## FANUC AC SPINDLE MOTOR @i series

## **DESCRIPTIONS**

- No part of this manual may be reproduced in any form.
- All specifications and designs are subject to change without notice.

The products in this manual are controlled based on Japan's "Foreign Exchange and Foreign Trade Law". The export from Japan may be subject to an export license by the government of Japan.

Further, re-export to another country may be subject to the license of the government of the country from where the product is re-exported. Furthermore, the product may also be controlled by re-export regulations of the United States government.

Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual we have tried as much as possible to describe all the various matters.

However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.

Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

### **SAFETY PRECAUTIONS**

This "Safety Precautions" section describes the precautions which must be observed to ensure safety when using FANUC spindle motors.

Users of any spindle motor model are requested to read this manual carefully before using the spindle motor.

The users are also requested to read this manual carefully and understand each function of the motor for correct use.

The users are basically forbidden to do any behavior or action not mentioned in this manual. They are invited to ask FANUC previously about what behavior or action is prohibited.

For matters that are not described in this manual, a machine must be designed and assembled in accordance with EN60204-1 to ensure the safety of the machine and compliance with European specifications. For details, refer to the specification.

#### Contents

DEFINITION OF WARNING, CAUTION, AND NOTE	s-2
WARNING	s-3
CAUTION	s-5
NOTE	s_7

### **DEFINITION OF WARNING, CAUTION, AND NOTE**

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warning and Caution according to their bearing on safety. Also, supplementary information is described as a Note. Read the Warning, Caution, and Note thoroughly before attempting to use the machine.

### **↑** WARNING

Applied when there is a danger of the user being injured or when there is a damage of both the user being injured and the equipment being damaged if the approved procedure is not observed.

#### **⚠** CAUTION

Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

#### **NOTE**

The Note is used to indicate supplementary information other than Warning and Caution.

- Read this manual carefully, and store it in a safe place.

### **WARNING**

### 

- Be safely dressed when handling a motor.

Wear safety shoes or gloves when handling a motor as you may get hurt on any edge or protrusion on it or electric shocks.

- Use a crane or lift to move a motor from one place to another.

A motor is heavy. If you lift the motor by hand, you may get a backache, or you may be seriously injured when you drop the motor. A suitable crane or lift must be used to move the motor. (For the weight of motors, refer to this manual.)

When moving a motor using a crane or lift, use a hanging bolt if the motor has a corresponding tapped hole, or textile rope if it has no tapped hole. If a motor is attached with a machine or any other heavy stuff, do not use a hanging bolt to move the motor as the hanging bolt and/or motor may get broken.

- Before starting to connect a motor to electric wires, make sure they are isolated from an electric power source.

A failure to observe this caution is vary dangerous because you may get electric shocks.

- Be sure to secure power wires and short-bars.

If operation is performed with a terminal loose, the terminal block may become abnormally hot, possibly causing a fire. Also, the terminal may become disconnected, causing a ground fault or short-circuit, and possibly giving you electric shocks. See the section in this manual that gives the tightening torque for attaching power wires and short-bars to the terminal block.

- Be sure to ground a motor frame.

To avoid electric shocks, be sure to connect the grounding terminal in the terminal box to the grounding terminal of the machine.

- Do not ground a motor power wire terminal or short-circuit it to another power wire terminal.

A failure to observe this caution may cause electric shocks or a burned wiring.

\* Some motors require a special connection such as a winding switching. Refer to their respective motor specification manuals for details.

- Do not supply the power to the motor while any terminal is exposed.

A failure to observe this caution is very dangerous because you may get electric shocks if your body or any conductive stuff touches an exposed terminal.

### **⚠ WARNING**

- Do not bring any dangerous stuff near a motor.

Motors are connected to a power line, and may get hot. If a flammable is placed near a motor, it may be ignited, catch fire, or explode.

- Do not get close to a rotary section of a motor when it is rotating.

You may get your clothes or fingers caught in a rotary section, and may be injured. Before starting a motor, ensure that there is no stuff that can fly away (such as a key) on the motor.

- Do not touch a motor with a wet hand.

A failure to observe this caution is vary dangerous because you may get electric shocks.

- Before touching a motor, shut off the power to it.

Even if a motor is not rotating, there may be a voltage across the terminals of the motor.

Especially before touching a power supply connection, take sufficient precautions.

Otherwise you may get electric shocks.

- Do not touch any terminal of a motor for a while (at least 5 minutes) after the power to the motor is shut off.

High voltage remains across power line terminals of a motor for a while after the power to the motor is shut off. So, do not touch any terminal or connect it to any other equipment. Otherwise, you may get electric shocks or the motor and/or equipment may get damaged.

- To drive a motor, use a specified amplifier and parameters.

If a motor is driven with a wrong combination of an amplifier and parameters, the motor may exhibit abnormal behavior, such as runaway or excessive torque output, possibly causing damage to the motor and machine. There also is a danger that workpieces, tools, or other objects may fly away due to excessive rotation, possibly injuring the user.

- Before driving a motor, be sure to secure it.

If a motor is drove without being secured, it may roll over during acceleration or deceleration, injuring the user.

### **CAUTION**

### **⚠** CAUTION

- Do not touch a motor when it is running or immediately after it stops.

A motor may get hot when it is running. Do not touch the motor before it gets cool enough. Otherwise, you may get burned.

- Be careful not get your hair or cloths caught in a fan.

Be careful especially for a fan used to generate an inward air flow. Be careful also for a fan even when the motor is stopped, because it continues to rotate while the amplifier is turned on.

- FANUC spindle motors are designed for use with machine tool spindles. Do not use them for any other purpose.

If a FANUC motor is used for an unintended purpose, it may cause an unexpected symptom or trouble. If you want to use a motor for an unintended purpose, previously consult with FANUC.

- Ensure that a base or frame on which a motor is mounted is strong enough.

Motors are heavy. If a base or frame on which a motor is mounted is not strong enough, it is impossible to achieve the required precision.

- Ensure that motors and related components are mounted securely.

If a motor or its component slips out of place or comes off when the motor is running, it is very dangerous.

- Be sure to connect motor cables correctly.

An incorrect connection of a cable cause abnormal heat generation, equipment malfunction, or failure. Always use a cable with an appropriate current carrying capacity (or thickness). For how to connect cables to motors, refer to their respective specification manuals.

- Ensure that motors are cooled if they are those that require forcible cooling.

If a motor that requires forcible cooling is not cooled normally, it may cause a failure or trouble. For a fan-cooled motor, ensure that it is not clogged or blocked with dust and dirt. For a liquid-cooled motor, ensure that the amount of the liquid is appropriate and that the liquid piping is not clogged. For both types, perform regular cleaning and inspection.

- When attaching a component having inertia, such as a pulley, to a motor, ensure that any imbalance between the motor and component is minimized.

If there is a large imbalance, the motor may vibrates abnormally, resulting in the motor being broken.

### **⚠** CAUTION

- Be sure to attach a key to a motor with a keyed shaft.

If a motor with a keyed shaft runs with no key attached, it may impair torque transmission or cause imbalance, resulting in the motor being broken. With the  $\alpha i$  series, a shaft with no key is used as standard.

### **NOTE**

### NOTE

- Do not step or sit on a motor.

If you step or sit on a motor, it may get deformed or broken. Do not put a motor on another unless they are in packages.

- When storing a motor, put it in a dry (non-condensing) place at room temperature (0 to 40 °C).

If a motor is stored in a humid or hot place, its components may get damaged or deteriorated. In addition, keep a motor in such a position that its shaft is held horizontal and its terminal box is at the top.

- Do not remove a nameplate from a motor.

If a nameplate comes off, be careful not to lose it. If the nameplate is lost, the motor becomes unidentifiable, resulting in maintenance becoming impossible.

- Do not apply shocks to a motor or cause scratches to it.

If a motor is subjected to shocks or is scratched, its components may be adversely affected, resulting in normal operation being impaired. Be very careful when handling plastic portions, sensors, and windings, because they are very liable to break. Especially, avoid lifting a motor by pulling its plastic portion, winding, or power cable.

- Do not conduct dielectric strength or insulation test for a sensor.

Such a test can damage elements in the sensor.

- When testing the winding or insulation resistance of a motor, satisfy the conditions stipulated in IEC34.

Testing a motor under a condition severer than those specified in IEC34 may damage the motor.

- Do not disassemble a motor.

Disassembling a motor may cause a failure or trouble in it. If disassembly is in need because of maintenance or repair, please contact a service representative of FANUC.

- Do not modify a motor.

Do not modify a motor unless directed by FANUC. Modifying a motor may cause a failure or trouble in it.

- Use a motor under an appropriate environmental condition.

Using a motor in an adverse environment may cause a failure or trouble in it. Refer to this manual for details of the operating and environmental conditions for motors

### NOTE

- Do not apply a commercial power source voltage directly to a motor.

Applying a commercial power source voltage directly to a motor may result in its windings being burned. Be sure to use a specified amplifier for supplying voltage to the motor.

- For a motor with a terminal box, make a conduit hole for the terminal box in a specified position.

When making a conduit hole, be careful not to break or damage unspecified portions. Refer to an applicable specification manual.

- Before using a motor, measure its winding and insulation resistances, and make sure they are normal.

Especially for a motor that has been stored for a prolonged period of time, conduct these checks. A motor may deteriorate depending on the condition under which it is stored or the time during which it is stored. For the winding resistances of motors, refer to this manual, or ask FANUC. For insulation resistances, see the following table.

- To use a motor as long as possible, perform periodic maintenance and inspection for it, and check its winding and insulation resistances.

Note that extremely severe inspections (such as dielectric strength tests) of a motor may damage its windings. For the winding resistances of motors, refer to their respective specification manuals, or ask FANUC. For insulation resistances, see the following table.

#### MOTOR INSULATION RESISTANCE MEASUREMENT

Measure an insulation resistance between each winding and motor frame using an insulation resistance meter (500 VDC). Judge the measurements according to the following table.

Insulation resistance	Judgment
100 M $\Omega$ or higher	Acceptable
10 to 100 MΩ	The winding has begun deteriorating. There is no problem with the performance at present. Be sure to perform periodic inspection.
1 to 10 MΩ	The winding has considerably deteriorated. Special care is in need. Be sure to perform periodic inspection.
Lower than 1 M $\Omega$	Unacceptable. Replace the motor.

B-65272EN/05 PREFACE

### **PREFACE**

The models covered by this manual, and their abbreviations are:

Series	Model
	$\alpha i$ I 0.5/10000, $\alpha i$ I 1/10000, $\alpha i$ I 1.5/10000, $\alpha i$ I 2/10000,
	$\alpha i$ I 3/10000, $\alpha i$ I 6/10000, $\alpha i$ I 8/8000, $\alpha i$ I 12/7000,
	$\alpha i$ I 15/7000, $\alpha i$ I 18/7000, $\alpha i$ I 22/7000, $\alpha i$ I 30/6000,
α <i>İ</i> I series	$\alpha i$ I 40/6000, $\alpha i$ I 50/4500, $\alpha i$ I 1/15000, $\alpha i$ I 1.5/20000,
200V type	$\alpha i$ I 2/20000, $\alpha i$ I 3/12000, $\alpha i$ I 6/12000, $\alpha i$ I 8/10000,
	$\alpha i$ I 12/10000, $\alpha i$ I 12/12000, $\alpha i$ I 15/10000, $\alpha i$ I 15/12000,
	$\alpha i$ I 18/10000, $\alpha i$ I 18/12000, $\alpha i$ I 22/10000, $\alpha i$ I 22/12000
	$\alpha i$ I 0.5/10000HV, $\alpha i$ I 1/10000HV, $\alpha i$ I 1.5/10000HV,
	lpha iI 2/10000HV, $lpha i$ I 3/10000HV, $lpha i$ I 6/10000HV,
αİI series	$\alpha i$ I 8/8000HV, $\alpha i$ I 12/7000HV, $\alpha i$ I 15/7000HV,
400V type	lpha iI 22/7000HV, $lpha i$ I 30/6000HV, $lpha i$ I 40/6000HV,
	$lpha \dot{i}$ I 60/4500HV, $lpha \dot{i}$ I 100/4000HV
	$\alpha i$ IP 12/6000, $\alpha i$ IP 15/6000, $\alpha i$ IP 18/6000, $\alpha i$ IP 22/6000,
α <i>t</i> IP series	$\alpha i$ IP 30/6000, $\alpha i$ IP 40/6000, $\alpha i$ IP 50/6000, $\alpha i$ IP 60/4500,
200V type	$\alpha \dot{t}$ IP 12/8000, $\alpha \dot{t}$ IP 15/8000, $\alpha \dot{t}$ IP 18/8000, $\alpha \dot{t}$ IP 22/8000
$\alpha i$ IP series	$\alpha i$ IP 15/6000HV, $\alpha i$ IP 22/6000HV, $\alpha i$ IP 40/6000HV,
400V type	lpha iIP 50/6000HV, $lpha i$ IP 60/4500HV
	$\alpha i$ IT 1.5/20000, $\alpha i$ IT 2/20000, $\alpha i$ IT 3/12000,
α <i>İ</i> IT series	$α\dot{t}$ Ιτ 6/12000, $α\dot{t}$ Ιτ 8/12000, $α\dot{t}$ Ιτ 8/15000,
200V type	$α\dot{t}$ ΙΤ 15/10000, $α\dot{t}$ ΙΤ 15/15000, $α\dot{t}$ ΙΤ 22/10000
	$lpha \dot{t}$ IT 1.5/20000HV, $lpha \dot{t}$ IT 2/20000HV, $lpha \dot{t}$ IT 3/12000HV,
αİIT series	$α\dot{i}$ Ιτ 6/12000HV, $α\dot{i}$ Ιτ 8/12000HV, $α\dot{i}$ Ιτ 8/15000HV,
400V type	αiΙτ 15/10000HV, $αi$ Ιτ 15/15000HV, $αi$ Ιτ 22/10000HV
α <i>İ</i> I∟ series 200V type	$\alpha i$ IL 8/20000, $\alpha i$ IL 15/15000, $\alpha i$ IL 26/15000
α <i>i</i> IL series 400V type	lpha iIL 8/20000HV, $lpha i$ IL 15/15000HV, $lpha i$ IL 26/15000HV

### **TABLE OF CONTENTS**

SA	FETY	PRECAUTIONS	s-1
		NITION OF WARNING, CAUTION, AND NOTE	
	WAR	NING	s-3
	CAU	TION	s-5
	NOT	<b>=</b>	s-7
PR	EFAC	E	p-1
1. 1	FANU	C AC SPINDLE MOTOR $lpha i$ SERIES	
1	GEN	IERAL	3
2	CON	IFIGURATION OF THE $lpha i$ series	5
3	МОТ	OR TYPES	6
4	NOT	ES ON INSTALLATION	7
	4.1	COMMON	8
	4.2	METHOD OF USING THE MOTOR WITH CONSIDERATION GIVEN TO	0
		ITS ENVIRONMENTAL RESISTANCE	15
	4.3	POWER LEAD CONNECTION	27
	4.4	FAN MOTOR CONNECTION	33
	4.5	WHEN A MOTOR IS CONNECTED TO A SPINDLE VIA A BELT	36
	4.6	WHEN A MOTOR IS CONNECTED TO A SPINDLE VIA A GEAR	39
	4.7	WHEN A MOTOR IS DIRECTLY CONNECTED TO A SPINDLE VIA A	
		COUPLING	
5	NOT	ES ON OPERATION	42
6	DET	ERMINING THE ACCELERATION TIME	43
7	DET	ERMINING THE ALLOWABLE DUTY CYCLE	49
8	DISF	POSAL OF SPINDLE MOTORS BY MATERIAL TYPE	52
II.	FAN	JC AC SPINDLE MOTOR $lpha m{i}$ I series 200V type	
1	GEN	IERAL	55
2	SPE	CIFICATIONS	56

3	OUT	PUT/TORQUE CHARACTERISTICS	66
	3.1	MODEL $lpha i$ I 0.5/10000	67
	3.2	MODEL $lpha i$ I 1/10000	67
	3.3	MODEL $lpha i$ I 1.5/10000	68
	3.4	MODEL $lpha i$ I 2/10000	68
	3.5	MODEL $lpha i$ I 3/10000	69
	3.6	MODEL $lpha i$ I 6/10000	69
	3.7	MODEL $lpha i$ I 8/8000	70
	3.8	MODEL $lpha i$ I 12/7000	70
	3.9	MODEL $lpha i$ I 15/7000	71
	3.10	MODEL $lpha i$ I 18/7000	71
	3.11	MODEL $lpha i$ I 22/7000	72
	3.12	MODEL $lpha i$ I 30/6000	72
	3.13	MODEL $lpha i$ I 40/6000	73
	3.14	MODEL $lpha i$ I 50/4500	73
	3.15	MODEL $lpha i$ I 1/15000	74
	3.16	MODEL $lpha i$ I 1.5/20000	75
	3.17	MODEL $lpha \dot{i}$ I 2/20000	76
	3.18	MODEL $lpha i$ I 3/12000	77
	3.19	MODEL $lpha \dot{i}$ I 6/12000	78
	3.20	MODEL $lpha i$ I 8/10000	79
	3.21	MODELS $lpha i$ I 12/10000 AND $lpha i$ I 12/12000	80
	3.22	MODELS $lpha i$ I 15/10000 AND $lpha i$ I 15/12000	81
	3.23	MODELS $lpha i$ I 18/10000 AND $lpha i$ I 18/12000	82
	3.24	MODELS $lpha i$ I 22/10000 AND $lpha i$ I 22/12000	83
4	LOA	DMETER (DYNAMOMETER)	84
	4.1	STANDARD TYPE	
5	CON	NECTIONS	89
	5.1	MODEL $\alpha i$ I 0.5/10000	90
	5.2	MODELS $lpha i$ I 1/10000 TO $lpha i$ I 50/4500	92
	5.3	CONNECTION OF SIGNAL LEAD	93
6	ΔΙΙ	OWABLE RADIAL LOAD	94

7	ASSE	EMBLING ACCURACY	95
8	EXTE	RNAL DIMENSIONS	96
	8.1	MODEL $lpha i$ I 0.5/10000 (FLANGE MOUNTING TYPE)	97
	8.2	MODELS $lpha i$ I 1/10000 AND $lpha i$ I 1/15000 (FLANGE MOUNTING TYPE).	98
	8.3	MODEL $lpha \dot{i}$ I 1/10000 (FOOT MOUNTING TYPE)	99
	8.4	MODEL $lpha \dot{i}$ I 1.5/10000 (FLANGE MOUNTING TYPE)	100
	8.5	MODEL $lpha \dot{i}$ I 1.5/20000 (FLANGE MOUNTING TYPE)	101
	8.6	MODEL $lpha \dot{i}$ I 1.5/10000 (FOOT MOUNTING TYPE)	102
	8.7	MODEL $lpha \dot{i}$ I 2/10000 (FLANGE MOUNTING TYPE)	103
	8.8	MODEL $lpha \dot{i}$ I 2/20000 (FLANGE MOUNTING TYPE)	104
	8.9	MODEL $lpha i$ I 2/10000 (FOOT MOUNTING TYPE)	105
	8.10	MODELS $lpha i$ I 3/10000 AND $lpha i$ I 3/12000 (FLANGE MOUNTING TYPE).	106
	8.11	MODEL $lpha i$ I 3/10000 (FOOT MOUNTING TYPE)	107
	8.12	MODELS $lpha i$ I 6/10000 AND $lpha i$ I 6/12000 (FLANGE MOUNTING TYPE).	108
	8.13	MODEL $lpha i$ I 6/10000 (FOOT MOUNTING TYPE)	109
	8.14	MODELS $lpha i$ I 8/8000 AND $lpha i$ I 8/10000 (FLANGE MOUNTING TYPE)	110
	8.15	MODEL $lpha \dot{i}$ I 8/8000 (FOOT MOUNTING TYPE)	111
	8.16	MODELS $lpha i$ I 12/7000, $lpha i$ I 12/10000, AND $lpha i$ I 12/12000 (FLANGE	
		MOUNTING TYPE)	112
	8.17	MODEL $lpha i$ I 12/7000 (FOOT MOUNTING TYPE)	113
	8.18	MODELS $lpha i$ I 15/7000, $lpha i$ I 15/10000, AND $lpha i$ I 15/12000 (FLANGE	
		MOUNTING TYPE)	114
	8.19	MODEL $lpha \dot{i}$ I 15/7000 (FOOT MOUNTING TYPE)	115
	8.20	MODELS $lpha i$ I 18/7000, $lpha i$ I 18/10000, AND $lpha i$ I 18/12000 (FLANGE	
		MOUNTING TYPE)	
	8.21	MODEL $lpha i$ I 18/7000 (FOOT MOUNTING TYPE)	117
	8.22	MODELS $lpha i$ I 22/7000, $lpha i$ I 22/10000, AND $lpha i$ I 22/12000 (FLANGE	
		MOUNTING TYPE)	
	8.23	MODEL $\alpha i$ I 22/7000 (FOOT MOUNTING TYPE)	
	8.24	MODEL $\alpha i$ I 30/6000 (FLANGE MOUNTING TYPE)	
	8.25	MODEL $\alpha i$ I 30/6000 (FOOT MOUNTING TYPE)	
	8.26	MODEL $\alpha i$ I 40/6000 (FLANGE MOUNTING TYPE)	122
	8 27	MODEL at 40/6000 (FOOT MOUNTING TYPE)	123

	8.28	MODEL $lpha \dot{t}$ I 50/4500 (FLANGE MOUNTING TYPE)	124
	8.29	MODEL $lpha \dot{i}$ I 50/4500 (FOOT MOUNTING TYPE)	125
ш.	FAN	UC AC SPINDLE MOTOR $lpha i$ I series 400V type	
1	GEN	ERAL	129
2	SPE	CIFICATIONS	130
3	OUTI	PUT/TORQUE CHARACTERISTICS	136
	3.1	MODEL $\alpha i$ I 0.5/10000HV	
	3.2	MODEL $lpha \dot{i}$ I 1/10000HV	137
	3.3	MODEL $lpha i$ I 1.5/10000HV	138
	3.4	MODEL $lpha i$ I 2/10000HV	138
	3.5	MODEL $lpha i$ I 3/10000HV	139
	3.6	MODEL $lpha \dot{i}$ I 6/10000HV	139
	3.7	MODEL $lpha i$ I 8/8000HV	140
	3.8	MODEL $lpha \dot{i}$ I 12/7000HV	140
	3.9	MODEL $lpha\dot{i}$ I 15/7000HV	141
	3.10	MODEL $lpha \dot{i}$ I 22/7000HV	141
	3.11	MODEL $lpha \dot{i}$ I 30/6000HV	142
	3.12	MODEL $lpha \dot{i}$ I 40/6000HV	142
	3.13	MODEL $lpha \dot{i}$ I 60/4500HV	143
	3.14	MODEL $lpha \dot{i}$ I 100/4000HV	144
4	CON	NECTIONS	145
	4.1	MODEL $lpha i$ I 0.5/10000HV	146
	4.2	MODELS $lpha i$ I 1/10000HV TO $lpha i$ I 100/4000HV	148
	4.3	CONNECTION OF SIGNAL LEAD	149
5	ALLO	DWABLE RADIAL LOAD	150
6	ASSI	EMBLING ACCURACY	151
7	EXTE	ERNAL DIMENSIONS	152
	7.1	MODEL $lpha \dot{i}$ I 0.5/10000HV (FLANGE MOUNTING TYPE)	153
	7.2	MODEL $lpha \dot{i}$ I 1/10000HV (FLANGE MOUNTING TYPE)	154
	7.3	MODEL $lpha \dot{i}$ I 1/10000HV (FOOT MOUNTING TYPE)	155
	7 4	MODEL ail 1 5/10000HV (ELANGE MOUNTING TYPE)	156

	7.5	MODEL $\alpha i$ I 1.5/10000HV (FOOT MOUNTING TYPE)	157
	7.6	MODEL $lpha i$ I 2/10000HV (FLANGE MOUNTING TYPE)	158
	7.7	MODEL $lpha i$ I 2/10000HV (FOOT MOUNTING TYPE)	159
	7.8	MODEL $lpha i$ I 3/10000HV (FLANGE MOUNTING TYPE)	160
	7.9	MODEL $lpha i$ I 3/10000HV (FOOT MOUNTING TYPE)	161
	7.10	MODEL $lpha i$ I 6/10000HV (FLANGE MOUNTING TYPE)	162
	7.11	MODEL $lpha i$ I 6/10000HV (FOOT MOUNTING TYPE)	163
	7.12	MODEL $lpha i$ I 8/8000HV (FLANGE MOUNTING TYPE)	164
	7.13	MODEL $lpha i$ I 8/8000HV (FOOT MOUNTING TYPE)	165
	7.14	MODEL $lpha\dot{i}$ I 12/7000HV (FLANGE MOUNTING TYPE)	166
	7.15	MODEL $lpha i$ I 12/7000HV (FOOT MOUNTING TYPE)	167
	7.16	MODEL $lpha i$ I 15/7000HV (FLANGE MOUNTING TYPE)	168
	7.17	MODEL $lpha i$ I 15/7000HV (FOOT MOUNTING TYPE)	169
	7.18	MODEL $lpha\dot{i}$ I 22/7000HV (FLANGE MOUNTING TYPE)	170
	7.19	MODEL $lpha i$ I 22/7000HV (FOOT MOUNTING TYPE)	171
	7.20	MODEL $lpha i$ I 30/6000HV (FLANGE MOUNTING TYPE)	172
	7.21	MODEL $lpha i$ I 30/6000HV (FOOT MOUNTING TYPE)	173
	7.22	MODEL $lpha i$ I 40/6000HV (FLANGE MOUNTING TYPE)	174
	7.23	MODEL $lpha i$ I 40/6000HV (FOOT MOUNTING TYPE)	175
	7.24	MODEL $lpha i$ I 60/4500HV (FLANGE MOUNTING TYPE)	176
	7.25	MODEL $lpha i$ I 60/4500HV (FOOT MOUNTING TYPE)	177
	7.26	MODEL $\alpha i$ I 100/4000HV (FOOT FLANGE MOUNTING TYPE)	178
IV.	FΔNI	JC AC SPINDLE MOTOR $\alpha m{i}$ IP series 200V type	
			404
1		RAL	
2	SPEC	CIFICATIONS	182
3	OUTP	PUT/TORQUE CHARACTERISTICS	188
	3.1	MODEL $lpha i$ IP 12/6000	189
	3.2	MODEL $\alpha i$ IP 15/6000	190
	3.3	MODEL α <i>İ</i> IP 18/6000	191
	3.4	MODEL $\alpha i$ IP 22/6000	192
	3.5	MODEL $\alpha i$ IP 30/6000	193

	3.6	MODEL $lpha i$ IP 40/6000	194
	3.7	MODEL $lpha i$ IP 50/6000	195
	3.8	MODEL $lpha i$ IP 60/4500	196
	3.9	MODEL $lpha i$ IP 12/8000	197
	3.10	MODEL $lpha i$ IP 15/8000	198
	3.11	MODEL $lpha i$ IP 18/8000	199
	3.12	MODEL $lpha i$ IP 22/8000	200
4	CON	NECTIONS	201
	4.1	MODELS $lpha i$ IP 12/6000 TO $lpha i$ IP 60/4500	
	4.2	CONNECTION OF SIGNAL LEAD	203
5	ALL	OWABLE RADIAL LOAD	204
6	ASSI	EMBLING ACCURACY	205
7	EXT	ERNAL DIMENSIONS	206
	7.1	MODELS $lpha \dot{i}$ IP 12/6000 AND $lpha \dot{i}$ IP 12/8000	
		(FLANGE MOUNTING TYPE)	207
	7.2	MODEL $lpha i$ IP 12/6000 (FOOT MOUNTING TYPE)	208
	7.3	MODELS $lpha i$ IP 15/6000 AND $lpha i$ IP 15/8000	
		(FLANGE MOUNTING TYPE)	209
	7.4	MODEL $\alpha i$ IP 15/6000 (FOOT MOUNTING TYPE)	210
	7.5	MODELS $lpha i$ IP 18/6000 AND $lpha i$ IP 18/8000	
		(FLANGE MOUNTING TYPE)	
	7.6	MODEL αİIP 18/6000 (FOOT MOUNTING TYPE)	212
	7.7	MODELS $\alpha i$ IP 22/6000 AND $\alpha i$ IP 22/8000	
		(FLANGE MOUNTING TYPE)	
	7.8	MODEL αİIP 22/6000 (FOOT MOUNTING TYPE)	214
	7.9	MODELS $\alpha i$ IP 30/6000 AND $\alpha i$ IP 40/6000	
	7.40	(FLANGE MOUNTING TYPE)	
	7.10	MODELS $\alpha i$ IP 30/6000 AND $\alpha i$ IP 40/6000 (FOOT MOUNTING TYPE).	
	7.11	MODEL αİΤΡ 50/6000 (FLANGE MOUNTING TYPE)	
	7.12	MODEL αİIP 50/6000 (FOOT MOUNTING TYPE)	
	7.13	MODEL αİIP 60/4500 (FLANGE MOUNTING TYPE)	
	7.14	MODEL $\alpha I_{P}$ 60/4500 (FOOT MOUNTING TYPE)	220

V. F	FANU	IC AC SPINDLE MOTOR $lpha t$ IP series 400V type	
1	GEN	ERAL	223
2	SPE	CIFICATIONS	224
3	OUT	PUT/TORQUE CHARACTERISTICS	229
	3.1	MODEL $\alpha i$ IP 15/6000HV	
	3.2	MODEL $lpha i$ IP 22/6000HV	231
	3.3	MODEL $lpha i$ IP 40/6000HV	232
	3.4	MODEL $lpha i$ IP 50/6000HV	233
	3.5	MODEL α <i>İ</i> IP 60/4500HV	234
4	CON	NECTIONS	235
	4.1	MODELS $lpha i$ IP 15/6000HV TO $lpha i$ IP 60/4500HV	
	4.2	CONNECTION OF SIGNAL LEAD	237
5	ALL	OWABLE RADIAL LOAD	238
6	ASSI	EMBLING ACCURACY	239
7	EXTE	ERNAL DIMENSIONS	240
	7.1	MODEL $lpha i$ IP 15/6000HV (FLANGE MOUNTING TYPE)	241
	7.2	MODEL $lpha i$ IP 15/6000HV (FOOT MOUNTING TYPE)	242
	7.3	MODEL $lpha i$ IP 22/6000HV (FLANGE MOUNTING TYPE)	243
	7.4	MODEL $lpha i$ IP 22/6000HV (FOOT MOUNTING TYPE)	244
	7.5	MODEL $lpha i$ IP 40/6000HV (FLANGE MOUNTING TYPE)	245
	7.6	MODEL $lpha i$ IP 40/6000HV ((OOT MOUNTING TYPE)	246
	7.7	MODEL $lpha i$ IP 50/6000HV (FLANGE MOUNTING TYPE)	247
	7.8	MODEL $lpha i$ IP 50/6000HV (FOOT MOUNTING TYPE)	248
	7.9	MODEL $lpha \dot{t}$ IP 60/4500HV (FLANGE MOUNTING TYPE)	249
	7.10	MODEL $lpha i$ IP 60/4500HV (FOOT MOUNTING TYPE)	250
VI.	FAN	UC AC SPINDLE MOTOR $lpha i$ IT series 200V type	
1	GEN	ERAL	253
2	SPE	CIFICATIONS	255
3	OUT	PUT/TORQUE CHARACTERISTICS	261
		MODEL ait 1 5/20000	262

	3.2	MODEL α <i>İ</i> ΙΤ 2/20000	263
	3.3	MODEL $lpha i$ IT 3/12000	264
	3.4	MODEL $lpha \dot{i}$ IT 6/12000	265
	3.5	MODEL $lpha \dot{i}$ IT 8/12000	266
	3.6	MODEL $lpha \dot{i}$ IT 8/15000	267
	3.7	MODEL $lpha \dot{i}$ IT 15/10000	268
	3.8	MODEL $lpha i$ IT 15/15000	269
	3.9	MODEL $lpha i$ IT 22/10000	270
4	CON	FIGURATION AND ORDERING NUMBER	271
	4.1	CONFIGURATION	272
	4.2	ORDERING NUMBER	273
5	CON	NECTIONS	274
	5.1	CONNECTION OF THE POWER, FAN MOTOR, AND $lpha i$ MZ SENSOR	
		SIGNAL LEADS	275
	5.2	CONNECTION OF SIGNAL LEAD	277
6	ASS	EMBLING ACCURACY	278
7	EXT	ERNAL DIMENSIONS	279
	7.1	MODEL $lpha \dot{i}$ IT 1.5/20000	280
	7.2	MODEL $lpha \dot{i}$ IT 2/20000	281
	7.3	MODEL $lpha \dot{i}$ IT 3/12000	282
	7.4	MODEL $lpha \dot{i}$ IT 6/12000	283
	7.5	MODELS $lpha i$ IT 8/12000 AND $lpha i$ IT 8/15000	284
	7.6	MODEL $lpha \dot{i}$ IT 15/10000	285
	7.7	MODEL $lpha \dot{i}$ IT 15/15000	286
	7.8	MODEL $lpha \dot{i}$ IT 22/10000	287
	7.9	DISTANCE BLOCK TYPE $lpha \dot{i}$ IT 1.5	288
	7.10	DISTANCE BLOCK TYPE $lpha \dot{i}$ IT 2	289
	7.11	DISTANCE BLOCK TYPE $lpha \dot{i}$ IT 6	290
	7.12	DISTANCE BLOCK TYPE $lpha \dot{i}$ IT 15	291
	7.13	DISTANCE BLOCK WITH WINDOWS TYPE $lpha i$ IT 2	292
	7.14	DISTANCE BLOCK WITH WINDOWS TYPE $\alpha i$ IT 6	293
	7 15	DISTANCE BLOCK WITH WINDOWS TYPE ait 15	204

8	POI	NTS ABOUT DIRECT CONNECTION STRUCTURE	295
9	NOT	ES ON MOTOR INSTALLATION	296
	9.1	HIGHER-PRECISION MOUNTING FLANGE AND SHAFT	297
	9.2	CENTERING USING CENTERING PLATES	298
	9.3	CHECKING MOTOR VIBRATION (TO SEE WHETHER CENTERING	
		SUCCESSFUL)	
	9.4	COUPLING SELECTION	
	9.5 9.6	ROTATION JOINTCOOLANT JOINT	
	9.7	ROTATION JOINT SUPPORT HOUSING	
VI	I. FAN	NUC AC SPINDLE MOTOR $lpha i$ IT series 400V type	
1	GEN	ERAL	311
2	SPE	CIFICATIONS	312
3	OUT	PUT/TORQUE CHARACTERISTICS	318
	3.1	MODEL $lpha i$ IT 1.5/20000HV	319
	3.2	MODEL $lpha i$ IT 2/20000HV	320
	3.3	MODEL $lpha i$ IT 3/12000HV	321
	3.4	MODEL $lpha i$ IT 6/12000HV	322
	3.5	MODEL $\alpha i$ IT 8/12000HV	323
	3.6	MODEL $\alpha i$ IT 8/15000HV	324
	3.7	MODEL $\alpha i$ IT 15/10000HV	325
	3.8	MODEL $\alpha i$ IT 15/15000HV	326
	3.9	MODEL $\alpha i$ IT 22/10000HV	327
4	CON	IFIGURATION AND ORDERING NUMBER	328
	4.1	CONFIGURATION	329
	4.2	ORDERING NUMBER	330
5	CON	INECTIONS	
	5.1	CONNECTION OF THE POWER, FAN MOTOR, AND $lpha i$ MZ SENSOR	
		SIGNAL LEADS	
	5.2	CONNECTION OF A SINGLE-PHASE FAN MOTOR	
	5.3	CONNECTION OF SIGNAL LEAD	334
6	ASS	FMBLING ACCURACY	335

7	EXT	ERNAL DIMENSIONS	336
	7.1	MODEL $lpha i$ IT 1.5/20000HV	337
	7.2	MODEL $lpha i$ IT 2/20000HV	338
	7.3	MODEL $lpha i$ IT 3/12000HV	339
	7.4	MODEL $lpha i$ IT 6/12000HV	340
	7.5	MODELS $lpha i$ IT 8/12000HV AND $lpha i$ IT 8/15000HV	341
	7.6	MODEL $lpha i$ IT 15/10000HV	342
	7.7	MODEL $lpha i$ IT 15/15000HV	343
	7.8	MODEL $lpha i$ IT 22/10000HV	344
VII	I. FA	NUC AC SPINDLE MOTOR $lpha i$ IL series 200V type	
1	GEN	IERAL	347
2	SPE	CIFICATIONS	348
3	OUT	PUT/TORQUE CHARACTERISTICS	351
	3.1	MODEL $lpha i$ IL 8/20000	352
	3.2	MODEL $lpha i$ IL 15/15000	353
	3.3	MODEL $lpha i$ IL 26/15000	354
4	CON	INECTIONS	355
	4.1	TOTAL CONNECTION DIAGRAM	356
	4.2	SIZE OF POWER LEAD	357
	4.3	CONNECTION OF SIGNAL LEAD	
	4.4	COOLING	359
5	ASS	EMBLING ACCURACY	361
6	EXT	ERNAL DIMENSIONS	362
	6.1	MODEL $lpha i$ IL 8/20000	363
	6.2	MODEL αiIL 15/15000	364
	6.3	MODEL $lpha i$ IL 26/15000	365
IX.	FAN	UC AC SPINDLE MOTOR $lpha m{i}$ IL series 400V type	
1	GEN	IERAL	369
2	SDE	CIFICATIONS	370

3 OI	JTPUT/TORQUE CHARACTERISTICS	373
3.1	MODEL $lpha i$ IL 8/20000HV	374
3.2	MODEL $lpha i$ IL 15/15000HV	375
3.3	MODEL $lpha i$ IL 26/15000HV	376
4 CC	ONNECTIONS	377
4.1	POWER WIRE CRIMP TERMINAL SIZE	378
4.2	CONNECTION OF SIGNAL LEAD	379
4.3	COOLING	380
5 AS	SSEMBLING ACCURACY	382
6 EX	(TERNAL DIMENSIONS	383
6.1	MODEL $lpha i$ IL 8/20000HV	384
6.2	MODEL $lpha i$ IL 15/15000HV	385
6.3	MODEL $\alpha i$ IL 26/15000HV	386

I. FANUC AC	SPINDLI	E MOTOF	R $lpha i$ SERIES

### **GENERAL**

As motors for driving the spindle of a CNC machine tool, the FANUC AC Spindle Motor  $\alpha i$  series has incorporated accumulated technologies and employs the latest design and manufacturing techniques to provide the features listed below.

#### **Features**

- The series provides a lineup of motors that satisfy various spindle driving structures such as gear driving, belt driving, and direct motor connection. So, the user can choose an optimal motor that meets the spindle driving structure of the user.
- By employing winding switching, a wider rated output range required for the spindle driving motor of a machine tool is achieved. With the αi series and αi series, a high-speed winding is used to remarkably increase the output level in the high-speed area, thus reducing acceleration/deceleration time. With the αi series, a low-speed winding is used to increase the torque by a factor of 1.5.
- An up-to-date stator cooling method is employed for direct air-cooling of the electromagnetic steel plate. So, a high power and high torque are achieved with a compact size.
- By precision rotor aluminum casting and accurate rotor balance correction, vibration grade V3 (option) is achieved even at high speed.
- The user can select a motor fan exhaust direction: forward direction or backward direction. An exhaust direction that subjects the machine to less heat deformation can be selected.
   With the αi series, the cooling air path is optimized to further improve cooling performance.
- Two types of speed sensors built into the motor are available:  $\alpha iM$  sensor based on the A/B-phase signal and  $\alpha iMZ$  sensor based on the A/B-phase signal and one-rotation signal. The user can choose between the two types according to the spindle configuration and spindle function.
- This series employ waterproof and pressure-proof design conforming to the international standard (IEC).



 $\alpha i$ I series

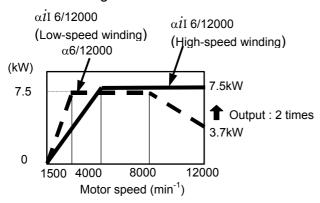


 $\alpha i$ IT series

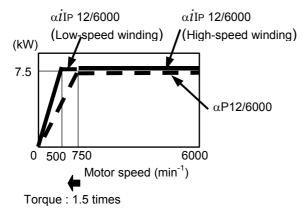
### Features of $\alpha i$ I

- Higher speed
- Increased rated output range by employing winding switching

 $\alpha i$ I,  $\alpha i$ IT: Remarkable output increase in the high-speed area by employing a high-speed winding.



 $\alpha i$ IP: Remarkable torque increase in the low-speed area by employing a low-speed winding  $\rightarrow$  Enables optimal spindle speed selection and motor model downsizing



- Low vibration: Vibration grade V3 (optional specification with the non-key type only)

### CONFIGURATION OF THE $\alpha i$ series

The FANUC AC Spindle Motor  $\alpha i$  series consists of the series listed below with their features.

Series	Rated output [kW]	Feature	Example of applicable machine
<i><b>©</b>i</i> I 200∨ type	0.55 to 45	Standard motors for machine-tool spindles	
<i>⊚</i> iI 400V type	0.55 to 100	lpha i I series directly connectable to a 400 V power supply	For Lathe and Machining center
αiip	5.5 to 30	Motors with constant output over a wide range, which require no reduction units	
<b>⊘</b> ii⊤	1.5 to 22	Model for direct spindle connection used with machining centers	For Machining center
<b></b> ØiI∟	7.5 to 30	Liquid-cooled model for direct spindle connection used with high precision machining centers	For Machining Cerner

### Lineup for Spindle Motor @i series

- 200V type

<u> </u>																	
Rated output [kW]	0.55	1.1	1.5	22	3.7	5.5	7.5	9	11	15	18.5	22	30	37	45	60	100
<b>⊘</b> ⁄iI	αiΙ 0.5/ 10000	αiI 1/ 10000	α iI 1.5/ 10000	α iI 2/ 10000	αiI 3/ 10000	αiΙ 6/ 10000	αiI 8/ 8000		α iI 12/ 7000	α iI 15/ 7000	α iI 18/ 7000	α iI 22/ 7000	αiI 30/ 6000	α iI 40/ 6000	αiI 50/ 4500		
Ø11		α i 1/ 15000	αiI 1.5/ 20000	α <i>i</i> I 2/ 20000	α i I 3/ 12000	α i 6/ 12000	α iI 8/ 10000		α iI 12/ 12000	α iI 15/ 12000	α iI 18/ 12000	α iI 22/ 12000					
<b></b> Ø <i>i</i> Ip						α <i>i</i> IP 12/ 6000	αiIP 15/ 6000	αiIP 18/ 6000	αiIP 22/ 6000	α iIP 30/ 6000	α i IP 40/ 6000	α i IP 50/ 6000	α iIP 60/ 4500				
<b>₡</b> <i>i</i> Iт			α iIτ 1.5/ 20000	α iIτ 2/ 20000	α iIτ 3/ 12000	α iIτ 6/ 12000	α <i>i</i> Iτ 8/ 12000			α iIτ 15/ 15000		α <i>i</i> Iτ 22/ 10000					
<b>⊘</b> ii∟							αiIL 8/ 20000			α iIL 15/ 15000			α i IL 26/ 15000				

- 400V type

∞iI	α iI 0.5/ 10000 HV	αίΙ 1/ 10000 HV	α iI 1.5/ 10000 HV	αίΙ 2/ 10000 HV	αίΙ 3/ 10000 HV	αίΙ 6/ 10000 HV	αίΙ 8/ 8000 HV	αίΙ 12/ 7000 HV	α <i>i</i> I 15/ 7000 HV		αίΙ 22/ 7000 HV	αίΙ 30/ 6000 HV	α iI 40/ 6000 HV	αίΙ 60/ 4500 HV	αίΙ 100/ 4000 HV
<b></b> Øiip							α <i>i</i> IP 15/ 6000 HV	α i IP 22/ 6000 HV		α <i>i</i> IP 40/ 6000 HV	αiIP 50/ 6000 HV	α iIP 60/ 4500 HV			
<b>∞</b> <i>i</i> I⊤			α iIτ 1.5/ 20000 HV	αiIT 2/ 20000 HV	α i IT 3/ 12000 HV	α <i>i</i> Iτ 6/ 12000 HV	α i IT 8/ 12000 HV		α <i>i</i> Iτ 15/ 15000 HV		α i IT 22/ 10000 HV				
<i>∝i</i> IL							αiIL 8/ 20000 HV		αiIL 15/ 15000 HV			αiIL 26/ 15000 HV			

Model supporting winding switching

### **MOTOR TYPES**

Each model includes the types of motors listed below, and the user can make an optimal choice according to the spindle driving structure. See the ordering list (B-65271EN) for available motors.

Item	Type	Use	Remarks
Mounting types	Flange mounting type	Connected to spindle via a gear Directly connected to a spindle Connected to spindle via a belt	The motor can be positioned accurately.
	Foot mounting type	Connected to spindle via a belt	
Built-in sensor	lpha iM sensor	When connected to the spindle via a belt or gear at a deceleration ratio other than 1:1 (When the spindle has a sensor)	For a detailed explanation, refer to the following descriptions: Subsection, "Spindle Amplifier ( $\alpha i$ SP)"
	lpha iMZ sensor	When connected to the spindle via a belt, gear, or coupling on a 1:1 basis (When the spindle has no sensor)	in the FANUC SERVO AMPLIFIER $\alpha i$ series DESCRIPTIONS (B-65282EN)
Shaft figure	With no key	Connected to a pulley	A shaft with no key is used as standard to facilitate pulley and gear balance correction and acceleration/ deceleration operation. When a shaft with a key is needed, contact your FANUC sales representative.
Cooling air	Rearward exhaust (Exhaust from side opposite the output shaft)	When the machine is positioned at the output shaft side	Direct the exhaust out and away from
exhaust direction	Forward exhaust (Exhaust from the output shaft side)	When the machine is positioned at the side opposite the output shaft	the machine.
	Oil seal	Gear connection, direct connection, and belt driving	Used in flange mounting type standard-speed models.
Output shaft seal	Labyrinth	Belt driving and direct connection (Only when no lubricant or coolant splashes onto the flange surface of the motor)	Used in flange mounting type high-speed models. (Some high-speed models have an oil seal.)
	No seal	Belt driving (Only when no lubricant splashes onto the flange surface of the motor)	Foot-mounting type models have no output shaft seal, but can be changed to a model with an oil seal or labyrinth. For the models that can be changed, refer to "Order List" (B-65271EN).
Maximum speed	Standard-speed model	-	Consider the maximum speed of each
iviaxiiiluili speed	High-speed model	-	model and select a model accordingly.

### **NOTES ON INSTALLATION**

### 4.1 COMMON

Be sure to observe the following, regardless of the connection method of the motor:

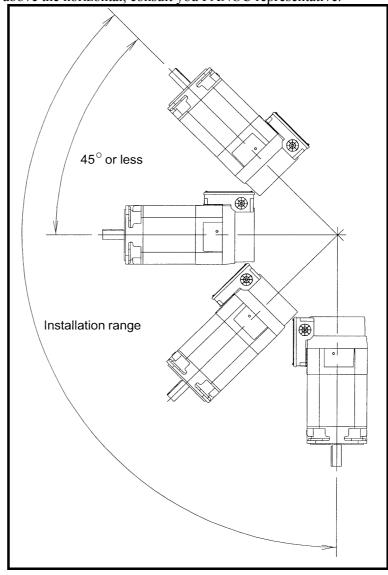
**⚠ WARNING** 

When connecting a metallic conduit to a plastic terminal box, connect the conduit to ground on the power magnetics cabinet side.

**⚠** CAUTION

1 Mount the motor so that the output shaft points in a direction ranging within 45° degrees above the horizontal to vertically downwards.

When the motor needs to be pointed to more than 45° degrees above the horizontal, consult you FANUC representative.



- 3 Use the eyebolt of the motor to lift only a motor alone, (gear and pulley may be attached).
- 4 Place a cover over an air-cooled motor to prevent the motor from being exposed to cutting fluid or lubricant.
- 5 Limit the vibration acceleration at the rear bracket of the motor to 0.5 G (4.9 m/s<sup>2</sup>) to ensure the long-term reliability of each part of the motor.

In particular, to limit the acceleration in the case of direct connection to 0.5 G, carefully perform centering with the mating spindle and make the motor shaft parallel with the spindle.

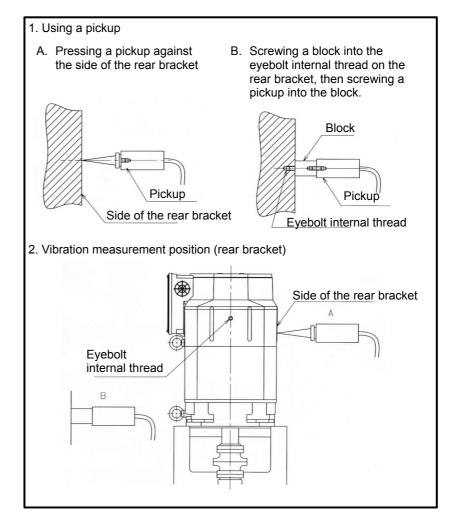
#### Details of the measuring method

Measuring instrument:

Equivalent to the VM-3314A or VM-3304 manufactured by IMV CORPORATION.

Condition: At the time of highest-speed rotation with no load Measurement frequency range with no load at the highest speed: 10 to 1000 Hz

Criteria:  $0.5 \text{ G} (4.9 \text{ m/s}^2)$  or less at the rear bracket



### 6 Dynamic balance

During high-speed operation, a small imbalance may cause a large vibration, resulting in an unusual sound, premature bearing damage, or some other abnormality.

Therefore, reduce the amount of the imbalance with the dynamic balance of the other rotation shafts, as well as the gear and pulley mounted on the output shaft of the motor, as much as possible.

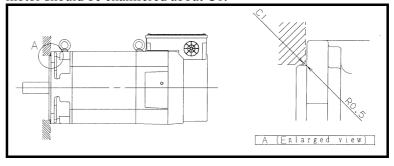
#### - Balance correction

With the  $\alpha i$  series, a shaft with no key is used as standard to facilitate the balance correction of a pulley, gear, and coupling attached to the shaft. Use a completely symmetric pulley, gear, or coupling, and use a backlash-less tightening part such as a SPANN ELEMENTE to secure a pulley, gear, or coupling to the shaft. When attaching a pulley to a shaft, for example, adjust the periphery vibration to within 20  $\mu$ m. This basically eliminates the need for balance correction. To further reduce the vibration level, make a field balance correction, for example, by tightening a screw into the tapped hole for balance correction provided on a component such as a pulley.

#### NOTE

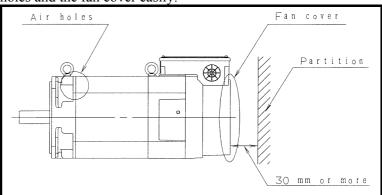
When a shaft with a key is required, contact your FANUC sales representative.

7 The edge of the fauset joint to mount the flange mounting type motor should be chamfered about C1.



8 Please space 30 mm or more between the fan cover and the partition to keep the cooling ability well.

We recommend to take a structure such as you can clean air holes and the fan cover easily.

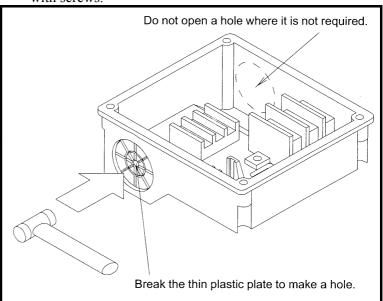


### NOTE

### 3 Cable wiring

Follow the procedure below to install the cable.

- (1) Use a hammer to strike the portion for the cable hole on the terminal box and open the hole.This time, pay attention not to break the other place except hole. (In some models, it is not necessary to make a hole.)
- (2) Thread the cable through a conduit. Connect the conduit with the connector. (\*1)
- (3) Tighten the connector at the cable hole of the terminal box using a nut. (\*2, \*3)
- (4) Connect each terminal appropriately in the terminal box with screws.



When a hole once made is not used, purchase the following rubber bushing and mount it at the hole.

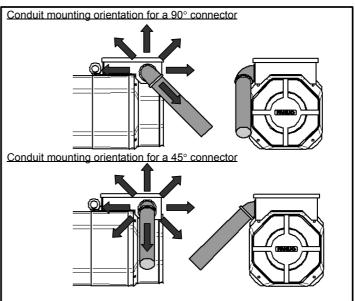
Model	Ordering number
lpha iI 1 to $lpha i$ I 15 , $lpha i$ I <sub>P</sub> 12 to $lpha i$ I <sub>P</sub> 22	
lpha iIT 1.5/20000 to $lpha i$ IT 15/10000	
lpha iI 6HV to $lpha i$ I 22HV	AOCD 0754 K004
$α\dot{i}$ ΙΡ 15HV, $α\dot{i}$ ΙΡ 22HV	A06B-0754-K001
lpha iIT 1.5/20000HV to $lpha i$ IT 22/10000HV	
lpha iIL 8/20000, $lpha i$ IL 8/20000HV	
$\alpha i$ I 18, $\alpha i$ I 22, $\alpha i$ IP 30, $\alpha i$ IP 40,	
αiΙΡ 50 $αi$ ΙΡ 40ΗV, $αi$ ΙΡ 50ΗV	
lpha iIT 15/15000, $lpha i$ IT 22/10000	A06B-0731-K001
lpha iIL 15/15000, $lpha i$ IL 26/15000	
lpha iIL 15/15000HV, $lpha i$ IL 26/15000HV	

High-speed models are same as above.

\*1 If a 90° connector is used on any of the following models, the mounting orientation of its conduit is limited as shown below to avoid interference between the conduit and motor. If you want to mount the conduit in any orientation, use a 45° connector. (For any model other than listed below, the conduit for a 90° connector can be mounted in any orientation.)

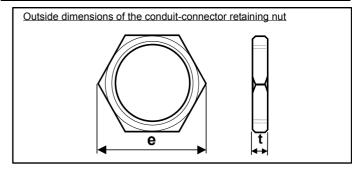
Applicable models:

 $\alpha i$ I 12 to  $\alpha i$ I 15,  $\alpha i$ IP 12 to  $\alpha i$ IP 22,  $\alpha i$ IT 15/10000,  $\alpha i$ I 12HV to  $\alpha i$ I 22HV,  $\alpha i$ IP 15/6000HV to  $\alpha i$ IP 22/6000HV,  $\alpha i$ IT 15/10000HV,  $\alpha i$ IT 15/15000HV,  $\alpha i$ IT 22/10000HV



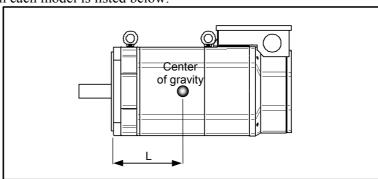
\*2 The nut used to fasten the connector to the terminal box must be smaller than the size listed below. (Any larger nut interferes with the terminal box.) For the diameter of the cable hole in each model, refer to the outside dimension drawing of the respective models.

Cable hole diameter	Outside diameter e	Width t
φ42.5 mm	53 mm (maximum)	9 mm (maximum)
φ61 mm	80 mm (maximum)	15 mm (maximum)



## 2

Center of gravity
The distance L from the flange end face to the center of gravity in each model is listed below.



αiI series 200V type	$lpha i  ext{I}$ series 400V type	$\alpha i$ IP series 200V type	$\alpha i$ IP series 400V type	Center of gravity [mm]
α <i>i</i> I 0.5/10000	α <i>İ</i> I 0.5/10000HV	-	-	95±5
α <i>İ</i> Ι 1/10000	α <i>İ</i> Ι 1/10000HV			125±5
α <i>İ</i> I 1/15000	αιι Ι/10000Ην	-	-	120±0
$lpha\dot{i}$ I 1.5/10000	α <i>İ</i> I 1.5/10000HV	_	_	145±5
α <i>İ</i> I 1.5/20000	ati 1.5/1000011V		-	14313
lpha iI 2/10000	α <i>İ</i> I 2/10000HV	_	_	125±5
lpha iI 2/20000	0.11 2/1000011V		-	12313
lpha iI 3/10000	α <i>İ</i> I 3/10000HV	_	_	170±5
α <i>İ</i> I 3/12000	W11 0/ 1000011V			17010
lpha iI 6/10000	α <i>İ</i> I 6/10000HV	_	_	150±5
α <i>İ</i> I 6/12000	ar 5/ 1000111			10010
α <i>İ</i> I 8/8000	α <i>ἱ</i> Ι 8/8000HV	_	_	185±5
α <i>İ</i> I 8/10000	3.71 0.0000111			.0020
α <i>İ</i> I 12/7000	α <i>İ</i> Ι 12/7000HV	$\alpha i$ IP 12/6000	_	160±5
α <i>İ</i> I 12/10000	ar 12/1000111	α <i>İ</i> IP 12/8000		10010
lpha iI 15/7000	α <i>ἱ</i> Ι 15/7000HV	lpha iIP 15/6000	α <i>İ</i> IP 15/6000HV	
α <i>İ</i> I 15/10000	att 10/7 00011V	α <i>İ</i> IP 15/8000	0.711 10/0000114	
α <i>ἱ</i> Ι 18/7000	_	lpha iIP 18/6000	_	
α <i>İ</i> I 18/10000		α <i>İ</i> IP 18/6000		
$\alpha i$ I 22/7000	α <i>İ</i> I 22/7000HV	$\alpha i$ IP 22/6000	α <i>İ</i> IP 22/6000HV	
α <i>İ</i> I 22/10000	W1 22/7 00011V	α <i>İ</i> IP 22/8000	WHI 22/000011V	
α <i>İ</i> Ι 30/6000	α <i>İ</i> Ι 30/6000HV	α <i>İ</i> IP 30/6000	α <i>ἱ</i> I⊵ 40/6000HV	
		α <i>İ</i> IP 40/6000		
α <i>İ</i> I 40/6000	α <i>İ</i> I 40/6000HV	α <i>İ</i> IP 50/4500	α <i>İ</i> IP 50/6000HV	
α <i>İ</i> I 50/4500	-	-	-	
-	α <i>İ</i> I 60/4500HV	lpha iIP 60/4500	α <i>İ</i> IP 60/4500HV	
-	α <i>İ</i> I 100/4000HV	-	-	

# 4.2 METHOD OF USING THE MOTOR WITH CONSIDERATION GIVEN TO ITS ENVIRONMENTAL RESISTANCE

# **⚠** CAUTION

The motor is an electric part, and if the lubricant or cutting fluid falls on the motor, it will enter the inside of the motor, possibly adversely affecting the motor. In particular, if the cutting fluid adheres to the motor, it will deteriorate the resin or rubber sealing members, causing a large amount of cutting fluid to enter the inside of the motor and possibly damaging the motor. When using the motor, note the points described below.

# 1. Level of motor protection

According to IEC 60034-5, the models equipped with an oil seal comply with the degree of protection IP54, and the other models comply with IP40. Even for the models complying with IP40, their motor main body excluding the output shaft end (with a simple labyrinth for the high-speed models or with no seal for the foot mounting type models) complies with IP54.

IP5□: Machine protected from dust

- Ingress of dust is not totally prevented, but dust does not enter in sufficient quantity to interfere with satisfactory operation of the motor.

IP4□: Machine protected from introduction of solid foreign matter over 1.0 mm

- Electric cables and wires with a diameter or thickness greater than 1.0 mm do not enter.

IP $\square$ 4: Machine protected form water spray

 Water sprayed on the motor from any direction will have no harmful effect.

IP□0: Machine not protected

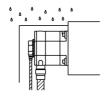
 No special protection is provided to prevent ingress of water.

Note that these models satisfy the provisions for short-time water immersion, and do not guarantee their water-proof performance in an atmosphere in which cutting fluid is applied directly to the motor. Before actual use, note the points described below.

# 2. Motor periphery

If the cutting fluid or lubricant falls on the motor, it will adversely affect the sealing properties of the motor surface, entering the inside of the motor and possibly damaging the motor.

 Make sure that the motor surface is never wet with the cutting fluid or lubricant, and also make sure that no fluid builds up around the motor. If there is a possibility of the surface being wet, a cover is required.

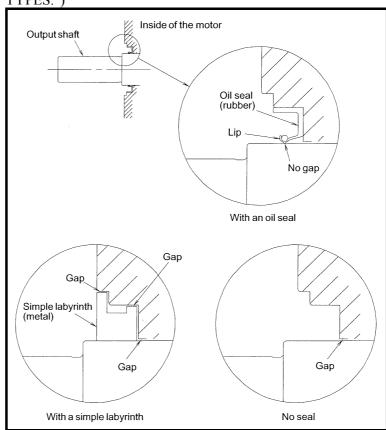




- If the cutting fluid is misted, the cutting fluid may be condensed on the inside of the cover and fall on the motor. Make sure that no condensed droplets fall on the motor.
- If the inside of the machine is full of misted cutting fluid, the cutting fluid adhered to the motor can enter the inside of the motor and damage the motor. Install a mist collector with an appropriate capacity to prevent the inside of the machine from becoming full of mist.
- Completely separate the machining area from the motor area, using a telescopic cover, accordion curtain, and so on. Note that partitions such as accordion curtains are consumable and require periodic inspection for damage.

### 3. Output shaft seal

To prevent cutting lubricant or dust from penetrating inside the motor, one of the following output shaft seals is provided on the output shaft. (For the use and applicable motors, see Chapter 3, "MOTOR TYPES.")



For those models with an oil seal, ensure that the surface of the lubricant is below the lip of the oil seal.

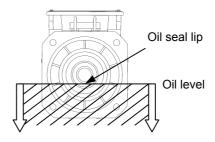
If a simple labyrinth is used as the output shaft seal (high-speed model) or if no seal is provided (foot mounting type), ensure that lubricant does not splash onto the flange surface. If such a motor is directly mounted on a gear box, the lubricant may gradually penetrate inside the motor even when no lubricant splashes on flange surface, thus resulting in motor failure. Therefore, do not mount such a motor on a gear box directly.

When the motor is used in an environment in which lubricant does not splash onto the motor, the simple labyrinth type instead of the oil seal type may be selected. Generally in a dry environment, the motor temperature of the simple labyrinth type will increase more moderately than that of the oil seal type.

#### 3.1 oil seal

The shaft of the motor is provided with an oil seal to prevent entry of lubricant and other fluids into the motor. (The high-speed model and the foot mounting type are excluded.) It does not, however, completely prevent the entry of lubricant and other fluids depending on the working conditions.

• When the motor is rotating, the oil seal has an effect of discharging any oil that enters, but if it is pressurized for a long time when the motor is stopped, it may allow oil to enter through the lip. When lubrication with an oil bath is conducted for gear engagement, for example, the oil level must be below the lip of the oil seal of the shaft, and the oil level must be adjusted so that the oil does nothing but splash on the lip.



Diameters of the oil seal lips of motor shafts

Motor model	Oil seal diameter [mm]
$lpha\dot{i}$ I 0.5, $lpha\dot{i}$ I 0.5HV	φ 20
αiΙ 1, $αi$ Ι 1.5, $αi$ Ι 1ΗV, $αi$ Ι 1.5ΗV	ф 30
lpha iI 2, $lpha i$ I 3, $lpha i$ I 6, $lpha i$ I 2HV, $lpha i$ I 3HV, $lpha i$ I 6HV	φ 40
α <i>İ</i> Ι 8, α <i>İ</i> Ι 8ΗV	ф 50
$\alpha i$ I 12, $\alpha i$ I 15, $\alpha i$ I 18, $\alpha i$ I 22, $\alpha i$ I 12HV, $\alpha i$ I 15HV, $\alpha i$ I 22HV, $\alpha i$ IP 12, $\alpha i$ IP 15, $\alpha i$ IP 18, $\alpha i$ IP 22, $\alpha i$ IP 15HV, $\alpha i$ IP 22HV	ф 60
lpha iI 30, $lpha i$ I 40, $lpha i$ I 30HV, $lpha i$ I 40HV, $lpha i$ IP 30, $lpha i$ IP 40, $lpha i$ IP 50, $lpha i$ IP 40HV, $lpha i$ IP 50HV	ф 70
lpha iI 50, $lpha i$ I 60HV, $lpha i$ I 100HV, $lpha i$ IP 60, $lpha i$ IP 60HV	ф 85

• If foreign matter such as cutting chips is caught by the oil seal lip, it will be easily worn, losing its sealing properties. When the motor is used within a splash guard, and so cutting chips may fall on the motor, for example, take measures to prevent cutting chips from entering near the lip.

- In an environment in which dry and wet states alternate, if cutting fluid splashes onto the lip after it has worn in a dry state, the cutting fluid may easily enter the inside of the motor. In this case, provide a cover to prevent cutting fluid from splashing onto the oil seal of the motor.
- Ensure that no pressure is applied to the lip of the oil seal.
- The oil seal shows its sealing effect when a part such as the gear coupling is lubricated by oil bath. Cutting fluid does not provide lubrication for the oil seal lip, so the cutting fluid may easily penetrate the seal. Therefore, provide a cover to prevent cutting fluid from splashing onto the oil seal.

#### 3.2 When the oil seal is not used

When a simple labyrinth is used as the output shaft seal (high-speed models) or when no seal is provided (foot mounting type), ensure that lubricant does not splash onto the flange surface directly. If such a motor is directly mounted on a gear box, lubricant may gradually enter the inside of the motor even when the flange surface is protected against lubricant splash, therefore resulting in motor failure. So, do not mount such a motor on a gear box directly.

#### **NOTE**

1 The foot mounting type motors are not equipped with an oil seal. When an oil seal is necessary, add #0002 to a motor drawing number when ordering the motor. The oil seal, however, cannot be added to the high-speed models. For details, refer to the order list (B-65271EN).

Example)

Model  $\alpha II$  12/7000 (foot mounting type, with no key, rear exhaust)

To add an oil seal to A06B-1408-B200, order A06B-1408-B200#0002.

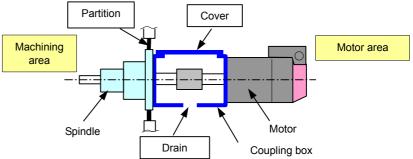
When lubricant does not splash onto the oil seal, remove the coil spring of the oil seal to reduce friction between the lip and shaft.

This does not affect sealing from dry dust. When the area in which the shaft touches the oil seal is dry, turning the shaft at a high speed may generate contact sound (abnormal sound) from that area or may damage the lip.

# 4. Motor coupling

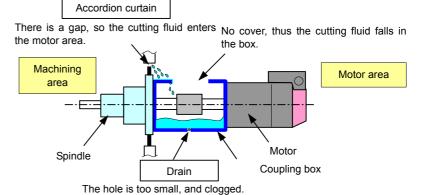
When a coupling box is used to connect the motor to the machine, take measures as follows not to allow leaked cutting fluid to build up in the coupling box.

- Provide a cover for the top and sides of the coupling box.
- Provide a drain hole at the bottom of the coupling box. The hole must be large enough to avoid clogging.



#### <Fault example>

The cutting fluid leaks from a gap in the accordion curtain to the motor area, and builds up in the coupling box. While the spindle is moving, the cutting fluid ripples, splashing onto the oil seal of the motor. The cutting fluid enters the inside of the motor there in large quantities, deteriorating the insulation of the motor.

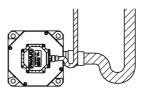


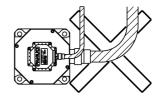
## 5. Connectors, terminal box, and their surroundings

#### 5.1 Connectors

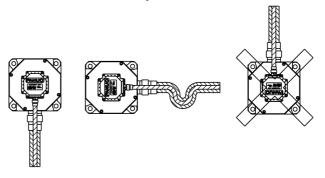
The  $\alpha iI$  0.5/10000 and  $\alpha iI$  0.5/10000HV use connectors to connect the power and signal cables.

• Make sure that no cutting fluid is introduced to the motor via cables. If the motor connector is used horizontally, this can be accomplished by forming a slack in the cable.





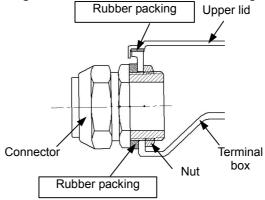
• If the motor connector is directed upward, the cutting fluid collects into the cable connector. Whenever possible, direct the motor connector sideways or downward.



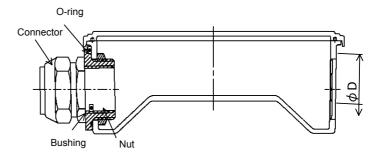
#### 5.2 terminal box

Models other than the  $\alpha iI$  0.5/10000 and  $\alpha iI$  0.5/10000HV use a terminal box to connect the power and signal cables.

 When a conduit is attached to the terminal box, use a water-proof connector with rubber packings to prevent lubricant and cutting fluid from entering the inside of the terminal box through its cable holes. • On the inner side of the upper lid of the terminal box, a rubber water-proof packing is installed. Ensure that the packings are not damaged, then install the lid so that no foreign matter is caught.



• If the connector you want to use is smaller than the cable hole on the terminal box, prepare the bushing, nut, and O-ring shown below.



Cable hole diameter	O-ring code				
φD	JIS B 2401	ISO 3601-1			
φ42.5 mm	P46	C0462G			
φ <b>61 mm</b>	P65	C0650G			

#### NOTE

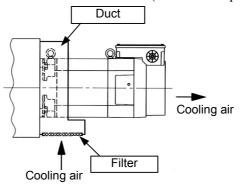
For the diameter of the cable hole in each model, refer to the outside dimension drawing of the respective models.

# 6. Fan motor and its surroundings

If lubricant or cutting fluid mist, particles, or cutting chips are drawn into the fan motor, the air holes in the motor and the blades of the fan motor will clog, causing the cooling capacity to reduce. Employ a machine structure that allows clean, cooling air to be fed into the motor.

#### Example)

When a duct with a filter is installed on a flange mounting type motor with a rear exhaust (The filter requires periodic cleaning.)



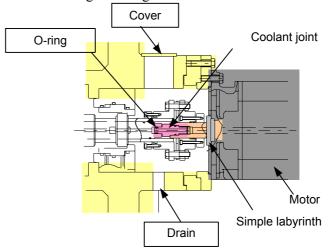
# 7. Motor with a through hole

The  $\alpha i I T$  series and  $\alpha i I L$  series motors with a through hole comply with the degree of protection IP40. The motor main body excluding the simple labyrinth at the end of the output shaft and the flinger at the rear end of the shaft complies with IP54. When center through coolant machining is performed, employ such a structure that cutting fluid leaked from the coolant joint or rotation joint does not enter the inside of the motor.

#### 7.1 Front side of the motor

A simple labyrinth is mounted on the shaft on the front side of the motor. Therefore, a splash of cutting fluid or cutting fluid leaked from the coolant joint can enter the inside of the motor.

- Employ such a structure that the O-ring of the coolant joint is not damaged by sliding.
- Provide a drain not to allow leaked cutting fluid to build up in case the O-ring is damaged.



#### 7.2 Rear side of the motor

When a separate external support type rotation joint is installed at the rear end of the shaft, cutting fluid leaks from the seal (where the stationary side and the rotation side come in contact); therefore, employ such a structure that the leaked cutting fluid does not enter the inside of the motor.

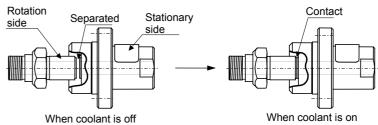
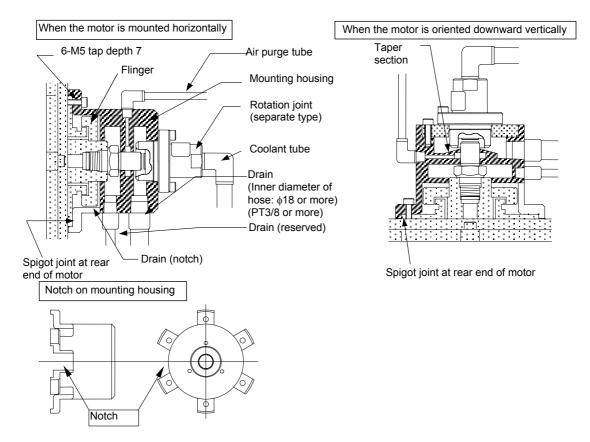


Fig. Example of a separate external support type rotation joint

- Provide the rotation joint mounting housing with notches and drains not to allow leaked cutting fluid to build up in the housing.
- The rotation joint is a consumable part. It requires periodic inspection and replacement.
- If the rotation joint is damaged, a large amount of cutting fluid can leak out. So, provide the mounting housing with many notches.
- When the motor is oriented downward vertically, enhance drainage by means such as air purging.



# 8. Notes on cutting fluid

Cutting fluid containing highly active sulfur, oil-free cutting fluid called synthetic cutting fluid, and highly alkaline, water-soluble cutting fluid in particular significantly affect the CNC, motor, or amplifier. Even when these components are protected from direct spraying of cutting fluid, problems as described below may arise. So special care should be taken.

- Cutting fluid containing highly active sulfur Some cutting fluids containing sulfur show extremely high activity of sulfur. Ingress of such cutting fluid into the CNC, motor, or amplifier can cause corrosion of copper, silver, and so on used as parts' materials, therefore resulting in parts' failures.
- Synthetic cutting fluid with high permeability
  Some synthetic type cutting fluids that use polyalkylene glycol
  (PAG) as a lubricant have extremely high permeability. Such
  cutting fluid can easily penetrate into the motor even if the motor
  is sealed well. Ingress of such cutting fluid into the CNC, motor,
  or amplifier can degrade insulation or lead to parts' failures.
- Highly alkaline, water-soluble cutting fluid
   Some cutting fluids that strengthen pH by alkanolamine show
   strong alkalinity of pH10 or higher when diluted to the standard
   level. Ingress of such cutting fluid into the CNC, motor, or
   amplifier can cause chemical reaction with plastic and so on and
   deteriorate them.

# 4.3 POWER LEAD CONNECTION

# **. WARNING**

To attach the power leads and jumpers, follow the procedure described in this section to make connections with specified torque. Driving a motor with terminals loosened could result in the terminal board overheating and causing a fire. In addition, it may remove terminal to cause a ground fault, short circuit, or electric shock.

# **⚠** CAUTION

1. When attaching the power leads and jumpers to the terminal board of a motor, tighten the screws with torque specified in the table. For the terminal size of a terminal board, refer to Chapter 4, "CONNECTIONS" in the manual of the corresponding series.

Terminal size	Tightening torque [N⋅m]
M4	1.1 to 1.5
M5	2.0 to 2.5
M6	3.5 to 4.5
M8	8 to 10
M10	15 to 16

- 2. To maintain the required isolation distance, observe the following:
  - When attaching a crimp terminal at the end of a power lead, cover the crimped portion of the crimp terminal with insulating tube.
  - If the terminal board is provided with an insulating cover, fasten the power leads with the screws, and then put back the insulating cover in place.

3. If you want to energize an output switching type motor only with the low- or high-speed winding rather than switching its output, jumper the low- or high-speed winding, whichever is applicable, and then connect three power leads (the U-, V-, and W-phase wires) to the motor (except for the  $\alpha i$ IT 15/12000 and  $\alpha i$ IL series motors).

For the following motors, a jumper is provided as standard in the terminal block.

Model name	Type of supplied jumper
$\alpha i$ I 6/12000, $\alpha i$ I 8/10000	
$\alpha i$ I 12/10000, $\alpha i$ I 12/12000	
$\alpha i$ I 15/10000, $\alpha i$ I 15/12000	For low-speed winding (Y connection)
$\alpha i$ I 18/10000, $\alpha i$ I 18/12000	
$\alpha i$ I 22/10000, $\alpha i$ I 22/12000	
lpha iIP 12/6000, $lpha i$ IP 12/8000	
lpha iIP 15/6000, $lpha i$ IP 15/8000	
lpha iIP 18/6000, $lpha i$ IP 18/8000	
lpha iIP 22/6000, $lpha i$ IP 22/8000	
lpha iIP 30/6000, $lpha i$ IP 40/6000	For High-speed winding (∆ connection)
lpha iIP 15/6000HV	
α <i>İ</i> IP 22/6000HV	
α <i>İ</i> IP 40/6000HV	

If you want to any other output switching type motor, place an order for jumpers according to the following list.

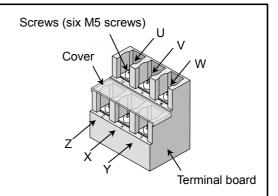
Terminal size	Specification of the winding to be used	Ordering number	Required quantity
M5	Low-speed winding	A65L-0001-0630/SS	1
M5	High-speed winding	A65L-0001-0630/SD	3
M6	Low-speed winding	A290-1410-X416	1
M6	High-speed winding	A290-1410-X417	3

4. How to connect power leads to output switching type motors

For output switching type motors, six power leads (the U-, V-, W-, X-, Y-, and Z-phase wires) can be connected on the terminal board

#### Detailed descriptions of an M5 type terminal board

The terminal board has two rows. The U-, V-, and W-phase leads can be connected to the upper row, while the Z-, X-, and Y-phase wires can be connected to the lower row.

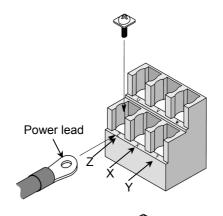


1) Using the motor by switching its output
To use the motor by switching its output, connect the six
power leads (the U-, V-, W-, X-, Y-, and Z-phase wires)
respectively to the terminal board screws marked U, V, W,
X, Y, and Z.

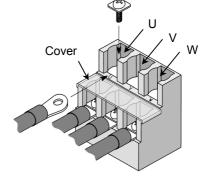
(For the  $\alpha i$ IT 15/12000 and  $\alpha i$ IL series motors, the terminal board screws are marked U<sub>1</sub>, V<sub>1</sub>, W<sub>1</sub>, U<sub>2</sub>, V<sub>2</sub>, and W<sub>2</sub>.)

