

**FANUC SYNCHRONOUS
BUILT-IN SPINDLE MOTOR *BiS* series**

DESCRIPTIONS

FOR USERS

Before getting started

- Be sure to read this manual thoroughly before using FANUC SYNCHRONOUS BUILT-IN SPINDLE MOTOR B/S series. It contains many important items.
- Do not try operation not described in this manual without permission. Otherwise, your motor may get into trouble. If it is unavoidable to operate your motor in a way not described in this manual, get FANUC's permission in advance.
- If you order the motor, please order spare motors for maintenance too.
- For easy maintenance, consider the structure for installing or uninstalling the motor on the machine.
- No part of this manual may be reproduced in any form.
- All specifications and designs are subject to change without notice.

SAFETY PRECAUTIONS

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

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

The users are also requested to 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.

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.

* A "motor" described in this manual means all parts of the motor: Stator and rotor.

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

WARNING

WARNING

- Wear the appropriate protectors and clothes when you handle the 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.

- Keep the rotor away from the person who has medical machines, implants, etc.

The rotor has strong magnet inside. So, keep the rotor away from the person who wears medical machines, implants, etc. The person who wears medical machines or implants must not handle the motor.

- Drive the motor with proper amplifier and parameters

B \dot{I} S series should be driven by specified proper amplifier and parameters. Incorrect combination of amplifier or parameter may cause serious accident.

- Don't drive *B \dot{I} S* series without Sub module SM (SSM)

SSM is always necessary for *B \dot{I} S* series. SSM protects person and machine from dangerous high voltage in abnormal accident. Connect the specified SSM without exceptions.

- Keep the rotor packed until assembly

The rotor is danger because of its strong magnetic force. So, keep the rotor packed until the rotor assembly. When the rotor is left temporarily for some preparations, the rotor should be wound by some thick soft non-magnetic material, such as corrugated cardboard etc., with the thickness of more than 30mm. And rope off the rotor, call attention that the rotor has strong magnetic force. to keep away from a person to access the rotor.

- The taps on the end surface of stator jacket should be used only for lifting stator alone

The taps on the end of the jacket are provided only for the assembling and handling the stator itself.

Do not lift up the stator with another parts on by this tap. The strength of the tap is not enough to lift the stator with additional weight.

- Use a crane or some supporting machine when you handle the motor

The motor parts are heavy. Use a crane or another equipment as required.

- Be careful to the magnetic force on the surface of the rotor

The rotor has strong permanent magnets inside. There is 50N/cm² of magnetic force on the rotor surface. So, keep away magnetic materials from the rotor, and keep the rotor away from magnetic materials. When they crash with each other, be careful not to sandwich your hand, etc.

- The rotor rushes into the stator, when assembling rotor into spindle

When you insert the rotor in the spindle, the rotor will suddenly rush into the stator bore by magnetic force. So, be careful enough not to sandwich your hands, etc. Do not stand on an axial extension line of the spindle.

- Do not touch the motor by a wet hand.

There might be an electric shock and is very danger.

- When you wire the power lead, confirm that a power supply is turned off.

There might be an electric shock and is very in danger.

- Inflammables or explosive substances must be kept away form the motor

The motor in driven is very hot. So, dangerous substances must be kept away from the motor.

- Motor must be grounded

To avoid getting an electric shock, the stator core or the parts which has good electrical connection to the stator core must be grounded.

- Do not short circuit the power line to the ground or short each other

To avoid getting an electric shock or damages of winding, do not short the circuit.

- Each lines terminals should be connect firmly

If a line comes off the terminal, the line may short circuit, or get an electric shock, etc., it is very danger.

If a clamping screw of a terminal is loose, the part runs hot and may cause a fire. Connect each Lines and terminals firmly.

- Cover all the terminal with insulator

If a hand or conductor touches an exposed terminal, there may be a danger of getting shocked.

- Keep away from rotating part when the motor is running

There is a danger that your clothing or fingers are rolled up or hit by a rotating part.

Check the rotating part that there is no loose part on the rotating part before running

- Turn off the power source when you touch the motor

Even if a motor does not run, there is the possibility that the voltage is alive on terminals.

Especially, when you touch power lead, terminals, etc., be careful not to get shocked.

- **Do not touch the terminals, power leads, etc., without checking voltage**
Even if the power line is turned off, the high voltage is still alive on the power lines for a few minutes. So, do not touch those power line parts without voltage check.

- **When the motor is running, do not stay in the dangerous area of the rotating axis**
The parts which on the rotating shaft may splash and hurt you.

- **The design and assemble of a machine should conform to EN60204-1**
For the safety design, the design and assemble of a machine should meet EN60204-1.

CAUTION

CAUTION

- **A magnetic card, magnetic media, computer, etc. should be kept away from the rotor**

An electric or magnetic equipments, such as camera, cellular phone, magnetic card, etc. might be broken by the leakage flux of the rotor.

- **Do not touch the running motor and the motor just after a stop**

The running motor is very hot. So, do not touch the motor until the motor gets cold enough in order to avoid a burn.

- **FANUC motor is designed only the usage for a machine tool. Do not use another purpose**

If a FANUC motor is used for unintended purpose, it may cause an unexpected accident or trouble. Use a FANUC motor only with machine tools.

- **The base or frame on which the motor is to be mounted must have sufficient stiffness**

Insufficient stiffness or rigidity may cause many troubles. For example, it generates rough surface in machining, harmful vibration, abnormal sound, and shorten the life of bearings. It causes also the bad machining precision of a machine tool itself.

- **Install a motor without failure.**

It is dangerous that a part of a motor or on the rotating part is removed or scattered when motor is rotating..

- **Connect motor cables correctly.**

An incorrect connection of a cable may cause trouble. Use a cable with thick enough for the current carrying capacity.

- **Cool a motor with specified cooling condition.**

Insufficient cooling may cause trouble. Keep a specified cooling condition. Check that the flow rate of liquid is appropriate and the liquid piping is not clogged. The periodic cleaning and inspection is necessary. Build the system to stop the motor when the cooling unit is in trouble.

- **Take measures to leakage current.**

The leakage current of the synchronous built-in spindle motor may exceed the value specified in EN60335-1. Take appropriate measures against leak current. For example, adopting a structure that prevents the operator from contacting conductive parts near the motor during power is alive.

- **Connect the thermistor line to amplifier**

For the thermal protection, connect the thermistor line to the amplifier.

- Do not drive B1S series without amplifier

Applying a power source voltage directly to a motor may burn its windings. Use a specified amplifier to drive B1S series.

NOTE

NOTE

- **Do not put on anything nor step on a motor**
If done, scratches and deformations may be caused. Do not pile up a motor without in package.

- **Avoid moisture and condensing at the temperature of 0 to 40°C for the safekeeping**
If a motor is stored in a bad environment, its performance may deteriorate.

- **Stick a name plate near the motor**
Stick a nameplate near the motor and the inside wall of the cabinet of the machine tool. And it should be seen easily and never to strip.

- **Do not give a shock or damage to a motor**
If done, it may cause a trouble. Since the stator resin and rotor magnet in particular are apt to get chipped or checked, exercise great care in handling a motor.

- **Do not apply dielectric test or insulation test to a sensor**
The elements in the sensor may be damaged.

- **When testing the winding or insulation resistance of a motor, follow the instructions of EN60034.**
Excess condition may damage the motor.

- **Do not disassemble a motor.**
If done, stator or rotor cannot be used again.

- **Do not modify a motor.**
If done, the motor is out of guaranty.

- **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.

- **Before mounting a motor, check its winding resistance and insulation resistances**
The motor that has been stored for a long period needs to be checked the winding resistance and insulation resistance. For the winding resistances of motors, refer to the following section of motor mounting.

- Perform periodic maintenance and inspection to the motor

Check the winding resistance and insulation resistance periodically.

Clean around the motor periodically.

However the excess inspections, such as a dielectric test, an insulation test, may damage its winding.

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SPECIFICATIONS

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Order No.

The explanations of Order No.

A06B-18□□-B□□□#□□□□
 □□□□□□□□ □□□□□□

The type of rotor and stator. Stands for the output type.

The scope of supply

The parts that are supplied by the order no. are the following three items.

- Stator
- Rotor (with 2 side rings)
- Name plate (packed with stator)

Following parts are necessary by another order.

- Sensor
- Amplifier (αi SP)
- O-ring kit
- SSM

Do not forget to order the above parts separately.

Sensor is another order.

Sensor is not included in motor's order No. Another order is necessary.

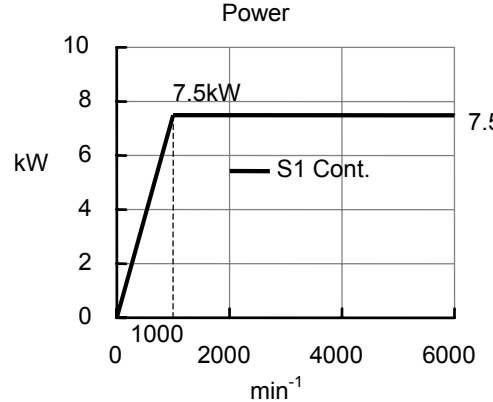
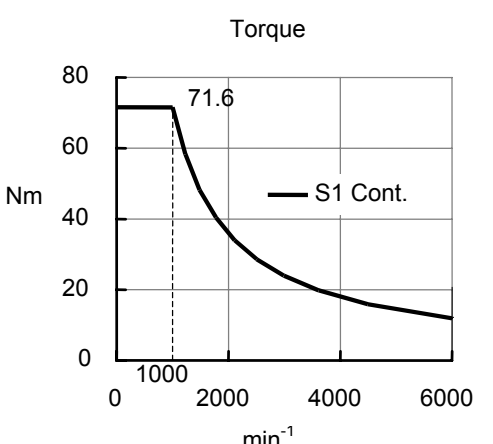
Please select αi BZ or αi CZ sensors that are suitable for your use. And please confirm surely that the allowable speed of sensor is more than the maximum speed of spindle.

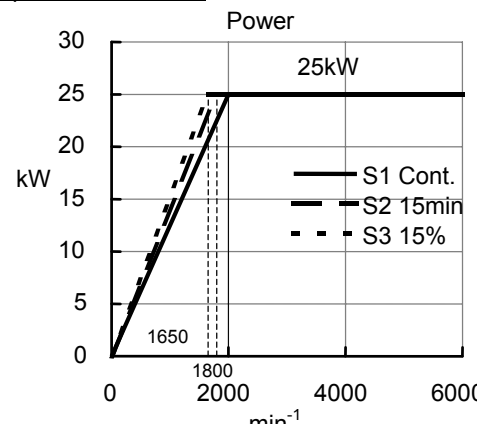
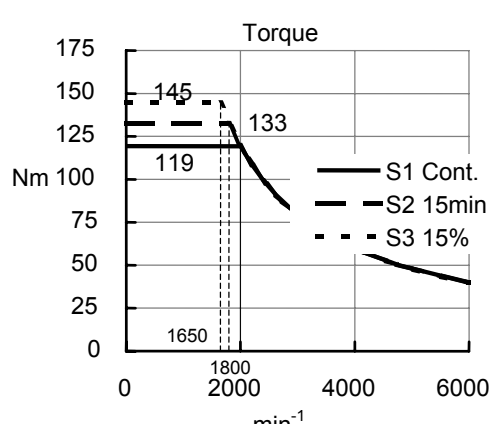
About sensor's specifications, please refer to the description manual(*) of latest version.

