

PowerXL™

DG1 Variable Frequency Drives Smoke Mode and Fire Mode



Level 2	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

Disclaimer

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1 General

Devices of the series **PowerXL™ DG1** have internal protective functions, to prevent them from being destroyed. When a protective function is activated, either the device is switched off or a message is displayed.

In case of a fire, the lives of human beings and animals must be protected. For that reason it is important, that smoke extractors and sprinklers still work, even in case of a fault, which normally leads to a shutdown.

Depending on the application different requirements exist, how a device has to behave in case of fire. It starts with bypassing of electronic devices and a direct connection of the motor to the supplying mains to the point of a special behavior of the variable frequency drive. The operating mode of the variable frequency drive in case of fire is called Fire Mode.

The Variable Speed Drives Group of the British Manufacturers Organization GAMBICA defines the Fire Mode as follows:

Fire Mode is a special operating mode of the VSD that is activated by a dedicated signal that specifically indicates a fire condition. Once operating in Fire Mode the VSD will ignore or reset faults in order to maintain availability.

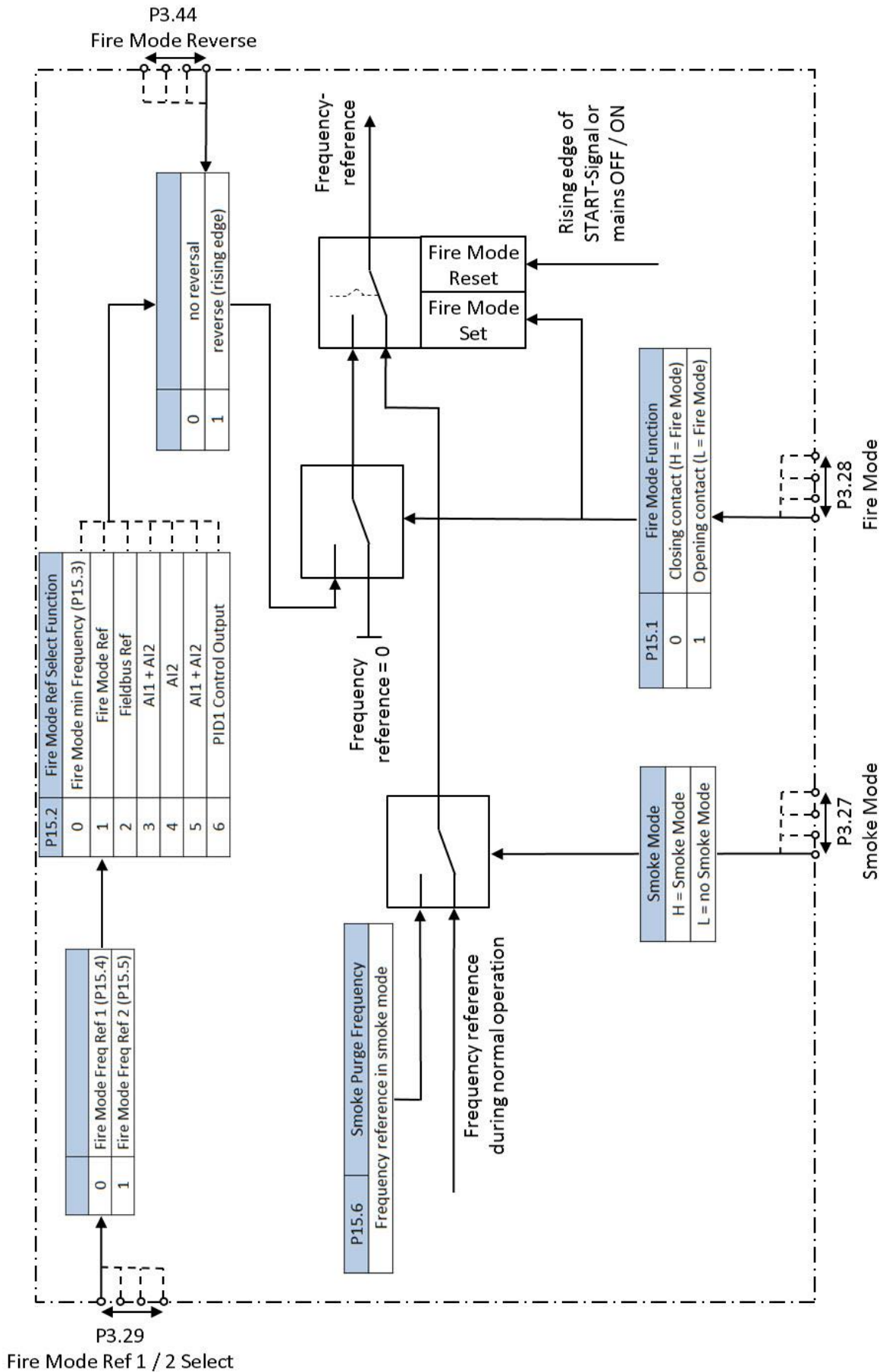
Fire Mode cannot be triggered by any other signal or manual option. Once the VSD enters Fire Mode, it cannot exit this mode until the fire condition signal is reset.

