avoid wrong connections. See Chapter VIII.

Model	Motor specification drwaing No.(*4) A06B-	Speed range switching	Rotor		Stator drawing No.	Sensor(*3)								Amplifier specification drawing No. A06B-6064	Output type
			Draw-ing No.	Shape (*1)		Built-in				High-resolution magnetic					Parameter specification drawing No. (*2) A06B-6064
						1	2	3	4	1	2	3	4		
B12	0932-B902	Provided	T201	2	T199	○								H315#H550	L523
	0932-B411	Provided	T203	2	T114	○								H326#H550	L524
	0932-B901	Provided	T212	1	T114	○								H326#H550	L524
B15	0935-B311	—	T201	2	T113	○								H322#H550	L135
B17	0937-B111	Provided	T201	2	T111	○								H312#H550	L525
	0937-B643	Provided	T211	1	T111							○		H312#H550	L525
	0937-B901	Provided	T221	3	T111	○								H312#H550	L525
B26	0946-B901	Provided	T221	4	T113				○					H312#H550	L526
	0946-B311	Provided	T201	2	T113	○								H315#H550	L527
	0946-B311	Provided	T201	2	T113	○								H318#H550	L528
	0946-B611	Provided	T211	1	T113	○								H315#H550	L527
	0946-B611	Provided	T211	1	T113	○								H318#H550	L528
	0946-B343	Provided	T201	2	T113							○		H315#H550	L527
	0946-B343	Provided	T201	2	T113							○		H318#H550	L528
	0946-B643	Provided	T211	1	T113							○		H315#H550	L527
	0946-B643	Provided	T211	1	T113							○		H318#H550	L528
	0946-B901	Provided	T221	4	T113				○					H315#H550	L535
B28	0960-B901	Provided	T221	2	T110	○								H312#H550	L529
	0960-B011	Provided	T201	2	T110	○								H315#H550	L530
	0960-B111	Provided	T201	2	T111	○								H326#H550	L531
	0960-B143	Provided	T201	2	T111							○		H326#H550	L531
B35	0965-B111	Provided	T201	2	T111	○								H326#H550	L532
	0965-B901	Provided	T211	1	T111	○								H326#H550	L532
B40	0970-B313	—	T201	3	T113			○						H030#H520	Under development
	0970-B313	—	T201	3	T113			○						H040#H520	L138
	0970-B344	—	T201	3	T113								○	H030#H521	Under development
	0970-B344	—	T201	3	T113								○	H040#H521	L138
B45(8)	0988-B313	Provided	T201	3	T113			○						H326#H550	L533
	0988-B901	Provided	T221	2	T113								○	H326#H550	L533
B50	0973-B611	Provided	T211	1	T111	○								H040#H520	L534

*1 The shape of a rotor is indicated as follows:

No.	1	2	3	4	5
Shape	Without a sleeve	Stepped sleeve	Locking assembly sleeve	Special rotor 1	Special rotor 2

*2 Among the parameters, the sensor-related parameters depend on the sensor used. For detailed information about the setting parameters, see Chapter XIV. The parameter specification drawing numbers are given according to the drawing number system indicated below.

Model	Drawing number system
Standard model (without speed range switching)	A06B-6064-L101 ~ L499
Model with speed range switching	A06B-6064-L501 ~ L799

*3 The sensors include the built-in sensors and high-resolution magnetic pulse coders indicated below. For detailed information, see Chapters VI and VII.

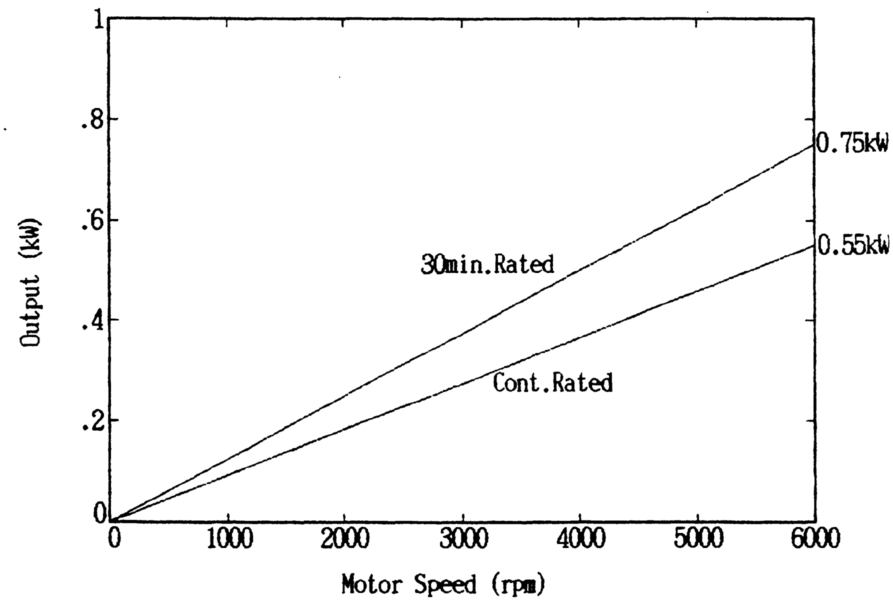
No.	1	2	3	4
Built-in sensor A860-0392-	T011	T012	T013	T014
High-resolution magnetic A860-0382-	T141	T142	T143	T144

*4 A motor specification drawing number determines which rotor, stator, and sensor to order.

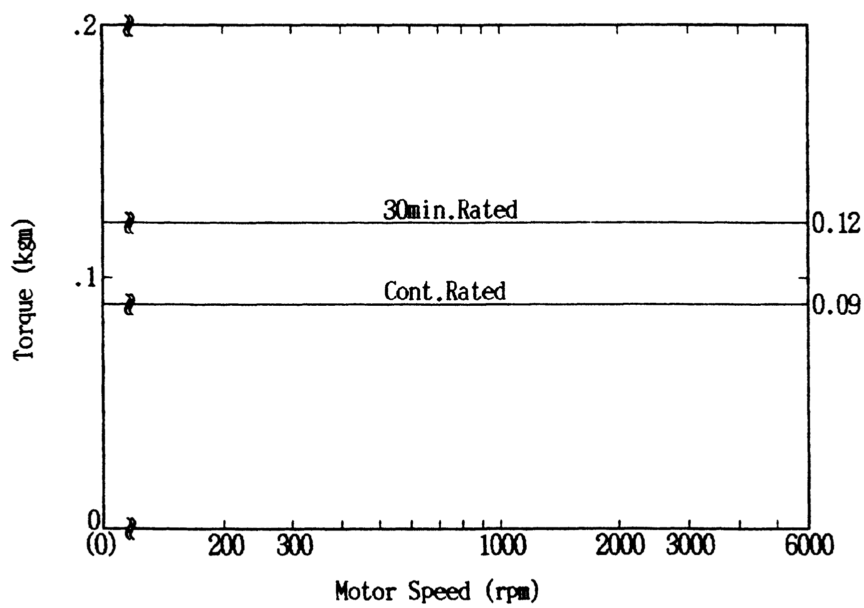
4. OUTPUT AND TORQUE CHARACTERISTICS

Model : B0.3
Output type : L127

POWER CURVE



TORQUE CURVE

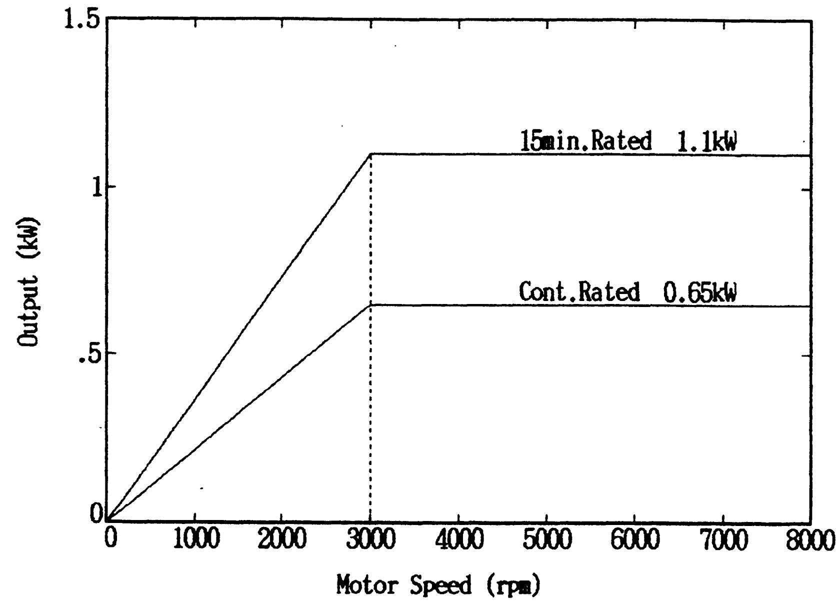


Corresponding rotor drawing No.
A290-0953-T211

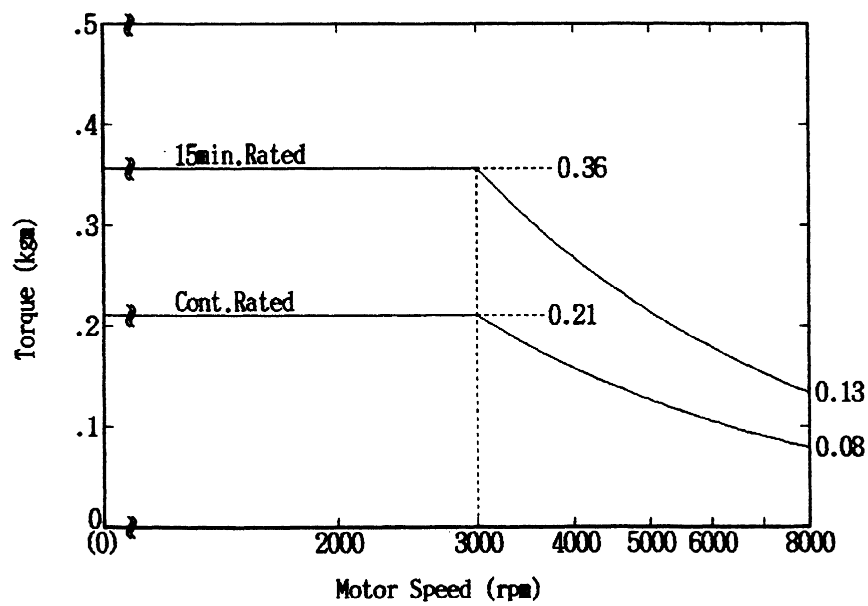
Corresponding stator drawing No.
A290-0953-T113

Model : B0.5
Output type : L113

POWER CURVE



TORQUE CURVE

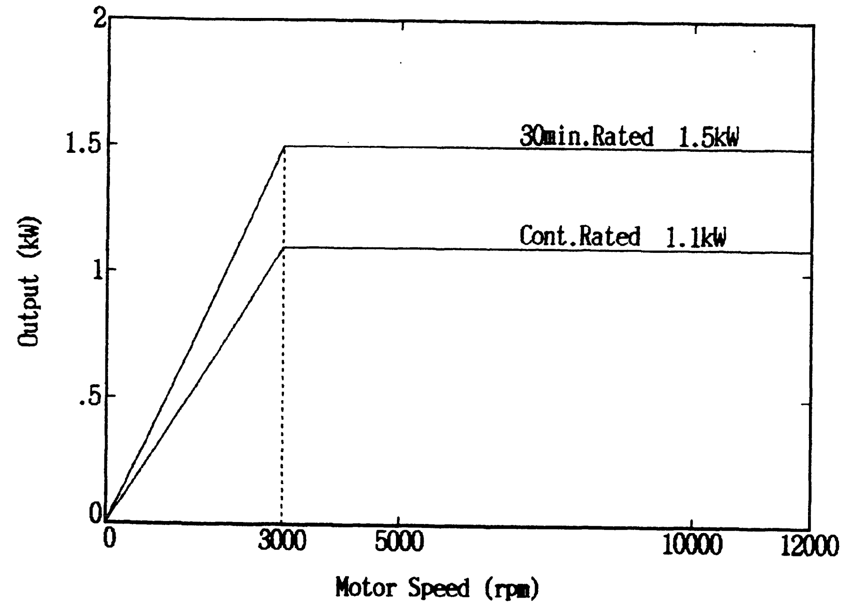


Corresponding rotor drawing No.
A290-0955-T211

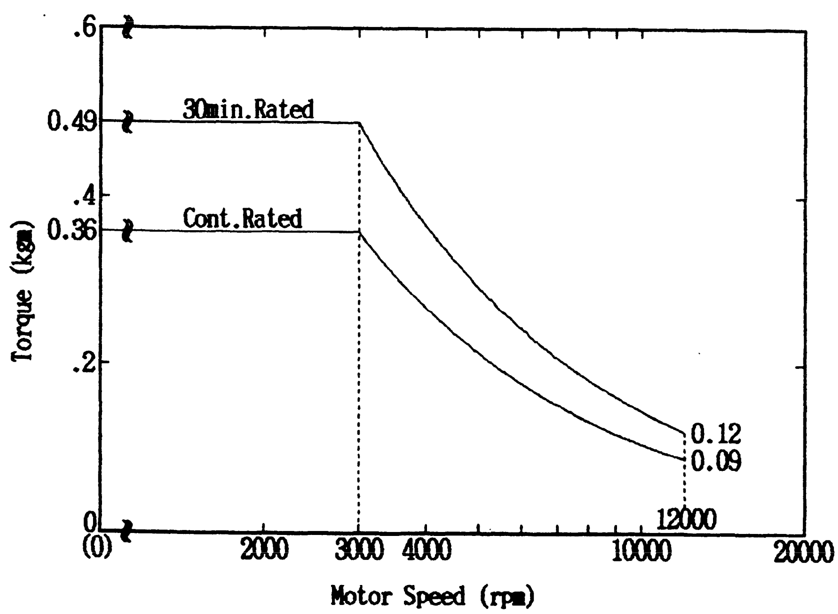
Corresponding stator drawing No.
A290-0955-T113

Model : B0.5
Output type : L128

POWER CURVE



TORQUE CURVE

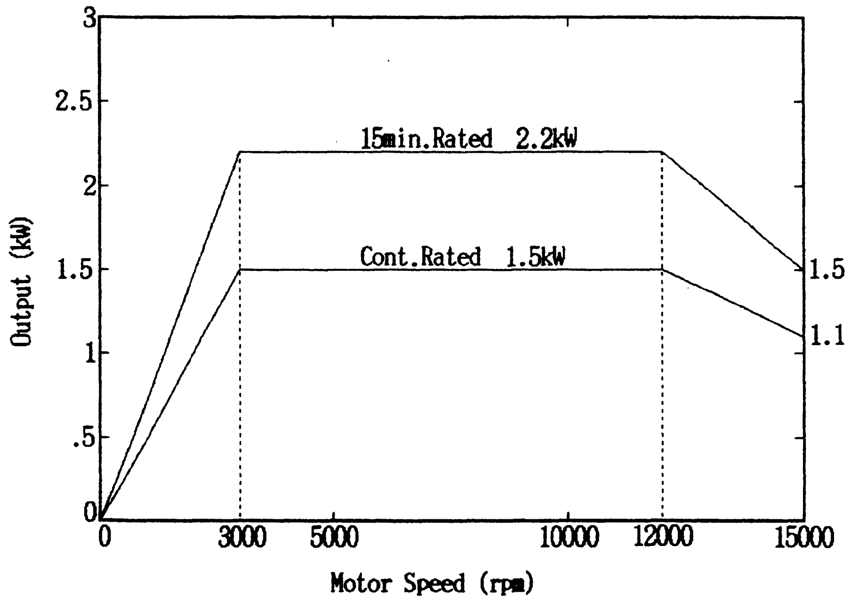


Corresponding rotor drawing No.
A290-0955-T211

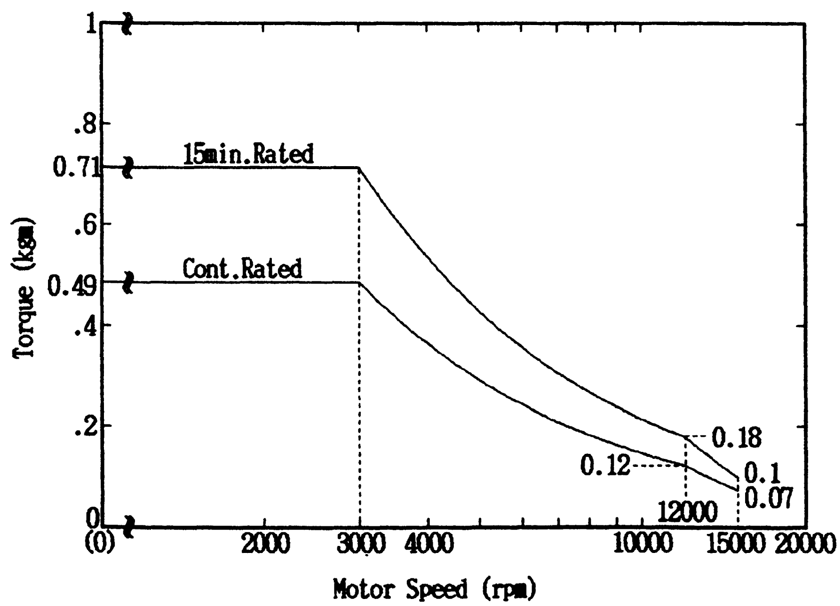
Corresponding stator drawing No.
A290-0955-T113

Model : B1
Output type : L129

POWER CURVE



TORQUE CURVE

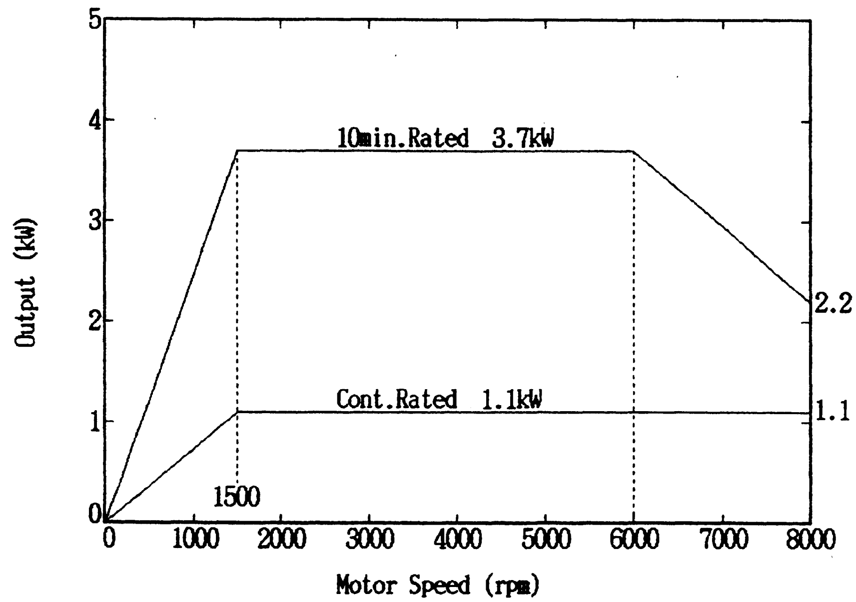


Corresponding rotor drawing No.
A290-0921-T201
A290-0921-T211

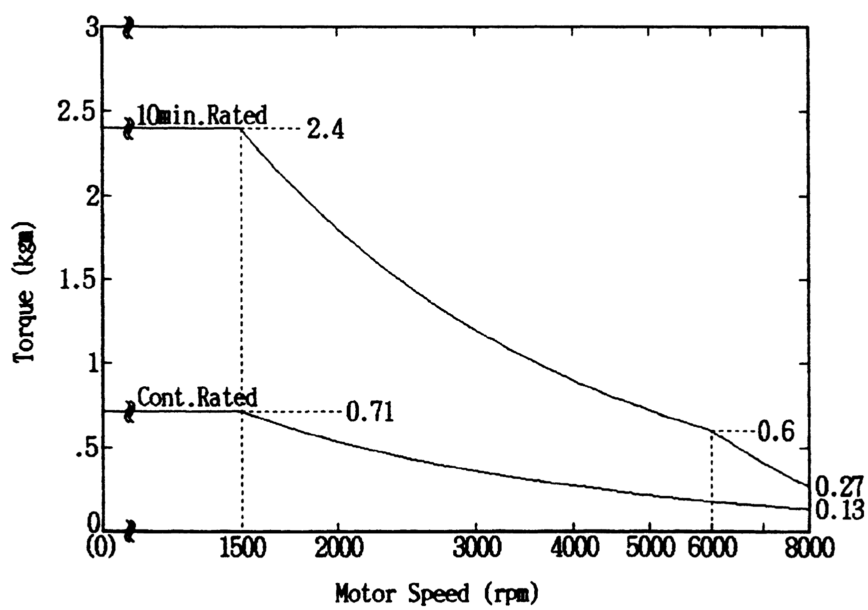
Corresponding stator drawing No.
A290-0921-T113

Model : B1.5
Output type : L130

POWER CURVE



TORQUE CURVE

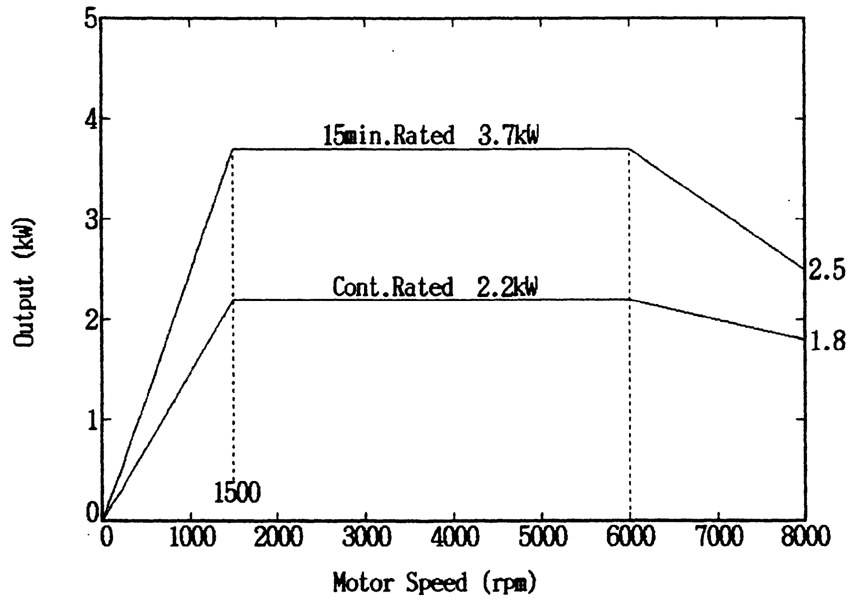


Corresponding rotor drawing No.
A290-0951-T202

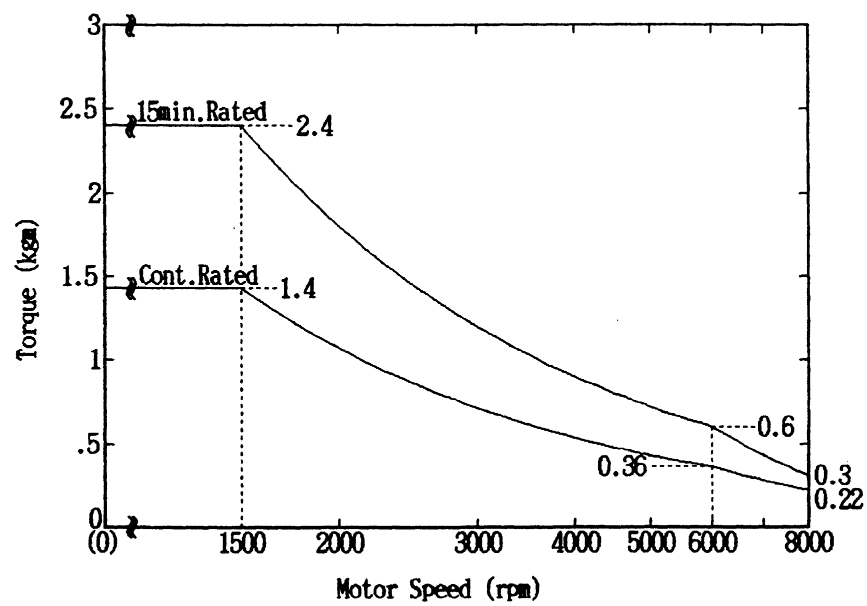
Corresponding stator drawing No.
A290-0951-T113

Model : B2
Output type : L120

POWER CURVE



TORQUE CURVE

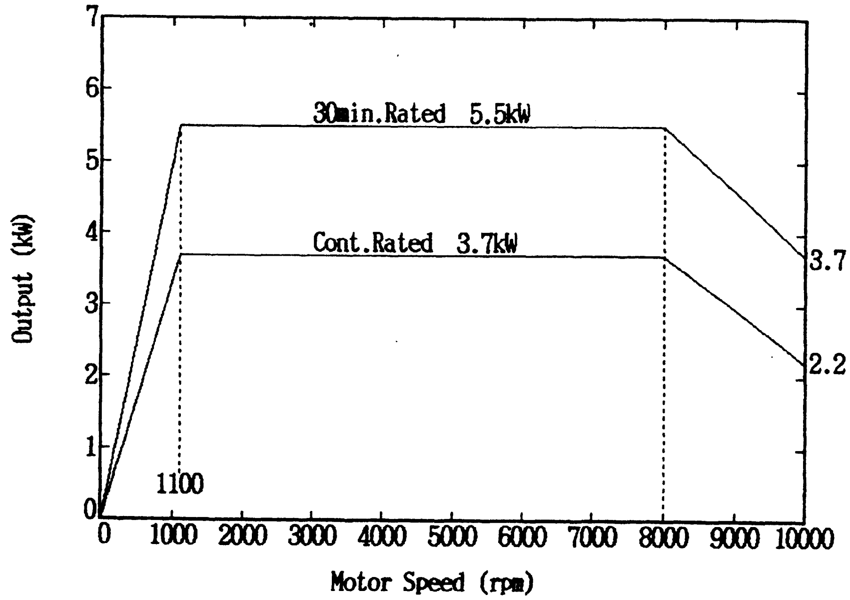


Corresponding rotor drawing No.
A290-0922-T202
A290-0922-T211

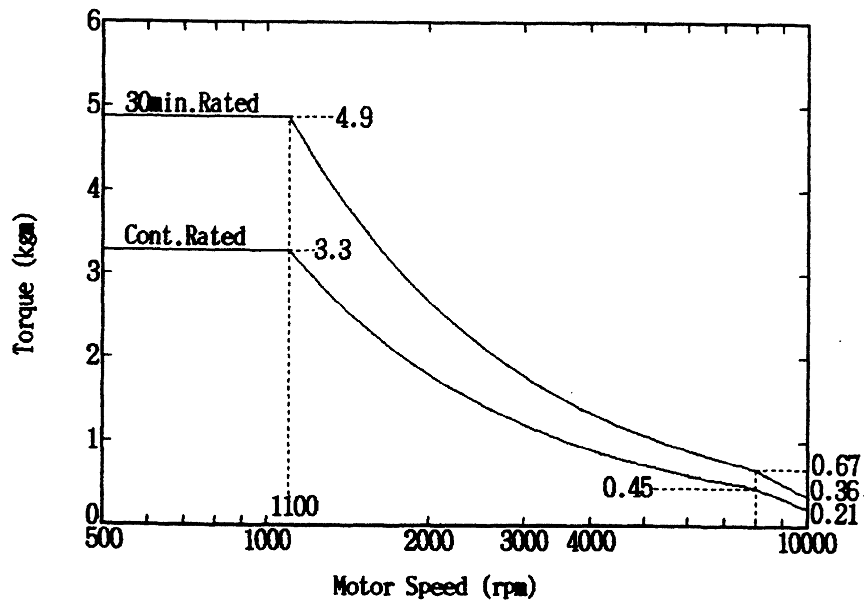
Corresponding stator drawing No.
A290-0922-T113

Model : B6
Output type : L131

POWER CURVE



TORQUE CURVE

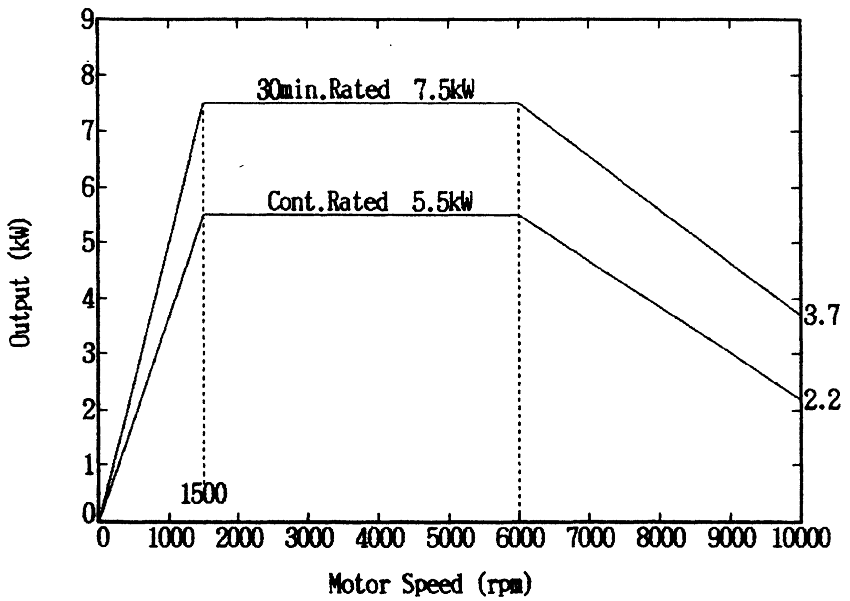


Corresponding rotor drawing No.
A290-0926-T201
A290-0926-T211

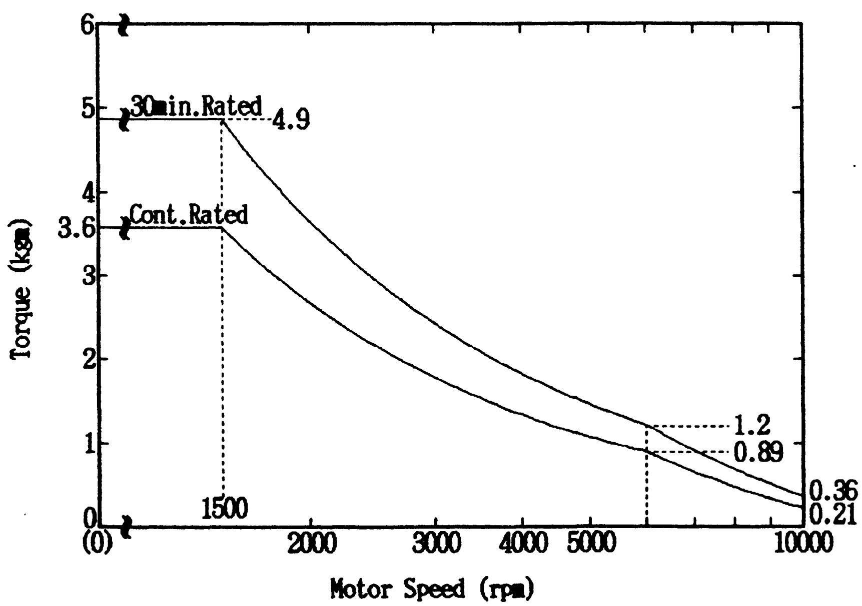
Corresponding stator drawing No.
A290-0926-T113

Model : B6
Output type : L132

POWER CURVE



TORQUE CURVE

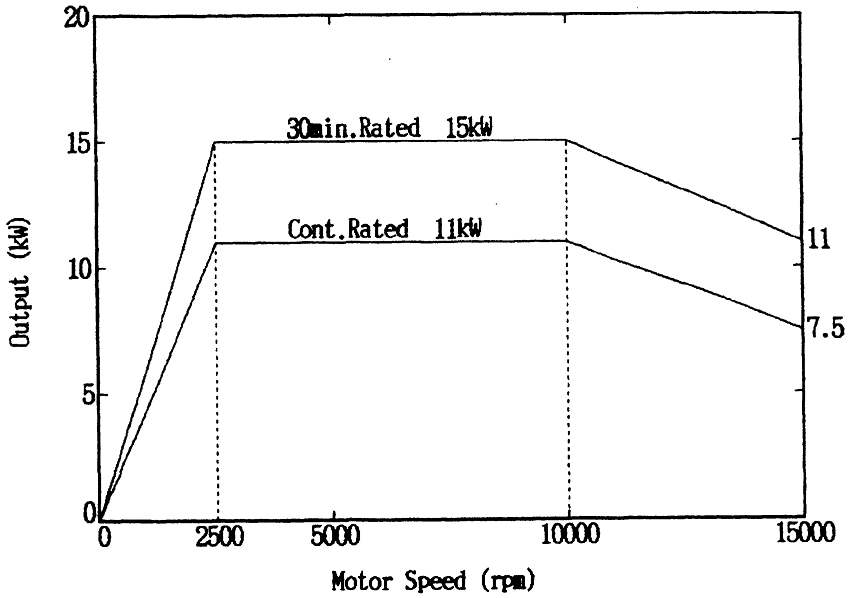


Corresponding rotor drawing No.
A290-0926-T201
A290-0926-T211

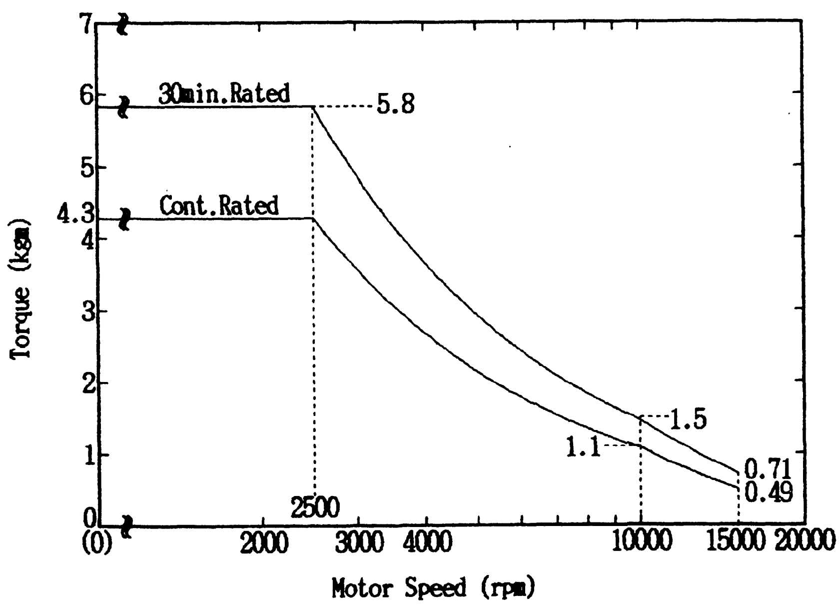
Corresponding stator drawing No.
A290-0926-T113

Model : B6
Output type : L133

POWER CURVE



TORQUE CURVE

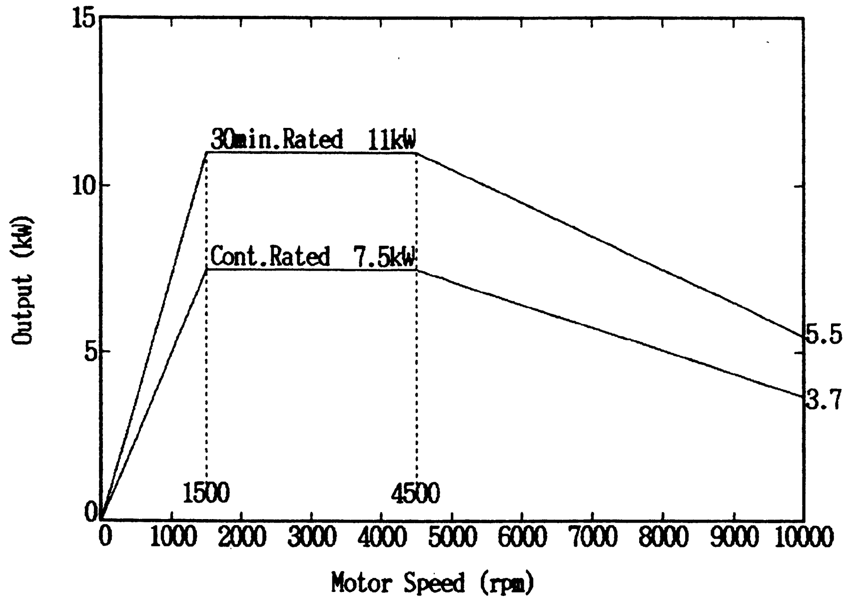


Corresponding rotor drawing No.
A290-0926-T211

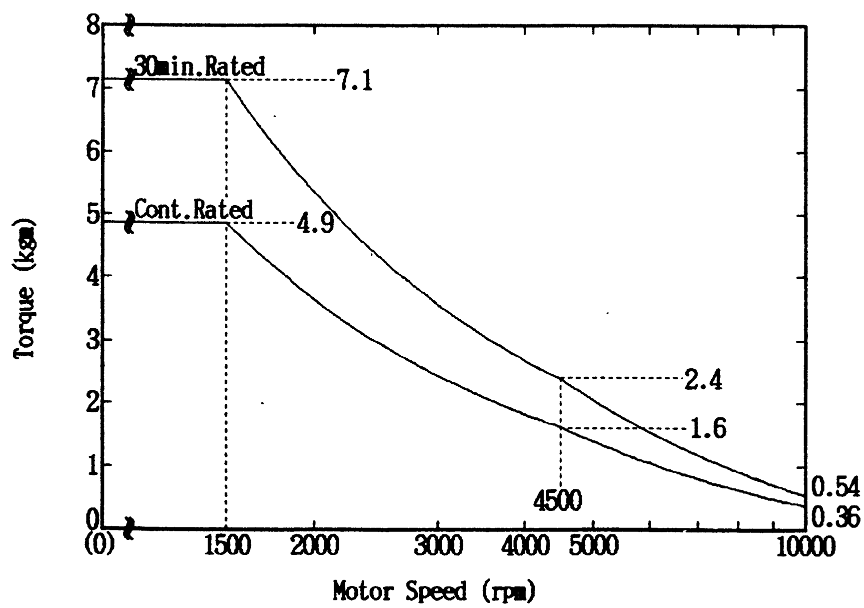
Corresponding stator drawing No.
A290-0926-T114

Model : B8
Output type : L134

POWER CURVE



TORQUE CURVE

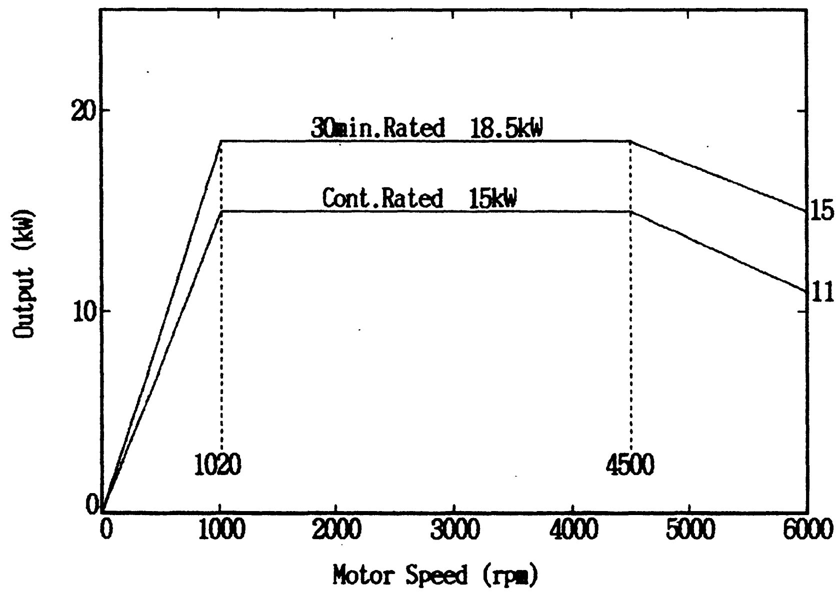


Corresponding rotor drawing No.
A290-0958-T201

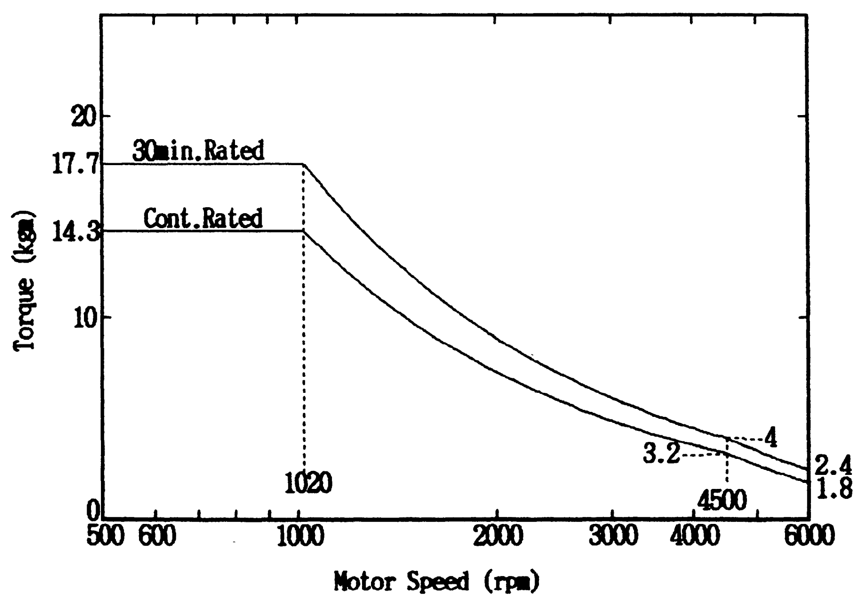
Corresponding stator drawing No.
A290-0958-T113

Model : B15
Output type : L135

POWER CURVE



TORQUE CURVE

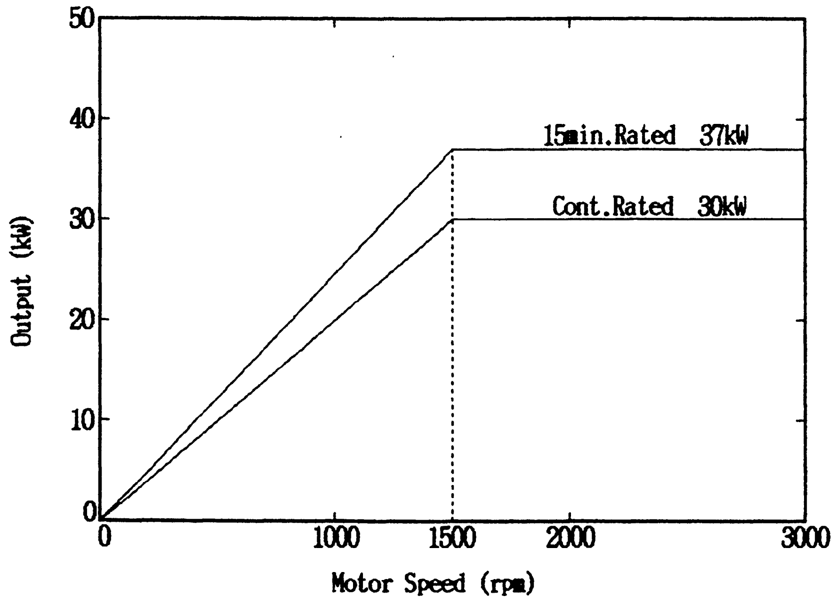


Corresponding rotor drawing No.
A290-0935-T201

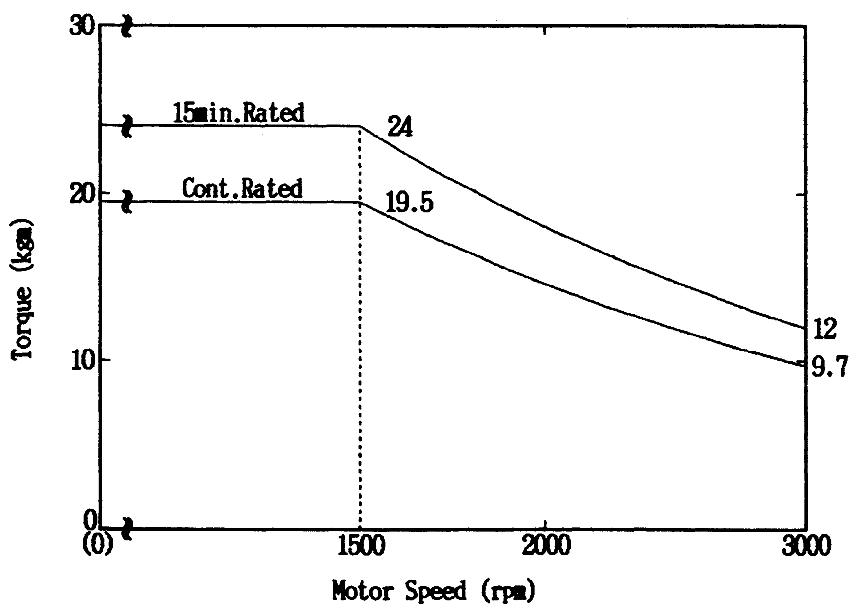
Corresponding stator drawing No.
A290-0935-T113

Model : B40
Output type : Under development

POWER CURVE



TORQUE CURVE

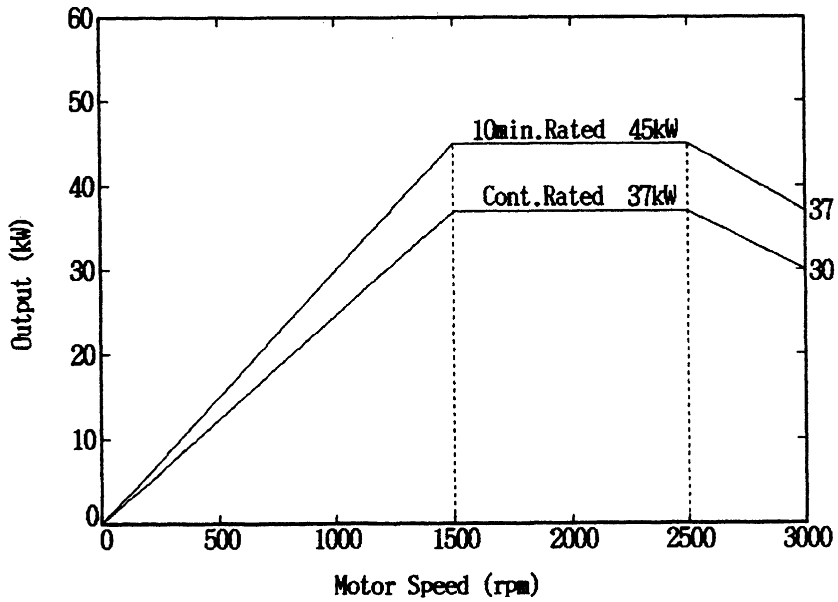


Corresponding rotor drawing No.
A290-0970-T201

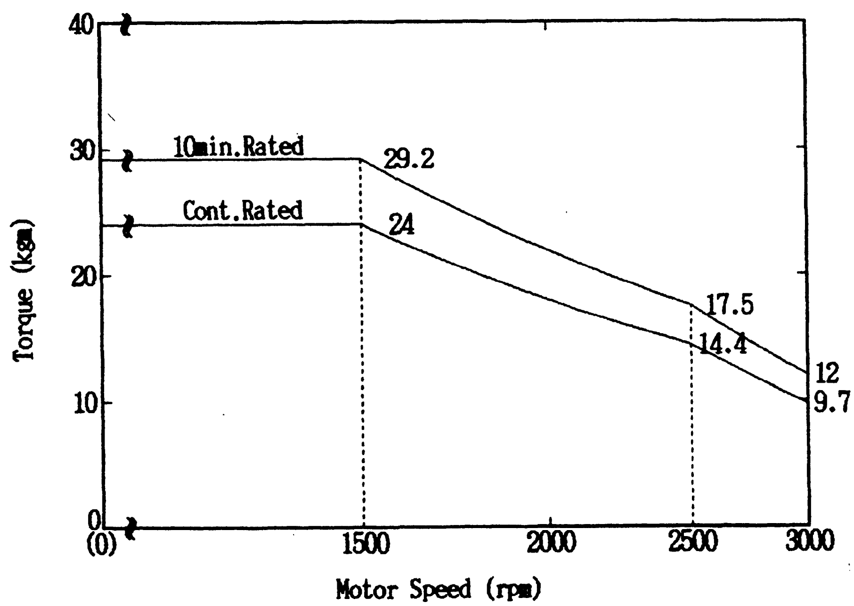
Corresponding stator drawing No.
A290-0970-T113

Model : B40
Output type : L138

POWER CURVE



TORQUE CURVE

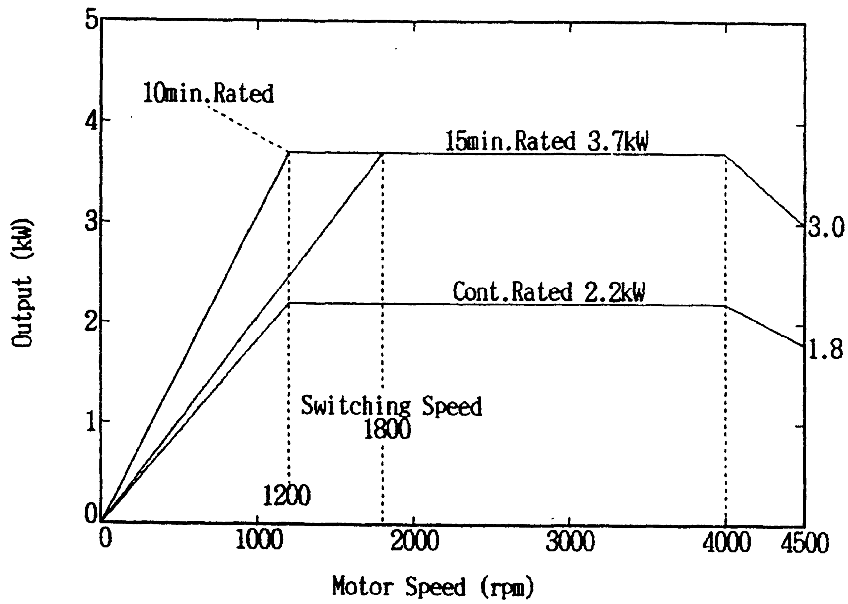


Corresponding rotor drawing No.
A290-0970-T201

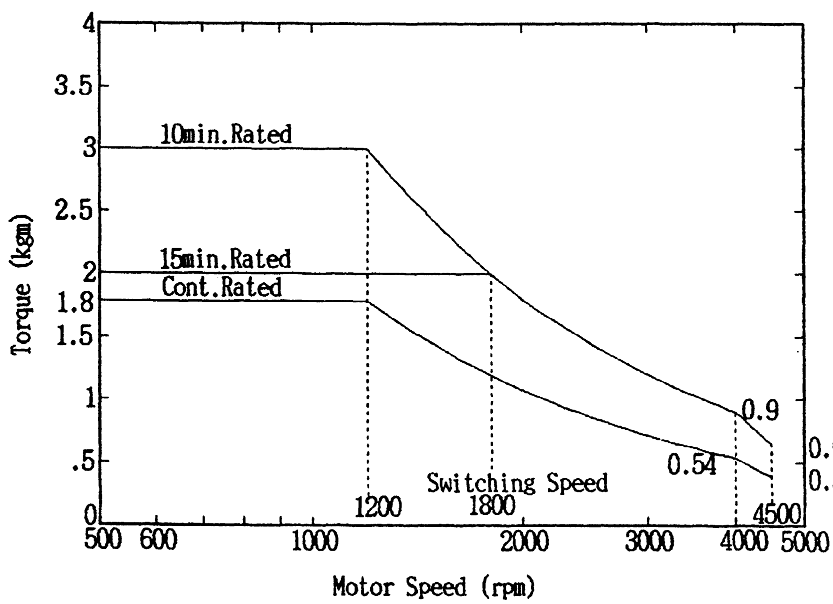
Corresponding stator drawing No.
A290-0970-T113

Model : B2(8)
Output type : L516

POWER CURVE



TORQUE CURVE

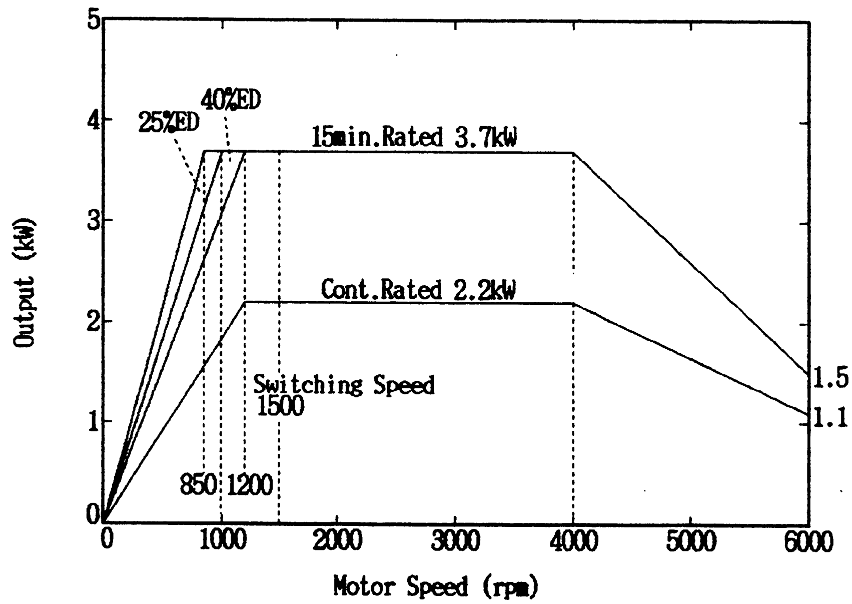


Corresponding rotor drawing No.
A290-0982-T211

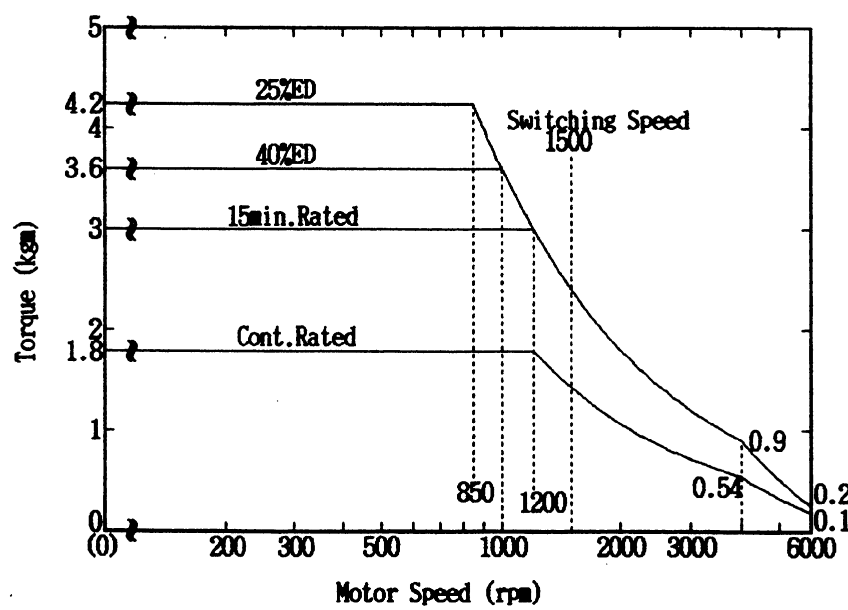
Corresponding stator drawing No.
A290-0982-T113

Model : B2
Output type : L515

POWER CURVE



TORQUE CURVE

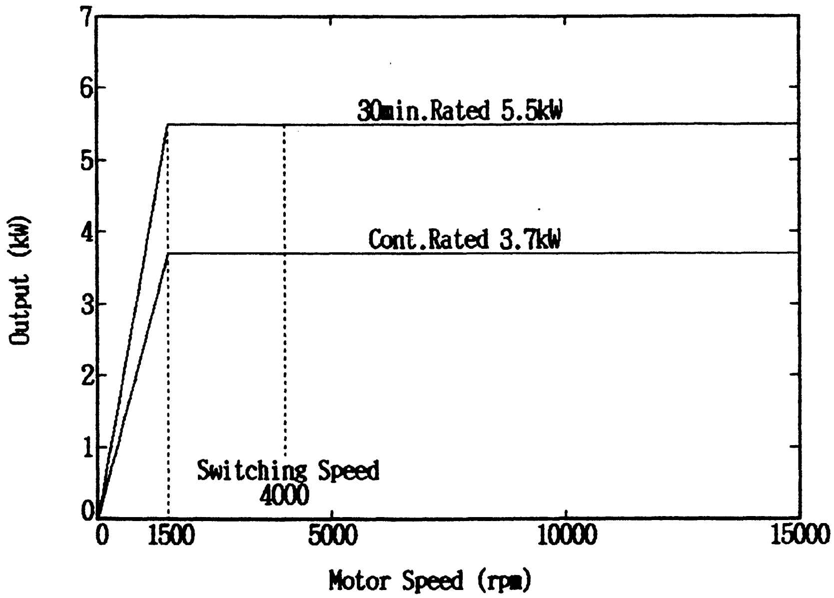


Corresponding rotor drawing No.
A290-0922-T202

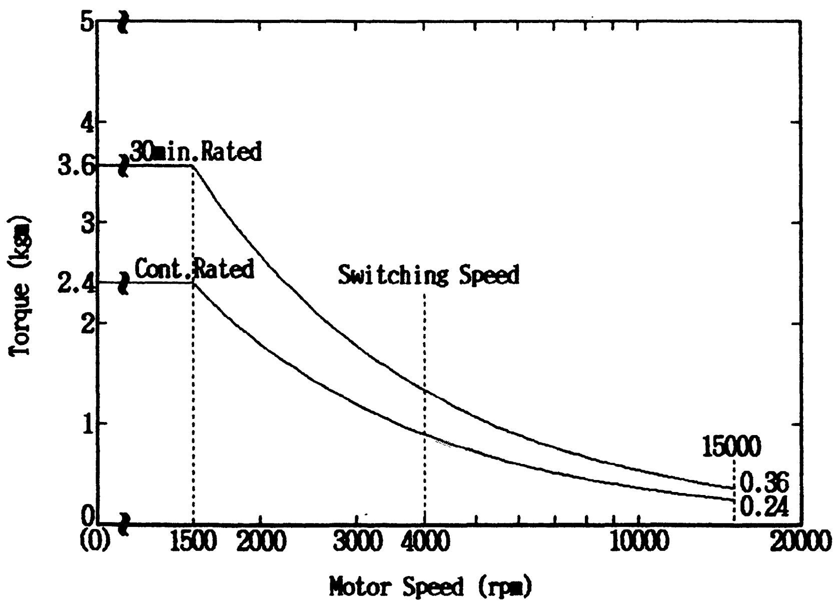
Corresponding stator drawing No.
A290-0922-T198

Model : B3
Output type : L517

POWER CURVE



TORQUE CURVE

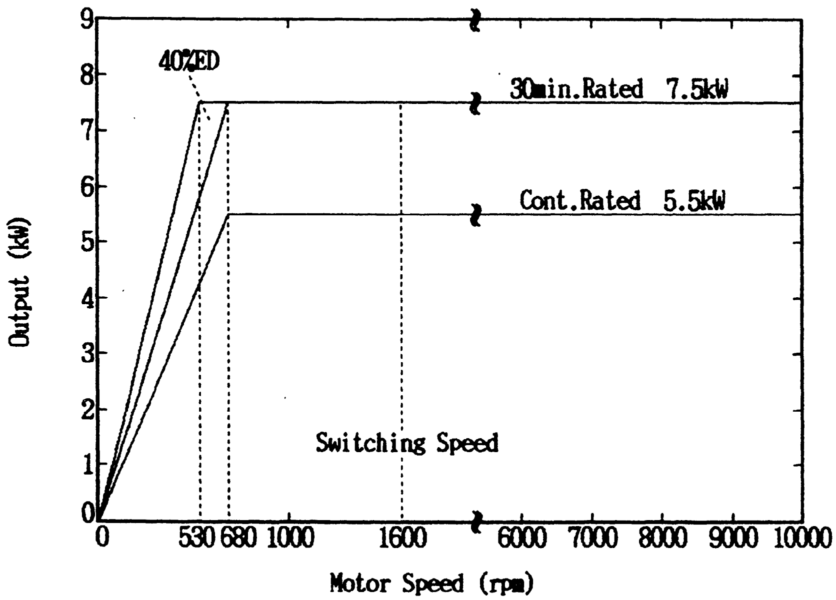


Corresponding rotor drawing No.
A290-0923-T201

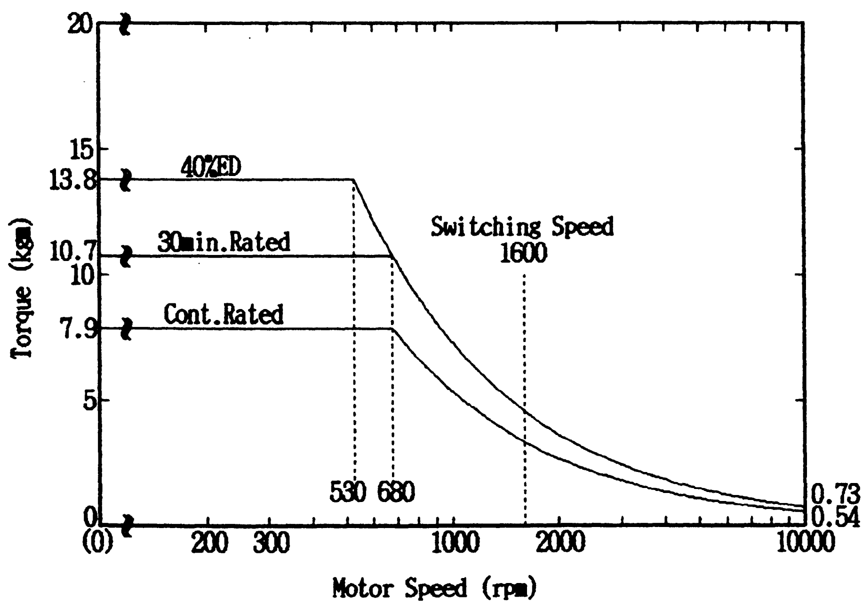
Corresponding stator drawing No.
A290-0923-T113

Model : B8
Output type : L511

POWER CURVE



TORQUE CURVE

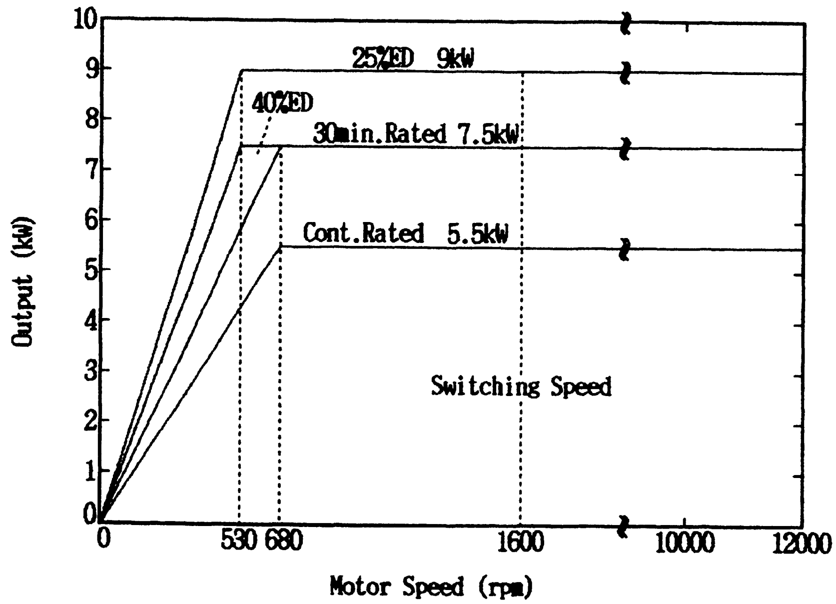


Corresponding rotor drawing No.
A290-0958-T201
A290-0958-T213

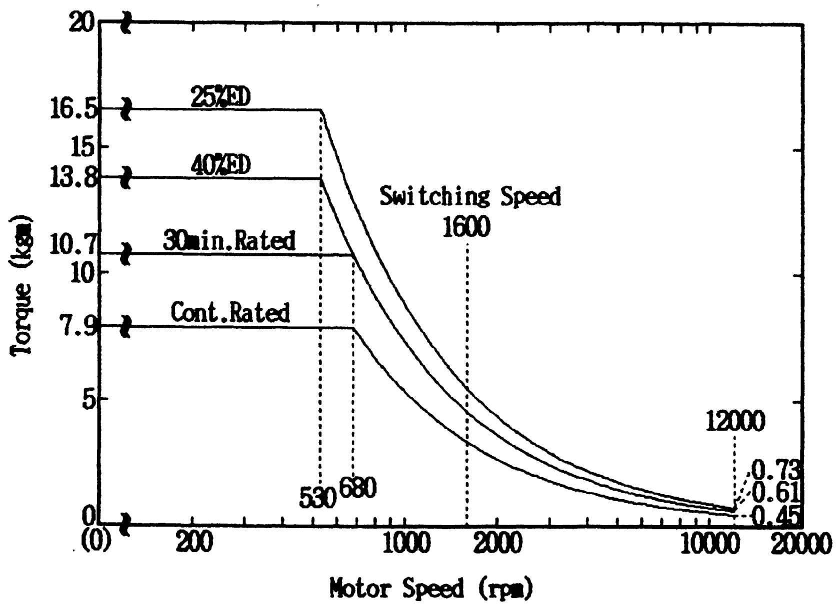
Corresponding stator drawing No.
A290-0958-T111

Model : B8
Output type : L519

POWER CURVE



TORQUE CURVE

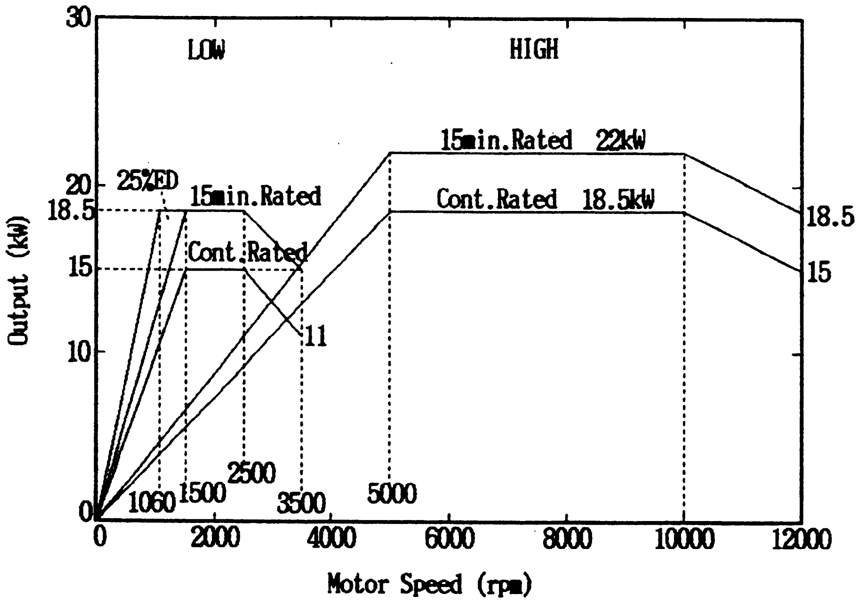


Corresponding rotor drawing No.
A290-0958-T201

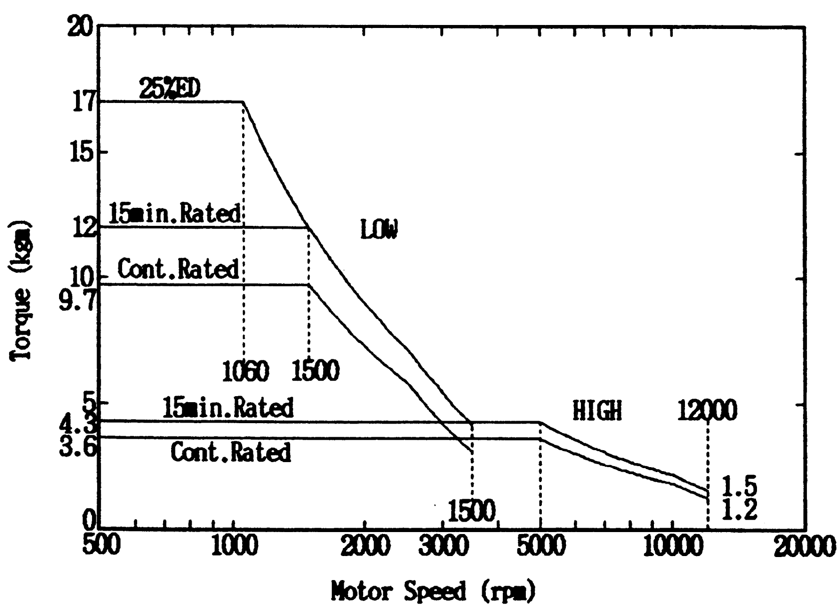
Corresponding stator drawing No.
A290-0958-T111

Model : B8
Output type : L520

POWER CURVE



TORQUE CURVE

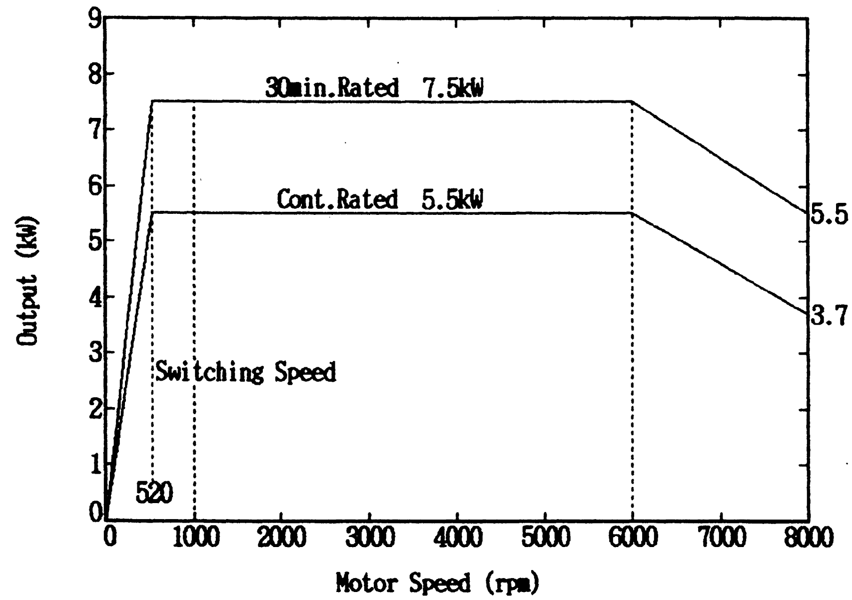


Corresponding rotor drawing No.
A290-0958-T201
A290-0958-T213

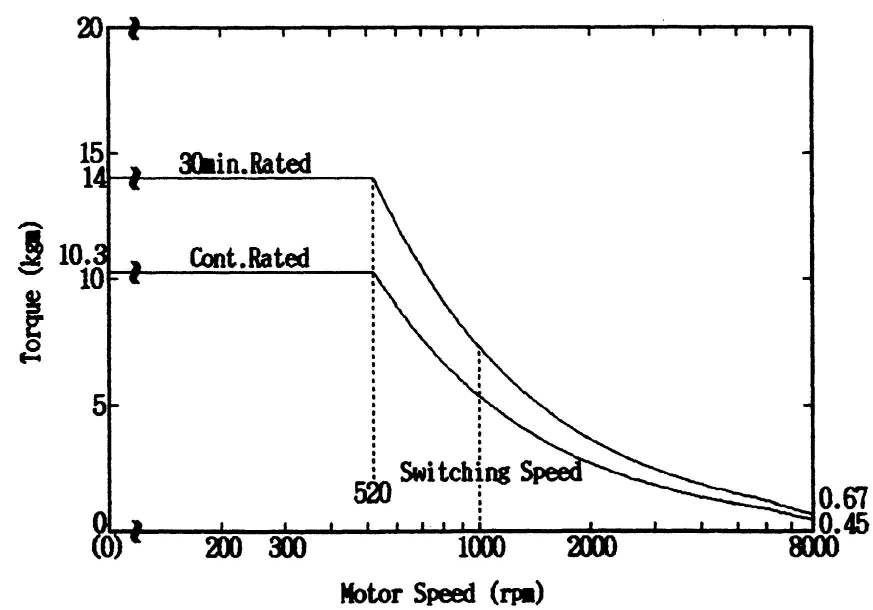
Corresponding stator drawing No.
A290-0958-T115

Model : B10
Output type : L521

POWER CURVE



TORQUE CURVE

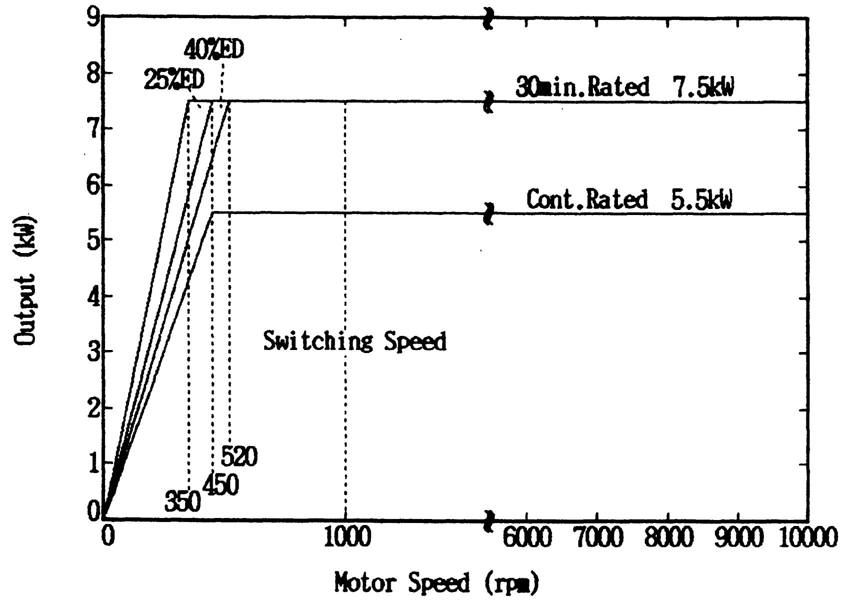


Corresponding rotor drawing No.
A290-0930-T201
A290-0930-T211

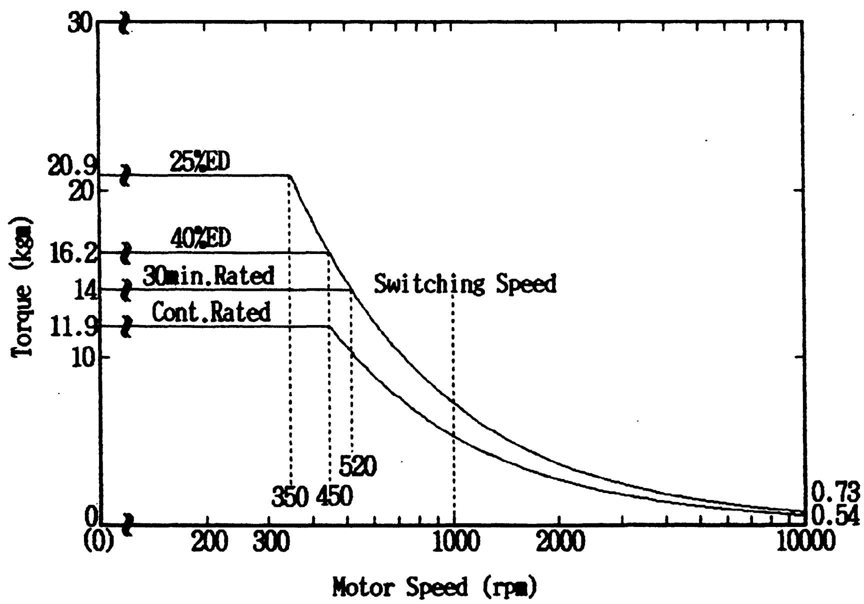
Corresponding stator drawing No.
A290-0930-T111

Model : B10
Output type : L522

POWER CURVE



TORQUE CURVE

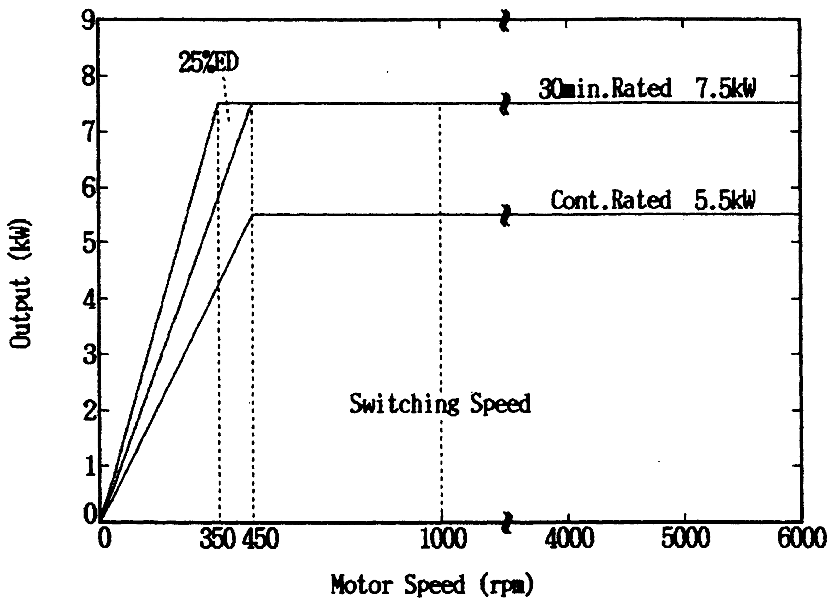


Corresponding rotor drawing No.
A290-0930-T201
A290-0930-T211

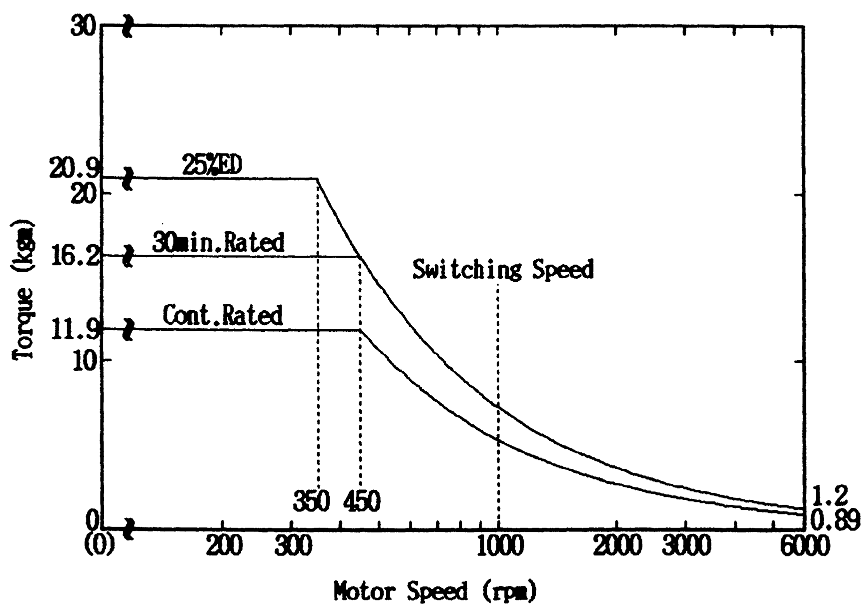
Corresponding stator drawing No.
A290-0930-T111

Model : B12
Output type : L523

POWER CURVE



TORQUE CURVE

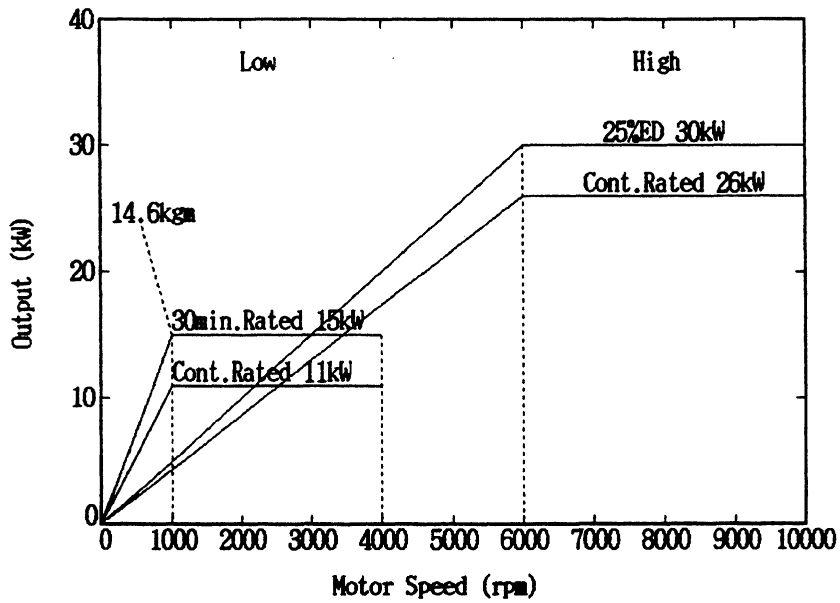


Corresponding rotor drawing No.
A290-0932-T201

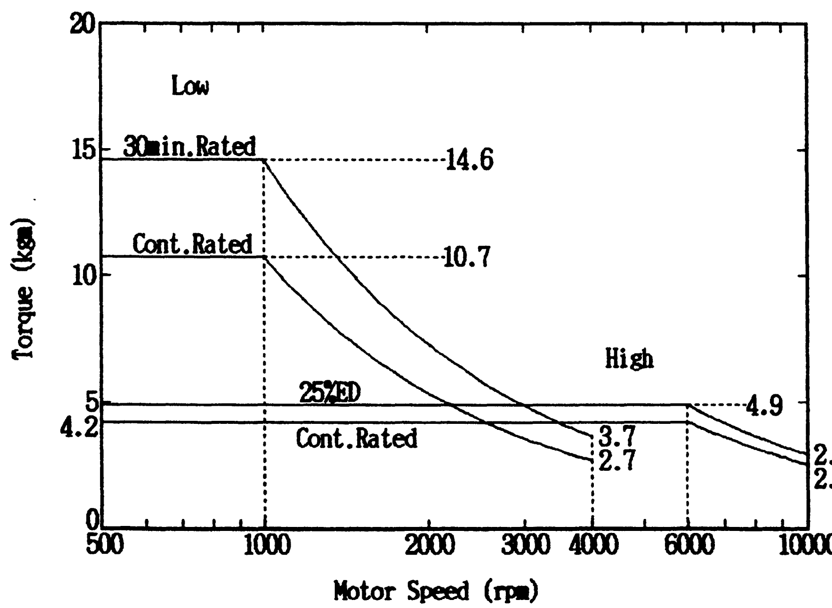
Corresponding stator drawing No.
A290-0932-T199

Model : B12
Output type : L524

POWER CURVE



TORQUE CURVE

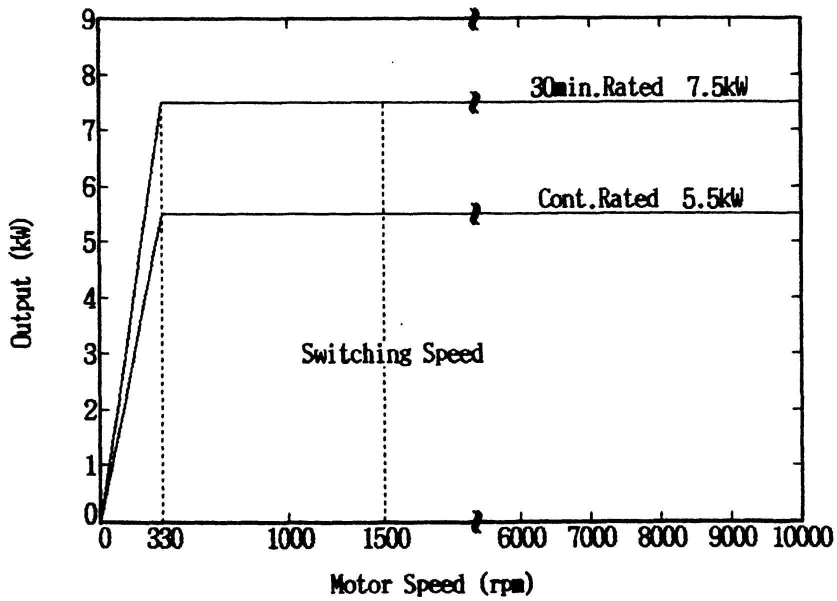


Corresponding rotor drawing No.
A290-0932-T203
A290-0932-T212

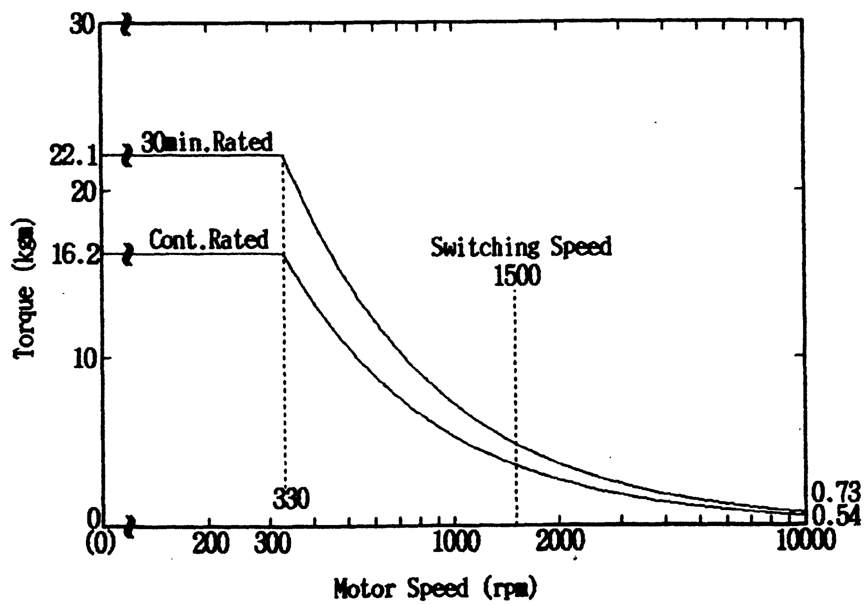
Corresponding stator drawing No.
A290-0932-T114

Model : B17
Output type : L525

POWER CURVE



TORQUE CURVE

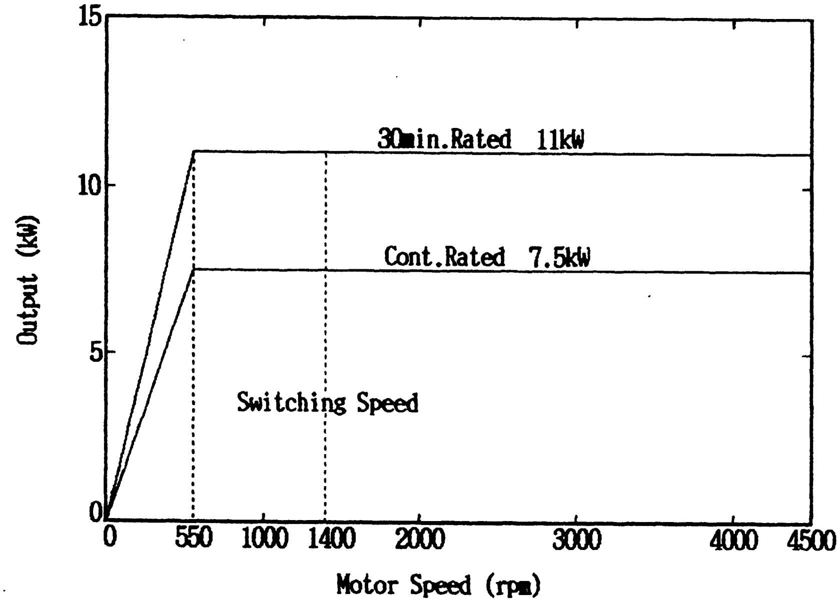


Corresponding rotor drawing No.
A290-0937-T201
A290-0937-T211
A290-0937-T221

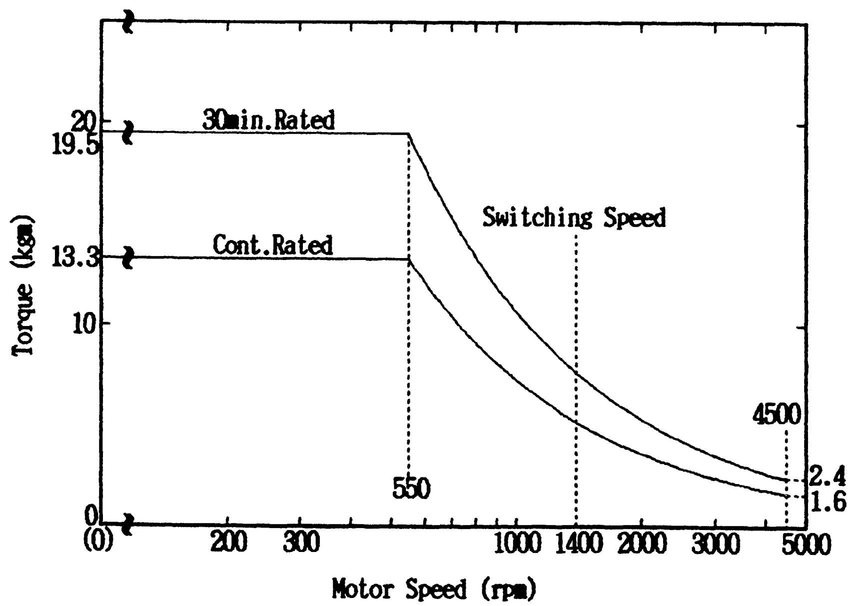
Corresponding stator drawing No.
A290-0937-T111

Model : B26
Output type : L526

POWER CURVE



TORQUE CURVE

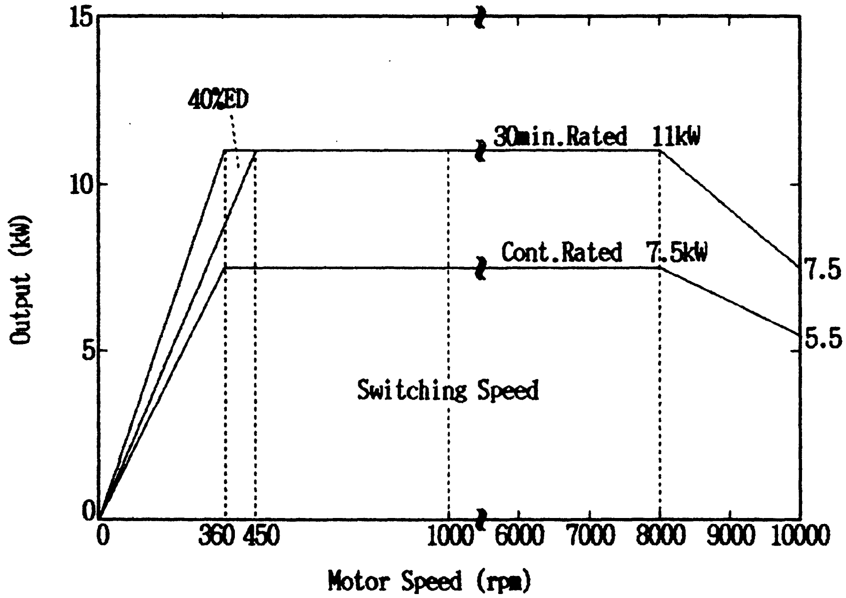


Corresponding rotor drawing No.
A290-0946-T221

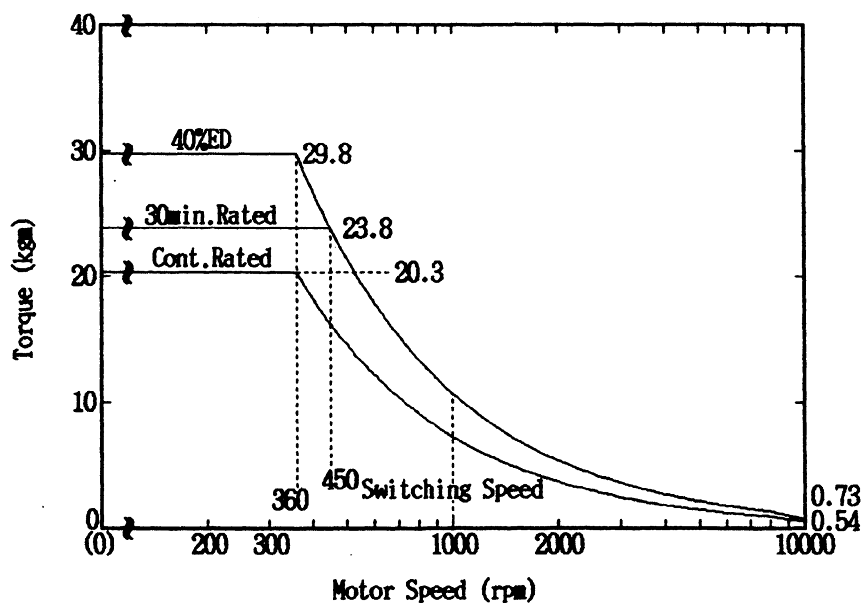
Corresponding stator drawing No.
A290-0946-T113

Model : B26
Output type : L527

POWER CURVE



TORQUE CURVE

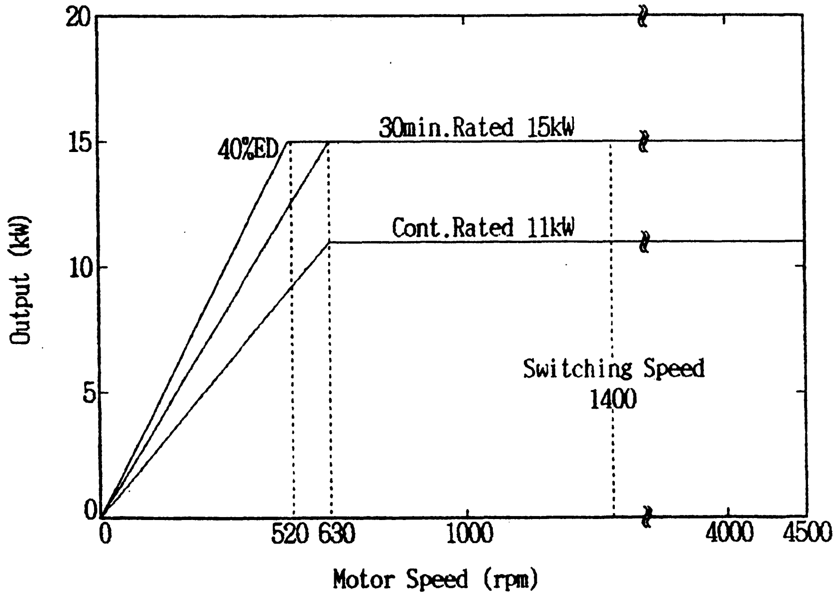


Corresponding rotor drawing No.
A290-0946-T201
A290-0946-T211

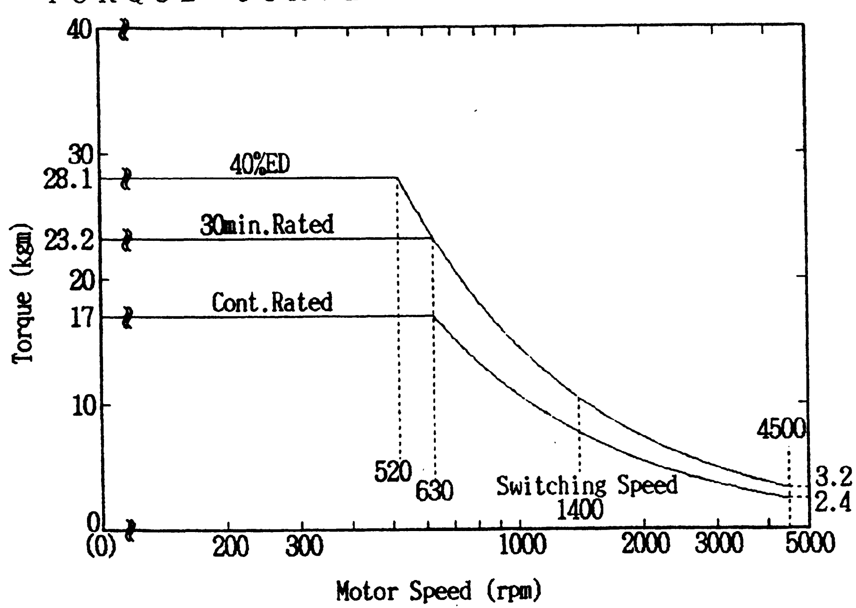
Corresponding stator drawing No.
A290-0946-T113

Model : B26
Output type : L535

POWER CURVE



TORQUE CURVE

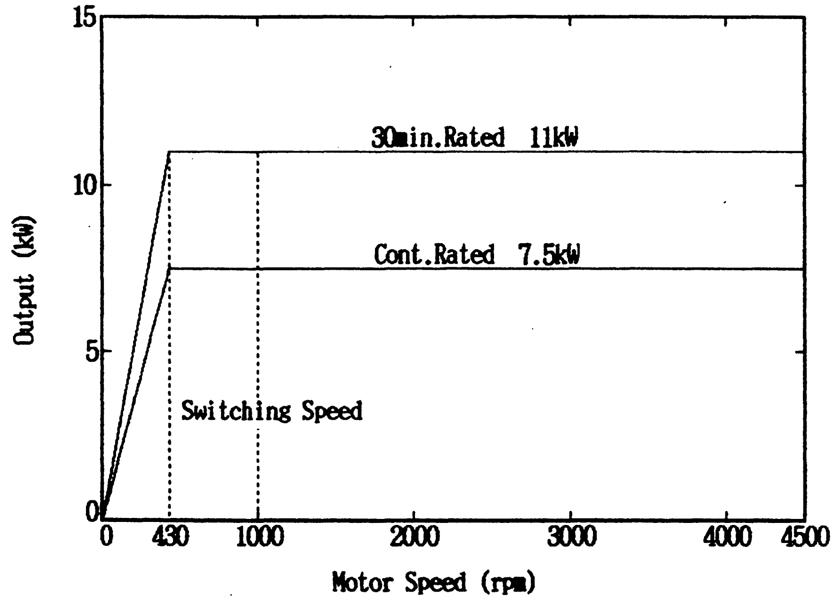


Corresponding rotor drawing No.
A290-0946-T211

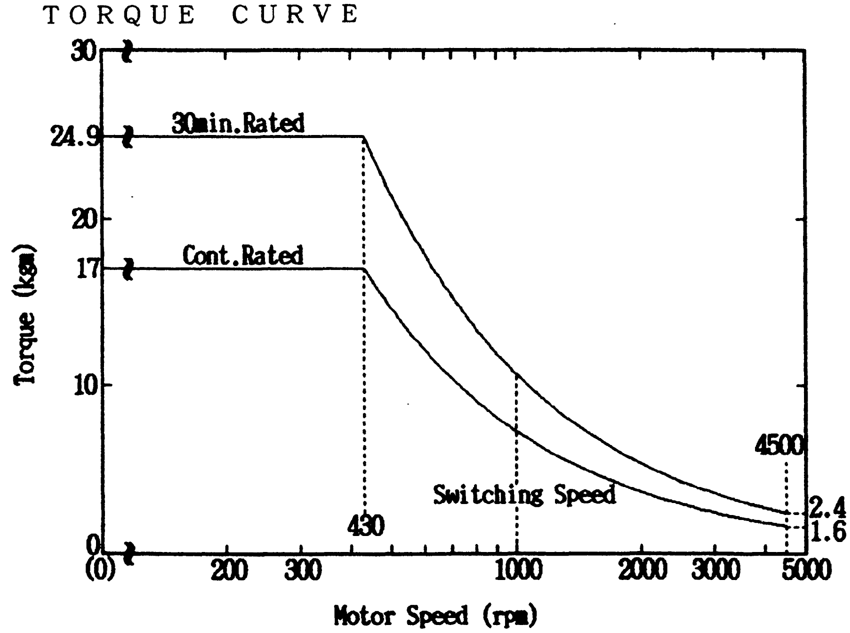
Corresponding stator drawing No.
A290-0946-T113

Model : B28
Output type : L529

POWER CURVE



TORQUE CURVE

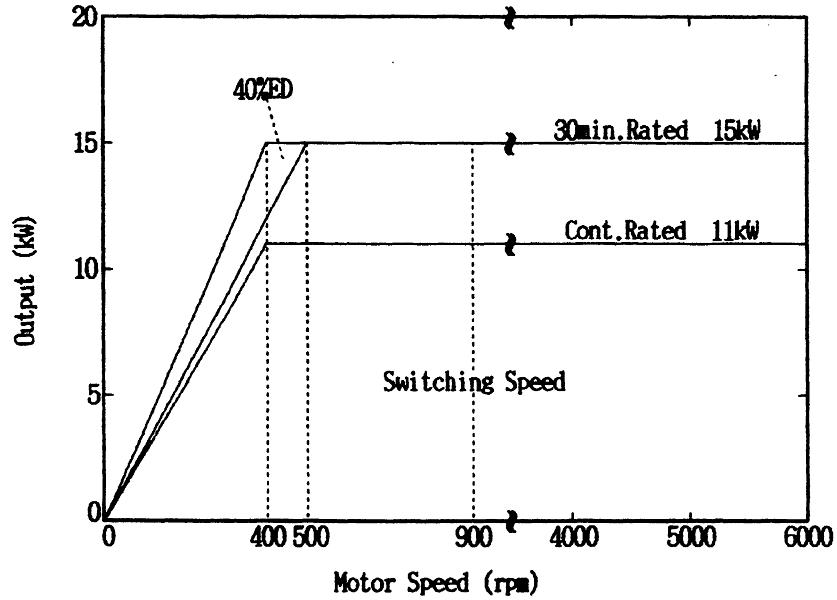


Corresponding rotor drawing No.
A290-0960-T221

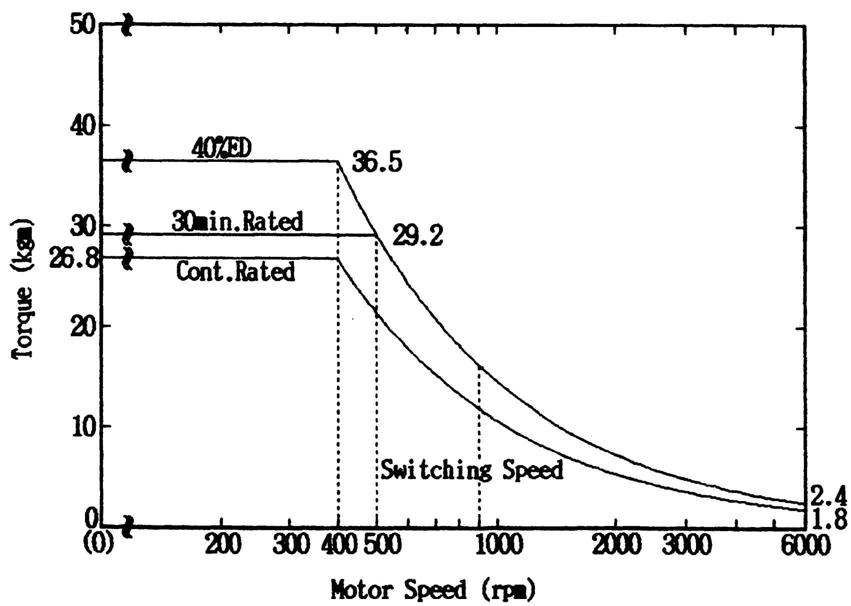
Corresponding stator drawing No.
A290-0960-T110

Model : B28
Output type : L530

POWER CURVE



TORQUE CURVE

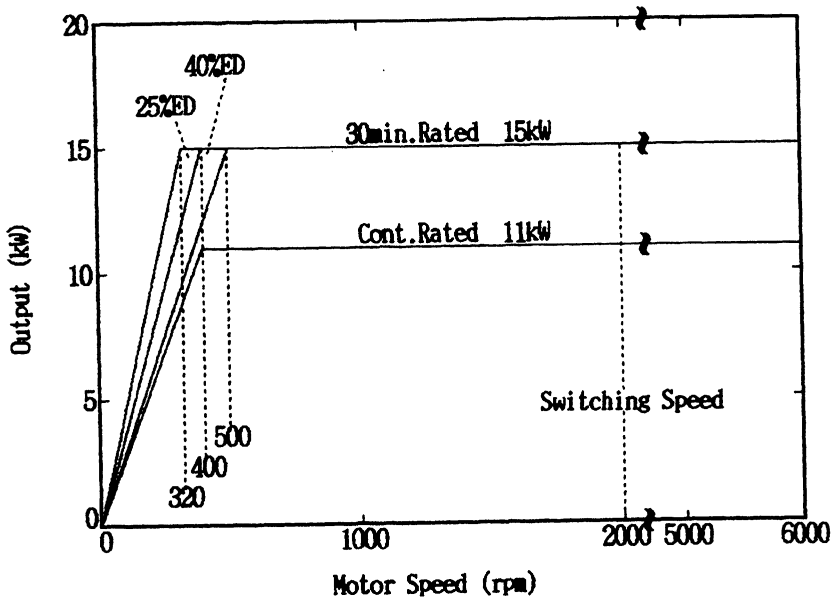


Corresponding rotor drawing No.
A290-0960-T201

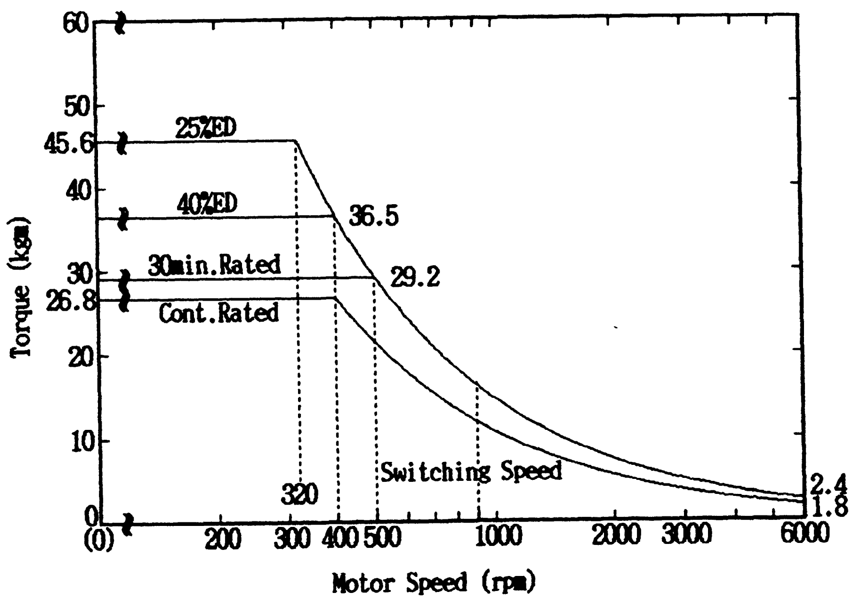
Corresponding stator drawing No.
A290-0960-T110

Model : B28
Output type : L531

POWER CURVE



TORQUE CURVE

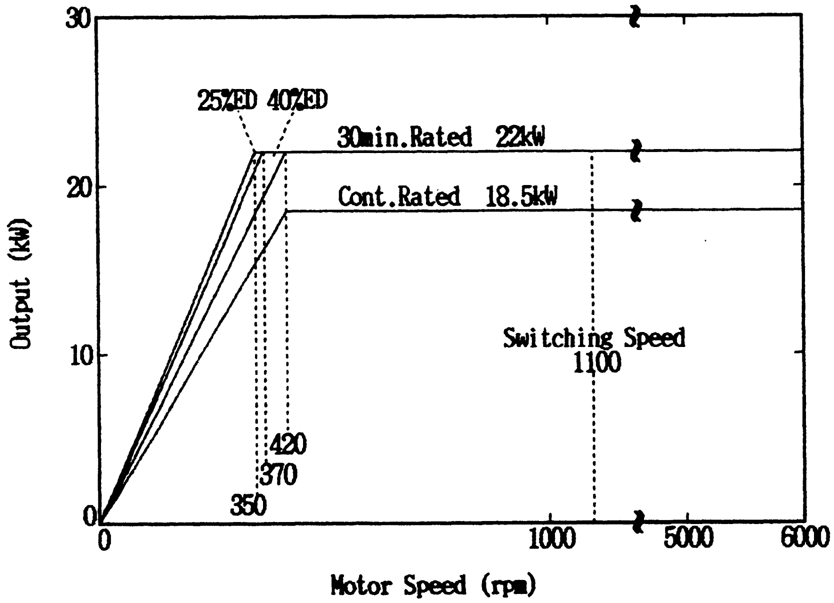


Corresponding rotor drawing No.
A290-0960-T201

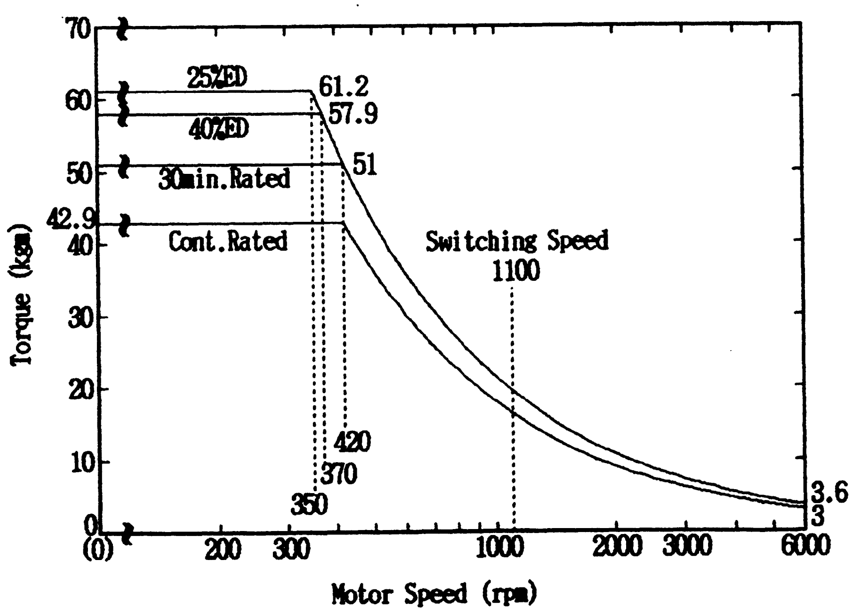
Corresponding stator drawing No.
A290-0960-T111

Model : B35
Output type : L532

POWER CURVE



TORQUE CURVE

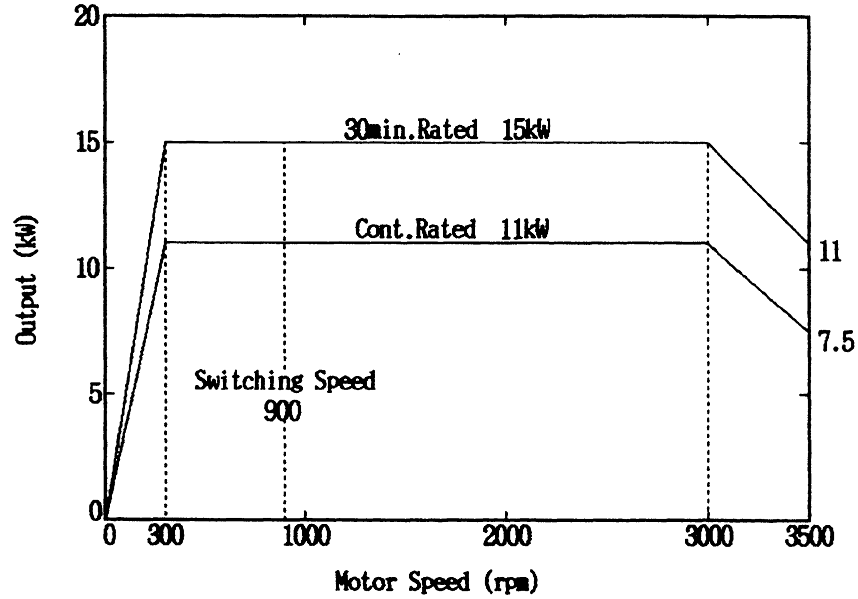


Corresponding rotor drawing No.
A290-0965-T201
A290-0965-T211

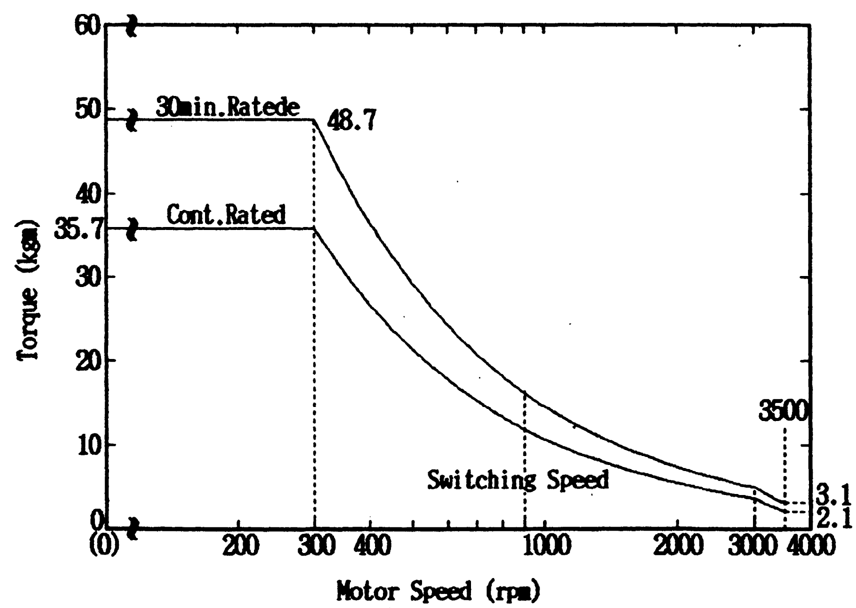
Corresponding stator drawing No.
A290-0965-T111

Model : B45
Output type : L533

POWER CURVE



TORQUE CURVE

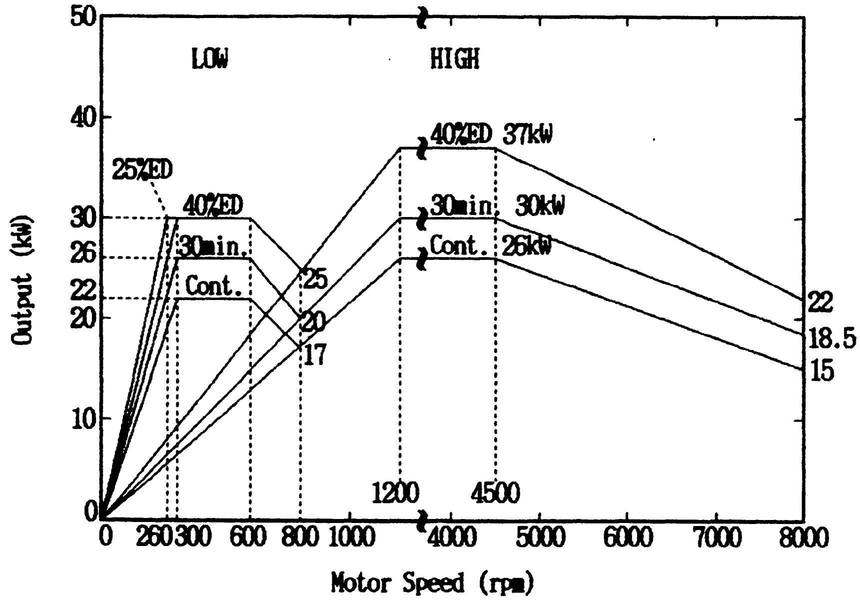


Corresponding rotor drawing No.
A290-0988-T221

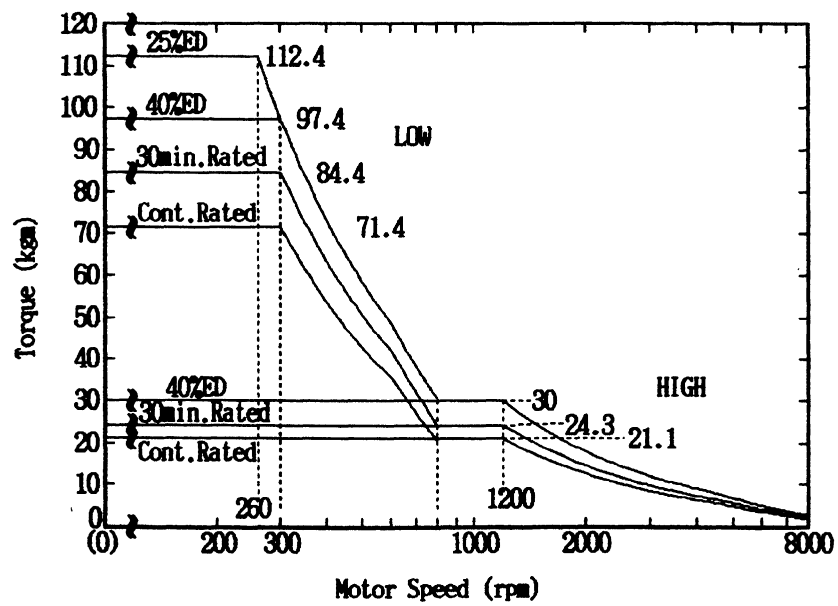
Corresponding stator drawing No.
A290-0988-T113

Model : B50
Output type : L534

POWER CURVE



TORQUE CURVE

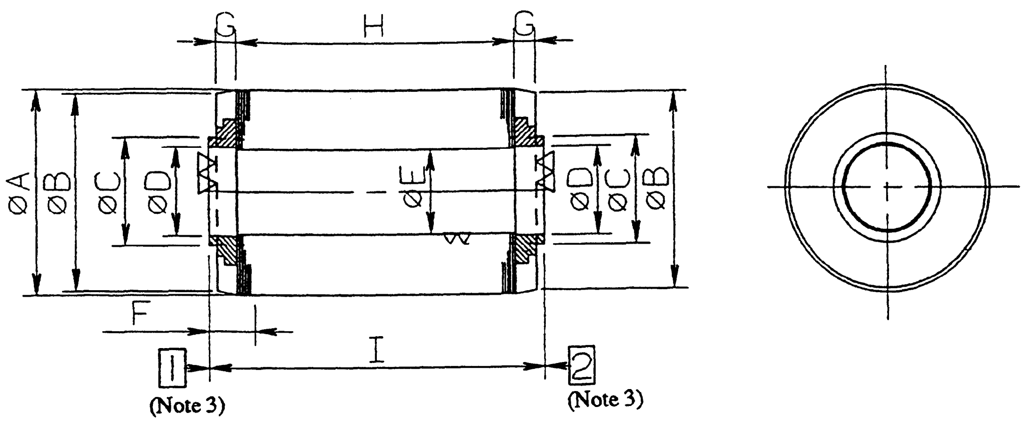


Corresponding rotor drawing No.
A290-0973-T211

Corresponding stator drawing No.
A290-0973-T111

5. ROTOR EXTERNAL DIMENSIONS

Model: B0.3
Rotor No.: A290-0953-T211
Output type: L127



Model	B0.3
A (Note 1)	49 (48.6 ± 0.01)
B	46
C	25.5
D (Note 2)	21 (25.5)
E (Note 2)	20 (25 ± 0.005)
F (Note 3)	12 (8 ± 0.1)
G	8
H	65
I (Note 3)	89 (81 ± 0.2)

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimension for finishing.