(*) BUILT-IN AC SPINDLE MOTOR αBi series DESCRIPTIONS (B-65292EN)

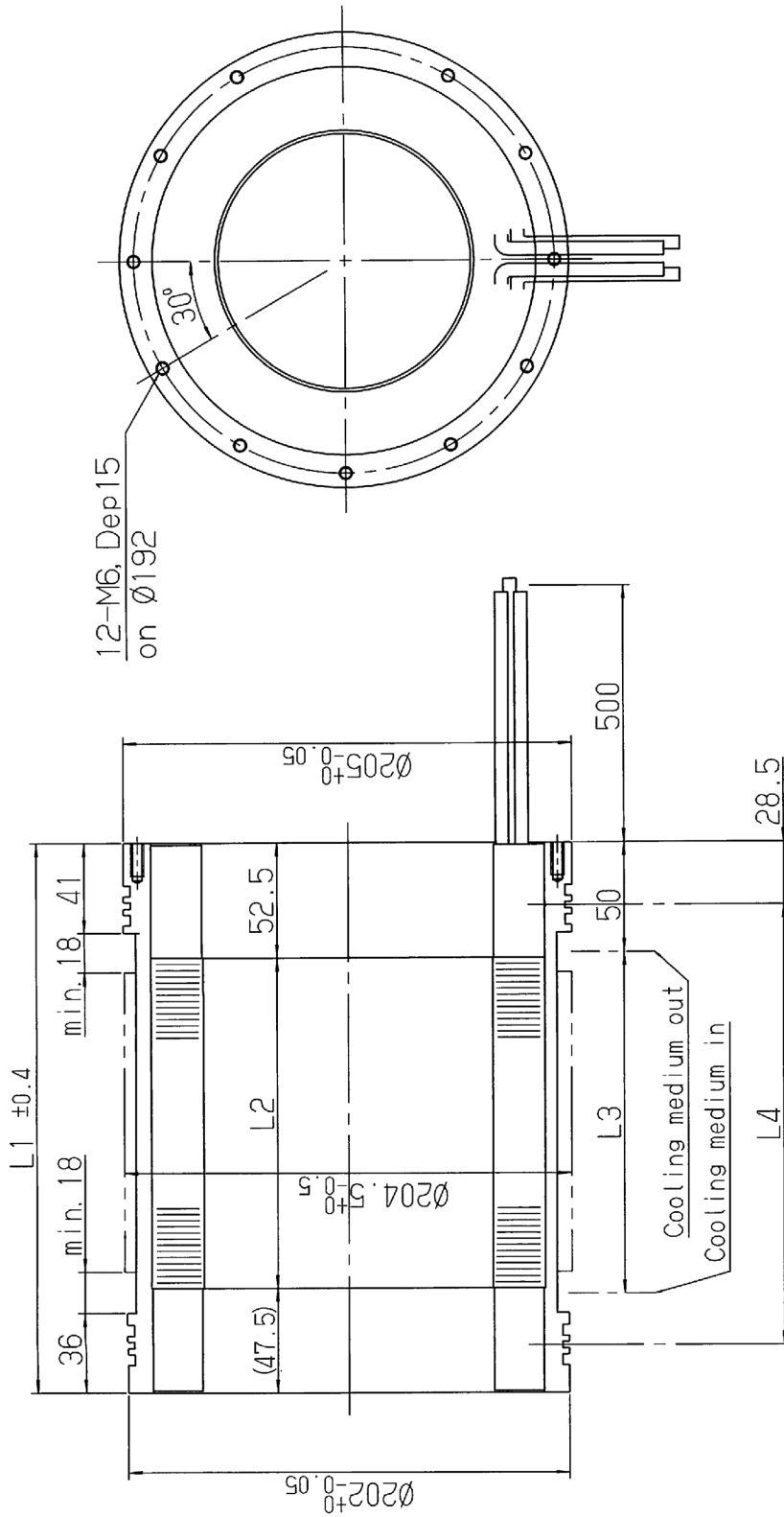
1.1 132 FRAME

1.1.1 132 Frame Specifications

Model: BiS132L2/6000			
A06B-1842-B141#0P4A			
Amplifier	A06B-6122-H045#H553 (α iSP-45HV Type B)		
Sub module	A06B-6111-H403 (SSM-100)		
O-Ring Kit	A06B-1840-K002		
Sensor	α iBZ, α iCZ (*) Check the permissible speed of the sensor.		
Amplifier Input	460 V	<u>PSM selection data</u> * These are not guaranteed values as motor output. Maximum Power 34 kW Constant Power 7.5 kW	
Motor input	Max. 430 V		
	Max. 100 A		
	Rated 77 A		
Mass of Stator	20 kg	<u>Output characteristics</u>  	
Mass of Rotor	7 kg		
Rotor moment of Inertia	0.023 kgm ²		
Cooling Power	More than 4 kW		
Cooling medium flow rate	More than 12 L/min		
Temperature of medium inlet	22 °C		
The rise of outlet from inlet	10 K		
Density of medium	0.88 g/cm ³		
Specific heat	1.78 J/gK		
Thermal class	F		
Degree of protection	Main body		IP00 (*2)
	Built-in		Must be minimum IP54
Allowable angular acceleration and deceleration (*1)			
	A06B-1842-B141		12000 rad/sec ²
(*1)Danger : In any conditions, the angular acceleration (deceleration) of the spindle must never exceed this value. The excess acceleration(deceleration) might cause a slip of the rotor, and in the worst case, there is some possibility being uncontrollable state because of the loss of pole position. If some accident is happen, such as the crash of spindle etc., the motor never been restarted without running a pole position detecting function. (*2)Notice : The stator is IP00 itself. Even if the stator is resin molded, the performance for environment is same as non molded motor. Therefore protection class must be IP54 or more.			

Model: BiS132L3/6000		
A06B-1843-B141#0P4B		
Amplifier	A06B-6122-H045#H553 ($\alpha\dot{I}$ SP-45HV Type B)	
Sub module	A06B-6111-H403 (SSM-100)	
O-Ring Kit	A06B-1840-K002	
Sensor	$\alpha\dot{I}$ BZ, $\alpha\dot{I}$ CZ (*) Check the permissible speed of the sensor.	
Amplifier Input	460 V	PSM selection data * These values are not guaranteed for motor output. Maximum Power 36 kW Constant Power 25 kW
Motor input	Max. 430 V	
	Max. 92 A Rated 72 A	
Mass of Stator	26 kg	Output characteristics 
Mass of Rotor	10 kg	
Rotor moment of Inertia	0.032 kgm ²	
Cooling Power	More than 4 kW	
Cooling medium flow rate	More than 15 L/min	
Temperature of medium inlet	22 °C	
The rise of outlet from inlet	8 K	
Density of medium	0.88 g/cm ³	
Specific heat	1.78 J/gK	
Thermal class	F	
Degree of protection Main body	IP00 (*2)	
Built-in	Must be minimum IP54	
Allowable angular acceleration and deceleration (*1)		
A06B-1843-B141	12000 rad/sec ²	
<p>(*1)Danger :</p> <p>In any conditions, the angular acceleration (deceleration) of a spindle must never exceed this value. The excess acceleration(deceleration) might cause a slip of the rotor, and in the worst case, there is some possibility being uncontrollable state because of the loss of pole position. If some accident is happen, such as a crash of spindle etc., the motor never been restarted without running a pole position detecting function.</p> <p>(*2)Notice :</p> <p>The stator is IP00 itself. Even if the stator is resin molded, the performance for environment is same as non molded motor. Therefore protection class must be IP54 or more.</p>		
		<p>(*) The data of S3 is valid for 3 min. duty cycle.</p>  <p>(*) The data of S3 is valid for 3 min. duty cycle.</p>

1.1.2 132 Frame Stator Dimensions

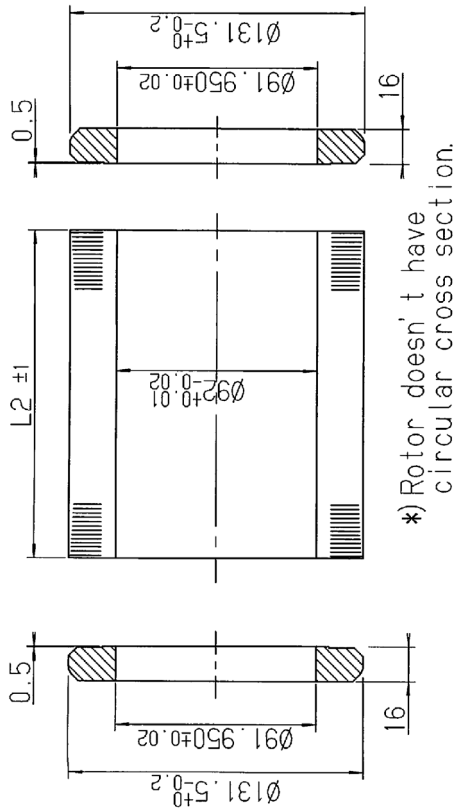


notes) Stator protection grade is IP00 itself.

Model	Dimensions mm				Power cable			Thermistor cable		
	L1	L2	L3	L4	The number of cables	cross section	Max. outer diameter	Length	The number of cables	Max. outer diameter
BIS132L2	200	100	105	150	3	14mm ²	$\varnothing 8\text{mm}$	500mm	1	$\varnothing 6\text{mm}$
BIS132L3	250	150	155	200	3	14mm ²	$\varnothing 8\text{mm}$	500mm	1	$\varnothing 6\text{mm}$

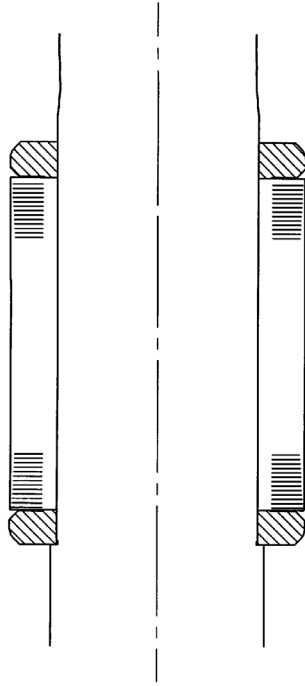
1.1.3 132 Frame Rotor Dimensions

1.Rotor dimensions

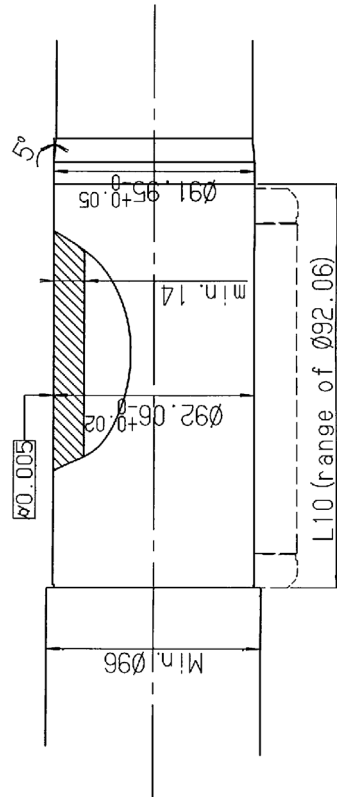


*) Rotor doesn't have circular cross section.

