

What must be observed when operating SINAMICS G120X devices on the public low-voltage system?

Devices and systems that are operated on the public low-voltage supply must comply with the limit values for electromagnetic interference (interference immunity and emission) defined in the relevant standards. Industrial networks are facing increased requirements, particularly regarding emitted interference. The requirements for standard-conformant operation on the public low-voltage system are explained in more detail in the following.

NOTE

Requirements may be defined in the technical connection conditions of the local network operator that exceed the standard requirements described in this document.

IEC 61800-3 (operation in the first EMC environment)

For SINAMICS devices, the EMC product standard IEC 61800-3 for variable-speed electrical drive systems (Power Drive Systems (PDS)) applies. This standard not only refers to the devices themselves, but to a complete, variable-speed drive system, which, in addition to the converter, also encompasses the motor and other equipment.

IEC 61800-3 makes a distinction between the first and second EMC environments and defines different requirements for these environments.

Definition of the first EMC environment: Residential buildings or locations at which the drive system is directly connected to a public low-voltage supply without intermediate transformer.

Definition of the second EMC environment: An environment that includes all other establishments which are not connected directly to a public low-voltage line supply. These are basically industrial areas that have their own medium-voltage supply via their own transformers.

The following general information applies to **use in the first EMC environment**:

NOTE

The drive systems are intended for commercial or industrial use in stationary machines and systems.

NOTE

The drive systems are intended to be installed and put into operation by specially trained personnel, in observance of EMC conditions and in observance of the installation information in the operating instructions and "EMC layout guidelines" configuration manual.

<http://support.automation.siemens.com/WW/view/en/60612658/0/en>

NOTE

For the integration of drive systems in machines or plants, additional measures may be necessary in order to comply with the product standards of these plants or machines. These measures are the responsibility of the plant or machine manufacturer.

NOTE

The flicker behavior can only be evaluated in a combination of the drive with an application (see IEC 61800-3, Section 6.2.4.2). The drive behaves passively in this regard, i.e. load fluctuations of the application will be visible without changes on the line side.

NOTE

Influence by ripple control signals

Ripple control signals in public supply systems can affect the operation of the drive system in unfavorable conditions and cause fault shutdowns (e.g. "undervoltage" or "phase failure"). This particularly applies to FSA-C devices if they are operated in the factory-set U/f control mode.

- Replace the U/f control mode with the vector control (Dynamic Mode application class) if ripple control signals are exerting unwanted influence.
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High-frequency, conducted and radiated interference emissions EMC Category C2

Drive systems can only be used in the first EMC environment if, at a minimum, the limit values of EMC Category C2 are adhered to in regard to the interference emissions. To this end, the requirements listed below must be satisfied:

- Operation on a TN or TT line system with a grounded neutral point.
 - Use of shielded motor cables with a length of max. 150 meters.
 - Operation using the default pulse frequency (or with a reduced pulse frequency)
 - FSA – FSG: Use devices with an integrated line filter C2 (-0AF0 in the last block of the article number)
 - FSH, FSJ: Use of an external line filter
 - 400-480 V 3 AC: 6SL3760-0MR00-0AA0
 - 500-690 V 3 AC: 6SL3760-0MS00-0AA0
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NOTE

In a residential environment, the devices can cause high-frequency interference. In these cases, additional interference suppression measures may be required

NOTE

If devices without integrated C2 filters or filters other than those listed above are used, the machine builder or plant engineer must certify that the interference emissions are limited acc. to EMC Category C2, at a minimum. Separate line filters for each device or a shared line filter for several devices can be used.

Current harmonics of individual devices

In regard to the adherence to limit values for the harmonic currents, the EMC product standard IEC 61800-3 for PDS refers to the compliance with standards IEC 61000-3-2 and IEC 61000-3-12. The limit values of these standards apply to devices that are defined for connecting to the public low-voltage system.

Depending on the rated output and the rated input current of the device, different requirements result for the direct connection to the low-voltage system.

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≤ 1 kW (LO basic load power)	The devices satisfy the requirements of IEC 61000-3-2
> 1 kW and ≤ 16 A (LO basic load output or LO input current)	No limit value requirements are defined in IEC 61000-3-2 for professionally used devices of this output range. Notification of the network operator and a system evaluation according to IEC 61000-3-14 or 61800-3 Annex B.4 are recommended.
> 16 A and ≤ 75 A (LO input current)	The devices comply with IEC 61000-3-12 (Table 4), provided that the short-circuit power S_{SC} at the point of connection of the customer system to the public network is greater than or equal to the value in the formula below. $S_{SC} = \frac{U_{rated}^2}{Z} \geq 120 \cdot \sqrt{3} \cdot U_{rated} \cdot I_{LO}$ The installer or plant operator must ensure that the devices are only connected to a supply system with sufficient short-circuit capacity. If the devices are to be connected to a supply system with a lower short-circuit capacity, the installer or plant operator must obtain a connection approval from the network operator in regard to harmonic currents.
> 75 A (LO input current)	No limit values for current harmonics are defined for these devices in the IEC standards. Notification of the network operator and a system evaluation according to IEC 61000-3-14 or 61800-3 Annex B.4 are recommended. The FSH and FSJ devices always require an upstream line reactor and an upstream line filter for operating on the public low-voltage system.

