1 Safety instructions

1.1 General safety instructions

**WARNING**
Danger to life due to live parts and other energy sources
Death or serious injury can result when live parts are touched.
- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules. Generally, six steps apply when establishing safety:
  1. Prepare for shutdown and notify all those who will be affected by the procedure.
  2. Disconnect the machine from the supply.
     - Switch off the machine.
     - Wait until the discharge time specified on the warning labels has elapsed.
     - Check that it really is in a no-voltage condition, from phase conductor to phase conductor and phase conductor to protective conductor.
     - Check whether the existing auxiliary supply circuits are de-energized.
     - Ensure that the motors cannot move.
  3. Identify all other hazardous energy sources, e.g. compressed air, hydraulic systems, water.
  4. Isolate or neutralize all hazardous energy sources by closing switches, grounding or short-circuiting or closing valves, for example.
  5. Secure the energy sources against switching on again.
  6. Ensure that the machine is completely interlocked.
After you have completed the work, restore the operational readiness in the inverse sequence.

**WARNING**
Danger to life through a hazardous voltage when connecting an unsuitable power supply
Touching live components can result in death or severe injury.
- Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.

**WARNING**
Danger to life when live parts are touched on damaged motors/devices
Improper handling of motors/devices can damage them. For damaged motors/devices, hazardous voltages can be present at the enclosure or at exposed components.
- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged motors/devices.

**WARNING**
Danger to life through electric shock due to unconnected cable shields
Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.
- As a minimum, connect cable shields and the cores of cables that are not used at one end at the grounded housing potential.

**WARNING**
Danger to life due to electric shock when not grounded
For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.
- Ground the device in compliance with the applicable regulations.

**WARNING**
Danger to life due to electric shock when opening plug connections in operation
When opening plug connections in operation, arcs can result in severe injury or death.
- Only open plug connections when the equipment is in a no-voltage state, unless it has been explicitly stated that they can be opened in operation.

**WARNING**
Danger to life through electric shock due to the residual charge of the power component capacitors
Because of the capacitors, a hazardous voltage is present for up to 5 minutes after the power supply has been switched off. Contact with live parts can result in death or serious injury.
- Wait for 5 minutes before you check that the unit really is in a no-voltage condition and start work.

**NOTICE**
Material damage due to loose power connections
Insufficient tightening torques or vibrations can result in loose electrical connections. This can result in damage due to fire, device defects or malfunctions.
- Tighten all power connections with the specified tightening torques, e.g. line supply connection, motor connection, DC link connections.
- Check all power connections at regular intervals. This applies in particular after transport.

**WARNING**
Danger to life due to fire spreading if housing is inadequate
Fire and smoke development can cause severe personal injury or material damage.
- Install devices without a protective housing in a metal control cabinet (or protect the device by another equivalent measure) in such a way that contact with fire is prevented.
- Ensure that smoke can only escape via controlled and monitored paths.

**WARNING**
Danger to life from electromagnetic fields
Electromagnetic fields (EMF) are generated by the operation of electrical power equipment, such as transformers, converters, or motors. People with pacemakers or implants are at particular risk in the immediate vicinity of this equipment.
- If you have a heart pacemaker or implant, maintain a minimum distance of 2 m from electrical power equipment.

**WARNING**
Danger to life from permanent-magnet fields
Even when switched off, electric motors with permanent magnets represent a potential risk for persons with heart pacemakers or implants if they are close to converters/motors.
- If you have a heart pacemaker or implant, maintain a minimum distance of 2 m.
- When transporting or storing permanent-magnet motors always use the original packing materials with the warning labels attached.
- Clearly mark the storage locations with the appropriate warning labels.
- IATA regulations must be observed when transported by air.
### Important safety notices for Safety Integrated functions

If you want to use Safety Integrated functions, you must observe the safety notices in the Safety Integrated manuals.

### Danger to life through unexpected movement of machines when using mobile wireless devices or mobile phones

Using mobile wireless devices or mobile phones with a transmitter power > 1 W closer than approx. 2 m to the components may cause the devices to malfunction, influence the functional safety of machines therefore putting people at risk or causing material damage.
- Switch the wireless devices or mobile phones off in the immediate vicinity of the components.

### Danger to life due to the motor catching fire in the event of insulation overload

There is higher stress on the motor insulation through a ground fault in an IT system. If the insulation fails, it is possible that death or severe injury can occur as a result of smoke and fire.
- Use a monitoring device that signals an insulation fault.
- Correct the fault as quickly as possible so the motor insulation is not overloaded.