#### Connecting power wires to an M5 type terminal board

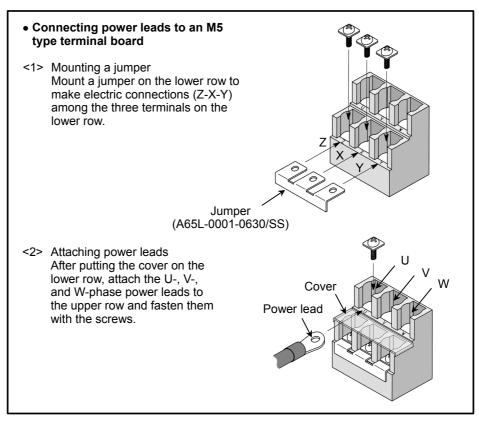
<1> Connecting power leads to the lower row Attach the Z-, X-, and Y-phase power leads to the lower row and fasten them with the screws.

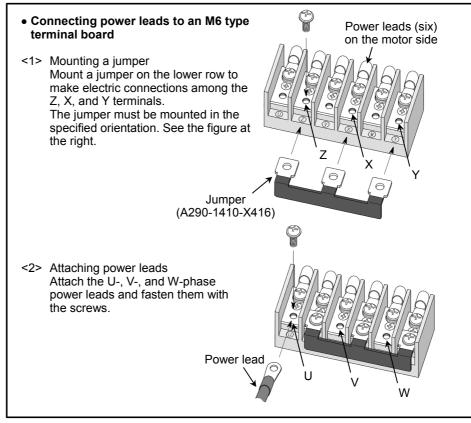


<2> Attaching power leads to the upper row After putting the cover on the lower row, attach the U-, V-, and W-phase power leads to the upper row and fasten them with the screws.

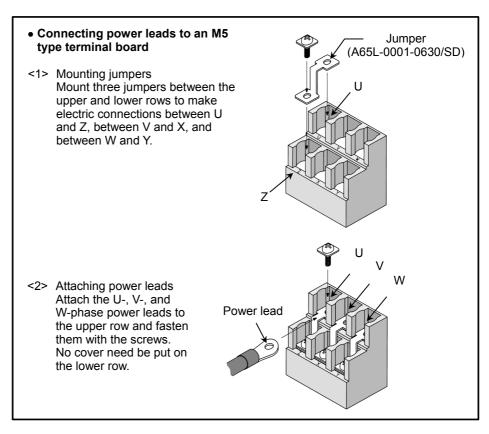


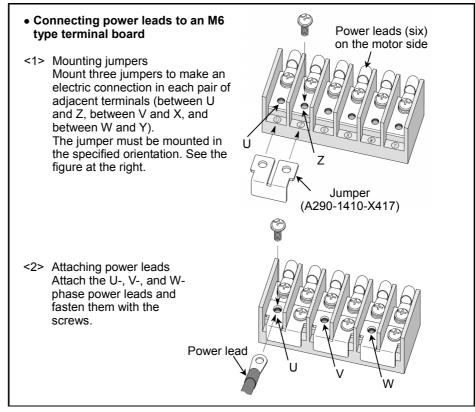
2) Using the motor by energizing it only with the low-speed winding (Y connection) rather than switching its output





Using the motor by energizing it only with the high-speed winding ( $\Delta$  connection) rather than switching its output

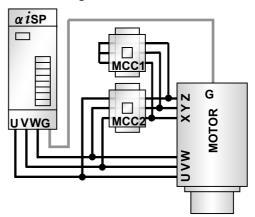




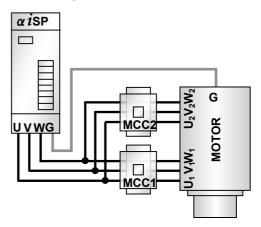
5. Connecting the motor and amplifier when output switching is used

To use output switching, connect the motor and amplifier as shown in the figure below. The switching method varies depending on the model used. Confirm the switching method by referring to Chapter 2, "SPECIFICATIONS", in each series.

#### 1) Y- $\Delta$ switching



#### 2) Y-Y switching



Relationship between the magnetic contactors (MCC) and the low- and high-speed windings

	Low-speed winding	High-speed winding
MCC1	ON	OFF
MCC2	OFF	ON

# 4.4 FAN MOTOR CONNECTION

#### Fan motor current values

mil milb milt corice	50Hz			αiI, αiIP, αiIT series			60Hz			
200V type spindle motor models	Usable voltage [V]	Rated voltage [V]	Rated current [A]	Surge current [Ap-p]	Usable voltage [V]	Rated voltage [V]	Rated current [A]	Surge current [Ap-p]		
α <i>İ</i> Ι 1, α <i>İ</i> Ι 1.5, α <i>İ</i> Ιτ 1.5	160-270	240	0.15	0.47	160-270	240	0.12	0.48		
αiΙ 2, $αi$ Ι 3, $αi$ Ιτ 2, $αi$ Ιτ 3	170-240	200	0.10	0.41	170-240	200	0.10	0.40		
αiΙ 6, $αi$ Ι 8, $αi$ Ιτ 6, $αi$ Ιτ 8	170-240	200	0.13	0.50	170-240	200	0.14	0.51		
α <i>i</i> Ι 12 to α <i>i</i> Ι 22, α <i>i</i> Ι <sub>Ρ</sub> 12 to α <i>i</i> Ι <sub>Ρ</sub> 22, α <i>i</i> Ι <sub>Τ</sub> 15, α <i>i</i> Ι <sub>Τ</sub> 22	170-240	200	0.22	1.15	170-240	200	0.32	1.10		
α <i>i</i> Ι 30, α <i>i</i> Ι 40, α <i>i</i> ΙΡ 30, α <i>i</i> ΙΡ 40, α <i>i</i> ΙΡ 50	170-253	200	0.65	3.12	170-253	200	0.8	3.06		
lpha iI 50, $lpha i$ I 60, $lpha i$ IP 60	170-253	200	0.75	3.96	170-253	200	0.75	3.68		

$\alpha i I$ , $\alpha i I$ P, $\alpha i I$ T series		50Hz			60Hz			
400V type spindle motor models	Usable voltage [V]	Rated voltage [V]	Rated current [A]	Surge current [Ap-p]	Usable voltage [V]	Rated voltage [V]	Rated current [A]	Surge current [Ap-p]
α <i>ἱ</i> Ι 1HV, α <i>ἱ</i> Ι 1.5HV, α <i>ἱ</i> Ιτ 1.5HV	170-220	200	0.09		195-253	230	0.11	
α <i>ἱ</i> Ι 2HV, α <i>ἰ</i> Ι 3HV, α <i>ἰ</i> Ιτ 2HV, α <i>ἰ</i> Ιτ 3HV	170-220	200	0.11		195-253	230	0.13	
α <i>ἱ</i> Ι 6HV, α <i>ἱ</i> Ι 8HV, α <i>ἱ</i> Ιτ 6HV, α <i>ἱ</i> Ιτ 8HV	323-440	400	0.07	0.31	391-528	480	0.08	0.37
lpha iI 12HV to $lpha i$ I 22HV, $lpha i$ IP 15HV, $lpha i$ IF 22HV, $lpha i$ IT 15HV, $lpha i$ IT 22HV	323-440	400	0.20	0.97	391-528	480	0.24	1.22
lpha iI 30HV, $lpha i$ I 40HV, $lpha i$ I 100HV (circumference fan), $lpha i$ IP 40HV, $lpha i$ IP 50HV	320-460	380	0.30	1.86	320-460	380	0.35	1.82
α <i>İ</i> Ι 60HV, α <i>İ</i> Ι <sub>Ρ</sub> 60HV	320-460	380	0.30	2.18	320-460	380	0.30	1.98
lpha iI 100HV (back fan)	320-528	400	0.30		320528	400	0.36	

#### NOTE

- 1 The term "surge current" represents a peak-to-peak current that flows when the power is turned on.
- 2 The values listed below are a rough standard. They are not guaranteed.

#### Cable for the fan motor

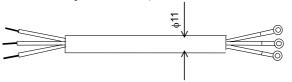
The machine tool builder is to prepare the following cable for the fan motor:

Vinyl heavy-duty power cord JIS C 3312 3-conductor

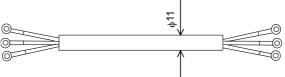
Conductor: 37/0.26 (2 mm<sup>2</sup>)

Sheath: PVC $\phi$ 11 Crimp terminal: T2-4S

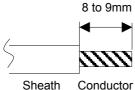
<1> For a non-screw terminal block (Peel off each wire sheath on the motor side by 8 to 9 mm.)

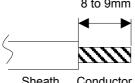


<2> For an M4 or M3.5 screw terminal block (Attach crimp terminals to the both ends.)



#### Method of connection to a non-screw terminal for the fan motor





# Screwdriver Conductor Spring Conductive plate

#### Peel-off length of a wire sheath

By using an appropriate tool, peel off each wire sheath by 8 to 9

#### Screwdriver

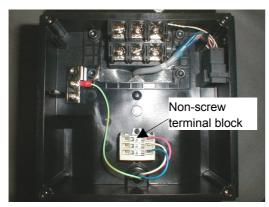
Use a flat-blade screwdriver with a blade size of  $3.5 \times 0.5$  mm. (210-120J (standard type), 210-350J (short type) manufactured by WAGO)

#### **Connection procedure**

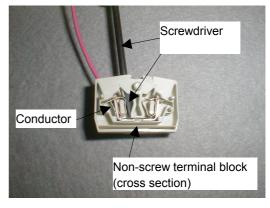
- <1> Insert the tip of the screwdriver into the screwdriver insertion slot (small rectangular hole) until the tip touches the spring. Next, while tilting the screwdriver toward the inside of the terminal block, push the screwdriver until it butts the conductive plate. In this state, the spring is opened completely, and the screwdriver is held in the terminal block. Ensure that the screwdriver is secured. Otherwise, the next step (wire insertion) cannot be conducted easily.
- <2> Check the peel-off length (8 to 9 mm), then insert the wire into the wire insertion slot (large rectangular hole) until it stops, by sliding the wire along the outer side of the hole slowly so that the conductor does not become loose. Be careful not to push a thin wire excessively.
- <3> While holding down the inserted wire by one hand, extract the screwdriver. The spring is closed to make a connection.
- <4> By slightly pulling the wire, check that the wire is connected firmly. The wire need not be pulled intensely.

#### **Cautions**

- Only one wire must be connected to one spring.
- A wire, which may be a stranded wire or single conductor, can be directly connected without performing terminal processing if its sheath is peeled off. A wire after ferrule processing can also be connected.



Inside the terminal box



State of cable connection

# 4.5 WHEN A MOTOR IS CONNECTED TO A SPINDLE VIA A BELT

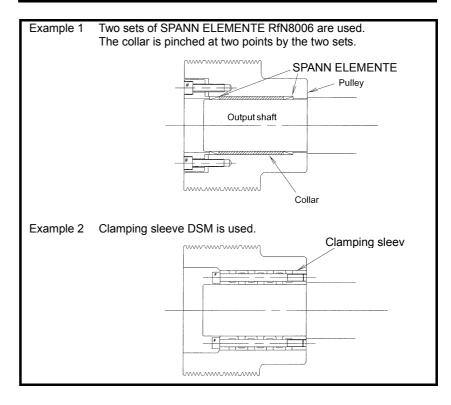
### **!** CAUTION

- 1 Mounting the pulley
  - The gap between the inner surface of the motor pulley and output shaft should be  $10\mu m$  to  $15\mu m$ .
  - If the gap is large when the high-speed rotation (4500 min<sup>-1</sup>), fretting produced at the gap causes a large vibration, resulting in damage to the motor bearing.
  - As the vibration is intensified, fretting occurs in the gap mentioned above, and the pulley and shaft can stick to each other.
  - To secure a pulley, use a friction-tightening part such as a SPANN ELEMENTE or clamping sleeve.

#### NOTE

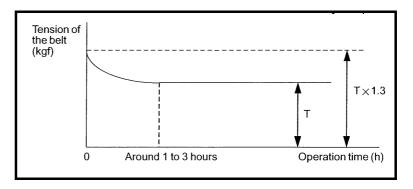
The SPANN ELEMENTE RfN8006 is manufactured by RINGFEDER.

The clamping sleeve DSM is manufactured by SPIETH.



- After attaching a pulley to the motor, adjust the vibration of the belt groove to within 20  $\mu$ m (T.I.R).
- 5 Before the belt is looped, FANUC recommends that the dynamic balance (field balance) be corrected.

- 4 Limit the radial load applied to the motor output shaft by the tension of the belt to the allowable value described in the manual for each series. If the allowable value is exceeded, the bearing or shaft may fail prematurely.
- 5 The tension of the belt is reduced as a result of abrasion during the initial several hours of operation. To transfer torque normally after this reduction in tension, the initial tension before operation should be set to a value 1.3 times the actually required tension T.



#### Recommended belts:

Ribace manufactured by BANDO. Ribstar manufactured by MITSUBOSHI. 6 Use an appropriate tension gage to tension the belt. Examples

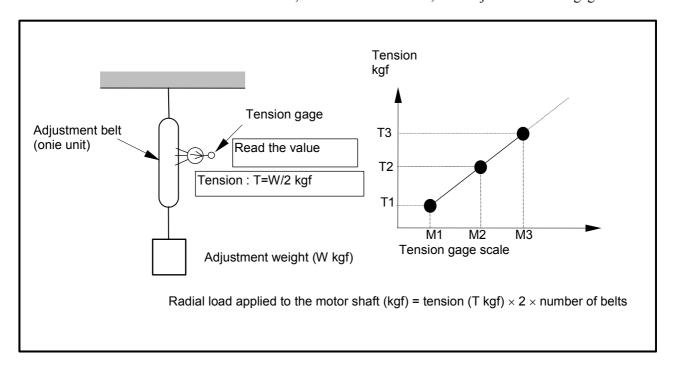
Sonic type:

U-305 series manufactured by UNITTA.

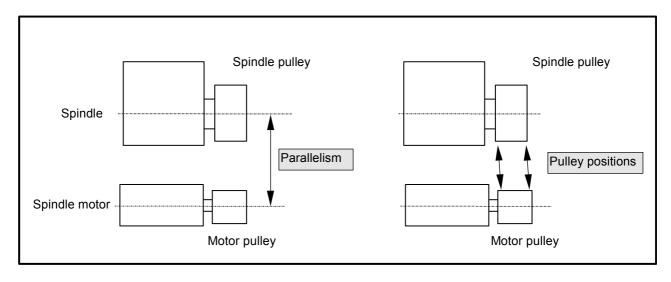
Mechanical type:

BT-33-73F manufactured by KENT-MOORE of the United States

A mechanical type tension gage may give a false reading depending on the belt's number of peaks and length. To overcome this problem, hang an object of a known weight on the belt, read the tension value, then adjust the tension gage.



7 Reduce the deviation between the positions of the motor and machine pulleys in the shaft direction as much as possible and ensure that the center lines of the shafts are as parallel as possible.

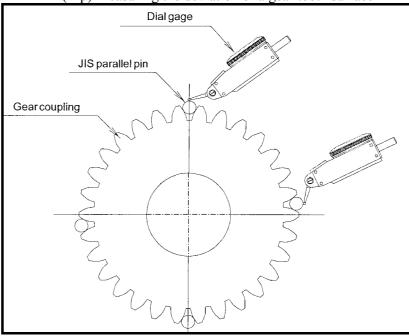


# **4.6** WHEN A MOTOR IS CONNECTED TO A SPINDLE VIA A GEAR

# **⚠** CAUTION

- 1 Do not use a helical gear which applies a load in the motor axial direction.
- 2 To prevent unusual gear sounds, apply the following precautions:
  - (1) The deviation of the gear tooth surface should indicate the proper value.

(Tip) Measuring the deviation of a gear tooth surface



- (2) The correct backlash should be provided.
- (3) The perpendicularity of the motor flange mounting surface to the machine shaft should indicate the proper value.
- 3 Mount the motor on the machine so that the vibration acceleration is 0.5 G or less when it is measured using the method described in CAUTION 4 of Section 4.1.

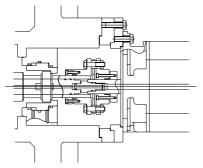
# 4.7 WHEN A MOTOR IS DIRECTLY CONNECTED TO A SPINDLE VIA A COUPLING

### **!** CAUTION

1 When connecting the spindle and motor shaft, be sure to use a flexible coupling.

(Flexible coupling examples)

- Diaphragm coupling (EAGLE INDUSTRY CO., LTD.)
- Oldham's coupling
- Gear coupling (MIKI PULLEY)



Example of disk coupling

Flexible coupling has three tolerances of degree of freedom: eccentricity, declination, and axial displacement. This enables coupling with less vibration and less noise to achieve high-speed rotation.

- Tolerances of eccentricity and declination: Slight eccentricity and declination that could not be absorbed by centering are absorbed.
- Tolerance of axial displacement: Extension of the spindle and motor shaft due to temperature increase is absorbed.

#### (Caution)

- These tolerances are criteria for preventing the coupling from being damaged, not criteria for preventing load from being applied to the spindle and motor bearings. Therefore, to perform rotation with low vibration and low noise before high-speed rotation is achieved, the spindle and motor shaft must be centered.
- FANUC has confirmed that with a coupling (disk coupling) that permits only the degrees of freedom of declination and axial displacement, rotation can take place properly if centering has been pereformed with a concentricity of 5 µm.
- 2 It is important to perform centering and obtain parallelism to avoid having to recourse to the flexibility of the coupling. At high speeds, any eccentricity may cause the bearing to fail prematurely.
- 3 Check all machines before shipping to confirm that the vibration acceleration is 0.5 G or less when measured using the method described in CAUTION 5 of Section 4.1.

- 4 Set the torsional rigidity of the coupling to an appropriate high value. If the torsional rigidity is low, vibration may be produced during orientation.
- When attaching the coupling to the motor shaft, never use a hammer or the like; otherwise, impact load is applied to the bearing.

# 5

# NOTES ON OPERATION

# **⚠** WARNING

When supplying voltage to the spindle motor or the fan motor, ensure that the earth cable is connected to the earth terminal and secure that the spindle motor is put to earth certainly. In addition, be sure to check that the power cable and jumper are secured to the terminal block.

# **!** CAUTION

- After a continuous and long operation, the temperature of model  $\alpha iI$  0.5 may rise higher than other motors because they have no fan motor. So please treat them carefully.
- 2 Sound and vibration Check that there is no abnormal sound or vibration.

#### 3 Cooling

Clean off dust from the cooling air inlet and outlet of the stator every year, and check the flow of air carefully. The table given below indicates the direction of the rotation of the cooling fan when viewed from the rear side of the motor. Check that the actual rotating direction is correct.

Model names	Rear exhaust (Exhaust on side opposite to load axis)	Front exhaust (Exhaust on load axis side)
$\alpha i$ I 2 to $\alpha i$ I 22, $\alpha i$ I 50 $\alpha i$ I 6HV to $\alpha i$ I 22HV, $\alpha i$ I 60HV $\alpha i$ IP 12 to $\alpha i$ IP 22, $\alpha i$ IP 60, $\alpha i$ IP 60HV $\alpha i$ IT 2 to $\alpha i$ IT 22	Counterclockwise (CCW)	Clockwise (CW)
Models other than the above	Clockwise (CW)	Clockwise (CW)

#### NOTE

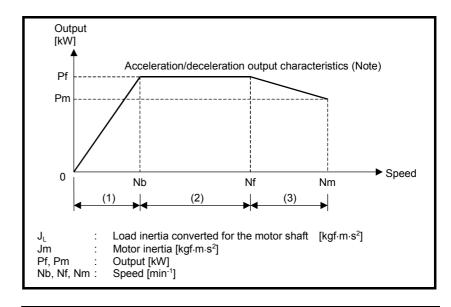
To increase the operating lifetime of a motor of these series, break in the motor. As a guideline, increase the speed of the motor from 1000 min<sup>-1</sup> to its maximum speed in 1000 min<sup>-1</sup> increments, and operate the motor at each speed for about 5 minutes.

6

# DETERMINING THE ACCELERATION TIME

The time required for each acceleration for the acceleration/ deceleration output characteristics shown below can be obtained from the following equation.

Since machine load torque is not taken into consideration, the actual time is slightly longer than the calculated time.



#### **NOTE**

Obtain an output value at acceleration time according to the following methods:

- When a maximum output value at acceleration time is shown in the output characteristics diagram, use the value.
- In other cases
   The target output during acceleration/deceleration is 1.2 times the 30-minute rated output of each model (10- or 15-minute rated output for some models).

- Acceleration time (t1) in the constant-torque range (0 to Nb)

- Acceleration time (t2) in the constant-output range (Nb to Nf)

$$(JL+Jm) \times (Nf^{2}-Nb^{2})$$
t2=0.10754×——— [sec]
$$2 \times Pf \times 1000$$

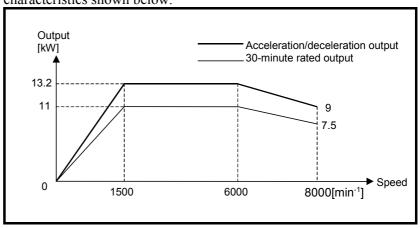
- Acceleration time (t3) in the decreasing-output range (Nf to Nm)

The total time (t) required for acceleration in the range from 0 to N m is t1+t2+t3 [sec]

Deceleration can be controlled so that the time required for deceleration is nearly equal to that for acceleration. When the power voltage is high, or the impedance of the power is high, the time required for deceleration may not be made equal to that for acceleration.

# **Calculation example**

Model  $\alpha iI$  8/8000 has the acceleration/deceleration output characteristics shown below.



In this case, the variables have the following values.

Jm: 0.0028 [kgf·m·sec<sup>2</sup>]

#### **NOTE**

The rotor inertia is 0.28 [kgf·cm·sec<sup>2</sup>] in the  $\alpha i$ I 8/8000 specifications. When the unit is changed for calculation, the rotor inertia is 0.28 [kgf·cm·sec<sup>2</sup>]/100 = 0.0028[kgf·m·sec<sup>2</sup>]

#### B-65272EN/05 FANUC AC SPINDLE MOTOR $\alpha i$ series 6.DETERMINING THE ACCELERATION TIME

Pf : 11×1.2=13.2 [kW] Pm : 7.5×1.2=9 [kW] Nb : 1500 [min<sup>-1</sup>] Nf : 6000 [min<sup>-1</sup>] Nm : 8000 [min<sup>-1</sup>]

#### **NOTE**

A value obtained by "30-minute rated output  $\times$  1.2" is a rough standard, not a guaranteed value. And, setting of the parameter related to acceleration/deceleration time constant is also necessary. (Refer to Parameter Manual (B-65280EN).)

Suppose that JL is 0.0056 [kgf·m·sec<sup>2</sup>]. Then the acceleration times are as follows:

- Acceleration time (t1) in the constant-torque range (0 to Nb)

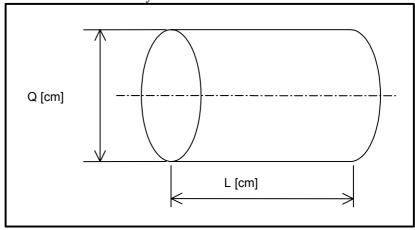
- Acceleration time (t2) in the constant-output range (Nb to Nf)

- Acceleration time (t3) in the decreasing-output range (Nf to Nm)

The total time required for acceleration in the range from 0 to 8000  $min^{-1}$  is t1+t2+t3=2.47 [s]

#### Reference 1

When a cylinder rotates about its center axis, its inertia can be obtained from the following equation. The inertia of a gear can be obtained in a similar way.



$$J = \frac{\pi \gamma}{32 \times 980}$$
 Q<sup>4</sup>L [kgf·cm·sec<sup>2</sup>]

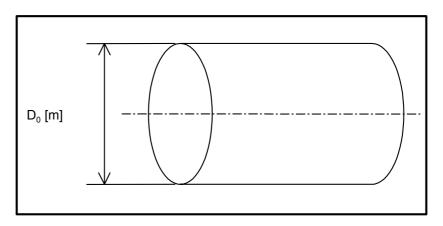
When steel ( $\gamma$ =7.8×10<sup>-3</sup> kgf/cm<sup>3</sup>) is used, the approximate inertia is obtained from the following equation.

When the unit for J is changed.

#### Reference 2

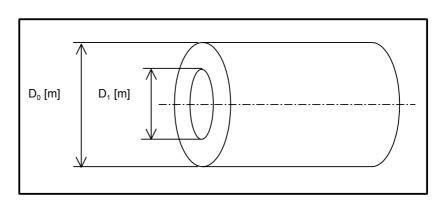
To obtain the value  $GD^2$  [kgf·m<sup>2</sup>] for cylinder, get the value of G from its weight in kilograms and use the following equation to get the value of  $D^2$ .

## - Solid cylinder



$$D^2 = D_0^2 / 2$$

# - Hollow cylinder



$$D^2 = (D_0^2 + D_1^2)/2$$

Use the following equiation to convert  $GD^2$  [kgf·m²] to J [kgf·cm·sec²] J[kgf·cm·sec²] =  $GD^2$  [kgf·m²]/4/g×100 =  $GD^2$  [kgf·m²]/4/9.8×100 =  $GD^2$  [kgf·m²] ×2.55

#### NOTE

g indicates the acceleration of gravity :  $9.80 \text{ [m/sec}^2\text{]}$ .

#### Reference 3

Note the following relationship between the value of inertia I  $[kg \cdot m^2]$  in SI units and the value of  $GD^2$   $[kgf \cdot m^2]$ :

 $I[kg \cdot m^2] = GD^2 [kgf \cdot m^2]/4$ 

Therefore, to convert I [kg·m²] to J [kgf·cm·sec²], use the following equation:

$$J[kgf \cdot cm \cdot sec^{2}] = GD^{2} [kgf \cdot m^{2}]/4/g \times 100$$

$$= I [kg \cdot m^{2}]/g \times 100$$

$$= I [kg \cdot m^{2}]/9.80 \times 100$$

$$= I [kg \cdot m^{2}] \times 10.2$$

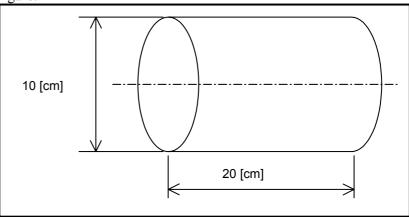
#### NOTE

g indicates the acceleration of gravity: 9.80 [m/sec<sup>2</sup>].

#### Reference 4

#### - Difference of inertia

Calculate the inertia of the solid steel cylinder shown in the following figure.



(1) Calculating J [kgf·cm·sec<sup>2</sup>]  
J = 
$$\pi \gamma /(32 \times 980) \times Q^4 \times L$$
  
=  $\pi \times 7.8 \times 10^{-3} /(32 \times 980) \times 10^4 \times 20$   
=  $0.156$ [kgf·cm·sec<sup>2</sup>]

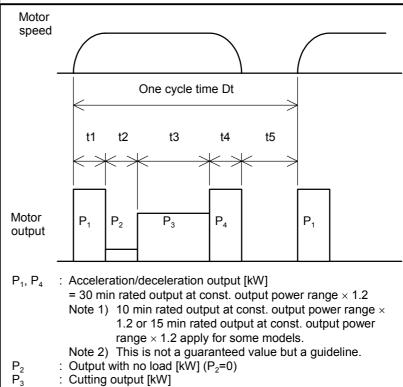
(2) Calculating GD<sup>2</sup> [kgf·m<sup>2</sup>]  
G = 
$$\pi/4 \times 10^2 \times 20 \times \gamma$$
  
=  $\pi/4 \times 10^2 \times 20 \times 7.8 \times 10^{-3}$   
= 12.25[kgf]  
D<sup>2</sup> = D<sub>0</sub><sup>2</sup>/2  
= 0.1<sup>2</sup>/2  
= 0.005[m<sup>2</sup>]  
GD<sup>2</sup> = 12.25×0.005  
= 0.0613[kgf·m<sup>2</sup>]

7

# DETERMINING THE ALLOWABLE DUTY CYCLE

When machining requires the spindle to accelerate and decelerate frequently, the average output per cycle must not exceed the continuous rated output. The allowable duty cycle for a typical AC spindle motor can be obtained as shown below.

**Duty cycle and average output** 



Average output Pav = 
$$\sqrt{\frac{P_1^2 t 1 + P_2^2 t 2 + P_3^2 t 3 + P_4^2 t 4}{D_t}}$$

#### NOTE

This is not a guaranteed value but a guideline.

#### NOTE

- 1 Cutting output P<sub>3</sub> at motor speed N which is lower than base speed Nb shall be calculated by the following equation.
  - $P_3=P_C \times Nb/N$  [kW] ( $P_C$ : Actual cutting output)
- 2 In case that P<sub>3</sub> is calculated by the load indicator voltage, use the following equation.

$$P_3 = P_1 \times L_3/10 \text{ [kW]}$$

(L<sub>3</sub>: Load indicator voltage in cutting [V])

#### Allowable duty cycle time Dt

From the equation for getting the value of Pav[kW].

$$Dt = \frac{1}{Pav^2} \times (P_1^2t1 + P_2^2t2 + P_3^2t3 + P_4^2t4)$$

Substitute the continuous rated output of the used AC spindle motor for Pav [kW] in the equation above. Example)

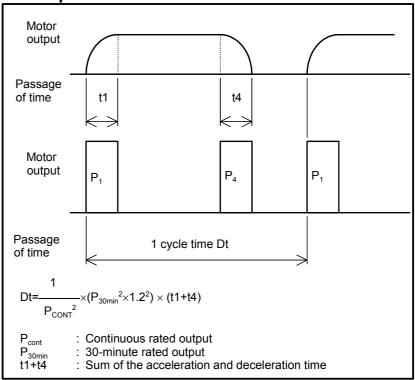
To obtain the allowable duty cycle when model  $\alpha iI$  3 accelerates and decelerates repeatedly without load ( $P_2=P_3=0$ ).

- Continuous rated output Pav=Pcont=3.7kW
- Acceleration/deceleration output  $P_1=P_4=5.5kW\times1.2=6.6kW$
- Acceleration time t1=3s, deceleration time t4=3s

$$Dt = \frac{1}{3.7^2} \times (6.6^2 \times 3 + 6.6^2 \times 3) = 19.1 \text{ seconds}$$

As shown above, when model  $\alpha iI$  3 accelerates and decelerates repeatedly, the allowable duty cycle time is 19 seconds.

Allowable duty cycle time Dt for repeated acceleration/deceleration



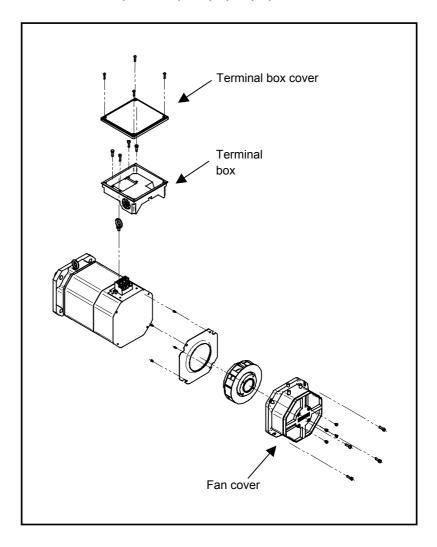
8

# DISPOSAL OF SPINDLE MOTORS BY MATERIAL TYPE

#### Disposal of motors by separating plastic parts from metal parts

After a motor is dismantled, the plastic parts (terminal box, terminal box cover, fan cover) must be separated for disposal. The plastic parts are made of the following material.

Plastic material: >(PBT+PC)-GF(30)FR(17)<



# II. FANUC AC SPINDLE MOTOR $\alpha \emph{i}$ I series 200V type

# 1

#### **GENERAL**

The FANUC AC spindle motor  $\alpha iI$  series 200V type is ideal for CNC machine tool spindles.

#### **Features**

- The motor is compact, light-weight and furnished with digital control for much higher performance.
- The motor inertia of the AC spindle motor is made smaller to shorten the acceleration/deceleration speed. Further, optimum control enables highly efficient cutting.
- The built-in  $\alpha iM$  sensor or  $\alpha iMZ$  sensor enables synchronous spindle and Z-axis feed and rigid tapping.
- Improvement in machining of the motor housing enhances the accuracy of the mounting part.
- Waterproof and pressure-proof design conforming to the international standard (IEC) is employed to improve reliability and make it resistant to most environments.

# **SPECIFICATIONS**

	Series	$lpha i  ext{I}$ series 200V type			
Item	Model	α <i>i</i> Ι 0.5/10000	α <i>i</i> Ι 1/10000	α <i>i</i> Ι 1.5/10000	
	Cont. rated kW	0.55	1.5	1.1	
	(HP)	(0.74)	(2.0)	(1.5)	
	30 min rated kW	1.1	2.2	3.7	
Output	[15 min, 10min]				
(*2)	(*3) (HP)	(1.5)	(3.0)	(5.0)	
	S3 60% kW	1.1	2.2	3.7	
	[40%,25%,15%]				
	(*4)(*5) (HP)	(1.5)	(3.0)	(5.0)	
Rated current A	Cont. rated	7	11	14	
(*6)	30 min rated, S3 60% (*3) (*4)	11	13	28	
( 0)	S3 25%	13		32	
Cnood	Dags and (*7)	3000	3000	1500	
Speed min <sup>-1</sup>	Base speed (*7)	(2400)	(2400)	(1300)	
IIIIII	Max. speed	10000	10000	10000	
	Output torque	1.75	4.77	7.00	
(Cont. rated tord	que at const. rated torque range)	(17.9)	(48.7)	7.00 (71.4)	
	N·m (kgf·cm)	(17.9)	(40.7)	(71.4)	
Rotor inertia	kg⋅m²	0.00048	0.003	0.0043	
Notor inertia	kgf.cm.s <sup>2</sup>	0.0048	0.03	0.04	
Weight kgf		7	18	24	
Vibration			V5 (option V3)		
Noise		75dB(A) or less			
Cooli	ng system (*8)	Totally enclosed and non-ventilated IC0A0	Totally enclosed and fan cooled IC0A6		
Co	oling fan W	None	17	7	
Insta	allation (*9)	within 45° degrees a	at the output shaft points bove the horizontal to ve V1,IMB3,IMB6,IMB7,IME	ertically downwards.	
Allowable over	erload capacity (1 min) (*10)	120	0 % of 30 min rated outp	ut	
	Insulation		Class H		
Ar	nbient temperature	0 to 40°C			
	Altitude	Height above sea level not exceeding 1000m			
	Painting color	Munsell system N2.5			
	Sensor	αiM sensor or αiMZ sensor			
Type of	thermal protection (*11)	TP211			
	the $\alpha i$ MZ sensor /rev.	2048			
	etected gear teeth per rotation λ/rev.	64 128			
	Bearing lubrication		Grease		
Maximum output during acceleration (*12)		1.32	2.64	4.44	
Apolio	cable spindle amplifier	aisi	P 2.2	α <i>i</i> SP 5.5	
, , , , , ,	Model	α <i>i</i> I 0.5/10000	α <i>i</i> Ι 1/10000	α <i>i</i> I 1.5/10000	
	MOUCI	aii 0.5/10000	ati 1/10000	0.11 1.5/10000	

	Series	$\alpha i$ I series 200V type				
Item	Model	α <i>i</i> Ι 2/10000	α <i>i</i> Ι 3/10000	α <i>i</i> Ι 6/10000	α <i>i</i> Ι 8/8000	
	Cont. rated kW	2.2	3.7	5.5	7.5	
	(HP)	(3.0)	(5.0)	(7.4)	(10)	
	30 min rated kW	3.7	5.5	7.5	11	
Output	[15 min, 10min]					
(*2)	(*3) (HP)	(5.0)	(7.4)	(10)	(14.7)	
	S3 60% kW	3.7	5.5	7.5	11	
	[40%,25%]					
	(*4)(*5) (HP)	(5.0)	(7.4)	(10)	(14.7)	
Rated current A	Cont. rated	19	23	43	43	
(*6)	30 min rated, S3 60% (*3)(*4)	27	29	49	53	
( - /	S3 25%	32		53		
Speed	Base speed (*7)	1500	1500	1500	1500	
min <sup>-1</sup>		(1350)	(1400)	(1200)	(1400)	
111111	Max. speed	10000	10000	10000	8000	
	Output torque	14.0	23.5	35.0	47.7	
(Cont. rated tord	que at const. rated torque range)	(143)	(240)	(357)	(487)	
1	N·m (kgf·cm)					
Rotor inertia	kg·m <sup>2</sup>	0.0078	0.0148	0.0179	0.0275	
	kgf·cm·s <sup>2</sup>	0.08	0.15	0.18	0.28	
Wei	<u> </u>	27 46 51 80				
	Vibration			tion V3)		
	Noise	_		a) or less		
	ng system (*8)	Totally enclosed and fan cooled IC0A6				
Cod	oling fan W	17 20				
Insta	allation (*9)	Mount the motor so that the output shaft points in a direction ranging within 45° degrees above the horizontal to vertically downwards.  IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5				
Allowable over	erload capacity (1 min) (*10)	120 % of 30 min rated output				
	Insulation	Class H				
An	nbient temperature	0 to 40°C				
	Altitude	Height above sea level not exceeding 1000m				
	Painting color	Munsell system N2.5				
	Sensor	lpha iM sensor or $lpha i$ MZ sensor				
Type of thermal protection (*11)		TP211				
Resolution of the $\alpha i$ MZ sensor /rev.		20	)48		96	
Number of detected gear teeth per rotation $\lambda$ /rev.		128 256			56	
Bearing lubrication			Gre	ease		
	tput during acceleration (*12) kW	4.44	6.6	9.0	13.2	
Applic	cable spindle amplifier	α <i>i</i> SP 5.5 α <i>i</i> SP 11		P 11		
	Model	α <i>İ</i> I 2/10000	α <i>İ</i> Ι 3/10000	α <i>İ</i> I 6/10000	α <i>İ</i> I 8/8000	

	Series	αiI series 200V type				
Item	Model	α <i>i</i> Ι <b>12/7000</b>	α <i>i</i> Ι <b>15/7000</b>	α <i>i</i> Ι 18/7000	α <i>i</i> I <b>22/7000</b>	
	Cont. rated kW	11	15	18.5	22	
	(HP)	(14.7)	(20.1)	(24.8)	(29.5)	
	30 min rated kW	15	18.5	22	26	
Output	[15 min, 10min]					
(*2)	(*3) (HP)	(20.1)	(24.8)	(29.5)	(34.9)	
	S3 60% kW	15	18.5	22	26	
	[40%,25%]	(00.4)	(0.4.0)	(00.5)	(0.4.0)	
	(*4)(*5) (HP)	(20.1)	(24.8)	(29.5)	(34.9)	
Rated	Cont. rated	54	70	82	98	
current A	30 min rated, S3 60% (*3)(*4)	64	82	95	111	
(*6)	S3 25%	72	96	4500	4500	
Speed	Base speed (*7)	1500	1500	1500	1500	
min <sup>-1</sup>	May apped	(1250) 7000	(1200)	(1200) 7000	(1250)	
	Max. speed Output torque	7000	7000	7000	7000	
(Cont_rated t	orque at const. rated torque range)	70.0	95.4	117.7	140.0	
(Cont. rated t	N·m (kgf·cm)	(714)	(974)	(1201)	(1428)	
	kg·m <sup>2</sup>	0.07	0.09	0.105	0.128	
Rotor inertia	kgf.cm·s <sup>2</sup>	0.77	0.93	1.08	1.29	
Weight kgf		95	110	125	143	
	Vibration		V5 (opt		_	
	Noise			) or less		
Co	poling system (*8)	To	tally enclosed and		A6	
	Cooling fan W	56				
		Mount the motor	so that the outpu	t shaft points in a	direction ranging	
Ir	nstallation (*9)	within 45° deg	rees above the ho	orizontal to vertical	lly downwards.	
		IM	B5,IMV1,IMB3,IM	B6,IMB7,IMB8,IM	V5	
Allowable	overload capacity (1 min) (*10)		120 % of 30 m	in rated output		
	Insulation	Class H				
	Ambient temperature	0 to 40°C				
	Altitude	Height above sea level not exceeding 1000m				
	Painting color	Munsell system N2.5				
	Sensor	lpha iM sensor or $lpha i$ MZ sensor				
Туре	of thermal protection (*11)	TP211				
Resolution	of the $\alpha i$ MZ sensor /rev.	4096				
Number of detected gear teeth per rotation $\lambda$ /rev.		256				
Bearing lubrication		Grease				
Maximum output during acceleration (*12)						
IVIGAIITIGIII	kW	18.0	22.2	26.4	31.2	
Ар	plicable spindle amplifier	lpha iSP 15	αiS	P 22	lpha iSP 26	
	Model	$\alpha i$ I 12/7000	α <i>ἱ</i> Ι 15/7000	α <i>ἱ</i> Ι 18/7000	α <i>ἱ</i> Ι 22/7000	

	Series	$lpha \dot{i}  ext{I}$ series 200V type			
Item	Model	α <i>i</i> Ι 30/6000	α <i>i</i> Ι 40/6000	α <i>i</i> Ι 50/4500	
	Cont. rated kW	30	37	45	
	(HP)	(40.2)	(49.6)	(60.3)	
	30 min rated kW	37	45	55	
Output	[15 min, 10min]				
(*2)	(*3) (HP)	(49.6)	(60.3)	(73.7)	
	S3 60% kW	37	45	55	
	[40%,25%]				
	(*4)(*5) (HP)	(49.6)	(60.3)	(73.7)	
Rated current A	Cont. rated	131	160	193	
(*6)	30 min rated,S3 60% (*3)(*4)	155	185	236	
( 0)	S3 25%				
Speed	Base speed (*7)	1150	1500	1150	
min <sup>-1</sup>	base speed (7)	(950)	(1200)	(950)	
111111	Max. speed	6000	6000	4500	
	Output torque	249.1	235.5	373.6	
(Cont. rated tord	que at const. rated torque range)	(2540)	(2402)	(3810)	
Ţ	N·m (kgf·cm)	, ,	(2402)	(0010)	
Rotor inertia	kg·m <sup>2</sup>	0.295	0.355	0.49	
	kgf·cm·s <sup>2</sup>	3.0	3.6	5.0	
Wei	<del>-</del>	250	290	460	
	Vibration	V5 (option V3) V10 (option V			
	Noise	,	A) or less	80dB(A) or less	
	ng system (*8)	•	enclosed and fan cooled		
Cod	oling fan W		84	185	
Insta	allation (*9)	Mount the motor so that the output shaft points in a direction ranging within 45° degrees above the horizontal to vertically downwards.  IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5			
Allowable ove	erload capacity (1 min) (*10)	120 % of 30 min rated output			
	Insulation	Class H			
An	nbient temperature	0 to 40°C			
	Altitude	Height above sea level not exceeding 1000m			
	Painting color	Munsell system N2.5			
	Sensor	lpha iM sensor or $lpha i$ MZ sensor			
Type of thermal protection (*11)		TP211			
Resolution of the $\alpha i$ MZ sensor /rev.		4096			
Number of detected gear teeth per rotation $\lambda$ /rev.		256			
Bearing lubrication			Grease		
Maximum output during acceleration (*12) kW		44.4	54.0	66.0	
Applic	cable spindle amplifier	$\alpha i$	SP 45	α <i>i</i> SP 55	
	Model	α <i>i</i> Ι 30/6000	α <i>İ</i> Ι 40/6000	α <i>i</i> Ι 50/4500	

	Series	lpha iI series 200V type				
Item	Model	α <i>ἱ</i> Ι 1/15000	α <i>i</i> Ι 1.5/20000	α <i>i</i> Ι 2/20000	α <i>i</i> Ι 3/12000	
	Cont. rated kW (HP)	1.5 (2.0)	1.5 (2.0)	2.2 (3.0)	3.7 (5.0)	
-	30 min rated kW	2.2	2.2	3.7	5.5	
Output	[15 min, 10min]	2.2	2.2	0.7	0.0	
(*2)	(*3) (HP)	(3.0)	(3.0)	(5.0)	(7.4)	
	S3 60% kW	2.2	2.2	3.7	5.5	
	[40%,25%]					
	(*4)(*5) (HP)	(3.0)	(3.0)	(5.0)	(7.4)	
Rated current A	Cont. rated	24	28	41	36	
(*6)	30 min rated (*3)	27	33	53	46	
	S3 60% (*4)					
Speed min <sup>-1</sup>	Base speed	3000	3000	3000	1500	
rnin	Max. speed	15000	20000	20000	12000	
(Capt rated tara	Output torque jue at const. rated torque range)	4.77	4.77	7.0	23.5	
(Cont. rated torq	N·m (kgf·cm)	(48.7)	(48.7)	(71.5)	(240)	
	kg⋅m <sup>2</sup>	0.003	0.0043	0.0078	0.0148	
Rotor inertia	kgf·cm·s <sup>2</sup>	0.03	0.04	0.08	0.15	
Wei		18	24	27	46	
Vibration		V3 V5 (option V3)				
	Noise	75dB(A) or less				
Coolir	ng system (*8)	To	otally enclosed and	d fan cooled IC0	A6	
Cod	oling fan W	17				
Insta	allation (*9)	within 45° deg	r so that the outpur grees above the ho IB5,IMV1,IMB3,IM	orizontal to vertica	lly downwards.	
Allowable ove	erload capacity (1 min) (*10)		120 % of 30 m	in rated output		
	Insulation		Clas	ss H		
An	nbient temperature		0 to	40°C		
	Altitude	Height above sea level not exceeding 1000m				
	Painting color	Munsell system N2.5				
	Sensor	α <i>İ</i> MZ sensor (*13)				
Type of	thermal protection (*11)	TP211				
Resolution of the $\alpha i$ MZ sensor /rev.		2048				
Number of detected gear teeth per rotation $\lambda$ /rev.		128				
Bearing lubrication		Grease				
Maximum ou	tput during acceleration (*12) kW	5.6 13 20 13			13	
Applic	cable spindle amplifier	α <i>İ</i> SP 5.5	α <i>i</i> SP 15	α <i>i</i> SP 22	α <i>İ</i> SP 11	
	Model	α <i>İ</i> Ι 1/15000	α <i>İ</i> Ι 1.5/20000	α <i>İ</i> I 2/20000	α <i>i</i> Ι 3/12000	

Series		lpha iI series 200V type			
Model		α <i>i</i> Ι 6/12000(*1)		α <i>i</i> Ι 8/10000(*1)	
ltem		Low-speed winding	High-speed winding	Low-speed winding	High-speed winding
item		(Y connection)	(∆ connection)	(Y connection)	(∆ connection)
	Cont. rated kW	5.5	5.5	7.5	7.5
-	(HP)	(7.4)	(7.4)	(10)	(10)
Output	30 min rated kW	7.5	7.5	11	11
Output	[15 min, 10min]	(40)	(40)	(4.4.7)	(4.4.7)
(*2)	(*3) (HP)	(10)	(10)	(14.7)	(14.7)
	S3 60% kW	7.5	7.5	11	11
	[40%,25%]	(40)	(40)	(4.4.7)	(4.4.7)
	(*4)(*5) (HP)	(10)	(10)	(14.7)	(14.7)
Rated current A	Cont. rated	38	38	43	46
(*6)	30 min rated (*3) S3 60% (*4)	48	45	53	56
Speed	Base speed	1500	4000	1500	4000
min <sup>-1</sup>	Max. speed	12000	12000	10000	10000
	Output torque	35.0	13.1	47.7	17.9
(Cont. rated toro	ue at const. rated torque range)	(357)	(133)	(487)	(183)
	N·m (kgf·cm)	(337)	(133)	(407)	(100)
Rotor inertia	kg⋅m²	0.0179 0.0275		275	
Notor intertia	kgf·cm·s <sup>2</sup>	0.18 0.28			28
Wei	ght kgf	51 80			
	Vibration		V5 (opt	tion V3)	
	Noise		75dB(A	) or less	
Coolir	ng system (*8)	To	tally enclosed and	d fan cooled IC0.	A6
Cod	oling fan W		2	20	
Insta	allation (*9)	Mount the motor so that the output shaft points in a direction ranging within 45° degrees above the horizontal to vertically downwards.  IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5			
Allowable ove	erload capacity (1 min) (*10)		120 % of 30 m	in rated output	
	Insulation	Class H			
An	nbient temperature	0 to 40°C			
	Altitude	Height above sea level not exceeding 1000m			
	Painting color	Munsell system N2.5			
	Sensor	αiM sensor or αiMZ sensor			
Type of	thermal protection (*11)	TP211			
Resolution of the $\alpha i$ MZ sensor /rev.		4096			
Number of detected gear teeth per rotation $\lambda$ /rev.		256			
Bearing lubrication		Grease			
Maximum output during acceleration (*12) kW		9 13.2			3.2
Applic	cable spindle amplifier	α <i>i</i> SP 11			
	Model	α <i>i</i> I 6/	12000	α <i>i</i> I 8/	10000

	Series	lpha iI series 200V type				
Model		α <i>i</i> Ι 12/10000(*1)		α <i>i</i> Ι 15/10000(*1)		
		α <i>i</i> Ι 12/12000		α <i>ἱ</i> Ι <b>15/12000</b>		
		Low-speed	High-speed	Low-speed	High-speed	
ltom		winding	winding	winding	winding	
Item		(Y connection)	(∆ connection)	(Y connection)	(∆ connection)	
	Cont. rated kW	11	11	15	15	
	(HP) 30 min rated kW	(14.7) 15	(14.7) 15	(20.1) 18.5	(20.1) 18.5	
Output	[15 min, 10min]	15	15	10.5	10.5	
(*2)	(*3) (HP)	(20.1)	(20.1)	(24.8)	(24.8)	
, ,	S3 60% kW	15	15	18.5	18.5	
	[40%,25%]					
	(*4)(*5) (HP)	(20.1)	(20.1)	(24.8)	(24.8)	
Rated	Cont. rated	54	52	70	71	
current A	30 min rated (*3)	64	63	82	81	
(*6)	S3 60% (*4)	1500	4000	1500	4000	
Speed min <sup>-1</sup>	Base speed Max. speed	10000,12000	10000,12000	10000,12000	10000,12000	
111111	Output torque	•	,	,	,	
(Cont. rated t	torque at const. rated torque range)	70.0	26.3	95.4	35.8	
`	N⋅m (kgf⋅cm)	(714)	(268)	(974)	(365)	
Rotor inertia	kg⋅m²	0.	07	0.	09	
rtotor incrtia	kgf.cm.s <sup>2</sup>	0.77 0.93				
\	Weight kgf	9	5		10	
	Vibration		10000 : V5	12000 : V3		
0.	Noise (*0)	т.	,	) or less	4.0	
	cooling system (*8) Cooling fan W	Totally enclosed and fan cooled IC0A6 56				
	Cooling lan W	Mount the motor	<u>_</u>	-	direction ranging	
l Ir	nstallation (*9)	Mount the motor so that the output shaft points in a direction ranging within 45° degrees above the horizontal to vertically downwards.				
	( )	_		B6,IMB7,IMB8,IM	•	
Allowable	overload capacity (1 min) (*10)		120 % of 30 m	in rated output		
	Insulation	Class H				
	Ambient temperature	0 to 40°C				
	Altitude	Height above sea level not exceeding 1000m				
	Painting color	Munsell system N2.5				
	Sensor	lpha iM sensor or $lpha i$ MZ sensor				
	e of thermal protection (*11)	TP211				
Resolution of the $\alpha i$ MZ sensor /rev.		4096				
Number of detected gear teeth per rotation		256				
λ/rev.						
Bearing lubrication  Maximum output during acceleration (*12)		Grease				
waximum output during acceleration (*12) kW		18.0 22.2		2.2		
Ap	pplicable spindle amplifier	α <i>i</i> SP 15 α <i>i</i> SP 22		P 22		
T			/10000		/10000	
	Model	$\alpha i I 12/12000$ $\alpha i I 15/12000$ $\alpha i I 15/12000$				

Series		lpha iI series 200V type				
Model		α <i>i</i> Ι 18/10000(*1)		α <i>i</i> I 22/10000(*1)		
		α <i>i</i> Ι 18/12000		α <i>ἱ</i> Ι <b>22/12000</b>		
		Low-speed	High-speed	Low-speed	High-speed	
14		winding	winding	winding	winding	
Item		(Y connection)	(∆ connection)	(Y connection)	(∆ connection)	
	Cont. rated kW	18.5	18.5	22	22	
-	(HP)	(24.8)	(24.8)	(29.5)	(29.5)	
Output	30 min rated kW	22	22	26	26	
Output (*2)	[15 min, 10min] (*3) (HP)	(29.5)	(29.5)	(34.9)	(34.9)	
(2)	S3 60% kW	(29.5)	(29.5)	26	26	
	[40%,25%]	22	22	20	20	
	(*4)(*5) (HP)	(29.5)	(29.5)	(34.9)	(34.9)	
Rated	Cont. rated	82	83	100	101	
current A	30 min rated (*3)	0.5			-	
(*6)	S3 60% (*4)	95	94	111	112	
Speed	Base speed	1500	4000	1500	4000	
min <sup>-1</sup>	Max. speed	10000,12000	10000,12000	10000,12000	10000,12000	
	Output torque	117.7	44.2	140.0	52.5	
(Cont. rated t	orque at const. rated torque range)	(1201)	(451)	(1428)	(536)	
	N·m (kgf·cm)				` ′	
Rotor inertia	kg·m²	0.1			128	
	kgf·cm·s <sup>2</sup>		08 25		29	
Weight kgf Vibration		14	10000 : V5	12000 : V3	43	
	Noise			) or less		
Co	poling system (*8)	Totally enclosed and fan cooled IC0A6				
	Cooling fan W	56				
		Mount the motor so that the output shaft points in a direction ranging				
In	nstallation (*9)	within 45° degrees above the horizontal to vertically downwards.				
	. ,	IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5				
Allowable	overload capacity (1 min) (*10)		120 % of 30 m	in rated output		
	Insulation			ss H		
	Ambient temperature			40°C		
	Altitude	Height above sea level not exceeding 1000m				
	Painting color	Munsell system N2.5				
	Sensor	lpha iM sensor or $lpha i$ MZ sensor				
, ,	of thermal protection (*11)	TP211				
Resolution of the $\alpha i$ MZ sensor /rev.		4096				
Number of detected gear teeth per rotation		256				
λ/rev. Bearing lubrication						
Maximum output during acceleration (*12)		Grease				
MANITUITI	kW	26.4 31.2		1.2		
Ар	plicable spindle amplifier		P 22		P 26	
	Model	$\alpha i$ I 18.	/10000	$\alpha i$ I 22	$\alpha i$ I 22/10000	
	Model	α <i>İ</i> I 18/12000		lpha iI 22/12000		

- (\*1) For  $\alpha i$ I 6/12000,  $\alpha i$ I 8/10000,  $\alpha i$ I 12/10000,  $\alpha i$ I 12/12000,  $\alpha i$ I 15/10000,  $\alpha i$ I 15/12000,  $\alpha i$ I 18/10000,  $\alpha i$ I 18/12000,  $\alpha i$ I 22/10000, and  $\alpha i$ I 22/12000, the CNC soft option and switching magnetic contactor unit associated with the output switch function (Y- $\Delta$  switch) are required. See FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN) for details of the output switch control.
- (\*2) The rated output is guaranteed at the rated voltage.

  (Amplifier input: 200/220/230V AC +10% -15%, 50/60 Hz ±1Hz)

  If the input voltage fluctuates, it is possible that the rated output cannot be obtained even when such fluctuations are within the allowable fluctuation range.
- (\*3) The output for  $\alpha i I 0.5/10000$ ,  $\alpha i I 1/10000$ ,  $\alpha i I 2/10000$ ,  $\alpha i I 1/15000$ ,  $\alpha i I 1.5/20000$ , or  $\alpha i I 2/20000$  is 15 min rated. That for  $\alpha i I 1.5/10000$  is 10 min rated.
- (\*4) S3 40% for  $\alpha i$ I 0.5/10000,  $\alpha i$ I 30/6000,  $\alpha i$ I 50/4500,  $\alpha i$ I 1/15000,  $\alpha i$ I 1.5/20000, or  $\alpha i$ I 2/20000, S3 15% for  $\alpha i$ I 1.5/10000.
- (\*5) The cycle time is 10 minutes, S3 60%: ON 6 minutes, OFF 4 minutes, S3 40%: ON 4 minutes, OFF 6 minutes and S3 25%: ON 2.5 minutes, OFF 7.5 minutes.
- (\*6) The rated current is not a guaranteed value but a guideline for the maximum current at rated output.
- (\*7) Values in parentheses represent the base speeds for S3 25% rated output. (For the  $\alpha i$ I 1.5/10000, the base speed is S3 15%.) To output S3 25% rating (S3 15% rating for the  $\alpha i$ I 1.5/10000), the  $\alpha i$ SP amplifier (A06B-6141-Hxxx) and dedicated parameters are required.
- (\*8) IC code conforms to IEC 34-6.
- (\*9) IM code conforms to IEC 34-7. When using  $\alpha i I 1/15000$ ,  $\alpha i I 1.5/20000$ , or  $\alpha i I 2/20000$ , the output shaft must be placed horizontally or vertically downward (IMB5, IMV1).
- (\*10) This is not a guaranteed value but a guideline for the maximum motor output at a rated supply voltage. 120 % of 15 min rated for  $\alpha i$ I 0.5/10000,  $\alpha i$ I 1/10000,  $\alpha i$ I 2/10000,  $\alpha i$ I 1/15000,  $\alpha i$ I 1.5/20000, or  $\alpha i$ I 2/20000 and 120% of 10 min rated for  $\alpha i$ I 1.5/10000.
- (\*11) Type conforms to IEC 34-11.
- (\*12) These values are to be used only as guidance for selecting a power supply ( $\alpha iPS$ ) and are not guaranteed.
- (\*13) There is another type of  $\alpha iI$  3/12000 that has a built-in  $\alpha iM$  sensor.
- (\*14) Degree of protection: with oil seal: IP54, without oil seal: IP40.

# 3

#### **OUTPUT/TORQUE CHARACTERISTICS**

# Reference Calculation for torque

Torque T can be obtained by the following equation.

 $T[N\cdot m]=P[kW]\times 1000/0.1047/N[min^{-1}]$  P[kW]: Motor output  $N[min^{-1}]:$  Motor speed

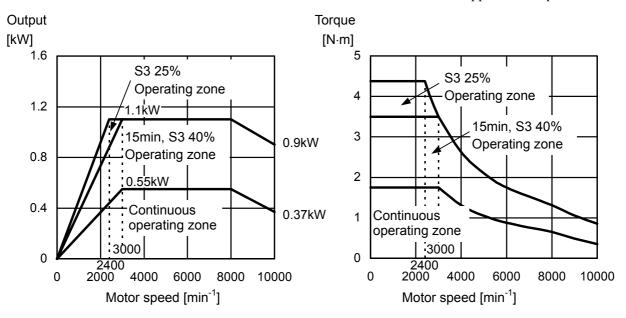
When the unit of T is [kgf·m],  $T[kgf·m]=P[kW]\times1000/1.0269/N[min^{-1}]$ 

#### **⚠** CAUTION

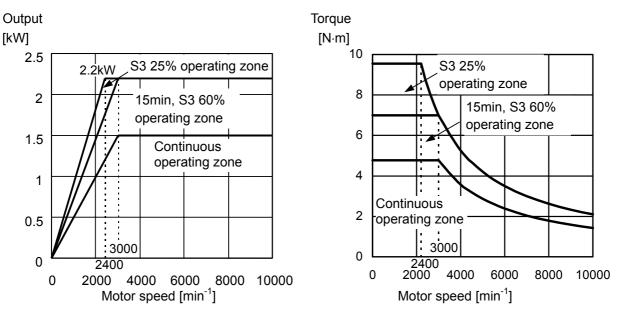
To output S3 25% rating (S3 15% rating for the  $\alpha i$ I 1.5/1000), the  $\alpha i$ SP amplifier (A06B-6141-Hxxx) and dedicated parameters are required.

# 3.1 MODEL $\alpha i$ I 0.5/10000

Applicable amplifier  $\alpha i SP 2.2$ 

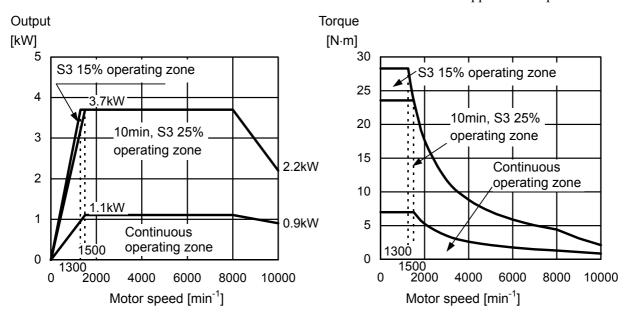


#### 3.2 MODEL $\alpha i$ I 1/10000

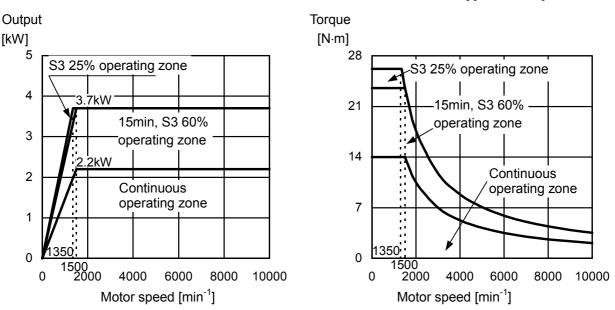


# 3.3 MODEL $\alpha i$ I 1.5/10000

Applicable amplifier  $\alpha i SP 5.5$ 

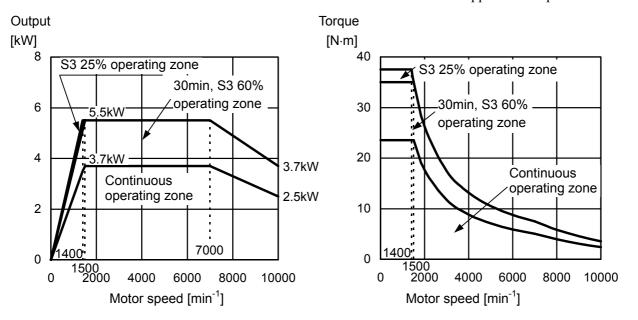


#### **3.4** MODEL $\alpha i$ I 2/10000

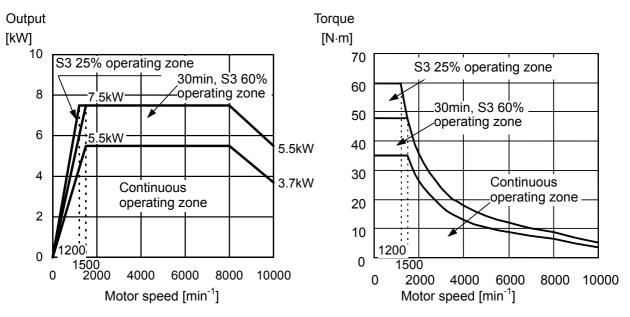


# 3.5 MODEL $\alpha i$ I 3/10000

Applicable amplifier  $\alpha i SP 5.5$ 

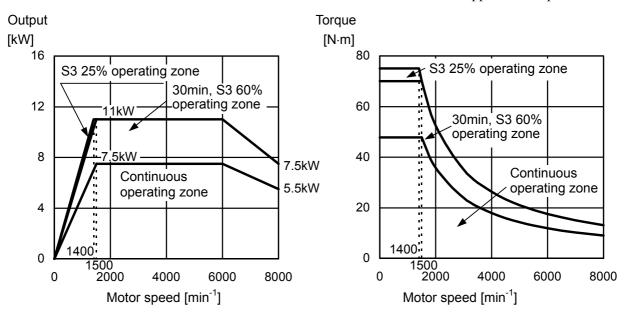


#### **3.6** MODEL $\alpha i$ I 6/10000

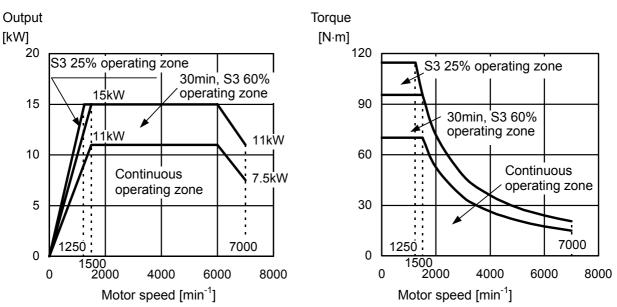


#### 3.7 MODEL $\alpha i$ I 8/8000

Applicable amplifier  $\alpha i$ SP 11

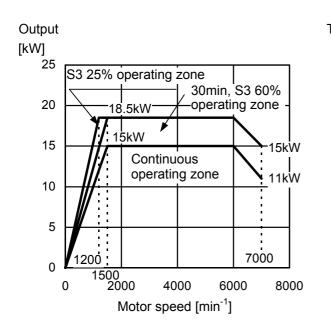


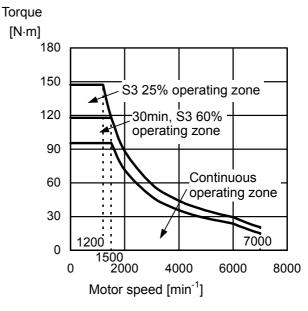
#### **3.8** MODEL $\alpha i$ I 12/7000



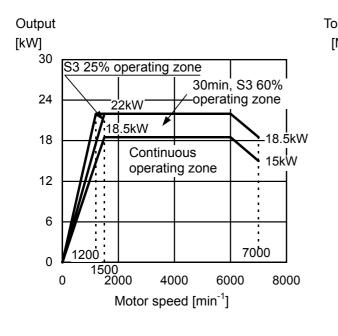
# 3.9 MODEL $\alpha i$ I 15/7000

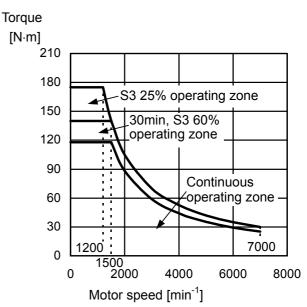
Applicable amplifier  $\alpha i$ SP 22





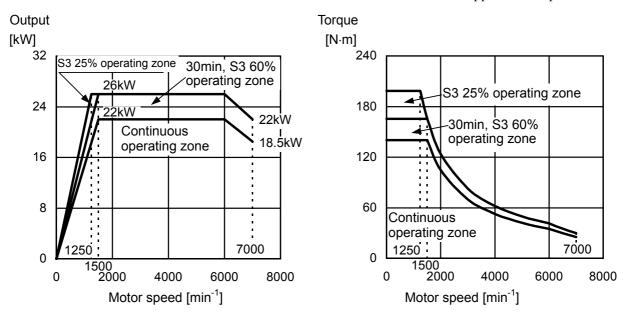
# **3.10** MODEL $\alpha i$ I 18/7000



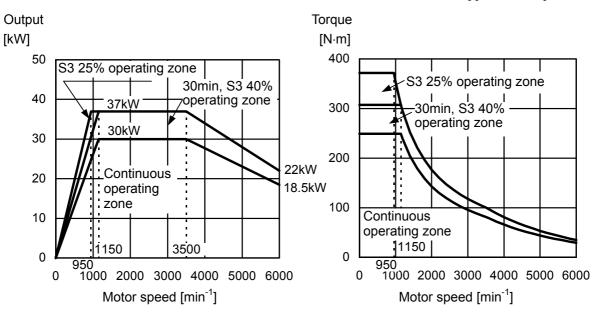


#### **3.11** MODEL $\alpha i$ I 22/7000

Applicable amplifier  $\alpha i$ SP 26

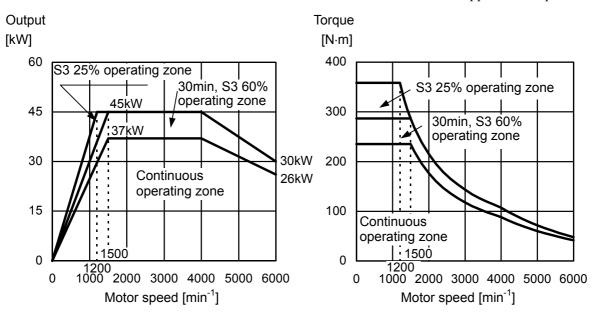


#### **3.12** MODEL $\alpha i$ I 30/6000

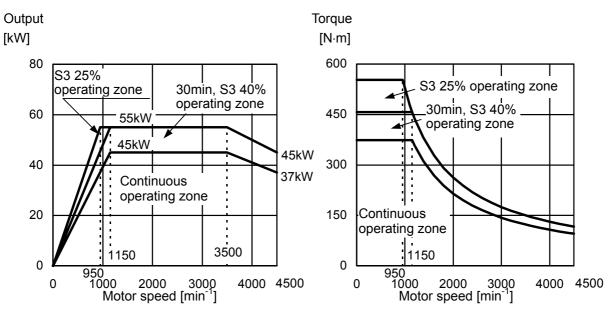


#### **3.13** MODEL $\alpha i$ I 40/6000

Applicable amplifier  $\alpha i$ SP 45

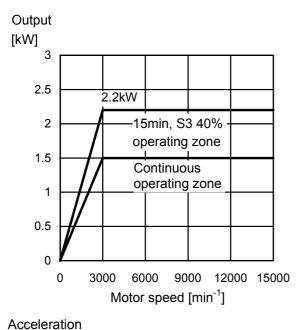


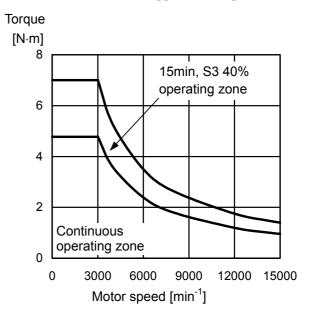
#### **3.14** MODEL $\alpha i$ I 50/4500

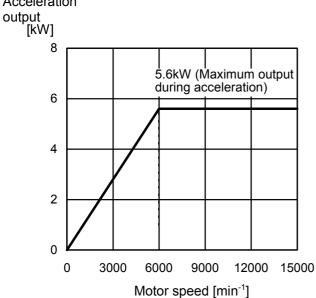


# **3.15** MODEL $\alpha i$ I 1/15000

Applicable amplifier  $\alpha i$ SP 5.5



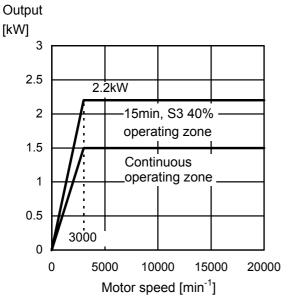


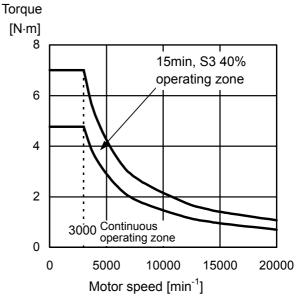


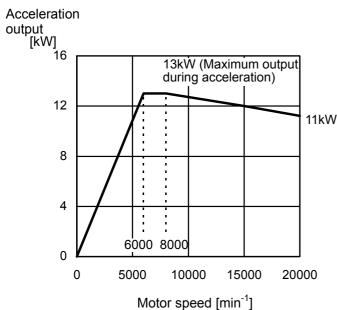
#### **NOTE**

# 3.16 MODEL $\alpha i$ I 1.5/20000

Applicable amplifier  $\alpha i$ SP 15



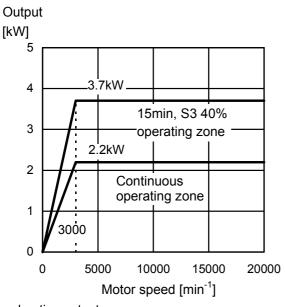


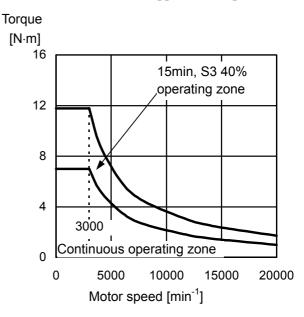


#### **NOTE**

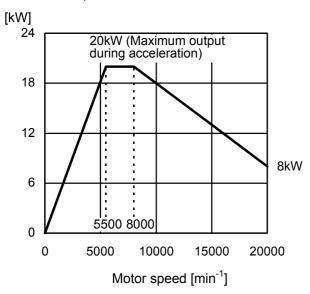
# 3.17 MODEL $\alpha i$ I 2/20000

Applicable amplifier  $\alpha i$ SP 22





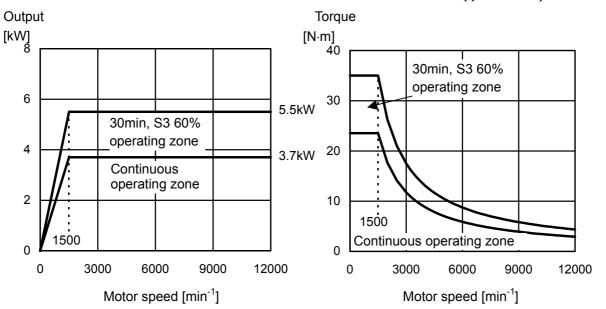
Acceleration output



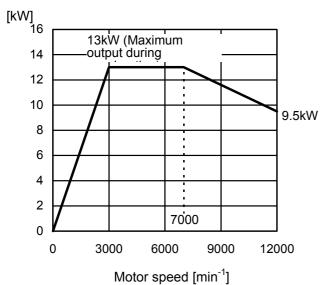
#### **NOTE**

# 3.18 MODEL $\alpha i$ I 3/12000

Applicable amplifier  $\alpha i$ SP 11



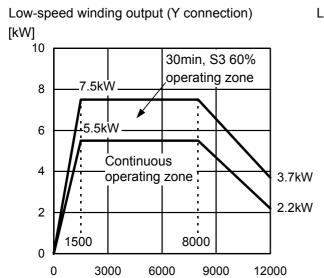
Acceleration output



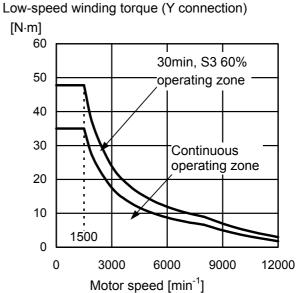
#### NOTE

# **3.19** MODEL $\alpha i$ I 6/12000

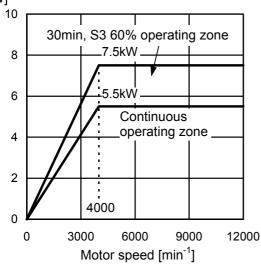
Applicable amplifier  $\alpha i$ SP 11



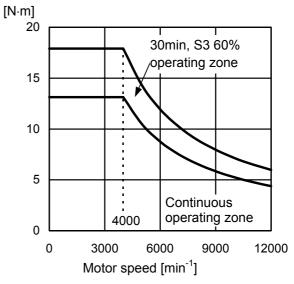
Motor speed [min<sup>-1</sup>]



 $\label{eq:linear_equation} \mbox{High-speed winding output } (\Delta \mbox{ connection}) \\ \mbox{[kW]}$ 



High-speed winding torque ( $\Delta$  connection)



#### **3.20** MODEL $\alpha i$ I 8/10000

Applicable amplifier  $\alpha i$ SP 11

Low-speed winding output (Y connection)

[kW]

16

30min, S3 60%
operating zone

12

7.5kW

Continuous
operating zone

4

1500

1500

1500

5.5kW

Low-speed winding torque (Y connection) [N·m] 80 30min, S3 60% operating zone 60 40 Continuous operating zone 20 1500 2000 4000 6000 8000 10000 0 Motor speed [min<sup>-1</sup>]

 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:likelihood}$  [kW]

4000

6000

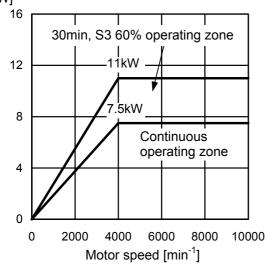
Motor speed [min<sup>-1</sup>]

8000

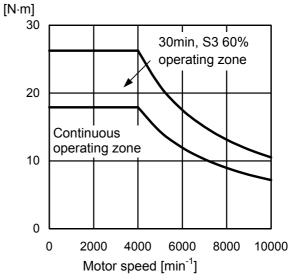
10000

2000

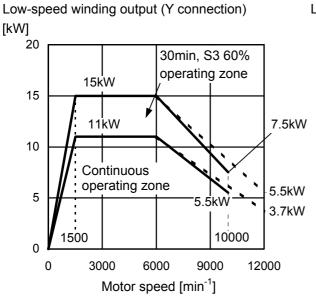
0

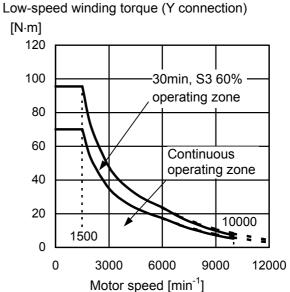


High-speed winding torque ( $\Delta$  connection)

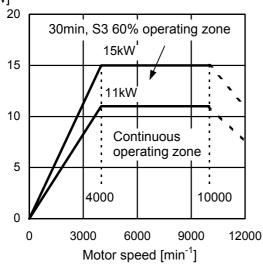


#### **3.21** MODELS $\alpha i$ I 12/10000 AND $\alpha i$ I 12/12000

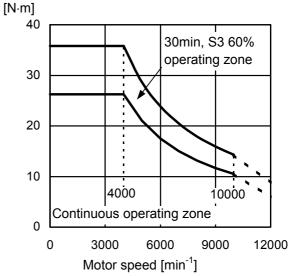




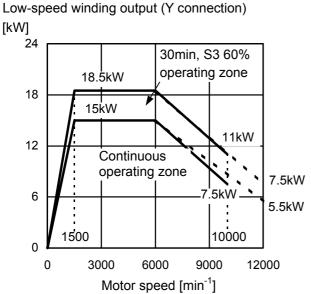
 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:linear_connection} \mbox{[kW]}$ 

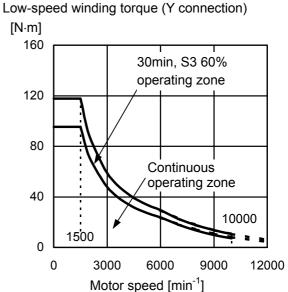


High-speed winding torque ( $\Delta$  connection)

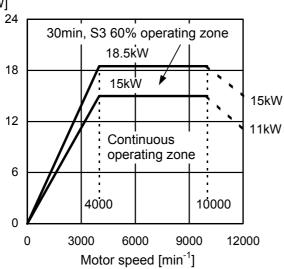


#### **3.22** MODELS $\alpha i$ I 15/10000 AND $\alpha i$ I 15/12000

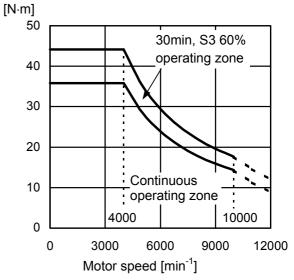




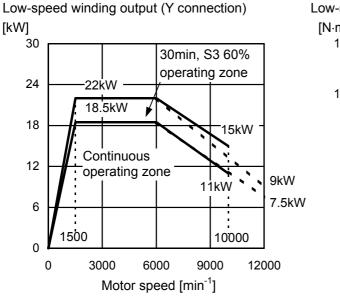
 $\label{eq:linear_equation} \mbox{High-speed winding output } (\Delta \mbox{ connection}) \\ \mbox{[kW]}$ 

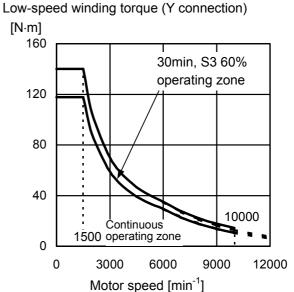


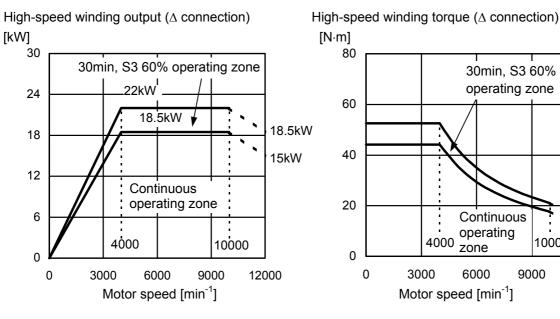
High-speed winding torque ( $\Delta$  connection)

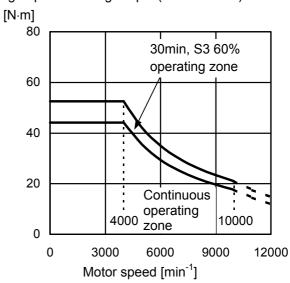


#### 3.23 MODELS $\alpha i$ I 18/10000 AND $\alpha i$ I 18/12000

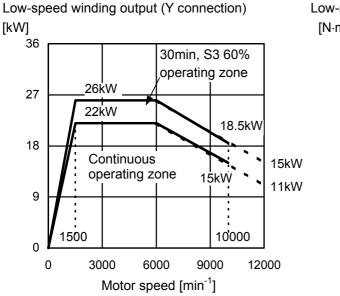


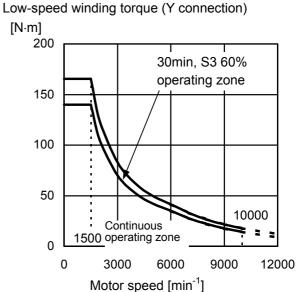


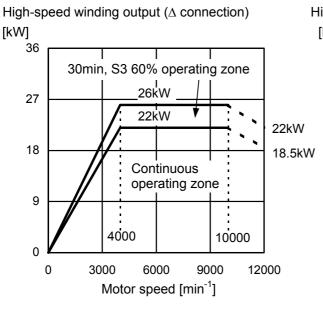


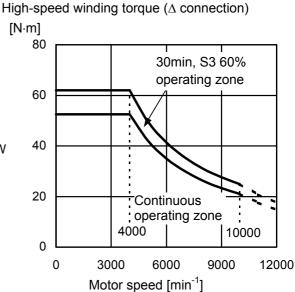


#### **3.24** MODELS $\alpha i$ I 22/10000 AND $\alpha i$ I 22/12000





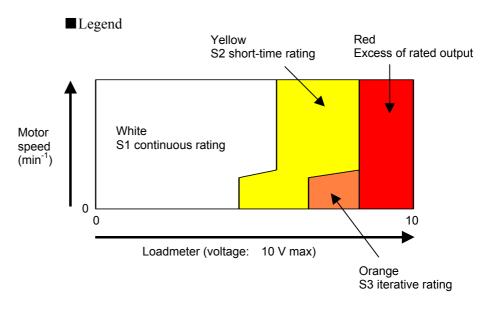




# 4

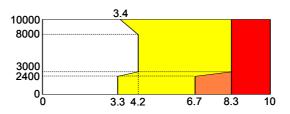
#### LOADMETER (DYNAMOMETER)

The loadmeter (dynamometer) shows the percentage of the load (load factor) to the maximum output that the motor can produce. At the maximum output, 10 V is output. It is output on pin 16 of the JY1 connector of the spindle amplifier ( $\alpha i$ SP). (For details, refer to "FANUC SERVO AMPLIFIER  $\alpha i$  series Descriptions" (B-65282EN).)

