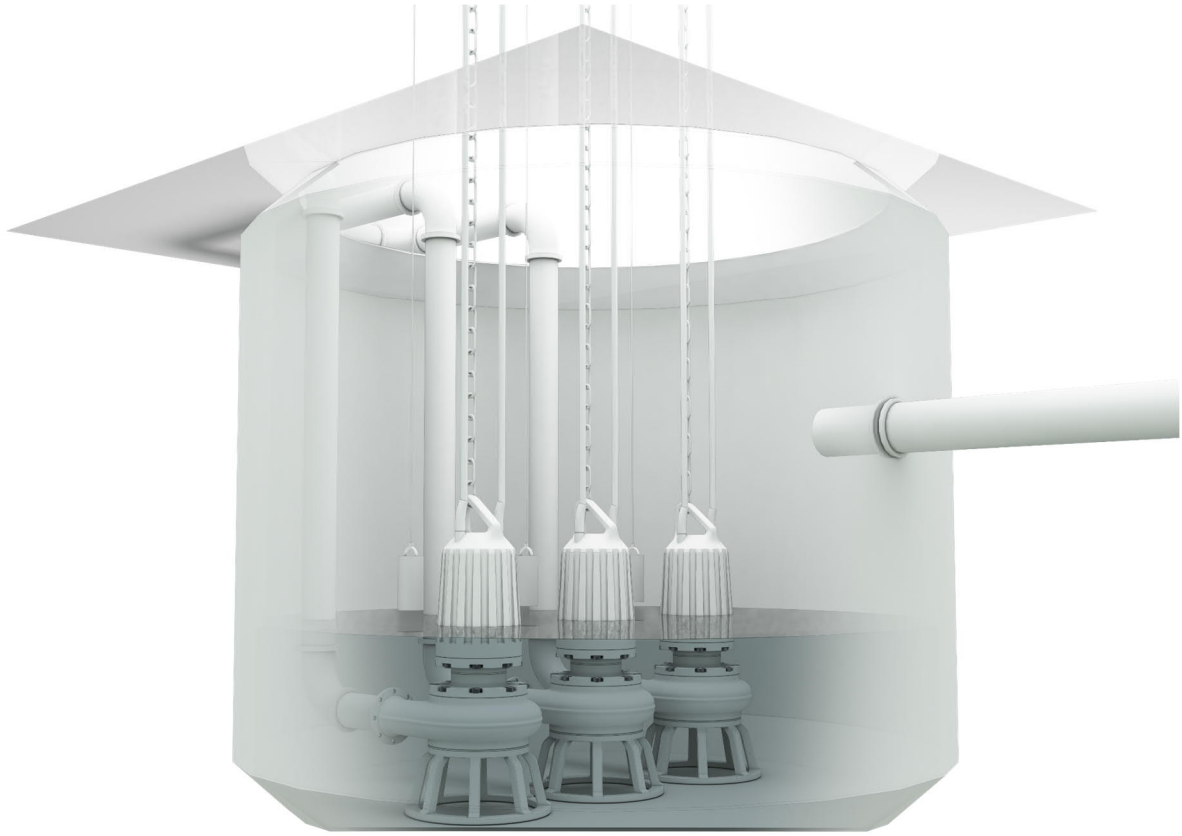
ABB DRIVES FOR WATER AND WASTEWATER

Level control ACQ580

This guide assists with the setup and use of the ACQ580 level control function in detail.



Contents

Introduction

Wet wells, sewer pumping stations or lift stations are used to move wastewater to higher elevations in order to allow further transport to the wastewater works by gravity flow. Sewage is processed into and sometimes stored (until it reaches a determined level) in a sealed underground pit.

Instrumentation is used to detect the level of sewage and when the level rises to a predetermined point, a pump is started to lift the sewage upward through a pressurized pipe system (sewer force main or rising main). Depending on the size and variation of the inflow and the degree of inconvenience in case of pump failure, there are often multiple pumps in a wet well. The number, spacing and size of pumps in the well is designed to minimize pump starts and stops (thus, reducing energy use and mechanical wear), while avoiding too long of a retention time in the tank (preventing the sewage from becoming septic and smelling).