### Danger to life due to fire if overheating occurs because of insufficient ventilation clearances

Inadequate ventilation clearances can cause overheating of components with subsequent fire and smoke. This can cause severe injury or even death. This can also result in increased downtime and reduced service lives for devices/systems.
- Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.

### Danger of an accident occurring due to missing or illegible warning labels

Missing or illegible warning labels can result in accidents involving death or serious injury.
- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, in the national language if necessary.
- Replace illegible warning labels.

### Device damage caused by incorrect voltage/insulation tests

Incorrect voltage/insulation tests can damage the device.
- Before carrying out a voltage/insulation check of the system/machine, disconnect the devices as all converters and motors have been subject to a high voltage test by the manufacturer, and therefore it is not necessary to perform an additional test within the system/machine.

### Danger to life when safety functions are inactive

Safety functions that are inactive or that have not been adjusted accordingly can cause operational faults on machines that could lead to serious injury or death.
- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

### Risk of injury due to touching hot surfaces

In operation, the motor can reach high temperatures, which can cause burns if touched.
- Mount the motor so that it is not accessible in operation.
- Measures when maintenance is required:
  - Safeguard all moving parts using the appropriate safety guards.
  - Do not touch any moving parts.
  - Operate the motor according to the relevant specifications.
  - Only operate the motors in conjunction with effective temperature monitoring.
  - Immediately switch off the motor if excessively high temperatures occur.

### 1.2 Handling electrostatic sensitive devices (ESD)

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.

### Damage through electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components.
1.3 Residual risks of power drive systems

Residual risks of power drive systems

When assessing the machine- or system-related risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer or system installer must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example, - Hardware and/or software errors in the sensors, control system, actuators, and cables and connections - Response times of the control system and of the drive - Operation and/or environmental conditions outside the specification - Condensation/conductive contamination - Parameterization, programming, cabling, and installation errors - Use of wireless devices/mobile phones in the immediate vicinity of electronic components - External influences/damage

2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:

- Component failure - Software errors - Operation and/or environmental conditions outside the specification - External influences/damage

3. Hazardous shock voltages caused by, for example, - Component failure - Influence during electrostatic charging - Induction of voltages in moving motors - Operation and/or environmental conditions outside the specification - Condensation/conductive contamination - External influences/damage

4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close

5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly

6. Influence of network-connected communication systems, e.g., ripple-control transmitters or data communication via the network

For more information about the residual risks of the drive system components, see the relevant sections in the technical user documentation.

NOTE

Protect the device, e.g., by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or NEMA 12. Further measures may be necessary for particularly critical operating conditions.

If condensation or conductive pollution can be excluded at the installation site, a lower degree of control cabinet protection may be permitted.

1.4 Warning labels

Warning labels on servo motors

- Do not exert any shock at the shaft end; otherwise, the encoder may be damaged.
- The surface temperature of the motor may exceed 80°C. Do not touch the hot surfaces.

Warning labels in this document

- Indicating death, severe personal injuries or material damages may result if proper precautions are not taken.
- Indicates that the actions that must not be performed.

2 Installation environment

<table>
<thead>
<tr>
<th>Ambient temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation: 0°C to 40°C</td>
</tr>
<tr>
<td>Note: When the surrounding temperature is between 30 °C and 40 °C, the 1FL605JA motors and 1FL609JA motors with brake will have a power derating of 10%.</td>
</tr>
<tr>
<td>Storage: -20°C to 65°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation: ≤ 90% RH (non-condensing at 30°C)</td>
</tr>
<tr>
<td>Storage: ≤ 90% RH (non-condensing at 30°C)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 1000 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vibration resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 49 m/s²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shock resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous axial shock: ≤ 25 m/s²</td>
</tr>
<tr>
<td>Continuous radial shock: ≤ 50 m/s²</td>
</tr>
<tr>
<td>Short-term (6 ms) shock: ≤ 250 m/s²</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Magnetic field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keep the servo motor with an absolute encoder at least 15 mm away from the devices that produce a magnetic field stronger than 10 mT.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protection class</th>
</tr>
</thead>
<tbody>
<tr>
<td>A motor with fitted connectors has a protection class of IP65 (dust-tight and water jetting proof). The shaft opening (2) is protected with an oil seal.</td>
</tr>
<tr>
<td>To guarantee adequate protection, use specified connectors (1) when wiring.</td>
</tr>
</tbody>
</table>
3 Mechanical installation

### Lifting a motor (for high inertia motor only)

**WARNING**

**Death or injuries by unresolved burdens**

At the transport the motor can cause death or injuries by unchecked movements.
- Use lifting equipment and load suspension devices which are only interpreted for the burden of the motor and intact.
- Do not stay under and in the jib range of unresolved burdens.
- Safeguard the motor against rolling away at the side when removing.
- Do not lift a motor by pulling the cables.

