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 PROFINET®, EtherCAT® and EtherNet/IP™ 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

EtherCAT®

Class 6 EtherCAT® 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)

PROFINET®

Class 6 PROFINET® 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

EtherNet/IP™

Class 6 EtherNet/IP™ 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

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	

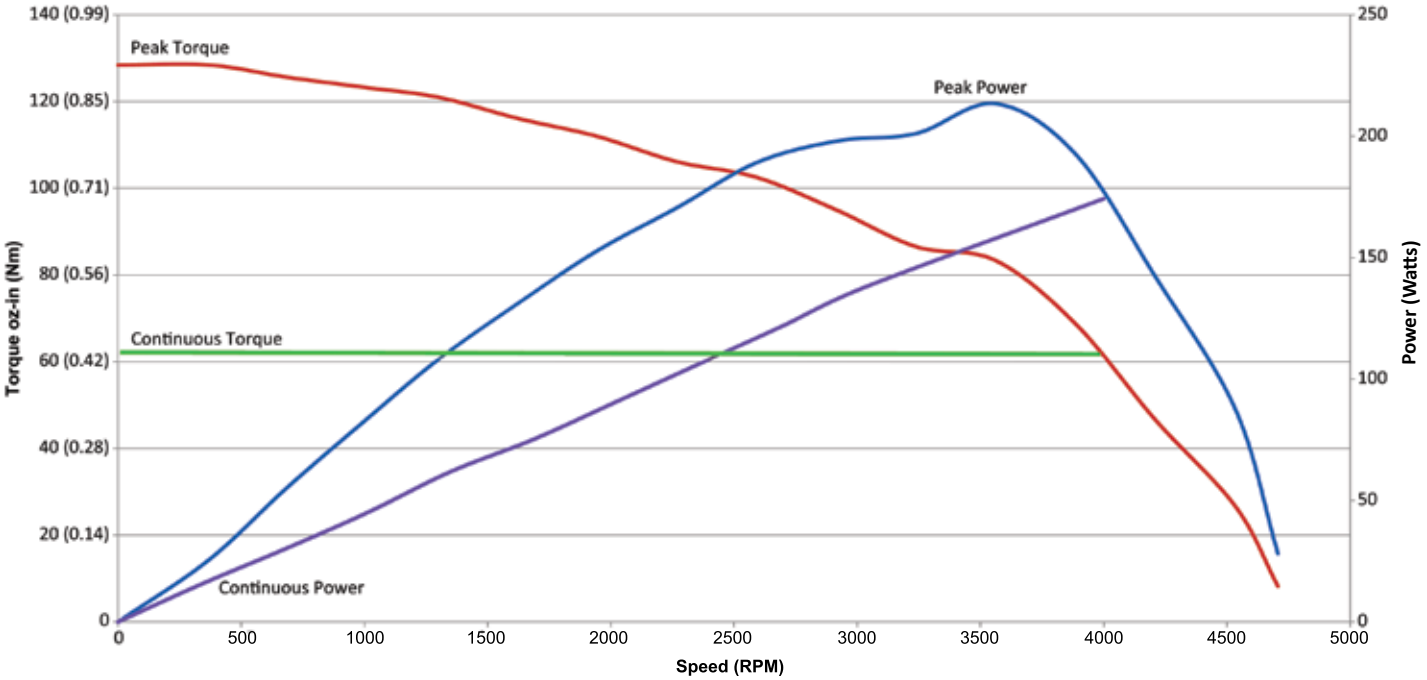
**For other data, please consult the factory.*

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.

