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The Energy Within

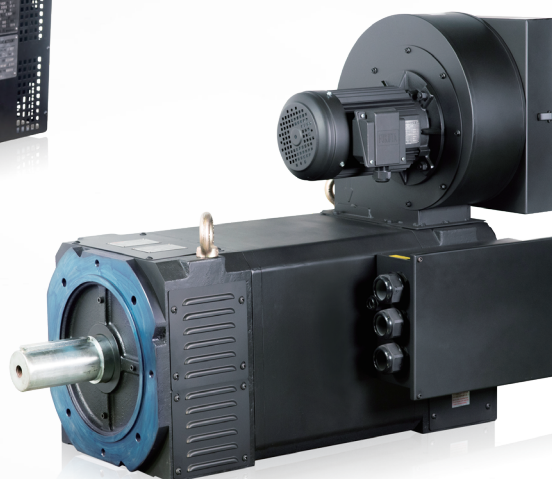
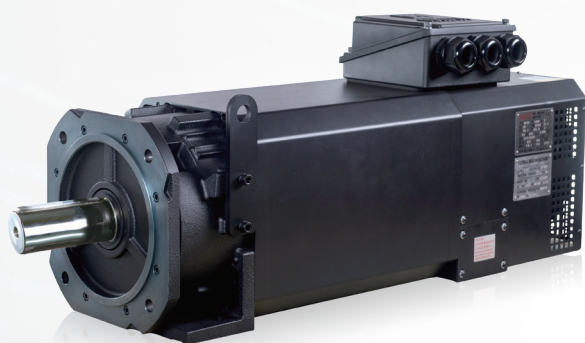
Servo Motor

Operation Manual / Maintenance Manual

伺服馬達系列使用手冊 / 保養手冊



Servo Motor 感應伺服馬達



Servo Motor Operation Manual

伺服馬達系列使用手冊



一、外觀檢查

- 1.1 收到貨品時請先檢查是否有因運送過程而造成的損傷，若有因運送上造成的損傷，請立即與客服聯繫。
- 1.2 開箱時，請確認馬達型號、馬達規格、額定電壓、頻率、型式與馬達上銘牌是否相符。
- 1.3 開箱過程請小心勿損傷馬達。
- 1.4 安裝前移除保護心軸的防鏽漆及絕緣膠帶。
- 1.5 檢查馬達外觀各部位是否有髒汙、油污、損傷、鏽蝕...等。
- 1.6 以上檢查若有任何問題，請與客服聯繫。

二、安裝

2.1 一般標準馬達通用環境場所大致如下：

- (1) 環溫：-20~+40°C。
- (2) 濕度：相對溼度 95% 以下。
- (3) 海拔高度：1000 公尺以下。
- (4) 工業區、屋內用、無有害氣體、無液體汙染、灰塵異物少、無浸水之疑慮的環境。
- (5) 基礎足夠之剛性，無共振、衝擊之疑慮的環境。
- (6) 裝置於通風不良之屋內時，由於馬達或機械發生之熱量造成周圍溫度超過規定，須考慮良好之通風對策。
- (7) 若塵埃多時須考量以下問題之發生的可能：

開放型馬達 (IP23)：線圈及鐵心如大量附著塵埃時，將導致線圈過熱，同時由於塵埃之吸濕性，導致絕緣降低；若轉子之塵埃附著不均勻時，也可能導致動平衡失效，而加大振動。若侵入軸承內部，會導致軸承加速損壞。

全密型馬達 (IP54)：堆積於外框之散熱鰭片時，會導致散熱效果降低。

如裝設於塵埃多之場所，務必顧慮以上情況而定期清潔。

- 2.2 安裝馬達時，請確認各安裝孔均以鋼質螺栓、螺帽穩固地鎖定並清除鎖附時產生之鐵屑，易產生鏽蝕的場所，宜採不鏽鋼螺栓，高振動的場合宜加裝防震華司。
- 2.3 直接耦合設備時，確保馬達和負載軸準確地對心，及使用可撓性聯軸器；固定螺栓須正確的鎖緊，以防止運轉後鬆脫變動，全部鎖定後，需再確認對心正確無誤，方可運轉。
- 2.4 側向耦合負載（如皮帶輪或齒輪驅動）請確保軸端的側向拉力，不致使馬達受損，若有疑問請洽客服人員。
- 2.5 所有的安裝動作，勿使用鐵鎚重力敲打，以避免引起軸承或編碼器損壞。