2.The view after assembly



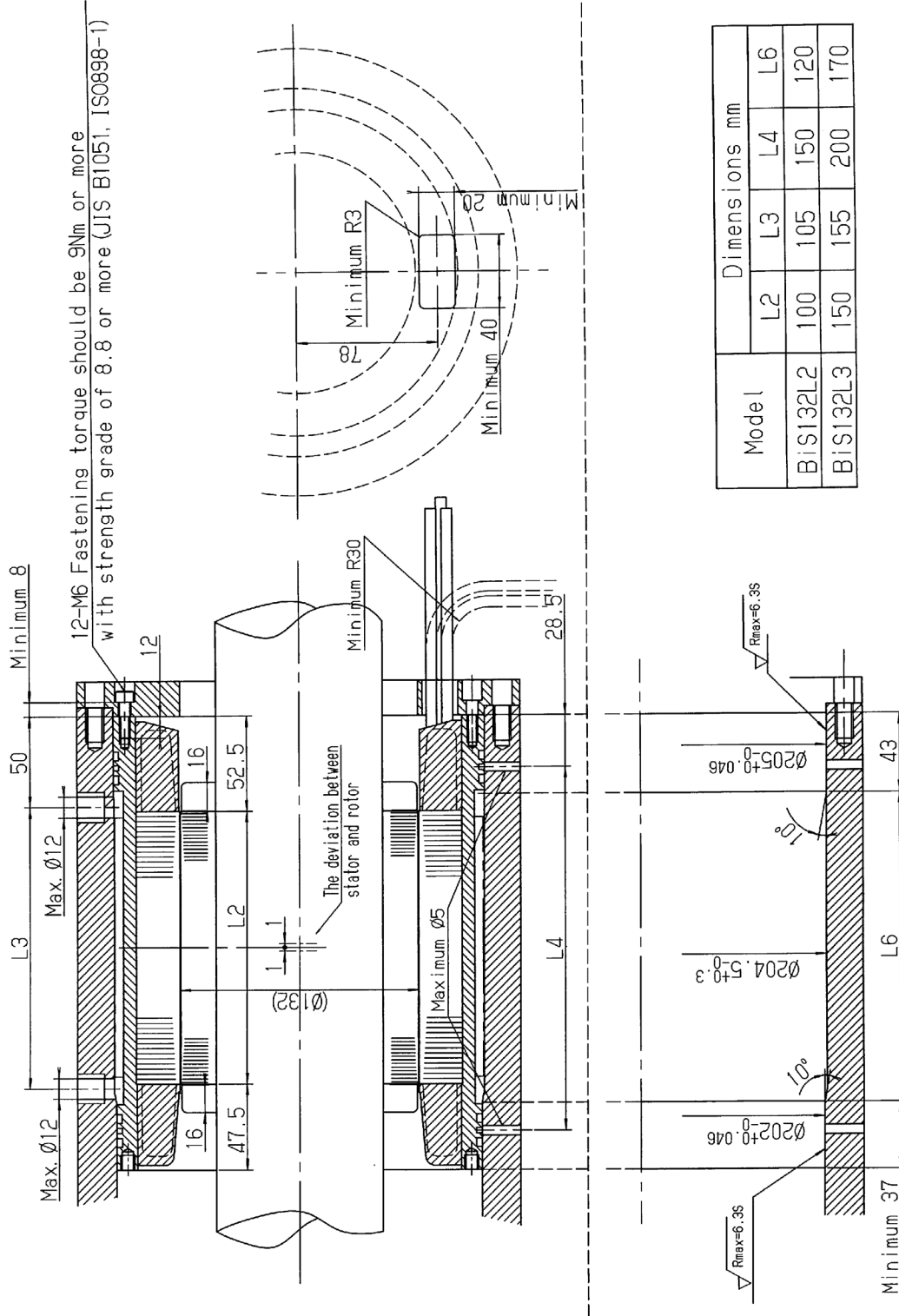
3.Shaft finishing dimensions



Model	Dimensions mm	
	L2	L10
BI S132L2	100	134
BI S132L3	150	184

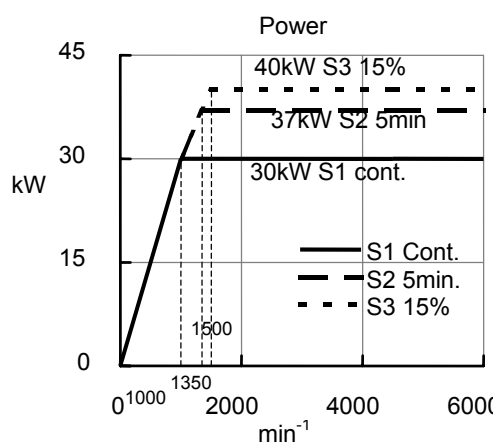
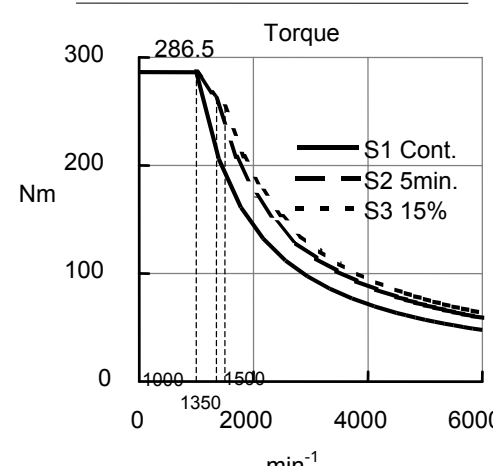
1.1.4 132 Frame Assembly

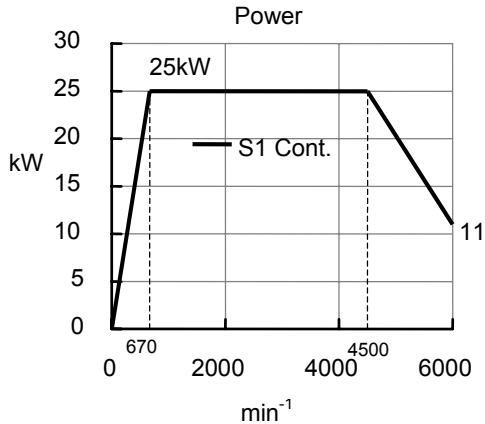
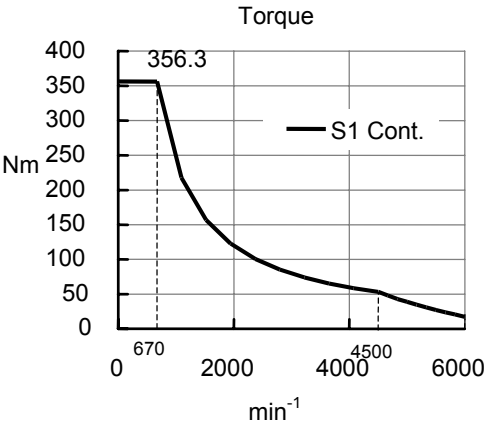
Installation position dimensions in rotor, stator and your shaft housing seem to become follows.