SM23166MT-EXX Torque Curves

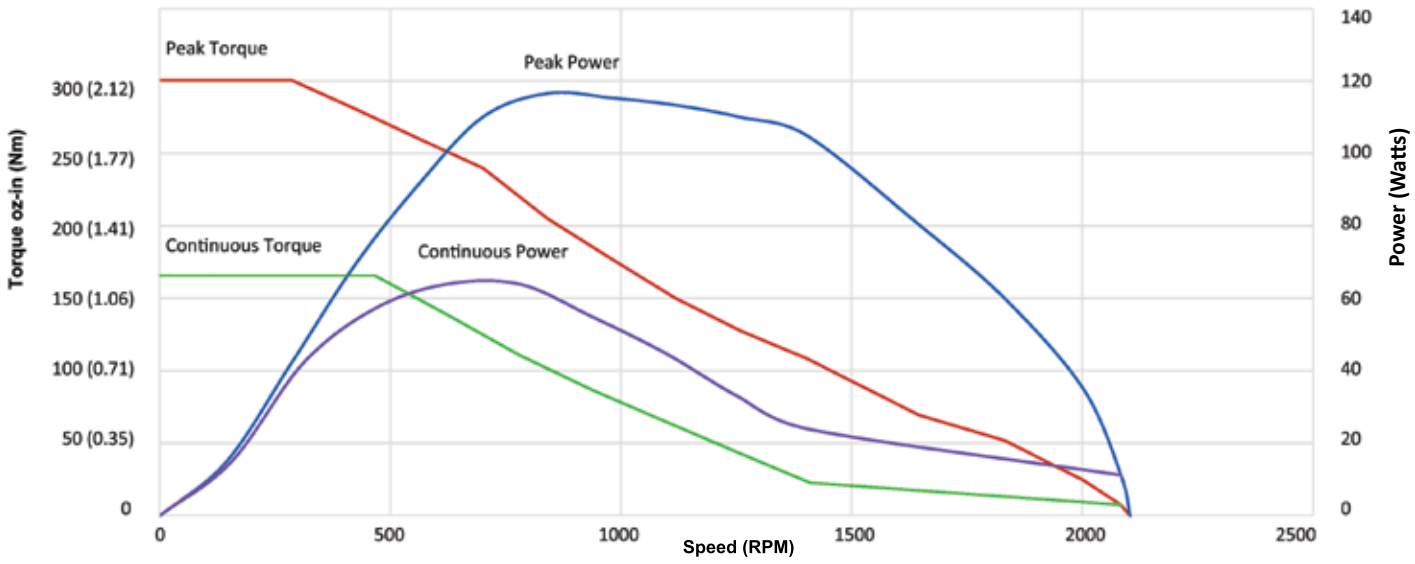
SM23166MT-EXX motor Torque vs. Speed, 48 volts, MDE commutation, 25°C ambient (curves are derated at higher ambient)



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.