Note 2) Dimensions F is the inside diameter of the rotor core. Finish this portion to the dimension in parentheses. Finish dimension D together with dimension F.

Note 3) A profile irregularity is not provided for faces $\boxed{1}$ and $\boxed{2}$. When the squareness to finishing dimension E needs to be obtained, use dimensions F and I for the reference inside diameter of the rotor, and finish it to the dimension in parentheses.

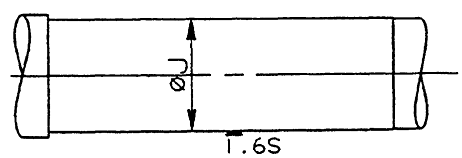
Note 4) When inserting the rotor into the shaft, apply shrink-fitting at min. 130°C and max. 180°C the room temperature.

Note 5) When coolant is used for machining, completely remove water from the cores after machining.

Note 6) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of Reference figure in Chapter II and F of supplementary report.)

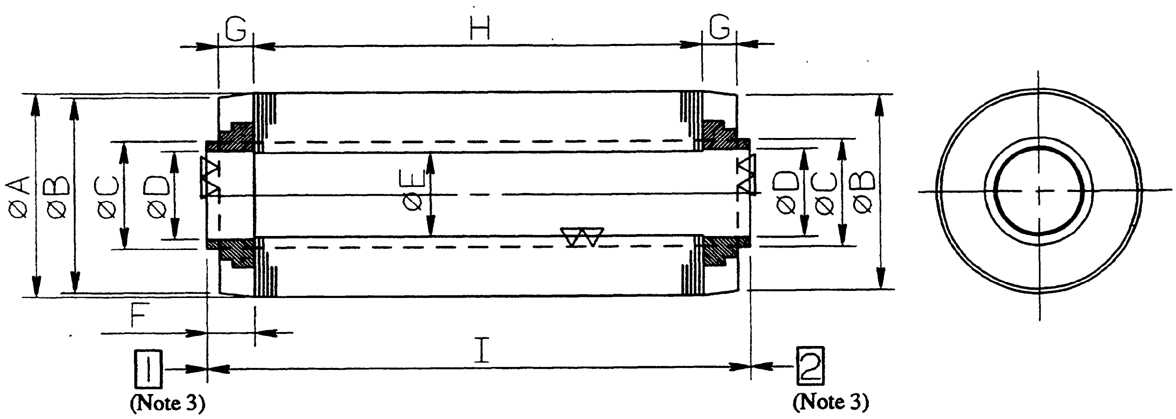
Reference size at spindle shaft:

(The size below is the shaft size when the axis is shrink-fit to E.)



	B0.3
J	$25^{+0.018}_{+0.012}$
Interference	7 to 23 μm

Model: B0.5
Rotor No.: A290-0955-T211
Output type: L113, L128



Model	B0.5
A (Note 1)	49 (48.6 ± 0.01)
B	46
C	25.5
D (Note 2)	21 (25.5)
E (Note 2)	20 (25 ± 0.005)
F (Note 3)	12 (8 ± 0.1)
G	8
H	106
I (Note 3)	130 (122.0 ± 0.2)

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimension for finishing.

Note 2) Dimensions F is the inside diameter of the rotor core. Finish this portion to the dimension in parentheses. Finish dimension D together with dimension F.

Note 3) A profile irregularity is not provided for faces $\boxed{1}$ and $\boxed{2}$. When the squareness to finishing dimension E needs to be obtained, use dimensions F and I for the reference inside diameter of the rotor, and finish it to the dimension in parentheses.

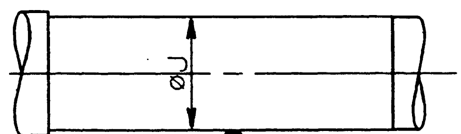
Note 4) When inserting the rotor into the shaft, apply shrink-fitting at min. 130°C and max. 180°C the room temperature.

Note 5) When coolant is used for machining, completely remove water from the cores after machining.

Note 6) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of Reference figure in Chapter II and F of supplementary report.)

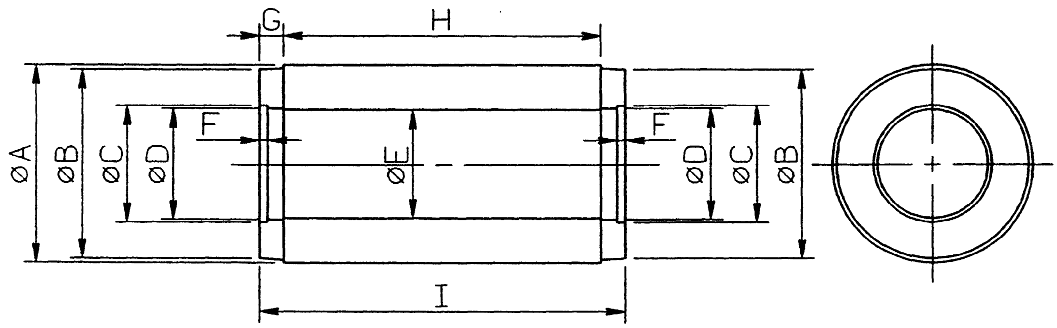
Reference size at spindle shaft:

(The size below is the shaft size when the axis is shrink-fit to E.)



	B0.5
J	$25^{+0.018}_{+0.012}$
Interference	7 to 23 μm

Model: B1
Rotor No.: A290-0921-T211
Output type: L129



Model	B1
A (Note 1)	$74.8^{+1}_{-0.5}$ (74.0 ± 0.01)
B	72
C	44
D (Note 2)	42 (42.5)
E (Note 2)	41 (42.0 ± 0.005)
F	3
G	9
H	118
I	136

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimensions for final finishing.

Note 2) The dimension of E is the inside diameter of the rotor core.

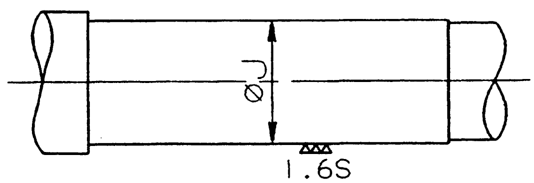
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

Reference size at spindle shaft:

(The size below is the shaft size when the shaft is shrink-fit into E.)

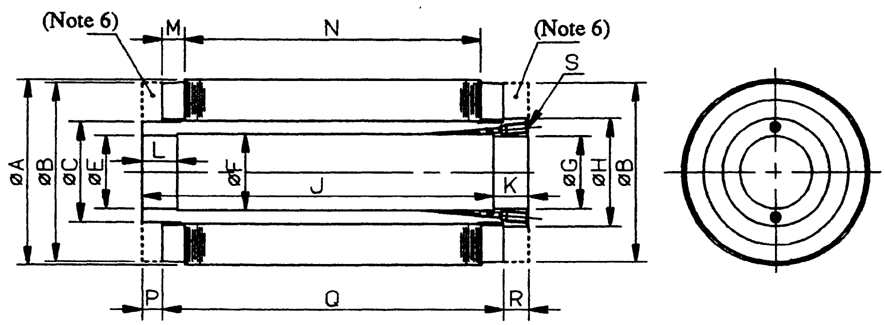


	B1
J	$42.03^{+0.005}_{-0}$
Interference	25 to 40 μm

Model: B1

Rotor No.: A290-0921-T201

Output type: L129



Model	B1		
A (Note 1)	<75>		
B	72		
C	40		
D (Note 2)			
E (Note 2)	29.2 ± 0.05 (29.5 ± 0.008)		
F	30.5		
G (Note 2)	28.9 ± 0.05 (29.2 ± 0.008)		
H	43		
I		N	118
J	140 ± 0.2	P	8
K	14 ± 0.1	Q	136
L	14 ± 0.1	R	10
M	9	S	M4 × P0.5

Note 1) The size in < > is a reference size.

Note 2) The final finishing is required. The size in ( ) is a reference size.

Note 3) For insertion into the shaft, shrinkage fitting is required.
(normal temperature +130°C or higher)

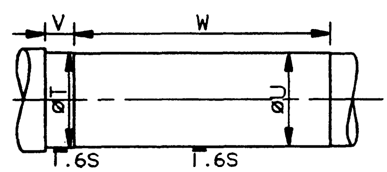
Note 4) For machining with coolant applied, sufficiently dry the moisture between the cores.

Note 5) Grinding allowance of the inside diameter is assumed to be ϕ0.3.

Note 6) Do not interfere with the broken line part: it is the balance corrected area.

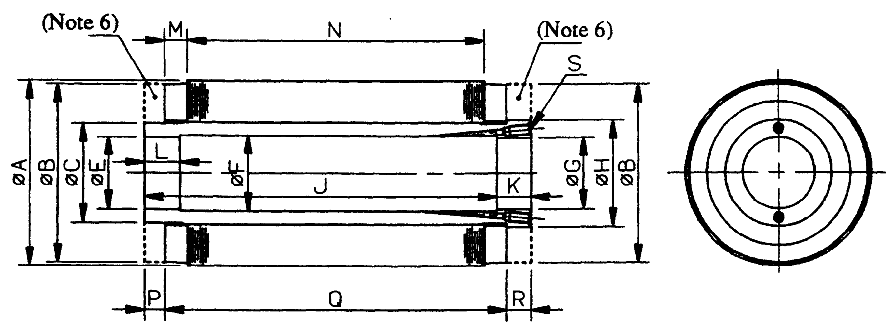
Reference size at spindle shaft:

(The size below is a shaft size when E and G are finished with the size in parenthesis above.)



	B1
T	$29.53^{+0.005}_{-0}$
U	$29.23^{+0.005}_{-0}$
V	14 ± 0.1
W	139.5 ± 0.2
Interference	from 22 to 43 μm

Model: B1.5
Rotor No.: A290-0951-T202
Output type: L130



Model	B1.5		
A (Note 1)	<75>		
B	72		
C	40		
D (Note 2)			
E (Note 2)	29.2 ± 0.05 (29.2 ± 0.008)		
F	30.5		
G (Note 2)	28.9 ± 0.05 (29.2 ± 0.008)		
H	43		
I		N	168
J	190 ± 0.2	P	8
K	14 ± 0.1	Q	186
L	14 ± 0.1	R	10
M	9	S	M4 × P0.5

Note 1) The size in < > is a reference size.

Note 2) The final finishing is required. The size in ( ) is a reference size.

Note 3) For insertion into the shaft, shrinkage fitting is required.
(normal temperature +130°C or higher)

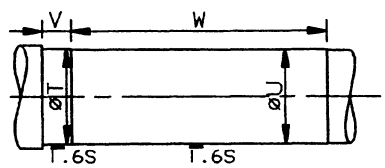
Note 4) For machining with coolant applied, sufficiently dry the moisture between the cores.

Note 5) Grinding allowance of the inside diameter is assumed to be ϕ0.3.

Note 6) Do not interfere with the broken line part: it is the balance corrected area.

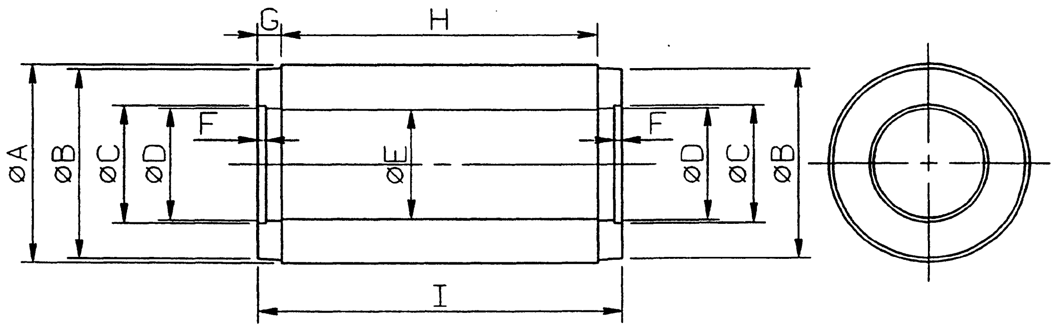
Reference size at spindle shaft:

(The size below is a shaft size when E and G are finished with the size in parenthesis above.)



	B1.5
T	$29.53^{+0.005}_{-0}$
U	$29.23^{+0.005}_{-0}$
V	14 ± 0.1
W	189.5 ± 0.2
Interference	from 22 to 43 μm

Model: B1.5
Rotor No.: A290-0951-T211
Output type: Under development



Model	B1
A (Note 1)	$74.8^{+1}_{-0.5}$ (74.0 ± 0.015)
B	72
C	44
D (Note 2)	42 (42.5)
E (Note 2)	41 (42.0 ± 0.005)
F	3
G	9
H	168
I	186

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimensions for final finishing.

Note 2) The dimension of E is the inside diameter of the rotor core.

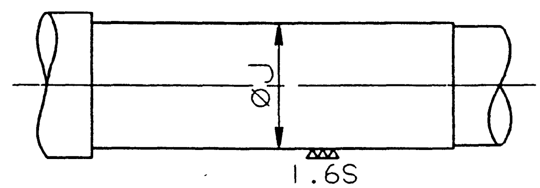
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

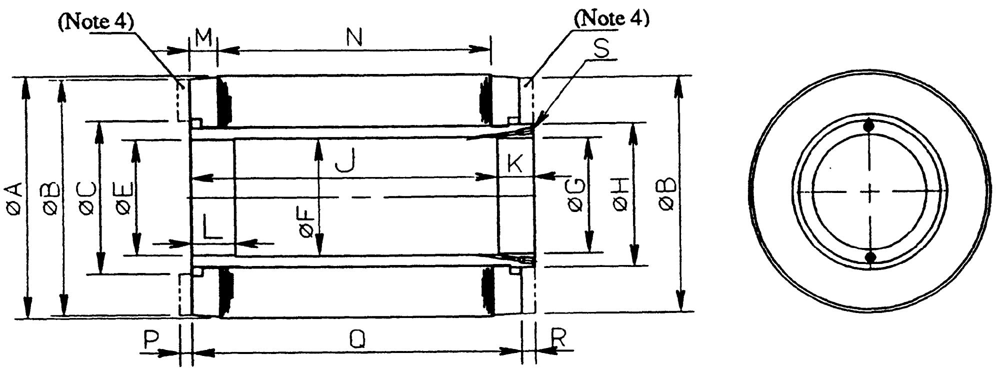
Reference size of the spindle shaft:

(The size below is the shaft size when the shaft is shrink-fit into E.)



	B1
J	$42.03^{+0.005}_{-0}$
Interference	25 to 40 μm

Model: B2
Rotor No.: A290-0922-T202
Output type: L120, L515



Model	B2		
A (Note 1)	<100>		
B	96		
C	57		
D (Note 2)			
E (Note 2)	44.86 ± 0.05 (45.16 ± 0.008)		
F	46		
G (Note 2)	44.66 ± 0.05 (44.96 ± 0.008)		
H	61		
I		N	108
J	117.2 ± 0.2	P	8
K	17 ± 0.1	Q	134
L	17 ± 0.1	R	8
M	13	S	M4 × P0.5

Note 1) The size in angle brackets (< >) is a reference size. Finishing is completed with a dimensional tolerance of +0.02.

Note 2) Apply final-finishing. The value in parentheses is a reference dimension for final finishing.

Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

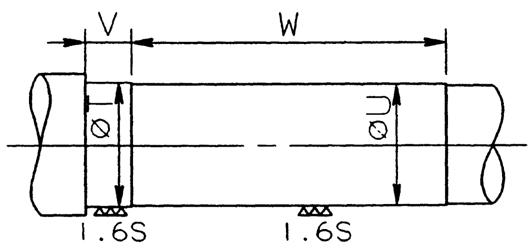
Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Grinding allowance of the inside diameter is assumed to be ϕ0.3.

Note 6) The dashed line indicates the balance correction areas of the rotor; an object such as a weight is attached to the rotor in this area. So, be careful not to allow any other parts to interfere with the area indicated by the dashed line. For balancing the spindle, see F of the reference figures in Chapter II and F of the supplemental report.

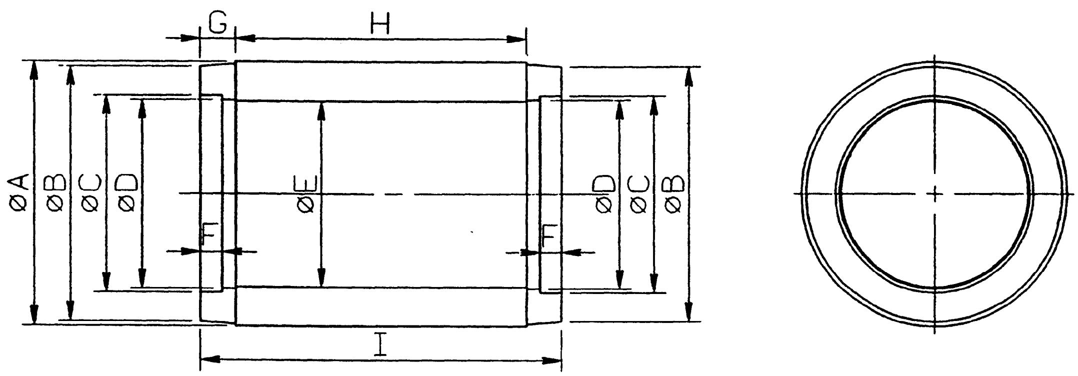
Reference size of the spindle shaft:

(The size below is the shaft size when E and G are finished according to the values in parentheses above.)



	B1.5
T	$45.20\ ^{+0.005}_{-0}$
U	$45.00\ ^{+0.005}_{-0}$
V	17 ± 0.1
W	116.5 ± 0.2
Interference	from 32 to 53 μm

Model: B2(8)
Rotor No.: A290-0982-T211
Output type: L516



Model	B2(8)
A (Note 1)	$99.3^{+0.2}_{-0}$ (99.0 ± 0.02)
B	96
C	74
D	71
E (Note 2)	70 (70.5 ± 0.005)
F	8
G	13
H	108
I	134

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimensions for final finishing.

Note 2) The dimension of E is the inside diameter of the rotor core.

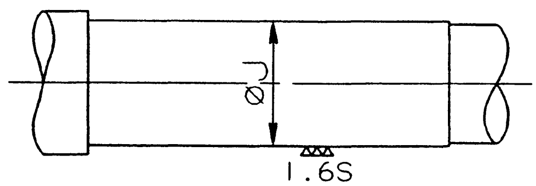
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

Reference size of the spindle shaft:

(The size below is the shaft size when the shaft is shrink-fit into E.)

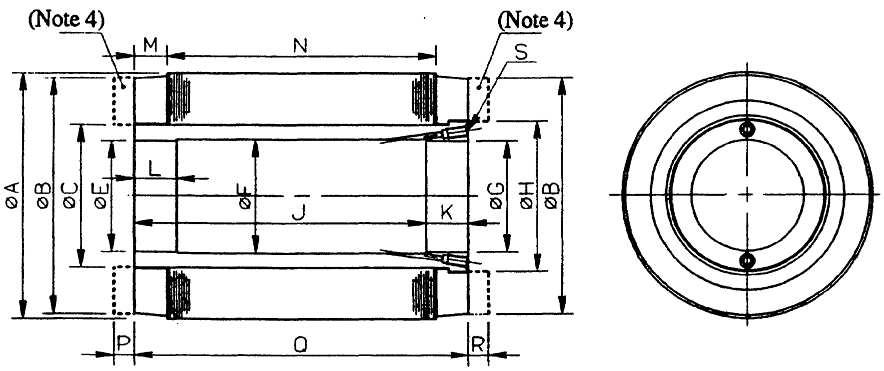


	B2(8)
J	$70.5^{+0.05}_{+0.04}$
Interference	30 to 55 μm

Model: B3

Rotor No.: A290-0923-T201

Output type: L517



Model	B2		
A (Note 1)	<100>		
B	96		
C	57		
D (Note 2)			
E (Note 2)	44.86 ± 0.05 (45.16 ± 0.008)		
F	46		
G (Note 2)	44.66 ± 0.05 (44.96 ± 0.008)		
H	61		
I		N	208
J	217 ± 0.2	P	8
K	17 ± 0.1	Q	234
L	17 ± 0.1	R	8
M	13	S	M4 × P0.5

Note 1) The dimension in < > is for reference.

Note 2) Final-finishing is required. The dimension in parentheses is for finishing reference.

Note 3) When inserting the rotor into the shaft, apply shrink-fitting at at least 130°C above the room temperature.

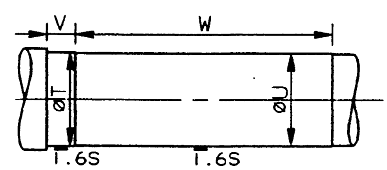
Note 4) When coolant is used for machining, completely remove water from the cores.

Note 5) The grinding tolerance of the inside diameter is assumed to be ϕ0.3.

Note 6) Make sure that the portions marked with broken lines do not interfere with other portions, because they are balancing areas.

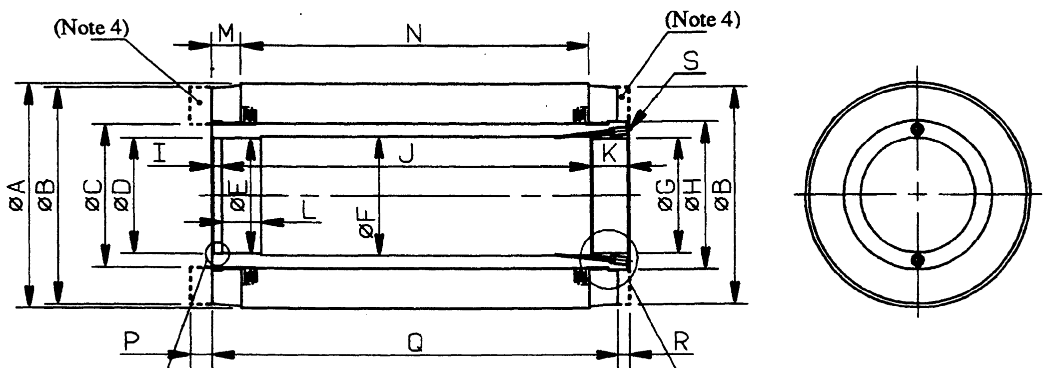
Reference size at spindle shaft:

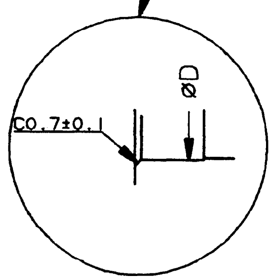
(The size below is a shaft size when E and G are finished with the size in parenthesis above.)

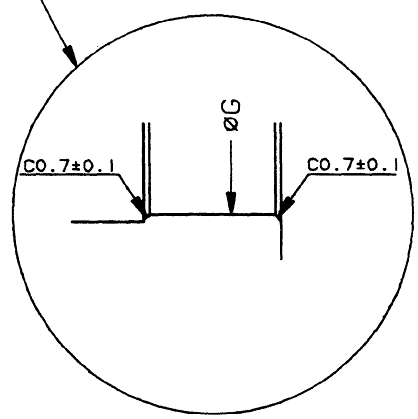


	B3
T	45.20 $^{+0.005}_{-0}$
U	45.00 $^{+0.005}_{-0}$
V	17 ± 0.1
W	216.5 ± 0.2
Interference	from 32 to 53 μm

Model: B6
Rotor No.: A290-0926-T201
Output type: L131, L132







Model	B6		
A (Note 1)	<115>		
B	111		
C	73		
D (Note 2)	59.3 ± 0.05 (59.6 ± 0.010)		
E (Note 2)	59.1 ± 0.05 (59.4 ± 0.008)		
F	61		
G (Note 2)	58.9 ± 0.05 (59.2 ± 0.008)		
H	75.6		
I	5	N	178
J	189 ± 0.2	P	8
K	20 ± 0.1	Q	208
L	20 ± 0.1	R	8
M	15	S	M4 × P0.5

Note 1) The size in < > is a reference size.

Note 2) The final finishing is required. The size in ( ) is a reference size.

Note 3) For insertion into the shaft, shrinkage fitting is required.
(normal temperature + 130°C or higher)

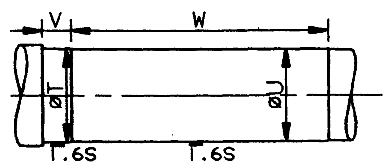
Note 4) For machining with coolant applied, sufficiently dry the moisture between the cores.

Note 5) Grinding allowance of the inside diameter is assumed to be ϕ0.3.

Note 6) Do not interfere with the broken line part: it is the balance corrected area.

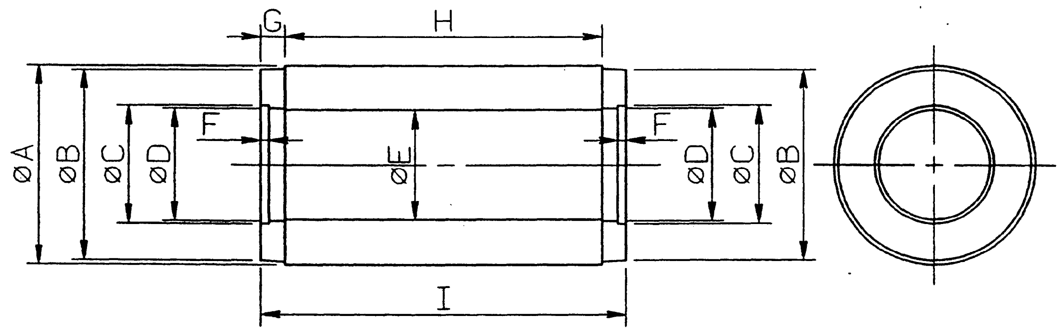
Reference size at spindle shaft:

(The size below is a shaft size when D, E, and G are finished with the size in parenthesis above.)



	B6
T	$59.46\ ^{+0.005}_{-0}$
U	$29.26\ ^{+0.005}_{-0}$
V	25 ± 0.1
W	188.5 ± 0.2
Interference	from 52 to 73 μm

Model: B6
Rotor No.: A290-0926-T211
Output type: L131, L132
(These types differ from L133 in the finishing dimension of the outside diameter of the rotor.)



Model	B6
A (Note 1)	$114.5^{+0.2}_{-0}$ (114.2 ± 0.02)
B	111
C	76
D (Note 2)	74.4 (75.2 ± 0.01)
E (Note 2)	74 (75.0 ± 0.01)
F	5
G	15
H	178
I	208

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimension for final finishing.

Note 2) The dimension of D is the inside diameter of the end rings. The dimension of E is the inside diameter of the rotor core. The values in parentheses are the dimensions for finishing.

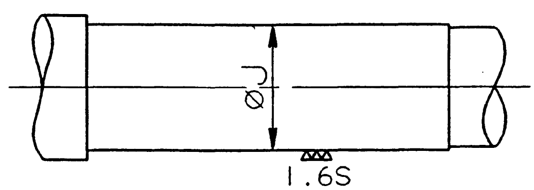
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

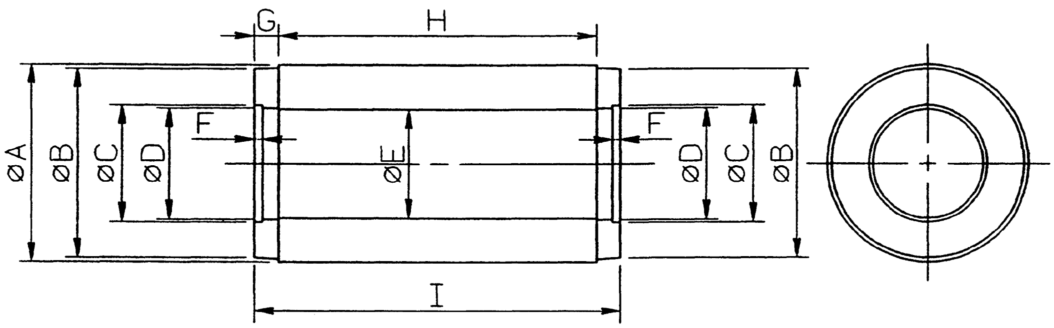
Reference size of the spindle shaft:

(The size below is the shaft size when the shaft is shrink-fit into E.)



	B1
J	$75.0^{+0.06}_{+0.04}$
Interference	30 to 70 μm

Model: B6
Rotor No.: A290-0926-T211
Output type: L133
(This type differs from L131 and L132 in the finishing dimension of the outside diameter of the rotor.)



Model	B6
A (Note 1)	$114.5^{+0.2}_{-0}$ (113.8 ± 0.02)
B	111
C	76
D (Note 2)	74.4 (75.2 ± 0.1)
E (Note 2)	74 (75.0 ± 0.01)
F	5
G	15
H	178
I	208

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimension for final finishing.

Note 2) The dimension of D is the inside diameter of the end rings. The dimension of E is the inside diameter of the rotor core. The values in parentheses are the dimensions for finishing.

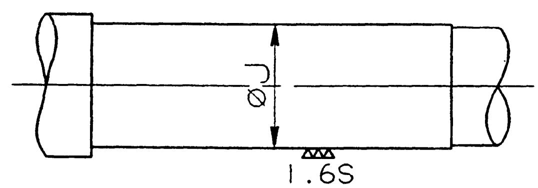
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

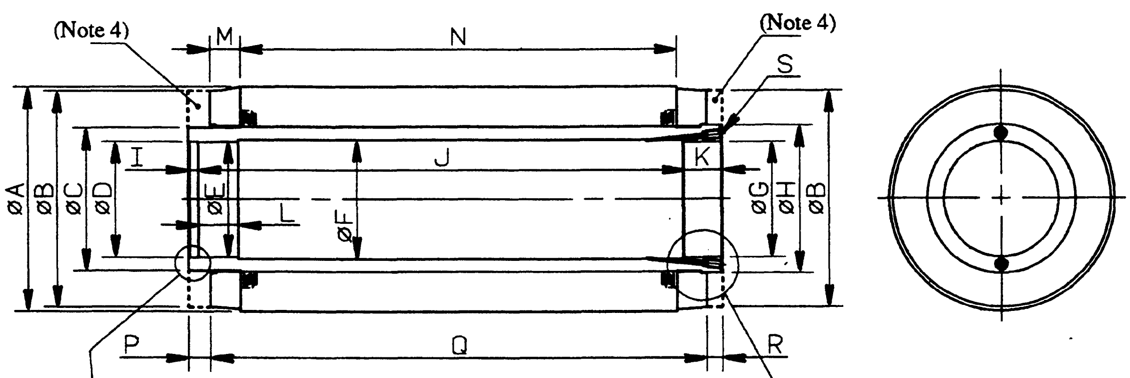
Reference size of the spindle shaft:

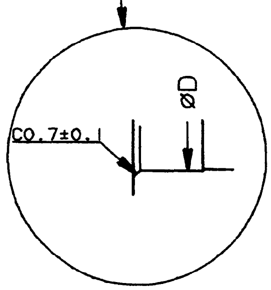
(The size below is the shaft size when the shaft is shrink-fit into E.)

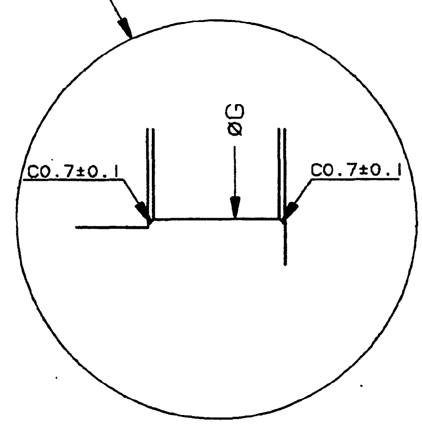


	B6
J	$75.0^{+0.06}_{-0.04}$
Interference	30 to 70 μm

Model: B8
Rotor No.: A290-0958-T201
Output type: L134, L511, L519, L520







Model	B8		
A (Note 1)	<115>		
B	111		
C	73		
D (Note 2)	59.3 ± 0.05 (59.6 ± 0.010)		
E (Note 2)	59.1 ± 0.05 (59.4 ± 0.008)		
F	61		
G (Note 2)	58.9 ± 0.05 (59.2 ± 0.008)		
H	75.6		
I	5	N	224
J	248 ± 0.2	P	11
K	20 ± 0.1	Q	254
L	20 ± 0.1	R	8
M	15	S	M4 × P0.5

Note 1) The size in < > is a reference size.

Note 2) The final finishing is required. The size in ( ) is a reference size.

Note 3) For insertion into the shaft, shrinkage fitting is required.
(normal temperature +130°C or higher)

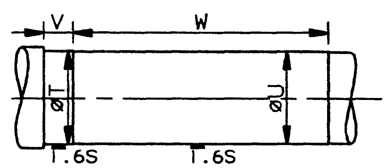
Note 4) For machining with coolant applied, sufficiently dry the moisture between the cores.

Note 5) Grinding allowance of the inside diameter is assumed to be ϕ0.3.

Note 6) Do not interfere with the broken line part: it is the balance corrected area. (See F of Reference figure in Chapter II and F of supplementary report.)

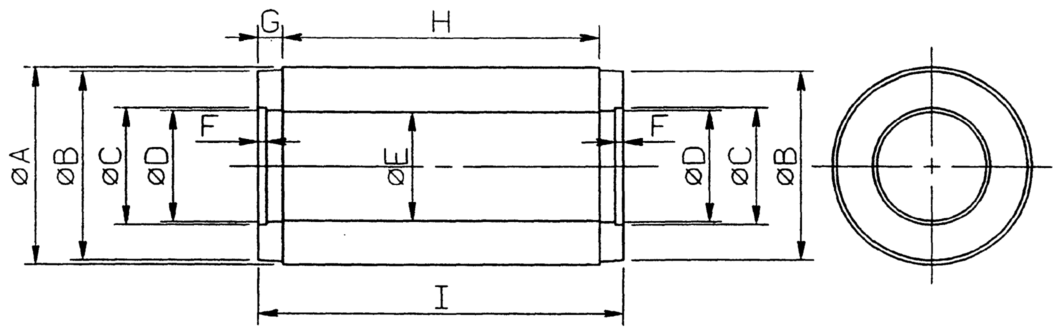
Reference size at spindle shaft:

(The dimension below is a shaft size when D, E, and G are finished with the size in parenthesis above.)



	B8
T	$59.46^{+0.005}_{-0}$
U	$59.26^{+0.005}_{-0}$
V	25 ± 0.1
W	247.5 ± 0.2
Interference	52 to 73 μm

Model: B8
Rotor No.: A290-0958-T213
Output type: L511, L520



Model	B8
A (Note 1)	$114.5^{+0.2}_{-0}$ (114.2 ± 0.02)
B	111
C	76
D (Note 2)	74.4 (75.2 ± 0.1)
E (Note 2)	74 (75.0 ± 0.01)
F	5
G	15
H	224
I	254

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimension for final finishing.

Note 2) The dimension of D is the inside diameter of the end rings. The dimension of E is the inside diameter of the rotor core. The values in parentheses are the dimensions for finishing.

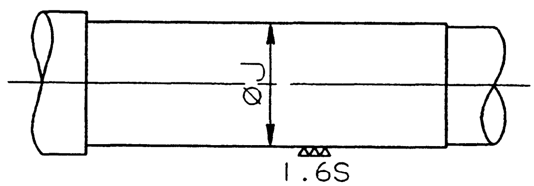
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

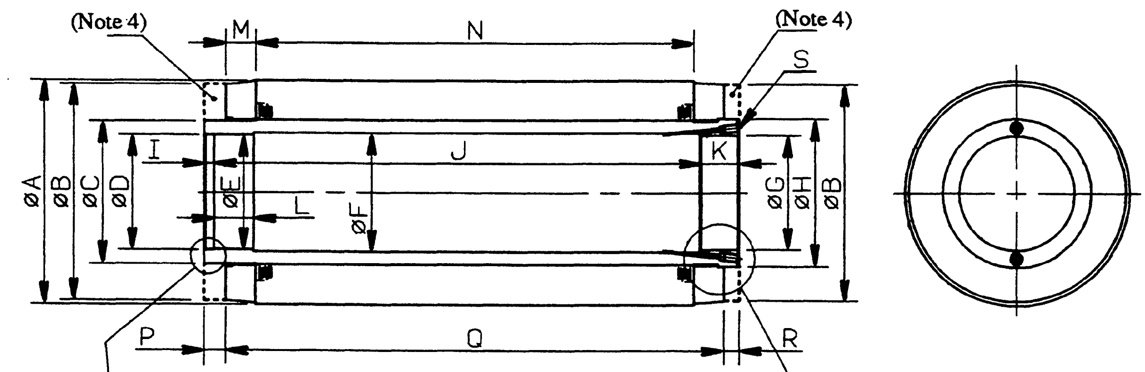
Reference size of the spindle shaft:

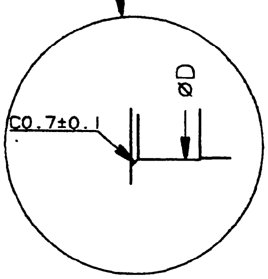
(The size below is the shaft size when the shaft is shrink-fit into E.)

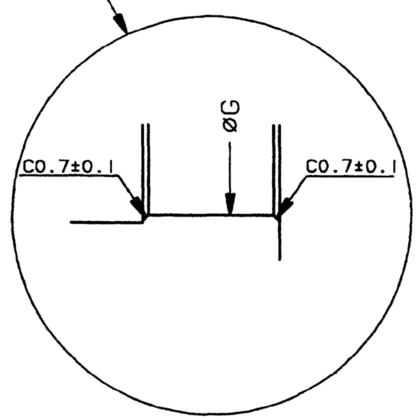


	B8
J	$75.0^{+0.06}_{+0.04}$
Interference	30 to 70 μm

Model: B10
Rotor No.: A290-0930-T201
Output type: L521, L522







Model	B10		
A (Note 1)	<115>		
B	111		
C	73		
D (Note 2)	59.3 ± 0.05 (59.6 ± 0.010)		
E (Note 2)	59.1 ± 0.05 (59.4 ± 0.008)		
F	61		
G (Note 2)	58.9 ± 0.05 (59.2 ± 0.008)		
H	75.6		
I	5	N	278
J	302 ± 0.2	P	11
K	20 ± 0.1	Q	308
L	20 ± 0.1	R	8
M	15	S	M4 × P0.5

Note 1) The size in < > is a reference size.

Note 2) The final finishing is required. The size in ( ) is a reference size.

Note 3) For insertion into the shaft, shrinkage fitting is required.
(normal temperature + 130°C or higher)

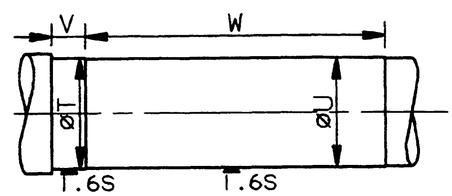
Note 4) For machining with coolant applied, sufficiently dry the moisture between the cores.

Note 5) Grinding allowance of the inside diameter is assumed to be ϕ0.3.

Note 6) Do not interfere with the broken line part: it is the balance corrected area. (See F of reference figure in Chapter II and F of supplementary report.)

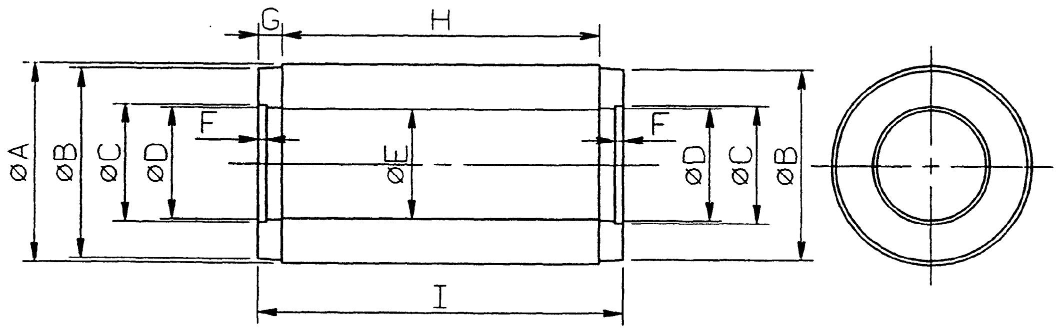
Reference size at spindle shaft:

(The size below is a shaft size when the D, E, and G are finished with the size in parenthesis above.)



	B10
T	$59.46^{+0.005}_{-0}$
U	$59.26^{+0.005}_{-0}$
V	25 ± 0.1
W	301.5 ± 0.2
Interference	from 52 to 73 μm

Model: B10
Rotor No.: A290-0930-T211
Output type: L521, L522



Model	B10
A (Note 1)	$114.5^{+0.2}_{-0}$ (114.2 ± 0.02)
B	111
C	76
D (Note 2)	74.4 (75.2 ± 0.1)
E (Note 2)	74 (75.0 ± 0.01)
F	5
G	15
H	278
I	308

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimension for final finishing.

Note 2) The dimension of D is the inside diameter of the end rings. The dimension of E is the inside diameter of the rotor core. The values in parentheses are the dimensions for finishing.

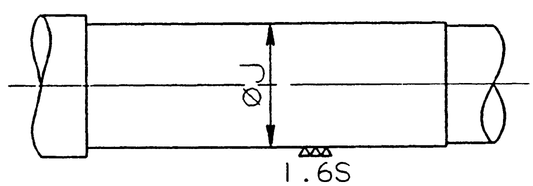
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

Reference size of the spindle shaft:

(The size below is the shaft size when the shaft is shrink-fit into E.)

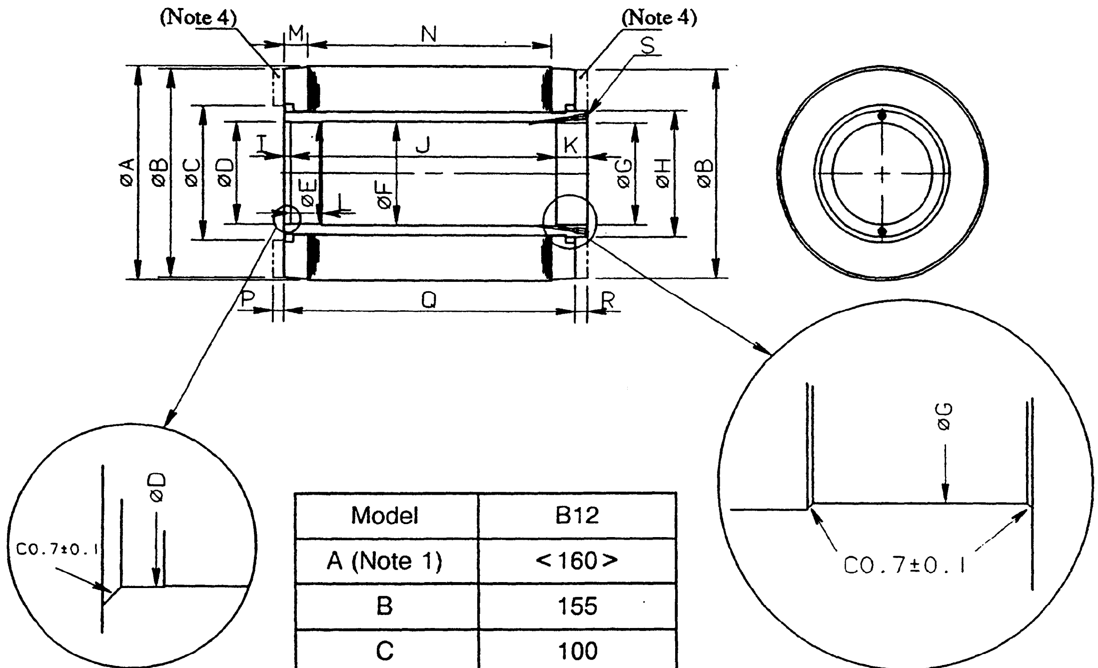


	B10
J	$75.0^{+0.05}_{+0.03}$
Interference	20 to 60 μm

Model: B12

Rotor No.: A290-0932-T201

Output type: L523



Model	B12		
A (Note 1)	<160>		
B	155		
C	100		
D (Note 2)	76.05 ± 0.05 (76.35 ± 0.010)		
E (Note 2)	75.8 ± 0.05 (76.1 ± 0.008)		
F	77		
G (Note 2)	75.6 ± 0.05 (75.9 ± 0.008)		
H	94		
I	5	N	180
J	196.5 ± 0.2	P	10
K	23.5 ± 0.1	Q	216
L	23 ± 0.1	R	10
M	18	S	M4 × P0.5

Note 1) The size in angle brackets (< >) is a reference size. Finishing is completed with a dimensional tolerance of ±0.02.

Note 2) Apply final-finishing. The value in parentheses is a reference dimension for final finishing.

Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

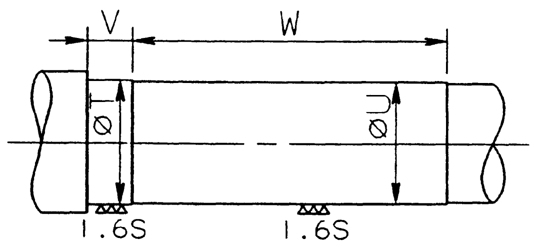
Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Grinding allowance of the inside diameter is assumed to be ϕ0.3.

Note 6) The dashed line indicates the balance correction areas of the rotor; an object such as a weight is attached to the rotor in this area. So, be careful not to allow any other parts to interfere with the area indicated by the dashed line. For balancing the spindle, see F of the reference figures in Chapter II and F of the supplemental report.

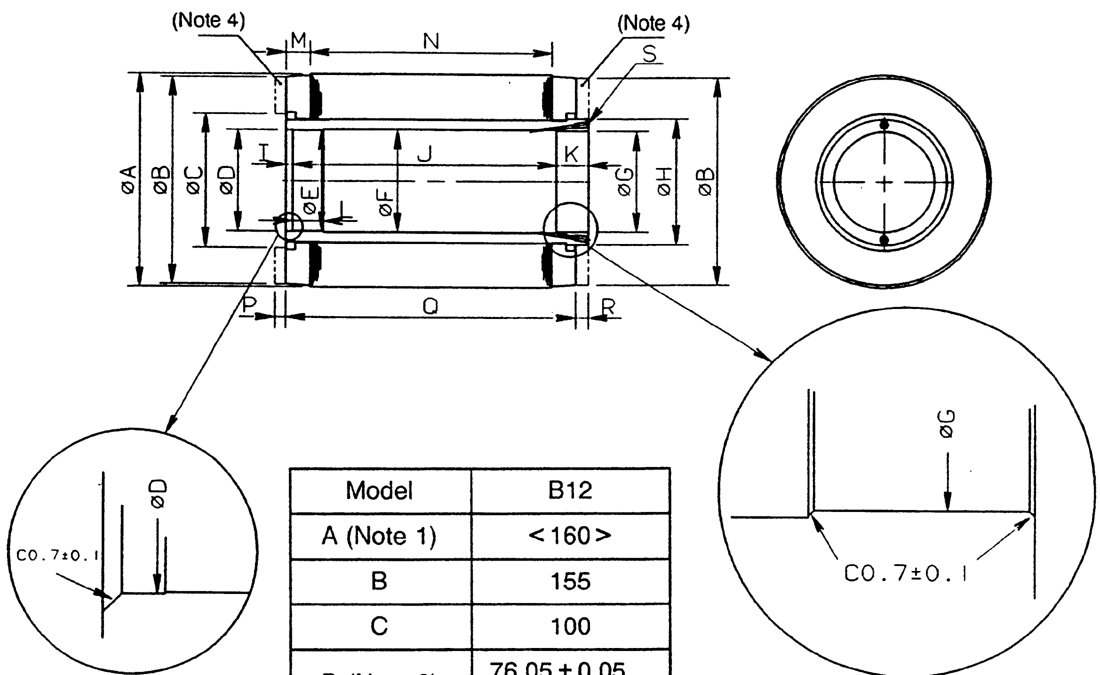
Reference size at spindle shaft:

(The size below is the shaft size when D, E, and G are finished according to the values in parentheses above.)



	B12
T	$76.18^{+0.005}_{-0}$
U	$75.98^{+0.005}_{-0}$
V	28 ± 0.1
W	196.5 ± 0.2
Interference	from 72 to 93 μm

Model: B12
Rotor No.: A290-0932-T203
Output type: L524



Model	B12		
A (Note 1)	< 160 >		
B	155		
C	100		
D (Note 2)	76.05 ± 0.05 (76.35 ± 0.010)		
E (Note 2)	75.8 ± 0.05 (76.1 ± 0.008)		
F	77		
G (Note 2)	75.6 ± 0.05 (75.9 ± 0.008)		
H	94		
I	5	N	180
J	196.5 ± 0.2	P	10
K	23.5 ± 0.1	Q	216
L	23 ± 0.1	R	10
M	18	S	M4 × P0.5

Note 1) The size in angle brackets (< >) is a reference size. Finishing is completed with a dimensional tolerance of +0.02.

Note 2) Apply final-finishing. The value in parentheses is a reference dimension for final finishing.

Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

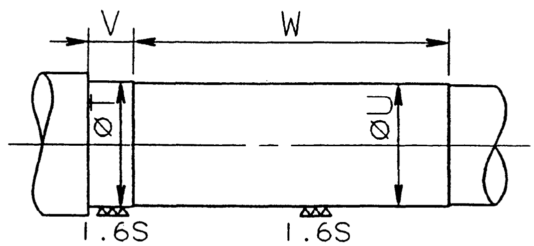
Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Grinding allowance of the inside diameter is assumed to be $\phi 0.3$.

Note 6) The dashed line indicates the balance correction areas of the rotor; an object such as a weight is attached to the rotor in this area. So, be careful not to allow any other parts to interfere with the area indicated by the dashed line. For balancing the spindle, see F of the reference figures in Chapter II and F of the supplemental report.

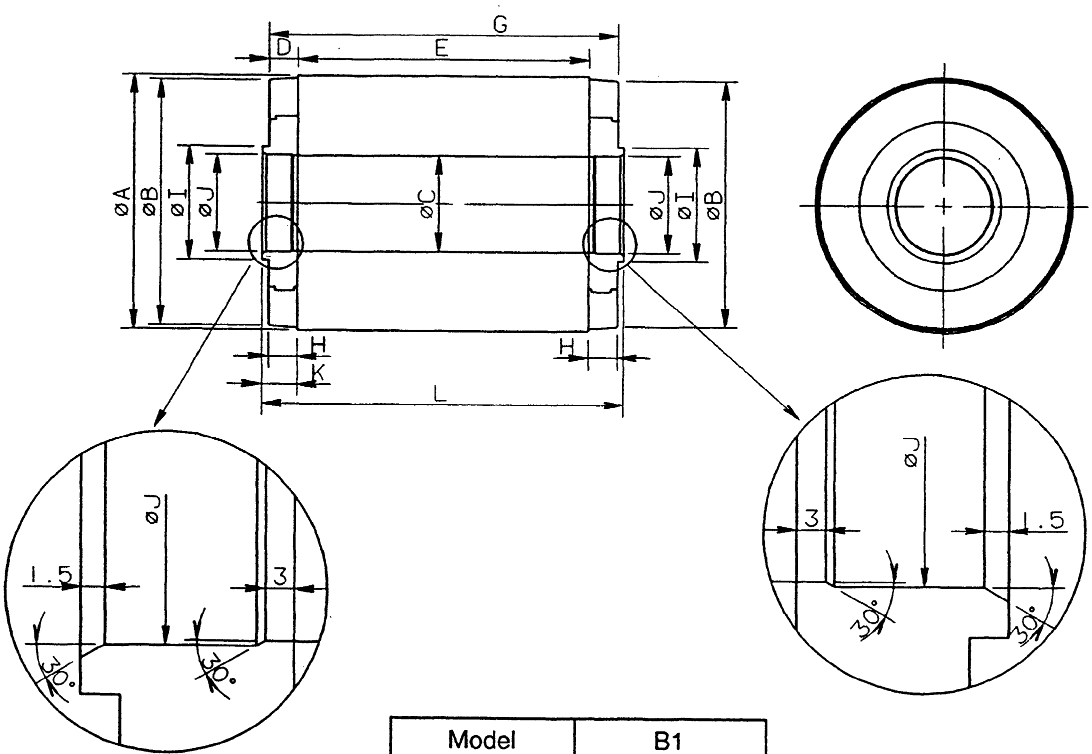
Reference size at spindle shaft:

(The size below is the shaft size when D, E, and G are finished according to the values in parentheses above.)



	B12
T	$76.18^{+0.005}_{-0}$
U	$75.98^{+0.005}_{-0}$
V	28 ± 0.1
W	196.5 ± 0.2
Interference	from 72 to 93 μm

Model: B12
Rotor No.: A290-0932-T212
Output type: L524



Model	B1
A (Note 1)	$158.6^{+0.2}_{-0}$ (158.3 ± 0.02)
B	154.7
C (Note 2)	60.1 (75 ± 0.01)
D	18
E	180
G	216
H	18
I (Note 2)	71.5 (75.5)
J (Note 2)	61.5 (75.5)
K (Note 2)	22 (18)
L (Note 2)	224 (216)

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimension for final finishing.

Note 2) The values in parentheses are the dimensions for finishing.

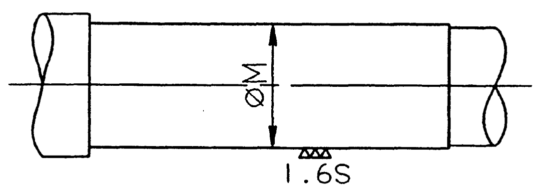
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

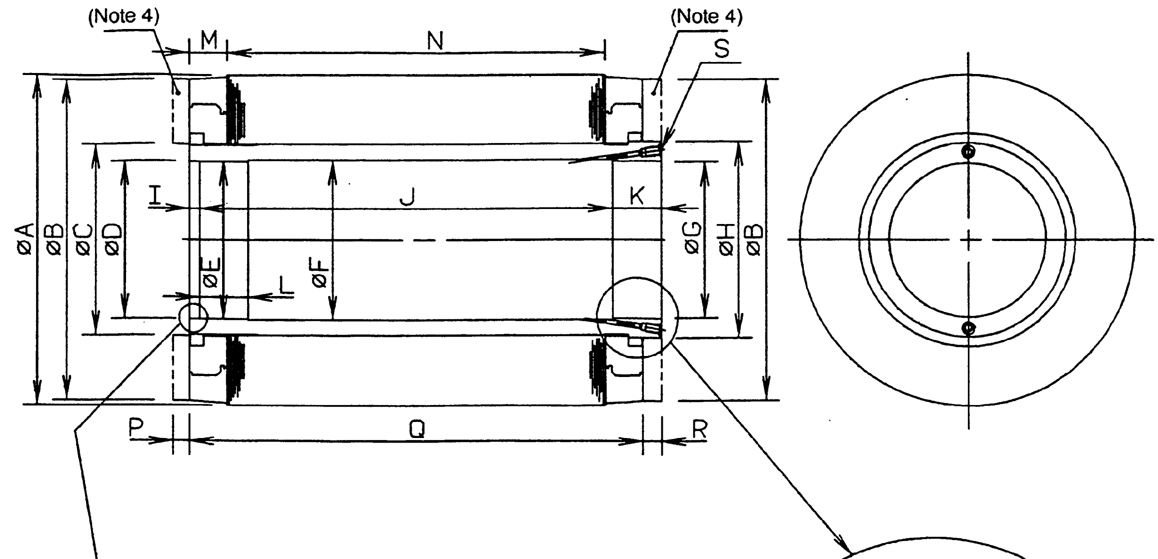
Reference size of the spindle shaft:

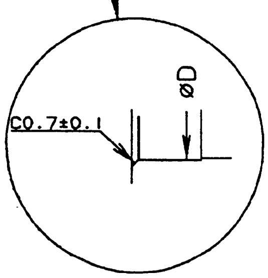
(The size below is the shaft size when the shaft is shrink-fit into C.)

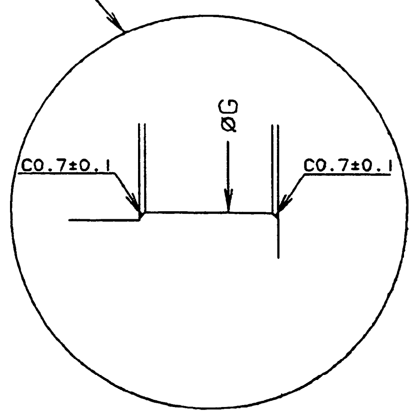


	B12
M	75.04 ± 0.01
Interference	from 20 to 60 μm

Model: B15
Rotor No.: A290-0935-T201
Output type: L135







Model	B15		
A (Note 1)	<160>		
B	155		
C	100		
D (Note 2)	76.05 ± 0.05 (76.35 ± 0.010)		
E (Note 2)	75.8 ± 0.05 (76.1 ± 0.008)		
F	77		
G (Note 2)	75.6 ± 0.05 (75.9 ± 0.008)		
H	94		
I	5	N	180
J	196.5 ± 0.2	P	10
K	23.5 ± 0.1	Q	216
L	23 ± 0.1	R	10
M	18	S	M4 × P0.5

Note 1) The size in angle brackets (< >) is a reference size. Finishing is completed with a dimensional tolerance of ±0.02.

Note 2) Apply final-finishing. The value in parentheses is a reference dimension for finishing.

Note 3) When inserting the rotor into the shaft, apply shrink-fitting at least 130°C above the room temperature.

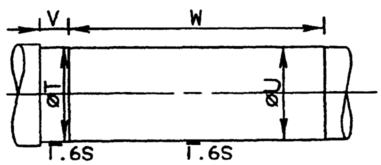
Note 4) When coolant is used for machining, completely remove water from the cores.

Note 5) The grinding tolerance of the inside diameter is assumed to be ϕ0.3.

Note 6) Make sure that the portions marked with broken lines do not interfere with other portions, because they are balancing areas.

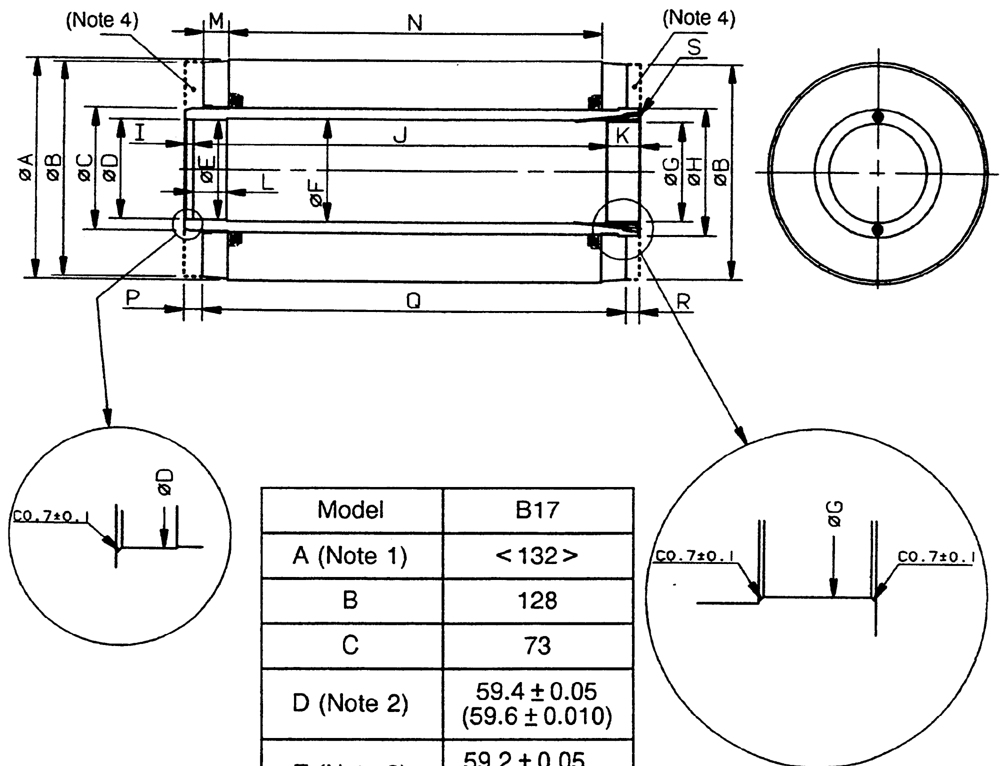
Reference size at spindle shaft:

(The size below is a shaft size when D, E, and G are finished with the size in parenthesis above.)



	B15
T	$76.18^{+0.005}_{-0}$
U	$75.98^{+0.005}_{-0}$
V	28 ± 0.1
W	196.5 ± 0.2
Interference	from 72 to 93 μm

Model: B17
Rotor No.: A290-0937-T201
Output type: L525



Model	B17		
A (Note 1)	< 132 >		
B	128		
C	73		
D (Note 2)	59.4 ± 0.05 (59.6 ± 0.010)		
E (Note 2)	59.2 ± 0.05 (59.6 ± 0.008)		
F	61		
G (Note 2)	59.0 ± 0.05 (59.2 ± 0.008)		
H	75		
I	5	N	224
J	248 ± 0.2	P	11
K	20 ± 0.1	Q	254
L	20 ± 0.1	R	8
M	15	S	M4 × P0.5

Note 1) The size in < > is a reference size. Finishing is completed with a dimensional tolerance of ± 0.02.

Note 2) The final finishing is required. The size in ( ) is a reference size.

Note 3) For insertion into the shaft, shrinkage fitting is required.
(normal temperature $+130°C$ or higher)

Note 4) For machining with coolant applied, sufficiently dry the moisture between the cores.

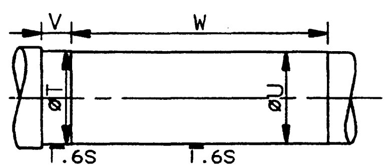
Note 5) Grinding allowance of the inside diameter is assumed to be $\phi 0.3$.

Note 6) Do not interfere with the broken line part: it is the balance corrected area.

Reference size at spindle shaft:

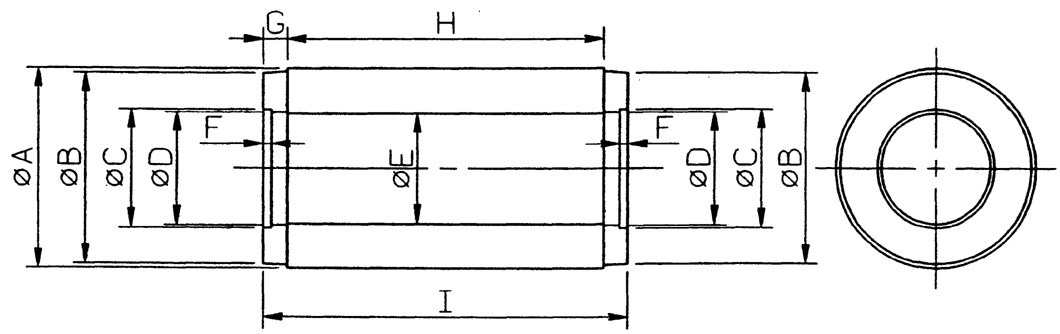
(The size below is a shaft size when D, E, and G are finished with the size in parenthesis above.)

To transmit motor torque sufficiently, the control for interference is required.



	B17
T	$59.46^{+0.005}_{-0}$
U	$59.26^{+0.005}_{-0}$
V	25 ± 0.1
W	247.5 ± 0.2
Interference	from 52 to 73 μm

Model: B17
Rotor No.: A290-0937-T211
Output type: L525



Model	B17
A (Note 1)	$131.3^{+0.2}_{-0}$ (131.0 ± 0.02)
B	128
C	75
D (Note 2)	74.4 (75.2 ± 0.1)
E (Note 2)	74 (75.0 ± 0.01)
F	5
G	15
H	224
I	254

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimension for final finishing.

Note 2) The dimension of D is the inside diameter of the end rings. The dimension of E is the inside diameter of the rotor core. The values in parentheses are the dimensions for finishing.

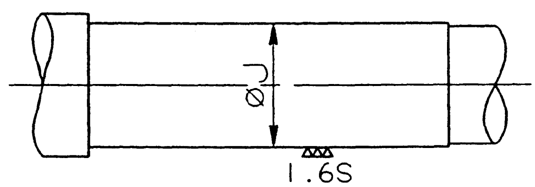
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

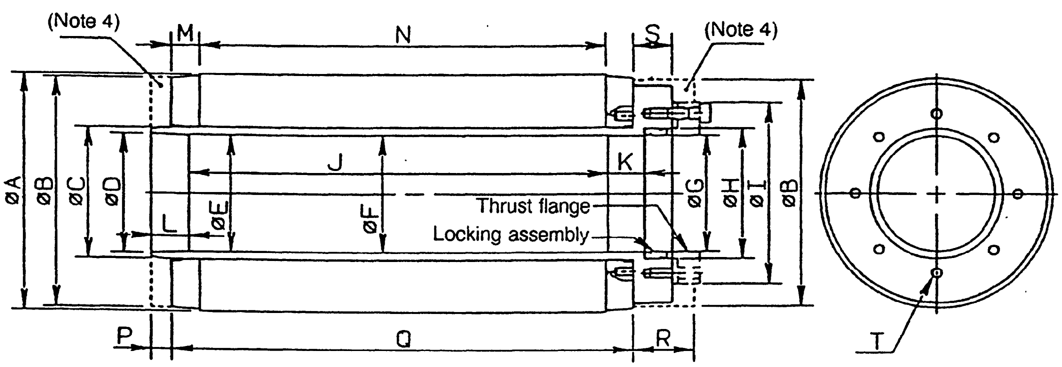
Reference size of the spindle shaft:

(The size below is the shaft size when the shaft is shrink-fit into E.)



	B17
J	$75.0^{+0.06}_{-0.04}$
Interference	30 to 70 μm

Model: B17
Rotor No.: A290-0937-T221
Output type: L525



Model	B17
A (Note 1)	< 132 >
B	128
C	73.5
D (Note 2)	$66.7^{+0}_{-0.3}$ ($67.0^{+0}_{-0.005}$)
E (Note 2)	$65^{+0}_{-0.3}$ ($65.3^{+0}_{-0.005}$)
F	65.5
G (Note 2)	64.7 ± 0.1 ($65^{+0.023}_{-0.015}$)
H (Note 2)	72.7 ± 0.05 ($73^{+0.03}_{-0}$)
I	101
J	231 ± 0.2
K	20 ± 0.1
L	20 ± 0.1

M	15
N	224
P	11
Q	254
R	33
S	21
T	8-M6 Depth 12 Equally spaced on ø89

Note 1) The size in angle brackets (< >) is a reference size. Finishing is completed with a dimensional tolerance of +0.02.

Note 2) Apply final-finishing. The value in parentheses is a reference dimension for finishing.

Note 3) The locking assembly method is used for joining the rotor with the shaft.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

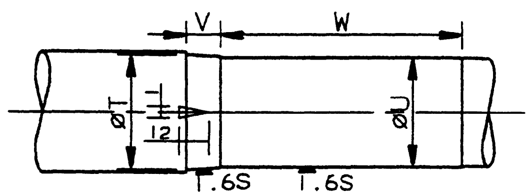
Note 5) Grinding allowance of the inside diameter is assumed to be $\phi 0.3$.

Note 6) The dashed line indicates the balance correction area of the rotor. Be careful not to allow any other parts to interfere with the area indicated by the dashed line.

Note 7) The thrust flange and locking assembly should be prepared.

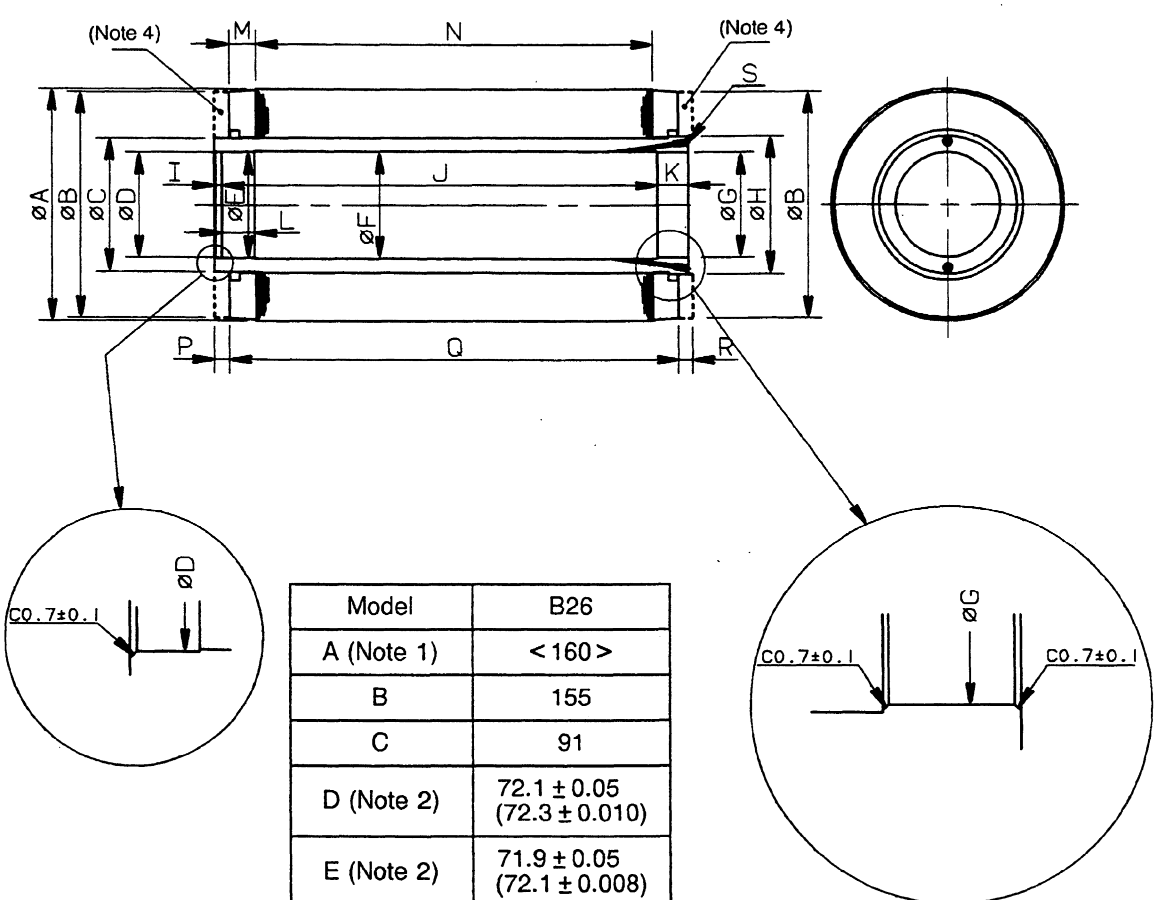
Reference size of the spindle shaft:

(The size below is the shaft size when D, E, and G are finished according to the values in parentheses above.)



	B17
T	$127.075^{+0}_{-0.005}$
U	125^{+0}
V	20 or more
W	263 or more

Model: B26
Rotor No.: A290-0946-T201
Output type: L527, L528



Model	B26		
A (Note 1)	<160>		
B	155		
C	91		
D (Note 2)	72.1 ± 0.05 (72.3 ± 0.010)		
E (Note 2)	71.9 ± 0.05 (72.1 ± 0.008)		
F	73		
G (Note 2)	71.6 ± 0.05 (71.8 ± 0.008)		
H	94		
I	5	N	270
J	296 ± 0.2	P	10
K	22 ± 0.1	Q	306
L	22 ± 0.1	R	10
M	18	S	M4 × P0.5

Note 1) The size in < > is a reference size.
Finishing is completed with a dimensional tolerance of ±0.03.

Note 2) The final finishing is required. The size in ( ) is a reference size.

Note 3) For insertion into the shaft, shrinkage fitting is required.
(normal temperature min. 130°C and max. 180°C .)

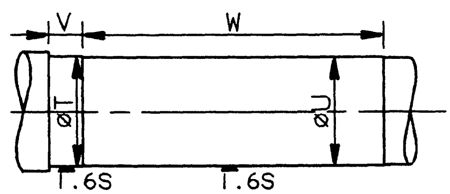
Note 4) For machining with coolant applied, sufficiently dry the moisture between the cores.

Note 5) Grinding allowance of the inside diameter is assumed to be ϕ0.2.

Note 6) Do not interfere with the broken line part: it is the balance corrected area.

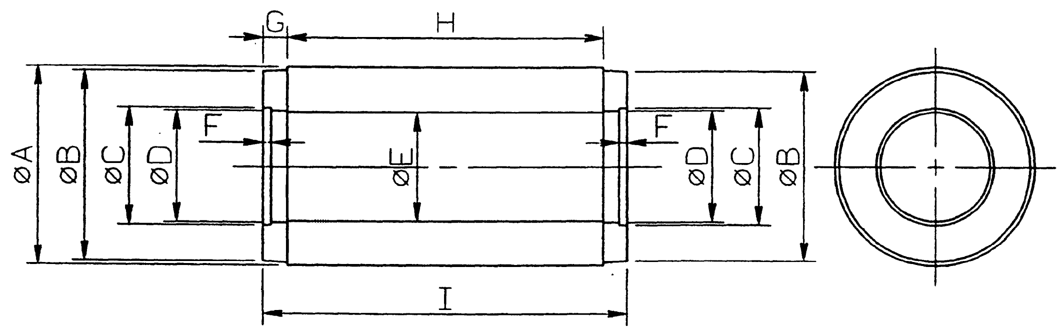
Reference size at spindle shaft:

(The size below is the shaft size when D, E, and G are finished with the size in parentheses above.)



	B26
T	$72.18^{+0.005}_{-0}$
U	$71.88^{+0.005}_{-0}$
V	27 ± 0.1
W	295.5 ± 0.2
Interference	from 72 to 93 μm

Model: B26
Rotor No.: A290-0946-T211
Output type: L527, L528



Model	B26
A (Note 1)	$159.2^{+0.2}_{-0}$ (158.8 ± 0.03)
B	155
C	102.4
D (Note 2)	92.4 ($95.1^{+0.05}_{-0}$)
E (Note 2)	92 ($95^{-0.01}_{-0.03}$)
F	7
G	18
H	270
I	306

Note 1) After press-fitting the rotor to the spindle, apply final-finishing to the outside surface of the rotor and the bearing of the spindle shaft.
The value in parentheses is the dimension for final finishing.

Note 2) The dimension of D is the inside diameter of the end rings. The dimension of E is the inside diameter of the rotor core. The values in parentheses are the dimensions for finishing.

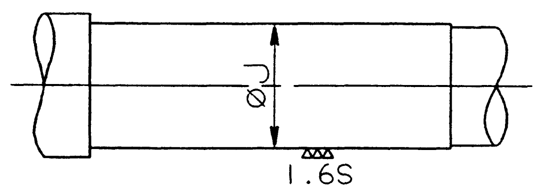
Note 3) To mate the shaft and rotor, apply shrink-fitting at 130°C to 180°C above room temperature.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

Note 5) Balance the rotor by attaching balance rings to the front and rear of the rotor. (See F of the reference figures in Chapter II and F of the supplemental report.)

Reference size at spindle shaft:

(The size below is the shaft size when the shaft is shrink-fit into E.)

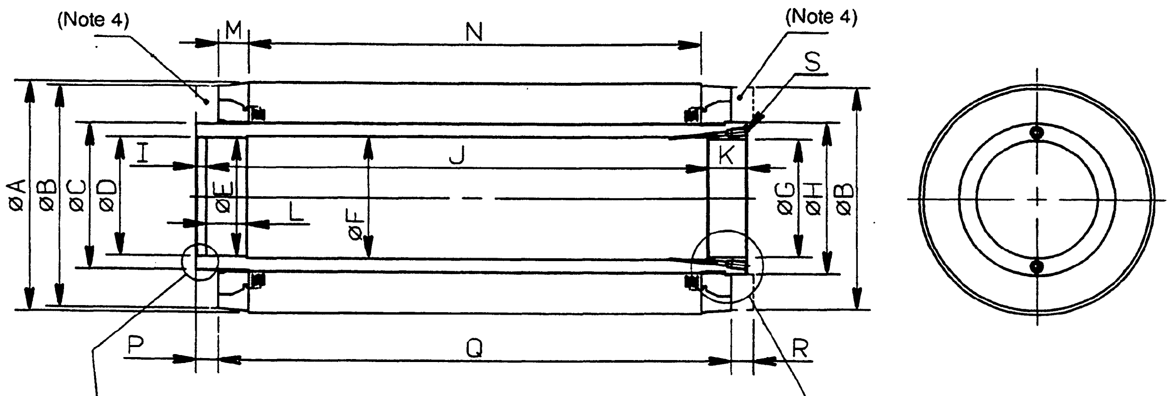


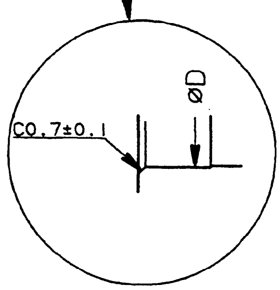
	B12
J	$95.0^{+0.03}_{-0.02}$
Interference	from 30 to 60 μm

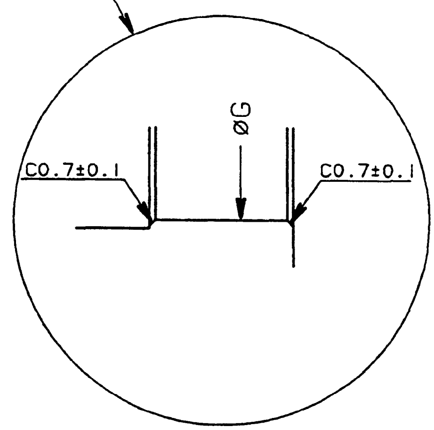
Model: B26

Rotor No.: A290-0946-T221

Output type: L526, L535







Model	B26		
A (Note 1)	<160>		
B	155		
C	100		
D (Note 2)	83.8 ± 0.05 (84.1 ± 0.010)		
E (Note 2)	83.6 ± 0.05 (83.9 ± 0.008)		
F	85		
G (Note 2)	83.3 ± 0.05 (83.6 ± 0.008)		
H	103		
I	5	N	270
J	291 ± 0.2	P	10
K	27 ± 0.1	Q	306
L	27 ± 0.1	R	10
M	18	S	M4 × P0.5

Note 1) The dimension in < > is for reference.

Note 2) Apply final-finishing. The dimension in parentheses are references for finishing.

Note 3) When inserting the rotor into the shaft, apply shrink-fitting at least 130°C above the room temperature.

Note 4) When coolant is used for machining, completely remove water from the cores.

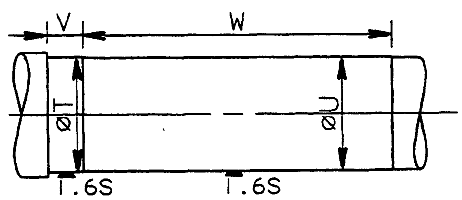
Note 5) The grinding tolerance of the inside diameter is assumed to be ϕ0.3.

Note 6) Make sure that the portions marked with broken lines do not interfere with other portions, because they are balancing areas.

Reference size at spindle shaft:

(The size below is a shaft size when D, E, and G are finished with the size in parenthesis above.)

To transmit motor torque sufficiently, the control for reference is required.

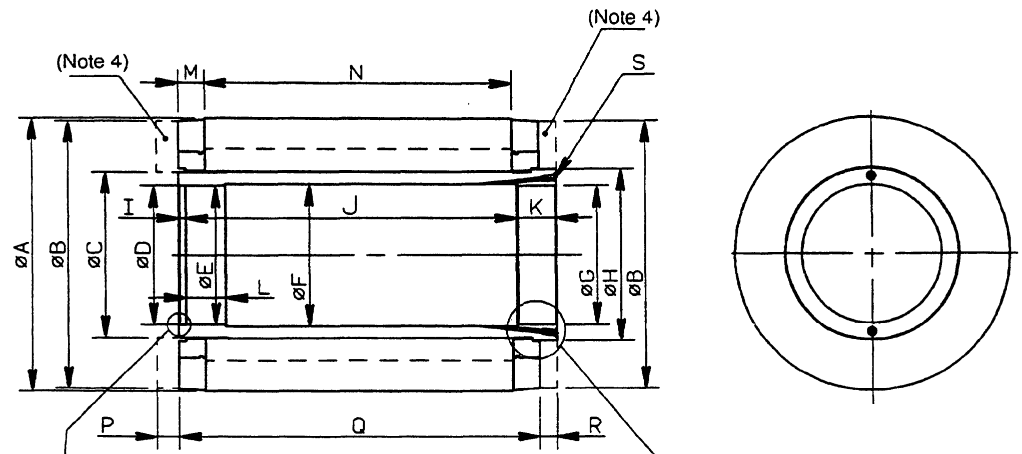


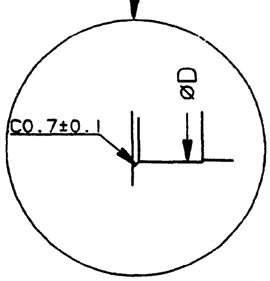
	B26
T	$83.97^{+0.005}_{-0}$
U	$83.67^{+0.005}_{-0}$
V	32 ± 0.1
W	290.5 ± 0.2
Interference	from 62 to 83 μm

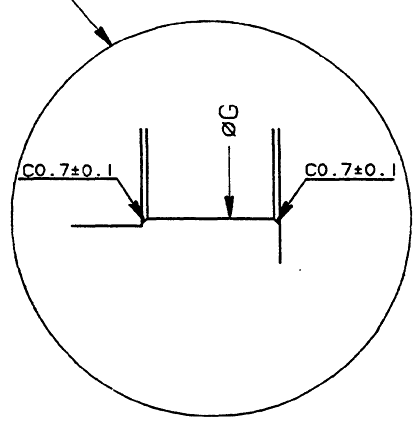
Model: B28

Rotor No.: A290-0960-T221

Output type: L529







Model	B28		
A (Note 1)	<190>		
B	185		
C	126.5		
D (Note 2)	103.8 ± 0.05 (104.1 ± 0.01)		
E (Note 2)	103.6 ± 0.05 (103.9 ± 0.008)		
F	105		
G (Note 2)	103.3 ± 0.05 (103.6 ± 0.008)		
H	126		
I	5	N	210
J	222 ± 0.1	P	15
K	31 ± 0.1	Q	246
L	31 ± 0.1	R	12
M	18	S	M4 × P0.5

Note 1) The dimension in < > is for reference.

Note 2) Apply final-finishing. The dimensions in parentheses are references for finishing.

Note 3) When inserting the rotor into the shaft, apply shrink-fitting at least 130°C above the room temperature.

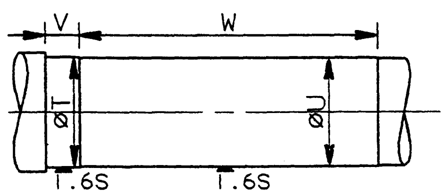
Note 4) When coolant is used for machining, completely remove water from the cores.

Note 5) The grinding tolerance of the inside diameter is assumed to be ϕ0.3.

Note 6) Make sure that the portions marked with broken lines do not interfere with other portions, because they are balancing areas.

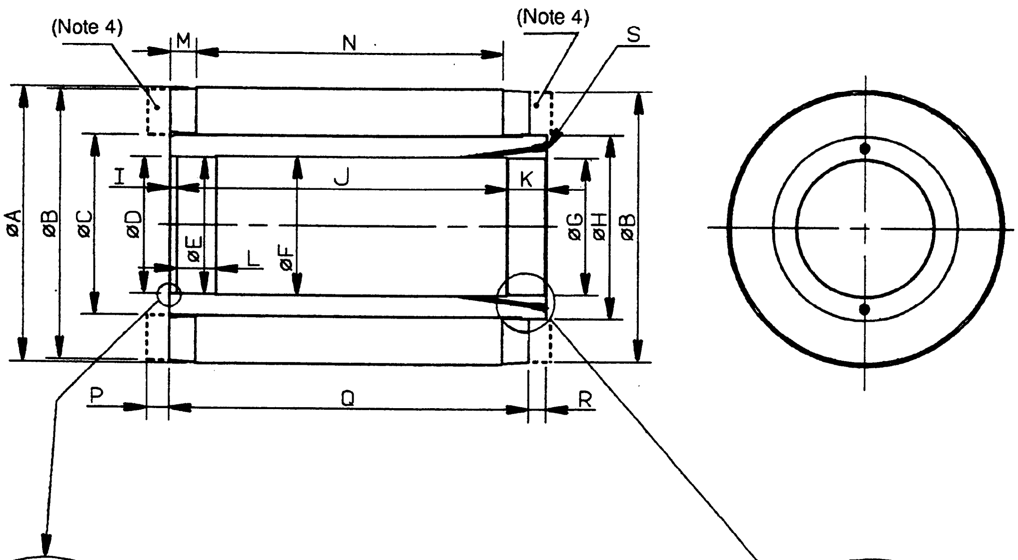
Reference size at spindle shaft:

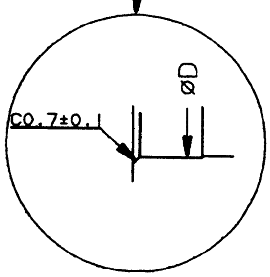
(The size below is a shaft size when E and G are finished with the size in parenthesis above.)

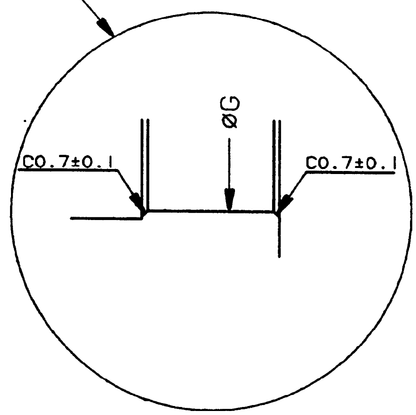


	B28
T	$103.99^{+0.005}_{-0}$
U	$103.69^{+0.005}_{-0}$
V	36 ± 0.1
W	221.5 ± 0.2
Interference	from 82 to 103 μm

Model: B28
Rotor No.: A290-0960-T201
Output type: L530, L531







Model	B28		
A (Note 1)	<190>		
B	185		
C	123		
D (Note 2)	93.8 ± 0.05 (94.1 ± 0.01)		
E (Note 2)	93.6 ± 0.05 (93.9 ± 0.008)		
F	95		
G (Note 2)	93.3 ± 0.05 (93.6 ± 0.008)		
H	126		
I	5	N	210
J	226 ± 0.1	P	16
K	27 ± 0.1	Q	246
L	27 ± 0.1	R	16
M	18	S	M4 × P0.5

Note 1) The size in < > is a reference size.

Note 2) The final finishing is required. The size in ( ) is a reference size.

Note 3) For insertion into the shaft, shrinkage fitting is required.
(normal temperature +130°C or higher)

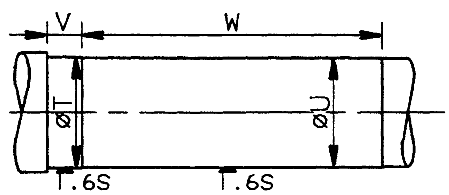
Note 4) For machining with coolant applied, sufficiently dry the moisture between the cores.

Note 5) Grinding allowance of the inside diameter is assumed to be ϕ0.3.

Note 6) Do not interfere with the broken line part: it is the balance corrected area.

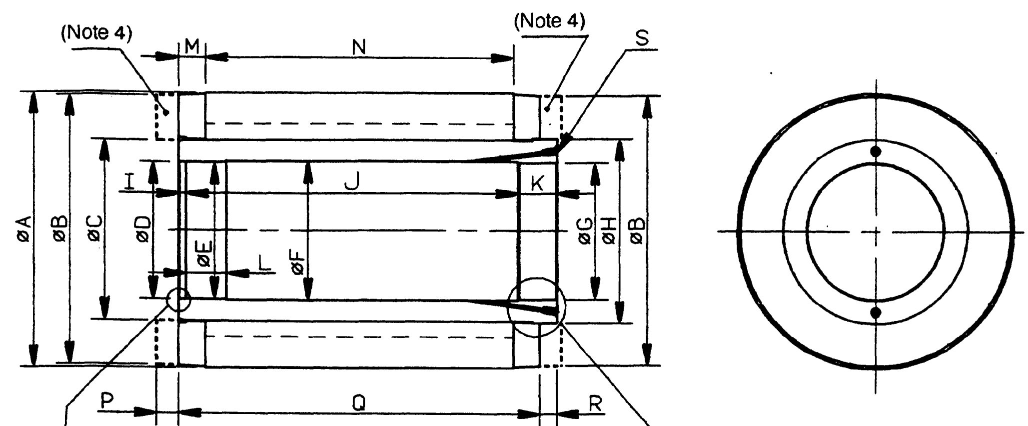
Reference size at spindle shaft:

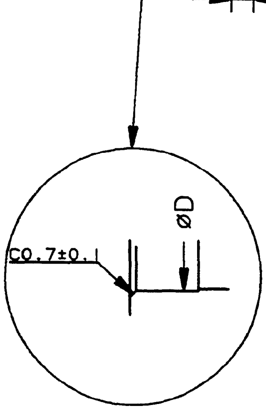
(The size below is a shaft size when D, E, and G are finished with the size in parenthesis above.)

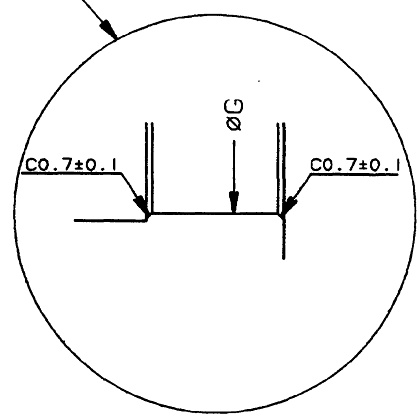


	B28
T	$93.97^{+0.005}_{-0}$
U	$93.67^{+0.005}_{-0}$
V	32±0.1
W	225.5±0.2
Interference	from 62 to 83 μm

Model: B35
Rotor No.: A290-0965-T201
Output type: L532







Model	B35		
A (Note 1)	<190>		
B	185		
C	123		
D (Note 2)	93.8 ± 0.05 (94.1 ± 0.01)		
E (Note 2)	93.6 ± 0.05 (93.9 ± 0.008)		
F	95		
G (Note 2)	93.3 ± 0.05 (93.6 ± 0.008)		
H	126		
I	5	N	360
J	376 ± 0.1	P	16
K	27 ± 0.1	Q	396
L	27 ± 0.1	R	16
M	18	S	M4 × P0.5

Note 1) The size in < > is a reference size.

Note 2) The final finishing is required. The size in ( ) is a reference size.

Note 3) For insertion into the shaft, shrinkage fitting is required.
(normal temperature +130°C or higher)

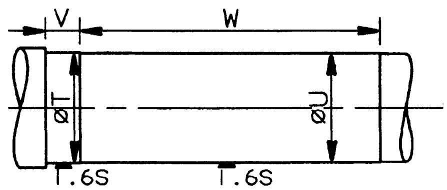
Note 4) For machining with coolant applied, sufficiently dry the moisture between the cores.

Note 5) Grinding allowance of the inside diameter is assumed to be $\phi 0.3$.

Note 6) Do not interfere with the broken line part: it is the balance corrected area.

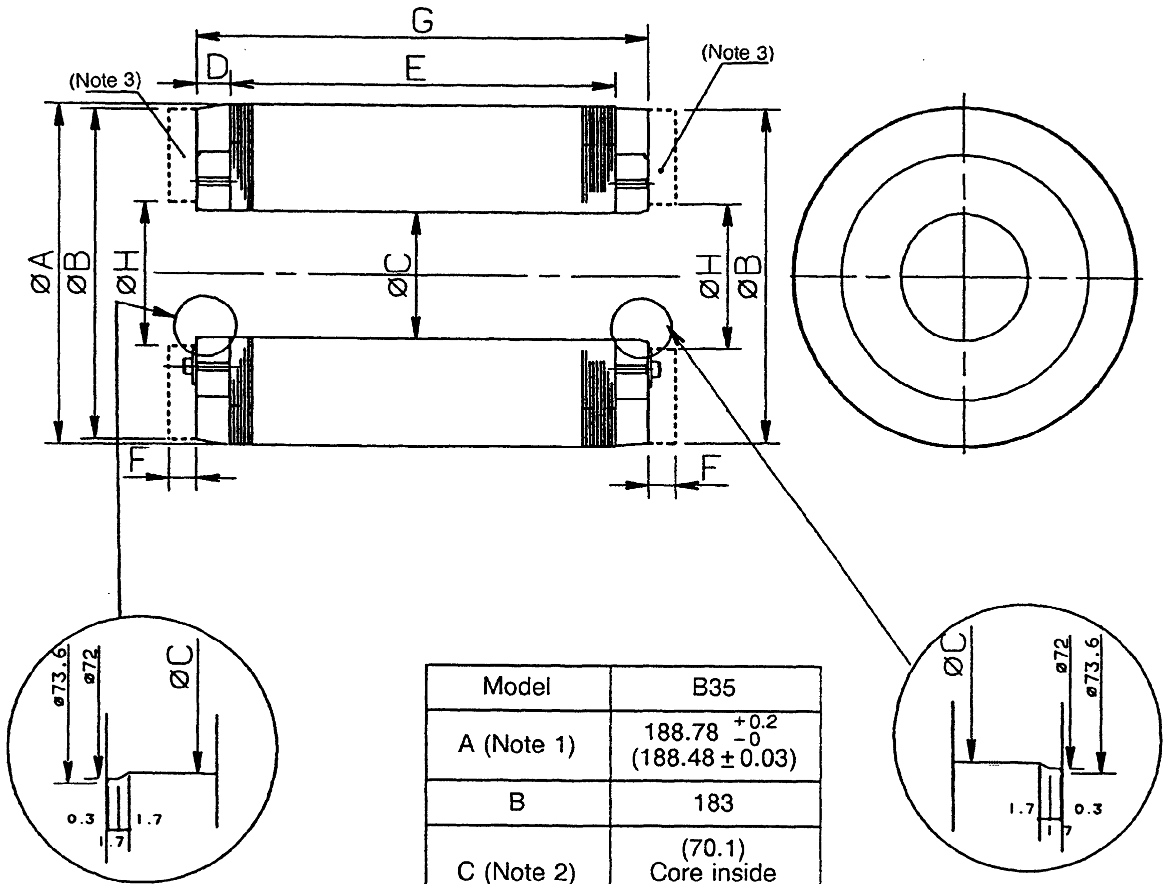
Reference size at spindle shaft:

(The size below is a shaft size when D, E, and G are finished with the size in parenthesis above.)



