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ABB DRIVES

# **ACH580-31, ACH580-34, ACQ580-31, ACQ580-34 drives**

Product note on DC voltage boost



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*Further information*

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# 1

## DC voltage boost

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### Introduction to this product note

This product note describes the use of the DC voltage boost function in these drives:

- ACH580-31
- ACH580-34
- ACQ580-31
- ACQ580-34.

### Description of the DC voltage boost function

The ultra low harmonic drives can boost their DC link voltage. In other words, they can increase the operating voltage of the DC link from its default value.

The user can take the DC voltage boost function in use by adjusting the User DC voltage reference value in parameter 94.22. The drive follows the user reference, if it is more than the measured DC voltage of the drive at the time of power up.

Benefits of the DC voltage boost function are:

- possibility to supply nominal voltage to the motor even when the supply voltage of the drive is below the motor nominal voltage. Example: A drive that is connected to 415 V can supply 460 V to a 460 V motor.
  - Compensation of a voltage drop due to an output filter, motor cable or input supply cables.
  - Increased motor torque in the field weakening area (that is, when the drive operates the motor in the speed range above the motor nominal speed).
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## Parameters

This table lists parameters relevant to the DC voltage boost feature.

Number	Name	Range	Default	Description
94.22	User DC voltage reference	0.0 ... 2000.0 V	0.0 V	User-set DC voltage reference. See the table in section <a href="#">Limitations (page 9)</a>

## Use case examples

### ■ **Example 1: Full motor voltage regardless of supply voltage fluctuations**

Supply voltage is 380 V, motor nominal voltage is 400 V. To get motor nominal voltage at nominal speed regardless of the supply voltage fluctuations:

1. Calculate the required user DC voltage reference:  $400 \text{ V} \times \sqrt{2} = 567 \text{ V DC}$ .
2. Set the value of parameter *94.22 User DC voltage reference* to 567 V.
3. Make sure that the value of parameter *99.07 Motor nominal voltage* is set to 400 V.

### ■ **Example 2: Sine filter at the output of the drive**

The drive is equipped with a sine filter at the output. Motor cable length is 300 m (984 ft). Estimated voltage loss across the filter and cable is 40 V. Motor nominal voltage is 400 V.

To compensate for the 40 V voltage loss at the nominal speed:

1. Calculate the required voltage at the drive output before the sine filter to compensate for the voltage drop:  $400 \text{ V} + 40 \text{ V} = 440 \text{ V}$ .
2. Calculate the required user DC voltage reference:  $440 \text{ V} \times \sqrt{2} = 622 \text{ V}$ .
3. Set the value of parameter *94.22 User DC voltage reference* to 622 V.

If the drive is configured to operate in vector control mode and the ID run is performed with the motor cable connected, no other configuration is needed. The vector motor control takes care of the estimated losses and boosts the output voltage to maintain the required nominal voltage at motor terminals.

If the drive is configured to operate in the scalar motor control mode, change the value of parameter *99.07 Motor nominal voltage* to 440 V to allow the motor control to go up to 440 V at the drive output at nominal speed.

**Note:** In scalar motor control mode, the output voltage can alternatively be increased by adjusting the *U/f* curve: by setting parameter *97.07 User flux level*. The value of *97.07*, can be calculated as the ratio of the desired voltage and the nominal voltage. In this example, the ratio is  $440 \text{ V} / 400 \text{ V} = 110\%$ . Set the value of *97.07* to 110% and leave motor nominal voltage as 400 V.

## Derating due to the output voltage boost

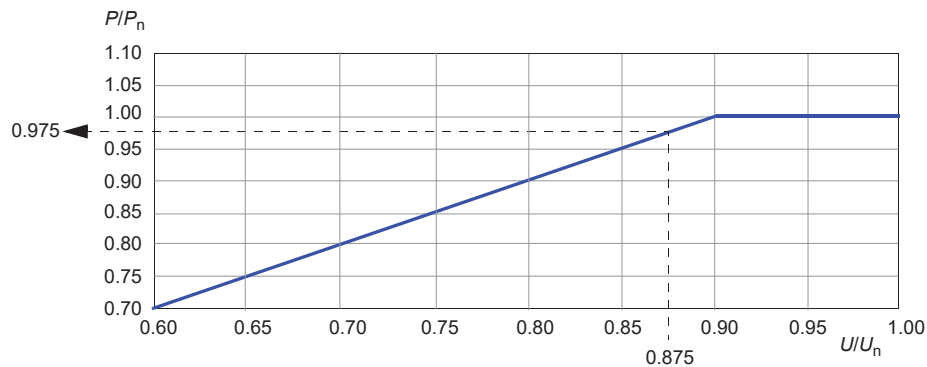
The drive can output a higher motor voltage than the supply voltage. This may require derating of the drive output power depending on the difference between the supply voltage and the output voltage to the motor for continuous operation. The graph in this section is applicable to ACH580-31, ACH580-34, ACQ580-31, and ACQ580-34 drives. The symbols used are described in the table below.