三、連結方式

- 3.1 馬達底座或法蘭面須以適當螺栓確實鎖緊密；使用聯軸器聯結出力軸時，須確實固定，並確認平行度、偏差在標準以內，其規範請參閱設計便覽。
- 3.2 滑輪、鏈輪或齒輪等在裝配時，應盡量靠近軸承以減少彎曲應力，與出力軸連接之鏈輪，皮帶輪等建議配合 H7 公差使用，可避免發出異聲與軸面受損。
- 3.3 聯軸器直結式傳動如兩軸同心度精度不良時，容易造成軸與軸承損壞，發生嚴重不良後果，安裝時必須確實確認兩軸的同心度符合需求。
- 3.4 將聯軸器安裝到馬達心軸上，必須遵照聯軸器製造商規定之安裝程序作業，安裝時軸端不得施予過冷或過熱的溫度。

四、運轉前注意

- 4.1 電線連結：所有控制及接地用之電源結線時須嚴格遵守國家電氣標準，及當地區域性規定，其結線請參照附於馬達上之結線銘牌。
- 4.2 請依照馬達銘牌電壓與驅動器規格來確認供電電源之正確適用。
- 4.3 當馬達安裝一切就緒後，需檢查線路。
 - a. 確認各線路接線正確無誤。
 - b. 使用電線之線徑是否正確，接頭有無鬆弛不良。
 - c. 除接線座外，其餘的接點應用絕緣膠帶加以包紮絕緣。
 - d. 開關器、保險絲或電磁接觸器容量是否正確，接觸器有無沾汙。
 - e. 接線箱及框架必須實施保護接地。
 - f. 啟動方式是否正確。
 - g. 開關器及啟動器是否設定於啟動位置。
 - h. 電熱器在開機運轉中請勿送電，待停機再使用。
- 4.4 運轉中不應有跳動、振動、摩擦、異音等異常現象。

五、注意事項

一、防止觸電

1. 請勿用濕手操作開關。否則可能會造成觸電。
2. 因為有觸電的可能，應在關閉電源 10 分鐘以上，充電指示燈熄滅後，待電壓測試確認後，才可作配線作業或檢查，否則可能造成觸電。
3. 伺服驅動器以及伺服馬達請務必切實做好接地。
4. 伺服驅動器以及伺服馬達請在安裝後再行配接線。否則會造成觸電。
5. 請勿損傷電纜，施加過大壓力，放置重物或擠壓。可能會造成觸電。
6. 通電時以及設備運行中請勿打開伺服驅動器的正面蓋板。否則會造成觸電。
7. 在拆下伺服驅動器正面蓋板後請勿運行設備。否則可能會因高壓端子和充電部位外露，造成觸電。
8. 除進行接線作業和定期檢查外，即使電源關閉，也請勿打開伺服驅動器的正面蓋板。伺服驅動器內部已充電，可能造成觸電。
9. 為防止觸電，請務必將伺服驅動器的保護接地 (PE) 端子 (帶標記的端子) 連接到保護櫃的保護接地 (PE) 上。
10. 為避免觸電，請在電源端子的連接部進行絕緣處理。

二、防止火災

1. 請將伺服驅動器、伺服馬達、回升電阻安裝在不可燃物上。直接安裝在可燃物上或者安裝在靠近可燃物的地方可能會造成火災。
2. 伺服驅動器故障時，要將伺服驅動器側之電源切斷，以免大電流繼續流入造成火災。
3. 使用回升電阻時，請用回升異常信號切斷電源。回升晶體管發生故障，可能會使回升電阻器異常過熱而造成火災。
4. 在伺服驅動器以及伺服馬達內部，請勿混入油、脂等可燃性異物和螺絲、金屬片等導電性異物。
5. 請務必在伺服驅動器的電源上連接無熔絲斷路器。

三、防止傷害

1. 請勿向各端子施加說明書規格規定電壓以外的電壓。否則可能會造成破裂、損壞。
2. 請勿弄錯端子連接，否則可能會造成破裂、損壞。
3. 請勿弄錯正負極性 (+·-)，否則可能會造成破裂、損壞。
4. 通電時和電源切斷後的一段時間內，伺服驅動器的散熱片、再生電阻、伺服馬達等可能出現高溫，請勿觸摸。否則可能造成燙傷。

四、接線

1. 請正確仔細地進行接線。否則可能會造成伺服馬達不正常運行。
2. 請正確連接伺服驅動器及伺服馬達（端子 U、V、W）。連接錯誤會造成伺服馬達動作異常。
3. 請將伺服驅動器的電源輸出 (U.V.W) 和伺服馬達的電源輸入 (U.V.W) 進行直接接線。兩者間請勿通過電磁接觸器連接。否則可能造成異常運行和故障。
4. 請務必以規定扭力進行緊固連接端子台的電纜，否則也可能由於接觸不良而導致電纜和端子台發熱。