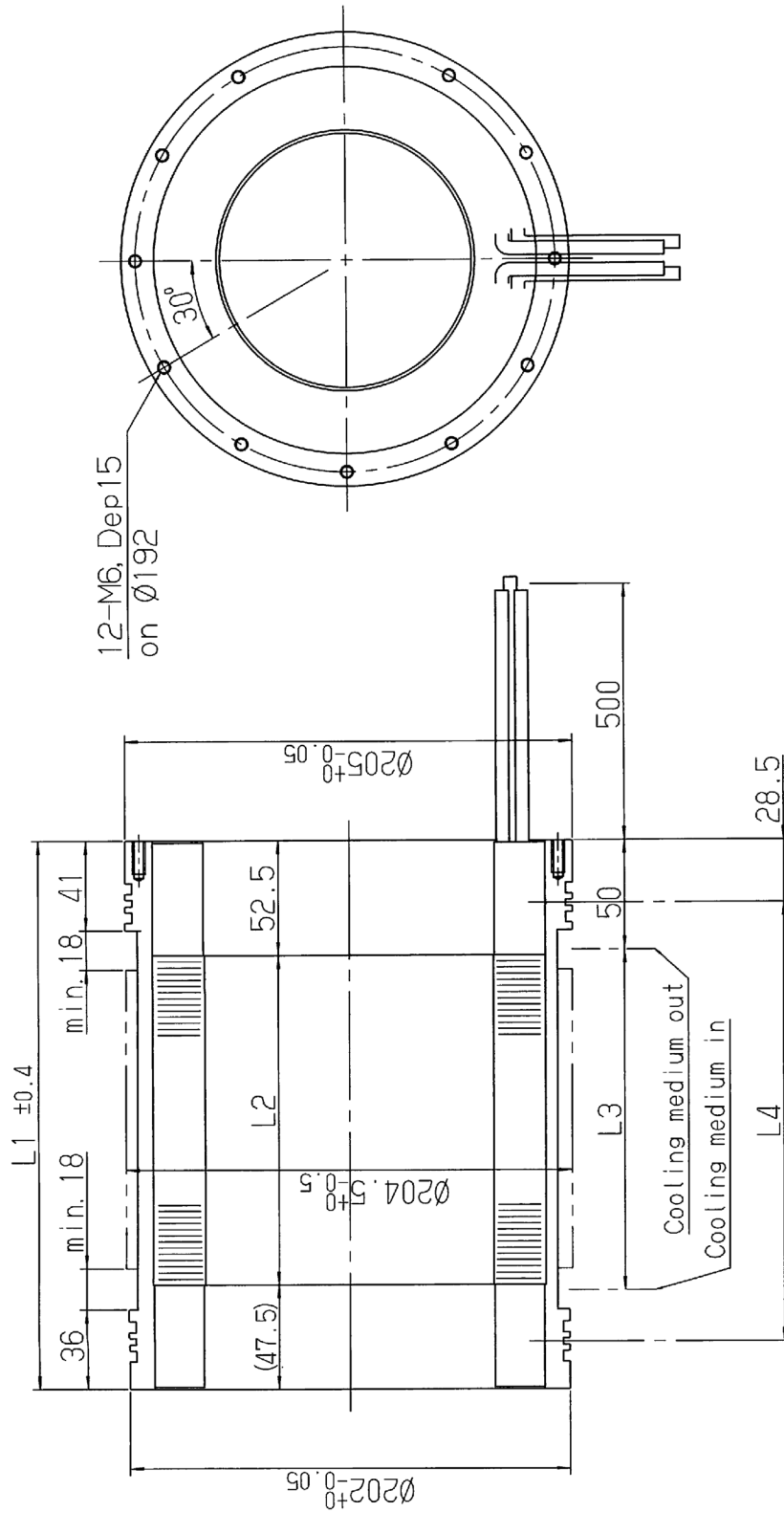
1.2 160 FRAME

1.2.1 160 Frame Specifications

Model: BiS160L4/6000			
A06B-1854-B141#0P4A			
Amplifier	A06B-6122-H045#H553 (αi SP-45HV Type B)		
Sub module	A06B-6111-H403 (SSM-100)		
O-ring Kit	A06B-1850-K002		
Sensor	αi BZ, αi CZ (*) Check the permissible speed of the sensor.		
Amplifier Input	460 V	PSM selection data * These values are not guaranteed output. Maximum Power 60 kW Constant Power 30 kW	
Motor input	Max. 430 V		
	Max. 100 A		
	Rated 77 A		
Mass of Stator	50 kg	Output characteristics  <p>The Power vs Speed graph shows power in kW on the y-axis (0 to 45) and speed in min⁻¹ on the x-axis (0 to 6000). Three curves are shown: S1 Cont. (solid line), S2 5min. (dashed line), and S3 15% (dotted line). S1 Cont. reaches 30 kW at 1350 min⁻¹ and remains constant up to 6000 min⁻¹. S2 5min. reaches 37 kW at 1500 min⁻¹ and remains constant up to 4000 min⁻¹. S3 15% reaches 40 kW at 1500 min⁻¹ and remains constant up to 4000 min⁻¹.</p>	
Mass of Rotor	16 kg		
Rotor moment of Inertia	0.080 kgm ²		
Cooling Power	More than 6 kW		
Cooling medium flow rate	More than 10 L/min		
Temperature of medium inlet	20 °C		
The rise of outlet from inlet	18 K		
Density of medium	0.88 g/cm ³		
Specific heat	1.78 J/gK		
Thermal class	F		
Degree of protection Main body	IP00 (*2)		
Built-in	Must be minimum IP54		
Allowable angular acceleration and deceleration (*1)			
A06B-1854-B141	7100 rad/sec ²		
<p>(*1)Danger :</p> <p>In any conditions, the angular acceleration (deceleration) of the spindle must never exceed this value. The excess acceleration(deceleration) might cause a slip of the rotor, and in the worst case, there is some possibility being uncontrollable state because of the loss of pole position.</p> <p>If some accident is happen, such as the crash of spindle etc., the motor never been restarted without running a pole position detecting function.</p> <p>(*2)Notice :</p> <p>The stator is IP00 itself. The protection class of the stator housing must be IP54 or more. Even if the stator is resin molded, the performance for environment is same as non molded motor.</p>			
			<p>(*) The S3 is valid for 3 min. duty cycle.</p>  <p>The Torque vs Speed graph shows torque in Nm on the y-axis (0 to 300) and speed in min⁻¹ on the x-axis (0 to 6000). Three curves are shown: S1 Cont. (solid line), S2 5min. (dashed line), and S3 15% (dotted line). All curves start at 286.5 Nm at 0 min⁻¹. S1 Cont. drops to 100 Nm at 1350 min⁻¹ and remains constant up to 6000 min⁻¹. S2 5min. drops to 150 Nm at 1500 min⁻¹ and remains constant up to 4000 min⁻¹. S3 15% drops to 200 Nm at 1500 min⁻¹ and remains constant up to 4000 min⁻¹.</p> <p>(*) The S3 is valid for 3 min. duty cycle.</p>

Model: BiS160L6/6000			
A06B-1856-B141#0P4A			
Amplifier	A06B-6122-H045#H553 ($\alpha\dot{I}$ SP-45HV Type B)		
Sub module	A06B-6111-H403 (SSM-100)		
O-ring Kit	A06B-1850-K002		
Sensor	$\alpha\dot{I}$ BZ, $\alpha\dot{I}$ CZ (*) Check the permissible speed of the sensor.		
Amplifier Input	460 V	PSM selection data * These values are not guaranteed for motor output. Maximum Power 60 kW Constant Power 25 kW	
Motor input	Max. 430 V		
	Max. 100 A		
	Rated 77 A		
Mass of Stator	70 kg	Output characteristics 	
Mass of Rotor	24 kg		
Rotor moment of Inertia	0.120 kgm ²		
Cooling Power	More than 12 kW		
Cooling medium flow rate	More than 15 L/min		
Temperature of medium inlet	20 °C		
The rise of outlet from inlet	22 K		
Density of medium	0.88 g/cm ³		
Specific heat	1.78 J/gK		
Thermal class	F		
Degree of protection	Main body IP00 (*2)		
	Built-in Must be minimum IP54		
Allowable angular acceleration and deceleration (*1)			
	A06B-1856-B141 7100 rad/sec ²		
(*1)Danger : In any conditions, the angular acceleration (deceleration) of the spindle must never exceed this value. The excess acceleration(deceleration) might cause a slip of the rotor, and in the worst case, there is some possibility being uncontrollable state because of the loss of pole position. If some accident is happen, such as the crash of spindle etc., the motor never been restarted without running a pole position detecting function. (*2)Notice : The stator is IP00 itself. The protection class of the stator housing must be IP54 or more. Even if the stator is resin molded, the performance for environment is same as non molded motor.			
			

1.2.2 160 Frame Stator Dimensions

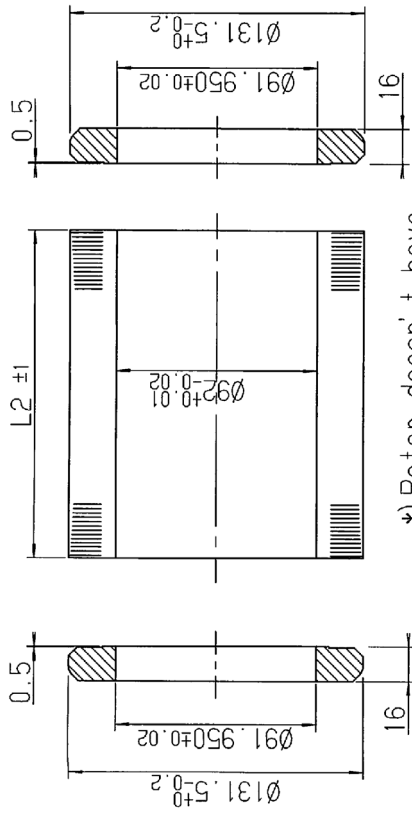


notes) Stator protection grade is IP00 itself.

Model	Dimensions mm				Power cable			Thermistor cable			
	L1	L2	L3	L4	The number of cables	cross section	Max. outer diameter	Length	The number of cables	Length	Max. outer diameter
BIS132L2	200	100	105	150	3	14mm ²	$\varnothing 8\text{mm}$	500mm	1	500mm	$\varnothing 6\text{mm}$
BIS132L3	250	150	155	200	3	14mm ²	$\varnothing 8\text{mm}$	500mm	1	500mm	$\varnothing 6\text{mm}$

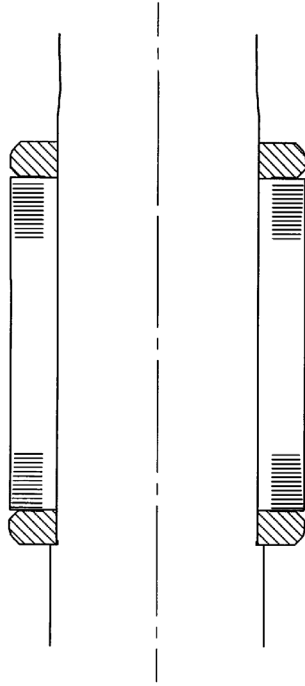
1.2.3 160 Frame Rotor Dimensions

1.Rotor dimensions

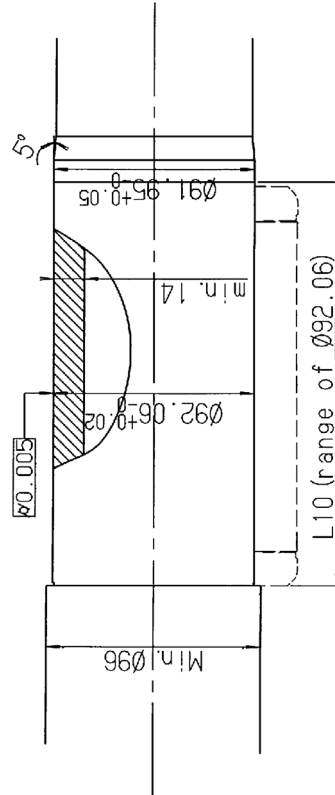


*) Rotor doesn't have circular cross section.

2.The view after assembly



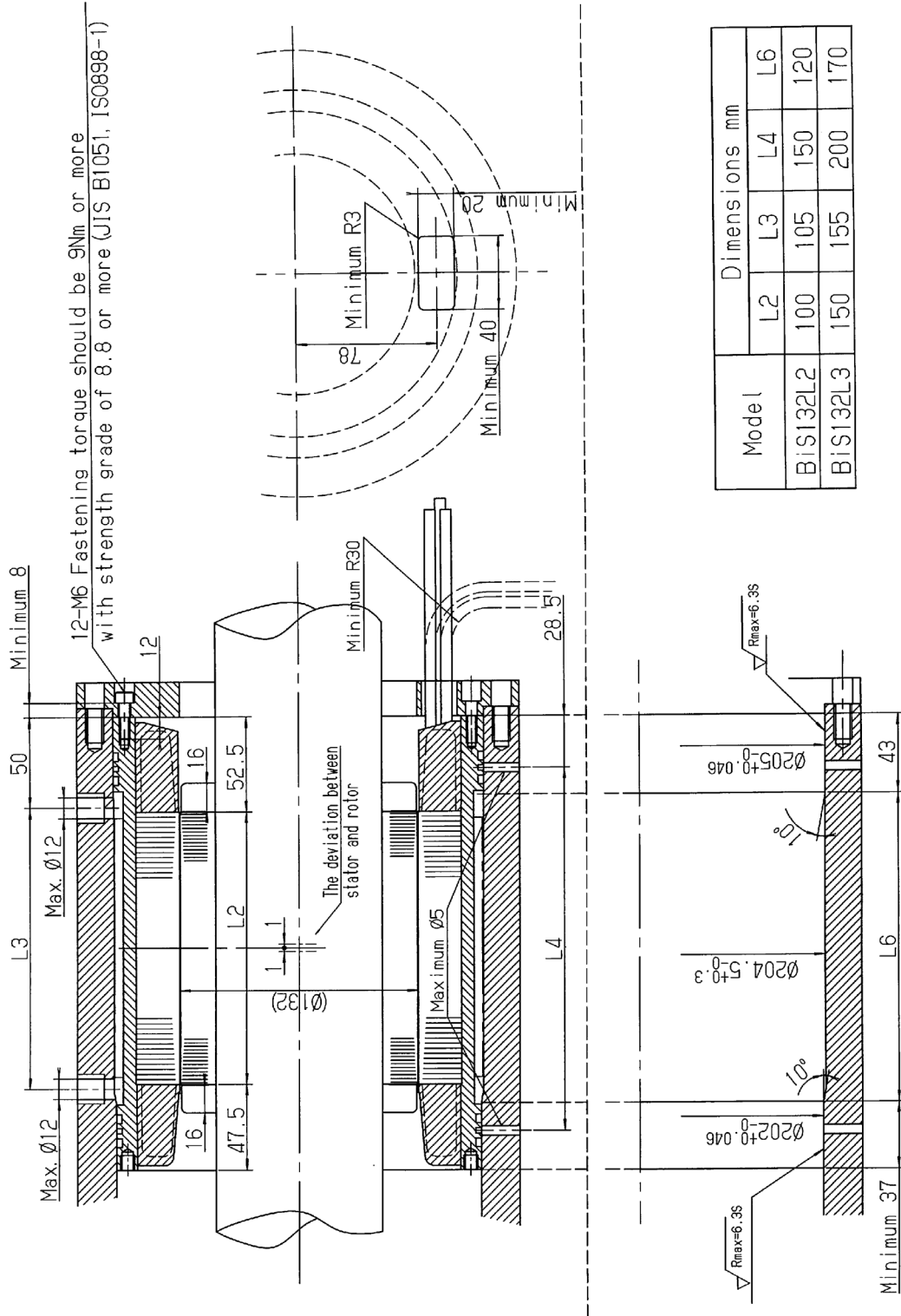
3.Shaft finishing dimensions



Model	Dimensions mm	
	L2	L10
BIS132L2	100	134
BIS132L3	150	184

1.2.4 160 Frame Assembly

Installation position dimensions in rotor, stator and your shaft housing seem to become follows.



