SINAMICS

SINAMICS G130
Cabinet design and EMC

Operating Instructions

Safety information

General

Basic information about EMC

EMC-compliant design and control cabinet configuration

Cabinet air conditioning

Firmware version V5.1
Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠️ DANGER

indicates that death or severe personal injury will result if proper precautions are not taken.

⚠️ WARNING

indicates that death or severe personal injury may result if proper precautions are not taken.

⚠️ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

⚠️ NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠️ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.
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</table>
1.1 General safety instructions

**WARNING**

**Electric shock and danger to life due to other energy sources**

Touching live components can result in death or serious injury.

- Only work on electrical equipment if you are appropriately qualified.
- Always observe the country-specific safety rules for all work.

Generally, the following steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check that every auxiliary circuit is de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness by following the above steps in the reverse order.

**WARNING**

**Electric shock due to connection to an unsuitable power supply**

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage that might result in serious injury or death.

- 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.
Safety information
1.1 General safety instructions

**WARNING**

**Electric shock due to equipment damage**

Improper handling may cause damage to equipment. For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged devices.

**WARNING**

**Electric shock due to unconnected cable shield**

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- Connect cable shields and unused conductors of power cables (e.g. brake conductors) at least on one side to the grounded housing potential.

**WARNING**

**Electric shock if there is no ground connection**

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**

**Arcing when a plug connection is opened during operation**

Opening a plug connection when a system is in operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

**NOTICE**

**Property damage due to loose power connections**

Insufficient tightening torques or vibration can result in loose power connections. This can result in damage due to fire, device defects or malfunctions.

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.
### Safety information

#### 1.1 General safety instructions

**WARNING**

**Spread of fire from built-in devices**

In the event of fire outbreak, the enclosures of built-in devices cannot prevent the escape of fire and smoke. This can result in serious personal injury or property damage.

- Install built-in units in a suitable metal cabinet in such a way that personnel are protected against fire and smoke, or take other appropriate measures to protect personnel.
- Ensure that smoke can only escape via controlled and monitored paths.

**WARNING**

**Failure of pacemakers or implant malfunctions due to 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 in the immediate vicinity of this equipment are at particular risk.

- If you have a heart pacemaker or implant, maintain a minimum distance of 2 m from electrical power equipment.

**WARNING**

**Unexpected movement of machines caused by radio devices or mobile phones**

When radio devices or mobile phones with a transmission power > 1 W are used in the immediate vicinity of components, they may cause the equipment to malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- If you come closer than around 2 m to such components, switch off any radio devices or mobile phones.
- Use the "SIEMENS Industry Online Support App" only on equipment that has already been switched off.

**WARNING**

**Motor fire in the event of insulation overload**

There is a greater load on the motor insulation as result of 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.
### 1.1 General safety instructions

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fire due to inadequate ventilation clearances</strong></td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>• Ensure compliance with the specified minimum clearance as ventilation clearance for the respective component.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unrecognized dangers due to missing or illegible warning labels</strong></td>
</tr>
<tr>
<td>Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.</td>
</tr>
<tr>
<td>• Check that the warning labels are complete based on the documentation.</td>
</tr>
<tr>
<td>• Attach any missing warning labels to the components, where necessary in the national language.</td>
</tr>
<tr>
<td>• Replace illegible warning labels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device damage caused by incorrect voltage/insulation tests</strong></td>
</tr>
<tr>
<td>Incorrect voltage/insulation tests can damage the device.</td>
</tr>
<tr>
<td>• 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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unexpected movement of machines caused by inactive safety functions</strong></td>
</tr>
<tr>
<td>Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.</td>
</tr>
<tr>
<td>• Observe the information in the appropriate product documentation before commissioning.</td>
</tr>
<tr>
<td>• Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.</td>
</tr>
<tr>
<td>• Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.</td>
</tr>
<tr>
<td>• Perform a function test.</td>
</tr>
<tr>
<td>• Only put your plant into live operation once you have absolutely guaranteed that the functions relevant to safety are operating correctly.</td>
</tr>
</tbody>
</table>
Note

**Important safety instructions for Safety Integrated functions**

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

### NOTICE

**Damage through electric fields or electrostatic discharge**

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g. conductive foam rubber or aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
  - Wearing an ESD wrist strap
  - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).