Since catchment characteristics change (i.e. extra demand from rainwater runoff) and flow estimates can be inaccurate, accurate pump selection can be difficult, hence oversizing is a common practice. Running an oversized pump at its Best Efficiency Point (BEP) instead of at full speed is an excellent reason to apply a variable frequency drive on the pump.

The picture below shows a traditional wet well set up. There are three level sensors (highlighted with red dots) in the pit to operate the pumping station with three pumps, via a PLC.

- Bottom sensor: Stop level
- Middle sensor: Start level 1 (1st pump)
- Top sensor: Start level 2 (2nd pump)

Whether filling a water tank or emptying a wet well, the level control function in the ACQ580 is an extremely helpful and easy to use feature.

The function helps the pumping system achieve economical and reliable wastewater tank emptying or potable water reservoir filling by

- Optimizing energy usage, as the pumps are running at the most efficient speed
- Avoiding caking by varying the surface level
- Ensuring sufficient wastewater flow in the pipelines to avoid sedimentation
- Creating a redundant system to ensure continuous operation
- Removing the need for mechanical components (float switches)
- Eliminating the need for a PLC

The level control function

Typical set up

There are two operation modes available in the level control:

- filling for potable water applications; the goal is to fill, for example, the water tower
- emptying for wastewater tank application; the goal is to empty the wastewater sewage collection tank

The level control function utilizes three external signals:

- Analog input for the measured level of the liquid
- Digital input for the high-level sensor*
- Digital input for the low-level sensor*

* the internal response to this sensor differs depending on if the ACQ580 is filling or emptying a tank.

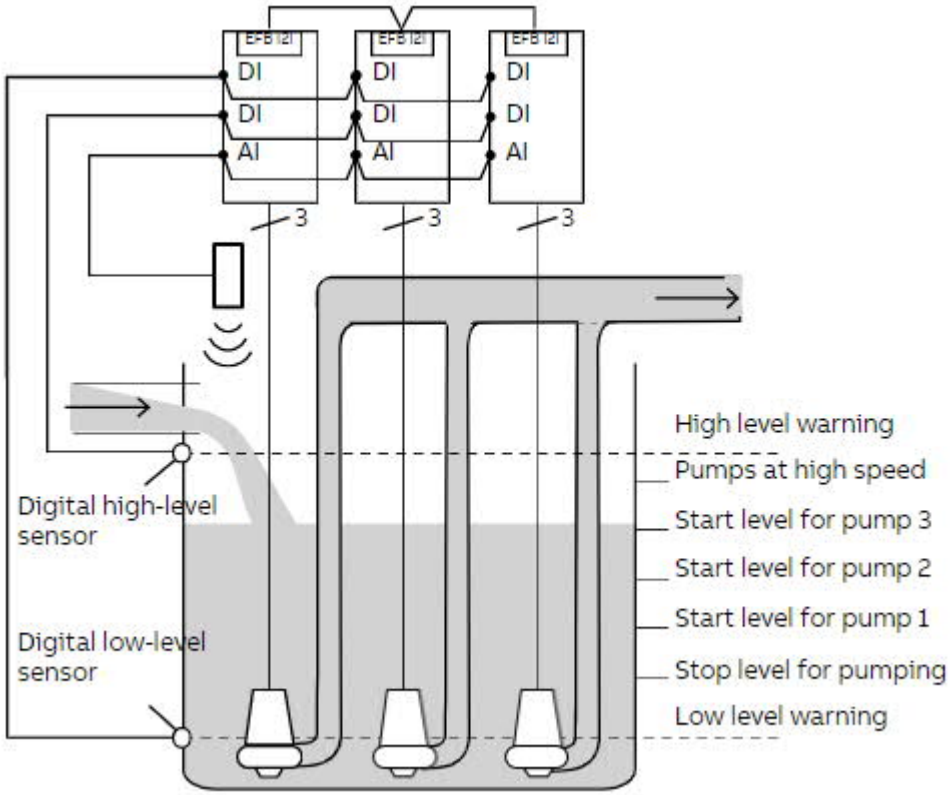


Figure 1: Example of typical wet well set up with three pumps

Please note:

