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Application paper: Fire Emergency Mode in VLT® HVAC Drive FC 102

Secure a **safe escape** and **protect inventory** in the event of a fire

32
control combinations ensure flexible multi-zone control in smoke extraction

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Safeguarding lives and property

In the event of a building fire, the first priority is to safeguard building occupants and protect inventory. For this purpose, the VLT® HVAC Drive FC 102 is equipped with an integrated Fire Emergency Mode.

Fire Emergency Mode acts to ensure that the drive sacrifices itself and "runs to dead" to keep ventilation fans and water pumps running for as long as possible.

This protects people from the fire by extending ventilation system operation to provide breathable air for as long as possible. It also assists a safe escape by ensuring overpressure on the stairwells and that the normal ventilation system switches to a smoke extraction mode to remove dangerous smoke from the escape route. Effective smoke extraction also minimizes damage to inventory.

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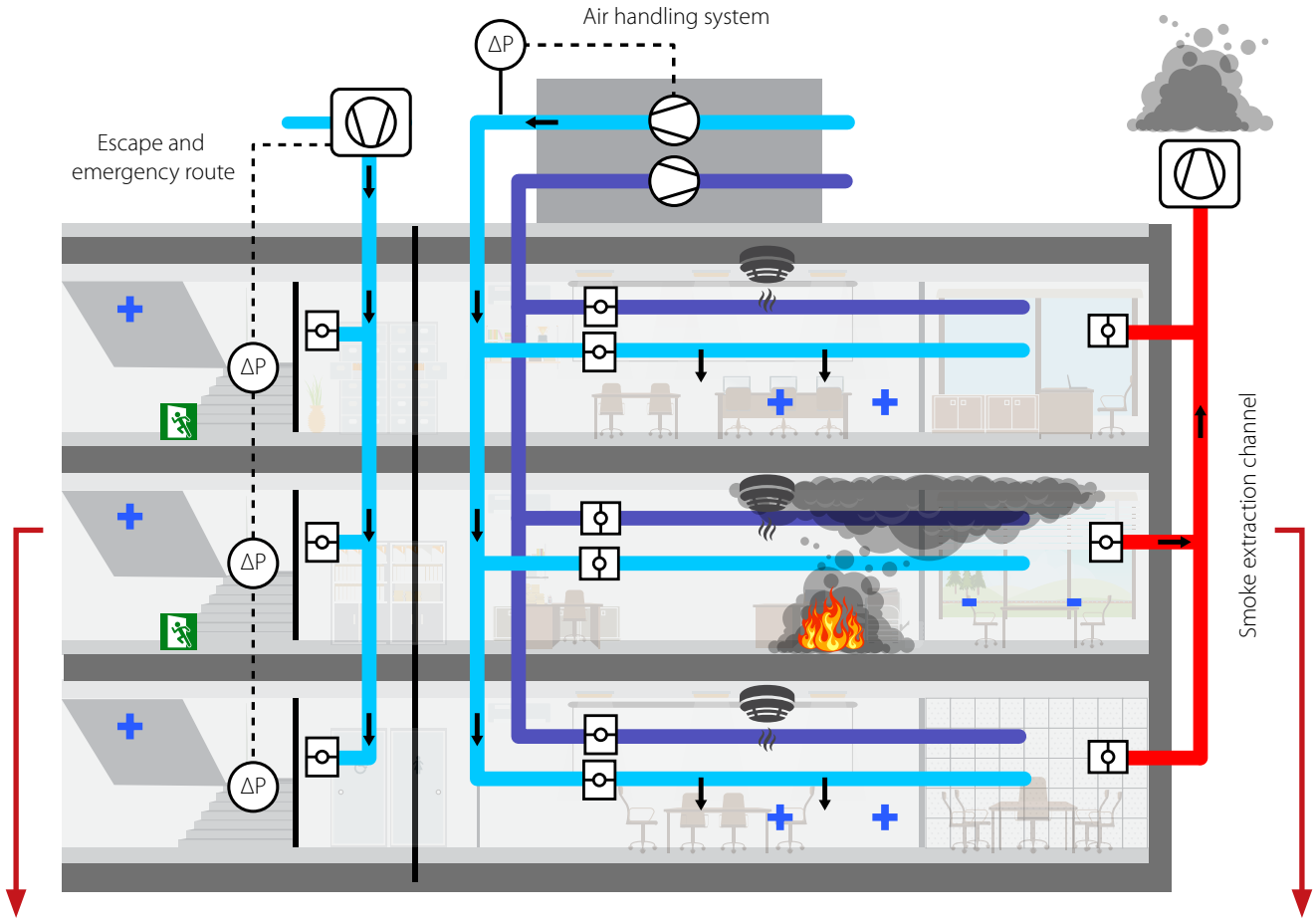
One drive solution for all your ventilation systems

