

SAM™ Well Manager Variable Speed Drive



LUFKIN
AUTOMATION



Lufkin Automation offers the ultimate in beam pump control that helps reduce failures and R&M costs, and helps increase uptime and production. The SAM™ Well Manager with a Variable Speed Drive (VSD) is a packaged system that matches pumping to reservoir conditions, eliminating shut downs. Instead of traditional on/off cycling to match well performance, the system keeps the well pumped down by continually adjusting pump speed—stroke by stroke. Horsepower ratings from 10 to 100 are available. Higher horsepower is available by special order.

The SAM Well Manager provides a variable analog output voltage as a speed control input to the VSD. The control algorithm optimizes pumping speed based on either downhole pump fillage or surface card setpoint. Speed is adjusted as often as once per pump cycle to keep the well pumped down.

Ideal for environments where your well can't be shut down.

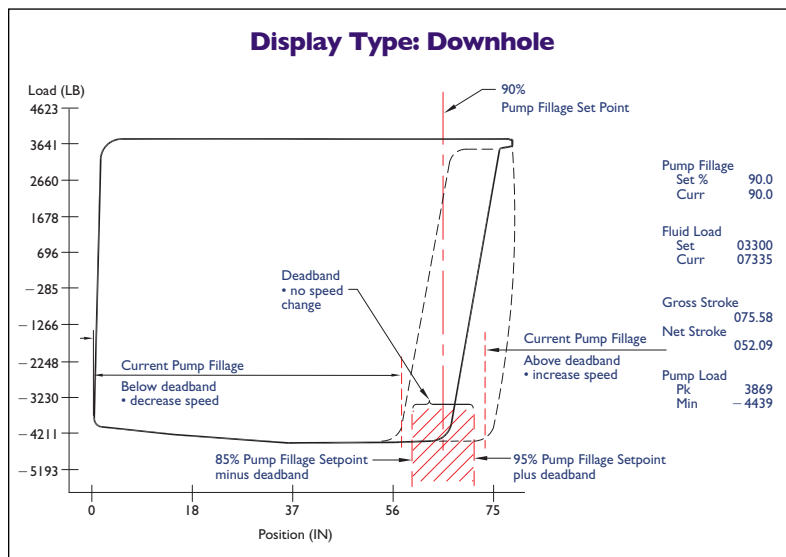
- Sanding/pump sticking problems
- Heavy crude production
- Steam flood operations
- Situations where shutting down would adversely affect production operations
- Speed changes without replacing sheaves

By slowing the unit just enough to avoid working load violations, this system can also help you manage rod float problems and peak rod load issues with heavy oil. And if the SAM Well Manager detects any other pumping equipment malfunction, you can choose to stop the well or continue running at a programmed minimum speed.

VSD control and safety features in the SAM Well Manager fully optimize production even within the mechanical limits imposed by difficult pumping applications.

VSD-Specific SAM Features

- **Configuration flexibility.** The SAM VSD is a smart rod pump control system that integrates VSD and rod pump controller. This combination replaces the traditional contactor box and provides everything in one enclosure.
- **Factory-tested integration.** The Lufkin combined package of the SAM Well Manager and the VSD in the same cabinet has been fully integrated and tested for compatibility. The combined package, with enhanced features, provides for simpler field installation, better service support and an assurance that the pre-wired, factory-tested cabinet has already addressed any interference issues.
- **Simplified setup.** Default VSD parameters for the Beam Pump application in the VSD simplifies setup, because most parameters are properly defaulted. Only items such as motor parameters need be entered.
- **Optional heater kit.** For cold climates, the SAM VSD features a thermostat-controlled heater.
- **Optional bypass contactors.** With the optional bypass, the SAM unit can detect a drive fault through Modbus communication or digital input. The user can program the delay time, and whether or not the SAM should switch automatically to normal downhole- or surface-operation mode and continue pumping the well at line frequency, cycling the well on and off at pumpoff. If not, the SAM unit will retry the allowed number of times prior to arriving at a malfunction state that will require user intervention.





