
APPLICATION GUIDE

ACH580

Override mode





Table of contents

4	What is override mode?
5 – 7	Override for ACH580
5	Introduction
7	Override method of operation
8 – 11	Override application examples
8	HVAC units in residential and commercial buildings
9	Evacuation routes in buildings
10	Tunnels
11	Malls, atriums, arenas and similar large volume spaces
12	Benefits for the owners
13	FAQs
	Notes

What is override mode?

Large buildings and other public facilities need sophisticated heating, ventilation and air conditioning systems. It is absolutely critical for controlling the indoor microclimate not just in everyday use but in extreme situations including fire.

ABB HVAC drives bring enormous benefits to buildings, whether commercial, residential, industrial, educational, and other public constructions. Yet many of these benefits haven't been widely recognized. As a result, end-users can be missing out on considerable cost and time savings, but most importantly, life and property safety. A significant, built-in feature of the modern variable frequency drive ACH580 to provide safety is override mode.

Override mode (that is short for fireman's override mode) makes our HVAC products respond properly in fire/life-safety situations. Thus, override mode in ACH580 allows the drive to run a motor at an adjustable, predefined or PID controlled speed in any direction to assist a building smoke control system during evacuation

and firefighting once a fire occurs. This increases safety of the building's occupants and minimizes fire damage and restoration costs.

The override mode is usually triggered with a special key at the firefighter's control station. Upon receipt of a signal (a contact closure) from the building's fire alarm system, the drive enters override mode and ignores all other irrelevant inputs whether they be analog or digital, and serial communication signals as well as commands from the drive's keypad.

The drive may be programmed to ignore or reset faults to ensure a "run at all costs" operation. Override mode cannot be triggered by any other signal: once override mode is activated, the drive cannot exit this mode until the fire condition signal is reset by opening the contact closure or removing power from the variable frequency drive (VFD).

IMPORTANT: Please check local regulations and requirements before using the system.

Override for ACH580

Introduction

Override mode is activated by a single digital input to the ACH580. When override mode is active, operation of the drive system is defined by a programmed set of parameters and most other control inputs are disabled. It is impossible to edit any of the drive's parameters during override mode. In addition, specific alarms and faults will be ignored or reset.

While this mode is most commonly used in a fire control or a smoke extraction situation, it can be used in any other application that requires such a function.

Fieldbus communications can be used to edit the VFD system's parameters during normal operation, but can neither control the VFD system nor edit its parameters when override is activated.

When ACH580 is in override mode:

- The display of the control panel will show a message that the override is active.
- It will not be possible to change any of the VFD's parameters.
- The HAND, OFF and AUTO keys on the control panel will be disabled.
- The impact of faults depends on their priority:
 - Faults are grouped into high priority faults and low priority faults.
 - High priority faults are displayed and they will stop the drive.
 - Reset of High priority faults can be defined to support limited or infinite reset trials.
 - Low priority faults have no impact on the operation of the system when override mode is activated.
- Configured interlocks, if not satisfied, stop the motor when override is activated.

During override mode, the following low priority faults are typically ignored:

- DC under voltage (although it may force the motor to slow down or stop if it is excessive)
- Analog input signal loss (although it may impact the speed of the controlled motor – programmable)
- Motor over temperature
- Drive over temperature
- Panel loss
- Motor stall
- Underload
- Overload
- Supply phase loss
- Motor phase loss
- Over speed
- Serial communication failure
- External faults
- All other low priority faults

Some faults will cause the system to trip during override mode since ignoring these faults would lead to the system failure. The system can be programmed to attempt a certain number of restarts with a programmed time delay between each restart. This automatic fault reset is programmable independently from the way that such restart attempts are executed during normal operation. These faults are:

- Overcurrent
- Earth leakage
- Short circuit
- DC link overvoltage
- Braking chopper fault
- Safe torque off

Figure 01. ACH580 control panel view for normal and override mode

During override operation, the ACH580 will be able to control its relay outputs, digital outputs, and analog outputs in order to communicate its status to the firefighter’s control station and the building management system. These may be programmed for different functions during override mode than are used during normal operation.

