KUDU Variable Frequency Drives
For progressing cavity pumps

APPLICATIONS

■ Progressing cavity pump (PCP) installations in
  ● heavy, medium, and light oil wells
  ● water wells
  ● coalbed methane and conventional gas wells (for dewatering)
  ● high-water-cut and high-sand-cut environments
  ● highly corrosive wells
  ● thermal applications
  ● horizontal, deviated, and vertical wells

BENEFITS

■ Lower energy consumption and operational costs
■ Extended PCP run life
■ Enhanced safety

FEATURES†

■ Torque limiting
■ Autorestart after power loss
■ Local data logging
■ Modular system to suit multiple applications
■ Configurable to meet all major compliance standards
■ 15 well-protection settings
■ Five control methods
■ Touchscreen interface for easy programming and supervision
■ Stuck-pump and desanding routines

†See “KUDU VFDs Features” table for details

The high-performance KUDU variable frequency drive (VFD) enables sophisticated motor control with speed and torque accuracy, low harmonics, and smooth speed ramping, thereby maximizing motor performance. The system enhances safety through controlled stopping and braking, limiting of maximum speed, and direction management.

Systems are available for all major voltage levels and both 50 Hz and 60 Hz. Enclosed in a NEMA Type 3R case, the VFD system can be configured in accordance with local compliance standards worldwide.

KUDU Advanced VFD

KUDU Advanced VFDs combine the standard KUDU VFD with an advanced controller and upgraded user interface to help operators manage well performance. A full-color touchscreen with an intuitive interface facilitates configuration and well supervision. Acquired data is stored on site and easily retrieved on a USB. The VFD can also be configured to enable remote administration by a SCADA system.

The KUDU Advanced VFD is easily upgraded to include the KUDU PCP Manager* well optimization unit’s functionality, resulting in a top-of-the-line well management system. Five production control modes provide the highest level of PCP control, optimization, protection, and monitoring. This advanced system helps operators understand well conditions, protects well equipment, increases energy efficiency, and optimizes production.

The following table outlines the features of KUDU VFDs: features and settings that describe the capabilities and functionalities of the system, such as soft start, torque limiting, autorestart capability, manual speed control, well-protection settings, backspin timer, data logging, and real-time trending, among others.

<table>
<thead>
<tr>
<th>Feature</th>
<th>KUDU VFD</th>
<th>KUDU Advanced VFD</th>
<th>KUDU Advanced VFD with KUDU PCP Manager Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft start</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Torque limiting</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Autorestart capability</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Manual speed control</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Well-protection settings</td>
<td>Two</td>
<td>Five</td>
<td>Fifteen</td>
</tr>
<tr>
<td>Backspin timers</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>PRESCO-SWITCH™ bypass timers</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Data logging with 8-GB Secure Digital (SD) card</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Real-time trending</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Rod speed and rod torque display</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>RS485/RS232 and Modbus® TCP/IP communication</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Stuck-pump routine</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desanding†</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottomhole pressure (BHP) control‡</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic liquid level (DLL) control§</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production optimization control††</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production target control††‡‡</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold weather package to extend use to –13 degF [–25 degC]</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cellular package for remote communication</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>Backspin control without power</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
</tbody>
</table>

†Requires surface flowmeter or downhole instrumentation
‡Requires surface pressure sensor and downhole instrumentation
§Requires surface pressure sensor and downhole instrumentation
††Requires surface flowmeter

*Requires downhole instrumentation
††Requires surface flowmeter
‡‡Requires surface flowmeter

KUDU Advanced VFD with KUDU PCP Manager well optimization unit functionality.
KUDU VFDs Specifications

<table>
<thead>
<tr>
<th>Drive rating, hp (kW)</th>
<th>30 [22]</th>
<th>75 [56]</th>
<th>100 [75]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output rating, kVA at 480 V</td>
<td>28.6</td>
<td>70</td>
<td>93.7</td>
</tr>
<tr>
<td>Output current, A</td>
<td>46.3</td>
<td>106</td>
<td>145</td>
</tr>
<tr>
<td>Ambient storage temperature, degF [degC]</td>
<td>14 to 122 [–10 to 50]</td>
<td>14 to 122 [–10 to 50]</td>
<td>14 to 122 [–10 to 50]</td>
</tr>
<tr>
<td>Approximate weight, lbm [kg]</td>
<td>932 [423]</td>
<td>1,140 [517]</td>
<td>1,141 [517]</td>
</tr>
</tbody>
</table>

Principal Control Parameters

- Motor control system: Pulse-width modulation (PWM) with flux open-loop vector control
- Input voltage: 380 to 480 V (–15% to 10%), 50 or 60 Hz (±5%)
- Output voltage regulation: ≤ Power supply voltage
- Frequency setting: 0.1 to 500 Hz, 0.1-Hz resolution
- PWM carrier frequency: 2 to 16 kHz adjustable
- Input configuration: 6-pulse diode
- Efficiency: 98% through speed range
- Power factor: 0.97 or better at nominal load
- Overload rating: 120% for 60 s

Enclosure and Environmental Ratings

- Enclosure: NEMA Type 3R (outdoor use); UL 508A service entrance rating
- Cooling method: Separate, air cooled with forced ventilation
- Maximum altitude: 3,330 ft [1,000 m] without derating; derating of the current by 1% for each additional 330 ft [100 m] up to an altitude of 15,748 ft [4,800 m]
- Relative humidity: 5%–95% with no condensation or dripping water, conforming to IEC 60068-2-3
- H₂S protection: Protective coating on electronic cards
- Enclosure material: 12-gauge carbon steel

KUDU Advanced VFD and KUDU Advanced VFD with KUDU PCP Manager Unit Specifications

- Processors: CPU: 32-bit ARM7 microcontroller, 32-MHz clock, integrated watchdog timer
  Microcontroller coprocessor, 20-MHz clock
- Memory: 16-MB flash ROM, 4-MB CMOS RAM, 4-KB EEPROM
- Nonvolatile RAM: CMOS SRAM with lithium battery retains contents for 2 years with no power
- Event logging capacity: 20,000 events
- Maximum database points: 1,000 typical

I/O

- Analog inputs: Eight: 0–20/4–20 mA, 0–5/0–10 V, software configurable
- Analog outputs: Two: 0–20/4–20 mA
- Digital I/O: 16 digital inputs: 12/24 V, 48 V, 115/125 V, 240 V
  10 relay outputs: dry contact or DC solid-state
  Dry contact rating: 3 A, 30 VDC or 240 VAC (resistive) DC solid-state rating: 3 A, 60 VDC
- Counter inputs: One: 0–10 Hz or 0–5 kHz (dry contact) Two: 0–10 kHz (turbine or dry contact)

Communications

- Serial port COM3: RS-232 port, 8-pin modular RJ45 jack, full or half duplex with RTS/CTS control and operator interface power control
- Serial protocols: DNP3 slave, DNP3 master, IEC60870-5-101 slave, IEC60870-5-103 master, Modbus RTU slave, Modbus RTU master, DF1

Touchscreen Interface

- Display type: Thin-film-transistor (TFT) color LCD
- Display size: 5.7 in
- Resolution: 320 × 240 pixels (QVGA)
- Touchpanel service life: 1 million taps or more
- USB interface: USB 2.0 (Type A)
- Local storage: SD card slot (maximum 32-GB SD/SDHC Class 10 card)

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