In addition there is the Smoke Mode inside the devices of the series **PowerXL™ DG1**, which changes the speed to the one especially defined for this mode, once the respective command is applied. This is used e.g. in smoke extractor or venting applications.

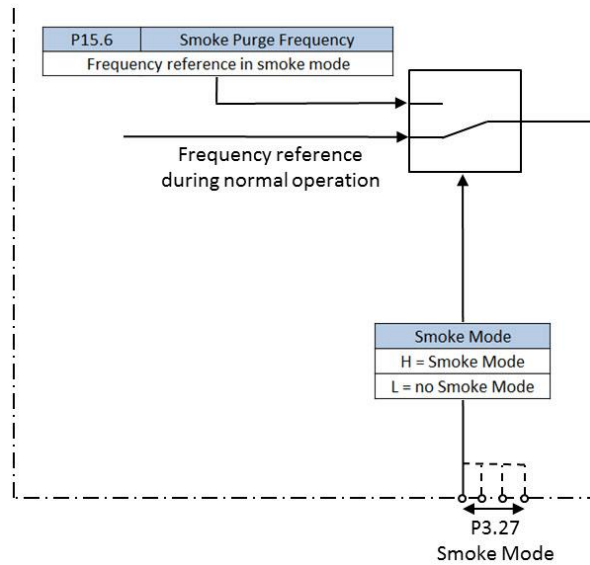
The functions described here, refer to an application software version 1.02.0032 and above (see parameter P21.2.3). It is available in the following applications (P21.1.2):

- Multi-Pump
- Multi-PID
- Multi-Purpose

2 Block diagram



3 Configuration of DG1 for Smoke Mode



Smoke Mode is activated with a HIGH signal at the source defined with P3.27 „Smoke Mode“. In this case the drive ramps to the “Smoke Purge Frequency” (P15.6). At removal of the command the speed is switched back to the one of the normal operation mode. The setting P3.27 = “DigIN: Normally Open” disables the Smoke Mode.

The sense of rotation is determined by the respective commands (Start Signal 1 / Start Signal 2). A reversal during Smoke Mode is possible.

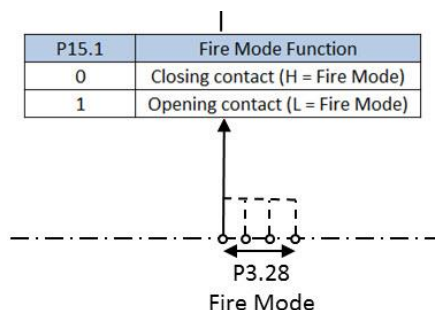
Contrary to Fire Mode the protective functions are not disabled during Smoke Mode.

External Commands	Function
Smoke Mode	LOW = no Smoke Mode HIGH = Smoke Mode

Parameter	Name	Range	Default
P3.27	SmokeMode	- DigIn: NormallyOpen - DigIn: NormallyClose - Digital Inputs: DigIn1 ... 8 - Digital inputs on the optional board in Slot B: DigIn 201 ... 206 - Time channel 1 ... 3 - Relays RO1 ... RO3 - virtual Relays VO1 ... VO2	DigIn: Normal-lyOpen
P15.6	Smoke Purge Frequency	0 ... 100 % 0 % = Min Frequency (P1.1) 100 % = Max Frequency (P1.2)	50 %

4 Configuration of DG1 for Fire Mode

4.1 Activation of Fire Mode



The Function Fire Mode is activated by applying a signal at the source defined with P3.28 „Fire Mode“. If Fire Mode is activated by a HIGH or a LOW signal, is determined by the setting of P15.1 “Fire Mode Function”.