While the system will continue to communicate and provide status information to the building control system via a fieldbus connection, commands from the fieldbus or other connectivity are not able to impact the operation of the VFD System or write to any of its parameters while override is active.

When override is no longer selected, the system will return to its operating state before override mode was activated:

- Any external interlocks which might interrupt the operation of the system during normal operation will again be able to provide the same function.
- The system’s control state of HAND, OFF or AUTO will return to the state it was in prior to override being activated. If the system was running in HAND mode from a LOCAL speed reference, it will resume operation at the same speed reference.
- If the system was in a faulted condition prior to the activation of override mode, the fault will initially be cleared. However, if the same fault occurs once override mode has been disabled, the fault will behave as programmed for normal operation.



Figure 01.

Override method of operation

The function of the override is determined by programming appropriate parameters in the ACH580 system. The parameter settings determine:

- How the speed of the ACH580's output frequency will be controlled.
- The digital and analog signals that will control the system during override mode.
- How the system will respond to external interlocks.
- How faults will impact the system's operation in override mode.
- How the system will attempt to automatically reset faults which cause the system to stop during override mode.

Access to editing these parameters for override operation is password protected during normal operation. The value of these parameters cannot be changed when override mode is active.

Functions of override mode:

Stop

This function stops the motor. Unlike a normal interlock, this will show on the control panel that the override function is active. It will protect the parameters from being changed, and keep the system from running in VFD mode.

VFD

This function activates the VFD in override mode. The system will follow the rules which were programmed for this mode of operation. If the VFD stops functioning, the system will stop.

For VFD override mode the ACH580 is programmed to control the speed of the motor. This may be the same method that is used for normal operation or it may be unique for the override mode. Examples of VFD operating modes are listed below. In all cases, it is possible to reverse the direction of the motor by activating an appropriate digital input.

Preset, fixed speed

When override is activated, the VFD will run the motor at a single, preprogrammed fixed speed.

Preset, multiple fixed speeds

Up to three digital inputs can be programmed to allow the selection of up to 8, preprogrammed fixed speeds. The selected speed can be changed while the system is running in override mode.

Variable speed Control

An analog speed reference signal can be programmed to control the speed of the motor during override operation. While this may be the same speed reference that is used for normal operation, it does not have to be. This speed command cannot be provided through a fieldbus or other connectivity.

Closed-loop PID control

The speed of the controlled motor can be controlled by the VFD's PID controller. This may be the same control method that is used during normal operation, although it may also be unique for override mode. The feedback signal will be hard-wired to one of the VFD's analog inputs. The setpoint may be provided by:

- a drive parameter that is programmed for the desired setpoint.
- an analog input to provide the setpoint for the PID controller.
- selecting from up to four unique setpoints.

The control signals for the override mode can be hard-wired analog and digital inputs. System operation during override cannot be controlled by a fieldbus or any other connectivity.

Floating point control

Two digital inputs are programmed for "increase speed" and "decrease speed". When either is activated, the output frequency of the VFD will change as dictated by the digital input activated. The rate of change of the output frequency will be determined by an appropriate acceleration and deceleration ramp setting.

Override application examples

Figure 02. Smoke control zones in buildings

Most of the deaths or injuries that occur in a fire are not caused by heat or flame, but instead are the result of smoke inhalation and intoxication due to high levels of carbon monoxide and nitrous oxides. Therefore, proper smoke management via airflow control is critically important for keeping people's injuries and deaths as well as building damage to a minimum. Here we give some examples of factors to be considered in fires regarding smoke and air control, and how the ACH580 override mode works in such situations.

HVAC units in residential and commercial buildings

Proper integration of HVAC components including VFDs into a building smoke control system is critical. Modern smoke control systems can automatically identify the location of the fire, stop fresh air supply to the source of fire, exhaust smoke, prevent its further spread and change the evacuation route depending where the fire is detected. To accomplish this advanced control, the VFD package must be specified with care.

