The Class 6 Industrial Ethernet SmartMotor™, which is available in both standard servo (shown) and hybrid servo versions, represents the next step in the evolution of the SmartMotor integrated motor design. The Class 6 motor lineup includes EtherCAT® (EEC option), PROFINET® (EPN option), and EtherNet/IP™ (EIP option) versions.

These motors are designed for maximum performance and connectivity. They incorporate a high-end, high-speed processor for exceptional performance, data update rates are as fast as 1 millisecond. There are dual industrial Ethernet ports onboard (no hub or switch required), as well as connections for RS-485 and USB. Additionally, they provide plenty of I/O, with the option to add more through an external expander, for easy integration into any system.

Key Features and Benefits

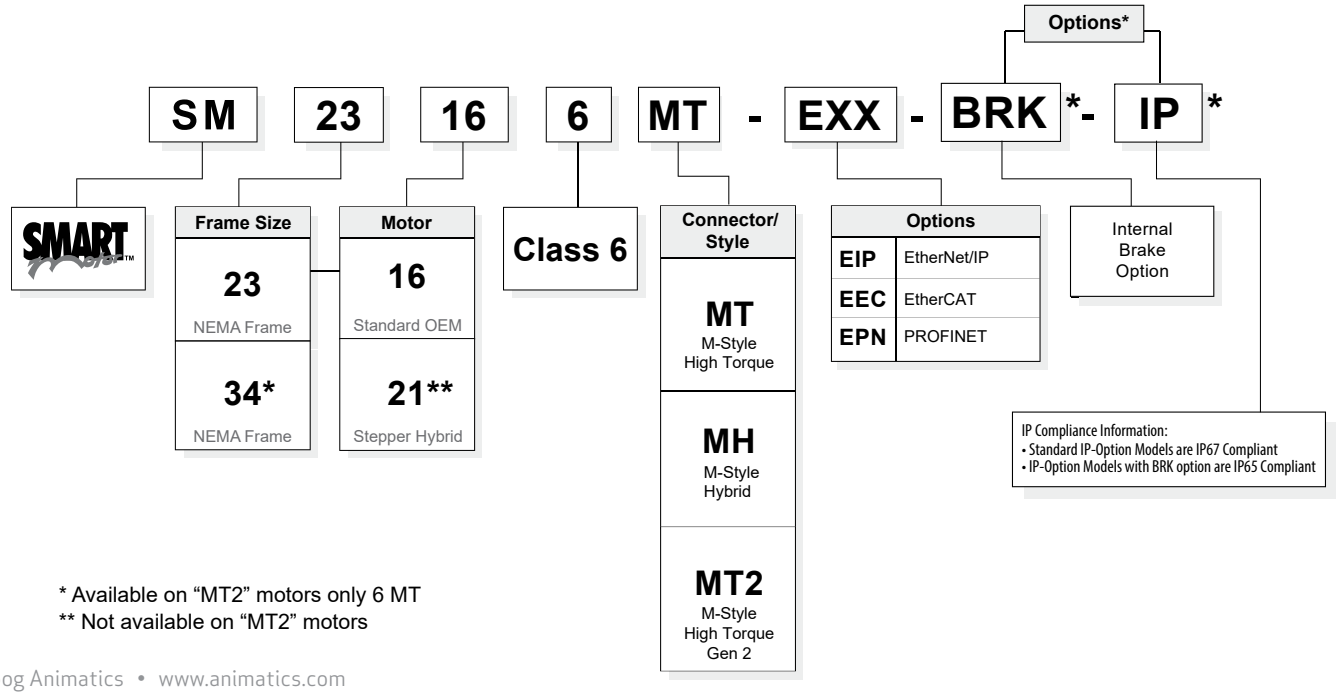
- Simplify wiring, reduce cost through the onboard dual-port Ethernet switch
- Optionally program, configure and get live diagnostics through the USB interface
- Optionally communicate with the motor through the RS-485 half-duplex port, which provides access as a Modbus Remote Terminal Unit (RTU) Slave
- Easily access SmartMotor programmable autonomous control features in slave mode, which allows special user-programmed functions
  - Reduce limit switch wiring and PLC programming through adaptable distributed control
  - Accurately capture position for high-speed registration applications
  - Quickly reduce costs and improve reliability through use of programmable homing and limits
  - Precisely define motion profiles with local cam execution
  - Easy configuration and status monitoring of Industrial Ethernet and field buses
  - Actively monitor/troubleshoot each motor through local error reporting and diagnostic codes
- Local/standalone benefits (see manual for details):
  - Simplify programming and calculate 32-bit precision motion parameters on the fly with floating-point math and trigonometric functions
  - Govern a move by running it on top of a gearing or camming relationship using the dual trajectory generators
  - Create precise spooling/winding shapes and control tension through advanced gearing (supports preset traverse/take-up parameters)
  - Create complex patterns through advanced camming (with cubic spline interpolation and dynamic frequency/amplitude)
  - Highly configurable local I/O for motion control and general-purpose use in user programs:
    - Drive enable input, fault output, travel limits, registration and position capture
    - External encoder input supporting A-quad-B or Step-and-Direction
    - Total of 7 configurable inputs
    - High-current outputs with external brake-control function