At removal of this command the variable frequency drive remains in Fire Mode until reset (see 4.5). With the setting P3.28 = DigIN: NormallyOpen Fire Mode is disabled.

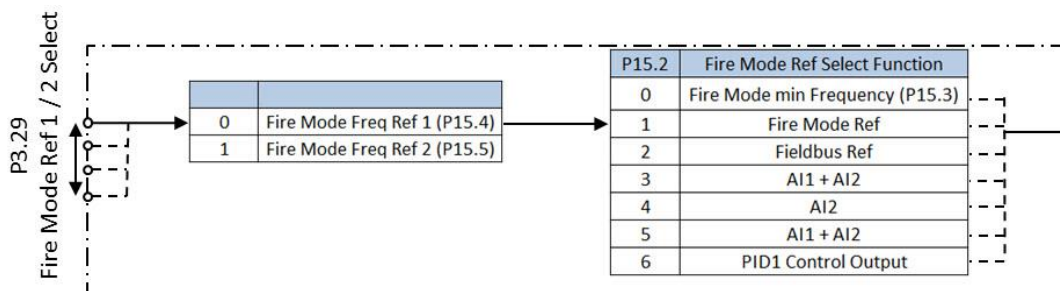
The command Fire Mode is enough to start the variable frequency drive. This also enables an automatic restart after a mains loss. Condition is, that the Fire Mode command is still present at the source defined with P3.28. In this case the variable frequency drive ALWAYS starts with a right rotating field at the output terminals. The motor has to be connected in a way, that a right rotating field at the output of the variable frequency drive leads to the sense of rotation, which is required during Fire Mode!

In Fire Mode all protective functions of the variable frequency drive are disabled. Solely the hardware based protective functions are active. In case one of these is activated, the drive is not able to work any longer. See also 4.6.

External commands	Function
Fire Mode	P15.1 = Closing contact Fire Mode is activated with a HIGH signal P15.1 = Opening contact Fire Mode is activated with a LOW signal

Parameter	Name	Range	Default
P3.28	Fire Mode	- DigIn: NormallyOpen - DigIn: NormallyClose - Digital Inputs: DigIn1 ... 8 - Digital inputs on the optional board in Slot B: DigIn 201 ... 206 - Time channel 1 ... 3 - Relays RO1 ... RO3 - virtual Relays VO1 ... VO2	DigIn: NormallyOpen
P15.1	FireMode Function	- closing contact - opening contact	closing contact

4.2 Frequency reference in Fire Mode



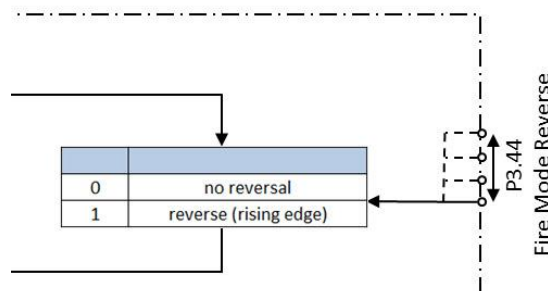
Parameter P15.2 „Fire Mode Ref Select Function” determines the frequency reference in Fire Mode. The possible settings are limited by P15.3 “Fire Mode Min Frequency” and P1.2 “Max Frequency”. The value of P15.3 must be greater than the one of the “Min Frequency” (P1.1).