The necessary ESD protective measures are clearly illustrated in the following diagram:

- a = conductive floor surface
- b = ESD table
- c = ESD shoes
- d = ESD overall
- e = ESD wristband
- f = cabinet ground connection
- g = contact with conductive flooring

![Figure 1-1 ESD protective measures](Diagram)
1.3 Industrial security

**Note**

**Industrial Security**

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art Industrial Security concept. Siemens products and solutions only represent one component of such a concept.

The customer is solely responsible for preventing unauthorized access to its plants, systems, machines and networks. Systems, machines and components should only be connected to the company's network or the internet if and to the extent necessary and with appropriate security measures (e.g. use of firewalls and network segmentation) in place.

Additionally, Siemens’ guidance on appropriate security measures should be taken into account. For more information about Industrial Security, please visit: Industrial Security ([http://www.siemens.com/industrialsecurity](http://www.siemens.com/industrialsecurity)).

Siemens’ products and solutions undergo continuous development to make them more secure. Siemens strongly recommends to apply product updates as soon as available and to always use the latest product versions. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer’s exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at: Industrial Security ([http://www.siemens.com/industrialsecurity](http://www.siemens.com/industrialsecurity)).

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**WARNING**

**Unsafe operating states resulting from software manipulation**

Software manipulation (e.g. viruses, trojans, malware or worms) can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by applying suitable protection measures, e.g. virus scanners.

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**Note**

**Industrial security Configuration Manual**

You can find a Configuration Manual on the topic of industrial security at this address ([https://support.industry.siemens.com/cs/ww/en/view/108862708](https://support.industry.siemens.com/cs/ww/en/view/108862708)).
1.4 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 the 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 connection system
   - Response times of the controller and drive
   - Operation and/or environmental conditions outside the specifications
   - Condensation/conductive pollution
   - Parameterization, programming, cabling, and installation errors
   - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
   - External influences/damage
   - X-ray, ionizing radiation and cosmic radiation

2. Unusually high temperatures, including open flames, as well as the emission of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:
   - Component malfunctions
   - Software errors
   - Operation and/or environmental conditions outside the specifications
   - External influences/damage

3. Hazardous shock voltages caused by, for example:
   - Component malfunctions
   - Influence of electrostatic charging
   - Induction of voltages in moving motors
   - Operation and/or environmental conditions outside the specifications
   - Condensation/conductive pollution
   - 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 residual risks of the components in a drive system, see the relevant sections in the technical user documentation.
As a result of the modular concept, each of the individual combinations cannot be described. Instead, fundamentals and generally applicable rules are explained, which when applied, allow special device combinations to be mechanically configured that are electromagnetically compatible.

As a result of their design, the components are intended for installation in housings and cabinets. These housings are generally steel cabinets or control boxes, which guarantee protection against direct contact and other environmental effects. They are part of an overall EMC concept.