1.3 SUB MODULE SM

To drive $B\dot{I}S$ series, it is necessary to connect a Sub module SM(SSM) between motor and amplifier for safety and machine protection.

Synchronous motor has permanent magnets inside of the rotor. So, if the motor runs freely by its inertia because of some power source trouble, the motor turns itself into generator and the high voltage comes back on power line terminal. In order to avoid this dangerous state, SSM is necessary for the driving of synchronous motor. SSM shorts the circuit of power line when an alarm is detected.

Order No. and dimensions are shown in this manual.

Also refer to the description manuals(*) of the latest version for the detailed connection and specifications.

(*) SYNCHRONOUS SPINDLE MOTOR driven manual A-63639-103 and SERVO AMPLIFIER αi series DESCRIPTIONS (B-65282EN)

WARNING

- 1 To drive $B\dot{I}S$ series, be sure to connect SSM between motor and amplifier for safety and machine protection without exception.
- 2 Even if the motor is driven only in low speed, SSM must be connected without exception for the safety measures in case of incorrect operation or unexpected accident. Never to drive the $B\dot{I}S$ series without SSM.

CAUTION

During 2 minutes from the SSM operation, such case as some spindle alarm or other emergency stop, the reset command of alarm is ignored. This is a standard function and not a trouble. While this process, if some rotation command is active, the spindle rotates suddenly after two minutes, so please be careful. For more details, refer to the description manual (*) of latest version .

(*)6.4 clause on SYNCHRONOUS SPINDLE MOTOR driven manual A-63639-103

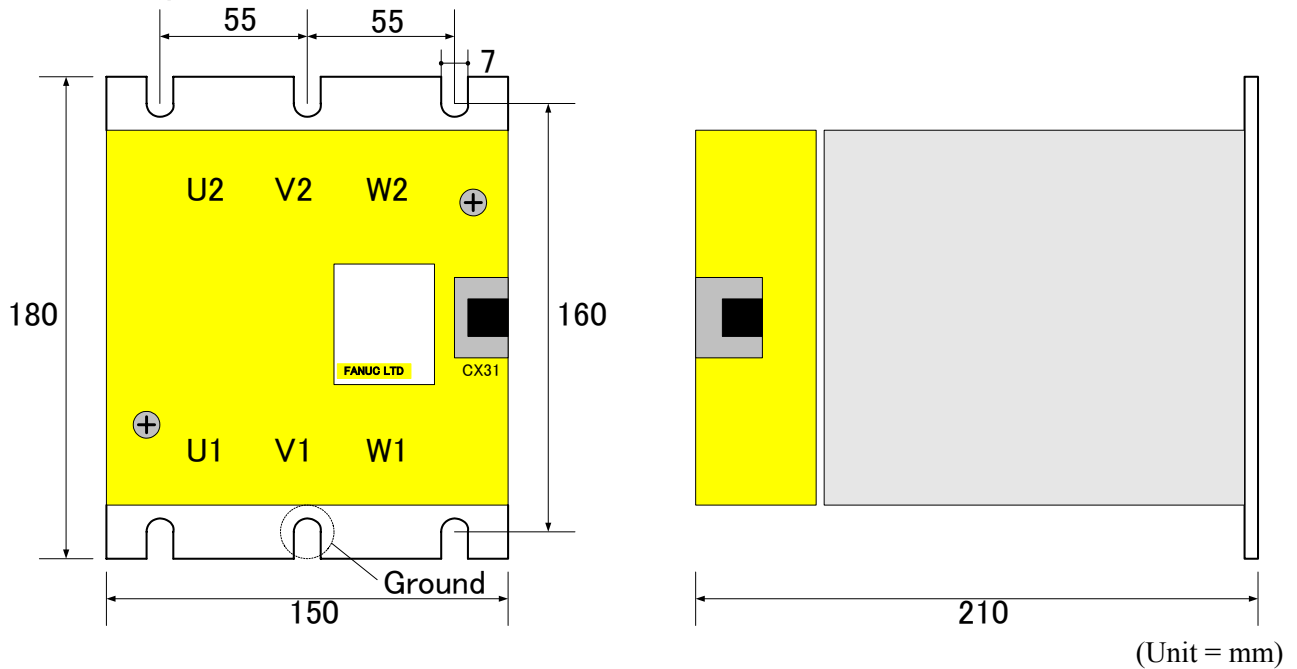
1.3.1 Type No.

Model	Type No.
SSM-100	A06B-6111-H403
SSM-200	A06B-6111-H404

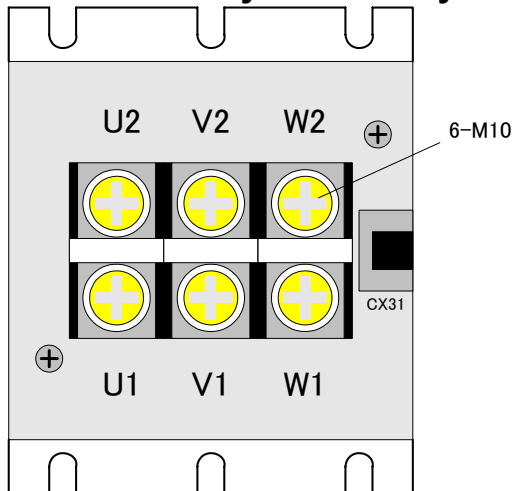
1.3.2 SSM Dimensions

The dimensions of SSM-100 ,SSM-200 are same, and following.

The view of with yellow safety cover. (This cover is fasten on the main body with 2-M4.)



The view of without yellow safety cover.



1.4 O-RING

1.4.1 Notes

- **O-Ring is expendable parts**

O-Ring is expendable parts. So, check the O-rings periodically. If leakage is found out, change the O-ring immediately.

The period of O-ring's life is widely changed by the cooling medium or motor's operating condition. Please check the O-rings periodically.

1.4.2 Type No.

- **Standard ordering No.**

Order the O-ring-kit according to following list. These are the standard ones. Four O-rings of same size are in one package, and is for one motor.

Motor model	O-ring type No.	Material	JIS-N-2401
A06B-184x-B14x#xxxx	A06B-1840-K002	Fluoric	4-D
A06B-185x-B14x#xxxx	A06B-1850-K002	Fluoric	4-D

NOTE

A06B-1850-K002 is compatible with "AS568-272 (American standard)" in dimensions.

- **O-ring of NBR**

The O-ring that FANUC recommend first is A06B-1840-K002, A06B-1850-K002 .

The following O-rings are made by NBR.

Generally the durability of NBR is not so perfect. It is necessary to check O-rings periodically.

If some leak or deterioration is found around O-rings, change the O-rings immediately.

Motor model	O-ring type No.	Material	JIS-N-2401
A06B-184x-B14x#xxxx	A06B-1840-K001	NBR	1-A
A06B-185x-B14x#xxxx	A06B-1850-K001	NBR	1-A

1.4.3 Installation

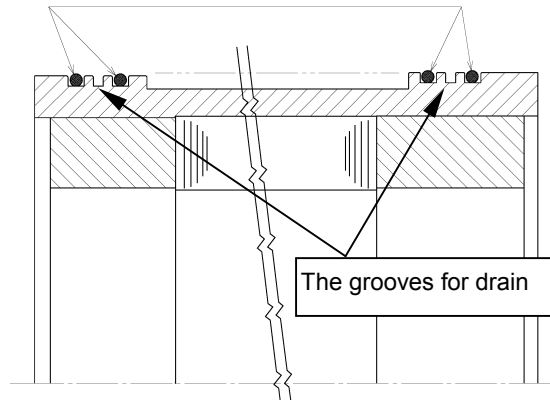
- The grooves to fit

Fit O-rings on the 4-grooves indicated in the drawing below.

- Drain

The middle grooves of each side are for drains. They should be coincided with drain holes on outer sleeve. The actual positions are shown in the drawings of assembly in former sections.

Please fit O-rings on each grooves.



2

SPINDLE DESIGNING AND MOTOR MOUNTING

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2.1 INFORMATION AND INSTRUCTION

2.1.1 Safety Information

Do not machine to motor parts

Do not machine motor parts such as the stator, rotor, and ring by yourself. Other wise, the necessary strength or accuracy cannot be achieved, causing a malfunction.

Liquid cooling

BiS series are developed on condition of liquid cooling. The rated output will not be obtained by another cooling e.g. air cooling.

Recommended coolant : ISO VG2(e.g. Idemitsu Super Multi2)
Select the coolant which has a manufacturing safety data sheet (MSDS) . When handling the coolant, refer to the data sheet.
When disposing of coolant, follow the related government and local laws and rules.

Design the spindle so that the pole position detecting function could execute

When driving a synchronous built-in spindle motor, it is indispensable for controller to catch pole position of the rotor. Therefore when the first driving after turning on amplifier, the pole position detecting function is always executed, and pole position is set. To run this function, the spindle should be able to rotate freely.

If speed increasing gear or brake is used, design the spindle so that make the spindle free from these loads when the detecting function is operating.

(*) 'Free' means that the force of constraint to spindle is almost only bearing's load.

Stator mold

The resin mold of the stator is applied to increase the heat rating. There is no advantage for bad environment than no molded motor. Therefore the protection class of the motor housing must be IP54 or more.

(*) There are some chips, bubbles and cracks in mold resin. If the protection class is IP54 or more, there is not bad influence in performance. There is some visible internal wire in coil-end mold, however it is not a problem in performance.

Thermistor

Do not cool the thermistor partially. If the thermistor partially cooled, the over heat alarm of the stator may not be detected. A thermistor is placed on the coil under the power lead outlet.

Design for easy maintenance

For easy maintenance, the structure of the spindle should be designed to assemble easy, for example, a stator, rotor and sensor should be disassembled by each unit.

Dry condition

BIS series is an electric component. It may be damaged by liquid like water and oil. Therefore keep away from them. If the air is supplied into a spindle, take some structure not to catch condensed dew. Even if the air is dried, dew condensation may occur by the effect of the adiabatic expansion. Therefore be care enough. If dew condensation happens in motor, trouble may occur.