In case of a fire in a large building, basically two functions of HVAC fans are required: to extract smoke and to bring in and manage fresh air flows. It must be ensured that no additional oxygen is being fed to the fire, while at the same time delivering air to escape routes and safety zones.

Smoke control strategy depends on numerous factors such as the number of floors and the construction of the building, but usually it implies pressurization technique in combination with compartmentation. In such case a building is considered as a number of smoke control zones that are separated from each other by walls, doors and floors. Depending on building and HVAC system design, a smoke control zone can include several floors and an individual floor may include several smoke control zones.

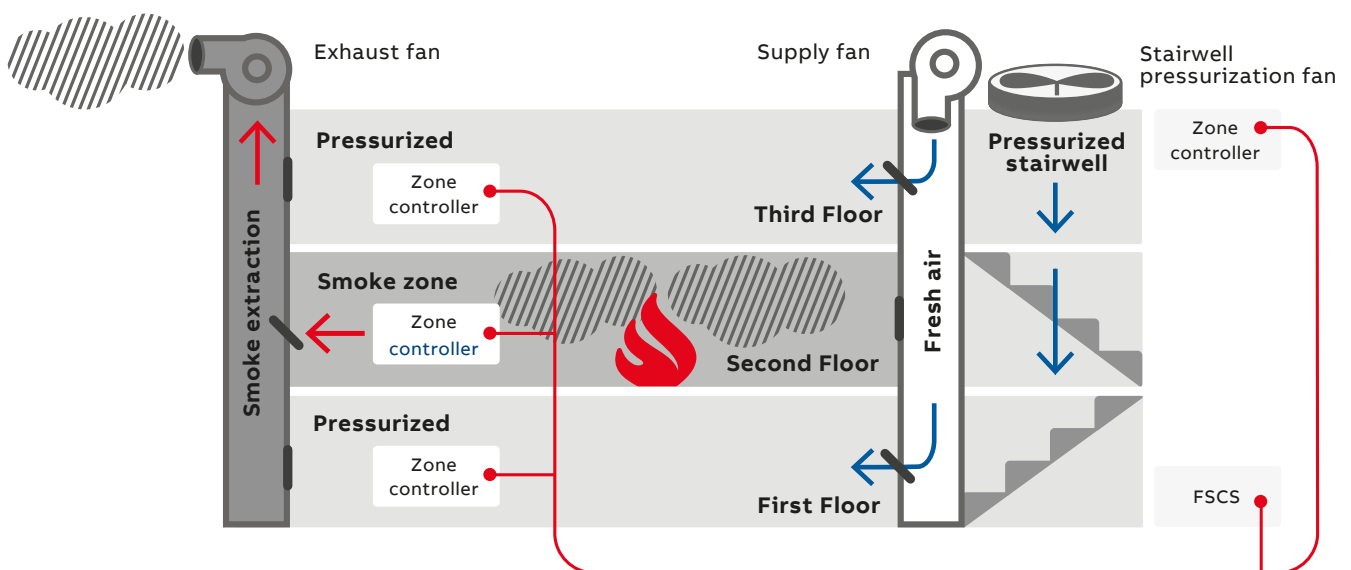


Figure 02.

—
Figure 03. Pressurized stairwell (single injection method)

When a fire occurs in a smoke control zone, all the adjacent zones get pressurized. The fireman's smoke control station (FSCS) may also pressurize unaffected zones or leave them in normal operation. Pressure produced by the fans limit smoke movement from a smoke control zone to adjacent and unaffected zones (figure 2). Some engineers call this concept a pressure sandwich. The ACH580 override feature allows it to run some exhaust fans in reverse to provide additional pressurizing capability that may be applicable in certain cases. Similarly, supply fans in reverse mode can help to remove smoke from the building.

Consequently, the ACH580 override is able to ensure that in complex smoke and airflow situations in large buildings the fans are running in the way required by fire control. So it can be a very useful tool in any smoke control strategy to extract the smoke, while providing fresh air for people.

