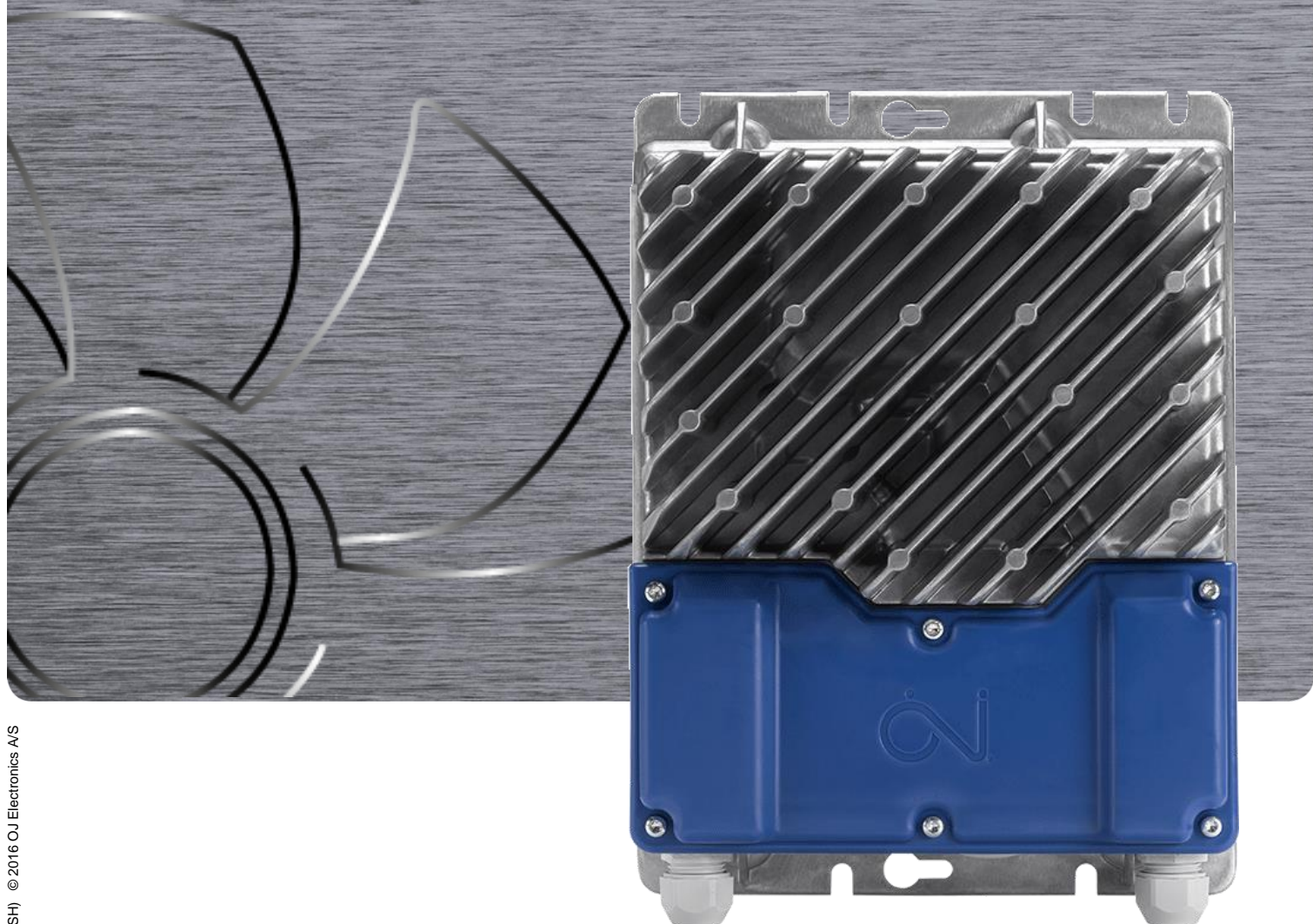


FIELD WEAKENING

OJ-DV



67652 09/16 (OSH) © 2016 OJ Electronics AS

OJ Drives®

A DRIVES PROGRAMME DEDICATED TO VENTILATION SOLUTIONS


OJ ELECTRONICS

1. Introduction to Field Weakening

Field Weakening is in various contexts also called “oversynchronous” or “supersynchronous” operation.

At OJ Electronics A/S, we use the term “Field Weakening”. For the drive, sometimes called the motor speed controller or even the frequency converter, we use the term “drive” at OJ.

Field Weakening makes it possible to operate a PM* motor above its nominal rated speed.

The motor manufacturer must be consulted to determine whether the motor concerned is suitable for a speed above its nominal speed, through Field Weakening operation.

