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# Guide
# Get started with VFD

HOYER
MOTORS

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# Energy efficiency and application control

**The possibility of increased energy efficiency and more precise control of speed and torque makes it attractive to drive applications with a combined electric motor and VFD (Variable Frequency Drive). We will guide you through the most important considerations when installing and using VFD.**

The use of an electric motor in combination with a VFD (Variable Frequency Drive) is becoming increasingly widespread in a number of industries and market segments. Typically, it is the opportunity to save energy, which is the companies' primary motivation. VFD can reduce energy consumption by up to 50 percent for certain types of applications, especially centrifugal applications such as pumps and fans.

For example, adjusting the flow of liquid with a centrifugal pump via VFD rather than using valves is more energy efficient. Likewise, the airflow in an industrial cooling tower can be precisely controlled by using VFD for the electric motors that drive the fans.

In many cases, VFD will be a prerequisite for being able to meet more stringent requirements for energy efficiency in e.g. the ecodesign regulation, and newer motor technologies such as permanent magnet motors that require the use of VFD. But VFD also offers other advantages: Better control, ability to connect intelligent control, less acoustic noise and less vibration.

**Here's how it works**

A VFD converts AC to DC and then back to AC. Thus VFD can be used to regulate the speed of an application driven by an electric motor by applying a flexible frequency and voltage that makes the motor run at the desired torque and rpm. This will often be more efficient than running the motor at full power and using hydraulic or mechanical regulation to control speed and torque.

# Application-specific benefits of VFD

**The exact benefits of using VFD vary for different types of applications and also depend on the specific application usage.**

**Pumps**

For both industrial and marine pumps, such as centrifugal pumps, rotary vane pumps, ballast pumps or scrubber pumps, energy savings can be achieved by reducing speed and flow. A 20-percent flow reduction saves almost 50 percent energy compared to regulation using valves. VFD also provides softer start and stop, which reduces any pressure peaks in connected pipes. It is also possible to utilise more of the pump capacity by running the speed over-synchronously, i.e. typically above 50Hz or 60Hz.

**Ventilation**

Applications such as Air Handling Units (AHU), cooling towers or marine ventilation of engine room and accommodation can also save up to 50 percent energy by reducing speed and airflow. Safety functions such as Safe Torque Off (STO) and special functions in case of fire can be programmed in. At the same time, VFD can reduce acoustic noise and resonance in ventilation systems. Existing applications are usually easy to upgrade to VFD use via retrofit of the ventilation unit.

**Refrigeration and Compressors**

For screw compressors for air or refrigeration it is possible to save 10-15 percent of energy compared to slide controllers. At the same time, the possibility of stepless regulation of capacity improves energy efficiency. This improves the lifetime of the compressor and also reduces noise and vibrations. Reciprocating compressor performance can also be optimised in VFD operation, although this often requires a high starting torque.

**Hydraulics for industry and marine**

Hydraulic Power Units (HPU) and other hydraulic applications can also achieve energy savings by reducing speed and flow. Softer starting and stopping reduce stress and strain on the hydraulic system. It is also possible to utilize more of the pump capacity by increasing the speed beyond the synchronous speed of the motor.

**Marine thrusters**

With VFD, azimuth and tunnel thrusters can be controlled both faster and more precisely, providing better control and positioning. Compared to hydraulic systems, energy efficiency is up to 40 percent higher, and the operation is both safer and more reliable, resulting in lower operating costs.

**Marine deck machinery**

Both torque and speed of cranes, winches and corresponding deck machinery can be controlled more precisely with a VFD. Full torque can be maintained at all speeds, even when the shaft is stationary. In addition, several gear motors can be connected to the same load. This makes VFD a perfect alternative to hydraulic systems as the risk of oil leaks is eliminated and noise levels are reduced significantly.

# Choose the right motor for VFD

Choosing the right motor is one of the most important points if you want to use VFD for your application. The motor must be prepared for VFD use, which among other things may require special winding insulation and, for bigger motor sizes, current-insulated bearing. In addition, the size and type of motor must suit your application.

With regard to energy, a newer motor generation, such as an IE3 or IE4 motor, would be preferable. However, for VFD retrofit on existing motors, sine-wave filters can be used to avoid voltage spikes that stress the motor windings. A sine-wave filter will also reduce the need for screened motor cables, which is an expensive factor in the installation.

