G120P & Stairwell Pressurisation - Application Guide

The Stair-Press application is one of the most difficult tasks for VSDs within the HVAC industry – due to many opposing factors and system variables. To make the commissioning process easier, the task should be broken down into stages, and an example is shown below: -

1. **Motor Commissioning**
   - If using the Basic Operator Panel, navigate to the Setup menu, and proceed as follows.
   - Select Sensor-Less Vector Control for the motor characteristic (P1300 = 20). Using SLVC greatly improves the dynamic response, and can halve the deceleration time.
   - Enter motor nameplate data as listed in the BOP2 Setup menu.
   - Ensure the Motor ID function is set to Still & Rotate (P1900 = 1). Note this should be set automatically when you select SLVC.
   - Skip over the MAc PAr P15 option in the BOP2 Setup menu. This parameter sets the default I/O assignment, but for us, the default setting of #12 is the most suitable.
   - Set the minimum motor speed (P1080) to 20%. For example 300rpm for 4 pole motor.
   - Set the motor ramp up (P1120) and ramp down (P1121) times to 20 seconds each for the initial test phase.
   - After selecting Yes for Finished, an **X** will appear on the screen. This is a warning (A7991) that at the next start command, the drive will do the Motor ID test instead.
   - Enter Hand mode and press the green Start button.
     - Note that an F1030 fault may occur the first time you try to run the motor with a new control unit. To clear this, you must remove the 3 phase power for at least 10 seconds. Once power is restored, the fault will be gone. This is a one time operation. Enter Hand mode again and press the green Start button.
     - The drive will commence the Motor ID test without rotating the motor, and you can hear the phases being pulsed. This normally takes less than a minute. Once complete the drive will go silent. The **X** will still be present.
     - Now press the Start button again to commence the second part of the Motor ID test, which is done with the motor rotating (usually about 40%). This time the speed will remain constant, interspersed with speed 'bursts'. Again, this takes under a minute. Once complete the drive will go silent and the **X** should disappear.
   - Providing no faults or warnings are present, enter the Extras menu, and select RAM to ROM option. Press Ok and wait for the drive to save the current settings into non-volatile memory. Note the results from the Motor ID test are only stored in the RAM by default – so if you cycle the power, these values will be lost and you will be prompted to retest.
   - Now you should start the drive a third time, and check the direction and motor amps at maximum speed – via the Monitoring menu. It would also be a good idea to check for any excess noise or vibration at this time too.
   - This completes the first stage. It is important not to proceed to the next stages if there are any faults or warnings present.

2. **PID Commissioning**
   - This stage really consists of two parts; Pressure regulation, and Step response – in that order.
   - **Part 1 - Pressure Regulation**.
   - Enter the PID parameters listed in the Application, but leave out the ESM ones for the moment. If you like you can temporarily assign P3880 to an unused input (e.g. r722.5).
   - With the doors shut, test the drive in Auto mode by activating the remote relay contact that bridge terminals 9 and 5. Remember to install the link between terminals 28 and 69.
   - Allow the pressure to settle, and adjust the PI values to suit. Recommended starting values are P2280 = 2, and P2285 = 15. The pressure setpoint is defined in P2201, and is typically set between 30Pa to 40Pa.
   - There is a useful feedback sensor time-filter (P2265) that can be used to smooth out any spurious fluctuations in the signal. I would recommend a value of 10 seconds to start with, but note this can be reduced later if the step-response is too slow. Remember there is no substitute for correct signal shielding to minimize EMI, and sensor installation to minimize gravity (e.g. for QBM66.201 diaphragm type) and vibration effects (e.g. when mounting on ducts). Also, try to keep the sensor air line lengths to a minimum.
   - You can check if the drive is controlling properly by looking at the PID error value – shown in r2273. Ideally this should be zero, and the fluctuations should be less than +/- 1%.
   - Other useful parameters include r2260 (actual PID setpoint, which should mirror the value set in P2201), r2272 (the actual stairwell pressure), and r2294 (actual PID output %).
   - At this point it would be a good idea to measure the door pressure, and alter the PID setpoint to suit the requirement. Once this is Ok, we can proceed to testing the step response.
   - **Part 2 – Step Response.**
   - Set the PID output lower limit (P2292) to be just under the value shown at the PID output (r2294). This helps prevent undershooting when the door slams shut
   - Set the PID starting value (P2302) to equal r2292. This greatly increases the response time during the initial start-up.
   - Test the step response by opening a door and letting the drive reach maximum speed. Sometimes the maximum speed will need to be limited – according to air speed/volume through the doors. If this is the case, reset P1082 (maximum motor RPM).
   - Shut the door and watch r2273 for reaction and settling time – which is not to be greater than 10 seconds. You may need to trim the PI values if this is too slow. Don't forget there is also the PID feedback sensor time filter (P2265 = 10 seconds) which may need to be reduced too. If you are experiencing over-voltage trips, then you may need to increase this value.
   - Only once the drive has been fine-tuned to provide an acceptable balance of stability and time-response should you proceed to the ESM stage.
3. **Essential Services Mode Commissioning**.
   - By now all the hard work is done, and you just have to enter the ESM parameters shown in the list. Note that if the remote start signal is still present on DI-0, when you set P3880 = r722.0, the drive will start – even if you are in Hand mode!
   - Retest the pressure control and step-response as before – which should mirror the previous results.
4. **Save your work**
   - It would be a good idea to perform another Ram to Rom in the Extras menu, and also a To BOP panel upload. The BOP-2 has one program memory slot.
   - If you have another stairwell with identical drive and motor specs, then you can shortcut the above by performing a From BOP panel download. In this case you should still test the system and fine-tune as required.
   - If you want to lock the parameters, set P7761=1.