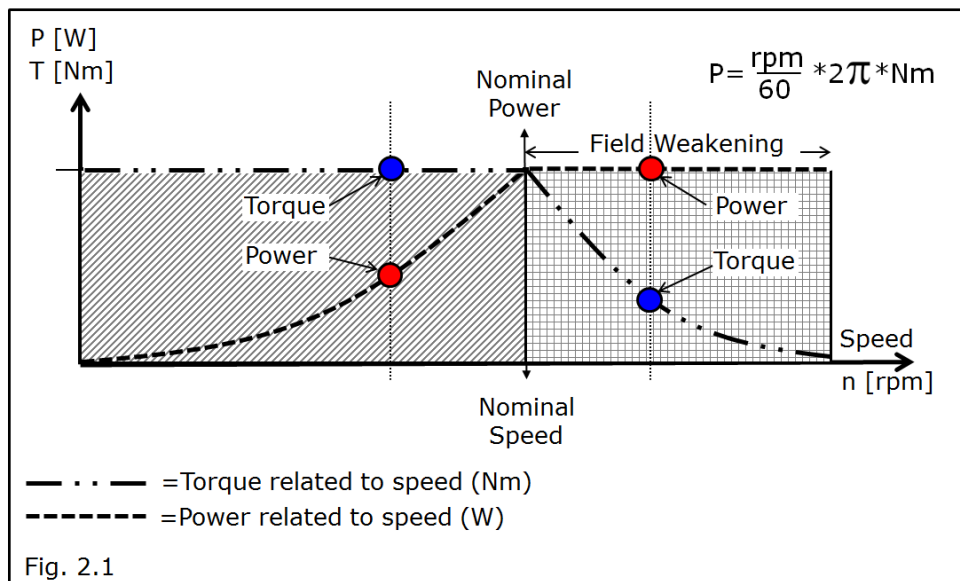
As with the fan wheel, interconnections and bearings are also affected by a speed higher than the nominal speed, and the manufacturer of the fan parts must also give their acceptance of a speed above the nominal rated speed. In Field Weakening mode, the motor will be operated at a higher speed, but with a lower output shaft torque. Field Weakening can only be achieved by using suitable drive signals.

2. Motor Torque and Power

At nominal torque and speed, a specific voltage is required for the motor. As long as the drive is able to increase the voltage to the motor, it is possible to increase the speed of the motor. This would give a higher speed and higher power at constant torque. The OJ-DV drive cannot deliver voltage higher than the nominal 360 V (single phase: 250 VAC) on the motor terminals.

So it is not possible to increase the speed to more than nominal speed by increasing the voltage. By the use of the built-in Field Weakening feature in the OJ-DV, it is possible to increase the speed to a speed even higher than the nominal motor speed. Not via higher drive voltage to the motor, but rather via weakening the field in the rotor and renouncing the constant torque (see fig. 2.1).

Field Weakening is not possible if the voltage and current are at the nominal maximum value. If the need is for a higher speed when the voltage and the current are at the maximum level, a larger OJ-DV must be selected.



3. How to make Field Weakening

In Field Weakening mode, the voltage to the motor is a continuous 360 V (single phase: 250 VAC). The current is at the nominal level for the motor concerned. To produce a higher speed in Field Weakening mode, the OJ-DV needs current to create the weakening of the rotor magnets (reduce *BackEMF).

This weakening of the rotor magnets is called Field Weakening and created by applying a stator magnetic field in the opposite direction to the rotor magnetic field.

The resulting magnetic field will be diminished.

The OJ-DV needs current to generate this reduction of the magnetic field (tesla**) in the rotor.

The OJ-DV cannot deliver voltage and current to generate this reduction of the rotor magnetic field that exceed their maximum nominal values. The result will instead be a reduction of the torque on the motor shaft.

In Field Weakening mode the power is constant. ($P = \frac{\text{rpm}}{60} * 2\pi * Nm$)

4. Nominal and max. speed

It is possible to set a parameter for max. speed for the OJ-DV. The max. speed is allowed to be higher than the nominal speed for the fan and motor concerned.

With Field Weakening enabled: When the OJ-DV reaches nominal max. voltage output and the max. speed is not reached, the OJ-DV will go into Field Weakening mode if an even higher speed is required to reach the max. speed. The qualification for the OJ-DV to go into Field Weakening mode is that the max. current limit not be reached, since the OJ-DV needs current to create Field Weakening.

In Field Weakening mode, it is possible to increase the speed until the max. current is reached or until the current used for generating Field Weakening equals to the current producing torque.

The setpoint for max. speed must never involve values higher than these capacity limits for Field Weakening. In Field Weakening mode, the power to the OJ-DV is constant, but the torque on the motor shaft is reduced (see fig. 2.1).

5. Implementation in OJ Drives®

Field Weakening mode is by default disabled at the OJ Electronics A/S factory. The Field Weakening function must be activated manually from the associated Modbus register (see Modbus protocol for OJ-DV).

The OJ-DV will, after activation, go into Field Weakening mode when maximum voltage from the OJ-DV to the motor is reached and the maximum speed has not been reached.

Nominal operation: OJ-DV output voltage (VAC ~) to the motor is increased while speed increases.

When OJ-DV output voltage to the motor is at the nominal voltage, the motor runs at a speed corresponding to the nominal (maximum) speed.

Field Weakening is a technology that ensures stable operation of the motor in exchange for a predefined curve controlling the rotor magnetisation (BackEMF) inside the motor, increasing the current (Amp) and changing the commutation.

Field Weakening is a standard feature in OJ-DV, ensuring continued stable operation of the motor at speeds above the nominal motor speed.

During Field Weakening operation, the motor will simultaneously run with reduced torque on the motor shaft at constant power (reduced airflow).

Field Weakening can only be used in PM* motors.

*

PM = Permanent Magnet motor; AC-IM = Asynchronous Induction Motor

BackEMF = Back Electromotive Force; EC= Electronically Commutated

**

Magnetisation field **B** is measured in tesla (symbol:T)