Evacuation routes in buildings

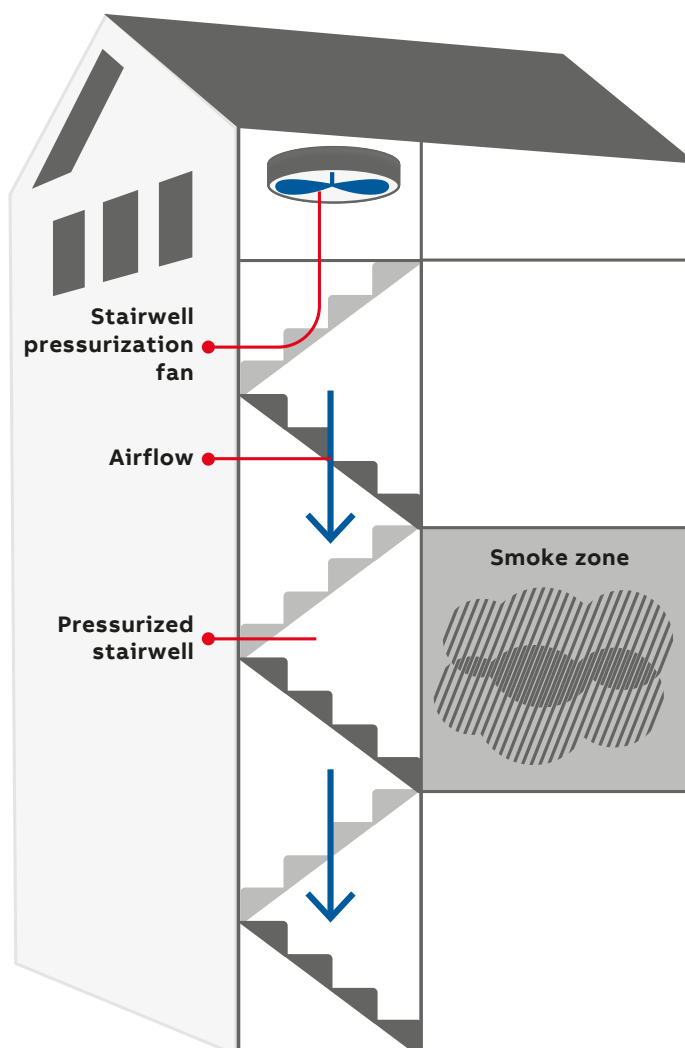
Smoke management for stairwells applies pressurization technique to prevent smoke from spreading through stairwells to other floors and to provide both safe evacuation routes for building occupants and staging area for a firefighting crew. In case of a fire, a stairwell becomes a high-pressure zone and pressure difference across closed stairwell doors prevents smoke infiltration to the stairwell.

Stairwell smoke control can use different air injection and pressure compensation techniques, but the most reliable and efficient solution to the problems associated with insufficient or excess pressure in stairwells is the application of variable frequency drives. VFDs allow to save a considerable amount of energy by running the fan motor at the required speed in normal mode, but the ACH580 is able to control the fan's speed and therefore the pressurization rate even during override mode.

Multiple speed operation during override mode solves a number of significant problems: it allows to avoid too high stairwell pressure that might cause blocking stairwell doors and cutting evacuation roads and, at the same time, keeps the pressure high enough to prevent smoke leakage to stairwell spaces.

Antti Matinlauri, Global Product Manager for HVAC drives, says that the emergence of stairwell pressurization to ensure escape routes are accessible is easier to achieve with a VFD in PID control than with an uncontrolled direct-on-line (DOL) motor. This is because DOL runs the motors at full speed without any control, whereas PID control maintains the pressure in a stairwell at constant value, thereby keeping the stairwell positively pressurized to keep smoke out.

The ACH580 with its ability to control speed, can enable a more elegant and adaptive smoke control strategy than traditional DOL approaches. If there is a sudden pressure change caused by doors opening or windows blowing out or walls burning away, the PID controller detects such changes and alters the motor speed accordingly to keep the pressure correct – DOL cannot do this as it is ON or OFF.