2.1 Safety information

<table>
<thead>
<tr>
<th>WARNING</th>
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<tbody>
<tr>
<td>Not observing fundamental safety instructions and residual risks</td>
</tr>
<tr>
<td>The non-observance of the fundamental safety instructions and residual risks stated in Chapter 1 can result in accidents with severe injuries or death.</td>
</tr>
<tr>
<td>• Adhere to the fundamental safety instructions.</td>
</tr>
<tr>
<td>• When assessing the risk, take into account residual risks.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger of injury caused by foreign objects in the device</td>
</tr>
<tr>
<td>Parts (e.g.: drilling chips, end sleeves) falling into the device can cause short-circuits and damage the insulation. This can lead to serious injuries (arcing, bangs, pieces flying out of the equipment).</td>
</tr>
<tr>
<td>• Only perform installation and other work when the devices are current-free.</td>
</tr>
<tr>
<td>• Cover the ventilation slots during the installation of the cabinet and remove the cover before switching on.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limitation of overvoltages</td>
</tr>
<tr>
<td>On systems with a grounded phase conductor and a line voltage &gt;600 VAC, line-side components should be installed to limit overvoltages to overvoltage category II in accordance with IEC 61800-5-1.</td>
</tr>
</tbody>
</table>
Note
Protection against the spread of fire
The converter may be operated only in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used.
Converters of the Open Type/IP20 degree of protection must be installed in a metal control cabinet or protected by another equivalent measure such that fire cannot spread and emissions outside of the control cabinet are prevented.

Note
Protection against condensation and electrically conductive contamination
To ensure the functional safety and safety functions of Safety Integrated, protect the converter, e.g. by installing it in a control cabinet with degree of protection IP54 according to IEC 60529 or Type 12 according to NEMA 250. Further measures may be necessary for particularly critical operating conditions.
If condensation and conductive pollution can be excluded at the installation site, a lower degree of cabinet protection may be permitted.

2.2 Directives
The switchgear cabinet must satisfy the following EC Directives in the European Economic Area (EEA):

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Description</th>
</tr>
</thead>
</table>
2.3 Standards

Note

The standards listed in the table below are non-binding and do not in any way claim to be complete. The standards listed do not represent a guaranteed property of the product. Only the statements made in the Declaration of Conformity shall be deemed binding.

Table 2-2 Fundamental, application-relevant standards in succession: EN, IEC/ISO, DIN, VDE

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<td>EN 1037</td>
<td>Safety of machinery; avoiding unexpected starting</td>
</tr>
<tr>
<td>ISO 14118</td>
<td></td>
</tr>
<tr>
<td>DIN EN 1037</td>
<td></td>
</tr>
<tr>
<td>EN ISO 9001</td>
<td>Quality management systems - requirements</td>
</tr>
<tr>
<td>ISO 9001</td>
<td></td>
</tr>
<tr>
<td>DIN EN ISO 9001</td>
<td></td>
</tr>
<tr>
<td>EN ISO 12100-x</td>
<td>Safety of Machinery; General Design Guidelines;</td>
</tr>
<tr>
<td>ISO 12100-x</td>
<td>Part 1: Basic terminology, methodology</td>
</tr>
<tr>
<td>DIN EN ISO 12100-x</td>
<td>Part 2: Technical Principles and Specifications</td>
</tr>
<tr>
<td>EN ISO 13849-x</td>
<td>Safety of machinery; safety-related parts of control systems;</td>
</tr>
<tr>
<td>ISO 13849-x</td>
<td>Part 1: General basic design principles</td>
</tr>
<tr>
<td>DIN EN ISO 13849-x</td>
<td>Part 2: Validation</td>
</tr>
<tr>
<td>EN ISO 14121-1</td>
<td>Safety of Machinery - Risk Assessment;</td>
</tr>
<tr>
<td>ISO 14121-1</td>
<td>Part 1: Guidelines</td>
</tr>
<tr>
<td>DIN EN ISO 14121-1</td>
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<tr>
<td>EN 55011</td>
<td>Industrial, scientific and medical high-frequency devices (ISM devices) - radio interference - limit values and measuring techniques</td>
</tr>
<tr>
<td>CISPR 11</td>
<td></td>
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<td>DIN EN 55011</td>
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<td>VDE 0875-11</td>
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<tr>
<td>EN 60146-1-1</td>
<td>Semiconductor converters; general requirements and line-commutated converters;</td>
</tr>
<tr>
<td>IEC 60146-1-1</td>
<td>Part 1: Defining the basic requirements</td>
</tr>
<tr>
<td>DIN EN 60146-1-1</td>
<td></td>
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<tr>
<td>VDE 0558-11</td>
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<tr>
<td>EN 60204-1</td>
<td>Electrical equipment of machines;</td>
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<tr>
<td>IEC 60204-1</td>
<td>Part 1: General definitions</td>
</tr>
<tr>
<td>DIN EN 60204-1</td>
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</tr>
<tr>
<td>VDE 0113-1</td>
<td></td>
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<tr>
<td>EN 60228</td>
<td>Conductors for cables and insulated leads</td>
</tr>
<tr>
<td>IEC 60228</td>
<td></td>
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<td>DIN EN 60228</td>
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<tr>
<td>VDE0295</td>
<td></td>
</tr>
<tr>
<td>EN 60269-1</td>
<td>Low-voltage fuses;</td>
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<tr>
<td>IEC 60269-1</td>
<td>Part 1: General requirements</td>
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<tr>
<td>DIN EN 60269-1</td>
<td></td>
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<tr>
<td>VDE 0636-1</td>
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</table>
## General

