Optidrive Applications Support Library

Application Note	**AN-ODV-2-073**
Title	**Multi Pump Cascade Control**
Related Products	**Optidrive HVAC**
Level **1**	1 – Fundamental - No previous experience necessary 2 – Basic – Some Basic drives knowledge recommended 3 – Advanced – Some Basic drives knowledge required 4 – Expert – Good experience in topic of subject matter recommended

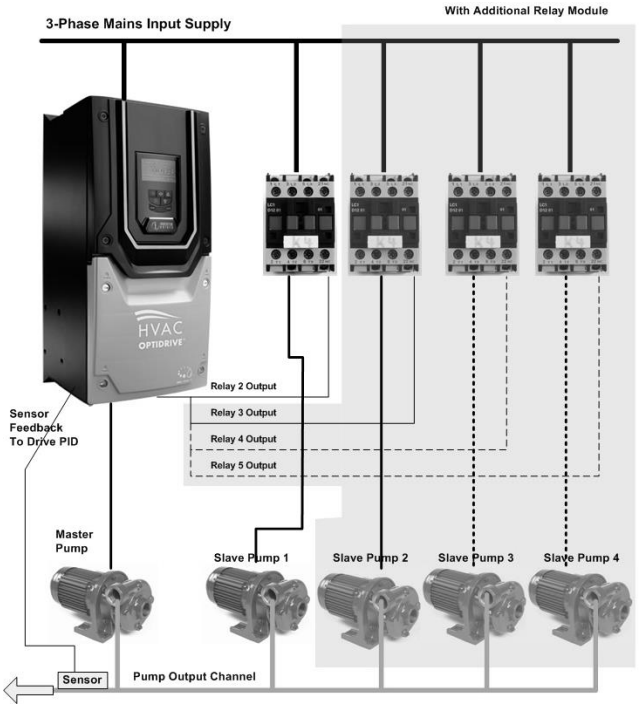
Overview

Optidrive HVAC has a dedicated Multi Pump Cascade Control feature embedded, allowing multiple pumps to be controlled in a closed loop system using a single drive. The drive itself can control a single pump in variable speed operation, and in addition, the starting of a single fixed speed assist pump. By adding the Cascade Option Module (OPT-s-CASCD-IN), an additional 3 fixed speed assist pumps may also be added.

The fixed speed pumps may be DOL, Star / Delta or Soft Started, and this is the choice of the user. The Optidrive HVAC simply determines when to start and stop the fixed speed assist pumps by monitoring the system pressure / head, and controlling its own output frequency and the staging of the assist pump.

System Overview Diagram

The below illustration shows the use of an Optidrive HVAC unit as the controller in a DOL pump staging system. The Master pump in this configuration is controlled from the output of the Optidrive HVAC in variable speed mode with direct relay control of up to four DOL slave pumps as shown below.



Relay 1 on the standard I/O terminals of the Drive (T14 & T15) cannot be used as part of the DOL control but is freely programmable to other functions through parameter P2-15. Relay 2 on the standard I/O terminals of the Drive (T17 & T18) can be used as the DOL control for the first

slave pump. Relay 2 is set to DOL control by setting parameter P2-18 = 8, or can be used for an alternative function by setting a value other than 8.
For staging configurations with more than one slave pump an optional extended I/O option module will be required. Options modules are available allowing up to 3 further slave DOL pumps (giving a maximum of 4 DOL slave pumps) to be connected. Intermittent switching relays may be required if the contactor voltage or current requirement is outside of the specification of the drive relays (see section 4.7, Control Terminal Connections).
The system output sensor is connected to the Optidrive HVAC analog input 1 or 2 (T6 or T10) and is selected as the feedback to the drive PID controller. See parameter menu 3 for PID configuration parameters and feedback selection.

Operational Overview:
The pump staging with DOL cascade function is enabled by setting parameter P8-14=1 (Pump staging function select). In addition, the value of P8-15, 'Pump staging DOL pump availability' must be set with the number of Slave DOL pumps available (to a value other than 0).
The Optidrive HVAC Drive runs the master pump in variable speed control. The number of Slave DOL pumps available in the system is configured by parameter P8-15. At a predefined level the slave DOL pumps are brought on-line in sequence to assist the Master variable speed pump. Switch on sequence is defined by the pump run time clocks (monitored and maintained by the Optidrive HVAC) with the least run time pump switched in first. A pre-defined settle time (Set in P8-19) is observed before any further pumps are switched in or out of the system. This allows the system to reach a steady operating state before additional pump requirements are assessed. Pump switch off is done at a predefined level in the sequence of least run time.
The maximum difference in run time between DOL slave pumps can be limited by setting the 'Pump Staging Duty Switch Over Time' parameter (P8-16). When a value is entered into P8-16 the Optidrive HVAC will automatically switch off the DOL slave pump with the longest run time and switch in the pump with the shortest run time once the difference in run times set in P8-16 is exceeded. When P8-16 is set to 0 pump switch-over based on run time is disabled and switch over is determined only by the threshold limits (demand based).
Duty run time clocks are available to view in P0-19. Clocks are reset by setting parameter P8-20 'Pump Staging Master Clock Reset' to 1 (reset).

Quick Setup Overview:

- Set Basic parameters P1-01 to P1-10. Energy Optimiser P1-06 must remain disabled.
- Set Parameter P1-14= 101 to allow access to extended parameters
- In Menu 3, Configure parameters for the PID Control
- If drive relay 2 is used as part of the slave DOL cascade then set P2-18 = 8
- Set parameter P8-14=1 to enable the Pump staging – DOL cascade function
- Set the number of DOL slave pumps available in the system (not including Master VFD pump) in P8-15
- Set Optidrive HVAC operating speed limits used to activate / deactivate DOL slave pumps as follows:
    - P8-17: Pump Staging DOL Switch In Speed – Threshold to bring in DOL Slave pump
    - P8-18: Pump Staging DOL Switch Out Speed – Threshold to switch out DOL Slave pump
- Set a pump staging settle time (minimum 10 seconds) in P8-19. The time entered in P8-19 must be sufficient for the PID feedback signal from the system output sensor to settle to a steady level.
- If the duty run times between DOL slave pumps are to be balanced then the maximum permissible difference in hours should be entered in P8-16.

Appendix

Revision History			
Issue	Comments	Author	Date
01	Document Creation	KB	28/04/14