When operated with LO rated power, the devices generate the following typical current harmonics (in percentage of the fundamental current):

Device	R _{SC}	I5	I7	I11	I13	I17	I19	I23	I25	THC
FSA-FSG	120	38%	18%	8%	5%	4%	3%	3%	2%	43%
FSH, FSJ with 2% line reactor	50	37%	13%	7%	3%	3%	2%	1%	1%	40%

The SIZER configuration tool allows the individual calculation of the harmonic parameters.

<https://w3.siemens.com/mcms/mc-solutions/en/engineering-software/drive-design-tool-sizer/Pages/drive-design-tool-sizer.aspx>

Line Harmonics Filter (LHF) for reducing current harmonics

The passive LHF (Line Harmonics Filters) available for the SINAMICS G120X devices allow a clear reduction of the current harmonics. It is especially recommended that LHF be used if devices FSE-FSG (above 75 A of rated input current) are to be operated on the public low-voltage system.

Typical current harmonics with LHF when operating with LO rated power (in percentage of the fundamental current):

Device	R _{SC}	I5	I7	I11	I13	I15	I17	I23	I25	THD
FSB-FSG / 400 V	33	1.7%	1.9%	2.2%	1.5%	0.8%	0.8%	0.7%	0.6%	4.2%
	120	1.8%	2.2%	2.4%	1.6%	0.8%	0.8%	0.7%	0.6%	4.4%

The power factor λ improves with LHF to approx. 98% when operating with rated output.

We reserve the right to technical modifications.

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No LHF are assigned to the FSA devices. If necessary, several FSA can be operated on a shared LHF. It must be ensured that the rated output of the LHF is not exceeded.
With an upstream LHF, the devices satisfy the limit values of the IEC 61000-3-2 and IEC 61000-3-12.

The following LHF are available for SINAMICS G120X FSB to FSG (380-415 V 3 AC):

LO output (kW) ¹⁾	G120X	Article number Line Harmonics Filter
5.5	FSB	UAC:FN34406112E2XXJRX
7.5	FSB	UAC:FN34408112E2XXJRX
11	FSC	UAC:FN344011113E2FAJRX
15	FSC	UAC:FN344015113E2FAJRX
18.5	FSD	UAC:FN344019113E2FAJRX
22	FSD	UAC:FN344022115E2FAJRX
30	FSD	UAC:FN344030115E2FAJRX
37	FSD	UAC:FN344037115E2FAJRX
45	FSE	UAC:FN344045115E2FAJRX
55	FSE	UAC:FN344055115E2FAJRX
75	FSF	UAC:FN344075116E2FAJRX
90	FSF	UAC:FN344090116E2FAJRX
110	FSF	UAC:FN3440110118E2FAJRX
132	FSF	UAC:FN3440132118E2FAJXX ²⁾
160	FSG	UAC:FN3440160118E2FAJXX ²⁾
200	FSG	UAC:FN3440200118E2FAJXX ²⁾
250	FSG	2x UAC:FN3440132118E2FAJXX ^{2) 3)}

1. Voltage 380-415 V, frequency 50 Hz.
2. At 160 kW, 200 kW and 250 kW, only operation in Vector Control is permitted. V/f cannot be used.

Harmonics at the power supply connection point acc. to IEC 61000-2-2

The IEC 61000-2-2 defines the compatibility level for voltage harmonics for the connecting point PCC (Point of Common Coupling) with the public supply system.

For systems in which SINAMICS G120X devices or other non-linear loads are widely used, a circuit feedback calculation that takes the individual system configuration into consideration should always be performed.

SINAMICS G120X devices with upstream Line Harmonics Filters (LHF) allow adherence to the compatibility level for voltage harmonics, regardless of what percentage of the overall load is made up of the converter load.

NOTE

The voltage distortions behavior in the frequency range of 2 kHz to 9 kHz (IEC 61000-2-2 AMD 1) and from 9 kHz to 150 kHz (IEC 61000-2-2 AMD 2) must be evaluated depending on the impedance at the power supply connection point.

Harmonics at the power supply connection point acc. to IEEE 519

IEEE 519 defines limit values for voltage and current harmonics for all of the loads at the shared connecting point PCC (Point of Common Coupling).

As a rule, systems only satisfy the limit values of IEEE 519 without implementing special measures if the share of SINAMICS G120X devices and other non-linear loads in the overall load is relatively low. The respective system should always be individually considered.

SINAMICS G120X devices with upstream Line Harmonics Filters (LHF) allow adherence to the limit values of IEEE 519 (requirement: $R_{Sc} \geq 20$).