### 2.3 Standards

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<tr>
<th>Standards*</th>
<th>Title</th>
</tr>
</thead>
</table>
| IEC 60287-1 to -3 | Cables - Calculation of the current carrying capacity  
Part 1: Current carrying capacity equations (100 % load factor) and calculating the losses  
Part 2: Thermal resistance -  
Part 3: Main sections for operating conditions |
| HD 60364-x-x  
IEC 60364-x-x  
DIN VDE 0100-x-x  
VDE 0100-x-x | Erection of power installations with nominal voltages up to 1000 V;  
Part 200: Definitions  
Part 410: Protection for safety, protection against electric shock  
Part 420: Protection for safety, protection against thermal effects  
Part 430: Protection of cables and conductors for over-current  
Part 450: Protection for safety, protection against undervoltage  
Part 470: Protection for safety; use of protection for safety  
Part 5xx: Selecting and erecting electrical equipment  
Part 520: Wiring systems  
Part 540: Earthing, protective conductor, potential bonding conductor  
Part 560: Electrical equipment for safety purposes |
| EN 60439  
IEC 60439  
DIN EN 60439  
VDE 0660-500 | Low-voltage switchgear assemblies;  
Part 1: Type-tested and partially type-tested assemblies |
| EN 60529  
IEC 60529  
DIN EN 60529  
VDE 0470-1 | Degrees of protection provided by enclosures (IP code) |
| EN 60721-3-x  
IEC 60721-3-x  
DIN EN 60721-3-x | Classification of environmental conditions  
Part 3-0: Classification of environmental parameters and their severities; Introduction  
Part 3-1: Classification of environmental parameters and their severities; Long-term storage  
Part 3-2: Classification of environmental parameters and their severities; Transport  
Part 3-3: Classification of environmental parameters and their severities; stationary use, weather protected |
| EN 60947-x-x  
IEC 60947 -x-x  
DIN EN 60947-x-x  
VDE 0660-x | Low-voltage switchgear |
| EN 61000-6-x  
IEC 61000-6-x  
DIN EN 61000-6-x  
VDE 0839-6-x | Electromagnetic compatibility (EMC)  
Part 6-1: Generic standard; Immunity for residential, commercial and light-industrial environments  
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| EN 61140  
IEC 61140  
DIN EN 61140  
VDE 0140-1 | Protection against electric shock; Common aspects for installation and equipment |
| EN 61800-2  
IEC 61800-2  
DIN EN 61800-2  
VDE 0160-102 | Adjustable-speed electrical power drive systems;  
Part 2: General requirements - Rating specifications for low-voltage adjustable frequency a.c. power drive systems |
| EN 61800-3  
IEC 61800-3  
DIN EN 61800-3  
VDE 0160-103 | Adjustable-speed electrical power drive systems;  
Part 3: EMC - Requirements and specific test methods |
### 2.3 Standards