五、維護和檢查

1. 進行維護或檢查時請確保電源指示燈關閉。
2. 只有合格的電機專業人員才可以安裝、配線及修理保養伺服驅動器以及伺服馬達。
3. 不得拆開伺服馬達，否則可能會造成觸電或人員受傷。
4. 當驅動器送電時，請勿連接或斷開驅動器和馬達 UVW 線。
5. 馬達內置電磁煞車作用是保持制動，禁止用於一般的制動操作。

A. Appearance Inspection

- 1.1 Check for external damage upon receiving goods. Contact Fukuta if damage is found.
- 1.2 Check the information on the plate to see whether the motor model, specification, rated voltage, frequency, and type are correct.
- 1.3 Take out the motor from box with care to avoid damage.
- 1.4 Remove the protecting paint and tape on shaft before installation.
- 1.5 Check the motor surface for contamination of dirt, oil stain, damage or rust.
- 1.6 Contact Fukuta for any appearance inconformity.

B. Installation

- 2.1 The general environment requirements for standard motors are as below:
 1. Ambient temperature: -20~+40°C
 2. Relative humidity: less than 95%
 3. Altitude: less than 1000m
 4. Install the motor in a clean, dry, hazardous gas and substance free, and pollution free environment.
 5. Install the motor on a firm ground, and in an environment free from resonance or other external impacts.
 6. Ensure the motor is installed and operated in a well-ventilated area.
 7. Beware of the following issues if the motor is installed and operated in dusty environment:
 - Weather Protected Motor:**
Accumulation of dust on stator and winding may cause overheating and decreasing of resistance. And accumulation of dust on rotor may cause unbalance rotation and increase vibration. The bearing may deteriorate rapidly if dust gets inside the bearing.
 - Totally Enclosed Fan Cooled Motor:**
The heat dissipation effectiveness may decrease if dust accumulate on the cooling fin.
- *Clean regularly to avoid the above-mentioned issues.
- 2.2 Ensure the motor is fastened properly when installing; use stainless steel bolts in environment that is subject to rust, and add a shake-proof washer in environment that is subject to obvious vibration.
- 2.3 Ensure the motor shaft and the load shaft of equipment are aligned properly and joined with flexible coupling when direct connection is required. Tighten the bolts properly to avoid loosening of join after starting operation. Check the alignment of shafts again after all bolts are tightened before starting.
- 2.4 Ensure the lateral force of shaft will not damage the motor when laterally coupling load is applied. Contact FUKUTA for any concern.
- 2.5 DO NOT hammer during installation to avoid damage to bearing or encoder.

C. Connection Method

- 3.1 Tighten retaining bracket or flange properly with correct bolts. Ensure proper fixing, and parallelism and deviation are within standard when the output shaft is connected with coupling (please refer to the design specifications).
- 3.2 Install the pulley, sprocket, and gear as close to the bearing as possible to reduce bending stress. Use H7 tolerance for sprocket and pulley that connect to the output shaft, to avoid noise and damage to the shaft surface.
- 3.3 Ensure the concentricity of the shafts when using coupling for direct connection, to avoid the damage of shaft and bearing.
- 3.4 Install the coupling on motor shaft in accordance with the coupling's instruction of installation. DO NOT apply any temperature at the shaft end while installing.

D. Operation

- 4.1 Wiring: Ensure all wire and cable connection used for control and grounding follow the NEC standard and local regulation. Please refer to the nameplate attached on the motor for connection.
- 4.2 Ensure the voltage and frequency of power supply are appropriate for intended application by checking the specification on the motor's nameplate. Unless the specific motor is suitable for voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$; the overall rate of variation: the sum of the absolute values is 10%.
- 4.3 Check the wiring connection after installation of the motor.
 - a. Ensure each of the wiring connection is correct.
 - b. Ensure the diameter of the wire used is correct, and whether the connector is loose.
 - c. Ensure all contacts, except the terminal block, are protected and insulated with insulating tape.
 - d. Ensure the contact capacity of switch, fuse, and magnetic contactor are appropriate; check whether the contactor is clean.
 - e. Ensure the junction box and frame are grounded.
 - f. Ensure the initiating method is correct.
 - g. Ensure the switch and the starter are set in correct position.
 - h. DO NOT supply power to the space heater (if the motor has) during operation.
- 4.4 Ensure no abnormal phenomenon such as jumping, vibrating, rubbing, or noise making is occurred during operation.