—
Figure 03.

Figure 04. Example of override situation in tunnel ventilation

Tunnels

A road tunnel is a sophisticated engineering construction that has very strict requirements for air quality. Special attention has to be paid to the design of tunnel ventilation systems which control the concentration of contaminants emitted by vehicles in normal operation. However, the most important design requirement is to extract smoke and provide evacuation routes with fresh air in case of a fire.

Smoke control in tunnels is typically achieved by either extracting the smoke through air ducts or by pushing it through the tunnel and out a portal. The choice of smoke control strategy depends on the type of ventilation systems, the mode of traffic operation and the surrounding environment.

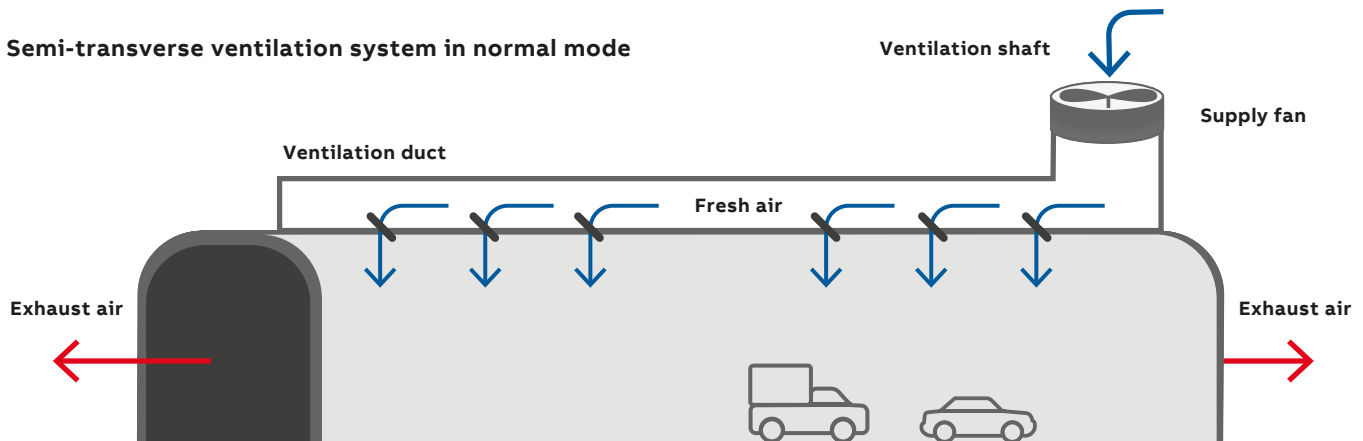
“Regardless ventilation system type, tunnels often ask for more than one fan speed while in override mode,” explains Simo Niskanen, Application Manager for HVAC. Override mode in tunnels typically starts at a low speed to maintain stratification and provide escape routes under the smoke layer. The speed increases after finishing the evacuation, to keep the smoke on the downstream side of the fire and provide a staging area for firefighters. In this case, the fireman’s smoke control station will provide individual contact closures

to the VFD to select the various preset (constant) speeds or use floating point control.

The ACH580 allows to run fans at any speed in either direction to better manage the airflow and control smoke movement inside the tunnel. Depending on the location of a fire and its stage, fire control system defines airflow speed and direction by, for example, placing air supply fans into reverse mode to provide smoke extraction.

Another important feature of the ACH580 indirectly referring to override mode is the ability to handle a flying start. Wind in a tunnel often causes freewheeling of the fans. Override mode presumes fans reversing. Thus, the drive that controls the fan motor, needs to be able to handle a flying start by catching the speed – to either continue turning the fan in the same direction, or change it if necessary. A change of direction can cause a huge mechanical shock to the system. The advantage of flying start capabilities in the ACH580 drive is that it recognizes what is happening in the particular situation and is able to quickly and smoothly “catch the speed” to move the fan in the desired direction, without first having to take the speed down to zero. Flux braking is also possible, so an external braking resistor may not be needed.

