Variable Speed Drives
Optimize production potential
Variable Speed Drives

Well conditions often change over time—reservoir pressures drop, GORs and watercuts vary, pressure maintenance and flood patterns change, abrasives impact flow rates, and power supplies fluctuate. Such events inevitably affect the performance of the ESP system and the well.

Optimize production, minimize downtime
Schlumberger variable speed drives (VSDs) help ESPs and surface pumping systems adapt to changing conditions in your well by adjusting production rates, thereby improving performance and optimizing productivity. Parameters to maximize performance can be preset, automatically controlled, and remotely adjusted as required.

By varying speeds, VSDs enable pumps to operate across a wider range than possible with fixed speed drives. This feature reduces the need to change out pumps as conditions change, decreasing downtime and operating costs, contributing to a longer system life, and enhancing production.

APPLICATIONS
- Wells with high water cut or high GOR
- Wells with viscous or abrasive fluids
- CO2 floods
- Wells with unstable flow
- Caibled methane dewathering
- Gas well dequalification
- Offshore, subsea, and deepwater installations
- Remote locations

BENEFITS
- Reduce costs and enhance productivity with increased efficiency, reliability, and run life
- Eliminate costs of reusing pumps with varying downhole conditions
- Minimize risks with multiple safety features
- Lower manpower requirements with facility to preset, automatically control, and remotely adjust parameters

FEATURES
- Surface pumping system and ESP compatibility
- Speed control to maintain constant load
- Low- and high-voltage drives for different power requirements
- Sinusoidal output with minimal harmonic distortion for downstream devices
- Indoor and outdoor models
- ‘Rocking’ start feature for freeing stuck pumps
- Optional lightning protection

Application-specific solutions
Our suite of VSDs includes models for a range of applications, from routine conditions to high-power, high-voltage, technically challenging situations, including:
- High-volume ashore developments
- Offshore platforms
- Deepwater subsea installations

The right VSD for the job, combined with expert electrical and pump system design, field operation, and monitoring throughout the life cycle of the well can significantly improve the profitability of your operations and maximize production.

Robust outdoor system protects the Amazon
Large amounts of formation water produced by oil and gas operations in the Amazon basin need to be disposed of without damaging the pristine environment. A major operator in Peru decided to reinject produced water into the reservoir to prevent contamination of the Amazon river and its tributaries. The operator chose REDA HPS® horizontal multistage surface pumps because of their proven robustness, efficiency, and long run life.

Reduced electrical system impact, and remote control and operation, shaped the operator’s choice of the SpeedStar MVD® VSD. The only outdoor, NEMA 3R-rated, medium-voltage VSD, it is ideally suited to the harsh Amazonian environment. This fit-for-purpose solution has reduced pollution of the Amazon river.

Outdoor drives suit indoor space constraints, offshore Middle East
Harsh environments have driven the historical use of indoor medium-voltage drives (MVDs) on offshore installations. In the Middle East, one major operator created a new demand for VSDs suitable for use in nonhazardous but hostile outdoor environments because of a lack of indoor climate-controlled space.

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Adaptive VSDs respond to changing conditions
In gaseous applications, downhole conditions change constantly and gas can cause the pump to lock, resulting in the loss of valuable production time. As these applications have become more prevalent, VSDs combining downhole gauge and surface electrical data have evolved that can quickly and automatically adjust to such changes.

Our VSDs enable operators to track a specific pressure reading or motor current (load), and adjust the VSD speed to maintain constant downhole pressure or load, respectively. When gas production conditions change between conditions, the VSD can compensate and maintain the performance of the pump. If water breaks through, the VSD can adjust the speed to keep the production rate unchanged. This feature has saved our clients substantial amounts in deferred production and operating costs.

Durability and remote control meet North Sea requirements
We can help you access the latest technology even in the most challenging locations. Remote and harsh field locations, like the North Sea, need solutions that are both cost-effective and reliable. When an operator needed a VSD for an unmanned power buoy installation, a minimum ESP system run life of four years was the top priority.

The SpeedStar MVD VSD met the operator’s requirements, providing a long run life with the minimum footprint for transportation. Today, remotely controlled VSDs installed on this buoy provide power for up to nine subsea ESP systems.

Lightning protection delivers 362% returns
With thousands operating globally under different environmental conditions, VSDs are constantly exposed to potentially damaging power disturbances caused by man-made and natural occurrences. The most severe disturbances result from lightning strikes, which can create spikes in the voltage and superimpose short-duration electrical transients on the input waveforms. Uncontrolled, such disturbances can cause VSDs to fail and may even render equipment repair unconceivable. StarShield® surge protection devices (SPDs) can be connected to the drive input to ground potentially crippling transient voltages.