Precautions

A. Electric Shock Prevention

1. Turn the switch with dry hand only at all time.
2. Ensure the power is off, the charging indicator is off, and the voltage test is confirmed before performing wiring work or inspection.
3. Ground the servo drive and servo motor properly.
4. Install the servo drive and servo motor before wiring.
5. Ensure the cable is not damaged, pressurized excessively, loaded with heavy object or squeezed.
6. DO NOT open the front cover of the servo drive while the power is on or the equipment is running.
7. Ensure the power remains off after removing the front cover of the servo drive.
8. Keep the front cover of the servo drive closed at all time (except for wiring and maintenance work), even the power is turned off; because, the servo drive has been charged internally.
9. Ensure the protective earth (PE) terminal of the servo drive is connected to the protective earth (PE) of the cabinet.
10. Insulate the connecting joint of the power terminal.

B. Fire Prevention

1. Ensure the servo drive, servo motor, and regenerative resistor are installed on non-combustible materials; no combustible material should be around.
2. Cut off the power supply of servo drive when it breaks down, to avoid high current flows in continuously and cause fire.
3. Use the abnormal signal to cut off the power when using regenerative resistor. Failure of the regenerative receiver transistor may cause unusual overheating to the regenerative resistor and lead to fire.
4. DO NOT let flammable substances (eg. oil, grease) and foreign conductive objects (eg. screw, metal chip) get inside the servo drive and servo motor.
5. Ensure the power supply of the servo drive is connected to a no fuse breaker.

C. Injury Prevention

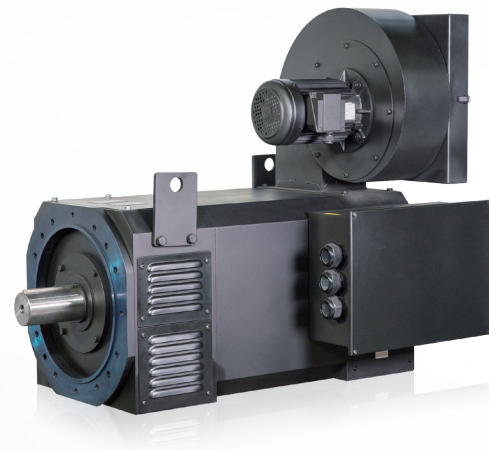
1. DO NOT apply voltage that is not specified in the instruction manual to terminals to avoid crack and damage.
2. Ensure terminals are connected correctly, to avoid crack and damage.
3. DO NOT confuse the positive and negative polarity (+.-), to avoid crack and damage.
4. DO NOT touch the cooling fin, regenerative resistor, and servo motor while the power is on, and right after the power is cut off. The heat may cause scald.

D. Connection

1. Connect the servo motor correctly and carefully, to avoid abnormal operation.
2. Connect the servo drive and servo motor correctly (terminals U, V, W), to avoid abnormal operation.
3. DO NOT the servo drive and servo motor through electromagnetic contactor, to avoid abnormal operation and malfunction.
4. Tighten the cable that connects to the terminal block with the specified torque, to avoid heat rise in cable and terminal caused by poor contact.

E. Maintenance and Inspection

1. Ensure the power indicator is off before performing maintenance or inspection.
2. Ensure all installation, wiring, repair and maintenance work are performed by qualified personnel.
3. DO NOT disassemble the servo motor, to avoid electric shock or injury.
4. DO NOT connect or disconnect the UVW wires while the servo drive power is on.
5. DO NOT use the built-in magnetic brake of motor for general brake operation. It should keep braking at all time.



Servo Motor Maintenance Manual

伺服馬達系列保養手冊

日常檢查和保養主要是操作人員透過視覺、聽覺、嗅覺，再加上電錶、溫度計等簡易儀器對馬達做檢查，從啟動與運轉的過程中可以判斷出馬達的運轉狀況是否正常以及其他消耗性零件的磨耗程度，才可以確保馬達的壽命，避免故障的發生。

