

# Vickers® by Danfoss Variable Speed Drive Solutions

Save energy. Cut costs. Reduce heat and noise.



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With the costs of energy steadily rising, energy consumption is playing a more significant role than ever in the total cost of machine operation. As a result, the hydraulics industry is demanding energy efficient solutions that also meet stringent government regulations for environmental

protection. Backed by experienced application engineering, service, training, and sales support, Vickers by Danfoss' proven pump and variable speed drive products are a powerful combination to resolve challenges in today's market.

### Proven value and benefits

- Up to 60% energy savings — Sustainability and cost reduction
- Quieter operation — Improved safety and regulation compliance
- Reduced or eliminated cooling needs — Machine cost reduction
- Pump and motor downsizing — Machine cost and footprint savings
- Danfoss standard products — Proven reliability and availability



### Reduced energy cost and consumption

Vickers by Danfoss Variable Speed Drives (VSDs) can help cut energy usage up to 60% depending on the machine duty cycle. This helps significantly reduce operating costs and quickly pay off the investment.

The proven performance and power density of Vickers piston pump family—combined with the smart control of Danfoss VLT Performance Drives enable these systems to achieve power-on-demand more efficiently than conventional constant-speed drive pump systems. Instead of operating constantly at 1500 rpm or 1800 rpm (depending on the region), Vickers by Danfoss VSD can be controlled to match the load requirements of the current duty cycle, thus eliminating energy waste.



### Reduced noise pollution

Noise reduction is another significant benefit of running pumps at variable speeds. In Vickers by Danfoss VSDs, the electric motor and pump speed vary to match the duty cycle requirement. This results in lower overall noise exposure for the machine operator.



### Reduced heat generation

With improved energy efficiency comes less heat production, so these systems can often allow downsizing or even elimination of oil coolers. Otherwise, they can help reduce the amount of hydraulic oil used and the size of the tanks, and extend the life of seals and oil.



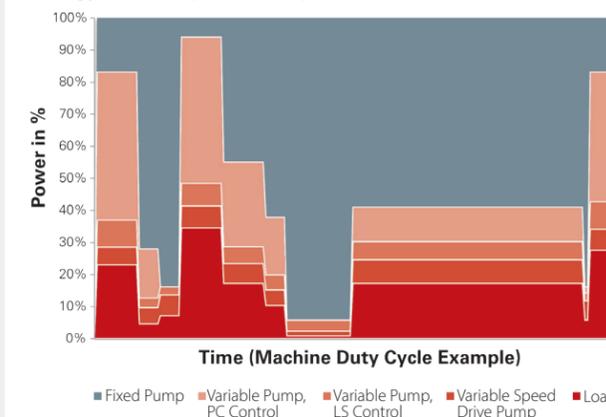
### Reduced pump and motor size

Vickers by Danfoss VSDs enable the downsizing of pumps to cut costs. Because the system can now utilize full motor speed range (up to 3000rpm for induction motors and up to 4000rpm for servo motors) rather than running at fixed 1500 rpm or 1800 rpm, pump displacement can be significantly smaller without changing the maximum available oil flow - shrinking the machine's overall footprint.

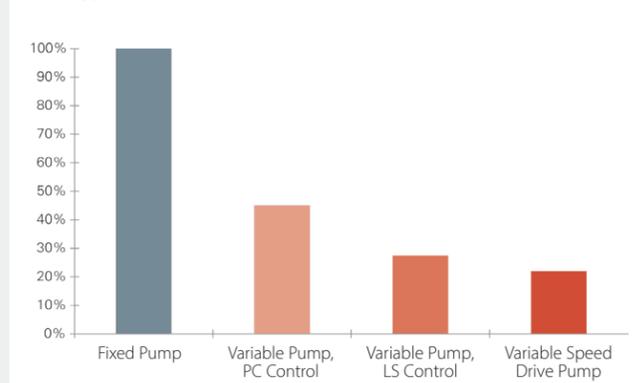
In addition, a pump with smaller displacement requires less torque to deliver the same pressure. Variable speed capability also enables utilization of the high overload capability of electric motors to deal with the short, high torque parts of the machine duty cycle. Both of these allow for the selection of a smaller motor size – further shrinking the machine's footprint and installed power, thus improving the total cost of ownership.

## Energy consumption comparison of different types of pump systems

Energy consumption comparison



Energy cost comparison



## Induction motor technology

Variable speed drives with induction motors are usually used with open loop control to provide flow on demand, tailored for the respective part of the duty cycle. The machine PLC sends the drive a flow command and the drive controls the motor speed to deliver the requested flow based on pump displacement and efficiency data in the drive.

Induction motors are robust, reliable but have only average

dynamic properties so the pressure and flow control valves are still needed in the system for the precise motion control, as in the traditional fixed speed system architecture.

