

DC voltage boost

What is it and when should I use it?

The ABB ultra-low harmonic (ULH) drives have a unique and powerful feature that may be of great use in certain applications; this feature is called DC boost. Though the feature has been mentioned in numerous product presentations, it's unclear if it's fully understood with the field on where and how to use this feature. This document suggests applications and situations where the feature would be of benefit to the end user and how to set up the feature in the drive. This document is applicable for ACQ580 and ACH580 drives (-31, -34).

Why are we talking about DC voltage on an AC drive?

Simplifying the operation of an AC drive, the incoming AC voltage into the drive is converted to DC voltage; this DC voltage is then converted back to AC at the voltage and frequency required to run the application. The maximum output AC voltage is purely dependent on the DC voltage.

When would you need to boost the DC voltage?

There are two main instances when the ability to boost the DC voltage, or at least control it, is important:

- There is a weak (unstable or low) network that supplies the drive
- There is a component (ie sine filter) between the drive and motor that creates a voltage drop

If the drive is connected to a weak network, and the incoming voltage is lower than the motor rating, the typical drive would not be able to compensate for the lower voltage; therefore, the output voltage would be too low for proper operation. A low output voltage may lead to an overheating motor as the drive outputs more current to the motor to achieve the required power (constant power with a lower voltage means higher current and current is what helps create heat in motors and other devices). Alternatively, a lower-than-expected output voltage at a given frequency leads to a motor running slower than expected/desired if the missing power cannot be compensated for with additional current.

When a filter is applied to the output of the drive and/or there are very long cable runs, for example in a bore hole pump (Figure 1), there are voltage drops across these components that need to be accounted for. If the rated motor voltage equals that of the incoming voltage, the voltage drop across these components affect the motor operation in the same way as a weak network.

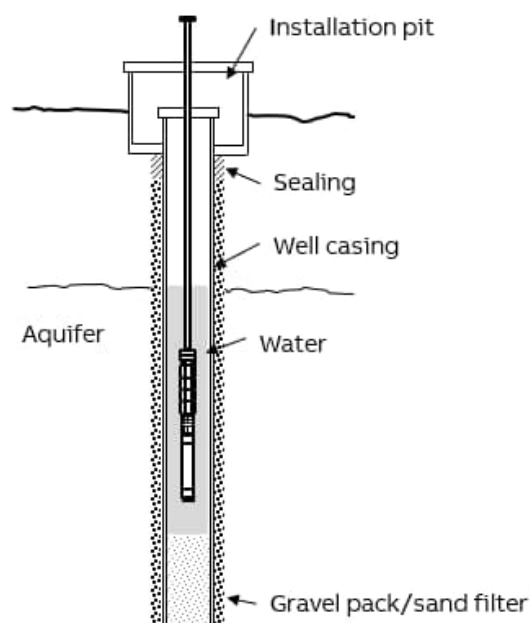


Figure 1: Bore hole pump

How does it work?

One way the ULH drive differs from a standard (6-pulse) drive is that it has an LCL (inductor-capacitor-inductor) filter as part of its design. By using the energy stored in the inductors of this filter, the ULH drive controls the DC voltage, 'regardless' of what is occurring with the incoming voltage.

How much can I boost the DC voltage?

There is not one answer here, such as 10% higher than the DC voltage based on incoming power. The voltage can be boosted to a level that is based on the highest allowable voltage for the voltage range displayed in parameter *95.01 Supply Voltage*. For instance, if 95.01 is 440...480, the amount you can boost on a 440V system is more than you can boost on a 480V system.

What are the drawbacks of boosting the DC voltage?

In most instances, nothing is completely free, and that's the case here. If the incoming voltage/desired output voltage ratio is less than 0.90, there is a sacrifice in rated output power (see Figure 2).

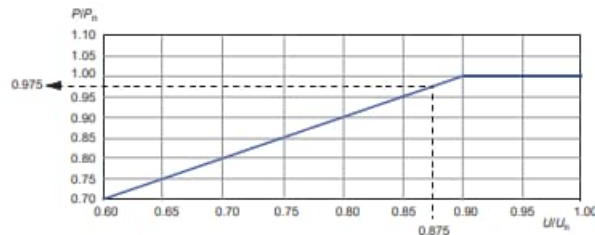


Figure 2: DC boost de-rate

Can other 580 drives (ie -01) boost the DC voltage?

No, only the ULH drives have the capability to raise and control the DC voltage.

Can non-ABB drives do something similar?

This feature is limited to drives that have an active front end and LCL filters. A few other manufacturers do have this technology; however, some of their offerings have drawbacks. Some others must use their regenerative drive, while others must use a common DC bus offering, both of which can lead to a larger and more expensive solution. Matrix technology does not have the LCL filter; therefore, does not have the components necessary for this feature.

How do I set up the drive to boost the DC voltage?

Set parameter *94.22 User DC voltage reference* to the desired value.

For the applications where you are running in Scalar mode and have a voltage drop between the drive and motor, you will also need to set *97.07 User flux level*, to ensure the proper voltage reaches the motor when rated speed is needed. The value to put in 97.07 is calculated by:

$$\frac{\text{voltage drop} + \text{rated motor voltage}}{\text{rated motor voltage}}$$

As you can see, the ULH has another great benefit for the end user, on top of the superior harmonic mitigation. Keep this in mind when you are comparing alternative mitigation methods, such as passive filters, multi-pulse solutions, etc.

For more detailed information on the function, limits, and calculations, please refer to the documents listed below:

- [3AXD50000769407](#) – ACH580-31, ACH580-34, ACQ580-31, ACQ580-34 drive Product note on DC voltage boost
- [3AXD50000035867](#) – ACQ580 Pump control program Firmware manual
- [3AXD50000027537](#) – ACH580 HVAC control program Firmware manual