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<th>Standards*</th>
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<tr>
<td>EN 61800-5-x</td>
<td>Adjustable-speed electrical power drive systems;</td>
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<tr>
<td>IEC 61800-5-x</td>
<td>Part 5: Safety requirements;</td>
</tr>
<tr>
<td>DIN EN 61800-5-x</td>
<td>Main section 1: Electrical, thermal and energy requirements</td>
</tr>
<tr>
<td>VDE 0160-105-x</td>
<td>Main section 2: Functional safety requirements</td>
</tr>
<tr>
<td>EN 62061</td>
<td>Safety of machinery;</td>
</tr>
<tr>
<td>IEC 62061</td>
<td>Functional safety of safety-related electrical, electronic and programmable electronic control systems</td>
</tr>
<tr>
<td>DIN EN 62061</td>
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</tr>
<tr>
<td>VDE 0113-50</td>
<td></td>
</tr>
<tr>
<td>UL 50</td>
<td>Enclosures for Electrical Equipment</td>
</tr>
<tr>
<td>CSA C22.2 No. 94.1</td>
<td></td>
</tr>
<tr>
<td>UL 508</td>
<td>Industrial Control Equipment</td>
</tr>
<tr>
<td>CSA C22.2 No. 142</td>
<td>Process Control Equipment</td>
</tr>
<tr>
<td>UL 508C</td>
<td>Power Conversion Equipment</td>
</tr>
<tr>
<td>CSA C22.2 No. 14</td>
<td>Industrial Control Equipment</td>
</tr>
<tr>
<td>UL 61800-5-1</td>
<td>Standard for Adjustable Speed Electrical Power Drive Systems</td>
</tr>
<tr>
<td></td>
<td>Part 5-1: Safety requirements – Electrical, thermal and energy</td>
</tr>
</tbody>
</table>

* The technical requirements in the standards listed are not necessarily identical.
Basic information about EMC

3.1 Introduction to EMC

What is meant by EMC?

Electromagnetic compatibility (EMC) describes the capability of an electrical device to function satisfactorily in an electromagnetic environment without itself causing interference unacceptable for other devices in the environment.

EMC therefore represents a quality feature for the
- Internal noise immunity: Resistance to internal electrical disturbances
- External noise immunity: Resistance against external electromagnetic disturbances
- Noise emission level: Environmental effects caused by electromagnetic emissions

To ensure that the cabinet unit functions satisfactorily in the system, the environment subject to interference must not be neglected. For this reason, special requirements exist regarding the structure and the EMC of the system.

Operational reliability and noise immunity

In order to achieve the greatest possible operational reliability and immunity to noise of a complete system (converter, automation, drive machines etc.), measures must be taken by the converter manufacturer and the user. Only when all these measures are fulfilled can the faultless functioning of the inverter be guaranteed and the specified legal requirements (2014/30/EU) be met.
Noise emissions

Product standard EN 61800–3 describes the EMC requirements placed on "Variable-speed drive systems". It specifies requirements for inverters with operating voltages of less than 1000 V. Different environments and categories are defined depending on where the drive system is installed.

![Figure 3-1 Definition of the first and second environments](image)

![Figure 3-2 Definition of categories C1 to C4](image)

![Table 3-1 Definition of the first and second environments](image)
### Definition of categories C1 to C4

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Rated voltage &lt;1000 V; unrestricted use in the first environment.</td>
</tr>
<tr>
<td>C2</td>
<td>Rated voltage for stationary drive systems &lt;1000 V; for use in the second environment. For use in the first environment only when sold and installed by skilled personnel.</td>
</tr>
<tr>
<td>C3</td>
<td>Rated voltage &lt;1000 V; use in the second environment only.</td>
</tr>
<tr>
<td>C4</td>
<td>Rated voltage ≥1000 V or for rated currents ≥ 400 A in complex systems in the second environment.</td>
</tr>
</tbody>
</table>
Basic information about EMC

