Technical note Maintaining required indoor air quality using CO₂ and temperature measurement via ABB standard drives for HVAC



Functional description

- 1. Activating start/stop (DI1) in both AC drives starts supply and return fans.
- 2. With start/stop (DI1) activated, supply fan drive's started relay (RO1) closes and dampers open. With dampers fully open, damper limit switch activates run enable (DI2) and supply fan starts running. Supply fan drive's run relay (RO2) activates return fan drive's run enable (DI2). Return fan starts running.
- 3. Supply and return fans stop if any damper closes, as supply fan drive's run enable (DI2) deactivates. This deactivates return fan drive's run enable (DI2) by deactivating supply fan drive's run relay (RO2).
- 4. Thermal ice detector (TZA) deactivates start enable 1 (DI4) if heating coil's return water temperature falls below setpoint in thermal ice detector. Supply fan stops as start enable 1 (DI4) deactivates. Dampers close as supply fan drive's started relay (RO1) is deactivated. Supply fan drive's run relay (RO2) is deactivated, which deactivates return fan drive's run enable (DI2). Return fan stops running.
- 5. Supply fan drive controls supply fan motor's rotating speed. Faster motor rotation generates higher supply air volume. Drive controls supply air volume via its process

PID controller according to CO₂ content in return air duct. CO₂ content sensor is connected directly to supply fan drive's analog input 1 (Al1). Fan motor rotates faster if high CO₂ content.

- 6. Heating coil varies supply air temperature according to supply air duct temperature. Hot water flow through heating coil is controlled via three-way valve. Higher air temperature demands greater hot water flow. Valve position is controlled by supply fan drive's external PID controller. The temperature sensor is connected to supply fan drive's analog input 2 (Al2) and three-way valve is connected to supply fan drive's analog output 1 (AO1).
- 7. Return fan drive controls return fan motor's rotating speed. Faster motor rotation leads to greater air removal from ventilated space. With variable supply air flow into ventilated space, return air flow is varied to keep pressure difference constant between outside air and ventilated space. Pressure difference sensor measure this situation. The sensor is connected to return fan drive's analog input 1 (Al1). Return fan drive's process PID controller keeps pressure difference constant along with motor speed control through using an AC drive.



Changed parameters Supply fan drive

Below are typical parameter settings, most of which can be adjusted depending on the air quality that is demanded. When the parameter settings are completed, the control panel displays motor output frequency (top line), CO₂ content in the return air duct (middle line) and supply air temperature (bottom line). Note that the display panel shown here depicts the results from this particular parameter setting. This will vary depending on each individual setup.



- 9902 = SUPPLY FAN [2] (application macro selection)
- 1102 = EXT2 [7] (speed reference given by process PID)
- 1301 = 0% (Al1 minimum value, adjustable)
- 1304 = 0% (Al2 minimum value, adjustable)
- 1501 = PID 2 OUTPUT [127] (AO1 output = external PID output)
- 1502 = 0% (AO1 minimum output value, adjustable)
- 2007 = 10 Hz (minimum fan motor speed, adjustable)
- 2202 = 5 s (fan speed ramp-up time, adjustable)
- 2203 = 5 s (fan speed ramp-down time, adjustable)
- 2606 = 12 kHz (switching frequency, selectable)
- 3001 = LAST SPEED [3] (speed if AI signal is lost)
- 3021 = 10% (Al1 signal fault limit)
- 4001 = application specific (process PID gain, adjustable)
- 4002 = application specific (process PID integration time, adjustable)
- 4003 = application specific (process PID derivation time, adjustable)
- 4006 = ppm [34] (process PID actual value unit, selectable)
- 4007 = 0 (process PID actual value scaling, 0 decimals)
- 4009 = 2000 ppm (maximum value of process PID actual value, adjustable)
- 4010 = INTERNAL [19] (process PID setpoint selection)
- 4011 = 700 ppm (process PID internal setpoint value, adjustable)
- 4016 = Al1 [1] (process PID actual value input selection)
- 4201 = application specific (external PID gain, adjustable)
- 4202 = application specific (external PID integration time, adjustable)
- 4203 = application specific (external PID derivation time, adjustable)
- 4206 = °C [9] (external PID actual value unit, selectable)
- 4207 = 1 (external PID actual value scaling, 1 decimal)
- 4209 = 50.0 °C (maximum value of external PID actual value, adjustable)
- 4210 = INTERNAL [19] (external PID setpoint selection)
- 4211 = 22.0 °C (external PID internal setpoint value, adjustable)
- 4216 = Al2 [2] (external PID actual value input selection)
- 4228 = ON [8] (external PID activation)
- 3408 = PID 1 FBK [130] (control panel display signal 2 selection) 3415 = PID 2 FBK [131] (control panel display signal 3 selection)

Changed parameters

Return fan drive

Below are typical parameter settings, most of which can be adjusted depending on the air quality that is demanded. When the parameter settings are completed, the control panel will display motor output frequency (top line), pressure difference setpoint (middle line) and pressure difference actual value (bottom line). Note that the display panel shown here depicts the results from this particular parameter setting. This will vary depending on each individual setup.



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9902 = RETURN FAN [3] (application macro selection)

- 1102 = EXT2 [7] (speed reference given by process PID)
- 1301 = 0% (Al1 minimum value, adjustable)
- 1304 = 0% (Al2 minimum value, adjustable)
- 1608 = NOT SEL [0] (start enable 1, not used)
- 1609 = NOT SEL [0] (start enable 2, not used)
- 2007 = 10 Hz (minimum fan motor speed, adjustable)
- 2202 = 5 s (fan speed ramp-up time, adjustable)
- 2203 = 5 s (fan speed ramp-down time, adjustable)
- 2606 = 12 kHz (switching frequency, selectable)
- 3001 = LAST SPEED [3] (speed if AI signal is lost)
- 3021 = 10% (Al1 signal fault limit)
- 4001 = application specific (process PID gain, adjustable)
- 4002 = application specific (process PID integration time, adjustable)
- 4003 = application specific (process PID derivation time, adjustable)
- 4006 = Pa [45] (process PID actual value unit, selectable)
- 4007 = 0 (process PID actual value scaling, 0 decimals)
- 4009 = 1000 Pa (maximum value of process PID actual value, adjustable)
- 4010 = INTERNAL [19] (process PID setpoint selection)
- 4011 = 200 Pa (process PID internal setpoint value, adjustable)
- 4016 = Al2 [2] (process PID actual value input selection)
- 3408 = PID 1 SETPNT [128] (control panel display signal 2 selection)
- 3415 = PID 1 FBK [130] (control panel display signal 3 selection)

About alarms

There are many different types of alarms available and below is a small sample. The alarms listed here refer to the supply fan and return fan parameters listed above.

- 2006 Al1 loss = analog input 1 is lost, check cabling
- 2007 AI2 loss = analog input 2 is lost, check cabling
- 2021 start enable 1 missing = thermal ice detector tripped
- 2022 start enable 2 missing = return fan not started or fault

For more information please contact:

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