G120P HVAC FW 4.4 – Stair-Press Parameter List

<u>These parameters are set during the Setup menu</u>

P1080, 0) = 450.000   'Minimum speed
P(1120, 0) = 20.000   'Ramp-function generator ramp-up time
P(1121, 0) = 20.000   'Ramp-function generator ramp-down time

<u>These parameters are set after the Setup and basic motor testing</u>

P(1200, 0) = 1   'FlyRest oper mode
P(1210, 0) = 26   'Automatic restart, mode
P(1213, 0) = 0 sec   'Automatic restart, Off timer
P(2200, 0) = 722.0   'BI: Technology controller enable
P(2201, 0) = 40.00 %   'CO: Technology controller, fixed value 1
P(2253, 0) = 2201   'CI: Technology controller setpoint 1
P(2261, 0) = 10.00 sec   'Technology controller setpoint value filter time constant
P(2264, 0) = 755.0   'CI: Technology controller actual value
P(2265, 0) = 10.00 sec   'Technology controller actual value filter time constant
P(2267, 0) = 120.00 %   'Technology controller upper limit actual value
P(2268, 0) = -10.00 %   'Technology controller lower limit actual value
P(2280, 0) = 2.000   'Technology controller proportional gain
P(2285, 0) = 15.000 sec   'Technology controller integral time
P(2289, 0) = 2292.0   'CI: Technology controller pre-control signal
P(2293, 0) = 10.00 sec   'Technology controller ramp-up/ramp-down time

<u>These parameters need to be reset after the PID part 1 test</u>

P(2292, 0) = 30.00 %   'CO: Technology controller minimum limiting
P(2302, 0) = 35.00 %   'Technology controller output signal starting value

<u>These parameters are set after the PID part 2 test</u>

P(3880, 0) = 722.0   'BI: ESM activation
P(3881, 0) = 4   'ESM setpoint source
P(3884, 0) = 2201.0   'CI: ESM setpoint technology controller

G120P HVAC FW 4.4 – PID LOOP GLOSSARY

Here is a list of the most commonly used parameters. Also shown are some of the lesser known parameters that can provide very useful PID enhancements.