When activated, the Fire Emergency Mode suppresses the alarms which normally protect the drive and ensure a "run to dead" operation of the application to protect lives and inventory. Multiple alternatives for controlling the ventilation system are available, to deliver maximum flexibility. For example, by setting up the fire protection system strategically, building operators can select the optimal solution for removing smoke out of the building and securing safe escape routes. The system can simultaneously ensure a continued supply of clean air to the unaffected areas, and cease air supply to stifle fire in the affected areas.

Building ventilation systems



The stairwell overpressure system prevents smoke entering the escape area. The maximum overpressure is limited to a level that ensures personnel can still open the doors and enter the stairwell.

The standard ventilation system ensures that the areas unaffected by the fire continue to operate normally. It also stops ventilation to the affected areas.

The smoke extraction system removes the smoke from the fire-affected area.

Flexible configuration

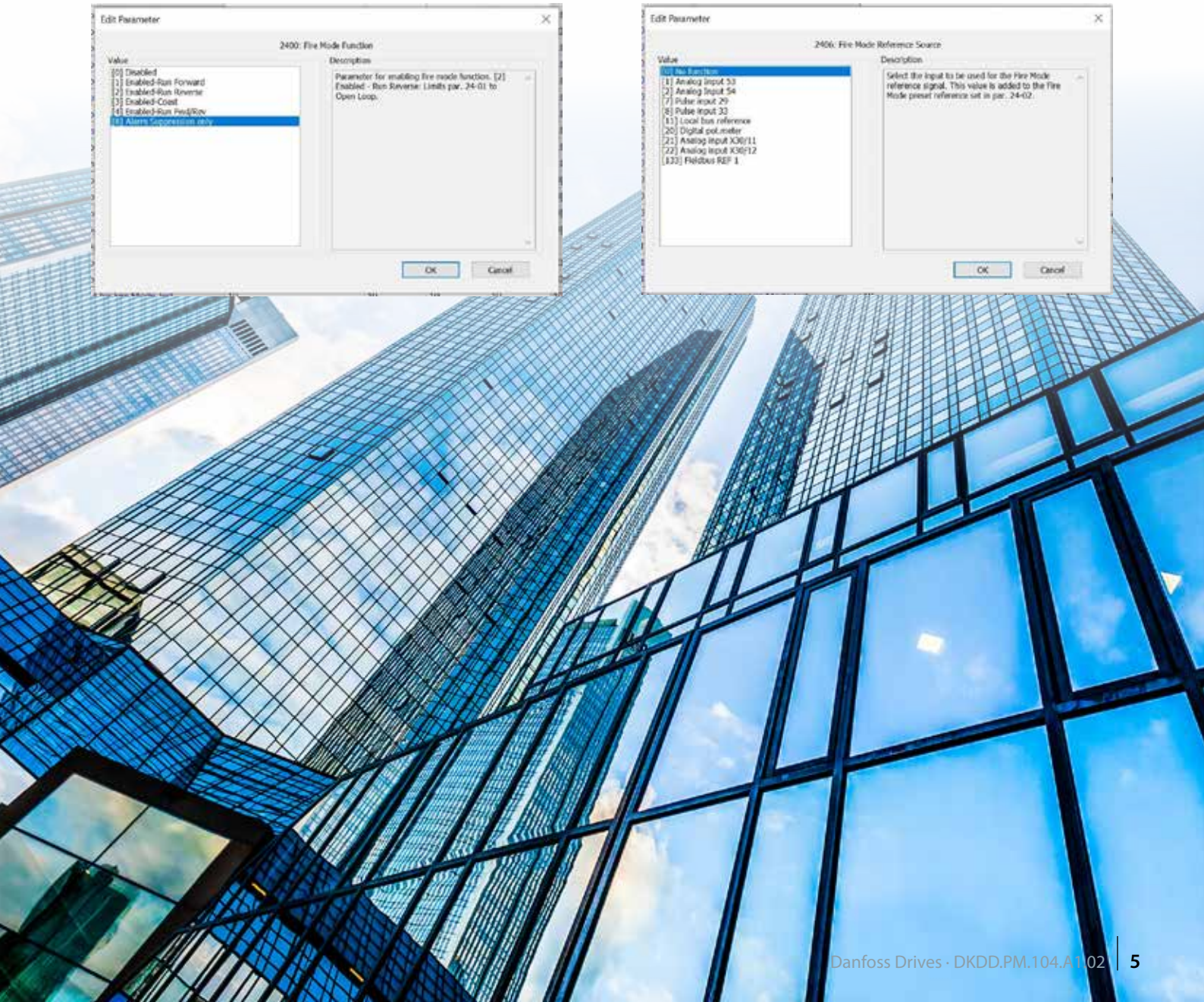
The VLT® HVAC Drive FC 102 enables you to configure the Fire Mode solution with great flexibility.