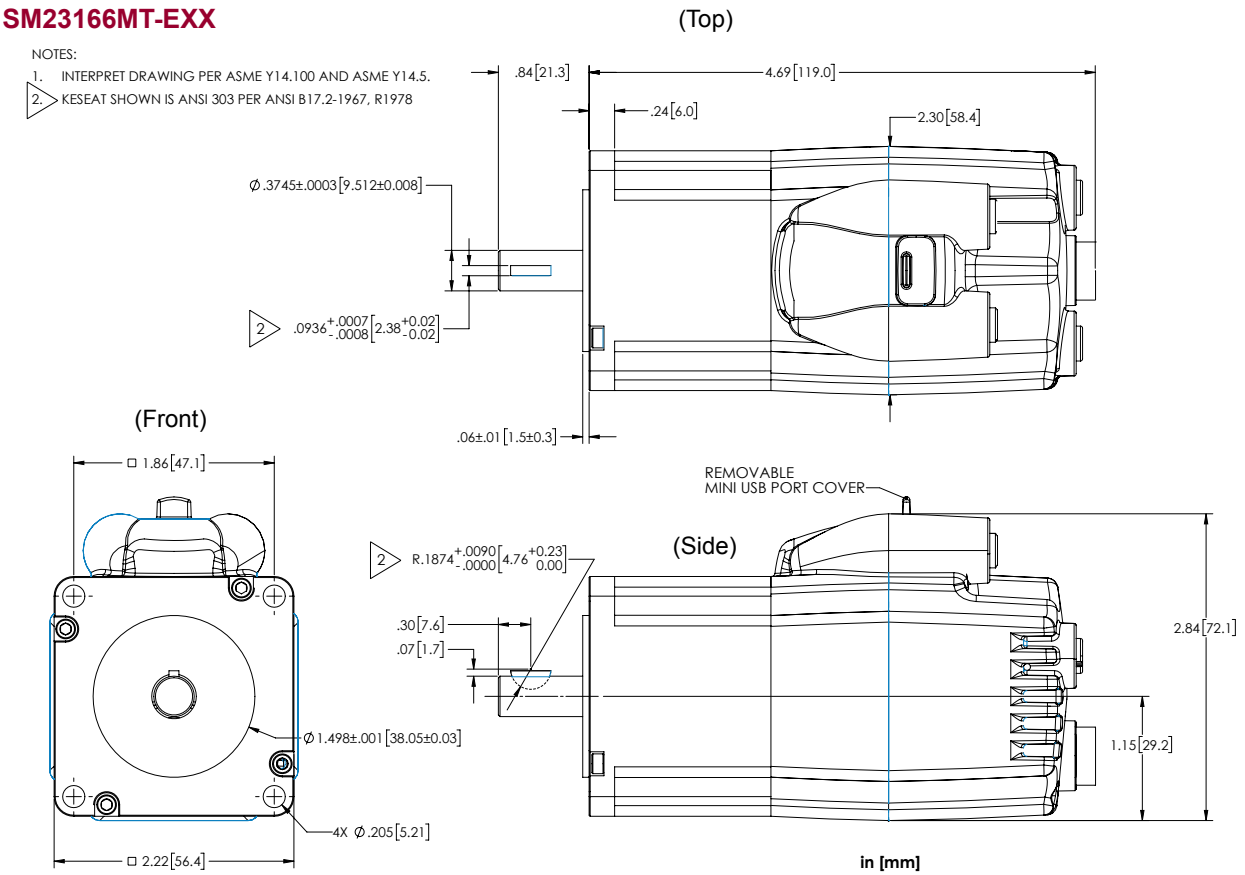
SM23216MH-EXX Torque Curves

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

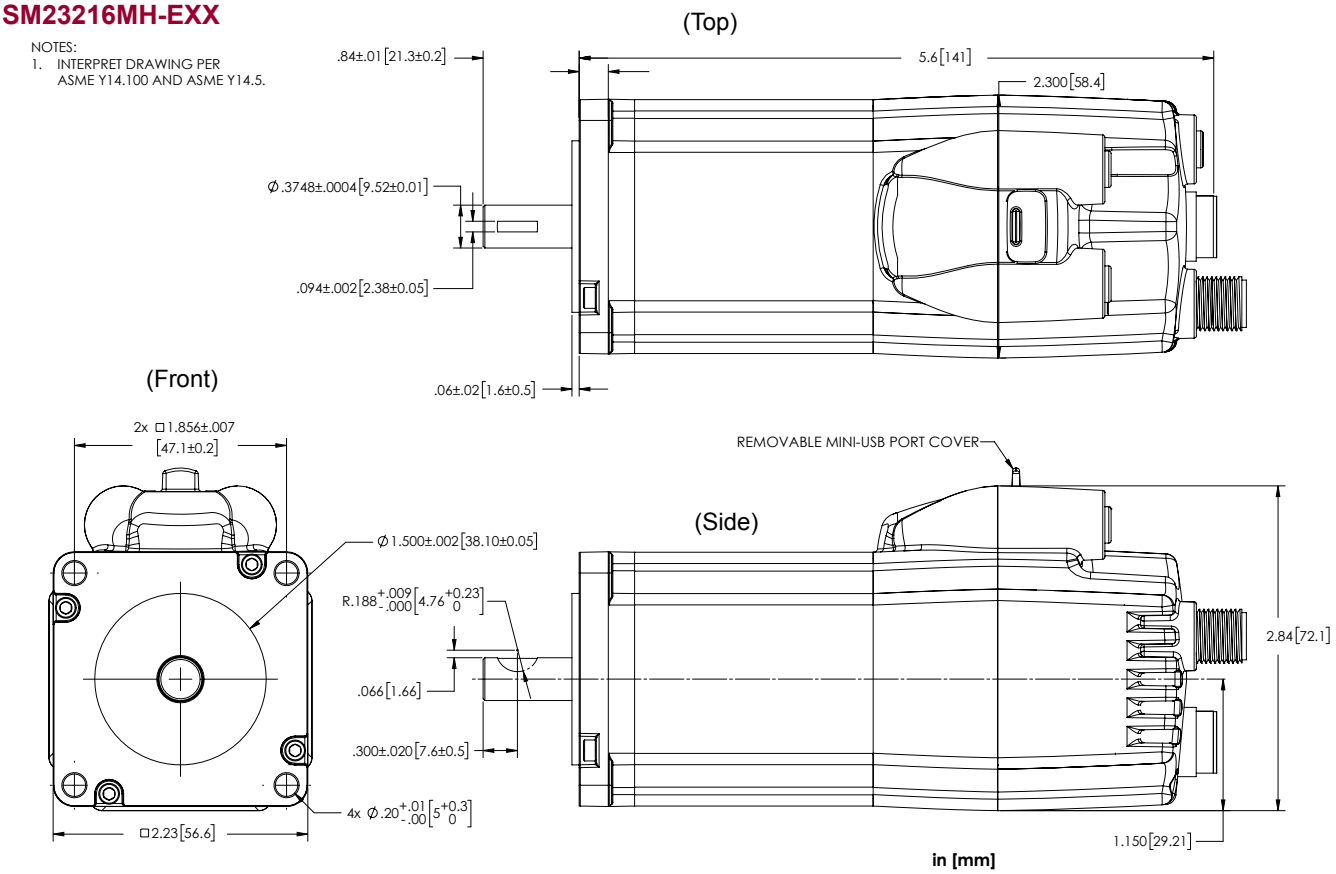


Continuous rating based on 25°C ambient temperature, motor mounted to a 6x6x¼ inch aluminum heat sink, and electronics/windings below maximum temperature. Peak torque is available for 3 seconds at a 10% duty cycle.

SM23166MT-EXX



SM23216MH-EXX



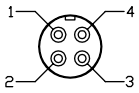
Class 6 M-Style Connector Pinouts

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

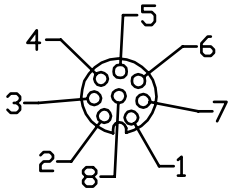
M16, 4 PIN MALE



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

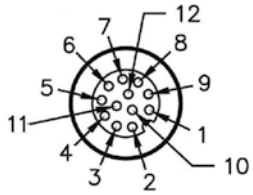
M12, 8-PIN
FEMALE END VIEW



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

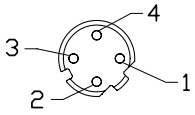
M12, 12-PIN
FEMALE END VIEW

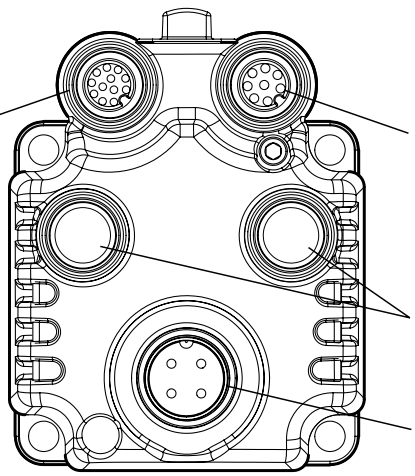


PIN	Industrial Ethernet Connectors		Specifications	Notes
	EtherNet/IP, EtherCAT	PROFINET	10/100BASE-T	Shield tied to motor housing
1	+TX	+TD	EtherCAT=100BASE-TX	EtherCAT=Input(L), Output(R)
2	+RX	+RD		
3	-TX	-TD		
4	-RX	-RD		

P4

M12, 5-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.

Key Features

- Integrated drive and controller, which reduces wiring, increases reliability, simplifies installation and reduces setup time
- Torque, position, velocity and contouring modes
- Encoder feedback with trapezoidal six step and Field-Oriented Control (FOC) commutation modes
- Powerful AniBasic (BASIC-like) language with over 200 commands for program flow, data handling, math and motion
- Expanded math functions
  - SIN, COS, TAN, ASIN, ACOS, ATAN, SQR
  - IEEE-754 single precision floating point
- Dual trajectory generators
- Following modes and advanced camming functions
- External encoder input supporting A-quad-B, Step-and-Direction
- User-defined interrupts with 3 priority levels
- Nonvolatile program and data storage
- RS-232 and CANopen interfaces are standard
- 24 VDC compatible I/O, three inputs and two outputs
  - Inputs are drive enable, and two configurable inputs (one can be a 0-10 VDC analog input)

