FOC-V3
Sensorless Field-Oriented Control for EC Motors
12 to 48 VDC / 80 A Phase Current

- Field-oriented control (FOC) for speed and torque control
- FOC algorithm based on a 32-bit microcontroller, implemented entirely in software for minimal hardware complexity and maximum flexibility
- Sensorless sinusoidal commutation with sinusoidal motor currents
- Outstanding speed stability and smooth, low-noise, vibration-free motor operation
- Suitable for brushless three-phase EC motors in delta or star (wye) configuration, with either surface-mounted or interior permanent magnets
- PID controllers for speed and torque control, with an underlying current control loop
- Sensorless rotor position detection at standstill, providing improved torque characteristics during startup
- Space Vector Modulation (SVM) for optimal torque generation
- Field-weakening operation for high-speed applications
- Dimensions: 105 × 85 × 30 mm
- SSI interface for a magnetic rotary encoder, enabling optional rotor position feedback and positioning operation
- Supply voltage: 12 to 48 VDC
- Maximum phase current: 80 A
- Interfaces: USB, CAN
- Two 24 V control inputs: Direction, Enable
- Four analog inputs: 0–10 V
- Four 24 V power outputs, 1 A each (internally current-limited)
- Six 5 V outputs
- Windows-based configuration software for easy commissioning, including automatic calculation of the parameters required for the motor model

FOC-V3 is a sensorless field-oriented control (FOC) drive for permanent-magnet synchronous machines (EC motors).

The control architecture combines a speed controller with an underlying current control loop, ensuring excellent speed stability together with smooth, low-noise, vibration-free motor operation.

Rotor position is determined from a mathematical motor model, which is also used to generate the appropriate phase signals for the power stage. Sensorless position detection at standstill is achieved by measuring the motor's inductance distribution. An optional magnetic rotary encoder with SSI interface can be used for rotor position feedback, enabling positioning applications.

The control concept inherently produces sinusoidal motor currents (sinusoidal commutation), requiring only the three phase currents as feedback signals.

A powerful and cost-effective 32-bit microcontroller executes the complete FOC algorithm in software. This minimizes hardware complexity while providing maximum flexibility for adaptation to different applications.

Space Vector Modulation (SVM) is implemented for optimal power stage control. In addition, field-weakening operation extends the maximum speed range of the EC motor.

The power stage is based on discrete MOSFET technology and achieves an efficiency of up to 98.5%.

The maximum motor phase current is 80 A. Current regulation is performed entirely in software.

The unit operates from a supply voltage of 12 to 48 VDC.

Two 24 V control inputs are provided for Enable and Direction functions. Speed setpoint control can be accomplished via any of the four 0–10 V analog inputs. A dedicated 24

FOC-V3– Technical Specifications



Operating Modes:	• Sensorless Field-Oriented Control (FOC) with Field-Weakening Operation • Space Vector Modulation (SVM) • Speed Control • Torque Control • Positioning Operation with Magnetic Rotary Encoder • Sinusoidal Commutation
Motor Type:	EC-motors
Rotor Types:	• Surface-mounted permanent magnet (SPM) rotors • Interior permanent magnet (IPM) rotors
Rotor Position Detection:	• Sensorless operation based on a mathematical motor model • Sensorless rotor position detection at standstill • Optional magnetic rotary encoder with SSI interface
Power Supply:	12 to 48 VDC, unregulated
Maximum Motor Current per Phase (Amplitude):	80 A
Power Stage: • Switching Frequency:	PWM switching frequency: 10 kHz to 17.5 kHz, adjustable (default setting: 14.4 kHz)
Connections: • Supply Voltage • Motor Phases • I/Os	2 × M4 power studs (+UB, GND) 3 × M4 power studs (PHA, PHB, PHC) 10-pin and 26-pin box headers
Interfaces:	USB 2.0 full-speed CAN
Outputs: 24 V Power Outputs:	4 × 24 V high-side outputs, 1 A continuous current each (max. 6 A internal current limit) - 3 programmable outputs - 1 brake control output
Inputs: • 24 V Inputs: • 24 V Safety Input: • Analog Inputs: • Digital Inputs: • Encoder Interface (Optional):	 2 × 24 V inputs (Enable, Direction) 1 × 24 V safety input for power stage enable and 24 V power output supply 4 × 0–10 V, 12-bit resolution 6 × TTL compatible (5 V) magnetic rotary encoder interface (SSI)
Dimensions:	105 mm x 85 mm x 30 mm
Operating Temperature Range:	0 ... +60 °C

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