Class 6 EtherCAT® (EEC option) Fieldbus
Industry standard CiA 402 motion profile supports:
- PP, PV, HM, TQ, CSP, CSV, and CST modes
- Dynamic mapping of process data objects (cyclic data exchanges)
- Real time coordinated control using Distributed Clock (DC)

Class 6 PROFINET® (EPN option) Fieldbus
- PROFINET RTC - Real Time Cyclic transfers
- Class 1 and 2 (certified) - unsynchronized
- Class 3 (certification pending) - synchronized SmartMotor clocks
- PROFINET RTA – Real Time Acyclic protocol
- DCP, LLDP, SNMP, MIB-II, and LLDP MIB support

Class 6 EtherNet/IP™ (EIP option) Fieldbus
Easily integrates as a position controller (10 h) device, for:
- Access to unique SmartMotor commands and parameters
- Improved uptime with optional redundant cabling through Device Level Ring (DLR)
- Optimal performance ensured through Quality of Service (QoS)
- Simplified, modular programming through Add On Instructions (AOI)
- Direct access to SmartMotor native commands and parameters through TCP/IP

Advanced Class 6 M-Style Part Numbering



* Available on “MT2” motors only 6 MT
** Not available on “MT2” motors

SmartMotor™ Series	SM23166MT-EXX	
Continuous Torque at 48 volts	68	oz-in
	0.48	N-m
Peak Torque	128	oz-in
	0.90	N-m
Nominal Continuous Power	189	watts
Nominal Peak Power	213	watts
No Load Speed	4,700	rpm
Voltage Constant	9.08	V/kRPM
Winding Resistance	0.7	Ohms
Encoder Resolution	4,000	counts/rev
Rotor Inertia	0.00103	oz-in-sec^2
	7.27	10^{-6} kg-m^2
Weight	1.7	lb
	0.77	kg
Shaft Diameter	.375	in
	9.53	mm
Shaft, Radial Load	15.0	lb
	6.80	kg
Shaft, Axial Thrust Load	3.00	lb
	1.36	kg
EtherCAT Available*	Yes	
PROFINET Available*	Yes	
EtherNet/IP Available*	Yes	

SM23166MT-EXX

Maximum temperature: 85°C at electronics, 130°C at windings.
Recommended ambient temperature range: 0°C – 50°C.
Storage temperature range: -10°C – 85°C.
Relative humidity: maximum 90%, noncondensing.