**NOTE**

Do not overtighten the eyebolts of 1FL609 motors.

- For 1FL609 motors, the eyebolts must be manually screwed in completely.
- Lift 1FL609 motors at the eyebolts.

### Installing a key (optional)

**WARNING**

**Injuries by an ejected key**

When a motor using a key is running, the fitted key on the shaft may be ejected, which can cause personal injuries. The fitted key on the shaft must be firmly secured to prevent them from being flung out.

**NOTE**

For the motor using a key (②), the key is preinstalled on the shaft extension. When reinstalling it, do not strike the key slot (①).

### Mounting a motor

**WARNING**

**Personal injuries and material damages by the drop of a vertical axis**

When a servo motor with a brake is used as a vertical axis, the axis will drop if the positive and negative poles of the 24 V DC power supply for the servo drive are connected inversely. Unexpected drop may cause personal injuries and material damages.

Before commissioning, mechanical end stops should be fixed at the end of the absolute traversing range of the machine axis in prevention of an unexpected drop. In addition, make sure that the 24 V DC power supply is correctly connected.

**NOTE**

To ensure better heat dissipation, do not insert any insulators between the motor flange and the mounting flange.

Mount the motor through a mounting steel flange, as shown in the left figure.

#### Low inertia motor

<table>
<thead>
<tr>
<th>Screw</th>
<th>Flange (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x M4 (1FL602-J)</td>
<td>120x100x40</td>
</tr>
<tr>
<td>4 x M5 (1FL603-J)</td>
<td>120x100x40</td>
</tr>
<tr>
<td>4 x M6 (1FL604-J)</td>
<td>120x100x40</td>
</tr>
<tr>
<td>4 x M8 (1FL605-J)</td>
<td>120x100x40</td>
</tr>
</tbody>
</table>

#### High inertia motor

<table>
<thead>
<tr>
<th>Screw</th>
<th>Flange (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 x M6 (1FL604-J)</td>
<td>270x270x10</td>
</tr>
<tr>
<td>4 x M8 (1FL606-J)</td>
<td>390x390x15</td>
</tr>
<tr>
<td>4 x M12 (1FL609-J)</td>
<td>420x420x20</td>
</tr>
</tbody>
</table>

### Selecting a coupling

Use a flexible coupling with high torsional rigidity specifically designed for servo motors, which allow to transfer the motor torque to the mechanics and to compensate radial, axial and angular misalignments.

### Installing a coupling

**NOTE**

Do not strike the shaft when installing a coupling and ensure that the radial and axial forces are smaller than the allowable maximum values specified in the Operating Instructions.

### Aligning a coupling

**NOTE**

When a motor is used with a flange coupling, ensure that the radial deviation is smaller than 0.03 mm. Otherwise, the bearing will be damaged.

**NOTE**

The required alignment accuracy differs with the motor speed and the coupling type. Please determine the accuracy according to actual applications.

### Coupling realignment

If the coupling gives out abnormal sounds, refer to the step “Aligning a coupling” to realign the coupling until the sounds disappear.

### Tension measurement

**NOTE**

The belt tension must be smaller than the allowable radial forces of the motor.

- Measure the belt tension at multiple points using a tension meter while turning the motor shaft by 45°.
- Try your best to reduce the axial misalignment of the belt-pulleys to keep the axial forces to the motor shaft to a minimum.

### Lubricating the oil seal

**NOTE**

Do not use a motor with an oil seal submerged in oil.

The oil seal (①) should be used with sufficient lubricant oil splashed on it.
4 Electrical installation

**WARNING**

Personal injuries by hazardous voltage and unregulated moves
If you connect the cables with the power supply switched on, it may cause personal injuries by a hazardous voltage and unregulated move from the motor.

- Switch off the power supply.
- Make sure that there are no voltage conditions.
- Prevent the energy sources from switching on again.

### Before connecting

Before connecting the cables, you must take necessary ESD protection measures, e.g. wearing an ESD wrist strap, ESD gloves, and ESD clothes.