- P2200 This is the PID enable, and you have a choice of either setting to 1 (on all the time), or pointing to a parameter like r722.n – which is the address of the digital inputs. To avoid integral wind-up, I would recommend using the later method.
- P2201 This is the first PID fixed setpoint.
- P2253 Selects the PID loop setpoint source. Typically you would point this to P2201.
- P2257 & P2258 Ramp up and ramp down times for PID loop. When the PID loop is activated, the standard ramp times (P1120 & P1121) are bypassed.
- r2260 Displays the actual PID working setpoint, and is useful for indicating if the PID loop is actually activated. If it is not, then this value will show zero.
- P2261 This is the setpoint signal time filter, and is used to prevent faults caused by excessive acceleration and deceleration of the motor. This is needed because the ramp-up/down times are bypassed when the PID loop is enabled.
- P2264 Selects the source of the PID feedback, and is usually pointed to r755.n – which is the analogue input address.
- P2265 This is the feedback signal time filter, and is very useful for smoothing a sensor signal that may be jumping around due to mechanical vibration, resonance effects, and EMI.
- P2267 This is the feedback sensor upper value failure threshold. It triggers F7426 (Off2).
- P2268 This is the feedback sensor lower value failure threshold. It triggers F7426 (Off2).
- r2272 This is a useful read-only parameter for checking the actual feedback value from the sensor.
- r2273 This is another read-only parameter which shows the difference between the setpoint and the sensor values (r2273 = r2260 - r2272). This is commonly referred to as the PID error value, and when the system is running, this value should be very close to zero. This parameter is especially useful when you are tuning the PID loop. When the sensor value is below the setpoint, this value is positive.
- P2280 This is where you set the PID Proportional gain value. The larger the number means the greater the sensitivity to the feedback error value – shown in r2273.
- P2285 This is the PID Integral time value. The smaller the number, the faster the response to the feedback error in r2273.
- P2292 This acts as the PID output lower limit, and prevents the output dropping below a nominated value. This should be used to eliminate the 'dead area' created by the minimum motor speed (P1080), and so improve the reaction time (or step response). Setting to 30% equates to 15Hz.
- P2293 This is the PID output ramp up and ramp down time setting. It is important to set this parameter, as the standard ramp up (P1120) and ramp down (P1121) times are bypassed when the PID loop is enabled.
- r2294 This is the output of the PID loop, and is a culmination of the individual PID processes, as well as any offset parameters like P2289, P2292, and the inversion parameter P2306.
- P2302 This provides a useful PID output starting value. When the PID loop is first enabled, the drive will ramp to this value first before allowing the PID loop to take over. It can greatly improve the initial response time of the drive. Note that this should only be set after the PID loop has been tuned and the setpoint agreed upon.
- P2306 This is the parameter responsible for selecting direct or reverse (in-direct) acting PID loop. The default value of 0 provides for indirect – which is suitable for the stair-press system.

G120P STAIRPRESS APPLICATION
– SINGLE ZONE VERSION

CU230P–2 HVAC CONTROL UNIT

31	+24V IN
32	GND IN
1	+10V OUT
2	GND
3	+AI.0 DSW
4	−AI.0
10	+AI.1 DSW
11	−AI.1
50	+AI.2 DSW
51	GND
52	+AI.3
53	GND
9	+24V OUT
28	GND
69	DI COM
5	DI.0
6	DI.1
7	DI.2
8	DI.3
16	DI.4
17	DI.5
14	T1 MOTOR
15	T2 MOTOR
+	+RS485
−	−RS485
S	SHIELD

+0−10V
0V

200MA MAX

FIRE RELAY

QBM66.201
100/200 Pa DP SENSOR 1

G
U
M

+
−

+ TO STAIRWELL
− TO REFERENCE

NOTE: SET DIP SW DOWN FOR 100PA RANGE

USUALLY MOUNTED IN STAIRWELL

– CONTINUED

18	DO.0 NC
19	DO.0 NO
20	DO.0 COM
21	DO.1 +
22	DO.1 −
23	DO.2 NC
24	DO.2 NO
25	DO.2 COM
12	+AO.0
13	GND
26	+AO.1
27	GND

FAULT (R)

RUN (G) N / A

30VDC 0.5A TRANSISTOR OUTPUT

240VAC MAX 2A PER CONTACT

NOTE DSW: SET DIP SW FOR SIGNAL TYPE
NOTE: BOX DENOTES ISOLATED FROM GND

DESCRIPTION

STAIRWELL PRESSURIZATION IS NORMALLY TRIGGERED BY A FIRE ALARM CONTACT. THE DRIVE IS SET FOR ESSENTIAL SERVICES MODE, WHICH OPTIMIZES THE RUN TIME BY MODIFYING THE FAULT REACTION. ONCE ENABLED THE DRIVE WILL CONTROL THE FAN TO MAINTAIN A SET PRESSURE WITHIN THE STAIRWELL.

THE CONTROL PARAMETERS LIKE SETPOINT (P2201), PROPORTIONAL GAIN (P2280), AND INTEGRAL TIME (P2285) MAY NEED TO BE ADAPTED TO SUIT THE PARTICULAR JOB. SEE NEXT PAGE FOR THE PARAMETER LIST. THE PARAMETERS AT THE END OF THE LIST STARTING WITH 'R' HAVE BEEN INCLUDED TO PROVIDE HANDY, READ−ONLY POINTS OF INTEREST TO MAKE COMMISSIONING EASIER.

ENSURE THE BASIC MOTOR COMMISSIONING HAS BEEN SUCCESSFULLY COMPLETED FIRST.