

## REDAStar

### Low-voltage variable speed drive

#### APPLICATIONS

- Operation of electric submersible pumps (ESPs) and surface pumps
- Optimization of power usage

#### ADVANTAGES

- Reduces operating costs with greater efficiency, reliability, and longer life
- Eliminates costs of resizing the pump, with automatic adjustment for varying downhole conditions
- Optimizes returns for wells with cyclical production

#### FEATURES

- Speed control to maintain constant load
- Start modes suitable for complex well conditions
- Hall-effect, high-frequency-response current transformer for current sensing
- 120-s operation with 50% rated voltage drop up to maximum VSD current
- 2-s operation with >50% rated voltage drop with motor shutdown
- Optional external input and output harmonic filters
- 220-V, 50-Hz, 6-A electrical socket
- Energy meter and global system (GSM) for mobile communications monitoring

Specifically designed for and manufactured in Russia, the REDAStar\* low-voltage variable speed drive (VSD) meets stringent customer specifications as well as national industrial and safety standards, including GOST standards for electrical components. It is used for operating ESPs and surface pumps.

#### Flexible, user-friendly operation

REDAStar drives ensure optimum ESP performance, with operating parameters that can be preset or automatically adjusted as downhole conditions fluctuate. This flexibility eliminates the need to resize the pump with changing conditions, reducing downtime and operating costs. Several operating modes are available for different well conditions, including start-with-synchronization, jerk start, and rocking start, which switches the direction of the motor back and forth to free the shaft when stuck. The current mode allows the pump to be set to a target load and its speed to be adjusted as operating conditions change, helping stabilize operations in gas and viscous environments, and maximizing uptime.

The drives interface with all the low-voltage wellsite surface equipment required to run Phoenix\* artificial lift downhole monitoring systems.

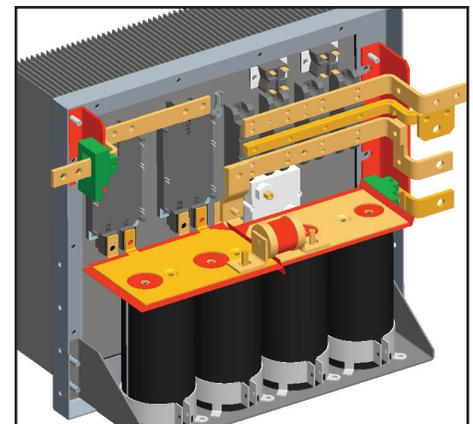
- The VSD controller provides
  - programmable cyclical production
  - the setting of alarms and parameters for auto restart
  - the ability to start an ESP while the motor is spinning
  - a large interface in the local language
  - laptop software to display trend data and controller settings
  - graphics and trending for up to eight parameters on well startup
  - USB flash drive access for rapid trend data download
  - true-rms VSD output phase currents
  - calibrated motor phase currents with current and voltage optimization

- downhole insulation measurement without downhole gauges
- support of downhole gauges from various manufacturers.

#### Reliability and extended life

REDAStar drives include three single-phase AC power modules in a design that reduces the number of components, facilitates troubleshooting, increases mean time between failures (MTBF), and lowers costs. They operate in temperatures ranging from -60 to 50 degC. The power electronics are protected from the outside environment in a completely enclosed space rated IP54, cooled by heat exchangers that separate the outside and inside air. The ventilation gaps of the cooling system are rated IP23.

Pulse-width modulation prolongs the life of the electrical system by providing higher torque per ampere, resulting in minimal motor heating, and by ensuring a constant speed and torque. Additionally, VSDs reduce the startup current to as low as 1.5 times the operating value, helping increase the insulation life for all electrical components downstream of the VSD, including connectors, splices, cables, and the motor.



Single-phase modules, one per phase.

## Reduced harmonics

Conversion of the supply frequency to the desired operating frequency gives rise to harmonic reflections into the input power supply. For six-pulse VSDs, this effect typically distorts the electric current by 25% to 100%, depending on the power system impedance. The distortion can elevate temperatures, weaken insulation, and damage other connected equipment, in addition to reducing power line capacity and

efficiency. REDAStar VSDs feature an optional DC link reactor and external input filter that effectively and reliably reduce the harmonic distortion on the power supply to levels compatible with GOST 13109-97 standards, dramatically improving the efficiency and utility of the electrical power system.