Keep the manufacturing number

Write down and remember the serial number on the lead wire of stator, and the manufacturing number on the side of rotor, so that you can find the manufacturing number of the motor when the maintenance.

Check resistance and insulation

Before assembling a spindle, check the resistance and insulation of winding. And also check them on periodically maintenance.



WARNING

Shutdown the power supply and disconnect the leads which are connected to the amplifier before measuring to prevent an electric shock. In measuring, insulate the open terminals so that not to touch.

Winding resistance

Measure the winding resistance by milli-ohm meter according to the following list. Insulate the terminals that are not used while measuring.

	U-V, V-W, W-U [mΩ]
A06B-1842-B14x#xxxx	285±5%
A06B-1843-B14x#xxxx	358±5%
A06B-1854-B14x#xxxx	298±5%
A06B-1854-B11x#xxxx	298±5%
A06B-1856-B14x#xxxx	403±5%
A06B-1856-B11x#xxxx	403±5%

Insulation between winding and frame

Measure at 500VDC with mega-ohm tester. And judge according to following.

Insulation resistance	Judgment
Over 100 M Ω	Good
10 to 100 M Ω	No problem in normal use. But check the insulation on regular intervals.
1 to 10 M Ω	Special care is required. Check the insulation on regular intervals.
Under 1 M Ω	Damaged. Change the motor to the new one.



CAUTION

The measurement operation of insulation resistance may slightly damage the insulation of a motor. So, the minimum time and minimum number of times to measure the resistance.

2.1.2 Protection Class (foreign matter and liquid protection)

Protection class of αiB series is IP00 when the delivery.

Protection class of motor part in the spindle must be IP54 or more, and the part of drain must be IP44 or more. (Refer to the IEC34-5 standard for details of IP.)

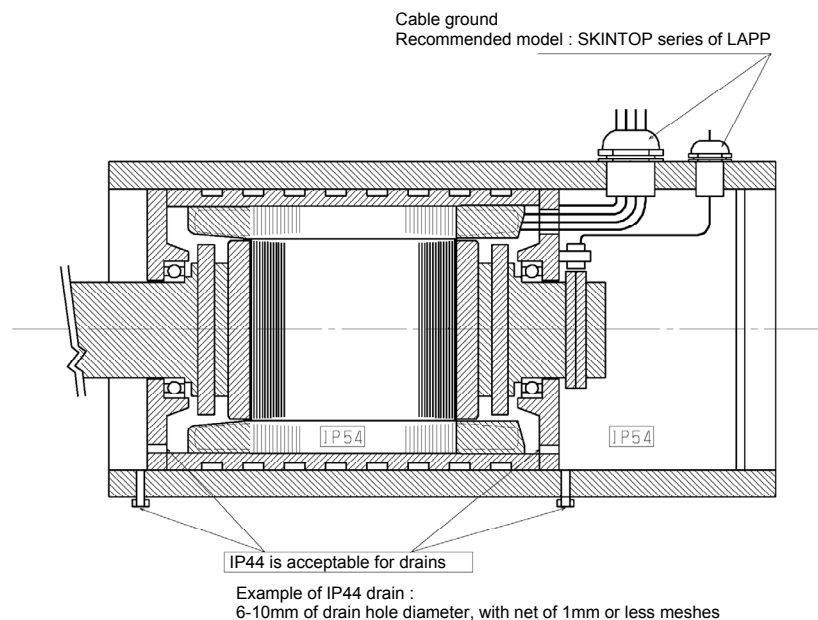
The oil circulating in the spindle for lubrication, such as oil-air lubricating oil, must be insulating oil.

Oil or mist of oil must be kept isolated from motor parts and sensor.

Recommended insulating oil

For cooling : Idemitsu Super Multi 2(ISO VG2)

For lubrication : Mulpose , NIPPON OIL CORPORATION



CAUTION

FANUC cannot guarantee the motor, when the protection is not enough.

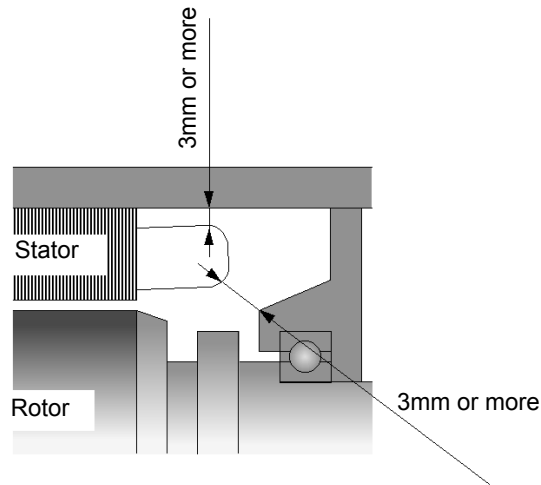
The stator in drawing is mold type. The stator without mold is same as induction built-in spindle motor, please refer to the FANUC AC SPINDLE MOTOR αiB series DESCRIPTIONS (B-65292EN).

2.1.3 Insulation

Clearance

Clearance between windings and other conductive materials have to be 3mm or more, and this condition have to be applied for all directions of windings. Refer to IEC664-1 for more details.

If a motor is mold type, the clearance is enough when no parts around molded resin contacts it.



Creepage distance

Creepage distance depends on materials used for insulation. In the case of general plastic material under IP54 condition, it has to be 2.5mm or more. Refer to VDE0110 for details.

NOTE

Clearance and creepage distance varies with the environment and materials. Therefore confirm actual value that is suitable for your machine system.

Terminal block and connector

Use IEC- or UL-certified terminal blocks and connectors for power leads connection.

For the clearance and creepage distance between terminals, conform to IEC664-1.

2.1.4 Conform Standards

Note on assembly

When installing *BIS* series on a machine, satisfy Article 19 of IEC60204-1. For details, refer to the standard.

IEC60204-1(excerpts)

19 Tests and verification

19.1 General

This standard specifies general requirements for electric equipment mounted on machines. Tests related to special types of machines are specified in specific product standards. If no product standard specific to a machine is specified, one or more tests listed below may be conducted as appropriate tests, but continuity in the protection bonding circuit shall always be verified(refer to Article 19.2)

- Verification of the match between electric equipment and technical document
- Continuity in the protection bonding circuit (Refer to Article 19.2.)
- Insulation resistance test (Refer to Article 19.3.)
- Voltage test (Refer to Article 19.4.)
- Protection against residual voltage (Refer to Article 19.5.)
- Function test (Refer to Article 19.6.)

It is desirable to conduct the above tests in the listed order. If electric equipment is modified, the requirements in Article 19.7 shall be applied.

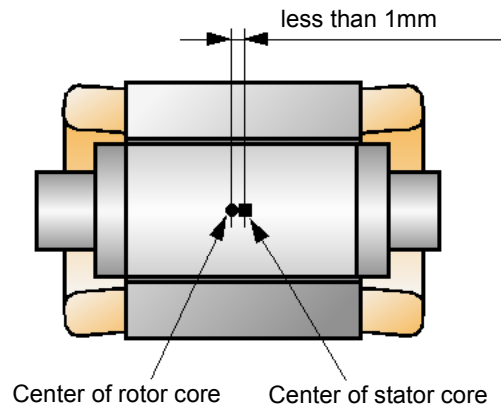
(The rest is omitted)

2.1.5 Deviation

Axial deviation of stator and rotor

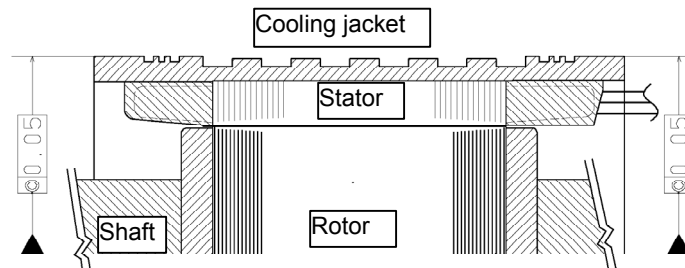
Axial deviation between the center of stator core and the center of rotor core must be less than 1mm.

Over 1mm deviation causes reduction of output power.



Position of stator and cooling jacket

To limit the radial offset of a rotor and stator, the eccentricity of a periphery of the jacket to the central axis must be less than 0.05mm.



2.1.6 Sensor

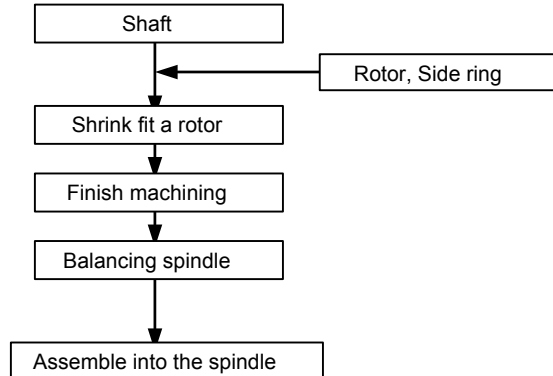
About a sensor, refer to description manual (*).

(*) FANUC AC SPINDLE MOTOR α iB series DESCRIPTIONS (B-65292EN).

2.2 SHRINKING THE ROTOR

2.2.1 Safety Information

- The outline flow for process is shown below.



- The way to fix a rotor on the spindle must be shrink fitting.
- Rotor and side rings are finished machining before shipment. Do not machine rotor and rings.
- "Finish machining" in above means that of bearing part or the part except motor.
In the machining, cover the rotor with some flexible sheet so that the rotor not to catch cutting chips on its surface. Furthermore, cover the rotor in industrial wrap so that the rotor doesn't get wet with cutting fluid.
- When shrink fitting a rotor, the actual temperature of the rotor must be measured directly so that the temperature never to exceed 150°C. If rotor temperature exceeds 150°C, internal magnet may be damaged. If you use an electric oven, measure the distribution of temperature inside of the oven. The rotor is never exposed to a hot wind directly. Never use the induction heater.
- Shaft should be cooled to 0°C or less.
- When the rotor is left temporarily for some preparations, the rotor should be wound by some thick soft non-magnetic material, such as corrugated cardboard etc., with the thickness of more than 30mm. And rope off the rotor, call attention that the rotor has strong magnetic force. to keep away from a person to access the rotor. Wrap is to prevent the rotor from caching metal chips on its surface, and soft material or corrugated cardboards is the buffer material for the safely.

- All the rotor are checked its unbalance in production process. So normally, it is unnecessary to balance for the rotor after shrinkage fit, only to balance the whole main shaft. If user needs more precise balancing of the rotor, the taps on the side ring's can be used. The allowable mass is following table. Do not exceed these value.

	Allowable mass [g]	
	Total mass per one ring	For one tap
B132Lx	6 g	2 g
B160Lx	8 g	2 g

- The taps on the side ring is only for the balancing the rotor. Never use it for the whole balancing of the main shaft.
- Never machine rotor and side ring.
- We recommend to mount the rotor to spindle directly without sleeve. If customer uses rotor sleeve, the interference should be taken enough so that the rotor not to slip.