	B35
T	$93.97^{+0.005}_{-0}$
U	$93.67^{+0.005}_{-0}$
V	32 ± 0.1
W	375.5 ± 0.2
Interference	from 62 to 83 μm

Model: B35
Rotor No.: A290-0965-T211
Output type: L532



Model	B35
A (Note 1)	188.78 $^{+0.2}_{-0}$ (188.48 ± 0.03)
B	183
C (Note 2)	(70.1) Core inside diameter
D	18
E	360
F	15
G	396
H	80

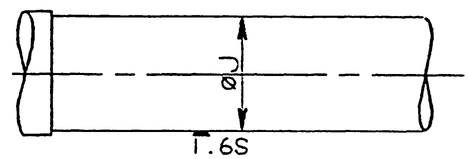
Note 1) After press-fitting, apply finishing to ϕA according to the dimension in parentheses.

Note 2) When the outside diameter of the sleeve is as indicated below, the interference is about 20μ for the core inside diameter to transfer the specified torque. Machining is not applied to ϕC. To mate the sleeve and rotor, apply shrink-fitting at 130°C or more above room temperature.

Note 3) After press-fitting the sleeve, use a mandrel, for example, to make a two-side correction at the balance areas (areas indicated by dashed lines) whose sizes are defined by F and H.)
Target: 0.6 gr x 5.2 = 2.65 gr.cm

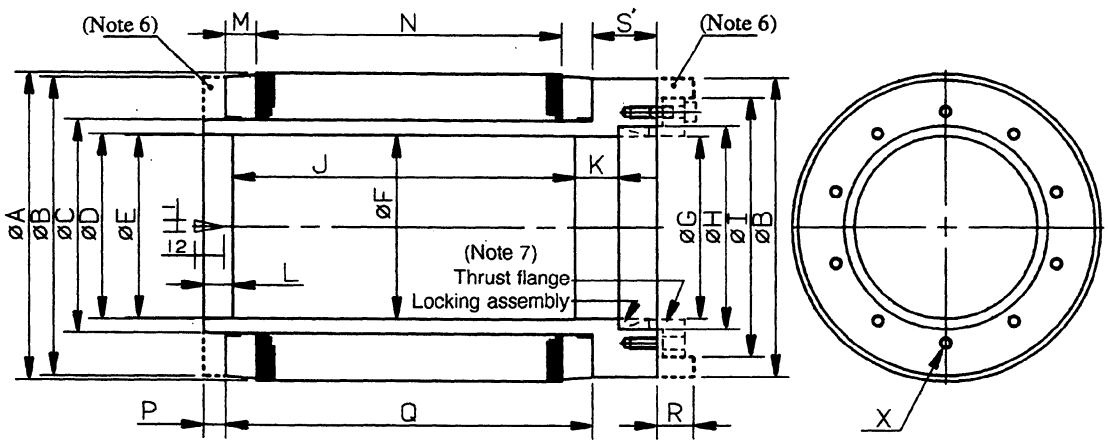
Reference size of the spindle shaft:

(The size below is a reference shaft size when the shaft is shrink-fit into C.)



	B35
J	$70.1^{+0.03}_{-0.01}$
Interference	40 to 60 μm

Model: B40
Rotor No.: A290-0970-T201
Output type: L138



Model	B40		
A (Note 1)	<210>		
B	204		
C	146		
D (Note 2)	126.7 $^{+0}_{-0.2}$ (127.075 $^{+0}_{-0.005}$)		
E (Note 2)	125 $^{+0}_{-0.2}$ (125.400 $^{+0}_{-0.005}$)		
F	125.5		
G (Note 2)	124.7 ± 0.05 (125H6 $^{+0.025}_{-0}$)		
H	138.7 ± 0.05 (139H7 $^{+0.04}_{-0}$)		
I	177	P	15
J	233 ± 0.2	Q	250
K	30 ± 0.1	R	25
L	20 ± 0.1	S	44
M	21	X	10-M8 depth 18, on ϕ158
N	208		

Note 1) The size in angle brackets (< >) is a reference size. Finishing is completed with a dimensional tolerance of ± 0.03.

Note 2) Apply final-finishing. The value in parentheses is the reference dimension for final finishing.

Note 3) The locking assembly method is used for joining the rotor with the shaft.

Note 4) When coolant is used for machining, completely remove moisture from the core after machining.

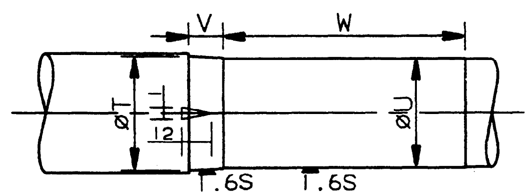
Note 5) Grinding allowance of the inside diameter is assumed to be $\phi 0.3$.

Note 6) The dashed line indicates the balance correction areas of the rotor; an object such as a weight is attached to the rotor in this area. So, be careful not to allow any other parts to interfere with the area indicated by the dashed line.

Note 7) The thrust flange and locking assembly should be prepared.

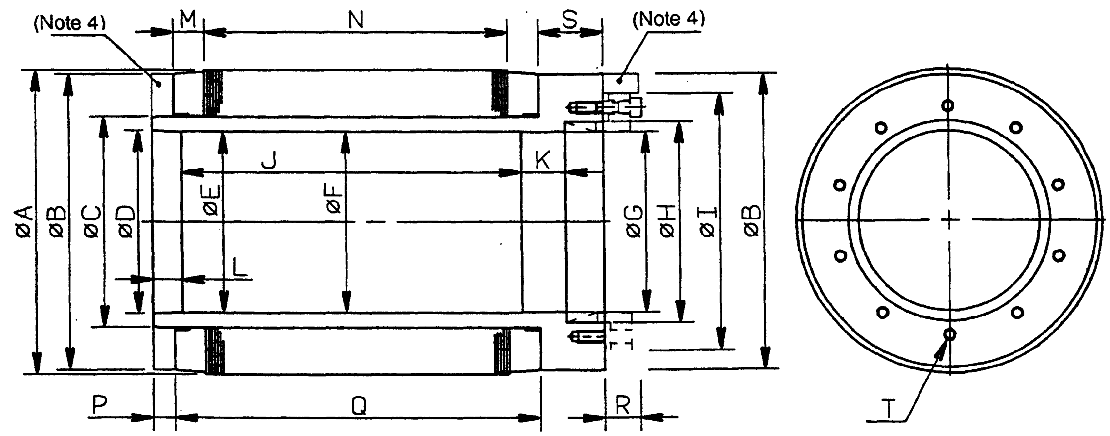
Reference size at spindle shaft:

(The size below is a shaft size when D, E, and G are finished with the size in parenthesis above.)



	B40
T	127.075 $^{+0.005}_{-0}$
U	125 $^{+0}$
V	More than 20
W	More than 263

Model: B45(8)
Rotor No.: A290-0988-T221
Output type: L533



Model	B45		
A (Note 1)	<210>		
B	204		
C	146		
D (Note 2)	$126.7^{+0}_{-0.2}$ ($127.075^{+0}_{-0.005}$)		
E (Note 2)	$125^{+0}_{-0.2}$ ($125.4^{+0}_{-0.005}$)		
F	125.5		
G (Note 2)	124.7 ± 0.05 (125H6 $^{+0.025}_{-0}$)		
H	138.7 ± 0.05 (139H7 $^{+0.04}_{-0}$)		
I	177	P	15
J	305 ± 0.2	Q	322
K	30 ± 0.1	R	25
L	20 ± 0.1	S	44
M	21	X	10-M8 Depth 18, Equally spaced on ϕ158
N	208		

Note 1) The dimension in < > is for reference. Finishing is completed with a dimensional tolerance of +0.03.

Note 2) Apply final-finishing. The dimensions in parentheses are references for finishing.

Note 3) A span ring is used to connect the rotor with the shaft.

Note 4) When coolant is used for machining, completely remove water from the cores.

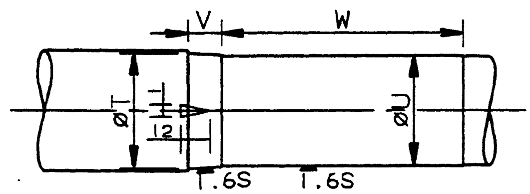
Note 5) The grinding tolerance of the inside diameter is assumed to be $\phi 0.3$.

Note 6) The dashed line indicates the balance correction areas of the rotor; an object such as a weight is attached to the rotor in this area. So, be careful not to allow any other parts to interfere with the area indicated by the dashed line.

Note 7) The thrust flange and locking assembly should be prepared.

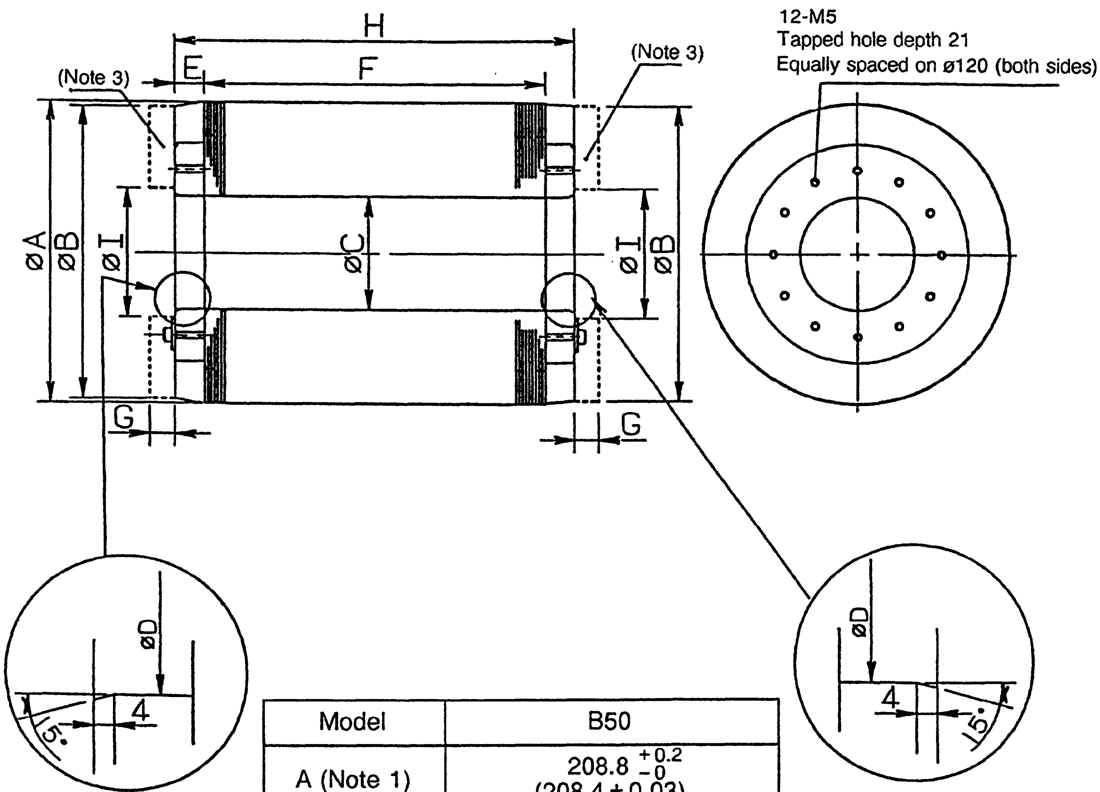
Reference size at spindle shaft:

(The size below is a shaft size when D, E, and G are finished with the size in parenthesis above.)



	B40
T	$127.075\ ^{+0}_{-0.005}$
U	$125\ ^{+0}$
V	20 or more
W	263 or more

Model: B50
Rotor No.: A290-0973-T211
Output type: L534



Model	B50
A (Note 1)	$208.8^{+0.2}_{-0}$ (208.4 ± 0.03)
B	204
C (Note 2)	80.1 (core inside diameter) (82.0 ± 0.01)
D	80.2 (82.5 ± 0.1)
E	21
F	350
G	15
H	392
I	90

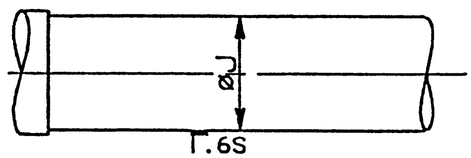
Note 1) After press-fitting, apply finishing to ϕA, ϕC, and ϕD according to the dimensions in parentheses.

Note 2) When the outside diameter of the spindle shaft is as indicated below, the interference is about 70μ to 95μ for the core inside diameter to transfer the specified torque. Machining is not applied to ϕC. To mate the sleeve and the rotor, apply shrink-fitting at 150°C to 180°C above room temperature.

Note 3) After press-fitting the sleeve, use a mandrel, for example, to make a two-side correction at the balance areas (dashed areas) whose sizes are defined by F and H.
Target: 0.5 gr × 6.0 = 3.0 gr.cm

Reference size of the spindle shaft:

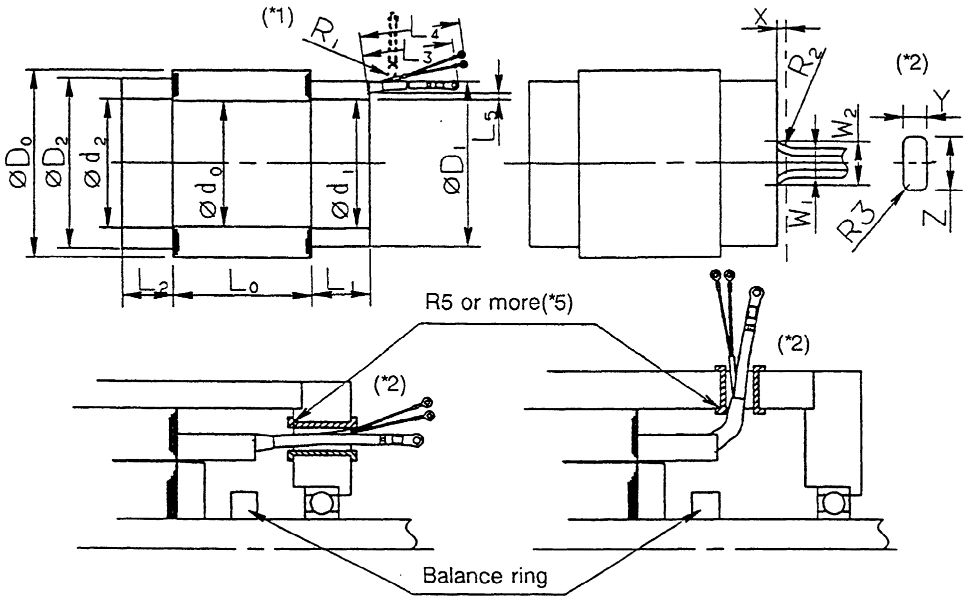
(The size below is a reference size when the sleeve is press-fit to C.)



	B50
J	$82.08^{+0.005}_{-0}$
Interference	70 to 95 μm

6. STATOR EXTERNAL DIMENSIONS

6.1 Standard



Reference Assembly Drawing 1 Reference Assembly Drawing 2

Model	B0.3	B0.5	B1	B1.5	B2	B6	B6	B8	B15
Stator drawing No. (A290-)	0953-T113	0955-T113	0921-T113	0951-T113	0922-T113	0926-T113	0926-T114	0958-T113	0935-T113
Output type	L127	L113 L128	L129	L130	L120	L131 L132	L133	L134	L135
D_0(*3)	88 ± 0.01	88 ± 0.01	120 ± 0.01	120 ± 0.01	156 ± 0.01	180 ± 0.01	180 ± 0.01	180 ± 0.01	240 ± 0.02
L_0	67	108	120	170	110	180	180	226	182
d_0	(49)	(49)	(75)	(75)	(100)	(115)	(115)	(115)	(160)
D_1	84^{+0}	84^{+0}	112^{+0}	112^{+0}	142^{+0}	167^{+0}	167^{+0}	167^{+0}	216^{+0}
D_2	84^{+0}	84^{+0}	112^{+0}	112^{+0}	142^{+0}	167^{+0}	167^{+0}	167^{+0}	216^{+0}
d_1	50^{-0}	50^{-0}	76^{-0}	76^{-0}	101^{-0}	118^{-0}	118^{-0}	118^{-0}	163^{-0}
d_2	50^{-0}	50^{-0}	76^{-0}	76^{-0}	101^{-0}	118^{-0}	118^{-0}	118^{-0}	163^{-0}
L_1	32^{+0}	34^{+0}	38^{+0}	38^{+0}	44^{+0}	57^{+0}	62^{+0}	57^{+0}	69^{+0}
L_2	25^{+0}	32^{+0}	35^{+0}	35^{+0}	42^{+0}	52^{+0}	52^{+0}	52^{+0}	58^{+0}
L_3, L_4(*4)	1000	1000	1000	2000	2000	2000	2000	2000	2000
Power line cross-sectional area (mm^2)	2.0	2.0	2.0	2.0	2.0	5.5	3.5	3.5	5.5
Number of power lines	3	3	3	3	3	3	6	6	6
Power line diameter	4	4	4	4	4	6	5	5	6
Power line crimp terminal	M4	M4		M5	M5	M6	M8	M6	M8
L_5	0	0	0	0	0	0	0	0	0
W_1	20	20	20	20	20	30	40	40	50
W_2	30	30	30	30	30	40	50	50	60
R_1	About 10 to 15	About 10 to 15	About 10 to 15	About 10 to 15	About 10 to 15	About 20 to 25	About 10 to 15	About 10 to 15	About 20 to 25
R_2	About 10 to 15	About 10 to 15	About 10 to 15	About 10 to 15	About 10 to 15	About 25 to 30	About 20 to 25	About 20 to 25	About 25 to 30
R_3	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5
X(*6)	3 or more	3 or more	3 or more	3 or more	3 or more	3 or more	3 or more	3 or more	3 or more
Y	20 or more	20 or more	20 or more	20 or more	20 or more	20 or more	20 or more	20 or more	20 or more
Z	40 or more	40 or more	40 or more	40 or more	40 or more	50 or more	60 or more	60 or more	70 or more
Interference (μm)(*7)	10 to 15	10 to 15	10 to 15	10 to 15	10 to 15	10 to 15	10 to 15	10 to 15	10 to 20
Method of connection(*10)	①	①	①	①	①	①	④	④	④

*1) R_1 represents the minimum radius of a power line bent at a right angle.

*2) Y, Z, and R_3 represent a recommended outlet at position X. To protect a power line at the outlet, an insulating material such as rubber should be attached to the hatched areas as shown in Reference Assembly Drawings 1 and 2.

*3) A tolerance of ± 0.01 (0.02, 0.03) represents a machining dimension. The core is laminated, and a distortion of about 0.1 may occur in subsequent processes which include winding. However, a tolerance of ± 0.01 (0.02, 0.03) is allowable for shrink-fitting dimensions.

*4) A power line or thermal lead wire, if too long, may be cut to a usable length. The cross-sectional area of thermal lead wire is (0.3 mm^2 × 2 wires). A round crimp terminal for M4 is attached to the tip of a thermal lead wire.

*5) A corner radius of R5 or more must be provided at the edges of a power line outlet to prevent the power line from being damaged.

*6) A clearance of at least 3 mm must be provided between the stator coil ends and internal surface of the housing.

*7) The interferences indicated here are applicable to the stators and housings when the housings are made of steel.

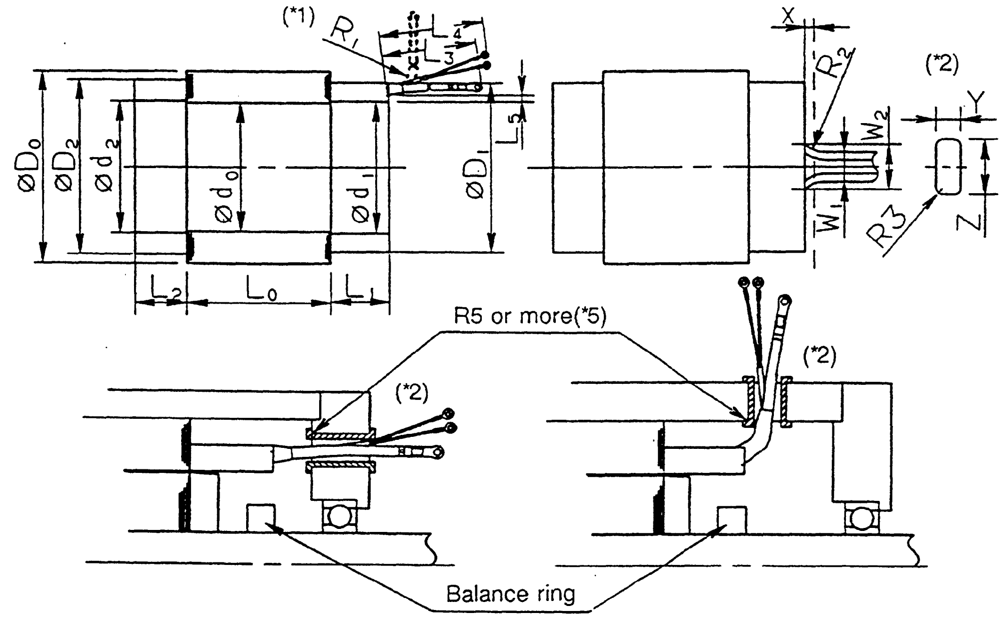
*8) The coil ends must not be damaged or deformed.

*9) To prevent the stator from being eccentric, the inside diameter of the housing must not be eccentric more than 0.05 with respect to the spindle shaft.

*10) Seven power line connection methods are available as indicated in the table below.

Method	Speed range switching	Marking	Connection method
①	Not provided	U, V, W	Connect power lines U, V, and W to U, V, and W of the amplifier.
②	Not provided	U_1, V_1, W_1 (U_2, V_2, W_2)	Connect power lines U_1, V_1, and W_1 to U, V, and W of the amplifier. Insulate U_2, V_2, and W_2 and leave them disconnected.
③	Not provided	U_2, V_2, W_2 (U_1, V_1, W_1)	Connect power lines U_2, V_2, and W_2 to U, V, and W of the amplifier. Insulate U_1, V_1, and W_1 and leave them disconnected.
④	Not provided	U, V, W X, Y, Z	Connect power lines U, V, and W to Z, X, Y, respectively, then connect U, V, and W to U, V, and W of the amplifier.
⑤	Not provided	U, V, W X, Y, Z	Short-circuit power lines X, Y, and Z. Then connect U, V, and W to U, V, and W of the amplifier.
⑥	Provided	U_1, V_1, W_1 U_2, V_2, W_2	For low-speed output, make connections according to ②; for high-speed output make connections according to ③. [Y-Y (star-star) connection]
⑦	Provided	U, V, W X, Y, Z	For low-speed output, make connections according to ⑤; for high-speed output make connections according to ④. [Y-Δ(star-delta) connection]

6.2 Speed Range Switching (B2 to B12)



Reference Assembly Drawing 1

Reference Assembly Drawing 2

Model	B2(8)	B2	B3	B8	B8	B10	B12	B12
Stator drawing No. (A290-)	0982-T113	0922-T198	0923-T113	0958-T111	0958-T115	0930-T111	0932-T199	0932-T114
Output type	L516	L515	L517	L511 L519	L520	L521 L522	L523	L524
D_0(*3)	146 ± 0.01	156 ± 0.01	156 ± 0.01	180 ± 0.01	180 ± 0.01	180 ± 0.01	240 ± 0.02	240 ± 0.02
L_0	110	110	210	226	226	280	182	182
d_0	(100)	(100)	(100)	(115)	(115)	(115)	(160)	(160)
D_1	142^{+0}	142^{+0}	147^{+0}	167^{+0}	174^{+0}	176^{+0}	227^{+0}	227^{+0}
D_2	142^{+0}	142^{+0}	147^{+0}	167^{+0}	174^{+0}	176^{+0}	227^{+0}	227^{+0}
d_1	100^{-0}	101^{-0}	100^{-0}	118^{-0}	118^{-0}	118^{-0}	162^{-0}	162^{-0}
d_2	100^{-0}	101^{-0}	100^{-0}	118^{-0}	118^{-0}	118^{-0}	162^{-0}	162^{-0}
L_1	49^{+0}	49^{+0}	49^{+0}	67^{+0}	63^{+0}	62^{+0}	70^{+0}	80^{+0}
L_2	42^{+0}	42^{+0}	42^{+0}	62^{+0}	52^{+0}	57^{+0}	62^{+0}	67^{+0}
L_3, L_4(*4)	2000	2000	2000	2000	2000	2000	2000	1500
Power line cross-sectional area (mm^2)	3.5	3.5	5.5	8.0	14	14	5.5	22
Number of power lines	6	6	6	6	6	6	6	6
Power line diameter	5	5	6	6	8	8	6	10
Power line crimp terminal	M6	M5	M6	M6	M8	M8	M6	M8
L_5	0	0	0	0	0	0	0	0
W_1	40	40	50	60	70	70	50	80
W_2	50	50	60	70	80	80	60	90
R_1	About 10 to 15	About 10 to 15	About 20 to 25	About 25 to 30	About 30 to 35	About 30 to 35	About 20 to 25	About 35 to 40
R_2	About 20 to 25	About 20 to 25	About 25 to 30	About 25 to 30	About 30 to 35	About 30 to 35	About 25 to 30	About 35 to 40
R_3	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5
X(*6)	3 or more	3 or more	3 or more	3 or more	3 or more	3 or more	3 or more	3 or more
Y	20 or more	20 or more	20 or more	25 or more	30 or more	30 or more	20 or more	40 or more
Z	60 or more	60 or more	70 or more	80 or more	90 or more	90 or more	70 or more	100 or more
Interference (μm)(*7)	10 to 15	10 to 15	10 to 15	10 to 15	10 to 15	10 to 15	10 to 20	10 to 20
Method of connection(*10)	⑥	⑦	⑦	⑥	⑥	⑥	⑦	⑦

*1) R_1 represents the minimum radius of a power line bent at a right angle.

*2) Y, Z, and R_3 represent a recommended outlet at position X. To protect a power line at the outlet, an insulating material such as rubber should be attached to the hatched areas as shown in Reference Assembly Drawings 1 and 2.

*3) A tolerance of ± 0.01 (0.02, 0.03) represents a machining dimension. The core is laminated, and a distortion of about 0.1 may occur in subsequent processes which include winding. However, a tolerance of ± 0.01 (0.02, 0.03) is allowable for shrink-fitting dimensions.

*4) A power line or thermal lead wire, if too long, may be cut to a usable length. The cross-sectional area of thermal lead wire is (0.3 $mm^2 \times 2$ wires). A round crimp terminal for M4 is attached to the tip of a thermal lead wire.

*5) A corner radius of R5 or more must be provided at the edges of a power line outlet to prevent the power line from being damaged.

*6) A clearance of at least 3 mm must be provided between the stator coil ends and internal surface of the housing.

*7) The interferences indicated here are applicable to the stators and housings when the housings are made of steel.

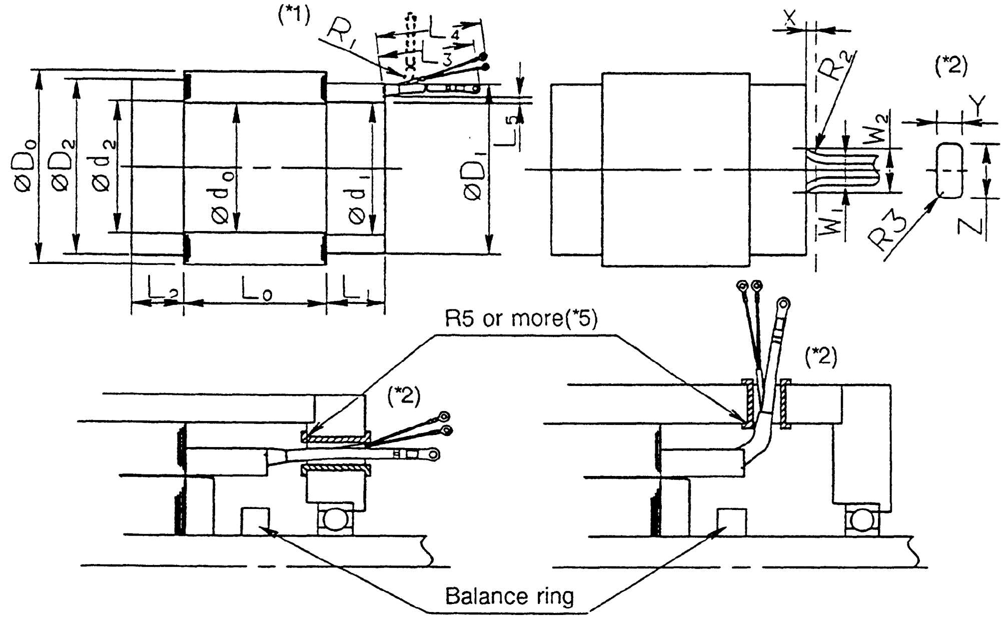
*8) The coil ends must not be damaged or deformed.

*9) To prevent the stator from being eccentric, the inside diameter of the housing must not be eccentric more than 0.05 with respect to the spindle shaft.

*10) Seven power line connection methods are available as indicated in the table below.

Method	Speed range switching	Marking	Connection method
①	Not provided	U, V, W	Connect power lines U, V, and W to U, V, and W of the amplifier.
②	Not provided	U_1, V_1, W_1 (U_2, V_2, W_2)	Connect power lines U_1, V_1, and W_1 to U, V, and W of the amplifier. Insulate U_2, V_2, and W_2 and leave them disconnected.
③	Not provided	U_2, V_2, W_2 (U_1, V_1, W_1)	Connect power lines U_2, V_2, and W_2 to U, V, and W of the amplifier. Insulate U_1, V_1, and W1 and leave them disconnected.
④	Not provided	U, V, W X, Y, Z	Connect power lines U, V, and W to Z, X, Y, respectively, then connect U, V, and W to U, V, and W of the amplifier.
⑤	Not provided	U, V, W X, Y, Z	Short-circuit power lines X, Y, and Z. Then connect U, V, and W to U, V, and W of the amplifier.
⑥	Provided	U_1, V_1, W_1 U_2, V_2, W_2	For low-speed output, make connections according to ②; for high-speed output [Y-Y (star-star) connection], make connections according to ③. [Y-Y (star-star) connection]
⑦	Provided	U, V, W X, Y, Z	For low-speed output, make connections according to ⑤; for high-speed output make connections according to ④. [Y-Δ (star-delta) connection]

6.3 Speed Range Switching (B17 to B45)



Reference Assembly Drawing 1

Reference Assembly Drawing 2

Model	B17	B26	B28	B28	B35	B45
Stator drawing No. (A290-)	0937-T111	0946-T113	0960-T110	0960-T111	0965-T111	0988-T113
Output type	L525	L526 L527 L528 L535	L529 L530	L531	L532	L533
D_0(*3)	249 ± 0.02	240 ± 0.02	292 ± 0.03	292 ± 0.03	292 ± 0.03	305 ± 0.03
L_0	226	272	212	212	362	282
d_0	(132)	(160)	(190)	(190)	(190)	(210)
D_1	222^{+0}	227^{+0}	281^{+0}	281^{+0}	281^{+0}	295^{+0}
D_2	222^{+0}	227^{+0}	281^{+0}	281^{+0}	281^{+0}	295^{+0}
d_1	138^{-0}	162^{-0}	199^{-0}	199^{-0}	197^{-0}	214^{-0}
d_2	138^{-0}	162^{-0}	199^{-0}	199^{-0}	197^{-0}	214^{-0}
L_1	64^{+0}	70^{+0}	91^{+0}	91^{+0}	91^{+0}	91^{+0}
L_2	57^{+0}	62^{+0}	80^{+0}	80^{+0}	80^{+0}	80^{+0}
L_3, L_4(*4)	2000	2000	2000	1500	1500	1500
Power line cross-sectional area (mm^2)	8.0	14	8.0	22	22	22
Number of power lines	6	6	6	6	6	6
Power line diameter	6	8	6	10	10	10
Power line crimp terminal	M6	M6	M8	M8	M8	M8
L_5	0	0	0	0	0	0
W_1	60	70	60	80	80	80
W_2	70	80	70	90	90	90
R_1	About 25 to 30	About 30 to 35	About 25 to 30	About 35 to 40	About 35 to 40	About 35 to 40
R_2	About 25 to 30	About 30 to 35	About 25 to 30	About 35 to 40	About 35 to 40	About 35 to 40
R_3	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5	About 3 to 5
X(*6)	3 or more	3 or more	3 or more	3 or more	3 or more	3 or more
Y	25 or more	30 or more	25 or more	40 or more	40 or more	40 or more
Z	80 or more	90 or more	80 or more	100 or more	100 or more	100 or more
Interference (μm)(*7)	10 to 20	10 to 20	15 to 25	15 to 25	15 to 25	15 to 25
Method of connection(*10)	⑥	⑦	⑥	⑥	⑥	⑥

*1) R1 represents the minimum radius of a power line bent at a right angle.

*2) Y, Z, and R_3 represent a recommended outlet at position X. To protect a power line at the outlet, an insulating material such as rubber should be attached to the hatched areas as shown in Reference Assembly Drawings 1 and 2.

*3) A tolerance of ±0.01 (0.02, 0.03) represents a machining dimension. The core is laminated, and a distortion of about 0.1 may occur in subsequent processes which include winding. However, a tolerance of ±0.01 (0.02, 0.03) is allowable for shrink-fitting dimensions.

*4) A power line or thermal lead wire, if too long, may be cut to a usable length. The cross-sectional area of thermal lead wire is ($0.3 \text{ mm}^2 \times 2$ wires). A round crimp terminal for M4 is attached to the tip of a thermal lead wire.

*5) A corner radius of R5 or more must be provided at the edges of a power line outlet to prevent the power line from being damaged.

*6) A clearance of at least 3 mm must be provided between the stator coil ends and internal surface of the housing.

*7) The interferences indicated here are applicable to the stators and housings when the housings are made of steel.

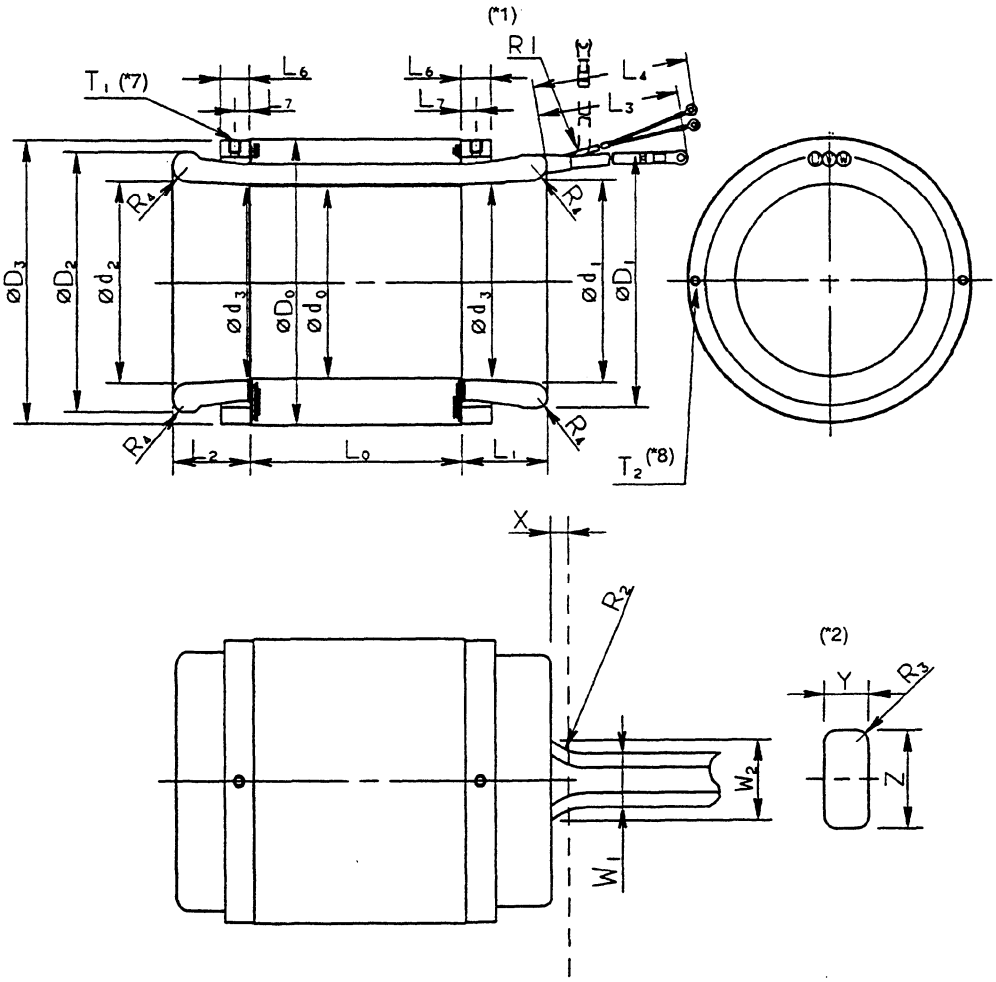
*8) The coil ends must not be damaged or deformed.

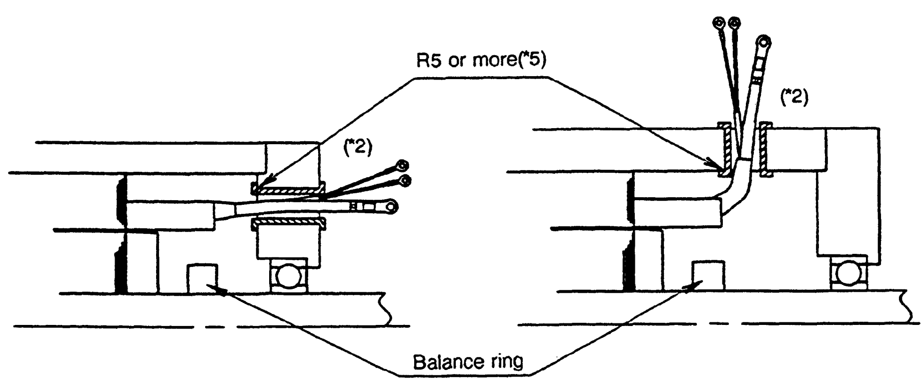
*9) To prevent the stator from being eccentric, the inside diameter of the housing must not be eccentric more than 0.05 with respect to the spindle shaft.

*10) Seven power line connection methods are available as indicated in the table below.

Method	Speed range switching	Marking	Connection method
①	Not provided	U, V, W	Connect power lines U, V, and W to U, V, and W of the amplifier.
②	Not provided	U_1, V_1, W_1 (U_2, V_2, W_2)	Connect power lines U_1, V_1, and W_1 to U, V, and W of the amplifier. Insulate U_2, V_2, and W_2 and leave them disconnected.
③	Not provided	U_2, V_2, W_2 (U_1, V_1, W_1)	Connect power lines U_2, V_2, and W_2 to U, V, and W of the amplifier. Insulate U_1, V_1, and W1 and leave them disconnected.
④	Not provided	U, V, W X, Y, Z	Connect power lines U, V, and W to Z, X, Y, respectively, then connect U, V, and W to U, V, and W of the amplifier.
⑤	Not provided	U, V, W X, Y, Z	Short-circuit power lines X, Y, and Z. Then connect U, V, and W to U, V, and W of the amplifier.
⑥	Provided	U_1, V_1, W_1 U_2, V_2, W_2	For low-speed output, make connections according to ②; for high-speed output make connections according to ③. [Y-Y (star-star) connection]
⑦	Provided	U, V, W X, Y, Z	For low-speed output, make connections according to ⑤; for high-speed output make connections according to ④. [Y-Δ (star-delta) connection]

6.4 Speed Range Switching (B40)





Reference Assembly Drawing 1

Reference Assembly Drawing 2

Model	B40	Power line crimp terminal	M10
Stator drawing No. (A290-)	0970-T113	L_5	0
		L_6	35
Output type	L138	L_7	17.5
D_0(*3)	340 ± 0.03	W_1	80
d_0	(210)	W_2	90
L_0	210	R_1	About 35 to 40
D_1	300^{+0}	R_2	About 35 to 40
D_2	300^{+0}	R_3	About 3 to 5
d_1	215^{-0}	R_4	About R15
d_2	216^{-0}	X(*6)	3 or more
D_3	338	Y	40 or more
d_3	212	Z	100 or more
L_1	93^{+0}	T_1(*7)	2-M12 Depth 15
L_2	77^{+0}	T_2(*8)	2-M12 Depth 20 Equally spaced at $\phi 320$
L_3, L_4(*4)	2000		
Power line cross-sectional area (mm^2)	22	Interference (μm)(*9)	10 to 30
Number of power lines	6	Method of connection(*12)	④
Power line diameter	10		

*1) R_1 represents the minimum radius of a power line bent at a right angle.

*2) Y, Z, and R_3 represent a recommended outlet at position X. To protect a power line at the outlet, an insulating material such as rubber should be attached to the hatched areas as shown in Reference Assembly Drawings 1 and 2.

*3) A tolerance of ± 0.03 represents a machining dimension. The core is laminated, and a distortion of about 0.1 may occur in subsequent processes which include winding. However, a tolerance of ± 0.03 is allowable for shrink-fitting dimensions.

*4) A power line or thermal lead wire, if too long, may be cut to a usable length. The cross-sectional area of thermal lead wire is (0.3 mm^2 × 2 wires). A round crimp terminal for M4 is attached to the tip of a thermal lead wire.

*5) A corner radius of R5 or more must be provided at the edges of a power line outlet to prevent the power line from being damaged.

*6) A clearance of at least 3 mm must be provided between the stator coil ends and internal surface of the housing.

*7) This is a tapped hole for transferring the stator.

*8) This is a tapped hole for holding (suspending) the stator in shrink fitting.

*9) The interference indicated here is applicable to the stator and housing when the housing is made of steel.

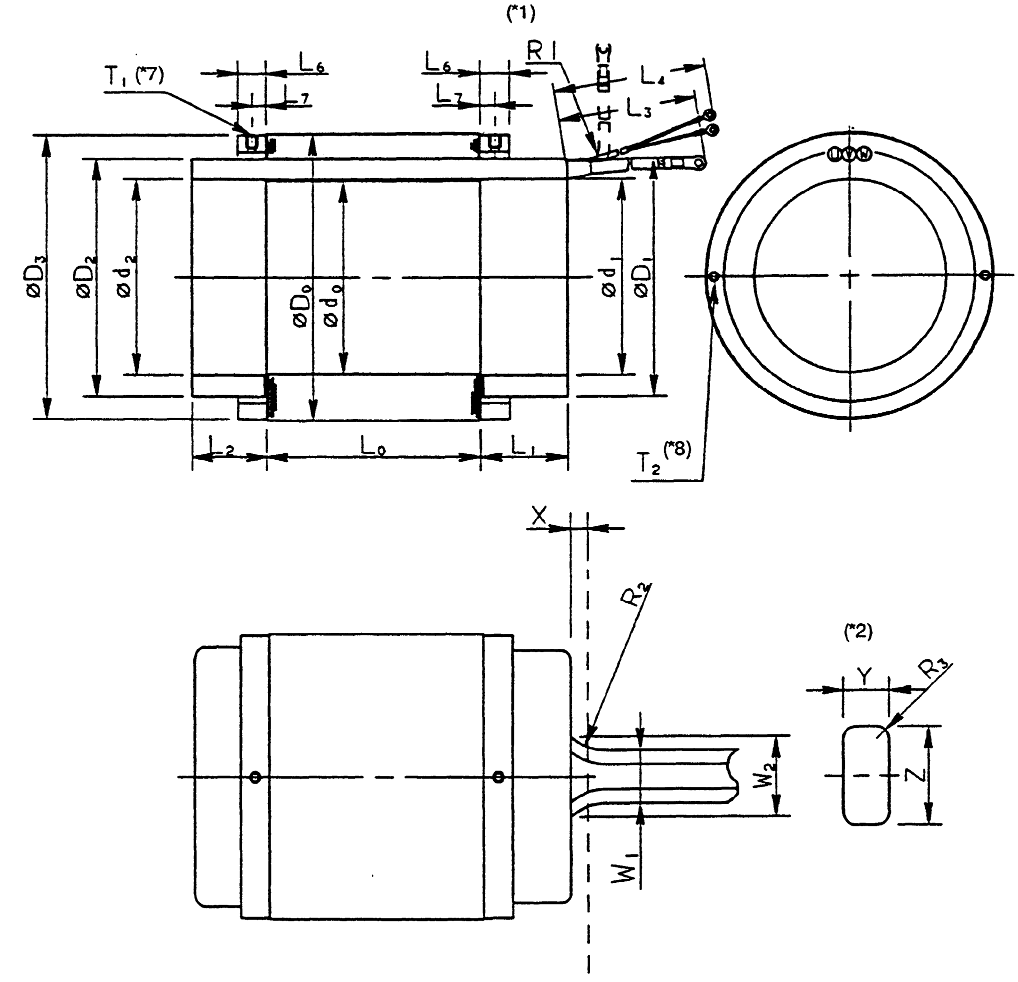
*10) The coil ends must not be damaged or deformed.

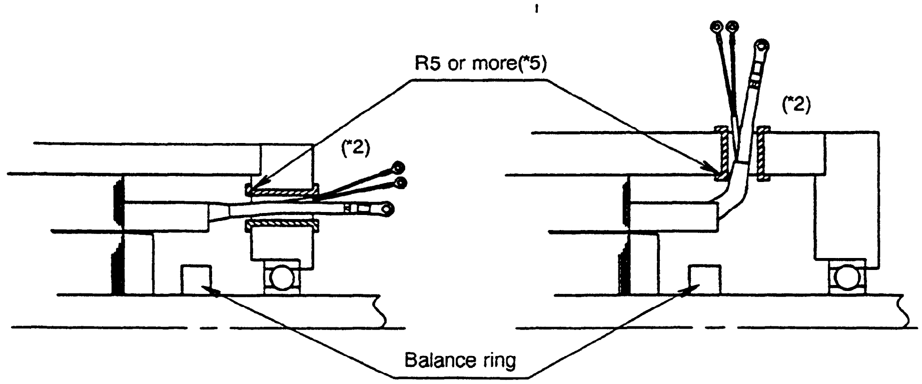
*11) To prevent the stator from being eccentric, the inside diameter of the housing must not be eccentric more than 0.05 with respect to the spindle shaft.

*12) Seven power line connection methods are available as indicated in the table below.

Method	Speed range switching	Marking	Connection method
①	Not provided	U, V, W	Connect power lines U, V, and W to U, V, and W of the amplifier.
②	Not provided	U_1, V_1, W_1 (U_2, V_2, W_2)	Connect power lines U_1, V_1, and W_1 to U, V, and W of the amplifier. Insulate U_2, V_2, and W_2 and leave them disconnected.
③	Not provided	U_2, V_2, W_2 (U_1, V_1, W_1)	Connect power lines U_2, V_2, and W_2 to U, V, and W of the amplifier. Insulate U_1, V_1, and W1 and leave them disconnected.
④	Not provided	U, V, W X, Y, Z	Connect power lines U, V, and W to Z, X, and Y, respectively, then connect U, V, and W to U, V, and W of the amplifier.
⑤	Not provided	U, V, W X, Y, Z	Short-circuit power lines X, Y, and Z. Then connect U, V, and W to U, V, and W of the amplifier.
⑥	Provided	U_1, V_1, W_1 U_2, V_2, W_2	For low-speed output, make connections according to ②; for high-speed output make connections according to ③. [Y-Y (star-star) connection]
⑦	Provided	U, V, W X, Y, Z	For low-speed output, make connections according to ⑤; for high-speed output make connections according to ④. [Y-Δ (star-delta) connection]

6.5 Speed Range Switching (B50)





Reference Assembly Drawing 1

Reference Assembly Drawing 2

Model	B50	Power line crimp terminal	M10
Stator drawing No. (A290-)	0973-T111	L_5	0
		L_6	35
Output type	L534	L_7	17.5
D_0(*3)	340 ± 0.03	W_1	80
d_0	(210)	W_2	90
L_0	352	R_1	About 40 to 45
D_1	302^{+0}	R_2	About 40 to 45
D_2	292^{+0}	R_3	About 3to 5
d_1	214^{-0}	X(*6)	3 or more
d_2	214^{-0}	Y	40 or more
D_3	338	Z	100 or more
d_3	212	T_1(*7)	2-M12 Depth 15
L_1	99^{+0}	T_2(*8)	2-M12 Depth 20 Equally spaced at ϕ320
L_2	89^{+0}		
L_3, L_4(*4)	400	Interference (μm)(*9)	15 to 25
Power line cross-sectional area (mm^2)	38	Method of connection(*12)	⑥
Number of power lines	6		
Power line diameter	12		

*1) R_1 represents the minimum radius of a power line bent at a right angle.

*2) Y, Z, and R_3 represent a recommended outlet at position X. To protect a power line at the outlet, an insulating material such as rubber should be attached to the hatched areas as shown in Reference Assembly Drawings 1 and 2.

*3) A tolerance of ± 0.03 represents a machining dimension. The core is laminated, and a distortion of about 0.1 may occur in subsequent processes which include winding. However, a tolerance of ± 0.03 is allowable for shrink-fitting dimensions.

*4) A power line or thermal lead wire, if too long, may be cut to a usable length. The cross-sectional area of thermal lead wire is (0.3 mm^2 × 2 wires). A round crimp terminal for M4 is attached to the tip of a thermal lead wire.

*5) A corner radius of R5 or more must be provided at the edges of a power line outlet to prevent the power line from being damaged.

*6) A clearance of at least 3 mm must be provided between the stator coil ends and internal surface of the housing.

*7) This is a tapped hole for transferring the stator.

*8) This is a tapped hole for holding (suspending) the stator in shrink fitting.

*9) The interference indicated here is applicable to the stator and housing when the housing is made of steel.

*10) The coil ends must not be damaged or deformed.

*11) To prevent the stator from being eccentric, the inside diameter of the housing must not be eccentric more than 0.05 with respect to the spindle shaft.

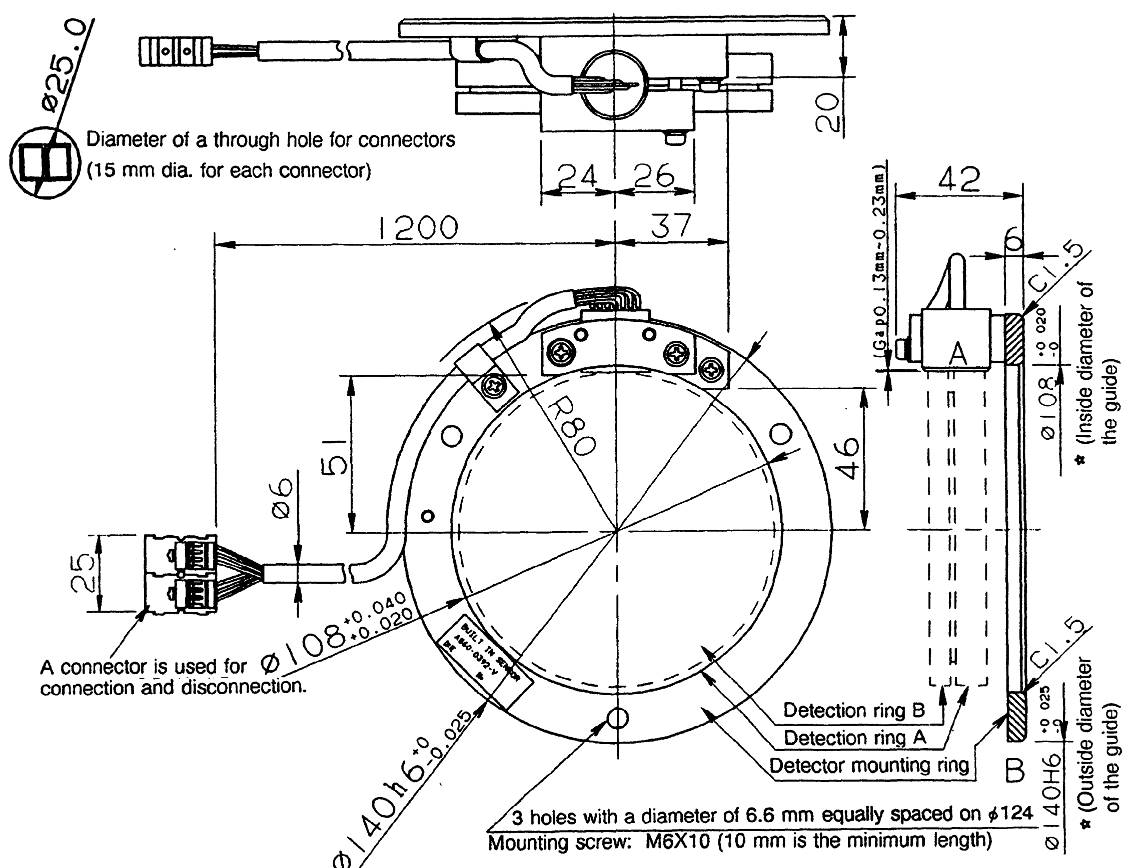
*12) Seven power line connection methods are available as indicated in the table below.

Method	Speed range switching	Marking	Connection method
①	Not provided	U, V, W	Connect power lines U, V, and W to U, V, and W of the amplifier.
②	Not provided	U_1, V_1, W_1 (U_2, V_2, W_2)	Connect power lines U_1, V_1, and W_1 to U, V, and W of the amplifier. Insulate U_2, V_2, and W_2 and leave them disconnected.
③	Not provided	U_2, V_2, W_2 (U_1, V_1, W_1)	Connect power lines U_2, V_2, and W_2 to U, V, and W of the amplifier. Insulate U_1, V_1, and W1 and leave them disconnected.
④	Not provided	U, V, W X, Y, Z	Connect power lines U, V, and W to Z, X, Y, respectively, then connect U, V, and W to U, V, and W of the amplifier.
⑤	Not provided	U, V, W X, Y, Z	Short-circuit power lines X, Y, and Z. Then connect U, V, and W to U, V, and W of the amplifier.
⑥	Provided	U_1, V_1, W_1 U_2, V_2, W_2	For low-speed output, make connections according to ②; for high-speed output make connections according to ③. [Y-Y (star-star) connection]
⑦	Provided	U, V, W X, Y, Z	For low-speed output, make connections according to ⑤; for high-speed output make connections according to ④. [Y-Δ (star-delta) connection]

7. DETECTOR

7.1 Detector 1 (Drip-Proof Type)

Ordering drawing number: A860-0392-T011



(Note 10):
Accessories (manufactured by Honda Tsushin Kogyo Co. Ltd.)
Connector: Z-374, 2 each
Contact: HKP-F413, 12 each

Reference:
Crimping tool for HKP-F413: KP-309

Note 1) Be sure to install the detector so it is aligned with the inner or outer diameter of the guide. Otherwise, the detector may produce incorrect output.

Note 2) The dimensions marked with a star apply to the fitting diameter.

Note 3) This detector can detect speed and position.

Note 4) Handle these precision parts with special care. In particular, never apply external force to part A.

Note 5) The detector consists of electric circuitry. So, provide protection against dust and leakage to prevent oil, for example, from accumulating on the detector surface.

Note 6) The gap is preadjusted between 0.13 mm and 0.23 mm. So, never remove the detecting element from part B.

Note 7) Connect the shield wire.

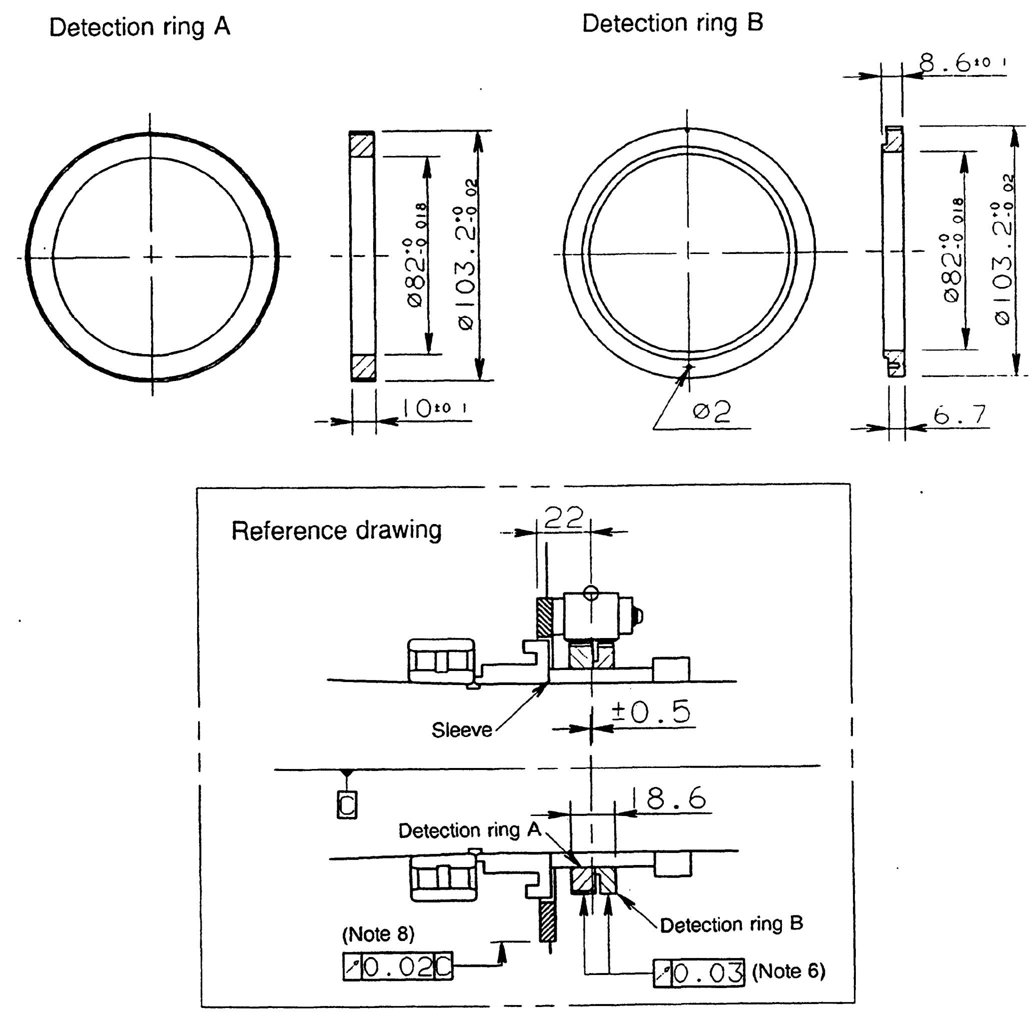
Note 8) For easy maintenance, consider a replaceable structure.

Note 9) Use the detection rings described in Section 7.2.

Note 10) Mating connectors are provided with the detector.

7.2 Detecting Ring 1

Ordering drawing number: A860-0392-T011



Note 1) Press-fit the rings on the sleeve, then insert the spindle into the sleeve. Be sure to completely insert detection ring A and detection ring B.

Note 2) The circumference has special teeth. So, carefully protect against deformation and chipping due to external force, particularly, when performing additional machining.

Note 3) The eccentricity and parallelism of the speed detection ring circumference are within 0.01 with respect to the internal surface after finishing.

Note 4) Install detection ring A and detection ring B as shown in the reference drawing above.

Note 5) Install the speed/position detector and detection rings so that the distance between half of the detection ring width (18.6 mm/2) and the center of the speed/position detector (22 mm above the bottom surface) is within ±0.5 mm.

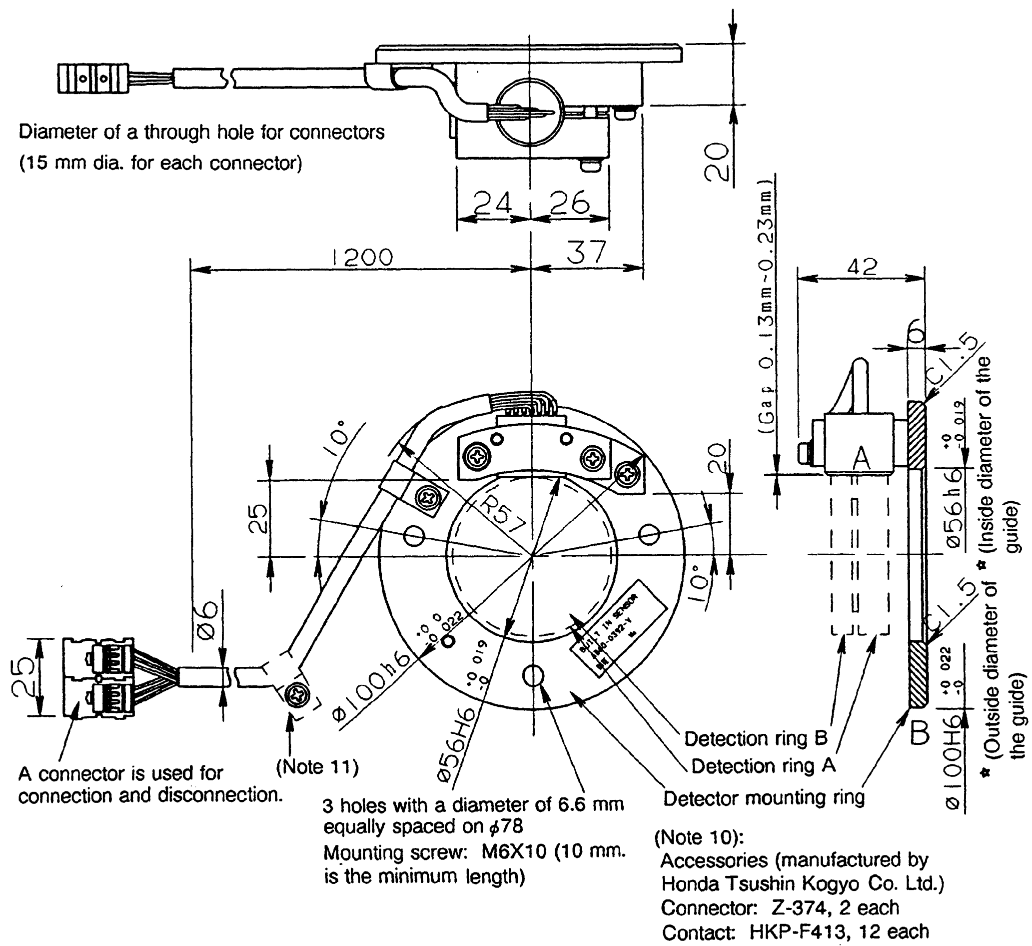
Note 6) The runout of the detection rings with respect to the speed/position detector must be within ±0.03 mm.

Note 7) See Section 7.10 for interference data for shrink-fitting of the detection rings.

Note 8) When the detector mounting ring is eccentric, the gap may not be 0.13.

7.3 Detector 2 (Drip-Proof Type)

Ordering drawing number: A860-0392-T012



Note 1) Be sure to install the detector so it is aligned with the inner or outer diameter of the guide. Otherwise, the detector may produce incorrect output.

Note 2) The dimensions marked with a star apply to the fitting diameter.

Note 3) This detector can detect speed and position.

Note 4) Handle these precision parts with special care. In particular, never apply external force to part A.

Note 5) The detector consists of electric circuitry. So, provide protection against dust and leakage to prevent oil, for example, from accumulating on the detector surface.

Note 6) The gap is preadjusted between 0.13 mm and 0.23 mm. So, never remove the detecting element from part B.

Note 7) Connect the shield wire.

Note 8) For easy maintenance, consider a replaceable structure.

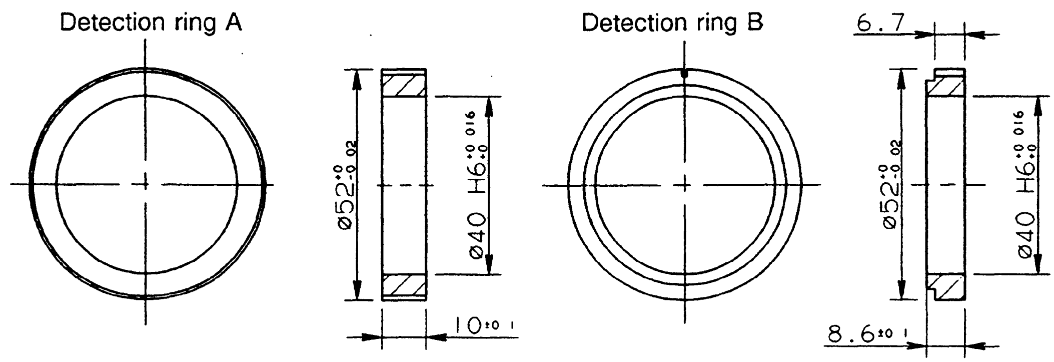
Note 9) Use the detection rings described in Section 7.4.

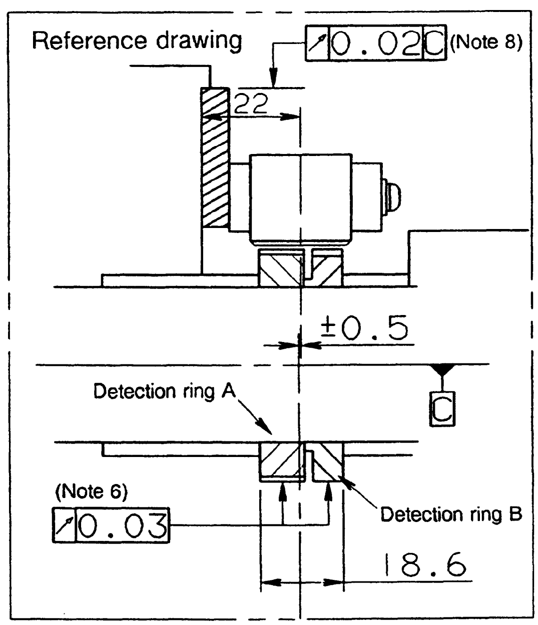
Note 10) Mating connectors are provided with the detector.

Note 11) Clamp the cable at a proper position.

7.4 Detecting Ring 2

Ordering drawing number: A860-0392-T012





Note 1) Be sure to completely insert detection ring A and detection ring B.

Note 2) The circumference has special teeth. So, carefully protect against deformation and chipping due to external force, particularly, when performing additional machining.

Note 3 The eccentially and parallelism of the speed detection ring circumference are within 0.01 with respect to the internal surface after finishing.

Note 4) Install detection ring A and detection ring B as shown in the reference drawing above.

Note 5) Install the speed/position detector and detection rings so that the distance between half of the detection ring width (18.6 mm/2) and center of the speed/position detector center (22 mm above the bottom surface) is within ±0.5 mm.

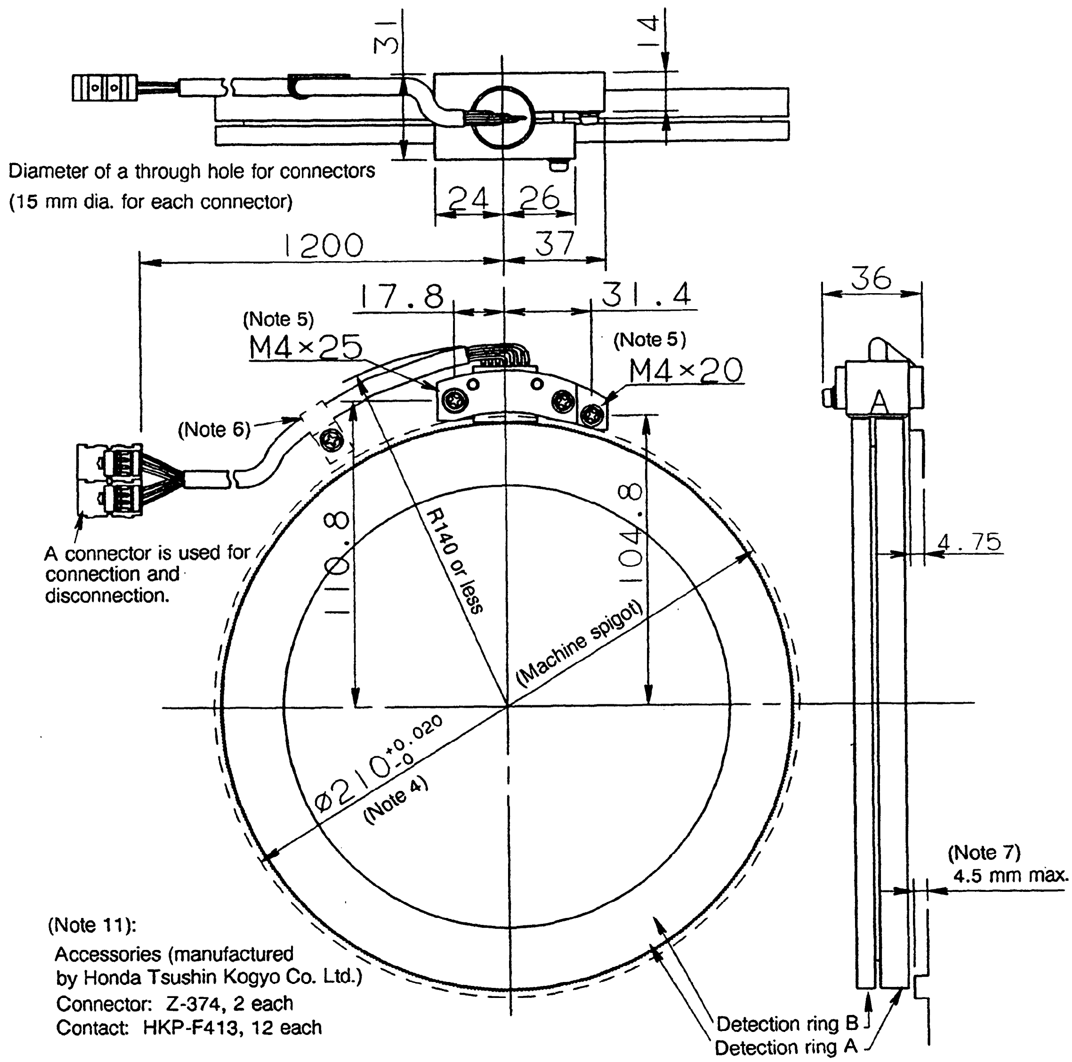
Note 6 The runout of the detection rings with respect to the speed/position detector must be within ±0.03 mm.

Note 7) See Section 7.10 for interference data for shrink-fitting of the detection rings.

Note 8) When the detector mounting ring is eccentric, the gap may not be 0.13.

7.5 Detector 3 (Drip-Proof Type)

Ordering drawing number: A860-0392-T013



Note 1) This detector can detect speed and position.

Note 2) Handle these precision parts with special care. In particular, never apply external force to part A.

Note 3) This detector is drip-proof. For higher reliability, however, make additional provisions to protect against dust and leakage.

Note 4) The detector must be installed by butting the sensor holder against the machine side spigot ($\phi 210^{+0.020}_{-0}$).

Note 5) Use mounting screws of M4X20 mm and M4X25 mm.

Note 6) Clamp the cable at a proper position.

Note 7) The height of the machine side rabbet must not exceed 4.5 mm.

Note 8) Connect the shield wire.

Note 9) For easy maintenance, consider a replaceable structure.

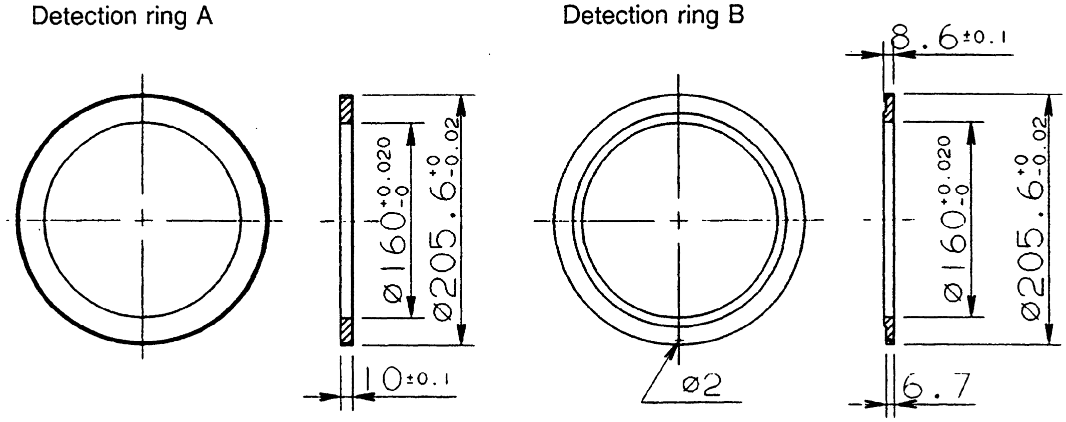
Note 10) Use the detection rings described in Section 7.6.

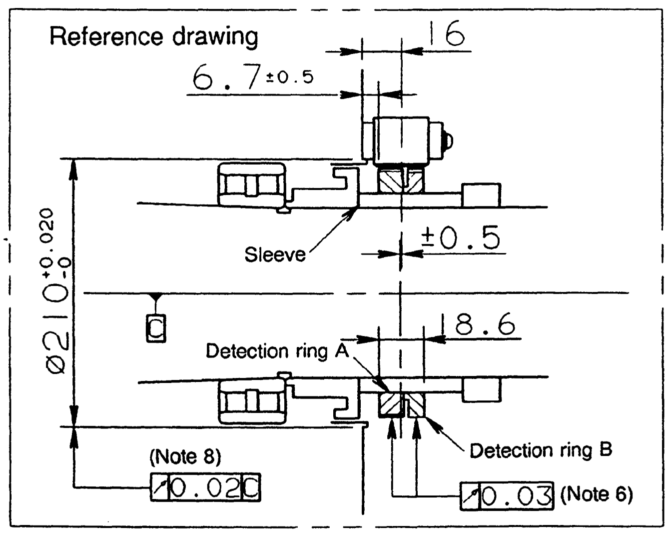
Note 11) Mating connectors are provided with the detector.

7.6 Detecting Ring 3

<u>Ordering drawing number: A860-0392-T013</u>

Detection ring A   Detection ring B





Note 1) Press-fit the rings on the sleeve, then insert the spindle into the sleeve. Be sure to completely insert detection ring A and detection ring B.

Note 2) The circumference has special teeth. So, carefully protect against deformation and chipping due to external force, particularly, when performing additional machining.

Note 3) The eccentricity and parallelism of the speed detection ring circumference are within 0.01 with respect to the internal surface after finishing.

Note 4) Install detection ring A and detection ring B as shown in the reference drawing above.

Note 5) Install the speed/position detector and detection rings so that the distance between half of the detection ring width (18.6 mm/2) and the center of the speed/position detector (22 mm above the bottom surface) is within ±0.5 mm.

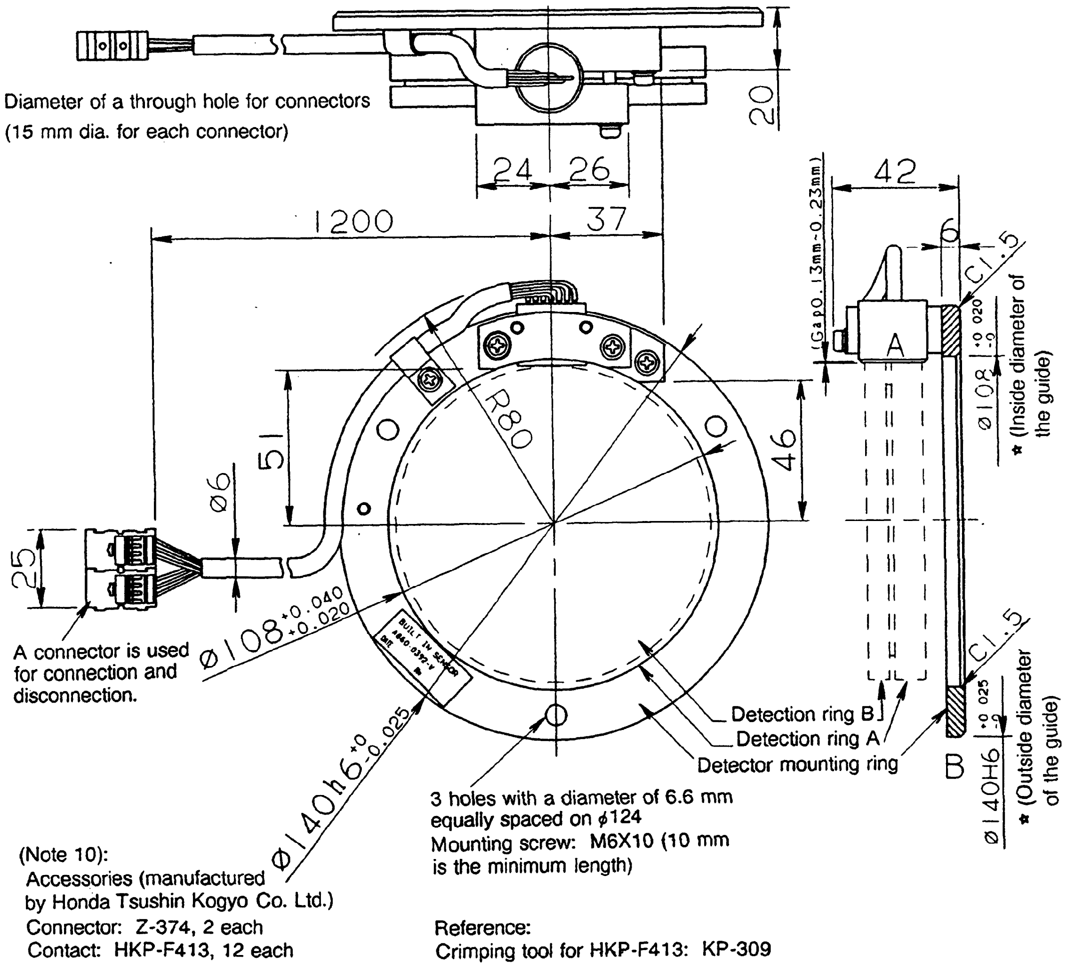
Note 6) The runout of the detection rings with respect to the speed/position detector must be within ±0.03 mm.

Note 7) See Section 7.10 for interference data for shrink-fitting of the detection rings.

Note 8) When the spigot on the machine (ø210) is eccentric, the gap may not be 0.13.

7.7 Detector 4 (Drip-Proof Type)

Ordering drawing number: A860-0392-T014



Note 1) Be sure to install the detector so it is aligned with the inner and outer diameter of the guide. Otherwise, the detector may produce incorrect output.

Note 2) The dimensions marked with a star apply to the fitting diameter.

Note 3) This detector can detect speed and position.

Note 4) Handle these precision parts with special care. In particular, never apply external force to part A.

Note 5) The detector consists of electric circuitry. So, provide protection against dust and leakage to prevent oil, for example, from accumulating on the detector surface.

Note 6) The gap is preadjusted between 0.13 mm and 0.23 mm. So, never remove the detecting element from part B.

Note 7) Connect the shield wire.

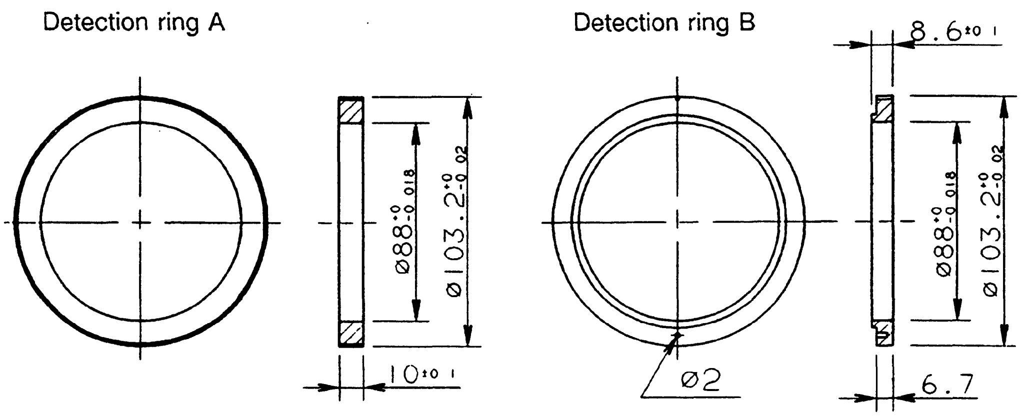
Note 8) For easy maintenance, consider a replaceable structure.

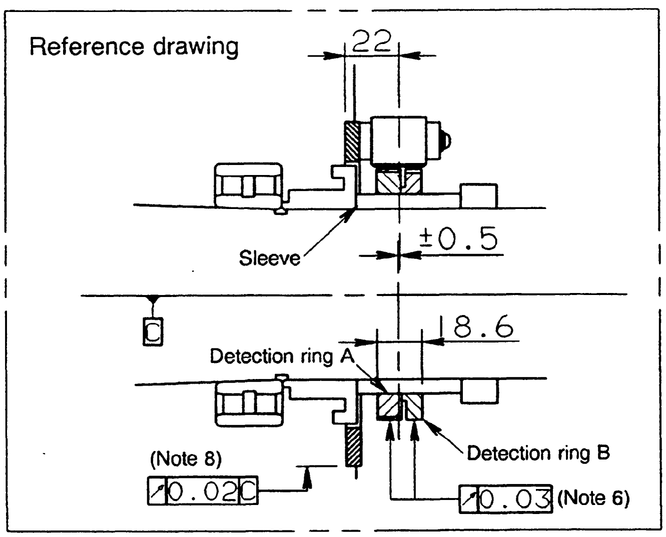
Note 9) Use the detection rings described in Section 7.8.

Note 10) Mating connectors are provided with the detector.

7.8 Detecting Ring 4

Ordering drawing number: A860-0392-T014





Note 1) Press-fit the rings on the sleeve, then insert the spindle into the sleeve. Be sure to completely insert detecting ring A and detecting ring B.

Note 2) The circumference has special teeth. So, carefully protect against deformation and chipping due to external force, particularly, when performing additional machining.

Note 3) The eccentricity and parallelism of the speed detection ring circumference are within 0.01 with respect to the internal surface after finishing.

Note 4) Install detection ring A and detection ring B as shown in the reference drawing above.

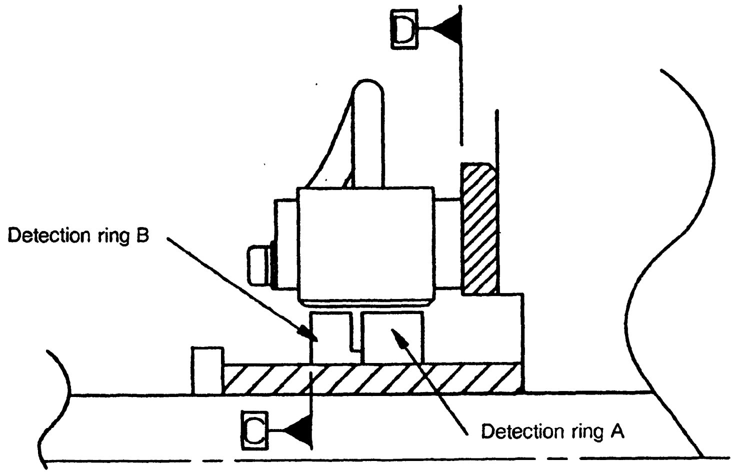
Note 5) Install the speed/position detector and detection rings so that the distance between half of the detection ring width (18.6 mm/2) and the center of the speed/position detector (22 mm above the bottom surface) is within ±0.5 mm.

Note 6) The runout of the detection rings with respect to the speed/position detector must be within ±0.03 mm.

Note 7) See Section 7.10 for interference data for shrink-fitting of the detection rings.

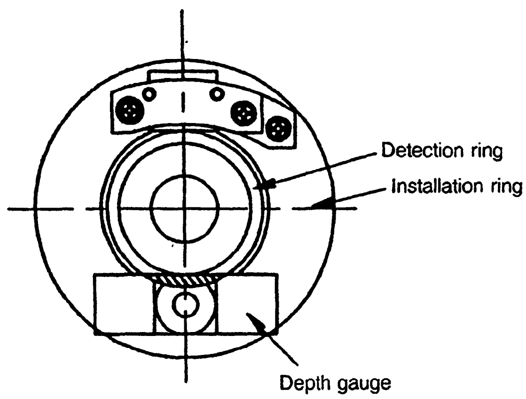
Note 8) When the detector mounting ring is eccentric, the gap may not be 0.13.

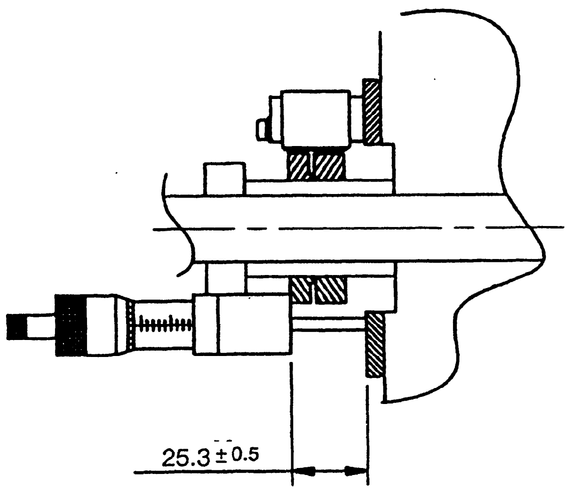
7.9 How to Measure ± 0.5 mm to Check the Positional Relationship between the Detector and the Detection Ring



Check that the distance between surfaces C and D is 25.3 ± 0.5 mm. The rings must contact when the distance is measured.

Method: Hold the depth gauge against the detection ring and measure the distance from the detection ring to the detector.



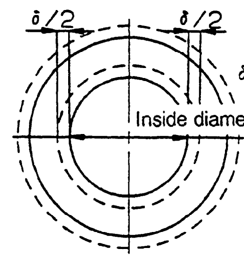


7.10 Interference for Detection Rings A and B

Detection rings A and B are expanded by centrifugal force when the spindle rotates.

The interference for the detection rings to the spindle or sleeve must be greater than the expansion at the maximum spindle speed.

The following table lists recommended interferences. Use the recommended interference corresponding to the specified maximum speed for each model.



Example: B6 (A06B-0926-B311)

According to the ordering list of drawing numbers, the drawing number of the detector is A860-0392-T011. The maximum spindle speed is 10.000 rpm. The interference is therefore 13 to 41 μm in diameter according to the table below.

The outside diameter of the sleeve for the detection ring is determined to be $\phi 82 {}^{+0.023}_{-0.013}$. when the inside diameter of the detection ring is $\phi 82 {}^{+0}_{-0.018}$.

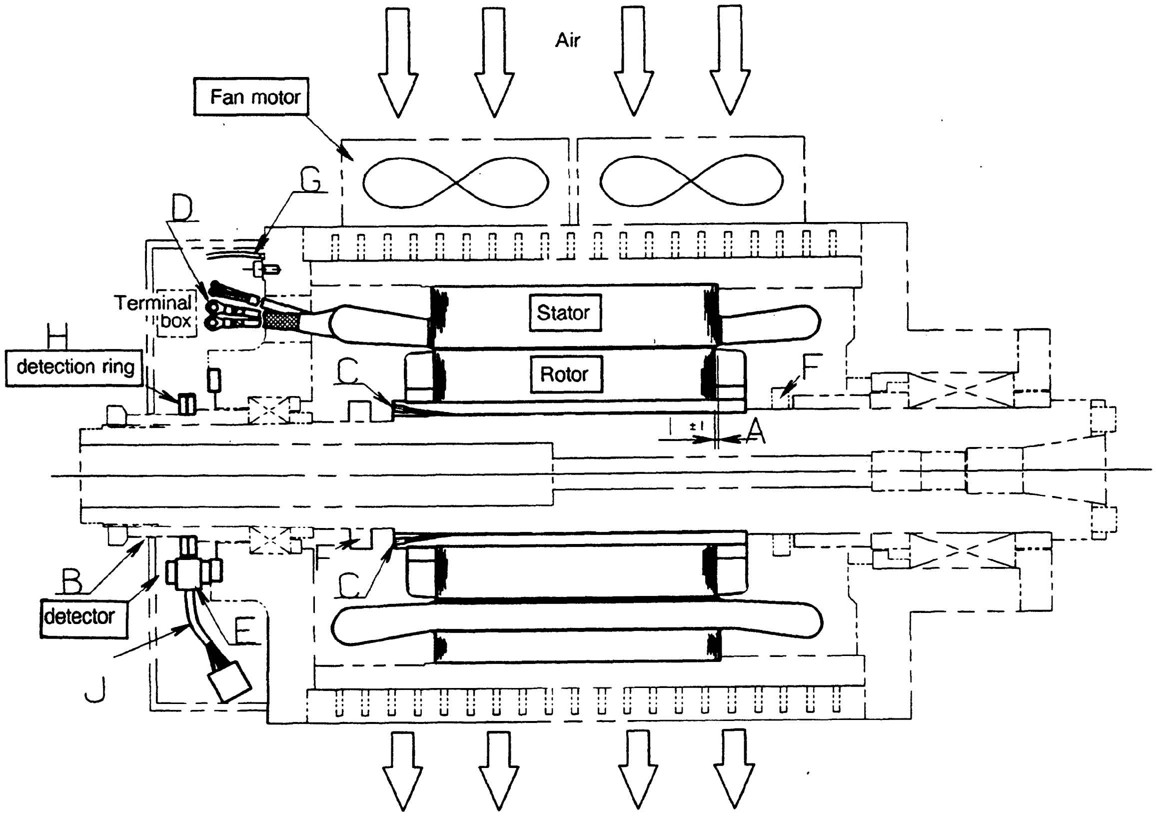
Recommended interferences for detection rings

Maximum spindle speed (rpm)	A860-0392-T012 (Inside diameter: φ40 Outside diameter: φ52)	A860-0392-T011 (Inside diameter: φ82 Outside diameter: φ103.2)	A860-0392-T014 (Inside diameter: φ88 Outside diameter: φ103.2)	A860-0392-T013 (Inside diameter: φ160 Outside diameter: φ205.6)
3000	–	–	–	φ10 to φ40μm
3500	–	–	φ6 to φ34μm	–
4500	–	φ7 to φ35μm	7 to 35	–
6000	φ5 to φ31μm*	8 to 36	–	–
8000	6 to 32	11 to 39	–	–
10000	6 to 32	13 to 41	–	–
12000	7 to 33	16 to 44	–	–
15000	8 to 34	23 to 51	–	–

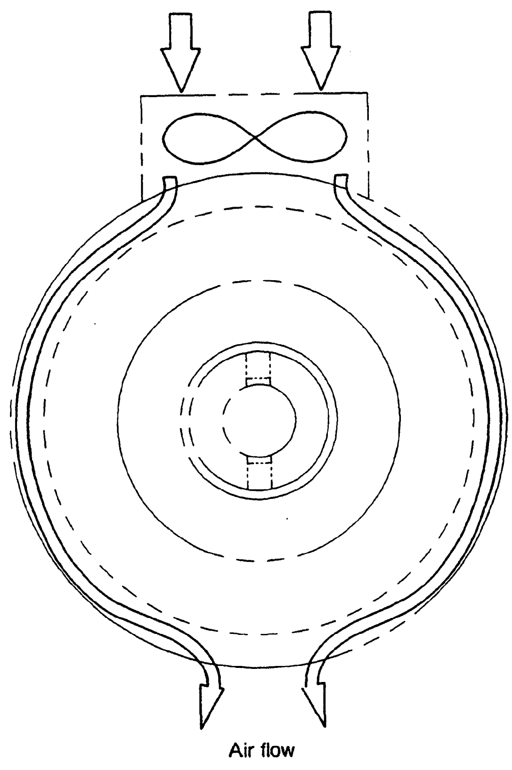
* The interferences in the table include the following:
Tolerance of the outside diameter of the sleeve: 10 μm
Tolerance of the inside diameter of the detection ring: 16 μm for T012, 18μm for T011 and T014, and 20 μm for T013

II. REFERENCE FIGURE

1. ASSEMBLY WITH AIR-COOLED MOTOR



* The machine tool builder is requested to manufacture components other than those indicated by thick lines (rotor, stator, detector, detection ring.)

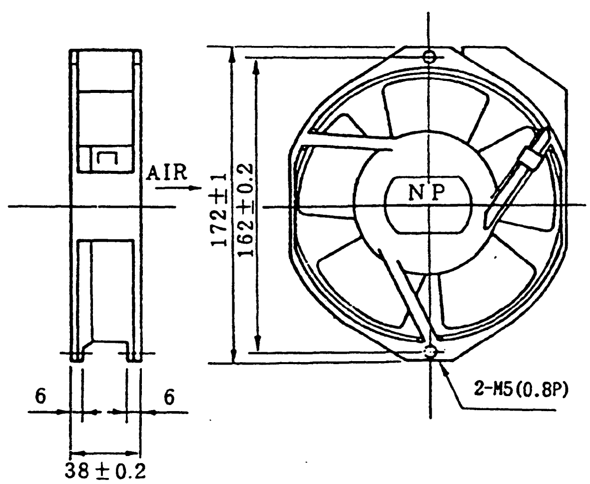


1.1 Cooling the Built-in Motor by Air

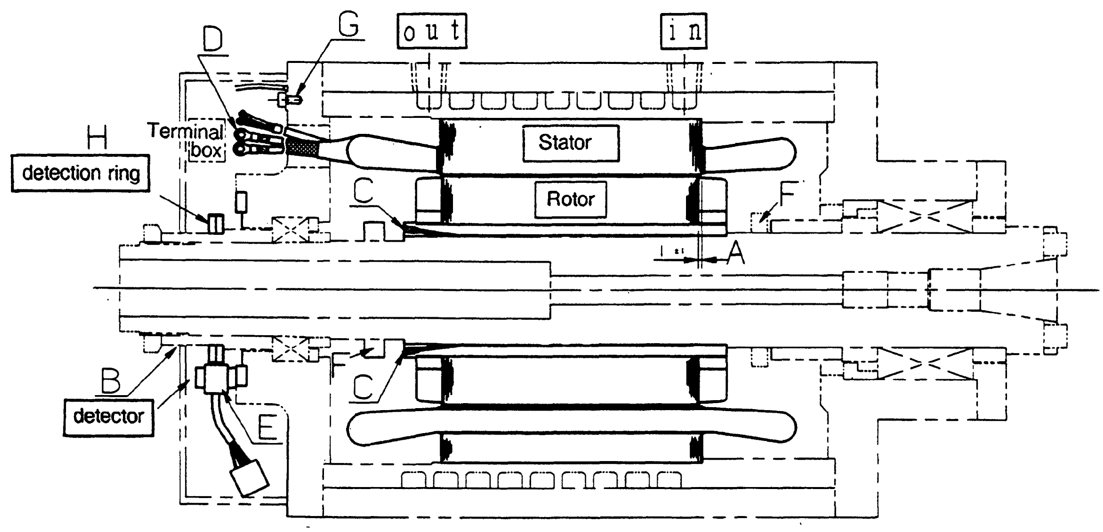
Of standard built-in motors, the models listed in the table below require forced-air cooling. The table also shows the number of fan motors required for those models. A fan motor manufactured by Minebea Co., Ltd., 5915PT-20W-B30-S04, is recommended. The figure below show the recommended fan motor. For the air-cooling mechanism, see 1, "Assembly with Air-Cooled Motor" in Part II, "Reference Assembly Drawings."

Motor model	B1	B1.5	B2	B6			B8	B15	B30	
Motor output [kW]	2.2	3.7	3.7	5.5	7.5	15	11	18.5	7.5	11
Number of fan motors	1	1	2	2	2	2	2	2	2	2

Fan motor (three-phase, 200 V)

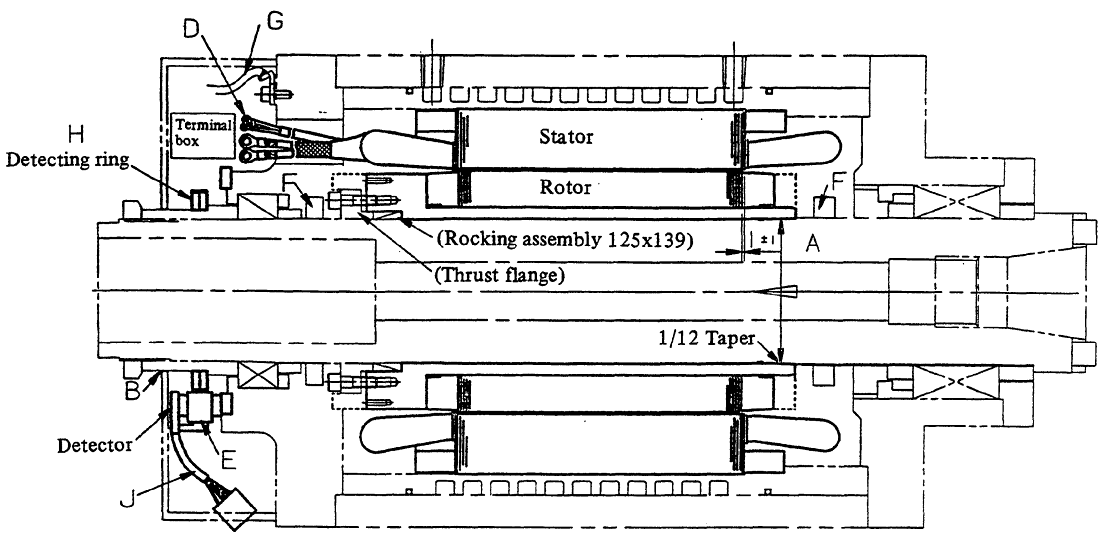


2. ASSEMBLY WITH LIQUID-COOLED MOTOR



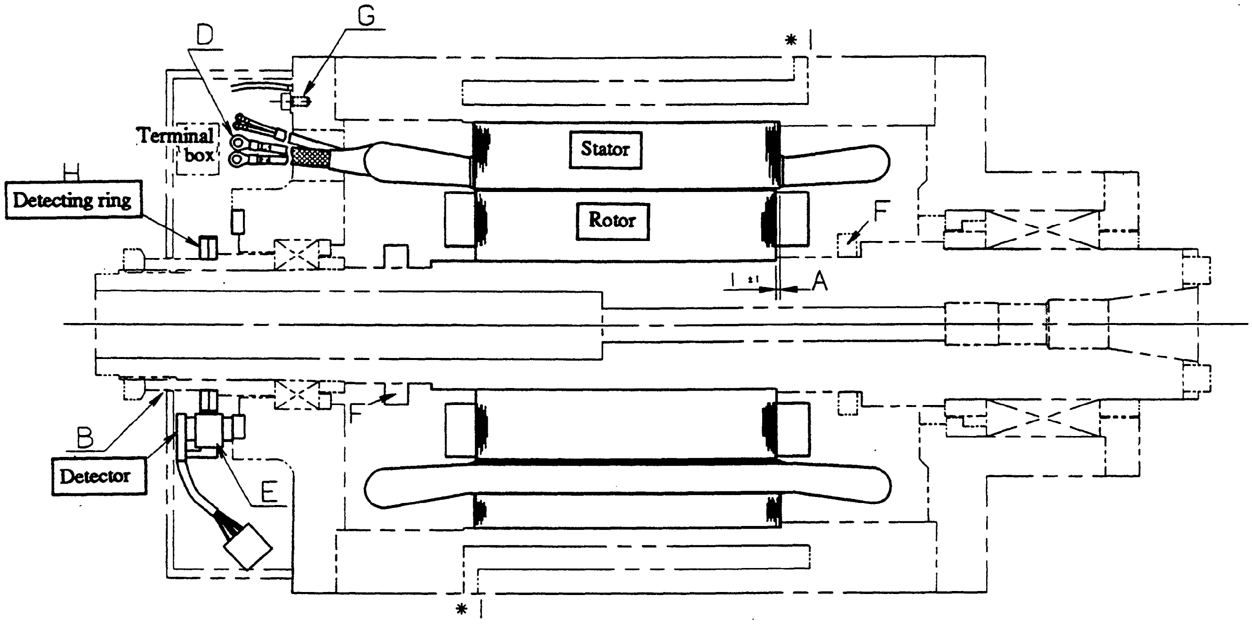
* The machine tool builder is requested to manufacture components other than those indicated by thick lines (rotor, stator, detector, detection ring.)

3. LOCKING ASSEMBLY TYPE



* The machine tool builder is requested to manufacture components other than those indicated by thick lines (rotor, stator, detector, detection ring.)

4. ASSEMBLY WITH NO ROTOR SLEEVE



*1 The outer circumference of the stator needs to be cooled.

*2 The machine tool builder is requested to manufacture components other than those indicated by thick lines (rotor, stator, detector, detection ring.)

*3 The structure of the bearing must be such that it can be extracted from both the front and rear.

(Notes on Operation)

Of the following notes on operation, B, D, E, and J affect the reliability of the rotor. Check them carefully. A to J correspond to A to J marked in the reference assembly drawings.

A. Install the stator and rotor so that the mounting error in the axial direction is within ±1 mm.

B. To protect the speed detection unit, provide a labyrinth seal that prevents foreign matter from entering.

C. To remove the rotor from the spindle, inject oil at a pressure of about 400 kg/cm^2 through the M4 screw section on the rotor sleeve. One of the two M4 screw sections on the rotor sleeve is used to release air from the sleeve. Hermetically seal the pocket when it is filled with oil. (See (10) and (11) in Section 2, "Rotor," Part III, "Notes.")

D. After incorporating the stator in the housing, check the following between the winding and housing:
Insulation resistance: 100MΩ or higher
Dielectric strength: 1500 VAC, one minute

E. If the speed detection unit (ring and detector) is incorrectly installed the spindle will not rotate normally. After installing the speed detection unit, check the following: The spindle rotates normally at a predetermined speed and the signal is output normally. Check them before installing the cylinder and drawbar. (See Section VI. 11, "Adjusting the Signal Conversion Circuit.")

F. Before starting high-speed rotation, balance rotor. Mount a balancing ring between the front and rear bearings, if possible.

G. To prevent malfunctions caused by noise, connect the housing of the stator to the ground terminal of the spindle amplifier.

H. The speed detector can synchronize the rotation. When a ring with a diameter of 52 mm is used, however, the number of pulses is halved and the repeatability in orientation becomes 0.4°.

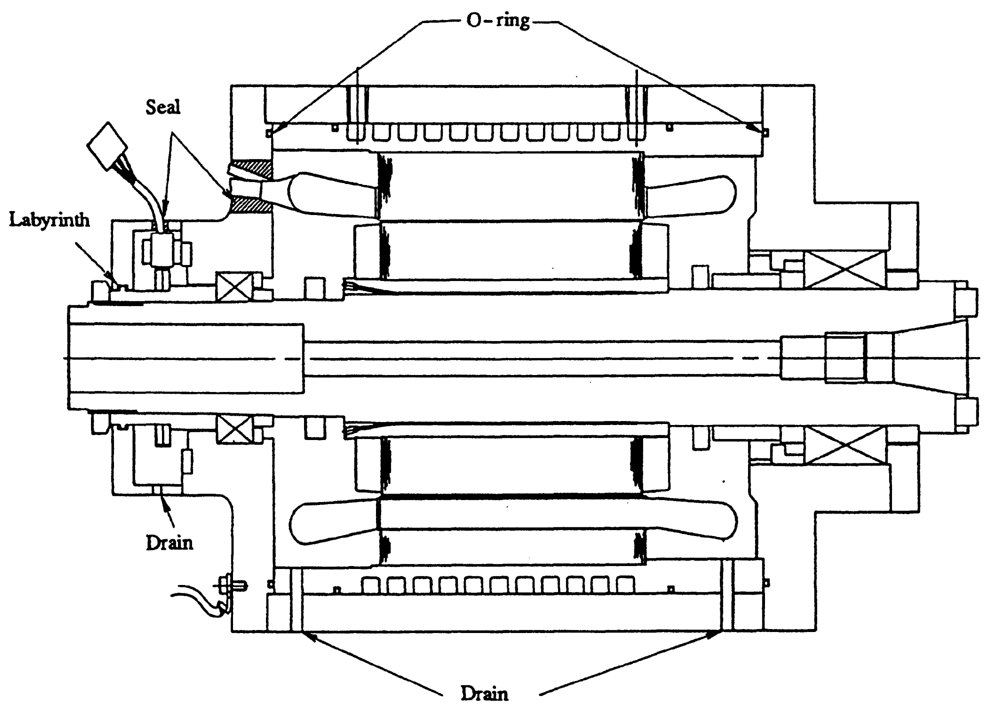
I. Position control requires the signal conversion circuit. For details, refer to "Built-in Sensor Signal Conversion Circuit Descriptions."

J. When the signal lines are connected with connectors, securely fasten the connectors. Do not let the connectors dangle.

5. PROTECTION OF THE BUILT-IN MOTOR

1. The built-in motor and the built-in sensor need not be protected against oil and grease such as lubricating oil for bearings.
2. To improve waterproofing, put an O-ring or seal on the housing of the motor to prevent coolant or oil from penetrating the motor.
3. For dust-proofing, attach labyrinth seals.
4. In addition to the above, it is recommended to make a drain.

Reference assembly drawing (for horizontal setting.)



III. PRECAUTIONS

1. STATOR

1) There is no tap for hoisting on this stator. (B40, B50 is with M12 tap.)

2) There may be causes when there is a distortion of 0.1 mm in the stator outer diameter, but even so, this is acceptable if the standard value of the stator outer diameter is taken as the dimension of the outer diameter dimension diagram. (Example: when B26, $\phi 240 \pm 0.02$)
Even if there is a distortion of 0.1 mm, it is considered as having been inserted in the housing.

3) In principle it is recommended that the connection of the stator and housing be by shrinking. The following is the recommended value of the shrinkage amount. In actual practice it is recommended that a shrinkage margin (interference) be used.

Model	Shrinkage margin (interference) mm
B03 – B10	0.01 – 0.015
B17 – B26	0.01 – 0.020
B27	0.015 – 0.025
B28 – B45	0.01 – 0.025
B50	0.015 – 0.025

4) For method of heating of stator housing (oil jacket), an electric oven is best but even when using an oil tank, this is acceptable. However, taking into account the influence on the coil, use an insulating oil.

5) Because there are no taps for hoisting when shrinking, prepare a jig to retain the stator after widening the inner diameter of the stator. (Refer to the next page.)

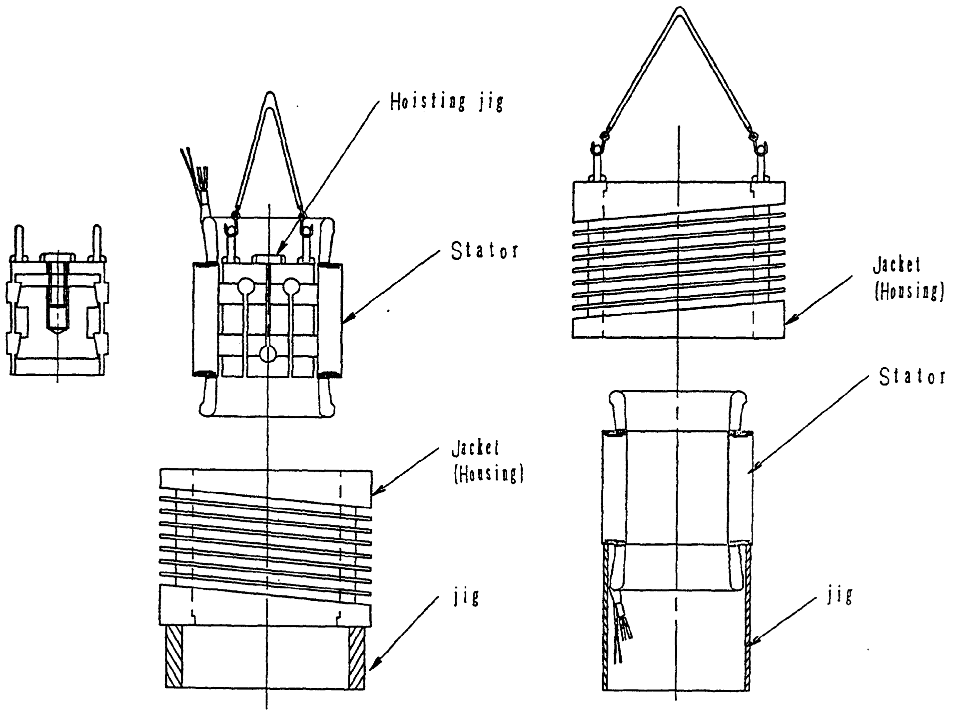
6) This is an example assembly of after setting the clearance of the stator and housing. In this case there seem to be many pins inserted in order to stop the rotation in the radial direction. It is also possible to suppress it at edge, but because the stator is layered with thin iron plates, it will somewhat stretch/compress in the axis direction.