### Connecting sequence

**NOTICE**

Do not put much stress upon cables or connectors while wiring.

<table>
<thead>
<tr>
<th>Type</th>
<th>Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power cable</td>
<td>5 x outer diameter</td>
</tr>
<tr>
<td>Encoder cable</td>
<td>5 x outer diameter</td>
</tr>
<tr>
<td>Brake cable</td>
<td>5 x outer diameter</td>
</tr>
</tbody>
</table>

The minimum static bending radii for the cables are listed as follows:

Connect the cables in the following order:
1. Encoder cable (③)
2. Brake cable (②)
3. Power cable (①)

### Connecting the encoder cable

**NOTICE**

Do not touch the encoder pins at the motor with naked hands to avoid being contaminated.

**Low inertia motors**

<table>
<thead>
<tr>
<th>No.</th>
<th>Encoder type</th>
<th>Number of notches</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Incremental</td>
<td>-</td>
</tr>
<tr>
<td>②</td>
<td>Absolute</td>
<td>-</td>
</tr>
<tr>
<td>③</td>
<td>Incremental</td>
<td>Two</td>
</tr>
<tr>
<td>④</td>
<td>Absolute</td>
<td>Three</td>
</tr>
</tbody>
</table>

**High inertia motors**

<table>
<thead>
<tr>
<th>No.</th>
<th>Encoder type</th>
<th>Number of notches</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Incremental</td>
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<td>②</td>
<td>Absolute</td>
<td>Three</td>
</tr>
<tr>
<td>③</td>
<td>Incremental</td>
<td>Three</td>
</tr>
</tbody>
</table>

### Connecting the brake cable

**NOTICE**

Before connecting the brake cable, ensure that the 24 V power supply has a voltage tolerance of ±10%. Otherwise, the brake cannot work normally.

**NOTE**

The motor brake is designed for holding purpose only. Unless absolutely necessary, do not apply the motor brake as an emergency stop or deceleration mechanism.

### Routing cables

Route the power cables and the encoder cables as shown in the figure, especially in a humid environment.

### Adjusting cable directions

**WARNING**

Before adjusting the cables, switch off the power supply. Otherwise, the motor contains a hazardous voltage and a risk of electrical shock.

Low inertia motors of SH50 + high inertia motors with straight connectors:
1. Loosen the connectors by rotating the screw rings (①) in the illustrated direction (②).
2. Adjust the cable directions by rotating the connectors.
3. Tighten the connectors by rotating the screw rings inversely.

High inertia motors with angular connectors:
Adjust the cable directions by rotating the connectors.

5 Technical support

<table>
<thead>
<tr>
<th>Country</th>
<th>Hotline</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>+86 400 810 4288</td>
</tr>
<tr>
<td>Germany</td>
<td>+49 911 895 7222</td>
</tr>
<tr>
<td>Italy</td>
<td>+39 (02) 24362000</td>
</tr>
<tr>
<td>India</td>
<td>+91 22 2760 0150</td>
</tr>
<tr>
<td>Turkey</td>
<td>+90 (216) 4440747</td>
</tr>
</tbody>
</table>

For further service contact information, visit:

The diagrams in this installation guide are illustrated with the high inertia motor. For more information, see the SINAMICS V90, SIMOTICS S-1FL6 Operating Instructions.
1 安全说明

1.1 一般安全说明

危险
触电带电部件和其他能源供给会引发电气伤害事故
触电带电部件会造成人员重伤,甚至死亡。
- 只有专业人员才允许在电气设备上作业。
- 在所有作业中必须遵守本国的安全规定。
通常有六项安全步骤:
1. 做好断电的准备工作,并通知会受断电影响的组员。
2. 断开设备电源。
   - 关闭设备。
   - 请等待至警告牌上说明的放电时间届满。
   - 确认导线与导线之间和导线与接地线之间无电压。
   - 确认辅助电压回路已断电。
   - 确认电机无法运动。
3. 检查其他所有危险的能源供给,例如: 压缩空气、液压、水。
4. 断开所有危险的能源供给,措施比如有: 闭合开关、接地或短接或闭合阀门。
5. 确定能源供给不会自动接通。
6. 确保正确的设备已经完全闭锁。
结束作业后以相反的顺序恢复设备的就绪状态。

警告
连接不适当的电源所产生的危险电压可引发电气伤害事故
接触带电部件可能造成人员重伤或死亡。
- 所有的对带电部件使用时允许使用可以提供 SELV (Safety Extra Low Voltage: 安全低压) 输出电压的电源。