In one year, a field in North Africa suffered seven failures among 29 drives because of lightning strikes, resulting in downtime and costly repairs. The failed drives were retrofitted with StarShield SPDs and experienced no failures the following year, leading the customer to equip all the VSDs with surge protectors. The demonstrated 362% rate of return in a single year is typical of the economic value provided by this innovative solution.

‘Rocking’ start saves nearly USD 10 million
One of the greatest challenges for an ESP system is starting the motor when solids fallback—caused by natural formation production, workovers, or drilling operations—plug the ESP and causes the pump to become stuck. The rocking-start feature electrically switches the direction of rotation of the motor back and forth, freeing the pump and allowing production to continue without costly downtime and intervention.

In an offshore field with sand production from an unconsolidated formation, a power brownout caused 109 wells to shut down. When production was restarted with a fixed speed drive, 36 wells could not be brought back online because of stuck pumps. Subsequently, a VSD with the rocking-motor feature was used, reestablishing production from 33 of those wells and saving the project nearly USD 10 million in workover costs.

Comparison of waveform distortion
Sinusoidal waveform
- Up to 50% reduction in ESP run life

Unfiltered VSD output waveform
- ESP run life (days)

Understanding waveform distortion
A PWM VSD can increase ESP system run life up to 50% more than a PWM or other nonfiltered VSD

1. High efficiency and reliability
2. Lower customer infrastructure costs
3. Reduced operating costs over the life of the well because of higher efficiency and reliability

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System integrity

Because early system failure can be financially catastrophic, we provide solutions that maintain overall system integrity. Expert services and software packages can help predict the harmonic content and determine the mitigation requirements for your installation.

We offer a complete range of solutions for harmonic control. Conversion of the supply frequency to the desired operating frequency gives rise to harmonic reflections into the input power supply.

- For 6-pulse low-voltage drives (LVDs), the electric current is typically distorted 25%, depending on the power system impedance.
- 12-pulse LVDs halve the distortion to 11% by a process of phase multiplication, from three phases to six.
- The 18-pulse SpeedStar 519 SWD* VSD effectively reduces the current distortion by 80% compared to a 6-pulse VSD. With just 5% current distortion, subject to power system impedances, it is an economical method of conforming to IEEE 519–1992 guidelines.

Current demands

The emphasis on VSDs is on system optimization, and to some extent auto-adaptive systems using intelligent controllers and increasing efficiency gains, including adherence to clean line or supply power according to recommended guidelines on voltage and current harmonic distortion levels. We offer technologies that include high voltage direct to MVD applications using integral input isolation type transformers.

The input transformer is designed to match customer specified supply voltage and frequency, eliminating the need for additional transformers, thereby raising efficiency and lowering your operating costs.
Variable Speed Drives

Reliability and safety

Our VSDs are among the most reliable in the industry, with a mean time between failures (MTBF) design philosophy of 5 to 10 years for LVDs and MVDs respectively.

Because medium voltage can be lethal, SpeedStar MVDs have a high level of built-in safety. Features include a visible disconnect switch interlocked with Kirk keys to protect personnel and assets, input fuses that provide a current limit, and vacuum contactors that will interrupt a fault and possibly prevent fire and explosion. In addition, a precharge circuit limits the inrush current to a maximum of 150% full load amperage, thereby limiting any mechanical and electrical stresses during startup and ensuring longer term reliability. The SpeedStar MVD also generates its own internal control power for microprocessors and cooling fans, ensuring a single source of power into the MVD and consequently, a single lockout and tagout safety procedure.

<table>
<thead>
<tr>
<th>VSD Type</th>
<th>6 Pulse</th>
<th>12 Pulse</th>
<th>18 Pulse</th>
<th>24 Pulse</th>
<th>36 Pulse</th>
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<tbody>
<tr>
<td>THD (%)</td>
<td>26</td>
<td>11</td>
<td>5</td>
<td>4</td>
<td>3</td>
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VSD portfolio line harmonic solutions for a weak power system (typical outdoor remote land applications) where the percent absolute values will vary with different types of power systems, but the ratios mostly apply and are typical.
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Quality support

Whether you need a brief consultation or the most comprehensive solution, our experts are available anywhere and anytime. Since 1976, our power systems team, based at the Edmonton Technology Center in Canada, has provided innovative and advanced solutions for the control, automation, remote monitoring, and electrical protection of ESP and surface pumping installations. These experts help ensure the efficient and economical use of power through field measurements and computer modeling, by analyzing power system components including VSDs, and by delivering customized solutions.