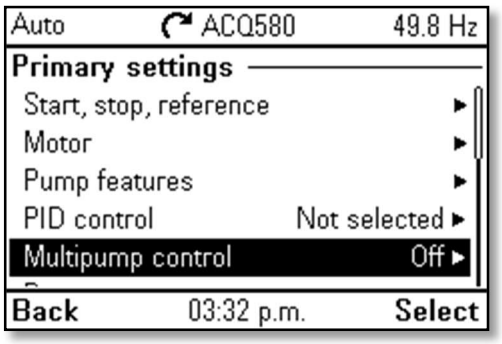
- The level control function is typically used with multiple pumps; however, it can be used with a single pump.
- The level control does not regulate to a level (i.e. it's not a PID function), it runs the pumps at either the BEP speed or full speed.

Commissioning the drive(s)

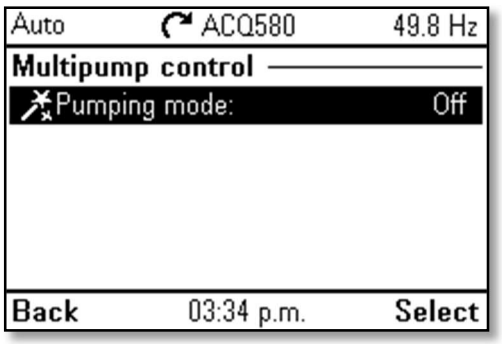
How to set up the level control function

Using the assistant control panel, access the Multipump control section in the Primary settings.

Menu – Primary settings – Multipump control

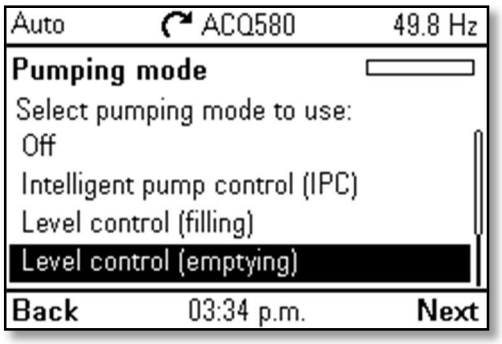


Select Pumping mode



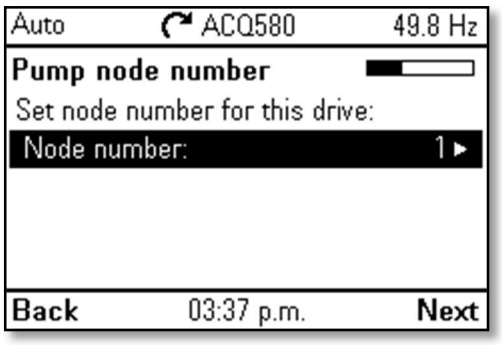
Select the desired Level control (filling or emptying) and press Next

* For this example, we will be setting up a wastewater tank that will be emptied. However, the steps to follow will be the same when setting up the drive to fill a tank.

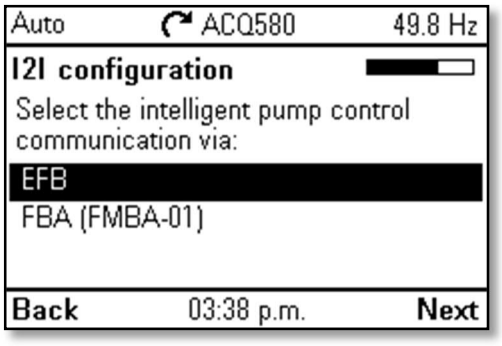


Set the Node number for the drive by pressing the Right Arrow
After setting the number, press Save and then Next

* Note: Node numbers must be unique for each drive in the tank and should not be 0 (zero)

