

Application Note 5: Drive closed loop and sleep mode

Introduction

This application note is meant to be a guideline for using Danfoss VLT Aqua Drive in closed loop applications which allows the pump/fan to be stopped for a period of time depending on the demand. The idea is to make an easy guideline of how to commission the VLT® AQUA Drive.

Application description

The system consists could be a pump application, where the pump can be stopped in a low demand period in order to reduce energy consumption.

In Danfoss we call it sleep mode.

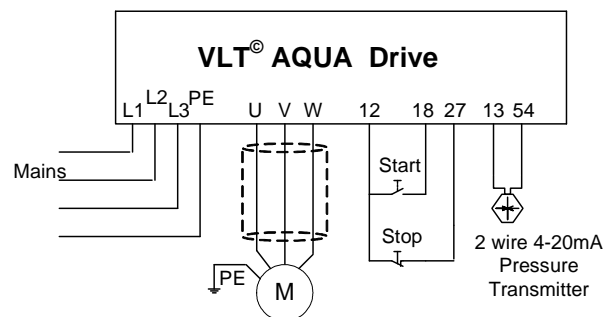
In VLT® AQUA Drive sleep mode can be entered in two ways. It can based on a low speed detection, where the closed loop simply runs the drive at minimum speed for a user specified time, where after the drive enter sleep mode and wait for wake up signal which is a difference in % to the setpoint defined by the user. Or it can be based on a low flow/low Power detection, where the drive simply compare the current power at the current speed with a power curve set up in the drive at commissioning. The first one is the most simple and the second option will monitor the flow demand at all speeds.

The application note describes an example with installation diagram, all needed parameters and typical settings.

Example

In the example below the application considered is a water boost pump with a 4-20mA pressure transducer with a pressure range of 0-10bar controlled in closed loop maintaining a setpoint of 4Bar. The pressure transmitter is connected to the second analogue input terminal 54 in order to make commissioning easy and possible with the quick menu. (This is recommended for all closed loop applications, since most needed settings then will be default and available in the quick menu)

Electrical wiring



Typical Parameter settings

Typical/recommended settings in brackets().

Parameters:

General settings

Change display language P0-01
 Set motor speed unit P0-02 (RPM/Hz)

Motordata

Motor rated power P1-20 /P1-21 (kW/HP)
 Motor rated Voltage P1-22
 Motor current P1-24
 Motor rated speed P1-25

Please set analogue input 2, (terminal 54) format to mA. (Switch 202)

Enable Automatic Motor Adaption (AMA in parameter 1-29)

Display settings

The display can be set up to show 5 different variables.

The variables can be changed in P0-2* but default it will show, setpoint, current, frequency and feedback.

References

- Min reference P3-01 (30Hz)
- Max reference P3-02 (50/60Hz)
- Normal ramp up time P3-41 (8sec.* Depending on size)
- Normal ramp down time P3-42 (8sec.* Depending on size)

Limits

- Motor min speed P4-11 (30Hz)
- Motor Max speed P4-13 (50/60Hz)

Closed loop settings

For easy setup closed loop setting it is an advantage to use the closed loop wizard under “Quick Menu_Function_Setup” or use the following from main menu.

- Change from open to closed loop operation P1-00 (closed loop)
- Feedback unit P20-12 (Bar, PSI, etc)
- Low scaling value of feedback P6-24 (0 Bar) Match the transducer range
- High scaling value of feedback P6-25 (10 Bar) Match the transducer range

- PID settings
- Choose normal or inverse control P20-81 (Inverse = level control)
- Choose PID start speed P20-83 (30Hz)
- Set point P20-21 (ex. 6 Bar)

The PID gain and integral time can be set in P20-93 and P20-94 or these can be autotuned for max performance by the following steps.

Please note PI Auto tune must be enabled from LCP. Not possible from MCT10.

The PI auto tune parameters are located in P20-7*.

For many applications default values is sufficient, but the following parameters is recommended to consider before carrying out the PI auto tune.

- Closed loop type P20-70 (fast or slow reacting system)
- Max output change during auto tune P20-72 (default +/-10%)
- Min allowable feedback level P20-73 (in critical systems the auto tune will stop, if the feedback falls below this level in units)
- Max allowable feedback P20-74 (Same as P20-73, just max level)
- Enable auto tune P20-79
- Follow the steps shown in the display

After auto tune is completed You can accept the calculated values or cancel. If accept is chosen the system will be ready to run in closed loop.

Sleep mode

In systems with varying demands the pump may be stopped during low flow periods in order save energy.

Sleep mode based on low speed detection

- Enable low speed detection P22-22
- Choose function at low speed P22-23 (Sleep mode)
- Choose low speed delay before entering sleep mode P22-24 (the time running on low speed)
- Set up wake up feedback level in % from setpoint when the feedback is 10% below the set point P22-44 (10% will wake up the drive)

Boos mode

The drive can be set up to boost the pressure before entering sleep mode in order to let the drive be stopped for a longer time period. To be used in constant pressure systems.

To enable boost, use the following steps.

- Set the pressure at which the pressure can be increased in % of set point P22-45
- Set the maximum boost time, the drive can be allowed to boost the pressure P22-46