This makes it easy to switch from fixed speed to variable speed system without the major changes of the machine architecture (besides the motor-pump itself).

Vickers by Danfoss  
Induction Variable Speed Drive



### Induction motor VSD system components



Vickers by Danfoss PVM Code B piston pump

- Up to 315 bar rated and 350bar peak pressure
- Displacements: 18-131cc
- Operating range: 0 up to 2800 rpm - rated pressure available from 250 rpm



Danfoss VLT® AutomationDrive FC 302

- Designed for variable speed control of all asynchronous motors and permanent magnet motors, on any industrial machine or production line
- Standard features out of the box include graphical control panel, IP20 chassis for cabinet mount, coated PCB board for longer lifetime, RFI filter, and sensor-less speed feedback
- Optional features include chassis options up to IP66, analogue I/O cards, brake choppers and EMC filters, various fieldbus protocols and safety functions (STO, SS1, SLS, SMS and SSM)

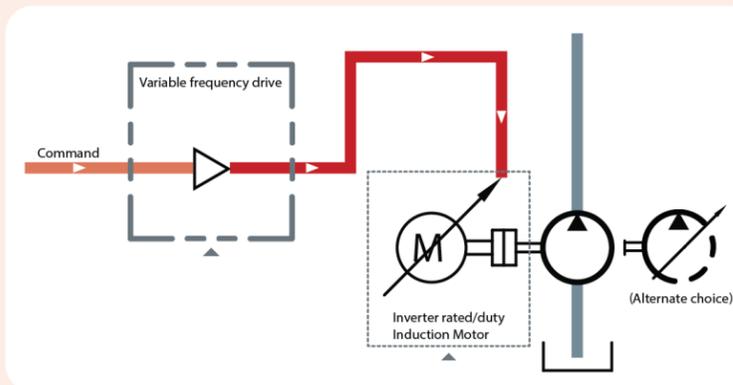


Asynchronous induction motors

- High efficiency electric motors with nominal power 3 - 90 kW meeting Ecodesign European requirements (IE3 class <75kW, IE4 class above 75kW)
- Equipped with both flange and feet (B35 mount) for freedom in machine design
- Available with standard cooling (IC411) or forced cooling (IC416) to meet requirements of various application duty cycles

### Open-loop motion control mode

Flow on demand:  
PLC of the machine provides speed/flow command to the drive. There is no resolver/encoder on the motor and per default, no speed feedback to the drive. The drive features a "sensor-less feedback" capability which makes the closed loop speed control possible if needed.



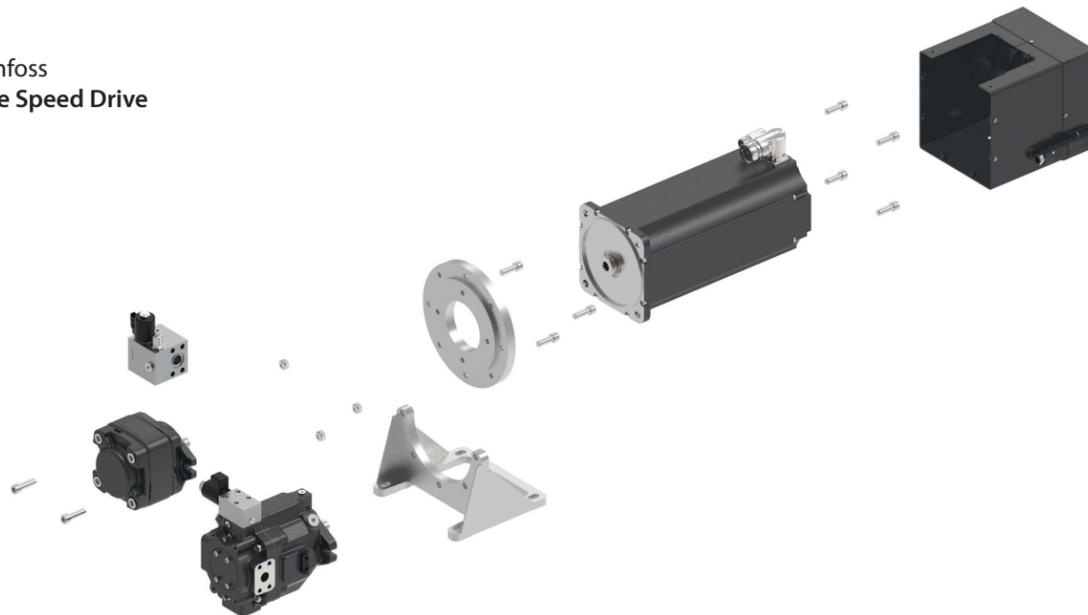
## Servo motor technology

Variable speed drives with servo motors are usually used with closed loop control to provide a precise pressure and flow on demand, tailored for the respective part of the duty cycle. The machines PLC sends the drive a pressure or flow command and the drive controls the motor speed to deliver the requested pressure or flow based on pump displacement and efficiency data in the drive and closed loop feedback from motor speed and pressure sensor.