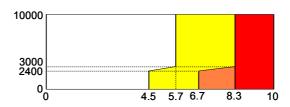


## 4.1 STANDARD TYPE

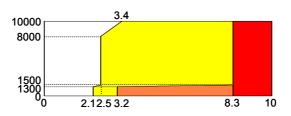
#### α*i*Ι 0.5/10000



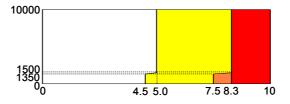
#### α*i*Ι 1/10000



#### α*i*Ι 1.5/10000

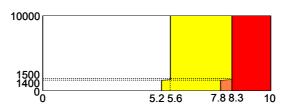


#### α*i*Ι 2/10000

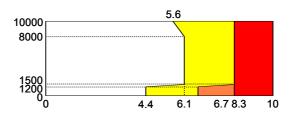


#### 4.LOADMETER (DYNAMOMETER) FANUC AC SPINDLE MOTOR αİI series 200V type B-65272EN/05

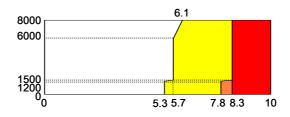
### $\alpha i$ I 3/10000



#### α*i*Ι 6/10000



### α*i*Ι 8/8000

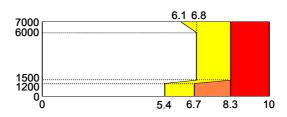


#### α*i*Ι **12/7000**

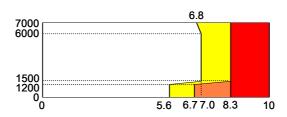


#### B-65272EN/05 FANUC AC SPINDLE MOTOR αİI series 200V type 4.LOADMETER (DYNAMOMETER)

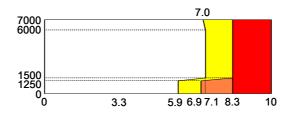
### $\alpha i$ I 15/7000



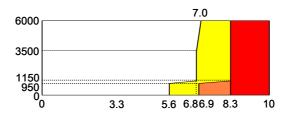
#### α*i*Ι 18/7000



#### α*i*Ι **22/7000**

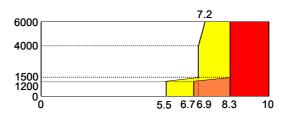


#### α*i*Ι 30/6000



#### 4.LOADMETER (DYNAMOMETER) FANUC AC SPINDLE MOTOR αİI series 200V type B-65272EN/05

### α*i*Ι **40/6000**



#### α*i*Ι **50/4500**

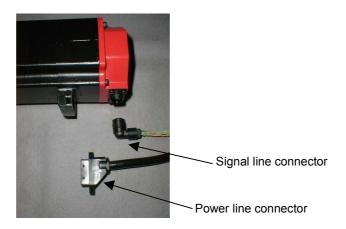


### **CONNECTIONS**

#### *5.1* MODEL $\alpha i$ I 0.5/10000

The power lead and signal lead are connected with the connector. Use the shield cable for the connection.

Refer to FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN) for other respects in the connection.



#### Connection of power lead

Connector parts related to cable side

	Ordering number	Tyco Electronics AMP specification
Connector kit of power lead	A06B-6114-K220/S (FANUC specification : A63L-0001-0875/SC)	1473063-2

Power lead specification

Number of core	Conductor size	Grounding cable cross-section	Sheath diameter (Note)
4 or more	AWG16 to 18	φ1.8 to 2.8mm	φ10.4 to 11.4mm

#### **NOTE**

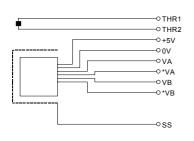
If the outer sheath diameter is inadequate, the waterproofness can degrade.

Connector pins arrangement

Connector	oms arrange	iiiciit			
1	2	3	4	5	6
U	V	W	G	_	_

#### Connection of signal lead

### - For type with lpha iM sensor



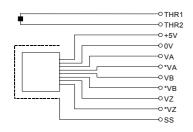
Connector parts related to cable side

	Japan Aviation Electronics Industry specification
	JN2xS10SL1-R: Applicable sheath diameter φ5.7 to 7.3
	JN2xS10SL2-R: Applicable sheath diameter φ6.5 to 8.0
Connector	$\uparrow$
	D: Straight plug
	F: Elbow plug
Terminal	JN1-22-22S

Connector pins arrangement

Ι.		. 0					
	•	1	2	2		3	
	*\	/A	*\	/B		-	
4			5	6	6	7	,
V	Α	>	/B	-		0	<b>/</b>
	8	3	(	9	1	0	
	+5	5V	TH	R1	TH	IR2	
	4 V	4 VA	1 *VA	1 2 2 1 1 2 2 1 1 1 1 2 2 1 1 1 1 1 1 1	1 2 *VA *VB 4 5 6 VA VB -	1 2 *VA *VB 4 5 6 *VA VB - 8 9 1	1 2 3 *VA *VB -  4 5 6 7  VA VB - 0  8 9 10

#### - For type with lpha iMZ sensor



Connector parts related to cable side

	Japan Aviation Electronics Industry specification
Connector	JN2xS10SL1-R: Applicable sheath diameter φ5.7 to 7.3
	JN2xS10SL2-R:Applicable sheath diameter φ6.5 to 8.0
	$\uparrow$
	D: Straight plug
	F: Elbow plug
Terminal	JN1-22-22S

Connector pins arrangement

	Č						
	•	1	2	2	,	3	
	*\	/A	*VB		*VB *VZ		
4			5	6	6	7	,
V	4	V	/B	V	Z	0,	V
	8	3	Ç	9	1	0	
	+5	5V	TH	R1	T⊦	IR2	

#### - Thermistor specification

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).

### **5.2** MODELS $\alpha i$ I 1/10000 TO $\alpha i$ I 50/4500

Cables for power lead and fan motor are connected to the terminal block.

 $\alpha iM$  sensor or  $\alpha iMZ$  sensor signal or thermistor signal use a connector manufactured by Tyco Electronics AMP.

The connector housing and the connector are attached to the motor.

Size of screws used in	Power	lead	Fan motor
the terminal block	U,V,W,G	X,Y,Z	FMU,FMV,FMW
α <i>i</i> Ι 1/10000, α <i>i</i> Ι 1.5/10000	M5	-	M4
lpha iI 2/10000 to $lpha i$ I 15/7000	M5	ı	Screw-less terminal block
lpha iI 18/7000 to $lpha i$ I 22/7000	M6	ı	Screw-less terminal block
lpha iI 30/6000 to $lpha i$ I 40/6000	M10	ı	Screw-less terminal block
α <i>İ</i> I 50/4500	M8	-	Screw-less terminal block
α <i>i</i> Ι 1/15000, α <i>i</i> Ι 1.5/20000	M5	-	M4
αίΙ 2/20000, αίΙ 3/12000	M5	-	Screw-less terminal block
lpha iI 6/12000 to $lpha i$ I 15/10000	M5	M5	Screw-less terminal block
lpha iI 18/10000 to $lpha i$ I 22/10000	M6	M6	Screw-less terminal block

#### Cable for the power lead

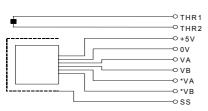
For the power lead cable specification, refer to "FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN)".

#### Cable for the fan motor

For the fan motor current value and cable specifications, refer to Section I.4.3, "FAN MOTOR CONNECTION" in this manual.

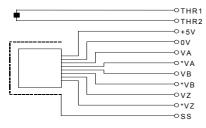
#### 5.3 **CONNECTION OF SIGNAL LEAD**

#### Connector attachment for a motor with a built-in $\alpha i$ M sensor



Connector pins arrangement						
Number	B1	B2	В3	B4	B5	В6
Color						
Signal		*VA	*VB		0V	THR2
Number	A1	A2	A3	A4	A5	A6
Color						
Signal	+5V	VA	VB		SS	THR1

### Connector attachment for a motor with a built-in lpha iMZ sensor



Connector pins arrangement						
Number	B1	B2	В3	B4	B5	В6
Color						
Signal		*VA	*VB	*VZ	0V	THR2
Number	A1	A2	A3	A4	A5	A6
Color						
Signal	+5V	VA	VB	VZ	SS	THR1

#### - Connector housing and contact specifications

Connector and contact:

Tyco Electronics AMP specification D-3000 series

	Motors	side	Cable side		
	FANUC specification	Manufacture specification	FANUC specification	Manufacture specification	
Housing	A63L-0001-0535/121KDF	178964-6	A63L-0001-0460/121KD	178289-6	
Contact	A63L-0001-0456/ASMT	175288-2	A63L-0001-0456/ASM	1-175217-2	

Crimping tool: 91559-1 Extractor: 234168-1

#### - Thermistor specification

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).



#### ALLOWABLE RADIAL LOAD

Use the motor output shaft below the allowable radial loads shown in the table below.

Model	Allowable radial load (kgf)			
Model	At output shaft end	At output shaft center		
α <i>İ</i> I 0.5/10000	294N (30kgf)	323N (33kgf)		
α <i>İ</i> I 1/10000	392N (40kgf)	441N (45kgf)		
α <i>İ</i> I 1.5/10000	882N (90kgf)	980N (100kgf)		
α <i>İ</i> I 2/10000	882N (90kgf)	999N (102kgf)		
α <i>İ</i> I 3/10000	1470N (150kgf)	1607N (164kgf)		
α <i>İ</i> I 6/10000	1960N (200kgf)	2205N (225kgf)		
α <b>i</b> I 8/8000	2940N (300kgf)	3371N (344kgf)		
$\alpha i$ I 12/7000, $\alpha i$ I 15/7000	2940N (300kgf)	3410N (348kgf)		
$\alpha i$ I 18/7000, $\alpha i$ I 22/7000	4410N (450kgf)	4988N (509kgf)		
lpha iI 30/6000, $lpha i$ I 40/6000	5390N (550kgf)	6134N (626kgf)		
α <i>İ</i> I 50/4500	1078N (1100 kgf)	1230N (1255 kgf)		
$\alpha i$ I 1/15000, $\alpha i$ I 1.5/20000	Direct connection	on to the spindle		
α <i>İ</i> I 2/20000	Direct connection	on to the spindle		
α <i>İ</i> I 3/12000	980N (100kgf)	1068N (109kgf)		
lpha iI 6/12000	1470N (150kgf)	1656N (169kgf)		
α <i>İ</i> I 8/10000	1960N (200kgf)	2244N (229kgf)		
$\alpha i$ I 12/10000, $\alpha i$ I 12/12000	24E0N (2E0kerf)	20.42N (200kmf)		
$\alpha i$ I 15/10000, $\alpha i$ I 15/12000	2450N (250kgf)	2842N (290kgf)		
$\alpha i$ I 18/10000, $\alpha i$ I 18/12000	2040N (200kaf)	2222NI (240kcf)		
$\alpha i$ I 22/10000, $\alpha i$ I 22/12000	2940N (300kgf)	3332N (340kgf)		

#### **NOTE**

- 1 When using a belt, adjust the tension so the allowable loads indicated above are not exceeded. If an excessive load is applied, consider the use of a support bearing on the machine side to maintain the long-term reliability of the motor. (If an excessive load is applied, it is possible that an abnormal sound may occur.)
- 2 When the belt tension is maximized at a point outside the output shaft end, the allowable loads are less than those at the output shaft end.
- 3 If a thrust load is applied when a helical gear is used, the shaft moves in the direction of the thrust. So, as a general rule, never apply a thrust load.

### **ASSEMBLING ACCURACY**

Model Item	lpha iI 0.5 to $lpha i$ I 22	α <i>i</i> I 30 to α <i>i</i> I 50	$\alpha i$ I 1/15000 to $\alpha i$ I 2/20000, $\alpha i$ I 12/12000 to $\alpha i$ I 22/12000	Measuring method
Run-out at the end of the output shaft	20μm or less	20μm or less	10μm or less	1/2 the output shaft length
Run-out of the faucet joint for mounting the flange against the core of the shaft (only for flange type)	40μm or less	60μm or less	30μm or less	10
Run-out of the flange mounting surface against the core of the shaft (only for flange type)	80μm or less	100μm or less	40μm or less	10

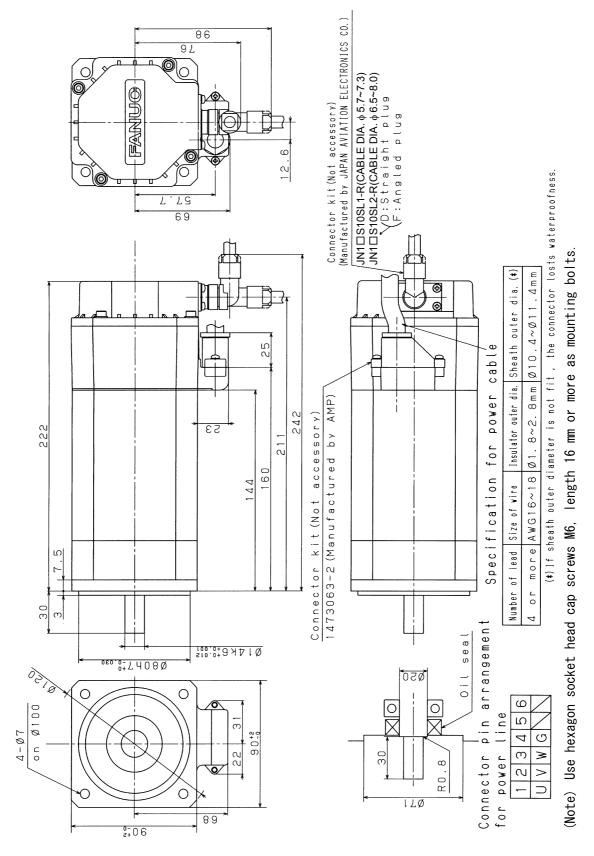
#### **⚠** CAUTION

Except for  $\alpha i$ I 1/15000 to  $\alpha i$ I 2/15000, the assembling accuracies of high-speed models are the same as those of the standard models shown above.

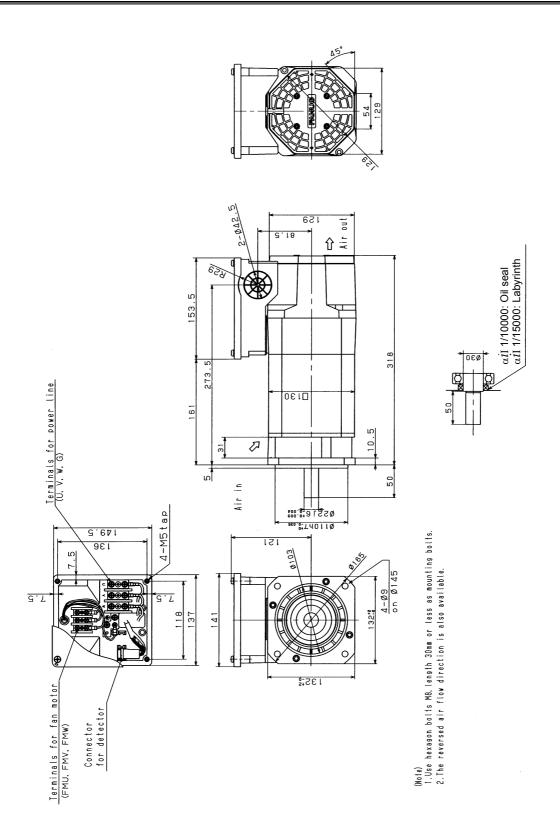
### **EXTERNAL DIMENSIONS**

Model name	Section
Model $lpha i$ I 0.5/10000 (flange mounting type)	8.1
Models $lpha \dot{t} I$ 1/10000 and $lpha \dot{t} I$ 1/15000 (flange mounting type)	8.2
Model $\alpha i$ I 1/10000 (foot mounting type)	8.3
Model αİI 1.5/10000 (flange mounting type)	8.4
Model $\alpha i$ I 1.5/20000 (flange mounting type)	8.5
Model $\alpha i$ I 1.5/10000 (foot mounting type)	8.6
Model $\alpha i$ I 2/10000 (flange mounting type)	8.7
Model αİΙ 2/20000 (flange mounting type)	8.8
Model $\alpha i$ I 2/10000 (foot mounting type)	8.9
Models $\alpha i I$ 3/10000 and $\alpha i I$ 3/12000 (flange mounting type)	8.10
Model αİΙ 3/10000 (foot mounting type)	8.11
Models $\alpha i I$ 6/10000 and $\alpha i I$ 6/12000 (flange mounting type)	8.12
Model $\alpha i$ I 6/10000 (foot mounting type)	8.13
Models $\alpha i$ I 8/8000 and $\alpha i$ I 8/10000 (flange mounting type)	8.14
Model $\alpha i$ I 8/8000 (foot mounting type)	8.15
Models $\alpha i$ I 12/7000, $\alpha i$ I 12/10000, and $\alpha i$ I 12/12000 (flange	8.16
mounting type)	8.17
Model αÎI 12/7000 (foot mounting type)	_
Models $\alpha i$ I 15/7000, $\alpha i$ I 15/10000, and $\alpha i$ I 15/12000 (flange mounting type)	8.18
Model αİΙ 15/7000 (foot mounting type)	8.19
Models $\alpha i$ I 18/7000, $\alpha i$ I 18/10000, and $\alpha i$ I 18/12000 (flange mounting type)	8.20
Model αİI 18/7000 (foot mounting type)	8.21
Models $\alpha i$ I 22/7000, $\alpha i$ I 22/10000, and $\alpha i$ I 22/12000 (flange mounting type)	8.22
Model αİI 22/7000 (foot mounting type)	8.23
Model αİI 30/6000 (flange mounting type)	8.24
Model αiI 30/6000 (foot mounting type)	8.25
Model αİΙ 40/6000 (flange mounting type)	8.26
Model αİI 40/6000 (foot mounting type)	8.27
Model αiI 50/4500 (flange mounting type)	8.28
Model αiI 50/4500 (foot mounting type)	8.29

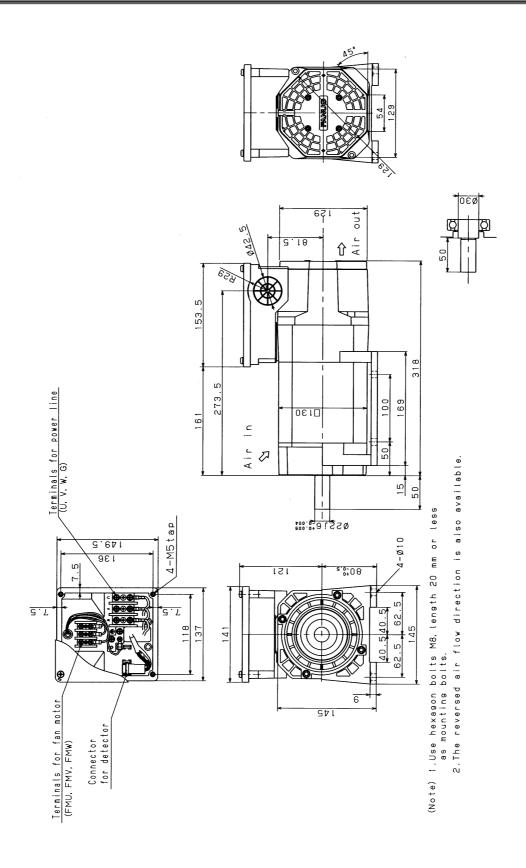
## **8.1** MODEL $\alpha i$ I 0.5/10000 (FLANGE MOUNTING TYPE)



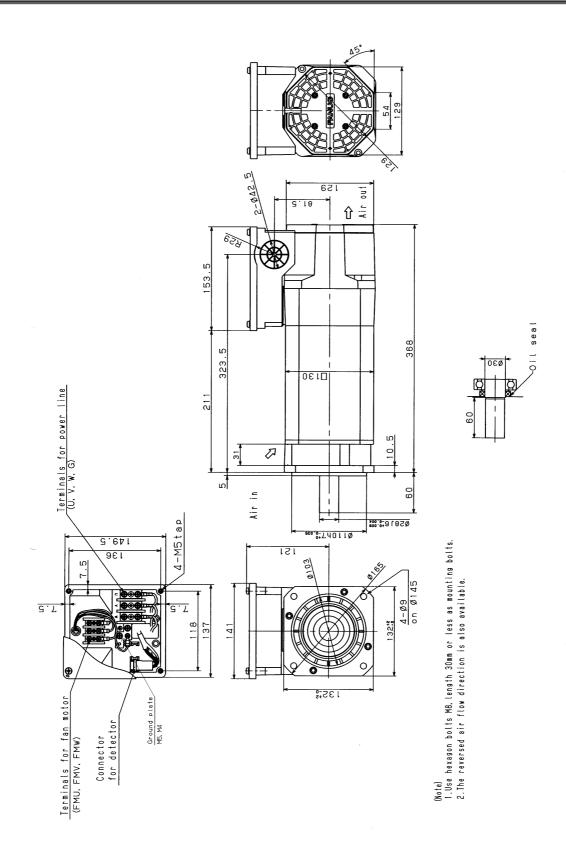
# 8.2 MODELS $\alpha i$ I 1/10000 AND $\alpha i$ I 1/15000 (FLANGE MOUNTING TYPE)



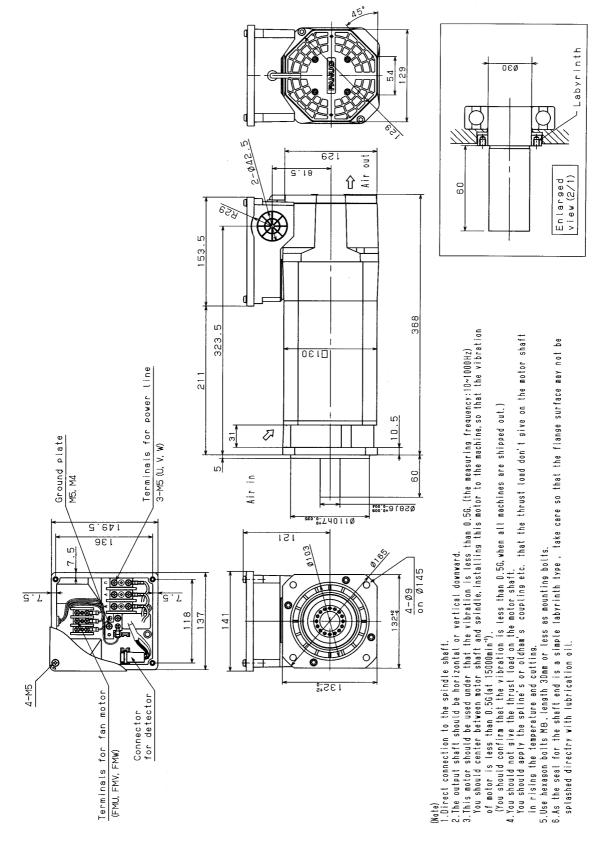
## 8.3 MODEL $\alpha i$ I 1/10000 (FOOT MOUNTING TYPE)



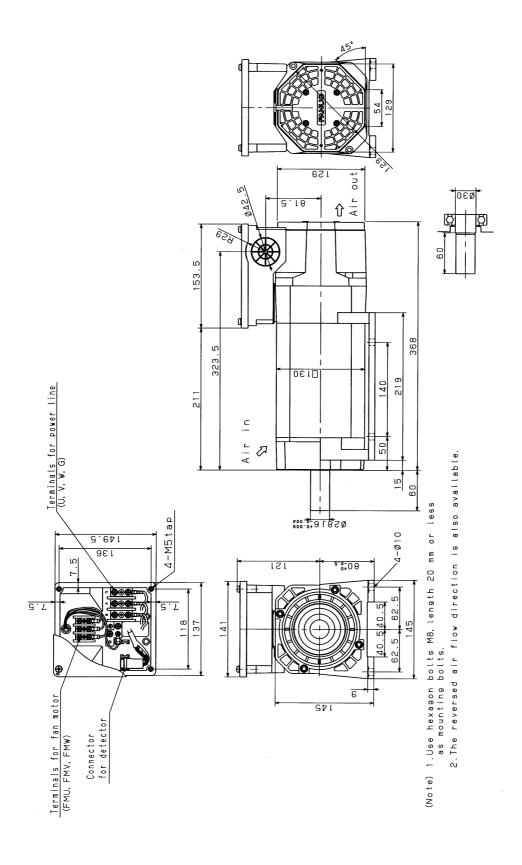
## 8.4 MODEL $\alpha i$ I 1.5/10000 (FLANGE MOUNTING TYPE)



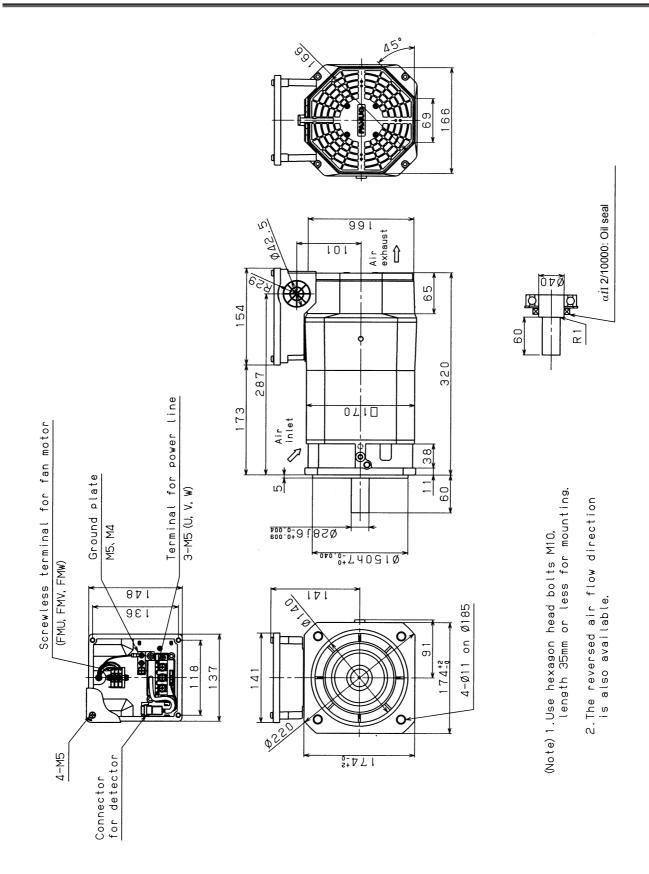
## 8.5 MODEL $\alpha i$ I 1.5/20000 (FLANGE MOUNTING TYPE)



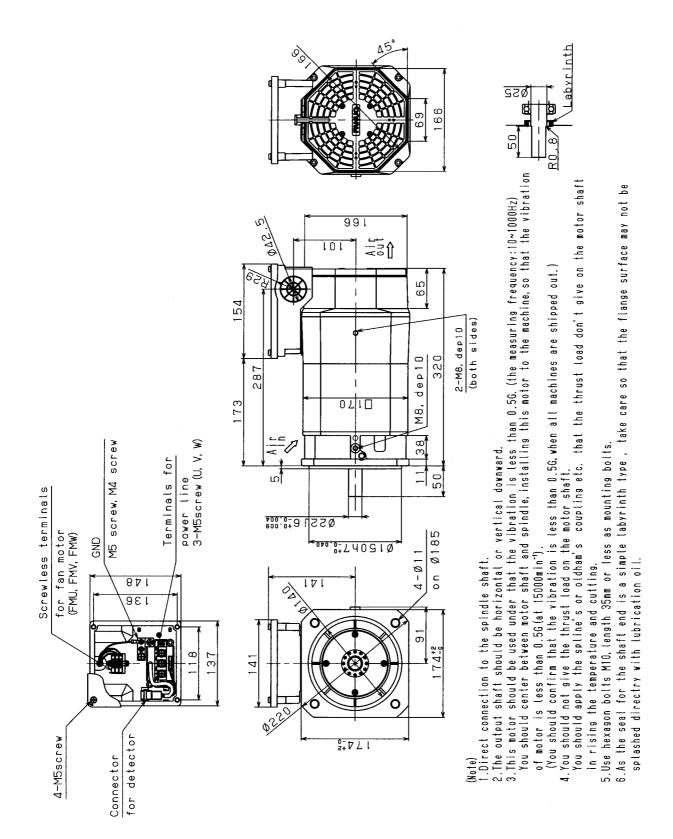
## 8.6 MODEL $\alpha i$ I 1.5/10000 (FOOT MOUNTING TYPE)



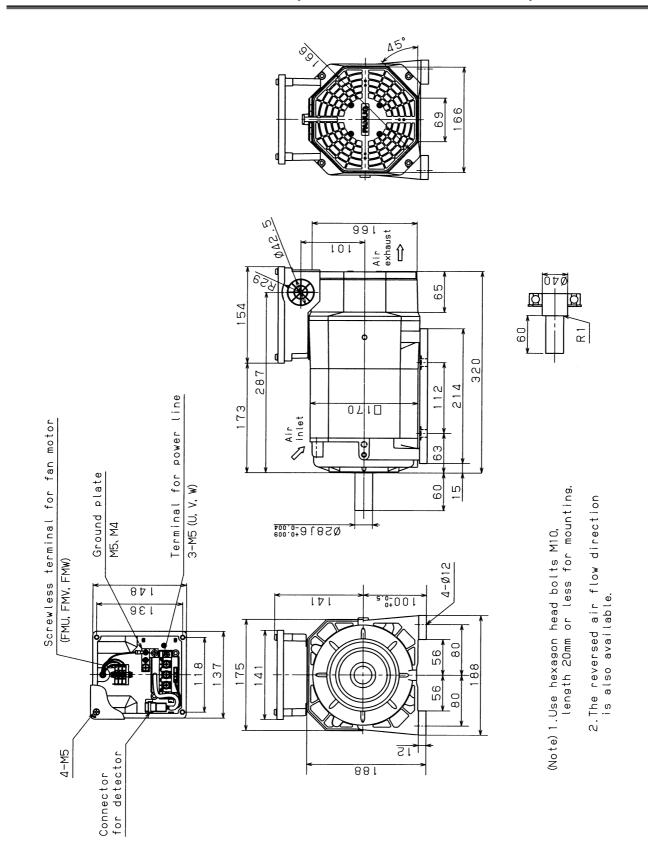
## 8.7 MODEL $\alpha i$ I 2/10000 (FLANGE MOUNTING TYPE)



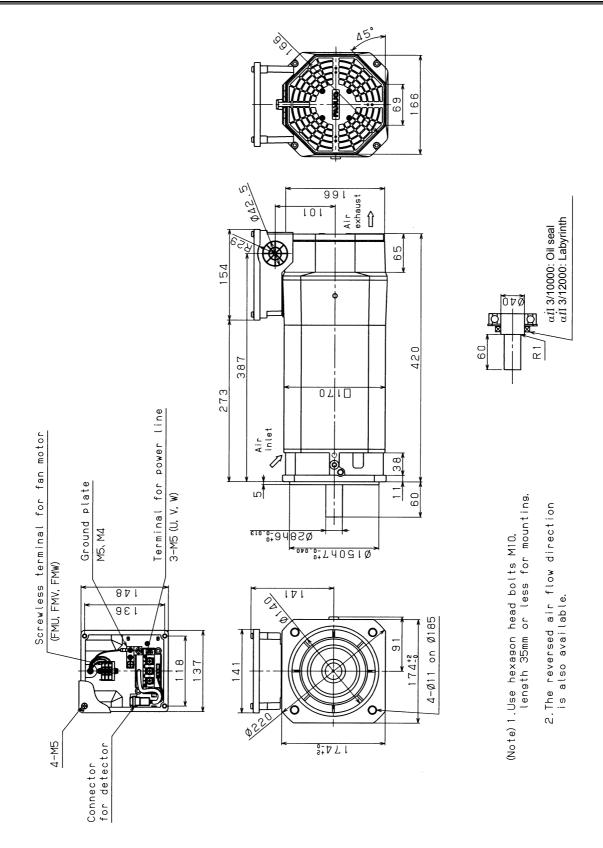
## 8.8 MODEL $\alpha i$ I 2/20000 (FLANGE MOUNTING TYPE)



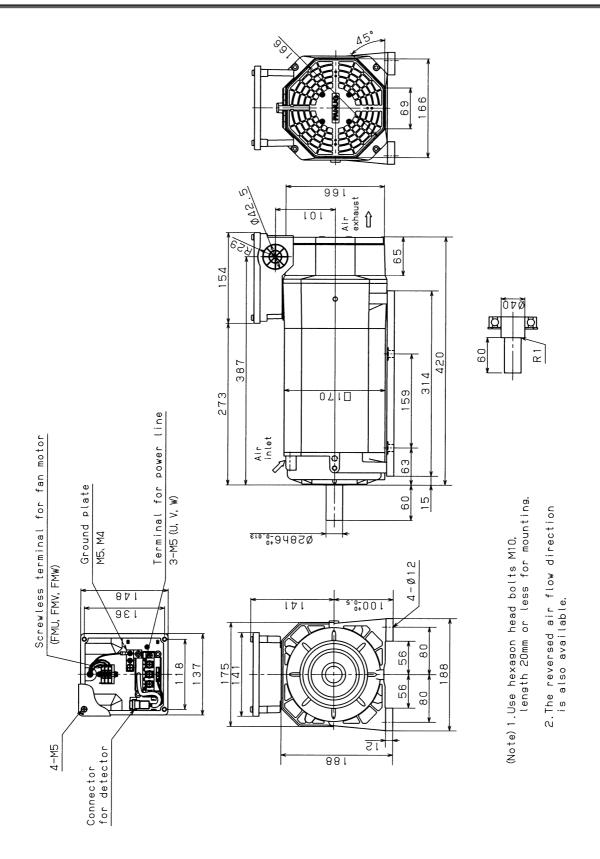
## 8.9 MODEL $\alpha i$ I 2/10000 (FOOT MOUNTING TYPE)



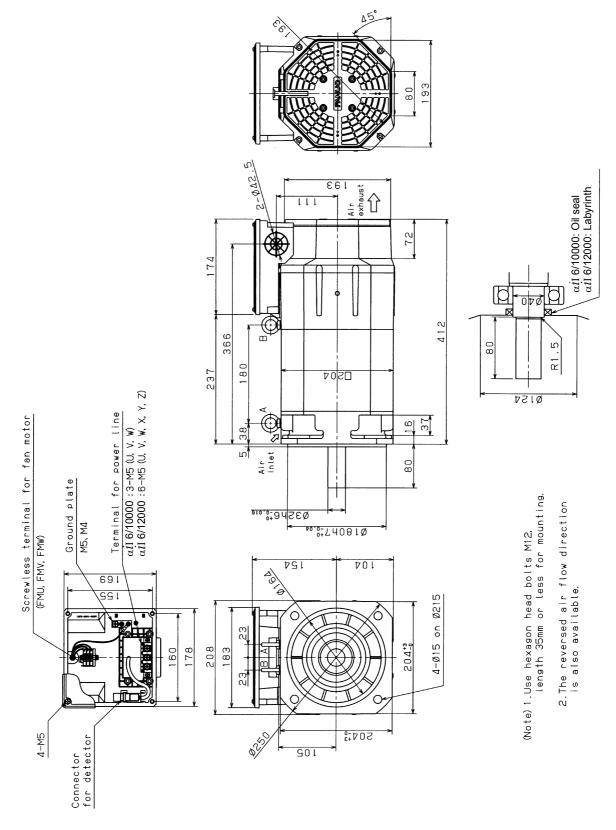
# **8.10** MODELS $\alpha i$ I 3/10000 AND $\alpha i$ I 3/12000 (FLANGE MOUNTING TYPE)



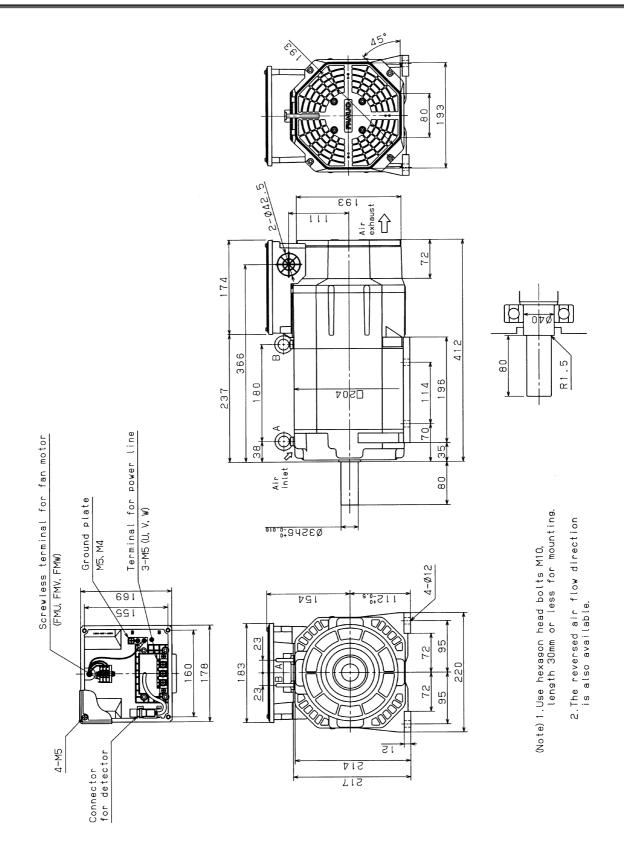
## **8.11** MODEL $\alpha i$ I 3/10000 (FOOT MOUNTING TYPE)



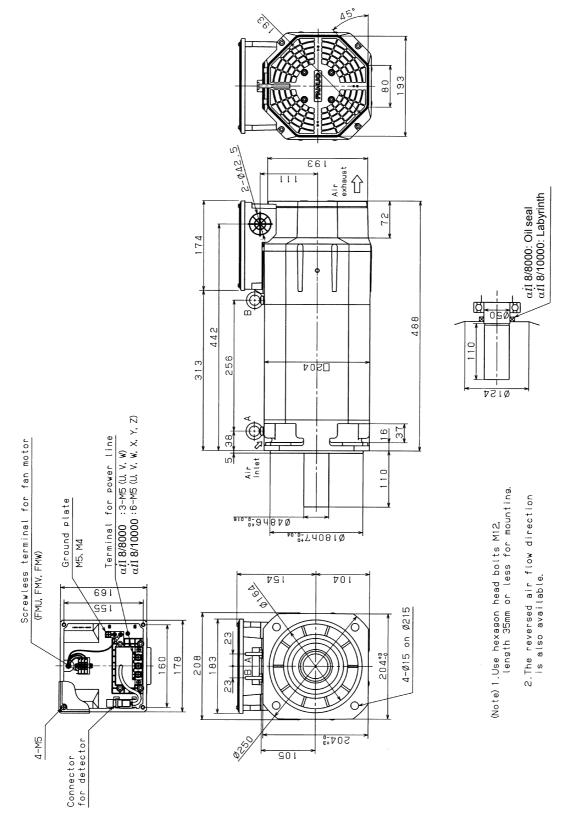
# **8.12** MODELS $\alpha i$ I 6/10000 AND $\alpha i$ I 6/12000 (FLANGE MOUNTING TYPE)



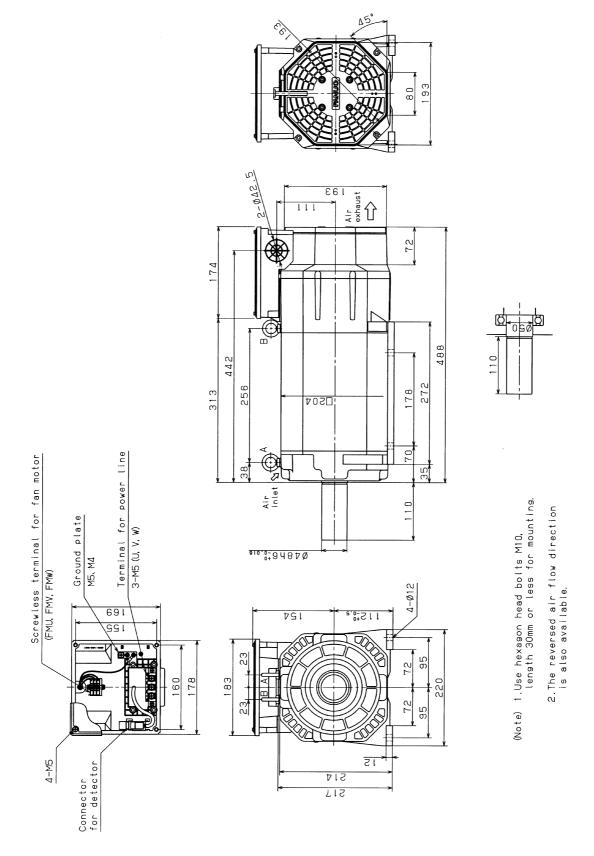
## 8.13 MODEL $\alpha i$ I 6/10000 (FOOT MOUNTING TYPE)



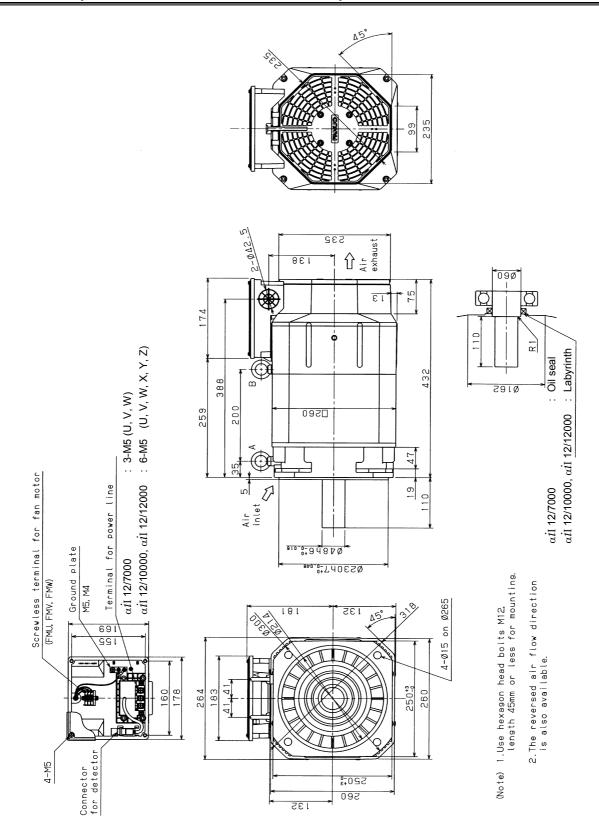
# **8.14** MODELS $\alpha i$ I 8/8000 AND $\alpha i$ I 8/10000 (FLANGE MOUNTING TYPE)



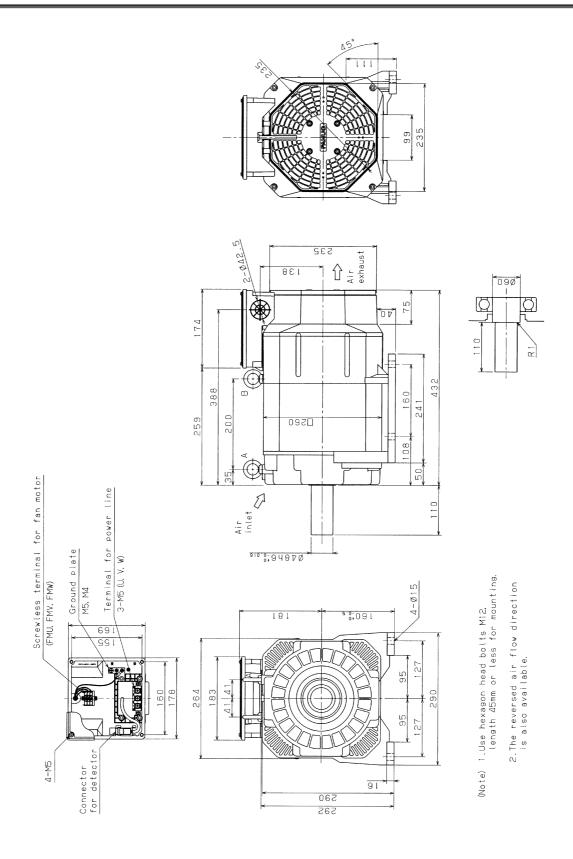
## 8.15 MODEL $\alpha i$ I 8/8000 (FOOT MOUNTING TYPE)



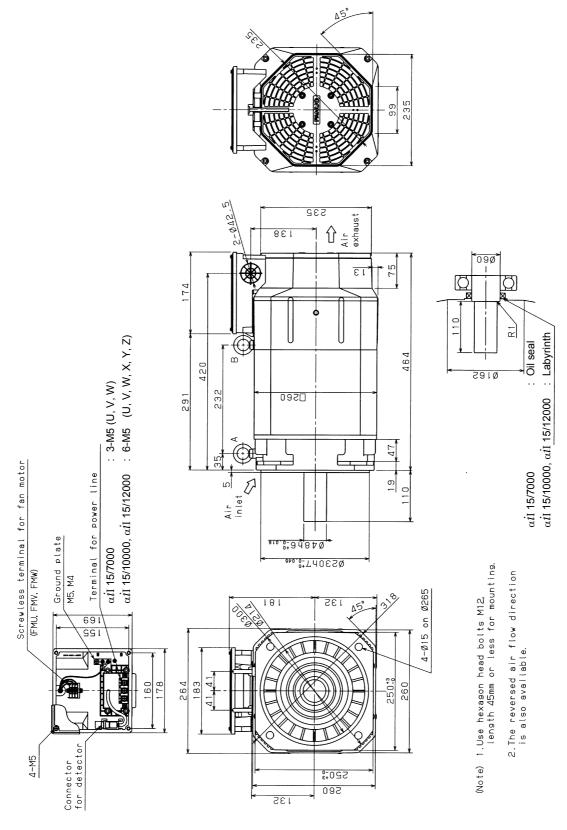
## 8.16 MODELS $\alpha i$ I 12/7000, $\alpha i$ I 12/10000, AND $\alpha i$ I 12/12000 (FLANGE MOUNTING TYPE)



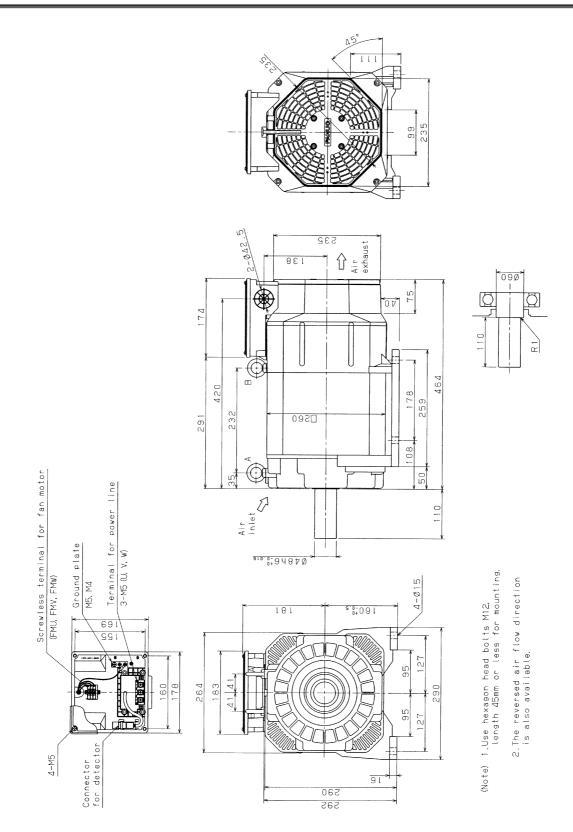
## 8.17 MODEL $\alpha i$ I 12/7000 (FOOT MOUNTING TYPE)



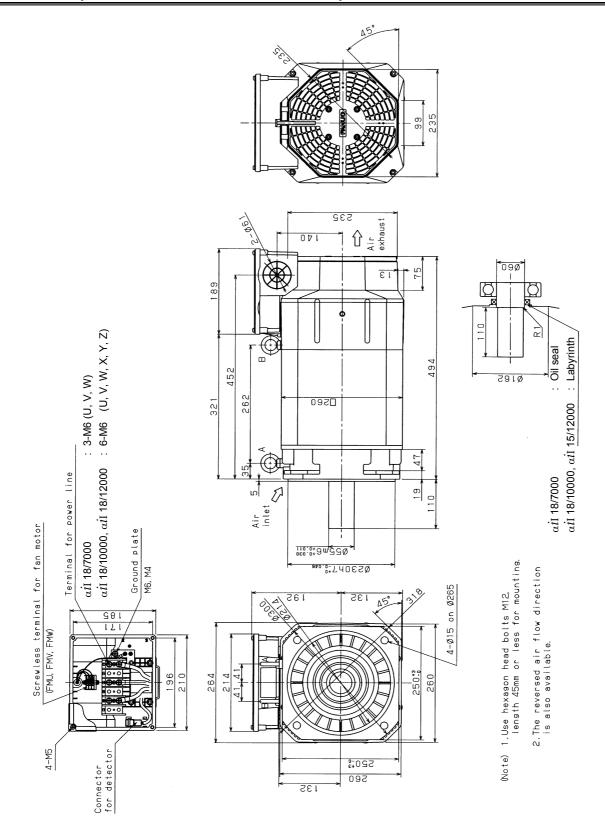
## 8.18 MODELS $\alpha i$ I 15/7000, $\alpha i$ I 15/10000, AND $\alpha i$ I 15/12000 (FLANGE MOUNTING TYPE)



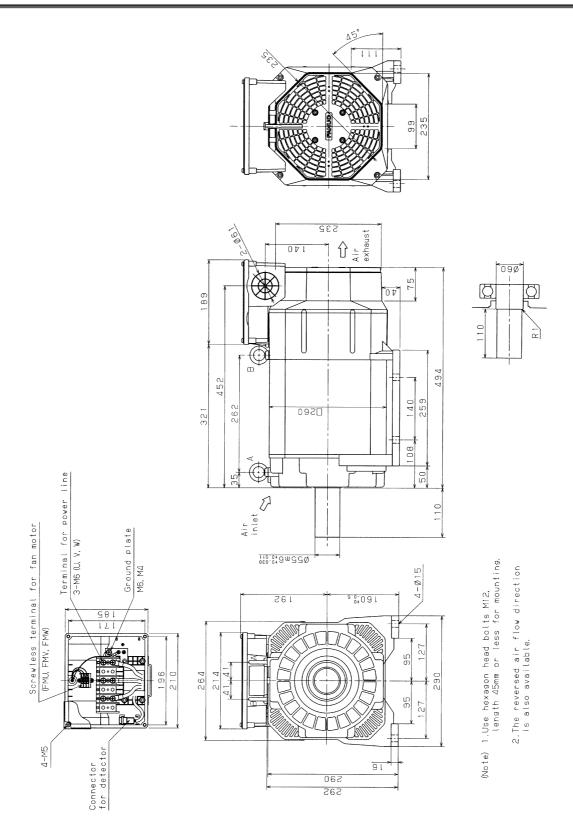
## 8.19 MODEL $\alpha i$ I 15/7000 (FOOT MOUNTING TYPE)



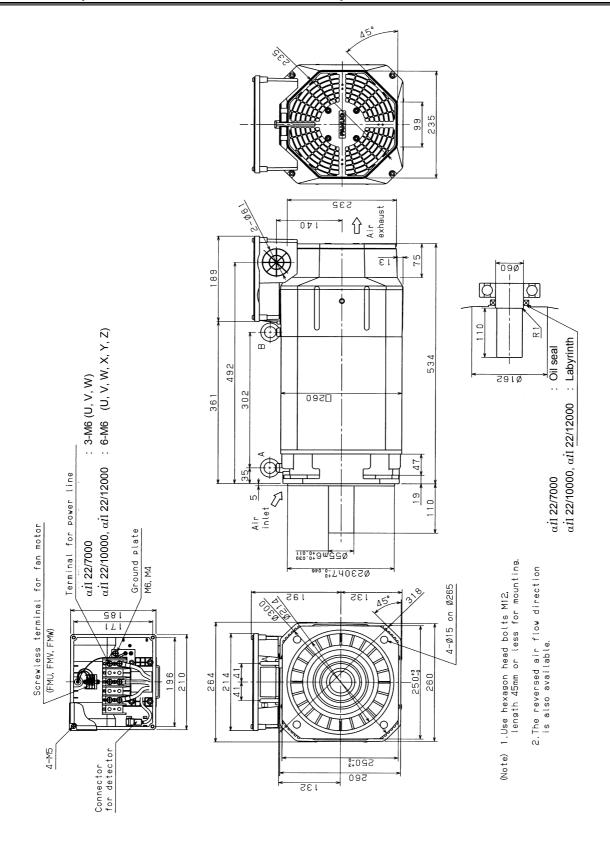
# **8.20** MODELS $\alpha i$ I 18/7000, $\alpha i$ I 18/10000, AND $\alpha i$ I 18/12000 (FLANGE MOUNTING TYPE)



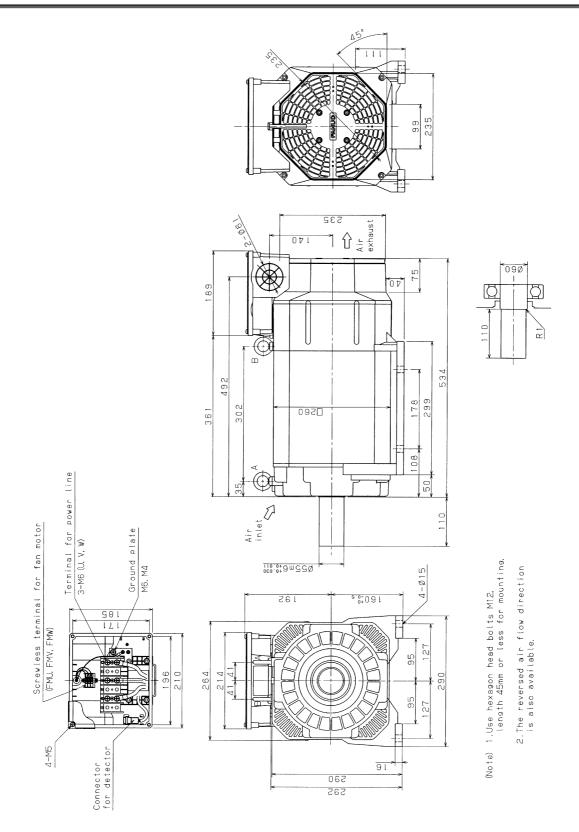
## **8.21** MODEL $\alpha i$ I 18/7000 (FOOT MOUNTING TYPE)



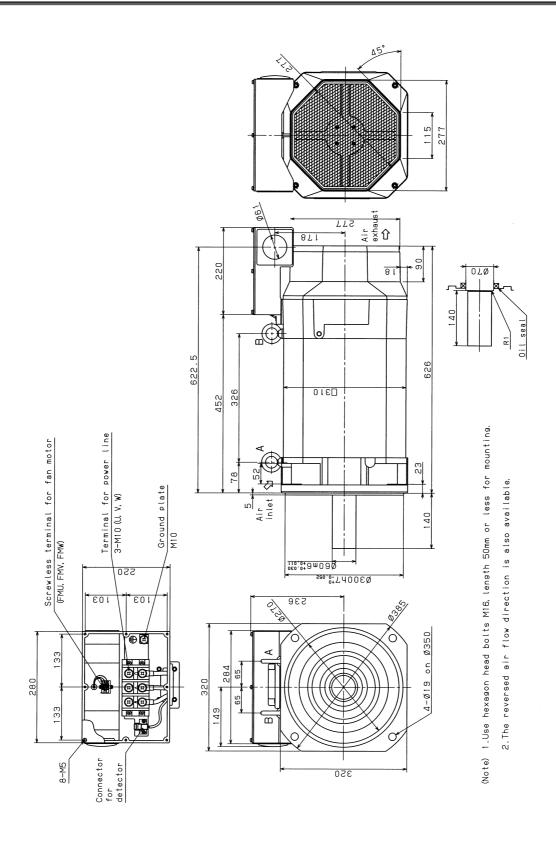
# 8.22 MODELS $\alpha i$ I 22/7000, $\alpha i$ I 22/10000, AND $\alpha i$ I 22/12000 (FLANGE MOUNTING TYPE)



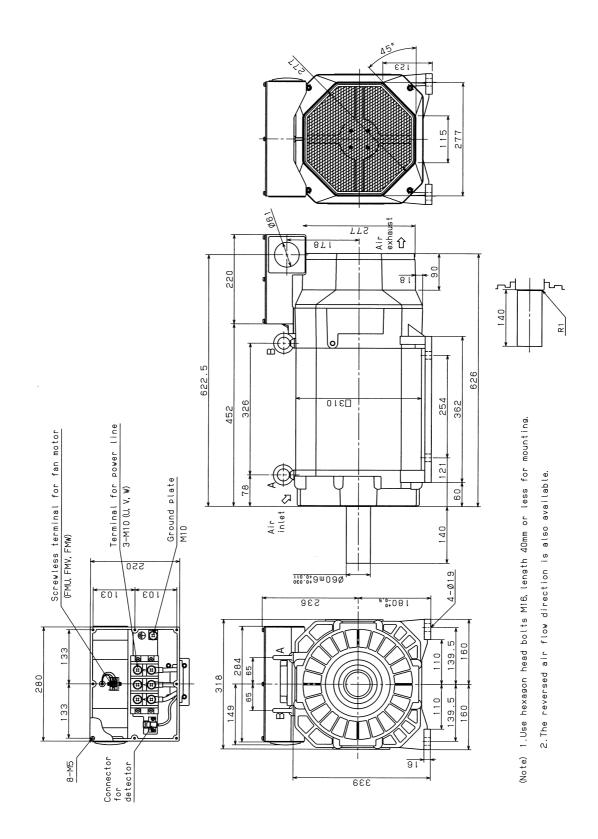
## 8.23 MODEL $\alpha i$ I 22/7000 (FOOT MOUNTING TYPE)



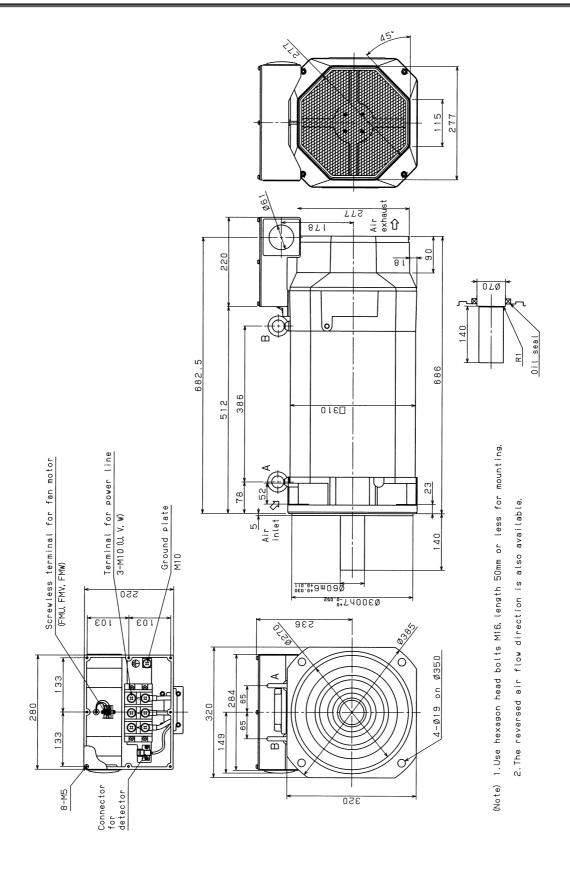
## **8.24** MODEL $\alpha i$ I 30/6000 (FLANGE MOUNTING TYPE)



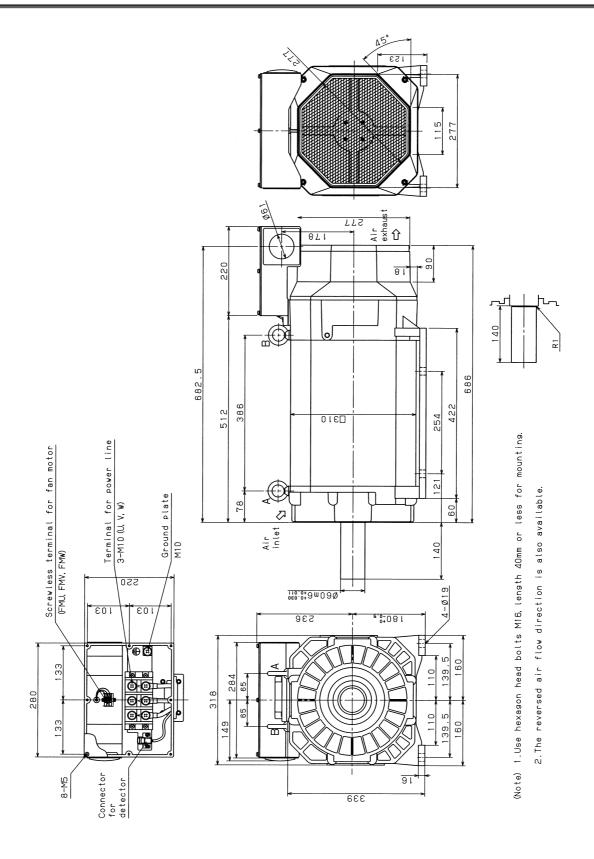
## **8.25** MODEL $\alpha i$ I 30/6000 (FOOT MOUNTING TYPE)



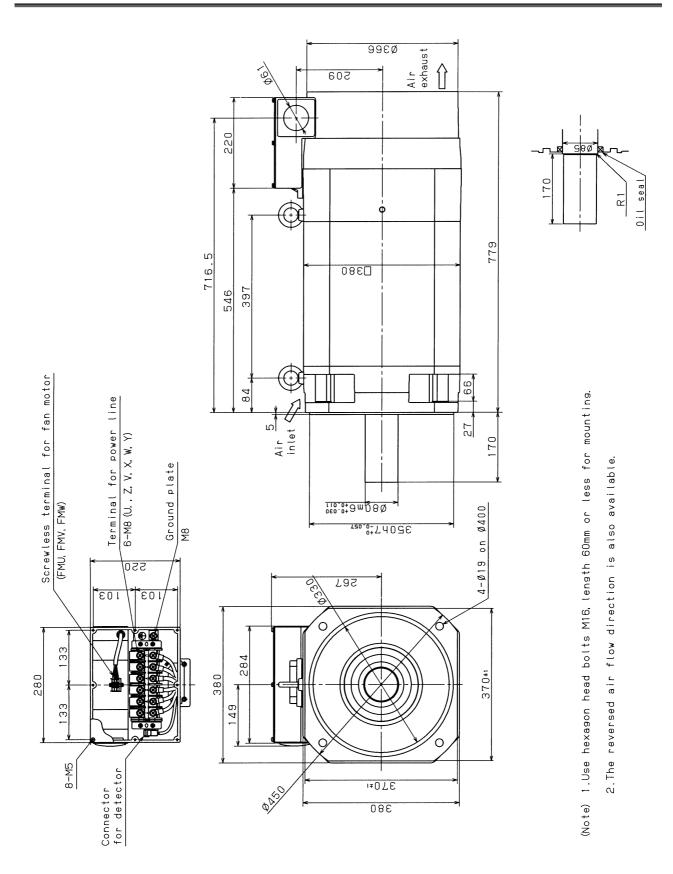
## **8.26** MODEL $\alpha i$ I 40/6000 (FLANGE MOUNTING TYPE)



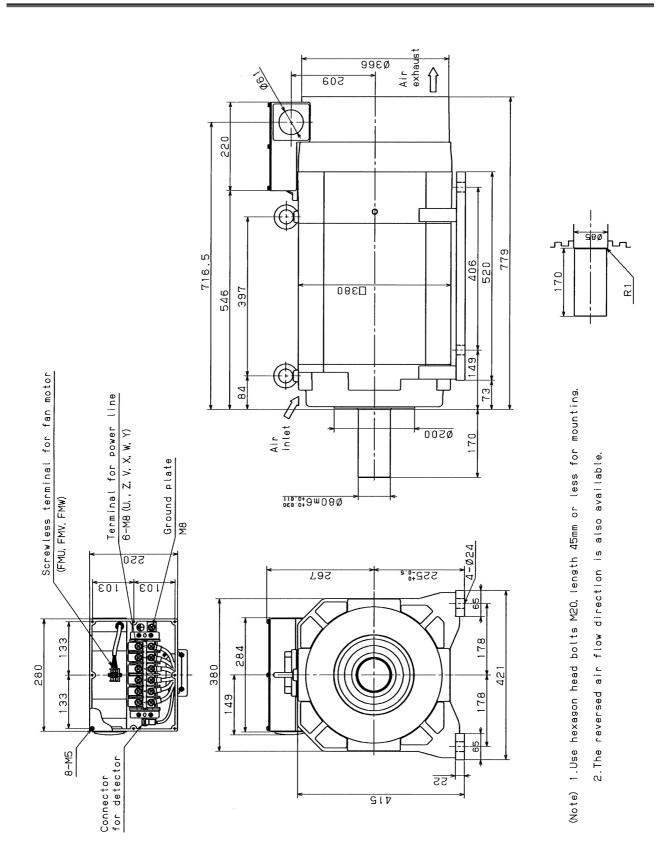
## **8.27** MODEL $\alpha i$ I 40/6000 (FOOT MOUNTING TYPE)



## 8.28 MODEL $\alpha i$ I 50/4500 (FLANGE MOUNTING TYPE)



## **8.29** MODEL $\alpha i$ I 50/4500 (FOOT MOUNTING TYPE)



# III. FANUC AC SPINDLE MOTOR $\alpha \emph{i}$ I series 400V type

## 1

#### **GENERAL**

The FANUC AC spindle motor  $\alpha iI$  series 400V type includes standard spindle motors for CNC machine tool spindles, which can be driven by 400 to 480VAC without a step-down transformer<sup>(\*1)</sup>.

(\*1) For models  $\alpha iI$  1HV,  $\alpha iI$  1.5HV,  $\alpha iI$  2HV, and  $\alpha iI$  3HV, however, a single-phase step-down transformer for fan motors is required when 480VAC is applied.

#### **Features**

- The motor is compact, light-weight and furnished with digital control for much higher performance.
- The motor inertia of the AC spindle motor is made smaller to shorten the acceleration/deceleration speed. Further, optimum control enables highly efficient cutting.
- The built-in  $\alpha iM$  sensor or  $\alpha iMZ$  sensor enables synchronous spindle and Z-axis feed and rigid tapping.
- Improvement in machining of the motor housing enhances the accuracy of the mounting part.
- Waterproof and pressure-proof design conforming to the international standard (IEC) is employed to improve reliability and make it resistant to most environments.

## **SPECIFICATIONS**

	Series	lpha iI series 400V type				
Item	Model	lpha iI 0.5/10000HV	lpha iI 1/10000HV	αiΙ 1.5/10000HV		
	Cont. rated kW	0.55	1.5	1.1		
	(HP)	(0.74)	(2.0)	(1.5)		
	30 min rated kW	1.1	2.2	3.7		
Output	[15 min, 10min]					
(*2)	(*3) (HP)	(1.5)	(3.0)	(5.0)		
	S3 60% kW	1.1	2.2	3.7		
	[40%,25%] (*4)(*5) (HP)	(1.5)	(3.0)	(5.0)		
	Cont. rated	4	5	(3.0)		
Rated current A	30 min rated (*3)			·		
(*6)	S3 60% (*4)	5	7	14		
Speed	Base speed	3000	3000	1500		
min <sup>-1</sup>	Max. speed	10000	10000	10000		
	Output torque					
(Cont. rated torq	ue at const. rated torque range)	1.75	4.77	7.00		
	N⋅m	(17.9)	(48.7)	(71.4)		
	(kgf⋅cm)	0.000.40	0.000	0.0040		
Rotor inertia	kg·m <sup>2</sup>	0.00048	0.003	0.0043		
10/0:	kgf·cm·s <sup>2</sup>	0.0048 7	0.03 18	0.04		
Wei	ght kgf Vibration	1	V5 (option V3)	24		
	Noise		75dB(A) or less			
		Totally enclosed and				
Coolir	ng system (*7)	non-ventilated IC0A0	Totally enclosed and fan cooled IC0A6			
Cod	oling fan W	None (*13)				
Insta	allation (*8)	Mount the motor so that the output shaft points in a direction ranging within 45° degrees above the horizontal to vertically downwards.  IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5				
Allowable over	erload capacity (1 min) (*9)	120 % of 30 min rated output				
	Insulation	Class H				
Am	nbient temperature	0 to 40°C				
	Altitude	Height above sea level not exceeding 1000m				
	Painting color	Munsell system N2.5				
	Sensor	lpha iM sensor or $lpha i$ MZ sensor				
Type of	thermal protection (*10)	TP211				
Resolution of t	the $lpha i$ MZ sensor /rev.	2048				
Number of de	tected gear teeth per rotation					
	λ/rev.	64	12			
	earing lubrication	-	Grease	+		
Maximum ou	tput during acceleration(*11) kW	1.32	2.64	4.44		
Applic	cable spindle amplifier		lpha iSP 5.5HV			
	Model	α <i>İ</i> I 0.5/10000HV	α <i>ἱ</i> Ι 1/10000HV	α <i>İ</i> I 1.5/10000HV		

	Series	$lpha \dot{i}$ I series 400V type				
Item	Model	α <i>i</i> Ι 2/10000HV	α <i>i</i> Ι 3/10000HV	α <i>i</i> Ι 6/10000HV	α <i>ἱ</i> Ι 8/8000HV	
	Cont. rated kW (HP)	2.2 (3.0)	3.7 (5.0)	5.5 (7.4)	7.5 (10)	
	30 min rated kW	3.7	5.5	7.5	11	
Output	[15 min, 10min]					
(*2)	(*3) (HP)	(5.0)	(7.4)	(10)	(14.7)	
	S3 60% kW [40%,25%]	3.7	5.5	7.5	11	
	(*4)(*5) (HP)	(5.0)	(7.4)	(10)	(14.7)	
Rated current A	Cont. rated	10	11	20	21	
(*6)	30 min rated (*3) S3 60% (*4)	15	14	26	28	
Speed	Base speed	1500	1500	1500	1500	
min <sup>-1</sup>	Max. speed	10000	10000	10000	8000	
(Cont. rated torq	Output torque que at const. rated torque range) N·m (kgf·cm)	14.0 (143)	23.5 (240)	35.0 (357)	47.7 (487)	
Rotor inertia	kg·m <sup>2</sup>	0.0078	0.0148	0.0179	0.0275	
Rotor mertia	kgf·cm·s <sup>2</sup>	0.08	0.15	0.18	0.28	
Wei	ght kgf	27	46	51	80	
	Vibration		V5 (opt	tion V3)		
	Noise	75dB(A) or less				
	ng system (*7)	Totally enclosed and fan cooled IC0A6				
Cod	oling fan W	(*13)				
Insta	allation (*8)	Mount the motor so that the output shaft points in a direction ranging within 45° degrees above the horizontal to vertically downwards.  IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5				
Allowable over	erload capacity (1 min) (*9)	120 % of 30 min rated output				
	Insulation			ss H		
An	nbient temperature	0 to 40°C				
	Altitude	Height above sea level not exceeding 1000m				
	Painting color	Munsell system N2.5				
	Sensor			r $\alpha i$ MZ sensor		
	thermal protection (*10)			211 I		
	the $\alpha i$ MZ sensor /rev.	20	)48	40	96	
Number of de	etected gear teeth per rotation λ/rev.	1:	28	25	56	
	earing lubrication		Gre	ase		
Maximum ou	tput during acceleration(*11) kW	4.44	6.6	9.0	13.2	
Applic	cable spindle amplifier	α <i>İ</i> SP	5.5HV	lpha iSP	11HV	
	Model	α <i>İ</i> I 2/10000HV	α <i>İ</i> I 3/10000HV	α <i>İ</i> I 6/10000HV	α <i>İ</i> I 8/8000HV	

	Series		lpha iI series	400V type		
Item	Model	α <i>ἱ</i> Ι <b>12/7000HV</b>	α <i>i</i> Ι <b>15/7000HV</b>	α <i>i</i> I 22/7000HV	α <i>i</i> Ι 30/6000HV	
	Cont. rated kW	11	15	22	30	
<b> </b>	(HP)	(14.7)	(20.1)	(29.5)	(40.2)	
	30 min rated kW	15	18.5	26	37	
-	Output [15 min, 10min]					
(*2)	(*3) (HP)	(20.1)	(24.8)	(34.9)	(49.6)	
	S3 60% kW	15	18.5	26	37	
	[40%,25%]					
	(*4)(*5) (HP)	(20.1)	(24.8)	(34.9)	(49.6)	
Rated	Cont. rated	27	37	50	68	
current A	30 min rated (*3)	33	45	57	81	
(*6)	S3 60% (*4)		10	0,	01	
Speed	Base speed	1500	1500	1500	1150	
min <sup>-1</sup>	Max. speed	7000	7000	7000	6000	
	Output torque					
(Cont. rated t	orque at const. rated torque range)	70.0	95.4	140.0	249.1	
	N⋅m	(714)	(974)	(1428)	(2540)	
	(kgf⋅cm)					
Rotor inertia	kg·m <sup>2</sup>	0.07	0.09	0.128	0.295	
	kgf·cm·s <sup>2</sup>	0.77	0.93	1.29	3.0	
V	Veight kgf	95	110	143	250	
	Vibration		V5 (opt			
	Noise	75dB(A) or less				
Co	ooling system (*7)	Totally enclosed and fan cooled IC0A6				
(	Cooling fan W					
In	nstallation (*8)	Mount the motor so that the output shaft points in a direction ranging within 45° degrees above the horizontal to vertically downwards.				
		IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5				
Allowable	overload capacity (1 min) (*9)	120 % of 30 min rated output				
	Insulation	Class H				
	Ambient temperature	0 to 40°C				
	Altitude	Height above sea level not exceeding 1000m				
	Painting color	Munsell system N2.5				
	Sensor	lpha iM sensor or $lpha i$ MZ sensor				
Туре	of thermal protection (*10)	TP211				
Resolution	of the $\alpha i$ MZ sensor /rev.	4096				
Number of	detected gear teeth per rotation $\lambda$ /rev.	256				
	Bearing lubrication		Gre	ase		
Maximum	output during acceleration(*11) kW	18.0	22.2	31.2	44.4	
Ap	plicable spindle amplifier	$\alpha i$ SP 15HV	lpha iSP	30HV	$\alpha i$ SP 45HV	
-	Model	α <i>İ</i> I 12/7000HV	α <i>İ</i> I 15/7000HV	α <i>İ</i> I 22/7000HV	α <i>i</i> I 30/6000HV	

	Series		lpha iI series 400V type				
	_				α <i>i</i> I <b>100/4000HV</b> (*1)		
Item		Model	α <i>i</i> Ι <b>40/6000HV</b>	α <i>i</i> I 60/4500HV	Low-speed winding (Y connection)	High-speed winding (∆ connection)	
	Cont. rated	kW	37	60	100	100	
	Cont. rated	(HP)	(49.6)	(80.4)	(134.0)	(134.0)	
<b>l</b>	30 min rated	kW	45	75	( 2 2 /	( /	
Output		(HP)	(60.3)	(100.5)	-	-	
(*2)	S3 60%	kW	,				
	[40%]		45 (60.3)	75 (100.5)	-	-	
	(*4)(*5)	(HP)	(00.3)	(100.5)			
Rated	Cont. rat	ted	84	138	159	170	
current A	30 min ra		97	163	_	_	
(*6)	S3 60%	6					
		Cont. rated	1500	1380	1000	2000	
Speed	Base speed	30 min rated	1500	1150	-	-	
min <sup>-1</sup>		120 min rated	-	1150	-	-	
	Max. spe	ed	6000	4500	3000	4000	
	Output torque						
(Cont. rated to	orque at const. rated	torque range)	235.5	415.1	955	477	
	N·m		(2402)	(4234)	(9738)	(4869)	
	(kgf⋅cm) kg⋅m²		0.255	0.40	0.98		
Rotor inertia	kgf-cm-		0.355 3.6	0.49 5.0	10		
V			290	468	820		
Weight kgf			V5	V10	0.	20	
	Vibration		(option V3)	(option V5)	V	10	
	Noise		75dB(A) or less	(000011 10)	80dB(A) or less		
Co		(*7)	` '	tally enclosed and		46	
		N	180 Circumference fan motor : 84> Rear fan motor : 84				
			Mount the motor	so that the output	shaft points in a	direction ranging	
In	stallation (	*8)	within 45° degrees above the horizontal to vertically downwards.				
		•	IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5				
Allowable	overload capacity (1	min) (*9)	120 % of 30 min rated output 120 % of continuous rated outp				
	Insulation			Clas	s H		
	Ambient temperature	Э	0 to 40°C				
	Altitude		Height above sea level not exceeding 1000m				
	Painting color		Munsell system N2.5				
Sensor			lpha iM sensor or $lpha i$ MZ sensor $lpha i$ MZ sensor				
Type of thermal protection (*10)			TP211				
Resolution of the $\alpha i$ MZ sensor /rev.			4096				
Number of detected gear teeth per rotation $\lambda$ /rev.				25	66		
Bearing lubrication				Grea	ase		
Maximum	output during accele	eration(*11)	54	90		17	
Ap	plicable spindle amp	lifier	$\alpha i$ SP 45HV	$\alpha i$ SP 75HV	αiSP	75HV	
-	Model		α <i>İ</i> I 40/6000HV	α <i>İ</i> I 60/4500HV		/4000HV	
				5 55, 155011V	WH 100/	. 5 0 0 . 1 7	

- (\*1) For αiI 100/4000HV, the CNC soft option and switching magnetic contactor unit associated with the output switch function (Y-Δ switch) are required.
  - See FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN) for details of the output switch control.
- (\*2) The rated output is guaranteed at the rated voltage. (Amplifier input:
  - $\alpha i I \ 100/4000 HV : 460/480 VAC + 10\% 0\%, 50/60 \ Hz \pm 1 Hz$  Models except  $\alpha i I \ 100/4000 HV : 400/480 VAC + 10\% 15\%,$
  - If the input voltage fluctuates, it is possible that the rated output cannot be obtained even when such fluctuations are within the allowable fluctuation range.
- (\*3) The output for  $\alpha i$ I 0.5/10000HV,  $\alpha i$ I 1/10000HV, or  $\alpha i$ I 2/10000HV is 15 min rated. That for  $\alpha i$ I 1.5/10000HV is 10 min rated.
- (\*4) S3 40% for  $\alpha i$ I 0.5/10000HV,  $\alpha i$ I 30/6000HV, or  $\alpha i$ I 60/4500HV, S3 25% for  $\alpha i$ I 1.5/10000HV.
- (\*5) The cycle time is 10 minutes, S3 60%: ON 6 minutes, OFF 4 minutes, S3 40%: ON 4 minutes, OFF 6 minutes and S3 25%: ON 2.5 minutes, OFF 7.5 minutes.
- (\*6) The rated current is not a guaranteed value but a guideline for the maximum current at rated output.
- (\*7) IC code conforms to IEC 34-6.