警告
接触损坏的设备或设备上的带电部件可引发电气伤害事故
未按规定操作设备时可能造成人员重伤或死亡。
- 在运输、存放和运行时应遵循技术数据中给出的限值。
- 不要使用已损坏的设备。

注意
电气连接件松动可造成财产损失
紧固扭矩不足或振动可能会导致电气连接件松动,从而导致火灾、设备损坏或功能异常。
- 用规定的紧固扭矩拧紧所有的电气连接件,例如电源接线端子、电机接线端子、直流母线连接端子。
- 请定期检查所有的电气连接件,尤其是正在运输之后。

警告
外壳大小空间不足可引起火灾从而引发电气伤害事故
断开设备电源会导致造成人员伤亡或火灾损失。
- 没有保护外壳的设备应安装在金属机柜中（或采取相同效果的措施进行保护），以避免设备接触明火。
- 确保烟雾只能经所设安全通道排出。

警告
电磁场可引发电气伤害事故
在电气能源技术设备例如变压器、变频器或电机运行时会产
生电磁场（EMF）。
因此可能会对设备附近的人员,特别是对那些带有心脏起搏
器或医疗植入体等器械的人员造成危险。
- 此类人员至少应和电气设备保持 2 m 的间距。

警告
永磁场可引发电气伤害事故
具有永磁场的电机即使在静止状态下也会对变频器/电机附近佩
戴有心脏起搏器或医疗植入体的人员有伤害。
- 此类人员至少应保持 2 m 的间距。
- 运输和储存永磁电机时请使用原包装并设置警示牌。
- 采用相应的警示牌标记储放位置。
- 在用飞机进行运输时请遵守 IATA 规定！

警告
使用移动无线电装置或移动电话时机器的意外运动可引发生
命危险
在距离本组件大约 2 m 的范围内使用发射功率大于 1 W 的
移动无线电装置或移动电话时,会导致设备功能故障,该故
障对设备功能安全产生影响并能导致人员伤亡或财产损
失。
- 关闭设备附近的无线电装置或移动电话。

警告
通风不足会引起过热、引发火灾,从而引发电气伤害事故
通风空间不足会导致过热,产生烟雾,引发火灾,从而造成
人员伤亡。这可能会造成人员重伤或死亡。此外,设备/系
统故障率可能会因此升高,使用寿命缩短。
- 系统之间应保持规定的最小间距,以便通风。
### 警告

**缺少警告牌或警示牌不清晰可导致事故**

缺少警告牌或警示牌不清晰可能会导致严重人身伤害或死亡。

- 根据文档检查警示牌的完整性。
- 为组件安装警示牌，必要时安装本国语言的警示牌。
- 替换掉不清晰的警示牌。

**注意**

不符合规定的电压/绝缘检测可损坏设备

不符合规定的电压/绝缘检测可导致设备损坏。

- 进行机器/设备的电压/绝缘检测前应先断开设备，因为所有的变频器和电机在出厂时都已进行过高压检测，所以无需在机器/设备内再次进行检测。

### 警告

**无效的安全功能可导致生命危险**

无效的或不适合的安全功能可引起机器功能故障，可能导致重伤或死亡。

- 调试前请注意相关产品文档中的信息。
- 对整个系统和所有安全相关的组件进行安全监控，以确保安全功能。
- 进行适当设置，以确保所使用的安全功能是与驱动任务和自动化任务相匹配并激活的。
- 执行功能测试。
- 在确保了机器的安全功能能正常工作后，才开始投入生产。