The Fire Mode solution normally suppresses self-protection alarms and continues in normal operation mode. Alternatively it switches to the special Fire Mode operation configuration, with up to 32 different operation configurations.

The 4 setup menus, with different operation options and minimum 8 different preset operation values, are controlled via the standard I/O signals or a connected fieldbus system that also delivers maximal flexibility to create an optimal fire management system.

ID	Name	Setup 1	Setup 2	Setup 3	Setup 4	Factory Setup	Unit
2400	Fire Mode Function	[4] Enabled-Run Fwd/Rev	[4] Enabled-Run Fw...	[4] Enabled-Run Fw...	[4] Enabled-Run Fw...	[0] Disabled	
2401	Fire Mode Configuration	[0] Open Loop	[3] Closed Loop	[0] Open Loop	[0] Open Loop	[0] Open Loop	
2402	Fire Mode Unit	[3] Hz	[1] %	[3] Hz	[3] Hz	[3] Hz	
2403	Fire Mode Min Reference	0.000	0.000	0.000	0.000	0.000	Hz
2404	Fire Mode Max Reference	50.000	100.000	75.000	100.000	50.000	Hz
2405.0	Fire Mode Preset Reference	-10.00	0.00	10.00	0.00	0.00	%
2405.1	Fire Mode Preset Reference	-20.00	30.00	20.00	0.00	0.00	%
2405.2	Fire Mode Preset Reference	-30.00	0.00	35.00	0.00	0.00	%
2405.3	Fire Mode Preset Reference	-50.00	0.00	60.00	0.00	0.00	%
2405.4	Fire Mode Preset Reference	-70.00	0.00	75.00	0.00	0.00	%
2405.5	Fire Mode Preset Reference	-80.00	0.00	83.00	0.00	0.00	%
2405.6	Fire Mode Preset Reference	-90.00	0.00	92.00	0.00	0.00	%
2405.7	Fire Mode Preset Reference	-100.00	0.00	100.00	0.00	0.00	%
2406	Fire Mode Reference Source	[0] No function	[1] Analog Input 53	[133] Fieldbus REF 1	[0] No function	[0] No function	
2407	Fire Mode Feedback Source	[0] No function	[2] Analog Input 54	[0] No function	[0] No function	[0] No function	
2409	Fire Mode Alarm Handling	[1] Trip, Critical Alarms	[1] Trip, Critical Alar...	[1] Trip, Critical Alar...	[1] Trip, Critical Alar...	[1] Trip, Critical Alar...	