7) Avoid machining the stator outer diameter again as much as possible from the stand point of reliability of the winding. However, when repeat machining is absolutely necessary, pay attention to the jig such that cutting particles will not become attached to the coil. Use a water soluble liquid for cutting liquid and dry it afterwards.

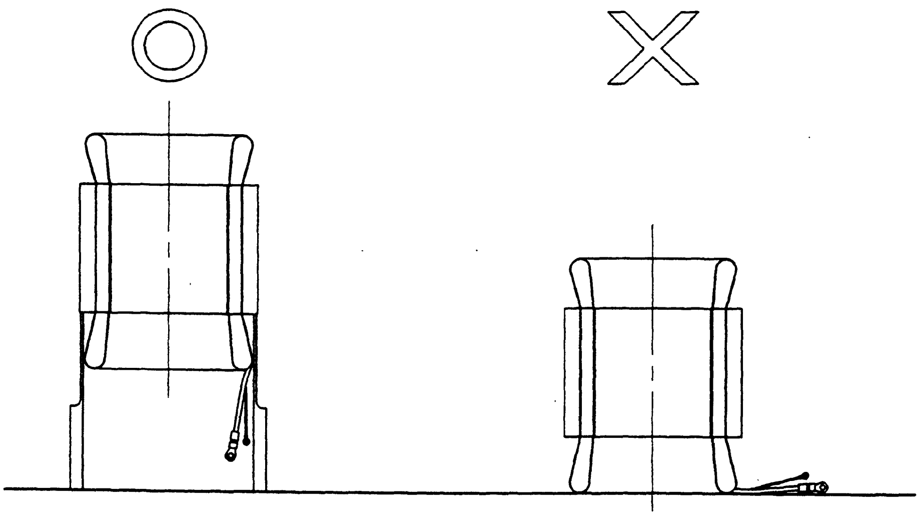
8) The following values are recommended for the precision of the whole machining of the housing (oil jacket) inner diameter.
Cutting machining is considered to be the best, but turning machining or boring machining is also acceptable.

Finishing surface roughness of hole machining	6.3S or less
Circularity	0.02 or less
Cylindrical	0.02 or less

Method of shrink fitting stator (For example)



9) When placing the stator upright, avoid putting it directly on the floor (as shown in the bottom right figure). The coil end may break, or a short circuit may occur. When placing the stator upright, put it on a jig (as shown in the bottom left figure).



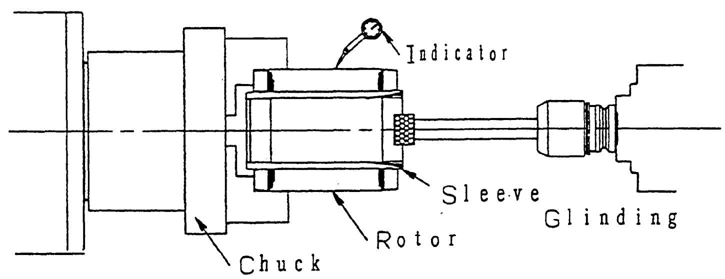
2. ROTOR

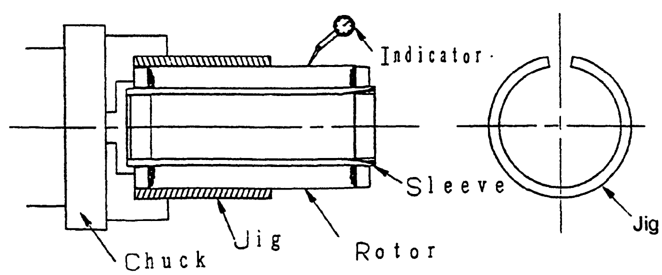
1) Inner diameter machining of rotor sleeve (only with sleeve)

The rotor outer diameter of the built-in motor is finishing machined. (±0.01 - 0.03) Therefore, when machining the inner diameter of the sleeve, machine the inner diameter while picking up the core of the outer diameter, for example, by setting the outer diameter of the rotor as the standard (chuck). Chucking the outer diameter is a method which uses a jig as shown in the diagram.

* The cutting margin of the outer diameter of the rotor is acceptable if it is within 0.05 mm (diameter).
* The allowable eccentricity after cutting the panel the panel section of the rotor inner diameter is up to 10 μm.

  (The rotor is factory-adjusted so that the runout of the inner wall from the outer wall is about 60 μm and the eccentricity is about 30 μm.)





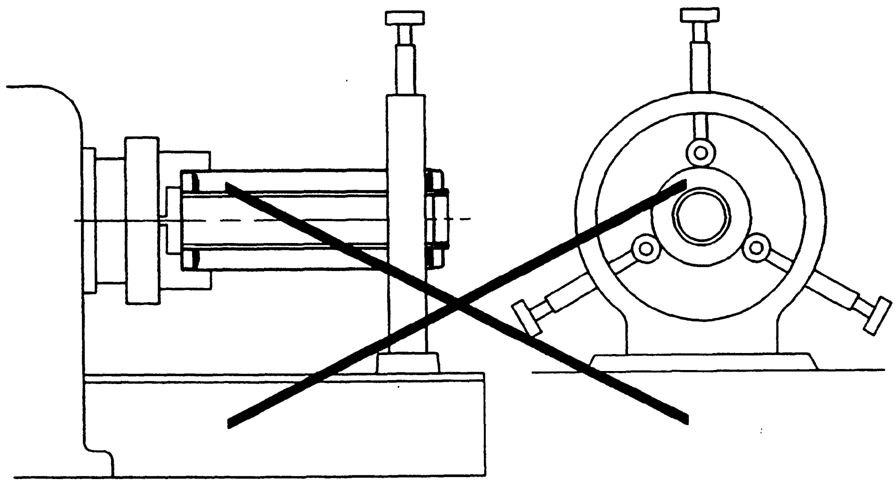
As shown in the diagram, if the rotor is gripped by a divided jig, the chucking is more stable.

Further, when the stroke of the tool axis is sufficiently longer than the rotor length, finish the rotor by one chuck without changing the grip

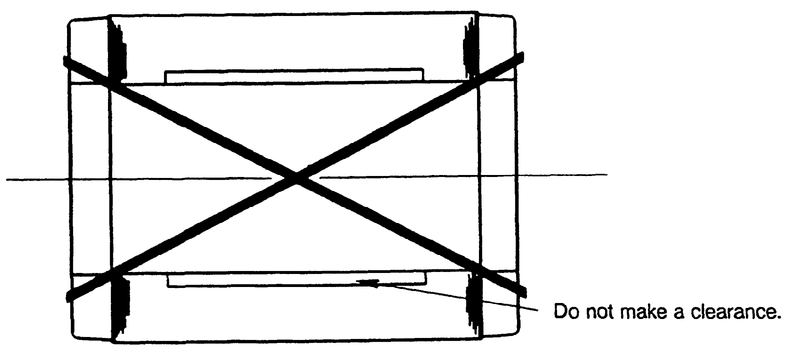
The table below indicates the recommended precision in machining the inner wall of the rotor.

Roundness	0.005
Cylindricity	0.005

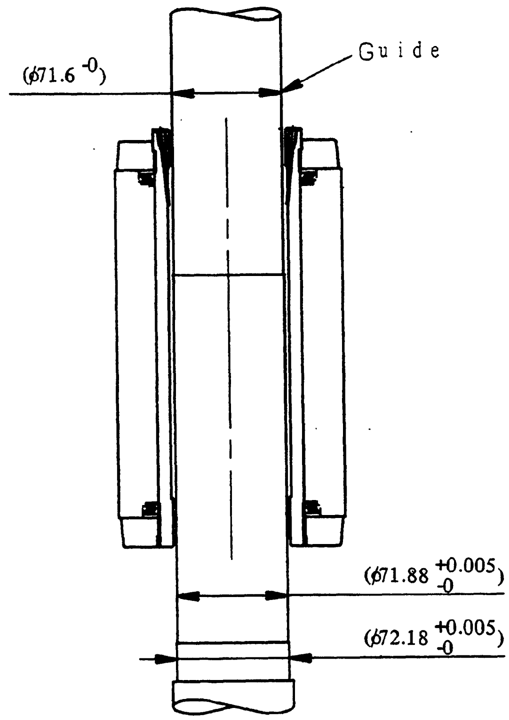
* Avoid using a steady rest. As the rotor has slots on its outer wall, the runout of the rotor increases if it is supported by a rest.



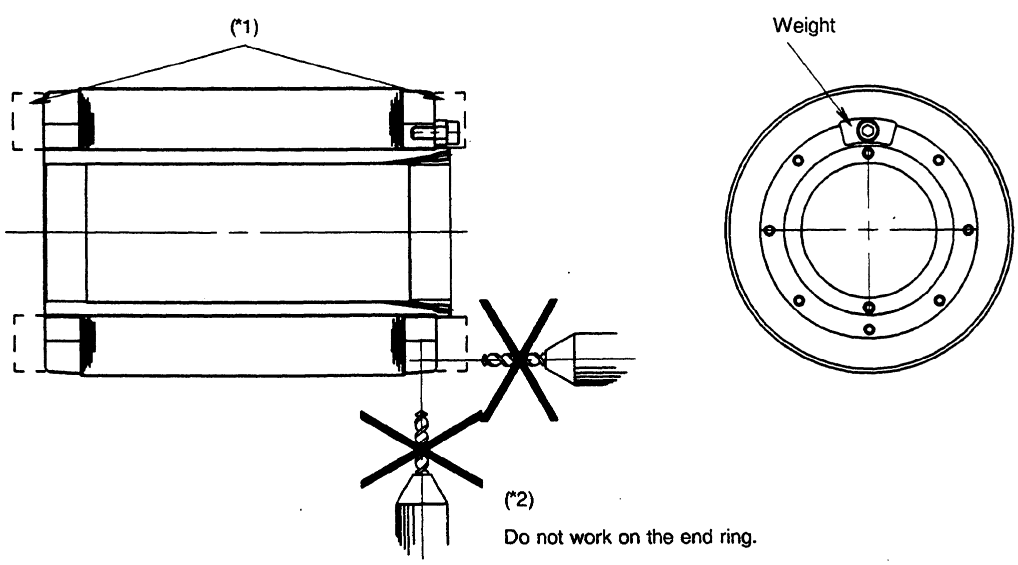
2) Machining the inner wall of the rotor (without sleeve)
When finishing a rotor without a sleeve, avoid making a clearance as shown below. The inner wall of the rotor must form a perfectly cylindrical surface. As the rotor is made of laminated steel, it has low rigidity and is likely to be deformed at the clearance during operation.



3) If guided at the spindle shaft side at the insertion, it can be assembled smoothly. (Refer to following diagram.)



4) Balancing the spindle
The balance of the spindle has an influence when it is rotating at a speed of 8000 rpm or higher. After the rotor is mounted, it is recommended to balance the entire spindle by separately installing a balancing ring. A balance of up to 5 cm × 0.5 g may be sufficient when the spindle speed is 8000 rpm or higher. The figure below shows the factory-adjusted state. A balance is mounted on the section indicated by a broken line(*1). Keep this section clear of other components. Avoid working on the aluminum end ring (for example, do not make a balancing hole in it).(*2)

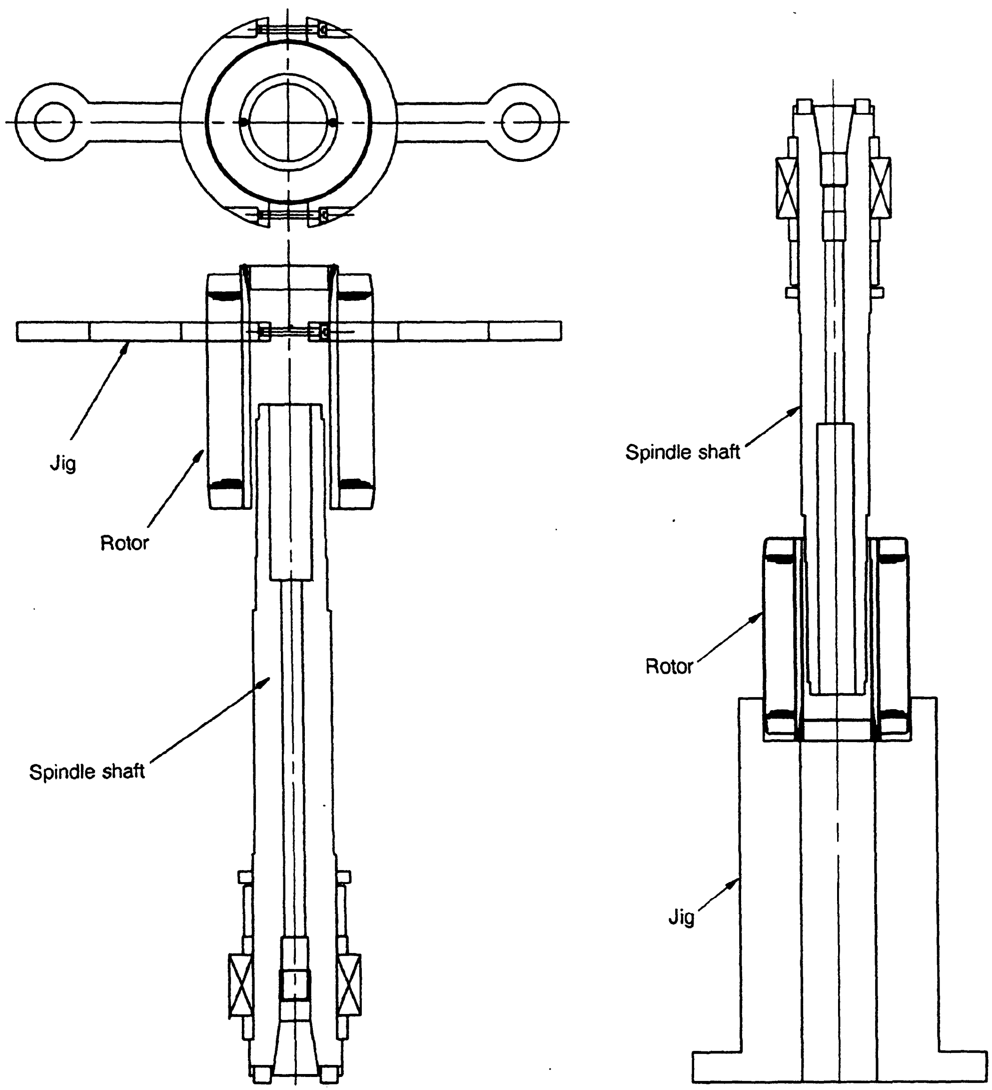


5) Set the clearance of the rotor and stator on average as 0.1 mm or less. Magnetic noise is generated at acceleration.

6) The slip between the stator and rotor axes directions is ±1 mm. If they slip, the torque generation section decreases by this amount only.

7) The rotor and stator are handled as a unit, but either one can be replaced by a part having an identical drawing number. This will not affect the characteristics of the motor.

Method of shrink fitting rotor (For example)

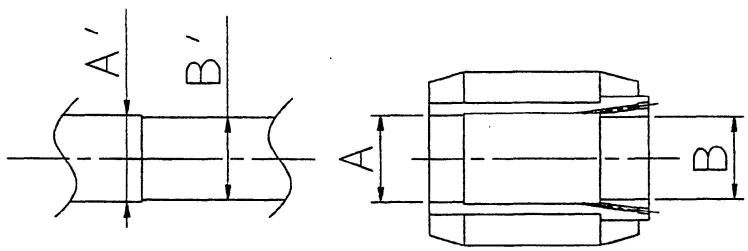


8) When heated 200°C or higher, the rotor may change its color. This will not affect the characteristics of the motor.

	Maximum temperature
Rotor without sleeve	200°C
Rotor with sleeve	240°C

9) Stepped sleeve test data

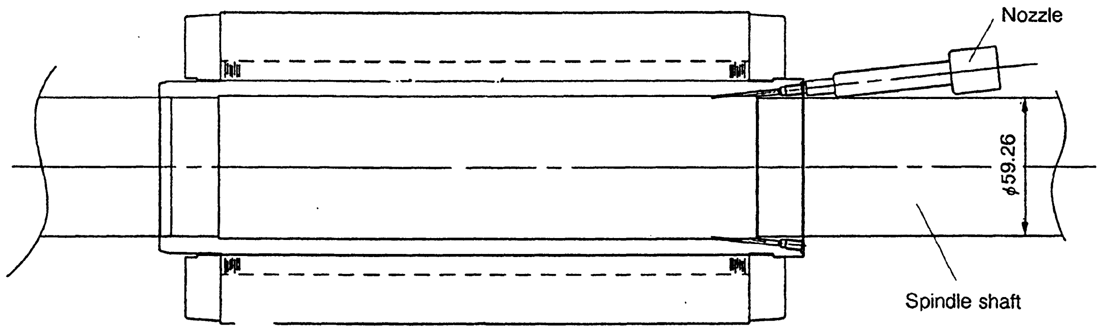
When the rotor inner diameter and shaft outer diameter have the values A, A', B, B', the rotor is separated from the shaft by using the oil pressure OIL in the stepped sleeve. (Actual measurement data)

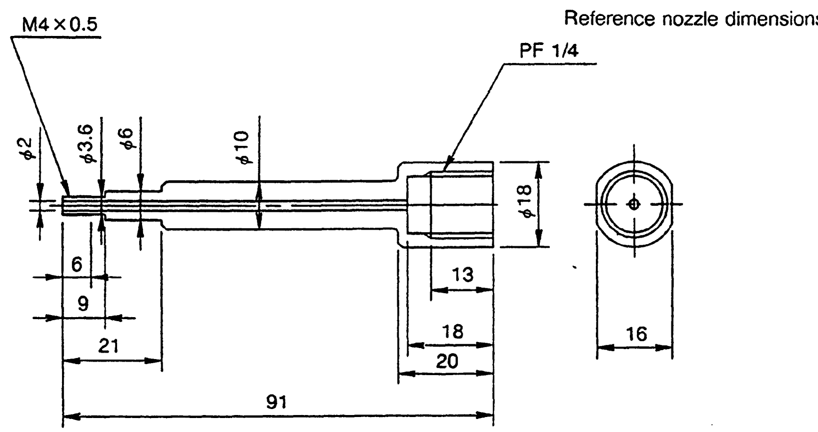


		B2	B6	B26	B28
Rotor inner diameter (mm)	A	45.162	59.309	72.098	93.989
	B	44.960	59.110	71.798	93.593
Shaft outer diameter (mm)	A'	45.202	59.367	72.180	93.962
	B'	45.002	59.158	71.880	93.670
Interference (μm)	A' - A	40	58	82	64
	B' - B	42	48	82	77
Oil pressure	kgf/cm^2	714	541	714	367
Separating force	kgf	201	101	242	163

Separating force = Oil pressure × (A/2 − B/2) × π × A

10) Reference figure of hydraulic pump adapter nozzle (for B17)





IV. AC SPINDLE SERVO UNIT SERIAL INTERFACE S series

1. GENERAL

The FANUC Spindle Servo Unit Serial Interface S series employs the latest microprocessor and power electronics technology to achieve stable smooth movement with little noise and vibration over a wide range of speeds, super low to high. High-speed optical information transference and increased storage space have been achieved by communicating information to and from the CNC via optical cables. Functions hitherto not available (Cs contour control, spindle synchronization control) are provided, enabling the requirements of the latest CNC machine tools to be met with ease.

2. FEATURES

(1) Since the speed detecting method has been completely digitalized, rotation speed adjustment and speed offset adjustment have become unnecessary. The number of adjustment processes the user has to make has been reduced.

(2) Displaying/setting/changing of spindle parameters are performed conventionally by the PCB of the spindle servo unit, but because it has become operable by the CRT of the CNC, the number of operation and adjustment processes have been reduced.

(3) The spindle orientation control function has been widely made into software form, and improvements in adjustment locations have been made to markedly reduce them and to make adjustments easy. The number of adjustment processes has been greatly reduced.

(4) Since the interface has become 1 optical cable between the CNC and the spindle servo unit, the conventional 50-core connector cable existing between the PMC and the spindle servo unit has become unnecessary, and the number of connection operations has been reduced.

(5) Since the quantity of information transmission between the CNCs has appreciably increased, hitherto unavailable new functions (Cs contour control, spindle synchronization control) have become possible.

(6) The light and compact unit is achieved owing to the plastic case.

(7) The heat radiation part is cooled by the outside air and the electric circuit in the magnetics cabinet can be completely closed resulting in higher reliability.

(8) Adoption of a custom LSI and a high-performance processor enhances the motor control performance and flexibility.

(9) The rigid tapping process involving synchronous feed of the spindle and the Z axis in the machining center is possible.

(10) Power-saving (energy-saving) design
The spindle servo unit is designed for energy-saving to obtain high power with a small current owing to the unique power factor improvement design in the input part.

(11) Power supply regenerative braking is possible. (Model 1S~40S)
The unique driving method (patent pending) allows the motor to serve as a generator during AC spindle motor deceleration so as to return energy to the power source.

(12) Low noise drive
The unique driving method (patent pending) reduces noises, even if the AC spindle motor is operated at low speed.

(13) Smooth low-speed rotation
The unique driving method (patent pending) assures very smooth rotation down to low speed.

(14)Electric spindle orientation control is applicable (option).
Since the spindle orientation can be done pure-electrically, the mechanical section is simplified, and the machine spindle can be composed with high reliability and largely reduced orientation time.

(15)The load detection signal
The load detection signal function is newly added. This function is used to detect the load status of the machine tool spindle. If the load is larger than the specified load, the contact signal is used to reduce the feed motor speed for moving the table and the cutting load, thus preventing the tools from being damaged.

(16)Override function with analog input (for 1S to 26S, small type 30S)
The override function with analog input has been added. This function is implemented by connecting a variable resistor to a spindle servo unit.
This function can apply override to spindle speed to obtain the optimum cutting conditions for an S command.

(17)Function for outputting an MCC cut-off check signal (for models 1S to 26S, and small type model 30S)
The newly added contact signal can check the cut-off state of the MCC in the spindle servo unit.

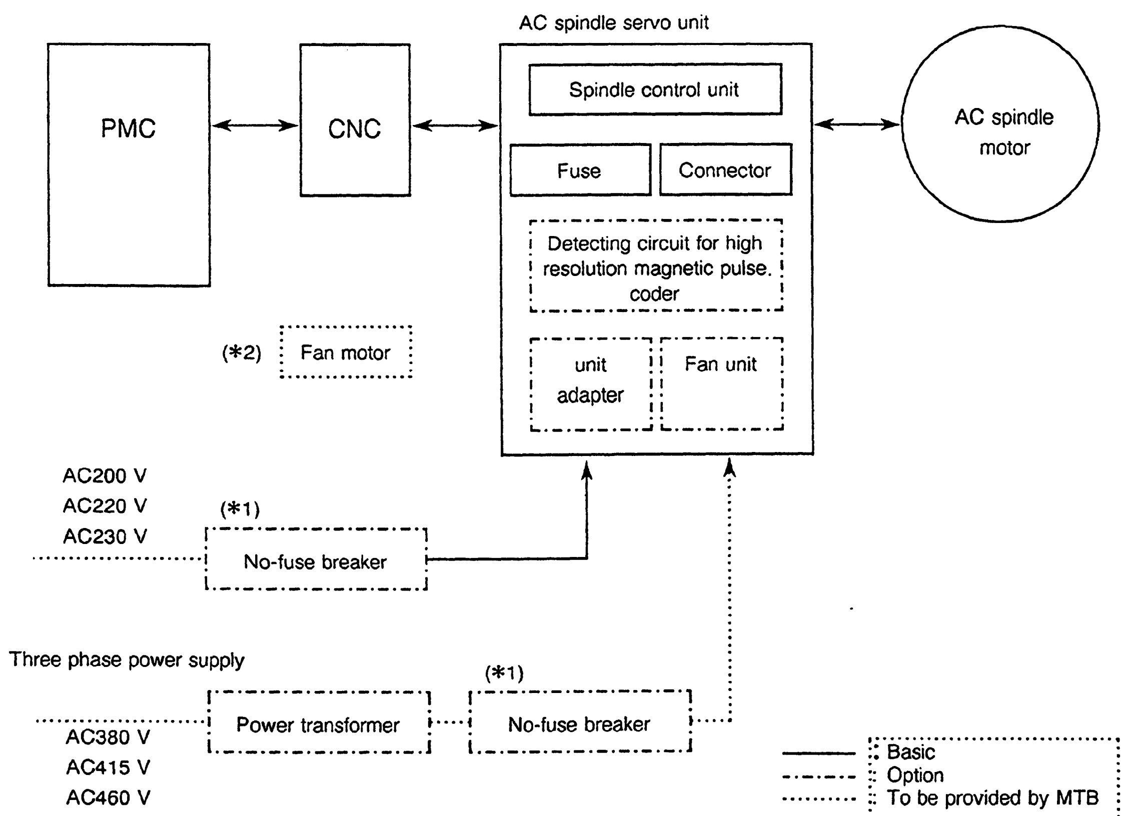
[Functions which have become unusable]
The analog speed command voltage has become unusable.

3. CONFIGURATION AND ORDER SPECIFICATION DRAWING NUMBER

3.1 Models 1S - 40S

FANUC Spindle Servo Unit Serial Interface S series (Models 1S, 2S, 3S, 6S, 8S, 12S, 15S, 18S, 22S, 26S, 30S, Small type 30S, 40S) comprises the following units and components.

(1) Spindle control unit .... (Basic)
(2) Fuse (spare) .... (Basic)
(3) Connector (for connection) .... (Basic)
(4) Detecting circuit for high resolution
magnetic pulse coder .... (Option)
(5) Power transformer .... (Option)
(6) Unit adapter .... (Special option for models 6S to 26S, Small type 30S)
(7) Fan unit .... (Special option for models 30S and 40S)



(*1) MTB to provide an overcurrent protector with a proper capacity such as a no-fuse breaker to the input power circuit of the AC spindle servo unit S series.

(*2) Make sure to prepare a fan motor to cool the spindle control unit forcibly. However, with respect to the models 1S to 3S, fan motors are built in. Moreover, a fan motor is not necessary either when unit adapters are used for models 6S to 26S, Small type 30S and when fan units are employed for models 30S and 40S.

3.2 Order Specification Drawing Number

Type	Item		Code number	Remarks	
Basic	Spindle control unit for model 1S		A06B-6064-H301#H550		
	Spindle control unit for model 2S		A06B-6064-H302#H550		
	Spindle control unit for model 3S		A06B-6064-H303#H550		
	Spindle control unit for model 6S		A06B-6064-H306#H550		
	Spindle control unit for model 8S		A06B-6064-H308#H550		
	Spindle control unit for model 12S		A06B-6064-H312#H550		
	Spindle control unit for model 15S		A06B-6064-H315#H550		
	Spindle control unit for model 18S		A06B-6064-H318#H550		
	Spindle control unit for model 22S		A06B-6064-H322#H550		
	Spindle control unit for model 26S		A06B-6064-H326#H550		
	Spindle control unit for small type model 30S		A06B-6064-H327#H550		
	Spindle control unit for model 30S		A06B-6064-H030#H520		
	Spindle control unit for model 40S		A06B-6064-H040#H520		
Basic	Optical fiber cable		A02B-0094-K801	Length: 5 m (*)	
	Connectors	When the Cs contour control function is not used	A06B-6062-K103	Solder type	
			A06B-6062-K104	Crimp type	
		When the Cs contour control function is used	A06B-6063-K105	Solder type	When the built-in spindle motor is used
			A06B-6063-K106	Crimp type	
	Fuses		A06B-6064-K305	For models 1S to 3S	
			A06B-6064-K026	For models 6S to 26S, Small type 30S	
			A06B-6044-K028	For model 30S	
			A06B-6044-K029	For model 40S	
Optional	Detection circuit for the high-resolution magnetic pulse coder		A06B-6064-J724	Spindle: $\phi 65$	
			A06B-6064-J725	Spindle: $\phi 130$	
			A06B-6064-J726	Spindle: $\phi 195$	
			A06B-6064-J727	Spindle: $\phi 97.5$	

(*) See the item of optical fiber cable for it's order specification drawing number.

Type	Item	Code number	Remarks
Optional	Unit adaptor	A06B-6059-K031	Models 6S to 12S
		A06B-6059-K032	Models 15S to 22S
		A06B-6059-K038	Models 26S, small type 30S
	Fan unit	A06B-6044-K040	Models 30S and 40S
	Feedback cable for position detection (for the Cs contour control function)	A06B-6063-K801	Preamplifier to CN15
		A06B-6063-K802	Preamplifier to CN16

Optical fiber cable

Type	Item		Code number	Remarks
Basic	Optical fiber cable (with reinforced cover, for external wiring)	5m	A66L-6001-0009#L5R003	
		10m	A66L-6001-0009#L10R03	
		15m	A66L-6001-0009#L15R03	
		20m	A66L-6001-0009#L20R03	
		30m	A66L-6001-0009#L30R03	
		40m	A66L-6001-0009#L40R03	
		50m	A66L-6001-0009#L50R03	
		60m	A66L-6001-0009#L60R03	
		80m	A66L-6001-0009#L80R03	
		90m	A66L-6001-0009#L90R03	
		100m	A66L-6001-0009#L100R3	
	Optical fiber cable (without reinforced cover, for internal wiring)	1m	A66L-6001-0008#L1R003	Because of no reinforced cover, cable forming can be easily done. However, since this cable is inferior to cable with reinforced cover in strength, use only for internal wiring.
		1.5m	A66L-6001-0008#L1R503	
		2m	A66L-6001-0008#L2R003	
		3m	A66L-6001-0008#L3R003	
	Optical cable relay adaptor		A02B-0094-K841	Only one can be used on a single transmission line. When using an optical cable relay adaptor to relay data, the maximum total cable length is 100 m.

CNC software

Group	Name	FANUC Series 0				FANUC Series 15			
			Specification	Q'ty	Remarks		Specification	Q'ty	Remarks
Basic	Spindle serial output function		A02B-0098-J940		T, TT series		A02B-0094-J710		T, M, TT series
			A02B-0099-J940		M series				
Option	Cs contour control function		A02B-0098-J944		T, TT series		A02B-0094-J726		T, M, TT series
			A02B-0099-J944		M series				
	Spindle synchronous control function		A02B-0098-J945		TT series only		A02B-0094-J744		TT series
	Spindle orientation function		A02B-0098-J982		T, TT series		A02B-0094-J730		T, M, TT series
			A02B-0099-J982		M series				
	Speed ragne switching function		A02B-0098-J984		T, TT series		A02B-0094-J732		T , M, TT series
			A02B-0099-J984		M series				
	Spindle positioning function		A02B-0098-J980		T, TT series		A02B-0094-J836		T , M, TT series
	Rigid tapping function						A02B-0094-J648		T , M, TT series
			A02B-0099-J885		M series only				

Group	Name	FANUC Series 16				POWER MATE			
			Specification	Q'ty	Remarks		Specification	Q'ty	Remarks
Basic	Spindle serial output function		A02B-0120-J850		T, TT series				Depends on the PT board
			A02B-0121-J850		M series				
Option	Cs contour control function		A02B-0120-J852		T, TT series		Function not available		
			A02B-0121-J852		M series				
	Spindle synchronous control function		A02B-0120-J858		T, TT series		Function not available		
			A02B-0121-J858		M series				
	Spindle orientation function		A02B-0120-J853		T, TT series		A02B-0118-J803		PMA
			A02B-0121-J853		M series		A02B-0122-J803		PMB
	Speed ragne switching function		A02B-0120-J854		T, TT series		A02B-0118-J804		PMA
			A02B-0121-J854		M series		A02B-0122-J804		PMB
	Spindle positioning function		A02B-0120-J851		T, TT series		Without function		
	Rigid tapping function		A02B-0120-J828		T, TT series		A02B-0118-J802		PMA
			A02B-0121-J828		M series		A02B-0122-J802		PMB

4. SPECIFICATIONS AND FUNCTIONS

4.1 Specifications

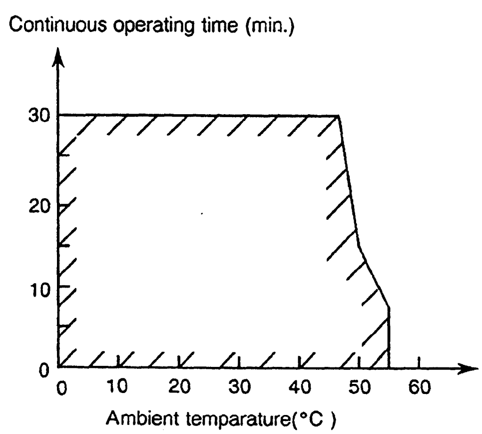
AC spindle servo unit

Item \ Model	1S	2S	3S	6S	8S	12S	15S	18S	22S	26S	small type 30S (*7)	30S	40S
Power source (*1)	AC200V/220V/230V +10%, −15% 50/60Hz±1Hz												
Main circuit system	Transistor PWM invertor												
Feed back system	Speed feed back by pulse generator												
Braking system (Regenerative energy processing system)	Regenerative braking (Power regeneration)												
Speed control range	Speed ratio of the minimum to the maximum: 1:100 (When the maximum motor speed is 6000 rpm, the ratio is 1:133.)												
Speed variation	Less than 0.1% of the maximum speed (Load variation 10 - 100%)												
Ambient temperature (*2)	0 - 55°C												
Weight kg	13			17				30				80	100

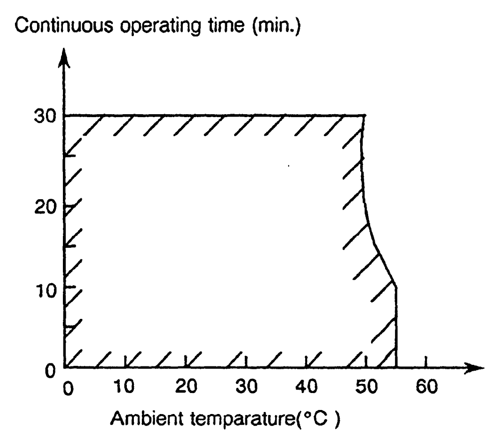
(*1) If the power voltage is other than specified herein, a transformer is needed.

(*2) The radiator fin of a servo unit needs to be cooled forcibly. When designing a cabinet for a servo unit, give special attention to the cooling fan and forced cooling system for the fin by seeing to 7 COOLING.

(*3) In Model 12S and Model 22S, the continuous operating time of the motor at 30-min. rated output is determined as follows by the thermal limitation of the unit.



Heat Restrictions on Continuous Operating Time for Model 12S



Heat Restrictions on Continuous Operating Time for Model 22S

4.2 Major Component Functions and Application

4.2.1 Spindle control unit

The spindle control unit rectifies three-phase AC input, and converts it into DC so as to perform the velocity control of the AC spindle motor through transistor PWM inverter.
The spindle control unit is provided with a protective and fault detection function as shown in (1) for the purpose of protecting machine, AC spindle motor, and AC spindle servo unit, if a trouble has occurred. It also provides an auxiliary function as shown in (2) for monitoring the operating conditions of the spindle.

(1) Protective and fault detection functions

Display	Cause of Alarm	Description	Restoration Method
"A" displayed	Abnormal program ROM (not loaded)	Senses that control program is not operating (not installed, etc.)	Load correct program ROM.
AL-01	Motor overheat	Senses that interior temperature of motor has risen above specified value.	Cool motor then conduct alarm reset.
AL-02	Excessive speed deviation	Senses that motor speed has deviated markedly from requested speed.	Alarm reset.
AL-03	Fusing in DC link	Senses that the fuse F4 has melted in the DC link section. (Models 30S and 40S)	Check the power transistor, etc. Replace the fuse.
AL-04	Input fuse melted	Senses that the input fuse F1, F2 or F3 has melted, or open phase and instantaneous power failure have occurred. (Models 30S and 40S)	Check open phase and power regeneration circuit operation. Replace the fuse.
AL-05	Fusing in control power section	Senses that the control power fuse AF2 or AF3 has melted. (Models 30S and 40S)	Check whether or not the control power has short-circuited. Replace the fuse.
AL-07	Excessive speed	Senses that motor speed has exceeded rated speed by 115% or more.	Alarm reset.
AL-08	High input voltage	Senses that the input power voltage changeover switch in on the AC 200 side when the input voltage is AC 230V or more. (Models 30S and 40S)	Set the changeover switch to AC 230V side.
AL-09	Main circuit overload	Senses that temperature of power transistor radiator has become abnormally high.	Cool radiator then conduct alarm reset.
AL-10	Power input undervoltage	Senses drop in input power voltage.	Remove cause then conduct alarm reset.
AL-11	Overvoltage in DC link	Senses that DC power voltage in power circuit has become abnormally high.	Remove cause then conduct alarm reset.
AL-12	Overcurrent in DC link	Senses overcurrent in DC section of power circuit.	Remove cause then conduct alarm reset.

Display	Cause of Alarm	Description	Restoration Method
AL-13	Memory abnormality in CPU internal data	Senses abnormality in data memory of CPU. This check is only carried out when power is turned ON.	Remove cause then conduct alarm reset.
AL-15	Spindle switching/output switching alarm	Senses that the switching sequence is illegal while spindle switching/output switching alarm.	Check the sequence.
AL-16	External RAM abnormality	Senses abnormality in external data memory (RAM). This check is only carried out when power is turned ON.	Remove causes then conduct alarm reset.
AL-18	Program ROM sumcheck abnormality	Senses abnormality in program ROM data. This check is only carried out when power is turned ON.	Remove cause then conduct alarm reset.
AL-19	Excessive offset in U-phase current detection circuit	Senses that offset of U-phase current detection circuit is too large. This check is only carried out when power is turned ON.	Remove cause then conduct alarm reset.
AL-20	Excessive offset in V-phase current detection circuit	Senses that offset of V-phase current detection circuit is too large. This check is only carried out when power is turned ON.	Remove cause then conduct alarm reset.
AL-24	Serial data transmission abnormality	Senses abnormality in serial transmission data. (NC power OFF, etc.)	Remove cause then conduct alarm reset.
AL-25	Serial data transmission halt	Senses that serial data transmission has halted.	Remove cause then conduct alarm reset.
AL-26	Speed detection signal for Cs spindle control discontinued	Senses abnormality in Cs spindle control speed detection signal (90000p). (Cable not connected, erroneous parameter setting, etc.)	Remove cause then conduct alarm reset.
AL-27	Position coder signal discontinued	Senses abnormality in position coder signal. (Cable not connected, erroneous parameter setting, etc.)	Remove cause then conduct alarm reset.
AL-28	Position detection signal for Cs spindle control discontinued	Senses abnormality in Cs spindle control position detection signal (90000p). (Cable not connected, erroneous parameter setting, etc.)	Remove cause then conduct alarm reset.
AL-29	Brief overload	Senses that excessive load was continuously imposed for a specified period. (Constrains motor shaft during positioning, etc.)	Remove cause then conduct alarm reset.
AL-30	Overcurrent in input circuit	Senses overcurrent in input circuit.	Remove cause then conduct alarm reset.
AL-31	Speed detection signal discontinued Motor constrained	Senses that motor cannot operate at requested speed (extremely slow or stationary). (Checks phase order.) (Checks the speed detection cable, etc.)	Remove cause then conduct alarm reset.

Display	Cause of Alarm	Description	Restoration Method
AL-32	RAM abnormality in serial data transmission-use LSI	Senses abnormality in RAM contained in LSI used for serial data transmission. This check is only carried out when power is turned ON.	Remove cause then conduct alarm reset.
AL-33	Insufficient recharging of DC link	Senses that DC voltage in power circuit is not sufficient when electromagnetic contacter in amp is turned ON.	Remove cause then conduct alarm reset.
AL-34	Parameter data setting exceeds allowable range	Senses that parameter data setting has exceeded allowable range.	Set correct data.
AL-35	Gear ratio setting too large	Senses that gear ratio data setting has exceeded allowable range.	Set correct data.
AL-36	Error counter overflow	Senses error counter overflow.	Remove cause then conduct alarm reset.
AL-37	Speed detector parameter error setting	Senses that the parameter setting for number of pulses of the speed detector is not correct.	Set correct data.
AL-39	Detection error of one rotation signal for Cs contour control	Senses that the one rotation signal for Cs contour control has not been captured correctly during Cs contour control.	Adjust the signal.
AL-40	One rotation signal for Cs contour control not detected	Senses that the one rotation signal for Cs contour control has not been generated during Cs contour control.	Adjust the one rotation signal. Check whether or not the cable is shielded correctly.
AL-41	Detection error of position coder one rotation signal	Senses that the position coder one rotation signal has not been captured correctly.	Adjust the signal in case of signal conversion circuit. Check whether or not the cable is shielded correctly.
AL-42	Position coder one rotation signal not detected	Senses that the position coder one rotation signal has not been generated.	Adjust the one rotation signal in case of signal conversion circuit.
AL-43	Position coder signal for differential mode disconnected	Senses that the position coder signal of the main spindle for differential mode is not connected (wire breaking).	Check to make sure whether or not the position coder signal of the main spindle is connected to the connector CN12.
AL-46	Detection error of position coder one rotation signal while threading	Senses that the position coder one rotation signal has not been captured correctly while threading.	Adjust the signal in case of signal conversion circuit. Check whether or not the cable is shielded correctly.
AL-47	Abnormal position coder signal	Senses that the position coder signal is not being counted correctly.	Adjust the signal in case of signal conversion circuit. Check whether or not the cable is shielded correctly.

Display	Cause of Alarm	Description	Restoration Method
AL-48	Abnormal position coder one rotation signal	Senses that the position coder one rotation signal generation has ceased.	Adjust the one rotation signal in case of signal conversion circuit.
AL-49	The converted differential speed is too high.	Detects that speed of other spindle converted to speed of local spindle has exceeded allowable limit in differential mode.	Calculate differential speed by multiplying speed of other spindle by gear ratio. Check if calculated value is not greater than maximum speed of motor.
AL-50	Excessive speed command calculation value in spindle synchronization control	Detects that speed command calculation value exceeded allowable range in spindle synchronization control.	Calculate motor speed by multiplying specified spindle speed by gear ratio. Check if calculated value is not greater than maximum speed of motor.
AL-51	Undervoltage at DC link section	Detects that DC power supply voltage of power circuit has dropped (due to momentary power failure or loose contact of magnetic contactor).	Correct cause, then reset alarm.
AL-52	ITP signal abnormality I	Detects abnormality in synchronization signal (ITP signal) with CNC (such as loss of ITP signal).	Correct cause, then reset alarm.
AL-53	ITP signal abnormality II	Detects abnormality in synchronization signal (ITP signal) with CNC (such as loss of ITP signal).	Correct cause, then reset alarm.
AL-54	Overload current alarm	Detects that excessive current flowed in motor for long time.	Check if overload operation or frequent acceleration/ deceleration is performed.
AL-55	Power line abnormality in spindle switching/output switching	Detects that switch request signal does not match power line status check signal.	Check operation of magnetic contractor for power line switching. Check if power line status check signal is processed normally.

(2) Supplementary Functions

The following supplementary functions are provided as standard features. For details, refer to the CNC Connectiing Manual and the parameter section in the Spindle Motor Maintenance Manual.

Supplementary Function	Description
Motor speed display	The actual motor speed (rpm) can be displayed as a 5-digit, 7-segment.
Load meter data	A 10V DC analog voltmeter can be connected.
Speed meter data	A 10V DC analog voltmeter can be connected.
Zero-speed signal output	It is possible to verify that the spindle motor has stopped.
Speed-achieved signal output	It is possible to verify that the speed of the spindle motor has reached the indicated speed.
Speed-detection signal output	It is possible to verify that the speed has dropped below a particular speed, such as that at which the clutch or gear can be changed.
Load detection signal output	When the size of the load exceeds the value specified in the corresponding parameter, it is output in 2 segments. Maximum output is divided into 100 units when set. This function reduces the feedrate to prevent the spindle from being stopped when the spindle is overloaded.
Torque restriction	This function can tentatively lower the output torque of the spindle motor while it operates.
Output restriction pattern selection	Parameter settings allow a number of output restriction patterns to be selected: • No output restriction • Output restriction during acceleration/deceleration only • Output restriction during normal rotation only • Restrict output over all operation areas Maximum output is divided into 100 units when set.
Soft start/stop	The gradient during alteration of speed command (i.e., during acceleration/deceleration) can be set.
Analog override (for models 1S to 26S and small type 30S)	This function applies override to spindle speed to obtain the optimum cutting conditions for an S command.
MCC cut-off check signal output (for models 1S to 26S and small type 30S)	This function can check that the MCC is cut off.

(3) Status error display function

This displays Er-XX on the display unit on the spindle control PCB when there is an erroneous parameter setting or the sequence is inappropriate. When the operation of the spindle motor is defective, check the error number on the display unit and remove the error by performing the following countermeasures.

(Note) Er- XX is not displayed on the NC screen.

Display	Contents	Countermeasure
Er-01	* Although ESP (there are 2 types: connection signal and PMC → CNC) and MRDY (machine ready signal) are not input, SFR/SRV is input. However, regarding MRDY, pay attention to the setting of use/not use spindle parameter MRDY.	* Confirm the sequence of ESP and MRDY.
Er-02	If spindle motor is not integrated with spindle in system with high-resolution magnetic pulse coder, speed detector of spindle motor is set to 128 p/rev. Attempt to excite motor fails if value other than 128 p/rev is set.	Set the spindle motor speed detector parameter to 128 p/rev.
Er-03	Parameter for high-resolution magnetic pulse coder is not set, but Cs contouring control command is entered. In this case, motor is not excited.	Check parameter setting for high-resolution magnetic pulse coder.
Er-04	Although parameter setting for using position coder was not performed, commands for servo mode and synchronous control are input. In this case, the motor will not be excited.	Confirm the parameter setting of the position coder.
Er-05	Although option parameter for orientation is not set, the orientation command (ORCM) is input.	Confirm the parameter setting of orientation.
Er-06	Although option parameter for output switchover is not set, LOW winding is selected.	Confirm the parameter setting for output switching and gravity line status signal.
Er-07	Although Cs contouring control command was entered, SFR/SRV is not entered.	Confirm the sequence.
Er-08	Although servo mode control command was input, SFR/SRV is not input.	Confirm the sequence.
Er-09	Although synchronous control command was input, SFR/SRV is not input.	Confirm the sequence.
Er-10	Cs control command was entered, but another mode (servo mode, synchronous control, orientation) is specified.	Never set another mode when Cs contouring control command is being processed. Before changing to another mode, clear Cs contouring control command.
Er-11	Servo mode command was entered, but another mode (Cs contouring control, synchronous control, orientation) is specified.	Do not command other modes during servo mode command. When moving to other modes, perform after releasing the servo mode command.

Display	Contents	Countermeasure
Er-12	Synchronous control command was entered, but another mode (Cs contouring control, servo mode, orientation) is specified.	Do not command other modes during synchronous control command. When moving to other modes, perform after releasing the synchronous control command.
Er-13	Orientation command was entered, but another mode (Cs contouring control, servo mode, synchronous control) is specified.	Do not command other modes during orientation command. When moving to other modes, perform after releasing the orientation command.
Er-14	SFR/SRV are simultaneously commanded.	Command one or the other.
Er-15	Cs contouring control command is entered when differential speed control function is enabled by parameter setting (No. 6500#5 = 1).	Check parameter setting and control input signal.
Er-16	Differential mode command (DEFMDA) is entered when differential speed function is disabled by parameter setting (No. 6500#5 = 0).	Check parameter setting and control input signal.
Er-17	Parameter setting (No. 6511#0,1,2) for speed detector is incorrect. (Specified speed detector is not present.)	Check parameter setting.
Er-18	Spindle orientation command of position coder type is entered when use of position coder signal is disabled by parameter setting (No. 6501#2 = 0).	Check parameter setting and control input signal.
Er-19	Although the command for orienting the magnetic sensor system was entered, another mode was issued.	Do not issue another mode while the orientation command is executed. Before issuing another mode, cancel the orientation command.
Er-20	Both the slave mode and the high-resolution magnetic pulse coder were enabled.	These two settings are incompatible. Check the parameter settings.
Er-21	The slave mode command (SLV = 1) was entered under position control (servo mode, orientation, etc.).	Enter the slave mode command in the normal operation mode.
Er-22	The position control command (servo mode, orientation, etc.) was entered in the slave operation mode (SLV = 1).	Enter the position control command in the normal operation mode.
Er-23	A slave mode command was entered when the slave mode is disabled.	Enable the slave mode.
Er-24	To perform continuous indexing in the mode for orienting the position coder system, incremental operation (INCMD = 1) was first performed, then the absolute position command (INCMD = 0) was entered.	Check the control input signal (INCMD). To execute the absolute position command continuously, be sure to perform orientation with the absolute position command first.

4.2.2 Fuse

Spare fuses are not attached to the AC spindle servo unit. Order more than one set of spare fuses for stock. Following fuses and parts are applied to each model of AC servo unit.

Name	Fuse Specifications FANUC Spec. Dwg. No.	Order specification			
		1S - 3S/ A06B-6064-K305	6S - 26S/ A06B-6064-K026	30S A06B-6044-K028	40S A06B-6044-K029
Fuse (225A)	A60L-0001-0183/225A			4	
Fuse (260A)	A60L-0001-0183/260A				4
Alarm fuse (S3.2A)	A60L-0001-0075/3.2			2	2
Alarm fuse (3.2A)	A60L-0001-0046/3.2	1	1	1	1
Fuse (5A)	A60L-0001-0031/5A	3	3	5	5
Fuse (1.0A)	A60L-0001-0175/1.0A	1	1		
Fuse (0.3A)	A60L-0001-0175/0.3A			4	4
Surge absorber	A50L-2001-0062/441-12			1	1
Surge absorber	A50L-2001-0155/20D431		3	3	3
Surge absorber	A50L-2001-0122/G431K	3			

4.2.3 Power transformer

When the input power voltage is out of range of 200 through 230 VAC, the power transformer is required.
Provide the transformer with the following specifications by the customer.

(1) Specifications

Item \ Model		1S	2S	3S	6S/ Small type 6S	8S	12S	15S/ Small type 15S	18S	22S	26S	30S/ Small type 30S	40S
Rated capacity (kVA)	30-minute	4	7	9	12	17	22	26	32	37	44	54	63
	Continuous	3	4	7	9	12	17	22	26	31	37	44	54
Secondary current (30-min.) (A)		12	21	26	35	48	62	72	88	105	130	156	182
Secondary tap output voltage		200V											
Secondary voltage regulation		5%											
Secondary tap voltage deviation		± 3%											

4.2.4 Unit adapter

This unit is applied to the AC spindle servo unit models 6S to 26S and small type 30S with the inner ventilation type. When this stay is mounted the maximum depth is 345mm for models 6S-12S, small type 15S and 341mm for models 15S-22S, 26S. For details, see 8 EXTERNAL DIMENTIONS AND MAINTENANCE AREA.

4.2.5 Fan unit (This unit is an option for models 30S and 40S.)

Order drawing No.: A06B-6044-K040
This is used when a fan is directly attached to the rear face of the unit for cooling the radiating section of the spindle servo unit for AC spindle motor models 30S and 40S.

[Fan motor specification]

Voltage V	Frequency Hz	Input W	Speed rpm	Maximum air quantity mm^3/min	Maximum static pressure mmH_2O	Noise level phon	Highest allowable ambient temperature °C
200	50	43	2750	6.5	15	49	70
	60	40	3200	7.5	16	53	

Equivalent product:
Model 7556X made by TORYO KOSAN
FANUC order drawing No.:
Fan motor: A90L-0001-0049/A
Finger guard: A97L-0071-0001/A

5. INSTALLATION

5.1 Environemental Conditions

Install the AC spindle servo unit in a place which meets the following environmental conditions.

5.1.1 Ambient temperature

Ambient temperature of the unit:	0 to 55°C
Ambient temperature of the storage cabient:	0 to 45°C

5.1.2 Humidity

Normally 95% RH or below, and condensation-free

5.1.3 Vibration

In operation: Below 0.5G

5.1.4 Atmosphere

No corrosive or conductive mists or drops should deposit directly on the electronic circuits.

5.2 Input Power and Grounding

(1) Input power

- Nominal voltage rating: 200/220/230 VAC
- Allowable voltage deviation: −15% to +10%
- Power frequency: 50/60 Hz
- Allowable frequency deviation: ±1 Hz
- Power impedance: Voltage deviation due to load (30 min. rating × 1.2 or when max. output range) should be less than 7%.

Such a system is adopted for AC spindle servo units that, during deceleration, the rotating energy of the motor is regenerated as shop power source using a transitor invertor (for models 1S to 26S and small type 30S) or a thyristor inverter (for models 30S, 40S, 30HV, 40HV and 60HV). For this reason, they are subject to the following restrictions or influences when the power impedance is large. Therefore, be careful when using a power transformer with a comparatively small capacity or a long cable.

(1) When power impedance is large, it may be necessary to reduce the regeneration current in order to lengthen the deceleration time.

6. UNIT CALORIFIC VALUE

Model	1S	2S	3S	6S	8S	12S	15S	18S	22S	26S	Small type 30S	30S	40S
Caloric value at continuous rated output [W]	230	250	290	360	440	600	750	900	1070	1250	1500	2000	2400

7. COOLING

The AC spindle servo unit S series employs the structure of eternal cooling for the radiating section of the power circuit. It is required to consider a forced-air cooling for cooling the radiating section of the power circuit.

(1) Models 1S - 3S, small type 6S
A fan motor for cooling has been built in. Give consideration to the inlet and output ports so that a sufficient wind speed may be obtained for forced-air cooling.

(2) Models 6S - 40S, small type 15S, small type 30S
A fan motor for cooling is not built in. A cooling fan motor required for forced-air cooling should by prepared by the machine manufacturer.

(Note) If he unit is not cooled properly, an overheat alarm or a problem may occur.

7.1 Cooling the AC Spindle Servo Unit

7.1.1 Models 1S - 3S

The AC spindle servo unit has such a construction that the radiating section of the power circuit section, the main heat generating section, is externally cooled by a built-in fan motor. Therefore, give consideration to the inlet and output ports so that a sufficient wind speed may be obtained for forced-air cooling, which can radiate 70% of the carolic value.

7.1.2 Models 6S - 22S

Cool the radiating section of the AC spindle servo unit using a wind and with a wind shown in Table 7.1.2, which can radiate 70% of the carolic value. See the diagram of the cooling system.

Table 7.1.2 Cooling the AC spindle servo unit

Model	6S - 12S	15S - 22S
Wind speed	More than 3 m/sec	More than 3.5 m/sec

7.1.3 Model 26S, small type 30S

Cool the radiating section of the AC spindle servo unit using a wind. Use four fan motors equivalent to the model 5915PT-20W-B30-S04 made by N.M.B. See the diagram of the cooling system.

(Note) Magnetic cabinet structure to be employed to prevent fan motor wind leakage whenever a forced-air cooling is performed.

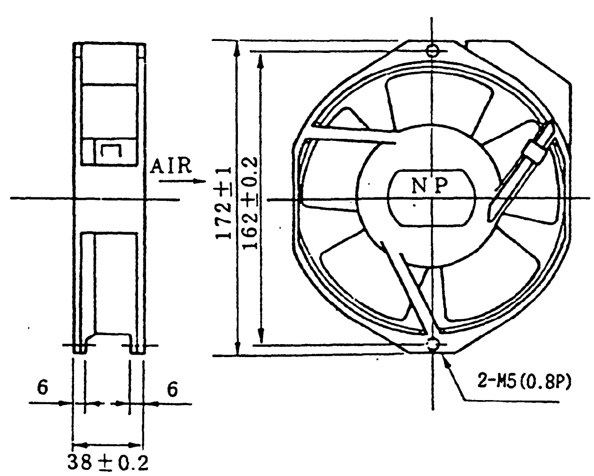
(Remarks) With respect to the models 6S to 22S, the required wind speed is obtained by using a unit adapter.

The unit adapter for models 6S to 12S has one 3-phase fan motor. The unit adapter for models 15S to 22S has two 3-phase fan motors. The unit adapter for models 26S and small model 30S has four 3-phase fan motors.
Each fan motor is a Minebea model 5915PT-20W-B30-S04.
An example of a 3-phase cooling fan motor, Minebea model 5915PT, is shown below.

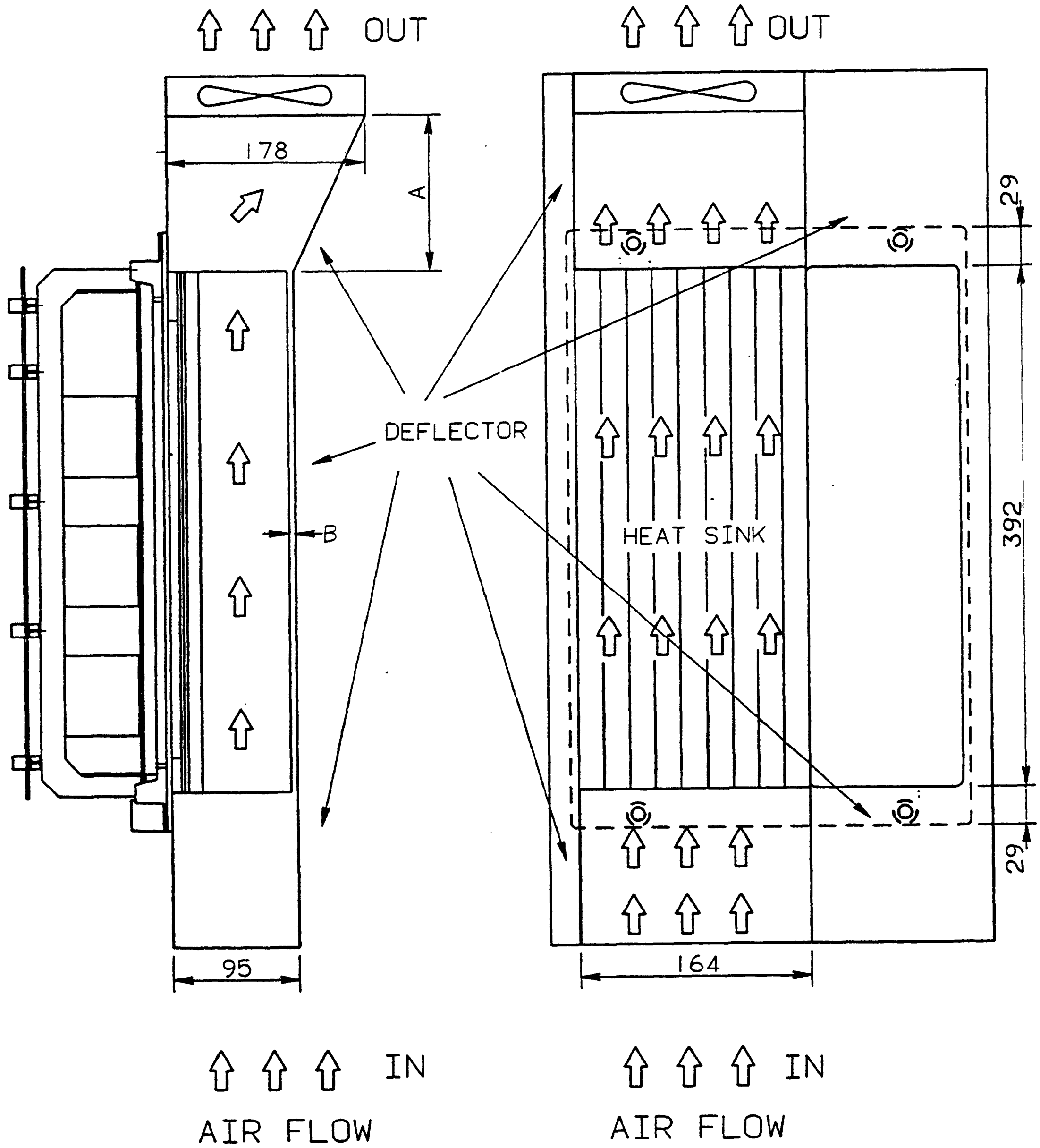
[Specifications]

Model		5915PC-20W-B30-S04	
Voltage	V	200, 3ϕ, +20%, −15%	200, 3ϕ, +30%, −15%
Frequency	Hz	50	60
Max. airflow	m3/min	5.5	6.3
static pressure	mmAq	13	14.5
Speed	rpm	2650	2900
Current	A	0.18	0.22
Input power	W	26.0	26.0
Noise	dB	53	55
Weight	kg	0.8	

[External dimension]



[Reference of Cooling system] Models 6S to 12S



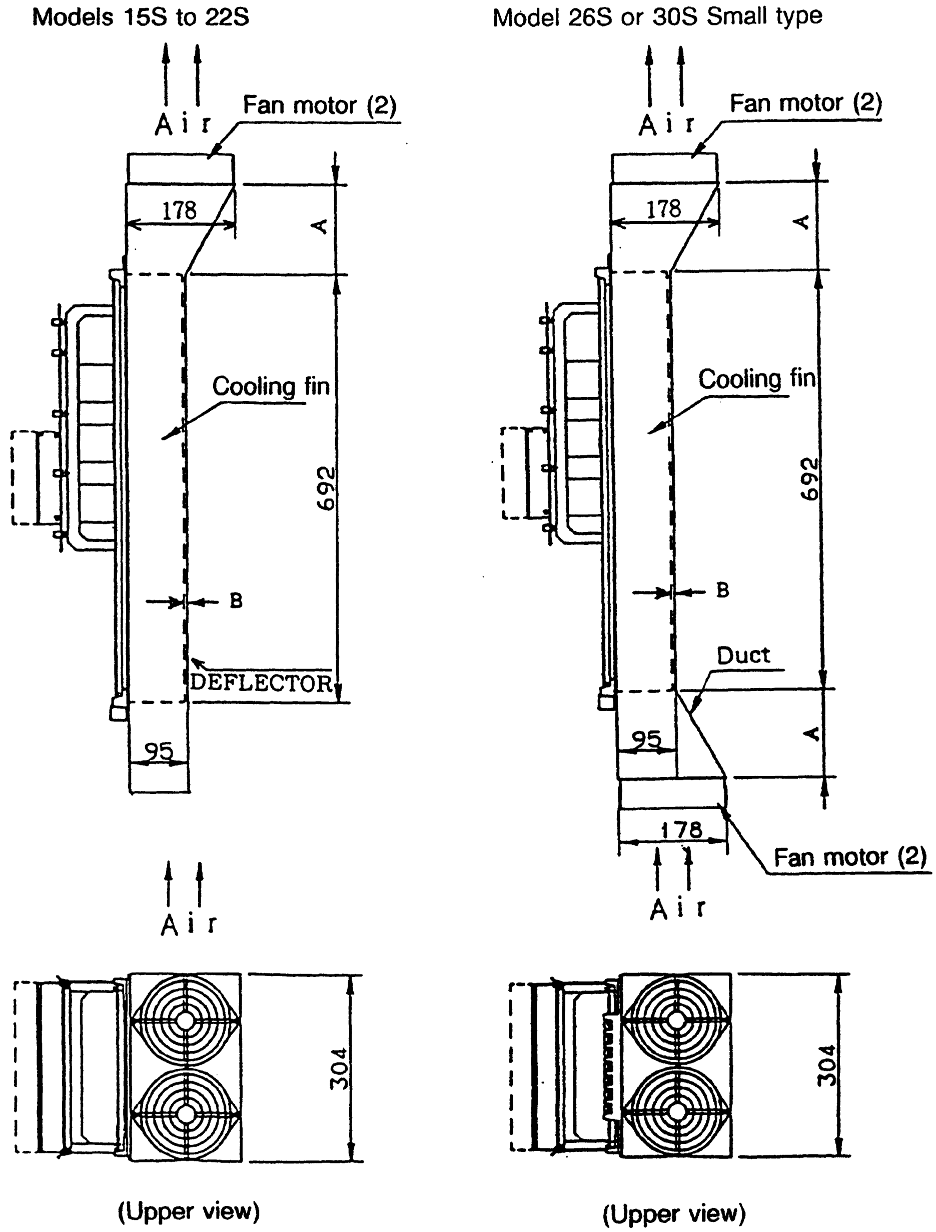
(Note 1) Dimension A must be 50mm or more.

(Note 2) Dimension B (gap between the radiator and duct) must be approx. 5mm so that the duct does not directly touch the radiator. This is because the radiating section (resistor) becomes very hot.

(Note 3) Use Minebea fan motors, model 5915PC-20W-B20-04 or equivalent. The air flow is 5.5m³/min at 50 Hz or 6.0m³/min at 60Hz. Prepare two fan motors for models 6S to 12S.

(Note 4) Mount a deflector so that air strikes the heat sink directly.

[Reference of Cooling system] Models 15S to 22S, 26S and 30S Small type



(Note 1) Dimension A must be 50mm or more.

(Note 2) Dimension B (gap between the radiator and duct) must be approx. 5mm so that the duct does not directly touch the radiator. This is because the radiating section (resistor) becomes very hot.

(Note 3) Use Minebea fan motors, model 5915PC-20W-B20-04 or equivalent. The air flow is 5.5m³/min at 50 Hz or 6.0m³/min at 60Hz. Prepare two fan motors for models 15S to 22S, and four fan motors for models 26S and small type model 30S.

(Note 4) Mount a deflector so that air strikes the heat sink directly.

7.1.4 Models 30S and 40S

70% of the carolic value generated by a unit can be radiated by attaching an appropriate fan motor.

(1) Fan motor with required wind speed/air quantity

Model	Models 30S and 40S
Wind speed	——
Air quantity output	$4.5m^3$/min or larger
Fan motor	7556X × 2 by TORYO or equivalent

(2) Required air quantity and ventilation route

Make sure to supply an air quantity of $4.5m^3$/min or more from the air inlet.
For supplying air, it is recommended to supply cooling air from the inlet so that the fan motor can be used for a long time. An optional fan unit can be attached directly to the air inlet as shown in the external dimensions in 8.1.6 or 8.1.7. In that occasion, keep a space of 50mm or more on the back side of the fan motor.
For designing a ventilation route, make good use of the M4 tap holes prepared around the inlet and outlet ports (six holes for each.)

(3) Cautions for air supply

When the condition of the environment is not good, such troubles are expected that after a long time the radiation capacity will by reduced, leakage will occur due to the deterioration of insulation in the resistor section, and the like. To prevent these troubles, make sure to supply air through an air filter. For filter dimension, select one so that a required quantity of air can be obtained.
Air filter: VILEDON PS/600 (by JAPAN Vilene CO., LTD.)
Fan motor: Model 7556 (2) by TORYO KOSAN

(4) Cautions for outlet

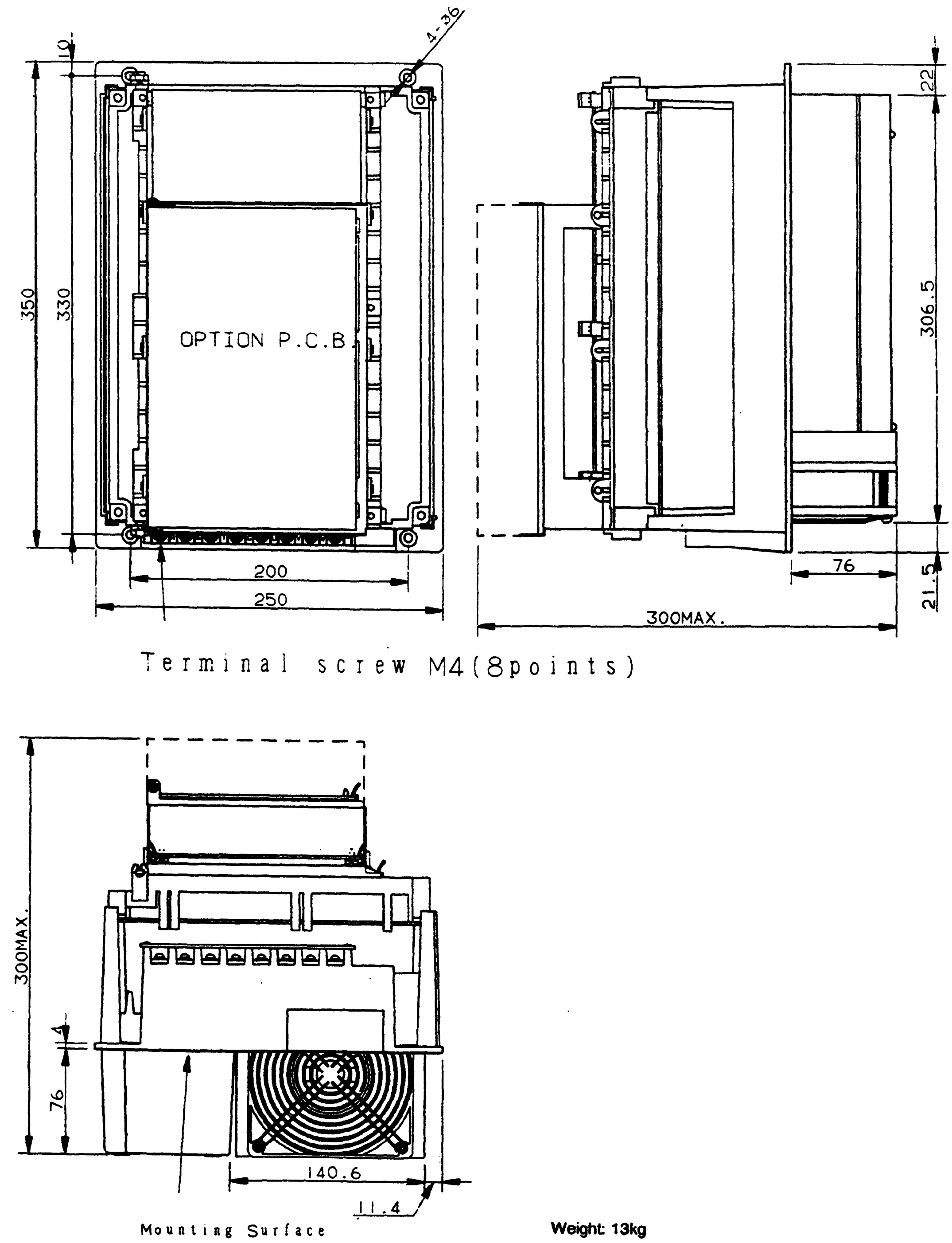
Take care so that machine oil may not flow in, or metal chips may not rush into through the outlet.

8. EXTERNAL DIMENSIONS AND MAINTENANCE AREA

8.1 External Dimensions

Refer to the next subsection for the external dimensions of the basic unit. Also for the optional units, refer to each subsection for its external dimensions.

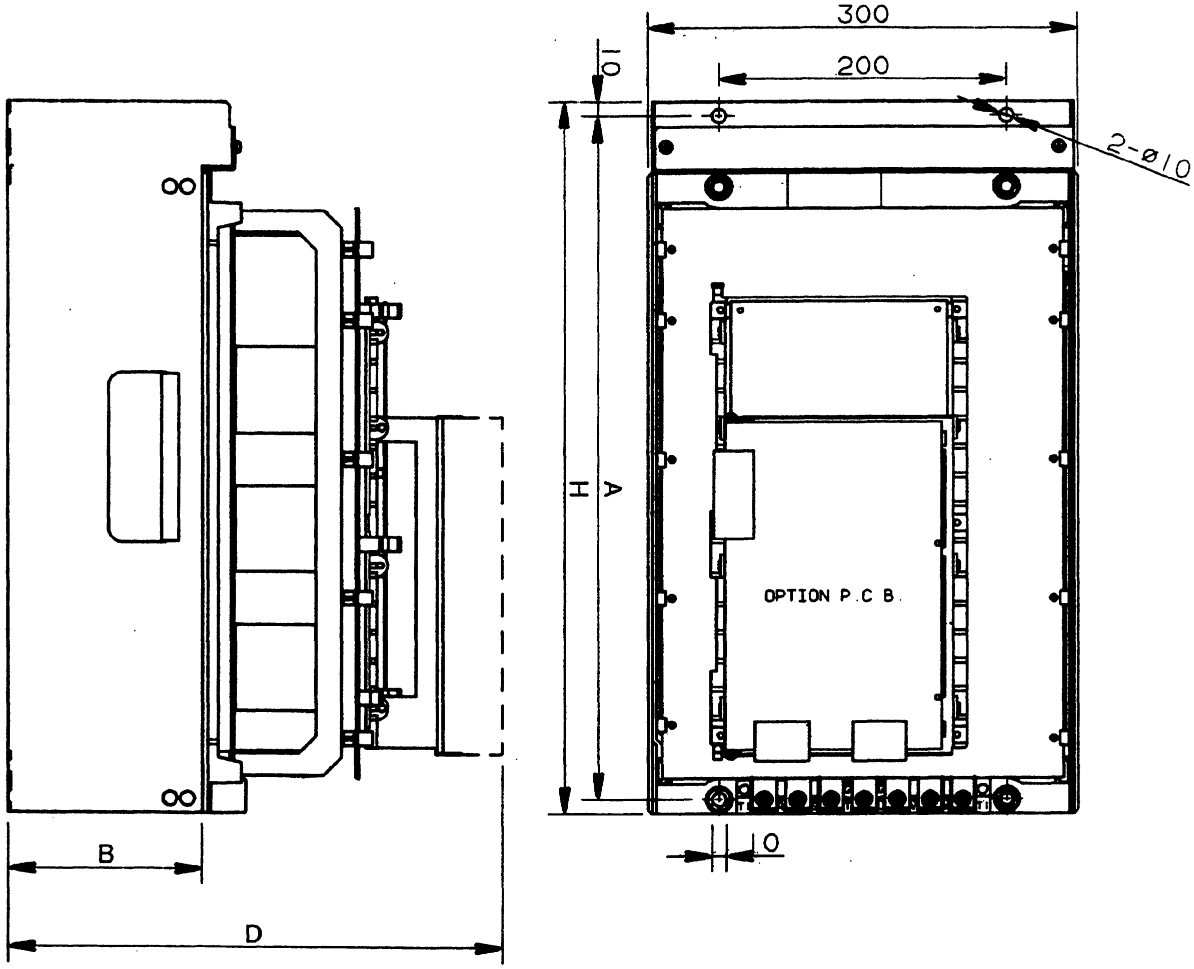
8.1.1 AC spindle servo unit models 1S - 3S (with an option)



Weight: 13kg

8.1.2 AC spindle servo unit models 6S - 12S (with unit adaptor)

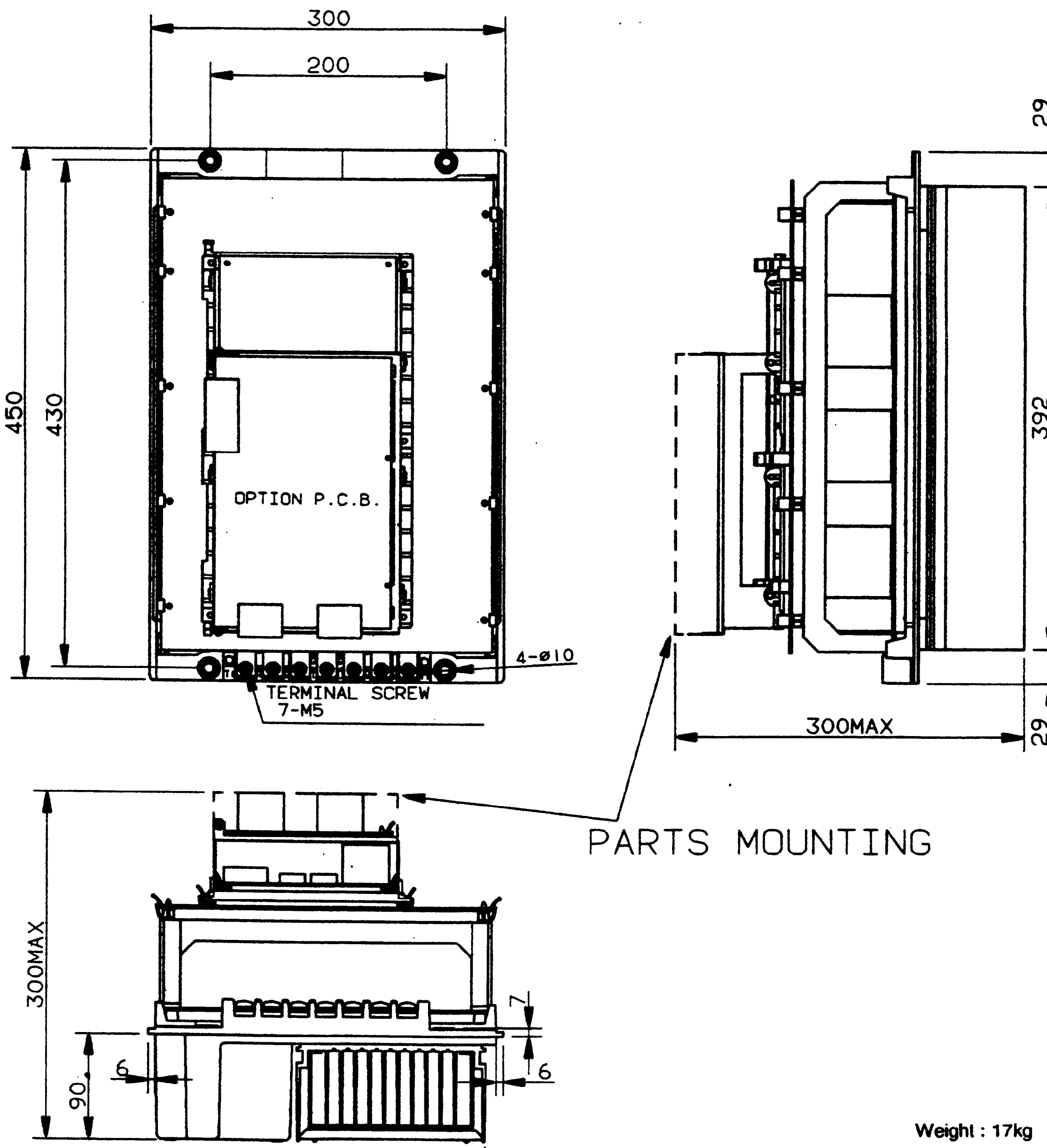
(See 8.1.8 for external dimension of unit adaptor)



Weight : 23kg

Model	H mm	A mm	D mm	B mm
6S - 12S	500	480	345	135

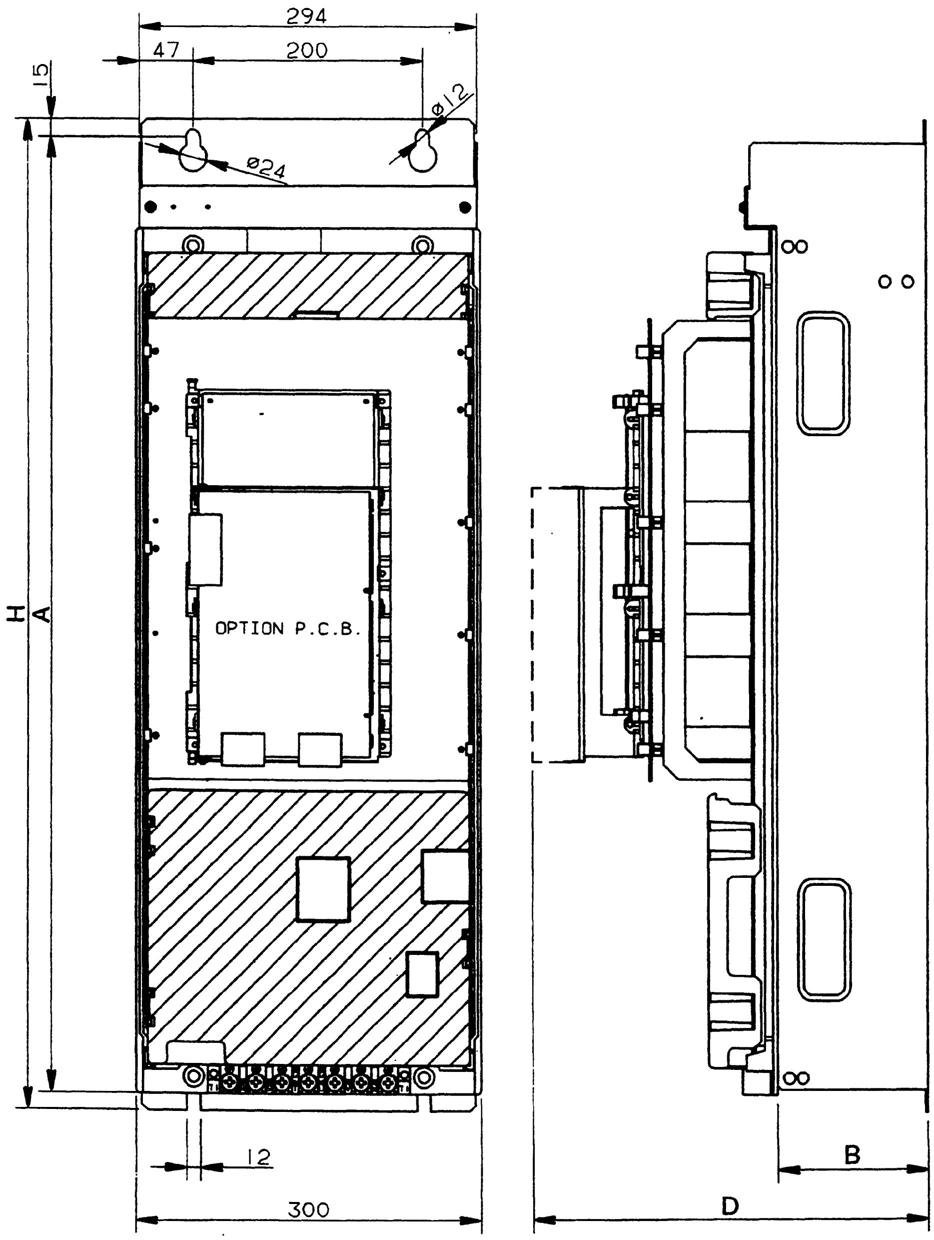
8.1.3 AC spindle servo unit models 6S - 12S (without unit adaptor)



Weight : 17kg

8.1.4 AC spindle servo unit models 15S - 22S, 26S, small type model 30S (with unit adaptor)

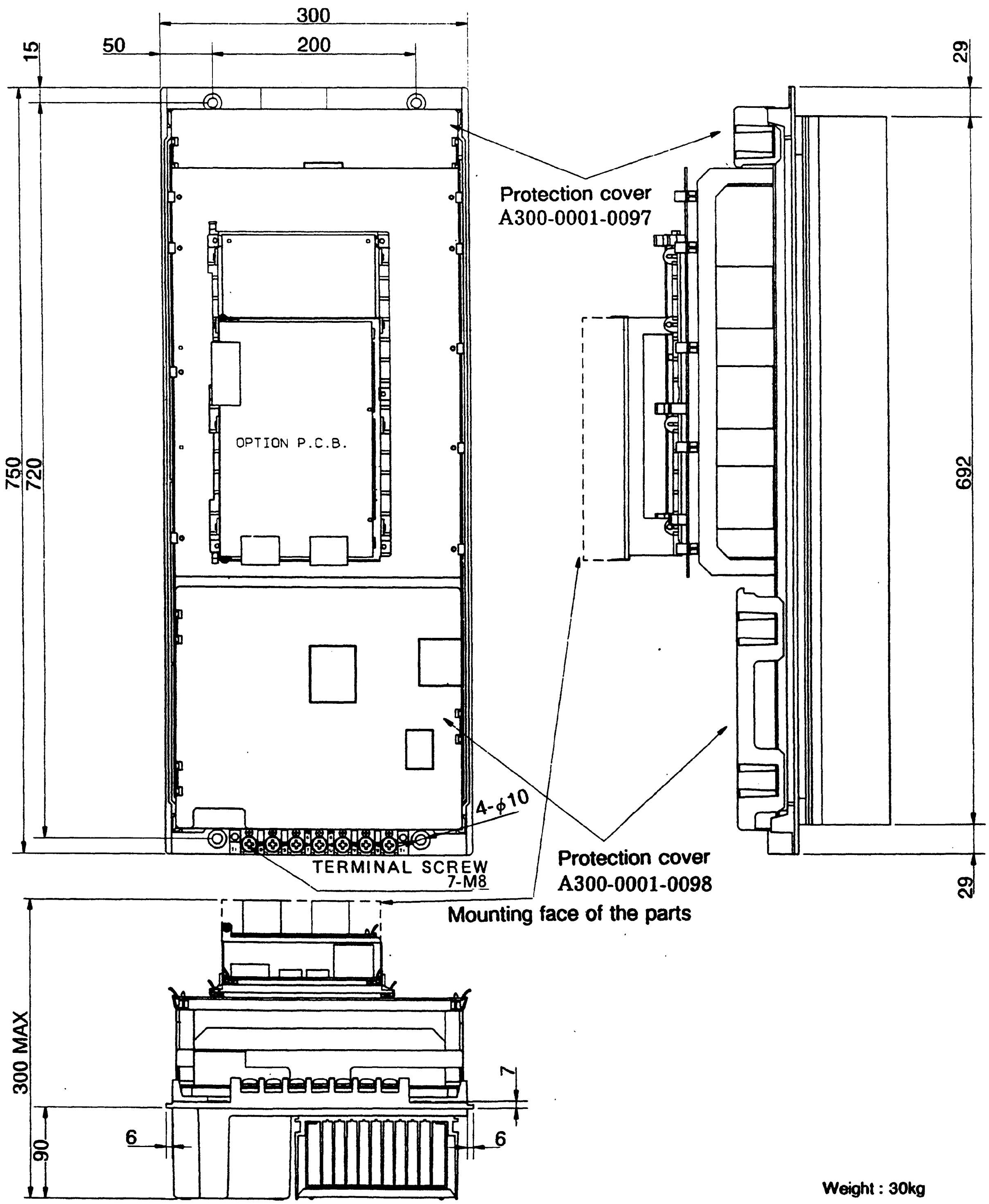
(Refer to 8.1.9 for the external dimensions for the unit adaptor.)



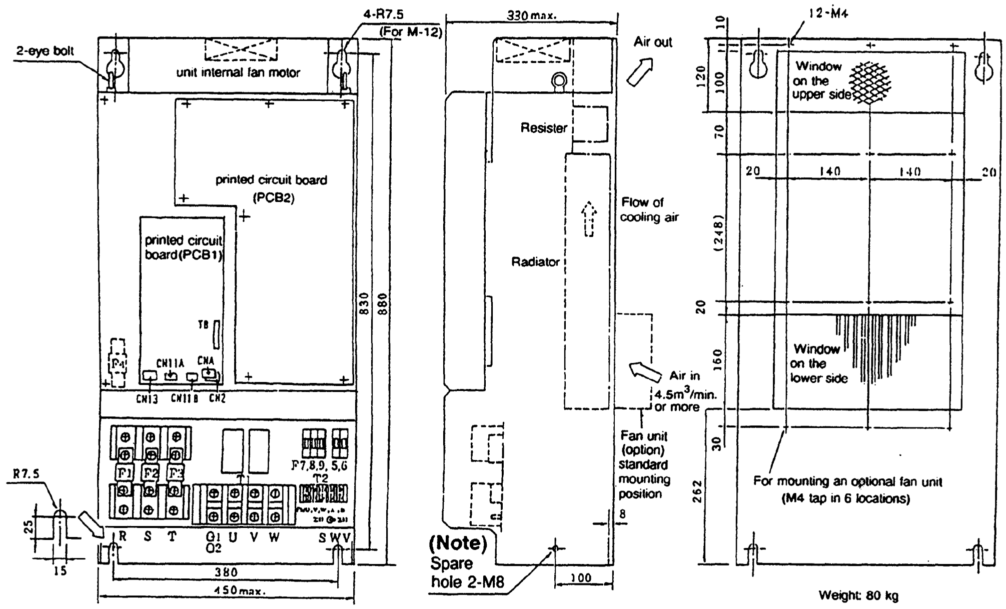
Weight : 40kg

Model	H mm	A mm	D mm	B mm
6S - 12S	860	830	341	131
26S, Small type	955	925	388	178

8.1.5 AC spindle servo unit models 15S - 26S, small type model 30S (without unit adaptor)

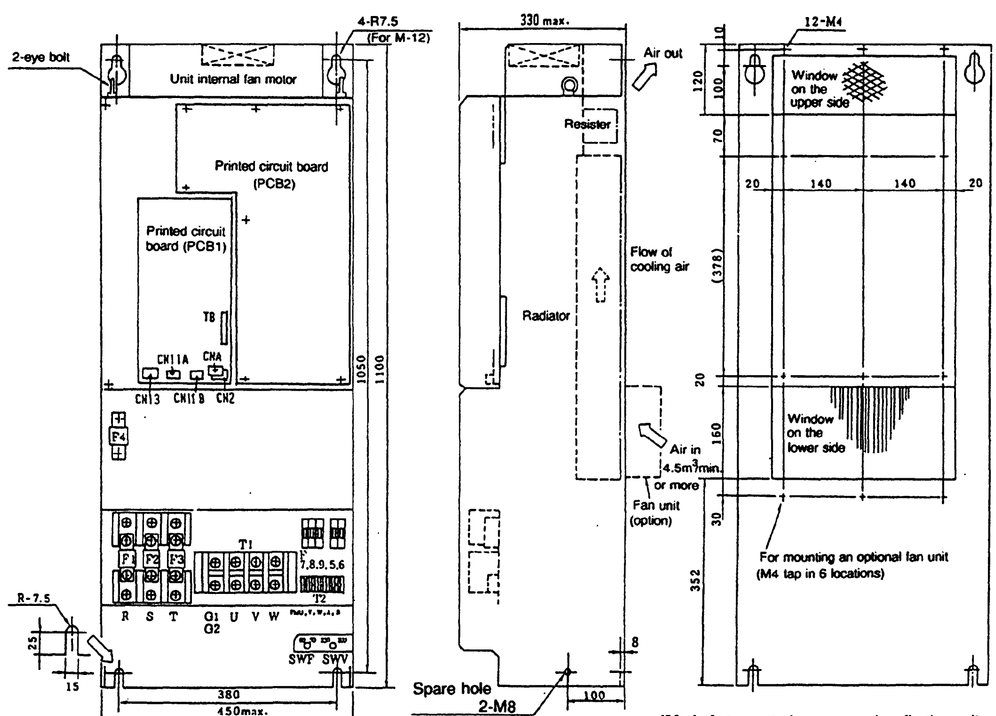


8.1.6 AC spindle servo unit model 30S



(Note) Spare holes are used to fix the unit to the conveyer during transportation.

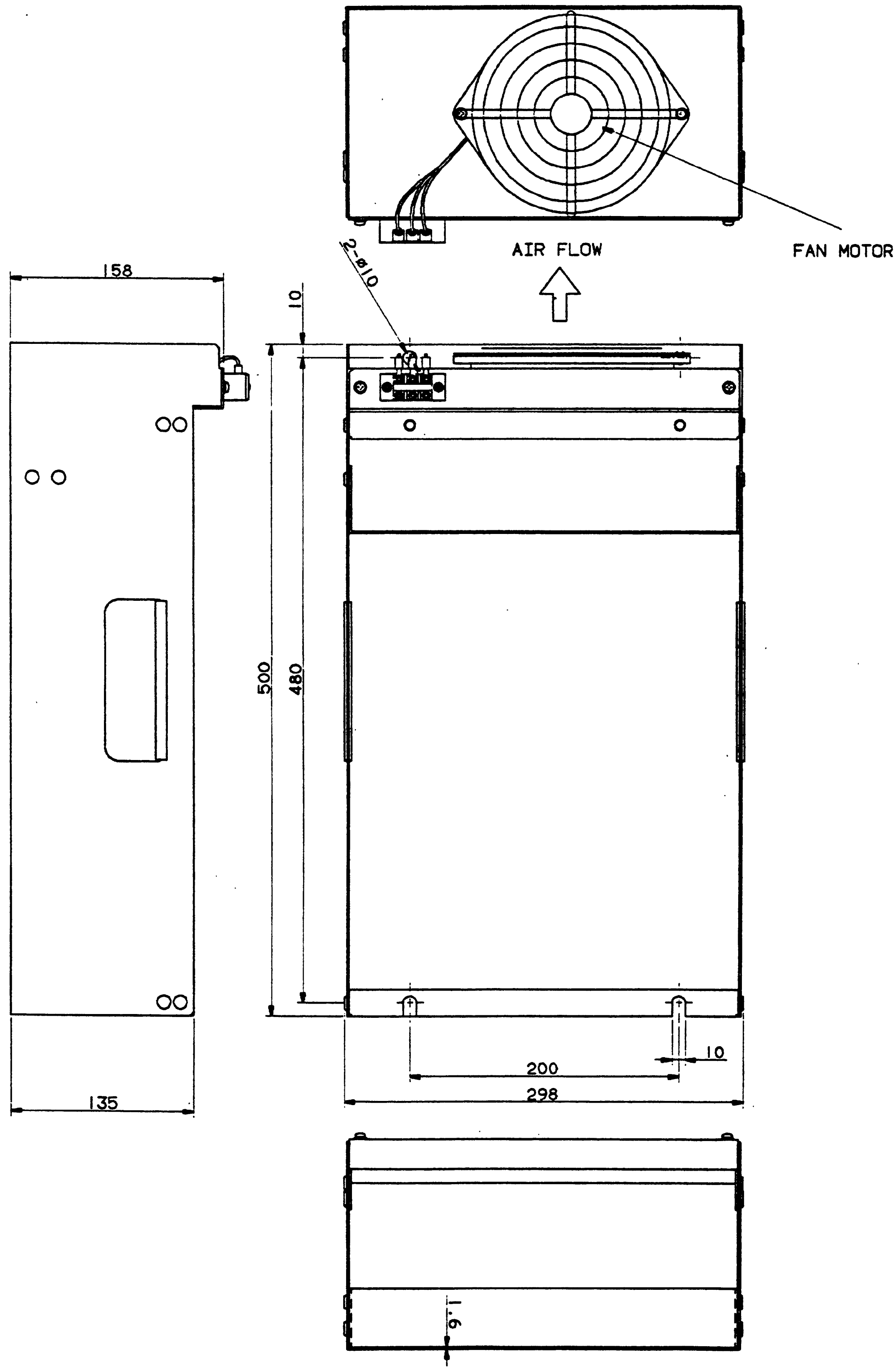
8.1.7 AC spindle servo unit model 40S



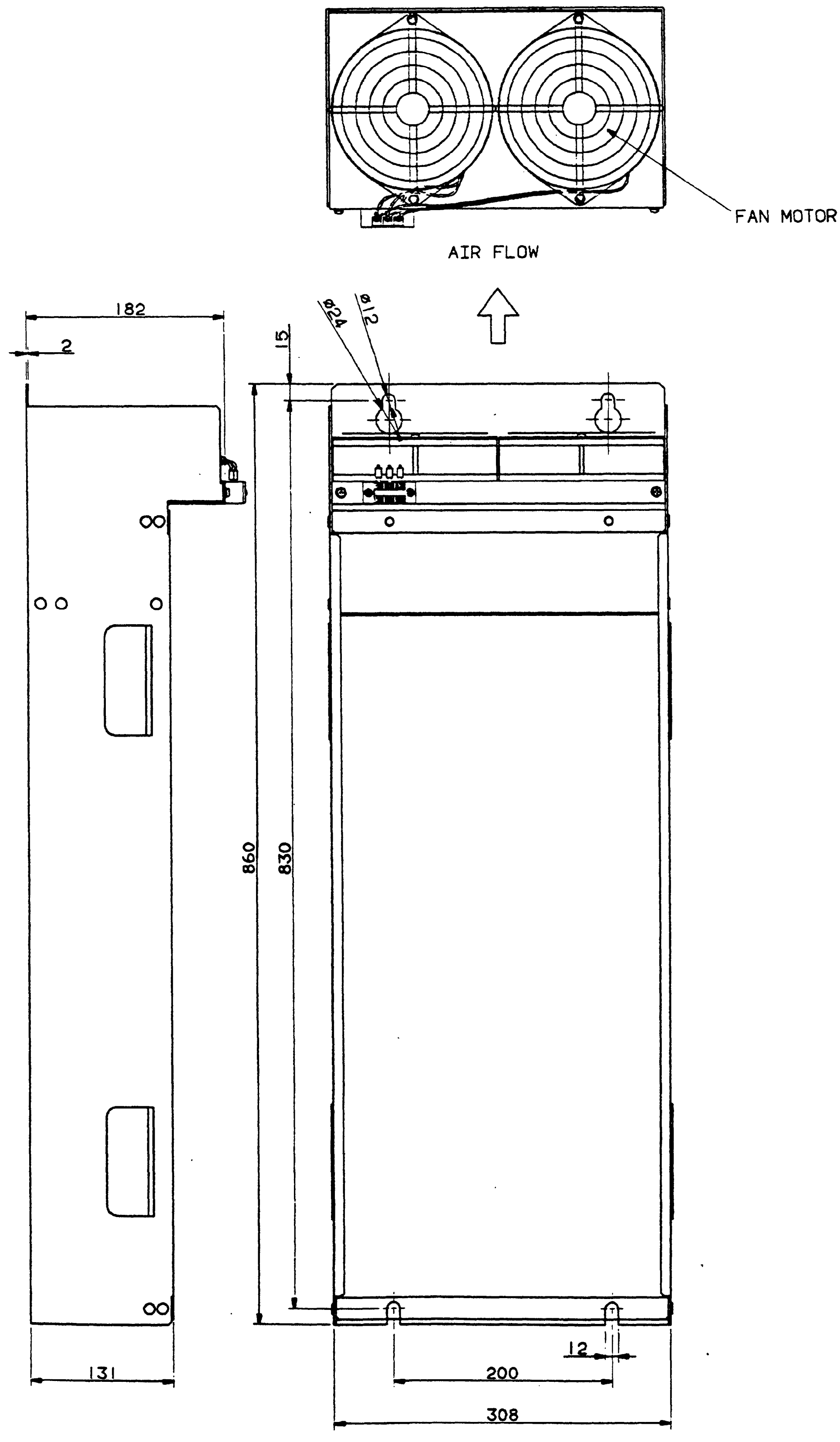
Weight: 100 kg

(Note) Spare holes are used to fix the unit to the conveyer during transportation.

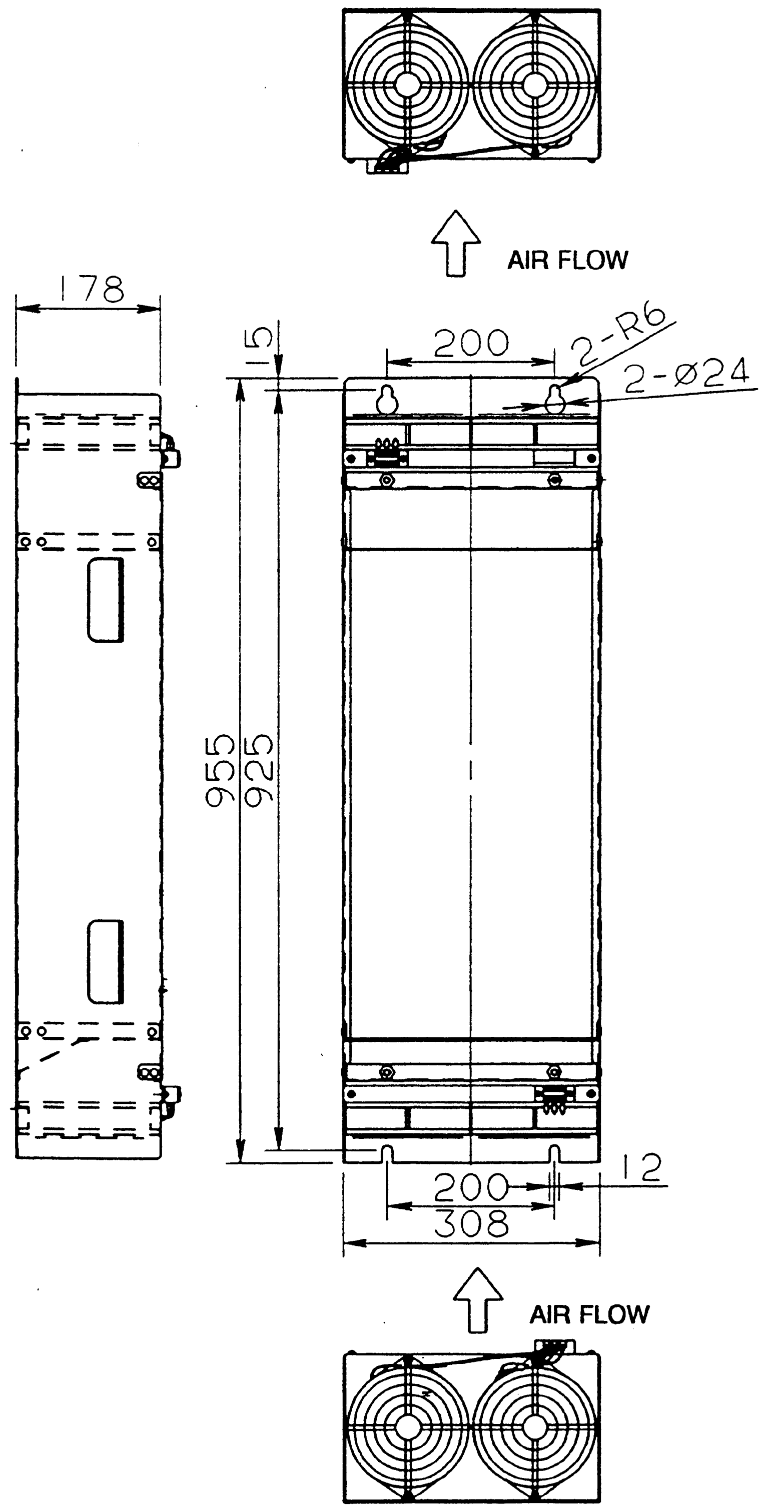
8.1.8 Unit adaptor models 6S - 12S (Order Spec. DWG No.: A06B-6059-K031)



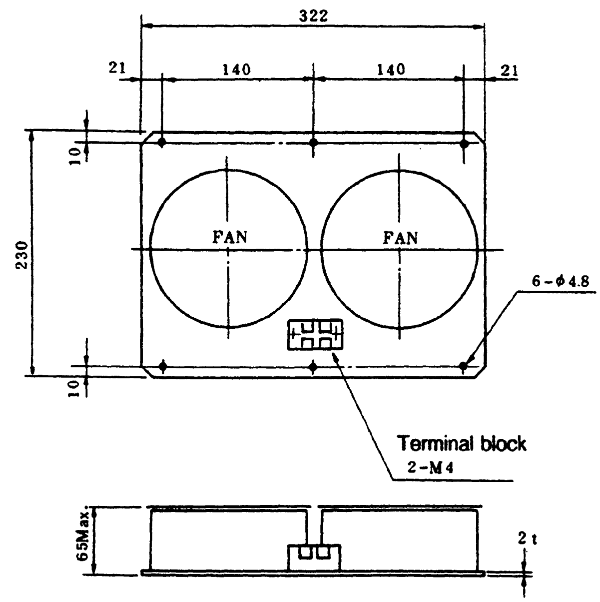
8.1.9 Unit adaptor models 15S - 22S (Order Spec. DWG No.: A06B-6059-K032)



8.1.10 Unit adaptor model 26S, small type model 30S (Order Spec. DWG No.: A06B-6059-K038)



8.1.11 Fan unit for models 30S, 40S (Order Spec. DWG No.: A06B-6044-K040)

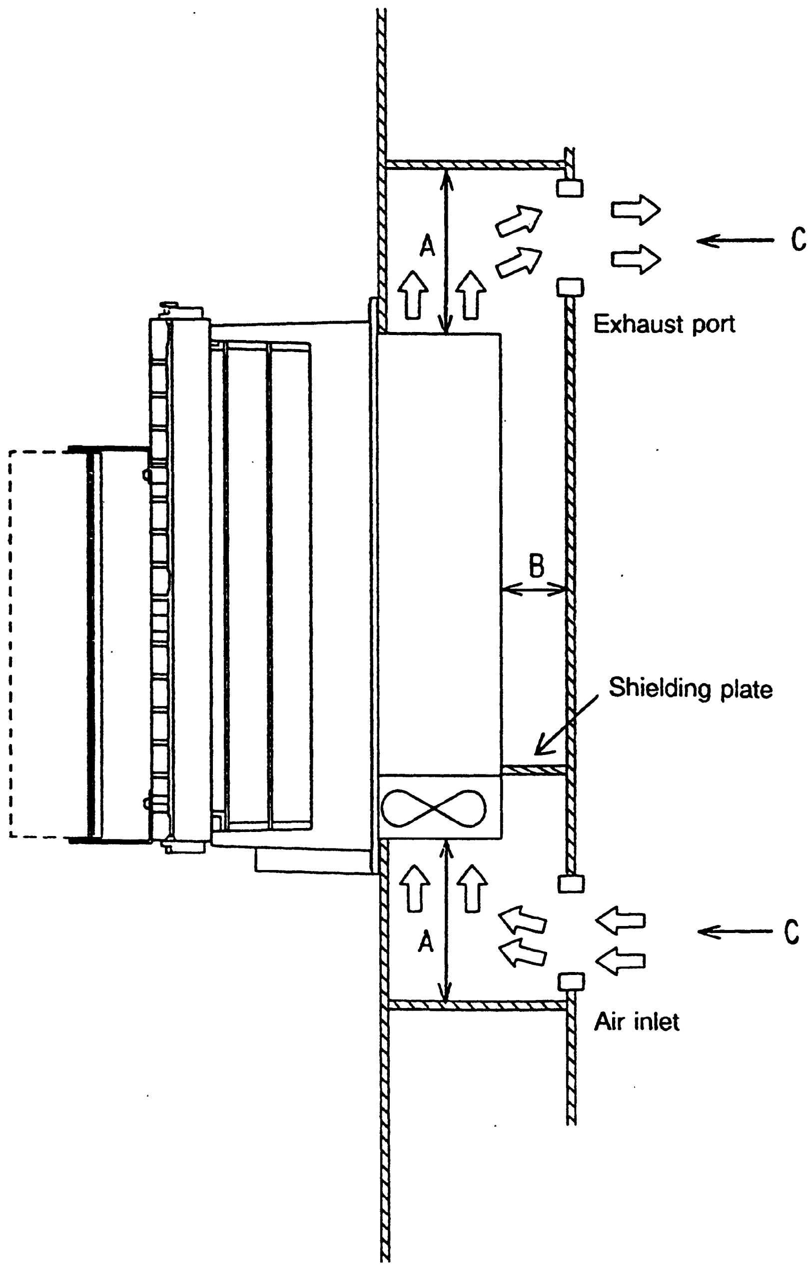


(Note) The six M4 screws for mounting the fan unit are to be prepared by the user.