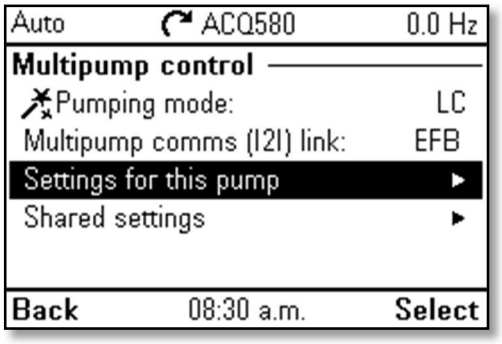


Select the I2I (drive to drive) communication method



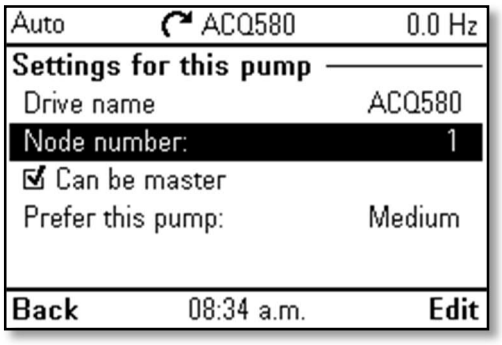
Next, it's time to set up some specifics for this drive

Select Settings for this pump



With these settings, you can

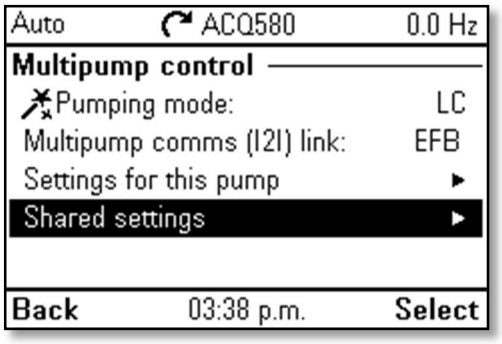
- set the drive name to match the pump identification
- change the node number (if you failed to earlier)
- determine if this drive should ever be the Master of the pumping system
- set the running preference (for even wear, set this the same in all drives).



Note: Master enabled drive processes the feedback signals and activates/deactivates the follower drives. For redundant operation, several drives must be allowed to act as master. Tank level feedback must be hardwired to all master enabled drives.

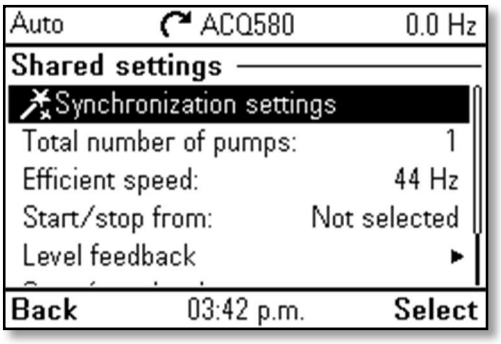
Now it's time to set up common settings within the system,

While still in the Multipump control section of Primary settings, select Shared settings



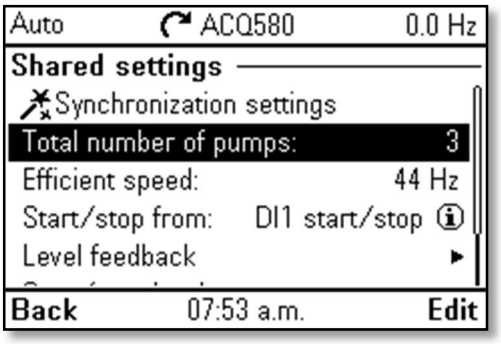
You can synchronize the settings with all drives on the I2I communication at this point.

Synchronization will save significant amount of time for the total system configuration. It also ensures that values within selected parameter groups are equal and copied according to last changed parameter.



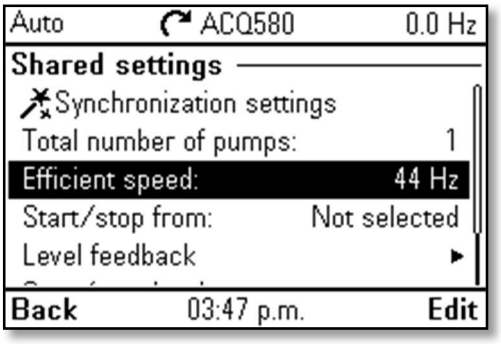
Set the number of pumps that are in the system (1 to 8)

Note: This will affect the number of settings that appear later when setting the Start/stop levels.