 $50/60 \text{ Hz} \pm 1 \text{Hz}$ 

- (\*8) IM code conforms to IEC 34-7.
- (\*9) This is not a guaranteed value but a guideline for the maximum motor output at a rated supply voltage. 120% of 15 min rated for  $\alpha i I$  0.5/10000HV,  $\alpha i I$  1/10000HV, or  $\alpha i I$  2/10000HV, 120% of 10 min rated for  $\alpha i I$  1.5/10000HV, and 120% of continuous rated for  $\alpha i I$  100/40000HV.
- (\*10) Type conforms to IEC 34-11.
- (\*11) These values are to be used only as guidance for selecting a power supply ( $\alpha i$ PS) and are not guaranteed.
- (\*12) Degree of protection: with oil seal:IP54, without oil seal:IP40. Degree of protection ( $\alpha \dot{i}$ I 100/4000HV): with oil seal:IP40.
- (\*13) Input power supply voltage of a fan motor for  $\alpha i I$  1/10000HV,  $\alpha i I$  1.5/10000HV,  $\alpha i I$  2/10000HV, or  $\alpha i I$  3/10000HV is 200/230VAC +10% -15%, 50/60 Hz ±1Hz.

# 3

## **OUTPUT/TORQUE CHARACTERISTICS**

## Reference Calculation for torque

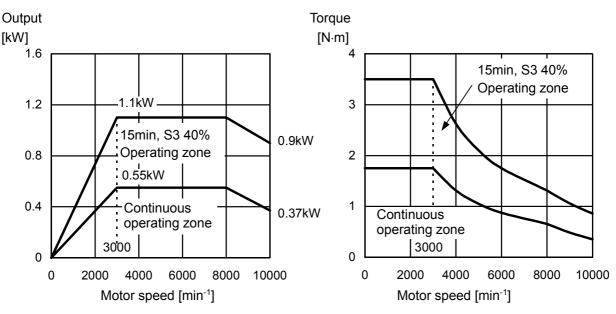
Torque T can be obtained by the following equation.

 $T[N \cdot m] = P[kW] \times 1000/0.1047/N[min^{-1}]$  P[kW]: Motor output  $N[min^{-1}]:$  Motor speed

When the unit of T is [kgf·m], T[kgf·m]= $P[kW]\times 1000/1.0269/N[min^{-1}]$ 

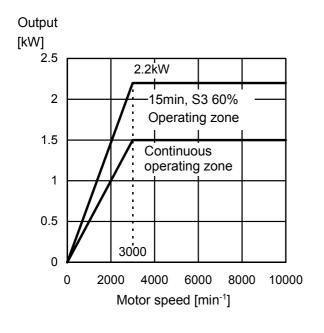
## **3.1** MODEL $\alpha i$ I 0.5/10000HV

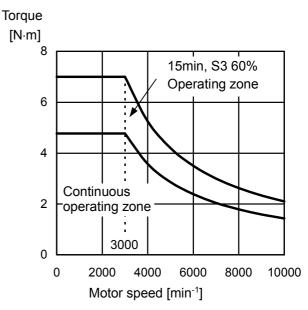
Applicable amplifier  $\alpha i$ SP 5.5HV



### 3.2 MODEL $\alpha i$ I 1/10000HV

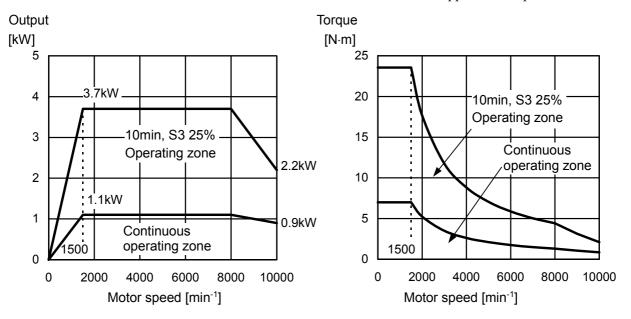
Applicable amplifier  $\alpha i$ SP 5.5HV





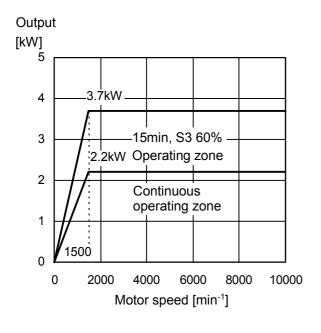
## **3.3** MODEL $\alpha i$ I 1.5/10000HV

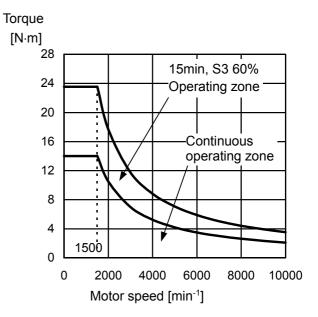
Applicable amplifier  $\alpha i$ SP 5.5HV



## 3.4 MODEL $\alpha i$ I 2/10000HV

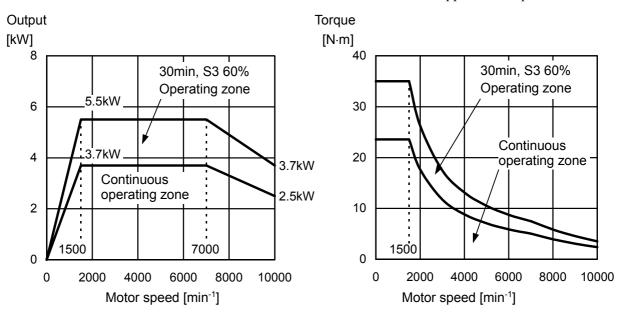
Applicable amplifier  $\alpha i$ SP 5.5HV





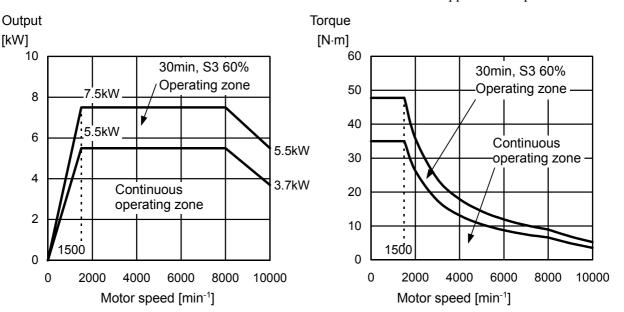
## 3.5 MODEL $\alpha i$ I 3/10000HV

Applicable amplifier  $\alpha i$ SP 5.5HV



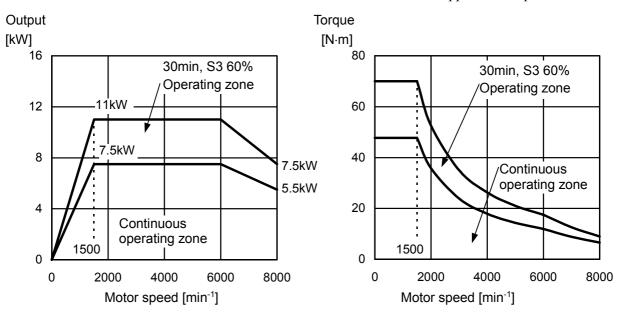
## **3.6** MODEL $\alpha i$ I 6/10000HV

Applicable amplifier  $\alpha i$ SP 11HV



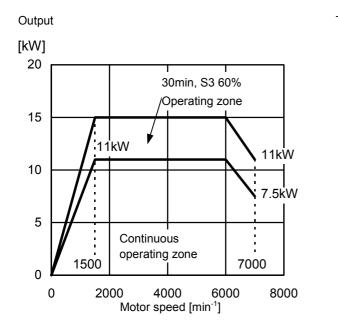
## **3.7** MODEL α*i*I 8/8000HV

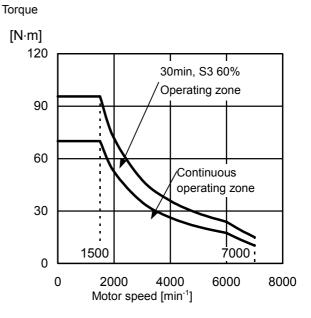
Applicable amplifier  $\alpha i$ SP 11HV



## **3.8** MODEL $\alpha i$ I 12/7000HV

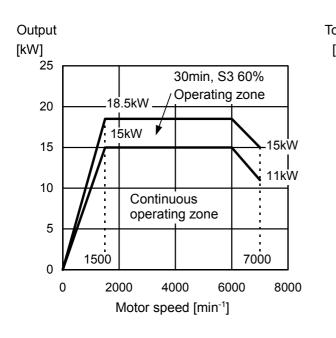
Applicable amplifier  $\alpha i$ SP 15HV

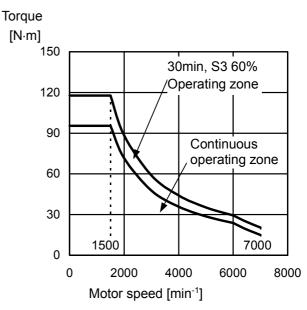




## **3.9** MODEL $\alpha i$ I 15/7000HV

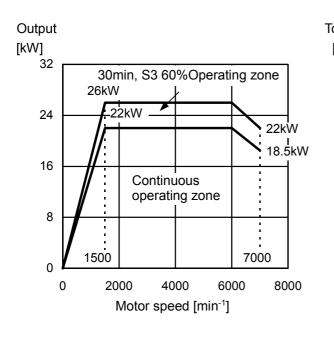
Applicable amplifier  $\alpha i$ SP 30HV

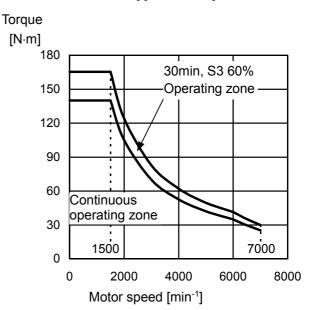




## **3.10** MODEL $\alpha i$ I 22/7000HV

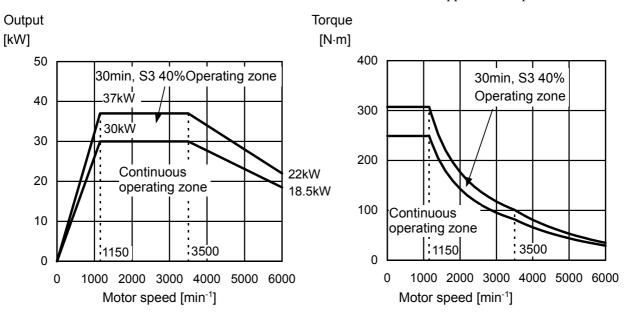
Applicable amplifier  $\alpha i$ SP 30HV





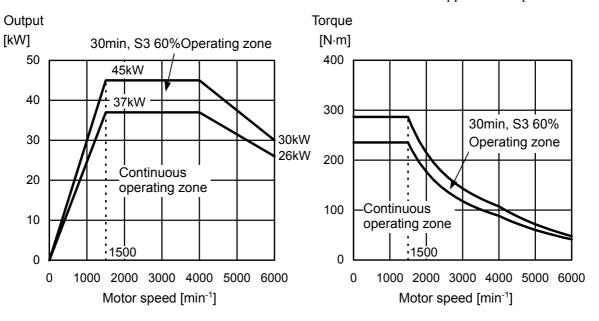
## **3.11** MODEL $\alpha i$ I 30/6000HV

Applicable amplifier  $\alpha i$ SP 45HV



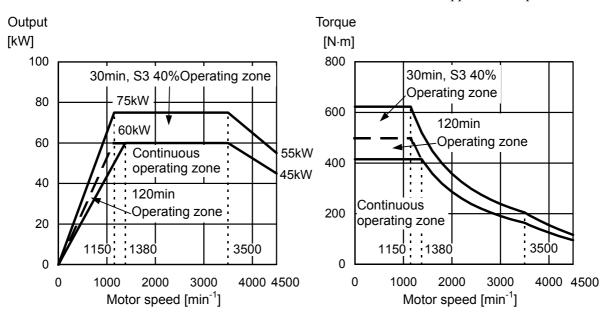
## **3.12** MODEL $\alpha i$ I 40/6000HV

Applicable amplifier  $\alpha i$ SP 45HV



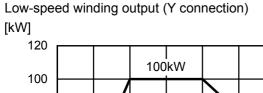
## **3.13** MODEL $\alpha i$ I 60/4500HV

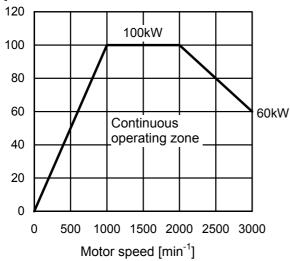
Applicable amplifier  $\alpha i$ SP 75HV



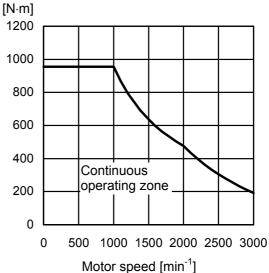
#### 3.14 MODEL $\alpha i$ I 100/4000HV

Applicable amplifier  $\alpha i$ SP 75HV

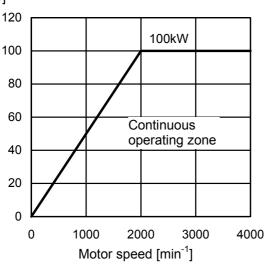




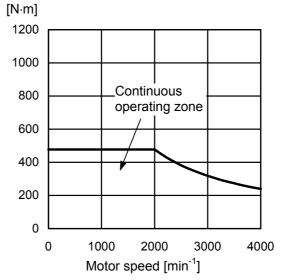
Low-speed winding torque (Y connection)



High-speed winding output (∆ connection) [kW]



High-speed winding torque ( $\Delta$  connection)

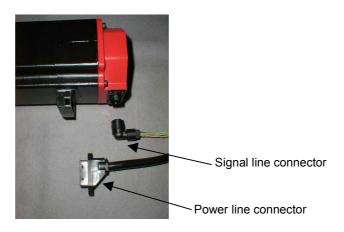


## **CONNECTIONS**

#### 4.1 MODEL $\alpha i$ I 0.5/10000HV

The power lead and signal lead are connected with the connector. Use the shield cable for the connection.

Refer to FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN) for other respects in the connection.



#### Connection of power lead

Connector parts related to cable side

	Ordering number	Tyco Electronics AMP specification
Connector kit of power lead	A06B-6114-K220/S (FANUC specification : A63L-0001-0875/SC)	1473063-2

Power lead specification

Number of core	Conductor size	Grounding cable cross-section	Sheath diameter (Note)
4 or more	AWG16 to 18	φ1.8 to 2.8mm	φ10.4 to 11.4mm

#### NOTE

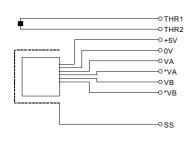
If the outer sheath diameter is inadequate, the waterproofness can degrade.

Connector pins arrangement

Connector	mis arrange	inent			
1	2	3	4	5	6
U	V	W	G	_	-

#### Connection of signal lead

### - For type with lpha iM sensor



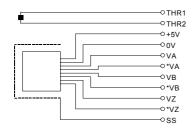
Connector parts related to cable side

	Japan Aviation Electronics Industry specification
	JN2xS10SL1-R: Applicable sheath diameter φ5.7 to 7.3
	JN2xS10SL2-R: Applicable sheath diameter φ6.5 to 8.0
Connector	$\uparrow$
	D:Straight plug
	F:Elbow plug
Terminal	JN1-22-22S

Connector pins arrangement

		. 0					
	•	1	2	2		3	
	*\	/A	*\	/B		-	
4			5	6	6	7	,
V	Α	>	/B	-		0	<b>/</b>
	8	3	(	9	1	0	
	+5	5V	TH	R1	TH	IR2	
	4 V	4 VA	1 *VA	1 2 2 1 1 2 2 1 1 1 1 2 2 1 1 1 1 1 1 1	1 2 *VA *VB 4 5 6 VA VB -	1 2 *VA *VB 4 5 6 *VA VB - 8 9 1	1 2 3 *VA *VB -  4 5 6 7  VA VB - 0  8 9 10

#### - For type with lpha iMZ sensor



Connector parts related to cable side

	Japan Aviation Electronics Industry specification
Connector	JN2xS10SL1-R: Applicable sheath diameter φ5.7 to 7.3
	JN2xS10SL2-R: Applicable sheath diameter φ6.5 to 8.0
	<b>↑</b>
	D:Straight plug
	F:Elbow plug
Terminal	JN1-22-22S

Connector pins arrangement

	č						
	1		2		3		
	*\	/A	*\	/B *\		VΖ	
4		5 6		5 7		,	
VA \		V	/B V:		Z	0'	<b>V</b>
	8		9		10		
	+5V		THR1		THR2		

#### - Thermistor specification

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).

#### 4.2 MODELS lpha iI 1/10000HV TO lpha iI 100/4000HV

Cables of primary winding and fan motor are connected to the terminal block.

 $\alpha iM$  sensor or  $\alpha iMZ$  sensor signal or thermistor signal use a connector manufactured by Tyco Electronics AMP.

The connector housing and the connector are attached to the motor.

Size of screws used in	Power lead		Fan motor		
the terminal block	U,V,W,G	X,Y,Z	FMU,FMV,FMW	FMU,FMV	
$lpha\dot{i}$ I 1/10000HV to $lpha\dot{i}$ I 1.5/10000HV	M5	-	-	M4	
$lpha \dot{i}$ I 2/10000HV to $lpha \dot{i}$ I 3/10000HV	M5	ı	-	Screw-less terminal block	
lpha iI 6/10000HV to $lpha i$ I 22/7000HV	M5	i	Screw-less terminal block	-	
lpha iI 30/6000HV, $lpha i$ I 40/6000HV	M10	ı	Screw-less terminal block	-	
α <i>İ</i> I 60/4500HV	M10	-	M3.5	-	
α <i>İ</i> I 100/4000HV	M8	M8	M3.5	-	

#### Cable for the power lead

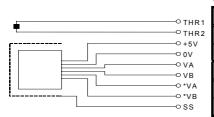
For the power lead cable specification, refer to "FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS (B-65282EN)".

#### Cable for the fan motor

For the fan motor current value and cable specifications, refer to Section I.4.3, "FAN MOTOR CONNECTION" in this manual.

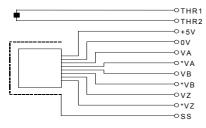
#### 4.3 **CONNECTION OF SIGNAL LEAD**

### Connector attachment for a motor with a built-in $\alpha iM$ sensor



Connector pins arrangement							
Number	B1	B2	В3	B4	B5	В6	
Color							
Signal		*VA	*VB		0V	THR2	
Number	A1	A2	A3	A4	A5	A6	
Color							
Signal	+5V	VA	VB		SS	THR1	

## Connector attachment for a motor with a built-in lpha iMZ sensor



Connector pins arrangement							
Number	B1	B2	В3	B4	B5	В6	
Color							
Signal		*VA	*VB	*VZ	0V	THR2	
Number	A1	A2	A3	A4	A5	A6	
Color							
Signal	+5V	VA	VB	VZ	SS	THR1	

#### - Connector housing and contact specifications

Connector and contact:

Tyco Electronics AMP specification D-3000 series

	Motors	side	Cable side			
	FANUC specification	Manufacture specification	FANUC specification	Manufacture specification		
Housing	A63L-0001-0535/121KDF	178964-6	A63L-0001-0460/121KD	178289-6		
Contact	A63L-0001-0456/ASMT	175288-2	A63L-0001-0456/ASM	1-175217-2		

Crimping tool: 91559-1 Extractor: 234168-1

#### - Thermistor specification

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).

5

### ALLOWABLE RADIAL LOAD

Use the motor output shaft below the allowable radial loads shown in the table below.

	Allowable radial load (kgf)			
Model	At output shaft end	At output shaft center		
α <i>İ</i> I 0.5/10000HV	294N (30kgf)	323N (33kgf)		
lpha iI 1/10000HV	392N (40kgf)	441N (45kgf)		
α <i>İ</i> I 1.5/10000HV	882N (90kgf)	980N (100kgf)		
lpha iI 2/10000HV	882N (90kgf)	999N (102kgf)		
lpha iI 3/10000HV	1470N (150kgf)	1607N (164kgf)		
lpha iI 6/10000HV	1960N (200kgf)	2205N (225kgf)		
α <i>İ</i> I 8/8000HV	2940N (300kgf)	3371N (344kgf)		
$lpha\dot{i}$ I 12/7000HV, $lpha\dot{i}$ I 15/7000HV	2940N (300kgf)	3410N (348kgf)		
lpha iI 22/7000HV	4410N (450kgf)	4988N (509kgf)		
$lpha\dot{i}$ I 30/6000HV, $lpha\dot{i}$ I 40/6000HV	5390N (550kgf)	6134N (626kgf)		
α <i>İ</i> I 60/4500HV	-	19600N (2000kgf)		
α <i>İ</i> I 100/4000HV	Direct connection to the spindle			

#### **NOTE**

- 1 When using a belt, adjust the tension so the allowable loads indicated above are not exceeded. If an excessive load is applied, consider the use of a support bearing on the machine side to maintain the long-term reliability of the motor. (If an excessive load is applied, it is possible that an abnormal sound may occur.)
- When the belt tension is maximized at a point outside the output shaft end, the allowable loads are less than those at the output shaft end.
- 3 If a thrust load is applied when a helical gear is used, the shaft moves in the direction of the thrust. So, as a general rule, never apply a thrust load.

# 6

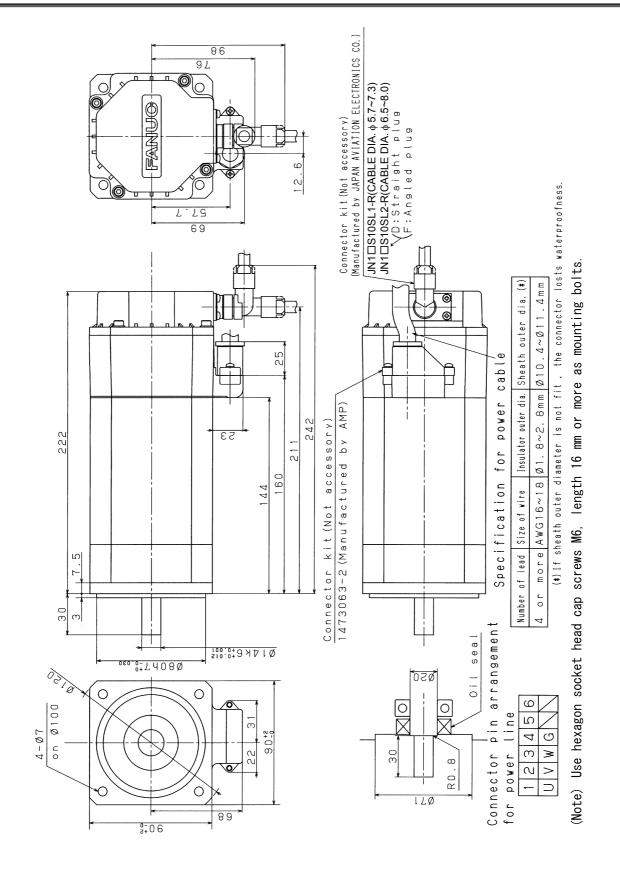
## **ASSEMBLING ACCURACY**

Model Item	lpha iI 0.5HV to $lpha i$ I 22HV	lpha iI 30HV to $lpha i$ I 60HV	α <i>ἱ</i> Ι 100HV	Measuring method
Run-out at the end of the output shaft	20μm or less	20μm or less	40μm or less	1/2 the output shaft length
Run-out of the faucet joint for mounting the flange against the core of the shaft (for flange type or foot flange type)	40μm or less	60μm or less	200μm or less	10
Run-out of the flange mounting surface against the core of the shaft (for flange type or foot flange type)	80μm or less	100μm or less	200μm or less	

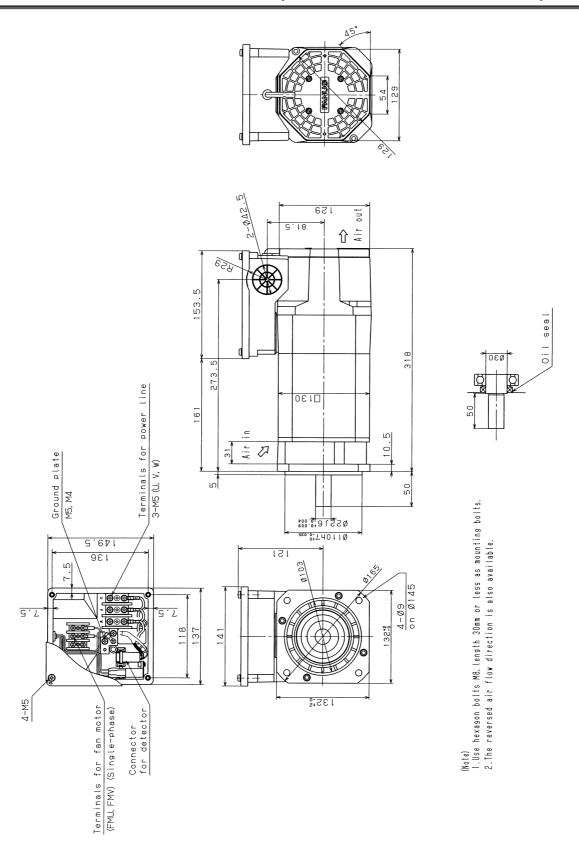
## **EXTERNAL DIMENSIONS**

Model name	Section
Model $lpha\dot{i} ext{I}$ 0.5/10000HV (flange mounting type)	7.1
Model αİΙ 1/10000HV (flange mounting type)	7.2
Model αiI 1/10000HV (foot mounting type)	7.3
Model αİΙ 1.5/10000HV (flange mounting type)	7.4
Model αİΙ 1.5/10000HV (foot mounting type)	7.5
Model αiI 2/10000HV (flange mounting type)	7.6
Model αİI 2/10000HV (foot mounting type)	7.7
Model αiI 3/10000HV (flange mounting type)	7.8
Model αİI 3/10000HV (foot mounting type)	7.9
Model αiI 6/10000HV (flange mounting type)	7.10
Model αiI 6/10000HV (foot mounting type)	7.11
Model αİI 8/8000HV (flange mounting type)	7.12
Model αİI 8/8000HV (foot mounting type)	7.13
Model αİΙ 12/7000HV (flange mounting type)	7.14
Model αİΙ 12/7000HV (foot mounting type)	7.15
Model αiI 15/7000HV (flange mounting type)	7.16
Model αİI 15/7000HV (foot mounting type)	7.17
Model αİI 22/7000HV (flange mounting type)	7.18
Model αİI 22/7000HV (foot mounting type)	7.19
Model αİI 30/6000HV (flange mounting type)	7.20
Model $\alpha i$ I 30/6000HV (foot mounting type)	7.21
Model $lpha i$ I 40/6000HV (flange mounting type)	7.22
Model $\alpha i$ I 40/6000HV (foot mounting type)	7.23
Model $lpha i I$ 60/4500HV (flange mounting type)	7.24
Model $lpha i$ I 60/4500HV (foot mounting type)	7.25
Model $lpha\dot{t}$ I 100/4000HV (foot flange mounting type)	7.26

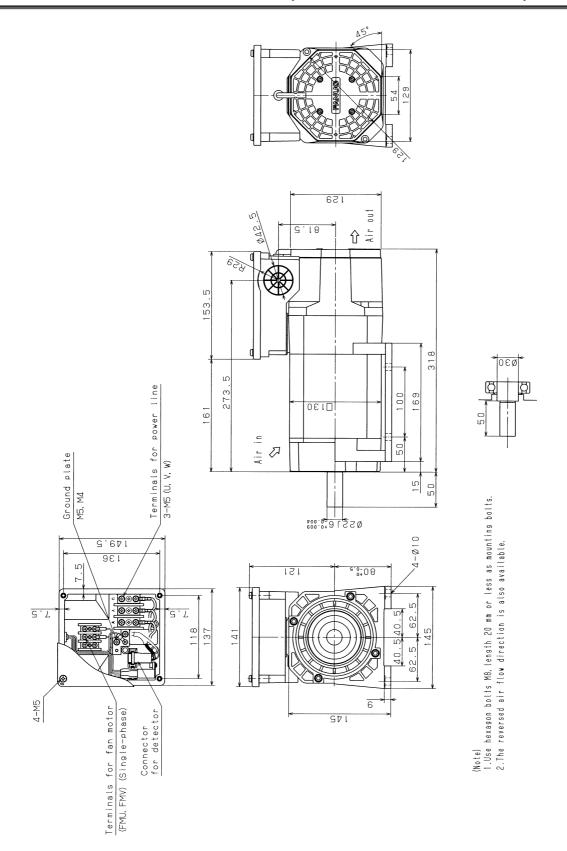
## 7.1 MODEL $\alpha i$ I 0.5/10000HV (FLANGE MOUNTING TYPE)



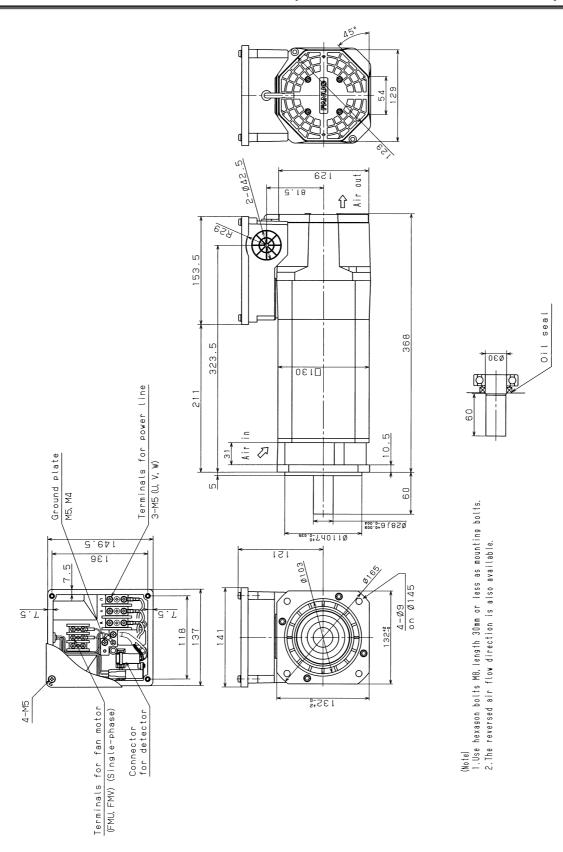
## 7.2 MODEL $\alpha i$ I 1/10000HV (FLANGE MOUNTING TYPE)



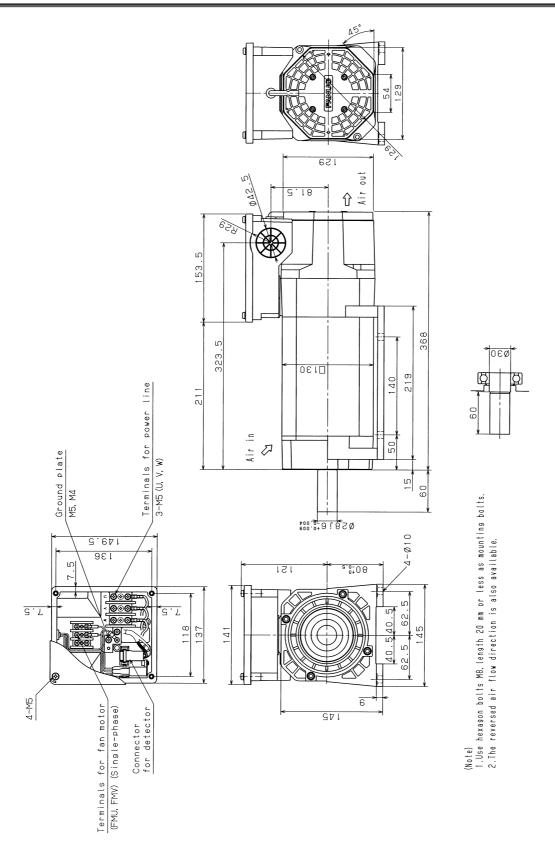
## 7.3 MODEL $\alpha i$ I 1/10000HV (FOOT MOUNTING TYPE)



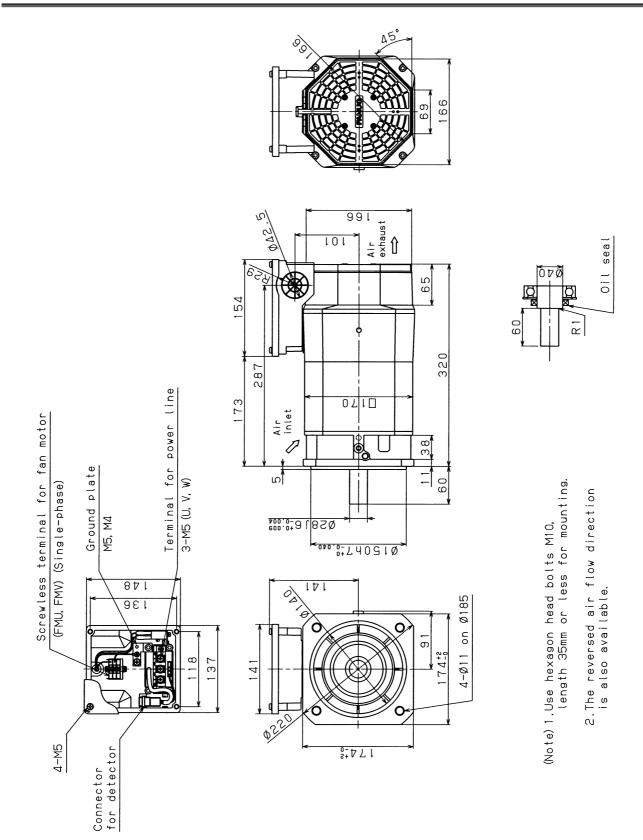
## 7.4 MODEL $\alpha i$ I 1.5/10000HV (FLANGE MOUNTING TYPE)



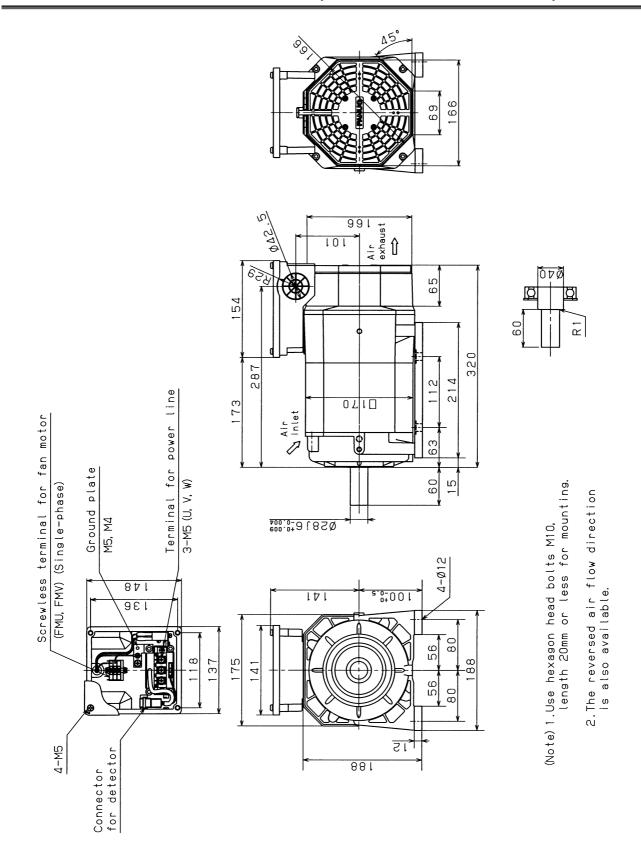
#### 7.5 MODEL $\alpha i$ I 1.5/10000HV (FOOT MOUNTING TYPE)



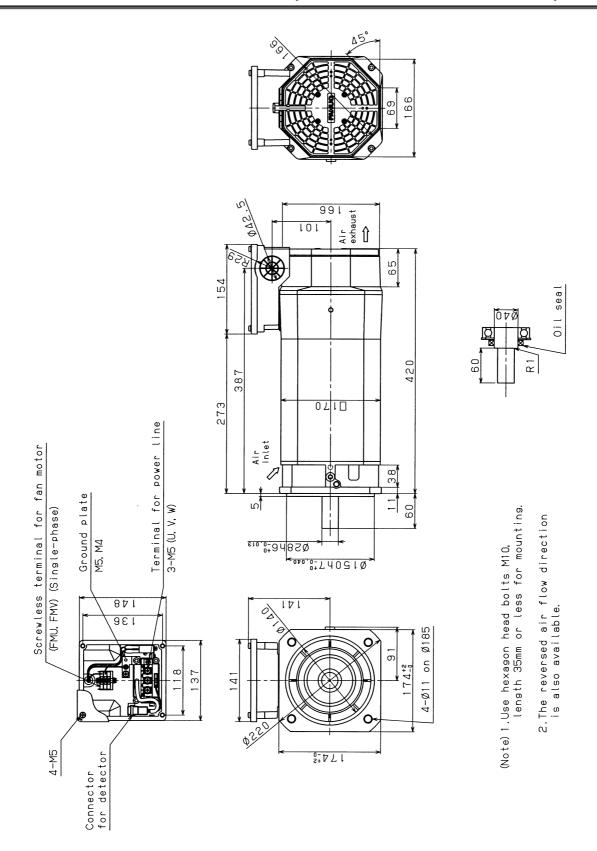
#### 7.6 MODEL $\alpha i$ I 2/10000HV (FLANGE MOUNTING TYPE)



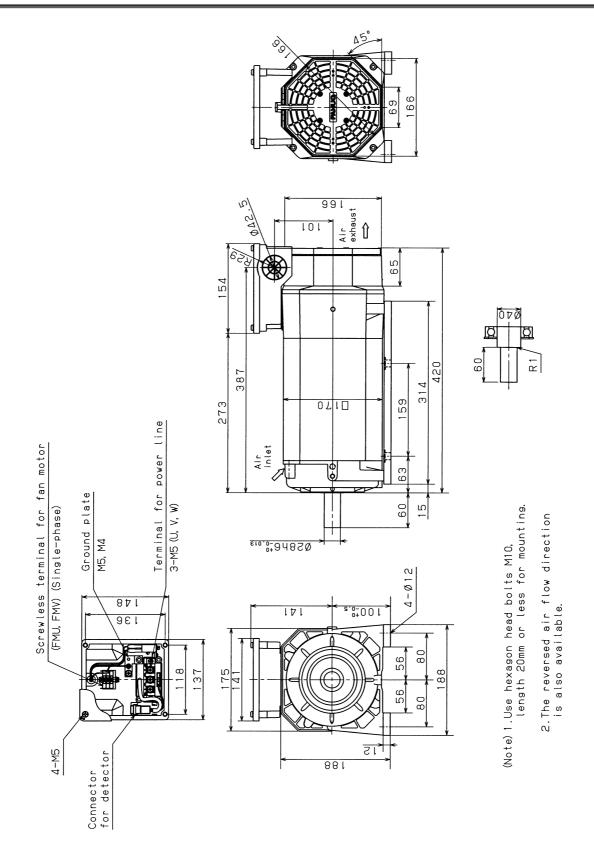
#### 7.7 MODEL $\alpha i$ I 2/10000HV (FOOT MOUNTING TYPE)



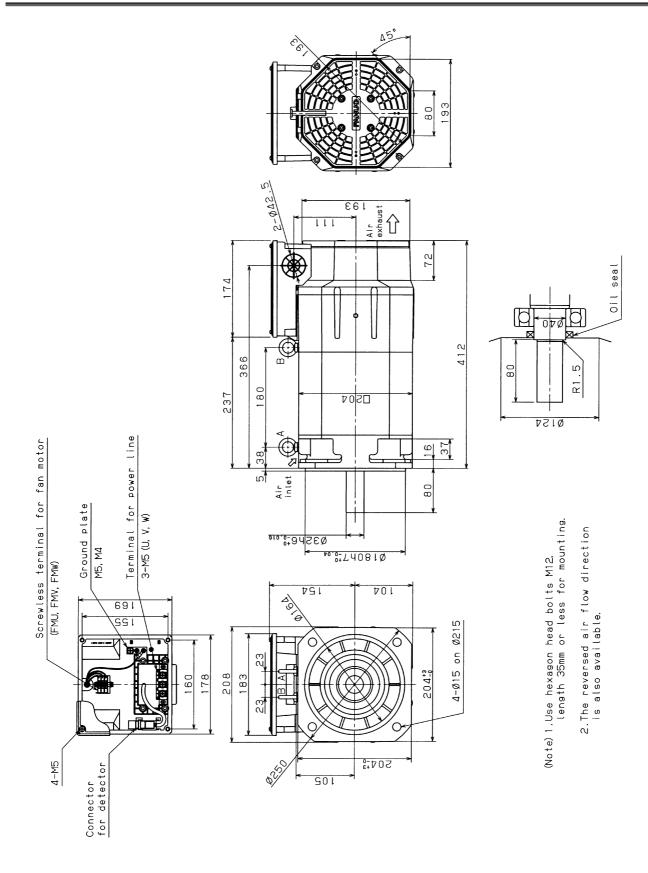
### 7.8 MODEL $\alpha i$ I 3/10000HV (FLANGE MOUNTING TYPE)



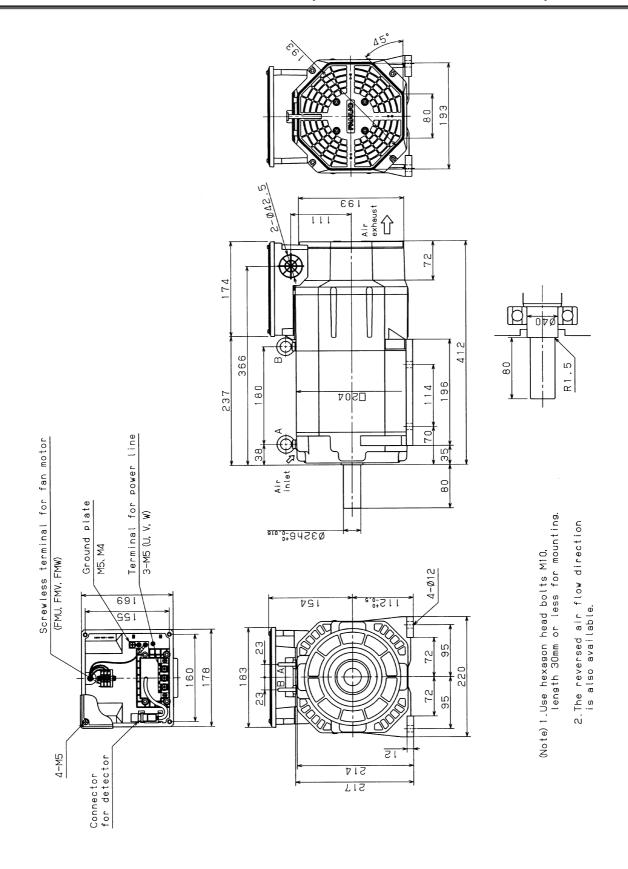
# 7.9 MODEL $\alpha i$ I 3/10000HV (FOOT MOUNTING TYPE)



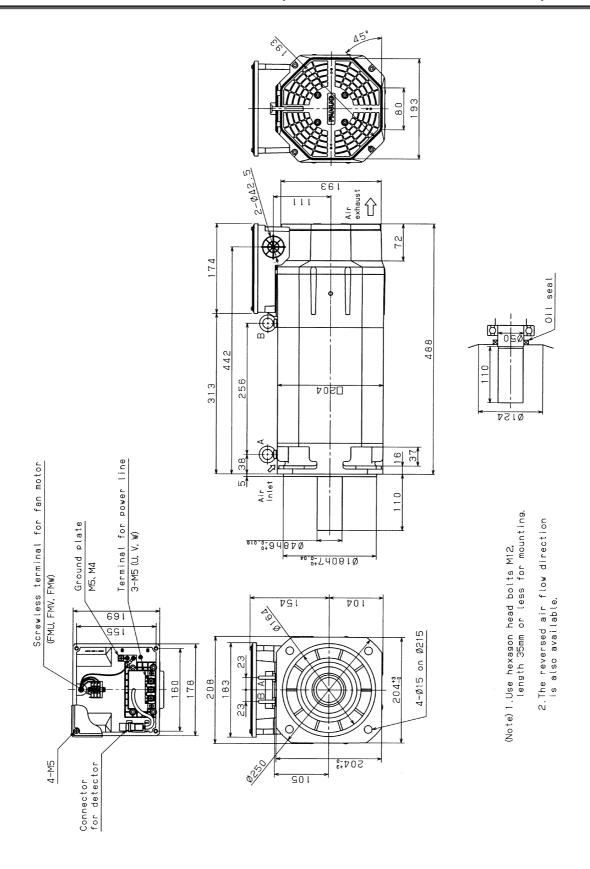
# 7.10 MODEL $\alpha i$ I 6/10000HV (FLANGE MOUNTING TYPE)



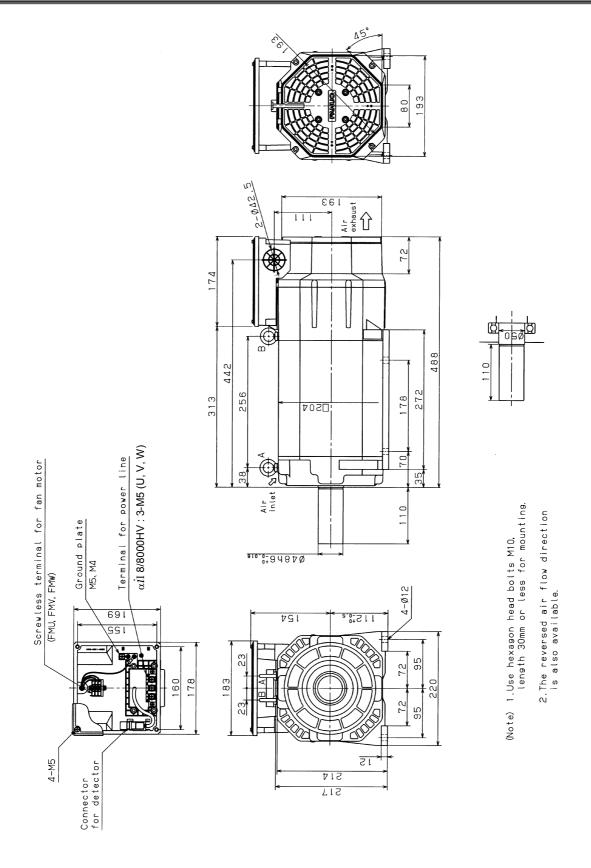
#### 7.11 MODEL $\alpha i$ I 6/10000HV (FOOT MOUNTING TYPE)



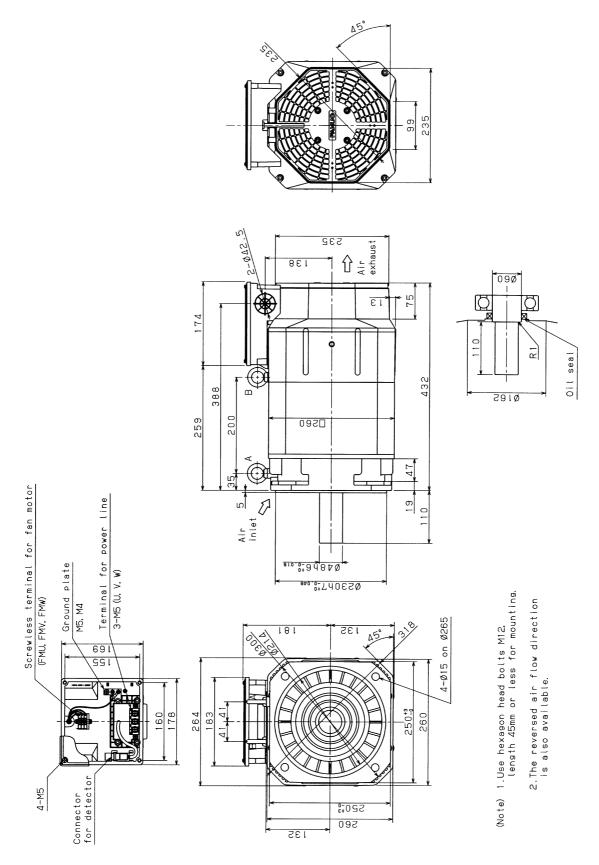
### 7.12 MODEL $\alpha i$ I 8/8000HV (FLANGE MOUNTING TYPE)



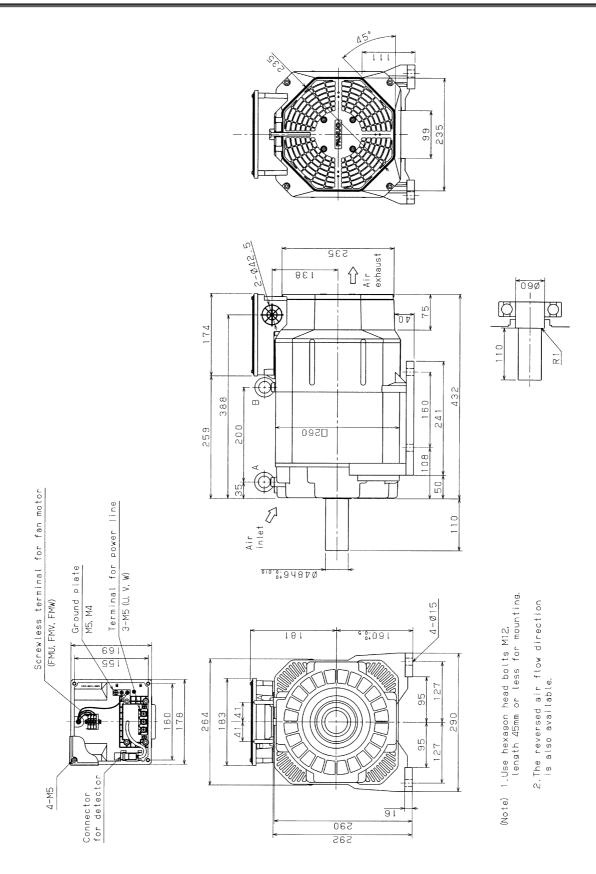
#### 7.13 MODEL $\alpha i$ I 8/8000HV (FOOT MOUNTING TYPE)



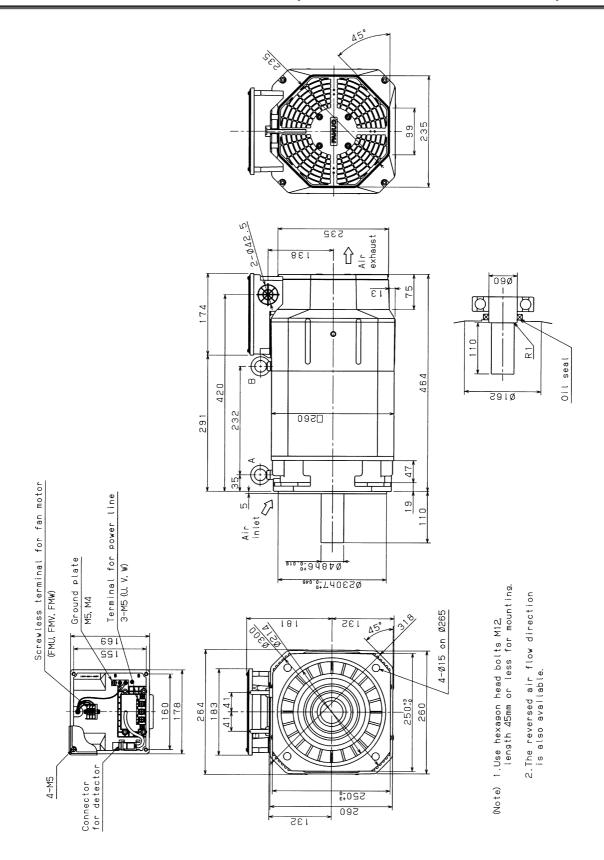
#### 7.14 MODEL $\alpha i$ I 12/7000HV (FLANGE MOUNTING TYPE)



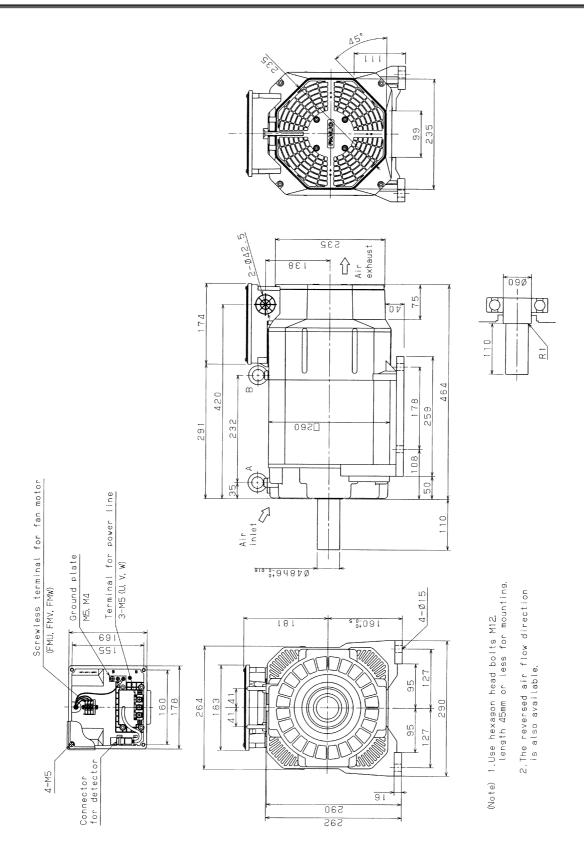
# 7.15 MODEL $\alpha i$ I 12/7000HV (FOOT MOUNTING TYPE)



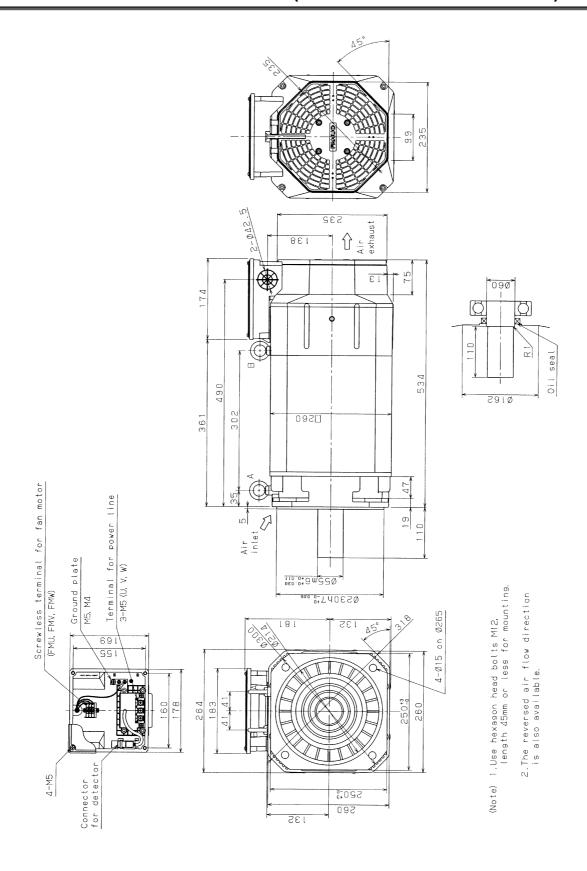
#### 7.16 MODEL $\alpha i$ I 15/7000HV (FLANGE MOUNTING TYPE)



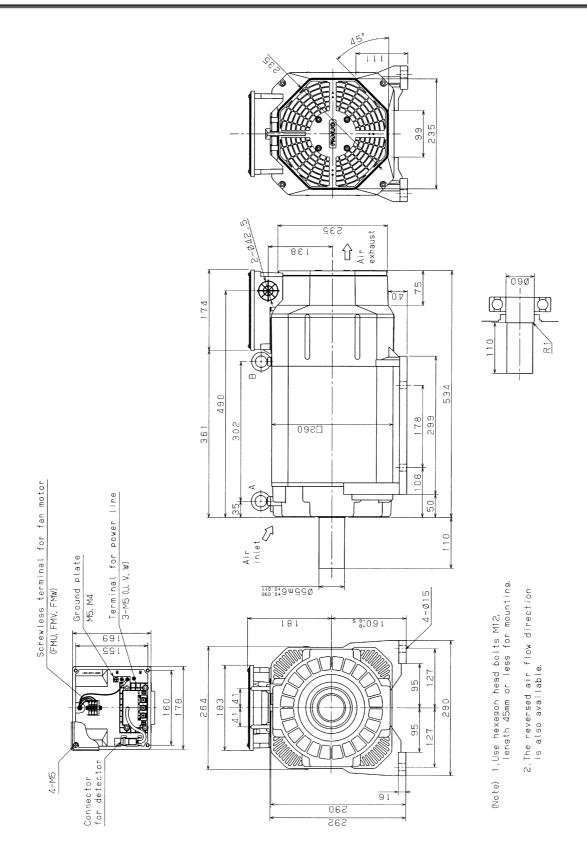
#### 7.17 MODEL $\alpha i$ I 15/7000HV (FOOT MOUNTING TYPE)



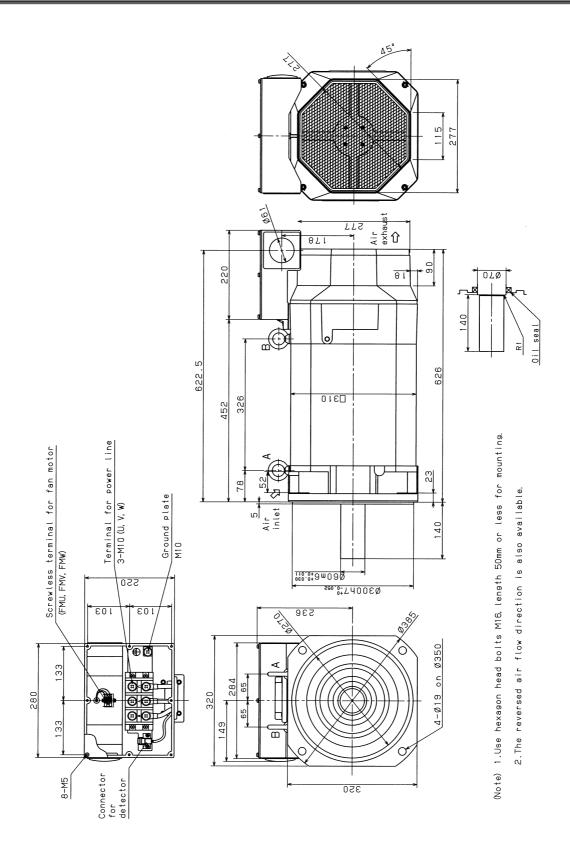
#### 7.18 MODEL $\alpha i$ I 22/7000HV (FLANGE MOUNTING TYPE)



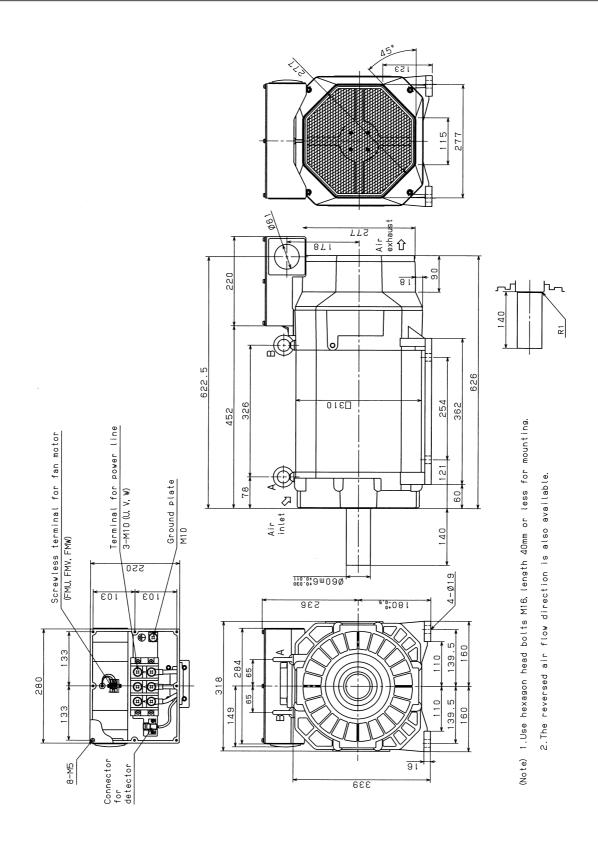
# 7.19 MODEL $\alpha i$ I 22/7000HV (FOOT MOUNTING TYPE)



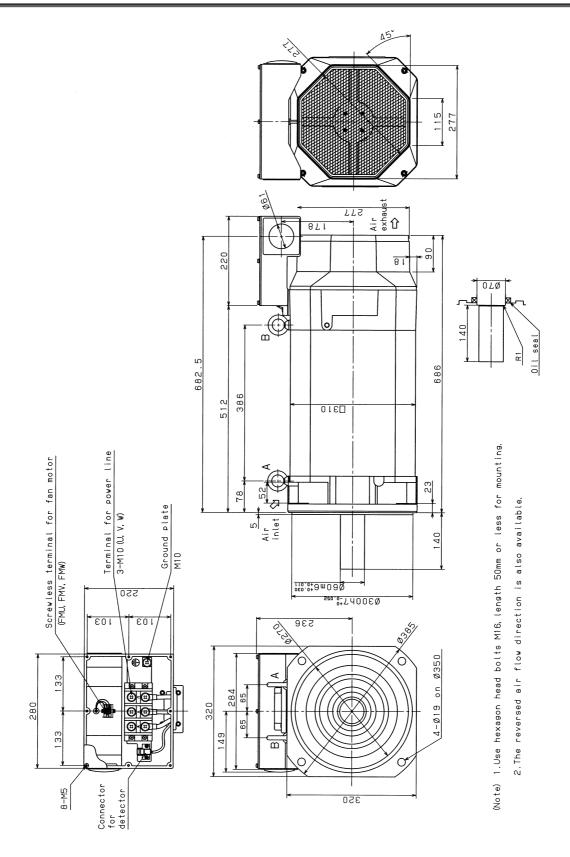
#### 7.20 MODEL $\alpha i$ I 30/6000HV (FLANGE MOUNTING TYPE)



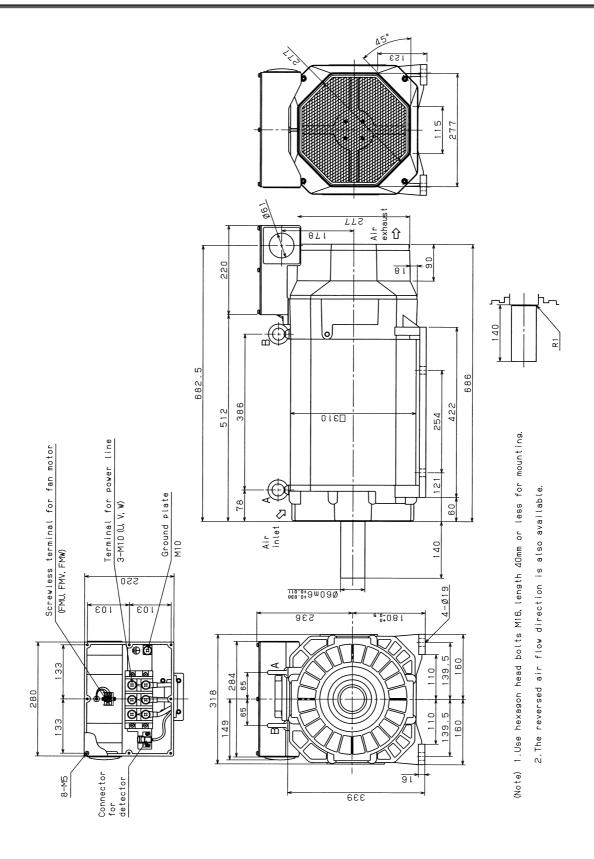
### 7.21 MODEL $\alpha i$ I 30/6000HV (FOOT MOUNTING TYPE)



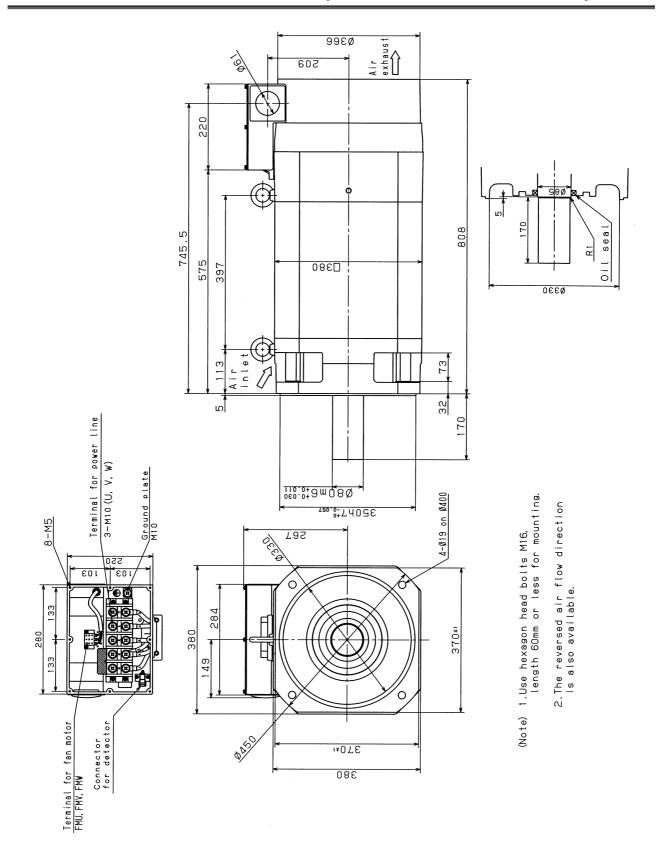
#### 7.22 MODEL $\alpha i$ I 40/6000HV (FLANGE MOUNTING TYPE)



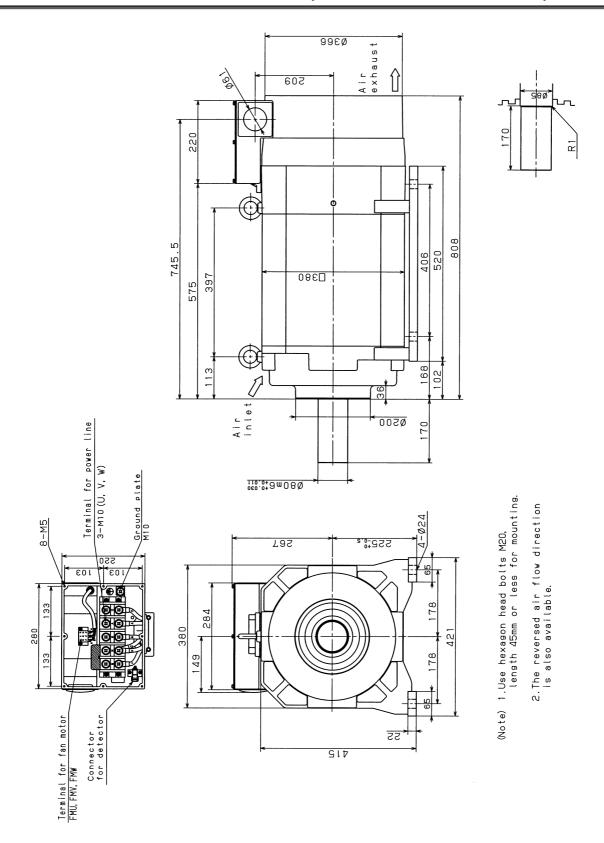
#### 7.23 MODEL $\alpha i$ I 40/6000HV (FOOT MOUNTING TYPE)



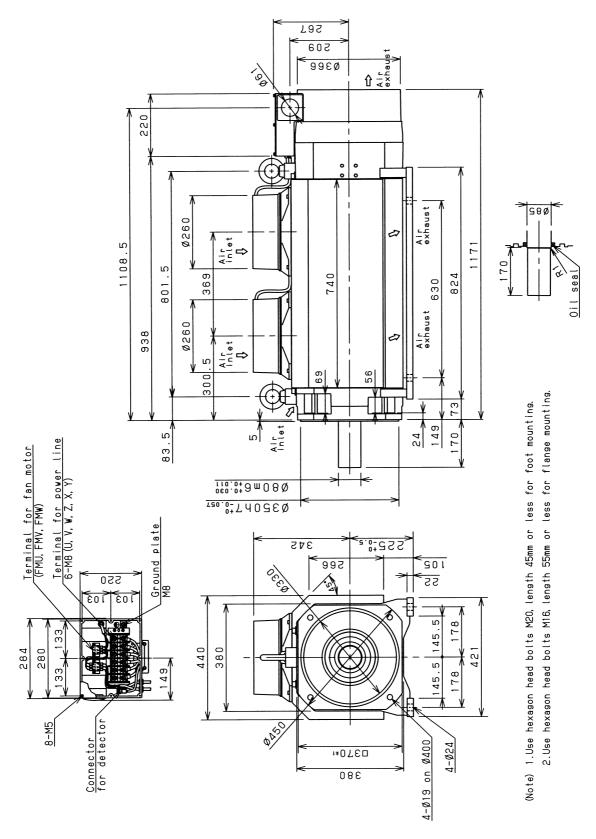
### 7.24 MODEL $\alpha i$ I 60/4500HV (FLANGE MOUNTING TYPE)



### 7.25 MODEL $\alpha i$ I 60/4500HV (FOOT MOUNTING TYPE)



# 7.26 MODEL $\alpha i$ I 100/4000HV (FOOT FLANGE MOUNTING TYPE)



# IV. FANUC AC SPINDLE MOTOR $\alpha i$ IP series 200V type

# 1

#### **GENERAL**

FANUC AC spindle motor  $\alpha i$ IP series 200V type is suitable for structural simplification by eliminating the machine spindle gear box.

#### **Features**

- As the rated output range is wide from 1:10 to 1:16, a gear box structure for speed change is not required, thereby allowing the structure of the machine to be simplified.
  - Accordingly, vibration and noise caused by the gear box structure is also eliminated.
- Improvement in efficiency of construction equipment
  Unnecessary use of time is reduced because it is not necessary to
  stop the spindle when switching the gear.
- Despite a compact configuration, a large low-speed torque can be obtained.
- The method of fan exhaust can be selected from either a exhaust front type or exhaust rear type, thus preventing heat deformation of the machine.
- Waterproof and pressure-proof design conforming to the international standard (IEC) is employed to improve reliability and make it resistant to most environments.