SmartMotor™ Series	SM23216MH-EXX	
Continuous Torque at 48 volts	165	oz-in
	1.17	N-m
Peak Torque	300	oz-in
	2.12	N-m
Nominal Continuous Power	60	watts
Nominal Peak Power	115	watts
No Load Speed	2,250	rpm
Encoder Resolution	4,000	counts/rev
Rotor Inertia	0.0065	oz-in-sec^2
	4.59	10^{-5} kg-m^2
Weight	2.79	lb
	1.27	kg
Shaft Diameter	.375	in
	9.53	mm
Shaft, Radial Load	16.86	lb
	7.65	kg
Shaft, Axial Thrust Load	3.37	lb
	1.53	kg
EtherCAT Available*	Yes	
PROFINET Available*	Yes	
EtherNet/IP Available*	Yes	

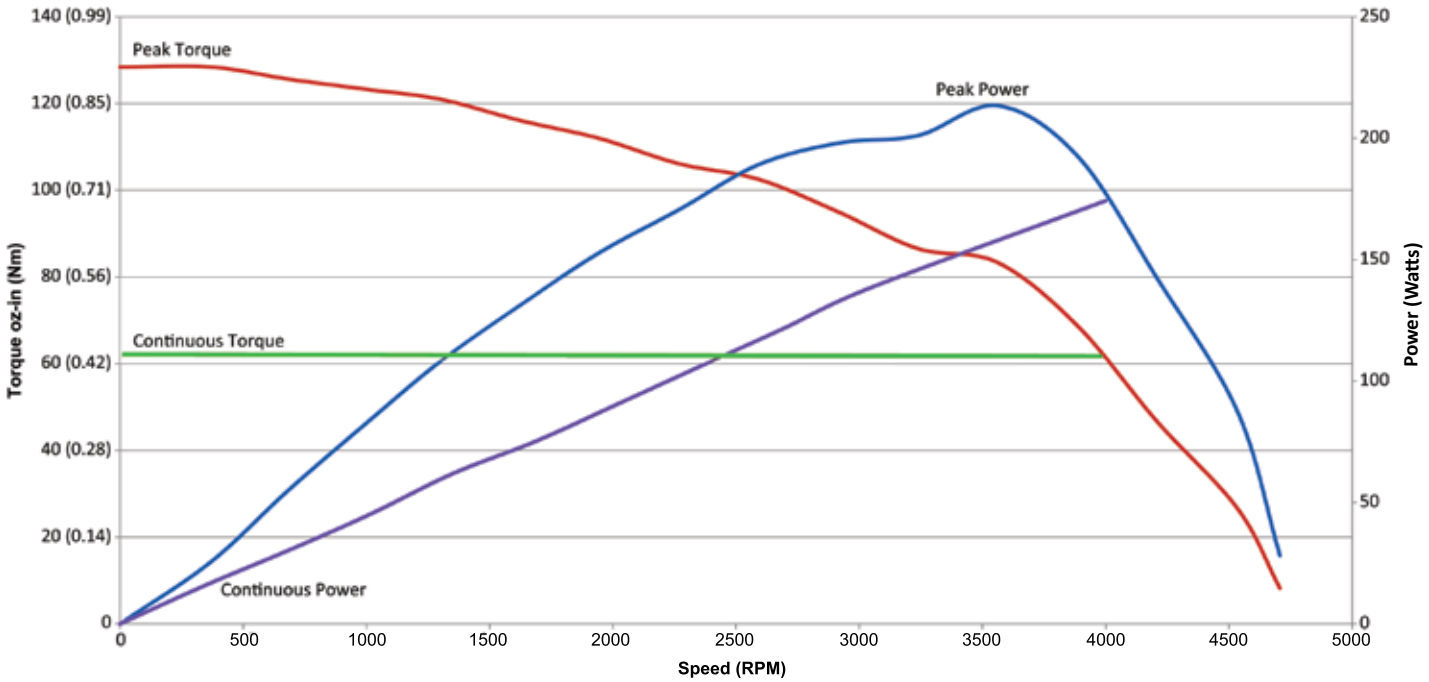
SM23216MH-EXX

Maximum temperature: 85°C at electronics, 130°C at windings.
Recommended ambient temperature range: 0°C – 50°C.
Storage temperature range: -10°C – 85°C.
Relative humidity: maximum 90%, noncondensing.