 **WARNING**

Synchronous spindle motor, control soft must always catch pole position. If it is missed by some causes, it will be possible to cause uncontrollable condition. This is very danger.

Therefore, the fixing torque must be taken enough so that not to slip the rotor.

If the possibility of the slip is happen, for example a crushing spindle, the spindle must not be restarted without running pole position detecting function.

- Electro static charge of the spindle :
There is some possibility that electro static voltage is charged on the spindle. It may be caused by bearing lubricating structure or cutting condition, and depends on the spindle structure. Particularly if a ceramic bearing is used, it is obvious. We recommend to take some structure that the electric potential voltage becomes equal between the grounded stator core and the spindle. If no measures are taken, electric discharge will happen between rotor and stator, or spindle and sensor, and it will be the cause of some trouble.

2.2.2 Operations

1. Preheating rotor and ring, and refrigerating shaft

- Preheat rotor and ring to 140°C-150°C. Cool the shaft less than 0°C.
- The rotor temperature must be measured directly, and the maximum temperature never exceed 150°C. If the rotor temperature exceeds 150°C, the rotor will be damaged.

Heat to 140°C -150°C

Ring (Provided by FANUC)

Customer spindle

Cool less than 0.°C.

A step or some supporting parts

Guide jig (Non-magnetism materials: SUS3**, MC nylon, POM and others)

(Guide diameter)=(Spindle diameter) × (0.5 to 0.8)

(Guide height)=(Spindle diameter) × (0.5 to 0.8)

-(φ0.05 to 0.1)

CAUTION
The rotor has strong magnets inside. So please be careful to its magnetic force and influence of the magnetic field.

2. Shrinking fit

- Mount the ring, rotor, ring, quickly and without a break.
- The ring has a front side and back side. The side which has a step is the side to the rotor.

0.5 step part

3. Figure of completion

- Gradually cooling.

WARNING
There are several dangerous operations. Be careful for the high temperature and a heavy object. Be careful for the strong magnetic force of the rotor. There is danger that magnetic metal (e.g. Iron) is crashed by strong magnetic force. Therefore do not bring them close to each other more than 50cm. When the rotor is put for the preparations of work temporarily, please wind corrugated cardboard or a buffer material around rotor surface more than 30mm, and rope off the rotor, call attention that the rotor has strong magnetic force. to keep away from a person to access the rotor.

2.3 THE WAY TO ASSEMBLE THE SPINDLE

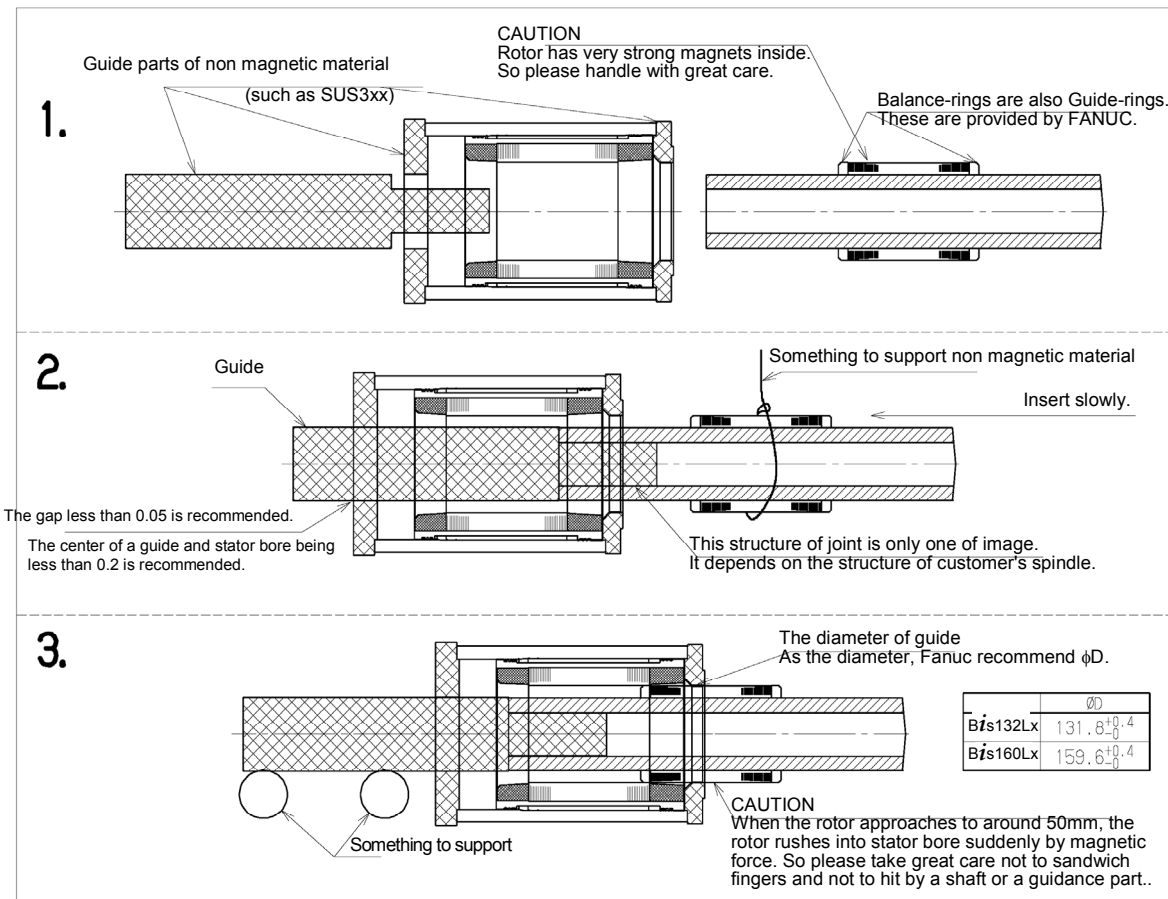
Please assemble the spindle, according to following information.

⚠ WARNING

- 1 Please be careful to magnetic force on rotor surface. Rotor has very strong magnets inside. Please take great care not to bring rotor close to magnetic materials. If crash is caused, and if a hand is sandwiched, it will be very danger.
- 2 When the rotor comes to close the stator bore, the rotor suddenly may rush into stator bore by magnetic force. Take great care not to be hit and sandwich fingers. Do not stand on axial extended direction.

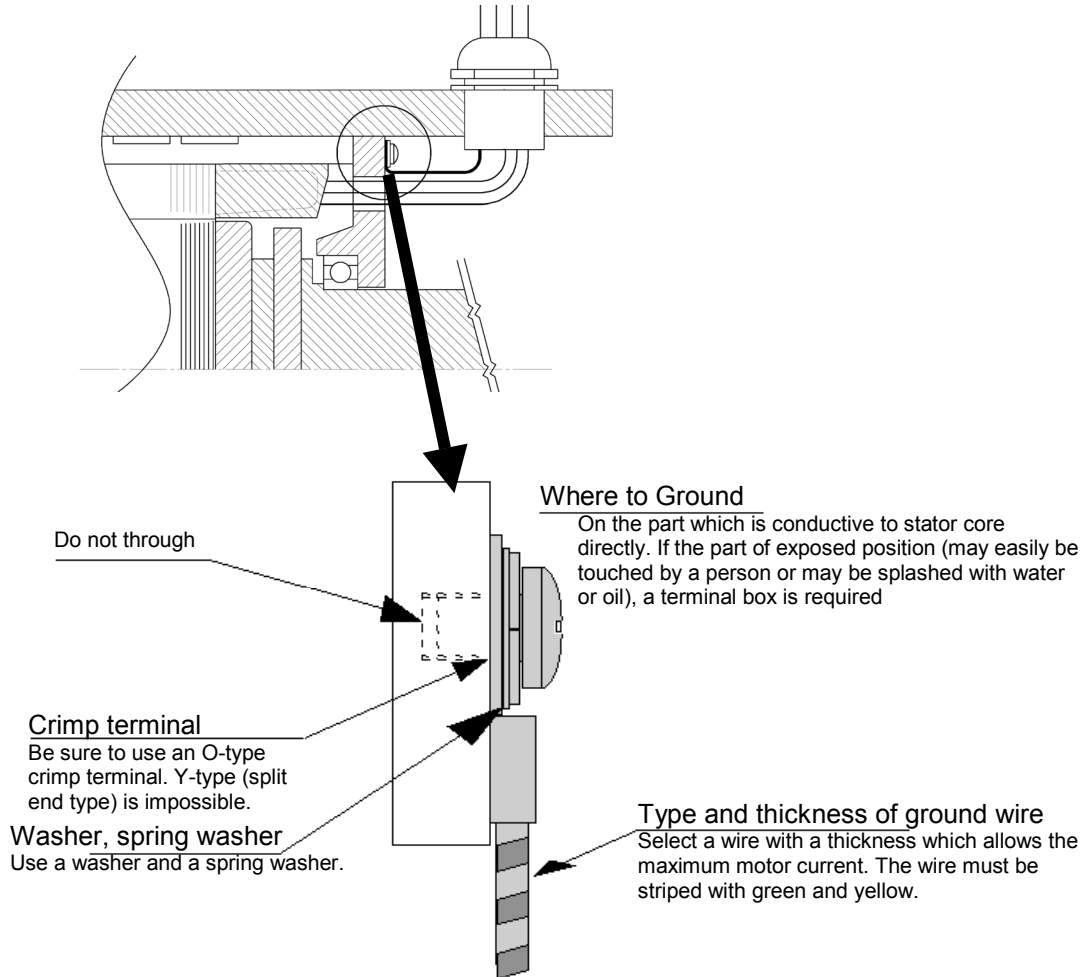
⚠ CAUTION

Rotor is very heavy. Therefore be careful to injuries.



2.4 GROUNDING A MOTOR

For safety, ground the parts which is conductive to stator core, such as jacket, surely. Refer to the following. The following shows an example of a CE marking conformity.