#### **SPECIFICATIONS**

Series		lpha iIP series				
Model		α <i>i</i> IP 12/6000		α <i>İ</i> IP <b>15/6000</b>		
		lpha iIP 12/8000		lpha iIP 15/8000		
Item	mous.	Low-speed	High-speed	Low-speed	High-speed	
		winding	winding	winding	winding	
		(Y connection)	(∆ connection)	(Y connection)	(∆ connection)	
	Cont. rated kW (HP)	3.7 (4.9)	5.5 (7.4)	5 (6.6)	7.5 (10)	
	30 min rated kW	, ,	(7.4)	(6.6)	,	
Output	[15 min]	7.5	7.5	9	9	
(*2)	(*3) (HP)	(10)	(10)	(12)	(12)	
	S3 60% kW	7.5	7.5	9	9	
	[15%]					
	(*4)(*5) (HP)	(10)	(10)	(12)	(12)	
Rated current A	Cont. rated	23	39	40	50	
(*6)	30 min rated (*3) S3 60%, 15% (*4)	42	49	61	58	
Speed	Base speed	500	750	500	750	
min <sup>-1</sup>	Max. speed	1500	6000, 8000	1500	6000, 8000	
Cont. rated tord	que at const. rated torque range	70.7	70	95.5	95.5	
	N⋅m	(721)	(714)	(974)	(974)	
	(kgf·cm)			, ,		
Rotor inertia kg·m²		0.07 0.09				
kgf·cm·s <sup>2</sup>   Weight kgf		0.77 0.93 95 110				
VVC	Vibration	V5 (option V3)				
	Noise	75dB(A) or less				
Cooli	ng system (*7)	Totally enclosed and fan cooled IC0A6				
Co	poling fan W	56				
		Mount the motor so that the output shaft points in a direction ranging				
Insta	allation (*8)	within 45° degrees above the horizontal to vertically downwards.				
Allowable overload capacity (1 min) (*9)		IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5  120 % of 30 min rated output				
Allowable o	Insulation	120 % of 30 min rated output  Class H				
An	nbient temperature	0 to 40 °C				
Altitude		Height above sea level not exceeding 1000m				
Painting color		Munsell system N2.5				
Sensor		lpha iM sensor or $lpha i$ MZ sensor				
Type of thermal protection (*10)		TP211				
Resolution of the $\alpha i$ MZ sensor /rev.		4096				
Number of detected gear teeth per rotation						
λ/rev.		256				
Bearing lubrication		Grease				
Maximum output during acceleration (*11) kW		12.3 13.5		3.5		
Applicable spindle amplifier		$\alpha i$ SP 11 $\alpha i$ SP 15		P 15		
Model			12/6000 α <i>i</i> I <sub>P</sub> 15/6000			

Model	α <i>j</i> ΙΡ 18				
Model	OVF1: 11	α <i>İ</i> IP 18/6000		α <i>i</i> IP <b>22/6000</b>	
	a/In 49/9000		$\alpha i$ IP <b>22/8000</b>		
Item	Low-speed	High-speed	Low-speed	High-speed	
	winding	winding	winding	winding	
	(Y connection)	, ,	(Y connection)	· ·	
Cont. rated kW (HP)	6 (8)	9 (12)	7.5 (10)	11 (14.7)	
30 min rated kW	. ,	,	, ,	, ,	
Output [15 min]	11	11	15	15	
(*2) (*3) (HP)	(14.7)	(14.7)	(20.1)	(20.1)	
S3 60% kW	11	11	15	15	
[15%]	(4.4.=)	<del>-</del> >	/aa //	(00.4)	
(*4)(*5) (HP)  Cont. rated	(14.7)	(14.7) 55	(20.1)	(20.1)	
Rated current A 30 min rated (*3)	32	55	43	69	
(*6) S3 60%, 15% (*4)	53	63	80	88	
Speed Base speed	500	750	500	750	
min <sup>-1</sup> Max. speed	1500	6000, 8000	1500	6000, 8000	
Cont. rated torque at const. rated torque range	114.6	114.6	143.2	140	
N·m	(1169)	(1169)	(1461)	(1428)	
(kgf·cm)  Reter inertia	` ' '			0.128	
Rotor inertia kgf·cm·s²	0.105 0.128 1.08 1.29		_		
Weight kgf	1.08 1.29			_	
Vibration	V5 (option V3)				
Noise	75dB(A) or less				
Cooling system (*7)	Totally enclosed and fan cooled IC0A6				
Cooling fan W	56				
	Mount the motor so that the output shaft points in a direction ranging				
Installation (*8)	within 45° degrees above the horizontal to vertically downwards.				
Allowable overload capacity (1 min) (*9)	IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5 120 % of 30 min rated output				
Insulation	Class H				
Ambient temperature	0 to 40 °C				
Altitude	Height above sea level not exceeding 1000m				
Painting color	Munsell system N2.5				
Sensor	lpha iM sensor or $lpha i$ MZ sensor				
Type of thermal protection (*10)	TP211				
Resolution of the $\alpha i$ MZ sensor /rev.	4096				
Number of detected gear teeth per rotation $\lambda$ /rev.	256				
Bearing lubrication	Grease				
Maximum output during acceleration (*11) kW	15.1 20.0		0.0		
Applicable spindle amplifier	α <i>i</i> SP 15 α <i>i</i> SP 22		P 22		
Model	α <i>İ</i> IP 18	3/6000	α <i>İ</i> IP 22/6000		

Series		lpha iIP series				
		α <i>i</i> IP 30/6000		α <i>i</i> IP <b>40/6000</b>		
Item	Model		High-speed winding	Low-speed winding	High-speed winding	
		(Y connection)	(∆ connection)	(Y connection)	(∆ connection)	
	Cont. rated kW	11	15	13	18.5	
	(HP)	(14.7)	(20.1)	(17.3)	(24.8)	
_	30 min rated kW	18.5	18.5	22	22	
Output	[15 min]	(24.8)	(24.8)	(29.5)	(29.5)	
(*2)	(*3) (HP)					
	S3 60% kW [15%]	18.5	18.5	22	22	
	(*4)(*5) (HP)	(24.8)	(24.8)	(29.5)	(29.5)	
	Cont. rated	54	86	70	108	
Rated current A	30 min rated (*3)					
(*6)	S3 60%, 15% (*4)	87	101	115	123	
Speed	Base speed	400	575	400	575	
min <sup>-1</sup>	Max. speed	1500	6000	1500	6000	
Cont. rated torg	ue at const. rated torque range	263	249	310	307	
	N·m	(2678)	(2540)	(3165)	(3133)	
	(kgf·cm) kg·m²	0.1	205	0.1	205	
Rotor inertia	kgf.cm.s <sup>2</sup>	0.295 0.295 3.0 3.0				
Wei		250 250				
	Vibration	V5 (option V3)				
	Noise	75dB(A) or less				
Coolir	ng system (*7)	Totally enclosed and fan cooled IC0A6				
Co	oling fan W	84				
Insta	allation (*8)	Mount the motor so that the output shaft points in a direction rangi within 45° degrees above the horizontal to vertically downwards.				
Allowable overload capacity (1 min) (*9)		IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5  120 % of 30 min rated output				
7 diovable o	Insulation	Class H				
An	nbient temperature	0 to 40 °C				
	Altitude	Height above sea level not exceeding 1000m				
Painting color		Munsell system N2.5				
Sensor		lpha iM sensor or $lpha i$ MZ sensor				
Type of thermal protection (*10)		TP211				
Resolution of the $\alpha i$ MZ sensor /rev.		4096				
Number of detected gear teeth per rotation $\lambda$ /rev.		256				
Bearing lubrication		Grease				
Maximum output during acceleration (*11) kW		25.0 29.0		9.0		
Applicable spindle amplifier		α <i>i</i> SP 22 α <i>i</i> SP 26		P 26		
Model		α <i>İ</i> IP 30/6000 α <i>İ</i> IP 40/6000		0/6000		

Series		lpha iIP series			
		α <i>i</i> IP 50/6000		$\alpha i$ IP <b>60/4500</b>	
Model		Low-speed	High-speed	Low-speed	High-speed
ltem		winding	winding	winding	winding
		(Y connection)	(∆ connection)	(Y connection)	(∆ connection)
	Cont. rated kW	22	22	18.5	22
	(HP)	(29.5)	(29.5)	(24.8)	(29.5)
	30 min rated kW	30	30	30	30
Output	[15 min]				
(*2)	(*3) (HP)	(40.2)	(40.2)	(40.2)	(40.2)
	S3 60% kW	30	30	30	30
	[15%]	(40.2)	(40.2)	(40.2)	(40.2)
	(*4)(*5) (HP)	(40.2)	(40.2)	(40.2)	(40.2)
Rated current A	Cont. rated	95	94	87	106
(*6)	30 min rated (*3) S3 60%, 15% (*4)	118	117	132	139
Speed	Base speed	575	1200	400	750
min <sup>-1</sup>	Max. speed	1500	6000	1500	4500
Cont. rated torq	que at const. rated torque range	365	175	442	280
	N·m	(3726)	(1785)	(4504)	(2850)
	(kgf⋅cm)				
Rotor inertia	kg·m² kgf·cm·s²	0.355		0.49 5.0	
\Mai		3.6 5.0 290 468			
Wei	ight kgf Vibration	V5 (option V3) V10 (option V5			
	Noise	75dB(A) or less 80dB(A) or less			
Coolir	ng system (*7)	Totally enclosed and fan cooled IC0A6			
	poling fan W	84 185			
		Mount the motor so that the output shaft points in a direction ranging			
Installation (*8)		within 45° degrees above the horizontal to vertically downwards. IMB5,IMV1,IMB3,IMB6,IMB7,IMB8,IMV5			
Allowable overload capacity (1 min) (*9)		120 % of 30 min rated output			
Insulation		Class H			
Ambient temperature		0 to 40 °C			
Altitude		Height above sea level not exceeding 1000m			
Painting color		Munsell system N2.5			
Sensor		lpha iM sensor or $lpha i$ MZ sensor			
Type of thermal protection (*10)		TP211			
Resolution of the $\alpha i$ MZ sensor /rev.		4096			
Number of detected gear teeth per rotation $\lambda$ /rev.		256			
Bearing lubrication		Grease			
Maximum output during acceleration (*11)		35.4 36		6	
Applicable spindle amplifier		αis	α <i>i</i> SP 26 α <i>i</i> SP 30		P 30
Model		$\alpha i$ IP 5	0/6000	α <i>İ</i> IP 60/4500	

- (\*1) When the output switch function is used, the CNC soft option and switching magnetic contactor unit associated with the output switch function  $(Y-\Delta \text{ switch})$  are required.
  - See FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN) for details of the output switch control.
- (\*2) The rated output is guaranteed at the rated voltage.

  (Amplifier input: 200/220/230V AC +10% -15%, 50/60 Hz ±1Hz)

  If the input voltage fluctuates, it is possible that the rated output cannot be obtained even when such fluctuations are within the allowable fluctuation range.
- (\*3) The output for low-speed winding models other than  $\alpha i \text{IP } 50/6000$  and  $\alpha i \text{IP } 60/4500$  is 15 min rated.
- (\*4) S3 15% for low-speed winding models other than  $\alpha i$ IP 50/6000 and  $\alpha i$ IP 60/4500
  - S3 25% for low-speed winding of  $\alpha i$ IP 50/6000 and  $\alpha i$ IP 60/4500
- (\*5) The cycle time is 10 minutes, S3 60%: ON 6 minutes, OFF 4 minutes, S3 25%: ON 2.5 minutes, OFF 7.5 minutes and S3 15%: ON 1.5 minutes, OFF 8.5 minutes.
- (\*6) The rated current is not a guaranteed value but a guideline for the maximum current at rated output.
- (\*7) IC code conforms to IEC 34-6.
- (\*8) IM code conforms to IEC 34-7.
- (\*9) This is not a guaranteed value but a guideline for the maximum motor output at a rated supply voltage.
- (\*10) Type conforms to IEC 34-11.
- (\*11) These values are to be used only as guidance for selecting a power supply ( $\alpha iPS$ ) and are not guaranteed.
- (\*12) Degree of protection: with oil seal: IP54, without oil seal: IP40.

# 3

#### **OUTPUT/TORQUE CHARACTERISTICS**

# Reference Calculation for torque

Torque T can be obtained by the following equation.

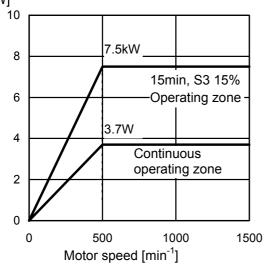
 $T[N \cdot m] = P[kW] \times 1000/0.1047/N[min^{-1}]$  P[kW]: Motor output  $N[min^{-1}]:$  Motor speed

When the unit of T is [kgf·m], T[kgf·m]= $P[kW]\times 1000/1.0269/N[min^{-1}]$ 

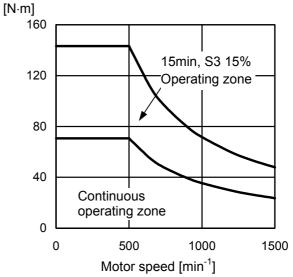
#### **3.1** MODEL $\alpha i$ IP 12/6000

Applicable amplifier  $\alpha i$ SP 11

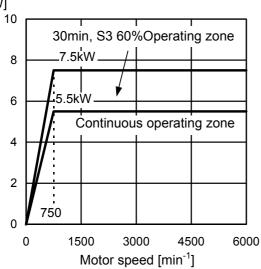
Low-speed winding output (Y connection)
[kW]
10



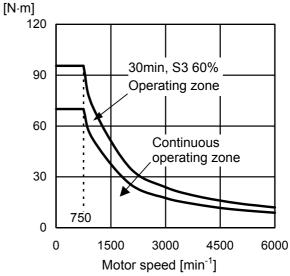
Low-speed winding torque (Y connection)



 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:linear_connection} \mbox{[kW]}$ 



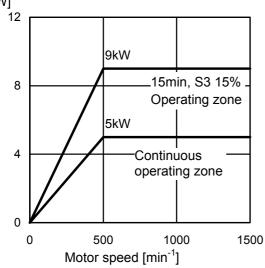
High-speed winding torque ( $\Delta$  connection)



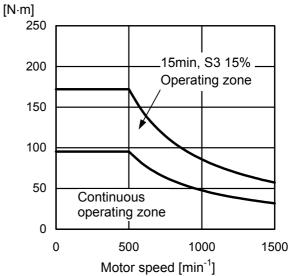
#### **3.2** MODEL $\alpha i$ IP 15/6000

Applicable amplifier  $\alpha i$ SP 15

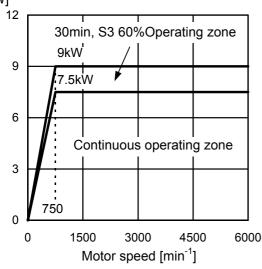
Low-speed winding output (Y connection) [kW]



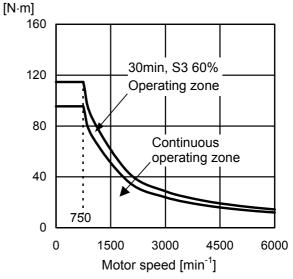
Low-speed winding torque (Y connection)



 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:linear_connection}$  [kW]



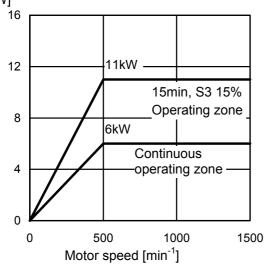
 $\mbox{High-speed winding torque } (\Delta \mbox{ connection})$ 



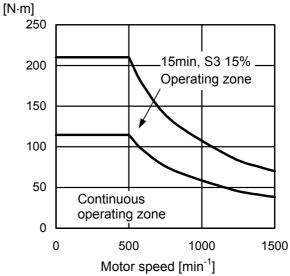
#### **3.3** MODEL $\alpha i$ IP 18/6000

Applicable amplifier  $\alpha i$ SP 15

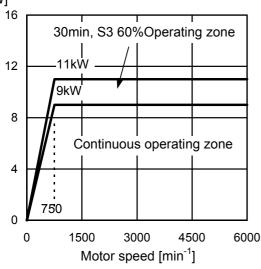
Low-speed winding output (Y connection) [kW]



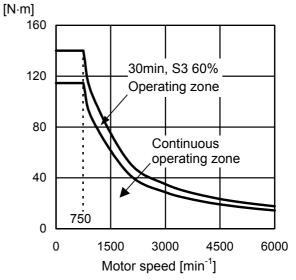
Low-speed winding torque (Y connection)



 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:linear_connection}$  [kW]



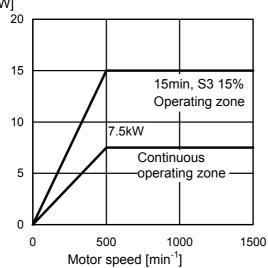
High-speed winding torque ( $\Delta$  connection)



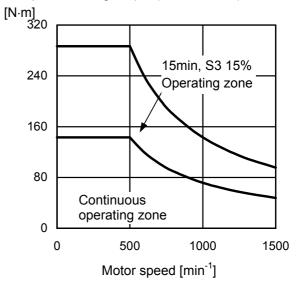
#### **3.4** MODEL $\alpha i$ IP 22/6000

Applicable amplifier  $\alpha i$ SP 22

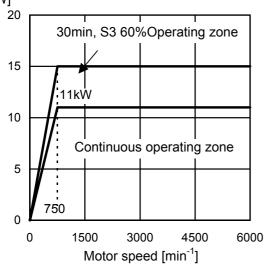
Low-speed winding output (Y connection) [kW]



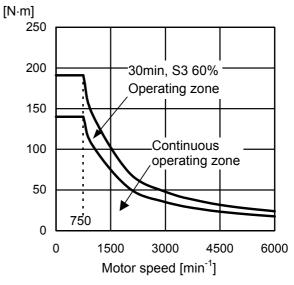
Low-speed winding torque (Y connection)



 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:linear_connection}$  [kW]

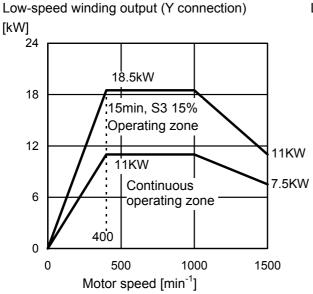


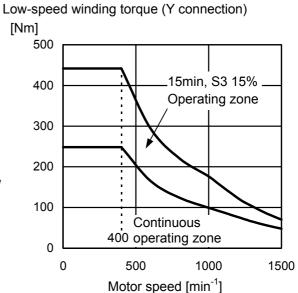
High-speed winding torque ( $\Delta$  connection)

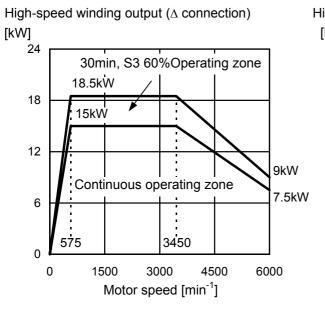


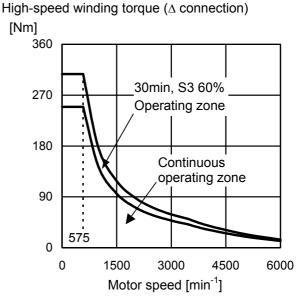
### **3.5** MODEL $\alpha i$ IP 30/6000

Applicable amplifier  $\alpha i$ SP 22



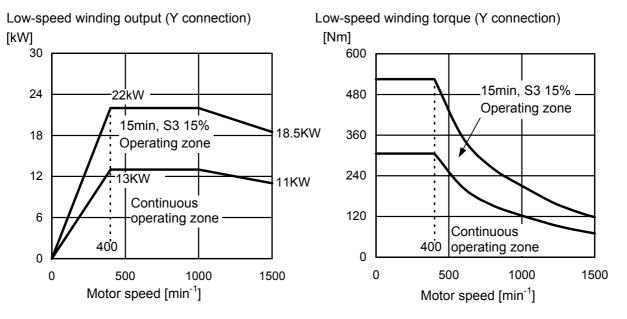


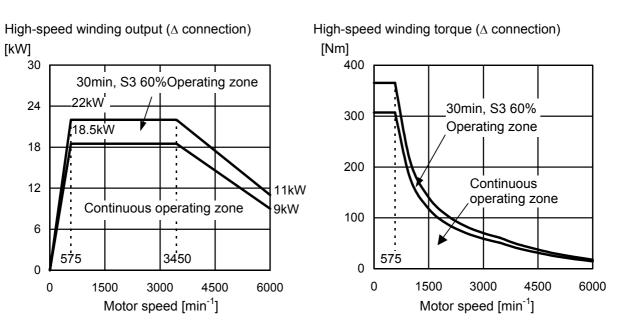




### **3.6** MODEL $\alpha i$ IP 40/6000

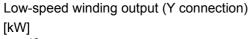
Applicable amplifier  $\alpha i$ SP 26

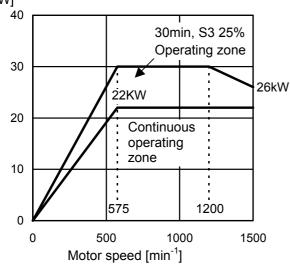




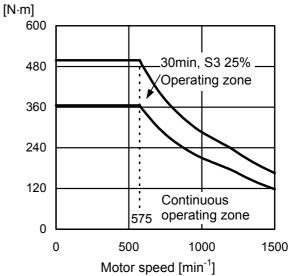
#### 3.7 MODEL $\alpha i$ IP 50/6000

Applicable amplifier  $\alpha i$ SP 26

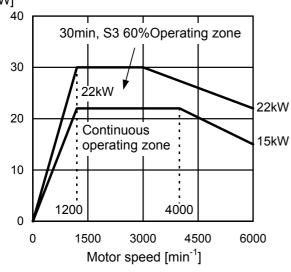




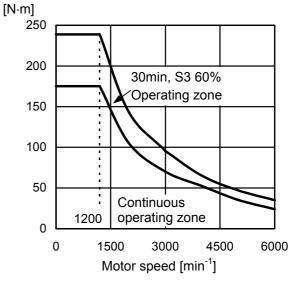
Low-speed winding torque (Y connection)



# High-speed winding output ( $\Delta$ connection) [kW]

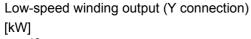


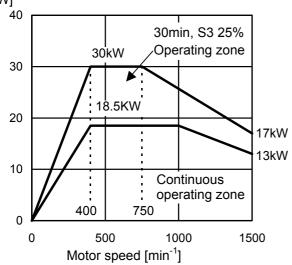
High-speed winding torque ( $\Delta$  connection)



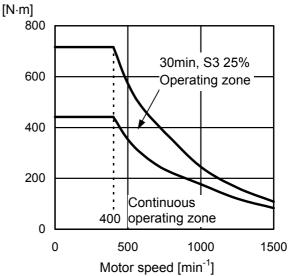
#### **3.8** MODEL $\alpha i_{\text{IP}} 60/4500$

Applicable amplifier  $\alpha i$ SP 30

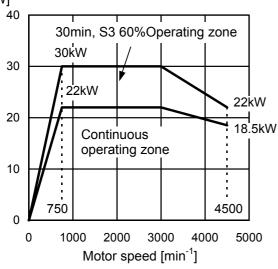




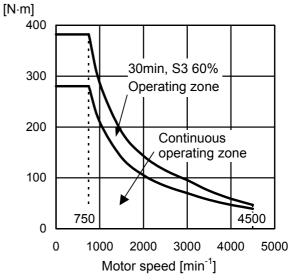
Low-speed winding torque (Y connection)



 $\label{eq:linear_equation} \mbox{High-speed winding output } (\Delta \mbox{ connection}) \\ \mbox{[kW]}$ 



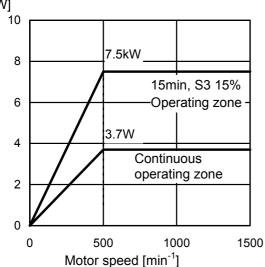
 $\mbox{High-speed winding torque } (\Delta \mbox{ connection})$ 



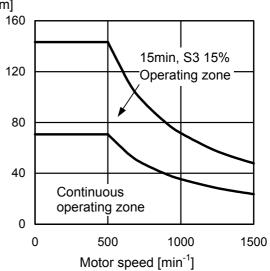
### **3.9** MODEL $\alpha i$ IP 12/8000

Applicable amplifier  $\alpha i$ SP 11

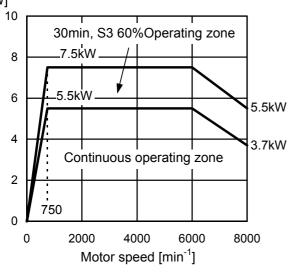
Low-speed winding output (Y connection) [kW]



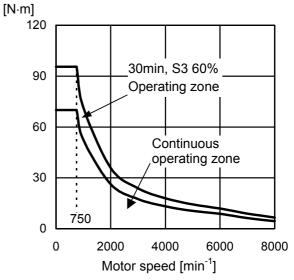
Low-speed winding torque (Y connection) [N·m]



High-speed winding output ( $\Delta$  connection) [kW]



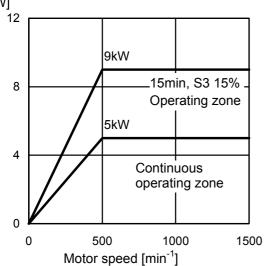
 $\mbox{High-speed winding torque } (\Delta \mbox{ connection})$ 



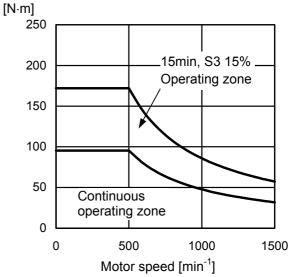
#### **3.10** MODEL $\alpha i$ IP 15/8000

Applicable amplifier  $\alpha i$ SP 15

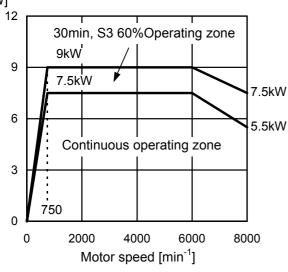
Low-speed winding output (Y connection) [kW]



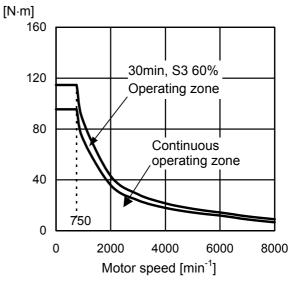
Low-speed winding torque (Y connection)



 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:linear_connection}$  [kW]



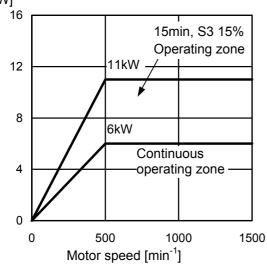
High-speed winding torque ( $\Delta$  connection)



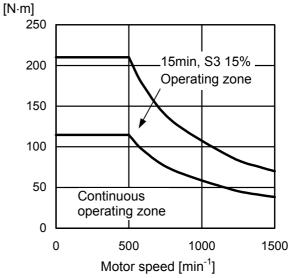
#### **3.11** MODEL $\alpha i$ IP 18/8000

Applicable amplifier  $\alpha i$ SP 15

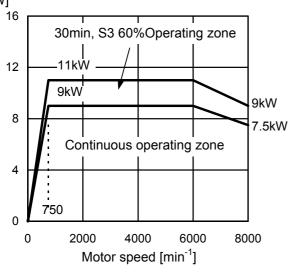
Low-speed winding output (Y connection) [kW]



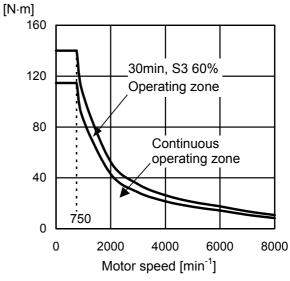
Low-speed winding torque (Y connection)



 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:likelihood}$  [kW]



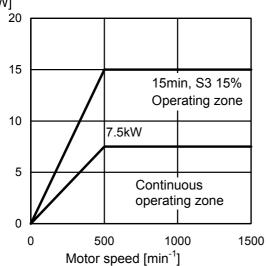
 $\mbox{High-speed winding torque } (\triangle \mbox{ connection})$ 



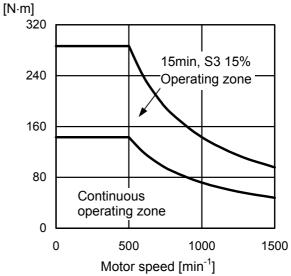
#### **3.12** MODEL $\alpha i$ IP 22/8000

Applicable amplifier  $\alpha i$ SP 22

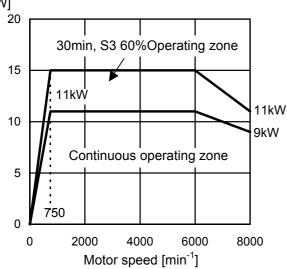
Low-speed winding output (Y connection) [kW]



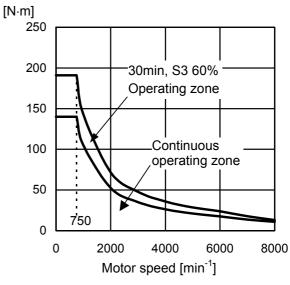
Low-speed winding torque (Y connection)



 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:likelihood}$  [kW]



High-speed winding torque ( $\Delta$  connection)





### **CONNECTIONS**

### **4.1** MODELS $\alpha i$ IP 12/6000 TO $\alpha i$ IP 60/4500

Cables for power lead and fan motor are connected to the terminal block.

 $\alpha iM$  sensor or  $\alpha iMZ$  sensor signal or thermo stat signal use a connector manufactured by Tyco Electronics AMP.

The connector housing and the connector are attached to the motor.

Size of screws used in	Power	lead	Fan motor
_	U,V,W,G	X,Y,Z	FMU,FMV,FMW
Model			
lpha iIP 12/6000 to $lpha i$ IP 22/6000	M5	M5	Screw-less terminal block
lpha iIP 30/6000 to $lpha i$ IP 50/6000	M6	M6	Screw-less terminal block
α <i>İ</i> IP 60/4500	M8	M8	M3.5

#### Cable for the power lead

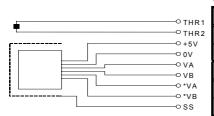
For the power lead cable specification, refer to "FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN)".

#### Cable for the fan motor

For the fan motor current value and cable specifications, refer to Section I.4.3, "FAN MOTOR CONNECTION" in this manual.

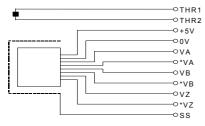
#### 4.2 **CONNECTION OF SIGNAL LEAD**

#### Connector attachment for a motor with a built-in $\alpha iM$ sensor



Connector pins arrangement							
Number	B1	B2	В3	B4	B5	B6	
Color							
Signal		*VA	*VB		0V	THR2	
Number	A1	A2	A3	A4	A5	A6	
Color							
Signal	+5V	VA	VB		SS	THR1	

#### Connector attachment for a motor with a built-in $lpha \emph{i}$ MZ sensor



Connector pins arrangement						
Number	B1	B2	В3	B4	B5	В6
Color						
Signal		*VA	*VB	*VZ	0V	THR2
Number	A1	A2	A3	A4	A5	A6
Color						
Signal	+5V	VA	VB	VZ	SS	THR1

#### - Connector housing and contact specifications

Connector and contact:

Tyco Electronics AMP specification D-3000 series

	- j v = - v v v v v p v v v v v v					
	Motor side		Cable side			
	FANUC specification	Manufacture specifica-tion	FANUC specification	Manufacture specification		
Housing	A63L-0001-0535/121KDF	178964-6	A63L-0001-0460/121KD	178289-6		
Contact	A63L-0001-0456/ASMT	175288-2	A63L-0001-0456/ASM	1-175217-2		

Crimping tool: 91559-1 Extractor: 234168-1

#### - Thermistor specification

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).

# 5

#### ALLOWABLE RADIAL LOAD

Use the motor output shaft below the allowable radial loads shown in the table below.

	Allowable radial load (kgf)				
Model	At output shaft end	At output shaft center			
$lpha \dot{i}$ IP 12/6000, $lpha \dot{i}$ IP 15/6000	2940N (300kgf)	3410N (348kgf)			
$lpha\dot{i}$ IP 18/6000, $lpha\dot{i}$ IP 22/6000	4410N (450kgf)	4988N (509kgf)			
lpha iIP 30/6000, $lpha i$ IP 40/6000, $lpha i$ IP 50/6000	5390N (550kgf)	6134N (626kgf)			
α <i>İ</i> IP 60/4500	-	19600N (2000kgf)			
$lpha\dot{i}$ IP 12/8000, $lpha\dot{i}$ IP 15/8000	2450N (250kgf)	2842N (290kgf)			
$lpha\dot{i}$ IP 18/8000, $lpha\dot{i}$ IP 22/8000	2940N (300kgf)	3332N (340kgf)			

#### NOTE

- 1 When using a belt, adjust the tension so the allowable loads indicated above are not exceeded. If an excessive load is applied, consider the use of a support bearing on the machine side to maintain the long-term reliability of the motor. (If an excessive load is applied, it is possible that an abnormal sound may occur.)
- When the belt tension is maximized at a point outside the output shaft end, the allowable loads are less than those at the output shaft end.
- 3 If a thrust load is applied when a helical gear is used, the shaft moves in the direction of the thrust. So, as a general rule, never apply a thrust load.



#### **ASSEMBLING ACCURACY**

Model Item	$\alpha i$ IP 12 to $\alpha i$ IP 22	$\alpha i$ IP 30 to $\alpha i$ IP 60	Measuring method
Run-out at the end of the output shaft	20μm or less	20μm or less	1/2 the output shaft length
Run-out of the faucet joint for mounting the flange against the core of the shaft (only for flange type)	40μm or less	60μm or less	10
Run-out of the flange mounting surface against the core of the shaft (only for flange type)	80μm or less	100μm or less	10

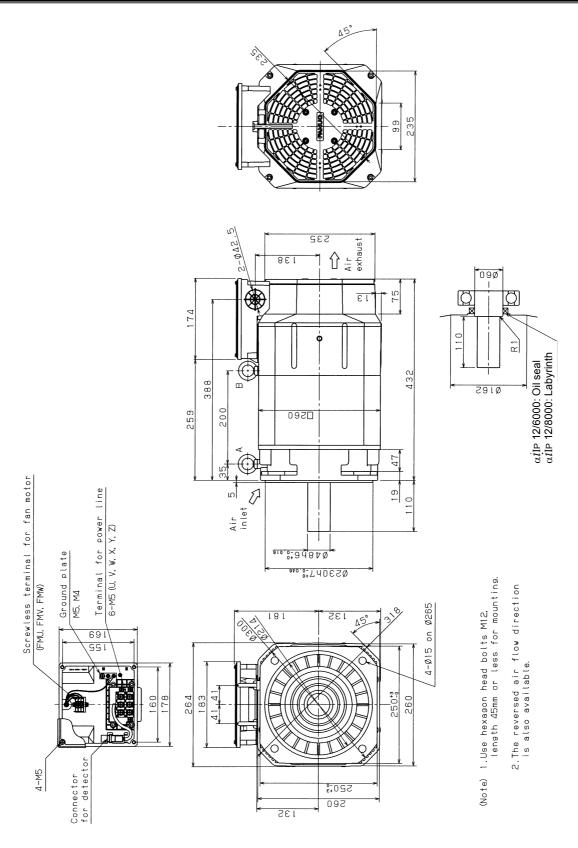
#### **⚠** CAUTION

Assembling accuracy of high speed models are same as above.

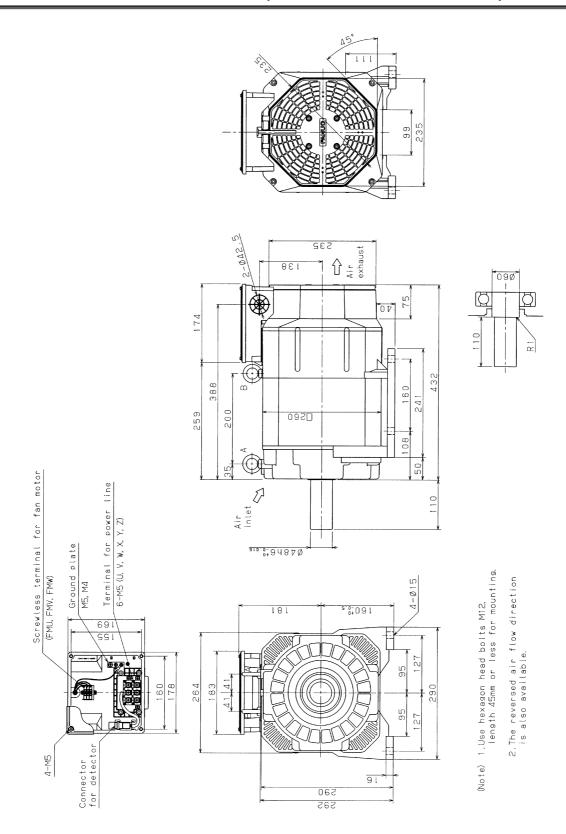
#### **EXTERNAL DIMENSIONS**

Model name	Section
Models $\alpha \dot{t}$ IP 12/6000 and $\alpha \dot{t}$ IP 12/8000 (flange mounting type)	7.1
Model $\alpha i$ IP 12/6000 (foot mounting type)	7.2
Models $\alpha i$ IP 15/6000 and $\alpha i$ IP 15/8000 (flange mounting type)	7.3
Model $\alpha i$ IP 15/6000 (foot mounting type)	7.4
Models $\alpha i$ IP 18/6000 and $\alpha i$ IP 18/8000 (flange mounting type)	7.5
Model $\alpha i$ IP 18/6000 (foot mounting type)	7.6
Models $\alpha i$ IP 22/6000 and $\alpha i$ IP 22/8000 (flange mounting type)	7.7
Model $\alpha i$ IP 22/6000 (foot mounting type)	7.8
Models $\alpha i$ IP 30/6000 and $\alpha i$ IP 40/6000 (flange mounting type)	7.9
Models $\alpha i$ IP 30/6000 and $\alpha i$ IP 40/6000 (foot mounting type)	7.10
Model $\alpha i$ IP 50/6000 (flange mounting type)	7.11
Model $\alpha i$ IP 50/6000 (foot mounting type)	7.12
Model $lpha i$ IP 60/4500 (flange mounting type)	7.13
Model $\alpha i$ IP 60/4500 (foot mounting type)	7.14

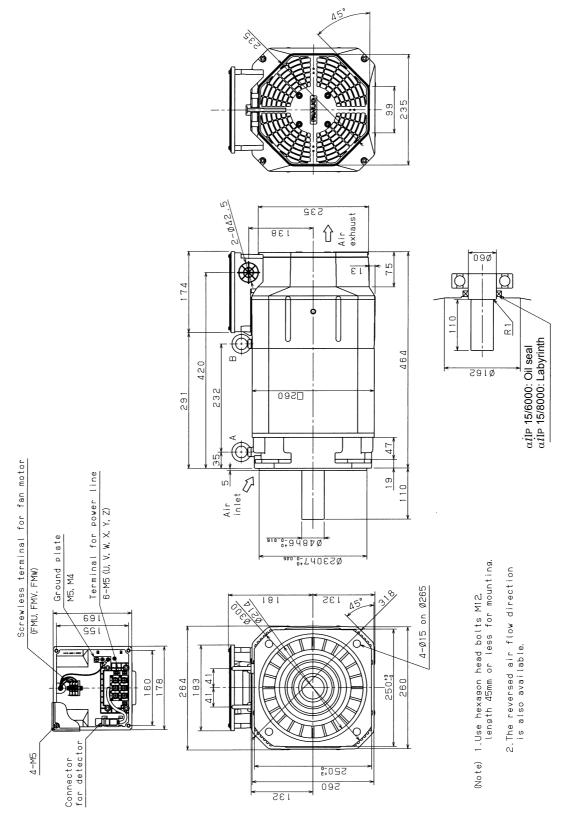
# 7.1 MODELS $\alpha i$ IP 12/6000 AND $\alpha i$ IP 12/8000 (FLANGE MOUNTING TYPE)



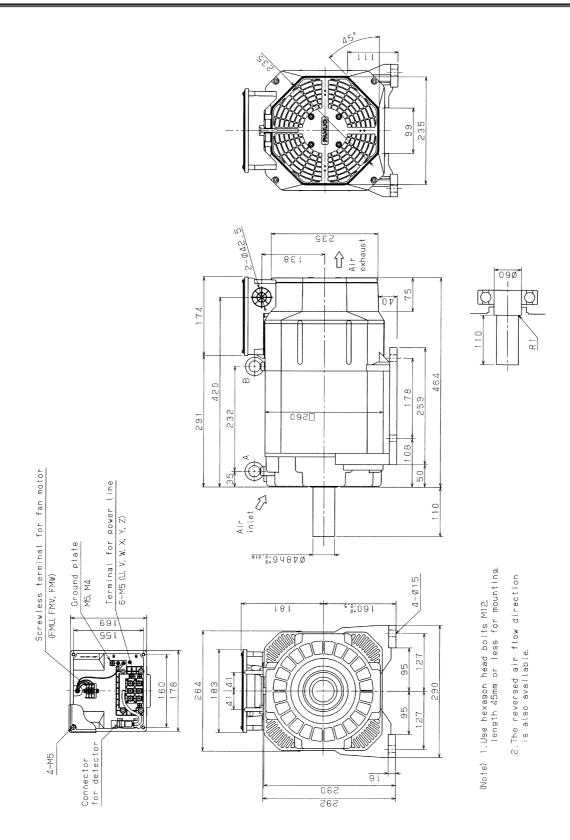
### 7.2 MODEL $\alpha i$ IP 12/6000 (FOOT MOUNTING TYPE)



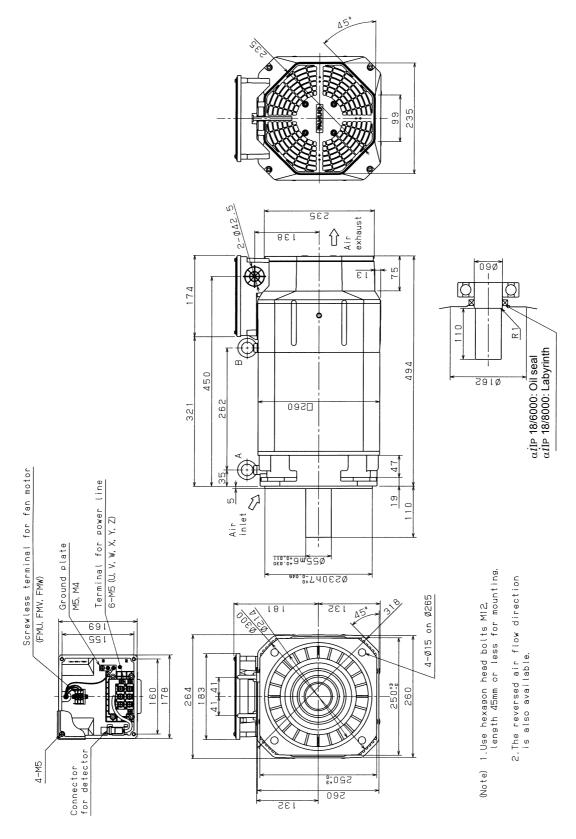
# 7.3 MODELS $\alpha i$ IP 15/6000 AND $\alpha i$ IP 15/8000 (FLANGE MOUNTING TYPE)



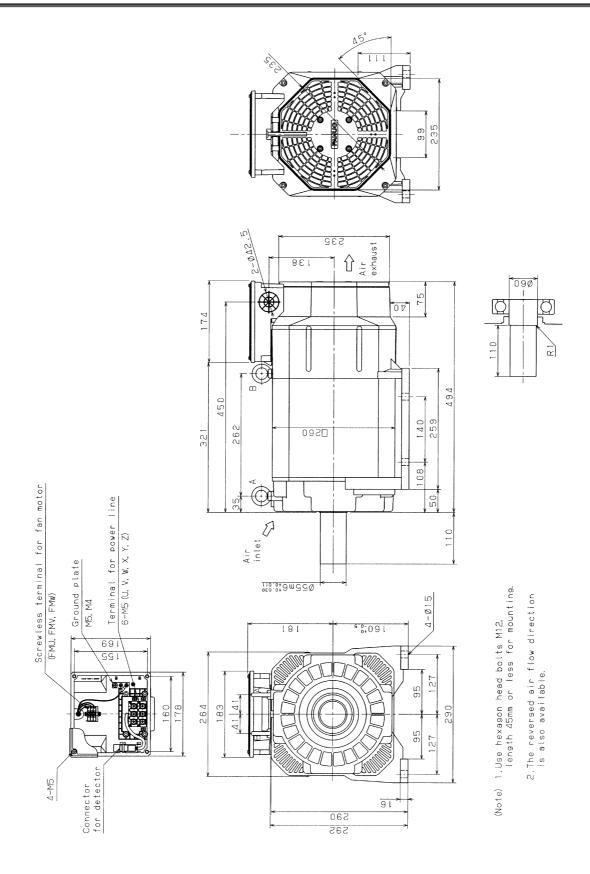
## 7.4 MODEL $\alpha i$ IP 15/6000 (FOOT MOUNTING TYPE)



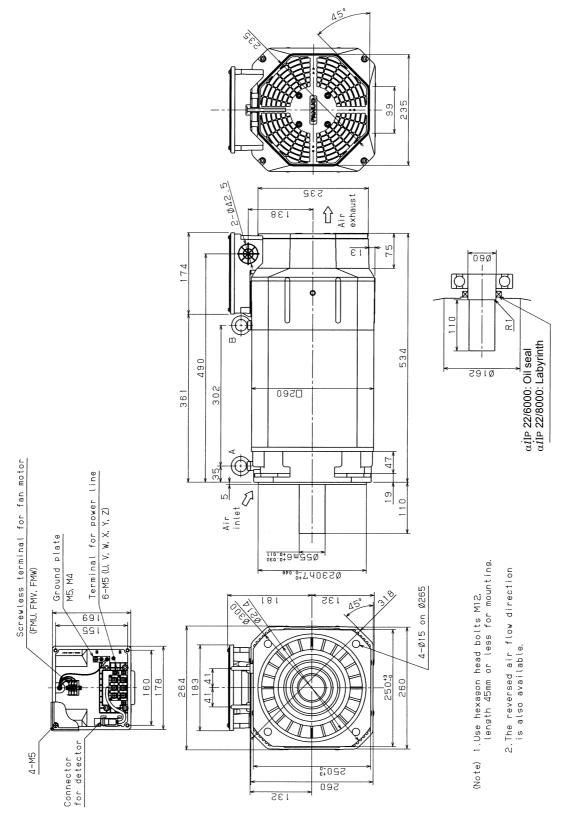
# 7.5 MODELS $\alpha i$ IP 18/6000 AND $\alpha i$ IP 18/8000 (FLANGE MOUNTING TYPE)



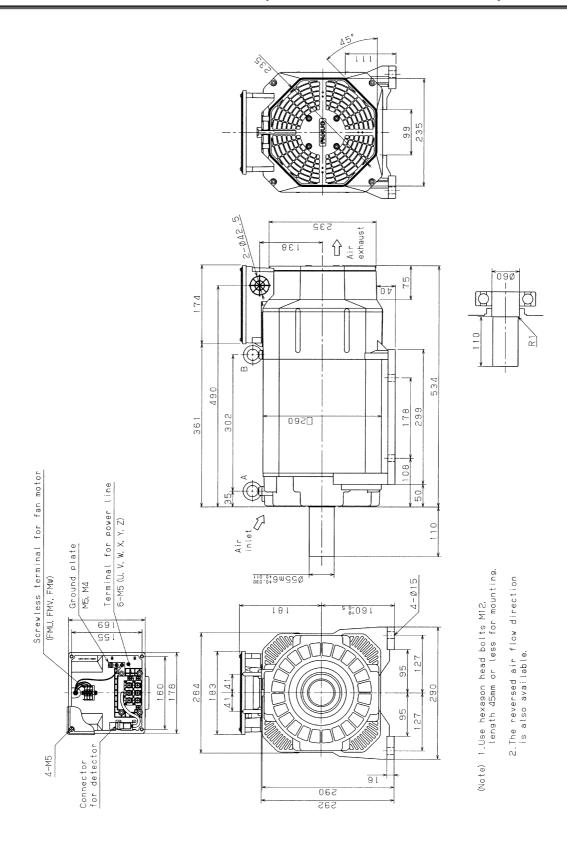
### 7.6 MODEL $\alpha i$ IP 18/6000 (FOOT MOUNTING TYPE)



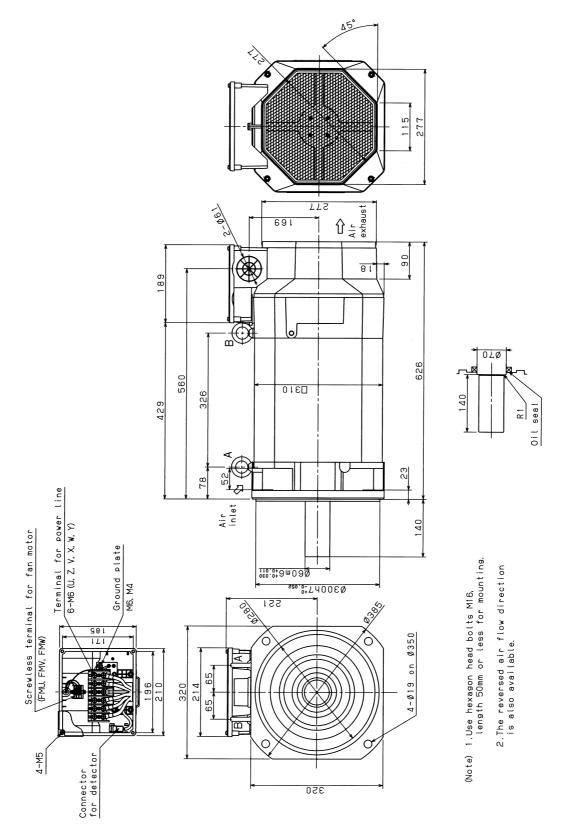
# 7.7 MODELS $\alpha i$ IP 22/6000 AND $\alpha i$ IP 22/8000 (FLANGE MOUNTING TYPE)



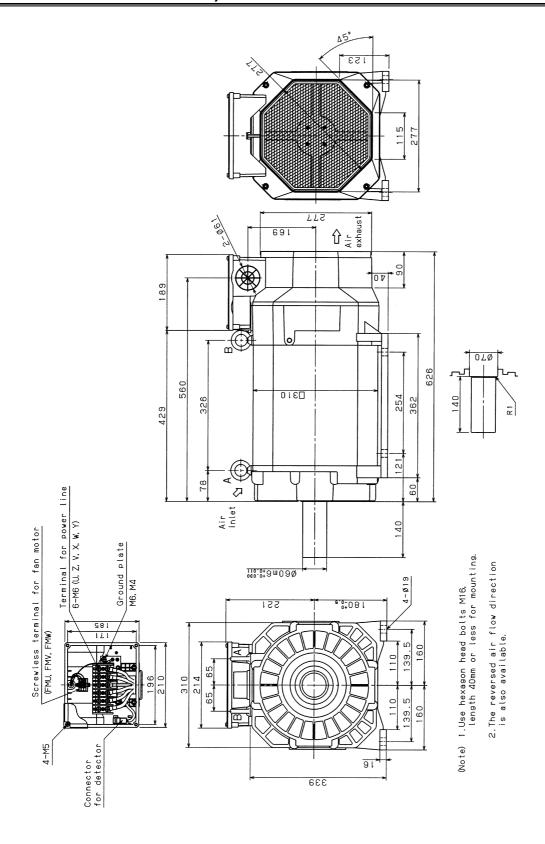
### 7.8 MODEL $\alpha i$ IP 22/6000 (FOOT MOUNTING TYPE)



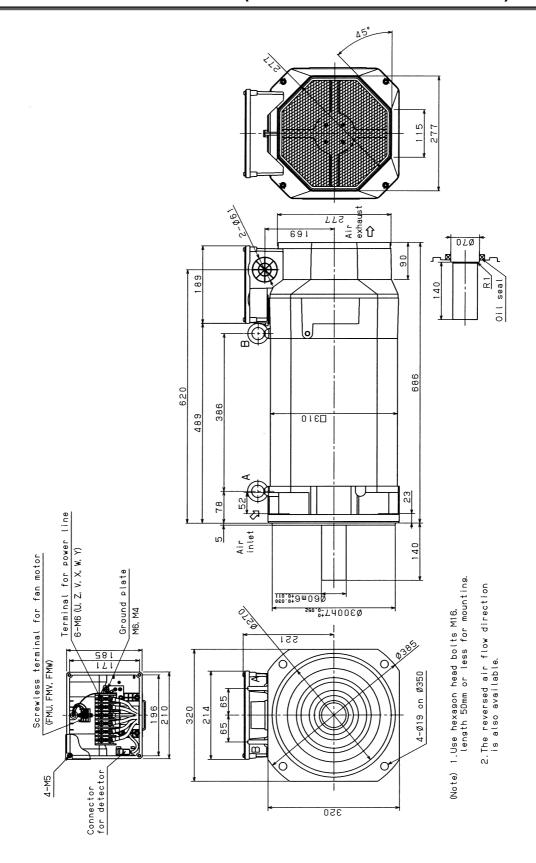
# 7.9 MODELS $\alpha i$ IP 30/6000 AND $\alpha i$ IP 40/6000 (FLANGE MOUNTING TYPE)



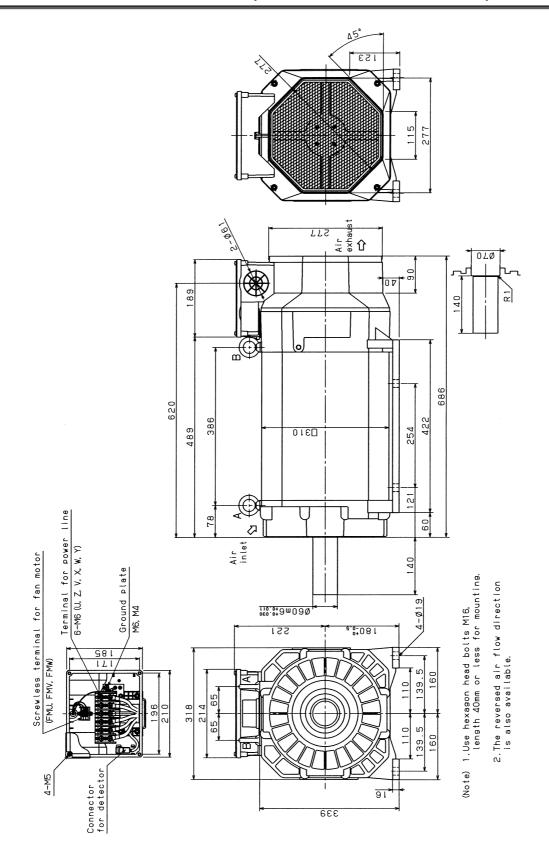
# 7.10 MODELS $\alpha i$ IP 30/6000 AND $\alpha i$ IP 40/6000 (FOOT MOUNTING TYPE)



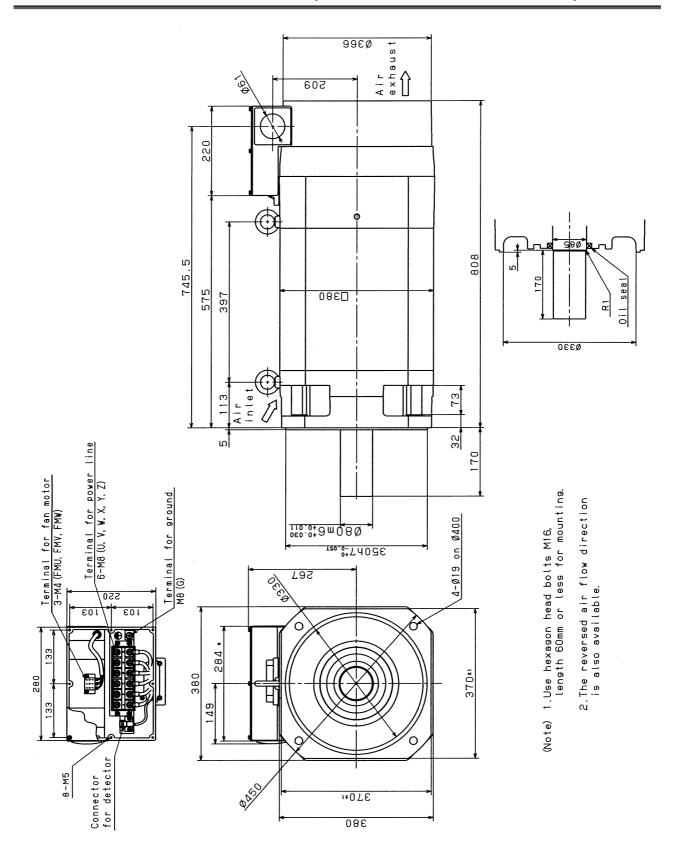
## 7.11 MODEL $\alpha i$ IP 50/6000 (FLANGE MOUNTING TYPE)



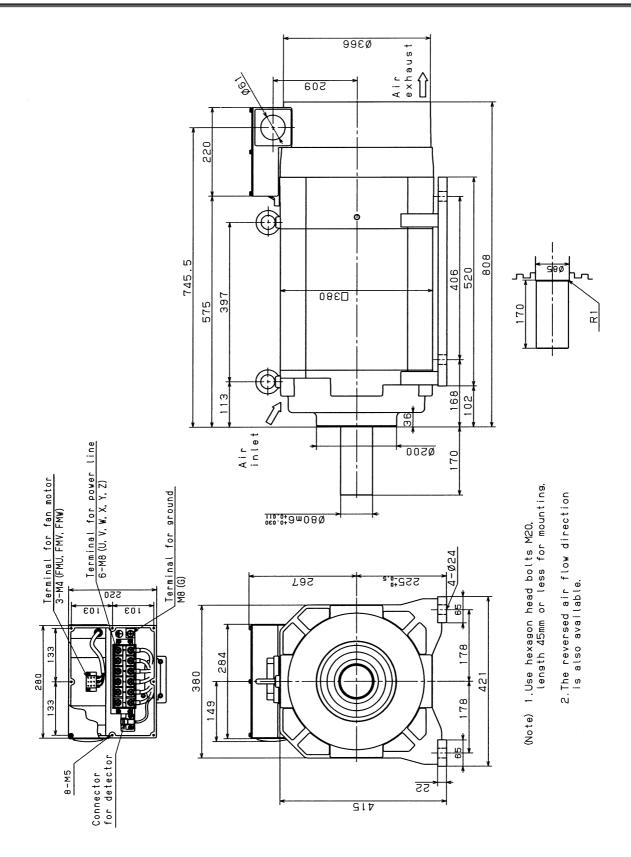
# 7.12 MODEL $\alpha i$ IP 50/6000 (FOOT MOUNTING TYPE)



### 7.13 MODEL $\alpha i$ IP 60/4500 (FLANGE MOUNTING TYPE)



# 7.14 MODEL $\alpha i$ IP 60/4500 (FOOT MOUNTING TYPE)



# V. FANUC AC SPINDLE MOTOR $\alpha i$ IP series 400V type

# 1

#### **GENERAL**

FANUC AC spindle motor  $\alpha i$ IP series 400V type is suitable for structural simplification by eliminating the machine spindle gear box.

#### **Features**

- As the rated output range is wide from 1:10 to 1:16, a gear box structure for speed change is not required, thereby allowing the structure of the machine to be simplified.
   Accordingly vibration and noise caused by the gear box
  - Accordingly, vibration and noise caused by the gear box structure is also eliminated.
- Improvement in efficiency of construction equipment
  Unnecessary use of time is reduced because it is not necessary to
  stop the spindle when switching the gear.
- Despite a compact configuration, a large low-speed torque can be obtained.
- The method of fan exhaust can be selected from either a exhaust front type or exhaust rear type, thus preventing heat deformation of the machine.
- Waterproof and pressure-proof design conforming to the international standard (IEC) is employed to improve reliability and make it resistant to most environments.

### **SPECIFICATIONS**

Series		lpha iIP series 400V type					
		lpha iIP 15/6000HV		α <i>İ</i> IP 22/6000HV			
	Model	Low-speed	High-speed	Low-speed	High-speed		
Item		winding	winding	winding	winding		
		(Y connection)	(∆ connection)	(Y connection)	(∆ connection)		
	Cont. rated kW	5	7.5	7.5	11		
	(HP)	(6.6)	(10)	(10)	(14.7)		
	30 min rated kW	9	9	15	15		
Output	[15 min]	(12)	(12)	(20.1)	(20.1)		
(*2)	(*3) (HP)	( /	( /	(====)	(==::)		
	S3 60% kW	9	9	15	15		
	[15%]	(12)	(12)	(20.1)	(20.1)		
	(*4)(*5) (HP)		25	25	20		
Rated current A	Cont. rated		25	25	38		
(*6)	30 min rated (*3) S3 60%, 15% (*4)		29	45	49		
Speed	Base speed	500	750	500	750		
min <sup>-1</sup>	Max. speed	1500	6000, 8000	1500	6000, 8000		
Cont. rated tord	que at const. rated torque range	95.5	95.5	143.2	140		
	N⋅m	(974)	(974)	(1461)	(1428)		
	(kgf·cm)				, ,		
Rotor inertia	kg·m²	0.09 0.128			_		
10/	kgf-cm-s <sup>2</sup>	0.93 1.29					
Wei	•	110 143 V5 (option V3)					
	Vibration		75dB(A) or less				
Coolin	Noise (*7)	Та	,		A.C.		
	ng system (*7) oling fan W	Totally enclosed and fan cooled IC0A6 56					
	oning ian w	Mount the motor		_	direction ranging		
Insta	allation (*8)	Mount the motor so that the output shaft points in a direction ranging within 45° degrees above the horizontal to vertically downwards.					
liloto	(3)	•		B6,IMB7,IMB8,IM	•		
Allowable ov	verload capacity (1 min) (*9)	120 % of 30 min rated output					
	Insulation	Class H					
An	nbient temperature	0 to 40 °C					
	Altitude	Height above sea level not exceeding 1000m					
	Painting color	Munsell system N2.5					
	Sensor	lpha iM sensor or $lpha i$ MZ sensor					
Type of thermal protection (*10)		TP211					
Resolution of the $\alpha i$ MZ sensor /rev.		4096					
Number of detected gear teeth per rotation		256					
λ/rev.							
Bearing lubrication			Gre	ease I			
iviaximum ou	tput during acceleration (*11) kW	13.5 20.0			0.0		
Applic	cable spindle amplifier	$\alpha i$ SP 15HV $\alpha i$ SP 30HV		30HV			
	Model	α <i>İ</i> Ι <sub>P</sub> 15/6000HV α <i>İ</i> Ι <sub>P</sub> 22/6000HV		6000HV			

	Series	lpha iIP series 400V type				
		α <i>İ</i> IP <b>40</b> /	6000HV	α <i>İ</i> IP 50/6000HV		
Item	Model	Low-speed winding (Y connection)	High-speed winding (Δ connection)	Low-speed winding (Y connection)	High-speed winding (Δ connection)	
	Cont. rated kW	13	18.5	22	22	
	(HP)	(17.3)	(24.8)	(29.5)	(29.5)	
	30 min rated kW	22	22	30	30	
Output	[15 min]	(29.5)	(29.5)	(40.2)	(40.2)	
(*2)	(*3) (HP)	(20.0)	(20.0)	(10.2)	(10.2)	
	S3 60% kW	22	22	30	30	
	[15%]	(29.5)	(29.5)	(40.2)	(40.2)	
	(*4)(*5) (HP)	24	F2	40	47	
Rated current A	Cont. rated	34	53	48	47	
(*6)	30 min rated (*3) S3 60%, 15% (*4)	54	61	59	59	
Speed	Base speed	400	575	575	1200	
min <sup>-1</sup>	Max. speed	1500	6000	1500	6000	
Cont. rated toro	que at const. rated torque range	310	307	365	175	
	N⋅m	(3165)	(3133)	(3726)	(1785)	
	(kgf⋅cm)	(5105)	(0100)	(3720)	(1700)	
Rotor inertia	kg·m²	0.295 0.355				
	kgf·cm·s <sup>2</sup>	3.0 3.6				
Wei	•	250 290				
	Vibration	V5 (option V3) 75dB(A) or less				
0 "	Noise				10	
	ng system (*7) poling fan W	10	otally enclosed and	d fan cooled IC0. 4	A6	
	allation (*8)	within 45° deg	so that the outpu rees above the ho B5,IMV1,IMB3,IM	t shaft points in a prizontal to vertica	lly downwards.	
Allowable ov	verload capacity (1 min) (*9)		120 % of 30 m	in rated output		
	Insulation			ss H		
An	nbient temperature	0 to 40 °C				
	Altitude	Height above sea level not exceeding 1000m				
	Painting color	Munsell system N2.5				
	Sensor	lpha iM sensor or $lpha i$ MZ sensor				
Type of thermal protection (*10)		TP211				
Resolution of the $\alpha i$ MZ sensor /rev.		4096				
Number of detected gear teeth per rotation $\lambda$ /rev.		256				
Bearing lubrication			Gre	ase		
Maximum ou	tput during acceleration (*11) kW	29.0 35.4			5.4	
Applic	cable spindle amplifier	αiSP	30HV	αiSP	30HV	
	Model	α <i>İ</i> IP 40/	6000HV	α <i>İ</i> IP 50/	6000HV	

Series		lpha iIP series 400V type				
	Model	lpha iIP <b>60</b> /-	4500HV			
ltem	Wiodei	Low-speed winding	High-speed winding			
		(Y connection)	(∆ connection)			
	Cont. rated kW	18.5	22			
  -	(HP)	(24.8)	(29.5)			
0	30 min rated kW	30	30			
Output	[15 min]	(40.2)	(40.2)			
(*2)	(*3) (HP) S3 60% kW					
	[15%]	30	30			
	(*4)(*5) (HP)	(40.2)	(40.2)			
	Cont. rated	44	53			
Rated current A	30 min rated (*3)	0.7	00			
(*6)	S3 60%, 15% (*4)	67	66			
Speed	Base speed	400	750			
min <sup>-1</sup>	Max. speed	1500	4500			
Cont. rated torq	ue at const. rated torque range	442	280			
	N·m	(4504)	(2850)			
	(kgf⋅cm) kg⋅m²		. ,			
Rotor inertia	кg·m kgf·cm·s²	0.4				
Wei		5.0 468				
VVCI	Vibration	V10 (option V5)				
	Noise	80dB(A)	•			
Coolir	ng system (*7)	Totally enclosed and fan cooled IC0A6				
	oling fan W	18				
		Mount the motor so that the output shaft points in a direction ranging				
Insta	allation (*8)	within 45° degrees above the ho	rizontal to vertically downwards.			
		IMB5,IMV1,IMB3,IMI				
Allowable overload capacity (1 min) (*9)		120 % of 30 m				
Insulation		Clas				
An	nbient temperature	0 to 4				
	Altitude Painting color	Height above sea level				
		$\alpha i$ M sensor or	stem N2.5			
T f	Sensor					
Type of thermal protection (*10)		TP211				
Resolution of the $\alpha i$ MZ sensor /rev.		4096				
Number of detected gear teeth per rotation		256				
λ/rev. Bearing lubrication						
	tput during acceleration (*11)	Grease				
Waxiiiaiii ou	kW	36				
Applia	cable spindle amplifier	αiSP	30HV			
		α <i>i</i> IP 60/4500HV				
Model		α <i>ι</i> 1 Ρ <b>6</b> 0/4	700011V			

- (\*1) When the output switch function is used, the CNC soft option and switching magnetic contactor unit associated with the output switch function  $(Y-\Delta \text{ switch})$  are required.
  - See FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN) for details of the output switch control.
- (\*2) The rated output is guaranteed at the rated voltage. (Amplifier input: 400/480 VAC + 10% -15%,  $50/60 \text{ Hz} \pm 1 \text{Hz}$ ) If the input voltage fluctuates, it is possible that the rated output cannot be obtained even when such fluctuations are within the allowable fluctuation range.
- (\*3) The output for low-speed winding models other than  $\alpha i \text{IP } 50/6000 \text{HV}$  and  $\alpha i \text{IP } 60/4500 \text{HV}$  is 15 min rated.
- (\*4) S3 15% for low-speed winding models other than  $\alpha i$ IP 50/6000HV and  $\alpha i$ IP 60/4500HV. S3 25% for low-speed winding of  $\alpha i$ IP 50/6000HV and  $\alpha i$ IP 60/4500HV
- (\*5) The cycle time is 10 minutes, S3 60%: ON 6 minutes, OFF 4 minutes, S3 25%: ON 2.5 minutes, OFF 7.5 minutes and S3 15%: ON 1.5 minutes, OFF 8.5 minutes.
- (\*6) The rated current is not a guaranteed value but a guideline for the maximum current at each rated output.
- (\*7) IC code conforms to IEC 34-6.
- (\*8) IM code conforms to IEC 34-7.
- (\*9) This is not a guaranteed value but a guideline for the maximum motor output at a rated supply voltage.
- (\*10) Type conforms to IEC 34-11.
- (\*11) These values are to be used only as guidance for selecting a power supply ( $\alpha iPS$ ) and are not guaranteed.
- (\*12) Degree of protection: with oil seal: IP54, without oil seal: IP40.

# 3

## **OUTPUT/TORQUE CHARACTERISTICS**

# Reference Calculation for torque

Torque T can be obtained by the following equation.

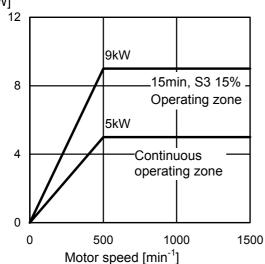
 $T[N\cdot m]=P[kW]\times 1000/0.1047/N[min^{-1}]$  P[kW]: Motor output  $N[min^{-1}]:$  Motor speed

When the unit of T is [kgf·m],  $T[kgf·m]=P[kW]\times1000/1.0269/N[min^{-1}]$ 

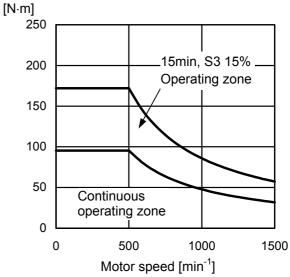
## 3.1 MODEL $\alpha i$ IP 15/6000HV

Applicable amplifier  $\alpha i$ SP 15HV

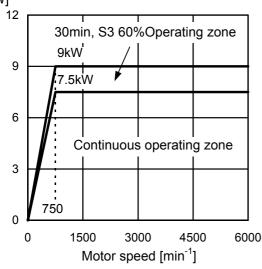
Low-speed winding output (Y connection) [kW]



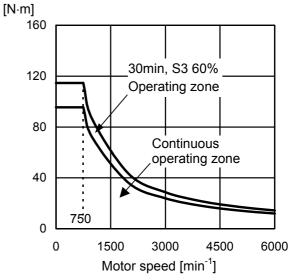
Low-speed winding torque (Y connection)



 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:likelihood}$  [kW]



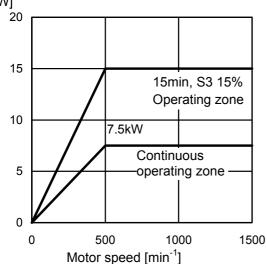
 $\mbox{High-speed winding torque } (\Delta \mbox{ connection})$ 



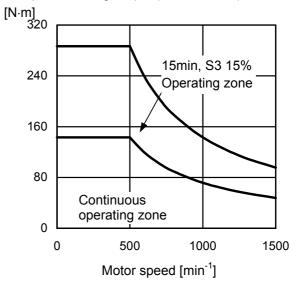
## 3.2 MODEL $\alpha i$ IP 22/6000HV

Applicable amplifier  $\alpha i$ SP 30HV

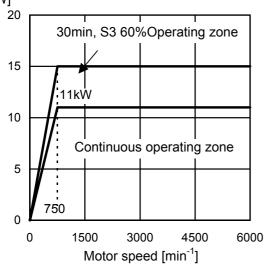
Low-speed winding output (Y connection) [kW]



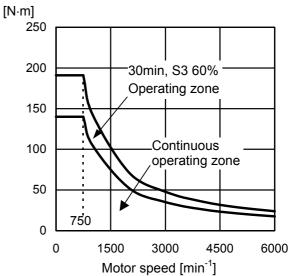
Low-speed winding torque (Y connection)



 $\mbox{High-speed winding output } (\Delta \mbox{ connection}) \label{eq:likelihood}$  [kW]

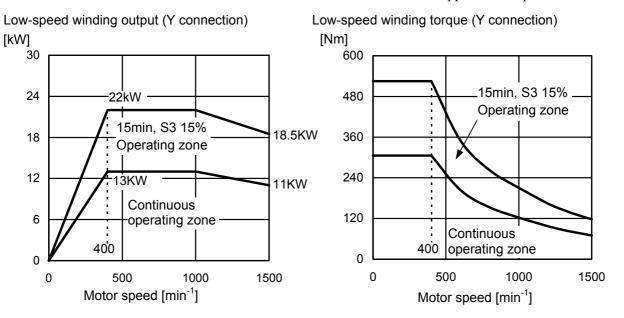


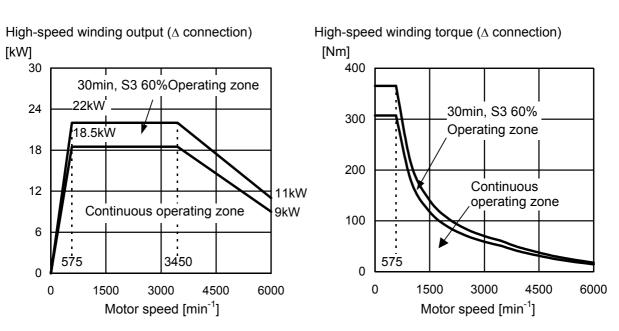
High-speed winding torque ( $\Delta$  connection)



## 3.3 MODEL $\alpha i$ IP 40/6000HV

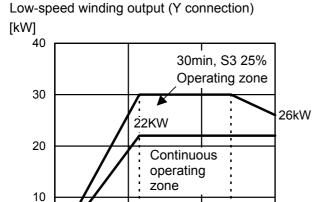
Applicable amplifier  $\alpha i$ SP 30HV





## 3.4 MODEL $\alpha i$ IP 50/6000HV

Applicable amplifier  $\alpha i$ SP 30HV



1200

1500

1000

Low-speed winding torque (Y connection) [N·m] 600 .30min, S3 25% 480 Operating zone 360 240 120 Continuous 575 operating zone 0 0 500 1000 1500

High-speed winding output ( $\Delta$  connection) [kW]

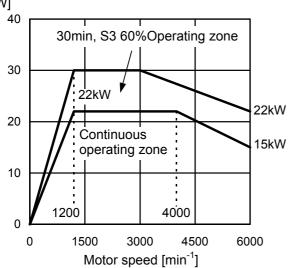
575

Motor speed [min<sup>-1</sup>]

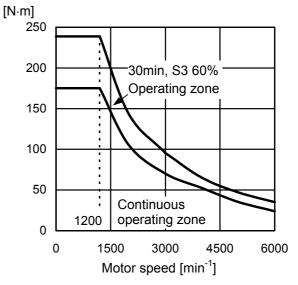
500

0

0



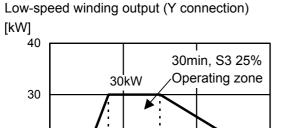
High-speed winding torque ( $\Delta$  connection)

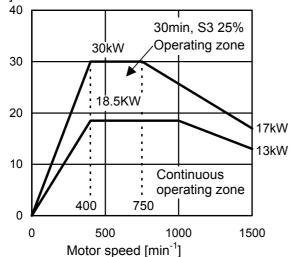


Motor speed [min<sup>-1</sup>]

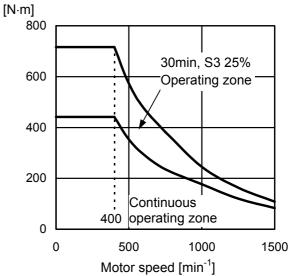
#### 3.5 MODEL $\alpha i$ IP 60/4500HV

Applicable amplifier  $\alpha i$ SP 30HV

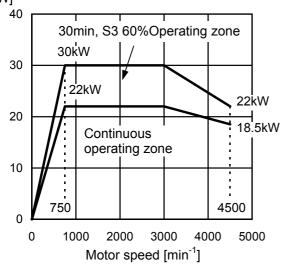




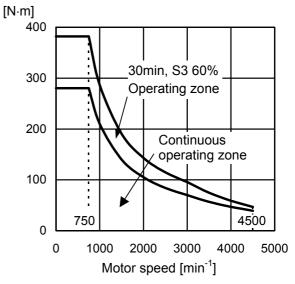
Low-speed winding torque (Y connection)



High-speed winding output (∆ connection) [kW]



High-speed winding torque (∆ connection)





## **CONNECTIONS**

## **4.1** MODELS $\alpha i$ IP 15/6000HV TO $\alpha i$ IP 60/4500HV

Cables for the power lead and fan motor are connected to the terminal block.

 $\alpha iM$  sensor or  $\alpha iMZ$  sensor signal or thermo stat signal use a connector manufactured by Tyco Electronics AMP.

The connector housing and the connector are attached to the motor.

Size of screws used in	Power	lead	Fan motor
the terminal block	U,V,W,G	X,Y,Z	FMU,FMV,FMW
α <i>İ</i> IP 15/6000HV	M5	M5	Screw-less terminal block
lpha iIP 22/6000HV	1410	1110	Corew lede terriiriai biook
α <i>İ</i> IP 40/6000HV	M6	M6	Screw-less terminal block
lpha iIP 50/6000HV	IVIO	IVIO	Ociew-less terrilliai block
α <i>İ</i> IP 60/4500HV	M8	M8	M3.5

#### Cable for the power lead

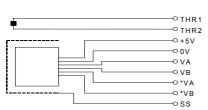
For the power lead cable specification, refer to "FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN)".

#### Cable for the fan motor

For the fan motor current value and cable specifications, refer to Section I.4.3, "FAN MOTOR CONNECTION" in this manual.

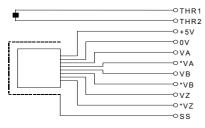
#### 4.2 **CONNECTION OF SIGNAL LEAD**

### Connector attachment for a motor with a built-in $\alpha iM$ sensor



Connector pins arrangement						
Number	B1	B2	B3	B4	B5	В6
Color						
Signal		*VA	*VB		0V	THR2
Number	A1	A2	A3	A4	A5	A6
Color						
Signal	+5V	VA	VB		SS	THR1

## Connector attachment for a motor with a built-in $lpha \emph{i}$ MZ sensor



Connector pins arrangement						
Number	B1	B2	В3	B4	B5	В6
Color						
Signal		*VA	*VB	*VZ	0V	THR2
Number	A1	A2	A3	A4	A5	A6
Color						
Signal	+5V	VA	VB	VZ	SS	THR1

### - Connector housing and contact specifications

Connector and contact:

Tyco Electronics AMP specification D-3000 series

	Motors	side	Cable side	
	FANUC specification	Manuafacture specification	FANUC specification	Manuafacture specification
Housing	A63L-0001-0535/121KDF	178964-6	A63L-0001-0460/121KD	178289-6
Contact	A63L-0001-0456/ASMT	175288-2	A63L-0001-0456/ASM	1-175217-2

Crimping tool: 91559-1 Extractor: 234168-1

### - Thermistor specification

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).

# 5

### ALLOWABLE RADIAL LOAD

Use the motor output shaft below the allowable radial loads shown in the table below.