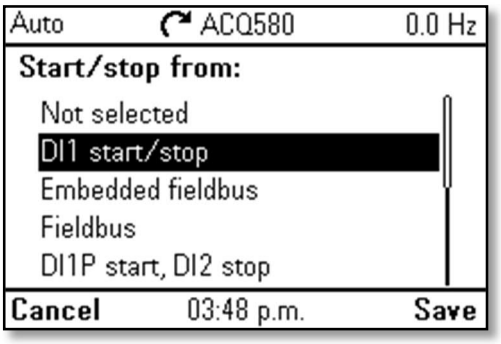
Set the BEP for the pump

This is the frequency at which the drive will run, as long as the pump can keep up with the inflow at this speed. A number of factors affect this value and a discussion with the pump supplier is required to determine the proper value.

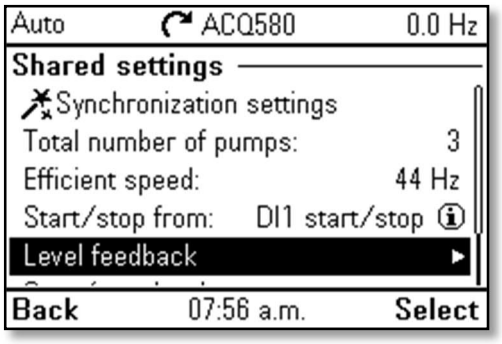


Set the start and stop control location

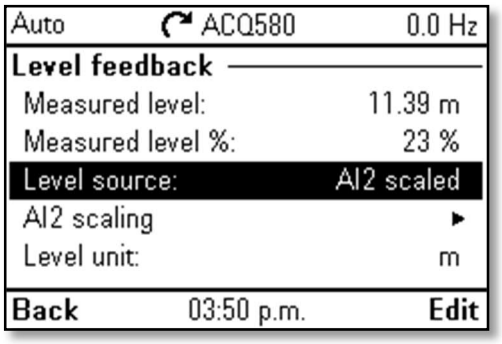
Note: This selection basically enables the drive to start when demand requires.



Set up the measured level information by selecting Level feedback

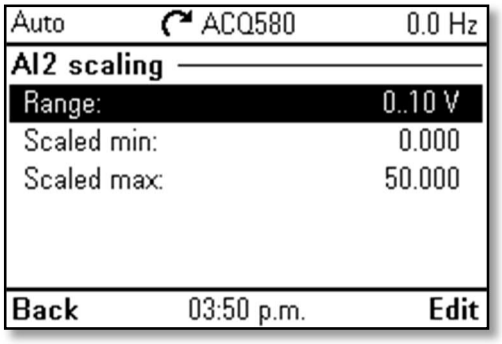


Select the Level source and then select the Level unit

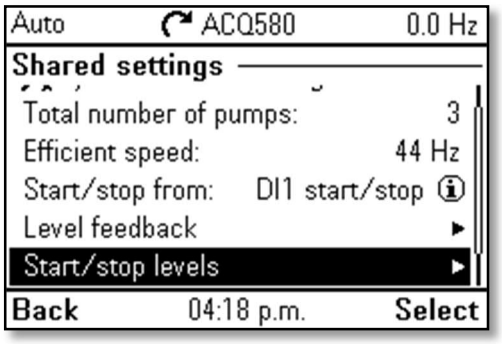


Now set the scaling for the selected Analog Input

Note: The name of this selection will be AI2 scaling or AI1 scaling depending on the Level source.

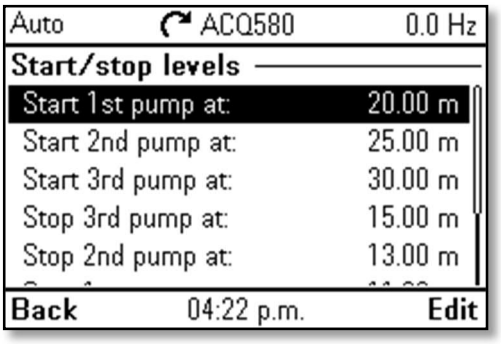


After the Level feedback setup is complete, back out one step and Select Start/stop levels to set up the system control.



