



Variable Frequency Drives

What is a variable frequency drive or adjustable speed drive?

Variable frequency drives (VFDs), also called adjustable speed drives (ASDs), allow induction-motor-driven loads such as fans and pumps to operate at increased efficiency. By controlling motor speed so that it finely corresponds to varying load requirements, VFD installations can increase energy efficiency and process precision, and afford other performance benefits such as over speed capability. They can also eliminate the need for expensive and energy-wasting throttling mechanisms such as control valves and outlet dampers.

Fundamentals of VFDs

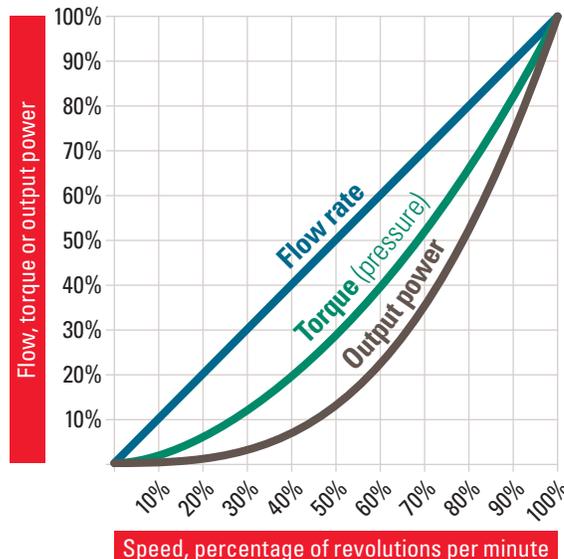
- A VFD changes the frequency and voltage supplied to the motor
- A reduction in frequency results in the shaft of the motor spinning at speeds lower than the standard 900, 1200, 1800, and 3600 RPMs, depending on the motor (900 RPM VFDs must be invoiced on or after January 1, 2017 to be eligible for a prescriptive rebate)

Benefits of VFDs

- Added control—smoother acceleration and deceleration, automated response to system conditions (e.g. pressure, flow, etc.)
- VFDs operate on an as-needed basis, saving energy, money and maintenance costs
- Energy savings—especially on variable-torque centrifugal fan and pump applications
- Improved process control, such as speeding up or slowing down a machine or process
- Bypass capability in the event of an emergency
- Protection from overload currents
- Extending the life of your motor equipment
- Reduce noise

Energy savings potential

- Centrifugal fans and pumps offer the highest potential for savings
- Example:
 - Flow increase 10%
 - Power increase 33%
 - Small decrease in flow = bigger decrease in power
- Savings vary by application
- Applications such as extruders and conveyors may experience savings, but not to the same degree as fans and pumps.¹



VFD rebates available	
Motor HP	Prescriptive rebate levels
1	\$400
1.5	\$400
2	\$400
3	\$400
5	\$600
7.5	\$750
10	\$1,000
15	\$1,250
20	\$1,600
25	\$2,000
30	\$2,400
40	\$3,000
50	\$3,500
60	\$4,000
75	\$5,000
100	\$6,000
125	\$7,000
150	\$7,000
200	\$8,000

For hp sizes that fall outside the hp chart, round down to the next hp value and use the corresponding rebate value.

Market segments that can benefit from VFD technology:

- Churches
- Cold storage
- Commercial buildings
- Food processing
- Grocery stores
- Hospitals
- Hotels
- Irrigation
- Schools/universities
- Water and wastewater treatment

¹Extruders and conveyors are custom VFD applications

VFD FAQs**Q: Do VFDs have a long payback period?**

A: Electric motors provide efficient, reliable and long-lasting service, and most require comparatively little maintenance. Despite these advantages, however, electric motors can be inefficient and costly to operate if they are not properly selected and maintained. Industrial plants can avoid unnecessary increases in energy consumption, maintenance and costs by choosing motors that are well suited to their applications and making sure that they are well maintained. Paybacks for VFD installations are especially attractive when combined with Xcel Energy rebates—and typically range between nine to 24 months.

Q: Do VFDs cause motors to run “choppy”?

A: VFDs enhance the precision and smooth operation of motors. They eliminate the need for expensive and energy-wasting throttling mechanisms such as control valves and outlet dampers. In addition to lowering electricity costs, VFDs reduce wear and tear on motors and related components, decreasing maintenance costs and prolonging equipment life.

VFDs often have inherent soft-start capabilities that can limit starting currents that gradually ramp up a motor’s operating speed at startup and greatly reduces the stress on components. On a typical startup, a constant-speed motor is subject to high torque and electrical surges often six to eight times that of the normal operating current.

Q: Will VFDs work with the kind of equipment that my business uses?

A: Facilities of all kinds can benefit from VFDs, including schools, hospitals, office buildings, retail spaces, food processing plants, hotels, convention centers and manufacturing facilities. Most applications that use motors to drive fans and pumps can find significant savings in the use of VFDs. Some of the most common applications for VFDs are found in the pumps and fans used for HVAC systems.

We are here to help.

For assistance in determining if VFDs would benefit your facility, or to find out more about rebates, contact one of our dedicated energy efficiency specialists at **855.839.8862** or **energyefficiency@xcelenergy.com**. Or visit our website at: **xcelenergy.com/MotorEfficiency**.

VFD savings potential by application²

High	<ul style="list-style-type: none"> • Axial fans • Blowers • Centrifugal fans and pumps • HVAC systems 	Lower speed operation results in significant energy savings, as shaft power of the motor theoretically drops with the cube of the rotational speed
Medium	<ul style="list-style-type: none"> • Compressors • Conveyers • Mixers 	Lower speed operation saves energy in direct proportion to the rotational speed
Low	<ul style="list-style-type: none"> • Lathes • Machine tools • Milling machines • Printing presses • Punch presses 	No energy savings at reduced speeds. Non-energy benefits that may result in cost savings can be realized

²Motor Decisions Matter, VFD Fact Sheet, http://www.motorsmatter.org/resources/MDM_VFD_FactSheet_Fnl.pdf