8.2 Consideration to Inlet and Outlet Ports

8.2.1 AC spindle servo unit models 1S - 3S

The AC spindle servo unit has such a construction that the radiating section of the power circuit section, the main heat generating section, is externally cooled by a built-in fan motor. Therefore, give consideration to the inlet and output ports so that a sufficient wind speed may be obtained for forced-air cooling.



A: Keep apart 100mm or more.

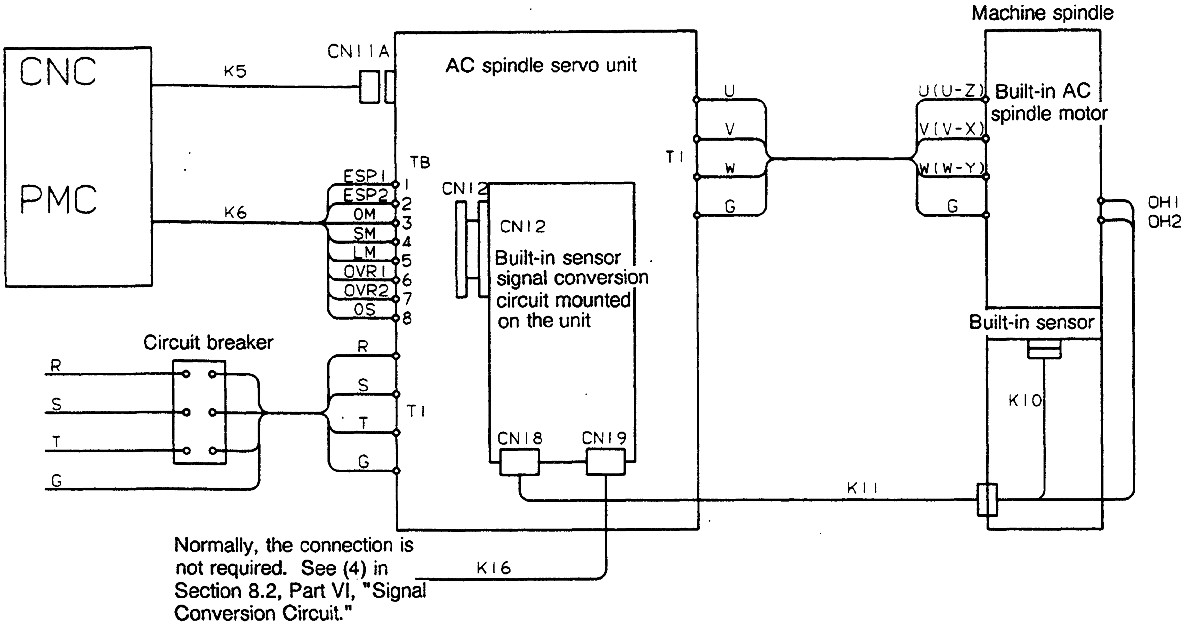
B: As the radiating section becomes very hot, give careful consideration to space.

C: Keep 15,000mm² or larger.

9. CONNECTION

9.1 Connection Diagram

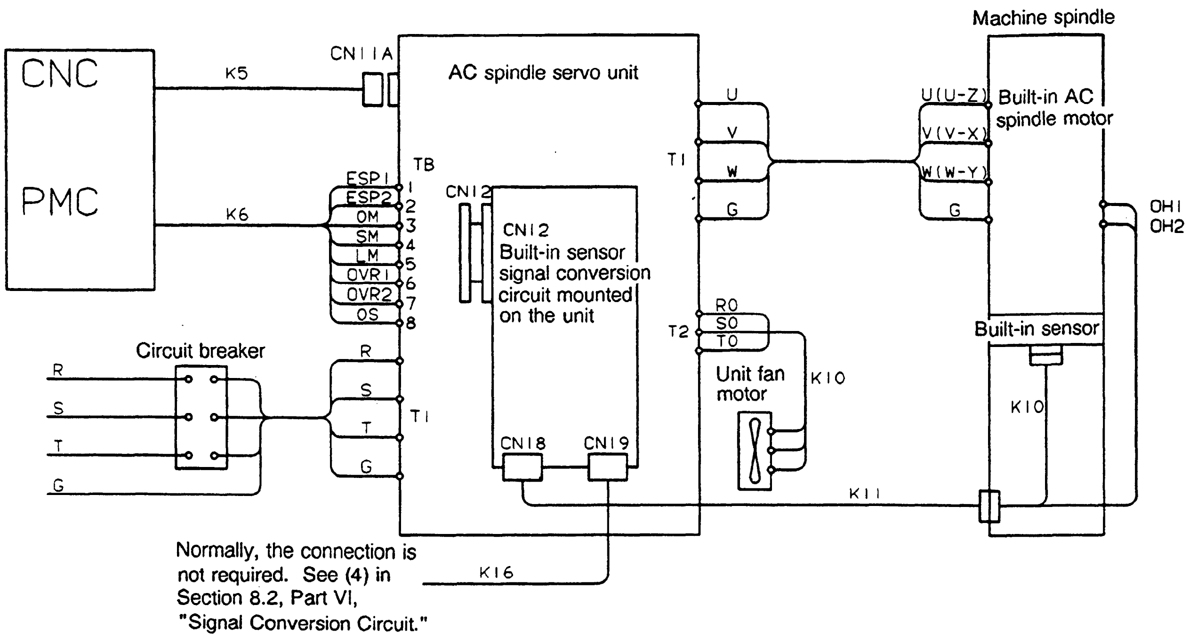
9.1.1 Motor models 1S - 3S



See Chapter 4, "Connection" in Part VIII for how to connect a model having output switching with other units.

Fig. 9.1.1 Connection diagram (Models 1S - 3S)

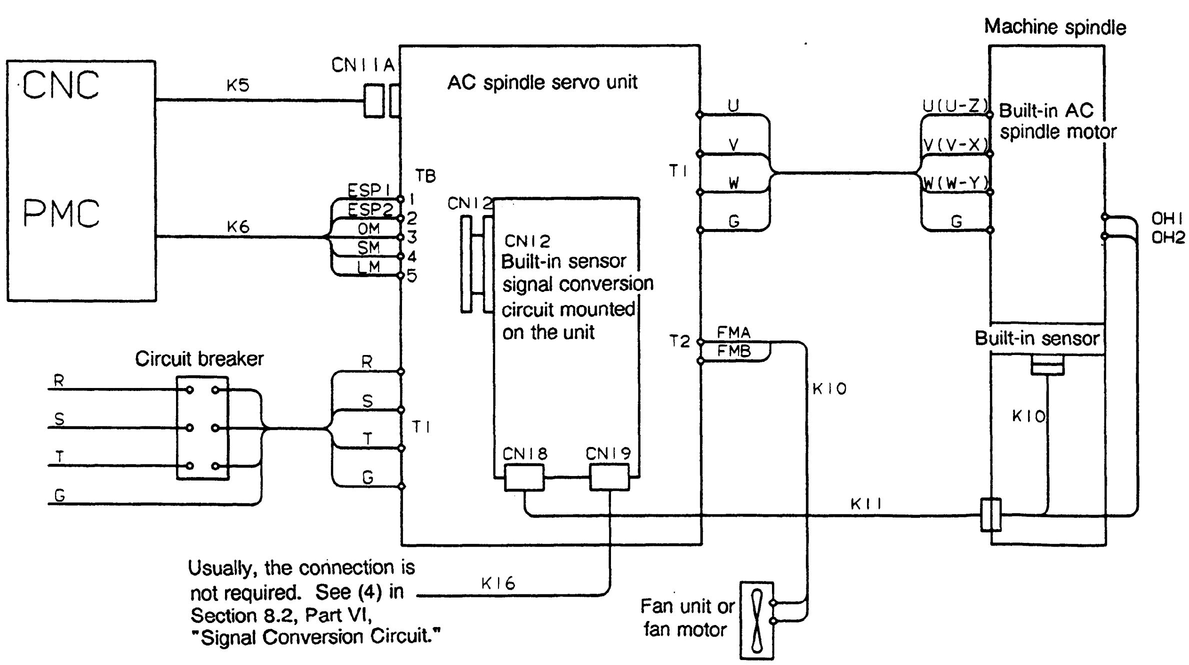
9.1.2 Motor models 6S - 26S, small type model 30S



See Chapter 4, "Connection" in Part VIII for how to connect a model having output switching with other units.

Fig. 9.1.2 Connection diagram (Models 6S to 26S and Small Model 30S)

9.1.3 Motor models 30S, 40S



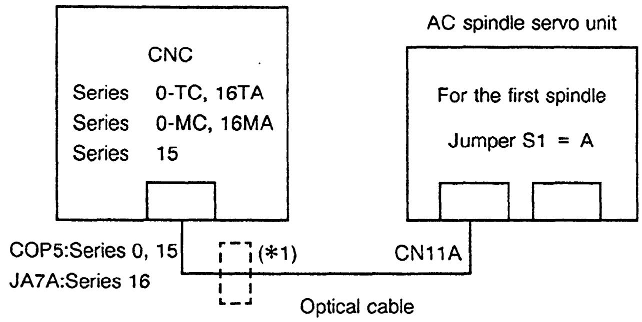
See Chapter 4, "Connection" in Part VIII for how to connect a model having output switching with other units.

Fig. 9.1.3 Connection diagram (Models 30S to 40S)

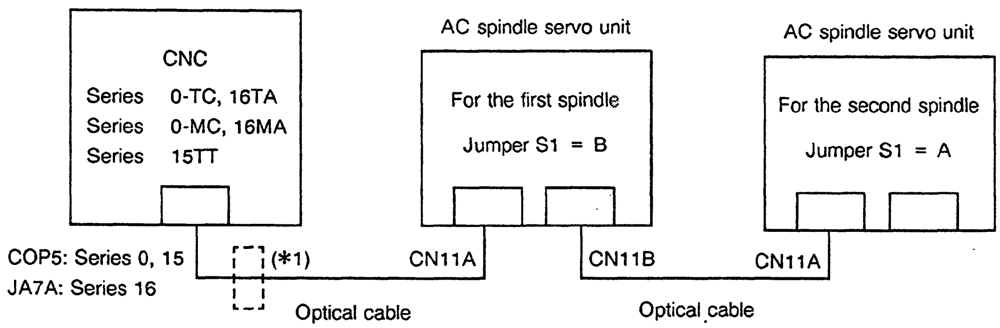
9.1.4 Connection between the CNC and AC spindle servo unit

(1) For the Series 0-TC, 0-MC, 15, and 16

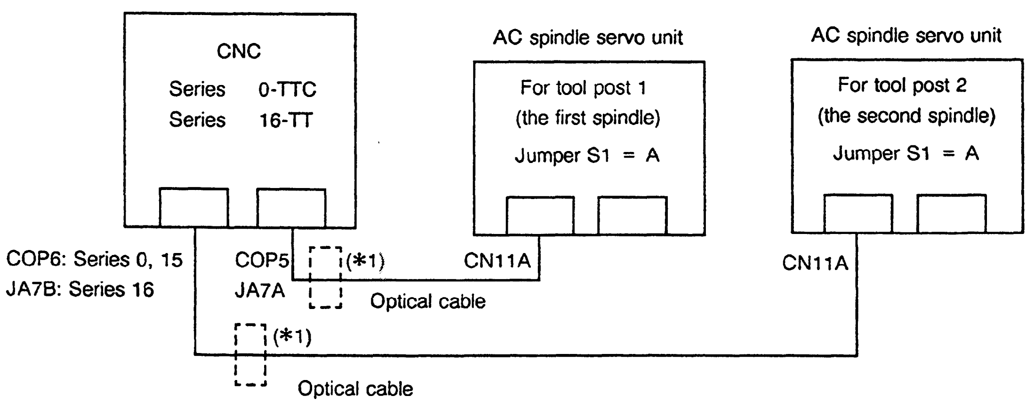
(a) When one AC spindle servo unit is used



(b) When two AC spindle servo units are used



(2) For the Series 0-TTC, 16-TT



(*1) The optical I/O Link adaptor is required for the Series 16.

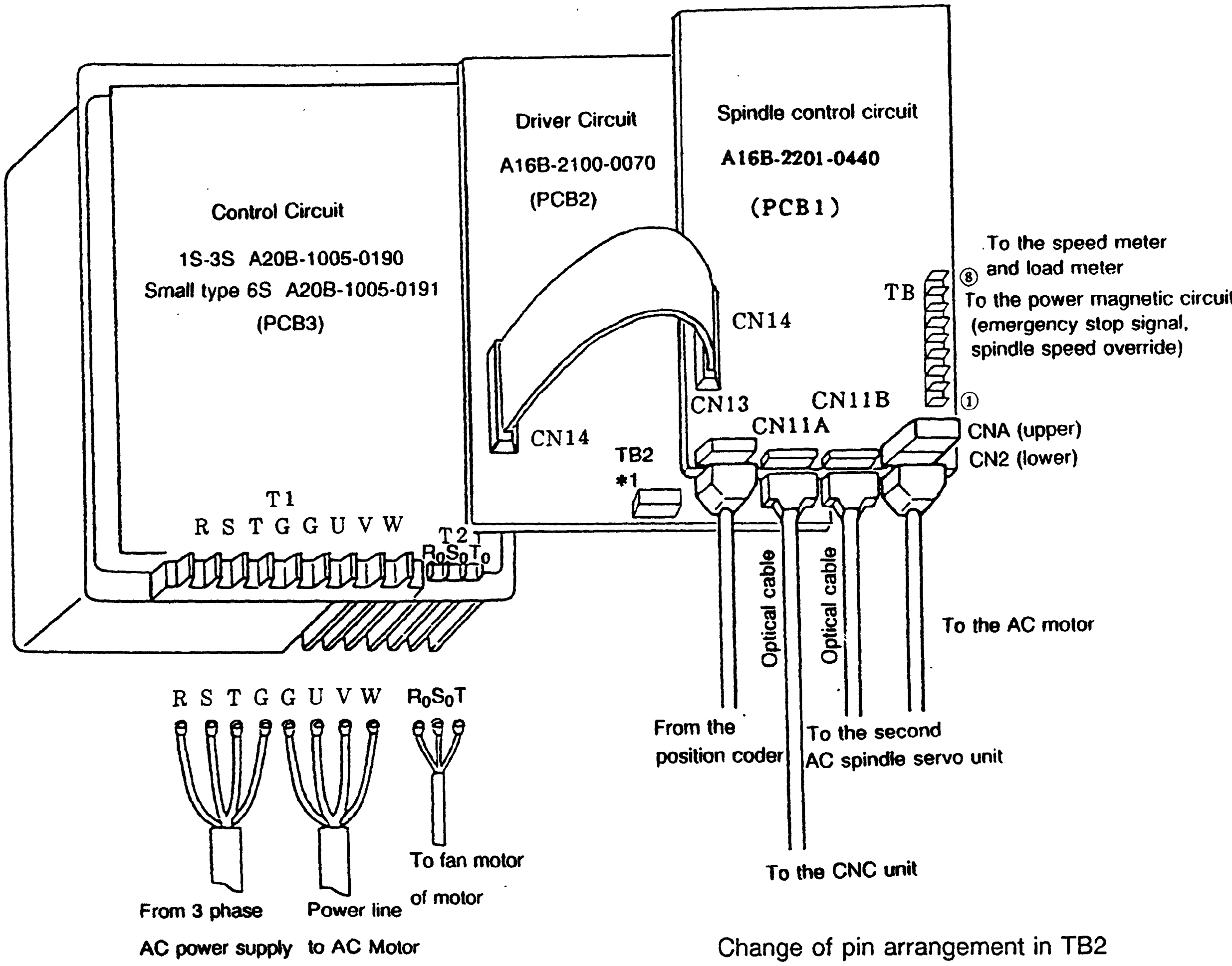
(Note 1) The parameter number for an AC spindle servo unit for tool post 2 is the same as that for the first spindle on the parameter screen for tool post 2.

(Note 2) When the second spindle is connected to a tool post, set jumper S1 for the AC spindle servo unit for the first spindle of the tool post to B.

9.2 Cable Routing

See Appendix 1.

9.2.1 Cable routing diagram of models 1S - 3S



Change of pin arrangement in TB2

(*1) Printed circuit board with general version 02A or earlier

③	②	①
VIN	PC0V	PC24V

Printed circuit board with version 03A or later

①	②	③
PC24V	PC0V	VIN

Fig. 9.2.1 Cable routing (Models 1S - 3S)

9.2.2 Cable routing diagram of models 6S - 12S

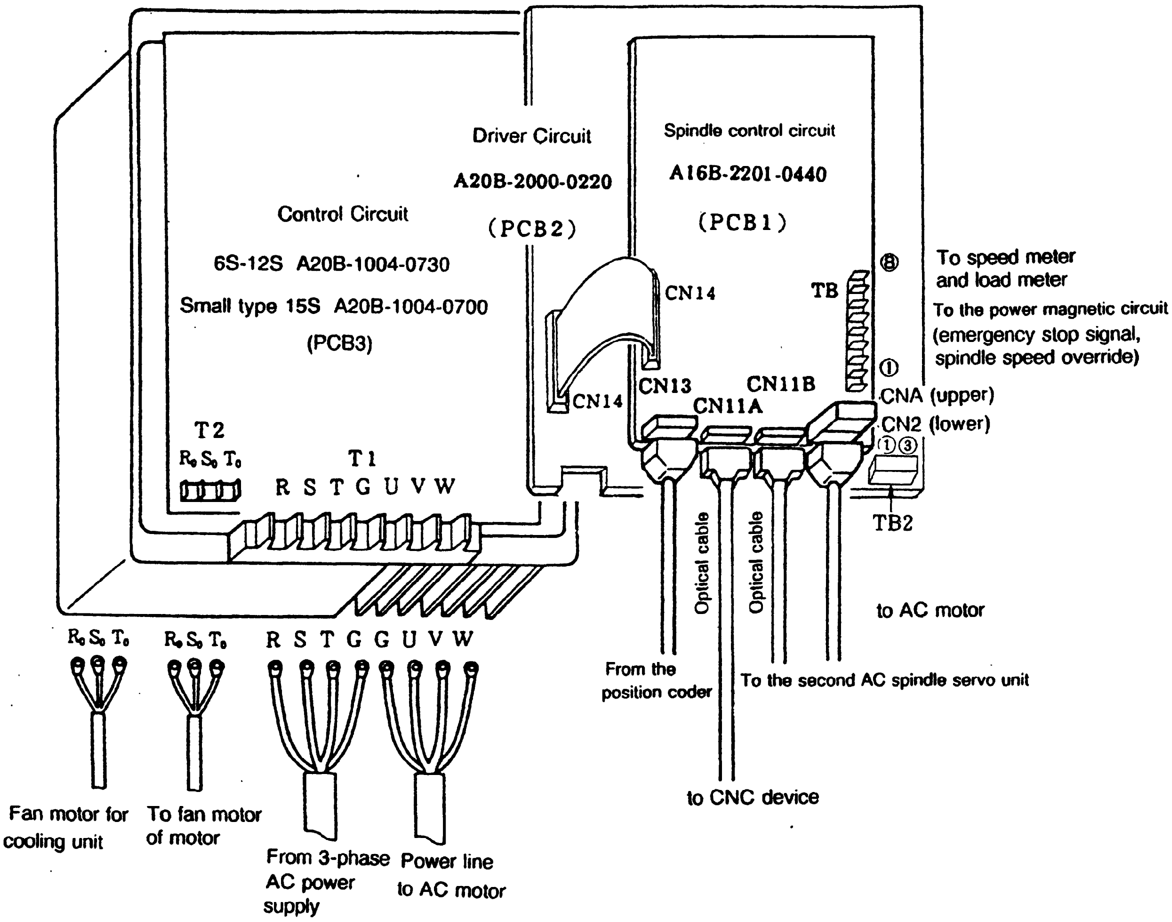


Fig. 9.2.2 Cable routing (Models 6S - 12S)

9.2.3 Cable routing diagram of models 15S - 26S, small type model 30S

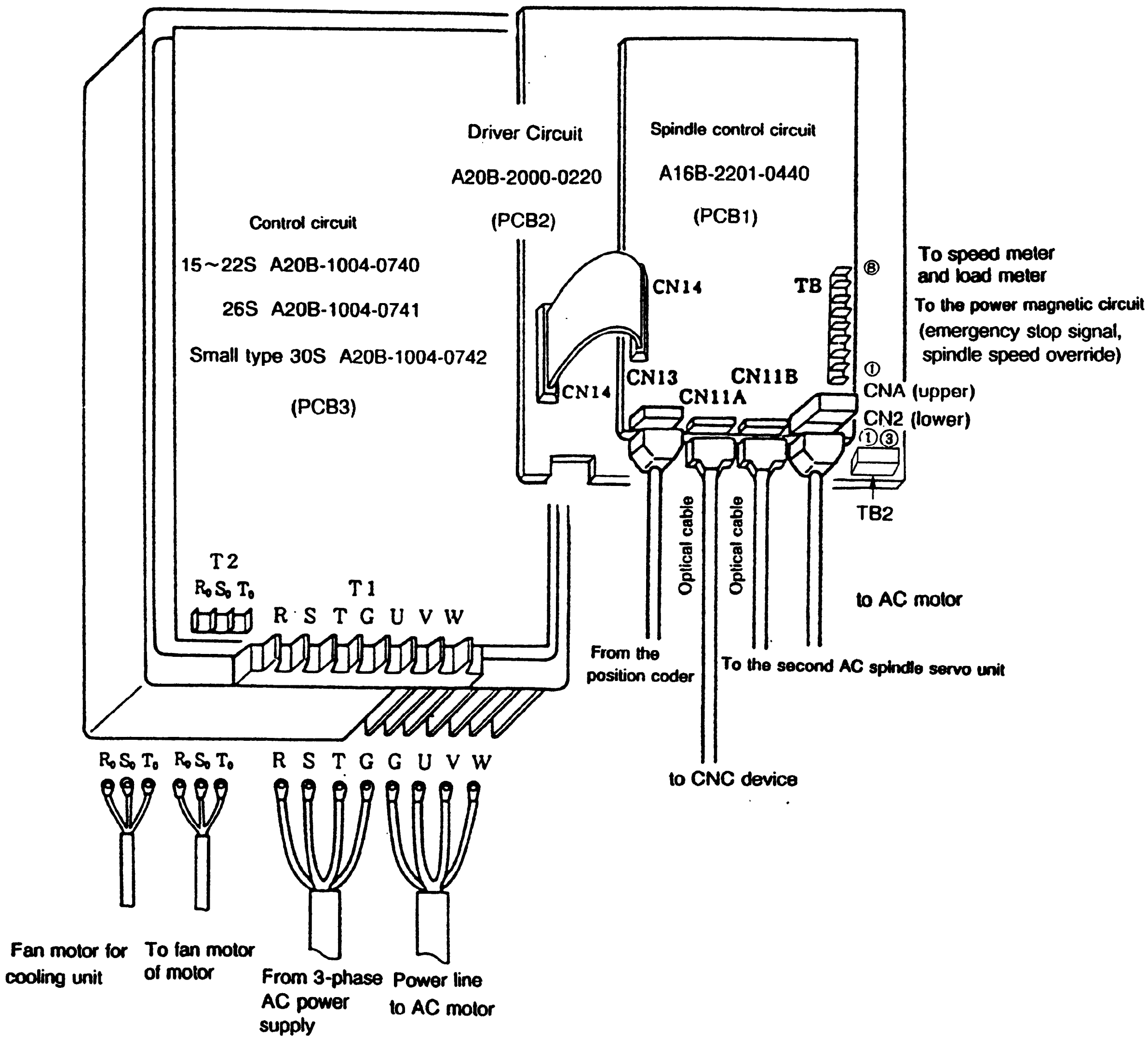


Fig. 9.2.3 Cable routing (Models 15S - 26S, small type model 30S)

9.2.4 Cable routing diagram of models 30S, 40S

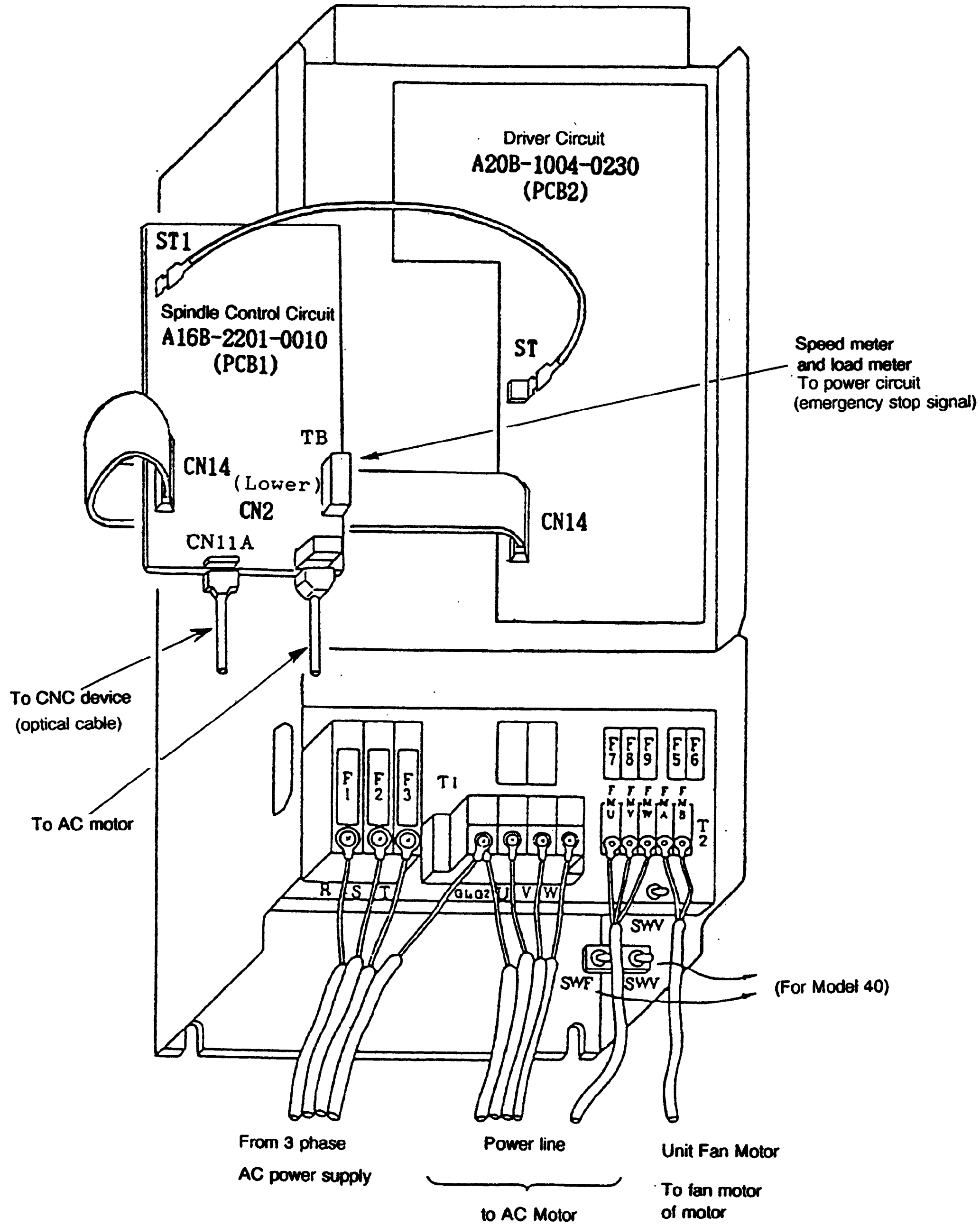


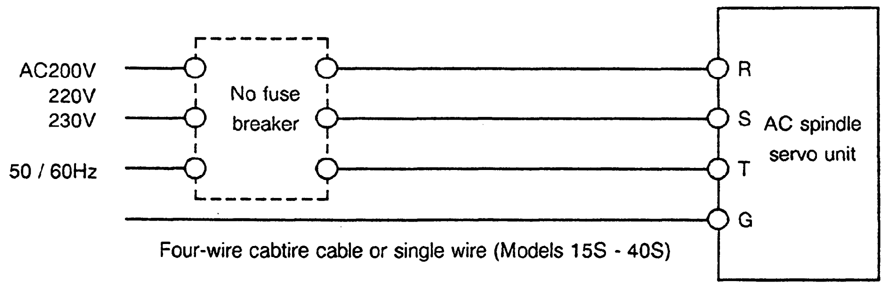
Fig. 9.2.4 Cable routing (Models 30S , 40S)

9.3 Detailed Connection Diagram

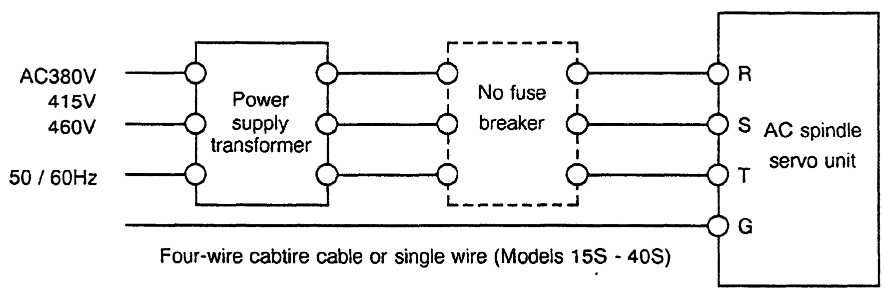
9.3.1 Connection of power source

(1) AC spindle servo unit Models 1S - 40S

- Without power transformer



- With power transformer



Model	Applicable wire		Unit terminal screw
1S	2 mm^2 or more		M4
2S	3.5 mm^2 or more		
3S	5.5 mm^2 or more		
6S	8 mm^2 or more		M5
8S,12S	14 mm^2 or more		
15S	Single wire of 14 mm^2 or thicker (heat resistant) (*1)		M8
18S-26S	Single wire of 22 mm^2 or thicker (heat resistant) (*1)		
Small type 30S	Between power suuply to amplifier	Single wire of 22 mm^2 or thicker (heat resistant) (*1)	M8
	Between amplifier to motor	R,S,T : Single wire of 38 mm^2 or thicker (heat resistant) (*1) G : Single wire of 22 mm^2 or thicker (heat resistant) (*1)	
30S	R,S,T : Single wire of 38 mm^2 or thicker (heat resistant) (*1) G : Single wire of 22 mm^2 (heat resistant)		M10
40S	R,S,T : Single wire of 50 mm^2 or thicker (heat resistant) (*1) G : Single wire of 22 mm^2 (heat resistant)		M10

(*1) Use the flame retardant poli-flex cable (MLFC)(Maximum temperature of conductor: 105°C)

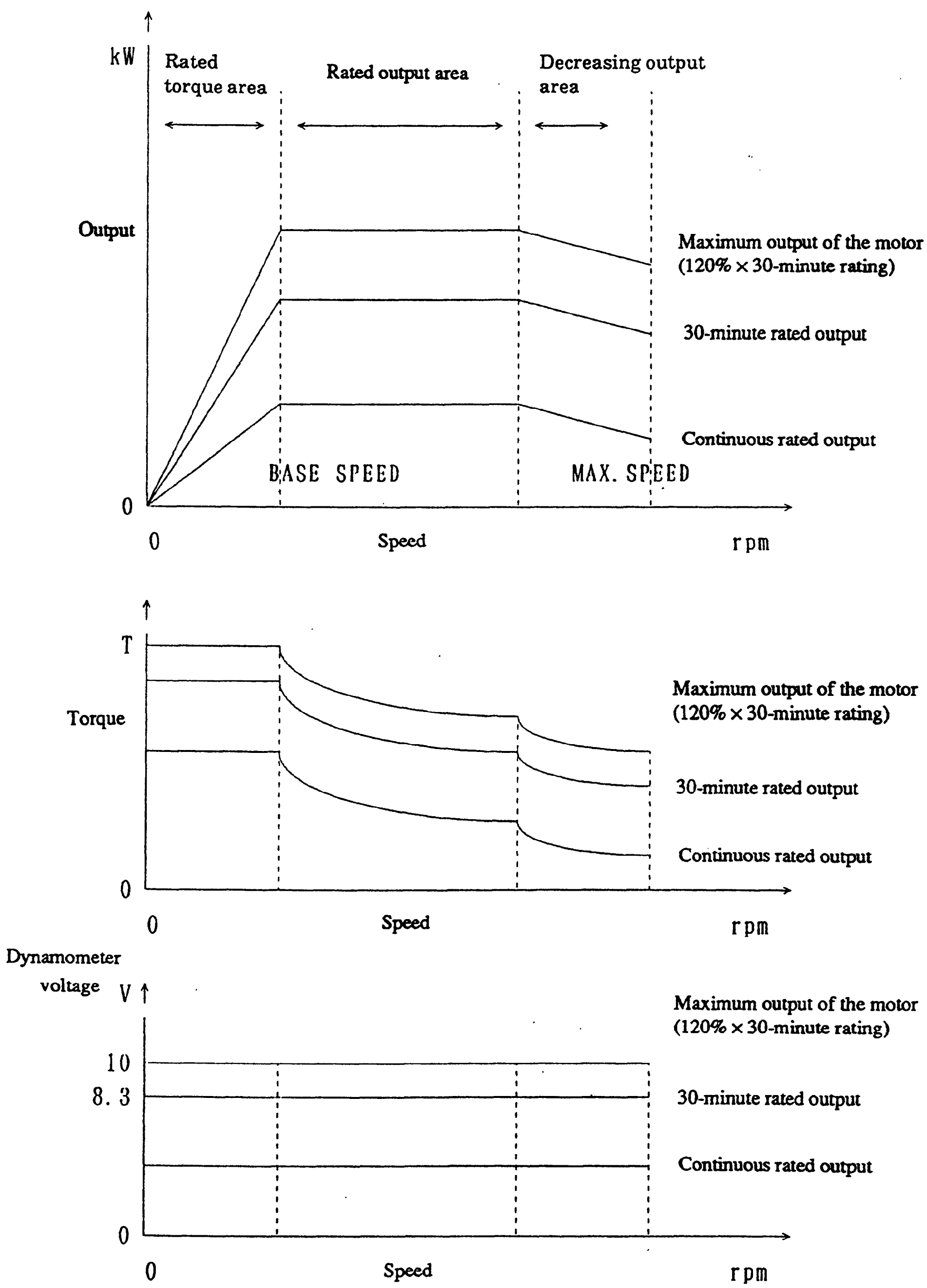
V. DYNAMOMETER (LOAD METER)

1. VOLTAGE SIGNALS (LM1 AND 0M) FOR DYNAMOMETER INDICATIONS

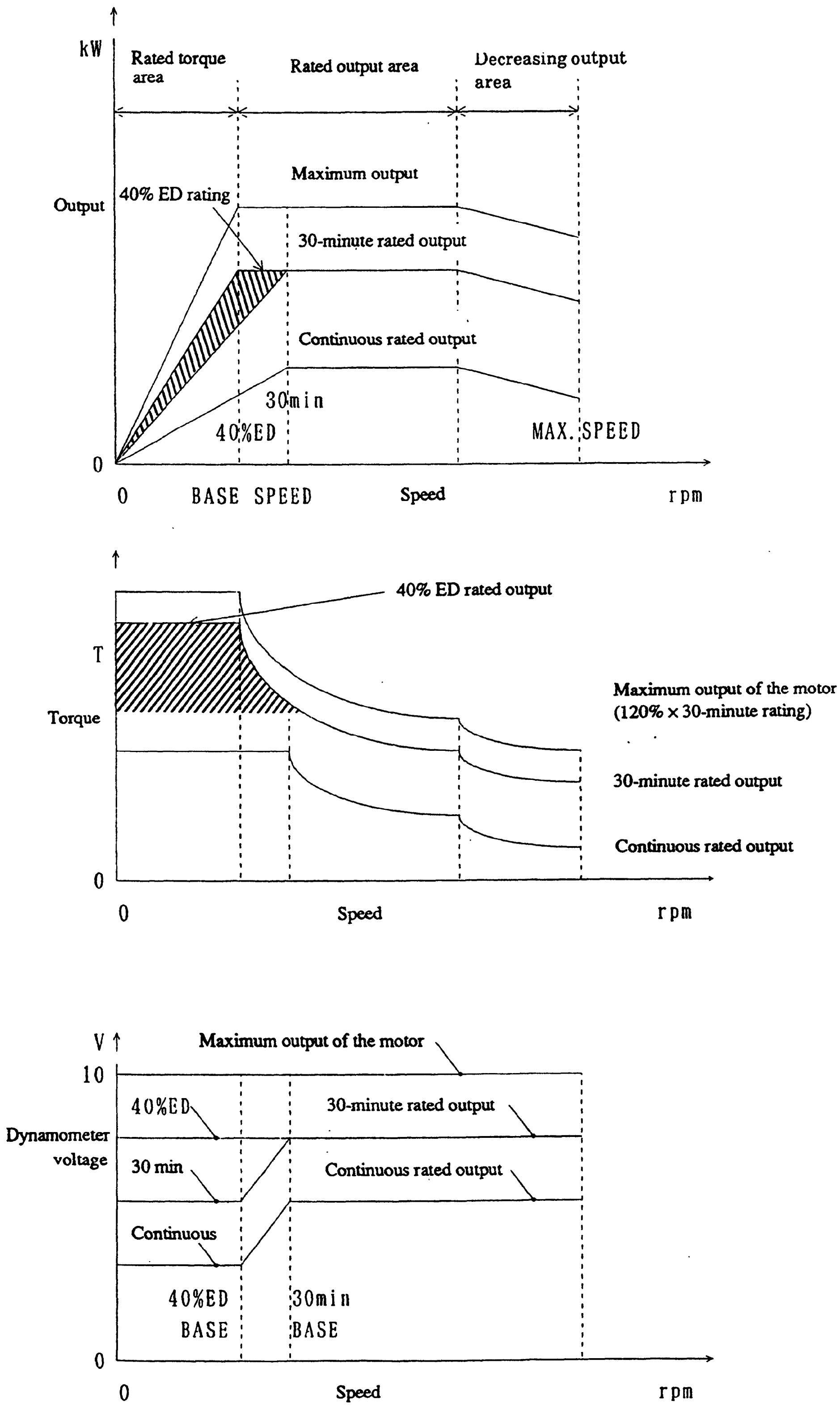
1) A dynamometer indicates the load factor. The load factor is the ratio of average output to the maximum output of the spindle motor when the spindle of the machine tool operates with no load and during cutting.

2) When the machine operates at the rated input voltage, the relationship between the output of the spindle motor and the speed, between the torque and the speed, and between the voltage for dynamometer indications and the speed are as follows.

① For the standard model



② For a model with 25% or 40% ED rated output



3) The dynamometer indication is a percentage of the continuous rating of the AC spindle motor. Table 1 shows the relationship between the output of the AC spindle motor and the voltage for dynamometer display.

4) As shown in Table 1, the dynamometer indications are classified into approximately five types. See Table 2 for the types of dynamometer indications.

5) Use a dynamometer (DC voltmeters) that meets the following requirements, except when the type-E dynamometer is used.
   · Pulsating DC voltmeter, including LM-80 manufactured by Kuwano Denki Co., Ltd.
   · With readings up to 10 VDC
   · Internal resistance of 10 kilohms or more

6) The interface for displaying the above signals can be connected from terminal block TB. Use a two-core shielded cable for the interface cable.

2. RELATIONSHIP BETWEEN THE OUTPUT OF EACH SPINDLE MOTOR AND THE VOLTAGES FOR THE DYNAMOMETER

Table 1 Relationship between the output of each spindle motor and the voltages for the dynamometer

Model	Type	Timing rating	Output (kW)	Dynamometer voltage (V)	Percentage to the continuous rating (%)	Dynamometer type	
						Applicable dynamometer	Percentage of the maximum value on the scale
B0.3	L127	Continuous rating	0.55	6.1	100	A	110
		30-minute rating	0.75	8.3	136		150
		Maximum output	0.90	10.0	164		180
B0.5	L113	Continuous rating	0.65	4.9	100	C	100
		15-minute rating	1.10	8.3	169		166
		Maximum output	1.32	10.0	203		200
B0.5	L128	Continuous rating	1.10	6.1	100	A	110
		30-minute rating	1.50	8.3	136		150
		Maximum output	1.80	10.0	163		180
B1	L129	Continuous rating	1.50	5.7	100	A	100
		15-minute rating	2.20	8.3	147		150
		Maximum output	2.64	10.0	176		180
B1.5	L130	Continuous rating	1.10	2.5	100	D	200
		10-minute rating	3.70	8.3	336		338
		Maximum output	4.44	10.0	404		400
B2	L120	Continuous rating	2.20	5.0	100	C	100
		15-minute rating	3.70	8.3	168		166
		Maximum output	4.44	10.0	202		200
B6	L131	Continuous rating	3.70	5.6	100	A	100
		30-minute rating	5.50	8.3	149		150
		Maximum output	6.60	10.0	178		180
B6	L132	Continuous rating	5.50	6.1	100	A	110
		30-minute rating	7.50	8.3	136		150
		Maximum output	9.00	10.0	164		180

Model	Type	Timing rating	Output (kW)	Dynamometer voltage (V)	Percentage to the continuous rating (%)	Dynamometer type	
						Applicable dynamometer	Percentage of the maximum value on the scale
B6	L133	Continuous rating	11.0	6.1	100	A	110
		30-minute rating	15.0	8.3	136		150
		Maximum output	18.0	10.0	164		180
B8	L134	Continuous rating	7.50	5.7	100	A	100
		30-minute rating	11.0	8.3	147		150
		Maximum output	13.2	10.0	176		180
B15	L135	Continuous rating	15.0	6.8	100	B	100
		30-minute rating	18.5	8.3	123		125
		Maximum output	22.2	10.0	148		150
B40	under development	Continuous rating	30.0	6.8	100	B	100
		15-minute rating	37.0	8.3	123		125
		Maximum output	44.4	10.0	148		150
B40	L138	Continuous rating	37.0	6.9	100	B	100
		10-minute rating	45.0	8.3	122		125
		Maximum output	54.0	10.0	146		150

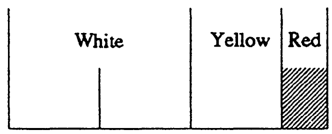
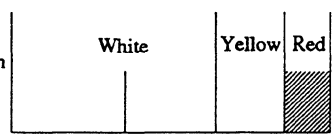
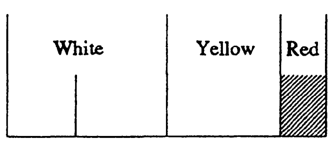
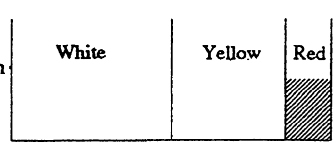
(Speed range switching)

Model	Type	Speed (rpm)	Timing rating	Output (kW)	Dynamometer voltage (V)	Percentage to the continuous rating (%)	Dynamometer type: Applicable dynamometer	Dynamometer type: Percentage of the maximum value on the scale	
B2	L516		Continuous rating	2.20	5.0	100	C	100	
			10-minute rating	3.70	8.3	168		166	
			Maximum output	4.44	10.0	202		200	
B3	L517		Continuous rating	3.70	5.6	100	A	100	
			30-minute rating	5.50	8.3	149		150	
			Maximum output	6.60	10.0	178		180	
B8	L511	0 to 530	Continuous rating	4.29	4.8	78	E	80	Va
			30-minute rating	5.85	6.5	106		100	Vb
			40% ED	7.50	8.3	136		140	Vc
			Maximum output	9.00	10.0	164		160	Vd
		680 or more	Continuous rating	5.50	6.1	100		100	Ve
			30-minute rating	7.50	8.3	136		150	Vf
			Maximum output	9.00	10.0	164		160	Vd
B10	L521		Continuous rating	5.50	6.1	100	A	110	
			30-minute rating	7.50	8.3	136		150	
			Maximum output	9.00	10.0	164		180	
	L522	0 to 350	Continuous rating	4.28	4.8	78	E	80	Va
			30-minute rating	5.05	6.5	92		100	Vb
			25% ED	7.50	8.3	136		140	Vc
			Maximum output	9.00	10.0	164		160	Vd
		520 or more	Continuous rating	5.50	6.1	100		100	Ve
			30-minute rating	7.50	8.3	136		150	Vf
			Maximum output	9.00	10.0	164		160	Vd

Model	Type	Speed (rpm)	Timing rating	Output (kW)	Dynamometer voltage (V)	Percentage to the continuous rating (%)	Dynamometer type		
							Applicable dynamometer	Percentage of the maximum value on the scale	
B17	L525		Continuous rating	5.50	6.1	100	A	110	
			30-minute rating	7.50	8.3	136		150	
			Maximum output	9.00	10.0	164		180	
B26	L526		Continuous rating	7.50	5.7	100	A	110	
			30-minute rating	11.0	8.3	147		150	
			Maximum output	13.2	10.0	176		180	
	L527	0 to 450	Continuous rating	6.00	4.5	80	E	80	Va
			30-minute rating	8.80	6.7	117		120	Vb
			40% ED	11.0	8.3	147		150	Vc
			Maximum output	13.2	10.0	176		180	Vd
		450 or more	Continuous rating	7.50	5.7	100		100	Ve
			30-minute rating	11.0	8.3	147		150	Vf
			Maximum output	13.2	10.0	176		180	Vd
B28	L529		Continuous rating	7.50	5.7	100	A	100	
			30-minute rating	11.0	8.3	147		150	
			Maximum output	13.2	10.0	176		180	
	L530	0 to 400	Continuous rating	8.80	4.9	80	E	80	Va
			30-minute rating	12.0	6.7	109		110	Vb
			40% ED	15.0	8.3	136		140	Vc
			Maximum output	18.0	10.0	164		160	Vd
		500 or more	Continuous rating	11.0	6.1	100		100	Ve
			30-minute rating	15.0	8.3	136		140	Vf
			Maximum output	18.0	10.0	147		150	Vd

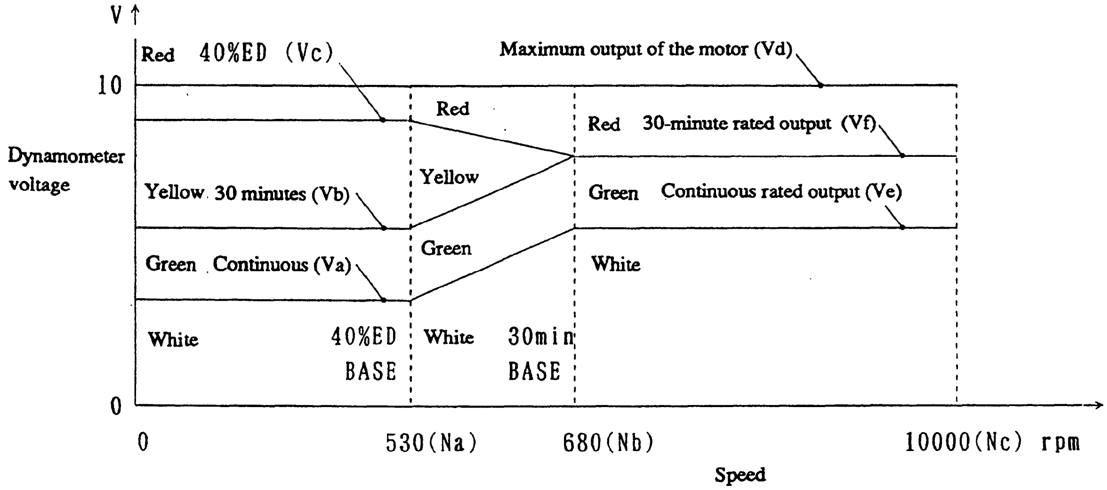
Model	Type	Speed (rpm)	Timing rating	Output (kW)	Dynamometer voltage (V)	Percentage to the continuous rating (%)	Dynamometer type		
							Applicable dynamometer	Percentage of the maximum value on the scale	
B28	L531	0 to 320	Continuous rating	8.80	4.9	80	E	80	Va
			30-minute rating	9.60	5.3	87		90	Vb
			25% ED	15.0	8.3	136		140	Vc
			Maximum output	18.0	10.0	164		160	Vd
		500 or more	Continuous rating	11.0	6.1	100		100	Ve
			30-minute rating	15.0	8.3	136		140	Vf
			Maximum output	18.0	10.0	164		150	Vd
B35	L532	0 to 350	Continuous rating	15.4	5.8	83	E	80	Va
			30-minute rating	18.5	6.9	100		100	Vb
			25% ED	22.0	8.3	119		120	Vc
			Maximum output	26.4	10.0	143		140	Vd
		420 or more	Continuous rating	18.5	7.0	100		100	Ve
			30-minute rating	22.0	8.3	119		120	Vf
			Maximum output	26.4	10.0	143		150	Vd
B45	L533		Continuous rating	11.0	6.1	100	A	100	
			30-minute rating	15.0	8.3	136		150	
			Maximum output	18.0	10.0	164		180	

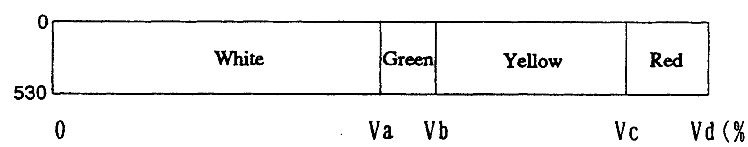
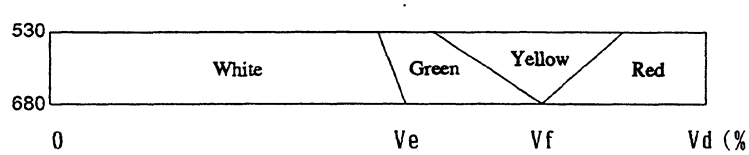
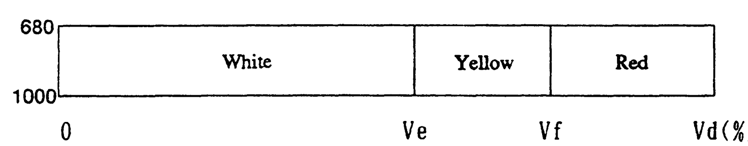
Table 2 Example of indications for types A to E

Dynamo-meter type	Example of indication	Applicable motor	
		Model	Type
A	Colour classification  Indication 0 50 100 150 180 % Voltage 0 5.5 8.3 10 V	B0.3, B1 B6 B8 B3, B10 B17, B26 B28, B45	L127 L131 L132 L133 L134 L517 L521 L525 L526 L529 L533
B	Colour classification  Indication 0 50 100 125 150 % Voltage 0 5.5 8.3 10 V	B0.5 B15 B40 B40	L128 L135 under development L138
C	Colour classification  Indication 0 50 100 166 200 % Voltage 0 5.0 8.3 10 V	B0.5 B2	L113 L516
D	Colour classification  Indication 0 200 338 400 % Voltage 0 5.5 8.3 10 V	B1.5	L130

Models with 25%-ED or 40%-ED rating require the following special dynamometer:

Dynamometer type E (for model B8/type L511)



Speed (rpm)	Example of indication
0 to 530 Na (40% ED rating, base speed)	
530 Na (40% ED rating, base speed) to 680 Nb (30-minute rating, base speed)	
680 Nb (30-minute rating, base speed) to 10000 Nc (maximum speed)	

VI. SIGNAL CONVERSION CIRCUIT

1. OUTLINE

This chapter describes the signal conversion circuit which, on the one hand, receives signals from the built-in sensors used in built-in sensor integrated type AC spindle motors and built-in motors and, on the other hand, outputs speed detection signals and position coder signals.

2. FEATURES

2.1 Added feature

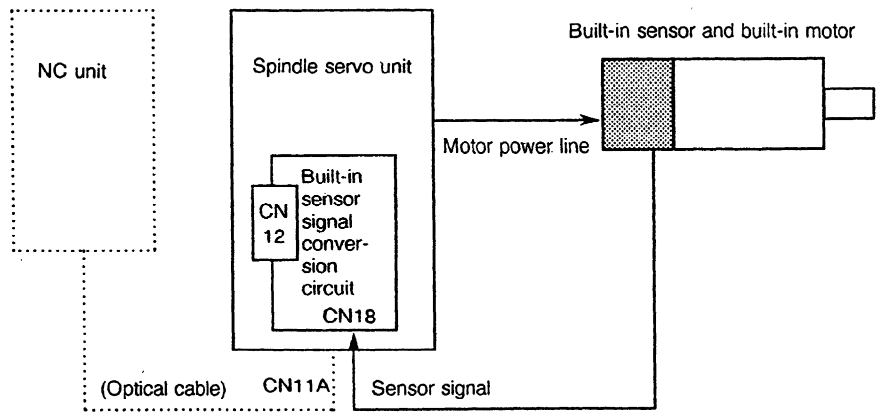
It is enabled to monitor the detection signal level and issue an alarm (for burnout) when a trouble has occurred.

2.2 Existing features

Both the motor velocity feedback signal and the spindle position coder signal can be obtained using a built-in sensor and this set of signal circuit.

3. SYSTEM CONFIGURATION

Signal conversion circuit (Unit mounting type)



4. ORDER DRAWING NUMBERS

4.1 Signal conversion circuit

Classification	Name	Specification No.	PCB specification No.
Option	Built-in sensor signal conversion circuit	A06B-6064-J704	A16B-1300-0220

5. SPECIFICATIONS

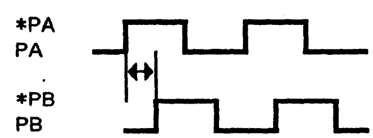
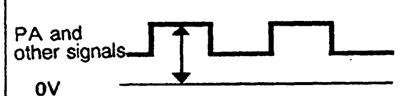
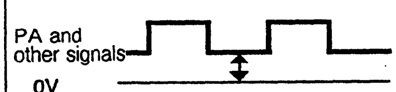
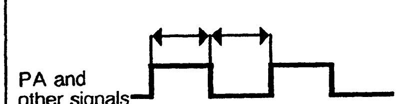
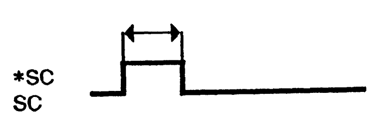
5.1 Position Coder Output Signals

(1) Number of teeth on detection gear and number of output pulses

	Number of teeth on detection gear	Magnification	SH 6	SH 7	Number of output pulses per revolution
Phase A Phase B	512	2	A	A	1024
	256	4	A	B	1024
	128				512
Phase Z	1	1			1

Note) Pins SH6 and SH7 determine the magnification.

(2) Specifications of the output signal (connector CN19) at 1500 rpm

Point to be checked	Item	Specifications	Sample waveform
Between CN19-16 (PA) and CN19-18 (PB) Between CN19-17 (*PA) and CN19-19 (*PB)	Phase difference	90 ± 10° (Counterclockwise rotation as viewed from the detector)	
CN19-16(PA) CN19-18(PB) CN19-14(SC) CN19-17(*PA) CN19-19(*PB) CN19-15(*SC)	High level	2.5 V or higher	
	Low level	1.2 V or lower	
PA, *PA PB, *PB	Duty ratio	50 ± 7%	
CN19-14(SC) CN19-15(*SC)	Width	116 ± 21 μS	

(3) Output circuit configuration

Balanced output by line driver IC75172

5.2 Power Supply

Voltage range	Maximum current
+5V ±5%	200 mA

Note) The power is supplied from the spindle servo unit.

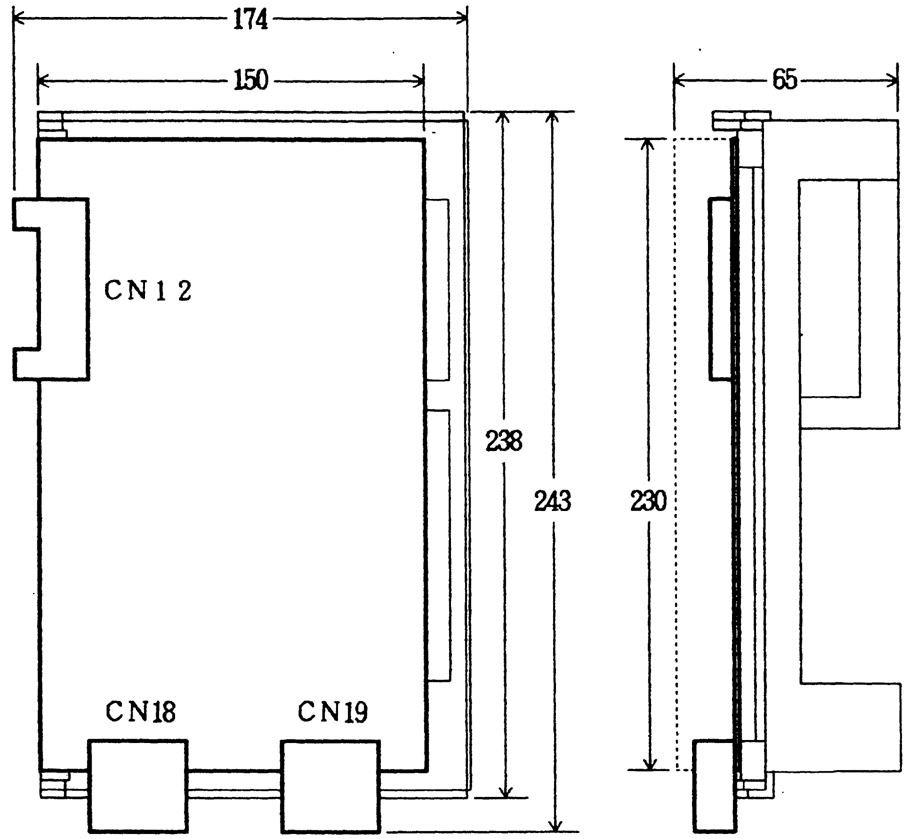
5.3 Operating Temperature Range

0°C to +55°C

6. EXTERNAL DRAWING

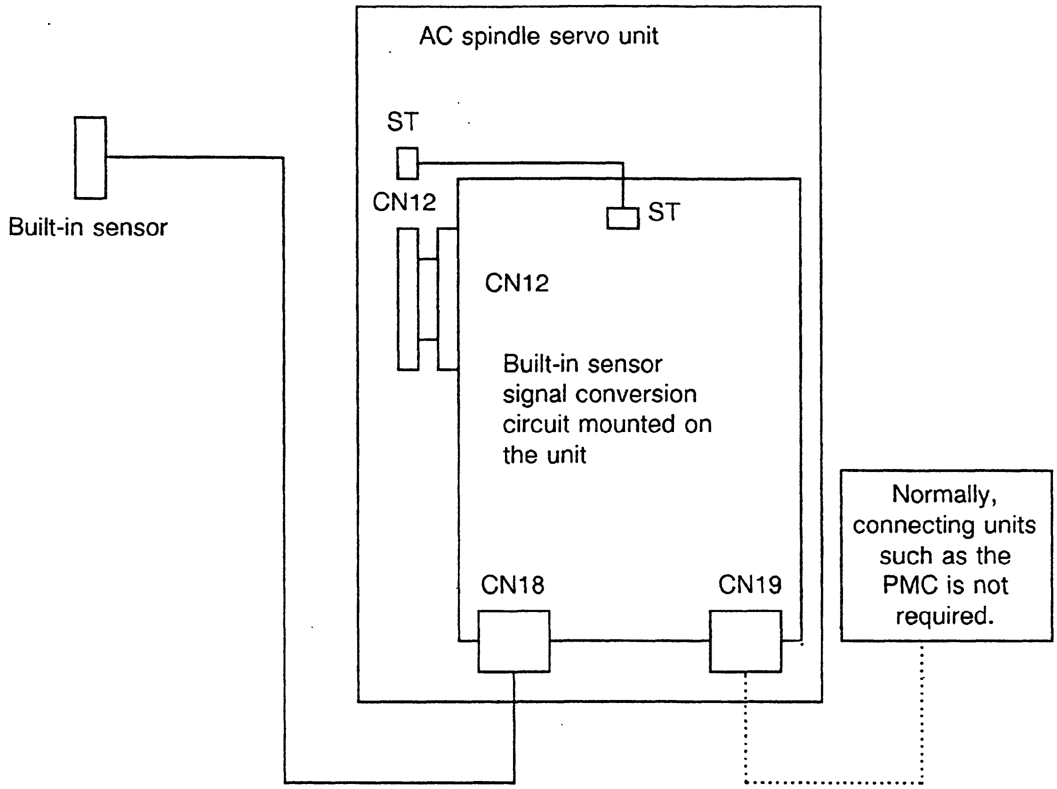
Signal conversion circuit (Unit mounting type)

(unit: mm)



7. CONNECTING CABLES

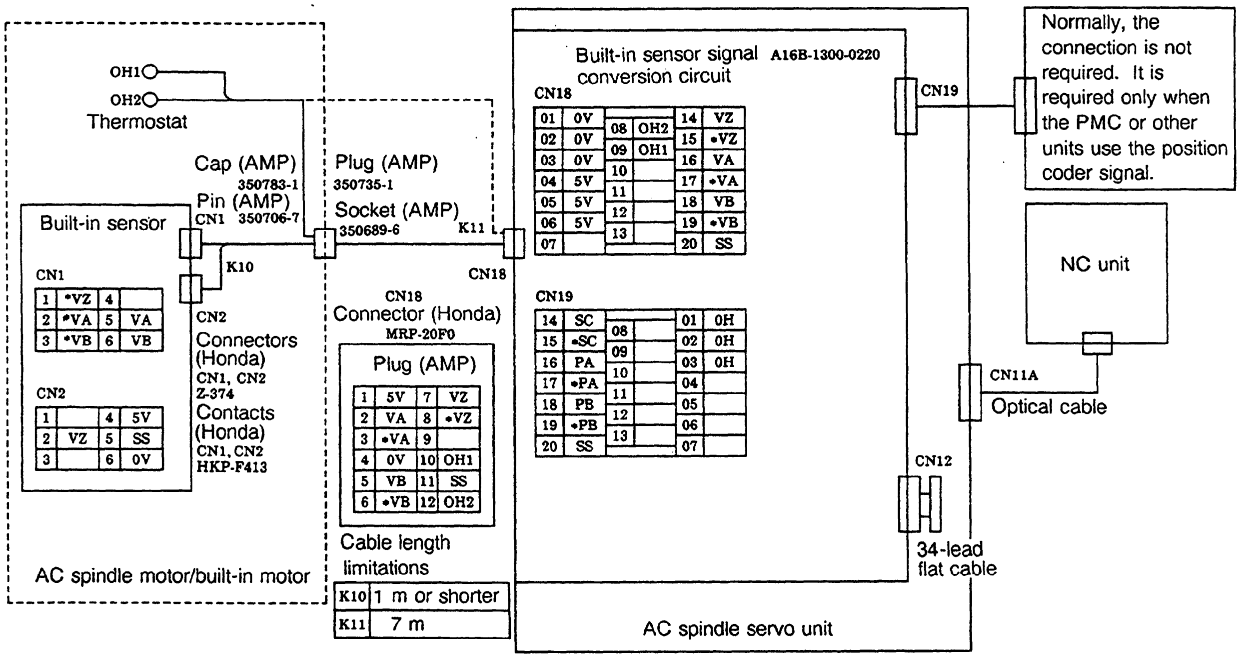
Signal conversion circuit (Unit mounting type)



8. CONNECTING UNITS

8.1 Connection Diagrams

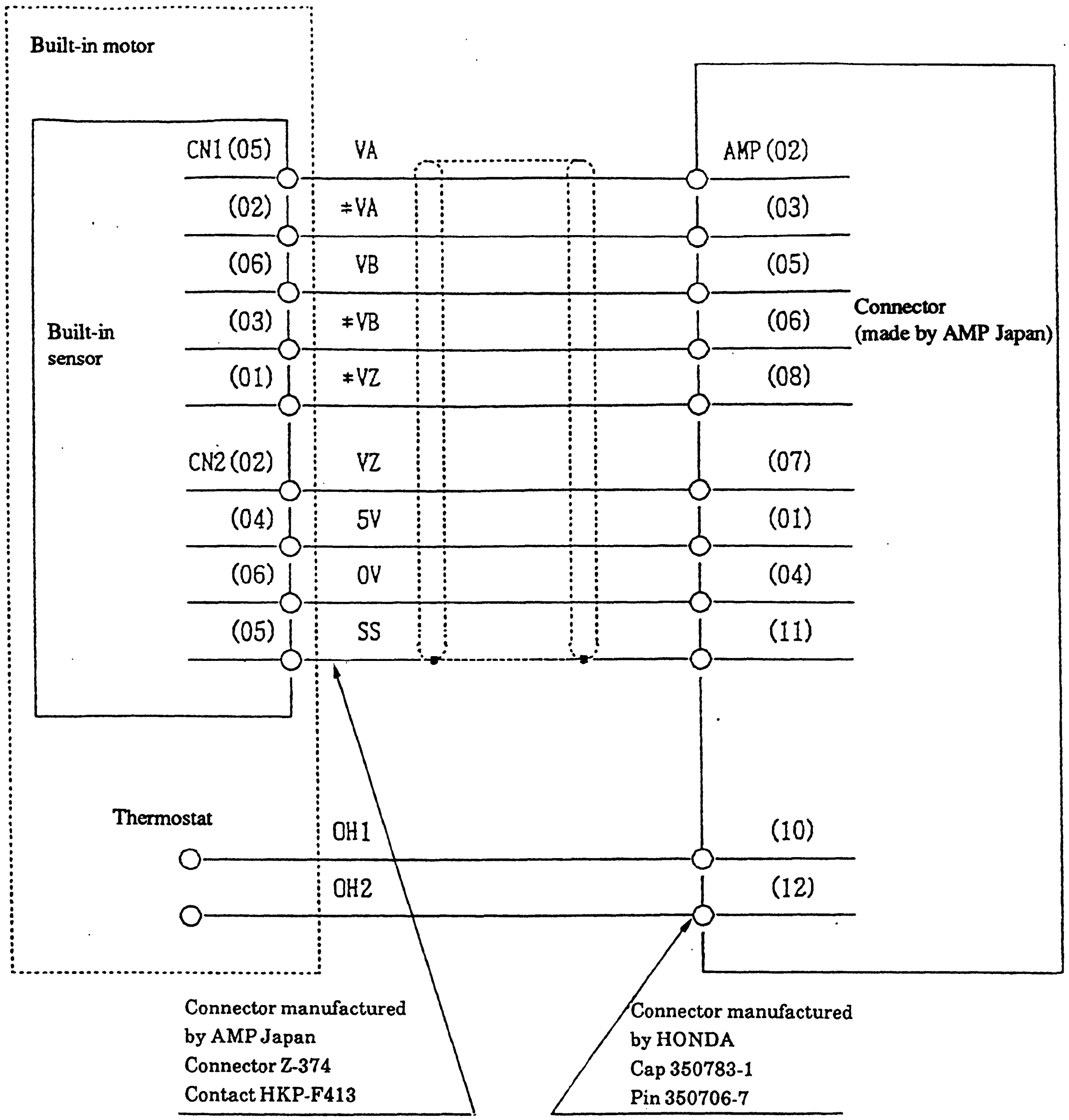
Signal conversion circuit (Unit mounting type)



For connections of OH1 and OH2, see Section 9.1, "Cable (K10)."

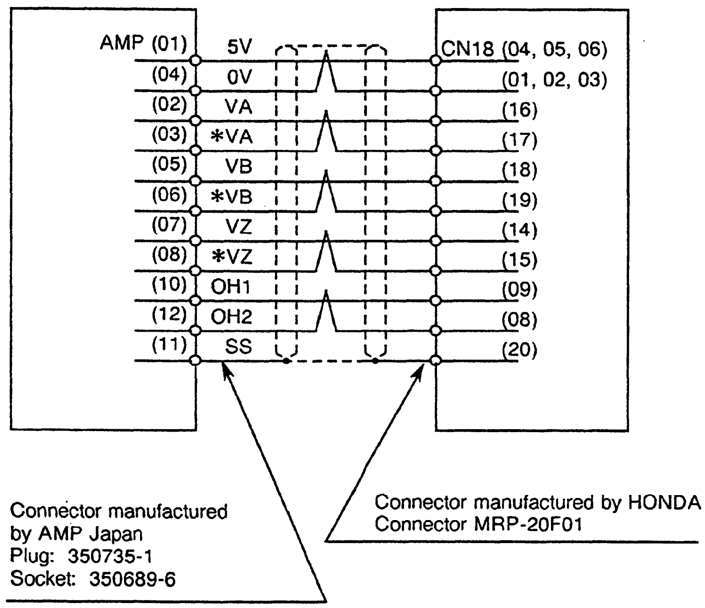
8.2 Details of connection between each unit

Built-in sensor and connector (Cable symbol: K10)



Cables for use: 8-wire-bundled shielded cable
0.2 mm^2 (7/0.18)

(2) Motor and built-in sensor signal conversion circuit (Cable symbol: K11)



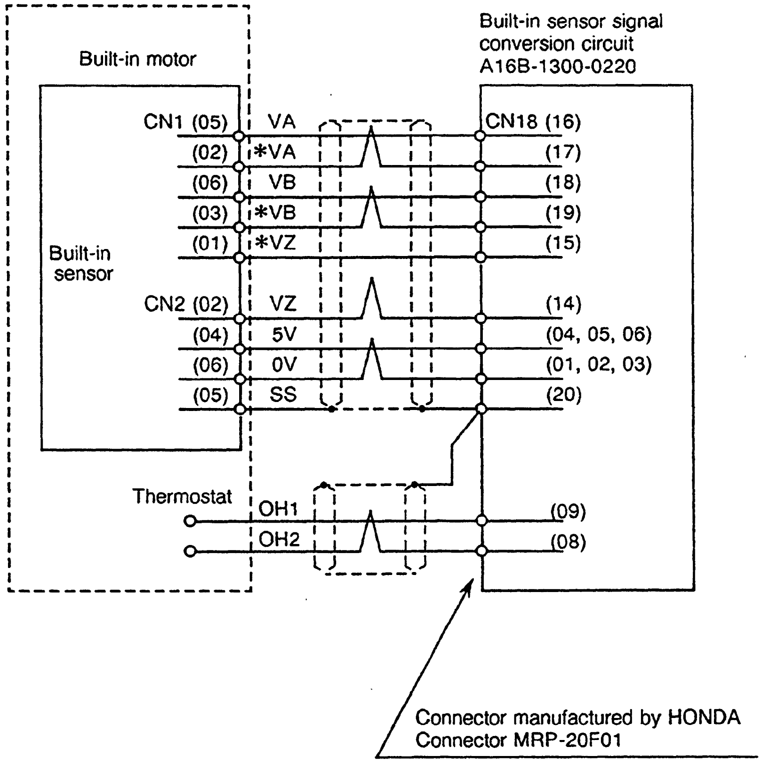
Cable: 10-pair shielded cable (all wires shielded in one braiding)
0.2 mm² (7/0.18)

Reference: For pin crimping and extraction, use the following tools:

A.M.P Handling tool model number	
Crimping tool	90300
Extracting tool	458994

(Note 1) AMP manual tool operator's manual: IS 7706
(Note 2) For the hand tool, use a die for wire size 22-24.
(*) See section 9.2 for length of the cable (7m: standard).

(3) Unit mounting type (when a separate cable is used for the overheat line.)
(Cable symbol: K11)

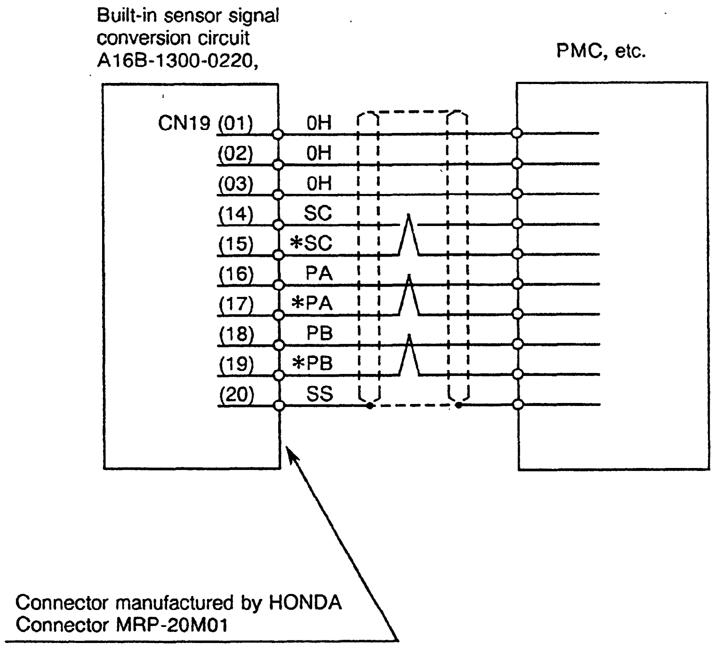


Cable: Shielded cable (all wires shielded in one braiding)
0.2 mm² (7/0.18)

(*) See section 9.2 for length of the cable.

(4) Unit mounting type (when the position coder signal is used by the PMC, etc.)
(Cable symbol: K16)

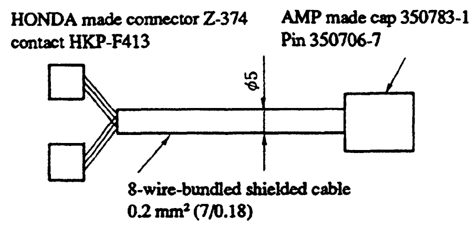
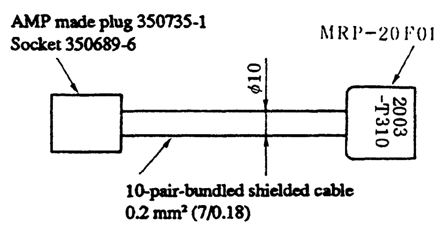
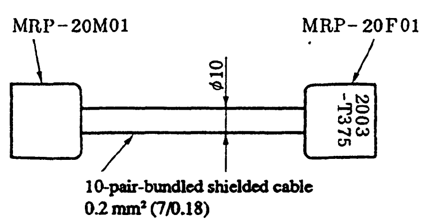
(Connector symbol: CN19) : The connection is unnecessary usually.



Cable: 10-pair shielded cable (all wires shielded in one braiding)
0.2 mm² (7/0.18)

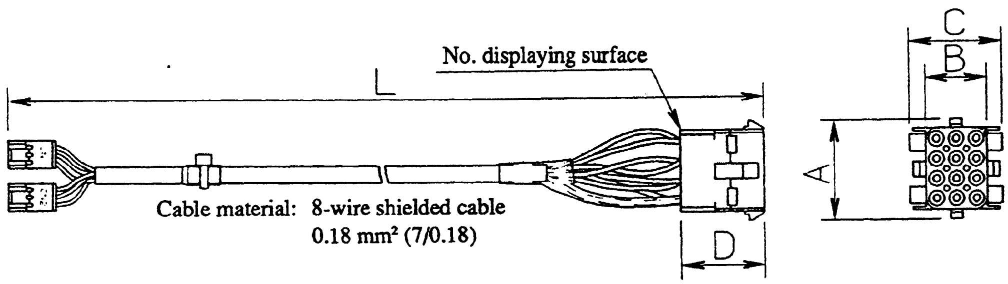
9. CABLES

Specifications for each cable are as follows. Cables are to be prepared by the user.

Purpose	Symbol	General specification	FANUC spec. dwg. No. (Cable assembly)
Built-in sensor | AMP made plug	K10		A06B-6059-K804 (0.5 m) A06B-6059-K805 (1 m)
AC spindle motor or AMP made cap | Built-in sensor signal conversion circuit	K11		A06B-6059-K806 (7 m)
Built-in sensor signal conversion circuit | NC device	K16		A06B-6059-K803 (7 m)

9.1 Details of the cable (K10)

FANUC specification drawing No. : A06B-6059-K804 (0.5 m)
A06B-6059-K805 (1 m)



1) Cable dimension

	Dimension	
Symbol \ Drawing No.	A06B-6059-K804	A06B-6059-K805
A	26.67	26.67
B	20.32	20.32
C	25.91	25.91
D	27.43	27.43
L	500 ±20	1000 ±20

2) Detector wiring connecting table

1	2	3
Red	Black	Blue
5V	VA	*VA
4	5	6
White/yellow	Green	White/orange
0V	VB	*VB
7	8	9
Grey	White/brown	
VZ	*VZ	
10	11	12
	Blue/transparent	
OH (Note)	SS	OH (Note)

Note) Connect the OH wire of the motor to Nos. 10 and 12.

3) Accessories

Name	Manufacturer	Model number	Q'ty
Plug	A.M.P	350735-1	1
Split pin	A.M.P	350706-7	2
Socket	A.M.P	350689-6	10

Reference) Use the tools listed below for crimping and pulling up pins.

AMP Handling tool model number	
Crimping tool	90300
Extracting tool	458994

* AMP manual tool operator's manual: IS 7706
* Use the dies on the wire size 22-24 side.

9.2 Cable (K11) Length

Specifications of the built-in sensor

Internal impedance	120Ω
Consumption current	41.67mA

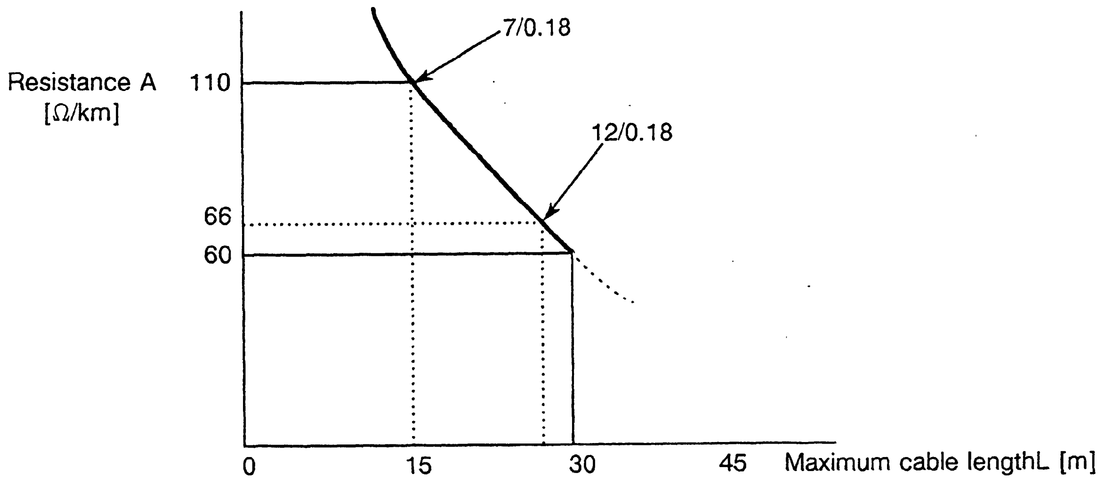
The total voltage drop across a cable both ways must be restricted to 0.15 V or less.
If a cable with resistance A is used, the maximum length of the cable (one way) is found from the formula:

$$L = \frac{1800}{A}$$

L: Maximum cable length [m]
A: Resistance of a cable used [Ω/km]

Reference: Cable resistance
7/0.18 (0.2mm^2) . . . 110Ω/km
12/0.18 (0.3mm^2) . . . 66Ω/km
20/0.18 (0.5mm^2) . . . 40Ω/km

The following figure shows the relationship between resistance and the maximum cable length.



Cable used	Maximum cable length
7/0.18	16.4m
12/0.18	27.3m

(Note) The maximum length of the cable shall be 30 m.

10. CAUTIONS IN USE

(1) Adjustment

For matching between the built-in sensor and signal conversion circuit, adjustments need to be made at the time of installation. For detailed information about adjustments, refer to the "FANUC AC Spindle Servo Unit Serial Interface Maintenance Manual" (B-65045E).

① Offset voltage adjustment (for A16B-1300-0220)

Adjustment location	Measurement location	Measurement conditions	Adjustment value	Remarks
VR1	CH7-CH10	Rotation direction: CW and CCW Speed: 1500 rpm Test equipment: DC voltmeter (DC range of digital multimeter, etc.) or oscilloscope	0 ± 35mV	Make adjustment to place centers of CW and CCW adjustment values close to 0 mV.
VR2	CH8-CH10		− 85mV to − 345mV	Make adjustment to place centers of CW and CCW adjustment values close to -200 mV.
VR3	CH9-CH10			

(2) Orientation for using the built-in sensor

	Number of detection pulses/rev	Signal conversion circuit interpolation magnification	Number of equivalent position corder signal output pulses/rev	Detection unit	Repeatability	
Phase A Phase B	512 pulses/rev	2	1024 pulses/rev	0.088°	±0.2°	(*1)
	256 pulses/rev	4	1024 pulses/rev	0.088°	±0.2°	
	128 pulses/rev	4	512 pulses/rev	0.176°	±0.4°	
Phase Z	1 pulse/rev		1 pulse/rev	——	——	

(Note 1) Error components due to the machine are excluded. A fluctuation of ±1 detection unit occurs at the time of stop at a fixed position by orientation.

(3) To prevent malfunction due to noise and fluctuation at the time of stop by orientation, note the following:

① Do not run the signal cable (K10) and power cable through the same duct. In addition, separate the signal cable (K11) from the power cable as far as possible.

② When using cables, be sure to use shield wires, and connect a shield wire to the SS pin of each connector. (K10, K11)

③ Be sure to pair the signal lines in a signal cable correctly.

④ If the spindle servo unit and motor are not connected to ground correctly, a speed feedback signal, speed command voltage, and so forth may pick up noise, thus causing fluctuation at the time of stop by orientation, erratic rotation, abnormal sound, and so on. Connect the spindle servo unit and motor to ground according to Item (4) below.

(4) Grounding

① Connect the G terminal on the power cabinet to the G terminal on the spindle servo unit.

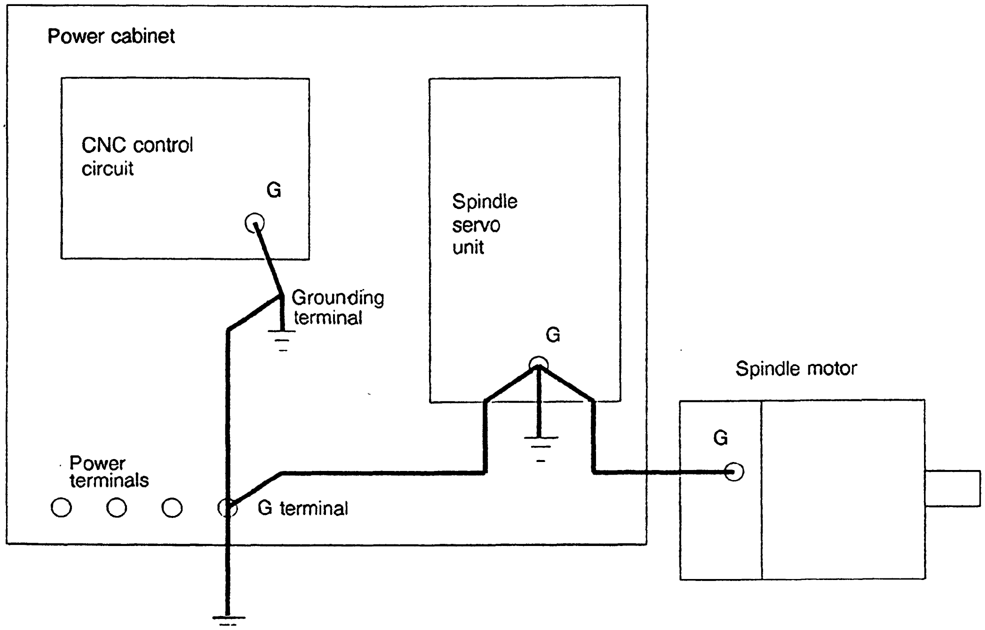
② Connect the G terminal on the spindle servo unit to the G terminal on the spindle motor.

③ Connect the G terminal on the spindle servo unit to the nearest point of the power cabinet frame.

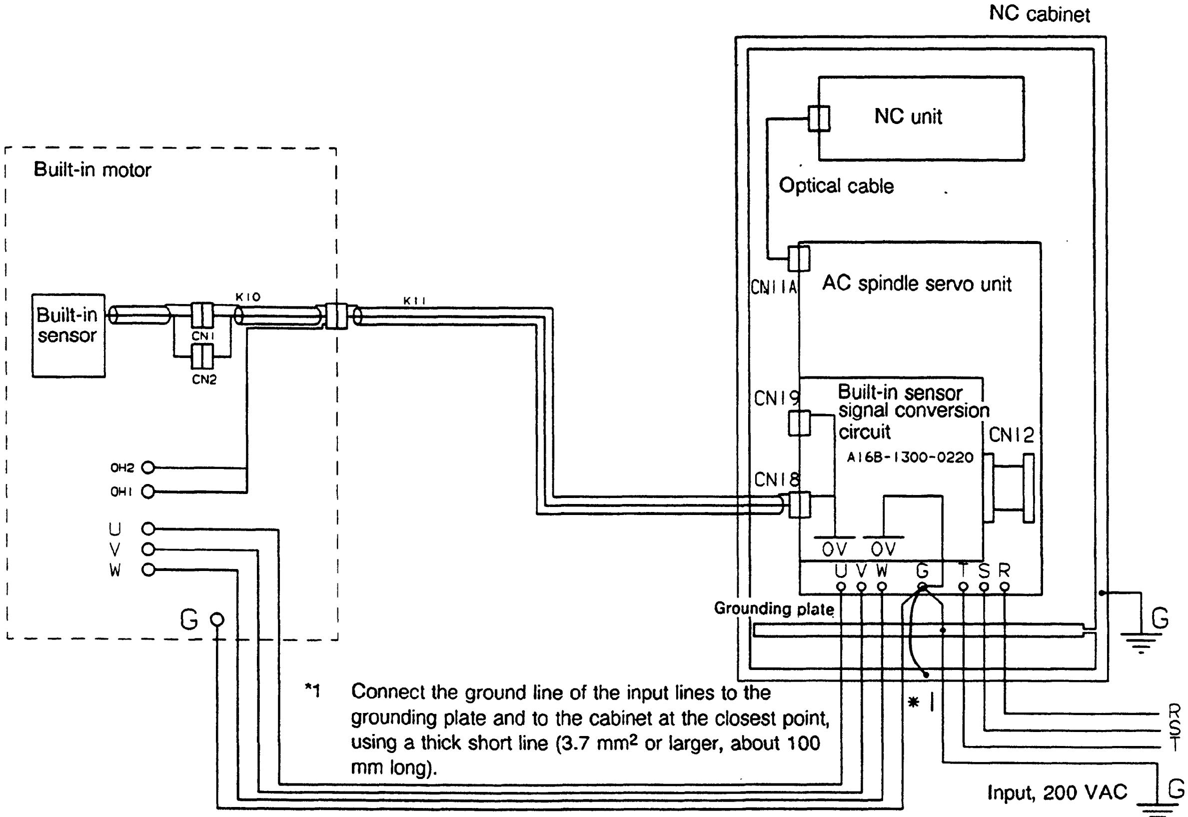
Reason: If the connection point is far from the G terminal on the power cabinet, grounding may not be sufficient.

④ Connect the G terminal on the power cabinet to an external ground wire.

(Note 1) Connect the G terminal of the power cabinet to a ground terminal installed according to Section 3 of "Technical Standard for Electric Installation."
(Note 2) Use a thick (5.5 mm^2 or more) wire when connecting the G terminal on the CNC control circuit to a ground G terminal, and the G terminal on the power cabinet to a ground terminal. Both connections should be made as close to each other as possible.



(5) Connecting a shielded grounding cable



*1 Connect the ground line of the input lines to the grounding plate and to the cabinet at the closest point, using a thick short line (3.7 mm² or larger, about 100 mm long).

11. ADJUSTING THE SIGNAL CONVERSION CIRCUIT

It is necessary to make the following adjustments and to check the output waveform, especially when the built-in sensor is attached by the user.

(1) Confirmation and change of setting pin
For the mounting positions of each pin, see Figure 1.

Printed circuit board A16B-1300-0220 (to be mounted on the unit)

<table>
<tr><th>No.</th><th>Pin No.</th><th>Function</th><th>Setting</th><th>Standard setting</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">SH3</td><td rowspan="2">Adjusts the phase-Z temperature drift.</td><td>A: Drift offset is not provided.</td><td rowspan="2">B</td></tr>
<tr><td>B: Drift offset is provided.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="2">SH4(*1)</td><td rowspan="2">Adjusts the phase-A (between CH7 and CH10) output gain.</td><td>A: The magnification is set to 0.9.</td><td rowspan="3">OPEN</td></tr>
<tr><td rowspan="1">Open: The magnification is set to 1.0.</td></tr>
<tr><td>SH5(*1)</td><td>Adjusts the phase-B (between CH8 and CH10) output gain.</td><td>B: The magnification is set to 1.1.</td></tr>
<tr><td>4</td><td>SH6, SH7</td><td colspan="2">Adjusts the magnification between the number of input pulses and the number of output pulses. Examples are given below.</td><td>SH6 : B
SH7 : A</td></tr>
</table>

SH6	SH7	Magnification	Number of input pulses → Number of output pulses	Remarks (compatibility)
A	A	2	512 → 1024	Compatible with A16B-1600-0390
B	A	4	256 → 1024 128 → 512	Compatible with A20B-9000-0180, A16B-1600-0370

Note 1) When V_{P-P} of the signal between CH28 and CH10 or between CH29 and CH10 is outside the allowable range (see (2) - (a)), the amplitude of the signal can be changed without changing the mounting position of the sensor. If V_{P-P} does not come within the range after the amplitude is changed, the mounting position of the sensor must be changed.

2) Adjustment

For the mounting positions for each variable resistor and check pin, see Fig. 10.10

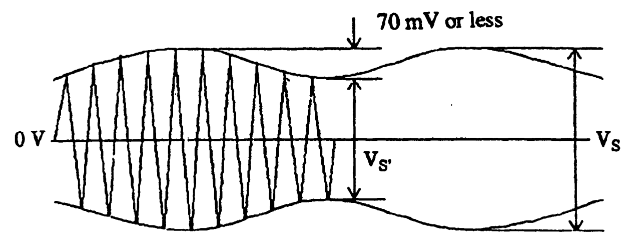
(a) Checking an output signal (for speed detection)

Conditions for measurement:

Rotating direction : Normal (CCW) / Reverse (CW)

Speed : 1500 rpm

A16B-1300-0220

Point to be measured	Vs, Vs'	Example waveform
CH28 - CH10 CH29 - CH10	0.36 to 0.5 V	

* During mounting, check to make sure that the ripple voltage of the output signal is 70 mV or less. If it is over 70 mV, the following adjustment may be impossible.

(b) Adjusting offset

Conditions for measurement:

Rotating direction : Normal (CCW) / Reverse (CW)

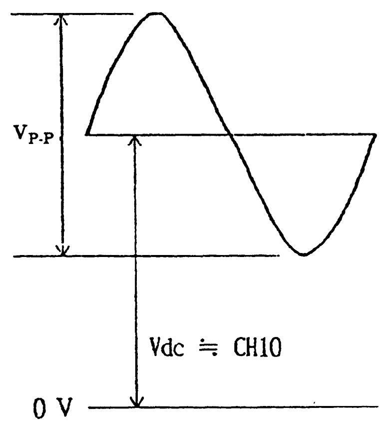
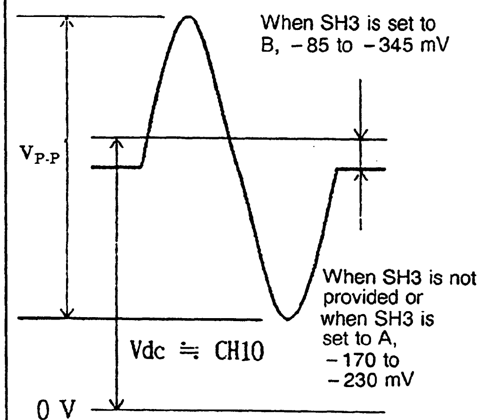
Speed : 1500 rpm

Use a digital voltmeter as a measuring device. (Use its DC range.)

Adjusting part	Point to be measured	Target value for A16B-1600-0220	Remarks
VR1	CH7 - CH10	0 ±35 mV	Make an adjustment so that the center values in clockwise and counterclockwise rotations approach 0 mV.
VR2	CH8 - CH10		
VR3	CH9 - CH10	−85 mV to −345 mV	Make an adjustment so that the center values in clockwise and counterclockwise rotations approach -200 mV.

(c) Sample waveform observed during adjustment

If the failure continues during or after the adjustment, observe the waveform on an oscilloscope.

<table>
<tr><td>Point to be checked</td><td colspan="2">CH7-CH11 (0V), CH8-CH11 (0V)</td><td colspan="2">CH9-CH11 (0V)</td></tr>
<tr><td>Sample waveform</td><td colspan="2">
</td><td colspan="2">
</td></tr>
<tr><td>V_{P-P} Voltage range</td><td>A16B-1300-0220</td><td>0.83 to 1.15 V</td><td>A16B-1300-0220</td><td>1.08 to 2.4 V</td></tr>
<tr><td>CH10 Voltage range (voltage between CH10 and CH11)</td><td>A16B-1300-0220</td><td>2.61 to 2.94 V</td><td>A16B-1300-0220</td><td>2.61 to 2.94 V</td></tr>
<tr><td>Vdc Voltage range(*1)</td><td>A16B-1300-0220</td><td>Voltage at CH10 ±35 mV</td><td>A16B-1300-0220</td><td>2.61 to 2.94 V</td></tr>
</table>

*1 Adjust the voltage range of Vdc while checking it on the DC-volt scale of a digital voltmeter. Rotate the motor counterclockwise and clockwise at 1500 rpm.

① Between CH7 and CH11 or between CH8 and CH11

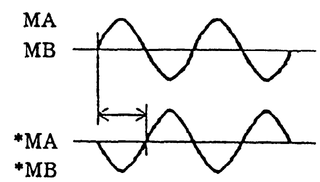
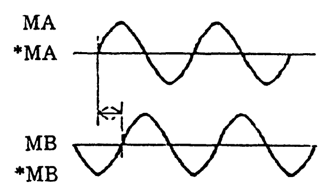
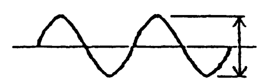
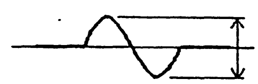
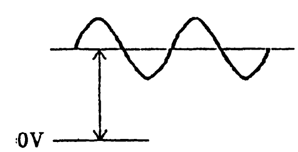
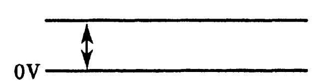
Make an adjustment so that the center values in counterclockwise and clockwise rotations approach the voltage of CH10.

② Between CH9 and CH11

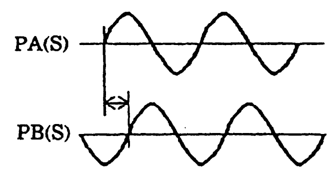
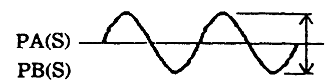
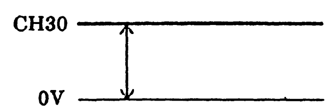
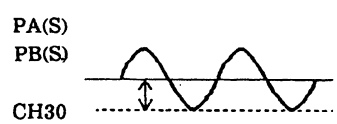
Make an adjustment so that the center values in counterclockwise and clockwise rotations approach the voltage of CH10 minus 200 mV.

3) Waveform for each part

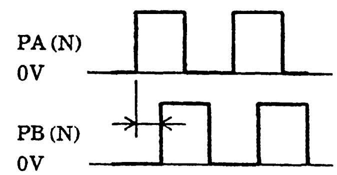
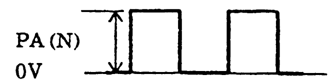
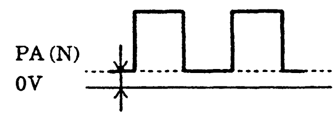
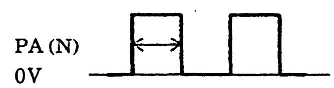
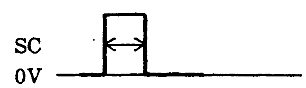
a) Input waveform (at a constant speed of 1500 rpm)

Point to be checked		Specifications	Sample waveform
Phase difference between CH1 (MA) and CH2 (*MA) Phase difference between CH3 (MB) and CH4 (*MB) (The waveform is observed with 0V (CH11) used as the reference voltage.)		180 ± 6°	
Phase difference between CH1 (MA) and CH3 (MB) Phase difference between CH2 (*MA) and CH4 (*MB) (The waveform is observed with 0V (CH11) used as the reference voltage.)		90 ± 3 ° (Counterclockwise rotation as viewed from the detector)	
Ampli- tude	CH1 (MA), CH2 (*MA) CH3 (MB), CH4 (*MB)	0.33 to 0.46 V	
	CH5 (MZ) (*MZ has no AC component.)	0.45 to 1.00 V	
Neutral- point voltage	CH1 (MA), CH2 (*MA) CH3 (MB), CH4 (*MB)	2.5V ± 25 mV	
	CH5 (MZ)	2.5V ± 35 mV	
	CH6 (*MZ)	2.5V ± 35 mV	

b) Output signal 1 (velocity feedback signal) at 1500 rpm

Point to be checked	Specifications	Sample waveform
Phase difference between CH28 (PA(S)) and CH29 (PB(S)) (The waveform is observed with 0V (CH11) used as the reference voltage.)	90 ± 10° (Counterclockwise rotation as viewed from the detector)	
Amplitude of CH28 (PA(S)) and CH29 (PB(S))	0.36 to 0.5 V	
Voltage of CH30 (RA(S) and RB(S))	2.61 to 2.91 V	
Neutral-point voltage of CH28 (PA(S)) and CH29 (PB(S))	Voltage of CH30 ± 15 mV	

c) Output signal 2 (position coder signal) at 1500 rpm

Point to be checked		Specifications	Sample waveform
Phase difference between CH16 (PA(N)) and CH17 (PB(N)).		90 ± 10° (Counterclockwise rotation as viewed from the detector)	
PA(N), PB(N), SC	High level	2.5 V or higher	
	Low level	0.5 V or lower	
Duty ratio of PA (N) and PB(N)		50% ±7%	
Pulse width of CH18 (SC)		116 ± 21 μS	

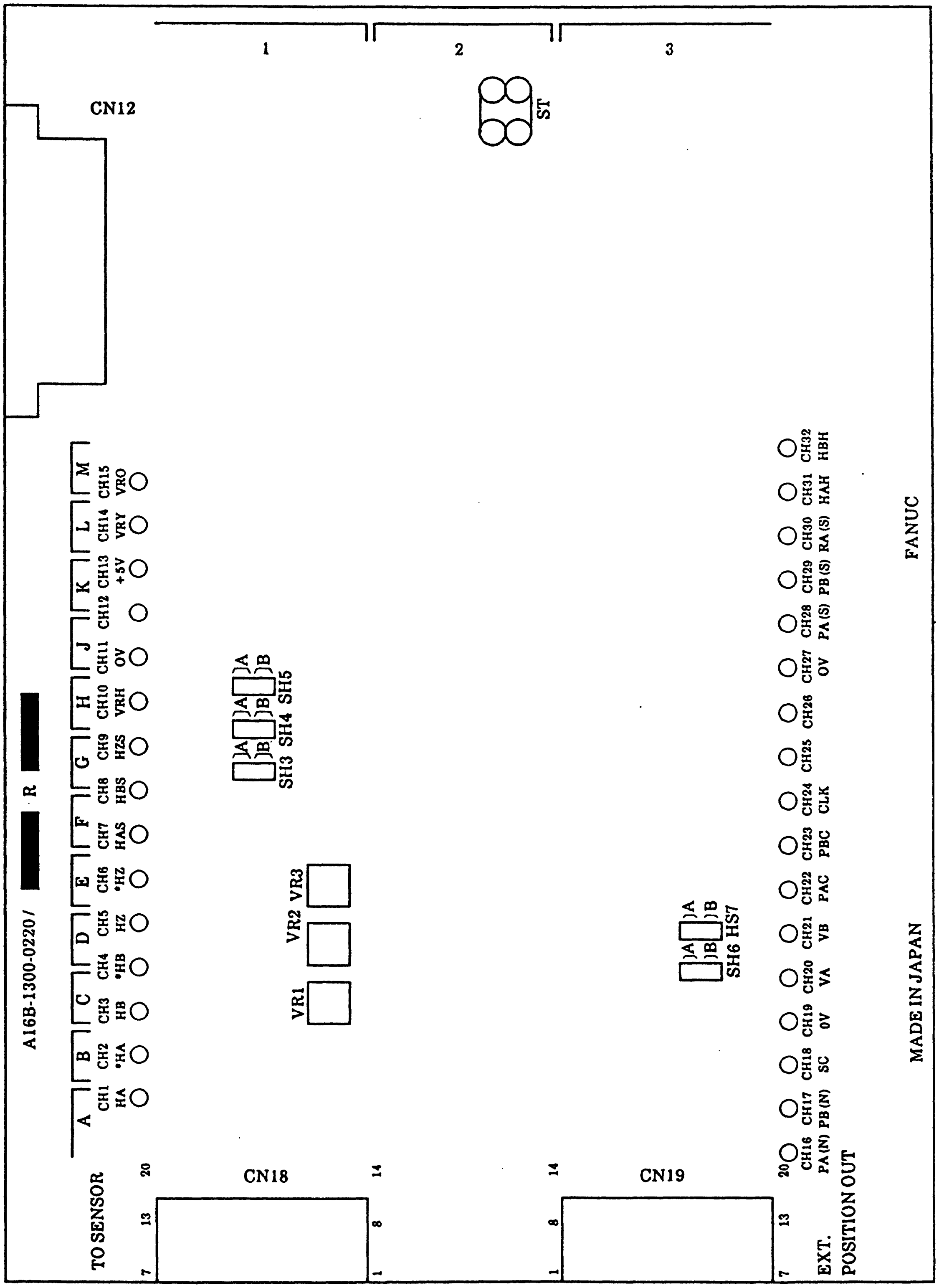


Fig.1 Jumpers, Variable Resistors, and Test Terminals on Printed Circuit Board A16B-1300-0220

12. SPECIFYING SPINDLE PARAMETERS FOR THE SIGNAL CONVERSION CIRCUIT (UNIT MOUNTING TYPE)

Parameter number

PM	0C	115	61	#7	#6	#5	#4	#3	#2	#1	#0
3003	6503 6643	3003 3143	4003	PCPL2	PCPL1		PCTYPE	DIRCT2	DIRCT1	PCCNCT	PCMGSL
Standard setting:				0	0	0	0	0	0	0	0

Setting the connection of the position coder signal, PCCNCT

Type	Separate	Unit-mounted
Drawing number of the PC board	A20B-9000-0180 A16B-1600-0370 A16B-1600-0390 A16B-1600-0440	A16B-1300-0220
PCCNCT	0	1

13. SPINDLE SERVO UNIT AND ROM EDITIONS

The following signal conversion circuits can be used with the spindle servo unit having any ROM edition: A20B-9000-0180, A16B-1600-0370, A16B-1600-0390, A16B-1600-0440. The signal conversion circuit of A16B-1300-0220 can be used only with the spindle servo unit having the following ROM edition:

ROM series	9A50
Edition	All editions

VII. HIGH-RESOLUTION MAGNETIC PULSE CODER

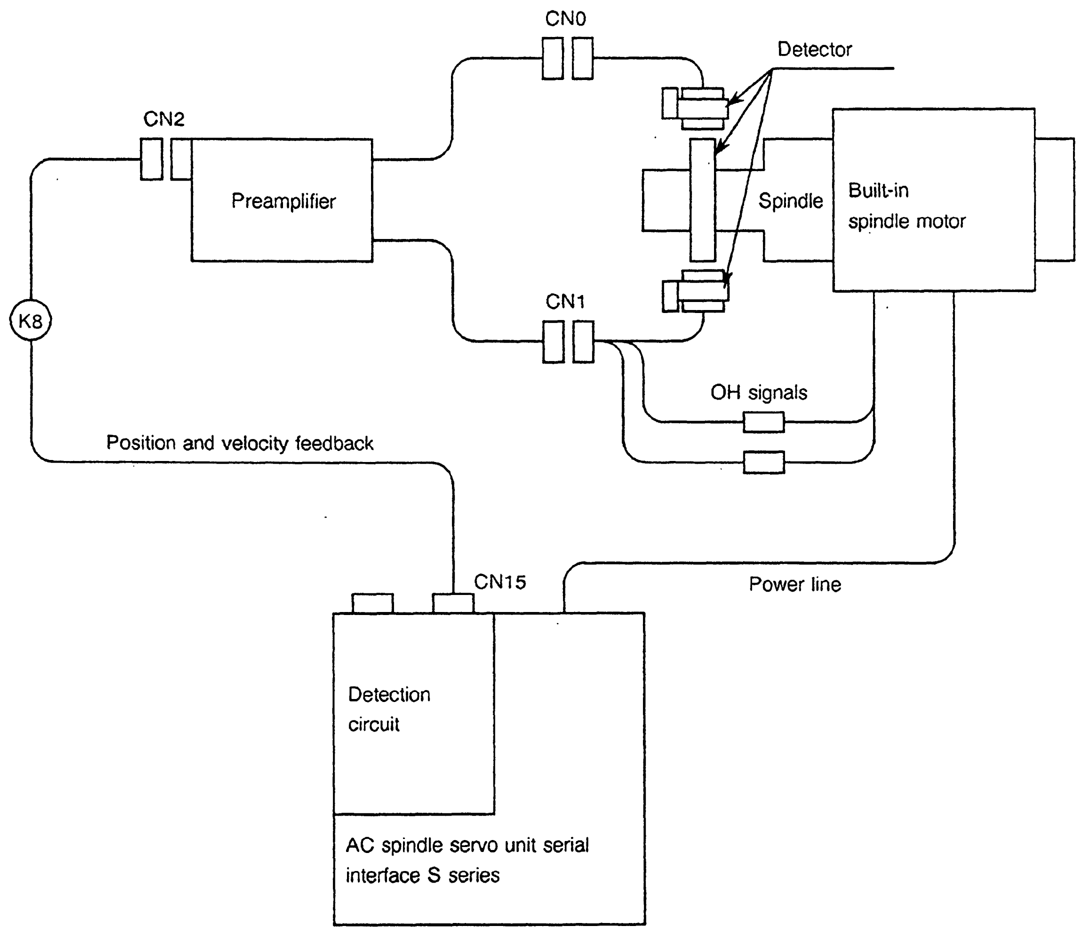
1. OVERVIEW

A detection system has been developed for controlling the servo of the spindle. It uses a magnetic encoder as the detector. When used with the detection circuit, the encoder can detect the position in units of 1/1000°.

