

SpeedStar MVD

Medium-voltage variable speed drive—NEMA 1 for indoor applications

APPLICATIONS

- High-horsepower, variable-speed ESP and surface electric motor applications, with the drive installed in a climate-controlled environment

BENEFITS

- Reduces operating costs
- Extends ESP system run life
- Enhances operational safety
- Optimizes space usage

FEATURES

- Plug-and-play sine wave output filter (for ESP applications)
- Multilevel pulse-width modulated (PWM) inverter output with no neutral point shift, suitable for surface electric motors
- Input power factor of 0.96 at all loads and speeds
- Built-in, visible, fused disconnect switch
- Built-in 24-pulse input transformer with precharge circuitry
- Ability to perform a smooth restart of a spinning motor
- Programmable automatic load reduction (soft-stall function)
- Speed control to maintain constant load or pressure
- Rocking start for wells where the pumps have stalled because of scale or sand
- Micro Series line available for even smaller footprints
- Instruct* all-in-one acquisition and control unit for control of the SpeedStar MVD VSD, downhole tools, SCADA system, and Liftwatcher* real-time surveillance service

The SpeedStar MVD* medium-voltage variable speed drive (VSD) is a NEMA 1 medium-voltage drive (MVD) for the control of ESPs and surface electric motor-driven applications. It is the only MVD in the industry available in multiple sizes. It includes a fused disconnect switch, inbuilt copper isolation transformer with precharge circuitry to reduce inrush current and maintain transformer reliability on startups, and input vacuum contactors with a 10-year mean time between failures—all within an innovative footprint customized for tight indoor spaces.

Design and operation

Unlike other designs, the control circuit topology of the SpeedStar MVD VSD uses just three-phase output power cells and provides high performance, which translates to low maintenance costs and simple troubleshooting and repair. The modular vertical design of this VSD has the smallest footprint in the industry, enabling quick power module interchangeability via rack-out power modules.

The main power circuit uses input diodes and insulated gate bipolar transistor (IGBT) technology at the output, a highly reliable way to control speed in medium- and low-voltage drives. The reduction in overall system energy consumption is as much as 6% compared with equivalent low-voltage systems.

The drive provides precise motor control by using full-wave diode rectification, a constant-voltage DC bus, and IGBT inversion. The inverter output is a multilevel PWM waveform with no neutral point shift. Coupled with a patented integral output sine wave filter, it allows the drive to be used with standard ESP motors and cables that typically have 5-kV-rated insulation, ensuring reliability and prolonging run life.

The control system features a reduced chip count, which provides high performance and reliability, and both Volts-per-Hertz (V/Hz) and vector control capabilities. V/Hz is the preferred control method due to its easy setup and flexibility during operation. In addition to target frequency, pressure or current control mode automatically adjusts the speed of the drive on the basis of predetermined set points.



The NEMA 1 version of the SpeedStar MVD VSD is intended for indoor use and can supply 500 to 2,500 hp.

SpeedStar MVD

SpeedStar MVD VSD Models and Dimensions NEMA 1 (3.3- to 6.6-kV input and up to 4.5-kV output [†])											
Output rating, A	62	74	87	99	112	124	155	186	217	248	
Output power at 4,160 V and 60Hz, kVA [hp]	447 [500]	536 [600]	625 [700]	715 [800]	804 [900]	893 [1,000]	1,116 [1,250]	1,340 [1,500]	1,536 [1,750]	1,786 [2,000]	
Standard MVD footprint with sine wave filter	Dimensions (H × W × D), in [cm]	103.7 × 74 × 43.4 [263.4 × 188.0 × 110.3]						103.7 × 122 × 43.4 [263.4 × 309.9 × 110.3]			
	Weight, lbm [kg]	7,160 [3,248]	7,380 [3,348]	7,610 [3,452]	7,910 [3,588]	8,210 [3,274]	9,010 [4,087]	11,830 [5,366]	12,630 [5,729]	13,530 [6,137]	14,180 [6,432]
Micro Series MVD footprint without sine wave filter	Dimensions (H × W × D), in [cm]	103.7 × 48 × 48 [263.4 × 121.9 × 121.9]		103.7 × 60 × 48 [263.4 × 152.4 × 121.9]				103.7 × 90 × 48 [263.4 × 228.6 × 121.9]			
	Weight, lbm [kg]	6,000 [2,722]	6,200 [2,813]	7,000 [3,175]	7,200 [3,266]	7,400 [3,357]	7,600 [3,448]	10,400 [4,718]	10,600 [4,808]	10,800 [4,899]	12,000 [5,444]
Micro Series MVD footprint with sine wave filter	Dimensions (H × W × D), in [cm]	103.7 × 48 × 48 [263.4 × 121.9 × 121.9]		103.7 × 60 × 48 [263.4 × 152.4 × 121.9]				103.7 × 112 × 48 [263.4 × 281.9 × 121.9]			
	Weight, lbm [kg]	6,440 [2,921]	6,640 [3,012]	7,580 [3,438]	7,840 [3,556]	8,040 [3,647]	8,240 [3,738]	11,780 [5,343]	12,580 [5,706]	13,480 [6,115]	14,130 [6,409]

Power System Specifications

Control system	Sinusoidal multilevel PWM control
Control precision	± 0.5% of maximum output frequency
Base control system	V/Hz, sensorless vector control, variable torque, closed-loop vector control, constant torque
Efficiency	96.5% (total system), 98% (inverter)
Input power factor	0.96
Overload capacity	115% for 60 s, 100% continuous (in some models, overload capacity is 110% for 60 s)
Input voltage supply	2,400 to 13,800 V [†] ; 50/60 Hz
Input tolerance	Voltage: ±10%; Frequency: ±5%
Output	Voltage: 0 to 4.5 kV; Frequency: 0 to 120 Hz
Main input power	Three-phase input isolation transformer, 24-pulse design with visible input fused disconnect and precharge circuitry
Control power supply	Integral to main transformer: three-phase 480-V, 50/60-Hz, 20-kVA capacity via tertiary winding; 15 kVA available for other uses
Internal protective functions	Current limit, overcurrent, overcharge, overload, undervoltage, overvoltage, ground fault, CPU error, abnormal cooling
PWM carrier frequency	2,048 kHz
Output transistor type	IGBT
Applicable standards	Electrical performance: NEC, ANSI
Components and others	NEC, NEMA, UL, cUL, and CE

[†] Requires addition of high-voltage circuit breaker at front end if higher than 6.6 kV

Construction Specifications

Panel construction	Free-standing, front-maintenance type with channel base
Cooling	Forced air cooled with optional redundant fan
Air filter	Front-mounted, aluminum, washable, screened
Paint and color	Gavlon 841, 2-mil minimum, UL1332 compliant, ANSI-61 gray

Enclosure and Environmental Ratings

Type	NEMA 1-rated, IP20, IEC-529, gasketed, and filtered
Ambient temperature operating range, degF [degC]	14 to 104 [-10 to 40]; output rating derated above upper temperature
Ambient temperature storage range, degF [degC]	-7 to 140 [-14 to 60]
Humidity	95% maximum (noncondensing)
Max. altitude, ft [m]	3,300 [1,000] above mean sea level
Vibration	0.5 g _n or less at 10 to 50 Hz
Installation	Indoor, no direct sunlight, protected against corrosive and explosive gases

[†]In some models, the MVD must be derated beyond 4.16 kV

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