Consult Factory For Availability

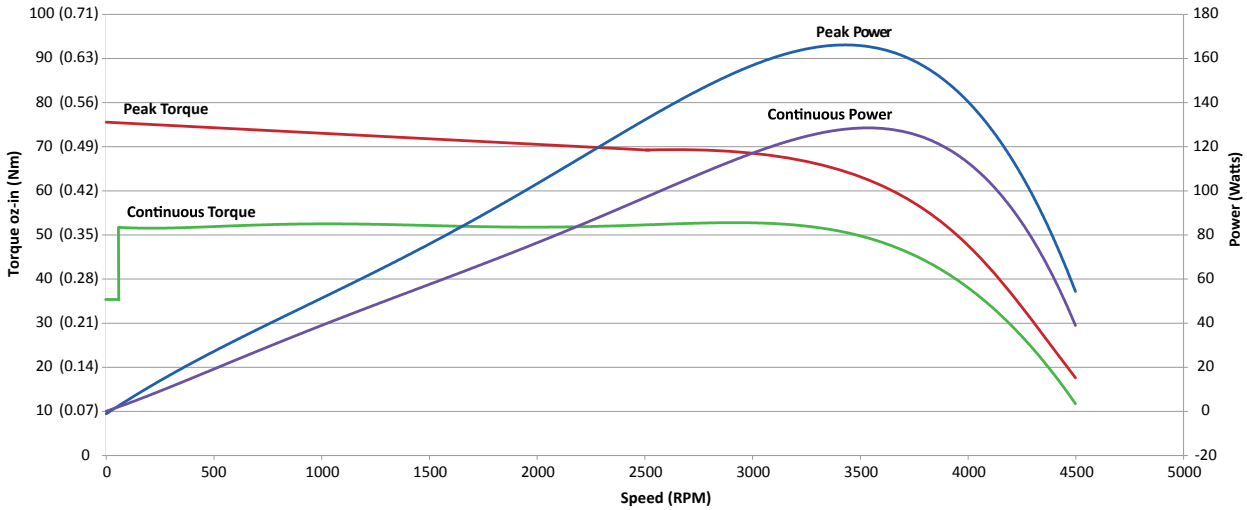
Specifications: 48 VDC at 25°C

SmartMotor™ Series	SL17406D	
Peak Torque	70	oz-in
	.49	N-m
Rated Torque	50	oz-in
	.35	N-m
Rated Shaft Power	130	watts
Speed at Rated Power	3,500	rpm
Encoder Resolution	4,000	counts/rev
Rotor Inertia	0.00066	oz-in-sec^2
	10	kg-m^2
Weight	30	oz
	0.850	kg
Shaft Diameter	.19	in
	5	mm
Shaft Radial Load	8	lb
	6	kg
Shaft, Axial Thrust Load	4	lb
	1.81	kg

Rated power measured in MDC mode at 25°C ambient and must be derated at higher ambient temperatures.
Maximum temperature: 100°C at electronics, 125°C at windings.
Recommended ambient temperature range: -20°C to + 70°C.
Storage temperature range: -40°C – 100°C.
Relative humidity: maximum 90%, noncondensing.

