Technical Note

Tank Level Control with VFD
## History

<table>
<thead>
<tr>
<th>Rev.</th>
<th>Comments</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.0</td>
<td>First published</td>
<td>12th September 2022</td>
</tr>
</tbody>
</table>
# Table of Contents

1 Introduction .............................................................................................................................. 4
2 Two Point Level Control with Digital Level Signals .......................................................... 5  
   2.1 Filling ....................................................................................................................................... 5  
   2.2 Emptying ............................................................................................................................ 6  
   2.3 Pumping Over ..................................................................................................................... 6  
3 Two Point Level Control with Analogue Level Sensor ...................................................... 7  
   3.1 Filling ....................................................................................................................................... 8  
   3.2 Emptying ............................................................................................................................ 8  
4 Continuous Level Control with Analogue Level Sensor ................................................... 9  
   4.1 Filling ....................................................................................................................................... 10  
   4.2 Emptying ............................................................................................................................ 10
1 Introduction

Tank level control is a very common requirement in pump applications. This technical note shows how to control tank level with two digital sensor signals or with an analog level sensor through a variable frequency drive.

Be aware that this document addresses qualified persons, and it cannot replace profound technical education and training.
2 Two Point Level Control with Digital Level Signals

Two digital 24 V signals define the upper and lower tank level. If the pump function is to fill the tank, the lower level signal starts the pump and the upper level signal stops the pump. In tank emptying applications, the upper level signal starts the pump and the lower level signal stops it. To pump over from one tank to another, connect the starting sensors in parallel and the stopping sensors in series. The sensor states in the schematics show the empty position.

Table 2.0.1 Two Point Level Control Parameters by Drive Model

<table>
<thead>
<tr>
<th>Functional Description</th>
<th>Parameter Number</th>
<th>C200, C2000 series, M300 series</th>
<th>VFD-E, VFD-EL, VFD-EL-W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation Command Source</td>
<td>00-21 = 1</td>
<td></td>
<td>02.01 = 1 or 2</td>
</tr>
<tr>
<td>Operation Control</td>
<td>02-00 = 3</td>
<td></td>
<td>04.04 = 2</td>
</tr>
<tr>
<td>Enable Drive</td>
<td>02-04 = 49</td>
<td></td>
<td>04.06 = 16</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>04-09 = 8</td>
</tr>
</tbody>
</table>

2.1 Filling

Figure 2.1 Sensor Configuration for Tank Filling
2.2 Emptying

Figure 2.2 Sensor Configuration for Tank Emptying

2.3 Pumping Over

Figure 2.3 Sensor configuration for Pumping Over
3 Two Point Level Control with Analogue Level Sensor

Only applicable to C200, C2000 series and M300 series drives. This sensor configuration does not work in pump over applications.

The pump operates between two definable levels. The settings assume that the sensor signal rises with the tank level, e.g. with a capacitive or pressure-based sensor. If the sensor signal rises contrary to the tank level, like with an ultrasonic sensor, reverse the direction of parameter 02-18.

For tank filling, the lower level signal starts the pump and the upper level signal stops the pump. For tank emptying, the upper level signal starts the pump and the lower level signal stops it.

Table 3.0.1 Two Point Level Control Parameters by Drive Model

<table>
<thead>
<tr>
<th>Functional Description</th>
<th>Parameter Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation Command Source</td>
<td>00-21 = 1</td>
</tr>
<tr>
<td>Output Signal ‘Analog Level Reached’</td>
<td>02-16 = 67</td>
</tr>
</tbody>
</table>
| Control Direction | 02-18 = 0 for filling  
02-18 = 8 for emptying |
| Analog Level Source | 03-44 = 0 for AVI or AVI1  
03-44 = 1 for ACI  
03-44 = 2 for AVI2 or AUI*1 |
| Upper Level | 03-45 = Desired Maximum Level in % |
| Lower Level | 03-46 = Desired Minimum Level in % |

*1: AVI2 or AUI only available on C200 and C2000 series drives
3.1 Filling

Figure 3.1 Sensor Configuration for Tank Filling

3.2 Emptying

Figure 3.2 Sensor Configuration for Tank Emptying
4 Continuous Level Control with Analogue Level Sensor

The pump maintains tank level constant at the percentage that the speed set point is of the maximum speed defined in parameter 01-00.

E.g. 01-00 = 50 Hz, set point = 25 Hz → the tank level control aims for 50% tank level.

The settings and schematics assume that the sensor signal rises with the tank level, e.g. with a capacitive or pressure-based sensor. If the sensor signal rises contrary to the tank level, e.g. with an ultrasonic sensor, reverse the function of parameter 08-00 for C200, C2000 series and M300 series or of parameter 10.01 for VFD-E, VFD-EL and VFD-EL-W drives.

Table 4.0.1 Continuous Level Control Parameters by Drive Model

<table>
<thead>
<tr>
<th>Functional Description</th>
<th>Parameter Number</th>
<th>C200, C2000 series, M300 series</th>
<th>VFD-E, VFD-EL, VFD-EL-W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback Source</td>
<td>03-00 = 5 for AVI</td>
<td></td>
<td>10.01 = 0 or 1 for AVI</td>
</tr>
<tr>
<td></td>
<td>03-01 = 5 for ACI</td>
<td></td>
<td>10.01 = 2 or 3 for ACI</td>
</tr>
<tr>
<td></td>
<td>03-02 = 5 for AUI*1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PID Level Control</td>
<td>08-00 = 1 for emptying</td>
<td></td>
<td>10.01 = 0 or 2 for emptying</td>
</tr>
<tr>
<td></td>
<td>08-00 = 4 for filling</td>
<td></td>
<td>10.01 = 1 or 3 for filling</td>
</tr>
</tbody>
</table>

*1: AVI2 or AUI only available on C200 and C2000 series drives
4.1 Filling

![Diagram of Tank Filling](image1)

Figure 4.1 Sensor Configuration for Tank Filling

4.2 Emptying

![Diagram of Tank Emptying](image2)

Figure 4.2 Sensor Configuration for Tank Emptying