When the high-resolution magnetic pulse coder detection circuit is used, the following circuits cannot be used:

Optional circuits that cannot be used with the high-resolution magnetic pulse coder detection circuit	
Name	Drawing number
Spindle switching circuit	A06B-6064-J701 A06B-6064-J702
Position coder signal input circuit	A06B-6064-J703
High-resolution position coder detection circuit	A06B-6064-J705
Built-in sensor signal conversion circuit to be mounted on the unit	A06B-6064-J704 A06B-6064-J706

2. SYSTEM CONFIGURATION



3. SPECIFICATIONS OF THE HIGH-RESOLUTION MAGNETIC PULSE CODER

Item	Specifications		
Supply voltage	5V ±5%		
Output signal	Cs-axis control signal		A, B
	Position coder signal		A, B
	Single rotation signal		Z
Number of output pulses	Cs-axis control signal		90,000 pulses/revolution
	Position coder signal	A860-0382-T141	1,024 pulses/revolution
		A860-0382-T142	1,536 pulses/revolution
		A860-0382-T143	2,048 pulses/revolution
		A860-0382-T144	3,072 pulses/revolution
Resolution	Cs-axis control signal		360,000 points/revolution
	Position coder signal	A860-0382-T141	4,096 pulses/revolution
		A860-0382-T142	6,144 pulses/revolution
		A860-0382-T143	8,192 pulses/revolution
		A860-0382-T144	12,288 pulses/revolution
Maximum speed	A860-0382-T141		15,000 rpm
	A860-0382-T142		10,000 rpm
	A860-0382-T143		10,000 rpm
	A860-0382-T144		6,500 rpm
Outside diameter of the magnetic drum	A860-0382-T141		ϕ65
	A860-0382-T142		ϕ97.5
	A860-0382-T143		ϕ130
	A860-0382-T144		ϕ195
Operating temperature range	Detector, preamplifier, detection circuit: 0°C to 50°C		

4. DRAWING NUMBERS FOR DETECTOR AND DETECTION CIRCUIT

Class	Outside diameter of the applicable magnetic drum	Drawing No. of the detector(*1)	Drawing No. of the detector circuit
Option	ϕ65	A860-0382-T141	A06B-6064-J724
	ϕ97.5	A860-0382-T142	A06B-6064-J727
	ϕ130	A860-0382-T143	A06B-6064-J725
	ϕ195	A860-0382-T144	A06B-6064-J726

*1 When an order is placed with the drawing number of the detector, the sensor, magnetic drum, and preamplifier for the detector are delivered with it.

*2 The drawing numbers of detectors have been changed. When replacing a detector having an old drawing number with current detector, see Note 6 in Section VII. 6.3, "Handling Precautions."

5. EXTERNAL DIMENSIONS OF THE DETECTOR

Please refer to 5.5 for the preamplifier dimensions drawing

5.1 Detector A860-0382-T141 Dimensions

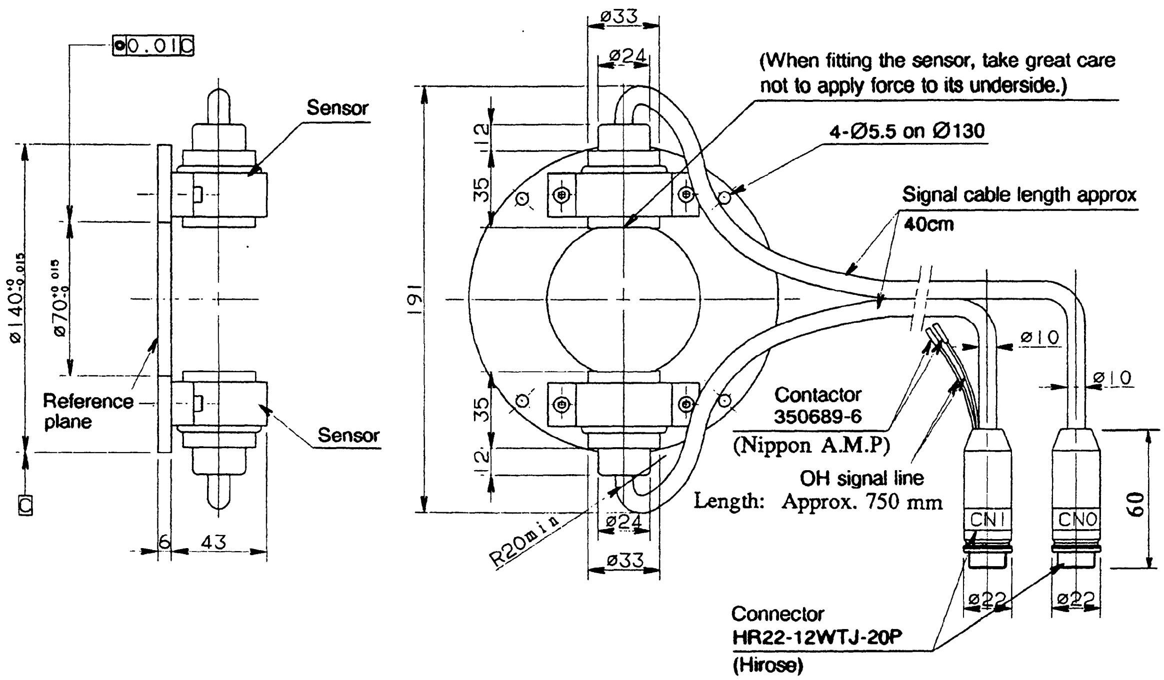


Fig. 5.1 (a) Detector dimensions

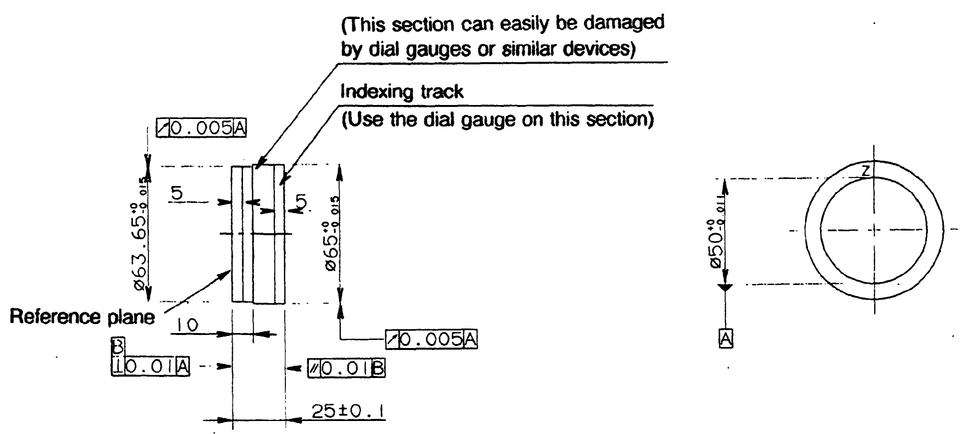


Fig. 5.1 (b) Magnetic drum dimensions

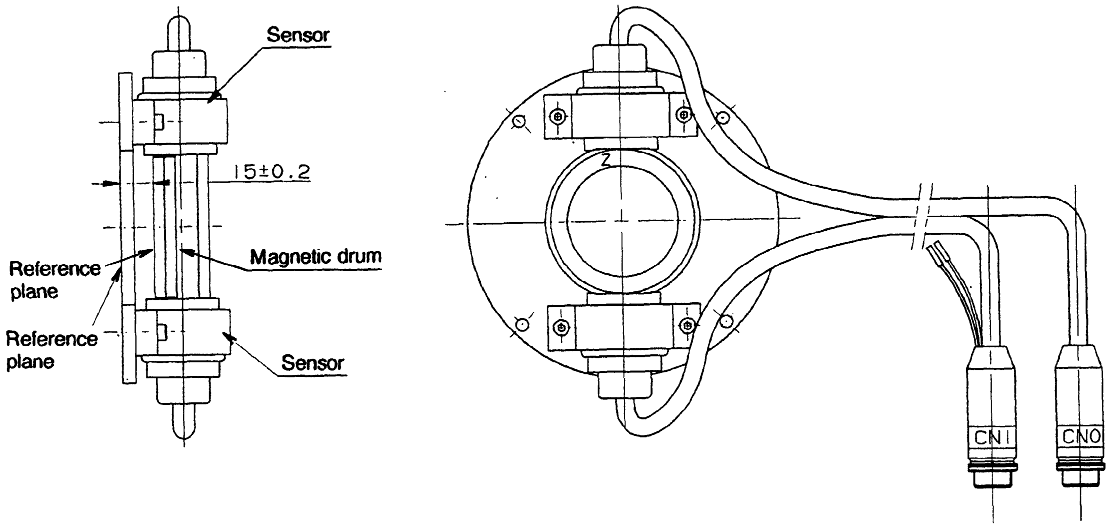


Fig. 5.1 (c) Detector

5.2 Detector A860-0382-T142 Dimensions

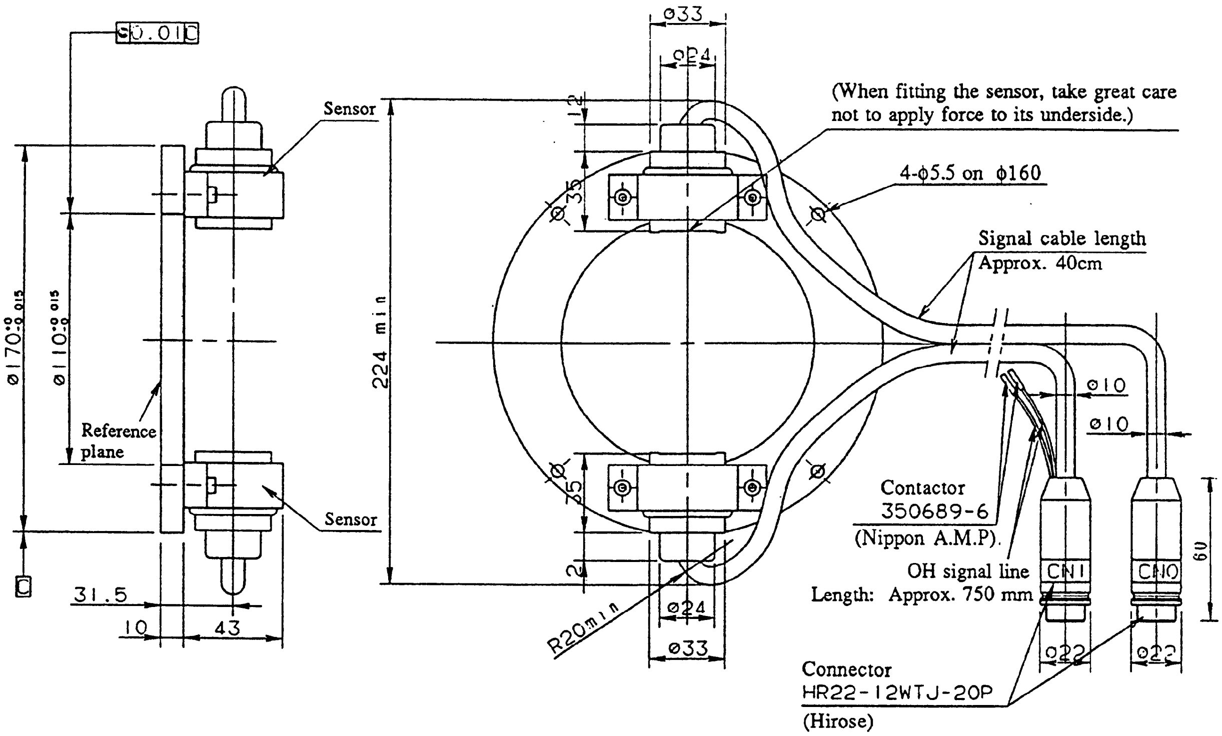


Fig. 5.2 (a) Detector dimensions (ϕ97.5)

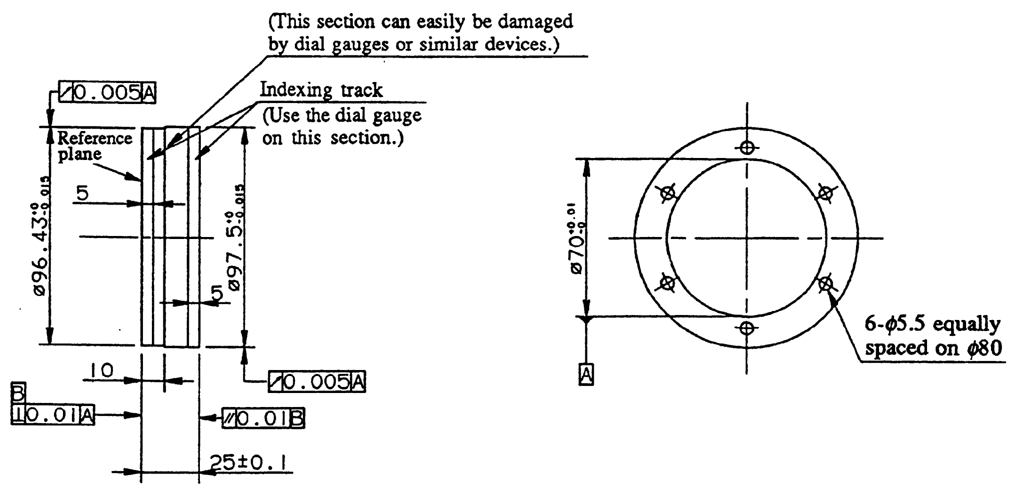


Fig. 5.2 (b) Magnetic drum dimensions (ϕ97.5)

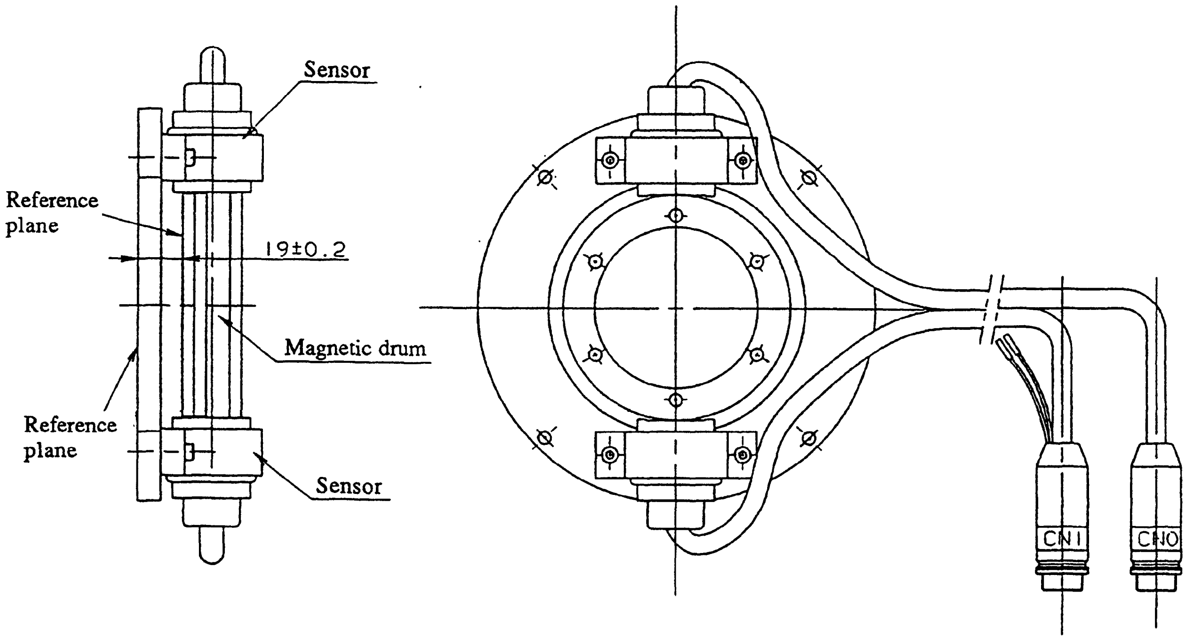


Fig. 5.2 (c) Detector (ϕ97.5)

5.3 Detector A860-0382-T143 Dimensions

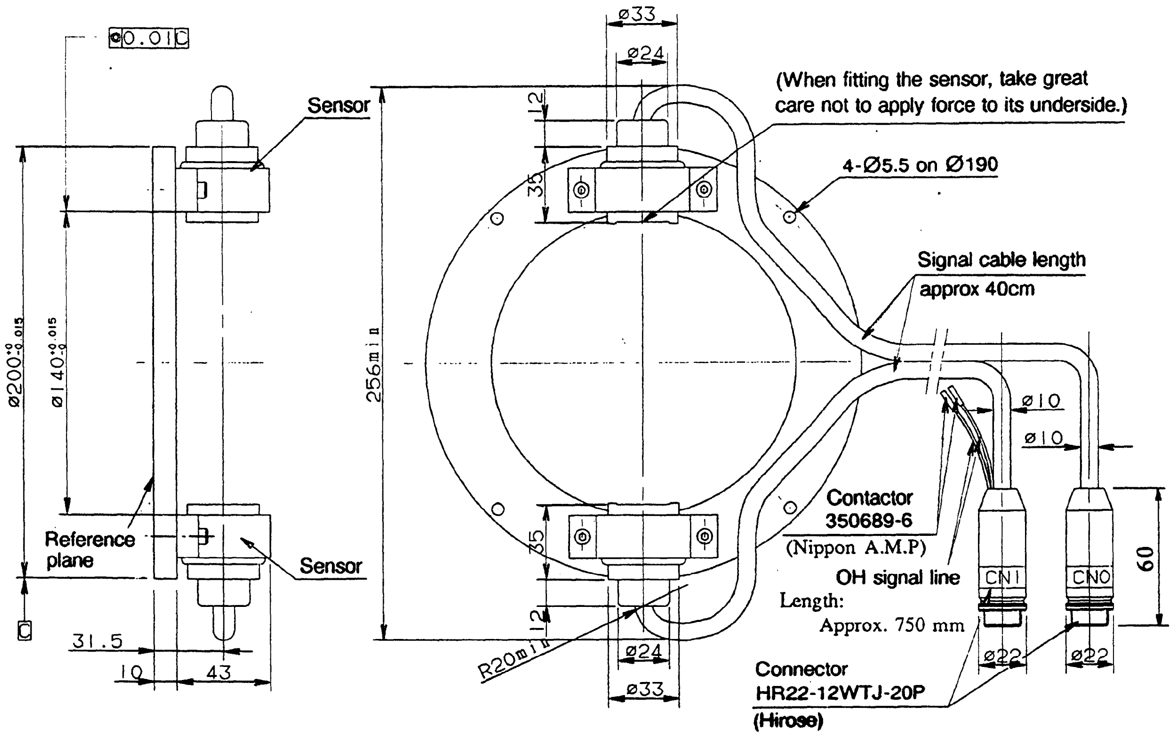


Fig. 5.3 (a) Detector dimensions

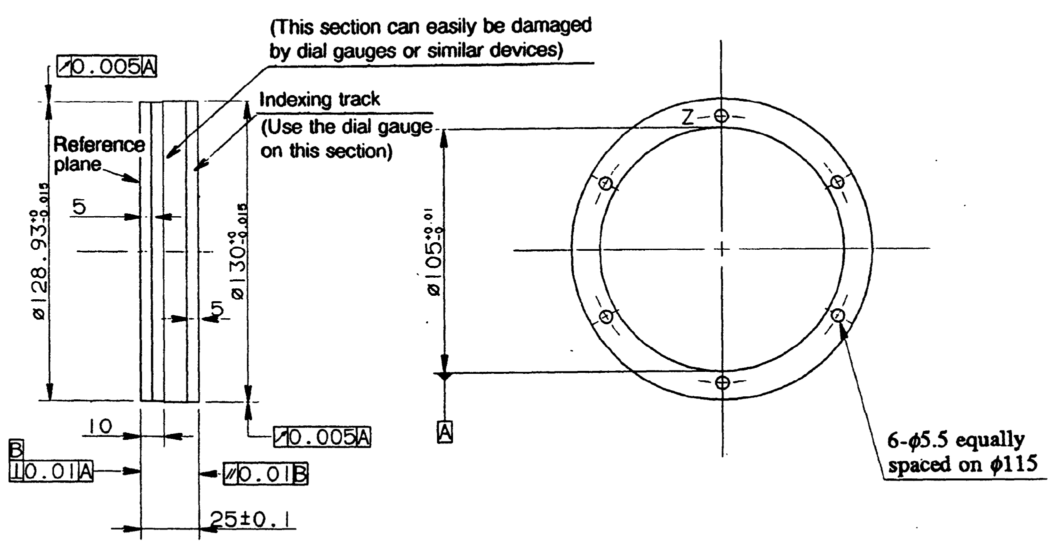


Fig. 5.3 (b) Magnetic drum dimensions

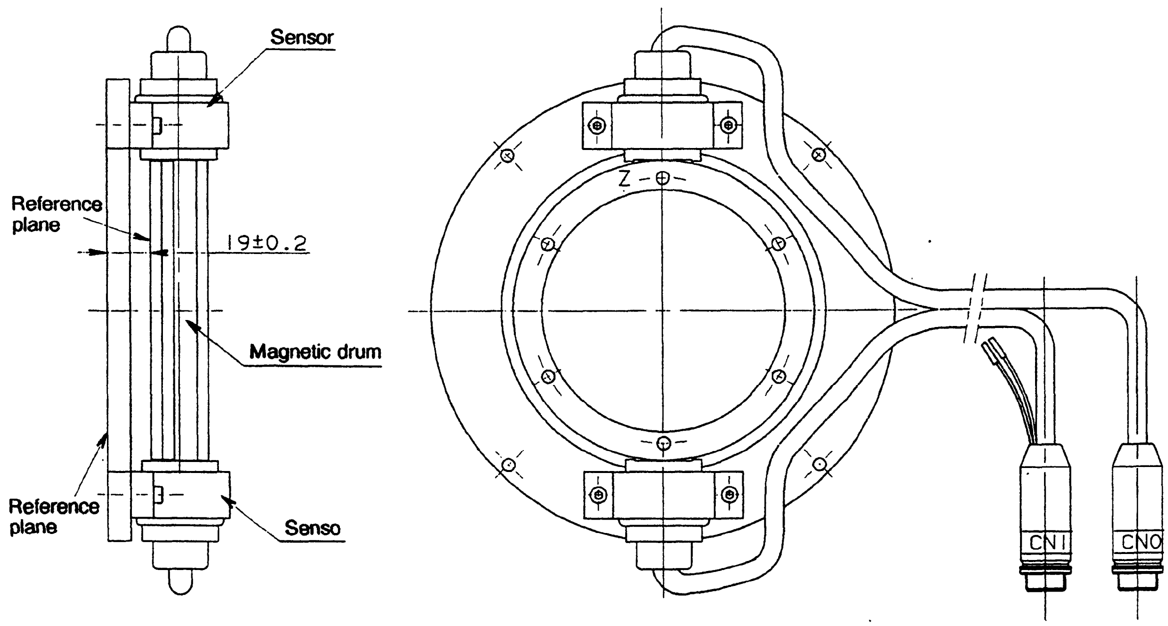


Fig. 5.3 (c) Detector

5.4 Detector A860-0382-T144 Dimensions

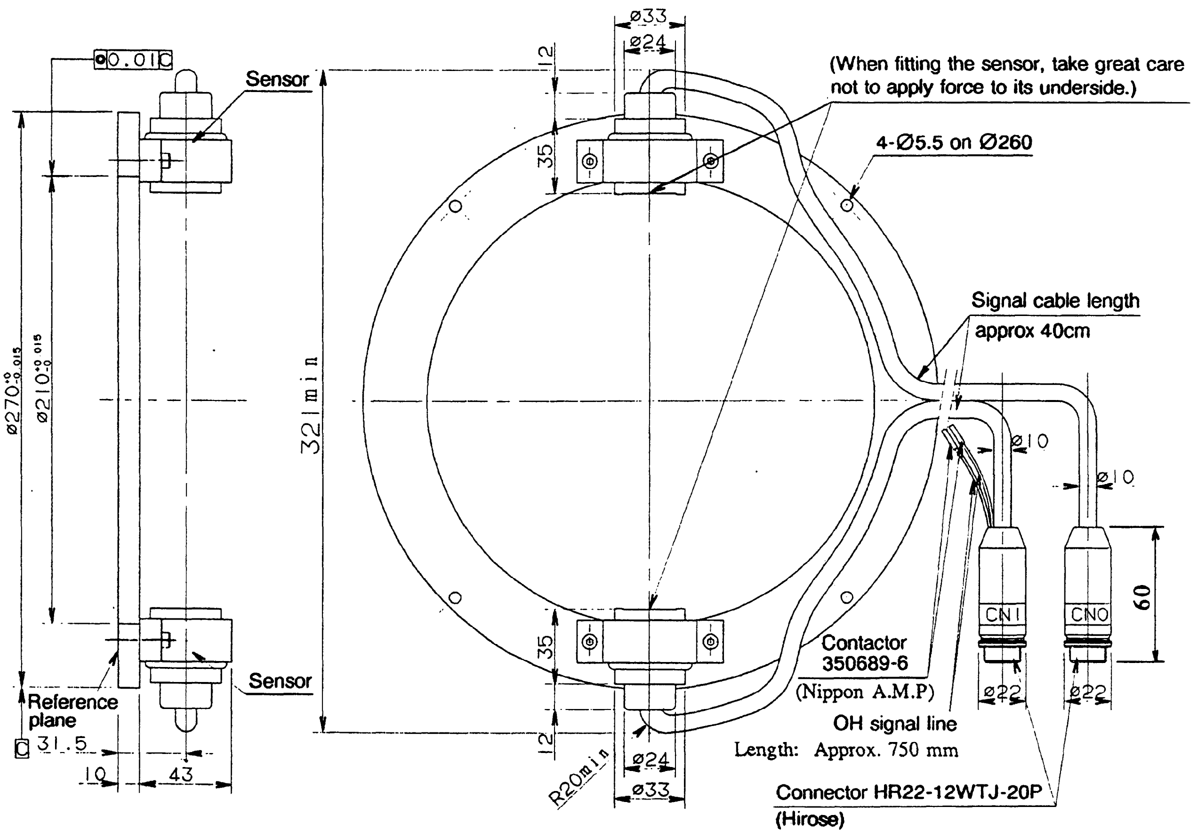


Fig. 5.4 (a) Detector dimensions

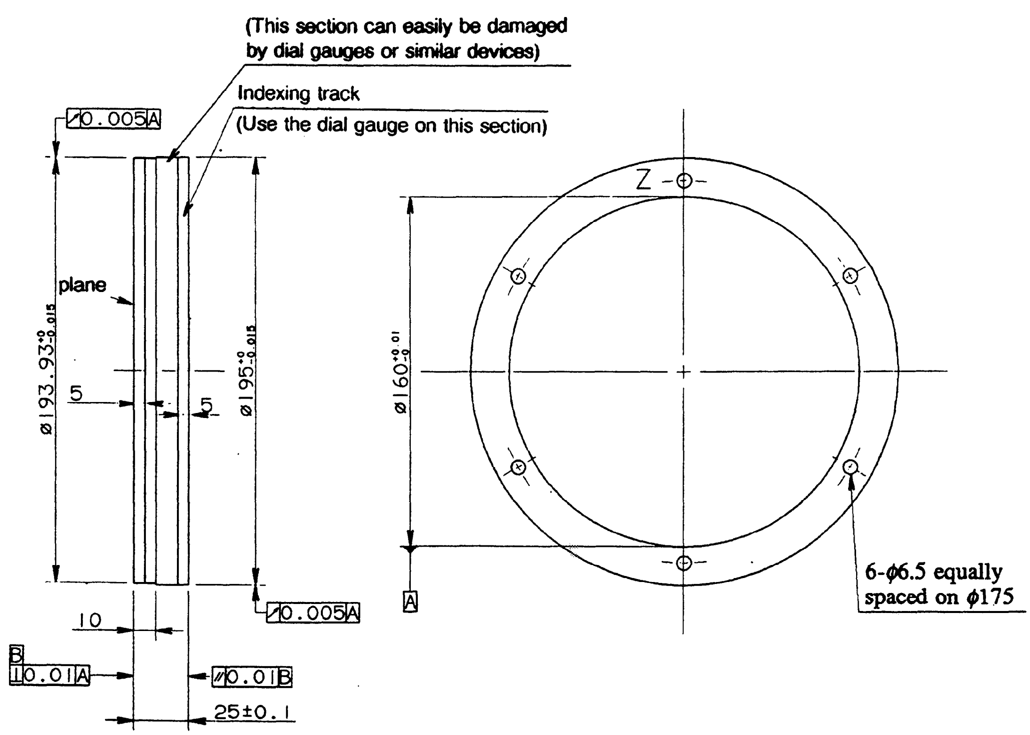


Fig. 5.4 (b) Magnetic drum dimensions

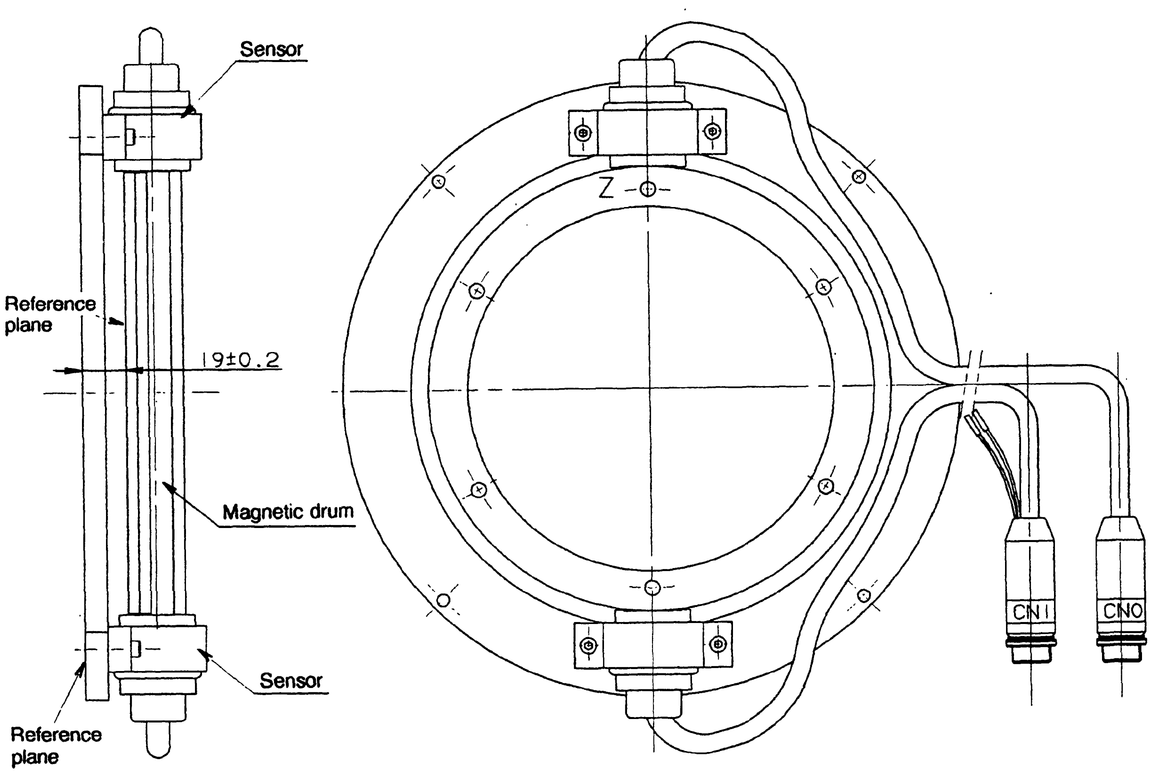
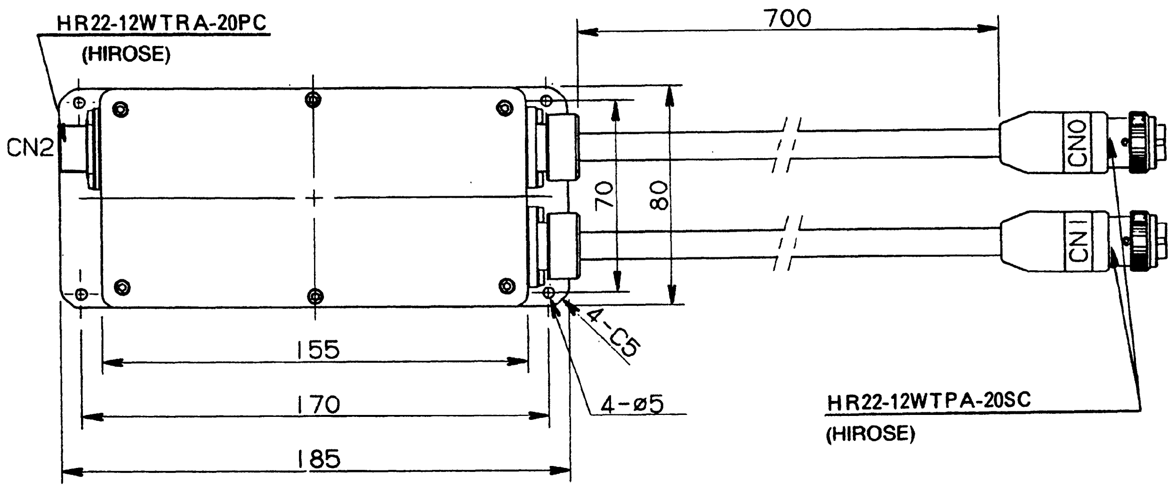
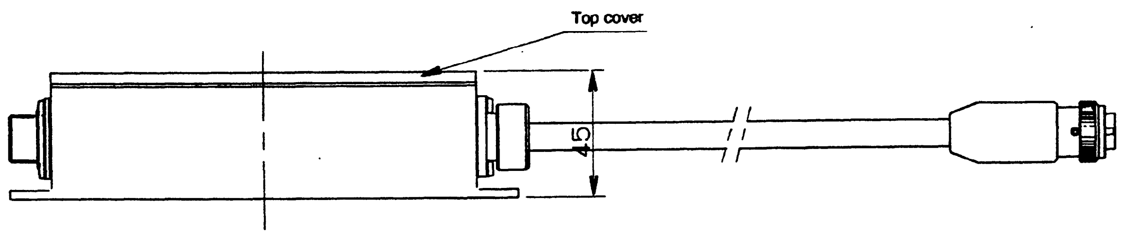


Fig. 5.4 (c) Detector

5.5 External Preamplifier Dimensions





Note 1) The preamplifier box anti-drip standards are expected to meet IEC standard IP55. However, if cutting oil comes into direct contact with the preamplifier box so that the box is continually wet, the oil may penetrate into the box and cause damage. For this reason, care should be taken to set up the machine so that cutting oil does not fall directly onto the preamplifier box.
(See VII 6.1 Mounting the Detector and Preamplifier)

Note 2) The preamplifier has been adjusted in advance so that the sensor and preamplifier match. Please use the same serial number for both. In normal circumstances, no further adjustment is required, but if the output waveform is outside the standard range, the preamplifier must be adjusted. To do this the top cover must be removed from the preamplifier.
(See VII 8 OBSERVING THE OUTPUT WAVE FORM AND ADJUSTING THE PREAMPLIFIER)

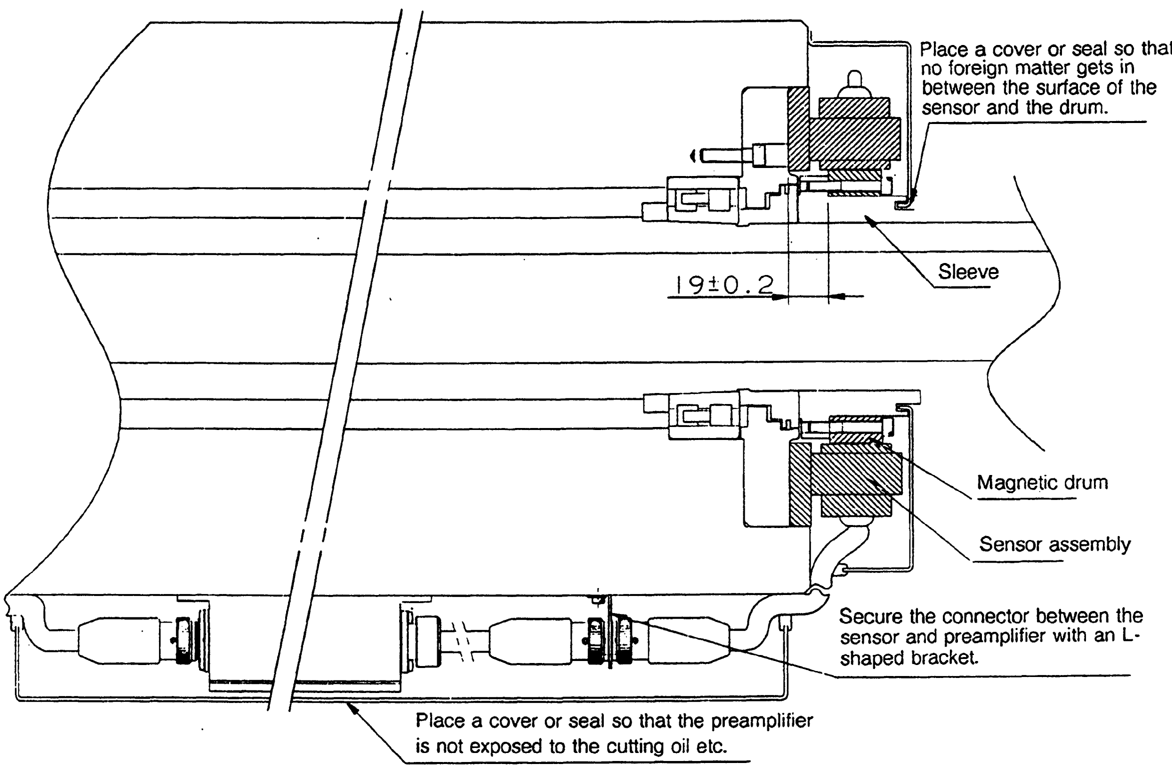
The preamplifier needs to be adjusted if the sensor assembly or drum is replaced. For this reason, <u>the preamplifier must be installed at a position where the top cover can be removed.</u>

Note 3) Because of restrictions on the output signal amplitude level, the preamplifier cable and sensor cable have a combined length of approximately 1.1m. The preamplifier must be fitted within 1.1m of the sensor.

Note 4) Vibration affecting the preamplifier box must not exceed 1G.

6. MOUNTING PROCEDURES AND PRECAUTIONS

6.1 Mounting the Detector and Preamplifier



6.2 Mounting Procedures

Mount the detector to the spindle, following the procedure described below:

① Mount the magnetic drum on the spindle.

Detector	A860-0382-T141	A860-0382-T142, A860-0382-T143, A860-0382-T144
Method of mounting the drum	Shrink-fit the drum or expansion-fit the sleeve (see figure above). The drum can be heated up to 100°C. Do not heat it over 100°C.	Mount the drum using the 6 holes (each hole is 5.5 mm - in diameter) on it. Mount the drum loosely as it is centered later.
Direction in which the drum is mounted	Mount the drum so that the datum plane faces the nose of the spindle. The datum plane of the drum is the surface on which Z is not marked. (See the figure below.)	

② Center the drum (with a runout of 8 μm or less).
Measure the runout of the outer surface of the drum with a dial indicator. Make an adjustment so that the runout becomes 8 μm or less. Then, firmly tighten the screws to mount the drum securely.

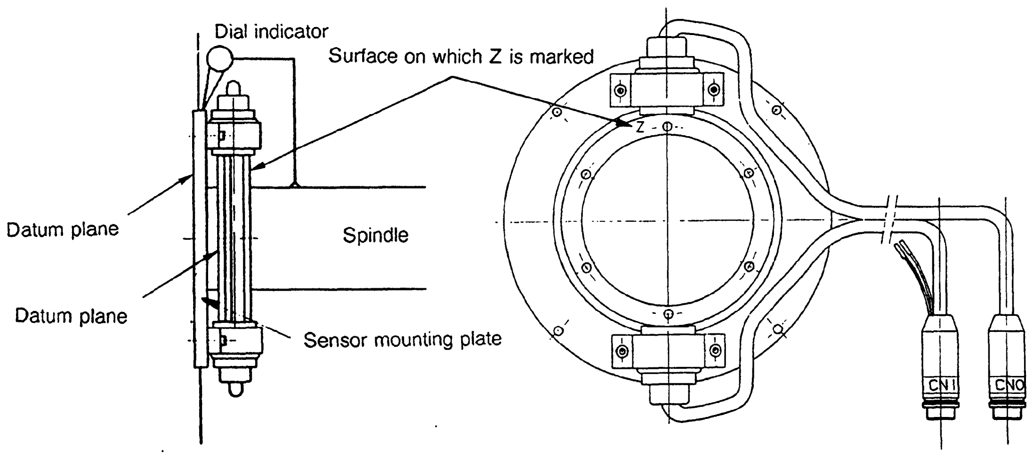
Note) When the A860-0382-T141 detector is used, the drum need not be centered.

③ Mount and adjust the sensor (with a runout of 20 μm or less).

Mount the sensor so that the datum plane of the sensor faces the same direction as that of the drum. (See the figure below.) Using a dial indicator, make an adjustment so that the runout of the spigot of the sensor mounting plate to the spindle becomes 20 μm or less. If the runout exceeds 20 μm, the sensor may not operate normally.

Note 1) Mount the sensor after centering the drum. If the drum is centered after the sensor is mounted, the drum may contact the sensor, which may cause a failure.

Note 2) The surface of the machine on which the sensor mounting plate is mounted must be at a right angle to the central axis of the spindle with an error of 20 μm or less. If they do not form a right angle, the sensor is tilted and the normal output waveform may not be obtained.



6.3 Handling Precautions

The detector is a precise component. Handle it carefully, taking the following precautions:

Note 1) Avoid exposing the sensor to cutting oil and cutting chips.

Note 2) Keep magnets and other magnetic material away from the surface of the magnetic drum. If a magnet (or magnetized screwdriver, magnet stand, etc.) approaches, the magnetic drum may be demagnetized and the sensor may not output.

Note 3) Do not apply a magnetic field of 20 gauss or greater to the sensor. If this occurs, the sensor may not operate normally.

Note 4) The clearance between the sensor and drum is about 0.1 mm after they are assembled together with spigot. Do not remove the sensor from the mounting plate.

Note 5) Handle the sensor and drum as a unit. Do not change the factory-adjusted combination, that is, avoid replacing only the sensor or drum even with a part having an identical drawing number. If the sensor or drum needs to be replaced in maintenance, replace both the sensor and drum. After the sensor and drum are replaced, the identical preamplifier can be used if the output signal is adjusted. However, it is recommended to replace the preamplifier together with the sensor and drum.

Note 6) The characteristics of the old detector (A860-0381-T***) are different from those of the current detector (A860-0382-T***). The old and current detectors must not be used together. Maintenance must be performed so that the entire system has only sensors, drums, and preamplifiers of either the old or current detector. The first table below lists the drawing numbers of the old and current detectors. The second table explains how to discriminate between them.

Drawing numbers

Diameter of the drum	Old detector	Current detector
ϕ65	A860-0381-T141	A860-0382-T141
ϕ97.5	A860-0381-T142	A860-0382-T142
ϕ130	A860-0381-T143	A860-0382-T143
ϕ195	A860-0381-T144	A860-0382-T144

Discriminating the detectors

	Old detector	Current detector
Sensor	Black serial number on a white background	Black serial number on an orange background
Drum	Z mark and serial number in black	Z mark and serial number in red

A tag indicating the serial number of the sensor is attached to the cable.

6.4 Precautions concerning the Machine Structure

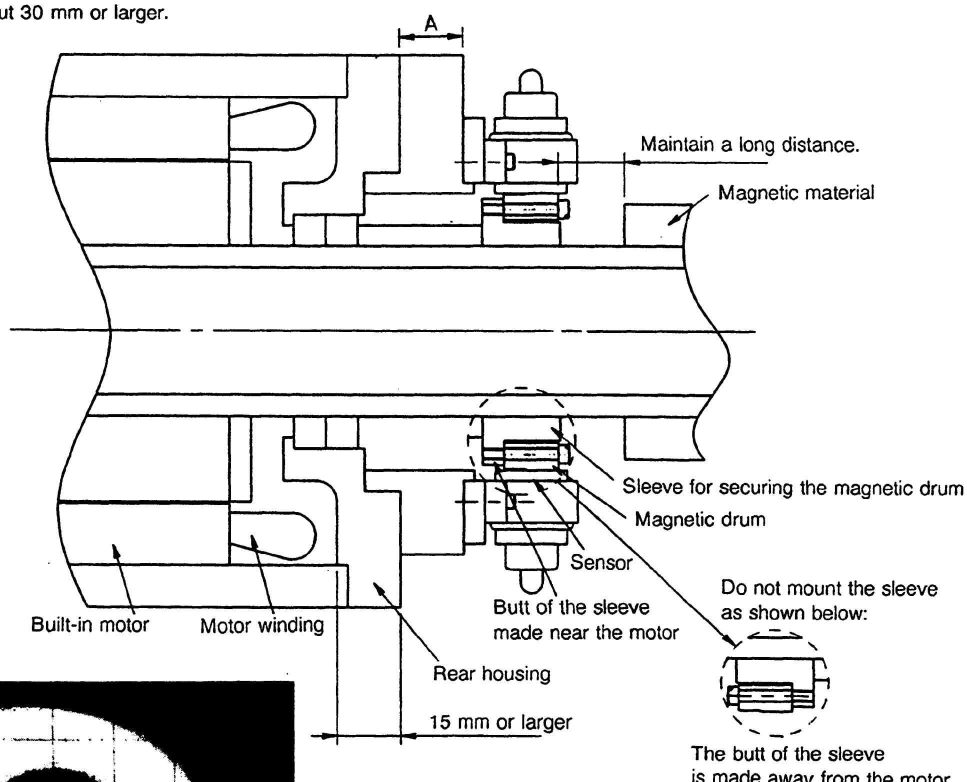
When the detector is used with the built-in motor, the magnetic flux generated by the motor may affect the sensor. In this case, the output waveform may fluctuate, causing an alarm (AL-28, 27: disconnection of the position detection signal for Cs-axis contour control.) When the magnetic flux affects the sensor, the Lissajous's output waveform becomes as shown below. To prevent this from occurring, take the following precautions:

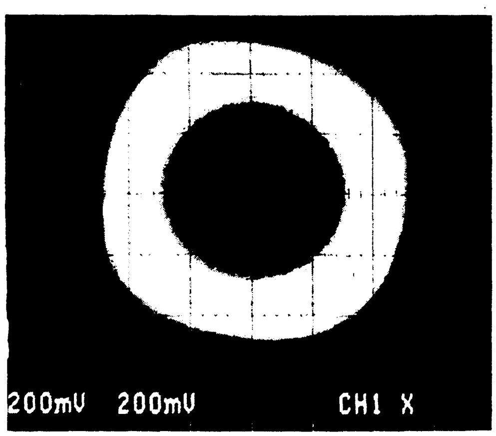
Note 1) To reduce the magnetic leakage from the built-in motor, make the housing of the motor from iron or another magnetic material. At the back of the stator winding, the thickness of the housing must be 15 mm or greater. (See the figure below.)

Note 2) The distance of A at which the detector (sensor and magnetic drum) is mounted must be 15 mm or greater.

Note 3) To reduce the magnetic leakage from the motor that goes through the sensor head, the butt of the sleeve for securing the magnetic drum must be made near the motor. (See the figure below.) If this is impossible, the sleeve for securing the magnetic drum must be made of stainless steel or another nonmagnetic material.

Note 4) If a magnetic material is at the rear of the magnetic drum, the distance between the magnetic material and the drum must be about 30 mm or larger.

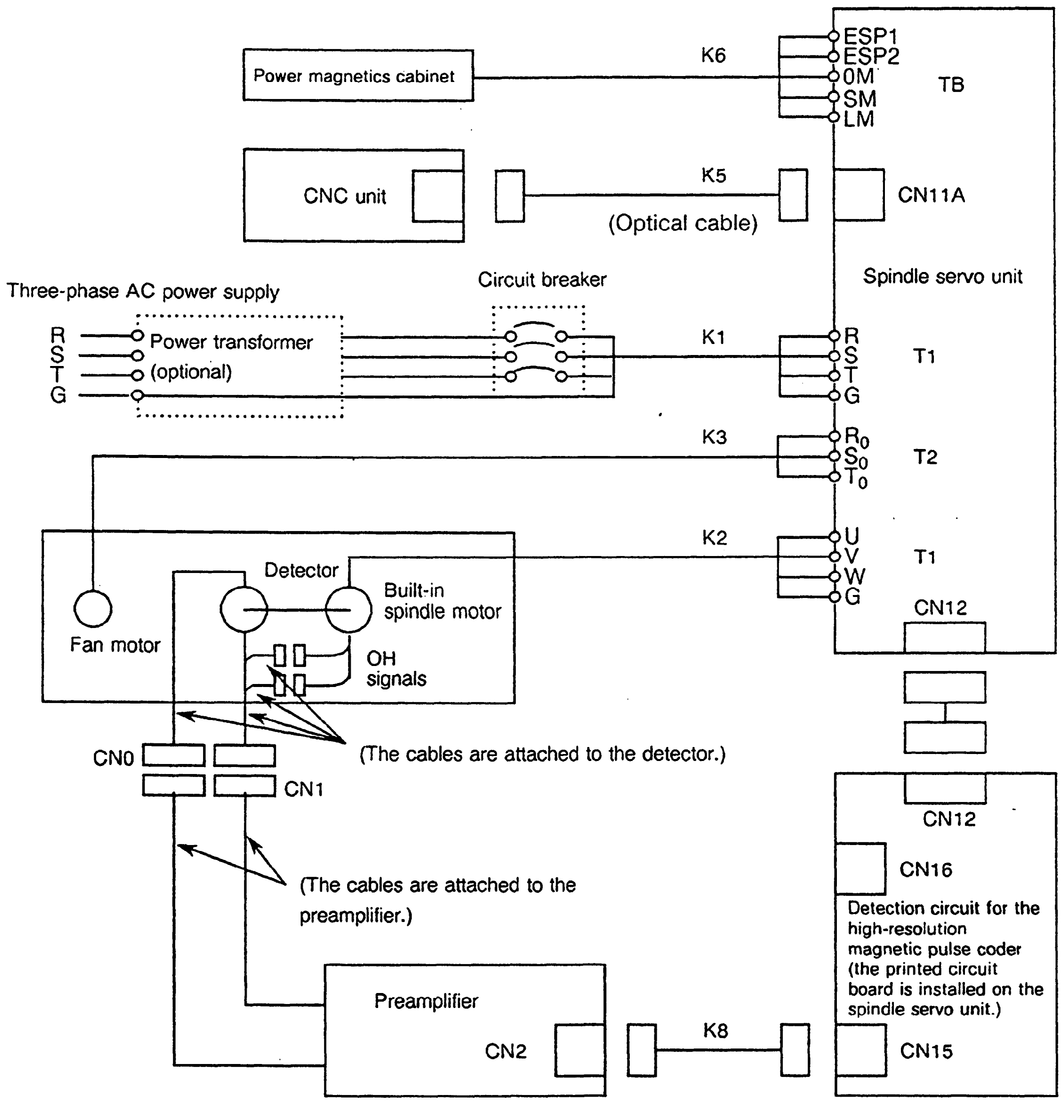




Lissajous's' waveform of the position signal when it is affected by the leakage flux of the motor

7. CONNECTION

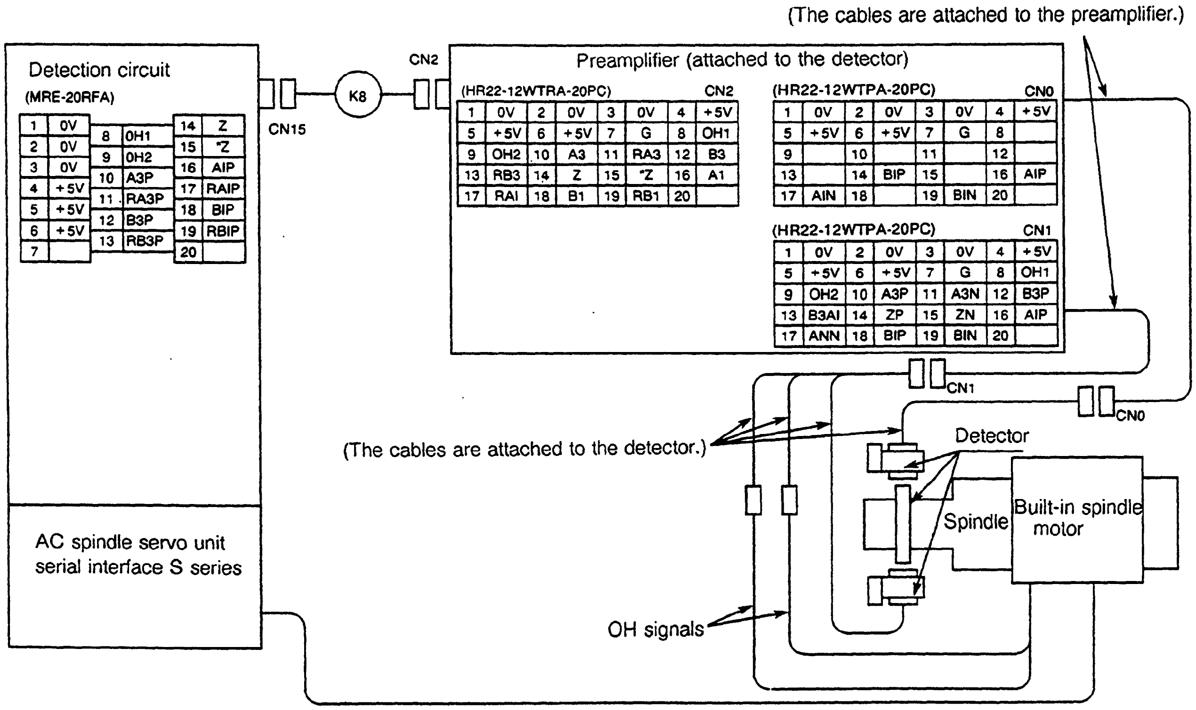
7.1 Connection Diagram



Note) The high-resolution magnetic pulse coder can output the position coder signal. The pulse coder is connected to the CNC unit through cable K5.

Cable K8 is 7 m long. Cables other than it must be prepared by the machine tool builder, according to Section 7.3, "Cable Connecting the Preamplifier and Detection Circuit."

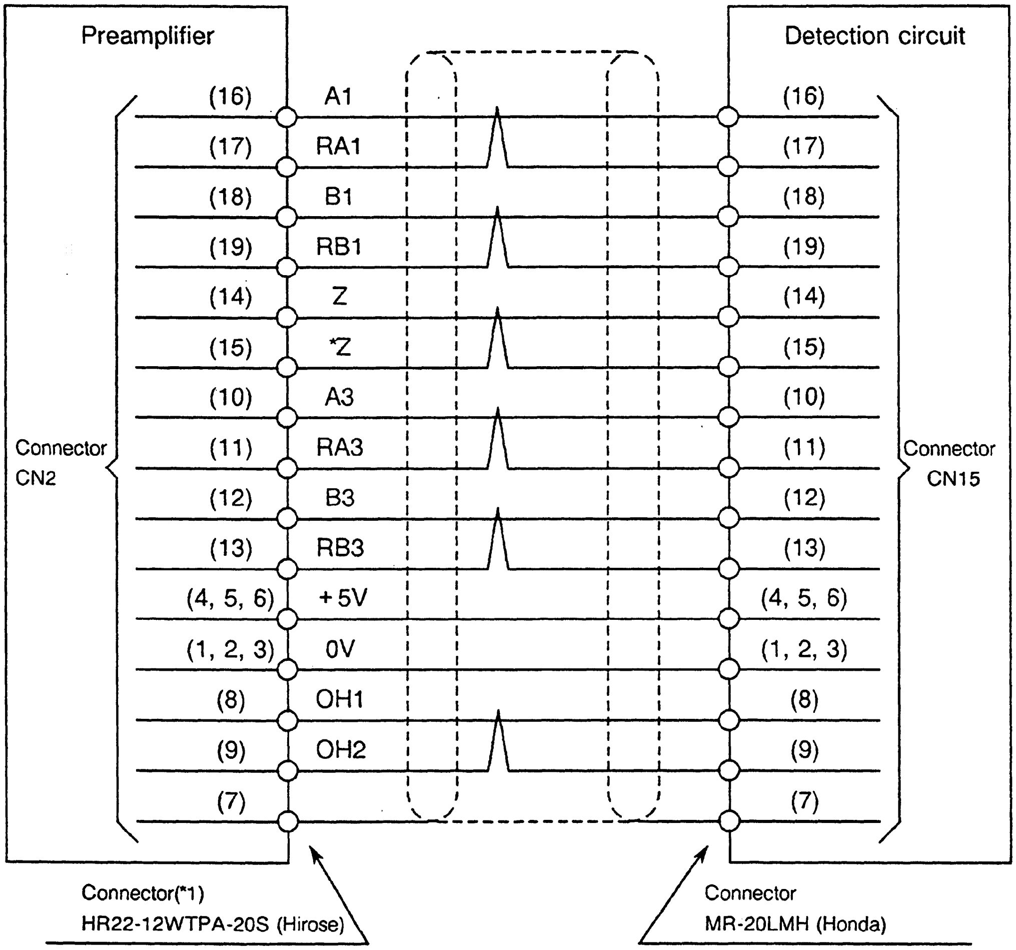
7.2 Signals in Connectors



Note) The single rotation signal is output from the sensor connected to CN1.

7.3 Cable Connecting the Preamplifier and Detection Circuit

Cable K8 (for the spindle sensor)



Cable: Maximum length is 14 m

+5 V, 0 V: Three wires each at least 0.3 mm^2 in size

Other wires: General pair shielded wires at least 0.18 mm^2 in size

Drawing No. for the appropriate FANUC cable: A06B-6063-K801, cable length is 7 m

*1 This is a solder connector. A crimp connector can be selected.

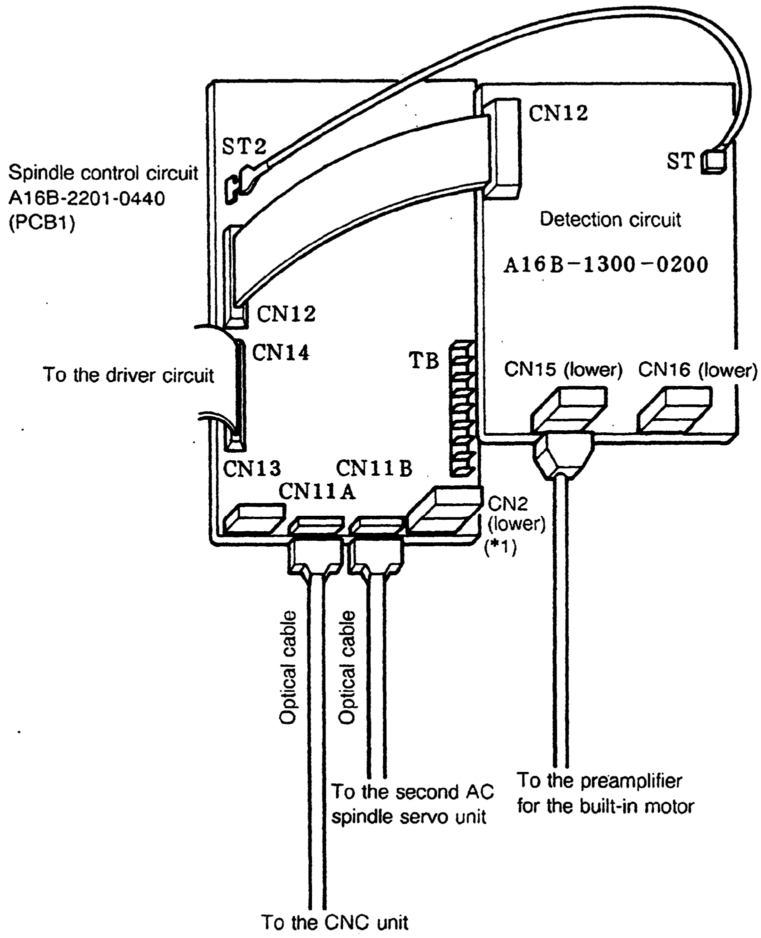
Select either a crimp or solder connector.

- Crimp connector
  - Crimp pin : HR22-SC-122 (20 pins are required for one connector.)
  - Connector housing : HR22-12WTPA-20SC
- Solder connector
  - HR22-12WTPA-20S

When the crimp connector is used, manually crimp the connector using the following crimping tool:

Crimping tool: HR22-TA-2428HC (Hirose)

7.4 Connecting the Servo Unit and the Detection Circuit

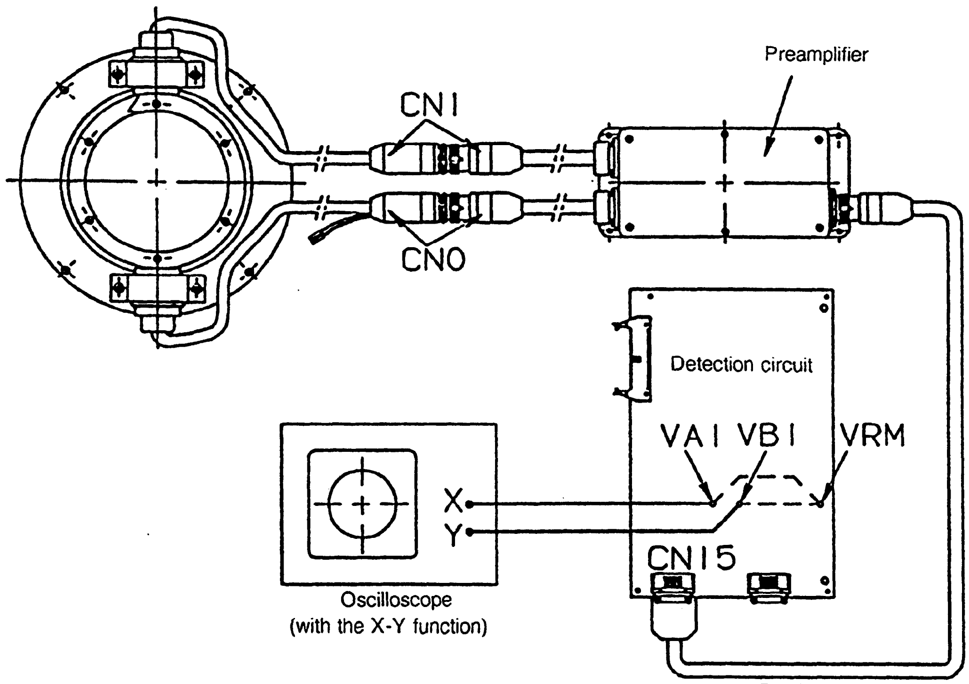


Cable routing diagram
(When the built-in spindle motor is used)

*1 Do not connect cables to connectors CN2 and CN16.

8. OBSERVING THE OUTPUT WAVEFORM AND ADJUSTING THE PREAMPLIFIER

The preamplifier is factory-adjusted. After installing the preamplifier on the machine, observe the waveform as described below. If the waveform is outside the predetermined range, the preamplifier must be adjusted. The waveform must be observed after the sensor is mounted, but before the pulley, drawbar, and brake are installed. The table below gives an overview of the adjustment. For details, see the following sections.



Observing the Lissajous's waveform

Observing the waveform and signals to be adjusted

	C-axis control signal	Position coder signal (velocity control signal)	Single rotation signal
Spindle sensor (position detection)	VA1 VB1	VA3 VB3	Z
Detector contained in the motor (velocity detection)	VA2 VB2	PA PB	
Test instrument for observing the waveform	· Observe the amplitude on an oscilloscope. · Measure the offset with a digital voltmeter.		Observe the offset on an oscilloscope.
Test terminal for observing the waveform	The test terminals are on the PC board of the detection circuit. (See the figure above.)		The test terminal, Z, is on the PC board of the preamplifier.
Adjusting method	Use variable resistors on the PC board of the preamplifier		

8.1 Preparing for the Adjustment

Before adjusting the preamplifier, prepare as described below. The sections following this section describe the procedures to be followed after the preparation is completed.

① Correctly connect the sensor, drum, preamplifier, and detection circuit. (See the figure above.)

② Turn the power on.
If the power can be supplied to the servo unit, the power is turned on by simply connecting the detection circuit to the servo unit. In this case, other power supply is not required.

If the local detection circuit is used, supply a voltage of 5 V to the 5 V and 0 V test terminals of the detection circuit. Before doing this, remove connector CN12, which connects the servo unit and detection circuit.

③ Prepare an oscilloscope having the X-Y function. For connecting and setting the oscilloscope, see the section describing the adjustment of the corresponding signal.

8.2 Adjusting the Cs-Axis Control Signal (Position Signal)

Oscilloscope connection	Oscilloscope setting
Connect the X probe to the VA1 terminal. Connect the Y probe to the VB1 terminal. Connect the probe ground to the VRM terminal.	X probe: 0.2 VDC/div. Y probe: 0.2 VDC/div. Mode: X-Y Sweep speed: 500 μs/div.

Note: Before starting the measurement, make a 0-V adjustment.

After connecting and setting the oscilloscope as shown above, rotate the motor manually or at a speed of 500 rpm or less. Observe the Lissajous's waveform. Fig.8.2 (a) shows a desirable waveform. Fig. 8.2 (b) shows an undesirable waveform.

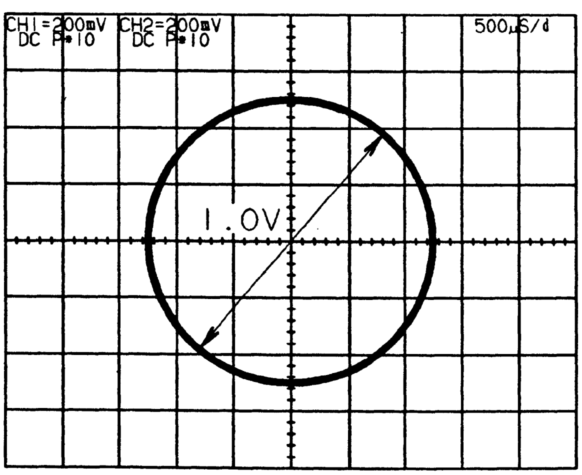


Fig. 8.2 (a) Desirable Waveform

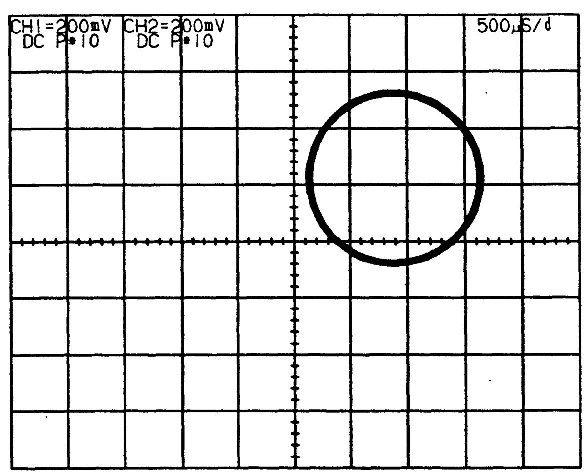


Fig. 8.2 (b) Undesirable Waveform

Adjust the variable resistors on the preamplifier (see the table below) so that the diameter of the Lissajous's waveform (circle) corresponds to about 1.0 V and the center of the waveform aligns with the center of the screen.

a) Adjusting the diameter of the Lissajous's waveform (output gain)
Adjust variable resistors A1G and B1G on the preamplifier.

Diameter of the waveform	0.8 to 1.0 V
Variable resistor A1G	Adjusts the diameter in the X-axis direction.
Variable resistor B1G	Adjusts the diameter in the Y-axis direction.

For the positions of the variable resistors on the preamplifier, see Fig. 8.4 (b).

b) Adjusting the position of the Lissajous's waveform (offset)
Adjust variable resistors A1O and B1O on the preamplifier.

Diameter of the waveform	±10 mV in both the X-axis and Y-axis directions
Variable resistor A1O	Adjusts the position in the X-axis direction.
Variable resistor B1O	Adjusts the position in the Y-axis direction.

For the positions of the variable resistors on the preamplifier, see Fig. 8.4 (b).

8.3 Adjusting the Position Coder Signal

Oscilloscope connection	Oscilloscope setting
Connect the X probe to the VA3 terminal. Connect the Y probe to the VB3 terminal. Connect the probe ground to the VRM terminal.	X probe: 0.2 VDC/div. Y probe: 0.2 VDC/div. Mode: X-Y Sweep speed: 1 ms/div.

Note: Before starting the measurement, make a 0-V adjustment.

After connecting and setting the oscilloscope as shown above, rotate the motor manually or at a speed of 500 rpm or less. Observe the Lissajous's waveform. Fig. 8.3 (a) shows a desirable waveform. Fig. 8.3 (b) shows an undesirable waveform.

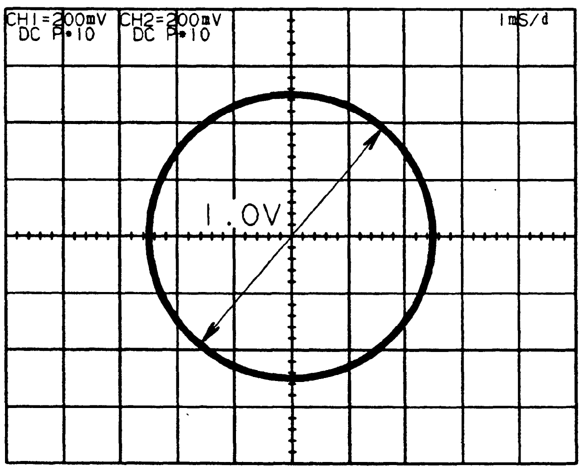


Fig. 8.3 (a) **Desirable Waveform**

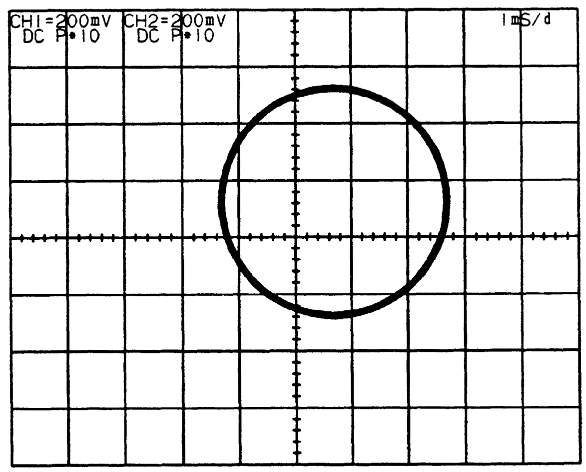


Fig. 8.3 (b) **Undesirable Waveform**

Adjust the variable resistors on the preamplifier (see the table below) so that the diameter of the Lissajous's waveform (circle) corresponds to about 1.0 V and the center of the waveform aligns with the center of the screen.

a) Adjusting the diameter of the Lissajous's waveform (output gain)
   Adjust variable resistors A3G and B3G on the preamplifier.

Diameter of the waveform	0.8 to 1.0 V
Variable resistor A3G	Adjusts the diameter in the X-axis direction.
Variable resistor B3G	Adjusts the diameter in the Y-axis direction.

For the positions of the variable resistors on the preamplifier, see Fig. 8.4 (b).

b) Adjusting the position of the Lissajous's waveform (offset)
Adjust variable resistors A30 and B30 on the preamplifier.

Diameter of the waveform	±10 mV in both the X-axis and Y-axis directions
Variable resistor A30	Adjusts the position in the X-axis direction.
Variable resistor B30	Adjusts the position in the Y-axis direction.

For the positions of the variable resistors on the preamplifier, see Fig. 8.4 (b).

8.4 Adjusting the Single Rotation Signal

Oscilloscope connection	Oscilloscope setting
Connect the X probe to the test terminal, Z, in the preamplifier. Connect the probe ground to the VRM terminal.	X probe: 0.2 VDC/div. Sweep speed: 5 ms/div.

Note: Before starting the measurement, make a 0-V adjustment.

After connecting and setting the oscilloscope as shown above, rotate the motor manually or at a speed of 500 rpm or less. Observe the output waveform. As the single rotation signal is a single-shot signal, use it as a trigger. Fig. 8.4 (a) shows a desirable waveform.

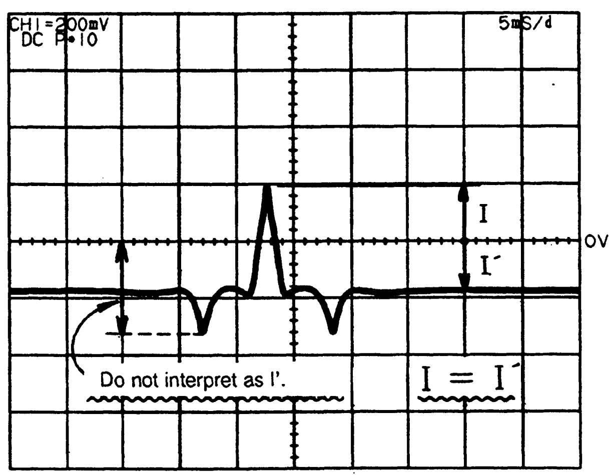


Fig. 8.4 (a) Desirable Waveform

If the output waveform is not like that shown in Fig. 8.4 (a), adjust the variable resistor (Z0) in the preamplifier until the position (offset) is corrected.

Variable resistor Z0	Adjusts the position in the Y-axis direction.

For the positions of the variable resistors on the preamplifier, see Fig. 8.4 (b).

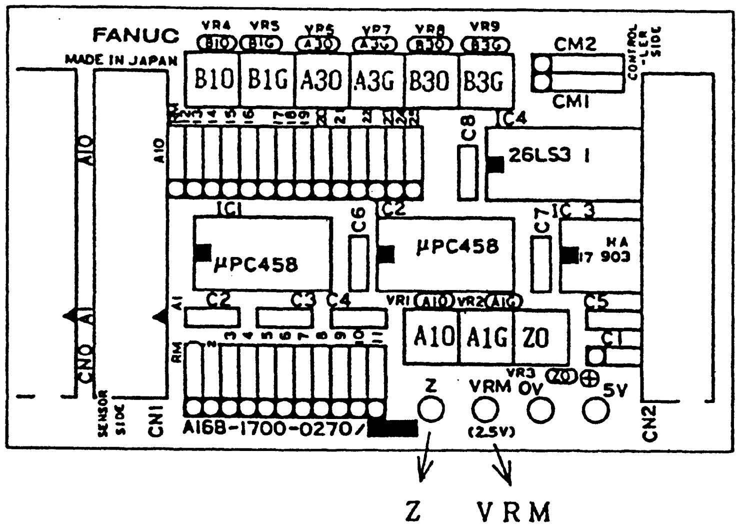


Fig. 8.4 (b) Preamplifier PC Board

VIII. SPEED RANGE SWITCHING CONTROL

1. GENERAL

Speed range switching control conducts control of speed range characteristics switching in one motor (motor designed specifically for speed range switching control) using the FANUC AC spindle servo unit SERIAL INTERFACE S series.

2. CONFIGURATION AND ORDER DRAWING NUMBER

2.1 Configuration

The following items are needed in addition to the FANUC AC spindle servo unit S series.

(1) Speed range switching control software(option)

(2) Relay circuit (including electromagnetic and drive relay)

(3) Switching signal from PMC

Configuration of the components is shown in Fig. 2.1.

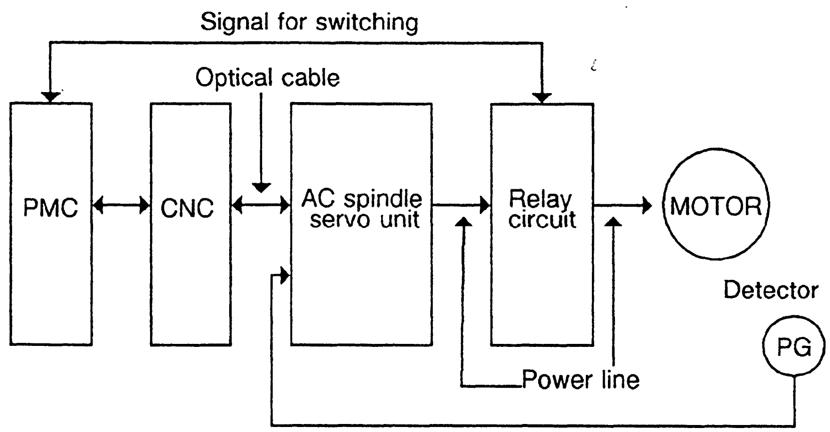


Fig. 2.1 System configuration

The machine tool manufacturer is required to provide the relay circuit and the swithing signal from the PMC.

2.2 Order Specifications

Speed range switching control software (CNC software option)

Series 15M/T	: A02B-0094-J732
Series 0MC	: A02B-0099-J984
Series 0TC, TT	: A02B-0098-J984
Series 16M	: A02B-0121-J854
Series 16T, TT	: A02B-0120-J854
Power Mate-MODEL A	: A02B-0118-J804
Power Mate-MODEL B	: A02B-0122-J804

3. SPECIFICATIONS

In order to conduct speed range switching control, the AC spindle servo unit S series, speed range switchingcontrol software and a relay circuit are required.
See Part IV for details of the AC spindle unit.

(Note) Precautions related to specifications when the speed range switching control circuit is provided with the AC spindle servo unit S series

(1) As the speed detecting signal (SDTA) is used for switching speed detection, it cannot be used for gear conversion speed detection, etc.

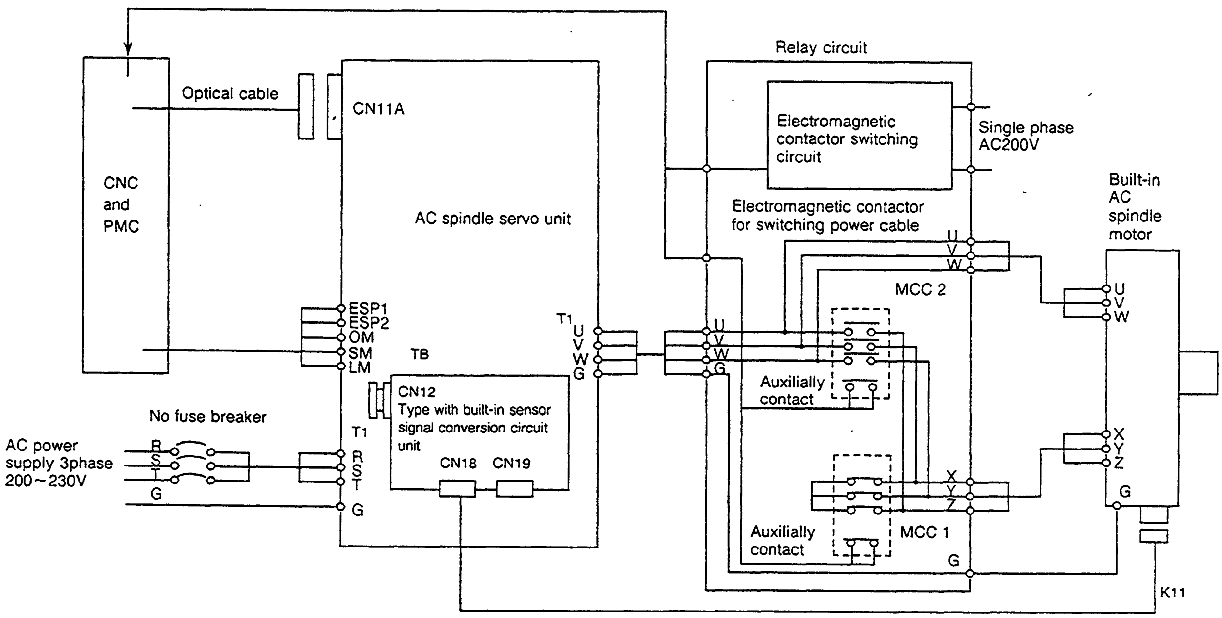
(2) The spindle orientation circuit option can be used even when the speed range switching control circuit is included.

(3) The input signals from PMC to CNC include the signal RCHA as a power-line status check signal. And, the function that the status of the electromagnetic contactors both on the high-speed side and on the low-speed side can be inputted was added, because the status of the power-line can be checked more certainly on the spindle side.
To check the status of the the power line, use the method for checking both the statuses of the main and subsidiary magnetic contacts.
This function can be selected by the parameter setting:
Series 0C: No. 6514 #3 = 1
Series 15: No. 3014 #3 = 1
Series 16: No. 4014 #3 = 1
PowerMate: No. 3014 #3 = 1

This function applied control software ROM series and edition number:
9A11 H version and later.
9A21 F version and later.
9A50 H version and later.

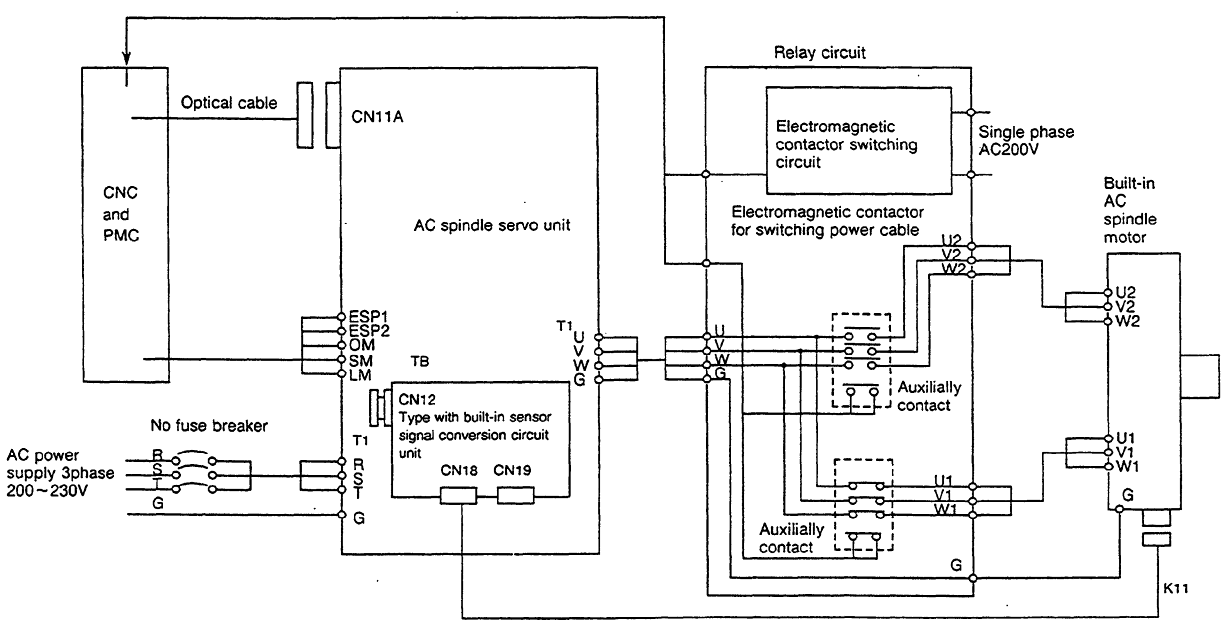
4. CONNECTIONS

4.1 Stator Connection ⑦ during 人 -△ Wiring (See the description of the stator connection in the table in Chapter 6, "Outline Drawing of the Stator" of Part 1 for the applicable models.)



Items such as units and cables other than the AC spindle servo unit and, AC spindlemotor, which are surrounded by the unbroken line, must be provided by the machine tool builder.

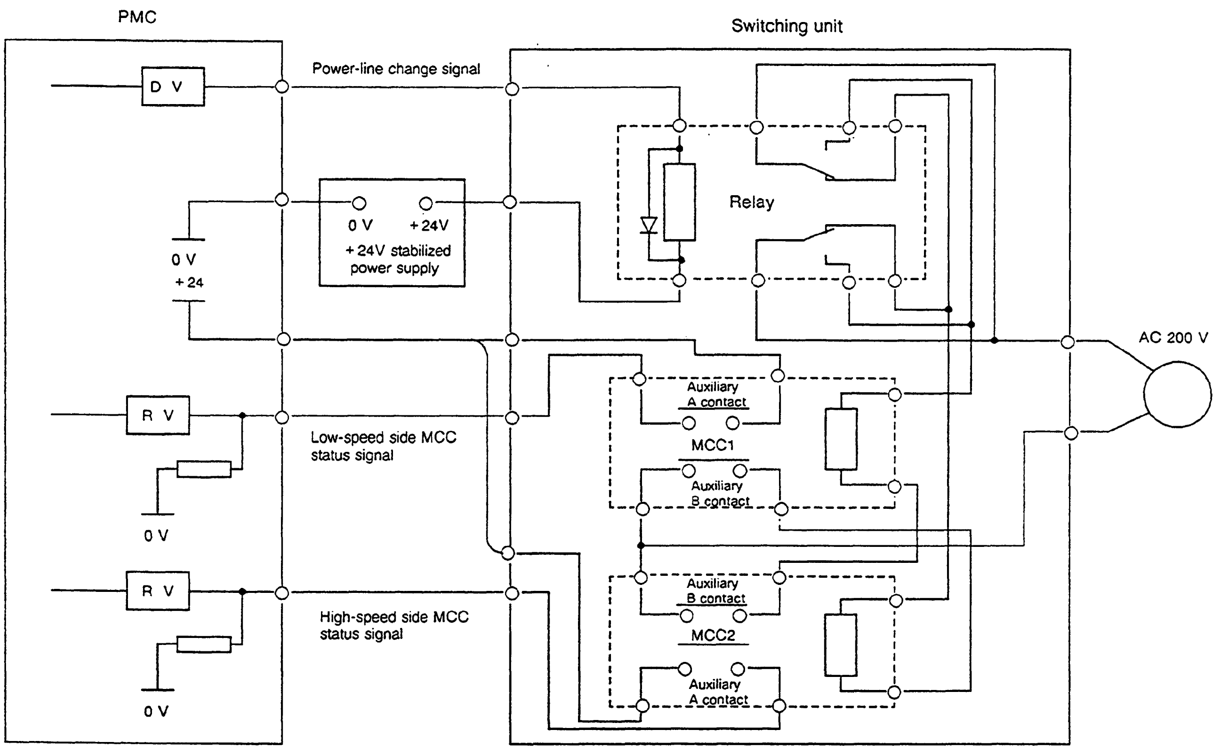
4.2 Stator Connection ⑥ during 人 - 人 Wiring (See the description of the stator connection in the table in Chapter 6, "Outline Drawing of the Stator" of Part 1 for the applicable models.)



Items such as units and cables other than the AC spindle servo unit and, AC spindlemotor, which are surrounded by the unbroken line, must be provided by the machine tool builder.

4.3 Details of Connection between PMC and Switching Unit

It shows the case that the status of the electromagnetic contactors both on the high-speed side and on the low-speed side is inputted.



(Note 1) The above drawing is an example of connections for a switching unit that switches with 1 driver and 2 receivers. The electromagnetic contactor state signal confirmed only low-speed characteristic side (MMC1) in the conventional connector.

(Note 2) The main contact terminals and power line in contact are omitted.

(Note 3) Add a surge absorber to the electromagnetic contactor operation coil as necessary.

(Note 4) Use a power-line switching electromagnetic contactor with the proper capacity for each spindle motor.

5. INTERFACE SIGNALS

See Part IV for details related to signals other than those described below.

5.1 Spindle Control Signals

5.1.1 Input signals (DI signals) PMC to CNC

	PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
1ST:	G112	G229	G227	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
2ND:	–	G233	G235	G074	MRDYB	ORCMB	SFRB	SRVB	TM1B	CTM2B	TLMHB	TLMLB
1ST:	G113	G230	G226	G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
2ND:	–	G234	G234	G075	RCHB	RSLB	INTGB	SOCNB	MCFNB	SPSLB	*ESPB	ARSTB

5.1.2 Change request signal (RSLA, RSLB)

[Function]

It is used as an instruction signal which selects power characteristics.

0: The high-speed characteristic is selected.

1: The low-speed characteristic is selected.

[Usage]

This instruction is usually set according to the velocity command (S instruction). In this case, parameter No. 6519 #4=1 (FS0) is set to work the change operation after speed detecting signal (SDTA) is confirmed on the spindle side, because a low-speed characteristic is selected immediately after the velocity command changes from a high speed to a low speed above the change speed. (It is applied to 9A11/H, 9A21/F, 9A50/H version or later.)

In addition, there is a method that this instruction is selected by the speed detecting signal (SDTA) which is one of output signals of CNC (DO signal). But, please note that this method changes the speed detecting signal in the following cases.

(1) When the motor speed crosses the speed detection level in the constant surface speed control.
At using a low-speed characteristic, the change-operation can be prevented by clamping at the change speed with the instruction (G50, G92) that clamps the maximum spindle speed at the constant surface speed control.

(2) In the case that the motor speed crosses the speed detection level when the speed is changed by a spindle override.

Since the power of motor is turned off in change-operation when the speed range switching control works in the following control modes, please select either power characteristics beforehand, and please do not change the change request signal while working.

1) Rigid tapping mode
2) Cs contouring control mode
3) Spindle synchronous control mode
4) Spindle indexing mode
5) The spindle orientation is completed.

5.1.3 Power-line status check signal (RCHA, RCHB)

(1) Parameter No. 6514 #3 = 0 (FS0) (Present function)

[Function]
The selection status signal of the electromagnetic contactor for the power characteristic changing of the spindle motor is inputted.

0: The high-speed characteristic is selected.
1: The low-speed characteristic is selected.

[Usage]
When the electromagnetic contactor changes from the low-speed side to the high-speed side, this signal is set from "1" to "0" after it is confirmed that the electromagnetic contactor on the low-speed side is off and that the electromagnetic contactor on the high-speed side is on.
When the electromagnetic contactor changes from the high-speed side to the low-speed side, this signal is set from "0" to"1" after it is confirmed that the electromagnetic contactor on the high-speed side is off and that the electromagnetic contactor on the low-speed side is on.

(2) Parameter NO. 6514 #3 = 1 (FS0) (New function)
(Rom series and edition number: Applied 9A11/H, 9A21/F, 9A50/H version or later)

[Function]
The opening and closing status signal of the electromagnetic contactor for a low-speed characteristic of the spindle motor is inputted.

0: The low-speed characteristic side electromagnetic contactor is open.
1: The low-speed characteristic side electromagnetic contactor is closed.

[Usage]
The status of the auxiliary contact ("A" contact) of electromagnetic contactor for a low-speed characteristic is usually inputted.
The status of the low-speed characteristic side electromagnetic contactor is inputted as this signal for parameter NO. 6514 #3 = 1 (FS0). (New function)

5.1.4 High-speed characteristic side electromagnetic contactor status signal (RCHHGA, RCHHGB)

This signal is effective for parameter NO. 6514 #3 = 1 (FS0).
(ROM series and edition number: Applied 9A11/H, 9A21/F, 9A50/H version or later)

[Function]

The opening and closing status signal of the electromagnetic contactor for a high-speed characteristic of the spindle motor is inputted.

0: The high-speed characteristic side electromagnetic contactor is open.
1: The high-speed characteristic side electromagnetic contactor is closed.

[Usage]

The status of the auxiliary contact ("A" contact) of the electromagnetic contactor for a high-speed characteristic is usually inputted.

5.1.5 Gear/clutch signals (CTH1A and CTH2A) (DI signals from the PMC to CNC)

[Function]

These signals are used for selecting spindle control parameters, such as velocity loop gain, position gain, and gear ratio, suitable for the gears and clutches selected for control other than output switching control.
In output switching control, these signals are used for selecting spindle control parameters suitable for the coil selected. The signals are interlocked.

CTH1A	CTH2A	Gear/clutch selection		Coil selection
0	0	High Gear	(High)	Coil for high-speed rotation
0	1	Medium High Gear	(High)	–
1	0	Medium Low Gear	(Low)	–
1	1	Low	(Low)	Coil for low-speed rotation

[Spindle control parameters]

Gear/clutch signals CTH1A and CTH2A select spindle control parameters as shown below.

When the coil for high-speed rotation is selected (CTH1A = 0, CTH2A = 0)

Parameter number PM	0C	15	16	Description
3040	6540 6680	3040 3180	4040	Velocity-loop proportional gain at normal rotation (High)
3042	6542 6682	3042 3182	4042	Velocity-loop proportional gain in orientation (High)
3044	6544 6684	3044 3184	4044	Velocity-loop proportional gain in the servo mode (such as in rigid tapping) (High)
3046	6546 6686	3046 3186	4046	Velocity-loop proportional gain in Cs contour control (High)
3048	6548 6688	3048 3188	4048	Velocity-loop integral gain at normal rotation (High)
3050	6550 6690	3050 3190	4050	Velocity-loop integral gain in orientation (High)
3052	6552 6692	3052 3192	4052	Velocity-loop integral gain in the servo mode (such as in rigid tapping) (High)
3054	6554 6694	3054 3194	4054	Velocity-loop integral gain in Cs contour control (High)
3060	6560 6700	3060 3200	4060	Position gain in orientation (High)
3065	6565 6705	3065 3205	4065	Position gain in the servo mode (such as in rigid tapping) (High)
3069	6569 6709	3069 3209	4069	Position gain in Cs contour control (High)

When the coil for low-speed rotation is selected (CTH1A = 1, CTH2A = 1)

Parameter number PM	0C	15	16	Description	
3041	6541 6681	3041 3181	4041	Velocity-loop proportional gain at normal rotation	(Low)
3043	6543 6683	3043 3183	4043	Velocity-loop proportional gain in orientation	(Low)
3045	6545 6685	3045 3185	4045	Velocity-loop proportional gain in the servo mode (such as in rigid tapping)	(Low)
3047	6547 6687	3047 3187	4047	Velocity-loop proportional gain in Cs contour control	(Low)
3049	6549 6689	3049 3189	4049	Velocity-loop integral gain at normal rotation	(Low)
3051	6551 6691	3051 3191	4051	Velocity-loop integral gain in orientation	(Low)
3053	6553 6693	3053 3193	4053	Velocity-loop integral gain in the servo mode (such as in rigid tapping)	(Low)
3055	6555 6695	3055 3195	4055	Velocity-loop integral gain in Cs contour control	(Low)
3063	6563 6703	3063 3203	4063	Position gain in orientation	(Low)
3068	6568 6708	3068 3208	4068	Position gain in the servo mode (such as in rigid tapping)	(Low)
3072	6572 6712	3072 3212	4072	Position gain in Cs contour control	(Low)

[Note]

Note that in rigid tapping and Cs contour control with the Series 15, the gear/clutch signals CTH1A and CTH2A also select parameters, such as the position gain, the number of teeth in an optional gear, the time constant, and the backlash of the feeding axis.

5.2 Output Signal (DO signal) CNC → PMC

PMC address

	PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
1ST:	F228	F281	F229	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
2ND:	-	F285	F245	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
1ST:	F229	F282	F228	F046					RCFNA	RCHPA	CFINA	CHPA
2ND:	-	F286	F244	F050					RCFNB	RCHPB	CFINB	CHPB

5.2.1 Power-line change signal (RCHPA, RCHPB)

[Function]

It is an instruction signal to select the electromagnetic contactor for the power characteristic changing of the spindle motor.

0: The electromagnetic contactor for a high-speed characteristic should be selected.
1: The electromagnetic contactor for a low-speed characteristic should be selected.

[Usage]

When change request signal (RSLA) changes, the power supply to the motor is automatically turned off.

Power supply OFF status continues until the change completion signal (RCFNA) changes.

At changing from the low-speed side to the high-speed side, this signal changes from "1" to "0" after the change request signal (RSLA) is received. As a result, the electromagnetic contactor for a low-speed characteristic is first turned off. After it is confirmed to have turned off the electromagnetic contactor for a low-speed characteristic, the electromagnetic contactor for a high-speed characteristic is turned on.

At changing from the high-speed side to the low-speed side, this signal changes from "0" to "1" after the change request signal (RSLA) is received. As a result, the electromagnetic contactor for a high-speed characteristic is first turned off. After it is confirmed to have turned off the electromagnetic contactor for a high-speed characteristic, the electromagnetic contactor for a low-speed characteristic is turned on.

5.2.2 Change completion signal (RCFNA, RCFNB)

[Function]

This signal shows by which power characteristic the spindle motor is controlled.

0: It is controlled by a high-speed characteristic.
1: It is controlled by a low-speed characteristic.

[Usage]

Change request signal (RSLA) changes. And after it is confirmed that this signal is corresponding to the change request signal (RSLA), it moves to the next movement.

Since the motor power is turned off until this signal is corresponding to the change request signal (RSLA) after the change of the change request signal (RSLA), please note not to apply the cutting load, etc. to the spindle in the change-operation.

5.2.3 Speed detecting signal (SDTA, SDTB)

[Function]

It becomes "1" while the motor speed is below the level (the change speed is normally set.) that is set by parameter.

0: It is above the change speed.
1: It is below the change speed.

[Usage]

It can be used for the change speed detection.
However, in the case that change-operation is done according to this signal, please note that this signal is changed by speed's changing when driven near the change speed and change-operation is occasionally done.
In this case, please do the change control with the velocity command (S instruction).

Hysteresis is given to this signal.
Quantity of hysteresis is set to 20 rpm as an initial parameter. And it can be changed by the parameter (NO. 6924 (FS0)).
This width of hysteresis is set to the value with margin, which is two times value of measured speed change at change-operation.
It is calculated by the following equation as a standard of the set data.

$$\text{(Width of hysteresis)} = \frac{\text{(Change-operation time)}}{\text{(Acceleration time up to the max. speed)}} \times \underset{\text{rpm}}{\text{(Max. speed)}} \times \underset{\uparrow}{0.2} \text{ :rpm}$$

When motor load at change-operation is supposed to be 20 percent of maximum output torque

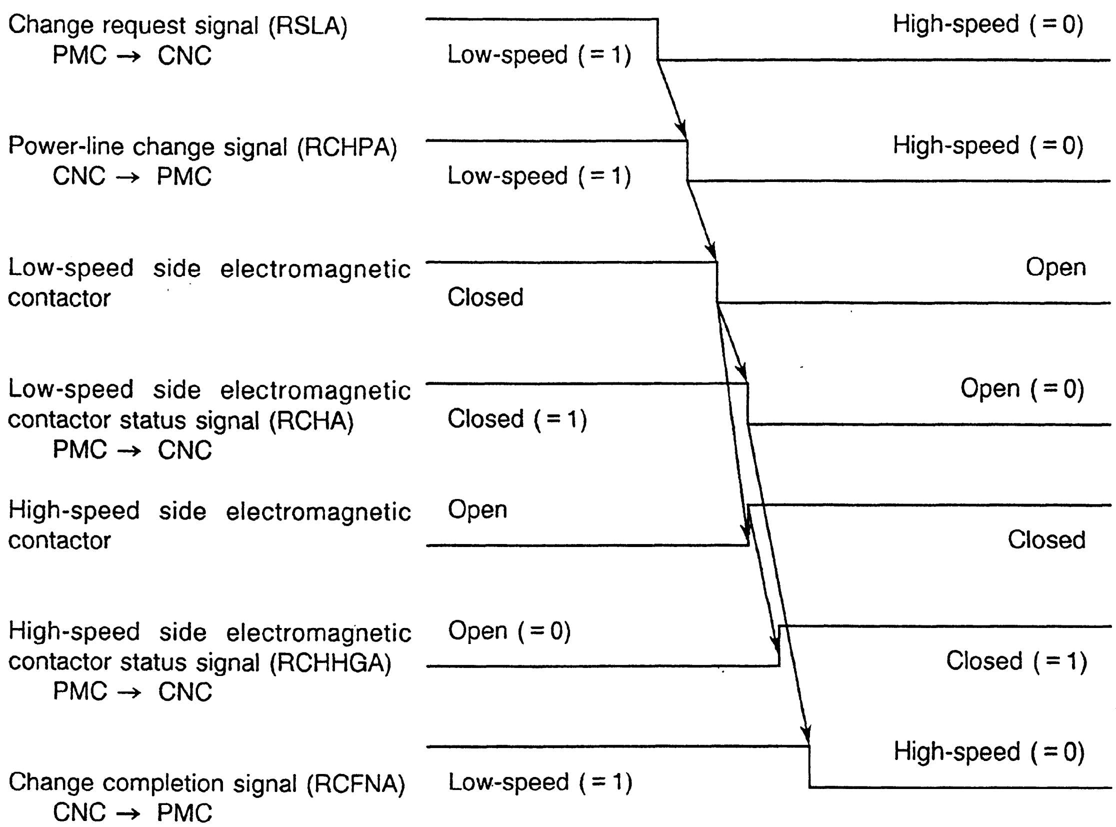
6. SEQUENCE

6.1 When the Status of both Electromagnetic Contactors for a Low-speed Characteristic (RCHA) and for a High-speed Characteristic (RCHHGA) is Confirmed and the Speed Range Switching Control Works (New Function)

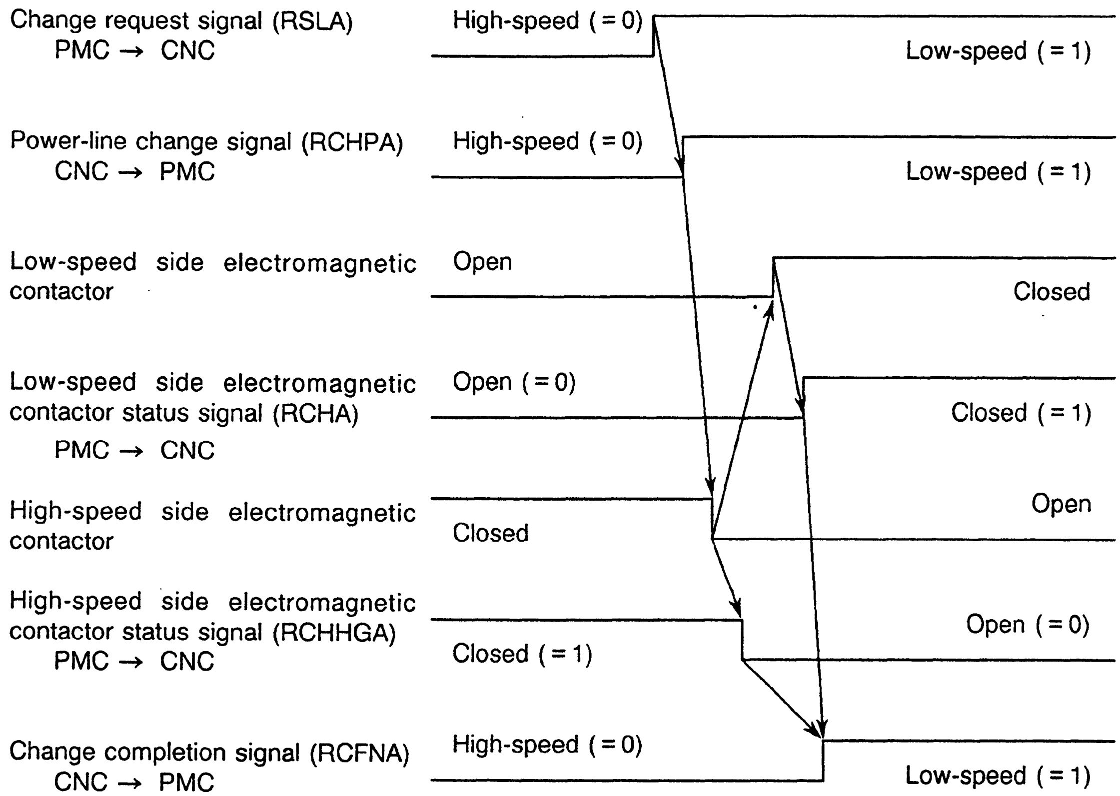
(Parameter NO. 6514 #3 = 1 (FS0))

(Applied ROM series and edition number: 9A11/H, 9A21/F, 9A50/H version or later)

6.1.1 Change-operation of a low-speed characteristic → a high-speed characteristic



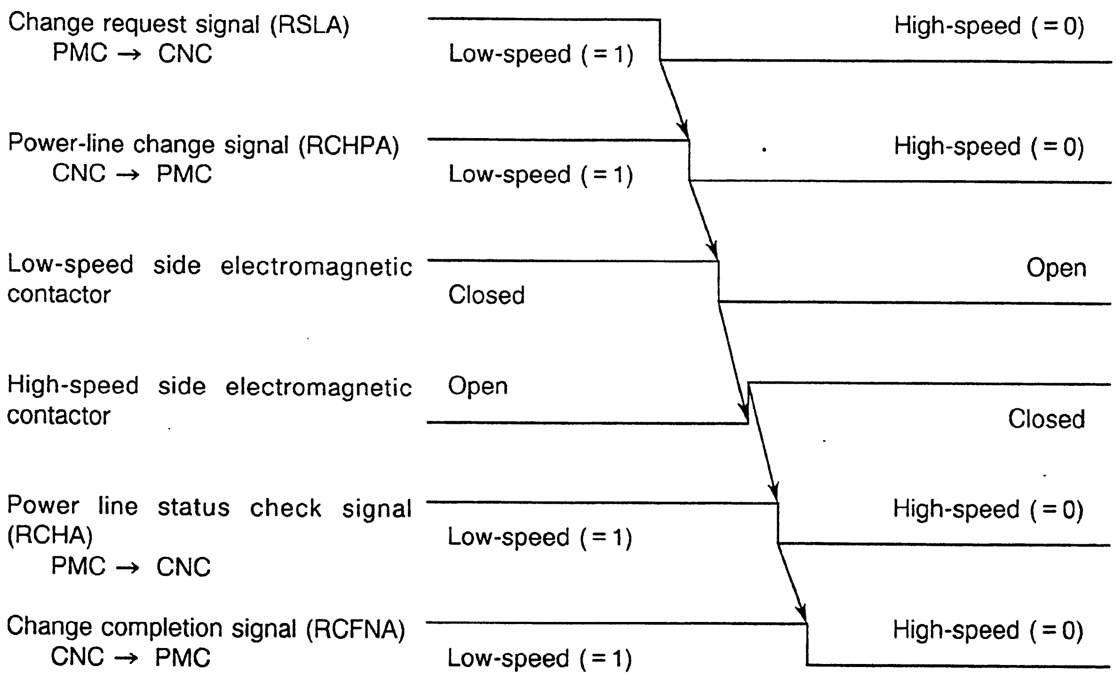
6.1.2 Change-operation of a high-speed characteristic → a low-speed characteristic



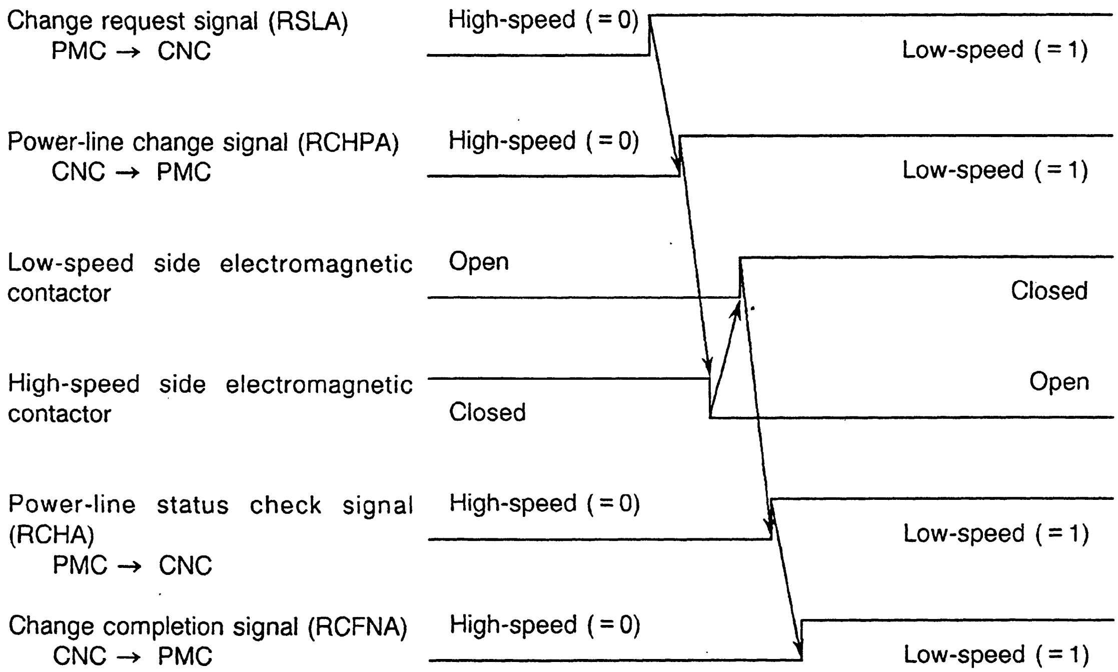
6.2 When the Speed Range Switching Control Works by Confirming Only the Power-line Status Check Signal (RCHA) (Present Method)

(For parameter NO. 6514 #3 = 0 (FS0)

6.2.1 Change-operation of a low-speed characteristic → a high-speed characteristic



6.2.2 Change-operation of a high speed characteristic → a low-speed characteristic



(Note 1) When converting from high-speed output to low-speed output, conversion demand exceeding conversion speed can not be input.