For other data, please consult the factory.
**EtherCAT® (EEC option), PROFINET® (EPN option), and EtherNet/IP™ (EIP option)*

SM23166MT-EXX Torque Curves

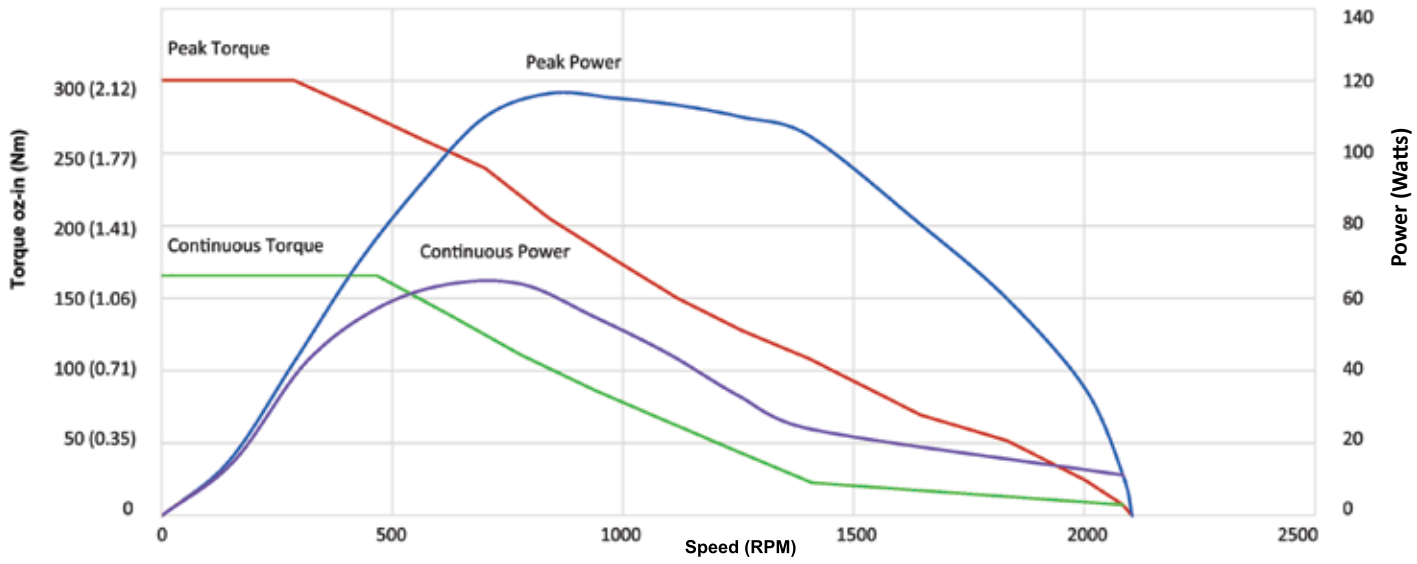
SM23166MT-EXX motor Torque vs. Speed, 48 volts, MDE commutation, 25°C ambient (curves are derated at higher ambient)



Continuous rating based on 25°C ambient temperature, motor mounted to a 6x6x¼ inch aluminum heat sink, and electronics/windings below maximum temperature. Peak torque is available for 3 seconds at a 10% duty cycle.

