

ePAC Electric Submersible Pump System

Designed for oilfield pumping applications, the ePAC, goes beyond conventional variable frequency or speed drives, incorporating flux vector technology for precision control of both speed and torque. This system allows optimization of electric-driven artificial lift systems. The drive provides a number of features specifically designed for electric submersible pumps (ESPs).

- Overload and underload detection protect submersible motors and pumps from damage
- Current limit control increases production from gassy wells by increasing motor speed during periods of reduced pump load
- Auto-restart returns the drive to operation, after an adjustable period of time, once the fault has been cleared
- Extensive electronic protection circuits reduce failures
- Rapid restart minimizes lost well production due to momentary power outages
- Real-time data logging of production information
- Flux vector operation for precise control of motor current and torque

Performance Features

- Event/fault logs for capturing diagnostic information
- Programmable auto restart for unattended operation
- Sine or trap wave outputs for operation of surface pumps
- Six-step or trap wave outputs for operation of submersible pumps
- Clock/calendar maintains accurate time during power outages
- High switching frequency IGBT devices for smooth, quiet operation
- Constant horsepower operation above base speed
- Dynamic braking control option for absorbing regenerated energy
- All-digital control for zero drift and repeatable motor operation
- Multiple preset speeds with adjustable acceleration and deceleration times



- Reduces power consumption
- Overload and underload detection
- Increases ESP run life
- Programmable auto restart reduces downtime

User Interface

eP artificial lift drives provide up to 12 operator devices such as pushbuttons, selectors, indicators, and potentiometers. The standard configuration for ESPs consists of Start and Stop pushbuttons, as well as, indicators for Run, Overload, Underload, and Fault.

- Comprehensive self-diagnostic message display
- Two line by 24-character descriptive, plain-language display
- Touch keypad for easy entry of application-specific setup adjustments

Operator Data Interface

The Operator Data Interface has been designed for ease of use for startup, monitoring, and troubleshooting. A 2-line by 24-character display provides easily read text and graphics. A 16-button keypad allows simple menu navigation and data entry. Password protection is used to prevent unauthorized access to drive parameters. On-line setup instructions, prompts, warnings, bar graph displays, and logical data groupings result in fast startups, smooth operation, and minimum downtime.

- Process variable display in bar graph and engineering units
- User programmable ladder diagrams and function blocks
- User-programmable analog and digital inputs and outputs
- Integral DC link choke for high power factor and low total harmonic distortion

Operator Display

- Motor amps
- Motor volts
- Output frequency
- Drive status for convenience of the operator

Bar Graph Display

- Drive parameters
- Numeric format
- Speeds
- Currents
- Voltages

Optimization of electric-driven artificial lift systems with precision control of both speed and torque.



Parameter Display

The parameter display is used to observe or enter data. The keypad can be used to scroll through a group of parameters or jump to a specific parameter. The keypad is also used to adjust parameters.

Fast Power Outage Recovery

The ePAC drives incorporate a unique design for fast recovery from power outages. This feature minimizes lost production from ESP wells operating in regions with frequent power interruptions. Conventional restart timers, used to avoid starting into a back spinning motor, introduce unnecessary delay. The drive uses a unique battery powered restart timer that begins timing on loss of power and keeps track of elapsed time during the power outage. This timer allows the pump to be started in the shortest period of time. For power outages that are shorter than the restart time, the drive waits until the restart time has elapsed before starting the pump.

Protection

- Ground fault
- Motor phase-to-phase short circuit
- AC input overvoltage
- AC input undervoltage
- Instantaneous overcurrent
- Motor overload
- Heat sink overtemperature
- Power transistor fault
- Logic power undervoltage
- Motor runaway
- Memory malfunction
- Processor running fault

Specifications

Electrical

Input Supply

Voltage	380- to 480-Vac ($\pm 10\%$)
Frequency	47- to 63-Hz

Power Factor

Overall	0.00 to 0.94 depending on speed for six-step outputs 0.94 at all speeds for pulse width modulated outputs 0.99 at all speeds with harmonic eliminator
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Output Rating

Voltage	Zero to input voltage, three-phase
Frequency	0- to 120-Hz flux vector control 0- to 300-Hz variable frequency control
Switching Frequency	Programmable, 2- to 12-kHz
Overload Current	Constant torque: 150% of rated for 1 minute, maximum of 200% rated
Variable Torque	120% of rated for 1 minute, maximum of 140% to 160% of rated
Extended Torque	110% of rated for 1 minute, maximum of 120% to 140% of rated

Conversion

Rectifier Unit	Six-SCR, three-phase (6-pulse) fullwave bridge rectification
Inverter Unit	Six-IGBT, four-quadrant, six-step, trapezoidal, or sinusoidal output

Environmental

Operating Temperature	32° to 122°F (0° to 50°C)
Storage Temperature	5° to 158°F (-15° to 70°C)
Relative Humidity	5% to 95%, noncondensing
Altitude	0 to 3,300 ft. (1,000 m) at full rating

Inputs and Outputs

Analog Inputs	Three 12 bit analog inputs (± 10 Vdc or 4- to 20-mA)
Analog Outputs	Two 12 bit analog outputs (± 10 Vdc and 4- to 20-mA)
Digital Inputs	12 digital inputs (requires sink of 1 mA to common)
Digital Outputs	Six digital outputs (open-collector drivers rated 24 Vdc @ 500 mA)

Serial Communications

Asynchronous Port	EIA RS-232 and RS-422/485, isolated, 0.3- to 19.2-kbaud ANSI-x3.28-2.5-A4, Allen-Bradley DF1, and Modicon RTU protocols
Synchronous Port	EIA RS-485 for high-speed master/slave networking



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