Dynamic Braking Resistor

■ **Optional dynamic braking.**

Negative torque load can occur due to normal variability in unit balance and well conditions. Thus most SAM VSD installations will benefit from a dynamic brake resistor. These assemblies dissipate excess regenerated power to keep the bus voltage from exceeding the rated limit of the drive.

- **Connect to existing NEMA D or B Motors.** The VSD can operate an existing induction motor, thereby reducing installation costs associated with purchasing a new motor.

A NEMA B motor should have somewhat higher average efficiency, but the initial cost vs. the power savings will likely have a long payout.

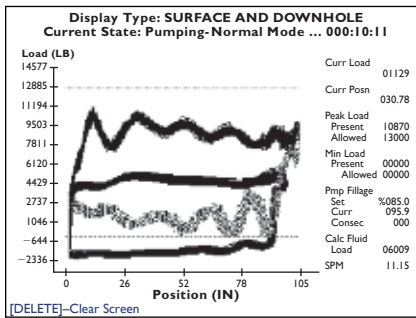
- **Optimized production and pumpdown.** Downhole or surface pump fillage is the basis for controlling speed to optimize production and pumpdown. The normal speed control algorithm is based on a programmed starting speed, and increases or decreases in speed are determined on every stroke from the dynamometer pump card.

- **Programmable upstroke/downstroke speed.** Downstroke speed can be programmed as a percentage change from the upstroke speed, and the point in the stroke at which the speed change occurs is also programmable.
- **Working-load limits for speed limiting.** If a peak or minimum working-load limit is exceeded (e.g., due to paraffin buildup or low flowline temperatures), the normal pump-fillage-speed control is overridden, and the speed is reduced in steps. On each stroke that a violation occurs, the speed is slowed an additional increment, until the violation no longer occurs. In this manner, production is optimized within the mechanical load limits established by the operator.
- **Stop on malfunction or run at minimum speed.** If any of the safety-limit violations occur, the operator has the option to continue operating at minimum speed or to stop the pump. Because of sanding or thermal issues, however, stopping may not be an option. When stopped or running at minimum speed, the unit is placed in a downtime state for the programmed downtime period. When that period expires, the unit will attempt to start up normally.
- **Optional harmonic filters.**

LFKA-I Standard Specifications		
Power Supply	Voltage/Frequency	460 V Class: 3-phase 380 to 480 V, 50/60 Hz
	Tolerance	Voltage + 10%, - 15% ($\pm 10\%$ during continuous 100% load) Frequency $\pm 5\%$
Rated Output Voltage		460 V Class: 3-phase 380 to 480 V (Maximum output voltage is limited by maximum input voltage.)
Output Frequency Range		0.01-500 Hz
Overload Current Rating		150% for 60 seconds, 165% for 2 seconds
Dynamic Braking Circuit		1/2-250 HP: Built-in IGBT 7, 300 HP and up: External Option
Main Function		Easy-Mode Parameter Setup, Learning Function, Programmable I/O Terminal Block, Multi-PID Control, My Functions
Ambient Temperature/Relative Humidity		- 40 to 60°C (derate above 50°C), 0-95% relative humidity, non-condensing (as integrated package)
Protection		Built-in surge protection; phase protection by MOVs and a surge arrestor that meets ANSI/IEEE C62.11-1993
Cooling Method		Forced Air Cooling
Built-in Filter		460 V 1-5 HP: Built-in EMI noise filter (EN55011 Class A, EN61800-3 category 2 compliant) 460 V 7.5-350 HP: Built-in EMI noise filter (EN5501 Class A, EN61800-3 category 3 compliant)
Built-in DC Link Reactor		460 V 25-100 HP (18.5-75 kW): Built-in DC Reactor 460 V 125-700 HP (90-500 kW): Attached DC Reader
Enclosure		NEMA 3R

- **Rod-float mitigation.** The rod-float mitigation feature provides options for minimizing or eliminating rod float on wells that experience this phenomenon. The unit is slowed when rod load drops below a programmable threshold.
- **Peak-power limiting** (programmable peak torque). In a steam-flood or steam-cyclic operation, the well cools with time, and the peak load and peak power increase with time. The SAM can be programmed with an overall peak-torque limit to protect equipment (e.g., from thermal motor overloads) and keep it operating within the limits of the system.