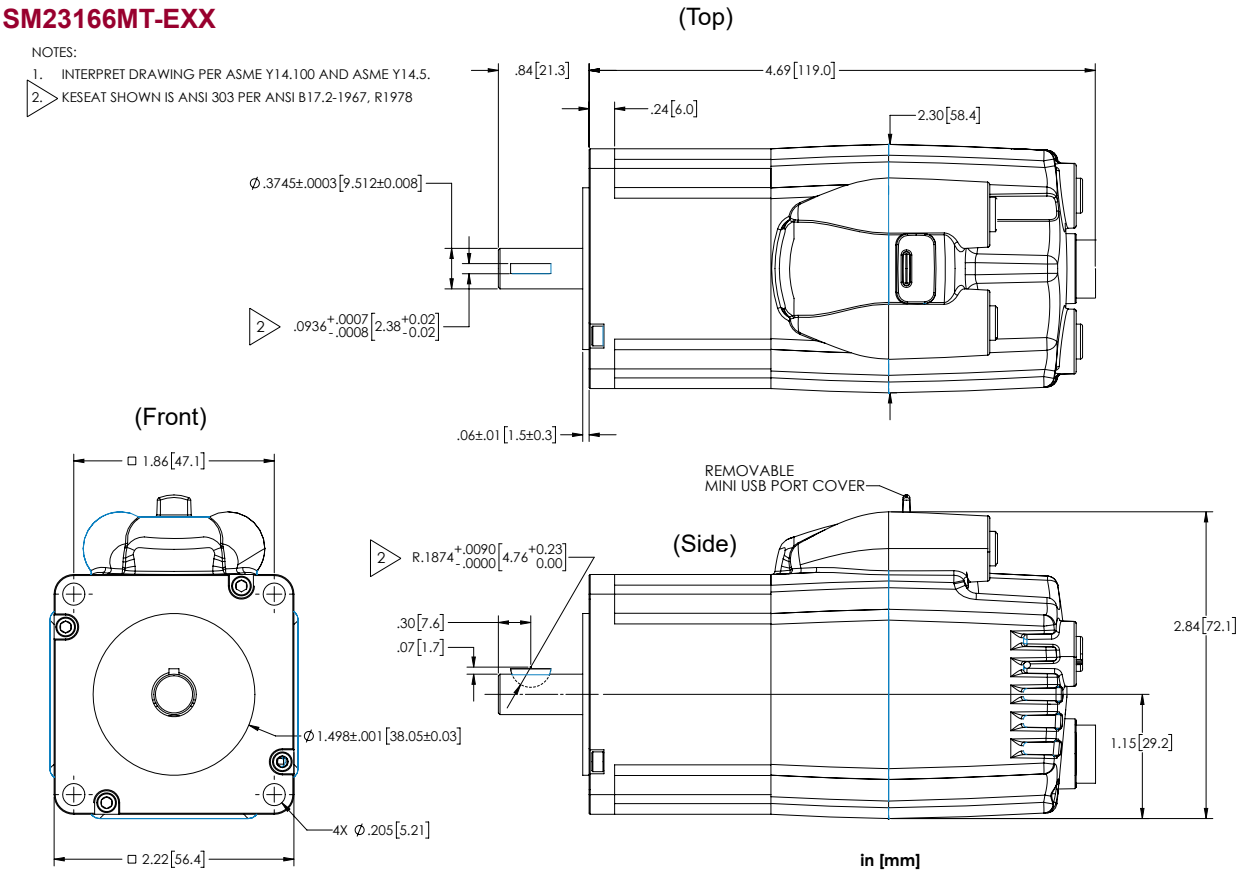
SM23216MH-EXX Torque Curves

SM23216MH-EXX motor Torque vs. Speed, 48 volts, MDC commutation, 25°C ambient (curves are derated at higher ambient)