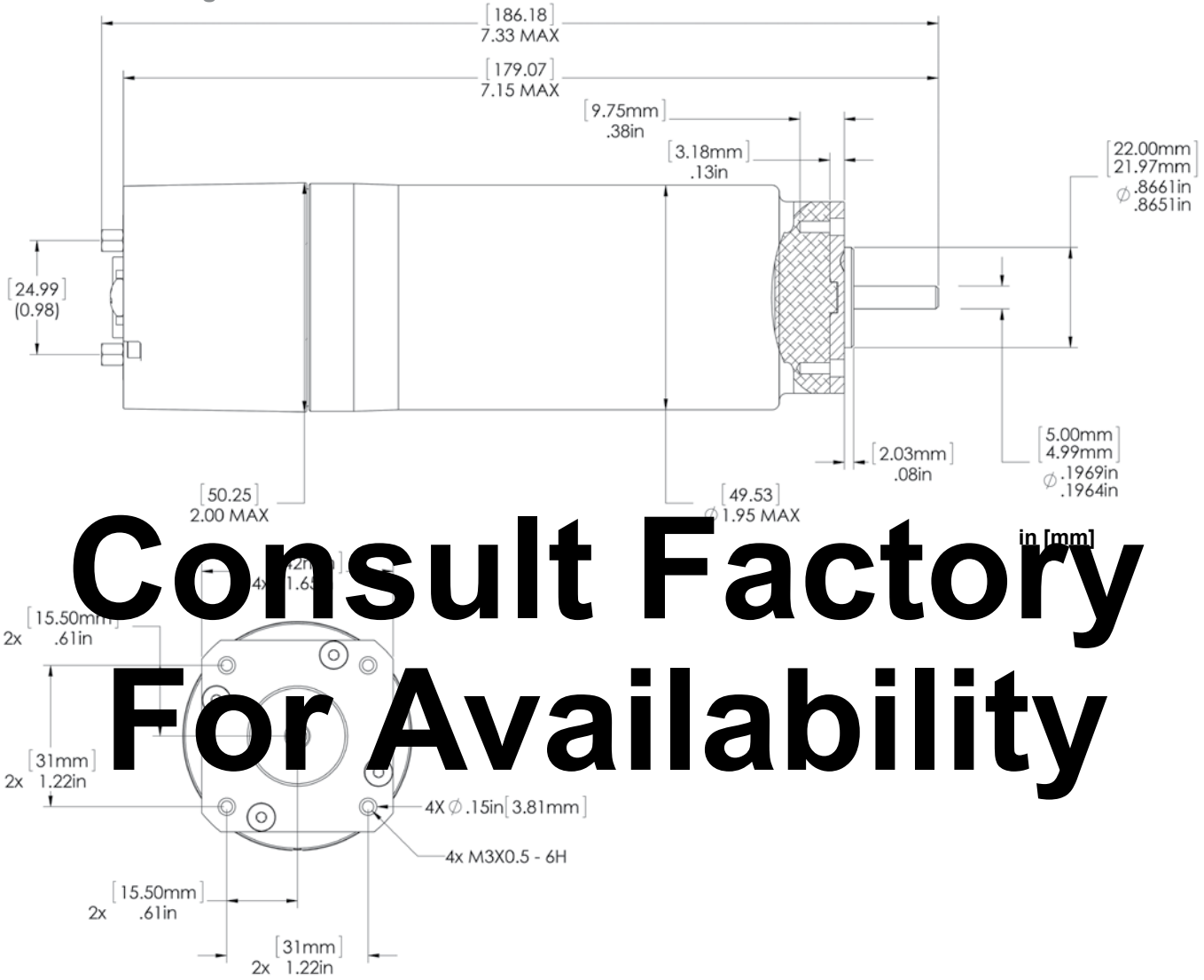
Torque Curves

SL17406D motor Torque vs. Speed, 48 volts, MDC commutation, 25°C ambient (curves are derated at higher ambient)



Continuous torque is software limited below 60 RPM. 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.

Dimension Drawing



Consult Factory For Availability

Connector Pinouts

PIN	Description	Notes
1	Drive Enable/DNET PWR Detect	Input (24V)
2	Busy	Output* (24V)
3	RS-232 TX	Moog Animatics RS-232 Daisy Chain Support
4	NEG Limit	Input, External Encoder Input (24V)
5	POS Limit	Input, Analog Input, External Encoder Input (24V)
6	CAN Hi	CAN Bus Communication Interface
7	CAN Lo	CAN Bus Communication Interface
8	No Faulted	Output* (24V)
9	RS-232 RX	Moog Animatics RS-232 Daisy Chain Support
10	Control Power (24V Typically)	Nominal 24 or 28 VDC controller power, used directly for the sourcing outputs
11	CAN GND	Isolated CAN Interface GND
12	Chassis (Earth)	Internally electrically tied to motor body
13	Servo PWR Return (GND)	Internally tied, but should be wired separately back to supplies
14	Control PWR Return (GND)	
15	Servo PWR (48V)	DC-Link supply for 3-phase servo

* For proper (industrial standard) 24 Volt sourcing IO, wire a nominal 24 VDC supply at pins 10 and 14.

DE-15 Male Connector