	Allowable radial load (kgf)			
Model	At output shaft end	At output shaft end		
lpha iIP 15/6000HV	2940N (300kgf)	3410N (348kgf)		
lpha iIP 22/6000HV	4410N (450kgf)	4988N (509kgf)		
$lpha\dot{i}$ IP 40/6000HV, $lpha\dot{i}$ IP 50/6000HV	5390N (550kgf)	6134N (626kgf)		
lpha iIP 60/4500HV	_	19600N (2000kgf)		

#### **NOTE**

- 1 When using a belt, adjust the tension so the allowable loads indicated above are not exceeded. If an excessive load is applied, consider the use of a support bearing on the machine side to maintain the long-term reliability of the motor. (If an excessive load is applied, it is possible that an abnormal sound may occur.)
- 2 When the belt tension is maximized at a point outside the output shaft end, the allowable loads are less than those at the output shaft end.
- 3 If a thrust load is applied when a helical gear is used, the shaft moves in the direction of the thrust. So, as a general rule, never apply a thrust load.

# 6

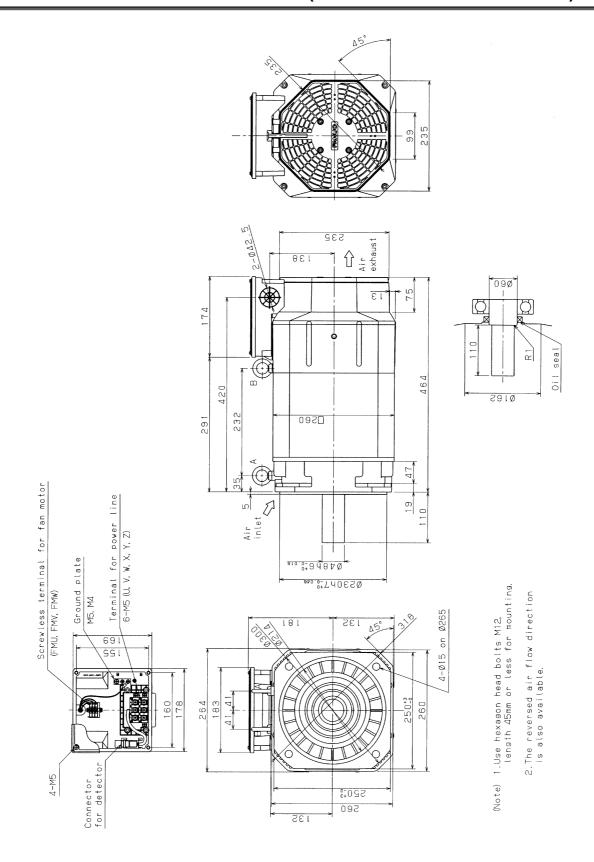
## **ASSEMBLING ACCURACY**

Model	α <i>i</i> I <sub>P</sub> 15HV α <i>i</i> I <sub>P</sub> 22HV	lpha iIP 40HV to $lpha i$ IP 60HV	Measuring method
Run-out at the end of the output shaft	20μm or less	20μm or less	1/2 the output shaft length
Run-out of the faucet joint for mounting the flange against the core of the shaft (only for flange type)	40μm or less	60μm or less	10
Run-out of the flange mounting surface against the core of the shaft (only for flange type)	80μm or less	100μm or less	10

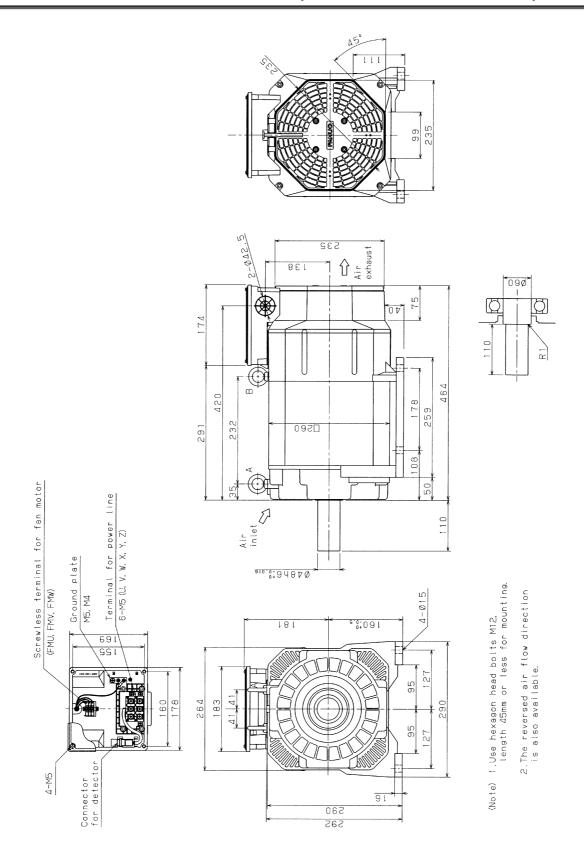
## **EXTERNAL DIMENSIONS**

Model name	Section
Model $lpha i$ IP 15/6000HV (flange mounting type)	7.1
Model $\alpha \dot{i}$ IP 15/6000HV (foot mounting type)	7.2
Model αİΡ 22/6000HV (flange mounting type)	7.3
Model αi IP 22/6000HV (foot mounting type)	7.4
Model αİP 40/6000HV (flange mounting type)	7.5
Model αi IP 40/6000HV ((oot mounting type)	7.6
Model αİP 50/6000HV (flange mounting type)	7.7
Model α <i>İ</i> IP 50/6000HV (foot mounting type)	7.8
Model αİP 60/4500HV (flange mounting type)	7.9
Model αİP 60/4500HV (foot mounting type)	7.10

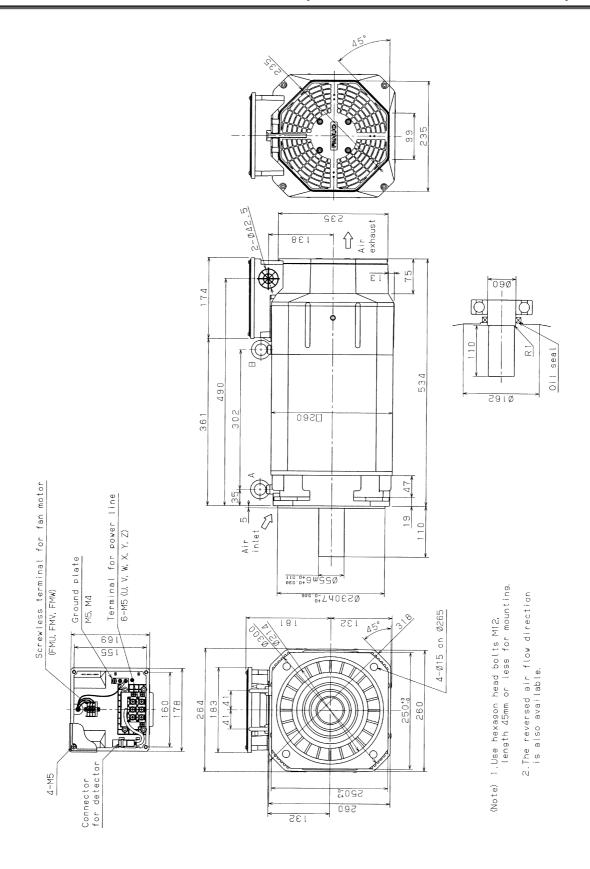
# 7.1 MODEL $\alpha i$ IP 15/6000HV (FLANGE MOUNTING TYPE)



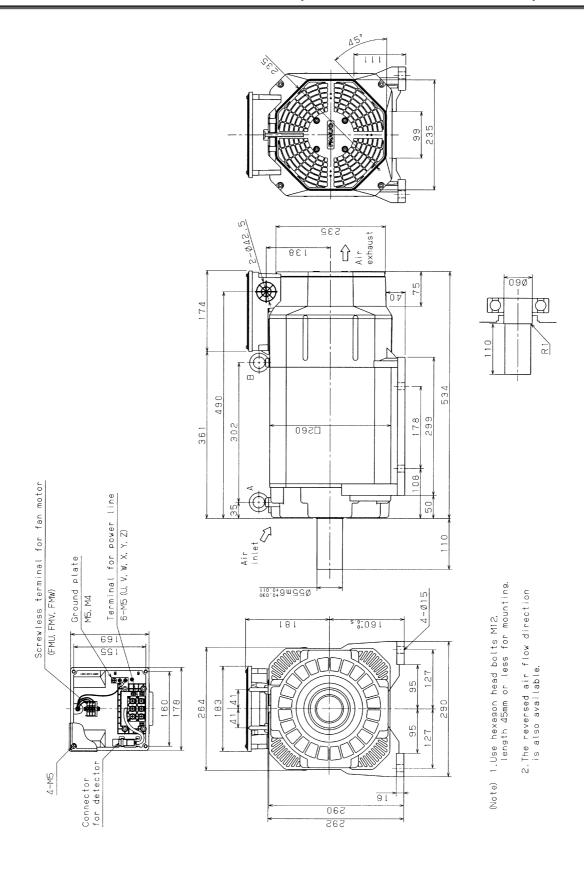
# 7.2 MODEL $\alpha i$ IP 15/6000HV (FOOT MOUNTING TYPE)



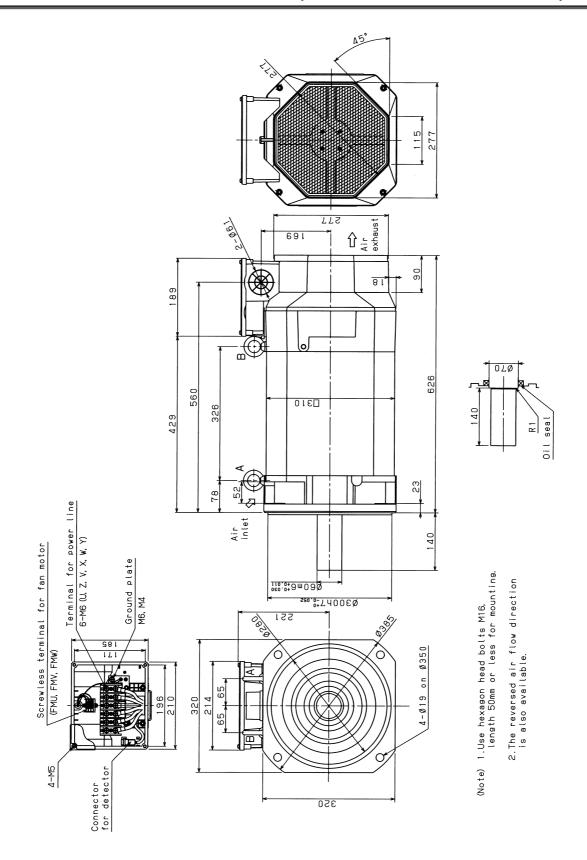
# 7.3 MODEL $\alpha i$ IP 22/6000HV (FLANGE MOUNTING TYPE)



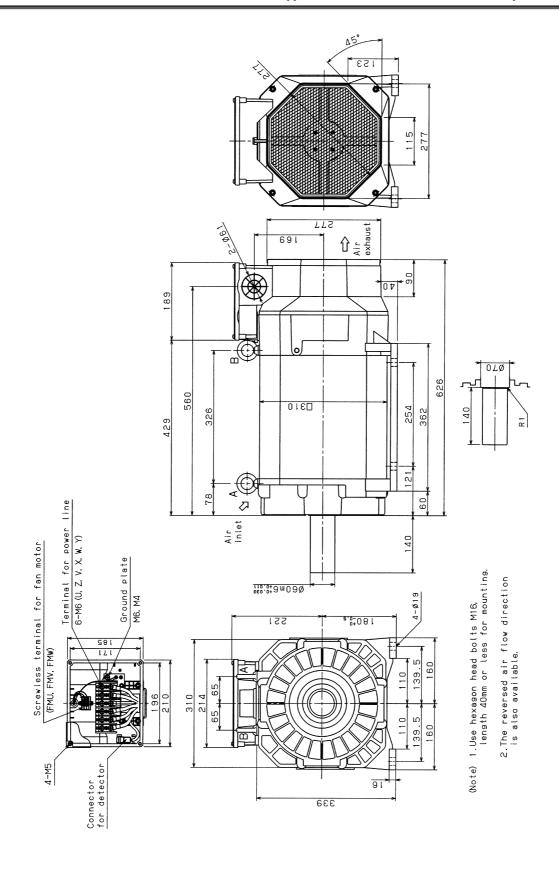
# 7.4 MODEL $\alpha i$ IP 22/6000HV (FOOT MOUNTING TYPE)



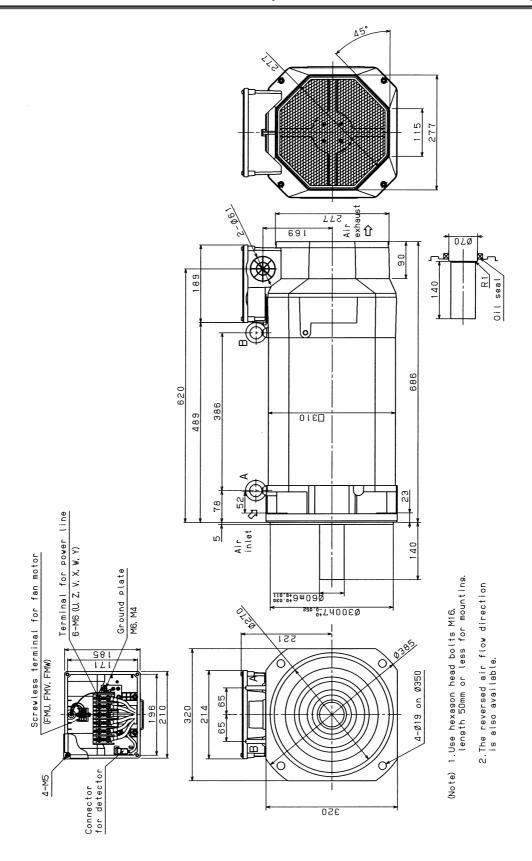
# 7.5 MODEL $\alpha i$ IP 40/6000HV (FLANGE MOUNTING TYPE)



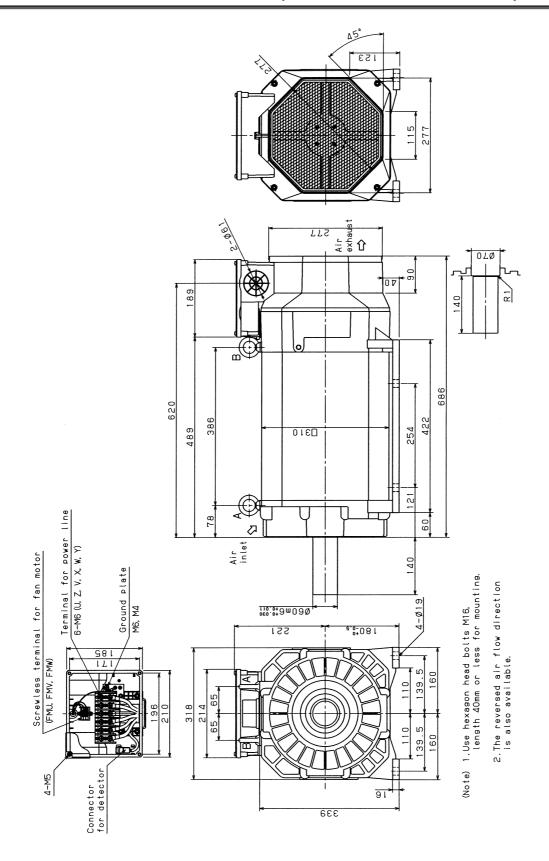
# 7.6 MODEL $\alpha i$ IP 40/6000HV ((OOT MOUNTING TYPE)



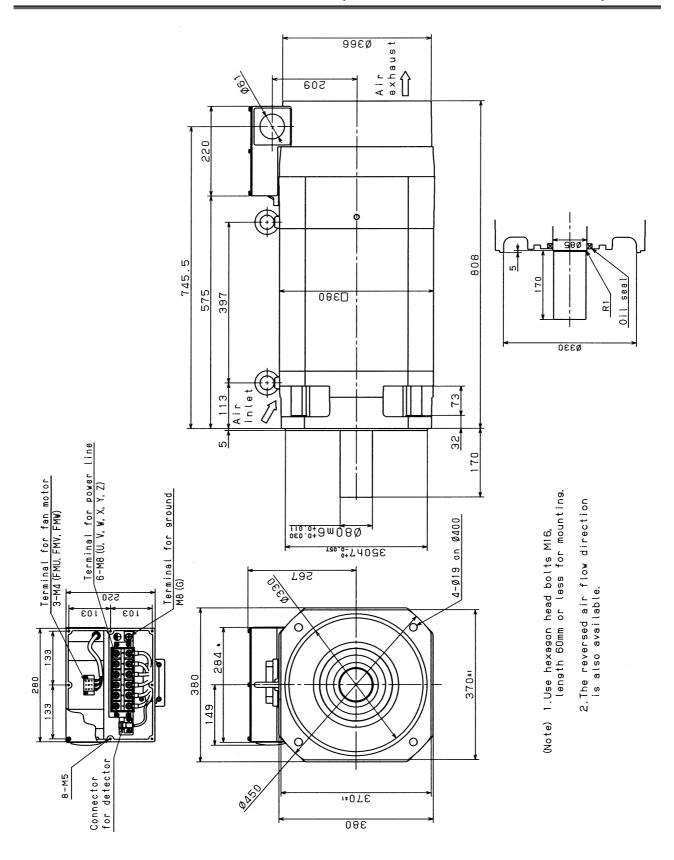
# 7.7 MODEL $\alpha i$ IP 50/6000HV (FLANGE MOUNTING TYPE)



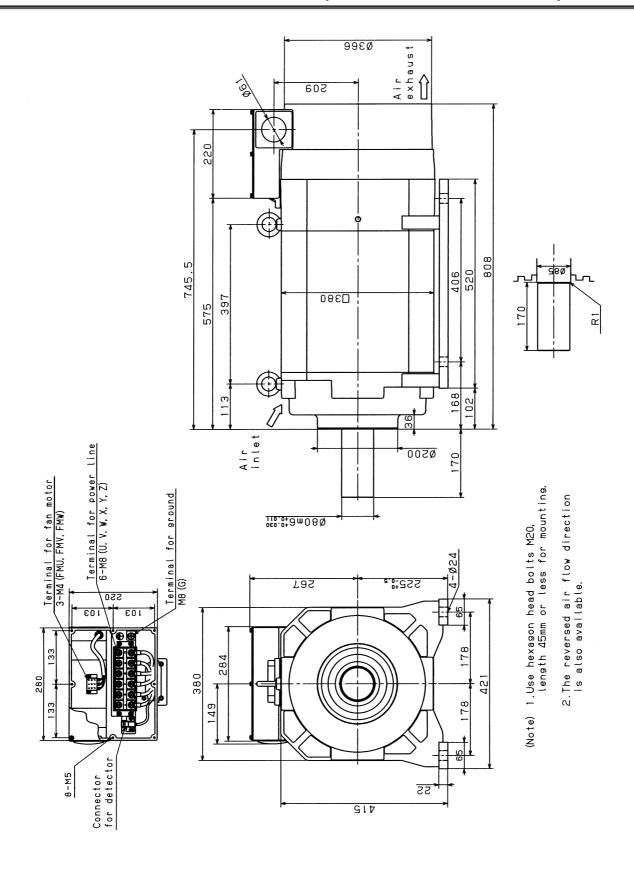
# 7.8 MODEL $\alpha i$ IP 50/6000HV (FOOT MOUNTING TYPE)



# 7.9 MODEL $\alpha i$ IP 60/4500HV (FLANGE MOUNTING TYPE)



# 7.10 MODEL $\alpha i$ IP 60/4500HV (FOOT MOUNTING TYPE)



# VI. FANUC AC SPINDLE MOTOR $\alpha i$ IT series 200V type

1

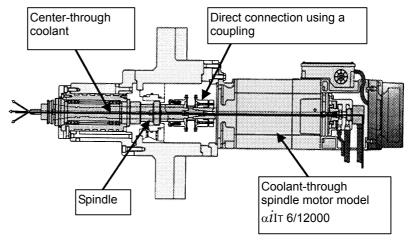
### **GENERAL**

#### **Features**

By directly connecting the spindle with a spindle motor (hollow shaft), higher-speed spindle rotation and highly efficient center-through coolant machining are enabled. A spindle of direct motor connection type is connected with a motor by using a coupling, so that this type of spindle has several advantages. For example, transfer of heat produced by the motor to the spindle is minimized, and each of the motor and spindle can be maintained separately.

Item of comparison	Belt driving, gear driving	Direct motor connection
Sindle rotation speed	-	Higher
Spindle vibration	-	Lower
Spindle heat-up	-	Lower

### **Example of spindle of direct motor connection structure**



#### Features of a spindle of direct motor connection type

- <1> Higher-speed spindle rotation can be achieved.
- <2> Transfer of heat produced by the motor to the spindle is minimized.
- <3> Each of the motor and spindle can be maintained separately.

#### Caution

- (1) For attachment of this type of motor to a spindle, only coupling-based direct connection with the spindle is allowed. When a spindle of direct motor connection type is used, fretting can occur with the motor shaft in a short-time operation, or the bearing of the spindle or motor can be damaged if the spindle and motor are not aligned precisely. As the method of quantitatively determining whether a spindle and motor are aligned precisely, FANUC recommends the user to measure the vibration (acceleration G) of the motor after being connected with the spindle. For details, see Section 9.3, "CHECKING MOTOR VIBRATION" in this manual.
- (2) Do not apply a thrust load onto the motor shaft. Select a coupling that does not apply a thrust load onto the motor shaft for a cause such as coolant pressure when the temperature rises or cutting is performed.

# 2

## **SPECIFICATIONS**

	Model	α <i>ἱ</i> Ιτ 1.5/20000	α <i>ἱ</i> Ιτ 2/20000	α <i>ἱ</i> Ιτ 3/12000		
Item	10.110					
	(S1)Cont. rated kW	1.5	2.2	3.7		
Output	(HP) (S2)30 min rated kW	(2.0)	(3.0)	(5.0)		
Ծաւթաւ (*1)	` '			5.5		
( 1)	[15 min](*2)(HP)	(3.0)	(5.0) 3.7	(7.4) 5.5		
	(S3)60%[40%]kW (*3) (*4) (HP)	(3.0)	(5.0)	(7.4)		
Rated		, ,	` '	` <i>`</i>		
current	(S1) A	28	41	36		
(*5)	(S2),(S3) A	33	53	46		
	Base speed	3,000	3,000	1,500		
min <sup>-1</sup>	Max. speed	20,000	20,000	12,000		
	rated torque at const.					
	ated torque range					
	N·m	4.77	7.0	23.5		
	(kgf·cm)	(48.7)	(71.5)	(240)		
Rotor	kg·m²	0.0043	0.0078	0.0148		
inertia	(kgf·cm·s <sup>2</sup> )	(0.04)	(0.08)	(0.15)		
Weight	kgf	24 27 46				
Vibration	1	V3 (rotation component)				
Noise		75dB(A) or less				
Cooling	system (*6)	Totally enclosed and fan cooled (IC0A6)				
Cooling	fan W	17				
Installati	on (*7)		the output shaft points in a dilly to vertically downwards. (IN			
Allowabl	e overload capacity		-			
(1 min)			120% of (S2)			
Insulatio	n		Class H			
Ambient	temperature		0°C to 40°C			
Altitude		Height a	above sea level not exceeding	g 1000m		
Painting	color		Munsell system N2.5			
Type of	thermal protection (*9)		TP211			
Resolution	on of the		Built-in with $lpha i$ MZ sensor			
built-in s	ensor p/rev		2048			
Number	of detected gear teeth		128			
per rotat	ion λ/rev.		120			
Bearing	lubrication		Grease			
	d seal, protection		Simplified labyrinth: IP40			
format (I		Simplified labyfillul. 1P40				
	of connection with the	To he	e directly connected with the s	pindle		
spindle	\ /	To be directly confidenced with the spiritie				
	e thrust load (*11)kgf	6				
	m output during	13.0	20.0	13.0		
accelera	` '					
Applicab	le spindle amplifier	$\alpha i$ SP 15 $\alpha i$ SP 22 $\alpha i$ SP 11				

<sup>\*</sup> See Page 260 for Cautions and limitations.

Model		$\alpha i$ IT 6	5/12000	$\alpha i$ IT 8	/12000			
Connection	on (*13)		Low-speed winding (Y connection)	High-speed winding (∆ connection)	Low-speed winding (Y connection)	High-speed winding (∆ connection)		
	(S1)Cont. rated	kW (HP)	5.5 (7.4)	5.5 (7.4)	7.5 (10)	7.5 (7.5)		
Output (*1)	(S2)30 min rated	kW (HP)	7.5 (10)	7.5 (10)	11 (14.7)	11 (14.7)		
	(\$3)60% (*4)	kW (HP)	7.5 (10)	7.5 (10)	11 (14.7)	11 (14.7)		
Rated current	(S1)	Α	37	38	49	51		
(*5)	(S2),(S3)	Α	47	45	61	62		
Speed	Base speed		1,500	4,000	1,500	4,000		
min <sup>-1</sup>	Max. speed	1	12,000	12,000	12,000	12,000		
Switching Cont. rat	ed torque at const. torque range N·m (kgf·cm)	min <sup>-1</sup> . rated	35.0 (357)	13.2 (134)	47.7 (487)	17.9 (182.7)		
Rotor ine	(kgf·cm·s-)		0.0179			28)		
Weight Vibration	kgf			51 V3 (rotation)	-	80		
Noise			V3 (rotation component) 75dB(A) or less					
Cooling system (*6)				Totally enclosed and				
Cooling fa				20	, ,			
Installatio				so that the output shaf	•	• •		
(1 min)	overload capacity (*8)			120% (				
Insulation				Clas				
	emperature			0°C to				
Altitude Painting o	color		ŀ	<u>Height above sea level</u> Munsell sy:		П		
	nermal protection	(*9)						
Resolutio		( 5)	TP211  Built-in with $\alpha i$ MZ sensor					
built-in se				4096				
Number o	of detected gear tee λ/rev.	eth per		25				
	ubrication		Grease					
Shaft end (IEC34)	seal, protection fo	ormat	Simplified labyrinth: IP40					
spindle	f connection with th (*10)		To be directly connected with the spindle					
	` ` '	kgf		1;	3			
accelerat				3.0	13			
Applicable	e spindle amplifier		α <i>i</i> SI	P 15	α <i>İ</i> SF	P 15		

<sup>\*</sup> See Page 260 for Cautions and limitations.

Item		α <i>ἱ</i> Ιτ 8	/4.5000	~ iI+ 45	5/4,0000	
		α.ι11 δι	715000	αίΙτ 15/10000		
Connection (*13)		Low-speed winding (Y connection)	High-speed winding (∆ connection)	Low-speed winding (Y connection)	High-speed winding (Δ connection)	
	(S1)Cont. rated kW (HP)	7.5 (10)	7.5 (10)	15 (20.1)	15 (20.1)	
Output	(S2)30 min rated kW (HP)	11 (14.7)	11 (14.7)	18.5 (24.8)	18.5 (24.8)	
(*1)	(S2) 10 min rated kW (HP)	15.0 (20.1)	15.0 (20.1)	-	-	
	(S3)60% kW (*4) (HP)	-	-	18.5 (24.8)	18.5 (24.8)	
Rated current	(S1) A	70	74	70	71	
(*5)	(S2),(S3) A	108	107	82	81	
	Base speed	1,500	4,000	1,500	4,000	
mın   Switchinç min <sup>-1</sup>	Max. speed g speed	4,000	15,000	10,000	10,000	
Cont. r	ated torque at const. ted torque range  N·m  (kgf·cm)	47.7 (487)	17.9 (182)	95.4 (974)	35.8 (365)	
Rotor ine	kg·m²	0.0275 (0.28)		0.09 (0.93)		
Weight	kgf	80			10	
Vibration			V3 (rotation		· •	
Noise			75dB(A)	) or less		
Cooling s	system (*6)		Totally enclosed and	d fan cooled (IC0A6)		
Cooling f	fan W	2			66	
Installatio	on (*7)		so that the output shat orizontally to vertically o	•	• •	
Allowable (1 min)	e overload capacity		120%	of (S2)		
Insulation	` '		Clas	ss H		
	temperature		0°C to			
Altitude	•		Height above sea leve		1	
Painting	color		Munsell sy	stem N2.5		
Type of t	thermal protection (*9)		TP	211		
Resolution built-in se			Built-in with o			
	of detected gear teeth	/50				
	lubrication	Grease				
	d seal, protection		Simplified la			
	of connection with the		To be directly conne	cted with the spindle		
	e thrust load (*11) kgf		1	3		
Maximun	m output during tion (*12) kW	28			2.2	
	le spindle amplifier	aisi	P 26	ais	P 22	

<sup>\*</sup> See Page 260 for Cautions and limitations.

Connection (*13)	v-speed winding Y connection)  15 (20.1)  18.5 (24.8)  22 (29.5)  -  76  104 1,400 4,000  3,4	High-speed winding (Y connection)  15 (20.1) 18.5 (24.8) 22 (29.5)  - 86 108 5,000 15,000	Low-speed winding (Y connection)  22 (29.5)  26 (34.9)  -  26 (34.9)  100  111  1,500  10,000  4,0	High-speed winding (Δ connection)  22 (29.5)  26 (34.9)  -  26 (34.9)  101  112  4,000  10,000	
Connection (*13)  (S1)Cont. rated kW (HP)  (S2)30 min rated kW (HP)  (*1)  (S2) 15 min rated kW (HP)  (S3)40% kW (*3)(*4) (HP)  Rated (S1) A  current (*5)  (S2),(S3) A  Speed Base speed min <sup>-1</sup> Max. speed  Switching speed min <sup>-1</sup> Cont. rated torque at const. rated torque range N·m (kgf·cm)	Y connection)  15 (20.1)  18.5 (24.8)  22 (29.5)  -  76  104  1,400  4,000  3,4	(Y connection)  15 (20.1)  18.5 (24.8)  22 (29.5)  -  86  108  5,000  15,000	(Y connection)  22 (29.5)  26 (34.9)  -  26 (34.9)  100  111  1,500  10,000	(Δ connection)  22 (29.5)  26 (34.9)  -  26 (34.9)  101  112  4,000  10,000	
Output (*1)  (S2)30 min rated kW (HP)  (*1)  (S2) 15 min rated kW (HP)  (S3)40% kW (*3)(*4) (HP)  Rated (S1) A  current (*5)  (S2),(S3) A  Speed Base speed min <sup>-1</sup> Max. speed Switching speed min <sup>-1</sup> Cont. rated torque at const. rated torque range N·m (kgf·cm)	(20.1) 18.5 (24.8) 22 (29.5) - 76 104 1,400 4,000 3,5	(20.1) 18.5 (24.8) 22 (29.5) - 86 108 5,000 15,000	(29.5) 26 (34.9) - 26 (34.9) 100 111 1,500 10,000	(29.5) 26 (34.9) - 26 (34.9) 101 112 4,000 10,000	
Output (*1)  (S2) 30 min rated kW (HP) (S2) 15 min rated kW (HP) (S3)40% kW (*3)(*4) (HP)  Rated (S1) A current (*5) (S2),(S3) A  Speed Base speed min <sup>-1</sup> Max. speed Switching speed min <sup>-1</sup> Cont. rated torque at const. rated torque range N·m (kgf·cm)	18.5 (24.8) 22 (29.5) - 76 104 1,400 4,000 3,5	18.5 (24.8) 22 (29.5) - 86 108 5,000 15,000	26 (34.9) - 26 (34.9) 100 111 1,500 10,000	26 (34.9) - 26 (34.9) 101 112 4,000 10,000	
Output (HP)  (*1) (S2) 15 min rated kW	(24.8) 22 (29.5) - 76 104 1,400 4,000 3,5	(24.8) 22 (29.5) - 86 108 5,000 15,000	(34.9)  -  26 (34.9)  100  111  1,500  10,000	(34.9)  -  26 (34.9)  101  112  4,000  10,000	
(*1) (S2) 15 min rated kW (HP) (S3)40% kW (*3)(*4) (HP)  Rated (S1) A current (*5) (S2),(S3) A  Speed Base speed min <sup>-1</sup> Max. speed  Switching speed min <sup>-1</sup> Cont. rated torque at const. rated torque range N·m (kgf·cm)	22 (29.5) - 76 104 1,400 4,000 3,3	22 (29.5) - 86 108 5,000 15,000	- 26 (34.9) 100 111 1,500 10,000	- 26 (34.9) 101 112 4,000 10,000	
(HP) (S3)40% kW (*3)(*4) (HP)  Rated (S1) A current (*5) (S2),(S3) A  Speed Base speed min <sup>-1</sup> Max. speed Switching speed min <sup>-1</sup> Cont. rated torque at const. rated torque range N·m (kgf·cm)	(29.5)  -  76  104  1,400  4,000  3,4	(29.5)  -  86  108  5,000  15,000	(34.9) 100 111 1,500 10,000	(34.9) 101 112 4,000 10,000	
(*3)(*4)         (HP)           Rated current (*5)         (S1)         A           (*5)         (S2),(S3)         A           Speed Base speed min-1         Max. speed           Switching speed min-1         Cont. rated torque at const. rated torque range N·m (kgf·cm)	104 1,400 4,000 3,5	108 5,000 15,000	(34.9) 100 111 1,500 10,000	(34.9) 101 112 4,000 10,000	
(*3)(*4)         (HP)           Rated current (*5)         (S1)         A           (*5)         (S2),(S3)         A           Speed Base speed min-1         Max. speed           Switching speed min-1         Cont. rated torque at const. rated torque range N·m (kgf·cm)	104 1,400 4,000 3,5	108 5,000 15,000	100 111 1,500 10,000	101 112 4,000 10,000	
current (*5)  (S2),(S3)  Speed  Base speed  min <sup>-1</sup> Max. speed  Switching speed  min <sup>-1</sup> Cont. rated torque at const. rated torque range N·m (kgf·cm)	104 1,400 4,000 3,5	108 5,000 15,000	111 1,500 10,000	112 4,000 10,000	
(*5) (S2),(S3) A  Speed Base speed min <sup>-1</sup> Max. speed  Switching speed min <sup>-1</sup> Cont. rated torque at const. rated torque range N·m (kgf·cm)	1,400 4,000 3,:	5,000 15,000	1,500 10,000	4,000 10,000	
min <sup>-1</sup> Max. speed  Switching speed min <sup>-1</sup> Cont. rated torque at const. rated torque range N·m (kgf·cm)	4,000	15,000	10,000	10,000	
Switching speed  min <sup>-1</sup> Cont. rated torque at const. rated torque range  N·m  (kgf·cm)	3,4		·		
Cont. rated torque at const. rated torque range  N·m  (kgf·cm)	102.2	500	4,0	000	
Cont. rated torque at const. rated torque range  N·m (kgf·cm)				4,000	
torque range  N·m (kgf·cm)  Rotor inertia					
N·m (kgf·cm) Rotor inertia					
Rotor inertia kg·m²	(1043.3)	28.6	140	52.5	
	\ · - · • · • /	(292.1)	(1428)	(536)	
	0.0	055	0.1	128	
	(0.56)		(1.29)		
Weight kgf	1	21	143		
Vibration		V3 (rotation	component)		
Noise		75dB(A)	or less		
Cooling system (*6)		Totally enclosed and	fan cooled (IC0A6)		
Cooling fan W		56			
Installation (*7)		so that the output shaf rizontally to vertically d	•		
Allowable overload capacity		1200/ 6	of (C2)		
(1 min) (*8)	120% of (S2)				
Insulation	Class H				
Ambient temperature	0°C to 40°C				
Altitude	Height above sea level not exceeding 1000m				
Painting color	Munsell system N2.5				
Type of thermal protection (*9)	TP211				
Resolution of the	Built-in with $lpha i$ MZ sensor				
built-in sensor p/rev	4096				
Number of detected gear teeth per	256				
rotation λ/rev.	200				
Bearing lubrication		Grea	ase		
Shaft end seal, protection format (IEC34)	Simplified labyrinth: IP40				
Method of connection with the spindle (*10)	To be directly connected with the spindle				
Allowable thrust load (*11) kgf		1:	3		
Maximum output during					
acceleration (*12) kW		38 31.2			
Applicable spindle amplifier	αis	P 30	αis	P 26	

<sup>\*</sup> See Page 260 for Cautions and limitations.

#### **Cautions and limitations**

- (\*1) The rated output is guaranteed at the rated voltage. (Amplifier input: 200/220/230VAC +10% -15%, 50/60Hz±1Hz) If the input voltage fluctuates, it is possible that the rated output cannot be obtained even when such fluctuations are within the allowable fluctuation range.
- (\*2) The output for  $\alpha i$ IT 1.5/20000 and  $\alpha i$ IT 2/20000 is 15 min rated.
- (\*3) 40% for  $\alpha i$ IT 1.5/20000,  $\alpha i$ IT 2/20000, and  $\alpha i$ IT 22/10000.
- (\*4) The cycle time is 10 minutes, S3 60%: ON 6 minutes, OFF 4 minutes and S3 40%: ON 4 minutes, OFF 6 minutes
- (\*5) The rated current is the maximum current for each rated output.
- (\*6) IC code conforms to IEC 34-6.
- (\*7) IM code conforms to IEC 34-7.
- (\*8) This is not a guaranteed value but a guideline for the maximum motor output at a rated supply voltage.
- (\*9) Type conforms to IEC 34-11.
- (\*10)When assembling a motor with the machine, align the motor shaft with the spindle so that the vibration acceleration of the motor does not exceed 0.5 G (at maximum speed).

  (Before shipping machines, check that the vibration acceleration is 0.5 G or less for all motors.)
- (\*11)Select a coupling that does not apply a thrust load onto the motor shaft for a cause such as coolant pressure when the temperature rises

Note that in the direction in which the motor shaft is pushed toward the inside of the motor, the allowable load is 0 kgf.

(If an Oldham coupling is used, the motor shaft can be left pushed into the inside of the motor when the motor shaft is inserted into the spindle. So, measure the distance between the mounting face for a rotation joint support housing and the flinger rear end face before and after insertion, and check that the two measured values are identical.

For details, see Section 9.4 "COUPLING SELECTION".)

- (\*12)These values are to be used only as guidance for selecting a power supply ( $\alpha iPS$ ) and are not guaranteed.
- (\*13)Switching methods of power lead are two types (Y- $\Delta$  switching and Y-Y switching).
  - Required are the CNC software option related to the output switching function and the switching magnetic connection unit.
  - Refer to FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS (B-65282EN) for output switching control.
- (\*14)The protection grade (IEC34-5) is IP40. However, the grade is IP54 when the labyrinth seal on the front side of the output axis and the flinger seal on the rear side are excluded.
  - Ensure that the labyrinth seal and flinger seal are not directly exposed to coolant and mist.

# 3

## **OUTPUT/TORQUE CHARACTERISTICS**

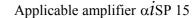
# Reference Calculation for torque

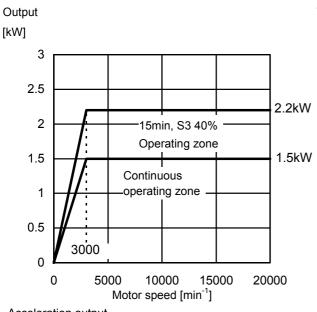
Torque T can be obtained by the following equation.

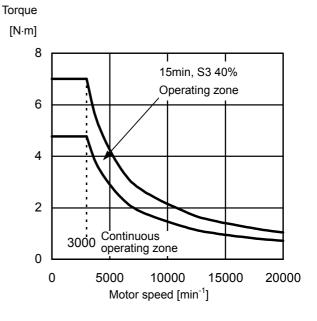
 $T[N\cdot m]=P[kW]\times 1000/0.1047/N[min^{-1}]$  P[kW]: Motor output  $N[min^{-1}]:$  Motor speed

When the unit of T is [kgf·m], T[kgf·m]= $P[kW]\times 1000/1.0269/N[min^{-1}]$ 

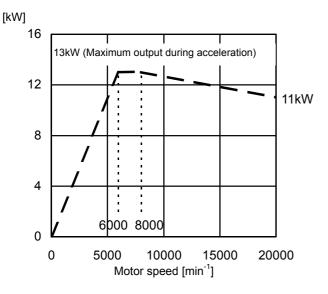
## **3.1** MODEL $\alpha i$ IT 1.5/20000







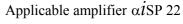
Acceleration output

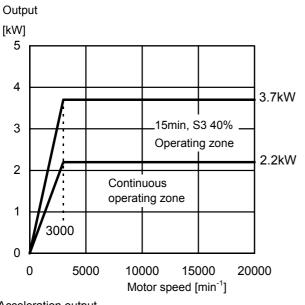


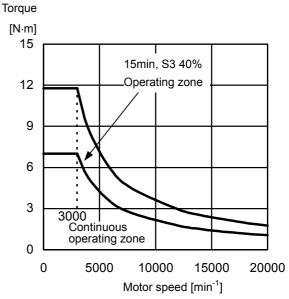
#### **NOTE**

Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

## 3.2 MODEL $\alpha i$ IT 2/20000

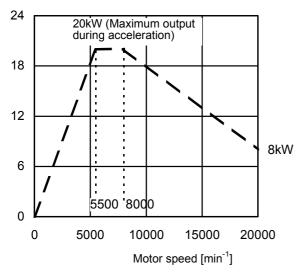






Acceleration output

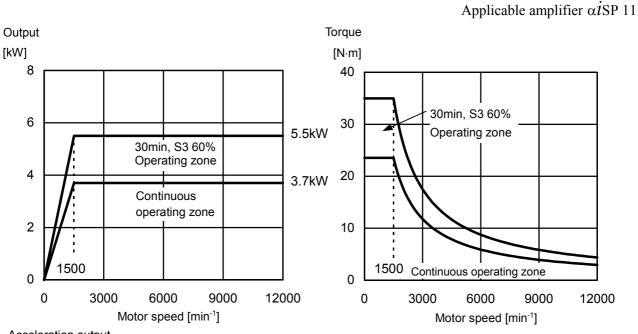
[kW]



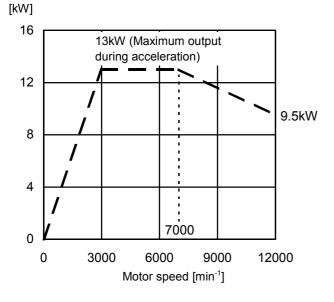
### NOTE

Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

## **3.3** MODEL $\alpha i$ IT 3/12000



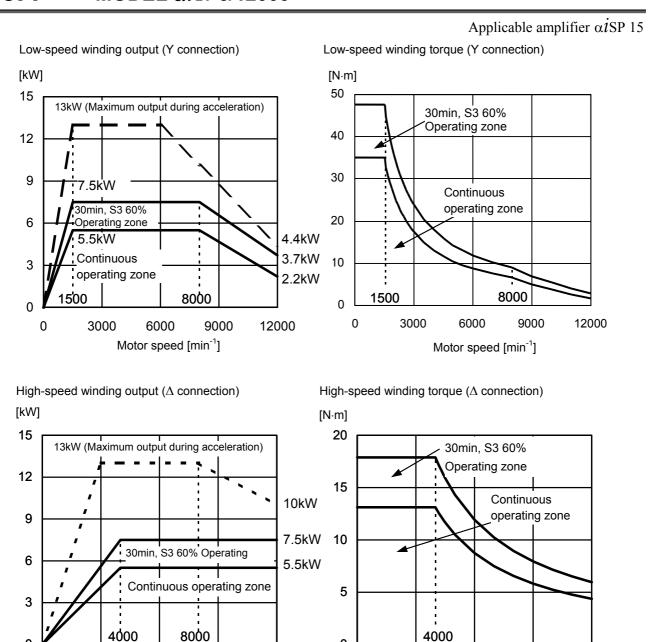
Acceleration output



#### **NOTE**

Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

#### 3.4 MODEL $\alpha i$ IT 6/12000



#### NOTE

12000

8000

9000

6000

Motor speed [min<sup>-1</sup>]

0

3000

Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

4000

6000

Motor speed [min<sup>-1</sup>]

9000

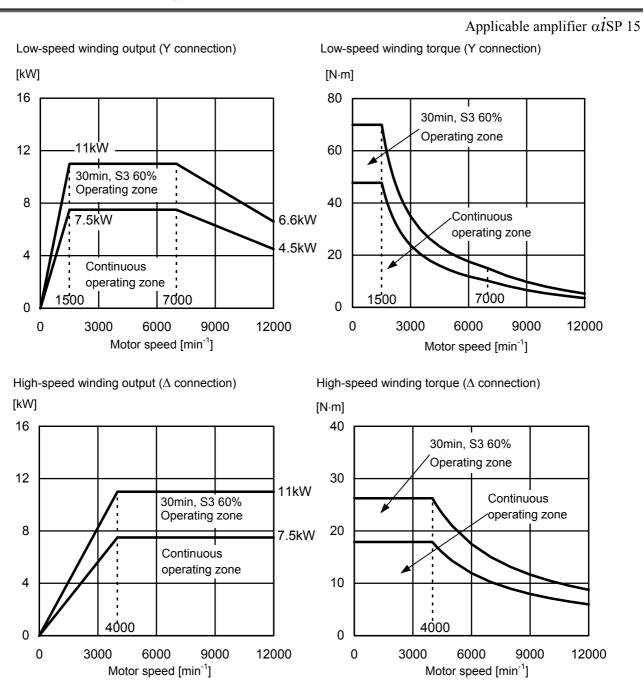
12000

3000

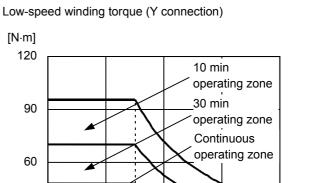
0

0

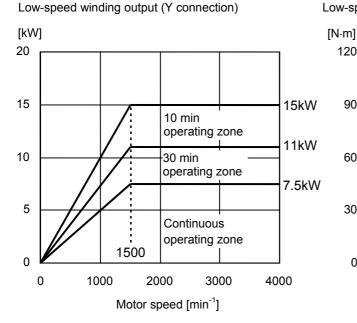
### **3.5** MODEL $\alpha i$ IT 8/12000

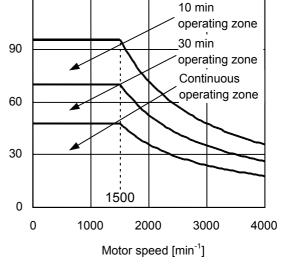


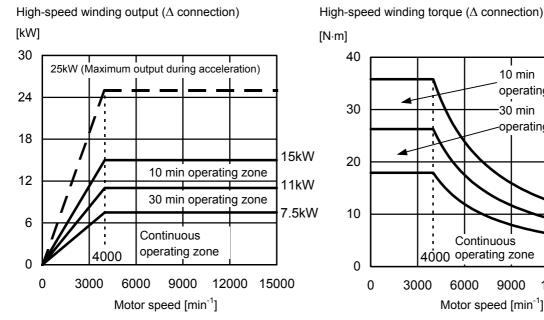
#### 3.6 MODEL $\alpha i$ IT 8/15000

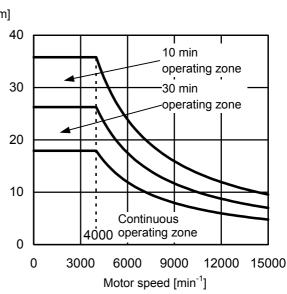


Applicable amplifier  $\alpha i$ SP 26





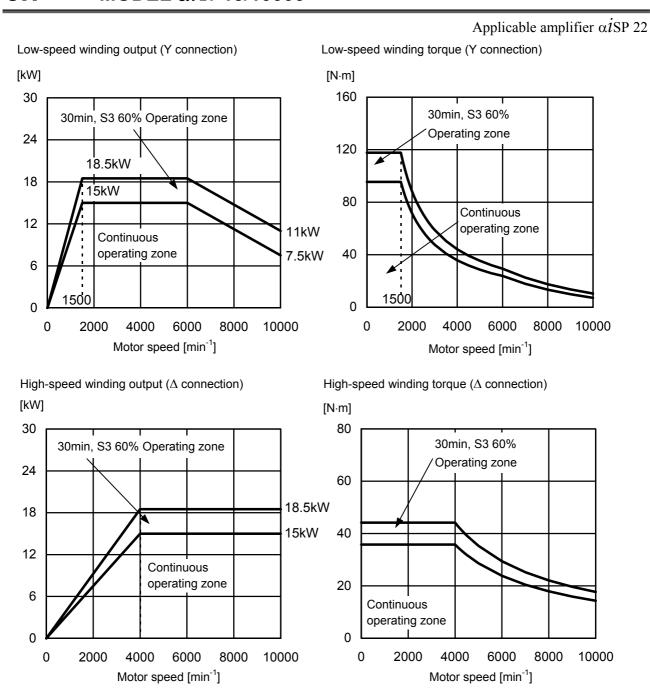




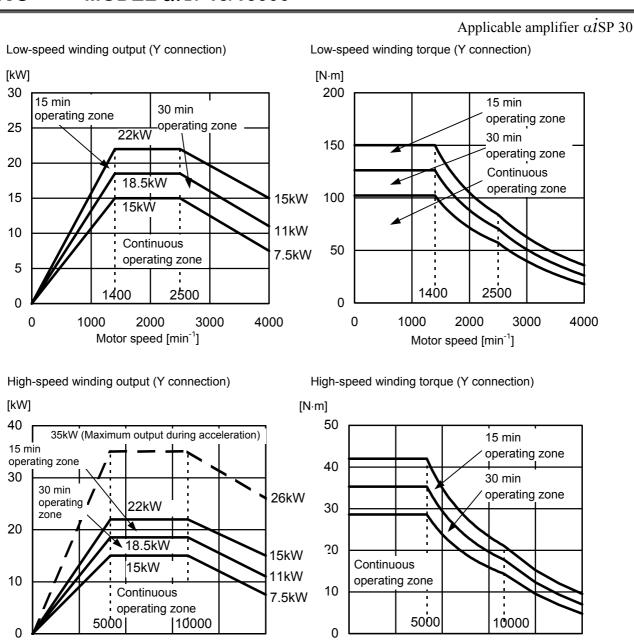
#### NOTE

Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

### 3.7 MODEL $\alpha i$ IT 15/10000



#### 3.8 MODEL $\alpha i$ IT 15/15000



#### **NOTE**

12000 15000

0

3000

6000

9000

Motor speed [min<sup>-1</sup>]

Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

3000

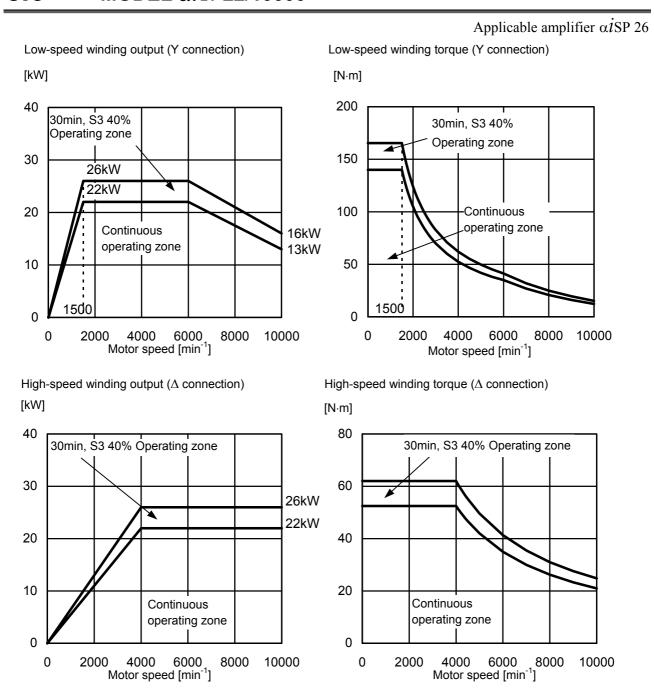
6000

Motor speed [min<sup>-1</sup>]

9000 12000 15000

0

### **3.9** MODEL $\alpha i$ IT 22/10000



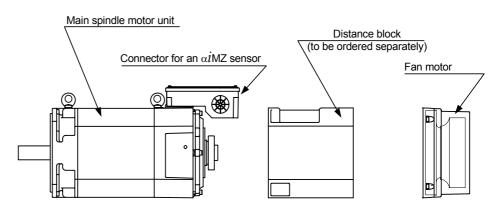
4

# CONFIGURATION AND ORDERING NUMBER

#### 4.1 CONFIGURATION

The  $\alpha i$ IT series motor 200V type consists of the following items:

- (1) Main spindle motor unit
- (2) Fan motor (Exhaust on the side opposite to the load axis. Packed separately.)
- (3) Connector (housing, contact) for an  $\alpha iMZ$  sensor The connector is contained in the terminal block.
- (4) Distance block (Separately packed. To be ordered separately in addition to the main motor unit.)



# 4.2 ORDERING NUMBER

Motor (including a cooling fan)

Model	Ordering number	SPM	Remarks
α <i>İ</i> Ιτ 1.5/20000	A06B-1463-B123#0121	lpha iSP 15	
αiΙτ 2/20000	A06B-1464-B123#0121	lpha iSP 22	
lpha iІт 3/12000	A06B-1465-B123#0021	lpha iSP 11	- Flange mounting type
lpha iІт 6/12000	A06B-1466-B123#0021	lpha iSP 15	- Hollow shaft
αiΙτ 8/12000	A06B-1467-B123#0021	lpha iSP 15	(with no key)
α <i>ἱ</i> Ιτ 8/15000	A06B-1477-B133#0121	$\alpha i$ SP 26	- Labyrinth - Built-in with α <i>i</i> MZ
α <i>İ</i> Ιτ 15/10000	A06B-1469-B123#0021	lpha iSP 22	sensor
α <i>İ</i> Ιτ 15/15000	A06B-1479-B133#0221	lpha iSP 30	0011001
α <i>İ</i> Ιτ 22/10000	A06B-1471-B123#0021	lpha iSP 26	

#### **Distance block**

\* Please prepare Distance-block by the machine tool builder.
The distance blocks indicated in the table below are available from FANUC as separate items.

#### Distance block

Name	Ordering number	Remarks
Type α <i>i</i> I <sub>T</sub> 1.5	A06B-1463-K560	For $lpha i$ I $_{ extsf{I}}$ 1.5
Type α <i>i</i> I <sub>T</sub> 2	A06B-1464-K560	For $lpha i$ I $_{ extsf{I}}$ 2 and $lpha i$ I $_{ extsf{I}}$ 3
Type α <i>i</i> I⊤ 6	A06B-1466-K560	For $\alpha i$ I $_{ extsf{T}}$ 6 and $\alpha i$ I $_{ extsf{T}}$ 8
Type α <i>i</i> I <sub>T</sub> 15	A06B-1469-K560	For $\alpha i$ I $_{ extsf{T}}$ 15 and $\alpha i$ I $_{ extsf{T}}$ 22

#### • Distance block with windows

Name	Ordering number	Remarks
Type $\alpha i$ I $_{ extsf{T}}$ 2	A06B-1464-K580	For $lpha i$ I $_{ extsf{I}}$ 2 and $lpha i$ I $_{ extsf{I}}$ 3
Type α <i>i</i> I <sub>T</sub> 6	A06B-1466-K580	For $\alpha i$ I $_{ extsf{T}}$ 6 and $\alpha i$ I $_{ extsf{T}}$ 8
Type α <i>i</i> Iτ 15	A06B-1469-K580	For $\alpha i$ I $_{ extsf{T}}$ 15 and $\alpha i$ I $_{ extsf{T}}$ 22

### **CONNECTIONS**

#### *5.1* CONNECTION OF THE POWER, FAN MOTOR, AND lpha iMZ **SENSOR SIGNAL LEADS**

Cables for power lead and fan motor are connected to the terminal block.

 $\alpha i$ MZ sensor signal or thermo stat signal use a connector manufactured by Tyco Electronics AMP.

The connector housing and the connector are attached to the motor.

Size of screws used in	Power	lead	Cooling fan
the terminal block	U,V,W,G	X,Y,Z	FMU,FMV,FMW
α <i>İ</i> ΙΤ 1.5/20000	M5	ı	M4
α <i>İ</i> I⊤ 2/20000	M5	ı	Screw-less terminal block
α <i>İ</i> Ιτ 3/12000	M5	ı	Screw-less terminal block
α <i>İ</i> Ιτ 6/12000	M5	M5	Screw-less terminal block
α <i>İ</i> Ιτ 8/12000	M5	M5	Screw-less terminal block
α <i>İ</i> Ιτ 8/15000	M5	M5	Screw-less terminal block
α <i>ἱ</i> Ιτ 15/10000	M5	M5	Screw-less terminal block
α <i>İ</i> Ιτ 15/15000	M6	M6	Screw-less terminal block
α <i>İ</i> Ιτ 22/10000	M6	M6	Screw-less terminal block

#### Size of power lead

Observe the sizes indicated below when using power leads to be used between the amplifier and motor, and crimp terminals.

	Crimp terminal size		Applicable power lead size (mm²)	
Motor model	Motor side	Amplifier side	<sup>(*1)</sup> LMFC	(*2) Flonlex power cable
α <i>İ</i> Ιτ 1.5/20000	M5	M5	-	8.0
α <i>İ</i> ΙΤ 2/20000	M5	M6	-	8.0
α <i>İ</i> Ιτ 3/12000	M5	M5	5.5	-
α <i>ἱ</i> Ιτ 6/12000	M5	M5	8	-
α <i>İ</i> Ιτ 8/12000	M5	M5	8	-
α <i>ἱ</i> Ιτ 8/15000	M5	M6	14	-
α <i>İ</i> ΙΤ 15/10000	M5	M6	14	-
α <i>İ</i> Ιτ 15/15000	M6	M6	22	-
α <i>İ</i> ΙΤ 22/10000	M6	M6	22	-

#### NOTE

- 1 LMFC power lead: Fire-retardant Polyflex power cable (Heat resistance: 105°C)
- 2 Flonlex power lead: Manufactured by HITACHI CABLE, Ltd. (Heat resistance: 200°C)

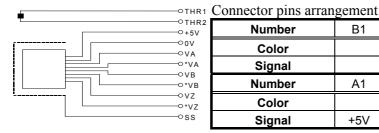
#### Cable for the fan motor

For the fan motor current value and cable specifications, refer to Section I.4.3, "FAN MOTOR CONNECTION" in this manual.

#### 5.2 CONNECTION OF SIGNAL LEAD

 $\alpha i$ MZ sensor signal or overheat signal use a connector manufactured by Tyco Electronics AMP.

The connector housing and the connector are attached to the motor.



Number	B1	B2	В3	B4	B5	B6
Color						
Signal		*VA	*VB	*VZ	0V	THR2
Number	A1	A2	A3	A4	A5	A6
Color						
Signal	+5V	VA	VB	VZ	SS	THR1

#### **Connector housing and contact specifications**

Connector and contact:

Tyco Electronics AMP specification D-3000 series

	Motor side		Cable side		
	FANUC specification	Manufacture specification	FANUC specification Manufacture Specific		
Housing	A63L-0001-0535/121KDF	178964-6	A63L-0001-0460/121KD	178289-6	
Contact	A63L-0001-0456/ASMT	175288-2	A63L-0001-0456/ASM	1-175217-2	

Crimping tool: 91559-1 Extractor: 234168-1

#### Thermistor specification

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).

# **ASSEMBLING ACCURACY**

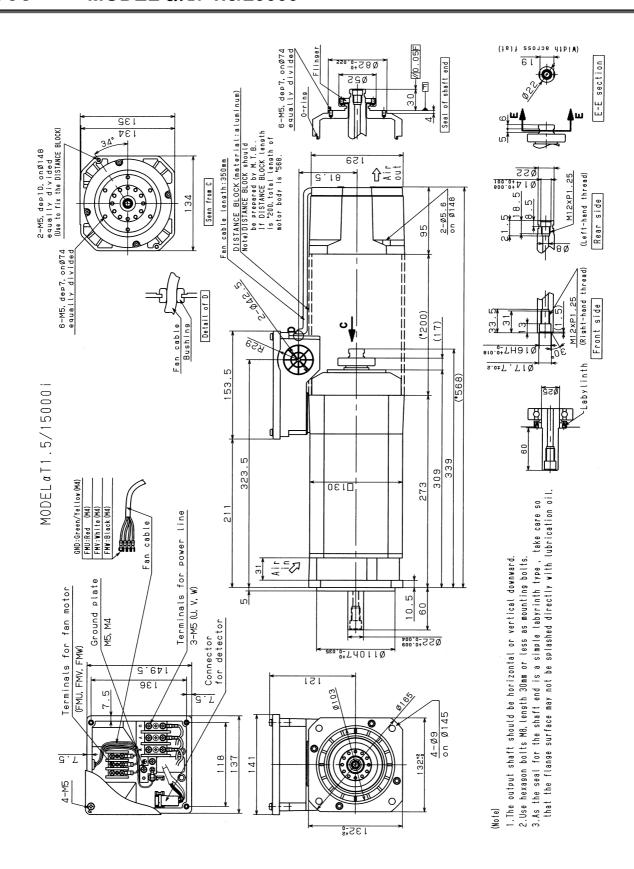
Item	Accuracy	Measuring method
Run-out at the end of the output shaft	10μm or less	1/2 the output shaft length
Run-out of the faucet joint for mounting the flange against the core of the shaft	30μm or less	
Run-out of the flange mounting surface against the core of the shaft	40μm or less	
Front shaft end through hole inlet Rear shaft end through hole inlet Run-out of socket and spigot joint	20μm or less	
Run-out of front shaft end face Run-out of rear shaft end face	10μm or less	

# 7

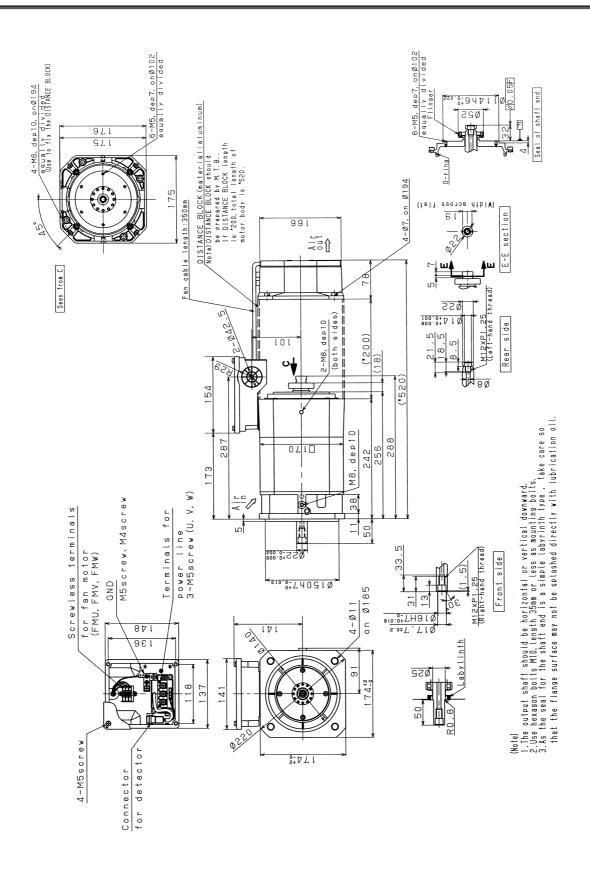
#### **EXTERNAL DIMENSIONS**

Model name	Section
Model α <i>İ</i> Ιτ 1.5/20000	7.1
Model α <i>İ</i> Ιτ 2/20000	7.2
Model α <i>İ</i> Ιτ 3/12000	7.3
Model α <i>İ</i> Ιτ 6/12000	7.4
Models $lpha i$ IT 8/12000 and $lpha i$ IT 8/15000	7.5
Model α <i>İ</i> ΙΤ 15/10000	7.6
Model α <i>İ</i> Ιτ 15/15000	7.7
Model α <i>İ</i> Ιτ 22/10000	7.8
Distance block Type αiIτ 1.5	7.9
Distance block Type α <i>i</i> Iτ 2	7.10
Distance block Type α <i>i</i> Iτ 6	7.11
Distance block Type α <i>i</i> Iτ 15	7.12
Distance block with windows Type $\alpha i$ IT 2	7.13
Distance block with windows Type $\alpha i$ IT 6	7.14
Distance block with windows Type $lpha i$ IT 15	7.15

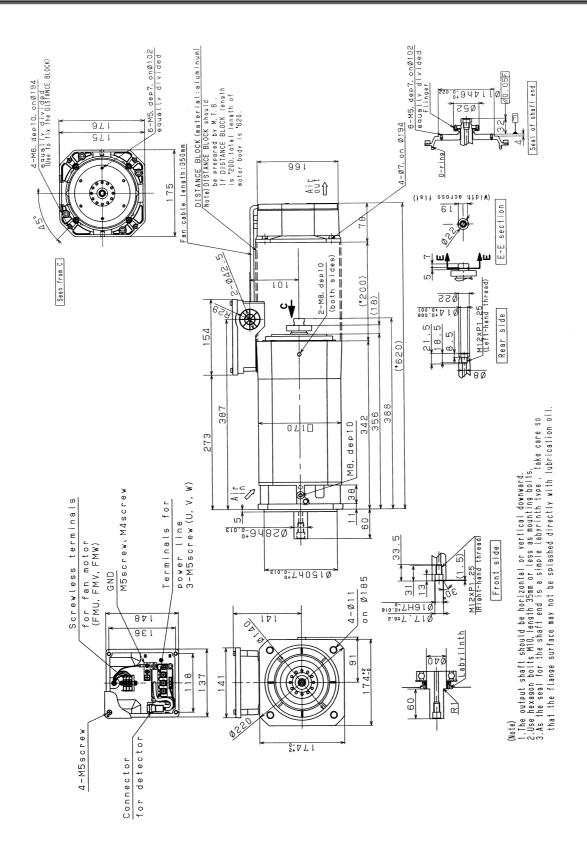
# **7.1** MODEL $\alpha i$ IT 1.5/20000



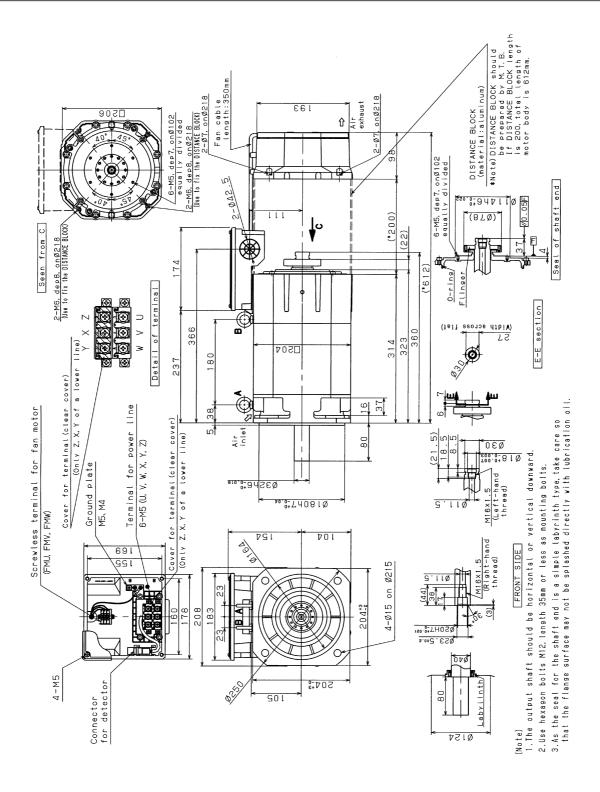
# **7.2** MODEL $\alpha i$ IT 2/20000



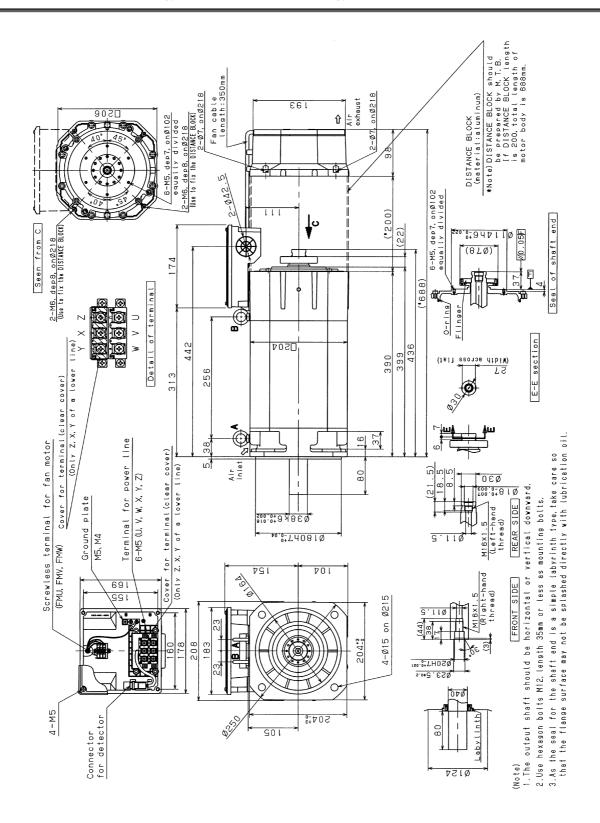
# **7.3** MODEL $\alpha i$ IT 3/12000



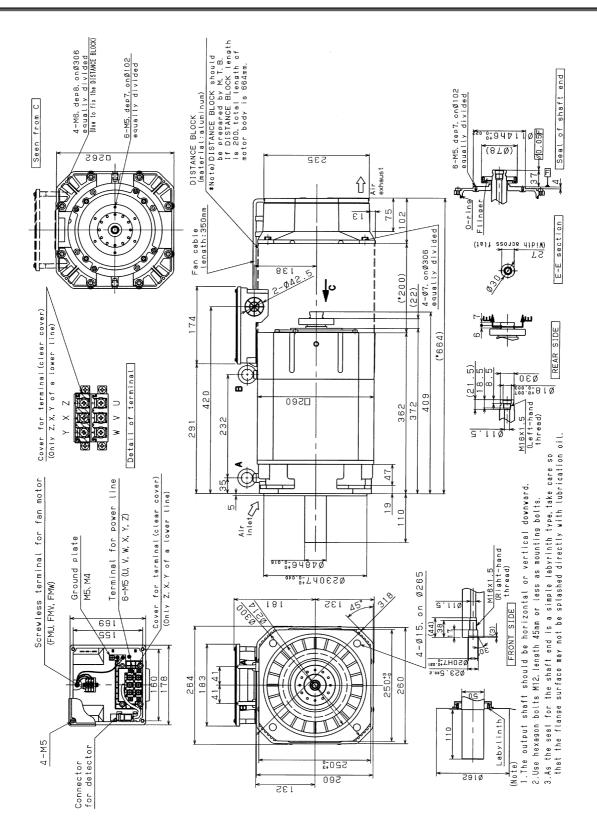
### **7.4** MODEL $\alpha i$ IT 6/12000



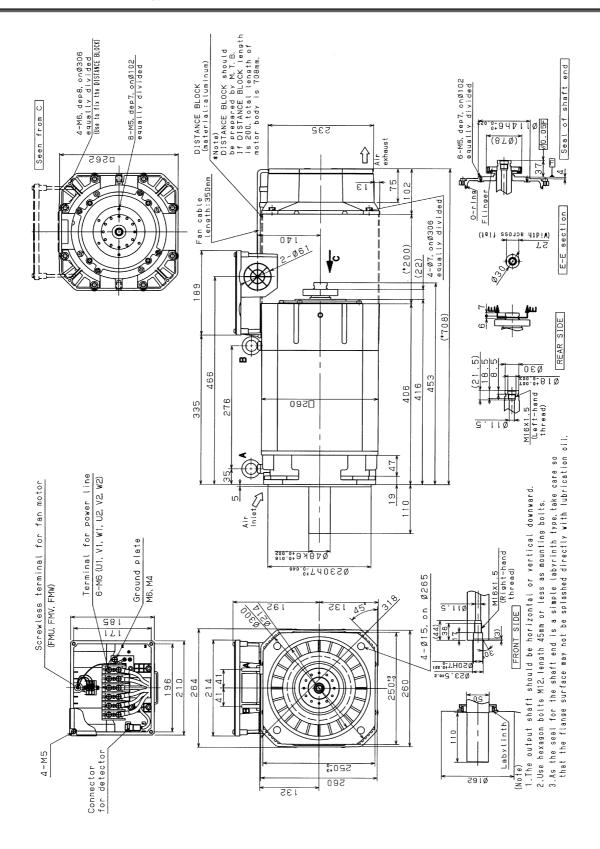
#### **7.5** MODELS $\alpha i$ IT 8/12000 AND $\alpha i$ IT 8/15000



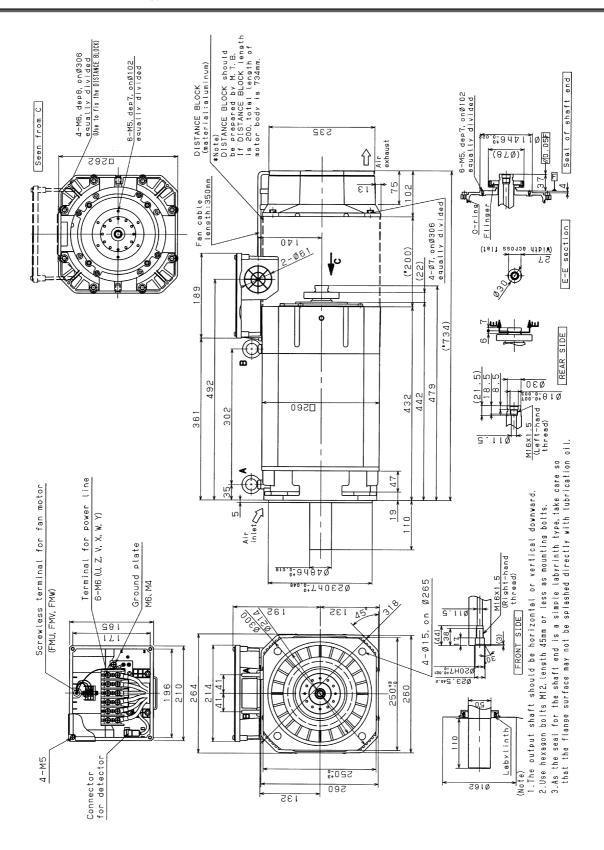
# **7.6** MODEL $\alpha i$ IT 15/10000



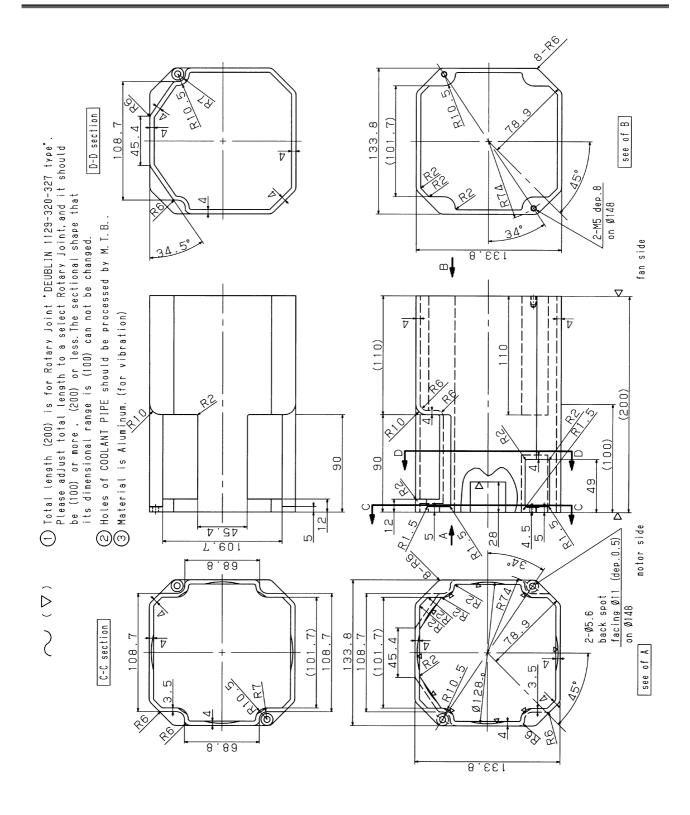
# 7.7 MODEL $\alpha i$ IT 15/15000



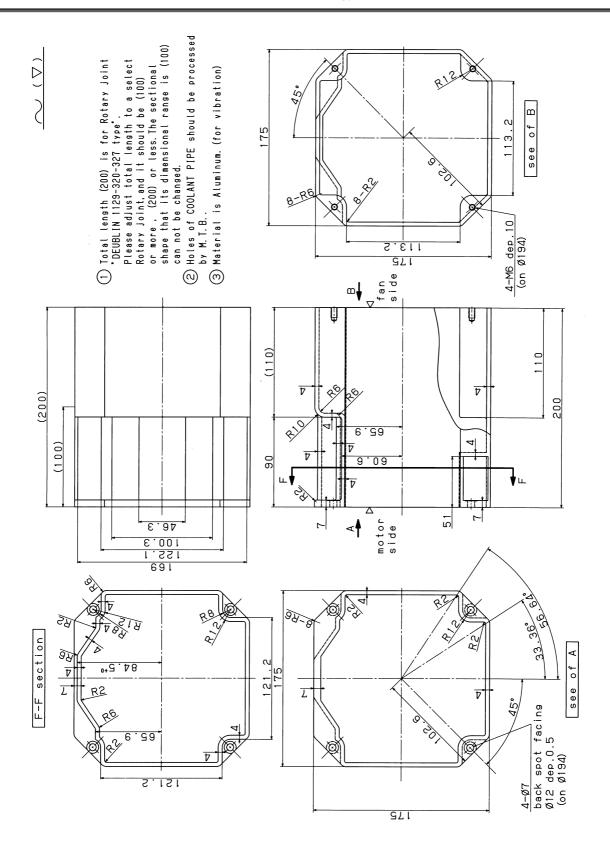
# **7.8** MODEL $\alpha i$ IT 22/10000



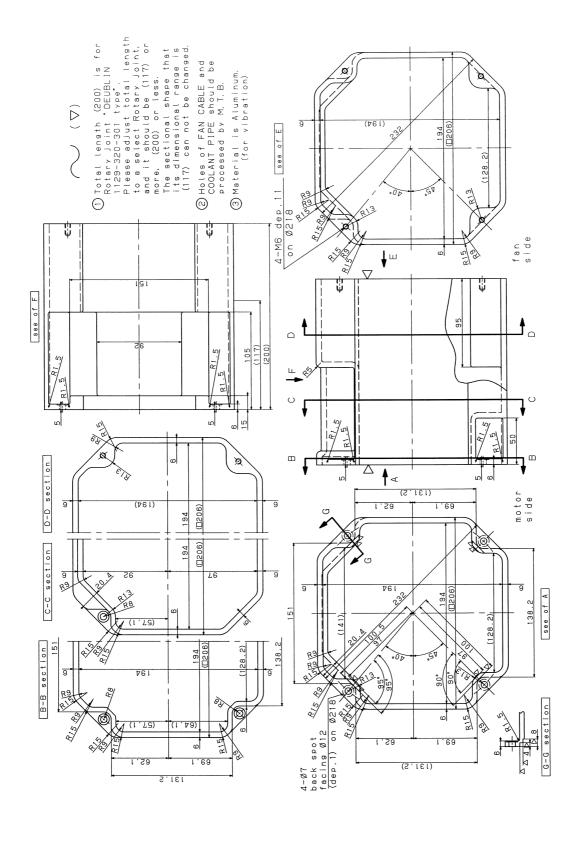
# 7.9 DISTANCE BLOCK TYPE $\alpha i$ IT 1.5



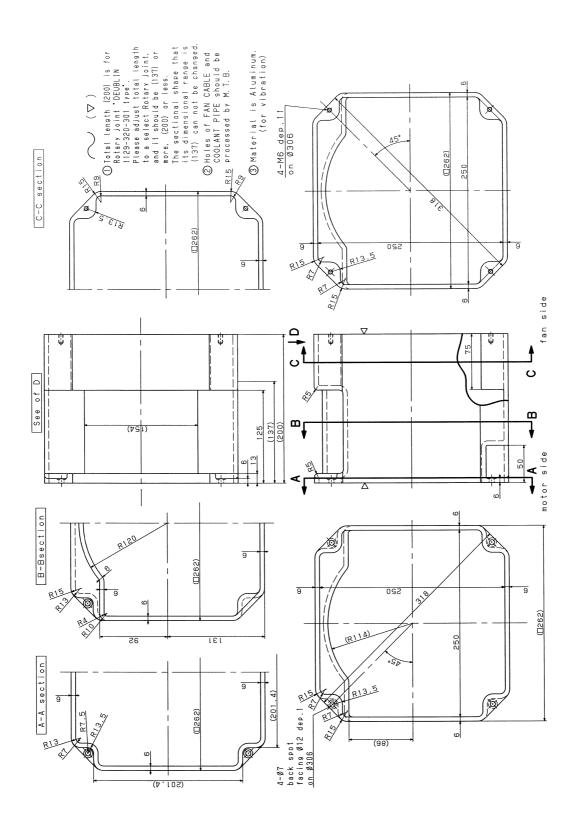
# 7.10 DISTANCE BLOCK TYPE $\alpha i$ IT 2



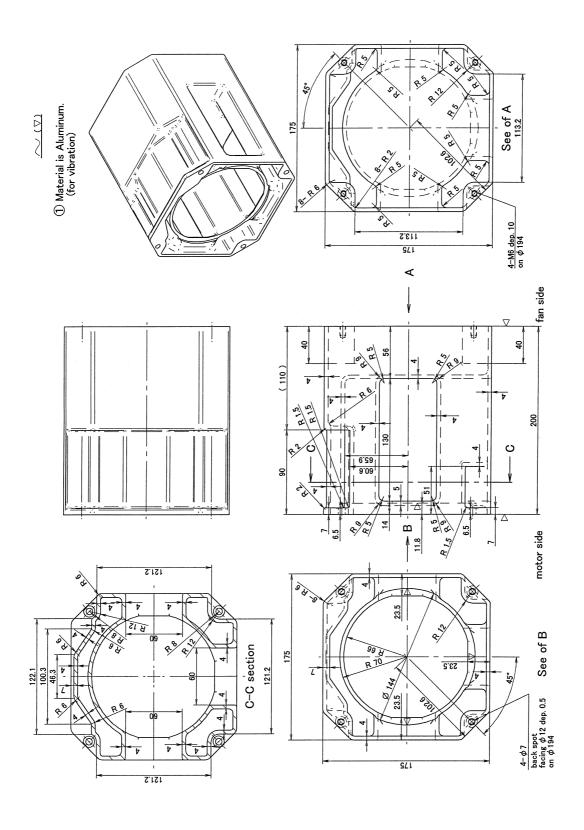
# 7.11 DISTANCE BLOCK TYPE $\alpha i$ IT 6



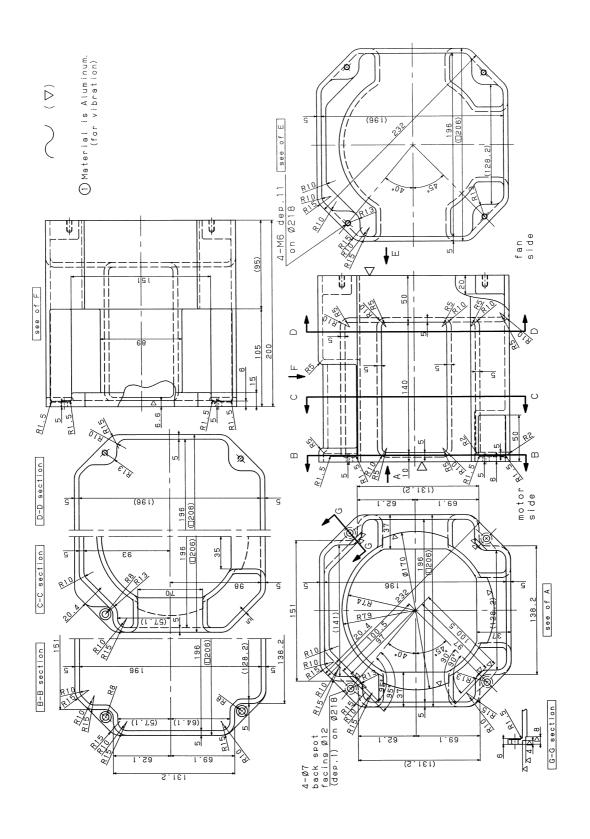
# 7.12 DISTANCE BLOCK TYPE $\alpha i$ IT 15



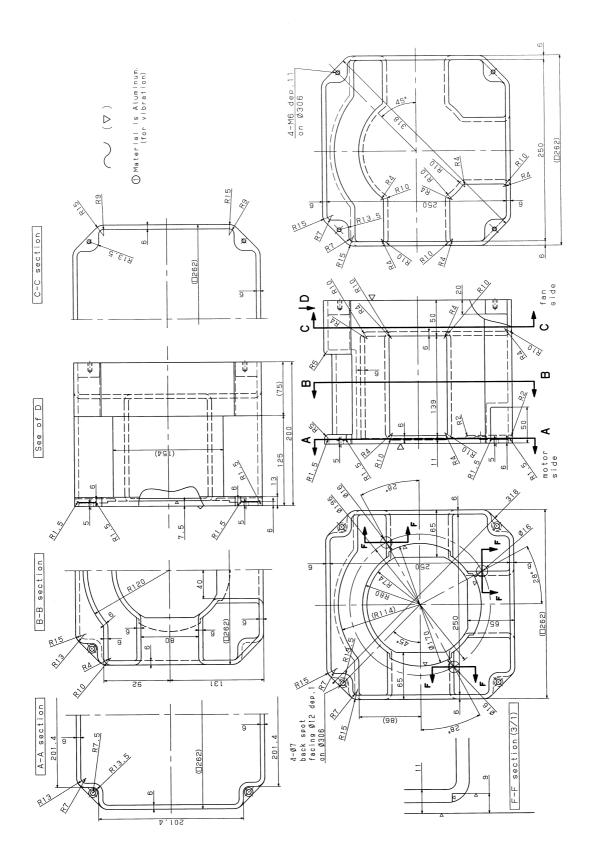
#### 7.13 DISTANCE BLOCK WITH WINDOWS TYPE $\alpha i$ IT 2



# 7.14 DISTANCE BLOCK WITH WINDOWS TYPE $\alpha i$ IT 6



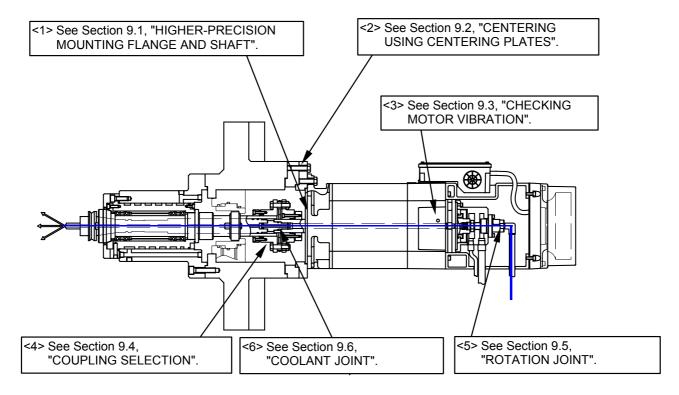
# 7.15 DISTANCE BLOCK WITH WINDOWS TYPE $\alpha i$ IT 15



8

# POINTS ABOUT DIRECT CONNECTION STRUCTURE

If the motor shaft and spindle are not centered precisely when the spindle motor is directly connected to the spindle, fretting can occur with the motor shaft in a short-time operation, or the bearing of the motor can be damaged because of vibration occurring at the joint. Six important points for high-speed rotation with low vibration in a direct motor connection structure are described below.