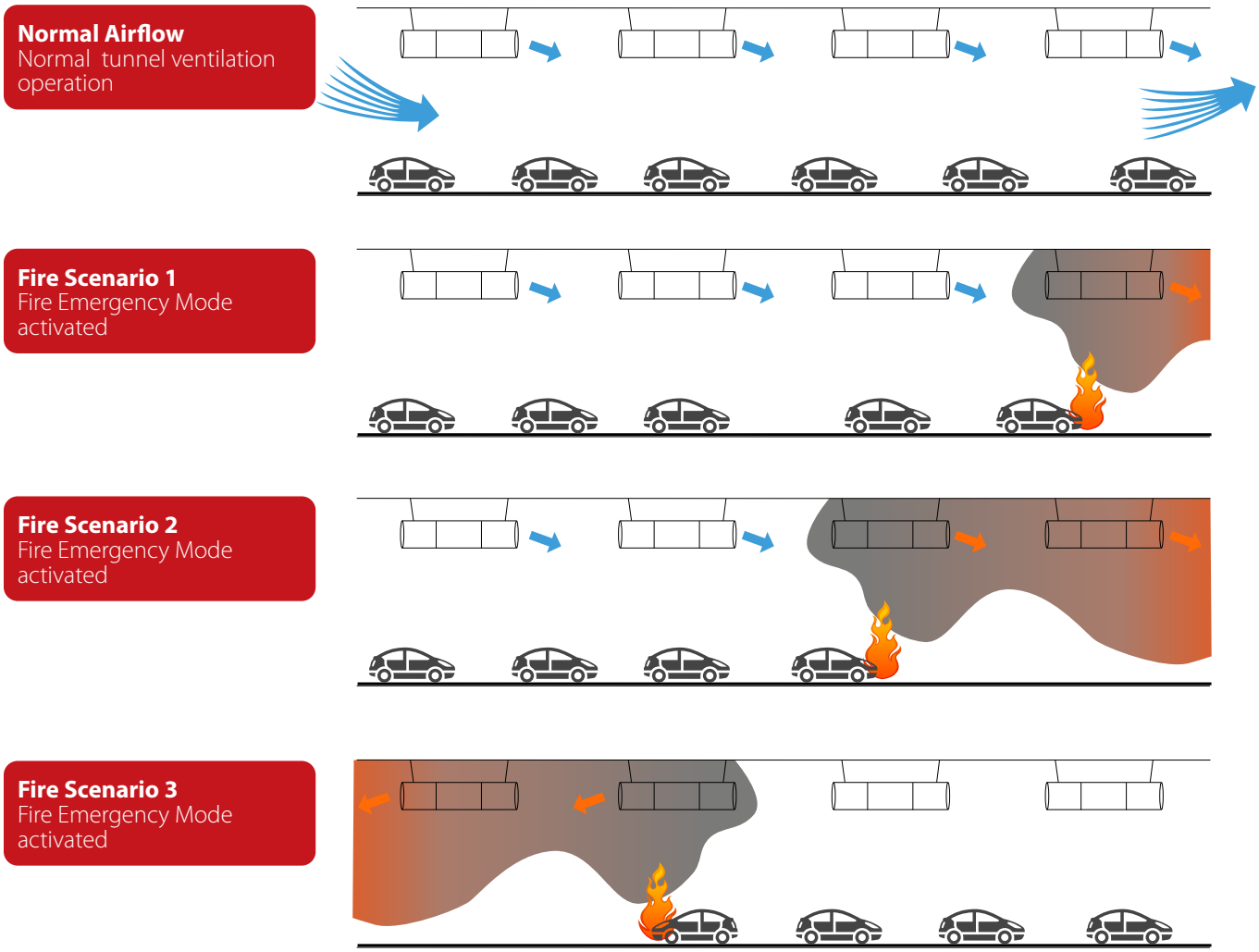
Parameter settings available for use in Fire Emergency Mode setup.



Tunnel systems

In tunnel systems, the Fire Emergency Mode system switches between different control solutions, to optimize the ventilation unit operation. It also removes smoke, to protect lives and inventory.

The VLT® HVAC Drive FC 102 is the perfect selection for tunnel applications, offering the Fire Emergency Mode functionality to handle normal ventilation and smoke extraction tasks. In addition, it can be installed with long motor cables, and delivers high EMC performance. Its robust enclosure handles 70 °C peak ambient temperatures for minimum one hour duration, making the FC 102 the perfect match for a tunnel application.