Servo motors have excellent dynamic properties, which allows the precise control of pressure and flow without any additional pressure and flow control valves even in demanding duty cycles.

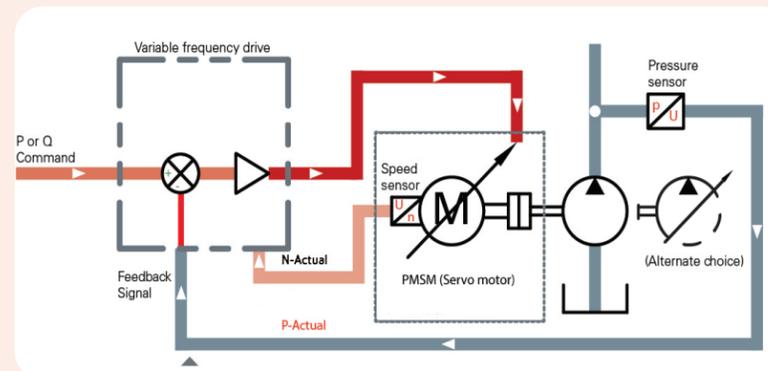
This allows for completely new simpler machine architecture where pressure and flow is directly controlled only by pump's output.

Vickers by Danfoss  
Servo Variable Speed Drive



### Closed-loop motion control mode

**p/Q control:**  
PLC of the machine sends command for required deliverable (pressure or flow) to the drive.  
The drive features a dedicated application p/Q software which controls the pressure or flow in a closed loop, utilizing pressure feedback from pressure sensor and flow feedback from the resolver on the motor combined with data about the pump in the drive. Both pressure and flow can be controlled interchangeably.



### Servo motor VSD system components



#### Vickers by Danfoss VGPS internal gear pump

- Primary choice for servo motor systems due to excellent efficiency, wide speed range and low noise
- Displacements from 4cc to 160cc across 3 frame sizes
- 315bar rated and 350bar peak pressure for most of the product range
- 3000rpm maximum speed across the whole product range
- Very low noise across the whole rpm and pressure range
- Excellent low speed efficiency, rated pressure holding (zero flow) at 30-60rpm



#### Vickers by Danfoss VGPS PVMX axial piston pumps

- Alternative for applications that require high rated pressure or benefit from variable (dual) displacement capability
- Next generation of industrial axial piston pumps designed for VSD systems
- 28cc displacement available with larger sizes coming soon
- 350bar rated and 420bar peak pressure
- 3800rpm maximum speed
- Low noise and good low speed efficiency
- Electronic dual displacement control (high and low displacement mechanically adjustable)



#### Bypass Block

- Optional accessory for application duty cycles with long (>1min) pressure holding (high pressure/zero output flow) periods
- Contains on/off solenoid valve and orifice to create controlled bypass flow on demand. This increases the flow through the pump, cooling it enough to sustain unlimited pressure holding operation.
- Contains pressure & temperature sensor for closed loop pressure control



#### Danfoss VLT(R) AutomationDrive iC7

- Latest generation of Danfoss Drives with high power density and servo like performance
- Includes custom p/Q software to control pressure (p) and/or flow (Q) in the closed loop
- Supports energy recovery to grid or DC-bus
- Secure-by-design: equipped with market-leading HW-based protection against unauthorized access with a built-in crypto chip on the control unit
- Functional safety to match every need. STO SIL3, Ple as standard makes certification easier. A flexible offering allows the addition of functional safety via fieldbus.
- Integrated OPC UA. This powerful protocol offers many benefits for secure asset management, cloud connectivity, and SCADA/HMI integration



#### PMSM servo motors

- Very high efficiency, excellent dynamic properties, low inertia, direct connection with pump via male/female spline
- High power density with high overload capability
- Integrated resolver for closed loop flow control
- Rated power range from 2.5kW to 79kW across 4 frame sizes
- Rated torque from 12Nm to 300Nm, peak torque from 40Nm to 1150Nm
- Convection (IC410) or forced air (IC416) cooling available to meet requirements of various application duty cycles

## VSD System sizing

Correct system sizing based on application duty cycle (flow and pressure demand in time) is essential for maximizing the benefits of VSD technology.

Only the knowledge of the machine and application demand (including idle times) allows for proper component sizing & selection based on their rated and overload capabilities.

Utilizing the overload capabilities of the components and variable speed capability to cover the peak pressure and flow demand allows for the solution with the highest power density and lowest size and cost.

Contact your Danfoss representative or Danfoss integration and distribution partner to have the VSD system sized for your application.



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