- P15.2 = Fire Mode Min Frequency (0)
 - Reference = minimum frequency in Fire Mode [Hz], set with P15.3
- P15.2 = Fire Mode Ref (1)
 - Reference in Fire Mode [%]. (0 % = P15.3 „Fire Mode Min Frequency”, 100 % = P1.2 „Max Frequency”)
 - One reference:
 - P3.29 = DigIN:NormallyOpen: Fire Mode Freq Ref 1, set with P15.4
 - P3.29 = DigIN:NormallyClose: Fire Mode Freq Ref 2, set with P15.5
 - Changeover between two references at the source defined with P3.29
 - LOW Fire Mode Freq Ref 1, set with P15.4
 - HIGH Fire Mode Freq Ref 2, set with P15.5
- P15.2 = Fieldbus Ref (2)
 - Reference comes from the fieldbus
- P15.2 = AI1 (3)
 - Reference at Analog Input 1 [%]. (0 % = P15.3 „Fire Mode Min Frequency”, 100 % = P1.2 „Max Frequency”)
- P15.2 = AI2 (4)
 - Reference at Analog Input 2 [%]. (0 % = P15.3 „Fire Mode Min Frequency”, 100 % = P1.2 „Max Frequency”)
- P15.2 = AI1 + AI2 (5)
 - The reference is equal to the sum of the references at AI1 and AI2. Each reference has a maximum influence of 50 %. (0 % = P15.3 „Fire Mode Min Frequency”, 100 % = P1.2 „Max Frequency”)
- P15.2 = PID1 Control Output (6)
 - The reference comes from the output of the PID1 controller

External commands	Function
Fire Mode Ref 1 / 2 Select	LOW Fire Mode Freq Ref 1, set with P15.4
	HIGH Fire Mode Freq Ref 2, set with P15.5

Parameter	Name	Range	Default
P3.29	Fire Mode Ref 1 / 2 Select	- DigIn: NormallyOpen - DigIn: NormallyClose - Digital Inputs: DigIn1 ... 8 - Digital inputs on the optional board in Slot B: DigIn 201 ... 206 - Time channel 1 ... 3 - Relays RO1 ... RO3 - virtual Relays VO1 ... VO2	DigIn: Normal-lyOpen
P15.2	Fire Mode Ref Select Function	- Fire Mode Min Frequency (0) - Fire Mode Ref (1) - Fieldbus Ref (2) - AI1 (3) - AI2 (4) - AI1 + AI2 (5) - PID1 Control Output (6)	Fire Mode Min Frequency (0)
P15.3	Fire Mode Min Frequency	P1.1 „Min Frequency“ ... P1.2 „Max Frequency“	15 Hz
P15.4	Fire Mode Freq Ref 1	P15.3 „Fire Mode Min Frequency“ ... P1.2 „Max Frequency“	75 %
P15.5	Fire Mode Freq Ref 2	P15.3 „Fire Mode Min Frequency“ ... P1.2 „Max Frequency“	100 %

4.3 Sense of rotation in Fire Mode



4.3.1 No reversal needed

P3.44 “Fire Mode Reverse” → Select DigIn:NormallyOpen (0)

When Fire Mode is activated the motor spins in the same direction it had before. Means: The sense of rotation during normal operation at the time when Fire Mode is activated determines the direction in Fire Mode. Once Fire Mode is activated “Start Signal 1” and “Start Signal 2” have no influence.

When Fire Mode is activated at a point of time where a reverse command was given in normal operation mode, but the motor is still ramping down, the motor will reverse and accelerates to the speed defined with P15.2.

4.3.2 Reversal needed

In Fire Mode the sense of rotation can be reversed with a rising edge at the source selected with P3.44 “Fire Mode Reverse”. This source may not have HIGH potential before the activation of Fire Mode. When it has HIGH before, no reversal takes place. The reversal must be activated at the same time or after the activation of Fire Mode. Assigning the same input to P3.28 “Fire Mode” and P3.44 “Fire Mode Reverse” leads to a reversal of the speed when Fire Mode is activated.

- P3.28 and P3.44 are assigned to the same input: the drive reverses when the Fire Mode signal is given for the first time. When the Fire Mode signal is removed and reapplied while the drive is still latched, the reverse command is ignored.
- P3.28 and P3.44 are assigned to different inputs
 - Fire Mode signal is not active, but drive is latched: no reversal with a rising edge of P3.44
 - Fire Mode signal is active: each rising edge of the reverse signal leads to a reversal!