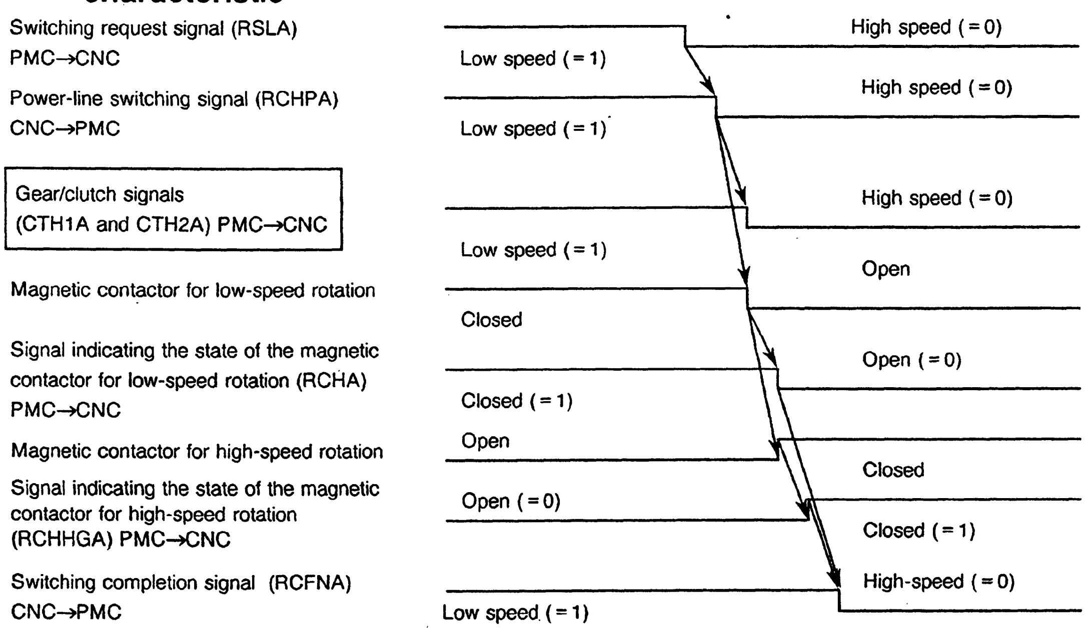
(Note 2) Because there are electromagnetic contactor operation delays etc. when checking electromagnetic contactor MCC1, MCC2 selection conditions in electromagnetic contactor MCC1 only, auxiliary contacts make sure that there is a minimum time lag of 50msec between operating the MCC1, MCC2 switch and changing the power cable condition verification signal (RCHA) with the power cable switching cable (RCHPA).
Be sure to take the delay time into account. Otherwise, switching between the low-speed and high-speed parameters in the amplifier will not operate properly, resulting in malfunctions such as motor vibration.
Make sure to input MCFN within 1 second of CHP being output otherwise Alarm AL-15 will be given if the power cable condition verification signal is not input within 1 second of the power cable switching signal being output.

6.3 When the status of both electromagnetic contactor for a low-speed characteristic (RCHA) and for a High-speed characteristic (RCHHGA) is confirmed and the speed range switching control works (The gear/clutch signals are used in this switching) (New Function) After Checking the RCHA Signal, which Indicates the State of the Magnetic Contactor for Low-Speed Rotation, and the RCHHGA Signal, which Indicates the State of the Magnetic Contactor for High-Speed Rotation (The gear/clutch signals are used in this switching)

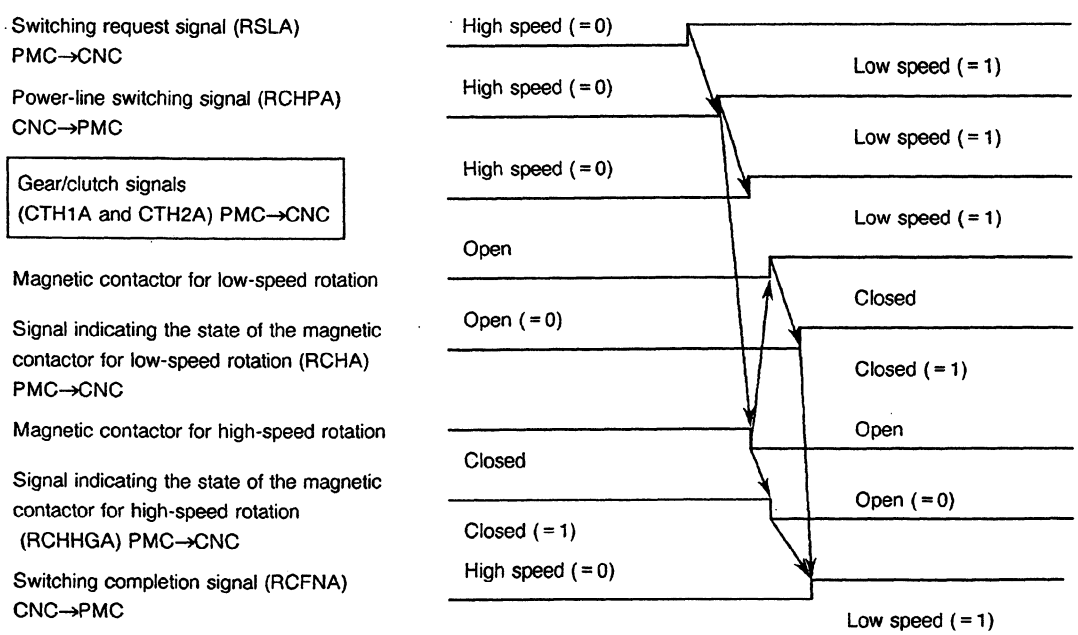
(This switching can be used when FSO, bit 3 of parameter No. 6514, is set to 1.)

(Applicable ROM series and edition: 9A11/H, 9A21/F, and 9A50/H and later)

6.3.1 Change-operation of a low-speed characteristic → a high-speed characteristic



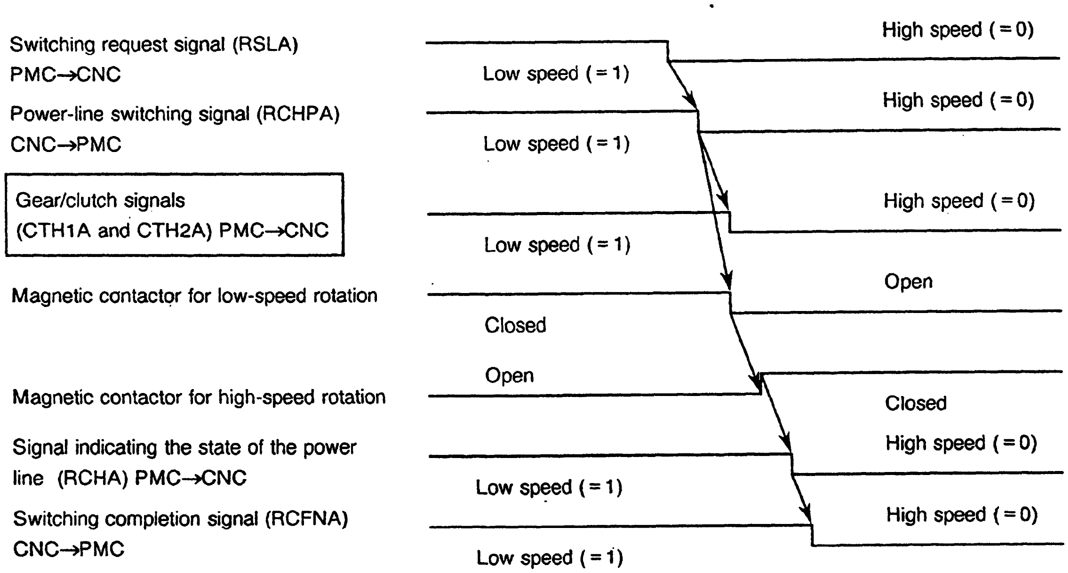
6.3.2 Change-operation of a high-speed characteristic → a low-speed characteristic



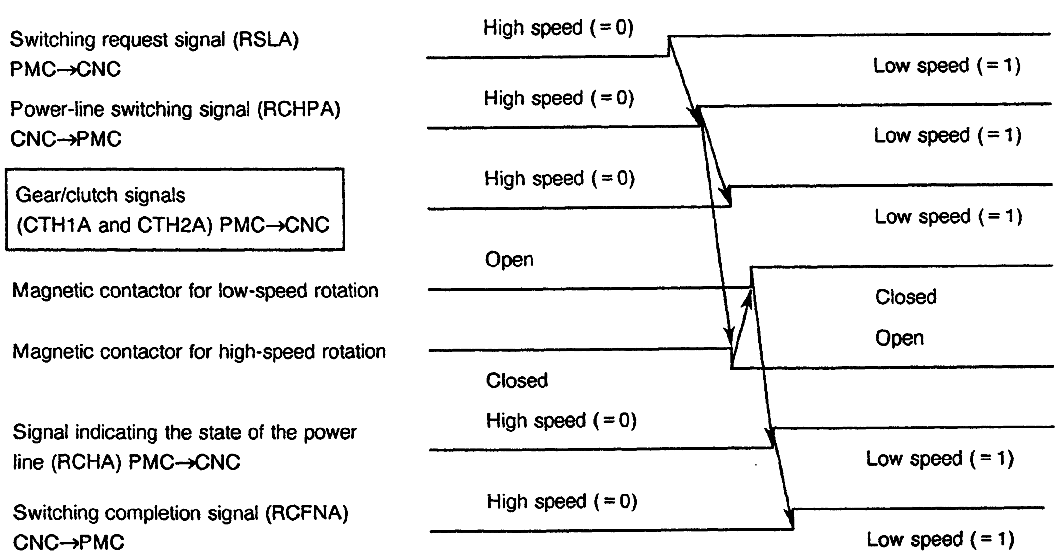
6.4 When the speed range switching control works by confirming only the power-line status check signal (RCHA) (The gear/clutch signals are used in this switching) (When parameter No. 6514#3 = 0 (FS0)) After Checking Only the RCHA Signal, which Indicates the State of the Power Line (The gear/clutch signals are used in this switching)

(This switching can be used when FSO, bit 3 of parameter No. 6514, is set to 0.)

6.4.1 Change-operation of a low-speed characteristic → a high-speed characteristic



6.4.2 Change-operation of a high-speed characteristic → a low-speed characteristic



7. ALARMS RELATED TO SPEED RANGE SWITCHING CONTROL

7.1 Speed Range Switching Control Sequence Alarm

(1) Alarm explanation

At parameter setting (NO. 6514 #3 = 1 (FS0)) that both contact status of the low-speed characteristic side and the high-speed characteristics side are confirmed, if the electromagnetic contactor status check signals for a low-speed characteristic (RCHA) and for a high-speed characteristic (RCHHGA) do not change within 1 second after the change request signal (RSLA) is changed, the alarm occurs.

At parameter setting (NO. 6514 #3 = 0 (FS0)) that only the power-line status check signal (RCHA) is confirmed, if the power-line status check signal (RCHA) does not change within 1 second after the change request signal (RSLA) is changed, the alarm occurs.

(2) Alarm display

It is displayed on 7 segment-LED of the spindle amplifier as | AL-15 | .

7.2 Power-line Status Abnormal Alarm (New addition)

(Applied ROM series and edition number: 9A11/H, 9A21/F, 9A50/H version or later)

(1) Alarm explanation

It is always checked whether the change request signal (RCHA) and the status of power-line are corresponding. If they do not correspond for 10 seconds or more, the alarm occurs.

(2) Alarm display and the internal status display at the alarm

When this alarm occurs, the following alarm and the internal status at the alarm occurrence are alternately displayed on 7-segment-LED of the spindle amplifier.

Alarm display | AL-55 | and internal status | | *4 | *3 | *2 | *1 | at the alarm occurrence are alternately displayed.

Meaning of the displayed internal status is as follows.

*1: It displays which parameter was used at the alarm occurrence, a high-speed characteristic or a low-speed characteristic.

0: The motor was controlled by the parameter for a high-speed characteristic.

2: The motor was controlled by the parameter for a low-speed characteristic.

*2: It displays the low-speed side electromagnetic contactor status signal (RCHA) at the alarm occurrence for parameter NO. 6514 #3 = 1 (FS0).

(At parameter NO. 6514 #3 = 0 (FS0), the power-line status check signal is displayed.)

0: The low-speed side electromagnetic contactor status signal RCHA was "0" (Open). (At parameter NO. 6514 #3 = 0 (FS0), the power-line status check signal RCHA was "0".)

2: The low-speed side electromagnetic contactor status signal RCHA was "1" (Closed).

(At parameter NO. 6514 #3 = 0 (FS0), the power-line status check signal RCHA was "1".)

*3: It displays the high-speed side electromagnetic contactor status signal (RCHHGA) at the alarm occurrence for parameter NO. 6514 #3 = 1 (FS0).
(At parameter NO. 6514 #3 = 0 (FS0), this display is invalid.)

0: The high-speed side electromagnetic contactor status signal RCHHGA was "0" (Open).

2: The high-speed side electromagnetic contactor status signal RCHHGA was "1" (Closed).

*4: It displays the change request signal (RSLA) at the alarm occurrence.

0: The high-speed side was selected.

2: The low-speed side was selected.

8. PRECAUTIONS ON USING THE ELECTROMAGNETIC CONTACTOR

(1) Use an electromagnetic contactor for switching output whose capacity is suited for the AC spindle servo unit.
For the sake of reference, the table below lists the model ratings of electromagnetic contactors made by Fuji Electric and Telemechanic.

Applicable AC spindle servo unit	30-minute rated current of the amplifier (A)	Electromagnetic contactor of Fuji Electric		Electromagnetic contactor of Telemechanic	
		Model rating	Flowing current (A)	Model rating	Flowing current (A)
1S	13.4	SC-4-0	22	LC1-D123A60	25
2S	27	SC-1N	50	LC1-D253A60	40
3S	30	SC-1N	50	LC1-D253A60	40
6S	35	SC-1N	50	LC1-D403	60
8S	48	SC-2N	60	LC1-D403	60
12S	63	SC-2SN	80	LC1-D633	80
15S	84	SC-3N	100	LC1-D803	125
18S	95	SC-4N	135	LC1-D803	125
22S	111	SC-5N	150	LC1-FF43	160
26S	133	SC-6N	150	LC1-FF43	160
30S	153	SC-7N	200	LC1-FG43	200
40S	183	SC-8N	260	LC1-FH43	315

(2) In order to suppress electrical noise generated at conversion in the electromagnetic contactor for speed range switching, use a surge absorber built into the resistor-condensor.

(3) When conducting rigid tapping, set the desired output characteristics in advance and do not perform switching.
Accordingly, when conducting rigid tapping, although the high-speed detection signal (SDTA) will be output from the AC spindle servo unit, be sure that this signal is ignored.

(4) Setting the machine ready signal (MRDYA)
For the purpose of safety, two signals have been included in the sequence to operable status. These are the emergency stop signal (*ESPA) and machine ready signal (MRDYA). Close the machine ready (MRDYA) contact to allow operation of the machine.

(5) Speed detection signal (SDTA) and selection signal
Two coils are installed within the AC spindle motor. Output characteristics can be changed by switching these two coils.
When conducting this speed range switching and the rigid tapping during rotation, the control may be limited by only the high-speed coil.

Ensure a sequence in the PMC that allows selection of 2 output characteristics and enables selection of a switching sequence during rotation.

(6) Use gear/clutch signal CTH1A and CTH2A to be able to set different speed loop gains for low-speed and high-speed.

IX. SPEED RANGE SWITCHING UNIT

1. ORDERING NUMBERS FOR SWITCHING UNITS

Ordering number	Use	Applicable amplifier
A06B-6059-K034	Speed range switching ⑥	Up to the model 12S
A06B-6059-K035	Speed range switching ⑦	
A06B-6059-K036	Speed range switching ⑥	Up to the model 26S
A06B-6059-K037	Speed range switching ⑦	

⑦ : 人 - Δ connection of the power line. ⑦ indicates the power line connection specified in the figure of stator.

⑥ : 人 - 人 connection of the power line. ⑥ indicates the power line connection specified in the figure of stator.

2. SPECIFICATION

2.1 Magnet Contactor (MCC) Specification

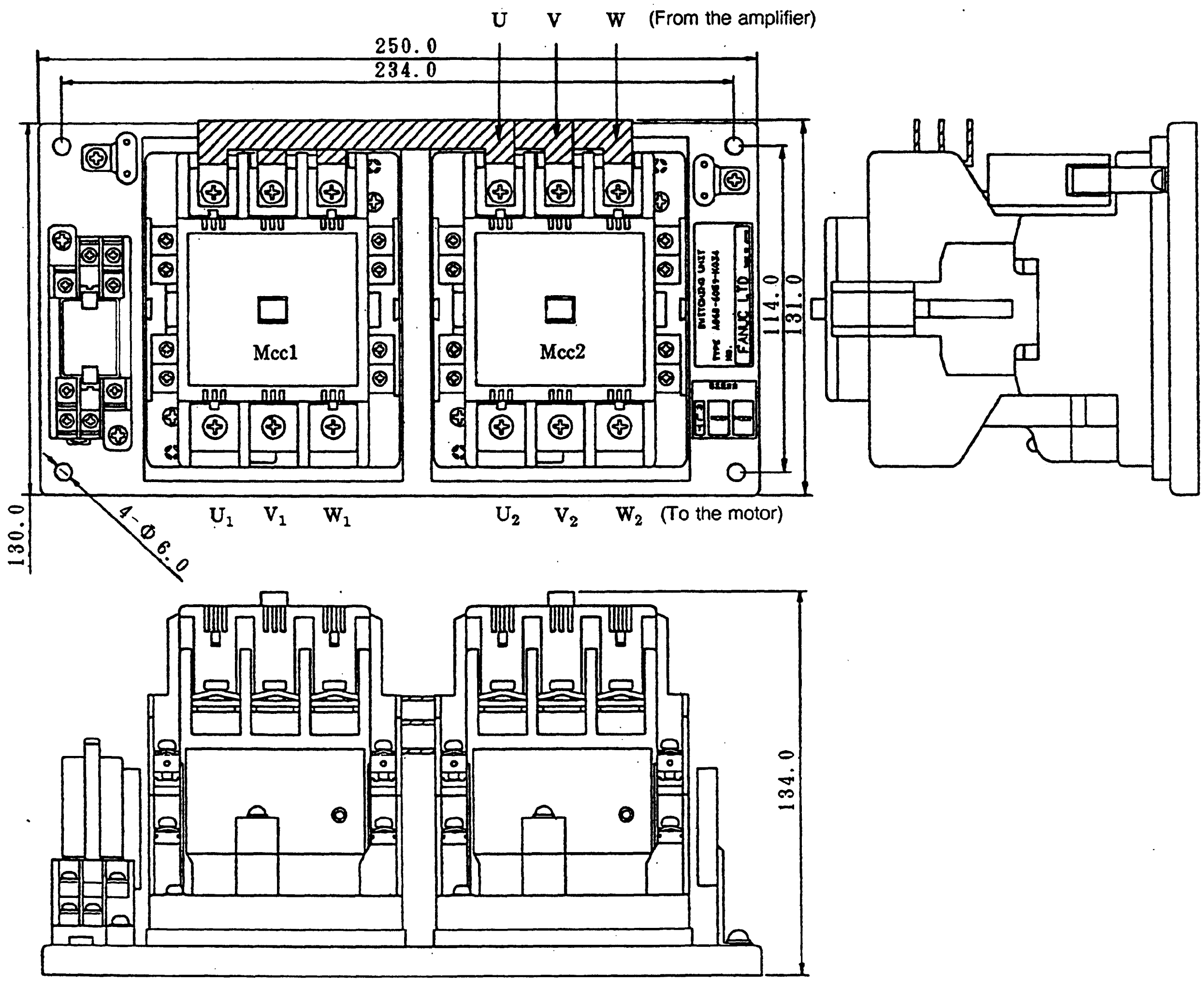
FANUC purchasing specification number	A58L-0001-0306 Fuji Electric Co., Ltd. (SC-3N)		A58L-0001-0312 Fuji Electric Co., Ltd. (SC-6N)	
Rated vaoltage	220 V		220 V	
Rated current	65 A		125 A	
Circuit closed/isolation current capacity	Closed	780A	Closing	1500A
	Isolation	650A	Breaking	1250A
Opening/closing frequency	1200 times/hour or more			
Life time	Mechanical	5 million times or more		
	Electrical	1 million times or more		
Rating of operation magnetic coil	200 V/220 V -15% - +10%, 50/60 Hz ±1 Hz			
Applied AC spindle servo	Up to the model 12S		UP to the model 26S	

2.2 Relay Specification

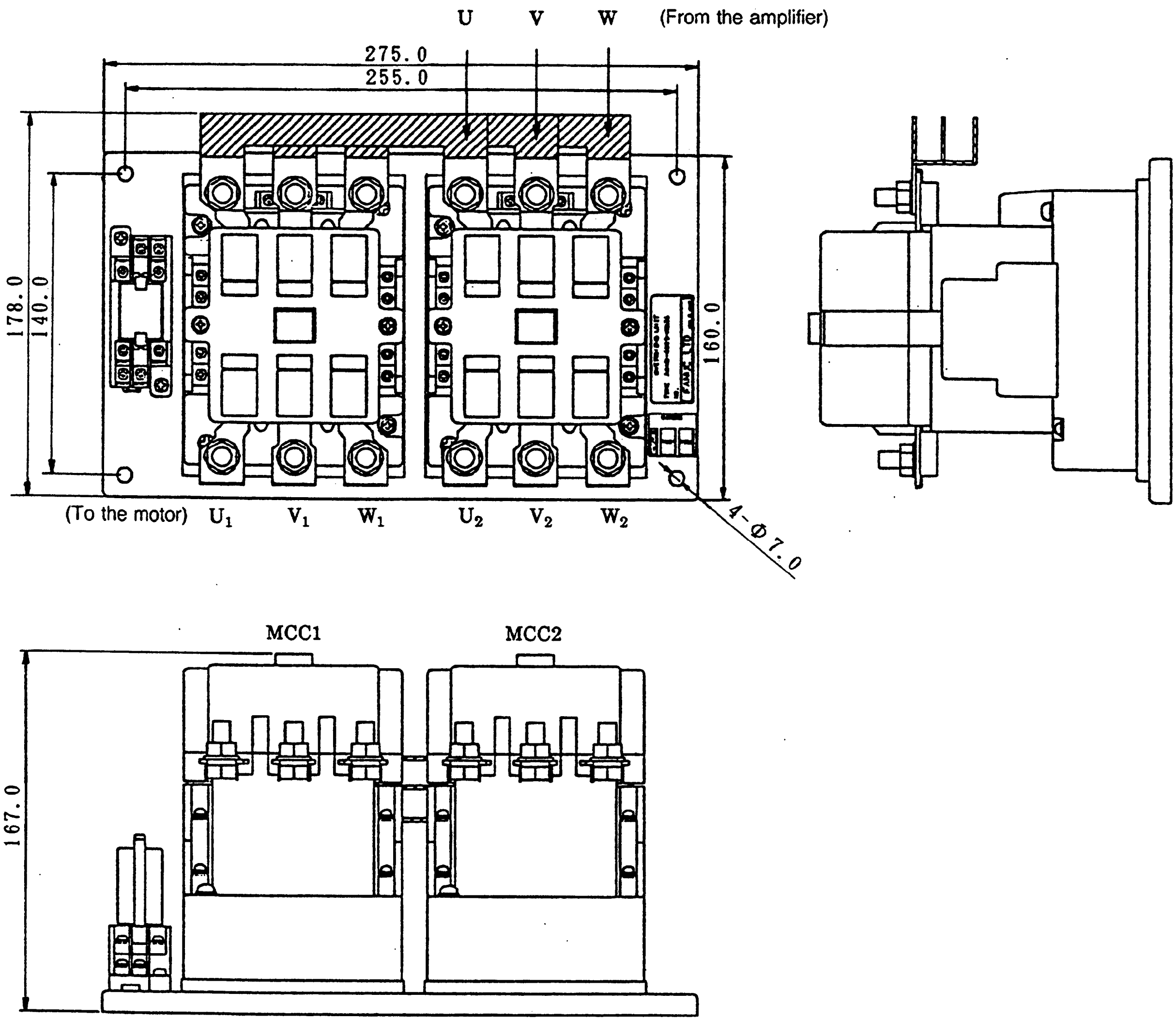
FANUC purchasing specification number	A58L-0001-0307 OMRON CO., LTD. (LY2-D)
Rated voltage	24 V ±10%
Rated current	36.9 mA

3. OUTLINE DRAWINGS AND DIMENSIONS

3.1 Unit for Controlling Speed Range Switching (Connection ⑥ 人 - 人 Connection)

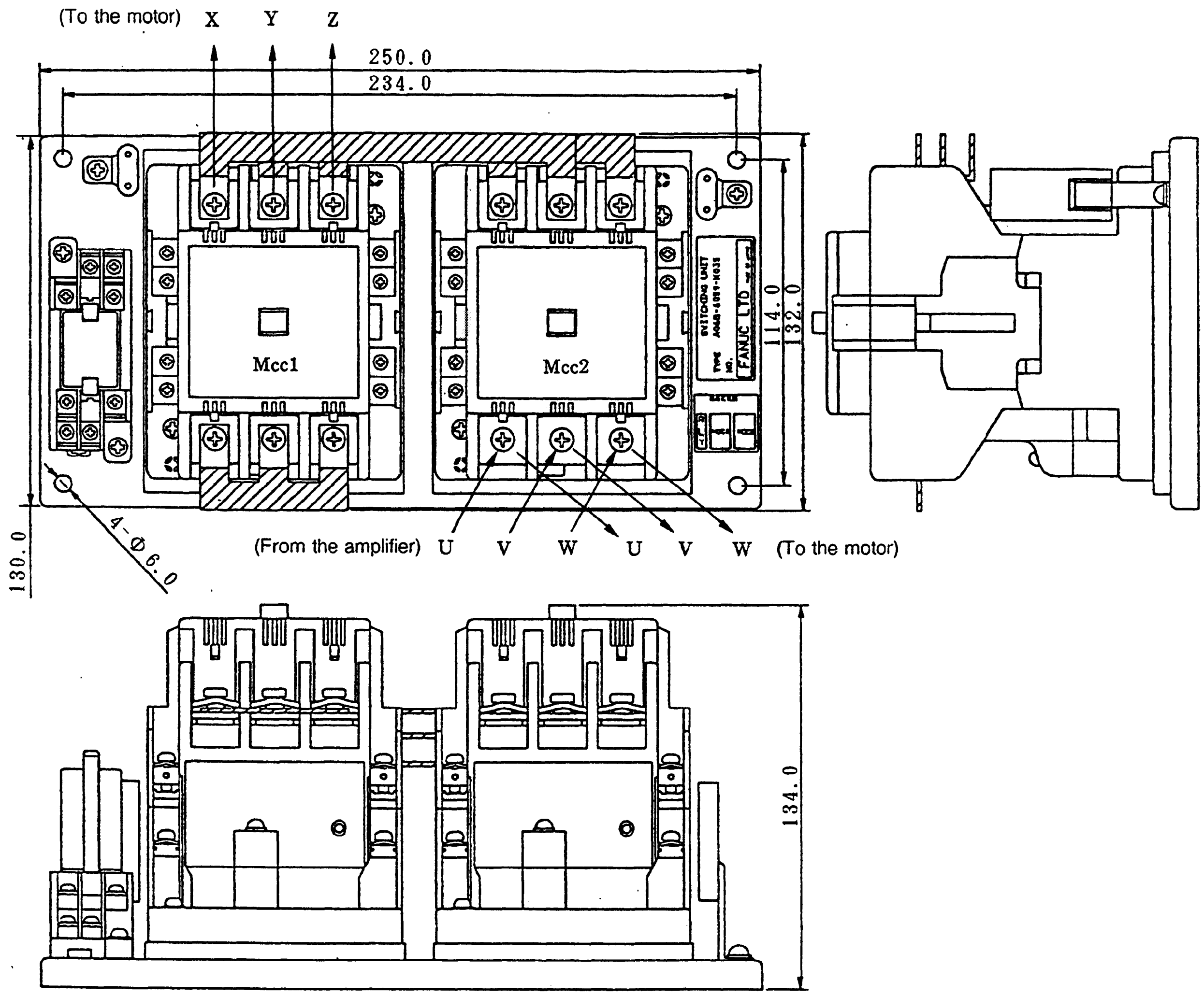


A06B-6059-K034

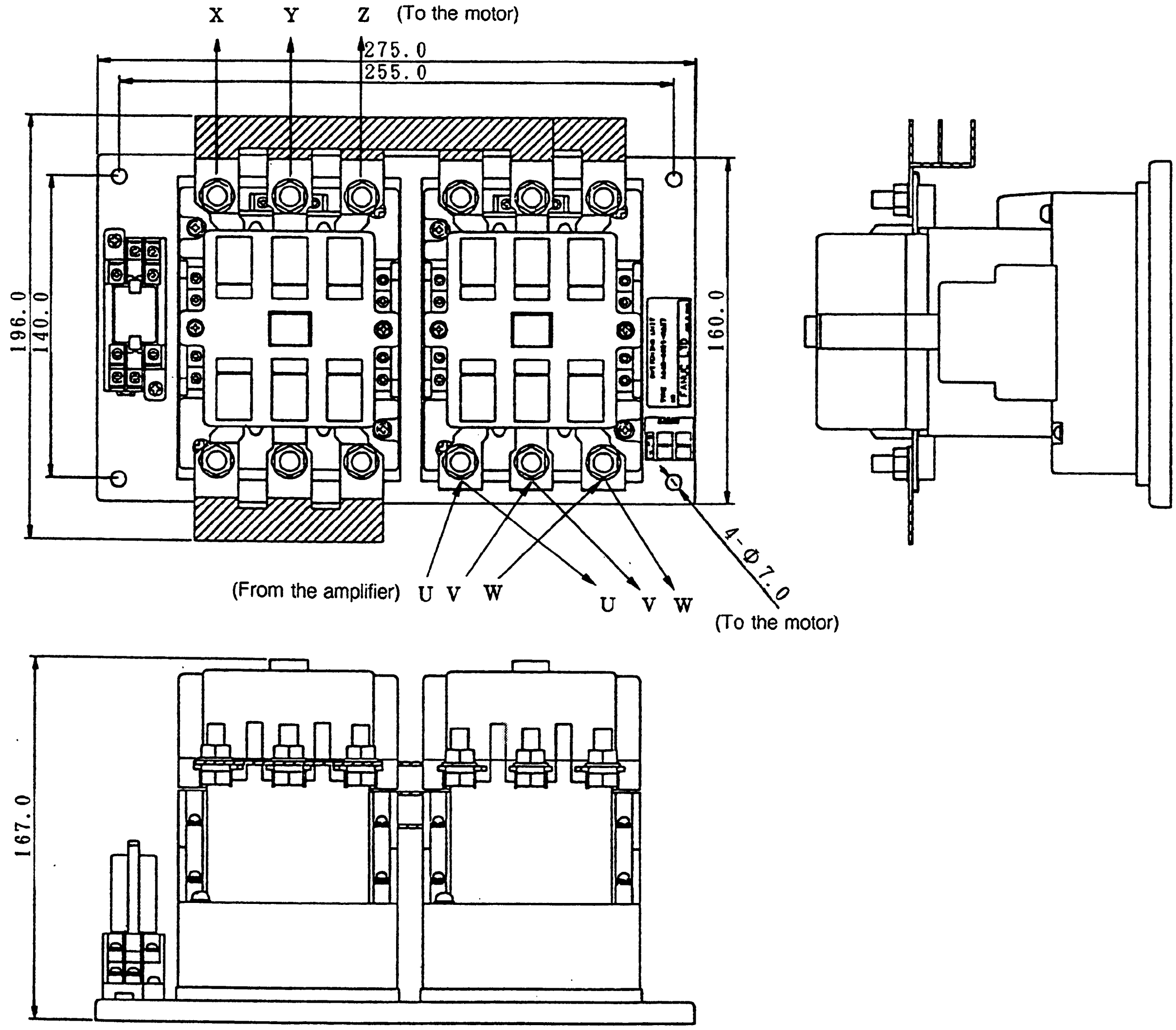


A06B-6059-K036

3.2 Unit for Controlling Speed Range Switching (Connection ⑦ Y- △ Connection)



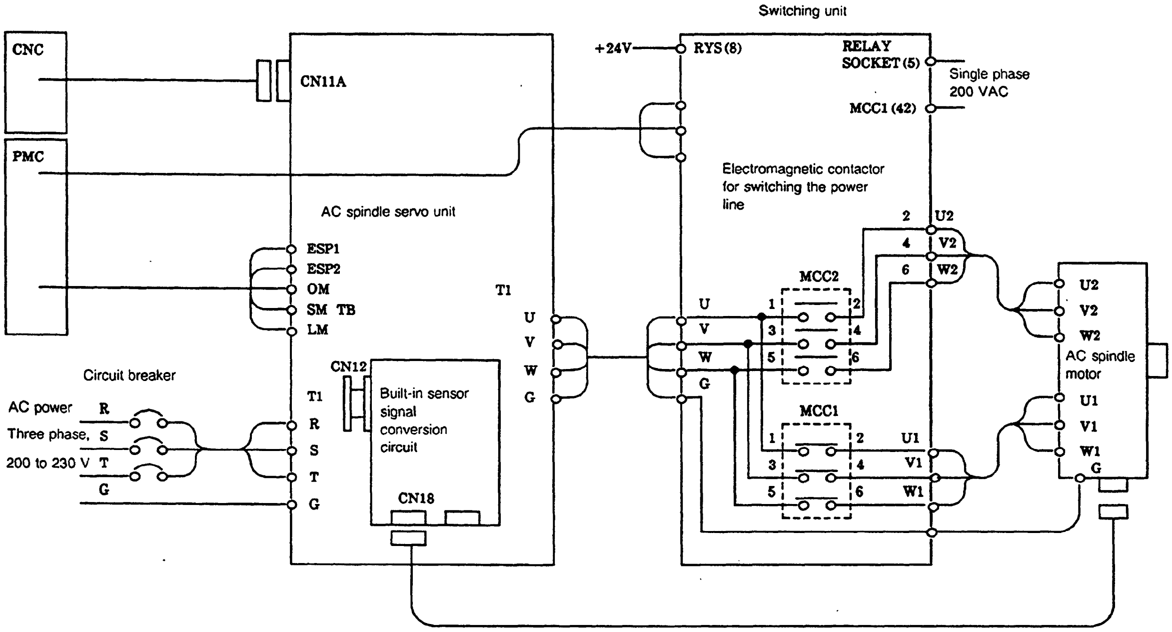
A06B-6059-K035



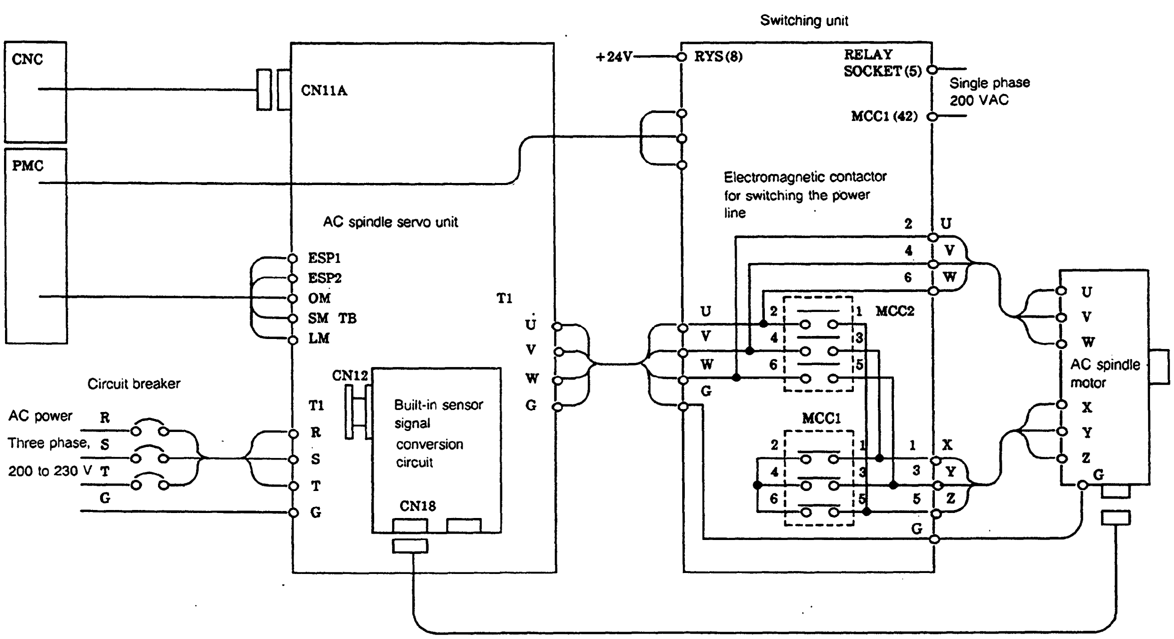
A06B-6059-D037

4. CONNECTING THE SPEED RANGE SWITCHING UNIT

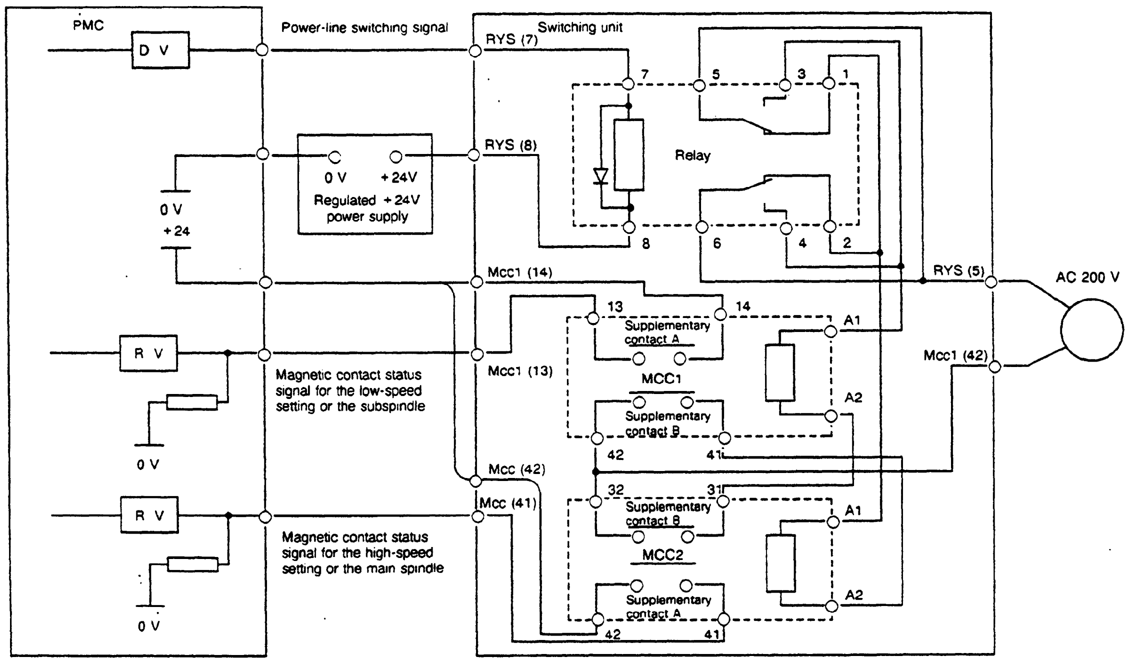
4.1 Connecting the Speed Range Switching Unit (Y-Y Connection: ⑥)



4.2 Connecting the Speed Range Switching Unit (Y-Δ Connection: ⑦)



4.3 Detailed Diagram of Connections between the PMC and the Switching Unit



(Note 1) This figure shows an example of connections between the PMC. and the switching unit with one driver and two receiver for switching. (In the above figure, 200 VAC power is not supplied.)

(Note 2) For connections between the main contacts of an electromagnetic contactor and a power line, see Section 4, "OUTPUT SWITCHING UNIT."

(Note 3) Connect the PMC to the switching unit at the screw terminals of the electromagnetic contactor and relay socket with screws.

(Note 4) For information on interface signals, see Parts VIII OUTPUT SWITCHING CONTROL

5. NOTE

5.1 Mounting

1) Install this unit as the same place in the environmental conditions as the spindle servo unit.
   Environmental conditions

· Ambient temperature	:	Ambient temperature of unit	; 0 - 55°C
		Ambient temperature of the storage cabinet	; 0 - 45°C
· Humidity	:	Normally 95% RH or below, and condensation-free	
· Vibration	:	In operation; Below 0.5 G	
· Atmosphere	:	No corrosive conductive mists or drops should directly on the electronic circuits	

2) For the mounting, the standard mounting in Fig. 5.1 (a) is correct one but an inclined mounting of up to 15 degree front and rear or left and right is acceptable.

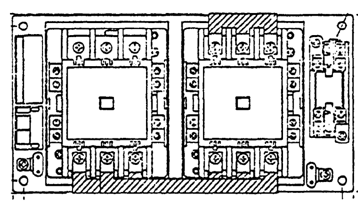


Fig. 5.1 (a) Standard mounting

3) When the horizontal mounting (Fig. 5.1 (b)) by the relationship of the wiring and mounting is necessary, there are almost no differences in the characteristics of the electromagnetic contactor, but the mechanical lifetime and opening/closing frequency will decrease.

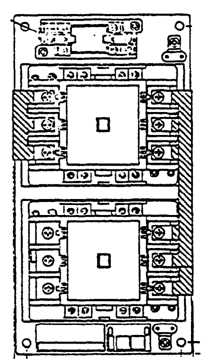


Fig. 5.1 (b) Horizontal mounting

4) Install the arc space shown in Fig. 5.1 (c). (The height of the opening/closing operation display button becomes the arc space dimensions.)

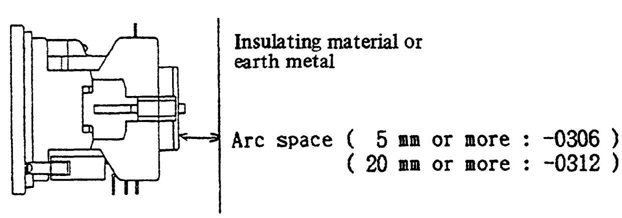


Fig. 5.1 (c) Arc space

5) If the mounting of the main unit of the electromagnetic contactor is incomplete, when the power is turned on the shock may cause the contact to distort and have an adverse influence on the lifetime. Further, when connecting the power cable, if insufficiently tightened this may be a cause of a serious accident from excess heat and power cable becoming disconnected.

Screw tightening torque electromagnetic contactor

Location	Screw tightening torque (kg.cm)	
	A58L-0001-0306	A58L-0001-0312
MCC. main terminal	62.0 (M6.0)	84.0 (M8.0)
MCC. auxiliary terminal	14.0 (M3.5)	14.0 (M3.5)

Relay socket

Location	Screw tightening torque (kg.cm)
Relay socket	14.0 (M3.5)

X. THERMAL DATA

As reference materials for the machine design, there follows temperature rise data for the coil and stator surface for 30-minute/continuous ratings of each built-in motor (speed range switching only).

1. Notes Relating to Reading the Graphs
2. How to Read the Graphs
3. Temperature Measuring Point
4. Temperature Rise Data

1. NOTES RELATING TO READING THE GRAPHS

1) For the temperature rise when short time rated, there is a tendency for the short time constant motor to be faster compared with a continuous rated.

2) The temperature rise value of the graphs shows the saturation temperature under the load and speed conditions described.

3) When a temperature rise value under a load of 100% is not written, this means OUTPUT could not be performed up to the continuous rating under that load/speed conditions.

4) The graph plots the temperature rise value from room temperature. Room temperature is displayed uniformly as 24°C.

5) Even when the circulation performance of the oil cooling device is the same, the oil flow differs slightly for individual motors because the duct resistance differs according to the type of motor.

6) The coil temperature is restricted to approximately 100°C up from room temperature. However, data may both exceed 100°C up and not exceed 100°C up because the temperature of thermal operation varies slightly according to each type of solid.

7) There are motors whose base speeds differ at 30-minute rated and continuous rated specifications. Because models B10, B26, and B28, are such motors, for these motors graphs for each base speed for both 30-minute rated and continuous rated have been prepared. Accordingly, there is only 1 graph for motors other than the above.
   In graph 1, data has been plotted for a 30-minute rated base speed, when a 30-minute rated output load is applied, when a continuous rated output load is applied, and when other outputs are applied.
   In graph 2, data has been plotted for a continuous rated base speed, when a continuous rated output load is applied, and other outputs are applied.

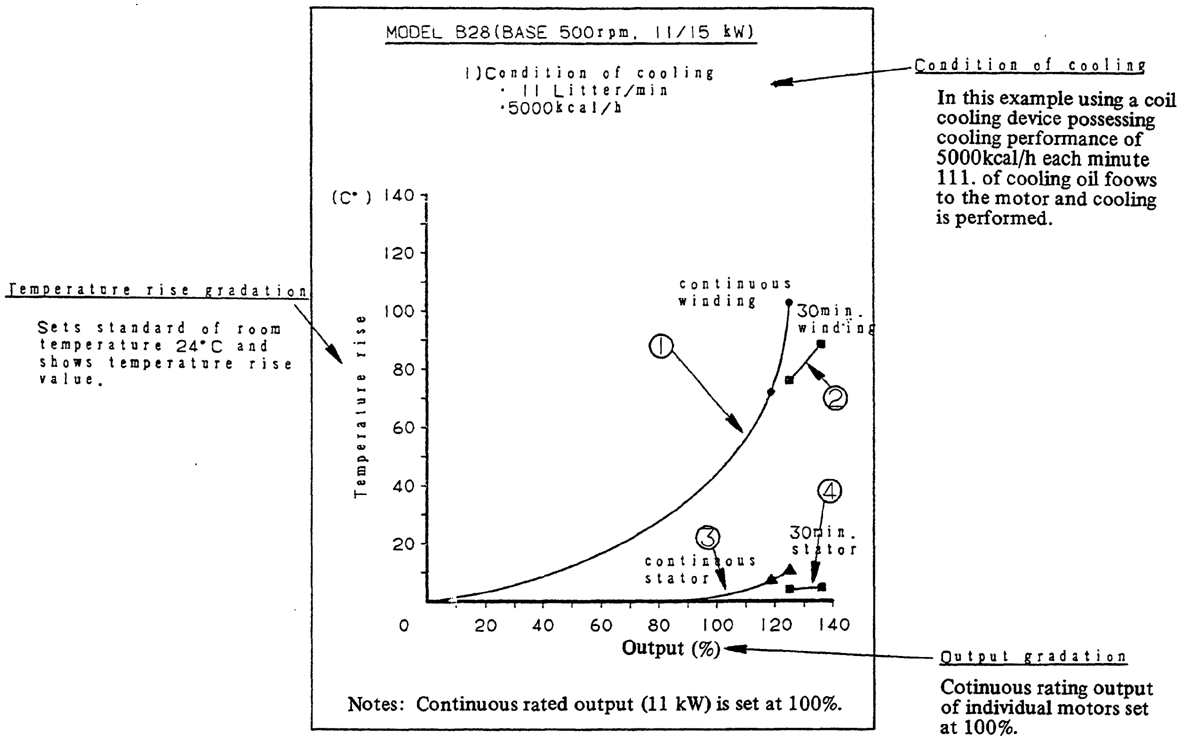
2. HOW TO READ THE GRAPHS

Example 1) Type, specifications of motor

In this example, motor : MODEL B28

Base : 500 rpm (graph was drawn up based on this speed)

Output : continuous rating 11 kW/30-minute rating 15kW



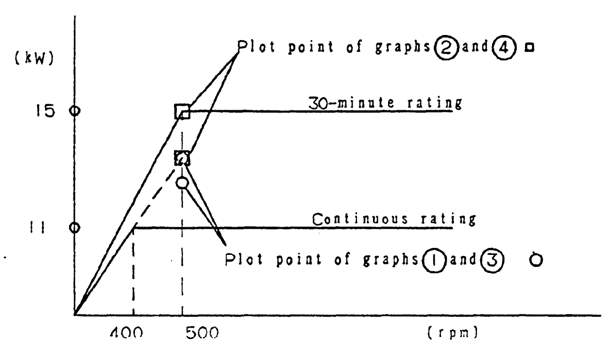
Notes: Continuous rated output (11 kW) is set at 100%.

① Shows saturation temperature of winding when continuous rating (rise value from room temperature).

② Shows temperature rise of winding when 30-minute rating (rise value from room temperature).

③ Shows saturation temperature of stator when continuous rating (rise value from room temperature).

④ Shows temperature rise of stator when 30-minute rating (rise value from room temperature).



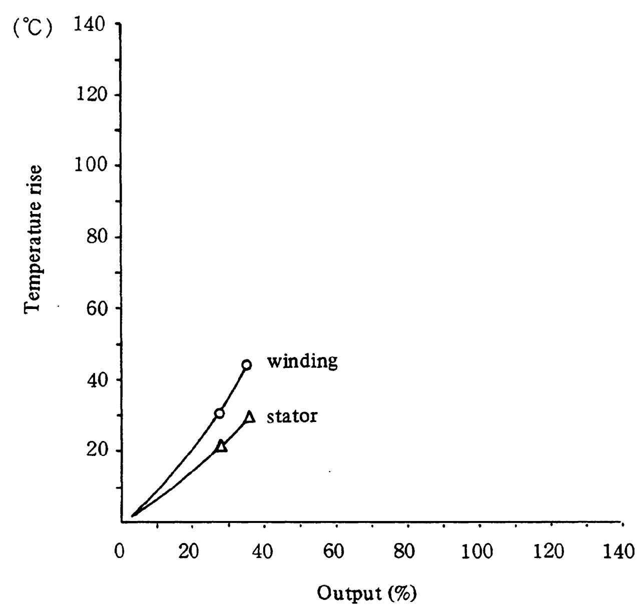
Note) Points plotted in the above graph are equivalent to the points in the power curve shown in the above diagram. In all of the above graph, the expected curve has been drawn based on these points.

Example 2) Without cooling

In the case of the graph below, when the load of 35% of 11 kW (i.e. 11 × 0.35 = 3.85 kW) is applied, the temperature of the coil will rise 45°C without cooling. In other words, as the cooling performance is not sufficient for the load of this amount or more, the temperature of the coil rises without saturation. In short, when the output for which the temperature rise graph (in this example, 35% or more) has not been drawn is loaded, the temperature of the coil continues to rise without saturation because the cooling performance is insufficient.

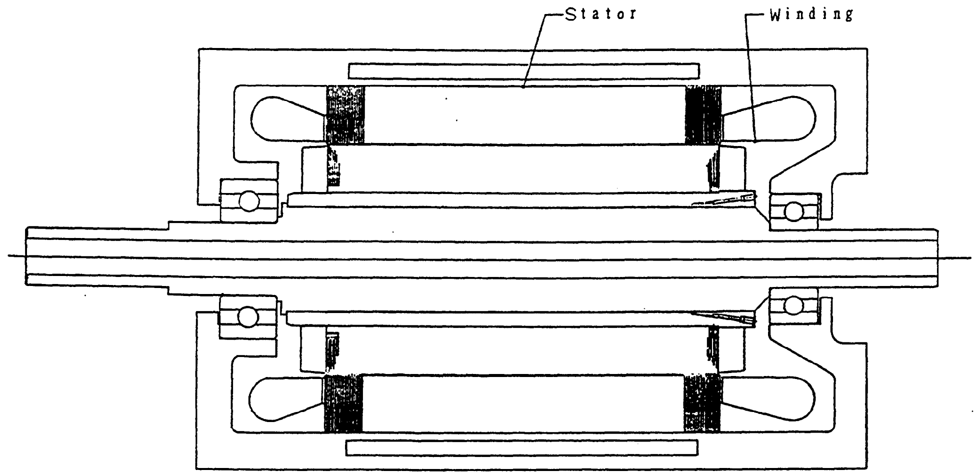
MODEL B28 (BASE 400 rpm. 11/15 kW) Cooling DATA

1) Condition of cooling . 0 Litter
. 0 kcal/h



Notes: Continuous rated output (11 kW) is set at 100%.

3. TEMPERATURE MEASURING POINTS

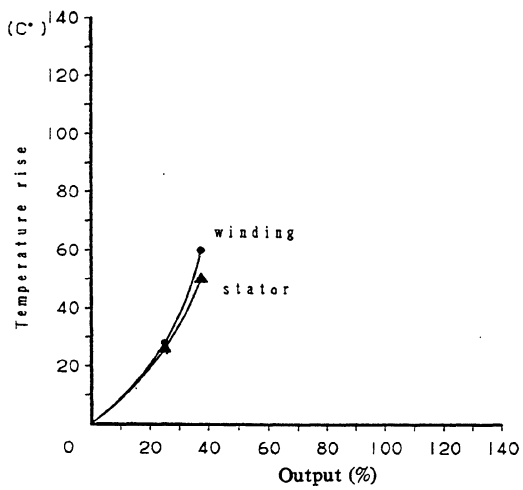


4. TEMPERATURE RISE DATA

4.1 Model B8 (Graph 1)

MODEL B8 (BASE 680 rpm. 5.5/7.5 kW) Cooling DATA

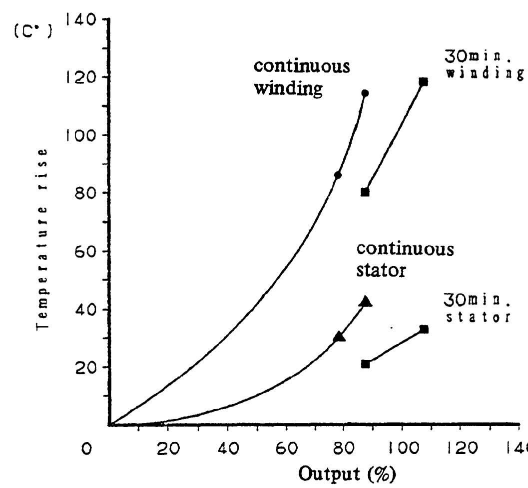
1)Condition of cooling
· 0 Litter/min
· 0 kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B8 (BASE 680 rpm. 5.5/7.5 kW) Cooling DATA

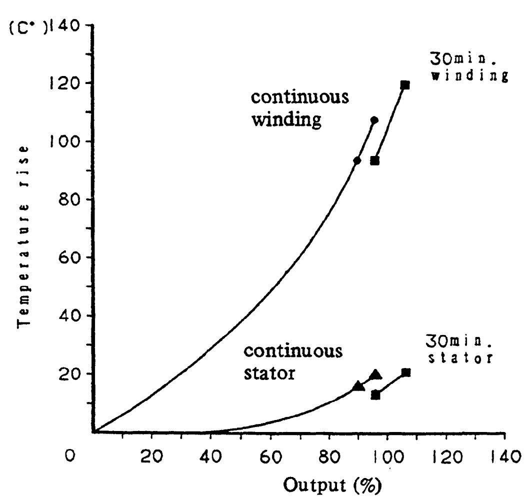
1)Condition of cooling
· 6 Litter/min
·3000kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B8 (BASE 680 rpm. 5.5/7.5 kW) Cooling DATA

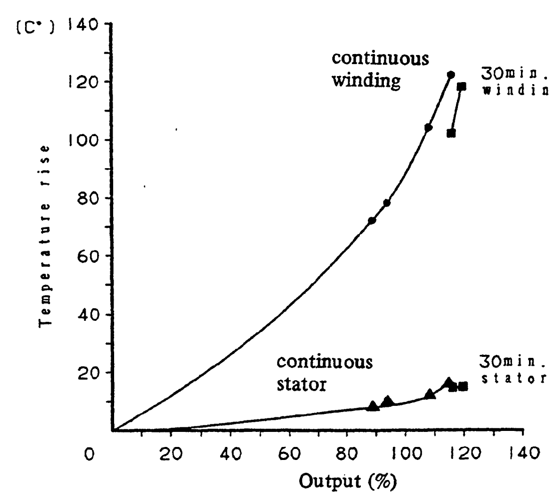
1)Condition of cooling
· 9 Litter/min
·4000kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B8 (BASE 680 rpm. 5.5/7.5 kW) Cooling DATA

1)Condition of cooling
· 8 Litter/min
·5000kcal/h

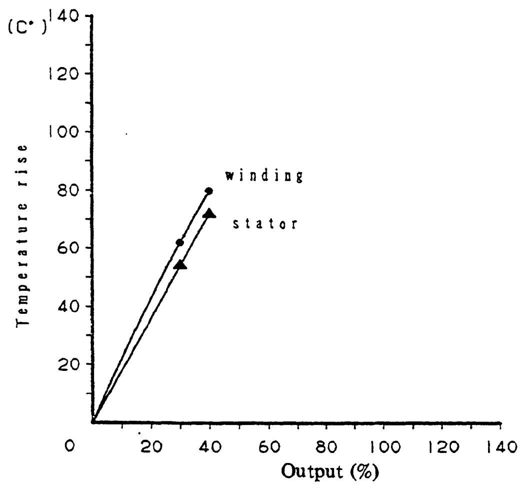


Notes: Continuous rated output (5.5 kW) is set at 100%.

4.2 Model B10 (Graph 1)

MODEL B10 (BASE 520 rpm. 5.5/7.5 kW) Cooling DATA

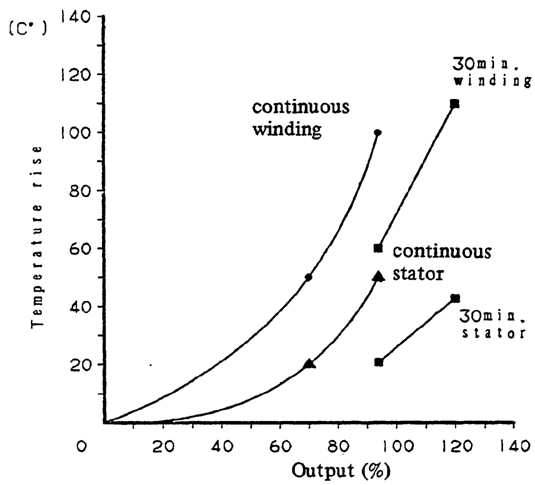
I)Condition of cooling
· 0 Litter/min
· 0 kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B10 (BASE 520 rpm. 5.5/7.5 kW) Cooling DATA

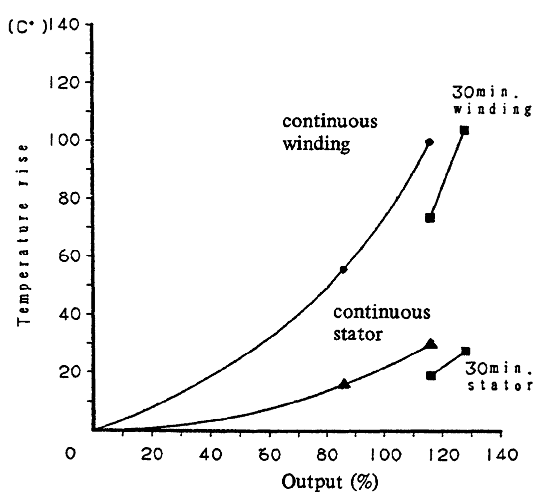
I)Condition of cooling
· 6 Litter/min
·3000kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B10 (BASE 520 rpm. 5.5/7.5 kW) Cooling DATA

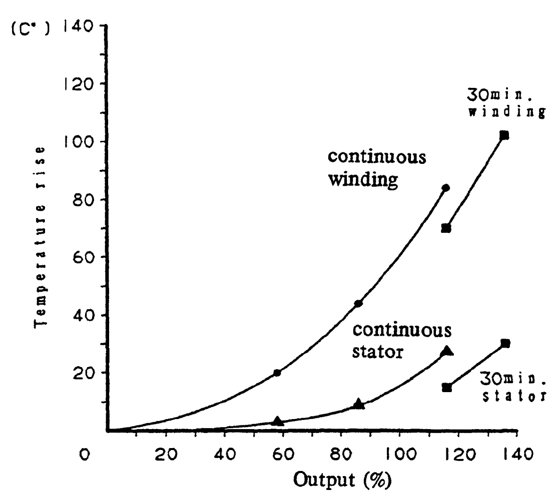
I)Condition of cooling
· 9 Litter/min
·4000kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B10 (BASE 520 rpm. 5.5/7.5 kW) Cooling DATA

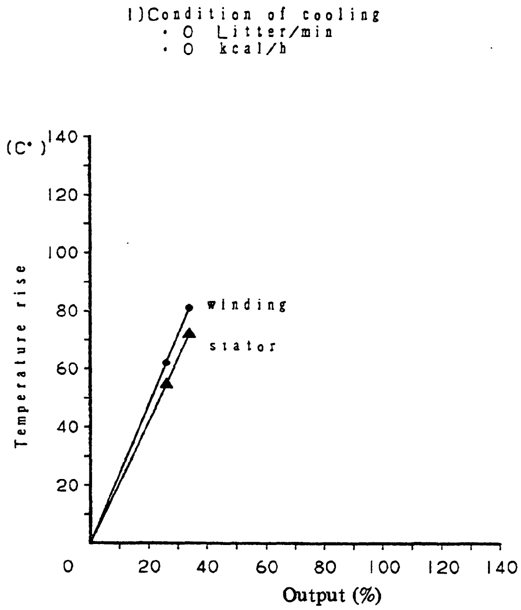
I)Condition of cooling
· 8 Litter/min
·5000kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

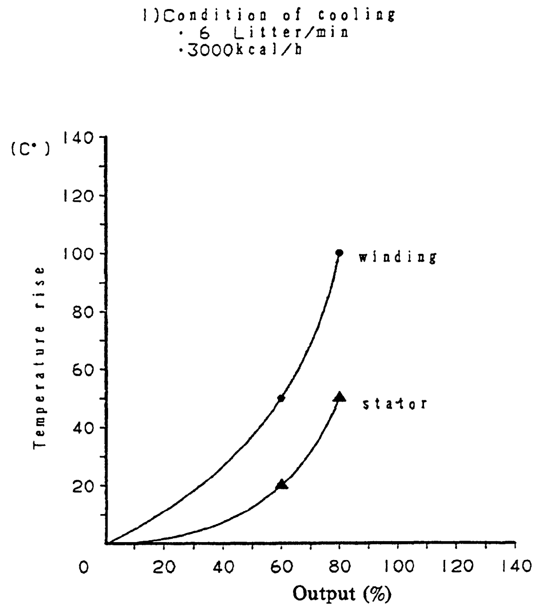
4.3 Model B10 (Graph 2)

MODEL B10 (BASE 450 rpm. 5.5/7.5 kW) Cooling DATA



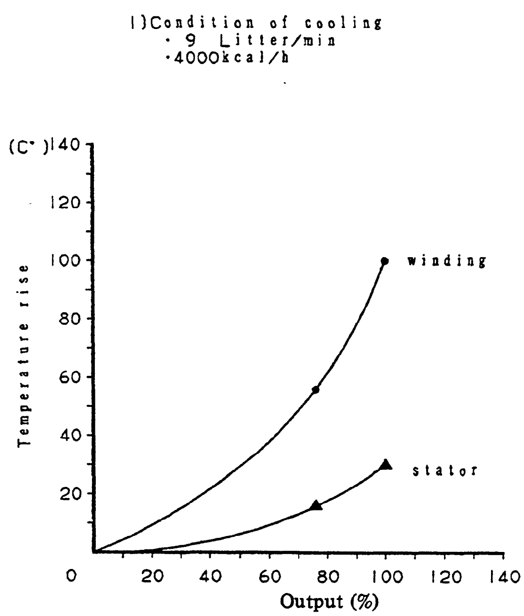
Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B10 (BASE 450 rpm. 5.5/7.5 kW) Cooling DATA



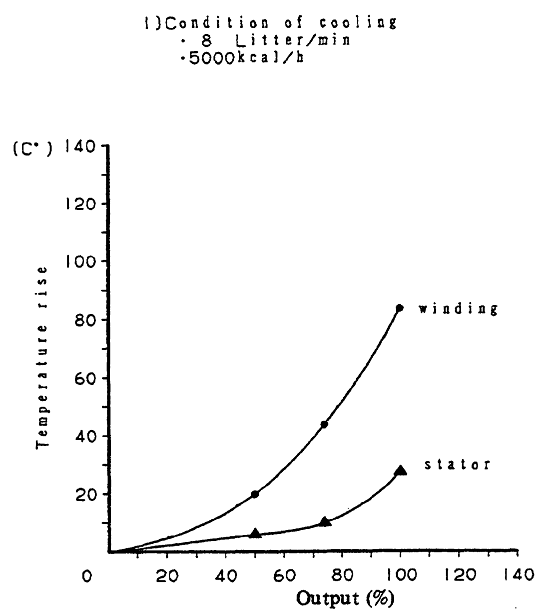
Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B10 (BASE 450 rpm. 5.5/7.5 kW) Cooling DATA



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B10 (BASE 450 rpm. 5.5/7.5 kW) Cooling DATA

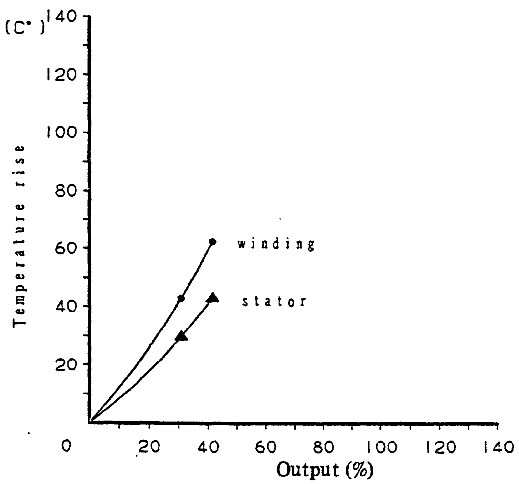


Notes: Continuous rated output (5.5 kW) is set at 100%.

4.4 Model B17 (Graph 1)

MODEL B17 (BASE 330 rpm. 5.5/7.5 kW) Cooling DATA

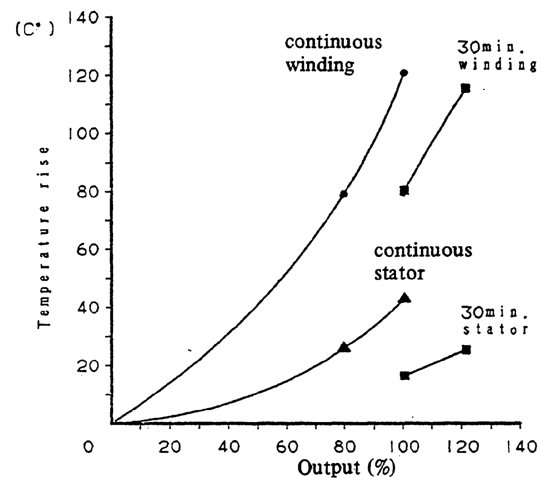
1)Condition of cooling
· 0 Litter/min
· 0 kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B17 (BASE 330 rpm. 5.5/7.5 kW) Cooling DATA

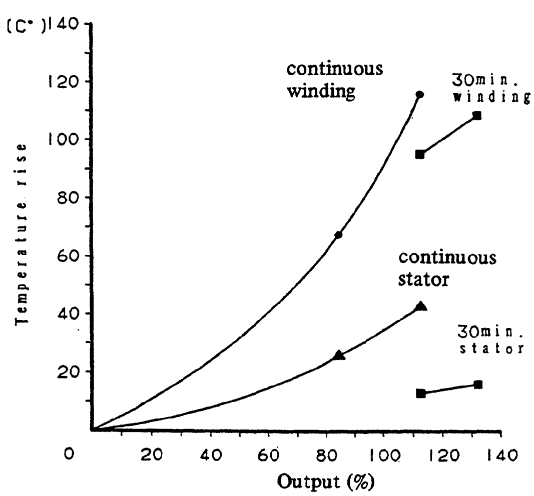
1)Condition of cooling
· 5 Litter/min
·3000kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B17 (BASE 330 rpm. 5.5/7.5 kW) Cooling DATA

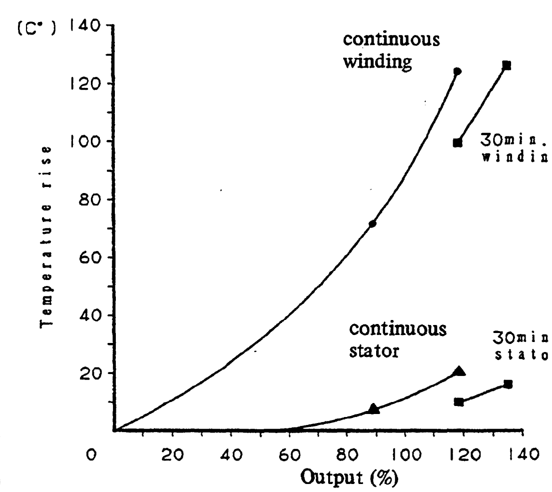
1)Condition of cooling
· 7 Litter/min
·4000kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

MODEL B17 (BASE 330 rpm. 5.5/7.5 kW) Cooling DATA

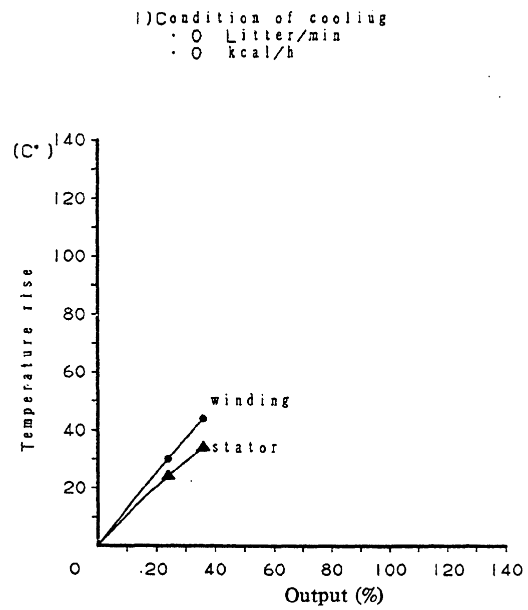
1)Condition of cooling
· 7 Litter/min
·5000kcal/h



Notes: Continuous rated output (5.5 kW) is set at 100%.

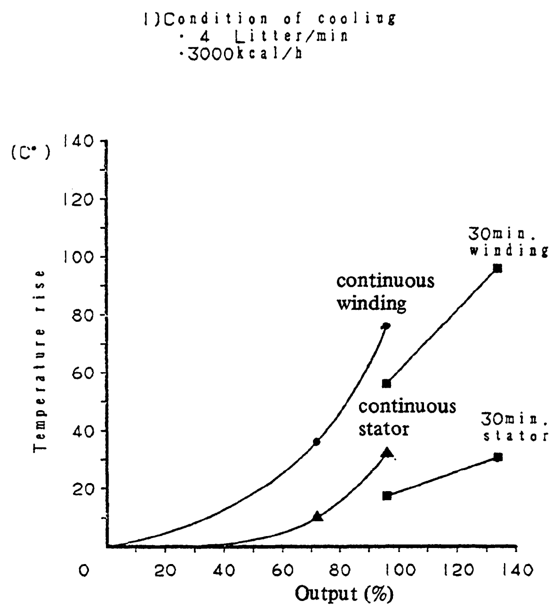
4.5 Model B26 (Graph 1)

MODEL B26 (BASE 450 rpm. 7.5/11 kW) Cooling DATA



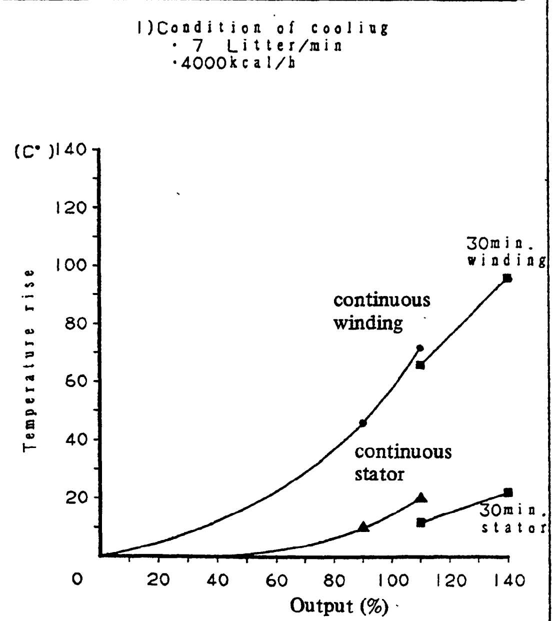
Notes: Continuous rated output (7.5 kW) is set at 100%.

MODEL B26 (BASE 450 rpm. 7.5/11 kW) Cooling DATA



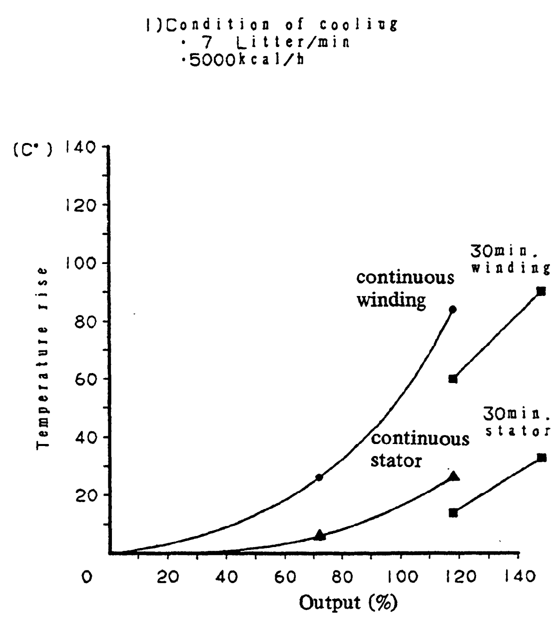
Notes: Continuous rated output (7.5 kW) is set at 100%.

MODEL B26 (BASE 450 rpm. 7.5/11 kW) Cooling DATA



Notes: Continuous rated output (7.5 kW) is set at 100%.

MODEL B26 (BASE 450 rpm. 7.5/11 kW) Cooling DATA

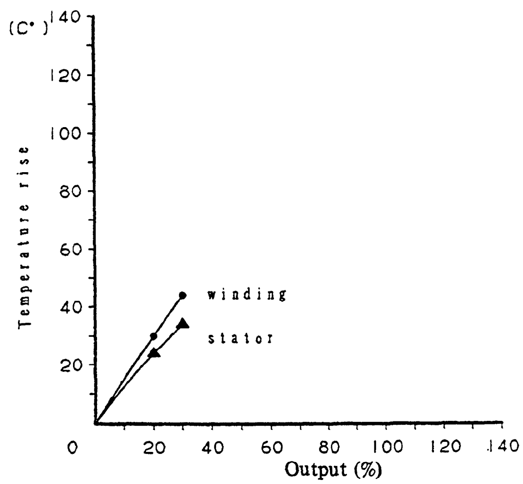


Notes: Continuous rated output (7.5 kW) is set at 100%.

4.6 Model B26 (Graph 2)

MODEL B26 (BASE 380 rpm. 7.5/11 kW) Cooling DATA

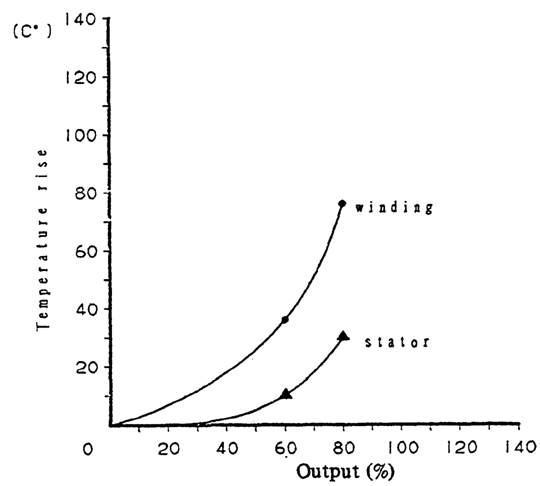
1)Condition of cooling
· 0 Litter/min
· 0 kcal/h



Notes: Continuous rated output (7.5 kW) is set at 100%.

MODEL B26 (BASE 380 rpm. 7.5/11 kW) Cooling DATA

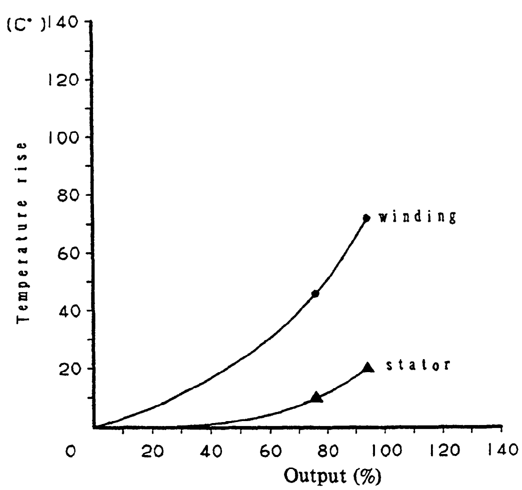
1)Condition of cooling
· 4 Litter/min
·3000kcal/h



Notes: Continuous rated output (7.5 kW) is set at 100%.

MODEL B26 (BASE 380 rpm. 7.5/11 kW) Cooling DATA

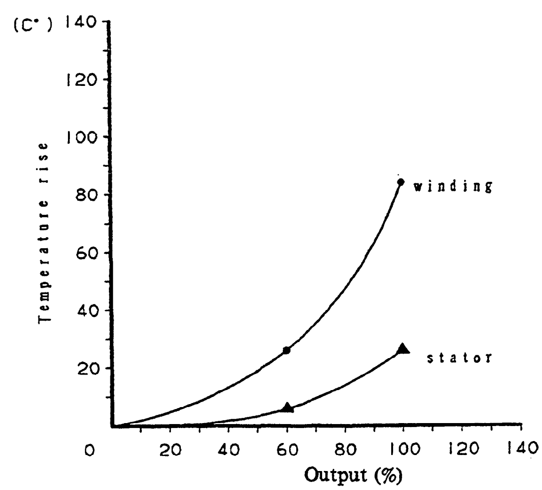
1)Condition of cooling
· 7 Litter/min
·4000kcal/h



Notes: Continuous rated output (7.5 kW) is set at 100%.

MODEL B26 (BASE 380 rpm. 7.5/11 kW) Cooling DATA

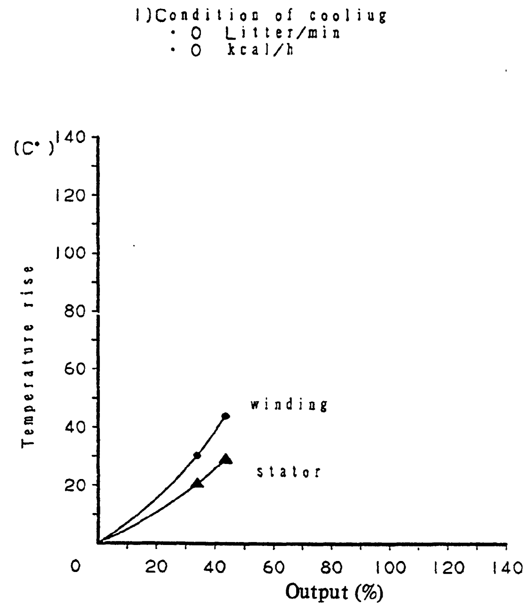
1)Condition of cooling
· 7 Litter/min
·5000kcal/h



Notes: Continuous rated output (7.5 kW) is set at 100%.

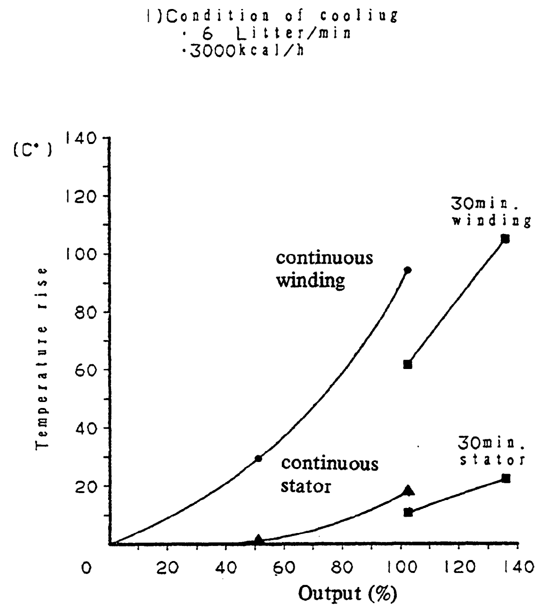
4.7 Model B28 (Graph 1)

MODEL B28 (BASE 500 rpm. 11/15 kW) Cooling DATA



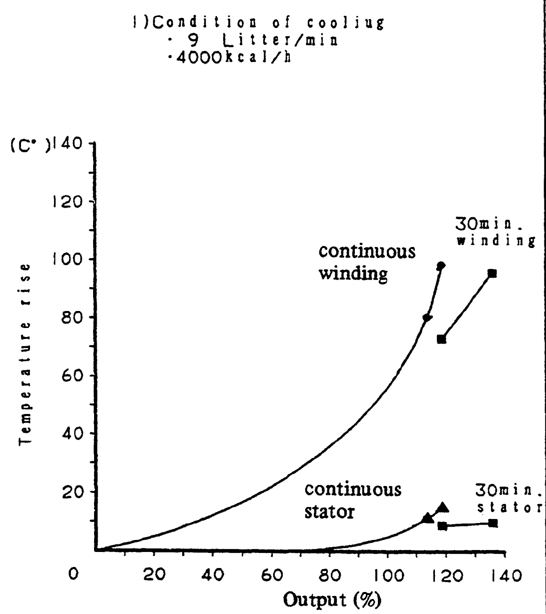
Notes: Continuous rated output (11 kW) is set at 100%.

MODEL B28 (BASE 500 rpm. 11/15 kW) Cooling DATA



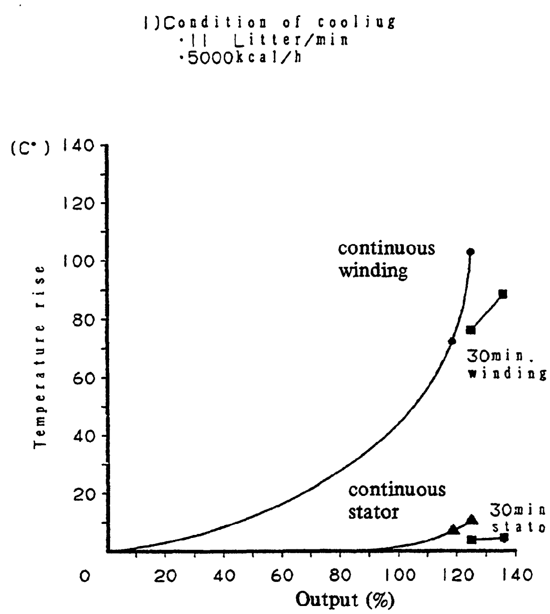
Notes: Continuous rated output (11 kW) is set at 100%.

MODEL B28 (BASE 500 rpm. 11/15 kW) Cooling DATA



Notes: Continuous rated output (11 kW) is set at 100%.

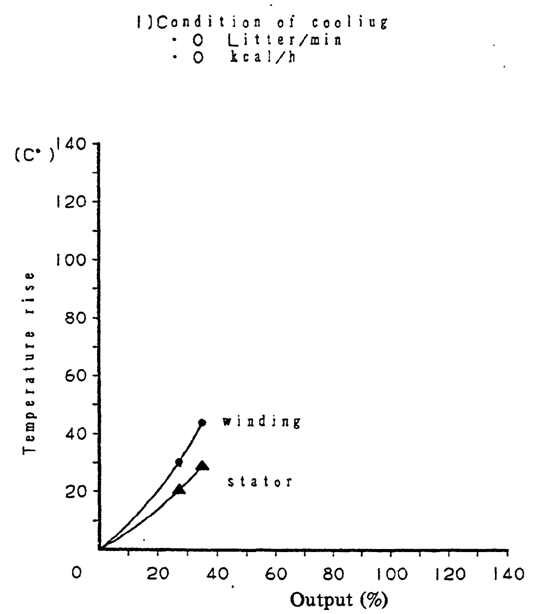
MODEL B28 (BASE 500 rpm. 11/15 kW) Cooling DATA



Notes: Continuous rated output (11 kW) is set at 100%.

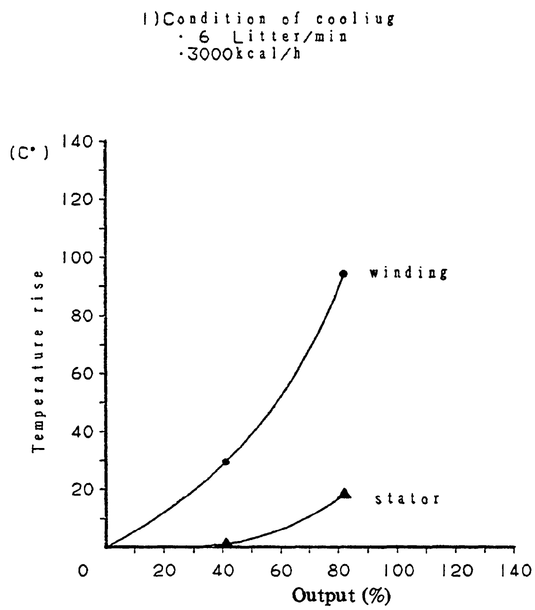
4.8 Model B28 (Graph 2)

MODEL B28 (BASE 400 rpm. 11/15 kW) Cooling DATA



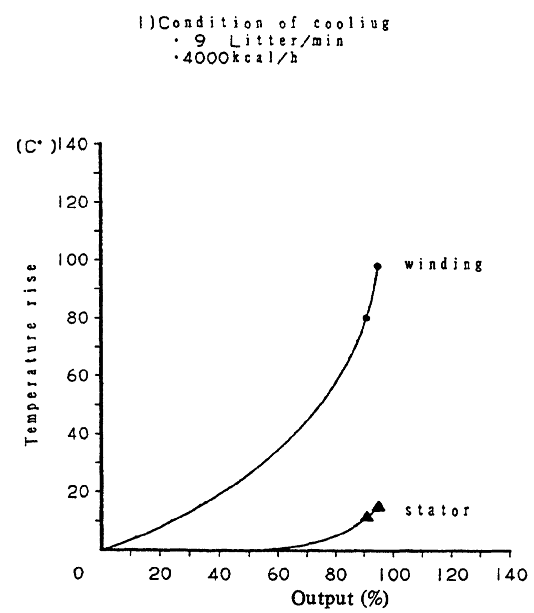
Notes: Continuous rated output (11 kW) is set at 100%.

MODEL B28 (BASE 400 rpm. 11/15 kW) Cooling DATA



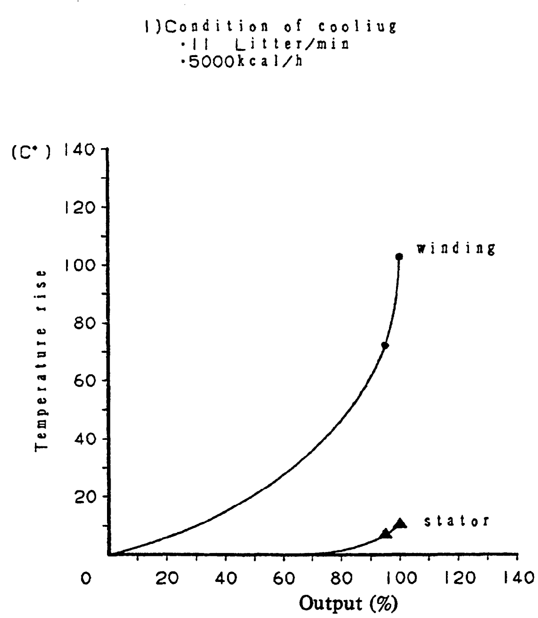
Notes: Continuous rated output (11 kW) is set at 100%.

MODEL B28 (BASE 400 rpm. 11/15 kW) Cooling DATA



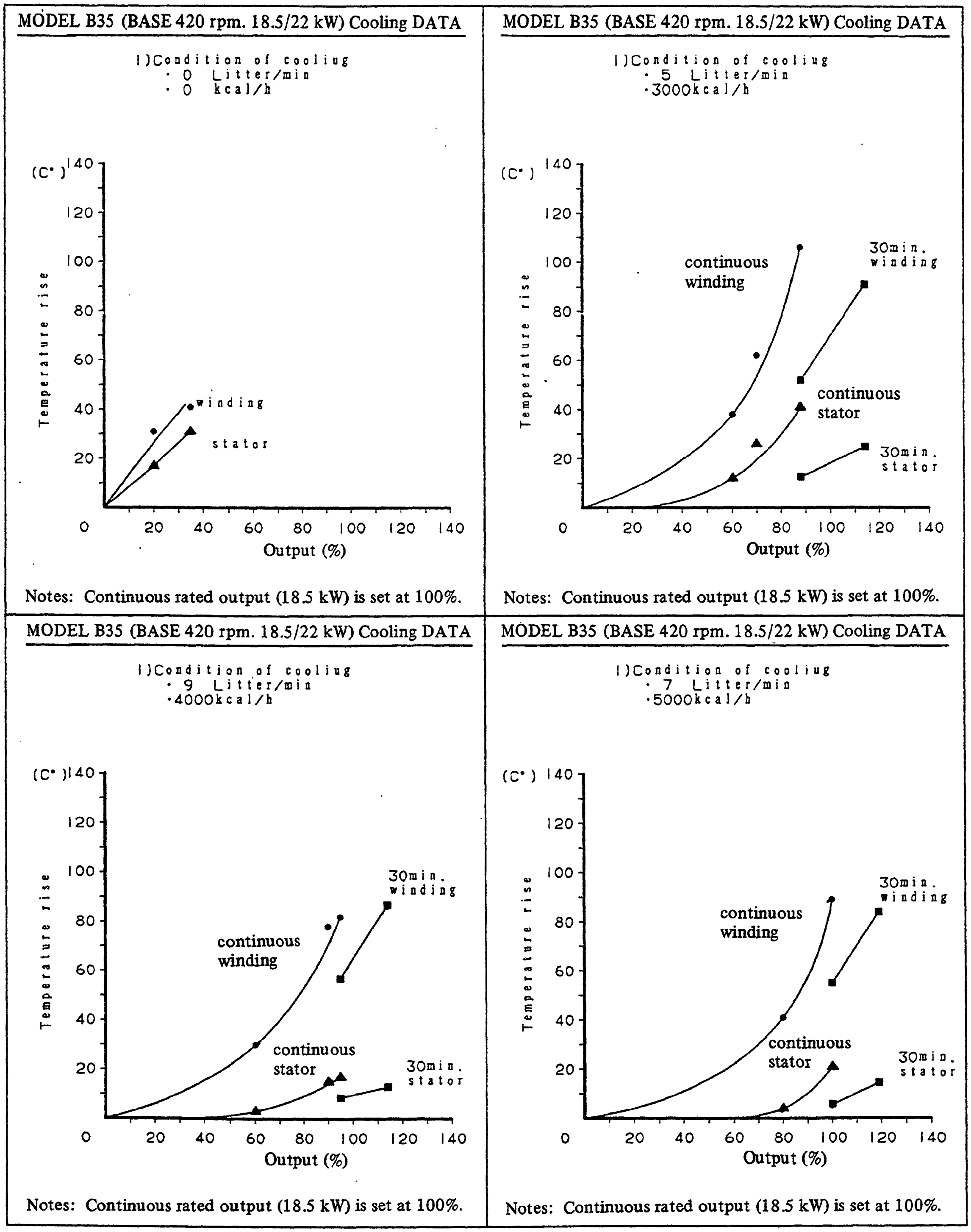
Notes: Continuous rated output (11 kW) is set at 100%.

MODEL B28 (BASE 400 rpm. 11/15 kW) Cooling DATA



Notes: Continuous rated output (11 kW) is set at 100%.

4.9 Model B35 (Graph 1)



XI. ORDERING NUMBERS OF BUILT-IN MOTORS

1. OVERVIEW

The following section lists the ordering numbers for built-in motors. For details of the signal conversion circuit and speed range switching control, see the corresponding chapter. Before placing an order, check the ordering number in the order list for the built-in AC spindle motor serial interface S series (B-65051).

2. ORDERING SPECIFICATION DRAWING NUMBERS (ALL MODELS)

Model	Ordering number(*1)			Speed range switching control (*2)	Sensor(*3)							
	Built-in AC spindle motor	AC spindle servo unit.	Parameter specifications		Built-in				High-resolution magnetic pulse coder			
					1	2	3	4	1	2	3	4
B0.3	A06B-0953-B612	A06B-6064-H301#H550	A06B-6064-L127	—		O						
B0.5	A06B-0955-B612	A06B-6064-H301#H550	A06B-6064-L113	—		O						
	A06B-0955-B612	A06B-6064-H302#H550	A06B-6064-L128	—		O						
B1	A06B-0921-B312	A06B-6064-H301#H550	A06B-6064-L129	—		O						
	A06B-0921-B612	A06B-6064-H301#H550	A06B-6064-L129	—		O						
B1.5	A06B-0951-B312	A06B-6064-H302#H550	A06B-6064-L130	—		O						
	A06B-0951-B612	A06B-6064-H302#H550	Under development	—		O						
B2	A06B-0922-B312	A06B-6064-H302#H550	A06B-6064-L120	—		O						
	A06B-0922-B612	A06B-6064-H302#H550	A06B-6064-L120	—		O						
	A06B-0922-B311	A06B-6064-H302#H550	A06B-6064-L120	—	O							
	A06B-0922-B611	A06B-6064-H302#H550	A06B-6064-L120	—	O							
	A06B-0922-B641	A06B-6064-H302#H550	A06B-6064-L120	—					O			
	A06B-0922-B341	A06B-6064-H302#H550	A06B-6064-L120	—					O			
	A06B-0922-B907	A06B-6064-H306#H550	A06B-6064-L515	Provided								
B2(8)	A06B-0982-B611	A06B-6064-H306#H550	A06B-6064-L516	Provided	O							
	A06B-0982-B642	A06B-6064-H306#H550	A06B-6064-L516	Provided						O		
B3	A06B-0923-B311	A06B-6064-H306#H550	A06B-6064-L517	Provided	O							
	A06B-0923-B312	A06B-6064-H306#H550	A06B-6064-L517	Provided		O						
B6	A06B-0926-B311	A06B-6064-H306#H550	A06B-6064-L131	—	O							
	A06B-0926-B311	A06B-6064-H308#H550	A06B-6064-L132	—	O							
	A06B-0926-B711	A06B-6064-H306#H550	A06B-6064-L131	—	O							
	A06B-0926-B711	A06B-6064-H308#H550	A06B-6064-L132	—	O							
	A06B-0926-B341	A06B-6064-H306#H550	A06B-6064-L131	—					O			
	A06B-0926-B341	A06B-6064-H308#H550	A06B-6064-L132	—					O			
	A06B-0926-B344	A06B-6064-H306#H550	A06B-6064-L131	—								O
	A06B-0926-B344	A06B-6064-H308#H550	A06B-6064-L132	—								O
	A06B-0926-B741	A06B-6064-H306#H550	A06B-6064-L131	—					O			
	A06B-0926-B741	A06B-6064-H308#H550	A06B-6064-L132	—					O			
	A06B-0926-B742	A06B-6064-H306#H550	A06B-6064-L131	—						O		
	A06B-0926-B742	A06B-6064-H308#H550	A06B-6064-L132	—						O		
	A06B-0926-B611	A06B-6064-H322#H550	A06B-6064-L133	—	O							
B8	A06B-0958-B311	A06B-6064-H312#H550	A06B-6064-L134	—	O							
	A06B-0958-B111	A06B-6064-H312#H550	A06B-6064-L511	Provided	O							
	A06B-0958-B611	A06B-6064-H312#H550	A06B-6064-L511	Provided	O							
	A06B-0958-B111	A06B-6064-H315#H550	A06B-6064-L519	Provided	O							
	A06B-0958-B511	A06B-6064-H327#H550	A06B-6064-L520	Provided	O							
	A06B-0958-B711	A06B-6064-H327#H550	A06B-6064-L520	Provided	O							

*1 The ordering numbers for parameter specifications are included. The parameter specifications define the output characteristics of the motor and list parameters for each spindle. Both the motor and amplifier must be specified.

*2 When connecting a model having the speed range switching control, check the power line connection indicated in the outline drawing of the stator, then connect the power line according to the described method.

Model	Ordering number			Speed range switching control	Sensor							
	Built-in AC spindle motor	AC spindle servo unit.	Parameter specifications		Built-in				High-resolution magnetic pulse coder			
					1	2	3	4	1	2	3	4
B10	A06B-0930-B111	A06B-6064-H312#H550	A06B-6064-L521	Provided	○							
	A06B-0930-B111	A06B-6064-H315#H550	A06B-6064-L522	Provided	○							
	A06B-0930-B611	A06B-6064-H312#H550	A06B-6064-L521	Provided	○							
	A06B-0930-B611	A06B-6064-H315#H550	A06B-6064-L522	Provided	○							
B12	A06B-0932-B902	A06B-6064-H315#H550	A06B-6064-L523	Provided	○							
	A06B-0932-B411	A06B-6064-H326#H550	A06B-6064-L524	Provided	○							
	A06B-0932-B901	A06B-6064-H326#H550	A06B-6064-L524	Provided	○							
B15	A06B-0935-B311	A06B-6064-H322#H550	A06B-6064-L135	—	○							
B17	A06B-0937-B111	A06B-6064-H312#H550	A06B-6064-L525	Provided	○							
	A06B-0937-B643	A06B-6064-H312#H550	A06B-6064-L525	Provided							○	
	A06B-0937-B901	A06B-6064-H312#H550	A06B-6064-L525	Provided	○							
B26	A06B-0946-B901	A06B-6064-H312#H550	A06B-6064-L526	Provided				○				
	A06B-0946-B311	A06B-6064-H315#H550	A06B-6064-L527	Provided	○							
	A06B-0946-B311	A06B-6064-H318#H550	A06B-6064-L528	Provided	○							
	A06B-0946-B611	A06B-6064-H315#H550	A06B-6064-L527	Provided	○							
	A06B-0946-B611	A06B-6064-H318#H550	A06B-6064-L528	Provided	○							
	A06B-0946-B343	A06B-6064-H315#H550	A06B-6064-L527	Provided							○	
	A06B-0946-B343	A06B-6064-H318#H550	A06B-6064-L528	Provided							○	
	A06B-0946-B643	A06B-6064-H315#H550	A06B-6064-L527	Provided							○	
	A06B-0946-B643	A06B-6064-H318#H550	A06B-6064-L528	Provided							○	
	A06B-0946-B901	A06B-6064-H315#H550	A06B-6064-L535	Provided				○				
B28	A06B-0960-B901	A06B-6064-H312#H550	A06B-6064-L529	Provided	○							
	A06B-0960-B011	A06B-6064-H315#H550	A06B-6064-L530	Provided	○							
	A06B-0960-B111	A06B-6064-H326#H550	A06B-6064-L531	Provided	○							
	A06B-0960-B143	A06B-6064-H326#H550	A06B-6064-L531	Provided							○	
B35	A06B-0965-B111	A06B-6064-H326#H550	A06B-6064-L532	Provided	○							
	A06B-0965-B901	A06B-6064-H326#H550	A06B-6064-L532	Provided	○							
B40	A06B-0970-B313	A06B-6064-H030#H520	Under development	—			○					
	A06B-0970-B313	A06B-6064-H040#H520	A06B-6064-L138	—			○					
	A06B-0970-B344	A06B-6064-H030#H521	Under development	—								○
	A06B-0970-B344	A06B-6064-H040#H521	A06B-6064-L138	—								○
B45(8)	A06B-0988-B313	A06B-6064-H326#H550	A06B-6064-L533	Provided			○					
	A06B-0988-B901	A06B-6064-H326#H550	A06B-6064-L533	Provided								○
B50	A06B-0973-B611	A06B-6064-H040#H520	A06B-6064-L534	Provided	○							

*3 The model with a built-in sensor requires a signal conversion circuit. The model with a high-resolution magnetic pulse coder requires a detection circuit. For details, see the corresponding chapter. The ordering numbers for the sensors indicated in the table are listed below:

No.	1	2	3	4
Built-in sensor A860-0392-	T011	T012	T013	T014
Number of teeth on the ring	256	128	512	256
High-resolution magnetic pulse coder	T141	T142	T143	T144
Outside diameter of the drum	65	97.5	130	195

*4 For fuses and transformers, see the ordering list of the S series.

3. SIGNAL CONVERSION CIRCUIT CABLE ORDER SPECIFICATION NUMBER (OPTIONAL)

Name	Order specification number	Use
Cable K10	A06B-6059-K804 (0.5 m)	Built-in sensor ⇔ relay ⇔ AMP plug (K11)
	A06B-6059-K805 (1.0 m)	Built-in sensor ⇔ relay ⇔ AMP plug (K11)
Cable K11	A06B-6059-K806 (7.0 m)	AMP plug (K11) ⇔ Signal conversion circuit
Cable K16	A06B-6059-K803 (7.0 m)	Signal conversion circuit ⇔ NC machine

4. BUILT-IN SENSOR CONNECTOR ORDER SPECIFICATION NUMBER (OPTIONAL)

Name	Order specification number	Detail	Appropriate cable
Honda manufactured connector (crimp-style)	A06B-6059-K105	Connector Z-374 (2) Contact HKP-F413 (14)	K10
AMP manufactured connector (crimp-style)	A06B-6059-K106	Cap 350783-1 (1) Pin 350706-7 (14)	K10
		Plug 350735-1 (1) Socket 350689-6 (14)	K11

Reference) Handling tool number

Connector	Crimping tool	Extracting tool
Honda manufactured connector	KP-309	HKP-KF
AMP manufactured connector	90300-2	458994-2

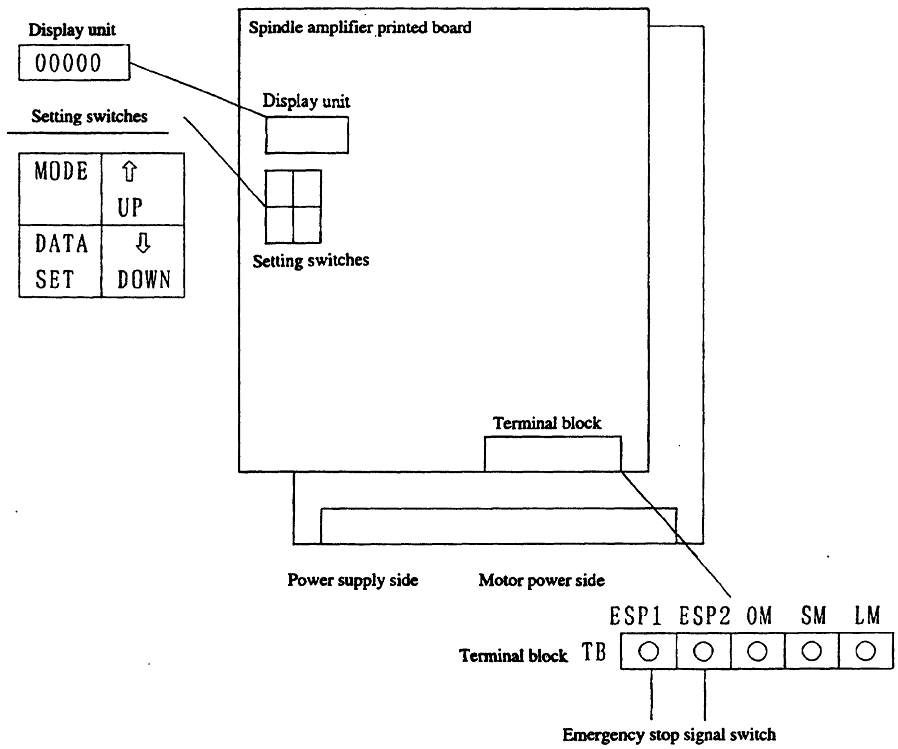
XII. HOW TO OPERATE THE SPINDLE MOTOR WITH A SINGLE SERIAL SPINDLE AMPLIFIER AND WITHOUT THE CNC UNIT

1. OUTLINE

This section describes how to supply power to a spindle motor through a serial spindle amplifier without using a CNC.

2. CONFIGURATION

The display unit and setting switches on the spindle amplifier printed board are used to execute this function. The following figure shows the configuration.



3. USE

3.1 Preparation

(1) Connect the power supply line, motor power line, and signal line.

(2) Mount the emergency stop signal (ESP) switch on ESP1 and ESP2 of the terminal block TB.

(3) Turn the power on.

(4) [SU-01] will blink on the display unit.

3.2 Operation

(1) Press the four setting switches simultaneously for more than 1 second.
[FFFFF] will be displayed.

(2) Pressing mode switch [MODE] displays [d-00]. The mode is changed to the internal data monitor mode.

(3) Release mode switch [MODE], [d-00] disappears about 0.5 second later, then data is displayed for about a second. The initial value of the data is 0.

(4) Change the data within this one second by pressing [↑ UP] or [↓ DOWN].

(5) When one second passes, the mode is changed automatically to the speed display mode, inhibiting data change. Turning [MODE] on and off allows data to be changed again.

(6) The following table explains mode d-00.

Mode	Data	Mode name	Display
d-00	0	Parameter check mode	F-□□□
	1	Internal data monitor mode	0000
	2	Serial unit operation mode	SI-□□
	3	Automatic operation mode	Ad-□□
	4	Parameter change mode	P-□□□
	5	--	----------------------

3.3 Operation in SI (Serial Unit Operation) Mode

The initialization parameter for the serial spindle motor is automatically loaded according to the following procedure performed in SI mode.