An optional external output sine wave filter (SWF) decreases harmonic distortion at the output, producing nearly sinusoidal wave-

forms, minimizing voltage surges, reducing the stress on the electrical system, and increasing the life of various components. It pushes the resonance band of the downhole system below the VSD carrier frequency, irrespective of cable length, motor type, and the transformer taps selected. With a simple, three-phase connection to the VSD output, the filter requires no wellsite tuning and is available in a range of sizes depending on the load.



REDAStar 400-A (263 kVA) VSD.



Input air filter.



Output sine wave filter.

## REDAStar VSD Specifications

### Operating parameters

Output current rating, A	250	400	630	800
Output power rating, kVA	164	263	414	526
Input supply	3 phases + 380 V ( $\pm 25\%$ ) 50 Hz ( $\pm 2$ Hz)			
Output voltage	3 phases, multilevel pulse-width modulated (PWM), range 0 to input voltage level			
Output frequency operating range, Hz	20–75, (resolution 0.01 Hz)			
PWM carrier frequency	Programmable, up to 3 kHz			
Current overload	125% of rated current for 5 min (mode 2 as per GOST 24607-88)			
Viability at voltage sags and complete power loss	<ul style="list-style-type: none"> <li>• 120-s operation with 50% rated voltage drop up to maximum VSD current</li> <li>• 2-s operation with &gt;50% rated voltage drop with motor shutdown</li> </ul>			
Input power factor	96%			
Efficiency factor	Not less than 96% with standard output sine wave filter (SWF)			
Output voltage total harmonic distortion (THD)	Not more than 5% (if standard output SWF is provided)			

### Enclosure

Dimensions (H × W × D), mm	TBD <sup>†</sup>	2,085 × 1,227 × 1,060	2,085 × 1,227 × 1,060	TBD
Weight, kg	TBD	510	570	TBD
Ingress protection code	IP54—internal enclosure space IP23—ventilation gaps for cooling system			
Anticorrosive coating	Powder polymer coating			

### Environmental conditions

Ambient properties	Ambient conditions must not be explosive and must not contain electrically conductive dust or aggressive gases or vapors at concentrations damaging to metals and insulation materials			
Ambient operating temperature, degC	–60 to 50			
Relative humidity	In environments up to 100% max. at 25 degC			
Altitude above sea level, m	Up to 1,000			

### Reliability

Lifetime, years	Not less than 10			
Mean restoration time, hours	1			

<sup>†</sup>To be determined

## Output Sine Wave Filter Specifications

### Operating parameters

Output current rating, A	250	400	630	800
Operating voltage rating of main circuit, V	380			
Max. operating voltage for main circuit, V	380 + 25%			
Voltage rating of auxiliary circuit (for cooling fans)	220 V, 50 Hz			
Current overload	200% of rated current for 10 s			
Output frequency operating range, Hz	20–90			
PWM carrier frequency, kHz	1.7 to 3.3			
Output voltage (total harmonic distortion)	No more than 5%			
Efficiency factor	Not less than 98%			

### Enclosure

Dimensions (H × W × D), mm	749 × 336 × 324	850 × 820 × 1100	965 × 546 × 597	1,143 × 661 × 635
Weight, kg	180	190	250	290
Ingress protection code	IP43			
Anticorrosive coating	Powder polymer coating			

### Environmental conditions

Ambient properties	Ambient conditions must not be explosive and must not contain electrically conductive dust, or aggressive gases or vapors at concentrations damaging to metals and insulation materials			
Ambient operating temperature, degC	–60 to 50			
Relative humidity	In environments up to 100% max. at 25 degC			
Altitude above sea level, m	Up to 1,000			

## Input Harmonic Filter Specifications

### Operating parameters

Output current rating, A	274	410	720	810
Operational voltage of main circuit	380 V (–15% +10%), 50 Hz			
Current overload	150% of rated current for 60 s			
Maximum no-load reactive current	<20% of rated value			
Rejected harmonics, H	≥ 5			
Output voltage (total harmonic distortion)	No more than 5%			
Efficiency factor	Not less than 99%			

### Enclosure

Dimensions (H × W × D), mm	1,143 × 661 × 635	1,308 × 813 × 749	1,499 × 1,003 × 864	1,677 × 1,118 × 965
Weight, kg	234	305	508	535
Ingress protection code	IP43			
Anticorrosive coating	Powder coating (per GOST 9.032-74); color: RAL 7035			

### Environmental conditions

Ambient properties	Ambient conditions must not be explosive, and must not contain electrically conductive dust or aggressive gases or vapors at concentrations damaging to metals and insulation materials			
Ambient operating temperature, degC	–60 to 50			
Relative humidity	In environments up to 100% max. at 25 degC			
Altitude above sea level, m	Up to 1,000			