External commands	Function
Reverse	A rising edge leads to a reversal (see above)

Parameter	Name	Range	Default
P3.44	Fire Mode Reverse	- DigIn: NormallyOpen - DigIn: NormallyClose - Digital Inputs: DigIn1 ... 8 - Digital inputs on the optional board in Slot B: DigIn 201 ... 206 - Time channel 1 ... 3 - Relays RO1 ... RO3 - virtual Relays VO1 ... VO2	DigIn: NormallyOpen

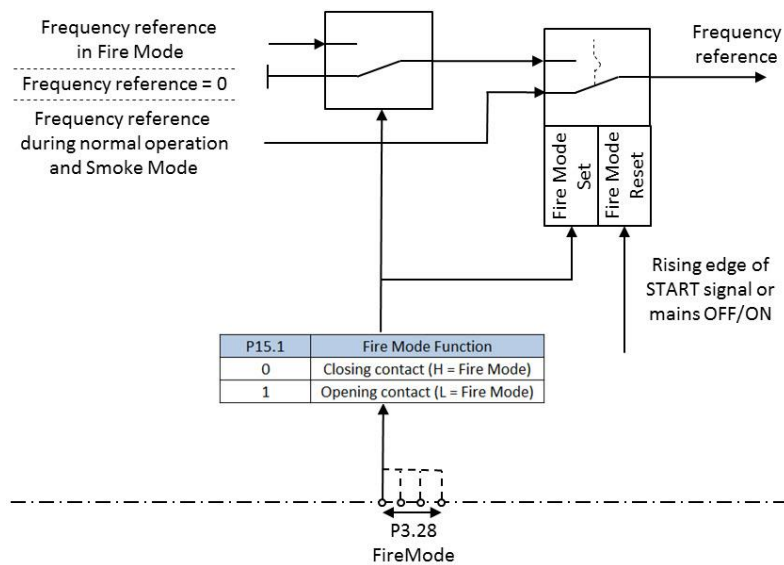
4.4 Status signals

When a signal to activate the Fire Mode is applied to the source defined with P3.28, it can be indicated via a digital output (static output, relay or virtual relay). The output has to be configured to “Fire Mode (25)”.

Note: This signal doesn’t indicate the latched Fire Mode of the drive, but if the signal at the source (P3.28) is present.

Parameter	Name	Range	Default
P5.1	DO1 Function	Ready (1) Fire Mode (25) RUN Bypass/Drive (60)	Ready (1)
P5.2	RO1 Function		Run (2)
P5.3	RO2 Function		Fault (3)
P5.4	RO3 Function		At speed (7)
P5.5	VO1 Function		Not Used (0)
P5.6	VO2 Function		Not used. (0)

4.5 How does DG1 behave in Fire Mode?



- During normal operation and in Smoke Mode the drive runs with the corresponding reference and the protective functions are active as configured in Menu 9.
- When applying a Fire Mode command to the source defined by P3.28 “Fire Mode”, the drive changes into Fire Mode. (see 4.1)
- The drive remains in Fire Mode until this operating mode is reset by a rising edge of the START signal or by cycling the mains voltage. At this point of time the Fire Mode command may not be present, otherwise the drive remains in Fire Mode.
- The frequency / speed in Fire mode is determined by P15.2 “Fire Mode Ref Select Function” (see 4.2), the sense of rotation by the signal at the source defined with P3.44 “Fire Mode Reverse” (see 4.3).
- When the Fire Mode command is removed while Fire Mode is latched inside the drive, the drive remains in Fire Mode (protective functions deactivated...), but ramps down to standstill (Stop). Applying the Fire Mode command again leads to a new start to the speed defined by P15.2.
- At a mains loss the drive is not able to run anymore, even in Fire Mode. When the mains voltage returns and the Fire Mode command is still applied, the drive starts automatically. In this case the output of the variable frequency drive has ALWAYS a right rotating phase sequence!

4.6 Note for Fire Mode commissioning

It cannot be excluded that machines and installations are not set up correctly at the time of commissioning. In these cases protective functions of the devices and installations prevent a damage. To test the behavior of the devices DG1 in Fire Mode it is possible, to keep the protective functions still active during commissioning and to deactivate them afterwards. The behavior can be selected with parameter P15.7 "Fire Mode Test Enable".

Parameter	Name	Range	Default
P15.7	Fire Mode Test Enable	Disabled (0): In Fire Mode protective functions are disabled. Enabled (1): In Fire Mode protective functions are enabled.	Disabled (0)