Semi-transverse ventilation system in normal mode



Semi-transverse ventilation system in case of fire

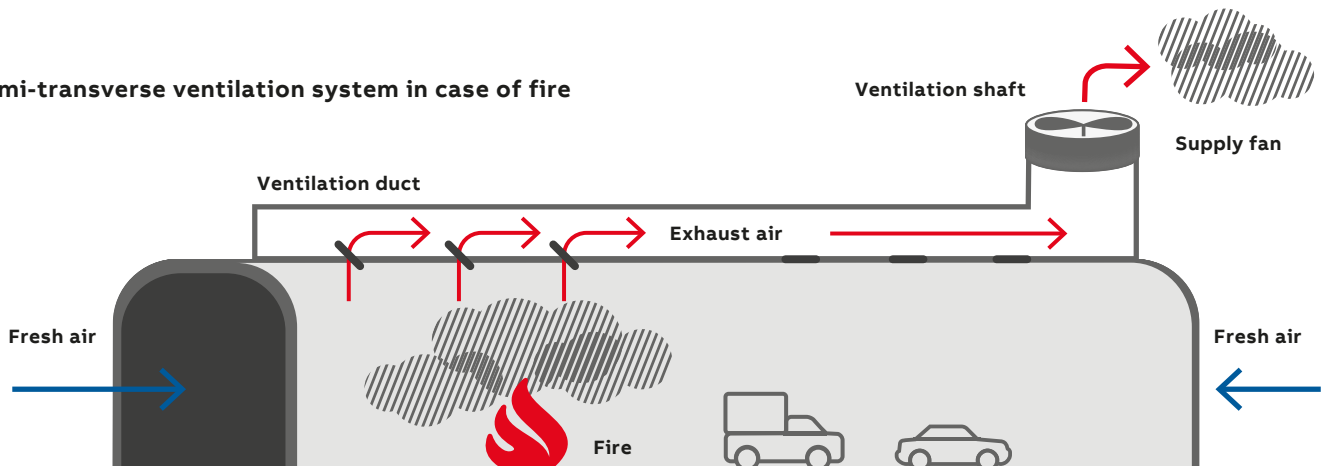


Figure 04.

Figure 05. An example of a smoke exhausting technique in large volume spaces

Tunnel ventilation systems have sophisticated design and high installation and operational costs since they consume a considerable amount of energy and require expensive, high-technology equipment. The ACH580 meets the requirements of the tunnel ventilation system design while also decreasing power consumption, boosting efficiency and increasing fire and life safety.

Malls, atriums, arenas and similar large volume spaces

Similar principles of smoke management apply to long-span, large-volume buildings but it's more difficult to control smoke and air flows since such buildings are quite often oriented more horizontally than vertically.

In case of fire in large volume spaces, a typical strategy is to exhaust smoke through the top of the structure. Smoke management system must be able to maintain smoke layer above the occupiable zone of the highest floor that is used

for evacuation purposes. Therefore, exhaust fans under the ceiling should remove smoke at a rate that is greater than or equal to the smoke production rate, or at a rate that prevents smoke layer descending and supports a safe evacuation.

In certain cases, smoke extraction is followed up by introducing fresh air to the space. Fresh air replaces the volume of smoke exhausted by fans and keeps inner indoor pressure positive to eliminate the process of smoke extraction.

A complex solution for HVAC systems in large volume spaces is required to maintain comfortable environment during normal operation and react properly in emergencies. The ACH580 is well equipped to meet airflow-management challenges in malls, atriums, arenas and similar buildings. The capabilities of bidirectional variable speed fan control, and the flexibility to change from normal mode to override, while ignoring all the low priority fault signals make this drive excellent support for fire control strategies.