3.1 Introduction to EMC
EMC-compliant design and control cabinet configuration

Detailed configuration instructions regarding the EMC-compliant design of drives and control cabinet configuration can be found in the "SINAMICS Low Voltage Configuration Manual", see Configuration Manual for SINAMICS G130, G150, S120 Built-in Units, S120 Cabinet Modules, S150 (https://support.industry.siemens.com/cs/ww/en/view/83180185).
5.1 General

The minimum dimensions listed below for ventilation clearances must be observed. No other components or cables must be located in these areas.

<table>
<thead>
<tr>
<th>Component</th>
<th>Frame size</th>
<th>Clearance (front) [mm]</th>
<th>Clearance (above) [mm]</th>
<th>Clearance (below) [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Module</td>
<td>FX</td>
<td>40 ¹)</td>
<td>250</td>
<td>150</td>
</tr>
<tr>
<td>Power Module</td>
<td>GX</td>
<td>50 ¹)</td>
<td>250</td>
<td>150</td>
</tr>
<tr>
<td>Power Module</td>
<td>HX, JX</td>
<td>40 ¹)</td>
<td>250</td>
<td>150</td>
</tr>
</tbody>
</table>

¹) The clearances refer to the area around the ventilation slots on the front cover.

Note

Notes on the dimensions
The dimensions refer to the outer edges of the devices.
A dimension drawing is available in the Operating Instructions.
5.2 Ventilation

The SINAMICS G130 devices are forced-ventilated by means of integrated fans. To ensure an adequate air supply, suitable openings for the inlet air (e.g. ventilation slots in the cabinet door) and discharged air (e.g. by means of a hood) must be provided.

The cooling air must flow through the components vertically from bottom (cooler region) to top (region heated by operation).

You must ensure that the air is flowing in the right direction. You must also ensure that the warm air can escape at the top. The ventilation clearances specified in the table “Ventilation clearances for the components” in the previous section must be observed.

Note
Cables must not be routed directly on the components. The ventilation slots must not be covered.

Cold air must not be allowed to blow directly onto electronic equipment.

**NOTICE**

*Device failure due to condensation as a result of unsuitable air guidance and cooling*

Unsuitable air guidance and cooling equipment can cause condensation, which can result in device failure.

- Choose air guidance measures, as well as the arrangement of and settings for the cooling equipment in such a way as to prevent condensation even with the highest relative humidity.
- If required, install cabinet enclosure heating.
Figure 5-1  Air guidance for Power Module, frame size FX, GX
Devices must not be operated in an “air short-circuit”, since this can damage equipment or cause it to fail.

The fan suction causes negative pressure to build up at the ventilation openings in the cabinet doors. The pressure is dependent on the volume flow rate and the hydraulic cross-section of the openings.

The air, which blows out of the top of the device, accumulates under the top cover/hood, resulting in overpressure.

The difference between the overpressure at the top of the cabinet and the negative pressure at the bottom creates a flow of air (air short-circuit). This can vary in strength depending on the cross-section of the door and cover openings, as well as the volume flow rate of the air.

Due to the flow of air within the cabinet, the device fan draws in pre-heated air. This heats up the components considerably and the ventilator does not function effectively.
NOTICE

Device failure due to air short-circuit in the control cabinet

Unsuitable air guidance can cause an air short-circuit, which can result in overheating in the control cabinet and device failure.

- Install suitable barriers in the control cabinet in order to prevent an air short-circuit from occurring.

Barriers must be installed in such a way that no air can flow along the outer sides on the top and bottom of the devices. In particular, air must be prevented from flowing from the top (warm discharged air) to the bottom (cold cooling air). Suitable plates can be used as barriers and must extend to the side panels or cabinet doors. They must be set up in such a way that the outgoing air current is not forced into the cabinet cross-beams but is instead diverted around them. Barriers must be in place for all degrees of protection higher than IP20.