Tunnel airflow during normal operation and three different fire control scenarios.

Programming of Fire Emergency Mode

When activated, the Fire Emergency Mode suppresses the alarms which normally protect the drive and enable the drive to 'run to dead'. This ensures normal operation of the application for much longer than would otherwise be possible.
Multiple alternatives for controlling the ventilation system are available, to deliver maximum flexibility. For example, the Fire Mode function automatically configures the ventilation and smoke extraction system based on the actual location and behavior of the fire in the building. Fire Mode function secures the best possible approach to ensure a safe escape route for building occupants.

Flexible configuration (operation)

1. Flexible Fire Emergency Mode interface

The Fire Emergency Mode has the power to override all other functions in emergencies and is activated by digital inputs or via fieldbus. A fieldbus interface enables easy sharing of information to enable the operating team and fire command system to make the best decision regarding smoke extraction and normal ventilation.

2. Smoke extraction with Multi-zone control

A Multi-zone function with 32 different control combinations including multiple signal inputs to define the operation of the smoke extraction system is a part of the Fire Emergency Mode.

3. Safe escape route

The Fire Emergency Mode can generate a safe escape route by creating overpressure in a room or Stairwell where smoke is cleared out or unable to enter. Controlled overpressure secures that people can still open the door to enter the stairwell.

4. Special configuration for fast operation during critical fires

During normal operation, the ventilation system runs smoothly to prolong the lifetime of the system. But in the event of a critical fire, human lives and protection of inventory are more important than the system itself and the ventilation system reacts immediately. Fire Emergency Mode is capable of handling both operation types by having special settings for critical operation.

5. Self-monitoring of ventilation fan & installation

An installation check function monitors if the complete ventilation system is ready to operate when needed. Monitoring the system may reduce the need for manual inspections which are defined by the local fire authorities. The installation check includes a complete signal chain check from the drive output via the internal cable connection to the motor, the service switch, and the motor, without starting the ventilation system.

6. Continued operation at extreme ambient temperatures

The VLT® HVAC Drive FC 102 is made of quality components and the design ensures continued operation in the Fire Emergency Mode even at high ambient temperatures. The drive has been tested operating at an ambient temperature of 70 °C for minimum one hour with load without affecting the operation of the drive.

7. Fire Emergency Mode operation documentation in a fire log

The operation of Fire Emergency Mode is documented in a fire log for the local fire authority to ensure regular testing. If critical limits are exceeded whilst the drive operates in Fire Emergency Mode, it prompts a notification that inspection is needed to ensure the system is fully operational, before a new critical situation occurs.

Compliance with relevant standards

Fire systems are approved according to regional and international standards to secure their operational functionality and durability in the event of a fire. These standards are increasingly harmonized. For example, the European standard EN 12101-3 "Smoke and heat control systems" defines how components in "smoke and heat exhaust ventilation systems" should perform.

The main elements and requirements of these standards focus on the equipment directly involved in smoke extraction, establishing overpressure in the escape routes, and the main fire control system which manages the fire situation. The VLT® HVAC Drive FC 102 is a component in a fire system solution, which is approved as compliant with the fire safety standards relevant to the project.