### 说明

**Safety Integrated 功能的重要安全说明**

使用 Safety Integrated 功能时务必要注意 Safety Integrated 手册中的安全说明。

### 警告

**因参数设置错误或修改参数设置引起机器误操作可引发生命危险**

参数设置错误可导致机器出现误操作，从而导致人员重伤或死亡。

- 防止恶意访问参数设置。
- 采取适当措施（如驻停或急停）应答可能的误操作。

### 警告

**运行部件和弹出部件可导致人员受伤**

电机运行时，接触正在运行的电机部件或驱动元件以及松动电机部件的弹出（例如：棱键）会导致人员重伤或死亡。

- 拆除或拧紧松动部件，防止弹出。
- 严禁接触正在运行的部件。
- 使用接触保护装置确保不会接触正在运行的部件。

### 警告

**通风不足会引起过热、引发火灾，从而导致生命危险**

通风空间不足会导致过热，产生烟雾，引发火灾，从而造成严重人身伤害或死亡。

- 请遵守电机冷却液的相关规定和要求。

### 警告

**不按规定操作会引发过热、引发火灾，从而导致生命危险**

不按规定操作会导致过热，产生烟雾，引发火灾，从而导致严重人身伤害或死亡。

- 根据说明运行电机。
- 仅允许在采取有效的温度监控措施后运行电机。
- 温度过高时立即关闭电机。

### 警告

**接触高温表面会引发受伤危险**

电机在运行时表面温度很高，接触电机壳会导致灼伤。

- 取出运行时接触到电机的安装方式。
- 维护情况下应采取的措施：
  - 待电机冷却后再进行操作。
  - 请穿着和佩戴相应的防护装备（如手套）。

### 注意

**电场或静电放电会损坏设备**

电场或静电放电可能会损坏单个元件、集成电路、模块或设备，从而导致功能故障。

- 仅允许使用原始产品包装或其他合适的包装材料（例如：导电的泡沫橡胶或铝箔）包装、存储、运输和发运元件、模块和设备。
- 只有采取了以下接地措施之一，才允许接触元件、模块和设备：
  - 佩戴防静电腕带
  - 在带有导电地板的防静电区域内穿着防静电鞋或配带防静电接地带
- 电子元件、模块或设备只能放置在导电性的垫板上（带防静电接地带）。

### 1.2 操作静电敏感设备（ESD）

静电敏感元器件（ESD）是可被静电场或静电放电损坏的元件、集成电路、电路板或设备。

- 电场或静电放电可损坏设备
  - 电场或静电放电可能会损坏单个元件、集成电路、模块或设备，从而导致功能故障。
  - 仅允许使用原始产品包装或其他合适的包装材料（例如：导电的泡沫橡胶或铝箔）包装、存储、运输和发运电子元件、模块和设备。
  - 只有采取了以下接地措施之一，才允许接触元件、模块和设备：
    - 佩戴防静电腕带
    - 在带有导电地板的防静电区域内穿着防静电鞋或配带防静电接地带
  - 电子元件、模块或设备只能放置在导电性的垫板上（带防静电接地带）。

### 注意

**电场或静电放电会损坏设备**

电场或静电放电可能会损坏单个元件、集成电路、模块或设备，从而导致功能故障。

- 仅允许使用原始产品包装或其他合适的包装材料（例如：导电的泡沫橡胶或铝箔）包装、存储、运输和发运电子元件、模块和设备。
- 只有采取了以下接地措施之一，才允许接触元件、模块和设备：
  - 佩戴防静电腕带
  - 在带有导电地板的防静电区域内穿着防静电鞋或配带防静电接地带
- 电子元件、模块或设备只能放置在导电性的垫板上（带防静电接地带）。

### 1.3 驱动系统（电气传动系统）的遗留风险

**驱动系统（电气传动系统）的遗留风险**

### 1.3 驱动系统（电气传动系统）的遗留风险

### 1.3 驱动系统（电气传动系统）的遗留风险

1. **调试、运行、维护和维修时机器或设备部件意外运行，原因（举例）：
   - 编码器、控制器、执行器和连接器中出现了硬件故障和/或软件故障
   - 控制器和传动设备的响应时间
   - 运行和/或环境条件不符合规定
   - 凝露/导电杂质
   - 参数设置、编程、布线和安装出错
   - 在电子元件附近使用无线电装置/移动电话
   - 外部影响/损坏
   - X 射线辐射、电磁辐射和宇宙辐射

2. 在出现故障时，组件内/外部出现异常温度、明火以及异常亮光、噪音、杂质、气体等，原因可能有：
   - 零件失灵
   - 软件故障
   - 运行和/或环境条件不符合规定
   - 外部影响/损坏

3. **危险的接触电压，原因（举例）：
   - 零件失灵
   - 静电充电感应
   - 静电场感应
   - 运行和/或环境条件不符合规定
   - 凝露/导电杂质
   - 外部影响/损坏