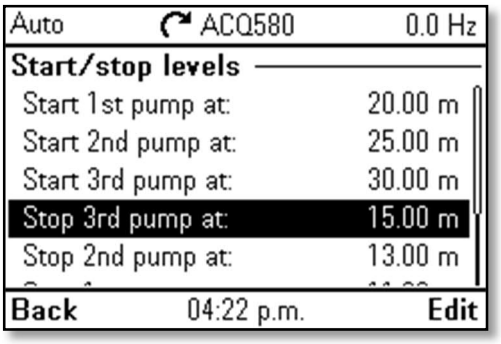
Set the desired starting levels for each pump in the system

Note: The number of pump settings appearing depend on the number that was entered earlier (Total number of pumps)



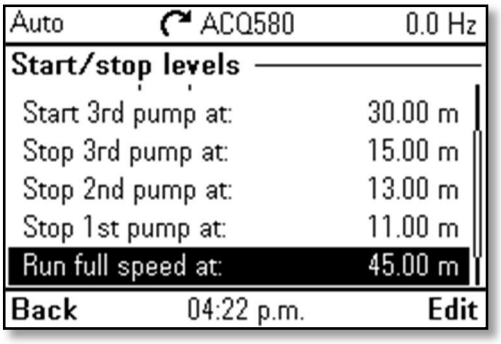
Set the desired stopping levels for each pump in the system

Note: The number of pump settings appearing depend on the number that was entered earlier (Total number of pumps)

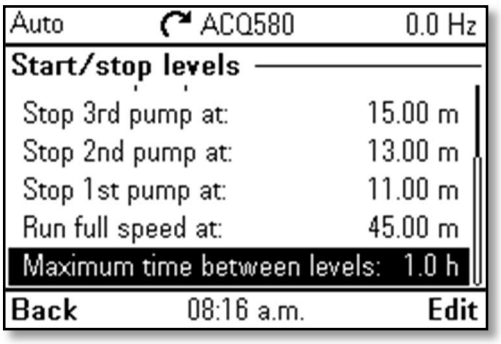


Set the measured level at which all running pumps should ignore the BEP and Run at full speed.

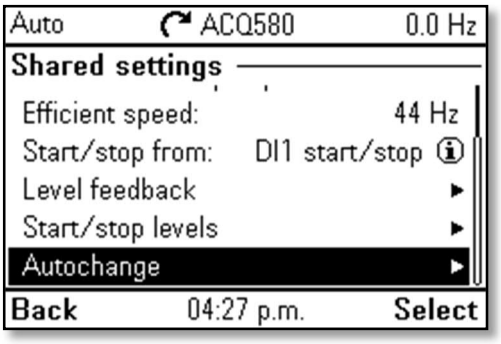
Note: This level is required to try and prevent overflow (when emptying) of wastewater



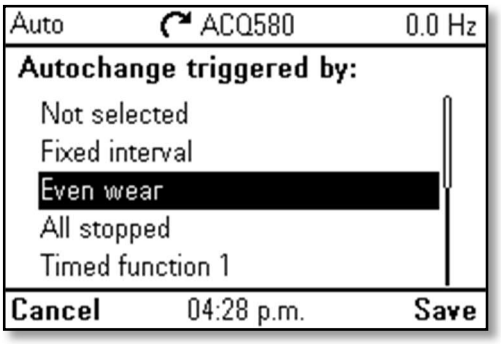
Finally, in order to try and prevent caking (by having the water sitting at one level too long), set the Maximum time between levels.



Back out of Start/stop levels and set up Autochange to define pump change trigger.

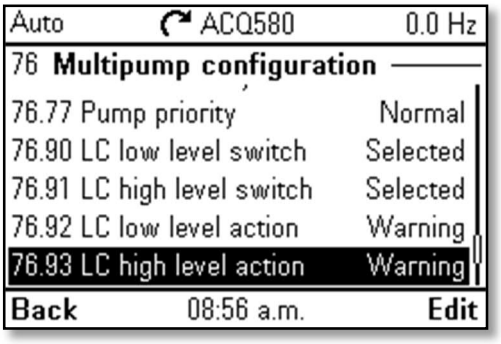


There are numerous Autochange triggers to choose from, select the one that meets the systems requirements.