(1) Change [d-00] data to [00002], and press [MODE] and [DATA SET] simultaneously within one second. [CCCCC] will be displayed about a second later.
Releasing [MODE] and [DATA SET] displays [PLoAd], which blinks.

(2) Pressing mode switch [MODE] displays [SI-□□].

(3) Release mode switch [MODE] . [SI-□□] disappears about 0.5 second later, and data is displayed for about one second.

(4) To change data, press [MODE] while data is displayed during this one second.
Use [↑ UP] or [↓ DOWN] to change the value in□□ .
The numbers used in SI mode are explained in the table below.

(5) After one second passes, the numbers cannot be changed. To reenable change, turn [MODE] on and off again.

(6) Set initialization parameter data according to the motor model code as follows:
Select [SI-18], then enter the specified model code as data. Then select [SI-17] and hold down both the [↑ UP] or [↓ DOWN] keys.
The display on the display unit counts from [F-000] to [F-355]. When count-up has been completed, all parameters have been loaded.

(7) The following table explains the SI mode numbers.

SI mode	Meaning	Abbreviation
SI-00		
*SI-01	Velocity command	VCMD
SI-02		
SI-03		
SI-04		
*SI-05	Reverse-rotation motor command	SRV
*SI-06	Normal-rotation motor command	SFR
SI-07		
*SI-08	Machine-ready signal	MRDY
*SI-09	Emergency stop signal	ESP
SI-10		
SI-11		
SI-12		
SI-13		
SI-14		
SI-15		
SI-16		
*SI-17	Parameter setting (loading)	
*SI-18	Model code	
SI-19		
SI-20		
SI-21		
SI-22		
SI-23		
SI-24		
SI-24		

Note) The numbers marked with * are used for motor control.

3.4 Changing Motor Model Parameters When the Motor Model Code Is Not Provided

If the motor model code is not provided, select [SI-18], and set 0 as the model code. The select [SI-17] and execute automatic parameter loading as shown in Section 3.3.

After parameter loading, the parameters specific to the motor must be changed according to the following procedure.

(1) Change the mode to P-□□□ (parameter change mode).
Press the four setting switches simultaneously for more than one second.
[FFFFF] is displayed and the mode is changed to [d-00]. Change [d-00] data to [00004], and press both [MODE] and [DATA SET] simultaneously within about a second. [CCCCC] is displayed and the mode is changed to P-□□□.

(2) Pressing mode switch [MODE] displays [P-□□□].

(3) Release mode switch [MODE]. [P-□□□] disappears about 0.5 second later, and the parameter data is displayed for about a second.

(4) To change parameter numbers in P-□□□, Press [↑ UP] or [↓ DOWN] while pressing [MODE].

(5) To change parameter data, press [↑ UP] or [↓ DOWN] while during the second in which the data is displayed.

(6) When one second passes, data cannot be changed. To reenable change, turn [MODE] on and off again.

(7) If parameter data is large, the digits place of the data to be changed can be shifted. For relationships between CNC parameter numbers and P-□□□ numbers, see Section 4.4.

To shift the digits place, press [↑ UP] or [↓ DOWN] along with [DATA SET] during the second in which the data is displayed.

Note) The parameters set in the unit operation mode are all deleted when the power is turned off. They must be set again after power is turned on.

(8) For bit parameters, set two parameters together in one . Set even address data in high-order bytes, and odd address data in low-order bytes of . Set them in 4-bit units as hexadecimal numbers.

Example) For parameter No. 6512 = 00000000 and No. 6513 = 00011010 in series 0C, P-006 = 0001A is set.

(9) To control the low-speed characteristics of a speed range switching motor, set the low-speed characteristics parameter data in the corresponding high-speed-characteristics parameters.

3.5 Operation

When parameter setting is completed, the mode is changed to the SI mode by performing the following operation.

(1) Press the four setting switches simultaneously for more than one second.
$\boxed{\text{FFFFF}}$ is then displayed, and the mode is changed to the $\boxed{\text{d-00}}$ mode. Change the $\boxed{\text{d-00}}$ data to $\boxed{\text{00002}}$, then press $\boxed{\text{MODE}}$ and $\boxed{\text{DATA SET}}$ simultaneously within about a second.
$\boxed{\text{CCCCC}}$ is then displayed and the mode is changed to the SI-□□ mode.

(2) Turning on the magnetic contactor
Turn the emergency stop signal (ESP) switch on. (Strap ESP1 and ESP2 on terminal block TB.)
Select SI-08, and set data 00001 to turn on the machine-ready signal.
Select SI-09, and set data 00001 to turn on the emergency stop signal.
The magnetic contactor in the spindle amplifier will be turned on.

(3) Supplying power to the spindle motor
Select SI-06, and set data 00001 to turn on the normal-rotation motor command (SFR).
(Select SI-05, and set data 00001 to turn on the abnormal-rotation motor command.)
For this setting, the spindle motor is excited.

(4) Entering the velocity command
Set data for the speed command in SI-01 in units of rpm.
The change digits used for setting data can be shifted according to Item (7) in Section 3.4.

(5) Stopping rotation
A. Turn off the normal-rotation motor command (SFR). (Turn off SRV for the reverse-rotation motor command.)
→ Set SI-06 = 00000. (Set SI-05 = 00000 for the reverse-rotation motor command.)
B. Set the velocity command to zero.
→ Set SI-01 = 00000. For this setting, the motor is excited.
C. Turn off the emergency stop signal (ESP) switch.
→ Rotation decelerates until it stops, and MCC in the spindle amplifier is turned off.
D. Turn off the emergency stop signal (SI-09) or machine-ready signal (SI-08).
→ Set SI-09 = 00000 or SI-08 = 00000.
→ Rotation decelerates until it stops, and MCC in the spindle amplifier is turned off.

3.6 Parameters

Power Mate	Series 0 first spindle side	Series 0 second spindle side	Series 15 first spindle side	Series 15TT second spindle side	Series 16	Contents	Internal data number
3000	6500	6640	3000	3140	4000	Bit parameter	000
3001	6501	6641	3001	3141	4001	Bit parameter	
3002	6502	6642	3002	3142	4002	Bit parameter	001
3003	6503	6643	3003	3143	4003	Bit parameter	
3004	6504	6644	3004	3144	4004	Bit parameter	002
3005	6505	6645	3005	3145	4005	Bit parameter	
3006	6506	6646	3006	3146	4006	Bit parameter	003
3007	6507	6647	3007	3147	4007	Bit parameter	
3008	6508	6648	3008	3148	4008	Bit parameter	004
3009	6509	6649	3009	3149	4009	Bit parameter	
3010	6510	6650	3010	3150	4010	Bit parameter	005
3011	6511	6651	3011	3151	4011	Bit parameter	
3012	6512	6652	3012	3152	4012	Bit parameter	006
3013	6513	6653	3013	3153	4013	Bit parameter	
3014	6514	6654	3014	3154	4014	Bit parameter	007
3015	6515	6655	3015	3155	4015	Bit parameter	
3016	6516	6656	3016	3156	4016	Bit parameter	008
3017	6517	6657	3017	3157	4017	Bit parameter	
3018	6518	6658	3018	3158	4018	Bit parameter	009
3019	6519	6659	3019	3159	4019	Bit parameter	
3020	6520	6660	3020	3160	4020	Maximum speed	010
3021	6521	6661	3021	3161	4021	Maximum speed in Cs contouring control	011
3022	6522	6662	3022	3162	4022	Speed arrival level	012
3023	6523	6663	3023	3163	4023	Speed detecting level	013
3024	6524	6664	3024	3164	4024	Speed zero detecting level	014
3025	6525	6665	3025	3165	4025	Setting of torque limit value	015
3026	6526	6666	3026	3166	4026	Load detecting level 1	016
3027	6527	6667	3027	3167	4027	Load detecting level 2	017
3028	6528	6668	3028	3168	4028	Output limit pattern setting	018
3029	6529	6669	3029	3169	4029	Output limit vlaue	019
3030	6530	6670	3030	3170	4030	Soft start/stop setting time	020
3031	6531	6671	3031	3171	4031	Position coder method orientation stop position	021
3032	6532	6672	3032	3172	4032	Acceleration/deceleration time constant at spindle synchronization control	022
3033	6533	6673	3033	3173	4033	Spindle synchronization speed arrival level	023
3034	6534	6674	3034	3174	4034	Shift amount at spindle phase synchronization control	024
3035	6535	6675	3035	3175	4035	Spindle phase synchronization compensation data	025
3036	6536	6676	3036	3176	4036	Feedforward coefficient	026
3037	6537	6677	3037	3177	4037	Velocity loop feedforward coefficient	027
3038	6538	6678	3038	3178	4038	Reserved	028
3039	6539	6679	3039	3179	4039	Reserved	029
3040	6540	6680	3040	3180	4040	Velocity loop proportion gain on normal operation (HIGH)	030
3041	6541	6681	3041	3181	4041	Velocity loop proportion gain on normal operation (LOW)	031
3042	6542	6682	3042	3182	4042	Velocity loop proportion gain on orientation (HIGH)	032
3043	6543	6683	3043	3183	4043	Velocity loop proportion gain on orientation (LOW)	033
3044	6544	6684	3044	3184	4044	Velocity loop proportion gain on servo mode (HIGH)	034

Power Mate	Series 0 first spindle side	Series 0 second spindle side	Series 15 first spindle side	Series 15TT second spindle side	Series 16	Contents	Internal data number
3045	6545	6685	3045	3185	4045	Velocity loop proportion gain on servo mode (LOW)	035
3046	6546	6686	3046	3186	4046	Velocity loop proportion gain in Cs contouring control (HIGH)	036
3047	6547	6687	3047	3187	4047	Velocity loop proportion gain in Cs contouring control (LOW)	037
3048	6548	6688	3048	3188	4048	Velocity loop integral on normal operation (HIGH)	038
3049	6549	6689	3049	3189	4049	Velocity loop integral on normal operation (LOW)	039
3050	6550	6690	3050	3190	4050	Velocity loop integral gain on orientation (HIGH)	040
3051	6551	6691	3051	3191	4051	Velocity loop integral gain on orientation (LOW)	041
3052	6552	6692	3052	3192	4052	Velocity loop integral gain on servo mode (HIGH)	042
3053	6553	6693	3053	3193	4053	Velocity loop integral gain on servo mode (LOW)	043
3054	6554	6694	3054	3194	4054	Velocity loop integral gain in Cs contouring control (HIGH)	044
3055	6555	6695	3055	3195	4055	Velocity loop integral gain in Cs contouring control (LOW)	045
3056	6556	6696	3056	3196	4056	Gear ratio (HIGH)	046
3057	6557	6697	3057	3197	4057	Gear ratio (MEDIUM HIGH)	047
3058	6558	6698	3058	3198	4058	Gear ratio (MEDIUM LOW)	048
3059	6559	6699	3059	3199	4059	Gear ratio (LOW)	049
3060	6560	6700	3060	3200	4060	Position gain on orientation (HIGH)	050
3061	6561	6701	3061	3201	4061	Position gain on orientation (MEDIUM HIGH)	051
3062	6562	6702	3062	3202	4062	Position gain on orientation (MEDIUM LOW)	052
3063	6563	6703	3063	3203	4063	Position gain on orientation (LOW)	053
3064	6564	6704	3064	3204	4064	Modification rate of position gain on orientation completion	054
3065	6565	6705	3065	3205	4065	Position gain on servo mode (HIGH)	055
3066	6566	6706	3066	3206	4066	Position gain on servo mode (MEDIUM HIGH)	056
3067	6567	6707	3067	3207	4067	Position gain on servo mode (MEDIUM LOW)	057
3068	6568	6708	3068	3208	4068	Position gain on servo mode (LOW)	058
3069	6569	6709	3069	3209	4069	Position gain in Cs contouring control (HIGH)	059
3070	6570	6710	3070	3210	4070	Position gain in Cs contouring control (MEDIUM HIGH)	060
3071	6571	6711	3071	3211	4071	Position gain in Cs contouring control (MEDIUM LOW)	061
3072	6572	6712	3072	3212	4072	Position gain in Cs contouring control (LOW)	062
3073	6573	6713	3073	3213	4073	Grid shift amount in servo mode	063
3074	6574	6714	3074	3214	4074	Origin return speed when Cs contouring/servo mode	064
3075	6575	6715	3075	3215	4075	Orientation completion signal detection	065
3076	6576	6716	3076	3216	4076	Motor speed limit value on orientation	066
3077	6577	6717	3077	3217	4077	Orientation stop position shift value	067
3078	6578	6718	3078	3218	4078	MS signal constant	068
3079	6579	6719	3079	3219	4079	MS signal gain adjustment	069
3080	6580	6720	3080	3220	4080	Limitation of regenerative power	070
3081	6581	6721	3081	3221	4081	Delay time until the motor power is cut off	071
3082	6582	6722	3082	3222	4082	Time setting during acceleration/deceleration	172
3083	6583	6723	3083	3223	4083	Motor voltage setting on normal rotation	073
3084	6584	6724	3084	3224	4084	Motor voltage setting on orientation	074
3085	6585	6725	3085	3225	4085	Motor voltage setting on servo mode	075
3086	6586	6726	3086	3226	4086	Motor voltage setting in Cs contouring control	076
3087	6587	6727	3087	3227	4087	Overspeed level	077
3088	6588	6728	3088	3228	4088	Velocity error excess detecting level on motor restriction	078
3089	6589	6729	3089	3229	4089	Velocity error excess detecting level on motor rotation	079

Power Mate	Series 0 first spindle side	Series 0 second spindle side	Series 15 first spindle side	Series 15TT second spindle side	Series 16	Contents	Internal data number
3090	6590	6730	3090	3230	4090	Overload detecting level	080
3091	6591	6731	3091	3231	4091	Reduction rate of position gain in returning to reference point on servo mode	081
3092	6592	6732	3092	3232	4092	Reduction rate of position gain in Cs contouring control reference point return	082
3093	6593	6733	3093	3233	4093	Estimating constant of acceleration	083
3094	6594	6734	3094	3234	4094	Constant of the torque disturbance compensating	084
3095	6595	6735	3095	3235	4095	Adjustment of speed meter output voltage	085
3096	6596	6736	3096	3236	4096	Adjustment of load meter output voltage	086
3097	6597	6737	3097	3237	4097	Spindle speed feedback gain	087
3098	6598	6738	3098	3238	4098	Maximum speed of position coder 1 revolution signal detection	088
3099	6599	6739	3099	3239	4099	Delay time for motor magnetization	089
3100	6600	6740	3100	3240	4100	Base speed of motor output specifications	090
3101	6601	6741	3101	3241	4101	Limit value for motor output specifications	091
3102	6602	6742	3102	3242	4102	Base speed	092
3103	6603	6743	3103	3243	4103	Magnetic flux down start speed	093
3104	6604	6744	3104	3244	4104	Current loop proportion gain on normal operation	094
3105	6605	6745	3105	3245	4105	Current loop proportion gain in Cs contouring control	095
3106	6606	6746	3106	3246	4106	Current loop integral gain on normal operation	096
3107	6607	6747	3107	3247	4107	Current loop integral gain in Cs contouring control	097
3108	6608	6748	3108	3248	4108	Current loop integral gain zero point	098
3109	6609	6749	3109	3249	4109	Current loop proportion gain speed coefficient	099
3110	6610	6750	3110	3250	4110	Current conversion constant	100
3111	6611	6751	3111	3251	4111	Secondary current coefficient for excitation current	101
3112	6612	6752	3112	3252	4112	Current prediction constant	102
3113	6613	6753	3113	3253	4113	Slip constant	103
3114	6614	6754	3114	3254	4114	Slip compensation constant of high-speed rotation	104
3115	6615	6755	3115	3255	4115	Motor applied voltage compensation constant by dead time	105
3116	6616	6756	3116	3256	4116	Electromotive voltage compensation coefficient	106
3117	6617	6757	3117	3257	4117	Electromotive voltage phase compensation constant	107
3118	6618	6758	3118	3258	4118	Electromotive voltage compensation speed coefficient	108
3119	6619	6759	3119	3259	4119	Time constant of voltage filter for electromotive voltage	109
3120	6620	6760	3120	3260	4120	Dead time compensation data	110
3121	6621	6761	3121	3261	4121	Time constant of torque change	111
3122	6622	6762	3122	3262	4122	Speed detection filter time constant	112
3123	6623	6763	3123	3263	4123	Overlead detecting time	113
3124	6624	6764	3124	3264	4124		114
3125	6625	6765	3125	3265	4125	Timer setting for automatic operation	115
3126	6626	6766	3126	3266	4126	Velocity command on automatic operation	116
3127	6627	6767	3127	3267	4127	Load meter display value on maximum output	117
3128	6628	6768	3128	3268	4128	Maximum output limit zero point	118
3129	6629	6769	3129	3269	4129	Secondary electrical current coefficient on rigid tap	119

Power Mate	Series 0 first spindle side	Series 0 second spindle side	Series 15 first spindle side	Series 15TT second spindle side	Series 16	Contents	Internal data number
3130	6630	6770	3130	3270	4130	Electromagnetic voltage phase compensation constant on deceleration	120
3131	6631	6771	3131	3271	4131	Speed detection filter time constant (on Cs contouring control)	121
3132	6632	6772	3132	3272	4132	V-phase current conversion constant	122
3133	6633	6773	3133	3273	4133	Motor model code	123
3134	6634	6774	3134	3274	4134		124, 125
3135	6635	6775	3135	3275	4135	Grid shift value on Cs contouring control	126, 127

XIII. TROUBLESHOOTING (SERIAL INTERFACE SERIES)

1. TROUBLESHOOTING (SERIAL INTERFACE SERIES)

Perform troubleshooting, referring to each item in Table 1 according to the trouble conditions.

Table 1 Sort of trouble condition

Item	Trouble conditions
1	Power voltage check
2	Power ON indicator lamp PIL does not light.
3	Alarm (AL-□□) is displayed on the PCB.
4	Motor rotation is not as specified.
5	Motor does not rotate.
6	Vibrations and noises are noticeable during rotation.
7	An abnormal noise is produced from motor during deceleration.
8	Motor speed overshoots or hunting occurs.
9	Cutting power drop.
10	Acceleration/deceleration time is longer than specified.
11	Status error has been displayed on the PCB.

1.1 Power Voltage Check

Check AC power voltage and DC power voltage on the spindle control PCB. Test points and standard values are as specified in Table 1.1.

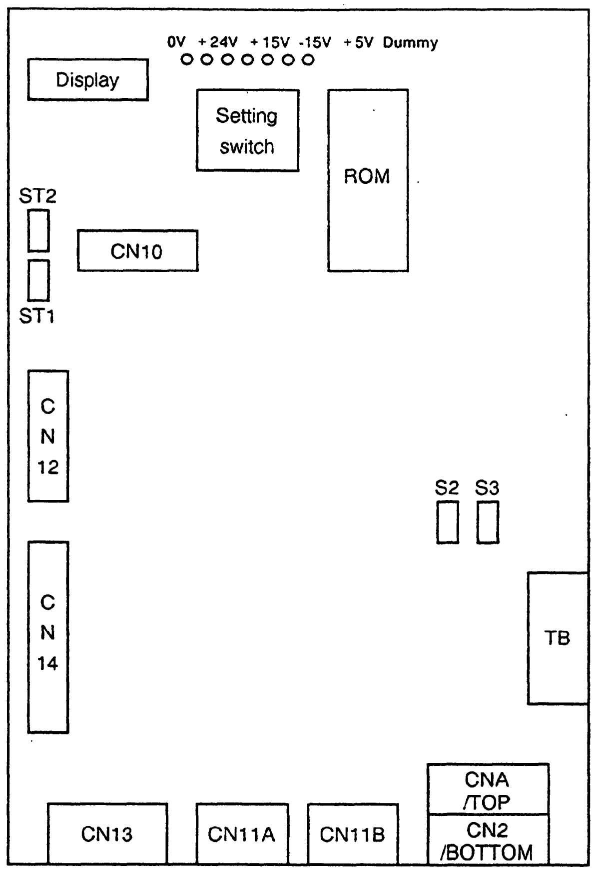
Table 1.1 Power voltage check

<table>
<tr><th>Item</th><th>Check procedure</th></tr>
<tr><td>AC power voltage check</td><td>Check at INPUT terminals R, S, T, G</td></tr>
<tr><td>DC power voltage check on the spindle control PCB</td><td>
<table>
<tr><th>Voltage</th><th>Test points</th><th>Standard value</th></tr>
<tr><td>+24 V</td><td>+24 V −0 V</td><td>About 23 V ±4%</td></tr>
<tr><td>+15 V</td><td>+15 V −0 V</td><td>+15 V ±4%</td></tr>
<tr><td>+5 V (*1)</td><td>+5 V −0 V</td><td>+5 V ±2%</td></tr>
<tr><td>−15 V</td><td>−15 V −0 V</td><td>−15 V ±4%</td></tr>
</table>
</td></tr>
</table>

*1) Power supply voltage +5 V must be adjusted using RV (for models 30S and 40S).
The power supply voltages have been adjusted at the FANUC factory. Do not change them.

Test points

A16B-2201-0440



1.2 Verification of ROM Series and ROM Version

After power is turned ON, "A□□□□" (where "□" represents a blank) appears in the PCB display. Approximately 1 second later the display changes to "10-02", and finally to "SU-01", which flashes. Verify the ROM series and ROM version using the second displayed message, as shown below.

"10 - 02"

↓ ↓

Lower 2 digits of ROM series. — ROM Version

Ex: If series is 9A10, "10" is displayed.

Version	Version A	Version B	...
Display	01	02	...

1.3 When the Power-on Lamp PIL does not Light

Table 1.3 Check procedure and remedy

Item	Causes	Check	Remedy
1	AC power is not supplied.	Check it at power input terminals R, S, T.	
2	Fuse FUR, FUS, or FUT (models 1S to 26S) or fuse F4a or F4b (models 30S and 40S) is blown.	Check the fuses.	Replace fuse FUR, FUS, or FUT (models 1S to 26S) or fuse F4a or F4b (models 30S and 40S) with a new one.
3	Fuse F1 (models 1S to 26S) or fuse AF1, AF2, or AF3 (models 30S and 40S) is blown.	Check if alarm indications of fuses F1, F2, F3 appear.	Check whether the cables for the pulse generator and the position coder are short-circuited. Replace fuse F1 (models 1S to 26S) or fuse AF1, AF2, or AF3 (models 30S and 40S) with a new one. If the fuse blows again after replacement, replace the PC board with a new one.
4	On the PC board, connectors CN4 to CN6 (models 1S to 26S) or connectors CN4 to CN7 (models 30S and 40S) are not inserted correctly.	Check whether the groove of the connector guide shows on the surface of the connector on the PC board.	Insert connectors correctly.
5	19A and 19B are not output because of a failure with transformer TF (for models 30S and 40S).	Check the voltages between check pins 19A and CT and between check pins 19B and CT. If both voltages are approximately 19 V, 19A and 19B are normal.	Replace the transformer with a new one.
6	PCB power circuit is defective.	Lamp PIL is lit by +5 V. Check power voltage according to Table 1.1.	Replace PCB.

1.4 When an Alarm is Indicated

Alarm on AC spindle motor and servo unit are indicated on five digits of seven-segment on the spindle control PCB. Correspondence between seven-segment indications and alarm signals is shown in Table 1.4.

Table 1.4 Alarm

Alarm No.	Meanings	Contents	Remedy
"A" display	Program ROM abnormality (not mounted)	Detects that control program is not starting up. (When not mounted)	Mount the regulation program ROM.
AL-01	Motor overheated	Detects that the internal motor temperature has exceeded the specification.	Check the load. Cool down the motor and reset the alarm.
AL-02	Speed deviation excessive	Detects that the motor speed has greatly slipped from the commanded speed.	Check the load. Reset the alarm.
AL-03	The fuse of the DC link circuit is blown.	Detects that fuse F4 of the DC link circuit is blown (for models 30S and 40S).	Check that the power transistor is normal. Replace the fuse with a new one.
AL-04	The input fuse is blown, or the input power supply is in the open phase.	Detects that one of input fuses F1 to F3 is blown, that a momentary power failure occurred (for models 30S and 40S), or that the input power supply is in the open phase.	Replace the fuse with a new one, check whether the power supply regenerative circuit operates normally, and check whether the input power supply is in the open phase.
AL-05	The fuse of the control power supply circuit is blown.	Detects that fuse AF2 or AF3 of the control power supply circuit is blown (for models 30S and 40S).	Check whether the control power supply is short-circuited, and replace the fuse with a new one.
AL-07	Excessive speed	Detects that the motor has exceeded 115% of its rated number of rotations.	Reset the alarm.
AL-08	The input voltage is too high.	Detects that the selector switch is set to 200 VAC when the input voltage is 230 VAC or higher (for models 30S and 40S)	Set the selector switch to the 230 VAC position.
AL-09	Excess load in the main circuit section.	Detects that the temperature of the radiator for the power transistor cooling has risen abnormally.	Cool down the radiator and reset the alarm.

Alarm No.	Meanings	Contents	Remedy
AL-10	Low voltage of input electric power	Detects that the input electrical power voltage has declined.	Remove the cause and reset the alarm.
AL-11	Excess voltage in DC link section	Detects that the direct current electric power voltage in the power circuit section has risen abnormally.	Remove the cause and reset the alarm.
AL-12	Excess current in DC link section	Detects that excess current flowed in the direct current section of the power circuit.	Remove the cause and reset the alarm.
AL-13	CPU internal data memory abnormality	Detects an abnormality in the CPU internal data memory. Check only when turning on the electric power.	Remove the cause and reset the alarm.
AL-15	Spindle/output switching alarm	Detects that the sequence of spindle/output switching is incorrect.	Check the sequence.
AL-16	RAM error	Detects an error in the RAM for external data. Check only when turning on the electric power.	Remove the cause and reset the alarm.
AL-18	Program ROM sum check abnormality	Detects an abnormality of program ROM data. Check only when turning on the electric power.	Remove the cause and reset the alarm.
AL-19	U-phase current detection circuit offset excessive	Detects that the offset of the U-phase current detection circuit is excessive. Check only when turning on the electric power.	Remove the cause and reset the alarm.
AL-20	V-phase current detection circuit offset excessive	Detects that the offset of the V-phase current detection circuit is excessive. Check only when turning on the electric power.	Remove the cause and reset the alarm.
AL-24	Serial transmission data abnormality	Detects an abnormality in the serial transmission data. (NC electric power OFF etc.)	Remove the cause and reset the alarm.
AL-25	Serial data transmission stopped	Detects that the serial data transmission has stopped.	Remove the cause and reset the alarm.

Alarm No.	Meanings	Contents	Remedy
AL-26	Cs contour control speed detection signal disconnection	Detects an abnormality in the Cs contour control speed detection signal (90000p). (Cable not connected, signal adjustment failure, etc.)	Remove the cause and reset the alarm.
AL-27	Position coder signal disconnection	Detects an abnormality in the position coder signal (Cable not connected, parameter miss setting, etc.)	Remove the cause and reset the alarm.
AL-28	Cs contour control position detection signal disconnection	Detects an abnormality in the Cs contour control position detection signal (90000p). (Cable not connected, signal adjustment failure, etc.)	Remove the cause and reset the alarm.
AL-29	Short time excessive load	Detects that an excessive load has been impressed continuously for a certain time. (Restraining the motor shaft when positioning etc.)	Remove the cause and reset the alarm.
AL-30	Input circuit excess current	Detects excess current has flowed in the input circuit.	Remove the cause and reset the alarm.
AL-31	Speed detection signal disconnection motor restraint	Detects that motor cannot rotate at commanded speed (Very low speeds or stopped). (Check on the cable for the speed detection signal.)	Remove the cause and reset the alarm.
AL-32	Serial data transmission LSI internal RAM abnormality	Detects an abnormality in the serial data transmission LSI internal RAM. Check only when turning on the electric power.	Remove the cause and reset the alarm.
AL-33	DC link section charging insufficient	Detects that the direct current electric power voltage of the power circuit section was not adequately charged when the amplifier internal electro-magnetic contactor is ON. (Out of phase, charge resistance defective, etc.)	Remove the cause and reset the alarm.

Alarm No.	Meanings	Contents	Remedy
AL-34	Parameter data setting exceeded permissible value.	Detects that the parameter data has been set exceeding the permissible value.	Set the correct data.
AL-35	Gear ratio setting data excessive	Detects that the gear ratio data has been set exceeding the permissible value.	Set the correct data.
AL-36	Excessive position deviation	Detects that the error counter has overflowed.	Remove the cause and reset the alarm.
AL-37	Erroneous setting of the parameter for the speed detector	Detects that the parameter for specifying the number of pulses for the speed detector is incorrectly set.	Set correct data in the parameter.
AL-39	Error in detecting the one-rotation signal for Cs contour control	Detects that the one-rotation signal is not received correctly at Cs contour controlling.	Adjust the signal, and check whether the cable is shielded properly.
AL-40	The one-rotation signal for Cs contour control is not detected.	Detects that the one-rotation signal is not issued during Cs contour control.	Adjust the one-rotation signal.
AL-41	Error in detecting the one-rotation signal for the position coder	Detects that the one-rotation signal for the position coder is not received correctly.	When the error occurs in the signal conversion circuit, adjust the one-rotation signal. In other cases, check whether the cable is shielded properly.
AL-42	The one-rotation signal for the position coder is not detected.	Detects that the one-rotation signal for the position coder is not issued.	When the error occurs in the signal conversion circuit, adjust the one-rotation signal.
AL-45	Disconnection of the position coder signal for the differential speed mode	Detects that the position coder signal of the main spindle to be used in the differential speed mode is not connected (disconnection).	Check that the position coder signal of the main spindle is connected to connector CN12.
AL46	Error in detecting the one-rotation signal for the position coder during the threading operation	Detects that the one-rotation signal for the position coder is not received correctly during the threading operation.	When the error occurs in the signal conversion circuit, adjust the one-rotation signal. In other cases, check whether the cable is shielded properly.

Alarm No.	Meanings	Contents	Remedy
AL-47	Error in the position coder signal	Detects that the position coder signal is not counted correctly.	When the error occurs in the signal conversion circuit, adjust the one-rotation signal. In other cases, check whether the cable is shielded properly.
AL-48	Error in the one-rotation signal for the position coder	Detects that the one-rotation signal for the position coder is turned off.	When the error occurs in the signal conversion circuit, adjust the one-rotation signal.
AL-49	Converted differential value is excessive	The remote spindle speed converted to the local one exceeds the allowable maximum value in the differential mode.	Calculate the differential speed by multiplying the remote spindle speed by the gear ratio. Check whether the calculated speed exceeds the maximum speed of the motor.
AL-50	Value of the speed command in spindle synchronous control is excessive	The calculated value of the spindle command in spindle synchronous control exceeds the allowable maximum value.	Calculate the motor speed by multiplying the value of the spindle speed command by the gear ratio. Check whether the calculated value exceeds the maximum speed of the motor.
AL-51	Low voltage at the DC link	The DC voltage of the power circuit is insufficient. (Due to instantaneous power failure, defective electromagnetic contactor, etc.)	Remove the cause of the error and reset the alarm.
AL-52	ITP signal failure I	The synchronization signal (ITP signal) with the CNC unit is not correct. (ITP signal stop, etc.)	Remove the cause of the error and reset the alarm.
AL-53	ITP signal failure II	The synchronization signal (ITP signal) with the CNC unit is not correct. (ITP signal stop, etc.)	Remove the cause of the error and reset the alarm.
AL-54	Overload current alarm	An excessive current has been applied to the motor for a long time.	Check whether the overload operation is executed or whether acceleration/deceleration is executed frequently.

Alarm No.	Meanings	Contents	Remedy
AL-55	Power line failure in spindle/output switching	The switching request signal does not agree with the power-line status check signal.	Check the operation of the electromagnetic contactor for switching the power line. Check whether the power-line status check signal is processed normally.

(1) Alarm "A" indication

A	ROM failure

No.	Cause	Item to check	Action to be taken
1	No control ROM is mounted. Alternatively, the control ROM is not mounted correctly.	Check whether the ROM is inserted correctly in the socket, whether the leads are not bent, and whether the contact is good.	Correctly mount the control ROM.
2	Defective control ROM	Check the ROM series. (The series name is indicated on the ROM package and displayed for one second when the power is turned on.)	Replace it with a correct one.
3	Wrong control ROM (low access speed)	Check the series name of the control ROM (indicated on the package).	Replace it with the correct one.
4	Defective control circuit	Replace the control circuit and check the operation.	Replace the control circuit.

(2) AL-01 : Motor overheats

AL-01	Motor overheat

No.	Cause	Item to check	Action to be taken
1	Defective fan motor in the motor	Check whether the fan motor is rotating.	Replace the fan motor.
2	Overload operation	Check the cutting conditions and the wear of each tool. Use a load meter to check the load during cutting.	Examine the cutting conditions and each tool.
3	Motor cooling system is dirty	Check whether the motor cooling system is dirty.	Clean the cooling system with cleaner or a jet of air.
4	Disconnection or insufficient contact of the motor overheat signal line	Check the connection of the signal line.	Correctly connect the signal line.

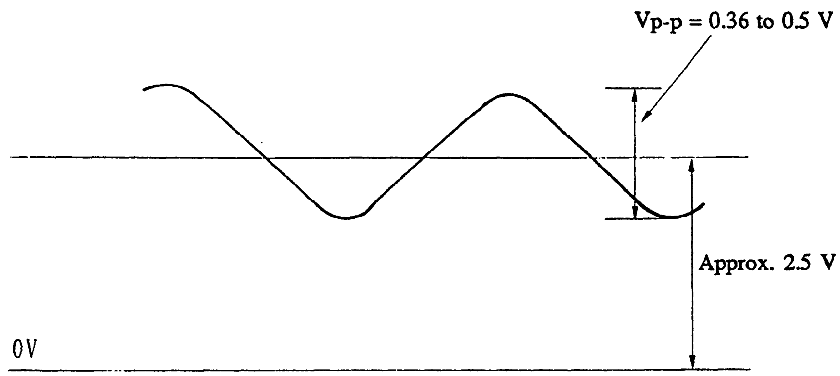
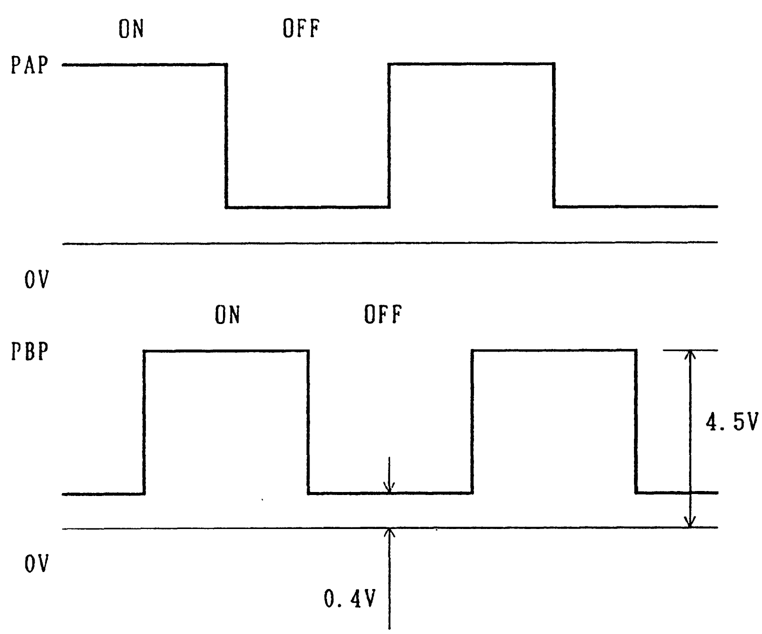
(3) Alarm No. 02

AL-02	Speed varies from the command value.

Item	Causes	Check	Remedy
1	Overload operation (Overload)	Check it using a load meter.	Re-examine cutting conditions and tools.
2	Transistor module is defective.	Transistor collector-emitter is open.	Replace transistor module.
3	Blown or poor connection of the driver protective fuse on PCB (Disconnection, poor contact, etc.)	Check fuses F4A-F4M for blown or missing.	Connect fuses securely, and replace blown fuses, if any.
4	Speed feedback signal is defective.	Check the speed feedback signal level. (Note)	Check the motor speed detector or signal cable.
5	Wiring failure (Disconnection, poor contact, etc.)	Check if connection cables are normally connected.	

Note) Speed feedback signal check

Observe the speed feedback signal using an oscilloscope under the rotation command off (motor stop, drive power off) condition after turning on the power supply. Observe it at the following check terminals, while slowly turning the motor by hand.

<table>
<tr><th>Test points</th><th>Normal waveforms</th></tr>
<tr><td>PA-0V</td><td>
</td></tr>
<tr><td>PB-0V</td><td>Same as shown above</td></tr>
<tr><td>RA-0V</td><td>DC 2.5 V ±0.2 V</td></tr>
<tr><td>RB-0V</td><td>Same as shown above</td></tr>
<tr><td>PAP-0V
PAP-0V
(CW rotation)</td><td>

Check that the ON/OFF duty is 50%.
(PAP and PBP signals are inverted in CCW direction.)</td></tr>
</table>

(4) Alarm No. 03

AL-03	The fuse in the DC link is blown.

The fuse (F4) in the DC link circuit is blown. The transistor module may also be faulty.

(5) Alarm No. 04

AL-04 The input fuse is blown or the input power supply is in the open phase.

Item	Causes	Check	Remedy
1	The impedance of the AC power supply goes too high. Example) When two transformers are connected in series or a variable auto-transformer is connected	Alarm 04 goes on only during deceleration from high speed. Alarm 04 may also go on when none of fuses F1 to F3 are blown.	Replace the power supply with one having a lower impedance. Looseness of the connection of the input cable Example) Open-phase caused by insufficient thread fastening
2	Defective transistor module		Replace the transistor module and fuse with new ones.
3	Defective diode module or thyristor module	Disconnect diode modules DM1 to DM3 and thyristor modules SM1 to SM3, and check that connection between pins A and K is normal using a multimeter. (Defective parts are often short-circuited.)	Replace defective parts and fuses with new ones.
4	Defective surge absorber or capacitor	Check surge absorbers Z1 to Z3 and capacitors C4 to C6.	Replace defective parts and fuses with new ones.
5	When the input fuse is not blown	Check whether the condition falls under item 1 above.	If not, replace the PC board with a new one.

(6) Alarm No. 05

AL-05 The fuse of the control power supply circuit is blown.

Item	Causes	Check	Remedy
1	Defective PC board	Check the AC input voltage.	Replace the PC board with a new one.
2	Abnormal supply voltage		

(7) AL-07 : Excessive speed

AL-07

Excessive speed (digital detection)

No.	Causes	Item to check	Action to be taken
1	Incorrect parameter (No. 6511) for specifying the number of velocity feedback pulses	Check whether the number of velocity feedback pulses agrees with the parameter.	Correct the parameter.

(8) Alarm No. 08

AL-08

The input voltage is too high.

Item	Causes	Check	Remedy
1	The AC supply voltage exceeds the rated voltage by 10% or more.	Check the supply voltage.	
2	The toggle switch for setting the voltage is set incorrectly.	Check the supply voltage.	Change the setting of the switch from 200 V to 230 V.

(9) Alarm No. 09

AL-09

Heat sink is overheated.

Item	Causes	Check	Remedy
1	Cooling fan is defective.	Check if fan is rotating.	Replace fan.
2	Overload operation	Check load by using a load meter.	Re-examine the cutting condition.
3	Dusty and dirty		Clean using compressed air or vacuum cleaner.

(10) Alarm No. 10

AL-10

Input power voltage drops.

This alarm indicates abnormally low AC power voltage (−15% or less).

This alarm may be generated even during momentary power failures.

(11) Alarm No. 11

AL-11 — Overvoltage of DC link circuit
(Regenerative circuit is faulty . . . Regeneration failure)

Item	Causes	Check	Remedy
1	High power impedance		Examine AC power specification.
2	PCB is defective.		Replace PCB.
3	Defective transistor module (TM1)		Replace transistor module.

(12) Alarm No. 12

AL-12 — Overcurrent flows to DC link circuit

Item	Causes	Check	Remedy
1	Output terminals or internal circuit of motor is shorted.	Check connections.	
2	Transistor module is defective.	Check the transistor module.	Replace transistor module.
3	PCB is defective.		Replace PCB.

(13) Alarm No. 13

AL-13 — CPU inter data memory alarm

Replace PCB.

(14) Alarm No. 16

Ram fault

Item	Causes	Check	Remedy
1	External data memory (RAM) defective		Replace memory (RAM).
2	PCB defective		Replace PCB.

(15) Alarm No. 18

Item	Causes	Check	Remedy
1	Program memory data (ROM) defective	Compare data displayed when power is turned ON with ROM labels.	Replace program memory (ROM).

(16) Alarm No. 19

No.	Causes	Item to check	Action to be taken
1	Defective A/D converter		Replace the A/D converter.
2	Defective U-phase current detection circuit	Check whether the offset voltage at test terminal IU is about ±100mV or greater at the time the power is turned on.	Replace the PC board.
3	Insufficient connection between the PC board and the power circuit.	Check the connector connecting the PC board and the power ciucuit.	Secure the connection.

(17) Alarm No. 20

No.	Causes	Item to check	Action to be taken
1	Defective V-phase current detection circuit	Check whether the offset voltage at test terminal IV is about ±100mV or greater at the time the power is turned on.	Replace the PC board.
2	Insufficient connection between the PC board and the power circuit	Check the connector connecting the PC board and the power circuit	Secure the connection.

(18) Alarm No. 24

Item	Causes	Check	Remedy
1	CNC power supply is OFF.	Check that CNC power is off.	Turn CNC power ON.
2	Defective optical cable for serial data transmission	Check that optical cable is fitted securely to the connector. Check that the cable is not broken. Check that transmission/reception surfaces of the cable are clean.	Connect securely. Replace optical cable. Clean optical cable transmission/reception surfaces.
3	Defective data transmission /reception elements in LSI used in serial data transmission		Replace LSI. Replace PCB.

(19) Alarm No. 25

CF. Alarm No. 24

(20) Alarm No. 26

Item	Causes	Check	Remedy
1	Signal level of spindle motor for Cs axis control is defective.	Check the signal level, and if necessary adjust to the normal level using the variable resistor for signal level adjustment in the preamp.	
2	Signal line of spindle motor for Cs axis control is defective.	Check that signal cable is connected securely to connector. Check that signal cable is not broken.	Connect signal cable securely. Replace signal cable.
3	Defective detector circuit for Cs axis control		Replace detector circuit.
4	Incorrect parameter setting	Check that the parameter setting does not indicate that the Cs axis control detector is used when actually it is not.	Series 15: 3001-BIT5 = 0 Series 0: 6501-BIT5 = 0 Series 16: 4001-BIT5 = 0

(21) Alarm No. 27

Item	Causes	Check	Remedy
1	Position coder signal line defective	Check that signal cable is connected securely to connector. Check that signal cable is not broken.	Connect signal cable securely. Replace signal cable.
2	Incorrect parameter setting	Check that the parameter setting does not indicate that the position coder signal is used when actually it is not.	Series 15: 3001-BIT2 = 0 Series 0: 6501-BIT2 = 0 Series 16: 4001-BIT2 = 0

(22) Alarm No. 28

Item	Causes	Check	Remedy
1	Signal level of spindle detector for Cs axis control is defective.	Check the signal level, and if necessary adjust to the normal level using the variable resistor for signal level adjustment in the preamp.	
2	Signal line of spindle detector for Cs axis control is defective.	Check that signal cable is connected securely to connector. Check that signal cable is not broken.	Connect signal cable securely. Replace signal cable.
3	Defective detector circuit for Cs axis control		Replace detector circuit.

(23) Alarm No. 29

Item	Causes	Check	Remedy
1	Overloaded operation (Overload)	Use loadmeter to check that a load close to the load resistance limit is not imposed continuously for 30 seconds or more.	Re-examine cutting conditions and tools.

(24) Alarm No. 30

Item	Causes	Check	Remedy
1	Defective of power transistor used for power	Check power transistor.	Replace power transistor.
2	Defective of power regeneration circuit		Replace PCB.

(25) Alarm No. 31

Item	Causes	Check	Remedy
1	Motor constrained	Check that nothing is preventing the motor from accelerating.	Remove cause.
2	Defective motor speed reversion signal	Check signal waveform. (Cf. section dealing with Alarm No. 2)	Remove cause.
3	Defective motor speed reversion signal cable	Check that cable is connected securely to connector. Check that cable is not broken.	Connect cable securely. Replace cable.

(26) Alarm No. 32

Item	Causes	Check	Remedy
1	Defective LSI used in serial data transmission		Replace LSI. Replace PCB.

(27) Alarm No. 33

Item	Causes	Check	Remedy
1	Defective relay used in DC link recharging Disconnection of resistor used in limiting recharge current	Check relevant parts.	Replace amp.
2	Incorrect spindle parameter	Example: Check bit 0 of parameter No. 3010 of the FS15.	For small model 30S and earlier models, the parameter must be set to 0. For 30S and 40S, the parameter must be set to 1.

(28) Alarm No. 34

Item	Causes	Check	Remedy
1	Incorrect parameter data setting	Check that no data settings exceed allowable ranges.	Set to within allowable ranges.

Note) With a series 9A50 of ROM edition B or later, the spindle amplifier display alternately indicates AL-34 and F-XXX when alarm AL-34 occurs. XXX is the number of the spindle parameter exceeding the maximum value. For the number of the internal spindle data, see the parameter table.

(29) Alarm No. 35

Item	Causes	Check	Remedy
1	Parameter data of gear ratio and position gain are too large.	Check gear ratio and position gain data.	Alter to suitable values.

(30) Alarm No. 37

No.	Causes	Item to check	Action to be taken
1	Incorrect parameter (No. 6511) for specifying the number of velocity feedback pulses	Check whether the number of velocity feedback pulses agrees with the parameter.	Correct the parameter.

(31) Alarm No. 39

No.	Causes	Item to check	Action to be taken
1	The detection circuit for Cs contour control uses the wrong type of data ROM. Alternatively, the setting is incorrect.	Check the setting and the type of data ROM of the detection circuit for Cs contour control.	Replace the ROM with the correct type of ROM. Correct the setting.
2	The level of the feedback signal for Cs contour control is low. Alternatively, noise accompanies the signal.	Check the level of the feedback signal. Also check whether noise is observed on the waveform of the feedback signal.	Adjust the feedback signal. Check the shielding.

(32) Alarm No. 40

No.	Causes	Item to check	Action to be taken
1	The single rotation signal of the feedback signals for Cs contour control is not generated. Alternatively, the offset of the single rotation signal is adjusted incorrectly.	Check the single rotation signal of the feedback signals for Cs contour control.	Adjust the offset of the single rotation signal. Check the cable.

(33) Alarm No. 41

No.	Causes	Item to check	Action to be taken
1	Incorrect parameter (No. 6503, bits #4, #6, #7) for specifying the number of pulses of the position coder signal	Check the parameter and the number of pulses of the position coder signal.	Correct the parameter.
2	The amplitude and offset of the position coder feedback signal are incorrect. Alternatively, noise accompanies the signal.	Check the level of the feedback signal. Check whether noise is observed on the wave form of the feedback signal.	Adjust the feedback signal. Check the shielding.

(34) Alarm No. 47

No.	Causes	Item to check	Action to be taken
1	Incorrect parameter (No. 6503, bits #4, #6, #7) for specifying the number of pulses of the position coder signal	Check the parameter and the number of pulses of the position coder signal.	Correct the parameter.
2	The amplitude and offset of the position coder feedback signal are incorrect. Alternatively, noise accompanies the signal.	Check the level of the feedback signal. Check whether noise is observed on the waveform of the feedback signal.	Adjust the feedback signal. Check the shielding.

1.5 When the Motor does not Rotate or Its Rotation is Abnormal

No.	Causes	Item to check	Action to be taken
1	Defective phases of motor power line	Alarm lamp lights on spindle servo unit when rotation command is given.	Repair phases.
		Alarm lamp does not light.	Apply higher speed command.
2	Command signal connection failure	Check signal cable connection.	
3	Spindle parameter is not proper.		Set spindle parameters correctly.
4	Incorrect NC parameter		Check the corresponding parameter. The correct parameters are listed below: Series 15 No. 5613 = 0 No. 5614 = 1000 Series 0 (T series) No. 539 = 0 No. 516 = 1000 Series 0 (M series) No. 577 = 0 No. 516 = 1000 Series 16 No. 3731 = 0 No. 3730 = 1000 For details, refer to Appendix 3 in "FANUC AC Spindle Motor Specifications (B-65042E/04.)"

1.6 When There is Excessive Vibration or Noise during Rotation

Item	Causes	Check	Remedy
1	Motor is defective.		Replace motor.
2	PCB is defective.	Idle the motor. To idle the motor, set MPOF to 1 from the PMC during rotation. Alternatively, set parameter No. 3009 (NC: FS15), bit #2 to 1 and turn the NC power off. The servo unit detects alarm AL-24 (data error in serial transfer). Note) If vibrations and noises are reduced during idle run as compared with normal rotation time, the control circuit is defective.	Replace PCB.

Note) To perform idle run contact the MTB to determine if it is possible. Some sequences require brake operation.

1.7 When the Motor Produces Noise during Deceleration

During deceleration of the motor, energy is regenerated to the power supply through the regenerative control circuit. If the regenerative energy is excessive, the regenerative current limit circuit operates to change the motor current waveform, causing an abnormal noise to be produced from the motor.

(1) In such a case, lessen regenerative power control parameter until no abnormal noise is produced. Lessening regenerative power control parameter makes the deceleration period longer.

Note) Parameters for controlling the regenerative power

Power Mate: No. 3080
Series 0: No. 6580
Series 15: No. 3080
Series 16: No. 4080

(2) When the following parameter is set to 1, the noise may be reduced:

Power Mate: No. 3019#3 = 1
Series 0: No. 6519#3 = 1
Series 15: No. 3019#3 = 1
Series 16: No. 4019#3 = 1

1.8 When Speed Overshooting or Hunting Occurs

Item	Causes	Check	Remedy
1	Overshooting	Increase the value of the parameter for the proportional gain of the velocity loop.	Change the value.
2	Spindle hunting	Increase the value of the parameter for the proportional gain of the velocity loop.	Change the value.

Note) Parameter numbers for velocity loop proportional gain data

Power Mate: No. 3040 and over
Series 0: No. 6540 and over
Series 15: No. 3040 and over
Series 16: No. 4040 and over

1.9 When the Cutting Force is Poor

Item	Causes	Check	Remedy
1	ROM is not proper.	Check the ROM according to the model code in the parameter table of each model.	Setting parameter after check parameter
2	Torque limit command is applied.	Check signal.	
3	Loosened belt	Check belt tension.	

Note) Motor model parameter numbers

Power Mate: No. 3133
Series 0: No. 6633
Series 15: No. 3133
Series 16: No. 4133

1.10 When Acceleration/Deceleration Takes a Long Time

Item	Causes	Check	Remedy
1	Torque limit command is applied.	Check signal.	
2	Parameter is not adjusted correctly.	If regenerative power control parameter is set too low, the deceleration period becomes long. Refer to section 1.6.	Readjust regenerative power control parameter.

1.11 When Er-□□ is Displayed

Status error display function

This displays Er-XX on the display unit on the spindle control PCB when there is an erroneous parameter setting or the sequence is inappropriate. When the operation of the spindle motor is defective, check the error number on the display unit and remove the error by performing the following countermeasures.

Note 1) Er-XX is not displayed on the NC screen.

Note 2) Refer to the control input signals and spindle parameters on the next page.

Display	Contents	Countermeasure
Er-01	* Although ESP (there are 2 types: connection signal and PMC → CNC) and MRDY (machine ready signal) are not input, SFR/SRV is input. However, regarding MRDY, pay attention to the setting of use/not use spindle parameter MRDY.	* Confirm the sequence of ESP and MRDY.
Er-02	When the spindle motor and spindle for a system with high-resolution magnetic pulse coder are different, the speed of the spindle motor detector is set as 128 p/rev. If the setting is kept at other than 128 p/rev, even if excitation is attempted, it will not be excited.	Set the spindle motor speed detector parameter to 128 p/rev.
Er-03	Although parameter setting with high-resolution magnetic pulse coder was not performed, Cs contour control command is input. In this case, the motor will not be excited.	Confirm the parameter setting of the high-resolution magnetic pulse coder.
Er-04	Although parameter setting for using position coder was not performed, commands for servo mode and synchronous control are input. In this case, the motor will not be excited.	Confirm the parameter setting of the position coder.
Er-05	Although option parameter for orientation is not set, the orientation command (ORCM) is input.	Confirm the parameter setting of orientation.
Er-06	Although option parameter for output switchover is not set, LOW winding is selected.	Confirm the parameter setting for output switching and gravity line status signal.
Er-07	Although Cs contour control command was input, SFR/SRV is not input.	Confirm the sequence.
Er-08	Although servo mode control command was input, SFR/SRV is not input.	Confirm the sequence.
Er-09	Although synchronous control command was input, SFR/SRV is not input.	Confirm the sequence.
Er-10	Although Cs contour control command was input, other modes (servo mode, synchronous control, orientation) are commanded.	Do not command other modes during Cs contour control command. When moving to other modes, perform after releasing the Cs contour control command.

Display	Contents	Countermeasure
Er-11	Although servo mode command was input, other modes (Cs contour control, synchronous control, orientation) are commanded.	Do not command other modes during servo mode command. When moving to other modes, perform after releasing the servo mode command.
Er-12	Although synchronous control command was input, other modes (Cs contour control, servo mode, orientation) are commanded.	Do not command other modes during synchronous control command. When moving to other modes, perform after releasing the synchronous control command.
Er-13	Although orientation command was input, other modes (Cs contour control, servo mode, synchronous control) are commanded.	Do not command other modes during orientation command. When moving to other modes, perform after releasing the orientation command.
Er-14	SFR/SRV are simultaneously commanded.	Command one or the other.
Er-15	Although bit 5 of parameter No. 6500 is set to 1, indicating that the differential control function is provided, the Cs contour control command is not entered.	Check the parameter and control input signal.
Er-16	Although bit 5 of parameter No. 6500 is set to 0, indicating that the differential control function is not provided, the differential mode command, DEFMDA, is entered.	Check the parameter and control input signal.
Er-17	Parameter No. 6511, bits #0, #1, #2 concerning the speed detector is incorrect. (The corresponding speed detector is not mounted.)	Check the parameter.
Er-18	Although bit 2 of parameter No. 6501 is set to 0, indicating that the position coder signal is not used, the command of spindle orientation by a position coder is entered.	Check the parameter and control input signal.

Control input signal PMC → CNC

Series 0 G229
Series 15 G227
Series 16 G070

MRDYA	ORCMA	SFRA	SRVA				

MRDYA 0: Turns off the magnetic contactor.
1: Turns on the magnetic contactor.

ORCMA 0: –
1: Controls the orientation of the spindle.

SFRA : Normal rotation command

SRVA : Reverse rotation command

Series 0 G230
Series 15 G226
Series 16 G071

RCHA	RSLA					*ESPA	

*ESPA 0: Emergency stop
1: Normal operation

RSLA 0: Speed range switching request signal (high-speed output characteristics)
1: Speed range switching request signal (low-speed output characteristics)

RCHA 0: Power line state confirmation signal (high-speed output characteristics)
1: Power line state confirmation signal (low-speed output characteristics)

Contactor signal for *ESPA	ESP1 and ESP2 of the PC board for spindle control	The contactor is open: Emergency stop The contactor is closed: Normal operation

Control input signal for Cs contour control or servo mode PMC → CNC

Series 0 G123

CON (M series)						COFF (T series)

CON 0: Spindle rotation control mode (turning mode)
1: Spindle contour control mode (contouring mode)

COFF 0: Spindle contour control mode (contouring mode)
1: Spindle rotation control mode (turning mode)

Series 15 G067 (first axis)
G071 (second axis)
G075 (third axis)
G079 (fourth axis)
G083 (fifth axis)
G087 (sixth axis)
Series 16 G027

SCNTRj							

SCNTRj 0: Spindle rotation control mode (turning mode)
1: Spindle contour control mode (contouring mode)

Control input signal for simultaneous control PMC → CNC

Series 0 G146
Series 16 G038

				SPPHS			

SPPHS 0: Releases the simultaneous control mode.
1: Puts the system in the simultaneous control mode.

Related spindle parameters

Power Mate 3001
Series 0 6501
Series 15 3001
Series 16 4001

	CAXIS2	CAXIS1			POSC2		MRDY1

MRDY1 0: The MRDYA signal is not used (MRDYA is always 1).
1: The MRDYA signal is used.

POSC2 0: The position coder signal is not used.
1: The position coder signal is used.

CAXIS1 0: The high-resolution pulse coder is not used.
1: The high-resolution pulse coder is used.

CAXIS2 0: The position detection signal for the high-resolution pulse coder is not used as the speed detection signal (for when the spindle is separated from the spindle motor).
1: The position detection signal for the high-resolution pulse coder is also used as the speed detection signal (for when the built-in motor is used).

Power Mate 3011
Series 0 6511
Series 15 3011
Series 16 4011

					VDT3	VDT2	VDT1

VDT3	VDT2	VDT1	Setting of speed detector
0	0	0	64 p/rev
0	0	1	128 p/rev
0	1	0	256 p/rev
0	1	1	512 p/rev

Power Mate 3015
Series 0 6515
Series 15 3015
Series 16 4015

					SPDSW	MSORT	PCORT

PCORT 0: The spindle orientation function by the position coder is not provided.
1: The spindle orientation function by the position coder is provided.

MSORT 0: The spindle orientation function by the magnetic sensor is not provided.
1: The spindle orientation function by the magnetic sensor is provided.

SPDSW 0: The speed range switching function is not provided.
1: The speed range switching function is provided.

XIV. SERIAL INTERFACE PARAMETERS

1. SERIAL INTERFACE PARAMETERS

1.1 Parameters for AC Spindle Servo Unit

Spindle parameter table (common for all models)

Parameter signal		Data	Contents
Series 15	Series 0		
3000	6500	00000000	Bit parameter
3001	6501	00000000	Bit parameter
3002	6502	00000000	Bit parameter
3003	6503	00000000	Bit parameter
3004	6504	00000000	Bit parameter
3005	6505	00000000	Bit parameter
3006	6506	00000000	Bit parameter
3007	6507	00000000	Bit parameter
3008	6508	00000000	Bit parameter
3009	6509	00000000	Bit parameter
3010	6510	00000000	Bit parameter
3011	6511	According to motor model	Bit parameter
3012	6512	00000000	Bit parameter
3013	6513	According to motor model	Bit parameter
3014	6514	00000000	Bit parameter
3015	6515	00000000	Bit parameter
3016	6516	00000000	Bit parameter
3017	6517	00000000	Bit parameter
3018	6518	00000000	Bit parameter
3019	6519	00000000	Bit parameter
3020	6520	According to motor model	Maximum speed
3021	6521	100	Maximum speed in Cs contouring control

Parameter signal		Data	Contents
Series 15	Series 0		
3022	6522	150	Speed arrival level
3023	6523	30	Speed detecting level
3024	6524	75	Speed zero detecting level
3025	6525	50	Setting of torque limit value
3026	6526	83	Load detecting level 1
3027	6527	95	Load detecting level 2
3028	6528	0	Output limit pattern setting
3029	6529	100	Output limit vlaue
3030	6530	0	Soft start/stop setting time
3031	6531	0	Position coder method orientation stop position
3032	6532	0	Acceleration/deceleration time constant at spindle synchronization control
3033	6533	0	Spindle synchronization speed arrival level
3034	6534	0	Shift amount at spindle phase synchronization control
3035	6535	0	Spindle phase synchronization compensation data
3036	6536	0	Feedforward coefficient
3037	6537	0	Velocity loop feedforward coefficient
3038	6538	0	Reserved
3039	6539	0	Reserved
3040	6540	10	Velocity loop proportion gain on normal operation (HIGH)
3041	6541	10	Velocity loop proportion gain on normal operation (LOW)
3042	6542	10	Velocity loop proportion gain on orientation (HIGH)
3043	6543	10	Velocity loop proportion gain on orientation (LOW)

Parameter signal		Data	Contents
Series 15	Series 0		
3044	6544	10	Velocity loop proportion gain on servo mode (HIGH)
3045	6545	10	Velocity loop proportion gain on servo mode (LOW)
3046	6546	30	Velocity loop proportion gain in Cs contouring control (HIGH)
3047	6547	30	Velocity loop proportion gain in Cs contouring control (LOW)
3048	6548	10	Velocity loop integral on normal operation (HIGH)
3049	6549	10	Velocity loop integral on normal operation (LOW)
3050	6550	10	Velocity loop integral gain on orientation (HIGH)
3051	6551	10	Velocity loop integral gain on orientation (LOW)
3052	6552	10	Velocity loop integral gain on servo mode (HIGH)
3053	6553	10	Velocity loop integral gain on servo mode (LOW)
3054	6554	50	Velocity loop integral gain in Cs contouring control (HIGH)
3055	6555	50	Velocity loop integral gain in Cs contouring control (LOW)
3056	6556	100	Gear ratio (HIGH)
3057	6557	100	Gear ratio (MEDIUM HIGH)
3058	6558	100	Gear ratio (MEDIUM LOW)
3059	6559	100	Gear ratio (LOW)
3060	6560	1000	Position gain on orientation (HIGH)
3061	6561	1000	Position gain on orientation (MEDIUM HIGH)
3062	6562	1000	Position gain on orientation (MEDIUM LOW)
3063	6563	1000	Position gain on orientation (LOW)

Parameter signal		Data	Contents
Series 15	Series 0		
3064	6564	100	Modification rate of position gain on orientation completion
3065	6565	1000	Position gain on servo mode (HIGH)
3066	6566	1000	Position gain on servo mode (MEDIUM HIGH)
3067	6567	1000	Position gain on servo mode (MEDIUM LOW)
3068	6568	1000	Position gain on servo mode (LOW)
3069	6569	3000	Position gain in Cs contouring control (HIGH)
3070	6570	3000	Position gain in Cs contouring control (MEDIUM HIGH)
3071	6571	3000	Position gain in Cs contouring control (MEDIUM LOW)
3072	6572	3000	Position gain in Cs contouring control (LOW)
3073	6573	0	Grid shift amount in servo mode
3074	6574	0	Origin return speed when Cs contouring/servo mode
3075	6575	10	Orientation completion signal detection
3076	6576	33	Motor speed limit value on orientation
3077	6577	0	Orientation stop position shift value
3078	6578	According to sensor installation	MS signal constant
3079	6579	0	MS signal gain adjustment
3080	6580	According to motor model	Limitation of regenerative power
3081	6581	20	Delay time until the motor power is cut off
3082	6582	10	Time setting during acceleration/ deceleration
3083	6583	According to motor model	Motor voltage setting on normal rotation

Parameter signal		Data	Contents
Series 15	Series 0		
3084	6584	According to motor model	Motor voltage setting on orientation
3085	6585	According to motor model	Motor voltage setting on servo mode
3086	6586	According to motor model	Motor voltage setting in Cs contouring control
3087	6587	115	Overspeed level
3088	6588	75	Velocity error excess detecting level on motor restriction
3089	6589	200	Velocity error excess detecting level on motor rotation
3090	6590	90	Overload detecting level
3091	6591	100	Reduction rate of position gain in returning to reference point on servo mode
3092	6592	100	Reduction rate of position gain in Cs contouring control reference point return
3093	6593	0	Estimating constant of acceleration
3094	6594	0	Constant of the torque disturbance compensating
3095	6595	0	Adjustment of speed meter output voltage
3096	6596	0	Adjustment of load meter output voltage
3097	6597	0	Spindle speed feedback gain
3098	6598	0	Maximum speed of position coder 1 revolution signal detection
3099	6599	0	Delay time for motor magnetization
3100	6600	According to motor model	Base speed of motor output specifications
3101	6601	According to motor model	Limit value for motor output specifications
3102	6602	According to motor model	Base speed
3103	6603	According to motor model	Magnetic flux down start speed

Parameter signal		Data	Contents
Series 15	Series 0		
3104	6604	According to motor model	Current loop proportion gain on normal operation
3105	6605	According to motor model	Current loop proportion gain in Cs contouring control
3106	6606	According to motor model	Current loop integral gain on normal operation
3107	6607	According to motor model	Current loop integral gain in Cs contouring control
3108	6608	According to motor model	Current loop integral gain zero point
3109	6609	According to motor model	Current loop proportion gain speed coefficient
3110	6610	According to motor model	Current conversion constant
3111	6611	According to motor model	Secondary current coefficient for excitation current
3112	6612	According to motor model	Current prediction constant
3113	6613	According to motor model	Slip constant
3114	6614	According to motor model	Slip compensation constant of high-speed rotation
3115	6615	According to motor model	Motor applied voltage compensation constant by dead time
3116	6616	According to motor model	Electromotive voltage compensation coefficient
3117	6617	According to motor model	Electromotive voltage phase compensation constant
3118	6618	According to motor model	Electromotive voltage compensation speed coefficient
3119	6619	According to motor model	Time constant of voltage filter for electromotive voltage
3120	6620	According to motor model	Dead time compensation data

Parameter signal		Data	Contents
Series 15	Series 0		
3121	6621	According to motor model	Time constant of torque change
3122	6622	0	Speed detection filter time constant
3123	6623	30	Overlead detecting time
3124	6624	20	
3125	6625	0	Timer setting for automatic operation
3126	6626	0	Velocity command on automatic operation
3127	6627	According to motor model	Load meter display value on maximum output
3128	6628	According to motor model	Maximum output limit zero point
3129	6629	0	Secondary electrical current coefficient on rigid tap
3130	6630	0	Electromagnetic voltage phase compensation constant on deceleration
3131	6631	0	Speed detection filter time constant (on Cs contouring control)
3132	6632	0	V-phase current conversion constant
3133	6633	According to motor model	Motor model code
3134	6634	0	
3135	6635	0	Grid shift value on Cs contouring control

1) The parameter data given in this table consists of standard values. It is necessary to reset according to the machine system.

Parameters for speed range switching low speed properties

Parameter signal		Data	Contents
Series 15	Series 0		
3280	6900	According to motor model	Motor voltage during normal rotation
3281	6901	According to motor model	Motor voltage on the servo mode
3282	6902	According to motor model	Base speed of motor output specifications
3283	6903	According to motor model	Limiting value for motor output specifications

Parameter signal		Data	Contents
Series 15	Series 0		
3284	6904	According to motor model	Base speed
3285	6905	According to motor model	Magnetic flux down start speed
3286	6906	According to motor model	Current loop proportion gain on normal operation
3287	6907	According to motor model	Current loop integral gain on normal operation
3288	6908	According to motor model	Current loop integral gain zero point
3289	6909	According to motor model	Current loop proportion gain speed coefficient
3290	6910	According to motor model	Current conversion constant
3291	6911	According to motor model	Secondary current coefficient for exciting current
3292	6912	According to motor model	Expected current constant
3293	6913	According to motor model	Slide constant
3294	6914	According to motor model	Slide compensation constant of high-speed rotation
3295	6915	According to motor model	Compensation constant for voltage imposed on motor dur to dead time
3296	6916	According to motor model	Electromotive voltage compensation constant
3297	6917	According to motor model	Electromotive voltage phase compensation constant
3298	6918	According to motor model	Electromotive voltage compensation speed coefficient
3300	6920	According to motor model	Time constant of change in torque
3301	6921	According to motor model	Maximum output limit zero point

1.2 Table of Parameters for Each Model

1) When setting automatically the parameters are set corresponding to the model code. (For parameters other than these, refer to the "Table of Common Parameters".)
2) When "None" is entered for the model codes corresponding to the models, the parameter data is mostly set automatically in agreement with the model codes.
   Change the sections that are different.
3) Applicable ROM version is which automatic setting data is prepared for displayed version and subsequence version.
4) If the applied ROM version is left blank, it indicates that the model code has yet to be released.
5) If the applied ROM version contains a slash, it indicates that, after the model code in the left column has been set and the automatic setting data loaded, the data must be partially altered before use.

Reference) Setting of detector is as follows.
- Motor models 1S-3S: Set "128"
- Motor models 6S-22S, 8P-50P: Set "256"

(However "128" is set, in the C contour detector)

Series 15: No. 3011: *001
Series 15: No. 3011: *010
(*001) * is option.

6) When the signal conversion circuit is mounted on the unit, specify the following parameter:

Power Mate	:	3003 - BIT1 = 1
Series 0	:	6503 - BIT1 = 1
Series 15	:	3003 - BIT1 = 1
Series 16	:	4003 - BIT1 = 1

7) Parameters concerning sensors must be adjusted to the selected sensors. For details of the parameters, refer to "FANUC AC Spindle Servo Unit (Serial Interface) Maintenance Manual (B-65045E.)"

Continuous/30-minute output (kW) Base/maximum speed (rpm)				0.5/0.75 6000/ 3000	0.65/1.1 3000/ 8000	0.75/1.5 3000/ 12000	1.1/2.2 1500/ 15000	1.1/3.7 1500/ 8000	2.2/3.7 1500/ 8000	3.7/5.5 1100/ 10000
Model code				None	23	None	15	16	17	19
Parameter number				B0.3	B0.5	B0.5	B1	B1.5	B2	B6
PM	OC	15	16	L127	L113	L128	L127	L130	L120	L151
3006	6506	3006	4006	00010000	00010000	00010000	00000000	00000000	00000000	00000000
3011	6511	3011	4011	00001001	00001001	00001001	00001001	00001001	00001001 (**)	00001010
3012	6512	3012	4012	00000000	00000000	00000000	00000000	00000000	00000000	00000000
3013	6513	3013	4013	00011010	00011010	00011010	00011010	00011010	00011010	00011010
3020	6520	3020	4020	6000	8000	12000	15000 (*)	8000	8000	10000
3040	6540	3040	4040	2	2	2	10	10	10	10
3080	6580	3080	4080	100	100	100	60	60	65	50
3083	6583	3083	4083	30	30	30	30	30	30	30
3084	6584	3084	4084	30	30	30	30	30	30	30
3085	6585	3085	4085	30	30	30	30	30	30	30
3086	6586	3086	4086	100	100	100	100	100	100	100
3100	6600	3100	4100	8000	3000	3500	3000	1500	1650	1100
3101	6601	3101	4101	75	100	100	100	100	100	100
3102	6602	3102	4102	8000	5500	5500	3000	2000	2200	1100
3103	6603	3103	4103	8000	5500	5500	3000	2000	2200	1600
3104	6604	3104	4104	900	500	500	1500	1500	1500	1600
3105	6605	3105	4105	900	500	500	1500	1500	1500	1600
3106	6606	3106	4106	1500	1500	1500	1500	1500	1500	1500
3107	6607	3107	4107	1500	1500	1500	1500	1500	1500	1500
3108	6608	3108	4108	300	300	300	500	500	300	300
3109	6609	3109	4109	10	10	10	10	10	10	10
3110	6610	3110	4110	3644	2811	2811	820	492	652	655
3111	6611	3111	4111	35	26	40	8	13	16	14
3112	6612	3112	4112	500	500	500	500	500	600	500
3113	6613	3113	4113	1400	1000	1400	1550	1600	550	655
3114	6614	3114	4114	10	10	10	10	10	10	10
3115	6615	3115	4115	5	5	5	3	2	2	5
3116	6616	3116	4116	100	100	100	100	100	100	105
3117	6617	3117	4117	20	20	20	20	20	20	20
3118	6618	3118	4118	20	10	10	10	10	10	10
3120	6620	3120	4120	45	20	50	40	40	60	30
3121	6621	3121	4121	5	50	5	5	5	5	5
3127	6627	3127	4127	163	203	164	176	403	202	178
3128	6628	3128	4128	0	0	8000	0	16000	30000	0
3130	6630	3130	4130	0	95	50	0	0	0	0
3133	6633	3133	4133	0	23	0	15	16	17	19
Applicable amplifier model				1S	1S	2S	1S	2S	2S	6S

* Adjust this parameter and parameter No. 3006 manually.

Continuous/30-minute output (kW) Base/maximum speed (rpm)				5.5/7.5 1500/ 10000	11/15 2500/ 15000	7.5/11 1500/ 10000	15/18.5 1500/ 6000	30/37 1500/ 3000
Model code				20	None	21	None	None
Parameter number				B6	B6	B8	B15	B40
PM	OC	15	16					
3006	6506	3006	4006	00000000	00000000	00000000		
3011	6511	3011	4011	00001010	00001010	00001010		
3012	6512	3012	4012	00000000	00000000	00000000		
3013	6513	3013	4013	00011010	00011010	00011010		
3020	6520	3020	4020	10000	15000	10000		
3040	6540	3040	4040	10	10	10		
3080	6580	3080	4080	60	65	50		
3083	6583	3083	4083	30	30	30		
3084	6584	3084	4084	30	30	30		
3085	6585	3085	4085	30	30	30		
3086	6586	3086	4086	100	100	100		
3100	6600	3100	4100	1900	2000	1700		
3101	6601	3101	4101	100	100	100		
3102	6602	3102	4102	1900	3625	1700		
3103	6603	3103	4103	1950	3625	1700		
3104	6604	3104	4104	1600	600	1500		
3105	6605	3105	4105	1600	600	1500		
3106	6606	3106	4106	1500	1500	1500		
3107	6607	3107	4107	1500	1500	1500		
3108	6608	3108	4108	300	300	300		
3109	6609	3109	4109	10	10	10		
3110	6610	3110	4110	754	686	500		
3111	6611	3111	4111	24	30	17		
3112	6612	3112	4112	800	500	500		
3113	6613	3113	4113	410	550	500		
3114	6614	3114	4114	10	50	0		
3115	6615	3115	4115	5	5	5		
3116	6616	3116	4116	105	105	100		
3117	6617	3117	4117	20	20	20		
3118	6618	3118	4118	10	10	10		
3120	6620	3120	4120	40	30	30		
3121	6621	3121	4121	5	5	5		
3127	6627	3127	4127	164	164	163		
3128	6628	3128	4128	0	0	0		
3130	6630	3130	4130	0	0	0		
3133	6633	3133	4133	20	0	21		
Applicable amplifier model				8S	22S	12S		

Continuous/30-minute output (kW) Base/maximum speed (rpm)				37/45 1500/ 3000
Model code				22
Parameter number				B40
PM	OC	15	16	
3006	6506	3006	4006	00000100
3011	6511	3011	4011	00001011
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00111110
3020	6520	3020	4020	3000
3040	6540	3040	4040	10
3080	6580	3080	4080	70
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1300
3101	6601	3101	4101	100
3102	6602	3102	4102	1300
3103	6603	3103	4103	1150
3104	6604	3104	4104	1100
3105	6605	3105	4105	1100
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	30
3109	6609	3109	4109	10
3110	6610	3110	4110	786
3111	6611	3111	4111	34
3112	6612	3112	4112	500
3113	6613	3113	4113	34
3114	6614	3114	4114	10
3115	6615	3115	4115	0
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3120	6620	3120	4120	45
3121	6621	3121	4121	5
3127	6627	3127	4127	146
3128	6628	3128	4128	0
3130	6630	3130	4130	0
3133	6633	3133	4133	0
Applicable amplifier model				40S

* Parameter 3006 must be changed manually.

Motor model				B2	Type				L515
Applicable amplifier				6S	Model code				None
Parameter for low-speed output characteristics				2.2/3.7kw	Parameter for high-speed output characteristics				2.2/3.7kw
Parameter No.				850/ 1500rpm	Parameter No.				1500/ 6000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001001
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00011010
					3020	6520	3020	4020	6000
					3040	6540	3040	4040	10
3166	6930	3310	4166	0	3080	6580	3080	4080	65
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	1330	3100	6600	3100	4100	1650
3139	6903	3283	4139	80	3101	6601	3101	4101	100
3140	6904	3284	4140	1330	3102	6602	3102	4102	2200
3141	6905	3285	4141	1330	3103	6603	3103	4103	2200
3142	6906	3286	4142	1500	3104	6604	3104	4104	1500
					3105	6605	3105	4105	1500
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	1370	3110	6610	3110	4110	1006
3147	6911	3291	4147	37	3111	6611	3111	4111	18
3148	6912	3292	4148	500	3112	6612	3112	4112	600
3149	6913	3293	4149	600	3113	6613	3113	4113	550
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	0	3115	6615	3115	4115	2
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	202
3158	6922	3302	4158	0	3128	6628	3128	4128	30000
					3130	6630	3130	4130	0
3161	6925	3305	4161	0	3133	6633	3133	4133	0

Motor model			B2		Type			L516	
Applicable amplifier			6S		Model code			None	
Parameter for low-speed output characteristics				2.2/3.7kw	Parameter for high-speed output characteristics				2.2/3.7kw
Parameter No.				1200/ 1800rpm	Parameter No.				1800/ 4500rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	10000100
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00011010
					3020	6520	3020	4020	4500
					3040	6540	3040	4040	10
					3080	6580	3080	4080	100
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	1100	3100	6600	3100	4100	2000
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	1100	3102	6602	3102	4102	2000
3141	6905	3285	4141	1100	3103	6603	3103	4103	2000
3142	6906	3286	4142	2000	3104	6604	3104	4104	2000
					3105	6605	3105	4105	2000
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	503	3110	6610	3110	4110	603
3147	6911	3291	4147	10	3111	6611	3111	4111	9
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	4250	3113	6613	3113	4113	3000
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	0	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	30	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	202
3158	6922	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	0

Motor model				B3	Type				L517
Applicable amplifier				6S	Model code				None
Parameter for low-speed output characteristics				3.7/5.5kw	Parameter for high-speed output characteristics				3.7/5.5kw
Parameter No.				1500/ 4000rpm	Parameter No.				4000/ 15000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00011010
					3020	6520	3020	4020	15000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	95
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	1600	3100	6600	3100	4100	4300
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	2000	3102	6602	3102	4102	5500
3141	6905	3285	4141	2000	3103	6603	3103	4103	5500
3142	6906	3286	4142	1000	3104	6604	3104	4104	700
					3105	6605	3105	4105	700
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	838	3110	6610	3110	4110	838
3147	6911	3291	4147	22	3111	6611	3111	4111	22
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	400	3113	6613	3113	4113	350
3150	6914	3294	4150	10	3114	6614	3114	4114	25
3151	6915	3295	4151	0	3115	6615	3115	4115	0
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	30	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	178
3158	6922	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	0

Motor model				B8	Type				L511
Applicable amplifier				12S	Model code				64
Parameter for low-speed output characteristics				5.5/7.5kw	Parameter for high-speed output characteristics				5.5/7.5kw
Parameter No.					Parameter No.				
PM	OC	15	16	680/ 1600rpm	PM	OC	15	16	1600/ 10000rpm
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00011010
					3020	6520	3020	4020	10000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	60
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	600	3100	6600	3100	4100	1600
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	700	3102	6602	3102	4102	2400
3141	6905	3285	4141	700	3103	6603	3103	4103	2400
3142	6906	3286	4142	1500	3104	6604	3104	4104	1100
					3105	6605	3105	4105	1100
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	503	3110	6610	3110	4110	377
3147	6911	3291	4147	20	3111	6611	3111	4111	13
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	955	3113	6613	3113	4113	625
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156		3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6922	3302	4158	0	3128	6628	3128	4128	25000
					3130	6630	3130	4130	0
					3133	6633	3133	4133	64

Motor model				B8	Type				L519
Applicable amplifier				15S	Model code				None
Parameter for low-speed output characteristics				5.5/7.5/ 9kw (25%ED)	Parameter for high-speed output characteristics				5.5/7.5/ 9kw (25%ED)
Parameter No.				500/ 1600rpm	Parameter No.				1600/ 12000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00100110
					3020	6520	3020	4020	12000
					3040	6540	3040	4040	10
3166	6930	3310	4166	0	3080	6580	3080	4080	60
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	800	3100	6600	3100	4100	1300
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	800	3102	6602	3102	4102	2400
3141	6905	3285	4141	800	3103	6603	3103	4103	2400
3142	6906	3286	4142	3000	3104	6604	3104	4104	1100
					3105	6605	3105	4105	1100
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	1117	3110	6610	3110	4110	754
3147	6911	3291	4147	36	3111	6611	3111	4111	20
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	550	3113	6613	3113	4113	625
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	50
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	196
3158	6922	3302	4158	0	3128	6628	3128	4128	25000
					3130	6630	3130	4130	0
3161	6925	3305	4166	0	3133	6633	3133	4133	0

Motor model				B8	Type				L520
Applicable amplifier				Small type model 30S	Model code				None
Parameter for low-speed output characteristics				15/18.5kw	Parameter for high-speed output characteristics				18.5/22kw
Parameter No.				1060/ 3500rpm	Parameter No.				5000/ 12000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00010000
					3011	6511	3011	4011	00011010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00100110
					3019	6519	3019	4019	00001000
					3020	6520	3020	4020	12000
					3040	6540	3040	4040	10
3166	6930	3310	4166	80	3080	6580	3080	4080	78
3136	6900	3280	4136	30	3083	6583	3083	4083	50
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	950	3100	6600	3100	4100	5000
3139	6903	3283	4139	100	3101	6601	3101	4101	76
3140	6904	3284	4140	1600	3102	6602	3102	4102	5000
3141	6905	3285	4141	1600	3103	6603	3103	4103	5000
3142	6906	3286	4142	1500	3104	6604	3104	4104	300
					3105	6605	3105	4105	300
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	0
3146	6910	3290	4146	1676	3110	6610	3110	4110	680
3147	6911	3291	4147	67	3111	6611	3111	4111	18
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	400	3113	6613	3113	4113	600
3150	6914	3294	4150	10	3114	6614	3114	4114	0
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	20	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	50
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	148
3158	6922	3302	4158	0	3128	6628	3128	4128	0
					3129	6629	3129	4129	26
					3130	6630	3130	4130	60
3161	6925	3305	4161	0	3133	6633	3133	4133	0

Motor model				B10	Type				L521
Applicable amplifier				12S	Model code				None
Parameter for low-speed output characteristics				5.5/7.5kw	Parameter for high-speed output characteristics				5.5/7.5kw
Parameter No.				520/ 1000rpm	Parameter No.				1000/ 8000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00011010
					3020	6520	3020	4020	8000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	65
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	600	3100	6600	3100	4100	1500
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	800	3102	6602	3102	4102	2000
3141	6905	3285	4141	800	3103	6603	3103	4103	2000
3142	6906	3286	4142	1850	3104	6604	3104	4104	1250
					3105	6605	3105	4105	1250
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	656	3110	6610	3110	4110	431
3147	6911	3291	4147	28	3111	6611	3111	4111	12
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	500	3113	6613	3113	4113	500
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	0	3118	6618	3118	4118	10
3156	6920	3300	4156		3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6922	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	

Motor model				B10	Type				L522
Applicable amplifier				15S	Model code				None
Parameter for low-speed output characteristics				5.5/7.5kw	Parameter for high-speed output characteristics				5.5/7.5kw
Parameter No.				350/ 1000rpm	Parameter No.				1000/ 10000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00100110
					3020	6520	3020	4020	10000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	70
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	350	3100	6600	3100	4100	1000
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	800	3102	6602	3102	4102	1915
3141	6905	3285	4141	800	3103	6603	3103	4103	1915
3142	6906	3286	4142	2000	3104	6604	3104	4104	1100
					3105	6605	3105	4105	1100
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	1676	3110	6610	3110	4110	838
3147	6911	3291	4147	62	3111	6611	3111	4111	22
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	400	3113	6613	3113	4113	400
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	50	3120	6620	3120	4120	50
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6922	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	0

Motor model				B12	Type				L523
Applicable amplifier				15S	Model code				None
Parameter for low-speed output characteristics				5.5/7.5kw	Parameter for high-speed output characteristics				5.5/7.5kw
Parameter No.				350/ 1000rpm	Parameter No.				1000/ 6000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00100110
					3020	6520	3020	4020	6000
					3040	6540	3040	4040	10
3166	6930	3310	4166	56	3080	6580	3080	4080	52
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	350	3100	6600	3100	4100	1000
3139	6903	3283	4139	69	3101	6601	3101	4101	47
3140	6904	3284	4140	500	3102	6602	3102	4102	1000
3141	6905	3285	4141	500	3103	6603	3103	4103	1000
3142	6906	3286	4142	2500	3104	6604	3104	4104	2500
					3105	6605	3105	4105	2500
3143	6907	3287	4143	2500	3106	6606	3106	4106	2500
					3107	6607	3107	4107	2500
3144	6908	3288	4144	200	3108	6608	3108	4108	500
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	1206	3110	6610	3110	4110	1077
3147	6911	3291	4147	36	3111	6611	3111	4111	32
3148	6912	3292	4148	500	3112	6612	3112	4112	450
3149	6913	3293	4149	280	3113	6613	3113	4113	260
3150	6914	3294	4150	50	3114	6614	3114	4114	5
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	20	3118	6618	3118	4118	20
3156	6920	3300	4156	3	3120	6620	3120	4120	55
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6922	3302	4158	2000	3128	6628	3128	4128	0
3161	6925	3305	4161	0	3130	6630	3130	4130	0
					3133	6633	3133	4133	0

Motor model				B12	Type				L524
Applicable amplifier				26S	Model code				None
Parameter for low-speed output characteristics				11/15kw	Parameter for high-speed output characteristics				26/30kw
Parameter No.				1000/ 4000rpm	Parameter No.				10000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00100110
					3020	6520	3020	4020	10000
					3040	6540	3040	4040	10
3166	6930	3310	4166	90	3080	6580	3080	4080	70
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	30
3138	6902	3282	4138	1100	3100	6600	3100	4100	8000
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	1800	3102	6602	3102	4102	8000
3141	6905	3285	4141	1800	3103	6603	3103	4103	6000
3142	6906	3286	4142	1500	3104	6604	3104	4104	600
					3105	6605	3105	4105	600
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	838	3110	6610	3110	4110	838
3147	6911	3291	4147	28	3111	6611	3111	4111	26
3148	6912	3292	4148	1500	3112	6612	3112	4112	2500
3149	6913	3293	4149	240	3113	6613	3113	4113	300
3150	6914	3294	4150	0	3114	6614	3114	4114	0
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	50
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6922	3302	4158	0	3128	6628	3128	4128	0
3161	6925	3305	4161	0	3130	6630	3130	4130	0
					3133	6633	3133	4133	0

Motor model				B17	Type				L525
Applicable amplifier				12S	Model code				66
Parameter for low-speed output characteristics				5.5/7.5kw	Parameter for high-speed output characteristics				5.5/7.5kw
Parameter No.				330/ 1500rpm	Parameter No.				1500/ 10000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00011010
					3020	6520	3020	4020	10000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	65
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	100	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	380	3100	6600	3100	4100	1550
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	650	3102	6602	3102	4102	2000
3141	6905	3285	4141	650	3103	6603	3103	4103	2000
3142	6906	3286	4142	2000	3104	6604	3104	4104	1500
					3105	6605	3105	4105	1500
3143	6907	3287	4143	100	3106	6606	3106	4106	100
					3107	6607	3107	4107	100
3144	6908	3288	4144	1	3108	6608	3108	4108	1
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	559	3110	6610	3110	4110	302
3147	6911	3291	4147	27	3111	6611	3111	4111	10
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	330	3113	6613	3113	4113	330
3150	6914	3294	4150	30	3114	6614	3114	4114	50
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	30
3154	6918	3298	4154	5	3118	6618	3118	4118	10
3156	6920	3300	4156		3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6922	3302	4158	1000	3128	6628	3128	4128	11000
					3130	6630	3130	4130	0
					3133	6633	3133	4133	66

Motor model				B26	Type				L526
Applicable amplifier				12S	Model code				None
Parameter for low-speed output characteristics				7.5/11kw	Parameter for high-speed output characteristics				7.5/11kw
Parameter number				550/ 1400rpm	Parameter number				1400/ 4500rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
—	—	—	—	—	3013	6513	3013	4013	00011010
					3020	6520	3020	4020	4500
					3040	6540	3040	4040	10
					3080	6580	3080	4080	60
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
—	—	—	—	—	3086	6586	3086	4086	100
3138	6902	3282	4138	550	3100	6600	3100	4100	1400
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	700	3102	6602	3102	4102	1400
3141	6905	3285	4141	700	3103	6603	3103	4103	1400
3142	6906	3286	4142	1500	3104	6604	3104	4104	1500
					3105	6605	3105	4105	1500
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6609	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	790	3110	6610	3110	4110	430
3147	6911	3291	4147	39	3111	6611	3111	4111	14
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	180	3113	6613	3113	4113	222
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	176
3158	6928	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	0

Motor model				B26	Type				L527
Applicable amplifier				15S	Model code				None
Parameter for low-speed output characteristics				7.5/11kw	Parameter for high-speed output characteristics				7.5/11kw
Parameter number				360/ 1000rpm	Parameter number				1000/ 10000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
—	—	—	—	—	3013	6513	3013	4013	00100110
					3020	6520	3020	4020	8000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	50
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
—	—	—	—	—	3086	6586	3086	4086	100
3138	6902	3282	4138	400	3100	6600	3100	4100	1000
3139	6903	3283	4139	100	3101	6601	3101	4101	80
3140	6904	3284	4140	640	3102	6602	3102	4102	1300
3141	6905	3285	4141	640	3103	6603	3103	4103	1300
3142	6906	3286	4142	1500	3104	6604	3104	4104	1500
					3105	6605	3105	4105	1500
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6609	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	754	3110	6610	3110	4110	754
3147	6911	3291	4147	27	3111	6611	3111	4111	24
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	300	3113	6613	3113	4113	200
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	176
3158	6928	3302	4158	0	3128	6628	3128	4128	10000
					3130	6630	3130	4130	0
					3133	6633	3133	4133	0

Motor model				B26	Type				L528
Applicable amplifier				18S	Model code				67
Parameter for low-speed output characteristics				7.5/11kw	Parameter for high-speed output characteristics				7.5/11kw
Parameter number				360/ 1000rpm	Parameter number				1000/ 10000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00111010
					3012	6512	3012	4012	00000000
—	—	—	—	—	3013	6513	3013	4013	00100110
					3020	6520	3020	4020	10000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	50
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
—	—	—	—	—	3086	6586	3086	4086	100
3138	6902	3282	4138	400	3100	6600	3100	4100	1300
3139	6903	3283	4139	100	3101	6601	3101	4101	70
3140	6904	3284	4140	640	3102	6602	3102	4102	1300
3141	6905	3285	4141	640	3103	6603	3103	4103	1300
3142	6906	3286	4142	1500	3104	6604	3104	4104	1500
					3105	6605	3105	4105	1500
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6609	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	754	3110	6610	3110	4110	754
3147	6911	3291	4147	27	3111	6611	3111	4111	26
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	300	3113	6613	3113	4113	200
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	105
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	176
3158	6928	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	67

Motor model				B28	Type				L529
Applicable amplifier				12S	Model code				None
Parameter for low-speed output characteristics				7.5/11kw	Parameter for high-speed output characteristics				7.5/11kw
Parameter number				430/ 1000rpm	Parameter number				1000/ 10000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001011
					3012	6512	3012	4012	00000000
—	—	—	—	—	3013	6513	3013	4013	00011010
					3020	6520	3020	4020	4500
					3040	6540	3040	4040	10
					3080	6580	3080	4080	50
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
—	—	—	—	—	3086	6586	3086	4086	100
3138	6902	3282	4138	550	3100	6600	3100	4100	1000
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	550	3102	6602	3102	4102	1250
3141	6905	3285	4141	550	3103	6603	3103	4103	1250
3142	6906	3286	4142	1500	3104	6604	3104	4104	1500
					3105	6605	3105	4105	1500
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6609	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	840	3110	6610	3110	4110	500
3147	6911	3291	4147	40	3111	6611	3111	4111	21
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	120	3113	6613	3113	4113	120
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	176
3158	6928	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	0

Motor model				B28	Type				L530
Applicable amplifier				15S	Model code				None
Parameter for low-speed output characteristics				11/15kw	Parameter for high-speed output characteristics				11/15kw
Parameter number				400/ 900rpm	Parameter number				900/ 6000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
—	—	—	—	—	3013	6513	3013	4013	00100110
					3020	6520	3020	4020	6000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	50
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
—	—	—	—	—	3086	6586	3086	4086	100
3138	6902	3282	4138	550	3100	6600	3100	4100	900
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	550	3102	6602	3102	4102	1200
3141	6905	3285	4141	400	3103	6603	3103	4103	1200
3142	6906	3286	4142	1500	3104	6604	3104	4104	1500
					3105	6605	3105	4105	1500
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6609	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	1676	3110	6610	3110	4110	838
3147	6911	3291	4147	60	3111	6611	3111	4111	26
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	90	3113	6613	3113	4113	120
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	105	3116	6616	3116	4116	105
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6928	3302	4158	0	3128	6628	3128	4128	4500
					3130	6630	3130	4130	0
					3133	6633	3133	4133	0

Motor model				B28	Type				L531
Applicable amplifier				26S	Model code				68
Parameter for low-speed output characteristics				11/15kw	Parameter for high-speed output characteristics				11/15kw
Parameter number				320/ 2000rpm	Parameter number				2000/ 6000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00111010
					3012	6512	3012	4012	00000000
—	—	—	—	—	3013	6513	3013	4013	00100110
					3020	6520	3020	4020	6000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	80
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
—	—	—	—	—	3086	6586	3086	4086	100
3138	6902	3282	4138	400	3100	6600	3100	4100	2000
3139	6903	3283	4139	100	3101	6601	3101	4101	68
3140	6904	3284	4140	700	3102	6602	3102	4102	2300
3141	6905	3285	4141	700	3103	6603	3103	4103	2300
3142	6906	3286	4142	1500	3104	6604	3104	4104	700
					3105	6605	3105	4105	700
3143	6907	3287	4143	1000	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6609	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	1250	3110	6610	3110	4110	500
3147	6911	3291	4147	58	3111	6611	3111	4111	20
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	115	3113	6613	3113	4113	110
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6928	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	68

Motor model				B35	Type				L532
Applicable amplifier				26S	Model code				69
Parameter for low-speed output characteristics				18.5/22kw	Parameter for high-speed output characteristics				18.5/22kw
Parameter number				350/ 1100rpm	Parameter number				1100/ 6000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
—	—	—	—	—	3013	6513	3013	4013	00100110
					3020	6520	3020	4020	6000
					3040	6540	3040	4040	10
					3080	6580	3080	4080	55
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
—	—	—	—	—	3086	6586	3086	4086	100
3138	6902	3282	4138	500	3100	6600	3100	4100	1500
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	500	3102	6602	3102	4102	1500
3141	6905	3285	4141	500	3103	6603	3103	4103	1500
3142	6906	3286	4142	2000	3104	6604	3104	4104	1100
					3105	6605	3105	4105	1100
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6609	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	838	3110	6610	3110	4110	539
3147	6911	3291	4147	38	3111	6611	3111	4111	23
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	120	3113	6613	3113	4113	100
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	0	3115	6615	3115	4115	0
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	50
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	143
3158	6928	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	69

Motor model				B45	Type				L533
Applicable amplifier				26S	Model code				None
Parameter for low-speed output characteristics				11/15kw	Parameter for high-speed output characteristics				11/15kw
Parameter number				300/ 900rpm	Parameter number				900/ 6000rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	1000101
					3012	6512	3012	4012	00000000
—	—	—	—	—	3013	6513	3013	4013	00100110
					3020	6520	3020	4020	3500
					3040	6540	3040	4040	10
—	—	—	—	—	—	—	—	—	—
					3080	6580	3080	4080	80
3136	6900	3280	4136	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
—	—	—	—	—	3086	6586	3086	4086	100
3138	6902	3282	4138	320	3100	6600	3100	4100	800
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	500	3102	6602	3102	4102	1300
3141	6905	3285	4141	500	3103	6603	3103	4103	1300
3142	6906	3286	4142	2400	3104	6604	3104	4104	2400
					3105	6605	3105	4105	2400
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6609	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	754	3110	6610	3110	4110	673
3147	6911	3291	4147	32	3111	6611	3111	4111	27
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	380	3113	6613	3113	4113	250
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	0
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	30	3120	6620	3120	4120	30
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6928	3302	4158	0	3128	6628	3128	4128	6000
					3130	6630	3130	4130	0
					3133	6633	3133	4133	0

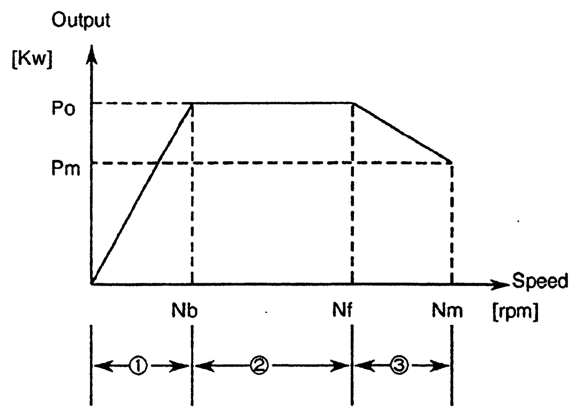
Motor model				B50	Type				L534
Applicable amplifier				40S	Model code				None
Parameter for low-speed output characteristics				22/26/ 30kw	Parameter for high-speed output characteristics				22/30/ 37kw
Parameter number				260/ 800rpm	Parameter number				1200/ 4500rpm
PM	OC	15	16		PM	OC	15	16	
					3006	6506	3006	4006	00000000
					3011	6511	3011	4011	00111010
					3012	6512	3012	4012	00000100
					3013	6513	3013	4013	00111110
					3020	6520	3020	4020	6000
					3040	6540	3040	4040	10
3166	6930	3310	4166	50	3080	6580	3080	4080	25
3136	6900	3280	4136	30	3083	6583	3083	4083	25
					3084	6584	3084	4084	30
3137	6901	3281	4137	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	360	3100	6600	3100	4100	1300
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	360	3102	6602	3102	4102	1300
3141	6905	3285	4141	360	3103	6603	3103	4103	1300
3142	6906	3286	4142	2000	3104	6604	3104	4104	800
					3105	6605	3105	4105	800
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6609	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	1473	3110	6610	3110	4110	523
3147	6911	3291	4147	65	3111	6611	3111	4111	20
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	210	3113	6613	3113	4113	280
3150	6914	3294	4150	0	3114	6614	3114	4114	0
3151	6915	3295	4151	5	3115	6615	3115	4115	0
3152	6916	3296	4152	110	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
3156	6920	3300	4156	0	3120	6620	3120	4120	40
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	171
3158	6922	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
3161	6925	3305	4161	0	3133	6633	3133	4133	0

APPENDIXES

1. CALCULATING THE ACCELERATION/DECELERATION TIME

In acceleration/deceleration, the output of the built-in AC spindle motor is 120% of the short-time rated output (including %ED).

The acceleration/deceleration time required for acceleration/deceleration (shown at the right) can be calculated from the expressions below. As the load torque of the machine is not considered in this calculation, the actual acceleration/deceleration time is slightly longer than the time calculated here.



Output characteristics at acceleration/deceleration

J_L: Load inertia converted into motor shaft [kg. m. sec^2]
※ Formula for calculating the value from GD^2 :
1 [kg. m^2] = 0.0255 [kg. m. sec^2]

Jm : Motor inertia [kg. m. sec^2]
Po, Pm : Output [kW]
Nb, Nf, Nm : Speed [rpm]

① Acceleration time (t_1) in the constant torque region (0 to N_b)

$$t_1 = 0.10754 \times \frac{(J_L + J_m) \times Nb^2}{P_0 \times 1000} \quad \text{[sec]}$$

② Acceleration time (t_2) in the constant output region (N_b to N_f)

$$t_2 = 0.10754 \times \frac{(J_L + J_m) \times (Nf^2 - Nb^2)}{2P_0 \times 1000} \quad \text{[sec]}$$

③ Acceleration time (t_3) in the output reduction region (N_f to N_m)

$$t_3 = 0.10754 \times \frac{(J_L + J_m) \times (N_m - N_f)}{(P_m - P_0) \times 1000}$$

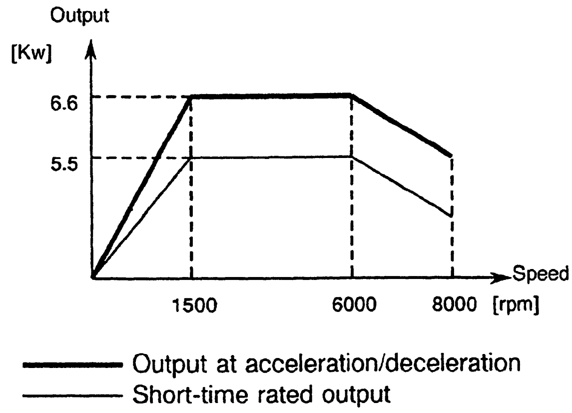
$$\times \{ (Nm - Nf) - \frac{P_0 \; N_m - P_m N_f}{P_m - P_0} \times \ln \left(\frac{P_m}{P_0}\right) \} \quad \text{[sec]}$$

Total acceleration time (t) from 0 to Nm is : t = t1 + t2 + t3

(Example)

When the built-in motor B2/L120 is used, the output characteristics at acceleration/deceleration as shown in the figure at the right. The values to be used in the calculation are as follows:

$Jm = 0.0008$ [kg.m.s^2]
$Po = 5.5 \times 1.2 = 6.6$ [kW]
$Pm = 3.7 \times 1.2 = 4.44$ [kW]
$Nb = 1500$ [rpm]
$Nf = 6000$ [rpm]
$Nm = 8000$ [rpm]
$J_L = 0.0016$ [kg.m.s^2]



① Acceleration time (t_1) in the constant torque region (0 to 1500)

$$t_1 = 0.10754 \times \frac{(0.0016 + 0.0008) \times 1500^2}{6.6 \times 1000} = 0.0880 \qquad \text{[sec]}$$

② Acceleration time (t_2) in the constant output region (1500 to 6000)

$$t_2 = 0.10754 \times \frac{(0.0016 - 0.0008) \times (6000^2 - 1500^2)}{2 \times 6.6 \times 1000} = 0.660 \qquad \text{[sec]}$$

③ Acceleration time (t_3) in the output reduction region (6000 to 8000)

$$t_3 = 0.10754 \times \frac{(0.0016 - 0.0008) \times (8000 - 6000)}{(4.44 - 6.6) \times 1000}$$

$$\times \{ (8000 - 6000) - \frac{6.6 \times 8000 - 4.44 \times 6000}{4.44 - 6.6} \ln (\frac{4.44}{6.6}) \} = 0.669 \qquad \text{[sec]}$$

Total acceleration time (t) from 0 to N_m is : $t = t_1 + t_2 + t_3 = 1.417$ [s]

2. SELECTION DATA TABLE

2.1 Built-in Spindle Motor Selection Data Table

MTB ____________________ DATE ____________________

Output Power Continuous rated 30-min. rated 40% ED rated	kW kW kW
Base Speed Maximum Speed	rpm rpm
Continuous Rated Torque (With Constant Torque Range) 30-min. Rated Torque (With Constant Torque Range)	kg.m kg.m
Rotor Inner Diameter (Spindle Outer Diameter) Main Bearing Inner Diameter Rear Bearing Inner Diameter	mm mm mm
Rotor Length (Sleeve Length, Bearing span)	 mm
Stator Outer Diameter	mm
Acceleration Time (0 rpm → Max. Speed) Spindle Inertia (Converted into motor shaft)	sec. $kg.cm.s^2$
Rigid Tapping (Example : M2,2000 rpm) Arrival Speed Acceleration Time	 rpm sec.
Built-in Sensor Inner Diameter of Ring Bearing Lubrication (Sensor Type : Standard or Dripproof)	 mm Grease or OIL-AIR
Machine	Lathe, MC, etc.

2.2 Spindle Servo Unit/NC

Model	Drawing number	C-axis detection circuit	Special conditions
	A06B- .H #H	Required/Not required	
CNC device	FANUC series		

2.3 Installation Conditions and Spindle Servo Unit Cooling Method

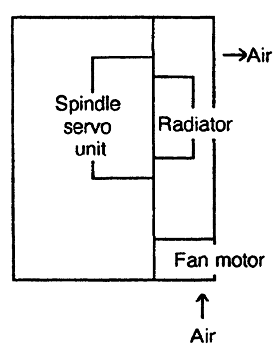
Input power supply voltage	AC200V/230V/380V/415V Others (AC V)	Power Supply Frequency	50Hz/60Hz
Ambient temperature	Motor: Approx. °C - °C, Spindle servo unit: Approx. °C - °C		
Ambient humidity	Approx. % - %		
Cooling method	Designed by customer/FANUC unit adapter specifications		
Conditions for spindle servo unit cooling method designed by customer			
Fan motor	Maximum air flow: m3/min. Maximum static pressure: mmAg Number of motors: motors		
Cooling wind circulation method	Power magnetic panel internal circulation/Fresh air direct cooling (air filter: equipped/not equipped)		

Cooling mechanism drawing
(See drawing below/See attachement)

Width Depth Height
Duct size: × × mm

Example)

Width Depth Height
Duct size: 50×20×100mm



2.4 Functions

Item	Description
C-axis control function	Used/Not used (Use: Cutting/Spindle indexing/Others)
Rigid tapping function	Used/Not used Target specifications: (Example) 2000 rpm for M2
Spindle orientation function	Magnetic sensor method Position coder mehod (Position coder/Built-in sensor) Use: ATC/Spindle indexing (workpiece indexing required) / Others
Constant surfave speed control function	Used/Not used
Output control function	Used/Not used Use
Torque control function	Used/Not used Use: Gear-shift/Others

2.5 Cutting Conditions In The Cs Contouring Control Mode

Item	Description
Motor model	
Spindle servo unit model	
Spindle and motor separated? Built-in motor used?	Separated Built-in motor
Outside diameter of Cs detector drum	65φ 97.5φ 130φ 195φ
Gear ratio of spindle to motor	
Spindle inertia calculated in terms of motor inertia	kg. cm. sec2
Workpiece material	
Workpiece diamter	mmφ
Tool diameter	mmφ
Number of tool teeth	teeth
Tool speed at cutting	rpm
Cutting feed speed	mm/minute deg/minute
Cutting depth (depth of cut)	mm
Workpiece shape	

INDEX

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Revision Record

FANUC BUILT-IN AC SPINDLE MOTOR series DESCRIPTIONS (B-65052E)

Revision	Date	Contents	Revision	Date	Contents
05	Mar., '93	1. Modification of all pages 2. Addition of new models B2, B8, B12 and B26 3. Addition of parameter No. A06B-6064-L***			
04	Sep., '91	1. Change in Section 17. Use of the spindle motor using a spindle amplifier has been changed. 2. Change in Section 20.11. The built-in spindle motor selection data table has been changed. 3. Built-in spindle motor selection data table is moved from 15.5 to 20.11.			
03	May., '91	1. Addition of descriptions of models B0.3, B0.5, B15, and B30 2. Addition of descriptions of models B3 and B45 3. Addition of descriptions of the serial interface			
02	Nov., '90	1. Addition of graph of thermal data 2. Correction of errors			
01	Jul., '90	———			
Revision	Date	Contents	Revision	Date	Contents

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