# 9

#### **NOTES ON MOTOR INSTALLATION**

# 9.1 HIGHER-PRECISION MOUNTING FLANGE AND SHAFT

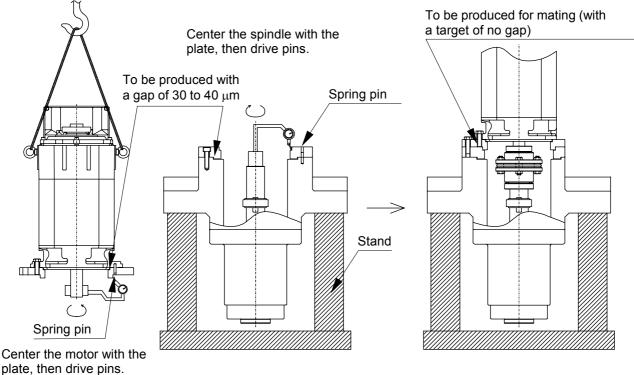
With the  $\alpha \dot{t}$ IT series, a mounting flange and shaft are assembled with higher precision for direct connection with the spindle. For details, see Chapter 6, "ASSEMBLY PRECISION".

#### 9.2 CENTERING USING CENTERING PLATES

When connecting the spindle with the motor shaft, make centering with a target concentricity of  $5\mu m$ . If centering accuracy measurement is difficult, it is recommended to use centering plates between the spindle head and motor.

Prepare two centering plates: one for the motor and the other for the spindle head. Mate the socket and spigot joint of the plate for the motor with the socket and spigot joint of the plate for the spindle head (with a target of no gap). After centering of the plate for the motor with the motor, center the plate for the spindle head with the spindle head. Then, attach the motor with the plate to the plate for the spindle head. (For plate centering, the user should prepare a stand and orient the spindle upward.)

This centering structure allows high-precision installation even in the case of motor replacement in the field.



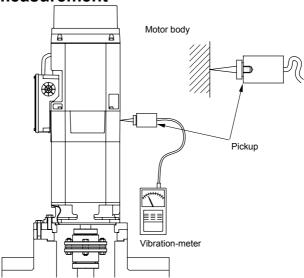
# 9.3 CHECKING MOTOR VIBRATION (TO SEE WHETHER CENTERING IS SUCCESSFUL)

To check whether the spindle is centered with the motor successfully, measure the vibration acceleration of the motor.

Center the motor shaft with the spindle so that the vibration acceleration of the motor does not exceed 0.5 G (at maximum speed). (Frequency range: 10 to 1000 Hz)

Before shipping machines, check that the vibration acceleration is 0.5 G or less for all motors.

#### Method of motor vibration measurement



(Recommended vibration-meter) Use the following vibration-meter or an equivalent:

Name: Anavibro Model: VM-3304

Manufacturer: IMV Corporation (TEL: 03-3262-6311)

Features: Since a pickup of moving-coil (velocity) type is

employed, the need for complicate setting is

eliminated to allow an easy measurement.

The frequency range is 10 to 1000 Hz, so that this vibration-meter is suitable for measurement of motor

rotation components.

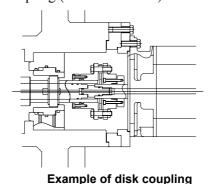
\* FANUC does not recommend a charge vibration-meter using a piezoelectric acceleration type pickup because it requires complicate setting for use.

#### **9.4** COUPLING SELECTION

1 When connecting the spindle and motor shaft, be sure to use a flexible coupling.

(Flexible coupling examples)

- Diaphragm coupling (EAGLE INDUSTRY CO., LTD.)
- Oldham's coupling
- Gear coupling (MIKI PULLEY)



Flexible coupling has three tolerances of degree of freedom: eccentricity, declination, and axial displacement. This enables coupling with less vibration and less noise to achieve high-speed rotation.

- Tolerances of eccentricity and declination: Slight eccentricity and declination that could not be absorbed by centering are absorbed.
- Tolerance of axial displacement: Extension of the spindle and motor shaft due to temperature increase is absorbed.

#### (Caution)

- These tolerances are criteria for preventing the coupling from being damaged, not criteria for preventing load from being applied to the spindle and motor bearings. Therefore, to perform rotation with low vibration and low noise before high-speed rotation is achieved, the spindle and motor shaft must be centered.
- FANUC has confirmed that with a coupling (disk coupling) that permits only the degrees of freedom of declination and axial displacement, rotation can take place properly if centering has been pereformed with a concentricity of 5 μm.
- 2 It is important to perform centering and obtain parallelism to avoid having to recourse to the flexibility of the coupling.

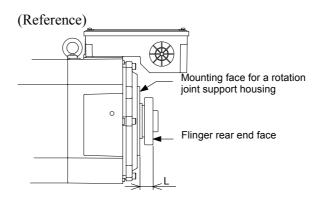
  At high speeds, any eccentricity may cause the bearing to fail prematurely.
- 3 Use a coupling in which thrust load is not applied to the motor shaft by, for example, an increased temperature, cutting operation, or coolant pressure.
- 4 Set the torsional rigidity of the coupling to an appropriate high value. If the torsional rigidity is low, vibration may be produced during orientation.

#### B-65272EN/05FANUC AC SPINDLE MOTOR $\alpha i$ IT series 200V type 9.NOTES ON MOTOR INSTALLATION

When attaching the coupling to the motor shaft, never use a hammer or the like; otherwise, impact load is applied to the bearing.

#### NOTE

If an Oldham coupling is used, the motor shaft can be left pushed into the inside of the motor when the motor shaft is inserted into the spindle. So, measure the distance (L in the figure below) between the mounting face for a rotation joint support housing and the flinger rear end face before and after insertion, and check that the two measured values are identical.



Motor model	End face distance L
α <i>İ</i> Iτ 1.5	(17)
$lpha i$ I $ extsf{T}$ 2 to $lpha i$ I $ extsf{T}$ 3	(18)
$\alpha i$ I $_{ extsf{T}}$ 6 to $\alpha i$ I $_{ extsf{T}}$ 22	(22)

(Reference) Contact points for couplings

Manufacturer	Type of coupling	Point of contact	Applicable maximum speed (*)
EAGLE INDUSTRY CO., LTD	Diaphragm	03-3438-1390	20,000 min <sup>-1</sup>
MIKI PULLEY CO., LTD	Disk	044-733-5151	12,000 min <sup>-1</sup>

- FANUC recommends diaphragm coupling for high-speed which is more than 12,000 min<sup>-1</sup> and high-torque motor.

  Because diaphragm coupling has three degrees of freedom (parallel offset, angular misalignment and axial movement) and will realize high-speed rotation under low vibration and low noise.
- \* Example of diaphragm coupling for  $\alpha i$ IT 3 to  $\alpha i$ IT 22. TYPE 67E304-30-ZZ (EAGLE INDUSTRY)

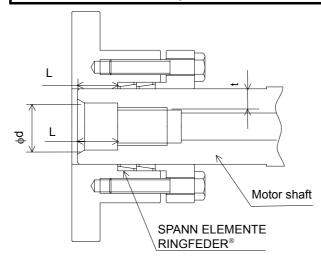
#### NOTE

Select SPANN ELEMENTE that can withstand a torque (\*1) 3.6 times greater than the S3 rated torque to protect against slippage in intermittent cutting. With the models  $\alpha i \text{I}_{\text{T}} 1.5/20000$  and  $\alpha i \text{I}_{\text{T}} 2/20000$ , however, the motor shaft to which a SPANN ELEMENTE is fastened is thin. So, select SPANN ELEMENTE and a fastening method so that the stress applied to the motor shaft does not exceed the yield point of the motor shaft (490 N/mm²). As shown below, provide a space of L mm or more between the SPANN ELEMENTE and the tip of the motor shaft.

\*1 With the high-acceleration type models  $\alpha i \text{I} \tau$  1.5/20000,  $\alpha i \text{I} \tau$  2/20000,  $\alpha i \text{I} \tau$  8/15000, and  $\alpha i \text{I} \tau$  15/15000, select SPANN ELEMENTE that can withstand a torque 3 times greater than the maximum torque at acceleration time.

See the example of SPANN ELEMENTE selection shown below. For the method of calculation and the location of fastening to the motor shaft, contact the following company:

TAKEDA TRADE CO., LTD. (RINGFEDER®) Tel: 06-6441-1503, 03-3815-6501



The models  $\alpha i \text{IT}$  1.5/20000 and  $\alpha i \text{IT}$  2/20000 have a less thickness (t).

[Stress applied to motor shaft] ≤ [Motor shaft yield point (490 N/mm²)]

#### B-65272EN/05FANUC AC SPINDLE MOTOR $\alpha i$ IT series 200V type 9.NOTES ON MOTOR INSTALLATION

Model	α <i>i</i> Ιτ 1.5/20000 <i>i</i> τ α <i>i</i> Ιτ 2/20000 <i>i</i> τ α <i>i</i> Ιτ 3/12000 <i>i</i> τ	α <i>i</i> Iτ 6/12000 <i>i</i> τ α <i>i</i> Iτ 8/12000 <i>i</i> τ α <i>i</i> Iτ 8/15000 <i>i</i> τ α <i>i</i> Iτ 15/10000 <i>i</i> τ α <i>i</i> Iτ 15/15000 <i>i</i> τ α <i>i</i> Iτ 22/10000 <i>i</i> τ
φd	$\phi 16^{+0.018}_{-0}$	$\phi 20^{+0.021}_{-0}$
L	13	17

An example of SPANN ELEMENTE selection for the model  $\alpha i$ IT 2/20000 is given below.

#### [Example of selection]

Condition 1: Two sets of SPANN ELEMENTE RfN8006  $22 \times 26$  (inner diameter  $\times$  outer diameter) are used. Condition 2: Four M5 bolts (strength class: 12.9) are tightened by a tightening torque of 10.0 [N·m].

Surface pressure P (170.7 [N/mm²]) is produced on the motor shaft, and torque T (128.2 [N·m]) becomes transferable.

#### Checking transferable torque T

[Check]: Transferable torque T ≥ 3 times maximum torque at motor acceleration time

The maximum torque at acceleration time of the model  $\alpha 2/20000i$ T is 34.8 [N·m]<sup>(\*2)</sup>. Accordingly, the following transferable torque is obtained:

 $128.2 \geq 3 \times 34.8$ 

From the produced surface pressure P and the transferable torque T, check stress  $\sigma$  applied onto the motor shaft. [Check]: Stress  $\sigma$  applied onto the motor shaft  $\leq$  Motor shaft yield point (490 [N/mm<sup>2</sup>])

From the produced surface pressure P (170.7 [N/mm²]) and the transferable torque (128.2 [N·m]), stress  $\sigma$  applied onto the motor shaft is calculated as  $\sigma$  = 453.1 [N/mm²]. Accordingly, the following is obtained:  $453.1 \le 490$ 

\*2 This data is calculated from a maximum output at acceleration time used as a guideline for power supply  $(\alpha iPS)$  selection and from the motor base speed, and is not a guaranteed value.

## 9.5 ROTATION JOINT

When coolant is flown through the through hole of the motor shaft, a coolant pressure acts on the end face of the coolant joint attached to the shaft front end, thus producing a thrust load that pushes the motor shaft backward. (See Section 9.6.)

If a rotation joint of separate external support type is attached to the motor shaft rear end, a coolant pressure acts also on the rotation joint to push the motor shaft forward, and therefore the thrust load can be canceled.

The  $\alpha i I_T$  series is designed assuming that a rotation joint indicated in the table below is attached to the shaft rear end:

Rotation joints of separate external support type manufactured by Deublin or Rix.

Motor model	$\alpha i$ I $\tau$ 1.5 to $\alpha i$ I $\tau$ 3		αiΙτ 6 to $αi$ Ιτ 22	
Mounting screw size	M12 × 1.25 (le	eft-hand screw)	M16 × 1.5 (left-hand screw)	
Piping direction	Straight type	Elbow type	Straight type	Elbow type
<b>Specification of Deublin</b>	1129-036-327	1129-033-327	1129-036-301	1129-033-301
Specification of Rix	ESX20M-S012 ESX20M-E012 ESX20M-S016 ESX			
Function <sup>(Caution)</sup>	Spindle-through coolant during rotation or stopping Air-through during stopping (Air-through disabled during rotation)			•

#### **⚠** CAUTION

When selecting a rotation joint, if the coolant-through frequency during the machine cycle is high (use in a dedicated machine or line machine), be sure to contact the rotation joint manufacturer.

#### NOTE

Inquire the following of the rotation joint manufacturer:

- Details of features of the rotation joint and its installation
- Type for enabling air-through during rotation

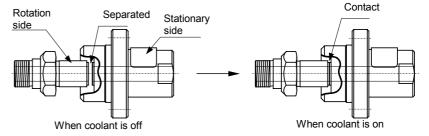
For rotation joints and support housings, contact:

Deublin Japan Ltd.

TEL 072-757-0099

Rotation Joint Div., RIX CORPORATION Co., LTD.

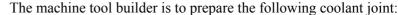
TEL 092-935-8913

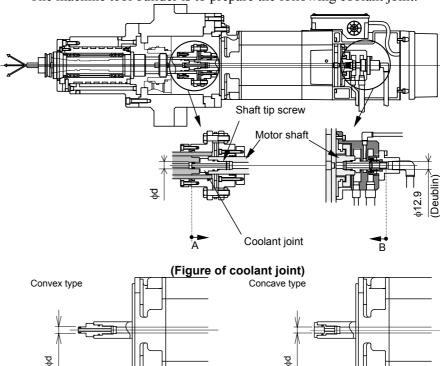


Example of rotation joint (separate external support type)

\* Before attaching a rotation joint to the motor shaft, apply screw locking adhesive.

## 9.6 COOLANT JOINT



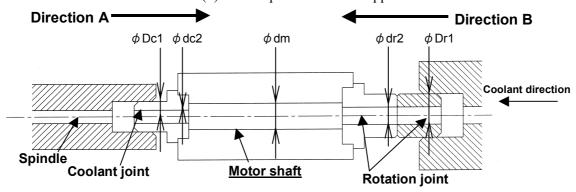


- \* when installing the coolant joint, apply thread-locking adhesive to the joint, and be sure to use the screw used at the end of the motor shaft.
  - Press the coolant joint against the shaft end face.
- (1) When center-through coolant is used, thrust load due to coolant is applied between the spindle and motor and between the motor and rotation joint. The motor can be made stable without affecting impacts such as pulsation of the coolant pump by setting a slightly larger thrust load in direction B in the above figure than a thrust load in direction A.
- (2) When a rotation joint described in Section 9.5 is used, the pressure reception diameter on the rotation joint side is  $\phi12.9$ (Deublin) or  $\phi12.6$ (Rix). So, ensure that the pressure reception diameter ( $\phi$ d) on the side of a coolant joint attached to the motor shaft tip follows the table below.
  - \* When the coolant pressure is 70 kgf/cm<sup>2</sup> or less (For a coolant pressure of more than 70 kgf/cm<sup>2</sup>, consult with FANUC.)

Motor model	Manufacturer	Rotation joint specification	Pressure reception diameter φd on coolant joint side	Shaft tip screw size
$\alpha i$ I $\tau$ 1.5 to $\alpha i$ I $\tau$ 3	Deublin	1129-036-327 1129-033-327	φ12.5	M12
αιιι 1.5 10 αιιτ 3	Rix	ESX20M-S012 ESX20M-E012	l	IVI I Z

Motor model	Manufacturer	Rotation joint specification	Pressure reception diameter φd on coolant joint side	Shaft tip screw size
ir ou ir oo	Deublin	1129-036-301 1129-033-301	ф12.0	1440
$\alpha i$ IT 6 to $\alpha i$ IT 22	Rix	ESX20M-S016 ESX20M-E016	Μ11 7	M16

(3) Concept of thrust load applied to the motor



<1> In the above figure, calculate the thrust load applied to the motor.

Coolant pressure: P

Outside diameter of coolant joint:  $\phi$ Dc1, outside area: Sc1 Inside diameter of coolant joint:  $\phi$ dc2, inside area: Sc2 Inside diameter of motor shaft:  $\phi$ dm, inside area: Sm Outside diameter of rotation joint:  $\phi$ Dr1, outside area: Sr1 Inside diameter of rotation joint:  $\phi$ dr2, inside area: Sr2

- Thrust load applied to the motor in direction A:  $F_A=P(Sc1-Sc2)+P(Sm-Sr2)$
- Thrust load applied to the motor in direction B:  $F_B=P(Sr1-Sr2)+P(Sm-Sc2)$
- Total thrust load applied to the motor:  $F=F_B-F_A=$  P(Sr1-Sr2)+P(Sm-Sc2)-(P(Sc1-Sc2)+P(Sm-Sr2))  $=P(Sr1-Sc1)=P(\pi (\phi Dr1)^2/4-\pi (\phi Dc1)^2/4)$

Therefore, only the coolant pressure, the outside diameter of the rotation joint ( $\phi$ Dr1), and the outside diameter of the coolant joint ( $\phi$ Dc1) are related to the calculation of the thrust load applied to the motor.

### B-65272EN/05FANUC AC SPINDLE MOTOR $\alpha i$ IT series 200V type 9.NOTES ON MOTOR INSTALLATION

<2> Example for calculating the thrust load

Assume that the coolant pressure is 70 kgf/cm<sup>2</sup>, the pressure reception diameter is  $\phi$ Dc1= $\phi$ 12.

Also assume that the rotation joint is manufactured by Deublin ( $\phi$ Dr1= $\phi$ 12.9).

The thrust load applied to the motor is then calculated as follows:

F=70kgf/cm<sup>2</sup> ×  $(1.31cm^2 (\phi 12.9) - 1.13cm^2 (\phi 12)) = \underline{12.6kgf}$  A thrust load of  $\underline{12.6 \ kgf}$  is applied in such a direction that it presses the motor shaft forward.

Also when the pressure reception diameter is  $\phi$ Dc1= $\phi$ 12.5, a thrust load of 5.6 kgf can be obtained by similar calculation.

## 9.7 ROTATION JOINT SUPPORT HOUSING

The machine tool builder is to prepare a rotation joint support housing. To secure a housing, use a socket and spigot joint and six M5 tapped holes at the motor rear end. Prepare six M5 bolts to secure a housing.

When a rotation joint of separate external support type is used, cutting fluid leaks from the sealing section (contact section between the stationary side and rotation side). So, be sure to provide a drain on the housing for the rotation joint. A drain of PT3/8 or more is required, and a hose with an inner diameter of  $\phi$ 12 mm or more is required.

(To determine the final figure of a drain, be sure to contact the manufacturer of a rotation joint.)

A housing of labyrinth structure for preventing cutting fluid from penetrating into the inside of the motor is required. Particularly when the motor is oriented downward vertically, enhance drainage by means such as air purging.

When the rotation joint is damaged, a large amount of cutting fluid can leak. So, provide many notches on the housing. Moreover, attach a flow rate sensor to the drain to perform periodic flow rate management. For details, refer to the specifications of each rotation joint.

### (Example of rotation joint support housing) When the motor is oriented horizontally When the motor is oriented downward vertically Taper section 6 M5 tapped holes Air purge piping with a depth of 7 Mounting housing Rotation joint (separate type) Coolant piping Drain (Inner hose diameter of φ18 or more) (PT3/8 or more) Drain (spare) (PT1/4) Drain (notch) Socket and spigot joint at Socket and spigot joint at the motor rear end the motor rear end Notch (window) on the mounting housing Notch (window)

# VII. FANUC AC SPINDLE MOTOR $\alpha i$ IT series 400V type

## 1

## **GENERAL**

The FANUC AC spindle motor  $\alpha i$ IT series 400V type includes spindle motors (hollow shaft), which can be driven by 400 to 480VAC without a step-down transformer<sup>(\*1)</sup>.

(\*1) For models  $\alpha i$ IT 1.5HV,  $\alpha i$ IT 2HV, and  $\alpha i$ IT 3HV, however, a single-phase step-down transformer for fan motors is required when 480VAC is applied.

#### **Features**

• For features of a spindle that is directly connected to a motor, see the  $\alpha i$ IT series 200V type section.

## **SPECIFICATIONS**

(S1)Cont. rated kW	Item	Model	α <i>i</i> Ιτ 1.5/20000HV	α <i>ἱ</i> Ιτ <b>2/20000HV</b>	α <i>ἱ</i> Ιτ 3/12000HV		
Output (S2)30 min rated kW         (2.0)         (3.0)         (5.0)           (*1)         (15 min)(*2)(HP)         (3.0)         (5.0)         (7.4)           (S3)60%(40%)kW         2.2         3.7         5.5           (S3)60%(40%)kW         2.2         3.7         5.5           (S1)         A         13         21         18           current (S1)         (S2),(S3)         A         16         28         23           Speed (S2),(S3)         A         16         28         23           Speed min*         Max. speed         20,000         3,000         1,500           Cont. rated torque aronge         N·m         4,77         7.0         23.5           Kef cm)         (48.7)         (71.5)         (240)           Rotor kg-m²         0.0043         0.0078         0.0148           inertia (kgf cm·s²)         (0.04)         (0.08)         (0.15)           Weight         kgf         24         27         46           Vibration         V3 (rotation component)         Noise         75dB(A) or less           Cooling system (*s)         Totally enclosed and fan cooled (IC0A6)         (*15)           Installation (*r)         Mount the motor s	Item	(S1)Cont_rated kW	1.5	2.2	2 7		
Output (*1)         (\$2)30 min rated kW [15 min](*2)(HP)         2.2         3.7         5.5           (*1)         (\$3)60%[40%]kW (*3)         (\$5.0)         (\$7.4)           (\$3)60%[40%]kW (*3)         2.2         3.7         5.5           Saction (*5)         (\$3)         (\$5.0)         (\$7.4)           Rated current (*5)         (\$1)         A         13         21         18           (\$2)(S3)         A         16         28         23           Speed min*         Base speed         3.000         3.000         1.500           Cont. rated torque at const. rated		` '					
(*1)         [15 min](*2)(HP)         (3.0)         (5.0)         (7.4)           (S3)60%(40%)ktW         2.2         3.7         5.5           (*3)(*4)         (HP)         (3.0)         (5.0)         (7.4)           Rated current         (S1)         A         13         21         18           current         (\$2),(S3)         A         16         28         23         5           Speed Max speed         3.000         3.000         1,500	Output	. ,					
Rated   (3)(6)(4)(6)(4)(HP)   (3.0)   (5.0)   (7.4)   (7.4)   (7.4)   (1.4)   (1.4)   (1.5)		` '					
(*3) (*4) (HP) (3.0) (5.0) (7.4)	( ')		` /				
Rated current (S1)							
Courrent (5)   S2),(S3)   A   16   28   23	Rated		, ,	, ,			
Speed   Base speed   3,000   3,000   1,500							
Base speed   3,000   3,000   1,500   Max. speed   20,000   20,000   12,000		(S2),(S3) A	16	28	23		
Max. speed   20,000   20,000   12,000   12,000	` '	Base sneed	3 000	3 000	1 500		
Cont. rated torque at const. rated torque range			·	•	,		
rated torque range		i	20,000	20,000	12,000		
N-m		-					
Rotor   kg·m²   0.0043   0.0078   0.0148	10		4 77	7.0	23.5		
Rotor         kg·m² (nertia         0.0043         0.0078         0.0148 (nertia           weight (kgf·cm·s²)         (0.04)         (0.08)         (0.15)           Weight (kgf)         24         27         46           Vibration         V3 (rotation component)           Noise         75dB(A) or less           Cooling system (*6)         Totally enclosed and fan cooled (IC0A6)           Cooling fan         W         (*15)           Installation (*7)         Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)           Allowable overload capacity (1 min) (*8)         120% of (\$2)           Insulation         Class H           Ambient temperature         0°C to 40°C           Allitude         Height above sea level not exceeding 1000m           Painting color         Munsell system N2.5           Type of thermal protection (*9)         TP211           Resolution of the built-in sensor p/rev         Built-in with αiMZ sensor           built-in sensor p/rev         2048           Number of detected gear teeth per rotation λ/rev.         3           Bearing lubrication         Grease           Shaft end seal, protection format (IEC34)         To be directly connected with the spindle							
inertia         (kgf·cm·s²)         (0.04)         (0.08)         (0.15)           Weight         kgf         24         27         46           Vibiration         V3 (rotation component)           Noise         75dB(A) or less           Cooling system (*6)         Totally enclosed and fan cooled (IC0A6)           Cooling fan         W         (*15)           Installation (*7)         Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)           Allowable overload capacity (1 min) (*8)         120% of (\$2)           Insulation         Class H           Ambient temperature         0°C to 40°C           Alltitude         Height above sea level not exceeding 1000m           Painting color         Munsell system N2.5           Type of thermal protection (*9)         TP211           Resolution of the built-in sensor p/rev         Built-in with αiMZ sensor           built-in sensor p/rev         2048           Number of detected gear teeth per rotation λ/rev.         Bearing lubrication           Shaft end seal, protection format (IEC34)         To be directly connected with the spindle           Method of connection with the spindle (*10)         To be directly connected with the spindle           Allowable thrust load (*11)kgf	Rotor	ka·m <sup>2</sup>	, ,	, ,	\ /		
Weight         kgf         24         27         46           Vibration         V3 (rotation component)         Noise         75dB(A) or less           Cooling system (*6)         Totally enclosed and fan cooled (IC0A6)           Cooling fan         W         (*15)           Installation (*7)         Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)           Allowable overload capacity (1 min) (*8)         120% of (\$2\$)           Insulation         Class H           Ambient temperature         0°C to 40°C           Altitude         Height above sea level not exceeding 1000m           Painting color         Munsell system N2.5           Type of thermal protection (*9)         TP211           Resolution of the built-in sensor p/rev         Built-in with αiMZ sensor           Number of detected gear teeth per rotation         2048           Number of detected gear teeth per rotation         Grease           Shaft end seal, protection format (IEC34)         Grease           Method of connection with the spindle (*10)         To be directly connected with the spindle spindle (*10)           Allowable thrust load (*11)kgf         6           Maximum output during acceleration (*12) kW         13.0		(kaf.cm.s <sup>2</sup> )					
Vibration     V3 (rotation component)       Noise     75dB(A) or less       Cooling system (*6)     Totally enclosed and fan cooled (IC0A6)       Cooling fan     W       Installation (*7)     Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)       Allowable overload capacity (1 min) (*8)     120% of (S2)       Insulation     Class H       Ambient temperature     0°C to 40°C       Alltiude     Height above sea level not exceeding 1000m       Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the built-in sensor p/rev     Built-in with αiMZ sensor       built-in sensor p/rev     2048       Number of detected gear teeth per rotation λ/rev.     128       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle spindle (*10)       Allowable thrust load (*11)kgf     6       Maximum output during acceleration (*12) kW     13.0			` '	, ,	. ,		
Noise 75dB(A) or less Cooling system (*6) Totally enclosed and fan cooled (IC0A6) Cooling fan W (*15) Installation (*7) Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1) Allowable overload capacity (1 min) (*8) 120% of (\$2) Insulation Class H Ambient temperature 0°C to 40°C Altitude Height above sea level not exceeding 1000m Painting color Munsell system N2.5 Type of thermal protection (*9) TP211 Resolution of the built-in sensor p/rev Number of detected gear teeth per rotation \(\frac{\chi}{\chi}\)/rev. Bearing lubrication Shaft end seal, protection format (IEC34) Method of connection with the spindle (*10) Allowable thrust load (*11)kgf 6 Maximum output during acceleration (*12) kW			2 1		10		
Cooling system (*6)     Totally enclosed and fan cooled (IC0A6)       Cooling fan     W       Installation (*7)     Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)       Allowable overload capacity (1 min) (*8)     120% of (S2)       Insulation     Class H       Ambient temperature     0°C to 40°C       Altitude     Height above sea level not exceeding 1000m       Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the built-in sensor     Built-in with αiMZ sensor       built-in sensor     p/rev       Number of detected gear teeth per rotation     3/rev.       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle spindle (*10)       Allowable thrust load (*11)kgf     6       Maximum output during acceleration (*12) kW     13.0							
Cooling fan     W     (*15)       Installation     (*7)     Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)       Allowable overload capacity (1 min)     (*8)     120% of (\$2)       Insulation     Class H       Ambient temperature     0°C to 40°C       Altitude     Height above sea level not exceeding 1000m       Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the built-in sensor     Built-in with αiMZ sensor       built-in sensor     p/rev       Number of detected gear teeth per rotation     λ/rev.       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle spindle (*10)       Allowable thrust load (*11)kgf     6       Maximum output during acceleration (*12) kW     13.0		system (*6)	Totall	```	:0Δ6)		
Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)  Allowable overload capacity (1 min) (*8) Insulation Class H  Ambient temperature 0°C to 40°C  Altitude Height above sea level not exceeding 1000m  Painting color Type of thermal protection (*9)  Resolution of the built-in sensor p/rev Duilt-in sensor p/rev 2048  Number of detected gear teeth per rotation \(\frac{\chi}{\chi}\)/rev.  Bearing lubrication Grease  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during acceleration (*12) kW  Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)  120% of (S2)  120% of (S2)  120% of (S2)  1200m  Munsell system N2.5  TP211  Built-in with \(\alpha\) iMZ sensor  2048  128  Bearing lubrication  Grease  Simplified labyrinth: IP40  To be directly connected with the spindle  6  Maximum output during acceleration (*12) kW			Totali		<del>, , , , , , , , , , , , , , , , , , , </del>		
Installation (*7)  Allowable overload capacity (1 min) (*8)  Insulation  Class H  Ambient temperature  Altitude  Painting color  Type of thermal protection (*9)  Resolution of the built-in sensor p/rev  Number of detected gear teeth per rotation  Bearing lubrication  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during and solution (*2)  Allowable thrust load (*12) kW  120% of (S2)  120	Cooming	iaii vv					
Insulation   Class H	Installat	ion (*7)					
Insulation  Class H  Ambient temperature  Altitude  Painting color  Type of thermal protection (*9)  Resolution of the  built-in sensor  Bearing lubrication  Shaft end seal, protection  format (IEC34)  Method of connection with the spindle  spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during  acceleration  Class H  Alexand  Class H  Alexand  Class H  Alexand  Class H  Alexand  Class H  Alexand  Class H  Alexand  Class H  Alexand  Class H  Alexand  Class H  Alexand  Class H  Alexand  Class H  Alexand  Class H  Alexand  Alexand  Alexand  Class H  Alexand  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Alexand  Class H  Alexand  Al	Allowab	le overload capacity		120% of (S2)			
Ambient temperature 0°C to 40°C Altitude Height above sea level not exceeding 1000m Painting color Munsell system N2.5 Type of thermal protection (*9) Resolution of the Built-in with \alpha iMZ sensor built-in sensor p/rev Number of detected gear teeth per rotation \(\lambda/\text{rev}\).  Bearing lubrication Shaft end seal, protection format (IEC34) Method of connection with the spindle (*10) Allowable thrust load (*11)kgf Maximum output during acceleration (*12) kW  Method of connection (*12) kW	(1 min)	(*8)		120 % 01 (32)			
Altitude     Height above sea level not exceeding 1000m       Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the     Built-in with αiMZ sensor       built-in sensor     p/rev       Number of detected gear teeth per rotation     128       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle       Allowable thrust load (*11)kgf     6       Maximum output during acceleration (*12) kW     13.0     20.0     13.0	Insulatio	on		Class H			
Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the built-in sensor p/rev     Built-in with αiMZ sensor       Number of detected gear teeth per rotation λ/rev.     128       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle       Allowable thrust load (*11)kgf     6       Maximum output during acceleration (*12) kW     13.0     20.0     13.0	Ambient	t temperature		0°C to 40°C			
Type of thermal protection (*9)  Resolution of the Built-in with αiMZ sensor built-in sensor p/rev  Number of detected gear teeth per rotation λ/rev.  Bearing lubrication  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during acceleration (*12) kW  TP211  Built-in with αiMZ sensor  2048  Simplified labyrinth: IP40  Simplified labyrinth: IP40  To be directly connected with the spindle	Altitude		Height a	above sea level not exceeding	1000m		
Resolution of the built-in sensor p/rev  Number of detected gear teeth per rotation λ/rev.  Bearing lubrication  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during acceleration (*12) kW  Built-in with αiMZ sensor  2048  Built-in with αiMZ sensor  2048  Tobe directly connected with the spindle spindle (*10)  128  Simplified labyrinth: IP40  To be directly connected with the spindle spindle (*10)  13.0	Painting	color		Munsell system N2.5			
built-in sensor     p/rev       Number of detected gear teeth per rotation     λ/rev.       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle       Allowable thrust load (*11)kgf     6       Maximum output during acceleration (*12) kW     13.0       20.0     13.0	Type of	thermal protection (*9)		TP211			
Number of detected gear teeth per rotation     128       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle       Allowable thrust load (*11)kgf     6       Maximum output during acceleration (*12) kW     13.0       13.0     20.0       13.0	Resoluti	ion of the		Built-in with $\alpha i$ MZ sensor			
Number of detected gear teeth per rotation \$\frac{\lambda{\sqrt{rev}}}{\lambda{\sqrt{rev}}}\$  Bearing lubrication \$\frac{\sqrt{grease}}{\sqrt{grease}}\$  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during acceleration (*12) kW  128  Simplified labyrinth: IP40  To be directly connected with the spindle 6  Maximum output during 20.0 13.0	built-in s	sensor p/rev		2048			
per rotation A/rev.  Bearing lubrication Grease  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during acceleration (*12) kW  Measure Grease  Simplified labyrinth: IP40  To be directly connected with the spindle 6  Maximum output during 13.0 20.0 13.0	Number	of detected gear teeth					
Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during acceleration (*12) kW  Simplified labyrinth: IP40  To be directly connected with the spindle 6  40  13.0  13.0  13.0		_		128			
Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during acceleration (*12) kW  Simplified labyrinth: IP40  To be directly connected with the spindle 6  40  13.0  13.0  13.0	Bearing			Grease			
Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during acceleration (*12) kW  To be directly connected with the spindle  6  Maximum output during 13.0 20.0 13.0				0: 1:5 11 1 : 11 15 10			
Method of connection with the spindle (*10)  Allowable thrust load (*11)kgf  Maximum output during acceleration (*12) kW  To be directly connected with the spindle  6  13.0  20.0  13.0			Simplified labyrinth: IP40				
Allowable thrust load (*11)kgf 6  Maximum output during acceleration (*12) kW 13.0 20.0 13.0		, ,	To be directly connected with the enindle				
Allowable thrust load (*11)kgf 6  Maximum output during 13.0 20.0 13.0  acceleration (*12) kW	spindle	(*10)	ro be directly connected with the spinale				
Maximum output during 13.0 20.0 13.0			6				
acceleration (*12) kW		· · · · · ·	40.0	00.0	40.0		
Approximation   Who is it   Who is it   Who is it			lpha iSP 15HV	α <i>İ</i> SP 30HV	α <i>i</i> SP 11HV		

<sup>\*</sup> See Page 317 for Cautions and limitations.

Cooling system (*6)     Totally enclosed and fan cooled (ICOA6)       Cooling fan W     Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)       Allowable overload capacity (1 min) (*8)     120% of (S2)       Insulation     Class H       Ambient temperature     0°C to 40°C       Altitude     Height above sea level not exceeding 1000m       Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the built-in sensor     Built-in with αiMZ sensor       built-in sensor     p/rev       Number of detected gear teeth per rotation     λ/rev.       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the     To be directly connected with the spindle	Item		Model	α <i>i</i> Ιτ <b>6</b> /1	12000HV	α <i>ἱ</i> Ιτ 8/1	2000HV	
Coutput   Carrest	Connectio	on (*13)						
S230 min rated		(S1)Cont. rated		5.5	5.5	7.5	7.5	
(*1)         (HP)         (10)         (10)         (14.7)         (14.7)           (S3)60%         kW         7.5         7.5         11         11           (*4)         (HP)         (10)         (10)         (14.7)         (14.7)           Rated         (S1)         A         18         18         23         25           current (*5)         (S2),(S3)         A         22         24         29         30           Speed         Base speed         1,500         4,000         1,500         4,000           Max. speed         12,000         12,000         12,000         12,000         12,000           Switching speed         min¹         4,000         4,000         4,000         4,000           Cont. rated torque at const. rated torque at	Output	(C2)20 min rated		` '				
S3)60%   KW   7.5   7.5   11   11   11   11   11   11   11		(32)30 min rated						
(*4) (HP) (10) (10) (14.7) (14.7) (14.7)	( 1)	(\$3)60%	` '			` '		
Rated current   (S2)   A								
current (*5)         (S2),(S3)         A         22         24         29         30           Speed min¹         Max. speed         1,500         4,000         1,500         4,000           Switching speed         min¹         4,000         12,000         12,000           Cont. rated torque at const. rated torque at const. rated torque range         N·m         35.0         13.2         47.7         17.9           Nome (kgf-cm)         (357)         (134)         (487)         (182.7)           Rotor inertia         kg·m²         (0.18)         (0.28)           Weight         kg         51         80           Vibration         V3 (rotation component)           Noise         Totally enclosed and fan cooled (ICOA6)           Cooling system (*6)         Totally enclosed and fan cooled (ICOA6)           Cooling fan         Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)           Allowable overload capacity (1 min) (*8)         120% of (S2)           Insulation         Class H           Ambient temperature         0°C to 40°C           Altitude         Height above sea level not exceeding 1000m           Painting color         Munsell system N2.5 <t< td=""><td>Rated</td><td><del> </del></td><td>` '</td><td>` '</td><td></td><td>` '</td><td>` '</td></t<>	Rated	<del> </del>	` '	` '		` '	` '	
Speed   Base speed   1,500   4,000   1,500   4,000   1,000   12	current	,						
Max. speed		Base speed		1.500	4.000	1.500	4.000	
Switching speed         min¹ torque at const. rated torque at const. rated torque range N·m (kgf·cm)         4,000         4,000           N·m (kgf·cm)         (357)         (134)         (487)         17.9 (182.7)           Rotor inertia kg·m² (kgf·cm·s²)         0.0179 (0.18)         (0.28)           Weight kgf         51         80           Vibration         V3 (rotation component)           Noise         75dB(A) or less           Cooling system (*6)         Totally enclosed and fan cooled (ICOA6)           Cooling fan W         Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)           Allowable overload capacity (1 min) (*8)         120% of (S2)           Insulation         Class H           Ambient temperature         0°C to 40°C           Allitude         Height above sea level not exceeding 1000m           Painting color         TP211           Type of thermal protection (*9)         TP211           Resolution of the built-in sensor p/rev         Built-in with α/IMZ sensor           Built-in sensor p/rev         4096           Number of detected gear teeth per rotation λ/rev.         Simplified labyrinth: IP40           Rease         Simplified labyrinth: IP40           Method of connection with the spindle (*10)						·	· · · · · · · · · · · · · · · · · · ·	
Cont. rated torque at const. rated torque range			min <sup>-1</sup>					
Rotor inertia   kg·m²   0.0179   0.0275   (0.28)		ed torque at const torque range						
Rotor inertia         kg·m² (kgf·cm·s²)         0.0179 (0.18)         0.0275 (0.28)           Weight kgf         51         80           Vibiration         V3 (rotation component)           Noise         75dB(A) or less           Cooling system (*6)         Totally enclosed and fan cooled (IC0A6)           Cooling fan         W           Installation (*7)         Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)           Allowable overload capacity (1 min) (*8)         120% of (S2)           Insulation         Class H           Ambient temperature         0°C to 40°C           Altitude         Height above sea level not exceeding 1000m           Painting color         Munsell system N2.5           Type of thermal protection (*9)         TP211           Resolution of the built-in sensor p/rev         Built-in with αiMz sensor           Number of detected gear teeth per rotation λ/rev.         256           Bearing lubrication         Grease           Shaft end seal, protection format (IEC34)         Simplified labyrinth: IP40           Method of connection with the spindle (*10)         To be directly connected with the spindle spindle with the spindle (*10)           Allowable thrust load (*11) kgf         13           Maximum								
Rotor inertial         (kgf cm·s²)         (0.18)         (0.28)           Weight         kgf         51         80           Vibration         V3 (rotation component)           Noise         75dB(A) or less           Cooling system         (*6)         Totally enclosed and fan cooled (IC0A6)           Cooling fan         W         Installation         Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)           Allowable overload capacity (1 min) (*8)         120% of (S2)           Insulation         Class H           Ambient temperature         0°C to 40°C           Alltitude         Height above sea level not exceeding 1000m           Painting color         Munsell system N2.5           Type of thermal protection (*9)         TP211           Resolution of the built-in sensor p/rev         Built-in with αiMZ sensor           Number of detected gear teeth per rotation         256           Bearing lubrication         Grease           Shaft end seal, protection format (IEC34)         Simplified labyrinth: IP40           Method of connection with the spindle (*10)         To be directly connected with the spindle spindle (*10)           Allowable thrust load (*11) kgf         13           Maximum output during acceleration (*12)		kn·m <sup>2</sup>						
Weight kgf     51     80       Vibration     V3 (rotation component)       Noise     75dB(A) or less       Cooling system (*6)     Totally enclosed and fan cooled (ICOA6)       Cooling fan W     Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)       Allowable overload capacity (1 min) (*8)     120% of (S2)       Insulation     Class H       Ambient temperature     0°C to 40°C       Altitude     Height above sea level not exceeding 1000m       Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the built-in sensor p/rev     Built-in with αiMZ sensor       Number of detected gear teeth per rotation λ/rev.     256       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle       Allowable thrust load (*11) kgf     13       Maximum output during acceleration (*12) kW     13.0	Rotor iner							
Vibration     V3 (rotation component)       Noise     75dB(A) or less       Cooling system (*6)     Totally enclosed and fan cooled (IC0A6)       Cooling fan W     Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)       Allowable overload capacity (1 min) (*8)     120% of (\$2)       Insulation     Class H       Ambient temperature     0°C to 40°C       Altitude     Height above sea level not exceeding 1000m       Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the built-in sensor p/rev     Built-in with αİMZ sensor       Number of detected gear teeth per rotation λ/rev.     256       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle spindle (*10)       Allowable thrust load (*11) kgf     13       Maximum output during acceleration (*12) kW     13.0	Weight						,	
Noise 75dB(A) or less Cooling system (*6) Totally enclosed and fan cooled (ICOA6) Cooling fan W Installation (*7) Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1) Allowable overload capacity (1 min) (*8) 120% of (\$2) Insulation Class H Ambient temperature 0°C to 40°C Altitude Height above sea level not exceeding 1000m Painting color Munsell system N2.5 Type of thermal protection (*9) TP211 Resolution of the built-in sensor p/rev Number of detected gear teeth per rotation \(\lambda/\text{rev}\). Bearing lubrication Grease Shaft end seal, protection with the spindle (*10) Allowable thrust load (*11) kgf 13 Maximum output during acceleration (*12) kW 13.0  Mount the motor so that the output shaft points in a direction ranging within the horizontal the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)  Allowable thrust load (*11) kgf 13  Maximum output during acceleration (*12) kW 13.0		3		·				
Cooling system (*6) Cooling fan W  Installation (*7) Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)  Allowable overload capacity (1 min) (*8) Insulation Class H  Ambient temperature Ambient temperature Altitude Height above sea level not exceeding 1000m Painting color Type of thermal protection (*9) TP211  Resolution of the built-in sensor p/rev Number of detected gear teeth per rotation N/rev. Bearing lubrication Shaft end seal, protection format (IEC34) Method of connection with the spindle Simplified labyrinth: IP40  Allowable thrust load (*11) kgf Maximum output during acceleration (*12) kW  Mount the motor so that the output shaft points in a direction ranging within the horizontal the notice output shaft points in a direction ranging within the horizontally eventually a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)  Allowable thrust load (*11) kgf  Totally enclosed and fan cooled (IC0A6)  Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)  Allowable thrust load (*11) kgf  To be directly connected with the spindle spindle of the output during acceleration (*12) kW	Noise			75dB(A) or less				
Cooling fan W  Installation (*7)  Mount the motor so that the output shaft points in a direction ranging within the horizontally to vertically downwards. (IMB5,IMV1)  Allowable overload capacity (1 min) (*8)  Insulation  Class H  Ambient temperature  O°C to 40°C  Altitude  Height above sea level not exceeding 1000m  Painting color  Type of thermal protection (*9)  Resolution of the built-in with \(\alpha\) iMZ sensor built-in sensor p/rev  Number of detected gear teeth per rotation  \(\begin{array}{c}\) \(\b		ystem (*6)			, ,			
Installation (*7)  Allowable overload capacity (1 min) (*8)  Insulation  Class H  Ambient temperature  Altitude  Painting color  Type of thermal protection (*9)  Resolution of the  built-in sensor  Built-in with \(\alpha\) insulation  Bearing lubrication  Shaft end seal, protection format (IEC34)  Method of connection with the spindle  Allowable thrust load (*11) kgf  Maximum output during  acceleration (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW					•			
(1 min) (*8)     120% of (S2)       Insulation     Class H       Ambient temperature     0°C to 40°C       Altitude     Height above sea level not exceeding 1000m       Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the built-in with αiMZ sensor built-in sensor p/rev     Built-in with αiMZ sensor       Number of detected gear teeth per rotation λ/rev.     256       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle       Allowable thrust load (*11) kgf     13       Maximum output during acceleration (*12) kW     13.0	Installatio	n (*7)			•	•		
Ambient temperature 0°C to 40°C  Altitude Height above sea level not exceeding 1000m  Painting color Munsell system N2.5  Type of thermal protection (*9)  Resolution of the Built-in with \(\alpha\) iMZ sensor  built-in sensor p/rev  Number of detected gear teeth per rotation \(\beta\)/rev.  Bearing lubrication Grease  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11) kgf  Maximum output during acceleration (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW  Allowable thrust load (*12) kW		•			120% (	of (S2)		
Altitude Height above sea level not exceeding 1000m  Painting color Munsell system N2.5  Type of thermal protection (*9) TP211  Resolution of the Built-in with \(\alpha\) iMZ sensor built-in sensor p/rev  Number of detected gear teeth per rotation \(\lambda\)/rev.  Bearing lubrication Grease  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11) kgf  Maximum output during acceleration (*12) kW  To be directly connected with the expendence with the spindle 13.0  13.0  13.2	Insulation				Clas	s H		
Painting color     Munsell system N2.5       Type of thermal protection (*9)     TP211       Resolution of the built-in sensor p/rev     Built-in with αtMZ sensor       Number of detected gear teeth per rotation λ/rev.     256       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle (*10)     To be directly connected with the spindle       Allowable thrust load (*11) kgf     13       Maximum output during acceleration (*12) kW     13.0	Ambient t	emperature			0°C to	40°C		
Type of thermal protection (*9)  Resolution of the Built-in with αtMZ sensor built-in sensor p/rev  Auge Number of detected gear teeth per rotation λ/rev.  Bearing lubrication  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11) kgf  Maximum output during acceleration (*12) kW  To be directly connected with the spindle 13.0  13.0  13.2	Altitude			ŀ	Height above sea level	not exceeding 1000r	n	
Resolution of the built-in sensor p/rev  Number of detected gear teeth per rotation \$\lambda/\text{rev}\$.  Bearing lubrication Grease  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11) kgf  Maximum output during acceleration (*12) kW  Built-in with \$\alpha iMZ\$ sensor  4096  Simplified labyrinth: IP40  Simplified labyrinth: IP40  To be directly connected with the spindle	Painting of	color			Munsell sy	stem N2.5		
built-in sensor     p/rev       Number of detected gear teeth per rotation     256       Bearing lubrication     Grease       Shaft end seal, protection format (IEC34)     Simplified labyrinth: IP40       Method of connection with the spindle     To be directly connected with the spindle       Allowable thrust load (*10)     13       Maximum output during acceleration (*12)     13.0       13.0     13.2	Type of th	nermal protection	(*9)	TP211				
Number of detected gear teeth per rotation \$\frac{\lambda{\text{Vrev}}}{\text{Number of detected gear teeth per rotation}\$\frac{\lambda{\text{Vrev}}}{\text{Detection}}\$\frac{\text{Grease}}{\text{Shaft end seal, protection format}}{\text{GIEC34}}\$\frac{\text{Simplified labyrinth: IP40}}{\text{Method of connection with the spindle}}\$\frac{\text{To be directly connected with the spindle}}{\text{3}}\$\frac{\text{Allowable thrust load (*11) kgf}}{\text{Maximum output during}}\$\frac{13}{13.0}\$\frac{13.0}{13.2}\$	Resolution	n of the		Built-in with $lpha i$ MZ sensor				
rotation $\lambda$ /rev.  Bearing lubrication Grease  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11) kgf  Maximum output during acceleration (*12) kW	built-in se	nsor p/rev			409	96		
Bearing lubrication Grease  Shaft end seal, protection format (IEC34)  Method of connection with the spindle (*10)  Allowable thrust load (*11) kgf  Maximum output during acceleration (*12) kW  Grease  Simplified labyrinth: IP40  To be directly connected with the spindle  13  13.0  13.2	Number o	of detected gear te	eth per					
Shaft end seal, protection format (IEC34)  Method of connection with the spindle  Simplified labyrinth: IP40  To be directly connected with the spindle  Allowable thrust load (*11) kgf  Maximum output during acceleration (*12) kW  Simplified labyrinth: IP40  To be directly connected with the spindle  13  13.0	rotation $\lambda$ /rev.		200					
Method of connection with the spindle (*10)  Allowable thrust load (*11) kgf  Maximum output during acceleration (*12) kW  Simplified labyrinth: IP40  To be directly connected with the spindle  13  13.0  13.2					Grea	ase		
spindle (*10)  Allowable thrust load (*11) kgf  Maximum output during acceleration (*12) kW  To be directly connected with the spindle		seal, protection fo	ormat	Simplified labyrinth: IP40				
Maximum output during 13.0 13.2	spindle	(*10)	he	· · · · · · · · · · · · · · · · · · ·				
acceleration (*12) kW	Allowable thrust load (*11) kgf		13					
				13.0 13.2			.2	
				$\alpha i$ SP	15HV	αiSP	15HV	

<sup>\*</sup> See Page 317 for Cautions and limitations.

Model		α <i>ἱ</i> Ιτ 8/1	5000HV	α <i>i</i> Ιτ <b>15</b> /	α <i>ἱ</i> Ιτ 15/10000HV	
Item				1		
Connec	tion (*13)	Low-speed winding (Y connection)	High-speed winding (∆ connection)	Low-speed winding (Y connection)	High-speed winding (∆ connection)	
	(S1)Cont. rated kW	7.5	7.5	15	15	
	(HP)	(10)	(10)	(20.1)	(20.1)	
	(S2)30 min rated kW	11	11	18.5	18.5	
Output	(HP)	(14.7) (14.7)		(24.8)	(24.8)	
(*1)	(S2) 10 min rated kW	15.0	15.0			
	(HP)	(20.1)	(20.1)	-	-	
	(S3)60% kW	_		18.5	18.5	
	(*4) (HP)		_	(24.8)	(24.8)	
Rated	(S1) A	35	37	37	36	
current (*5)	(S2),(S3) A	55	53	45	41	
Speed	Base speed	1,500	4,000	1,500	4,000	
min <sup>-1</sup>	Max. speed	4,000	15,000	10,000	10,000	
	ng speed	,				
min <sup>-1</sup>	ig specu	4,0	000	4,0	000	
Cont.	rated torque at const.					
ra	ated torque range					
	N·m	47.7	17.9	95.4	35.8	
	(kgf⋅cm)	(487)	(182)	(974)	(365)	
Rotor in	ertia kg·m²		275		09	
	(kgf·cm·s <sup>2</sup> )		28)	(0.	93)	
Weight	kgf	8	0		10	
Vibratio	n		V3 (rotation			
Noise			,	) or less		
Cooling			Totally enclosed and	nd fan cooled (IC0A6)		
Cooling	fan W					
Installat	ion (*7)		so that the output shat orizontally to vertically o	•	• •	
Allowab	le overload capacity		1200/	of (S2)		
(1 min)	(*8)		12070	01 (32)		
Insulatio	on		Clas	ss H		
Ambient	t temperature		0°C to	40°C		
Altitude			Height above sea leve	I not exceeding 1000m	1	
Painting	color		Munsell sy	stem N2.5		
Type of	thermal protection (*9)		TP:	211		
Resoluti	ion of the		Built-in with	lpha iMZ sensor		
built-in s	sensor p/rev		40	96		
Number	of detected gear teeth	256				
per rota	tion $\lambda$ /rev.	200				
Bearing	lubrication		Gre	ase		
	nd seal, protection	Simplified labyrinth: IP40				
format (						
	of connection with the		To be directly conne	cted with the spindle		
spindle	(*10)	· · · · · · · · · · · · · · · · · · ·				
	le thrust load (*11) kgf	f 13				
	m output during ation (*12) kW	28	3.0	22	2.2	
	ole spindle amplifier	aiSP	30HV	aiSP	30HV	
- P. Ouk		arei gariv				

<sup>\*</sup> See Page 317 for Cautions and limitations.

Model Item		α <i>ἱ</i> Ιτ <b>15</b> /	15000HV	α <i>i</i> Ιτ <b>22</b> /	10000HV		
Connecti	on (*13)		Low-speed winding	High-speed winding	Low-speed winding	High-speed winding	
Connecti	011 ( 10)		(Y connection)	( $\Delta$ connection)	(Y connection)	(∆ connection)	
	(S1)Cont. rated	kW	15	15	22	22	
		(HP)	(20.1)	(20.1)	(29.5)	(29.5)	
	(S2)30 min rated	kW	18.5	18.5	26	26	
Output		(HP)	(24.8)	(24.8)	(34.9)	(34.9)	
(*1)	(S2) 15 min rated	d kW	22	22	_		
		(HP)	(29.5)	(29.5)	-	-	
	(S3)40%	kW	_		26	26	
	(*3)(*4)	(HP)			(34.9)	(34.9)	
Rated	(S1)	Α	48	41	46	47	
current	(S2),(S3)	Α	67	56	54	53	
(*5)	(32),(33)						
Speed	Base speed		1,400	5,000	1,500	4,000	
min <sup>-1</sup>	Max. speed		4,000	15,000	10,000	10,000	
Switching	g speed		3.	500	4.0	000	
min <sup>-1</sup>					.,,	ı	
Cont. ra	ted torque at const	t. rated					
	torque range						
	N·m		102.2	28.6	140	52.5	
	(kgf·cm)		(1043.3)	(292.1)	(1428)	(536)	
Rotor ine	kg·m²			0.055 0.128			
	(kgf·cm·s-)			.56)	(1.29)		
Weight	kgf		121 143				
Vibration			V3 (rotation component)				
Noise			75dB(A) or less				
Cooling s			Totally enclosed and fan cooled (IC0A6)				
Cooling f	an W		Mount the motor so that the output shaft points in a direction ranging within the				
Installatio	on (*7)			so that the output shaf rizontally to vertically d			
	e overload capacity	/		120% (	of (S2)		
(1 min)	(*8)			120 /0 (	) (32)		
Insulation	า			Clas			
Ambient :	temperature			0°C to	40°C		
Altitude			ŀ	Height above sea level	not exceeding 1000r	n	
Painting (	color			Munsell sy	stem N2.5		
Type of the	hermal protection	(*9)	TP211				
Resolution	on of the		Built-in with $\alpha i$ MZ sensor				
built-in se	ensor p/rev		4096				
Number of detected gear teeth per							
rotation $\lambda$ /rev.		256					
Bearing lubrication			Grea	ase			
	d seal, protection for	ormat					
(IEC34)	<i>,</i> 1		Simplified labyrinth: IP40				
	of connection with t	:he					
spindle	(*10)	=	To be directly connected with the spindle				
		kgf	13				
	n output during						
accelerat				38 31.2		1.2	
	le spindle amplifier		aisp	230HV	aisp	30HV	
י יאטוויסטו	oplicable spindle amplifier $\alpha i$ SP 30HV $\alpha i$ SP 30HV				OULIV		

<sup>\*</sup> See Page 317 for Cautions and limitations.

#### **Cautions and limitations**

- (\*1) The rated output is guaranteed at the rated voltage. (Amplifier input: 400/480VAC +10%, -15%, 50/60Hz±1Hz) If the input voltage fluctuates, it is possible that the rated output cannot be obtained even when such fluctuations are within the allowable fluctuation range.
- (\*2) The output for  $\alpha i$ IT 1.5/20000HV and  $\alpha i$ IT 2/20000HV is 15 min rated.
- (\*3) 40% for  $\alpha i$ IT 1.5/20000HV,  $\alpha i$ IT 2/20000HV, and  $\alpha i$ IT 22/10000HV
- (\*4) The cycle time is 10 minutes, S3 60%: ON 6 minutes, OFF 4 minutes and S3 40%: ON 4 minutes, OFF 6 minutes
- (\*5) The rated current is the maximum current for each rated output.
- (\*6) IC code conforms to IEC 34-6.
- (\*7) IM code conforms to IEC 34-7.
- (\*8) This is not a guaranteed value but a guideline for the maximum motor output at a rated supply voltage.
- (\*9) Type conforms to IEC 34-11.
- (\*10)When assembling a motor with the machine, align the motor shaft with the spindle so that the vibration acceleration of the motor does not exceed 0.5 G (at maximum speed).

  (Before shipping machines, check that the vibration acceleration is 0.5 G or less for all motors.)
- (\*11)Select a coupling that does not apply a thrust load onto the motor shaft for a cause such as coolant pressure when the temperature rises.

Note that in the direction in which the motor shaft is pushed toward the inside of the motor, the allowable load is 0 kgf.

(If an Oldham coupling is used, the motor shaft can be left pushed into the inside of the motor when the motor shaft is inserted into the spindle. So, measure the distance between the mounting face for a rotation joint support housing and the flinger rear end face before and after insertion, and check that the two measured values are identical.

For details, see Section V-9.4 "COUPLING SELECTION".)

- (\*12)These values are to be used only as guidance for selecting a power supply ( $\alpha i$ PS) and are not guaranteed.
- (\*13)Switching method of power lead is Y-Δ switching.

  Required are the CNC software option related to the output switching function and the switching magnetic connection unit.

  Refer to FANUC SERVO AMPLIFIER αi series DESCRIPTIONS (B-65282EN) for output switching control.
- (\*14)The protection grade (IEC34-5) is IP40. However, the grade is IP54 when the labyrinth seal on the front side of the output axis and the flinger seal on the rear side are excluded. Ensure that the labyrinth seal and flinger seal are not directly
- exposed to coolant and mist.

  (\*15)The input power requirements of the fan motor for
  - $\alpha i$ IT 1.5/20000HV,  $\alpha i$ IT 2/20000HV, or  $\alpha i$ IT 3/12000HV are: 200/230VAC +10% -15%, single-phase, and 50/60 Hz±1Hz.

# 3

## **OUTPUT/TORQUE CHARACTERISTICS**

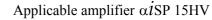
## Reference Calculation for torque

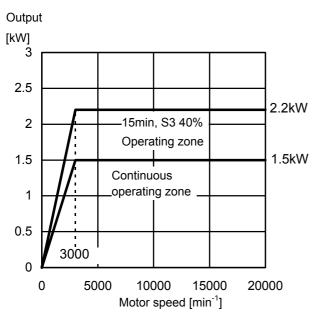
Torque T can be obtained by the following equation.

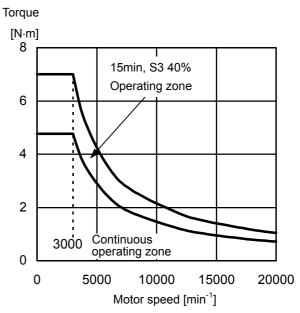
 $T[N \cdot m] = P[kW] \times 1000/0.1047/N[min^{-1}]$  P[kW]: Motor output  $N[min^{-1}]:$  Motor speed

When the unit of T is [kgf·m],  $T[kgf·m]=P[kW]\times1000/1.0269/N[min^{-1}]$ 

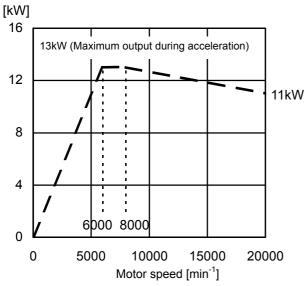
## **3.1** MODEL $\alpha i$ IT 1.5/20000HV





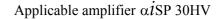


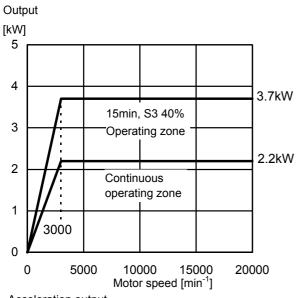
Acceleration output

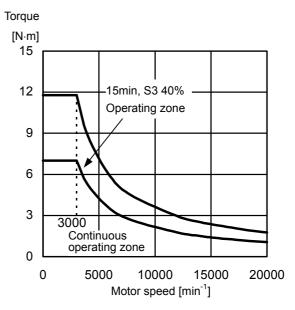


#### **NOTE**

## **3.2** MODEL $\alpha i$ IT 2/20000HV

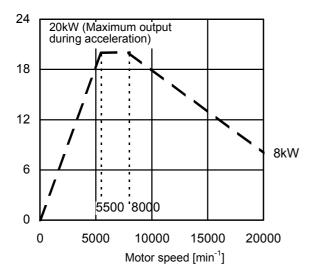






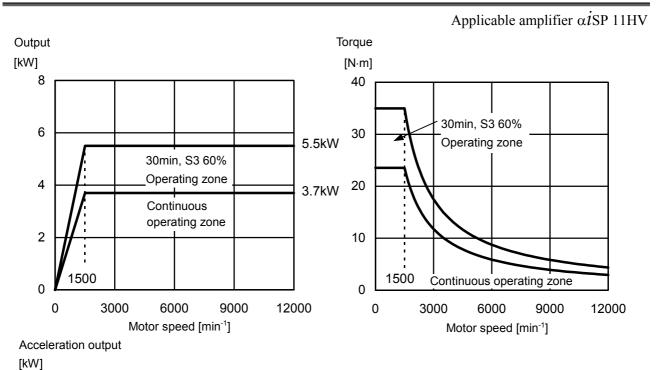
Acceleration output

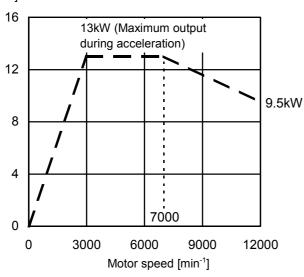
[kW]



### NOTE

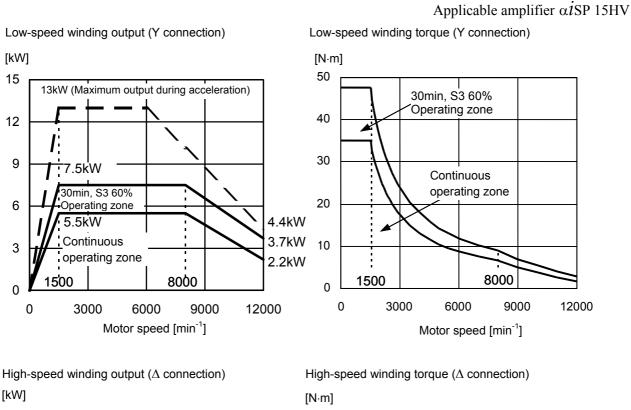
## **3.3** MODEL $\alpha i$ IT 3/12000HV

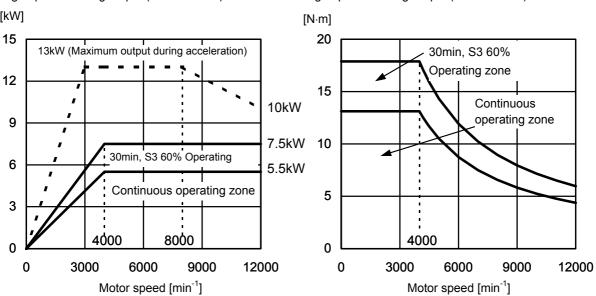




#### **NOTE**

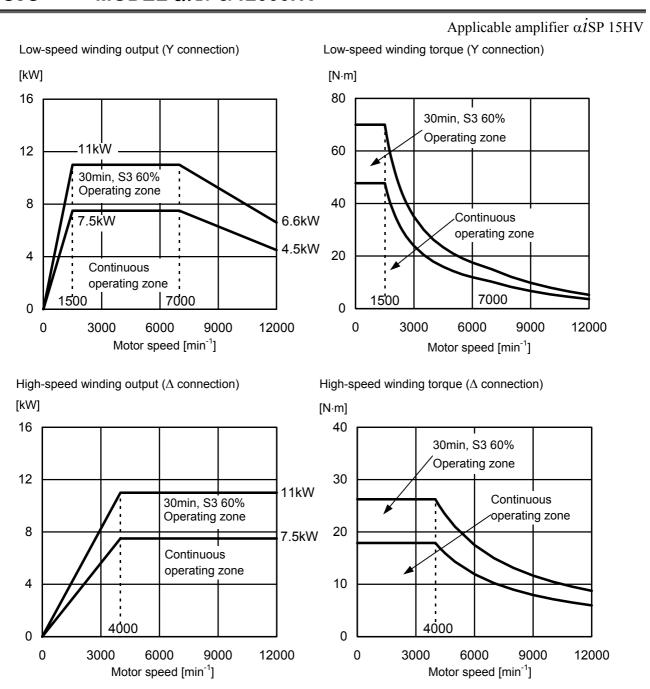
## **3.4** MODEL $\alpha i$ IT 6/12000HV



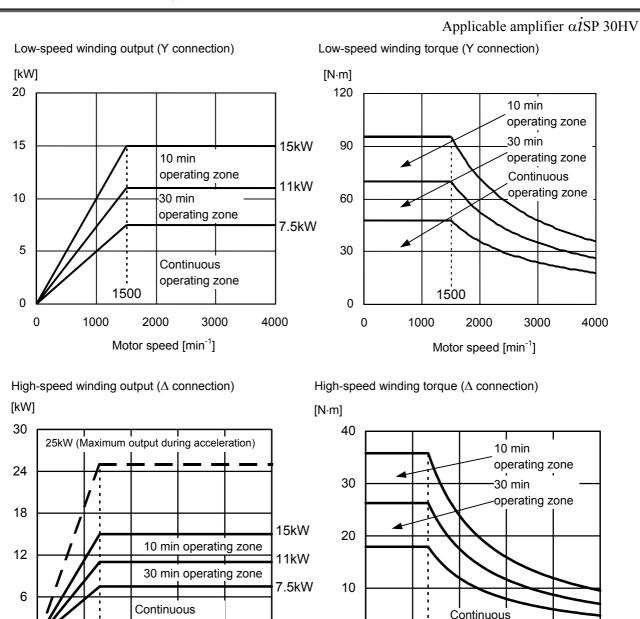


#### NOTE

## 3.5 MODEL $\alpha i$ IT 8/12000HV



## **3.6** MODEL $\alpha i$ IT 8/15000HV



#### NOTE

9000 12000 15000

operating zone

Motor speed [min<sup>-1</sup>]

4000

6000

3000

0

Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

3000

4000 operating zone

9000

Motor speed [min<sup>-1</sup>]

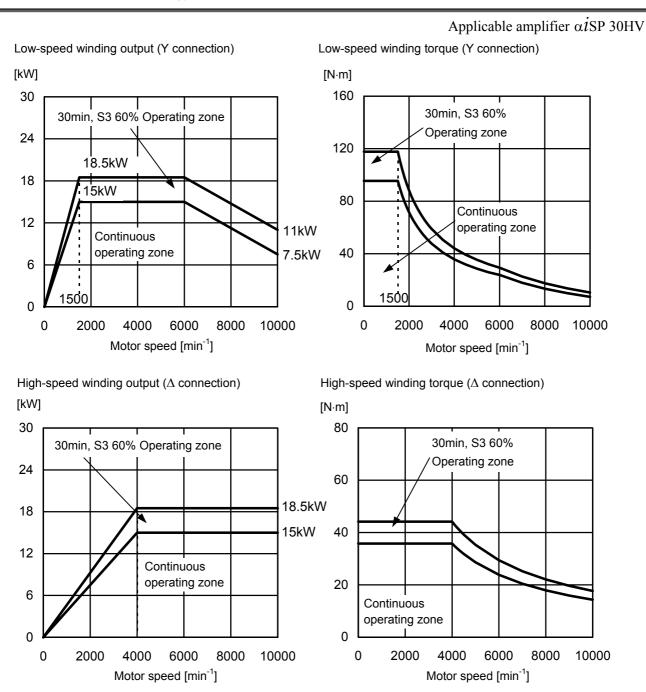
12000 15000

6000

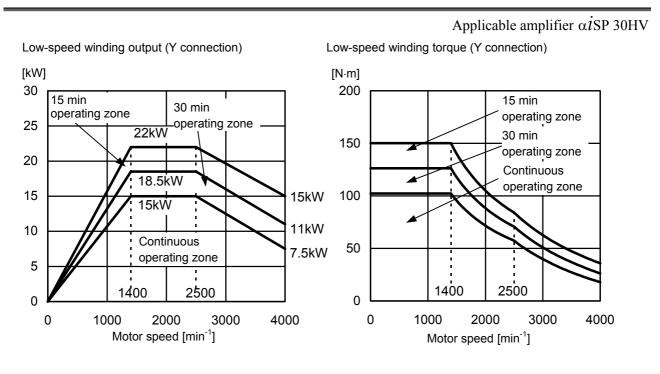
0

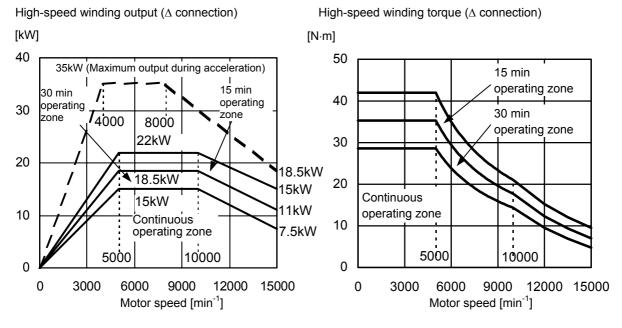
0

## **3.7** MODEL $\alpha i$ IT 15/10000HV



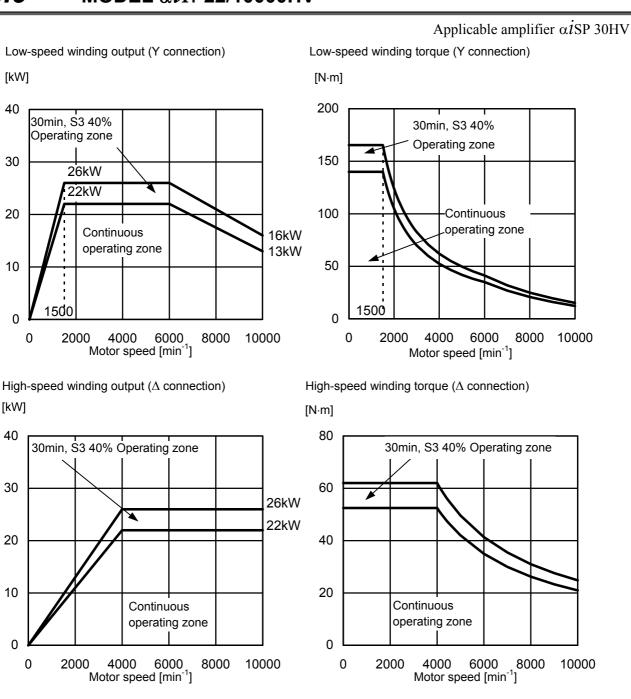
## **3.8** MODEL $\alpha i$ IT 15/15000HV





#### **NOTE**

## **3.9** MODEL $\alpha i$ IT 22/10000HV



#### **NOTE**

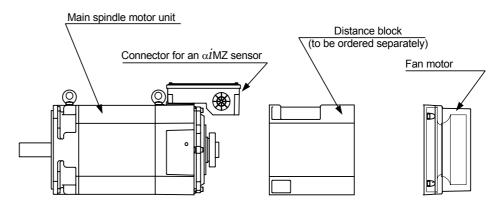
4

## CONFIGURATION AND ORDERING NUMBER

## 4.1 CONFIGURATION

The  $\alpha i$ IT series motor 400V type consists of the following items:

- (1) Main spindle motor unit
- (2) Fan motor (Exhaust on the side opposite to the load axis. Packed separately.)
- (3) Connector (housing, contact) for an  $\alpha iMZ$  sensor The connector is contained in the terminal block.
- (4) Distance block (Separately packed. To be ordered separately in addition to the main motor unit.)