The last thing to do is to set the feedback sources for the safety float switches (high and low limits) and the subsequent actions when hitting these switches. These settings are in parameters 76.90 – 76.93.

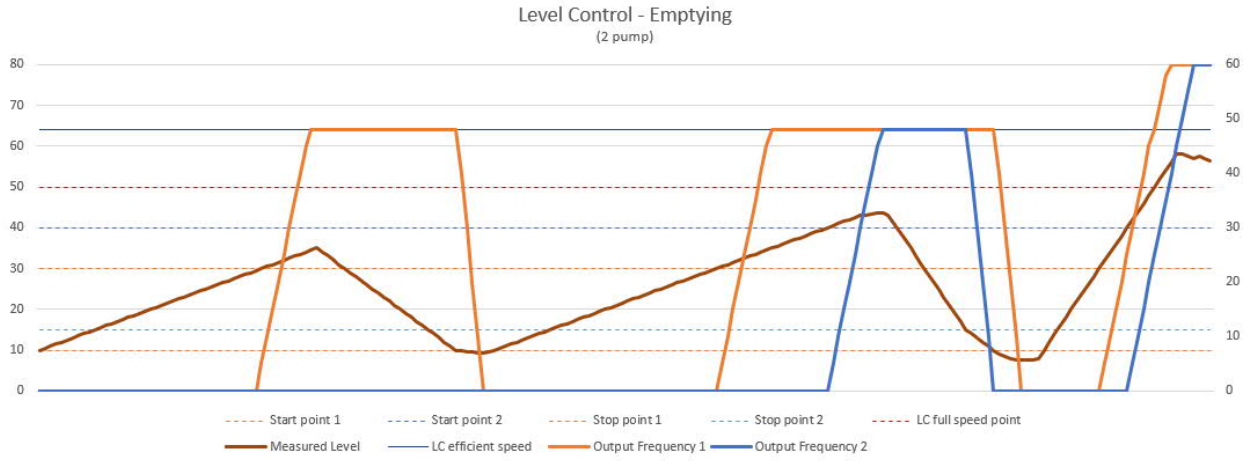
Note: A number of the prior settings can be reviewed and modified in group 76 Multipump configuration as well.

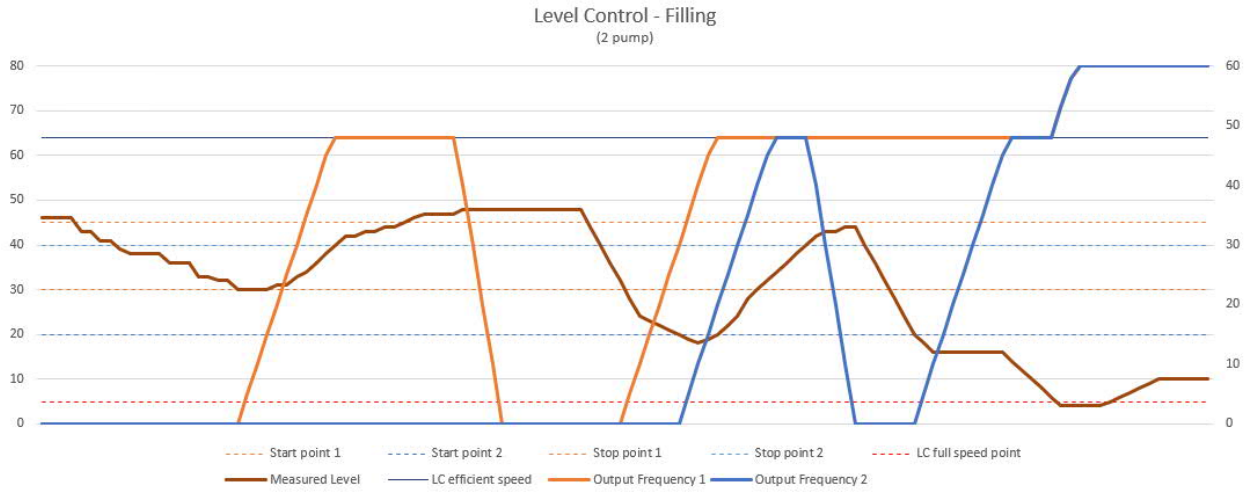


Please note that in addition to the Commissioning steps shown above, there are other parameters that are required for proper operation of the pumping system (not covered in this document):