Features and benefits - VLT® HVAC Drive FC 102 with Fire Emergency Mode

Features	Benefits
Protects human life	
Special Fire Emergency Mode (FEM) to suppress self-protection alarm and "run to dead" for maximum operation time.	High protection of human lives and inventory with maximum performance in critical situations.
Highly flexible	
Operation for smoke extraction and overpressure escape routes, such as a stairwell.	Flexible solution supporting the demands of a fire system.
Multi-zone control with 32 programmable zones, split into 4 set-up menus with 8 preset values or free scalable input from external source.	Great flexibility to adapt the FEM system to operate normal ventilation system and the fire situation.
FEM activation via fieldbus or manual inputs where the input signal can operate as normal or inverse "safe" signals.	Great flexibility to design and adapt the VLT® HVAC Drive FC 102 operation for a fire management system with positive and negative logic signals for the digital inputs.
Extremely reliable	
Continued operation at 70 °C ambient temperature for minimum 1 hour.	Durable solution which continues operation even when the temperature increases in the drive location.
Auto-check of the entire installation chain in the fire installation. For instance, if a service switch is not in the correct position after a service inspection, a notification is prompted.	Ensures continuous "ready to run" status.
Special test mode for operating the system with normal protection of the application.	Operation of the FEM system without compromising the "self-protection" and normal operation of the system.
Fast switch from normal operation to FEM operation with special settings for ramps for faster response to required changes.	Normal operating settings are unaffected by FEM, which ensures "stress-free" operation of the application in normal conditions.
Live-zero monitoring of external analog input and alignment of up to 3 input signals like a pressure transmitter in a stairwell.	Secures the fire system operates on reliable sensor inputs for correct overpressure in the stairwell.
Fully compliant	
Fire log documents the operation of the FEM.	Meets local fire authority requirement for proof that the the defined FEM test interval has been fulfilled.
Fire log documents which critical alarms were suppressed during the operation in FEM. After the event, this log is used to evaluate the readiness of the drive to start up again and operate as expected.	Documentation of critical alarms suppressed during FEM operation is available for use in service situations.
Fast response	
Ability to communicate when service is required as a result of critical alarms indicating that the recommended operating specification has been compromised, which may affect future operation of the drive.	Notification of potential compromise enables users to take early action, ensuring the fire system performance is restored to optimal prior to the next critical situation.
Multi-zone and set-up switch located inside the FEM operation settings means that the FEM set-up switch in FEM operation operates independently of the normal set-up switch.	Maximum flexibility in operation

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Specifications

System integration	
Operation condition	■ "Run to dead" for maximum performance by suppressing self-protection alarms in FEM operation ■ Operate FEM with special settings or in normal operation mode, with suppressed alarm limits
Control interface	Fieldbus for full integration of control signals and operation data, or digital and analogue I/O interface to control the FEM operation.
Digital inputs	■ Enable FEM ■ Operation in preset mode 1 / 2 / 3 (active "enable" signal to start operation) ■ FEM in reference mode 1 / 2 / 3 (direct start) ■ Setup selection mode to switch between the 4 FEM set-up menus. ■ Pulse input for actual speed (e.g. analogue input) ■ Enable test signal (normal alarm behavior, with no alarm suppression)
Digital outputs/relay	■ FEM active/inactive ■ FEM not operating as expected (switch to back-up system if critical) ■ FEM critical alarm activated (inspection needed to secure optimal operation)
Analogue inputs	■ Set fan speed (0-100%) ■ Pressure set point and feedback ■ Feedback from up to 3 analogue signals ■ Inputs have a live-zero monitoring to secure active measurement.
Software compatibility	FEM is implemented in VLT® HVAC Drive with software version V5.12 or later. ■ For all drives, apply the newest software version for maximum flexibility and performance ■ In addition, for VLT® HVAC Drive with software version earlier than V5.12, retrofit the drive with an up-to-date control card
Control parameterization	
Operation conditions	■ Suppress self-protection alarms when continuing normal operation, or with special operation settings and Multi-zone control. ■ Working in open- and closed-loop with internal pre-settings or external control and feedback signals. ■ Selection of critical alarm handling with: - auto reset for maximum operation time or trip on first critical alarm detection with manual reset, or - test simulation mode with stops on all alarms as in normal operation mode
Multi-zone fire control	■ 4 setup menus with 8 individual preset values as external control signals (minimum 32 different Multi-zone combinations). ■ Individual set-up selection for FEM operation and special FM setting
Motor controlling	Main PID controller for adjusting motor application, and additional 3 PID for sub applications.
Minimum and maximum speed	Own min-max setting for FEM extending the normal operation speed.
Special ramps for fast reactions	Own ramp-up & ramp-down to speed up the application control.
Environment	
Temperature	■ Extended operation condition with FEM enabled as normal temperature protection alarms are suppressed. ■ Continued operation down to -25 °C with special start-up conditions. ■ Problem-free operation under high load conditions at ambient temperature of+70 °C for minimum 1 hour: - Full load operation on all versions up to and 90 kW(P). - Load derated to 80% on versions from 110KW to and 315 kW versions (N). - Load derated to 68% on versions from 355KW to and 450 kW versions (N).