$U$	Actual supply voltage to the drive. (Nominal value: $U = 400$ V or $U = 480$ V.)
$U_n$	Motor nominal voltage or the required drive output voltage
$P$	Derated output power of the drive
$P_n$	Nominal power rating of the drive

### ■ 400 V and 480 V drives

This graph shows the required derating for 400 V and 480 V drive types.



**Example 1:**  $P_n$  for ACH580-31-206A-4 is 110 kW. The supply voltage ( $U$ ) is 350 V. The motor nominal voltage is 400 V.

Calculate the ratio between the supply voltage and required output voltage as follows:  $U/U_n = 350$  V / 400 V = 0.875. From the graph we can see that  $P/P_n = 0.975$ .

The derated power  $P = 0.975 \times 110$  kW = 107 kW.

To boost the output voltage to correspond the nominal supply voltage 400 V, increase the DC voltage to  $400$  V  $\times \sqrt{2} = 567$  V.

**Example 2:**  $P_n$  for ACH580-31-096A-4 is 75 hp. The supply voltage ( $U$ ) is 450 V.

$U/U_n = 450$  V / 480 V = 0.938. From the graph we can see that  $P/P_n = 1.00$ .

The derated power  $P = 1.00 \times 75$  hp = 75 hp.

To boost the output voltage to correspond the nominal supply voltage 480 V, increase the DC voltage to  $480$  V  $\times \sqrt{2} = 679$  V.

## Limitations

There are two types of limitations that you must take into account when you use the DC voltage boost function: limitations to the DC voltage reference and the limitation to the drive output voltage.

The drive calculates the minimum and maximum limits for the User DC voltage reference (94.22). The calculation is based on the actual supply voltage and the upper limit of the largest supply voltage range selection available for the drive (95.01). Limits are:

1. Minimum limit: Internal DC voltage reference ( $U_{dc,int}$ ).
2. Maximum limit: Maximum DC voltage reference ( $U_{dc,max}$ ).

For more information, see the table below and sections [Internal DC voltage reference \( \$U\_{dc,int}\$ \)](#) and [Maximum DC voltage reference \( \$U\_{dc,max}\$ \)](#).

## 10 DC voltage boost

This table summarizes the limits to the user-defined DC voltage reference and to the drive output voltage.

Drive type	95.01 selection	Internal DC voltage reference ( $U_{dc,int}$ ) <sup>1)</sup>	Maximum DC voltage reference ( $U_{dc,max}$ )	Maximum drive output voltage with parameter 97.04 default value
xxxA-4	380...415 V	553 V	767 V	553 V
	440...480 V	641 V	767 V	553 V

<sup>1)</sup> See section [Internal DC voltage reference \( \$U\_{dc,int}\$ \)](#).

### ■ Internal DC voltage reference ( $U_{dc,int}$ )

$$U_{dc,int} = U_{ac,rms} \times \sqrt{2} \times 1.03$$

where

$U_{dc,int}$  Internal DC voltage reference

$U_{ac,rms}$  Actual input supply voltage.

If the user-defined reference (94.22) is less than the internal reference value ( $U_{dc,int}$ ), the control program uses the internal reference as the drive DC voltage reference.

### ■ Maximum DC voltage reference ( $U_{dc,max}$ )

$$U_{dc,max} = U_{cat,hi} \times \sqrt{2} \times 1.13$$

where

$U_{dc,max}$  Maximum DC voltage reference

$U_{cat,hi}$  Upper limit of the largest supply voltage range selection available for the drive (95.01)

If the user-defined reference (94.22) is more than the maximum DC voltage reference ( $U_{dc,max}$ ), the control program uses the maximum value as the drive DC voltage reference.

### ■ Maximum drive output voltage

$$U_{ac,out} = (U_{dc} / \sqrt{2}) \times (1 - U_{res})$$

where

$U_{ac,out}$  Maximum output voltage of the drive

$U_{dc}$  Actual DC voltage

$U_{res}$  Value of parameter 97.04 Voltage reserve.

The voltage reserve setting (97.04) limits the maximum drive output voltage.

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■ **Limit calculation examples**

**Example 1: Calculating the internal DC voltage reference and maximum DC voltage reference**

The voltage category is 380 ... 480 V and the power line voltage is 400 V.

Internal DC voltage reference  $U_{dc,int} = 400 \text{ V} \times \sqrt{2} \times 1.03 = 583 \text{ V}$ .

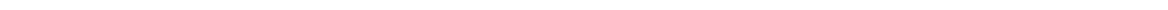
Maximum DC voltage reference  $U_{dc,max} = 480 \text{ V} \times \sqrt{2} \times 1.13 = 767 \text{ V}$ .

**Example 2: Calculating the maximum output voltage of the drive**

DC voltage is 650 V DC, and the voltage reserve setting (97.04) is -2%.

The maximum output voltage of the drive is  $U_{ac,out} = (650 / \sqrt{2}) \times (1 + 0.02) = 469 \text{ V}$ .

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# Further information

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Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to [www.abb.com/searchchannels](http://www.abb.com/searchchannels).

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