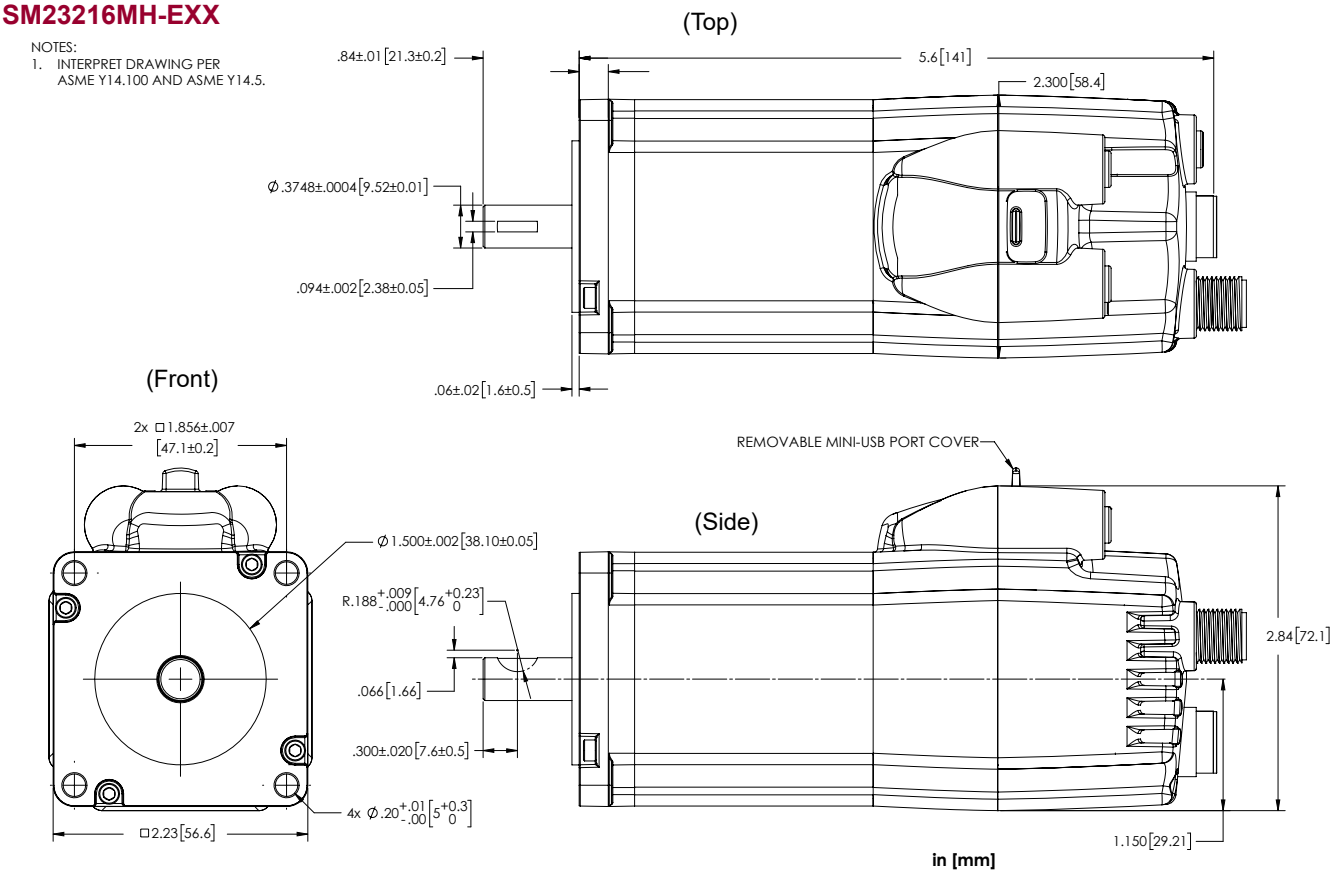


Continuous rating based on 25°C ambient temperature, motor mounted to a 6x6x¼ inch aluminum heat sink, and electronics/windings below maximum temperature. Peak torque is available for 3 seconds at a 10% duty cycle.

SM23166MT-EXX



SM23216MH-EXX



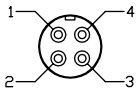
Class 6 M-Style Connector Pinouts

The following table shows the pinouts for the connectors on the Class 6 M-style SmartMotors.

PIN	Main Power	Specifications	Notes
1	Control Power In	+24V (±20%), 32V Max.	Also Supplies I/O
2	Chassis Ground	Chassis Ground Only	Not Connected to Common
3	Control, Com, I/O and Amplifier Ground	Common Ground (Req'd. Ground)	Nonisolated
4	Amplifier Power In	+24V Min., 48V Max.	Powers Amplifier Only

P1

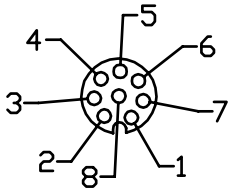
M16, 4 PIN MALE



PIN	Communications Connector	Specifications	Notes
1	Control, Com, I/O and Amp Ground	Common Ground	Nonisolated
2	RS-485 B, Com ch. 0	115.2 KBaud Max.	
3	RS-485 A, Com ch. 0	115.2 KBaud Max.	
4	Encoder A+ Input/Output	125 KHz Individual Line Frequency	Configurable as Encoder Output
5	Encoder B- Input/Output	125 KHz Individual Line Frequency	Configurable as Encoder Output
6	Encoder A- Input/Output	125 KHz Individual Line Frequency	Configurable as Encoder Output
7	+5V Out	50 mA Max.	
8	Encoder B+ Input/Output	125 KHz Individual Line Frequency	Configurable as Encoder Output