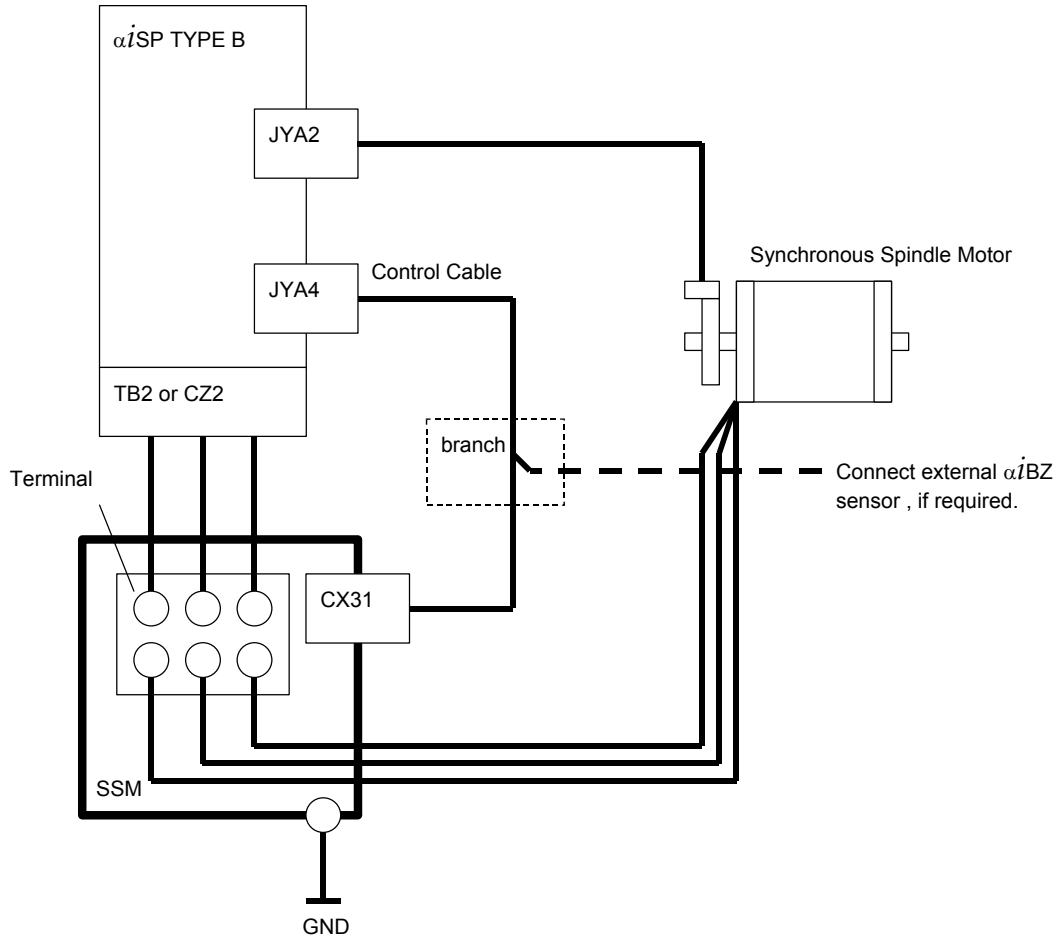
⚠ WARNING
Be sure to ground the motor, referencing the above instructions, to prevent shock hazards.

NOTE

- 1 Be sure to ground the motor to prevent accidents.
- 2 The motor does not have ground wire. Prepare them by customer referencing the maximum current listed in Chapter 1“SPECIFICATIONS”.

2.5 CABLE CONNECTION (OUTLINE)

For details, refer to the latest Descriptions (B-65282EN) of FANUC SERVO AMPLIFIER αi series.



NOTE

These diagrams are just for reference. For details, refer to the latest Descriptions (B-65282EN) of FANUC SERVO AMPLIFIER αi series and the newest Maintenance Manual (B-65285EN) of FANUC SERVO MOTOR αi series.

3

PARAMETER

The parameters for *BIS132L2* will be printed from next edition.

3.1 132 FRAME

Motor model: BiS132L3/6000

Output specification: #0P4B

Amplifier α iSP-45HV

Soft version After 9D53/B

SSM SSM-100

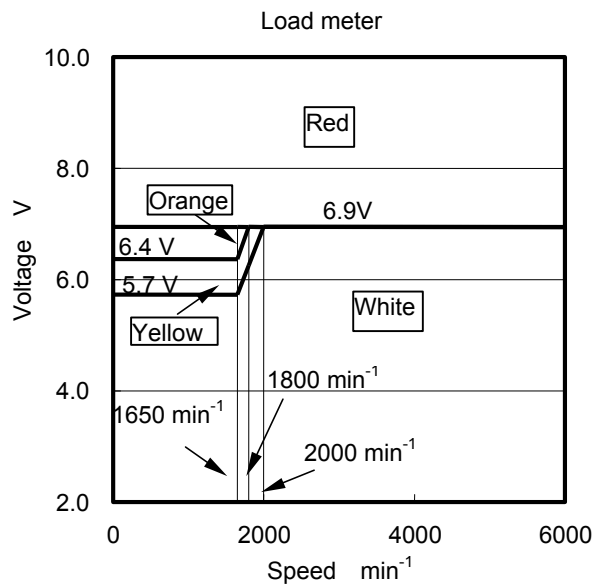
Number of poles 8-pole (4 pairs)

Power source voltage 460V

Parameter No.		Setting value
15i	16i	
3006	4006	0000 0000
3007	4007	0000 0000
3008	4008	0110 0000
3009	4009	0000 0001
3010	4010	0000 0001
3011	4011	1001 0***
3012	4012	1100 0010
3013	4013	0101 0010
3019	4019	0000 0100
3020	4020	6000
3040	4040	84
3048	4048	84
3080	4080	80
3083	4083	5840
3084	4084	0
3085	4085	0
3086	4086	1300
3100	4100	1500
3101	4101	100
3102	4102	1400
3103	4103	1400
3104	4104	13000
3105	4105	0
3106	4106	13000
3107	4107	0
3108	4108	0
3109	4109	0
3110	4110	1024
3111	4111	305
3112	4112	110
3113	4113	192
3114	4114	0
3115	4115	110
3116	4116	310
3117	4117	585
3118	4118	0
3119	4119	300
3120	4120	0
3124	4124	0
3127	4127	144
3128	4128	0
3130	4130	0
3134	4134	100

NOTE

- 1 Connect SSM without exceptions.
Make a bit for SSM effectively. (Bit 5 of parameter No. 3008=1)
- 2 Please refer to the newest Driving manual (A-63639-103) for Synchronous spindle motor.
- 3 Bits 0, 1, and 2 of parameter No.3011 (4011) should be set up according to the number of teeth of the sensor.
128/rev=001, 256/rev=010
384/rev=101, 512/rev=011
About others, please refer to the PARAMETER MANUAL.



3.2 160 FRAME

Motor model: BiS160L4/6000

Output specification: #0P4A

Amplifier α iSP-45HV

Soft version After 9D53/B

SSM SSM-100

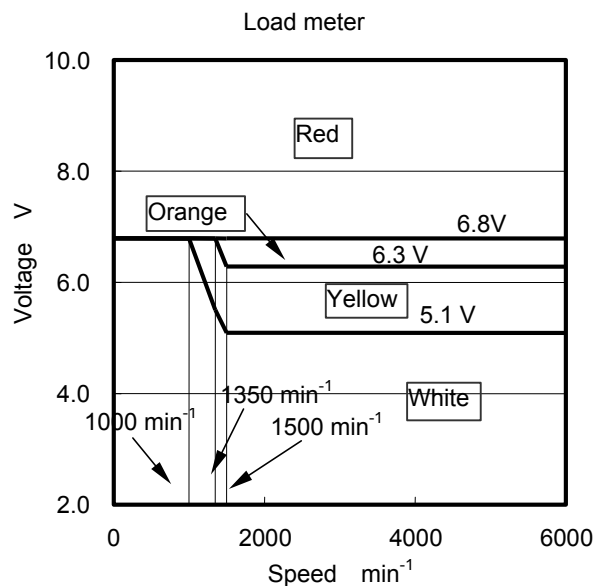
Number of poles 8-pole (4 pairs)

Power source voltage 460V

Parameter No.		Setting value
15i	16i	
3006	4006	0000 0000
3007	4007	0000 0000
3008	4008	0110 1000
3009	4009	0010 0001
3010	4010	0000 0001
3011	4011	1001 0***
3012	4012	1100 0010
3013	4013	0101 0000
3019	4019	0000 0100
3020	4020	6000
3040	4040	63
3048	4048	63
3080	4080	70
3083	4083	5050
3084	4084	0
3085	4085	0
3086	4086	1500
3100	4100	1000
3101	4101	100
3102	4102	1000
3103	4103	1000
3104	4104	15000
3105	4105	0
3106	4106	15000
3107	4107	0
3108	4108	0
3109	4109	0
3110	4110	1024
3111	4111	339
3112	4112	110
3113	4113	277
3114	4114	0
3115	4115	110
3116	4116	495
3117	4117	521
3118	4118	0
3119	4119	0
3120	4120	0
3124	4124	0
3127	4127	196
3128	4128	0
3130	4130	100
3134	4134	110

NOTE

- 1 Connect SSM without exceptions.
Make a bit for SSM effectively. (Bit 5 of parameter No. 3008=1)
- 2 Please refer to the newest Driving manual (A-63639-103) for Synchronous spindle motor.
- 3 Bits 0, 1, and 2 of parameter No.3011 (4011) should be set up according to the number of teeth of the sensor.
128/rev=001, 256/rev=010
384/rev=101, 512/rev=011
About others, please refer to the PARAMETER MANUAL.



Motor model: BiS160L6/6000**Output specification: #0P4A**Amplifier α iSP-45HV

Soft version After 9D53/B

SSM SSM-100

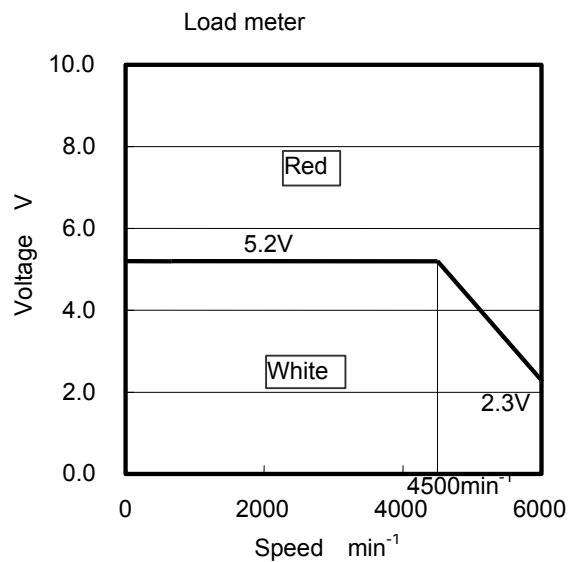
Number of poles 8-pole (4 pairs)

Power source voltage 460V

Parameter No.		Setting value
15i	16i	
3006	4006	0000 0000
3007	4007	0000 0000
3008	4008	0110 0000
3009	4009	0000 0001
3010	4010	0000 0001
3011	4011	1001 0***
3012	4012	1100 0010
3013	4013	0101 0010
3019	4019	0000 0100
3020	4020	6000
3040	4040	42
3048	4048	42
3080	4080	50
3083	4083	5040
3084	4084	0
3085	4085	0
3086	4086	1500
3100	4100	670
3101	4101	75
3102	4102	670
3103	4103	670
3104	4104	25000
3105	4105	0
3106	4106	25000
3107	4107	0
3108	4108	0
3109	4109	0
3110	4110	1024
3111	4111	339
3112	4112	110
3113	4113	274
3114	4114	24415
3115	4115	110
3116	4116	374
3117	4117	440
3118	4118	12815
3119	4119	800
3120	4120	0
3124	4124	0
3127	4127	192
3128	4128	0
3130	4130	0
3134	4134	100

NOTE

- 1 Connect SSM without exceptions.
Make a bit for SSM effectively. (Bit 5 of parameter No. 3008=1)
- 2 Please refer to the newest Driving manual (A-63639-103) for Synchronous spindle motor.
- 3 Bits 0, 1, and 2 of parameter No.3011 (4011) should be set up according to the number of teeth of the sensor.
128/rev=001, 256/rev=010
384/rev=101, 512/rev=011
About others, please refer to the PARAMETER MANUAL.



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<Number>

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