## 4.2 ORDERING NUMBER

Motor (including a cooling fan)

Model	Ordering number	SPM	Remarks
α <i>İ</i> Ιτ 1.5/20000HV	A06B-1563-B123#0121	lpha iSP 15HV	
α <i>İ</i> I⊤ 2/20000HV	A06B-1564-B123#0121	lpha iSP 30HV	
α <i>İ</i> I⊤ 3/12000HV	A06B-1565-B123#0021	$\alpha i$ SP 11HV	<ul> <li>Flange mounting type</li> </ul>
α <i>İ</i> I⊤ 6/12000HV	A06B-1566-B123#0021	lpha iSP 15HV	- Hollow shaft
α <i>İ</i> Ιτ 8/12000HV	A06B-1567-B123#0021	lpha iSP 15HV	(with no key)
α <i>İ</i> I⊤ 8/15000HV	A06B-1577-B133#0121	lpha iSP 30HV	- Labyrinth - Built-in with α <i>İ</i> MZ
α <i>İ</i> Ιτ 15/10000HV	A06B-1569-B123#0021	lpha iSP 30HV	sensor
α <i>İ</i> I⊤ 15/15000HV	A06B-1579-B133#0221	lpha iSP 30HV	
α <i>İ</i> Ιτ 22/10000HV	A06B-1571-B123#0021	$\alpha i$ SP 30HV	

#### **Distance block**

- \* Please prepare Distance-block by the machine tool builder.
  The distance blocks indicated in the table below are available from FANUC as separate items.
  - Distance block

Name	Ordering number	Remarks
Type α <i>i</i> Iτ 1.5	A06B-1463-K560	For α <i>İ</i> I⊤ 1.5HV
Type $\alpha i$ I $_{ extsf{I}}$ T	A06B-1464-K560	For $\alpha i$ I $_{ extsf{I}}$ 2HV and $\alpha i$ I $_{ extsf{I}}$ 3HV
Type α <i>i</i> Iτ 6	A06B-1466-K560	For $\alpha i$ I $_{ extsf{T}}$ 6HV and $\alpha i$ I $_{ extsf{T}}$ 8HV
Type α <i>i</i> Iτ 15	A06B-1469-K560	For $\alpha i$ IT 15HV and $\alpha i$ IT 22HV

#### • Distance block with windows

Name	Ordering number	Remarks
Type α <i>İ</i> I⊤ 2	A06B-1464-K580	For $\alpha i$ I $_{ extsf{T}}$ 2HV and $\alpha i$ I $_{ extsf{T}}$ 3HV
Type α <i>i</i> Iτ 6	A06B-1466-K580	For $\alpha i$ I $_{ extstyle  e$
Type α <i>i</i> I <sub>T</sub> 15	A06B-1469-K580	For $\alpha i$ IT 15HV and $\alpha i$ IT 22HV

## **CONNECTIONS**

## 5.1 CONNECTION OF THE POWER, FAN MOTOR, AND $\alpha i$ MZ SENSOR SIGNAL LEADS

Cables for power lead and fan motor are connected to the terminal block.

 $\alpha i$ MZ sensor signal or thermostat signal use a connector manufactured by Tyco Electronics AMP.

The connector housing and the connector are attached to the motor.

Size of screws used in	Power lead		Cooling fan	
the terminal block		X,Y,Z	FMU,FMV,FMW	FMU,FMV
α <i>ἱ</i> Ιτ 1.5/20000HV	M5	-	M4	M4
α <i>ἱ</i> Ιτ 2/20000HV	M5	-	-	Screw-less terminal block
α <i>ἱ</i> Ιτ 3/12000HV	M5	-	-	Screw-less terminal block
α <i>ἱ</i> Ιτ 6/12000HV	M5	M5	Screw-less terminal block	-
α <i>ἱ</i> Ιτ 8/12000HV	M5	M5	Screw-less terminal block	-
α <i>ἱ</i> Ιτ 8/15000HV	M5	M5	Screw-less terminal block	-
α <i>İ</i> Ιτ 15/10000HV	M5	M5	Screw-less terminal block	-
α <i>İ</i> Ιτ 15/15000HV	M5	M5	Screw-less terminal block	-
α <i>İ</i> Ιτ 22/10000HV	M5	M5	Screw-less terminal block	-

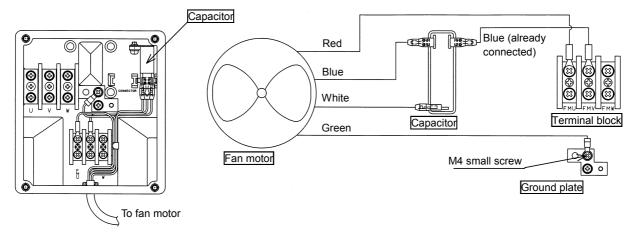
#### Cable for the fan motor

For the fan motor current value and cable specifications, refer to Section I.4.3, "FAN MOTOR CONNECTION" in this manual.

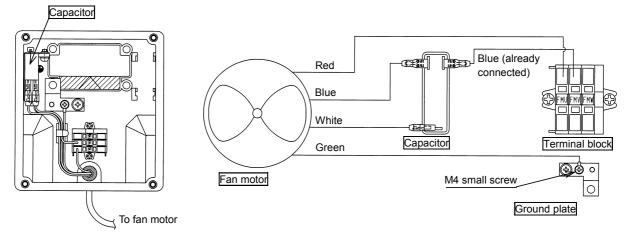
#### **5.2 CONNECTION OF A SINGLE-PHASE FAN MOTOR**

The input power requirements of the fan motor for  $\alpha i IT 1.5/20000HV$ ,  $\alpha i$ IT 2/20000HV, or  $\alpha i$ IT 3/12000HV are: 200/230VAC +10% -15%, single-phase, and 50/60 Hz±1Hz.

### For $\alpha i$ IT 1.5/20000HV



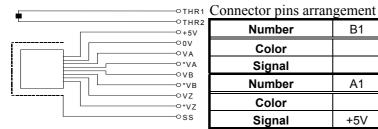
## For $\alpha i$ IT 2/20000HV and $\alpha i$ IT 3/12000HV



## 5.3 CONNECTION OF SIGNAL LEAD

 $\alpha i$ MZ sensor signal or overheat signal use a connector manufactured by Tyco Electronics AMP .

The connector housing and the connector are attached to the motor.



Connector pins urrangement						
Number	B1	B2	В3	B4	B5	B6
Color						
Signal		*VA	*VB	*VZ	0V	THR2
Number	A1	A2	A3	A4	A5	A6
Color						
Signal	+5V	VA	VB	VZ	SS	THR1

### Connector housing and contact specifications

Connector and contact:

Tyco Electronics AMP specification D-3000 series

	Motor side		Cable side		
	FANUC specification	Manufacture specification	FANUC specification	Manufacture specification	
Housing	A63L-0001-0535/121KDF	178964-6	A63L-0001-0460/121KD	178289-6	
Contact	A63L-0001-0456/ASMT	175288-2	A63L-0001-0456/ASM	1-175217-2	

Crimping tool: 91559-1 Extractor: 234168-1

### Thermistor specification

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).

# 6

## **ASSEMBLING ACCURACY**

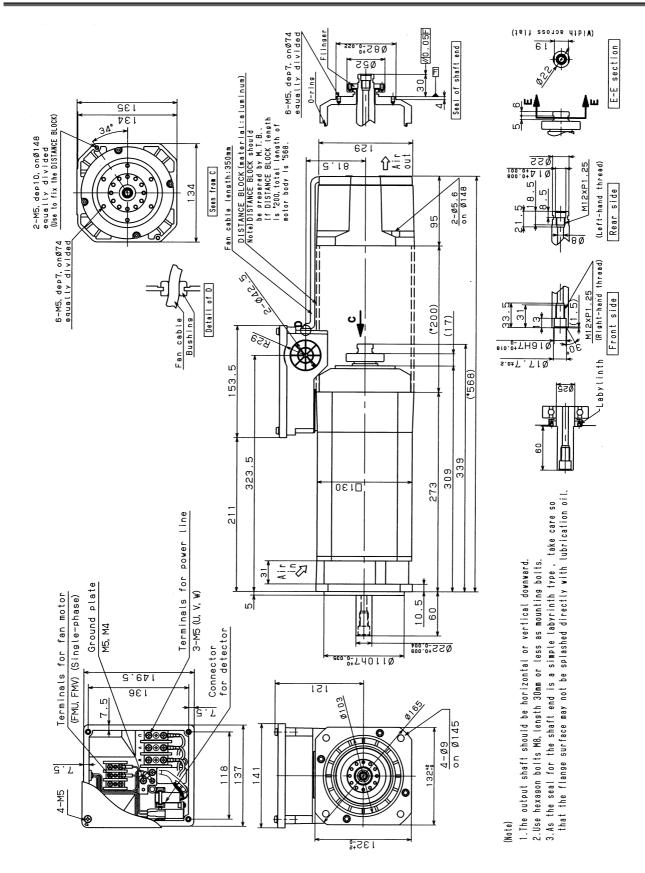
Item	Accuracy	Measuring method
Run-out at the end of the output shaft	10μm or less	1/2 the output shaft length
Run-out of the faucet joint for mounting the flange against the core of the shaft	30μm or less	10
Run-out of the flange mounting surface against the core of the shaft	40μm or less	
Front shaft end through hole inlet Rear shaft end through hole inlet Run-out of socket and spigot joint	20μm or less	
Run-out of front shaft end face Run-out of rear shaft end face	10μm or less	

## **EXTERNAL DIMENSIONS**

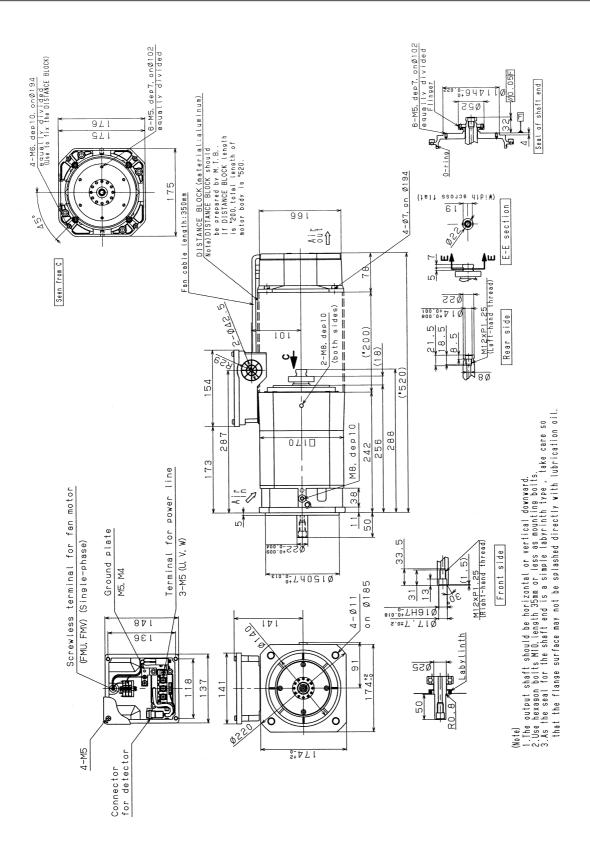
Model name	Section
Model α <i>İ</i> Ιτ 1.5/20000HV	7.1
Model αİΙΤ 2/20000HV	7.2
Model αİΙτ 3/12000HV	7.3
Model αİΙτ 6/12000HV	7.4
Models $lpha i$ IT 8/12000HV and $lpha i$ IT 8/15000HV	7.5
Model α <i>İ</i> Ιτ 15/10000HV	7.6
Model α <i>İ</i> Ιτ 15/15000HV	7.7
Model α <i>İ</i> Ιτ 22/10000HV	7.8

For a distance block, see the  $\alpha i$ IT series 200V type section.

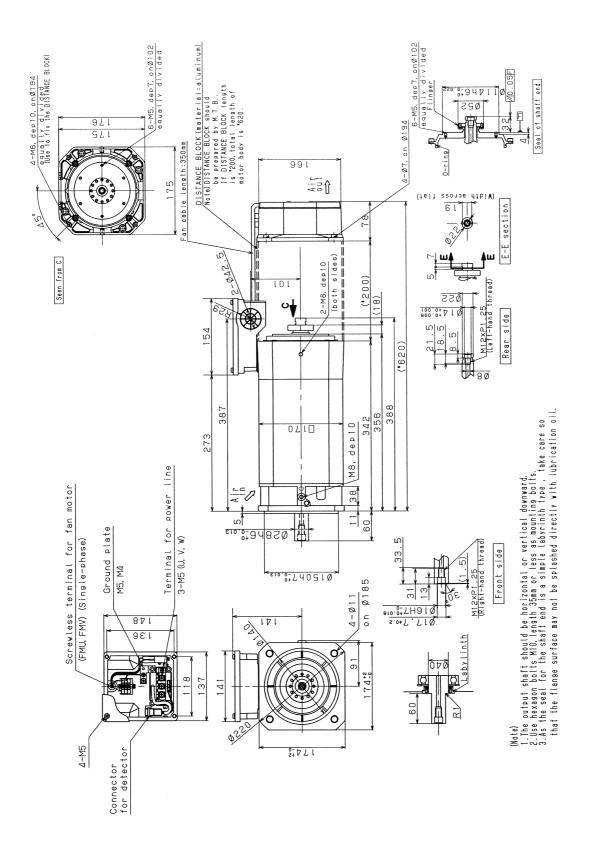
## **7.1** MODEL $\alpha i$ IT 1.5/20000HV



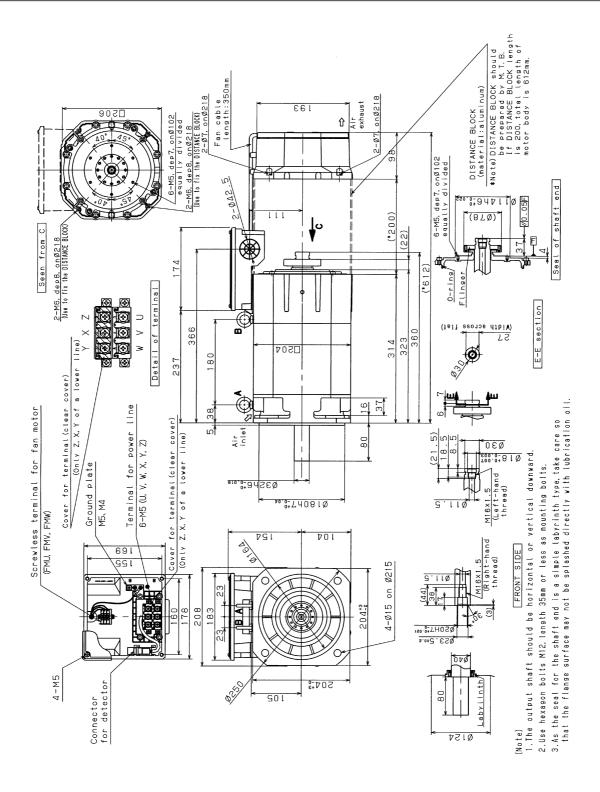
## **7.2** MODEL $\alpha i$ IT 2/20000HV



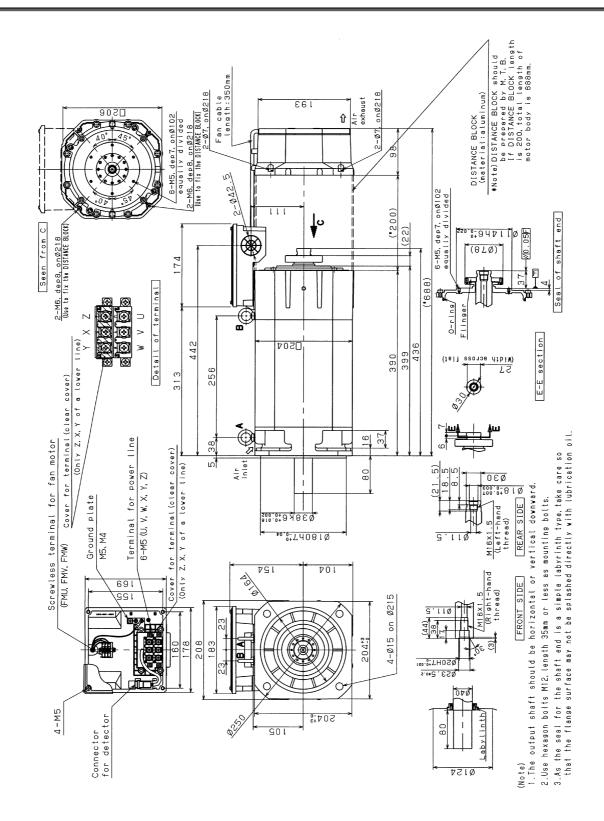
## **7.3** MODEL $\alpha i$ IT 3/12000HV



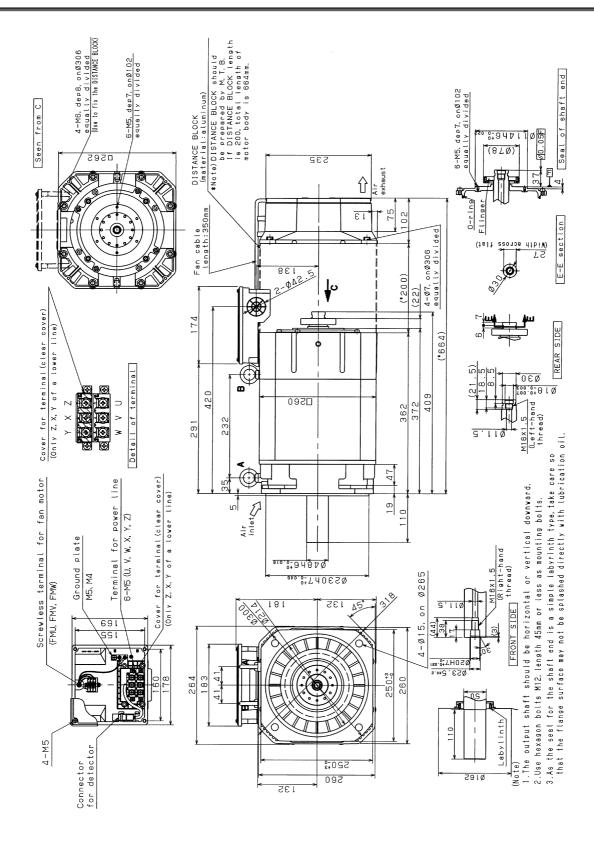
## **7.4** MODEL $\alpha i$ IT 6/12000HV



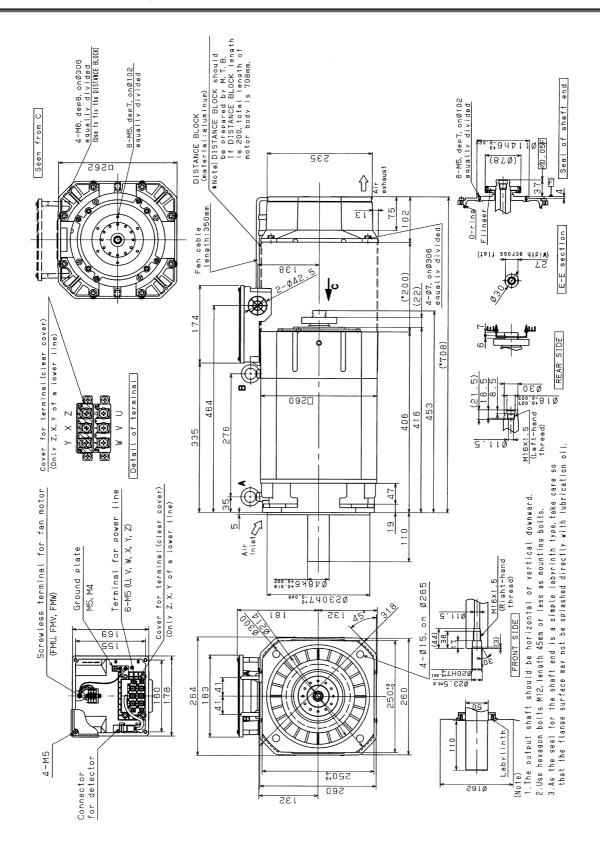
## 7.5 MODELS $\alpha i$ IT 8/12000HV AND $\alpha i$ IT 8/15000HV



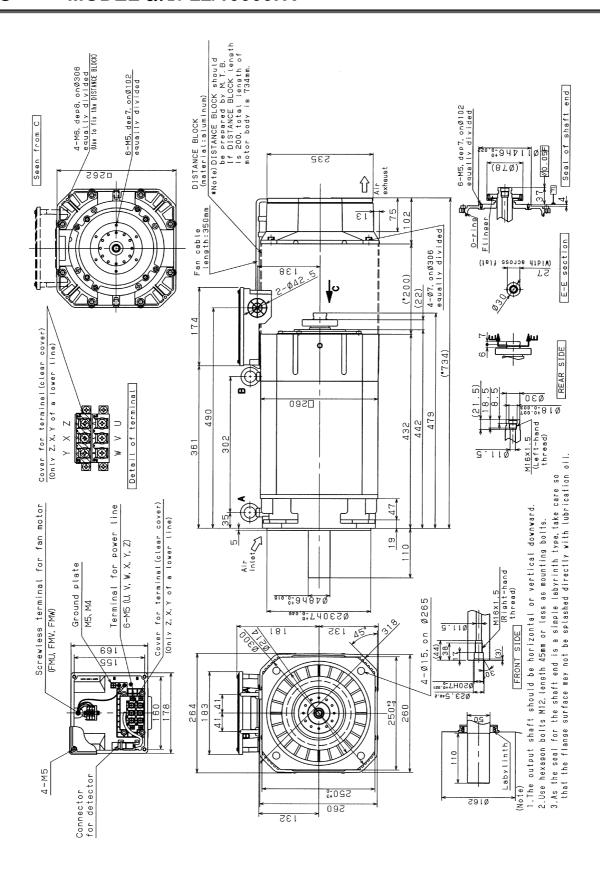
## **7.6** MODEL $\alpha i$ IT 15/10000HV



## 7.7 MODEL $\alpha i$ IT 15/15000HV



## **7.8** MODEL $\alpha i$ IT 22/10000HV



# VIII. FANUC AC SPINDLE MOTOR $\alpha i$ IL series 200V type

## 1

### **GENERAL**

The FANUC AC spindle motor  $\alpha IIL$  series 200V type is liquid-cooled motors. They feature low temperature rise, high-speed, high torque at low speed, and low vibration.

Coupling an  $\alpha i$ IL series 200V type motor directly to the spindle of a machining center makes it possible to realize gear-less, high-precision operation.

The motor shaft has a through hole, through which center-through coolant can be passed.

## (1) Thermal conduction to the spindle head and heat radiation to the machine column are reduced by cooling the front flange and motor case with a unique conduit structure (granted Japanese patent No. 2105-445 and US patent No. 5,084,642).

- (2) A high torque at low rotation speed is realized by achieving high-efficient cooling based on liquid coolant and employing an output switching function (Y-Y switching).
- (3) High-speed rotation is supported with grease-based lubrication.
- (4) A vibration class of V3 (rotation component) is attained by strict rotor balance adjustments.
- (5) The motor shaft is provided with a through hole for center-through coolant.
- (6) The  $\alpha i$ MZ sensor signal incorporated in the motor can be used in performing orientation and rigid tapping, so there is no need to mount a detector on the machine tool
- See descriptions about the  $\alpha i$ IT series for the features of the spindle coupled directly to the motor, the points of the direct coupling structure, and cautions for mounting the motor.

#### **Features**

## **SPECIFICATIONS**

		Model	ár o	(00000	ir. 45	44.5000	ár. oc	14.5000	
Item			α <i>ἶ</i> IL 8/20000		α <i>ἱ</i> Ι <b>∟ 15/15000</b>		α <i>i</i> IL <b>26/15000</b>		
Connection	(*1)		Low-speed winding (Y connection)	High-speed winding (Y connection)	Low-speed winding (Y connection)	High-speed winding (Y connection)	Low-speed winding (Y connection)	High-speed winding (Y connection)	
	(S1) Cont. rat	ed kW	11	15	18.5	18.5	15	26	
	(01) 00111. 141	(HP)	(14.7)	(20.1)	(24.8)	(24.8)	(20.1)	(34.9)	
	(S2) 30 min ra		( )	(20.1)	(21.0)	22	(20.1)	30	
	(02) 00 1111110	(HP)	-	-	-	(29.5)	-	(40.2)	
	(S2) 15 min ra	\ /			22	(=0.0)		(1012)	
Rated	(,	(HP)	-	-	(29.5)	-	-	-	
output	(S3)60%	kW	15	18.5	/			30	
(*2)	(*3)	(HP)	(20.1)	(24.8)	-	-	-	(40.2)	
	(S3)40%	kW	(==::/	(= ::=)			22	(1012)	
	(*3)	(HP)	-	-	-	-	(29.5)	-	
	(S3)25%	kW	15				, ,		
	(*3)	(HP)	(20.1)	-	-	-	-	-	
Rated	(S1)	Á	76	107	103	84	79	107	
current (*4)	(S2),(S3)	Α	119	121	121	96	108	133	
Speed	Base speed		1,500	5,000	1,400	6,000	600	2,500	
min <sup>-1</sup>	Max. speed		4,000	20,000	4,000	15,000	2,000	15,000	
Switching sp		min <sup>-1</sup>	4,000		4,000		·	300	
Cont. rated		N∙m	70.0	28.6	126.1	29.4	238.8	99.3	
	torque range	(kgf·cm)	(715)	(292)	(1286)	(300)	(2435)	(1013)	
		kg·m <sup>2</sup>	0.0275 0.055 0.167				67		
Rotor inertia	a (kgi	f·cm·s²)	(0.28) (0.56)			(1.	70)		
Weight		kgf	8	0	14	10	1	70	
Vibration					V3 (rotation	component)			
Noise			75dB(A) or less						
Cooling sys	tem (*5)		Liquid-cooling method (IC9U7A7)						
Installation	(*6)		Mount the		he output shaft y to vertically d	•	0 0	within the	
Allowable ov	verload capaci	tv			•	,			
(1 min) (*7	•	-,			120% of (S	(S3) or (S3)			
Insulation	,				Clas	s H			
Ambient ten	nperature				0°C to				
Altitude	•			Height a	bove sea level		1000m		
Painting col	or			<b>J</b> = 0.	Munsell sys				
	mal protection	(*8)			TP2				
Resolution of		` '			Built-in with o	-			
built-in sens		p/rev			204				
	detected gear t								
rotation	Jordona gear t	λ/rev			12	8			
Bearing lubi	rication	, O T			Grea	ase			
Shaft end se	eal, protection	format	Grease Simplified labyrinth: IP40						
(IEC34)	onnoction with	the			-	-			
	connection with (*9)	ıne		To be	directly connec	cted with the sp	pindle		
spindle	rust load (*10)	kaf		3		1:	3		
	, ,	kgf		,			J		
Maximum o	utput during ı (*11)	kW	4	1	4	1	4:	3	
	` ′		<i>i</i> 0	D 20	405	20	401	2.20	
Applicable spindle amplifier $lpha i$ SP 30					aiSP 30 αiSP 30				

<sup>\*</sup> See Page 350 for Cautions and limitations.

#### **Cautions and limitations**

- (\*1) The power wire switching method is Y-Y switching. Refer to FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN) for explanations about output switching control.
- (\*2) The rated output is guaranteed at the rated voltage.

  (Amplifier input: 200/220/230VAC +10% -15%, 50/60Hz±1Hz)

  If the input voltage fluctuates, it is possible that the rated output cannot be obtained even when such fluctuations are within the allowable fluctuation range.
- (\*3) The cycle time is 10 minutes, S3 60%: ON 6 minutes, OFF 4 minutes, S3 40%: ON 4 minutes, OFF 6 minutes, S3 25%: ON 2.5 minutes, OFF 7.5 minutes
- (\*4) The rated current is the maximum current for each rated output.
- (\*5) IC code conforms to IEC 34-6. Apply cooling conditions stipulated elsewhere.
- (\*6) IM code conforms to IEC 34-7.
- (\*7) This is not a guaranteed value but a guideline for the maximum motor output at a rated supply voltage.
- (\*8) Type conforms to IEC 34-11.
- (\*9) When assembling a motor with the machine, align the motor shaft with the spindle so that the vibration acceleration of the motor does not exceed 0.5 G (at maximum speed). (Before shipping machines, check that the vibration acceleration is 0.5 G or less for all motors.)
- (\*10)Select a coupling that does not apply a thrust load onto the motor shaft for a cause such as coolant pressure when the temperature rises.

Note that in the direction in which the motor shaft is pushed toward the inside of the motor, the allowable load is 0 kgf.

(If an Oldham coupling is used, the motor shaft can be left pushed into the inside of the motor when the motor shaft is inserted into the spindle. So, measure the distance between the mounting face for a rotation joint support housing and the flinger rear end face before and after insertion, and check that the two measured values are identical.

For details, see Section 9.4 "COUPLING SELECTION" in Part VI.)

- (\*11)These values are to be used only as guidance for selecting a power supply ( $\alpha i$ PS) and are not guaranteed.
- (\*12)The protection grade (IEC34-5) is IP40. However, the grade is IP54 when the labyrinth seal on the front side of the output axis and the flinger seal on the rear side are excluded. Ensure that the labyrinth seal and flinger seal are not directly exposed to coolant and mist.

## 3

### **OUTPUT/TORQUE CHARACTERISTICS**

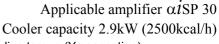
## Reference Calculation for torque

Torque T can be obtained by the following equation.

 $T[N \cdot m] = P[kW] \times 1000/0.1047/N[min^{-1}]$  P[kW]: Motor output  $N[min^{-1}]:$  Motor speed

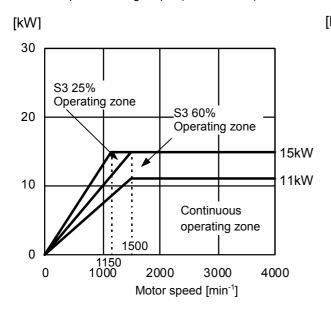
When the unit of T is [kgf·m],  $T[kgf·m]=P[kW]\times1000/1.0269/N[min^{-1}]$ 

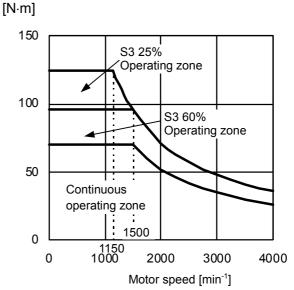
## **3.1** MODEL $\alpha i$ IL 8/20000



Low-speed winding output (Y connection)

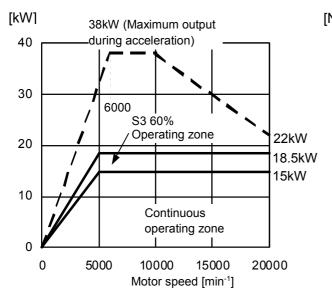
Low-speed winding torque (Y connection)

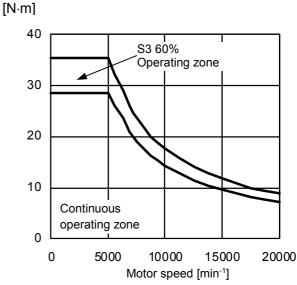




Low-speed winding output (Y connection)

Low-speed winding torque (Y connection)

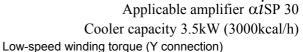




#### **NOTE**

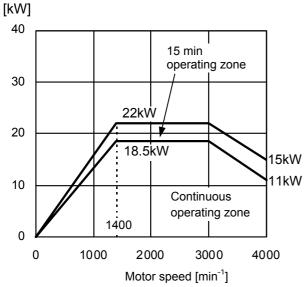
Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

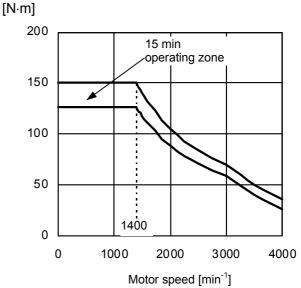
### **3.2** MODEL $\alpha i$ IL 15/15000



Low-speed winding output (Y connection)

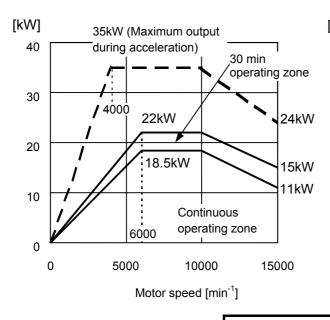
ction) Low-speed winding

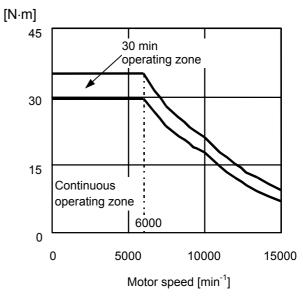




Low-speed winding output (Y connection)

Low-speed winding torque (Y connection)





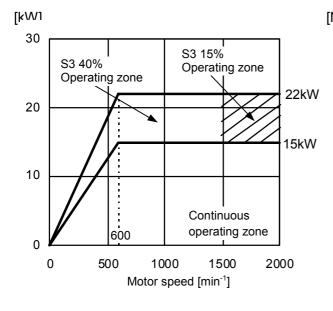
#### **NOTE**

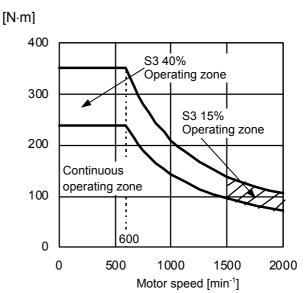
Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

## **3.3** MODEL $\alpha i$ IL 26/15000

Applicable amplifier  $\alpha i \mathrm{SP}\ 30$ Cooler capacity 4.1kW (3500kcal/h) Low-speed winding torque (Y connection)

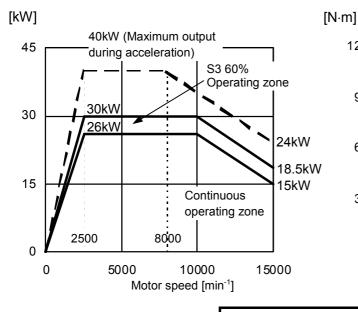
Low-speed winding output (Y connection)

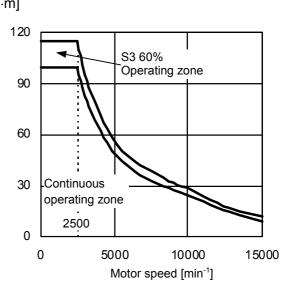




Low-speed winding output (Y connection)

Low-speed winding torque (Y connection)





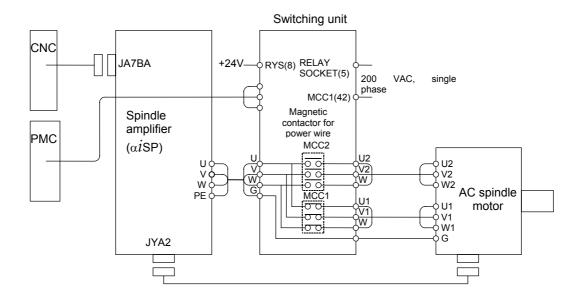
#### **NOTE**

Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.



## **CONNECTIONS**

#### 4.1 **TOTAL CONNECTION DIAGRAM**



#### NOTE

- The machine tool builder is requested to prepare cables for any equipment other than the spindle amplifier module, switching unit, or AC spindle motor, which are enclosed within the heavy-line frame.
- 2 Refer to FANUC SERVO AMPLIFIER  $\alpha i$  series DESCRIPTIONS (B-65282EN) for explanations about the switching unit and the low-/high-speed winding switching sequence.
- The power wire switching method is Y-Y switching.
- The relationships between the magnetic contactor in the switching unit and the winding state are listed below:

State	MCC1	MCC2
Low-speed winding	ON	OFF
High-speed winding	OFF	ON

#### *4.2* **SIZE OF POWER LEAD**

When connecting power wires to the amplifier, switching unit, and motor, use the wire size and crimp terminal listed below or equivalents.

Motor model	Crimp ter	rminal size	Applicable power lead size (mm²)		
Motor moder	Motor side	Amplifier side	<sup>(*1)</sup> LMFC	(*2) Flonlex power cable	
α <i>İ</i> IL 8/20000	M5	M6	22	14	
α <i>İ</i> IL 15/15000	M6	M6	22	14	
lpha iIL 26/15000	M6	M6	22	14	

#### **NOTE**

- 1 LMFC power lead: Fire-retardant Polyflex power cable (Heat resistance: 105°C)
- 2 Flonlex power lead: Manufactured by HITACHI CABLE, Ltd. (Heat resistance: 200°C)

B5

0V

Α5

SS

В6

THR2

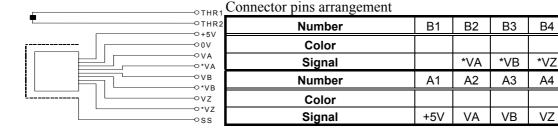
A6

THR1

### 4.3 CONNECTION OF SIGNAL LEAD

 $\alpha i$ MZ sensor signal or overheat signal use a connector manufactured by Tyco Electronics AMP.

The connector housing and the connector are attached to the motor.



#### Connector housing and contact specifications

Connector and contact:

Tyco Electronics AMP specification D-3000 series

	Motor	side	Cable side		
	FANUC specification	Manufacture specifica-tion	FANUC specification	Manufacture specification	
Housing	A63L-0001-0535/121KDF	178964-6	A63L-0001-0460/121KD	178289-6	
Contact	A63L-0001-0456/ASMT	175288-2	A63L-0001-0456/ASM	1-175217-2	

Crimping tool: 91559-1 Extractor: 234168-1

### Thermistor specification

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).

#### 4.4 **COOLING**

#### **Cooling conditions**

9	Conditions						
Item		α <i>ἱ</i> IL 8/20000	α <i>İ</i> IL 15/15000	α <i>İ</i> IL <b>26/15000</b>			
Cooler capacity	kw	2.3 to 3.5 <sup>(*1)</sup>	2.9 to 3.5 <sup>(*1)</sup>	2.9 to 4.1 <sup>(*1)</sup>			
cooler capacity	(kcal/h)	(2000 to 3000)	(2500 to 3000)	(2500 to 3500)			
Liquid coolant		1. Liquid		44-1			
Elquid Coolant		2. Liquid additive (ex	xample: 2% SHELL Do	ONAX CC) <sup>(*2)</sup>			
Liquid coolant flow	L/min		10 or more				
Liquid coolant	kPa(kgf/cm <sup>2</sup> )	100 or lower (F or lower) (so measured at the cooling pine inlet)					
pressure	KFa(Kgi/Cili )	490 or lower (5 or lower) (as measured at the cooling pipe inlet)					
Liquid coolant	m <sup>2</sup> /sec(cSt)	1	$0 \times 10^{-5}$ or lower (10 o	r lower)			
viscosity	111 /360(031)	1.		i lower)			
Liquid coolant	I/a K		1.87				
specific heat	J/g·K		1.07				
Liquid coolant	g/cm <sup>3</sup>	0.70					
density	g/cm	0.78					
Liquid coolant	(*3)	Room temperature +0°C to +10°C					
temperature	. , ,	(as m	easured at the cooling	g pipe inlet)			

- (\*1) This cooler capacity meets the corresponding CE marking standard.
- (\*2) It has been confirmed that a dilute solution with 2% of "SHELL DNAX CC" made by SHELL is usable for cooling.
- (\*3) If the temperature of the liquid coolant is lower than the room temperature as measured at the cooling pipe inlet, it is likely that condensation may occur in the motor. Be sure to strictly observe the specified temperature.

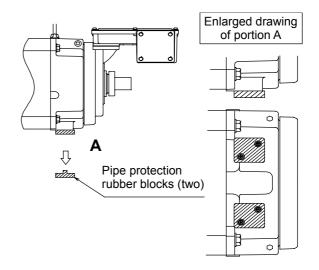
#### Liquid coolant piping

This motor series needs cooling based on liquid coolant.

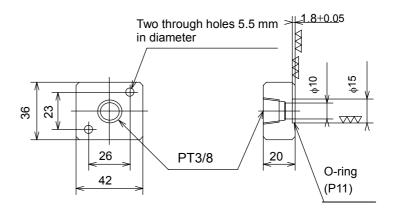
#### - Factory-setting

The motor comes with rubber blocks for pipe protection.

The machine tool builder is requested to prepare a pipe block according to the following drawing.



#### - Example of a pipe block



## 5

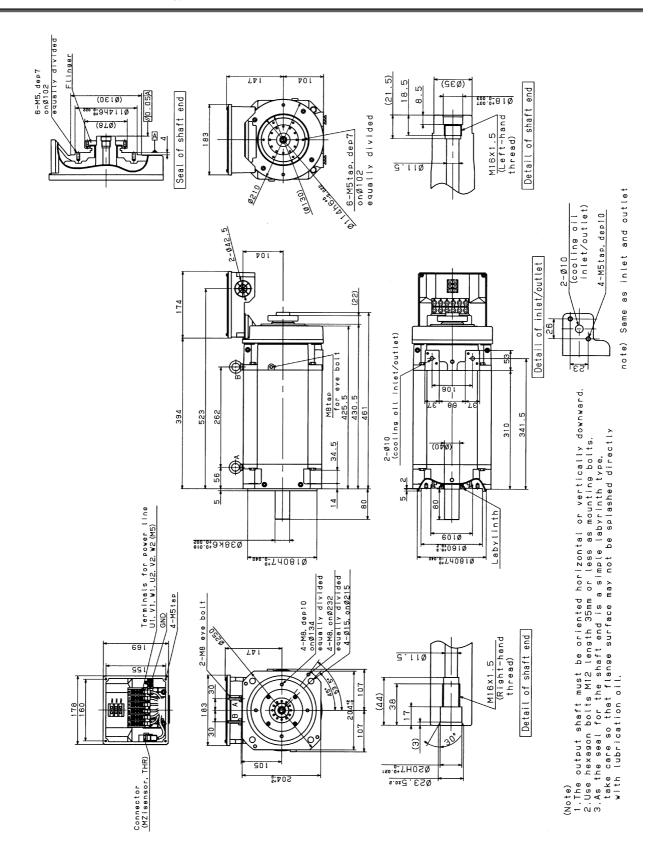
## **ASSEMBLING ACCURACY**

Item	Accuracy	Measuring method
Run-out at the end of the output shaft	10μm or less	1/2 the output shaft length
Run-out of the faucet joint for mounting the flange against the core of the shaft	30μm or less	00
Run-out of the flange mounting surface against the core of the shaft	40μm or less	10
Front shaft end through hole inlet Rear shaft end through hole inlet Run-out of socket and spigot joint	20μm or less	
Run-out of front shaft end face Run-out of rear shaft end face	10μm or less	

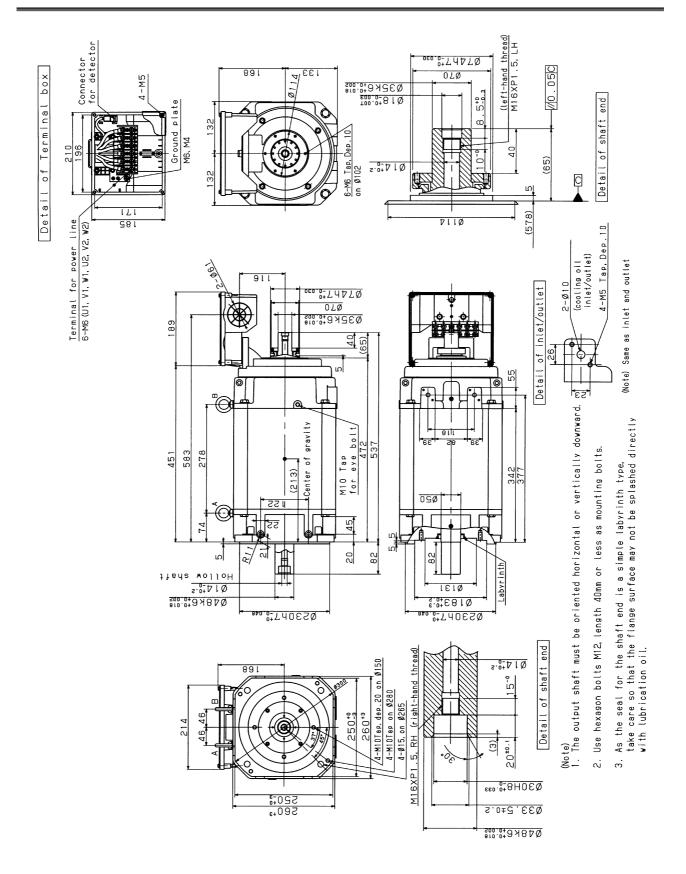
### **EXTERNAL DIMENSIONS**

Model name	Section
Model $\alpha i$ IL 8/20000	6.1
Model $lpha i$ IL 15/15000	6.2
Model α <i>İ</i> IL 26/15000	6.3

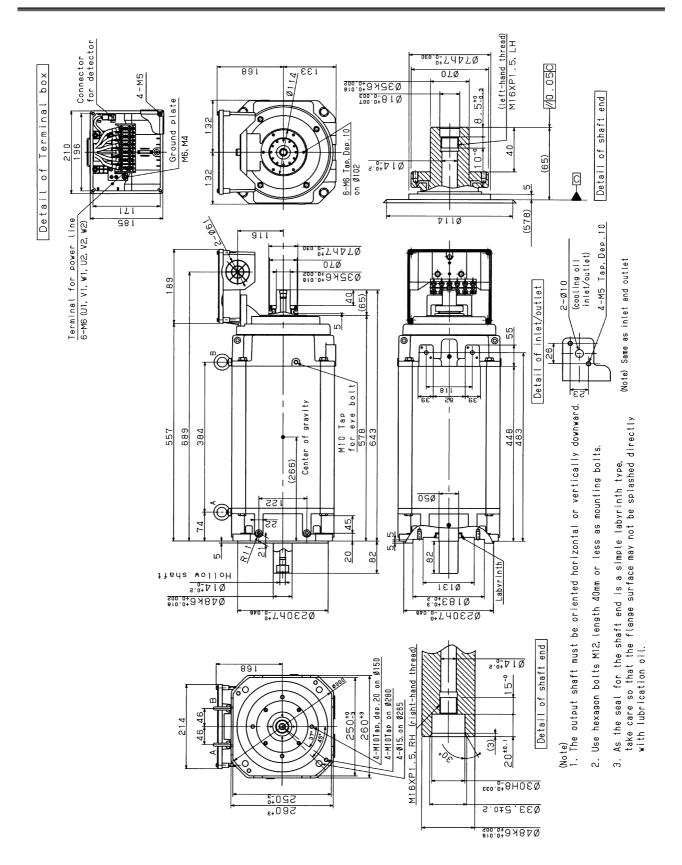
## **6.1** MODEL $\alpha i$ IL 8/20000



## 6.2 MODEL $\alpha i$ IL 15/15000



## 6.3 MODEL $\alpha i$ IL 26/15000



# IX. FANUC AC SPINDLE MOTOR $\alpha \emph{i}$ IL series 400V type

## 1

### **GENERAL**

The FANUC AC spindle motor  $\alpha iIL$  series 400V type is liquid-cooled motors that can be energized at 400 to 480 V without using a step-down transformer. They feature low temperature rise, high-speed, high torque at low speed, and low vibration.

Coupling an  $\alpha i$ IL series 400V type motor directly to the spindle of a machining center makes it possible to realize gear-less, high-precision operation.

The motor shaft has a through hole, through which center-through coolant can be passed.

## (1) Thermal conduction to the spindle head and heat radiation to the machine column are reduced by cooling the front flange and motor case with a unique conduit structure (granted Japanese patent No. 2105-445 and US patent No. 5,084,642).

- (2) A high torque at low rotation speed is realized by achieving high-efficient cooling based on liquid coolant and employing an output switching function  $(Y-\Delta)$  switching).
- (3) High-speed rotation is supported with grease-based lubrication.
- (4) A vibration class of V3 (rotation component) is attained by strict rotor balance adjustments.
- (5) The motor shaft is provided with a through hole for center-through coolant.
- (6) The  $\alpha i$ MZ sensor signal incorporated in the motor can be used in performing orientation and rigid tapping, so there is no need to mount a detector on the machine tool.
- See descriptions about the  $\alpha i$ IT series for the features of the spindle coupled directly to the motor, the points of the direct coupling structure, and cautions for mounting the motor.

#### **Features**

## **SPECIFICATIONS**

Item	Mo	odel	α <i>ἱ</i> IL <b>8/2</b>	0000HV	α <i>ἱ</i> IL <b>15</b> /1	15000HV	α <i>ἱ</i> ΙL <b>26</b> /	lpha iIL 26/15000HV	
Connection	(*1)		Low-speed winding (Y connection)	High-speed winding (∆ connection)	Low-speed winding (Y connection)	High-speed winding (∆ connection)	Low-speed winding (Y connection)	High-speed winding (∆ connection)	
	(S1) Cont. rated k	W	11	15	18.5	18.5	15	26	
	` '	P)	(14.7)	(20.1)	(24.8)	(24.8)	(20.1)	(34.9)	
	(S2) 30 min rated k	:W		,	, ,	22		30	
	(F	HP)	-	-	-	(29.5)	-	(40.2)	
Datad	(S2) 15 min rated k	:W			22				
Rated output	(H	P)	-	-	(29.5)	-	-	-	
output (*2)	(S3)60% k	W	15	18.5				30	
( 2)	(*3) (H	P)	(20.1)	(24.8)	-	-	-	(40.2)	
	(S3)40% k	W		_		_	22		
	(*3) (H	P)	ı	ı	-	ī	(29.5)	-	
	(S3)25% k	W	15						
	(*3) (H	P)	(20.1)	ı	-	ī	-	-	
Rated	(S1)	Α	48	47	66	53	51	54	
current (*4)	(S2),(S3)	Α	75	53	77	63	75	62	
Speed	Base speed		1,500	5,000	1,400	6,000	700	2,000	
min <sup>-1</sup>	Max. speed		4,000	20,000	4,000	15,000	2,000	15,000	
Switching sp	peed mi	n <sup>-1</sup>	4,0	000	4,0	00	1,5	500	
Cont. rated	d torque at		70.0	20.6	106.1	20.4	204.7	104.0	
const. rat	tad tarana	·m	70.0	28.6	126.1	29.4	204.7	124.2	
range	(kgf⋅cı		(715)	(292)	(1286)	(300)	(2088)	(1267)	
Rotor inertia	kg·ı		0.0275 0.055		55	0.1	167		
Rotor mertia	a (kgf·cm·s	$s^2$ )	(0.28)		(0.56)		(1.70)		
Weight	ŀ	κgf	80 140 170					70	
Vibration				V3 (rotation component)					
Noise			75dB(A) or less						
Cooling sys	tem (*5)		Liquid-cooling method (IC9U7A7)						
Installation	(*6)		Mount the		he output shaft y to vertically d	•		within the	
Allowable o	verload capacity				1200/ of (C	(C2)			
(1 min) (*7	7)				120% of (S	52) 01 (53)			
Insulation					Clas	s H			
Ambient ten	nperature				0°C to	40°C			
Altitude				Height a	bove sea level	not exceeding	1000m		
Painting col	or				Munsell sys	stem N2.5			
Type of ther	rmal protection (*8	3)	TP211						
Resolution of	of the		Built-in with $lpha i$ MZ sensor						
built-in sens	sor p/r	ev			204	18			
Number of o	detected gear teeth	per							
rotation	λ/r		128						
Bearing lubi	rication		Grease						
	eal, protection forma	at			0:				
(IEC34)	<u> </u>				Simplified lab	yrıntn: IP40			
	connection with the			T-1:	dina atlu	4	م الم		
spindle	(*9)			10 be	directly connec	tea with the sp	oiriale ————————————————————————————————————		
Allowable th	rust load (*10)	κgf		3		1:	3		
Maximum o	utput during		_	0		$\overline{}$	-		
acceleration		W	4	8	48		5	U 	
Applicable s	spindle amplifier		$\alpha i$ SP	45HV	α <i>i</i> SP 4	45HV	$\alpha i$ SP	45HV	
	<u> </u>				i				

See Page 372 for Cautions and limitations.

#### **Cautions and limitations**

- (\*1) The power wire switching method is Y-Δ switching. Refer to FANUC SERVO AMPLIFIER α*i* series DESCRIPTIONS (B-65282EN) for explanations about output switching control.
- (\*2) The rated output is guaranteed at the rated voltage.

  (Amplifier input:400/480VAC+10%-15%, 50/60Hz±1Hz)

  If the input voltage fluctuates, it is possible that the rated output cannot be obtained even when such fluctuations are within the allowable fluctuation range.
- (\*3) The cycle time is 10 minutes, S3 60%: ON 6 minutes, OFF 4 minutes, S3 40%: ON 4 minutes, OFF 6 minutes, S3 25%: ON 2.5 minutes, OFF 7.5 minutes
- (\*4) The rated current is the maximum current for each rated output.
- (\*5) IC code conforms to IEC 34-6. Apply cooling conditions stipulated elsewhere.
- (\*6) IM code conforms to IEC 34-7.
- (\*7) This is not a guaranteed value but a guideline for the maximum motor output at a rated supply voltage.
- (\*8) Type conforms to IEC 34-11.
- (\*9) When assembling a motor with the machine, align the motor shaft with the spindle so that the vibration acceleration of the motor does not exceed 0.5 G (at maximum speed).

  (Before shipping machines, check that the vibration acceleration is 0.5 G or less for all motors.)
- (\*10)Select a coupling that does not apply a thrust load onto the motor shaft for a cause such as coolant pressure when the temperature rises.

Note that in the direction in which the motor shaft is pushed toward the inside of the motor, the allowable load is 0 kgf.

(If an Oldham coupling is used, the motor shaft can be left pushed into the inside of the motor when the motor shaft is inserted into the spindle. So, measure the distance between the mounting face for a rotation joint support housing and the flinger rear end face before and after insertion, and check that the two measured values are identical.

For details, see Section 9.4 "COUPLING SELECTION" in Part VI.)

- (\*11)These values are to be used only as guidance for selecting a power supply ( $\alpha i$ PS) and are not guaranteed.
- (\*12)The protection grade (IEC34-5) is IP40. However, the grade is IP54 when the labyrinth seal on the front side of the output axis and the flinger seal on the rear side are excluded. Ensure that the labyrinth seal and flinger seal are not directly exposed to coolant and mist.

# 3

# **OUTPUT/TORQUE CHARACTERISTICS**

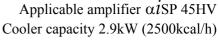
# Reference Calculation for torque

Torque T can be obtained by the following equation.

 $T[N \cdot m] = P[kW] \times 1000/0.1047/N[min^{-1}]$  P[kW]: Motor output  $N[min^{-1}]:$  Motor speed

When the unit of T is [kgf·m],  $T[kgf·m]=P[kW]\times1000/1.0269/N[min^{-1}]$ 

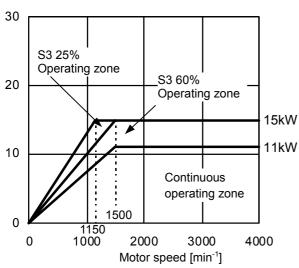
# 3.1 MODEL $\alpha i$ IL 8/20000HV

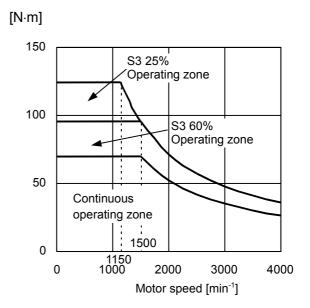


Low-speed winding torque (Y connection)



Low-speed winding output (Y connection)

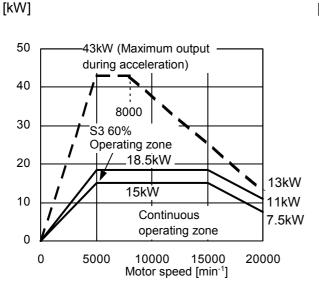


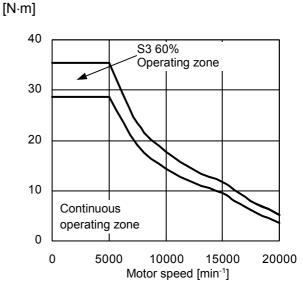


Low-speed winding output (∆ connection)

Low-speed winding torque (∆ connection)

#### M1





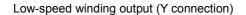
#### NOTE

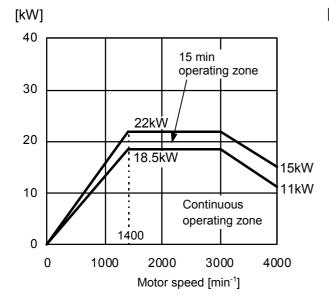
Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

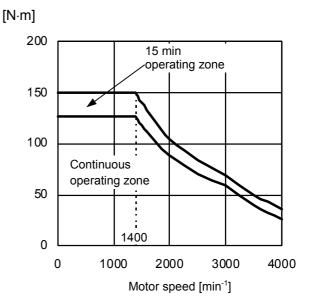
# **3.2** MODEL $\alpha i$ IL 15/15000HV

Applicable amplifier  $\alpha i$ SP 45HV Cooler capacity 3.5kW (3000kcal/h)

Low-speed winding torque (Y connection)

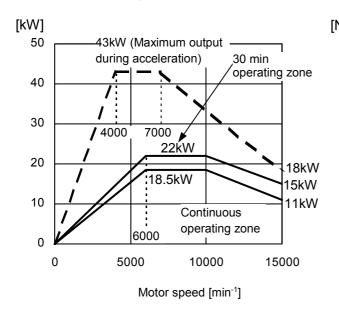


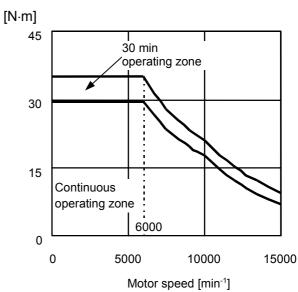




Low-speed winding output (∆ connection)

Low-speed winding torque (∆ connection)

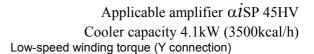




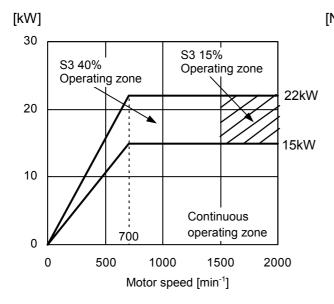
#### **NOTE**

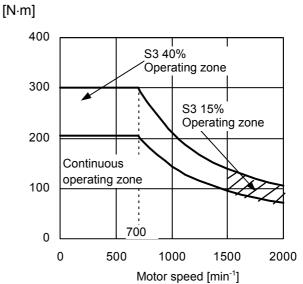
Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.

# 3.3 MODEL $\alpha i$ IL 26/15000HV



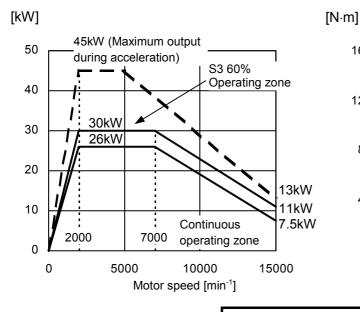
Low-speed winding output (Y connection)

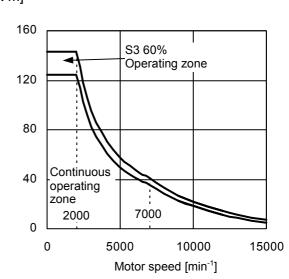




Low-speed winding output (∆ connection)

Low-speed winding torque ( $\Delta$  connection)





#### **NOTE**

Acceleration output is used as a measure to calculate the acceleration or deceleration time. Acceleration output is not an assured value.



# **CONNECTIONS**

#### 4.1 **POWER WIRE CRIMP TERMINAL SIZE**

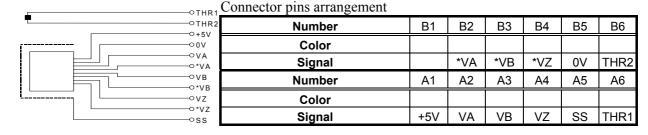
For the power wires, use the crimp terminals listed below or equivalents.

Motor model	Crimp terminal size		
	Motor side	Amplifier side	
α <i>İ</i> IL 8/20000HV	M5	M6	
α <i>İ</i> IL 15/15000HV	M6	M6	
α <i>İ</i> I∟ 26/15000HV	M6	M6	

### 4.2 CONNECTION OF SIGNAL LEAD

 $\alpha i$ MZ sensor signal or overheat signal use a connector manufactured by Tyco Electronics AMP.

The connector housing and the connector are attached to the motor.



#### Connector housing and contact specifications

Connector and contact:

Tyco Electronics AMP specification D-3000 series

	Motors	side	Cable side	
	FANUC specification	Manufacture specification	FANUC specification	Manufacture specification
Housing	A63L-0001-0535/121KDF	178964-6	A63L-0001-0460/121KD	178289-6
Contact	A63L-0001-0456/ASMT	175288-2	A63L-0001-0456/ASM	1-175217-2

Crimping tool: 91559-1 Extractor: 234168-1

#### **Thermistor specification**

Signal THR1 corresponds to one of the thermistor terminals, and signal THR2, to the other terminal. The resistance of the thermistor is about 30 to 90 k $\Omega$  as measured at room temperature (20°C to 30°C).

#### 4.3 **COOLING**

#### **Cooling conditions**

Item		α <i>İ</i> IL 8/20000HV	α <i>İ</i> IL 15/15000HV	α <i>İ</i> IL <b>26/15000HV</b>
Cooler consoity	kw	2.3 to 3.5 <sup>(*1)</sup>	2.9 to 3.5 <sup>(*1)</sup>	2.9 to 4.1 <sup>(*1)</sup>
Cooler capacity	(kcal/h)	(2000 to 3000)	(2500 to 3000)	(2500 to 3500)
Liquid coolant		1. Liquid		
Liquid coolant		2. Liquid additive (example: 2% SHELL DONAX CC) (*2)		
Liquid coolant flow	L/min	10 or more		
Liquid coolant pressure	kPa(kgf/cm <sup>2</sup> )	490 or lower (5 or lower) (as measured at the cooling pipe inlet)		
Liquid coolant viscosity	m <sup>2</sup> /sec(cSt)	$1.0 \times 10^{-5}$ or lower (10 or lower)		
Liquid coolant specific heat	J/g·K	1.87		
Liquid coolant density	g/cm <sup>3</sup>	0.78		
Liquid coolant temperature	(*3)	Room temperature +0°C to +10°C (as measured at the cooling pipe inlet)		

- (\*1) This cooler capacity meets the corresponding CE marking standard.
- (\*2) It has been confirmed that a dilute solution with 2% of "SHELL DNAX CC" made by SHELL is usable for cooling.
- (\*3) If the temperature of the liquid coolant is lower than the room temperature as measured at the cooling pipe inlet, it is likely that condensation may occur in the motor. Be sure to strictly observe the specified temperature.

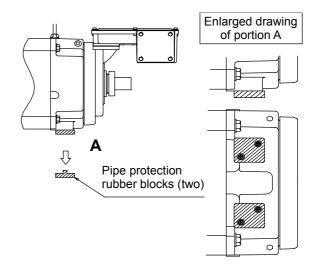
#### Liquid coolant piping

This motor series needs cooling based on liquid coolant.

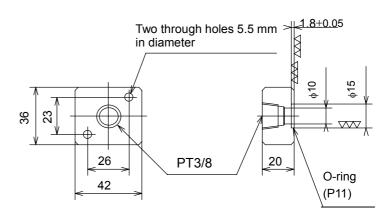
#### - Factory-setting

The motor comes with rubber blocks for pipe protection.

The machine tool builder is requested to prepare a pipe block according to the following drawing.



#### - Example of a pipe block



# **ASSEMBLING ACCURACY**

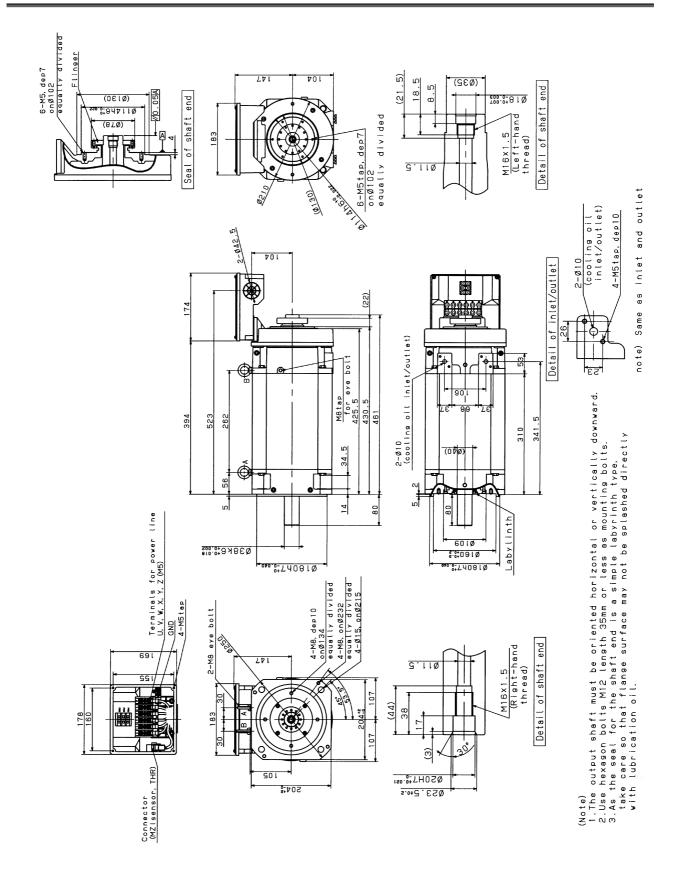
Item	Accuracy	Measuring method
Run-out at the end of the output shaft	10μm or less	1/2 the output shaft length
Run-out of the faucet joint for mounting the flange against the core of the shaft	30μm or less	2 1
Run-out of the flange mounting surface against the core of the shaft	40μm or less	
Front shaft end through hole inlet Rear shaft end through hole inlet Run-out of socket and spigot joint	20μm or less	
Run-out of front shaft end face Run-out of rear shaft end face	10μm or less	

6

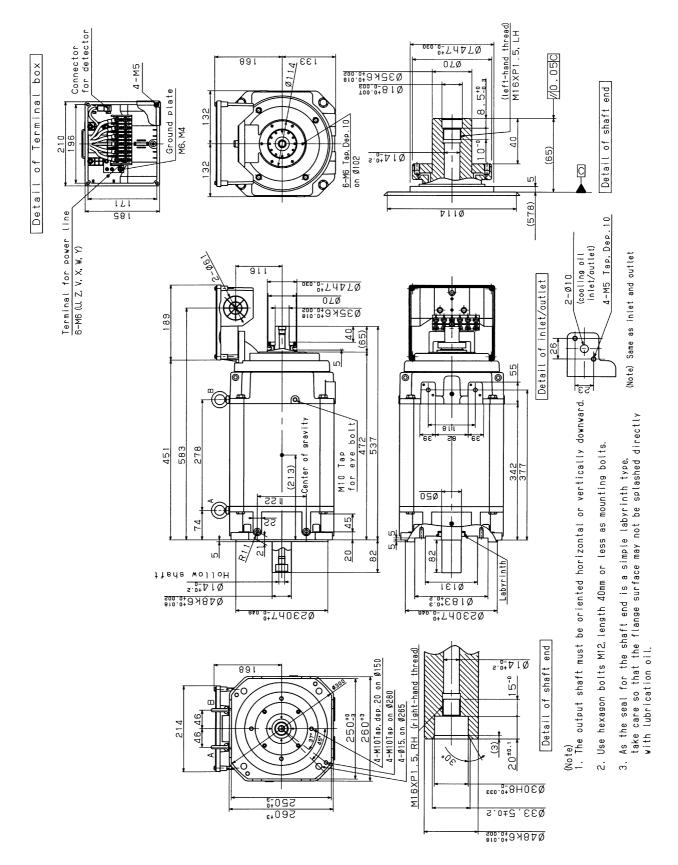
# **EXTERNAL DIMENSIONS**

Model name	Section
Model αİIL 8/20000HV	6.1
Model α <i>İ</i> IL 15/15000HV	6.2
Model α <i>i</i> I∟ 26/15000HV	6.3

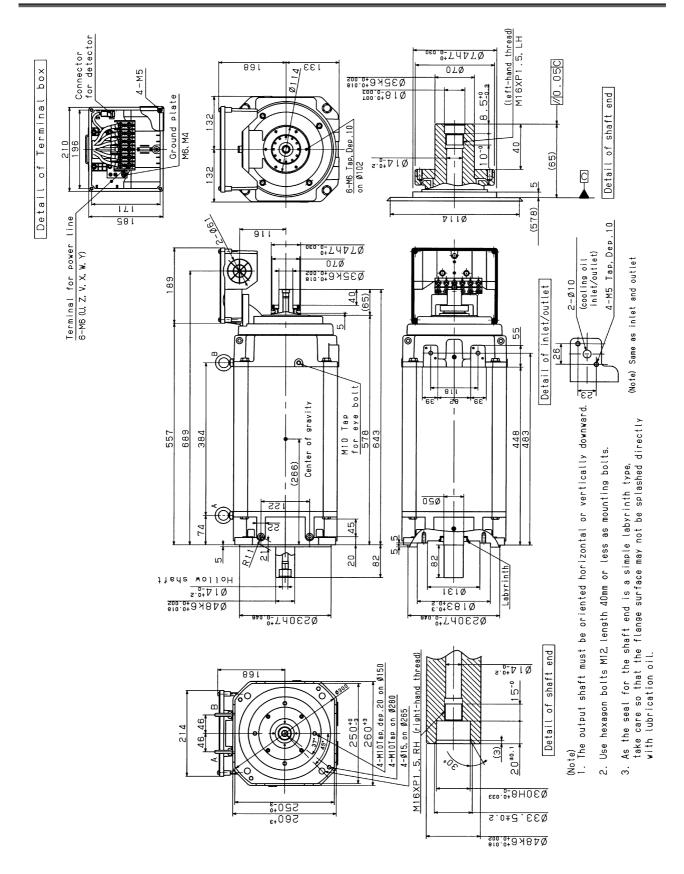
# 6.1 MODEL $\alpha i$ IL 8/20000HV



# **6.2** MODEL $\alpha i$ IL 15/15000HV



# **6.3** MODEL $\alpha i$ IL 26/15000HV



B-65272EN/05 INDEX

# **INDEX**

<a></a>	<h></h>
ALLOWABLE RADIAL LOAD94, 150, 204, 238	HIGHER-PRECISION MOUNTING FLANGE AND
ASSEMBLING ACCURACY	SHAFT297
95, 151, 205, 239, 278, 335, 361, 382	<l></l>
<>	LOADMETER (DYNAMOMETER)84
CAUTIONs-5	
CENTERING USING CENTERING PLATES298	<m></m>
CHECKING MOTOR VIBRATION	METHOD OF USING THE MOTOR WITH
(TO SEE WHETHER CENTERING IS	CONSIDERATION GIVEN TO ITS
SUCCESSFUL)299	ENVIRONMENTAL RESISTANCE15
COMMON8	MOTOR TYPES6
CONFIGURATION272, 329	<n></n>
CONFIGURATION AND ORDERING NUMBER	NOTEs-7
271, 328	NOTES ON INSTALLATION7
CONFIGURATION OF THE $\alpha i$ series5	NOTES ON MOTOR INSTALLATION296
CONNECTION OF A SINGLE-PHASE FAN	NOTES ON OPERATION 42
MOTOR333	10
CONNECTION OF SIGNAL LEAD	<0>
	ORDERING NUMBER273, 330
CONNECTION OF THE POWER, FAN MOTOR, AND	OUTPUT/TORQUE CHARACTERISTICS
$\alpha i$ MZ SENSOR SIGNAL LEADS275, 332	
CONNECTIONS 89, 145, 201, 235, 274, 331, 355, 377	<p></p>
COOLANT JOINT305	POINTS ABOUT DIRECT CONNECTION
COOLING359, 380	STRUCTURE295
COUPLING SELECTION300	POWER LEAD CONNECTION27
<d></d>	POWER WIRE CRIMP TERMINAL SIZE378
DEFINITION OF WARNING, CAUTION, AND	PREFACEp-1
NOTEs-2	<r></r>
DETERMINING THE ACCELERATION TIME43	ROTATION JOINT304
DETERMINING THE ALLOWABLE DUTY CYCLE .49	ROTATION JOINT SUPPORT HOUSING308
DISPOSAL OF SPINDLE MOTORS BY MATERIAL	ROTATION JOINT SULLOKI HOUSING
TYPE	<\$>
1112	SAFETY PRECAUTIONSs-1
<e></e>	SIZE OF POWER LEAD357
EXTERNAL DIMENSIONS	SPECIFICATIONS . 56, 130, 182, 224, 255, 312, 348, 370
96, 152, 206, 240, 279, 336, 362, 383	STANDARD TYPE85
<f></f>	<t></t>
FAN MOTOR CONNECTION33	TOTAL CONNECTION DIAGRAM356
	<w></w>
	WARNINGs-3

INDEX
B-65272EN/05

WHEN A MOTOR IS CONNECTED TO A SPIN	NDLE
VIA A BELT	36
WHEN A MOTOR IS CONNECTED TO A SPIN	NDLE
VIA A GEAR	39
WHEN A MOTOR IS DIRECTLY CONNECTED	D TO A
SPINDLE VIA A COUPLING	40

# Revision Record

# FANUC AC SPINDLE MOTOR $\alpha i$ series DESCRIPTIONS (B-65272EN)

					Contents
					Date
					Edition
Changing of model names of following series $\alpha i$ series, $\alpha i$ series, $\alpha i$ series, $\alpha i$ series, and $\alpha i$ series lncrease of torque of short-time rating at low speed in $\alpha i$ series	Changing of model names of following series $\alpha i$ P series, $\alpha i$ T series, $\alpha i$ L series, $\alpha (HV)i$ P, $\alpha (HV)i$ T, and $\alpha (HV)i$ L series Deleting of $\alpha Ci$ series	Addition of following series $lpha { m L}_i$ series and $lpha { m L}({ m HV})_i$ series	Addition of following series Large type of $\alpha i$ series, $\alpha Ci$ series, $\alpha (HV)i$ series, $\alpha P(HV)i$ series, and $\alpha T(HV)i$ series		Contents
Sep., 2006	Mar., 2003	Sep., 2002	Dec., 2001	Jul., 2001	Date
90	04	03	05	70	Edition