

PowerXL™

DG1 Variable Frequency Drives Operating at low temperatures



Level 2	<ul style="list-style-type: none"> 1 – Fundamental – No previous experience necessary 2 – Basic – Basic knowledge recommended 3 – Advanced – Reasonable knowledge required 4 – Expert – Good experience recommended
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Danger! - Dangerous electrical voltage!

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (AWA/IL) for the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalization. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automatic control functions.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specification, otherwise this may cause malfunction and/or dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes. Unlatching of the emergency-stop devices must not cause a restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been properly installed and with the housing closed.
- Wherever faults may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (e.g. by means of separate limit switches, mechanical interlocks etc.).
- Frequency inverters may have hot surfaces during and immediately after operation.
- Removal of the required covers, improper installation or incorrect operation of motor or frequency inverter may destroy the device and may lead to serious injury or damage.
- The applicable national safety regulations and accident prevention recommendations must be applied to all work carried on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant electrical regulations (e. g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations).
- Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the frequency inverters using the operating software are permitted.
- All covers and doors must be kept closed during operation.
- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the frequency inverter (increased motor speed or sudden standstill of motor). These measures include: – Other independent devices for monitoring safety related variables (speed, travel, end positions etc.).
 - Electrical or non-electrical system-wide measures (electrical or mechanical interlocks).
- Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be alive after disconnection. Consider appropriate warning signs.

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1 General

Devices of the series **PowerXL™ DG1** have internal protective functions to prevent them from being destroyed. This is always the case when a limit of the device or the application is reached. Beside electrical variables like voltage or current, which can lead to a trip, also the temperature is monitored. The minimal permissible ambient temperature of the devices during operation is -10 °C. Critical components are displays, capacitors and IGBTs in this case.

This application note describes the configuration of the protective function “Unit Under Temp” and the “Cold Weather Mode”, which permits to preheat the device and the motor at lower temperatures than -10 °C to enable an operation inside the permissible range afterwards.

2 Configuration of the protective function „Unit Under Temp“

Parameter P9.23 „Unit Under Temp Prot“ determines the behavior of the device in case a too low temperature is detected. In default the device trips at under temperature. Other reactions are also possible:

P9.23 = No Action (0)

- In this case the status is ignored and the device keeps on running.

P9.23 = Warning (1)

- The device keeps on running but a warning message is displayed.
 - Configuration of a digital output / relay “Warning” (5)

P9.23 = Fault (2)

- The device trips and a fault message is displayed. The motor stops according to the setting of P7.10:
 - P7.10 = Coasting (0): The motor coasts to stop.
 - The fault message appears directly at the appearance of the fault.
 - Configuration of a digital output / relay: „Fault“ (3)
 - Deactivation of the RUN signal directly after appearance of the fault.
 - Configuration of a digital output / relay: „RUN“ (2)
 - P7.10 = Ramp (1): The motor ramps down to standstill.
 - The fault message appears directly at the appearance of the fault.
 - Configuration of a digital output / relay: „Fault“ (3)
 - Deactivation of the RUN signal after ramp down at standstill
 - Configuration of a digital output / relay: „RUN“ (2)

P9.23 = Fault, Coast (3)

- The device trips and the motor coasts to stop.
 - The fault message appears directly at the appearance of the fault.
 - Configuration of a digital output / relay: „Fault“ (3)
 - Deactivation of the RUN signal directly after appearance of the fault.
 - Configuration of a digital output / relay: „RUN“ (2)

Note: With the setting P9.23 = „No Action“ respectively „Warning“ an operation at temperatures below -10 °C is possible. Nevertheless it is recommended not to use these settings to protect the device (see also chapter 3).

Parameter	Name	Range	Default
P7.10	Stop Mode	Coasting (0) Ramp (1)	Ramp (1)
P9.23	Unit Under Temp Prot	No Action (0) Warning (1) Fault (2) Fault, Coast (3)	Fault (2)

3 The Cold Weather Mode

In some extreme cases it can be necessary to operate the drive, even at temperatures below $-10\text{ }^{\circ}\text{C}$. This can be achieved by warming up the variable frequency drive and the motor before start. The idea is to inject a current into drive and motor by using a low voltage with low frequency to generate heat losses for temperature increase.

The cold weather mode is activated With P9.39 „Cold Weather Mode“. This brings the following consequences:

- The tripping point of the protective function „Unit Under Temp“ will be decreased from $-10\text{ }^{\circ}\text{C}$ to $-30\text{ }^{\circ}\text{C}$. The reaction below $-30\text{ }^{\circ}\text{C}$ is determined by parameter P9.23 “Unit Under Temp Prot” (see chapter 2).
 - ATTENTION: P9.23 has to be set to “Fault (2)” or “Fault, Coast (3)”. Other settings are not allowed.
- In the range between $-30\text{ }^{\circ}\text{C}$ and $-20\text{ }^{\circ}\text{C}$ a voltage, defined by P9.40 „Cold Weather Volt Level“ as a percentage of P1.8 „Motor Nom Voltage“ with a frequency of 0.5 Hz, is generated at the output of the drive. This causes a current flow through variable frequency drive and motor, which warms them up.
- In the temperature range between $-30\text{ }^{\circ}\text{C}$ and $-20\text{ }^{\circ}\text{C}$ the motor is at standstill and warms up. A Start signal is necessary. A warning message is displayed.
- When $-20\text{ }^{\circ}\text{C}$ is reached, the drive starts.
- In case the temperature is still below $20\text{ }^{\circ}\text{C}$ after the time defined with P9.41 „Cold Weather Time Out“ is expired, the drive trips because of under temperature. After a reset the warm up procedure can be repeated to heat up motor and drive further.

ATTENTION: Too high values of the output voltage (P9.40) respectively a too long period of time (P9.41) can lead to an overheating of the motor and consequently to a reduction of lifetime. Therefore the smallest values, which are possible for the application, shall be chosen.

Parameter	Name	Range	Default
P9.39	Cold Weather Mode	Disabled (0) Enabled (1)	Disabled (0)
P9.40	Cold Weather Volt Level	0 ... 20.0 % of P1.8	2.0 %
P9.41	Cold Weather Time Out	0 ... 10 min	3 min