- Set drive frequency/speed limits
- Set Motor data
- Check Constant speed(s) if needed
- Ext1/Ext2 selection, commands and reference

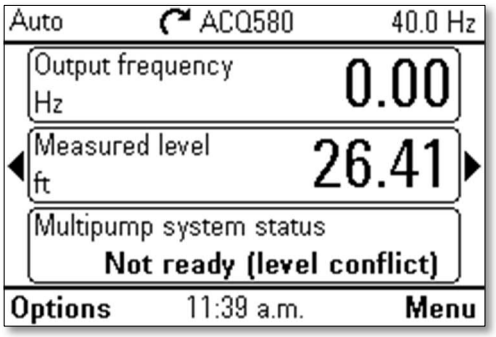
Simplified operation example





Additional notes

Level conflict



When setting up the Start and Stop levels:

- The levels should be within the AI2 scaled min/max
  - If a value is outside the scaling, the drive will not start and will indicate why (level conflict)
- The start levels should
  - Decrease from pump 1-2-3... when in Emptying control
  - Increase from pump 1-2-3... when in Filling control
- The stop levels should
  - Increase (or be the same) from pump 1-2-3... when in Emptying control
  - Decrease (or b the same) from pump 1-2-3... when in Filling control

Start/Stop point "1" does not always pertain to pump "A"

- ACQ580 will rotate the "master" of the system; the "master" uses Start/Stop point 1 and then subsequent pumps will use Start/Stop points 2-8.

Limited maximum number of pumps running at the same time

Sometimes there is a need to limit the maximum number of pumps running on Level control. This can be e.g. due to limitations on the pipeline capacity. Common set-up is duty-assist-standby configuration, where one of the pumps should always be on standby mode.
A solution for this kind of case is to set the start point of the standby pump to a level just within the level feedback AI scaling min/max.

- Example:
  - tank emptying, tank height 8 m
  - level sensor connected to AI
  - 3 pumps
  - AI scaled, scale from 0 to 10 m
  - Start point 1: 5m
  - Start point 2: 6 m
  - Start point 3: 9.99 m (So the 3rd starting point is outside the possible real-life water level, but inside the range defined with AI scaling parameters)
  - Run pumps with full speed: 7m (This level should be lower than 3rd pump starting level)

This setup would never start the 3rd pump but would have it always available in case needed.

Tank flush/Snoring

A common way to avoid sedimentation at the bottom of the tank it is pump the tank as empty as possible every now and then. This can be done by pumping the pump with full speed until the pump draws air and "snoring" sound is heard. A simple way is to assign constant speed to a digital input which in turn is connected to a push button on the control cabinet door.

Menu → Primary settings → Start, stop, reference → Auto control location
- Timed Function 1 (we will change this later)

Menu → Primary settings → Start, stop, reference → Primary auto control location
- Start/stop from: DI1 (the same as level control start source)
- Reference from: Not selected

Menu → Primary settings → Start, stop, reference → Constant frequencies/speeds
- Use constant frequencies/speeds
- Select frequency/speed from: DI6 frequency/speed 1
- Set Frequency 1 /Speed 1 to *snoring freq/speed* (normally pump's full speed is used)

The last settings must set via parameters:
Menu → Parameters → Complete list → 19 Operation mode →Par 19.11 Ext1/Ext2 selection → Other → 10 Standard DI, RO → 10.02 DI delayed status → DI6 (-1) (digital input 6 *inverted*)

With these settings the drive is normally part of the Level control system, but when the pushbutton (NO) connected to DI6 is pressed, snoring is started thus the pump is run with snoring speed as long as the button is pressed. If the button is used as trigger only for the snoring sequence, the length of the snoring sequence can be set at Par 10.16 DI6 OFF delay. Snoring is disabled if the start signal DI1 is off.

This guide is designed to help assist with using the level control function available in the ACQ580 VFD. Please consult your local ABB for additional assistance.