4. **系统中产生的电场、磁场和电磁场可能会损坏近距离的心脏起搏器支架、医疗植入体或其它金属物。**

5. **当不按规定操作以及/或违规处理废弃组件时，会释放破坏环境的物质并产生辐射。**

6. **影响通讯系统，如中央控制发送器或通过电网进行的数据通讯。**

其它有关驱动系统组件产生的遗留风险的信息见用户技术文档的相关章节。
说明

保护设备，例如：将组件装入符合 EN 60529 IP54 防护等级或符合 NEMA 12 的控制柜中。在特别关键的使用条件下必要时还需采取其他措施。

如果安装地点排除了凝露或导电异物，则使用较低防护等级的控制柜。

1.4 警告标识

伺服电机上的警告标识

严禁敲打轴端，否则会导致编码器损坏。

严禁触摸电机，其表面温度可能超过 80°C。

文档中的警告标识

表示不采取相应的预防措施会导致死亡、严重的人身伤害或设备损坏。

表示禁止执行的操作。

2 安装环境

环境温度

运行温度：0℃ 至 40℃
注意：当环境温度在 30°C 至 40°C 之间时，1FL605oji 电机和1FL609oji 电机的带抱闸系列会有 10% 的功率降额。

储存温度：-20°C 至 65°C

环境湿度

运行湿度：≤ 90% RH（30°C 时无凝露）

储存湿度：≤ 90% RH（30°C 时无凝露）

运行高度

≤ 1000 m

耐振性

≤ 49 m/s²

抗冲击性

• 连续轴向冲击：≤ 25 m/s²

• 连续径向冲击：≤ 50 m/s²

• 短时（6 ms）冲击：250 m/s²

磁场干扰

为防止绝对编码器受到磁干扰，请勿在绝对编码器附近使用电磁设备，如记事棒、存储卡和钥匙卡。

请勿在带绝对值编码器的伺服电机附近 15 mm 范围内放置会产生强磁场（高于 10 mT）的设备。

3 机械安装

吊装电机（仅用于高惯量电机）

警告

不稳定重物导致死亡或人身伤害

运输电机不定移动可能导致死亡或人身伤害。

• 请使用针对电机及其负载的专用吊装设备。

• 切勿站在负载吊臂下方或其移动范围内。

• 移动时必须固定电机，防止侧翻掉落。

• 切勿通过提拉电缆来吊装电机。

注意

旋拧 1FL609oji 电机吊环时不可过紧。

• 对于 1FL609oji 电机，吊装前必须手动完全拧紧吊环。

• 必须通过吊环进行 1FL609oji 电机的吊装。

安装轴键（可选）

警告

甩飞轴键导致人身伤害

当带键电机运行时，安装于轴端的轴键可能会甩出，从而导致人身伤害。

轴端的轴键必须安装紧固，以防甩出。

注意

对于带键电机，轴键（②）已预装在轴上。重新安装时，请勿敲打键槽（①）。

安装电机

警告

垂直轴掉落导致人身伤害和设备损坏

当带抱闸的伺服电机用作垂直轴时，如果伺服驱动的 24 V 直流电源正负极接反，该垂直轴则会掉落。垂直轴的意外掉落可能会导致人身伤害和设备损坏。

调试前，应在该轴的最大行程处安装机械挡板，以防意外掉落。另外还必须确保 24 V 直流电源连接正确。

说明

为保证良好的散热效果，请勿在电机法兰和安装法兰之间插入任何绝热体。

将电机安装到钢制安装法兰上。法兰和螺钉的信息如下。

低惯量电机

<table>
<thead>
<tr>
<th>螺钉</th>
<th>法兰（mm）</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x M4（1FL602oji）</td>
<td>120x100x40</td>
</tr>
<tr>
<td>4 x M5（1FL603oji）</td>
<td>120x100x40</td>
</tr>
<tr>
<td>4 x M6（1FL604oji）</td>
<td>120x100x40</td>
</tr>
<tr>
<td>4 x M8（1FL605oji）</td>
<td>120x100x40</td>
</tr>
</tbody>
</table>
选择联轴器