※ 注意：保養前須確保斷電，並且接地線接續妥當，方可開始作業。

一、外部保養

1. 馬達入風口處不得聚集灰塵，線頭等雜物，以免阻礙通路，使得空氣無法自由流通。
2. 避免灰塵堆積在扇葉，造成不平衡及振動。扇葉必須定期清除灰塵。
3. 馬達殼外觀不應有鏽蝕、髒污或脫漆，若發現以上問題，必須檢查造成原因，並且立即處理；若鏽蝕或脫漆，需除鏽後重新噴塗防鏽漆；如髒汙附著，應盡快清潔乾淨，避免時間久了，髒汙腐蝕面漆。
4. 需定期檢查螺絲是否鎖固於裝設面，並確認鎖固螺絲是否變形或生鏽，若有以上情況需進行更換，更換或鎖固螺絲需依照螺絲尺寸的建議鎖至固定扭力值。
5. 確認聯軸器或心軸是否接合正確，沒有脫離的疑慮。

二、軸承保養

1. 軸承的清潔度對軸承的壽命影響相當大，軸承的清潔度越高壽命越長，因此，軸承周圍應盡量保持清潔。
2. 超過三個月不運轉之設備，容易造成軸承生鏽，因此若長期不運轉，或停車周期過長之馬達，應定期旋轉馬達軸，讓潤滑脂充分潤滑，避免生鏽。
3. 軸承清潔時，應避免使用酸性或鹼性溶劑清潔，而導致軸承腐蝕。

三、長期存放或長停機再運轉

1. 馬達安裝後或使用一段時間後（視環境差異做周期調整），擬長期停車（超過一周），建議每三個月須運轉一次，避免軸承失油生鏽。
2. 長期存放之位置建議馬達若長時間儲存，或存於潮濕環境中，送電前須確認絕緣阻值大於 100MΩ。若低於 100MΩ 則需烘烤除濕到阻值大於 100MΩ 後再使用。

四、受潮與烘烤

若馬達已受潮需進行除濕的動作，可參考以下兩種方式除濕：

1. 置於溫度不超過 90°C 的烘乾爐中，並確保爐內、外通風良好。
2. 堵住轉子不動，低壓電接至馬達繞組，逐漸提高電壓致電流約 1/3 銘牌額定，必要時，請調整電壓確保繞組溫度不超過 90°C，當絕緣阻抗阻值停止不動並大於 100MΩ，即烘乾完成。

五、故障原因與排除

伺服馬達需搭配驅動器或變頻器使用，需以驅動器或變頻器上的故障代碼判斷故障原因與排除方法，可參閱搭配使用之驅動器或變頻器手冊。

Maintenance Manual

Daily check and maintenance shall be done by operator through sight, hearing, smell, and simple instruments like multimeter, thermometer and etc. By observing and checking the process of starting and operation of the motor, it is easy to determine whether the motor is operating normally, and whether the consumable parts should be replaced. These actions can prevent the occurrence of malfunction and prolong the service life of motor.

*Notice : Make sure the grounding wire is connected properly. Cut off the power supply before performing maintenance work.

A. Appearance Maintenance

1. Keep the air intake clean at all time. Make sure no accumulation of dust, wire lead and/or other debris obstruct the air intake.
2. Clean the fan blade regularly to prevent abnormal vibration that caused by accumulation of dust.
3. Clean and paint the motor housing when corrosion, stain or peeling paint are found. Find out the cause of these phenomena and deal with them immediately, to prevent recurrence.
4. Check the tightness of screws on surface regularly. Replace deformed or corroded screw when found.
5. Make sure the coupling and/or the motor shaft are properly connected.

B. Bearing Maintenance

1. Keep the bearing and its surrounding clean at all time.
2. Lubricate the motor shaft and run the motor regularly, at least once in 3 months, to prevent corrosion.
3. Use neutral solvent cleaner to clean the bearing only. Do not use acid or alkaline solvent cleaner.

C. Operation after long storage/downtime

1. Run the motor once in 3 months during long storage or downtime to prevent the bearing from rusting.
2. Make sure the insulation resistance value is over 100MΩ before supplying power to it. Bake or dehumidify the motor if the insulation resistance value is less than 100MΩ.

D. Dehumidification

The insulation resistance value should be over 100MΩ before connecting to power. In case the motor is damp, here are two methods for dehumidification:

1. Heat the motor in drying oven with temperature below 90°C . Make sure the oven has proper ventilation.
2. Block the rotor from rotating and connect low voltage power to the winding. Increase the voltage gradually to 1/3 of the rated voltage shown on nameplate. Adjust the voltage whenever necessary to ensure the winding temperature does not exceed 90°C .

E. Failure Factor and Troubleshooting

The servo motor needs to be connected with a driver or inverter. When issues happen, the fault code on the driver or inverter will indicate the cause of the fault and the troubleshooting method. Detail for troubleshooting can be found in the driver or inverter manual.

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