# Integrated or stand-alone VFD?

VFD can either be integrated with the motors, supplied as decentral stand-alone units in high enclosure classes or built into panel systems.

In the case of new designs, it will usually be best to choose an integrated plug-and-play solution in which VFD and motor are combined. This will also eliminate the need for shielded cables. Space considerations often determine whether an integrated solution is possible and most appropriate. Integrated solutions are available up to 30kW.

For stand-alone solutions, a VFD can be placed near the motor and connected with a cable. This will allow you to reuse the installation and upgrade existing applications with VFD. A decentralised VFD often requires a high degree of protection (IP55 or IP66).

Finally, VFD can be integrated into existing or new electrical cabinets, panels or switchgear systems. In this instance, a VFD with a lower enclosure class such as IP20 or IP23, which is designed for mounting in a cabinet, can usually be used.

CHECKLIST

# What you need to know when selecting a VFD

Whether your VFD is to be integrated or stand-alone, it needs to be adapted to a number of factors, both in terms of application type, grid, and the environment in which the application is to be used.

**Before selecting the right VFD solution, you should consider following parameters:**

- Motor type and data (kW/A/RPM/V)
- Voltage and frequency of supply to VFD (e.g. 400V/50Hz)
- Ambient temperature
- Installation environment (e.g. marine, industrial or residential)
- Supply network (IT, TT, TN (C-S-CS))
- Special approvals needed (DNV, UL, etc.)
- Application type (e.g. centrifugal pump, fan, conveyor)
- Whether the motor is running in generatoric operation (e.g. cranes and winches with high inertia)
- Requirements for starting torque, incl. any need for periodic overload
- Protection class (e.g. IP55)
- Location (integrated, stand-alone, panel/cabinet)
- Motor cable length for stand-alone VFD
- EMC filter requirements (e.g. C2 covering both industrial and residential)
- Need for special filters for input or output (e.g. dU/dt or sine-wave filter)
- Bus or Ethernet communication (e.g. Profibus or Ethernet IP)
- Special card requirements (e.g. Auxiliary I/O card or PT100 adaptation)
- Integrated service switch, circuit breaker or fuse on the input

# Does your VFD need to be connected to intelligent control?

A VFD can be adapted via sensors to collect data such as temperature and vibrations from the motor. These can be used to monitor the condition of the motor and pave the way for more intelligent management of the applications and predictive maintenance. This also makes it possible to monitor operation via a cloud solution, and in some cases, troubleshoot without being physically present on site.

It is possible to read off information such as operating hours and energy consumption, which in combination with the motor sensors can be used to diagnose worn equipment. It is thus possible to prevent breakdown of an application that needs to be serviced earlier than planned and defer the service of applications that are running fine. All these features help to improve the production uptime.

# Be aware of sources of noise

**A VFD can generate different types of disturbance:**

- Acoustic noise
- Online harmonics
- EMC noise, also known as electromagnetic compatibility, which can affect radio equipment and data transfers among other things.

Interferences must be limited via filters and screened cables in order for the installation to comply with EMC requirements, which are typically higher in residential areas than in industry. For this reason, professional advice should always be sought when selecting VFD. A service switch for mechanical maintenance may, for example, be built into the converter so as to avoid a typical EMC fault source and, at the same time, achieve savings on installation costs.

Find out more about Hoyer Drives & Controls

# About Hoyer Motors

**Hoyer Motors is an international supplier of high-end electric motors, drives and controls. Headquartered in Denmark and China, we are represented through sales offices and distributors worldwide.**

We pride ourselves on being an elite manufacturing enterprise with the highest attention to service and flexibility – a company where dedication, competitiveness and reliability are second to none.

We have a focus on selected industrial markets including Marine, HVAC, Industrial Pumps, Oil & Gas, Wind and HPU. Through strong partnerships with leading OEMs within these markets, we offer a unique set-up and industrial insight. We add supply chain value by understanding the business and markets of our customers.

Together with our business partners, we strive to improve industrial energy efficiency and thereby reduce emissions.

**Contact us**

We are ready to assist you in with the implementation of VFD. Please contact us if you have any further questions or if you would like to learn more about VFD's.

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