Real-time Dynagraph Cards



Sample Status Screen

SAM RPC Ver. 4.53		CS:0407E115		04-29-2004		09:25	
RPC Status Screen 1							
RTU Address	0001	Current Well State	Pumping-Normal Mode	Elapsed Time	000:10:56	Control Mode	VFD-DH
Operation Mode	NORMAL	Minimum Pump Strokes	002	Gauge-OFF time	08:00	Run Yesterday	000% 00:00 (hh:mm)
Downtime	0000:05 (hh:mm)	Run Since Gauge-OFF	100% 01:25 (hh:mm)	Inf Prod Yesterday	0000.0 (Bbls)	Inf Prod Since Gauge-OFF	0043.0 (Bbls)
Projected Daily InfProd	00403 (Bbls)	Rodometer	0000010785	Pumpmeter	0000010785	Pumping Speed	11.17 (strokes/min)
Pump Fillage	095.90%	VFD Current Speed	0005.0 Hz				
				[NEXT] to Page			
LUFKIN AUTOMATION				Tel. No. (281)-495-1100			

Quick-Start

SAM RPC Ver. 4.53		CS:0407E115		04-29-2004		09:29	
QUICK-START VFD/ VSD PARAMETERS							
VFD Drive Type	Petro-trAC WF2	Scaling Unit	A01	Maximum Speed	0120 Hz	Minimum Speed	0000 Hz
Deadband +/-	005.00	Speed Change Stroke Delay	001	Start Up Speed (% of Full Scale)	050	Speed Increase Size (% of Full Scale)	005
Speed Decrease Size (% of Full Scale)	005	Working Peak Load Limiting (LBS)	13000	Working Min Load Limiting (LBS)	00000	Working Peak Speed (Hz)	0085
Working Min Speed (Hz)	0025	Protection DT/Malfunction Control	RUN LOW SPEED	VFD Stroke State Detection Option	Single DO	Enable Disable Up/Down Stroke Speed	ENABLED
DownStroke Speed Change (% of SL)	010.00	Percent Speed Change	-10.0				
				[NEXT]-Next Screen			
LUFKIN AUTOMATION				Tel. No. (281)-495-1100			

- **Convenient Modbus master programming and monitoring.** A keypad and LCD give the operator a way to program and monitor VSD via the SAM unit which is capable of Modbus master communications, using RS-485. This has been customized for the Lufkin VSD application so that all normal drive programming can be accomplished through the SAM keypad, or via host, thereby providing a unified interface.
- **Speed plot for 24 hours** (1 minute sampling). Speed changes during the day can be viewed with the 24-hour speed plot to view production optimization effectiveness.

General SAM Features

- Hundreds of status registers (e.g., SPM, peak/min. load, RPM, pump fillage)
- Inferred production tracking (today, 60-day history, programmable oil cut, account for pump leakage)
- Graphical LCD with keypad
- Surface and downhole dynagraph cards
 - Real time
 - 5 recent stored cards
 - Startup card
 - Pumpup card
 - Last two shutdown card groups (5 cards each)
 - Standard card

- Standard SAM communication (laptop, radio, cell phone)
- Standard 60-day plots (inferred production, runtime, peak/min. loads, polished rod horsepower)
- Last 400 point load plot
- Accurate polished rod load cell or beam transducer load Input
- Accurate motor/crank hall-effect or inclinometer position Input
- Valve check/pump leakage diagnostic
- Notepad

- Advanced RTU features
 - Expanded I/O capability (w/alerts)
 - Logic expression
 - Register logging
 - Register digital output/alerts
 - Register calculator
 - AGA 3/NX-19 gas flow calculation
 - Well state alarms and logging

- Accumulator support
- Event logs (time stamped events, shutdown log, and alarm log)
- Coil tracking
- Complete unit can replace an existing contactor box or be used by itself for motor control on a new installation.

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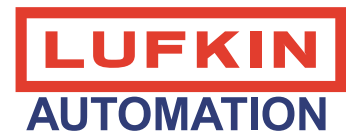
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