P2

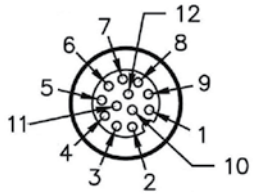
M12, 8-PIN
FEMALE END VIEW



PIN	24V I/O Connector	Specifications	Notes
1	IN0 GP, Discrete or Analog Input	Inp Impedance > 10 kohm	**For Inputs:**
2	IN1 GP, Discrete or Analog Input	Inp Impedance > 10 kohm	7 Configurable Inputs
3	IN2 Pos Limit or GP	Inp Impedance > 10 kohm	Low Lvl Thld: 3.6V Max.
4	IN3 Neg Limit or GP	Inp Impedance > 10 kohm	High Lvl Thld: 5.0V Min.
5	IN4 GP or Ext. Enc. Index Capture	Inp Impedance > 10 kohm	Inp Hysteresis: 1.0V Min.
6	IN5 GP or Int. Enc. Index Capture	Inp Impedance > 10 kohm	Analog Input Scale: 10V FS
7	IN6 GP, G Cmd, or Homing Inp (EtherCAT)	Inp Impedance > 10 kohm	
8	IN7 Drive Enable	Inp Impedance > 10 kohm	
9	OUT8 Brake or GP	250 mAmps Max.	**For Outputs:** Do Not Exceed
10	OUT9 NOT FAULT	250 mAmps Max.	500 mAmps Combined
11	+24 VDC Out (Supplied from P1, Pin 1)	12.5V Min., 23V Max. Load 2 Amps Max.	
12	Ground Common	Common Ground	Nonisolated

P3

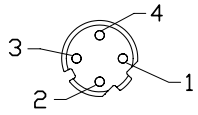
M12, 12-PIN
FEMALE END VIEW

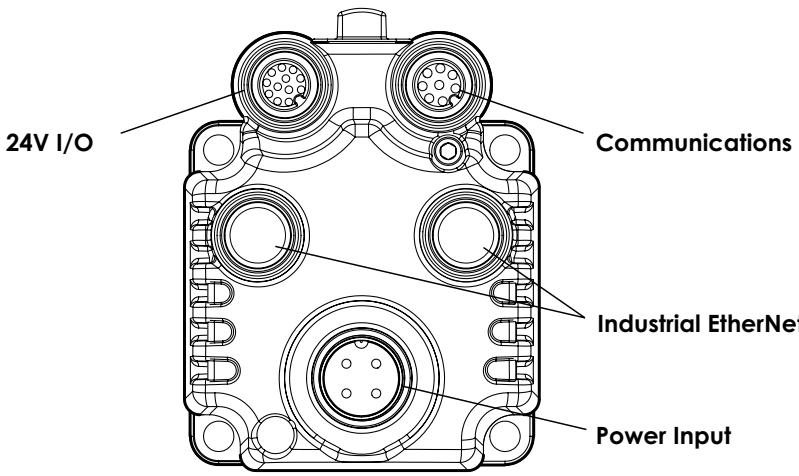


PIN	Industrial Ethernet Connectors		Specifications	Notes
	EtherNet/IP, EtherCAT	PROFINET	10/100BASE-T	Shield tied to motor housing
1	+TX	+TD	EtherCAT=100BASE-TX	EtherCAT=Input(L), Output(R)
2	+RX	+RD		
3	-TX	-TD		
4	-RX	-RD		

P4

M12, 4-PIN
FEMALE END VIEW





CAUTION: Exceeding 32 VDC into control power on any of the +24V pins may cause immediate damage to the internal electronics. Exceeding a sustained voltage of 48V to pin 4 of the P1 Power Input may cause immediate damage to the internal electronics. Exceeding these voltage limits will void the warranty.