The cabinets adjacent to the converter cabinets must also be taken into account when barriers are installed.

To ensure sufficient ventilation for the devices, the opening cross-sections (minimum values) specified in the following table must be observed.

The specified opening cross-sections comprise several small openings. To ensure that pressure loss is kept to a minimum and that the flow resistance does not become too great at these mesh-type openings, the cross-sectional area of each opening must be around at least 190 mm² (e.g. 7.5 mm x 25 mm or 9.5 mm x 20 mm).

To ensure that the devices operate continuously, suitable measures must be taken to prevent the ingress of dirt and dust. Wire lattices (wire fabric DIN 4189-St-vzk-1x0.28) or filter mats (min. filter class G2) must be used for this purpose. The choice of filter mats depends on the required degree of protection and the ambient conditions. If cabinets are installed in an environment containing fine dust particles or oil vapors, micro-filter mats must be used to prevent the devices from becoming contaminated.

If dirt filters are used, the specified opening cross-sections and the filter areas must be adjusted upwards.

NOTICE

Device failure due to overheating as a result of contaminated dirt filters

Contaminated filter mats cause the device to overheat and fail.

- If dirt filters are used, observe the specified replacement intervals.

If the filter mats are heavily contaminated, the volume of air drawn is reduced due to the increased flow resistance. This can cause the fans integrated in the devices to overload, or it could cause the devices themselves to overheat and become damaged.

The opening cross-sections specified in the table refer in each case to one device. If more than one device is installed in a cabinet, the opening cross-section increases accordingly. If the required openings cannot be made in the cabinet, the devices must be distributed across several cabinets, which are separated from each other by means of partitions.
The warm air must be discharged via the top cover/hood or via side openings in the cabinet at the level of the top of the device. The size of the opening cross-section must also be taken into account here.

With degrees of protection higher than IP20 and if a hood is used, it may be necessary to use an "active" hood. An "active" hood contains fans that blow the air current forwards. The hood is closed, with the exception of the air outlet point.

If you choose an "active" hood, you must ensure that the fans are sufficiently powerful to prevent air from accumulating in the cabinet. If air accumulates, the cooling capacity is reduced. This can overheat and destroy the devices. The air capacity of the fans should at least be equivalent to the device fan data.

### Table 5-2 Volume flow rate, opening cross-sections

| Power Module | Article number | 6SL3310- | 1GE32-1AA3 | 1GE32-6AA3 | 1GE33-1AA3 | 1GE33-8AA3 | 1GE35-0AA3 | 1GF31-8AA3 | 1GF32-2AA3 | 1GF32-6AA3 | 1GF33-3AA3 | 1GF34-1AA3 | 1GH31-8AA3 | 1GH31-2AA3 | 1GH31-5AA3 | 1GH31-8AA3 | 1GH32-2AA3 | 1GH33-6AA3 | 1GH33-3AA3 | 1GE36-1AA3 | 1GE37-5AA3 | 1GE38-4AA3 | 1GF34-7AA3 | 1GF35-8AA3 | 1GH34-1AA3 | 1GH34-7AA3 | 1GH35-8AA3 | 1GE41-0AA3 | 1GF37-4AA3 | 1GF38-1AA3 | 1GH37-4AA3 | 1GH38-1AA3 |
|--------------|----------------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|----------|
| Cooling air requirement [m³/s] | 0.17 | 0.23 | 0.36 | 0.78 | 1.48 |
| Min. opening cross-section in cabinet - Inlet - Outlet [m²] | 0.1 | 0.1 | 0.19 | 0.28 | 0.47 |
| [m²] | 0.1 | 0.1 | 0.19 | 0.28 | 0.47 |
Additional information

Siemens:
www.siemens.com

Industry Online Support (service and support):
www.siemens.com/online-support

IndustryMall:
www.siemens.com/industrymall

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