请根据伺服电机的转速和联轴器类型选择具有高扭转刚度和挠性联轴器，并确保联轴器可将电机扭矩传递给机构。

安装联轴器

注意

安装联轴器时请勿敲打轴，且需确保轴向和径向负载小于操作说明手册中规定的最大值。

联轴器定芯

注意

当电机使用凸缘联轴器时，请确保径向偏差小于0.03 mm，否则会损坏电机轴承。

定芯的精度要求因电机转速和联轴器类型而异，请根据实际的应用来确定精度要求。

• 通过旋转两侧轴来定芯。
• 建议通过测试来校正定芯精度。如果条件不具备，通过观察联轴器是否在两侧轴上自由滑动来判断定芯精度。

定芯调整

联轴器发出异常声响时，请参见“联轴器定芯”来重新调整定芯直至异响消失。

拉力测量

注意

传动带的拉力必须小于电机允许的最大径向力。

• 以45°角旋转电机轴，然后通过拉力计测量传动带各点的拉力。
• 尽量降低皮带轮的轴向偏差，使电机轴所受的轴向力降到最低。

油封润滑

注意

电机运行时请勿将油封浸到油面以下。

油封(1)应在有足够润滑油的情况下使用，但不可浸到油面以下。

4 电气安装

警告

危险电压和电机意外运动导致人身伤害

电机上电时连接电缆，存在危险电压和电机意外运动风险，会导致人身伤害。

• 切断电源。
• 确保无电压存在。
• 防止电源再次打开。

接线前准备

注意

连接电缆前请采取必要的静电防护措施，如穿上防静电服和穿着防静电鞋。

接线顺序

注意

接线时请勿对电缆或连接器过度用力。

电缆的最小静态折弯半径如表所示:

<table>
<thead>
<tr>
<th>电缆类型</th>
<th>半径</th>
</tr>
</thead>
<tbody>
<tr>
<td>动力电缆</td>
<td>5 x 电缆外径</td>
</tr>
<tr>
<td>编码器电缆</td>
<td>5 x 电缆外径</td>
</tr>
<tr>
<td>抱闸电缆</td>
<td>5 x 电缆外径</td>
</tr>
</tbody>
</table>

电缆的最小静态折弯半径均为155 mm。

请按以下顺序连接电缆:

• 编码器电缆（③）
• 连接抱闸电缆（②）
• 动力电缆（①）

连接编码器电缆

注意

切勿触摸电机的编码器针脚，以防受到污染。

低惯量电机：

<table>
<thead>
<tr>
<th>编号</th>
<th>编码器类型</th>
<th>凸槽数目</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>增量</td>
<td>-</td>
</tr>
<tr>
<td>②</td>
<td>绝对值</td>
<td>-</td>
</tr>
<tr>
<td>③</td>
<td>增量</td>
<td>两个</td>
</tr>
<tr>
<td>④</td>
<td>绝对值</td>
<td>三个</td>
</tr>
</tbody>
</table>

高惯量电机：

<table>
<thead>
<tr>
<th>编号</th>
<th>编码器类型</th>
<th>凸槽数目</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>增量</td>
<td>两个</td>
</tr>
<tr>
<td>②</td>
<td>绝对值</td>
<td>三个</td>
</tr>
<tr>
<td>③</td>
<td>增量</td>
<td>三个</td>
</tr>
</tbody>
</table>

连接抱闸电缆

注意

连接抱闸电缆前，请确保24 V电源的电压范围为±10%。否则抱闸不能正常工作。
说明

制动器仅设计用于电机的停机抱闸。如非绝对必要，请勿将制动器用作急停或减速装置。

- 运行伺服电机前请确认抱闸的实际打开时间和关闭时间。
- 抱闸上电后，电机即使处于伺服关闭的状态也会发热。注意这并非故障。

走线

请按左图所示的正确方向连接电源电缆和编码器电缆，特别是在潮湿环境中。

调整电缆方向

警告

调整接线或电缆方向前请先关闭电源，否则电机会存在危险电压和触电风险。

轴高 50 的低惯量电机 + 带直型连接器的高惯量电机：
1. 按图示方向（②）旋转螺环（①）以松开连接器。
2. 通过转动连接器来调整确定电缆方向。
3. 反方向旋转螺环以固定连接器。

带直角连接器的高惯量电机：
通过转动连接器来调整确定电缆方向。

5 技术支持

<table>
<thead>
<tr>
<th>国家</th>
<th>热线</th>
</tr>
</thead>
<tbody>
<tr>
<td>中国</td>
<td>+86 400 810 4288</td>
</tr>
<tr>
<td>德国</td>
<td>+49 911 895 7222</td>
</tr>
<tr>
<td>意大利</td>
<td>+39 (02) 24362000</td>
</tr>
<tr>
<td>印度</td>
<td>+91 22 2760 0150</td>
</tr>
<tr>
<td>土耳其</td>
<td>+91 (216) 4440747</td>
</tr>
</tbody>
</table>

更多服务联络信息，请访问：
https://support.industry.siemens.com/cs/ww/en/。

本安装指南中的图示以高惯量电机为例。更多产品信息，请参见 SINAMICS V90，SIMOTICS S-1FL6 操作说明。