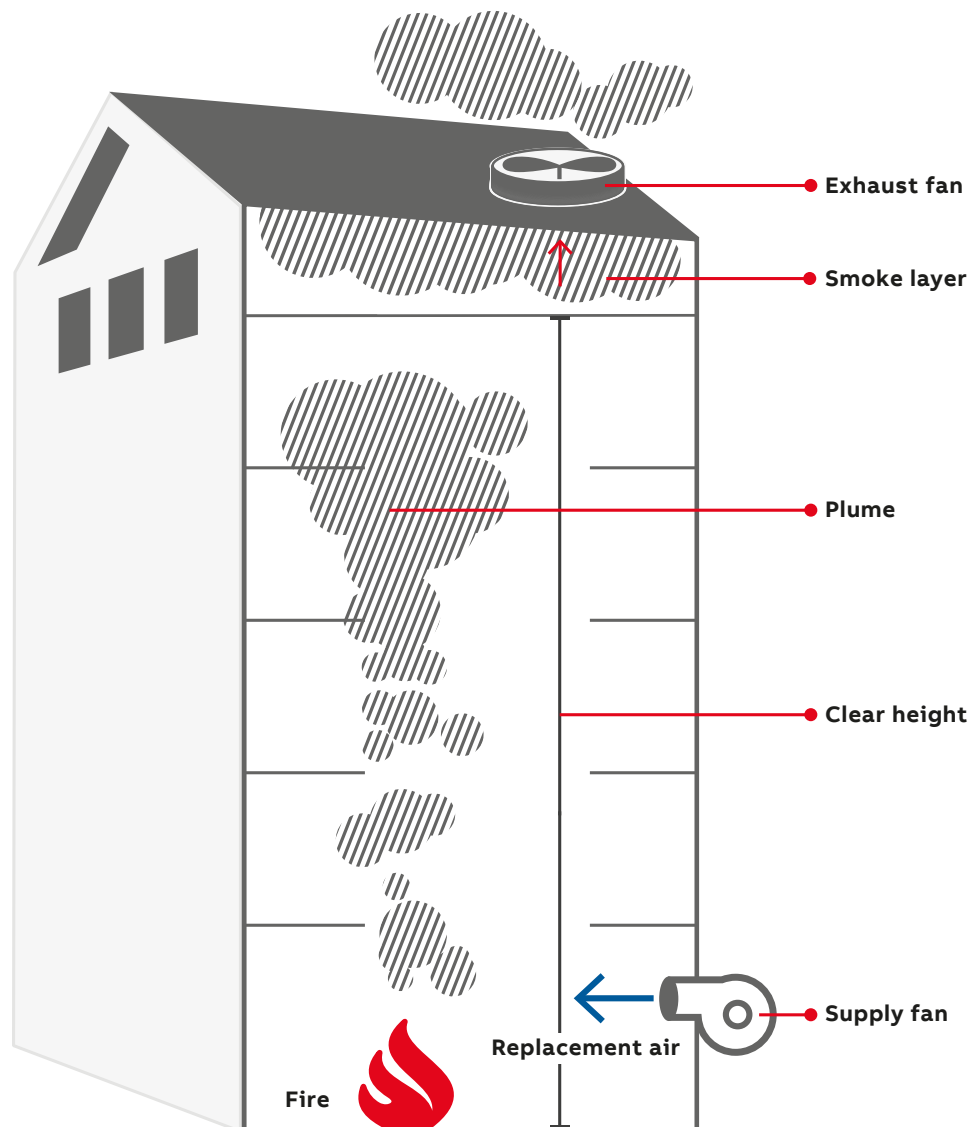


Figure 05.

Benefits for the owners

In addition to saving a considerable amount of energy during normal mode, the ACH580 makes the HVAC and smoke control systems more flexible and more robust during adverse conditions. The ACH580 override mode is one of the features that further enhances this robustness.

One of the key differences between the ACH580 and other drives that can be essential for the owner is the ability to shift from normal mode to override mode and then back again seamlessly without interrupting the operation the HVAC system. So, in buildings where override mode is used for evacuation purposes, properly designed and executed regular inspections and test runs (fire drills) will not upset the HVAC system even when the building is operated. The microclimate or the level of over pressure will not change.

Another important feature of the ACH580 is the ability to be controlled at multiple speeds without interrupting override mode. It is critical for pressure management in stairwells used for evacuation. Multiple speed feature of the ACH580 allows fans to produce enough pressure to keep smoke from entering the stairwell while avoiding too high overpressure that might cause blocking the doors to stairwells and trapping occupants on their floors.

The ACH580 provides reliable and efficient solutions to the problems with insufficient or excess pressure by regulating air flow and therefore pressurization even in case of the override mode. Furthermore, the ACH580 allows the smoke control system to place air supply fans into reverse mode immediately to provide

additional extraction capability in case of fire. ABB Drives engineers pride themselves on designing features specifically for different types of buildings. During the ACH580 design, we concentrated on thorough understanding of the overall HVAC market, VFDs applications and customer requirements. This focus was crucial to the resulting overall ACH580 design strategy, feature set and approach to the HVAC market. The ACH580 design allows the end user not to worry about the lack of any specific feature which their building may require. All advanced features are built-in as standard.

The sales and support departments of ABB Drives as well as ABB channel partners also play a major part in keeping building owners satisfied as spare parts are stocked across the world and are often available the same day. This is highly important when the application is a pressurized hospital, operating room or other critical environment. Components are often needed quickly and the expertise to repair or replace the VFD has to be readily available. ABB's global service and support network provides help whenever and wherever needed.

Residential, commercial, educational buildings, tunnels, arenas and other mission-critical environments all require very specific microclimates and they simply cannot tolerate failure. Fan packages are often sold based upon simplicity and their ease-of-use rather than whether they are fit for purpose. ABB HVAC drives are always fit for purpose, energy efficient, reliable and have spare parts available. All this makes a difference. Whether you are an owner or a contractor, the new ACH580 makes a whole lot of sense.

FAQs

What is Firefighter's override mode?

The override function is a function that aids building services engineers in designing functioning escape routes and escape strategies within a building. It also allows emergency services to easily trigger these essential functions to aid in the evacuation of residents or whilst fighting fires.

Variable speed allows more specific escape routes to be designed by employing areas of positive pressure to hold stairwells open, and because the speed can be variable and under PID control, changing building conditions can be accommodated.

Override mode should also ensure the drive continues to run as long as possible (to destruction if needed) prioritizing this mode and giving maximum availability for the mode once triggered.

How does it work?

Override mode is triggered by the emergency services or the Fire Smoke Control Panel and puts the drive into a pre-defined set of running instructions, including preset speeds and preset control locations.

The function can be protected by password.

When in override mode, the VFD is programmed to ignore most of its trips and warnings that would normally stop the drive, ensuring maximum availability during the emergency.

Why is it important?

Override mode is designed to allow fire departments and other emergency responders to use drives for assistance with smoke management and to maintain escape routes.

The mode is usually triggered with a special key at the firefighter's control station and the drives may then operate the HVAC motors in required direction to remove smoke from the building assisting with visibility and safety during firefighting. The ACH580's override mode also allows stairwell pressurization to be accomplished, which may require motors to be run "overspeed" to keep escape routes free of smoke.

Why is it not a feature of all drives?

The ACH580 has this feature as a standard because of the HVAC industry requirements. The feature allows the drives to take control reducing complicated wiring and central BMS control and it can be activated regardless of the state in which the drive is currently in. Other industries do not require this special function, so it is not included with non-HVAC VFDs.

What happens if there is no such a feature?

Without Firefighter's override mode built into the product, the function would have to be handled by the building management system (BMS), making programming and installation more complex. Also, since the drive has to locally control the motor so that it runs to destruction ignoring most faults, this function could not be performed by the BMS on its own, as the drive needs a special mode to ignore these issues internally. Simpler systems would have to be employed which would be less straightforward to control. As a result, modern high rise buildings would be harder to protect.

100

For more information
and contact details:

www.abb.com/drives
www.abb.com/drivespartners

