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REFER TO THE WEBSITE FOR THE LATEST PRODUCT DATA.
MOOG
ANIMATICS
Defining the Future of Motion Control
Motion is our passion.

Thank you for using or considering the use of our innovative automation products. Headquartered in California and with offices around the world, Moog Animatics has a unique approach to motion and machine control that can enable you to leapfrog your global competition. Before you dig into this catalog, we want to bring your attention to two critical areas where Moog Animatics is the world leader:

1. Moog Animatics offers the most highly integrated automation solutions in the industry. Starting with the SmartMotor™, the world's first fully-integrated servo system, and extending through a large variety of I/O, machine control and actuator products, Moog Animatics offers total solutions with a much smaller footprint, a lower cost and a simplicity that reduces your machine development and build time – getting you to market faster.

2. With offices in Tokyo, California, New York and Continental Europe, the sun never sets on Moog Animatics while we directly support key customers along with a global network of factory trained Automation Solution Providers; independent companies in your backyard ready to supply and support your Moog Animatics products through the long-haul.

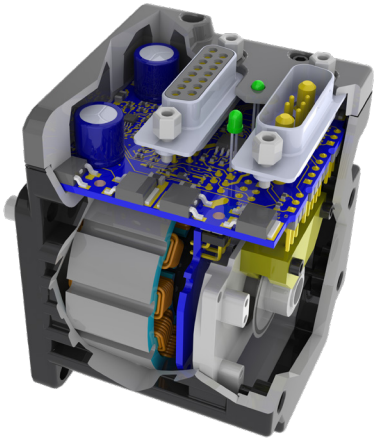
This catalog contains all Class 5 SmartMotor™ products and Moog Animatics' Actuator line (Linear Integrated Systems). All of the SmartMotor™ servos in this catalog have the latest feature set and are recommended for new designs. Earlier SmartMotor versions will continue to be sold and supported, but the best functionality and value will be found in the latest versions. Every effort has been made toward backward compatibility and little effort is required to adjust to the newer versions.

Future products will be released as "Classes" with each Class optimized for different markets, price points and applications exploiting an even greater variety of network protocols, industrial I/O capabilities and environmental sealing options.

Thank you again and welcome to Moog Animatics,
"*Defining the Future of Motion Control*™".

MOOG ANIMATICS

Defining the Future of Motion Control



Notice: All SmartMotor™, actuator and product specifications are subject to change without notice.

Consult the website or factory for the latest data.

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animatics_sales@moog.com

- We define the future of motion control by innovation, invention, and a dedication to the highest standards of professionalism and quality in everything we do and in every product that we make.
- We invite quality firms to ally with us and to participate in our inventions and innovations for the benefit of the companies that need and use our advanced technology and products.
- We invite our customers and users to join with us in the joint development of custom products and systems using our technology.
- We commit to providing a fair workplace for our employees. We subscribe to the principle of being a good corporate citizen, a good neighbor, and a protector of our environment.

Contents

The information in this section has been superseded.
Please see the information in the latest product catalog at:
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A Complete Motion Control System inside the SmartMotor

What makes the Moog Animatics SmartMotor™ by far the most powerful integrated motor in the industry is its unique ability to control an entire machine. The SmartMotor is not just a product; it is a complete motion control system and a byproduct of an innovative design philosophy. The unsurpassed programming ease, networking capability, highly flexible and expandable I/O, and high power density servo performance is exactly what you should expect from the pioneer and recognized global leader of truly integrated motion control.

Our line of advanced rotary and linear motion control products feature the ability to perform multi-axis motion including stand-alone coordinated motion. While priced similarly to other integrated servos, the SmartMotor brings real-world additional savings to the machine builder by eradicating other expensive and complicated elements in the machine such as PLCs, sensors, I/O blocks, and control cabinets. Additional axes can be easily added in the field, bringing additional processing power, but without parallel growth of existing cabinet size.

This simplicity and ease of use goes beyond just “compactness;” it results in overall reduced machine development time (shortening time-to-market), lower total machine cost, greater field reliability, and simplified machine design and build time, eliminating heavy procurement and support activities.

Will your new machine design be rooted in old 1978 PLC technology or will you take advantage of advanced Moog Animatics SmartTechnology™ to gain a dramatic savings in time and money that will put you miles ahead of your competition? New technology results from new, innovative approaches after careful study of the weakness and limitations of prior methods and technology. By far the greatest benefit of using the SmartMotor is that it lets you trump your competition by getting a dominant product to market weeks or potentially months sooner. Let our global network of factory-trained Automation Solution Providers show you how.

Unparalleled Customer Support

Customer support is a key area where Moog Animatics separates itself from the pack. We offer products at a cost you would think could only come without support, and yet we have a global network of factory trained support engineers dedicated to keeping you productive.

This support network is two-layer. It starts with a direct Moog Animatics office in every major market and time zone, and continues with a second layer of factory-trained engineers employed by our distributors and Automation Solution Providers residing, most likely, in your own backyard.

Our global support network is not just for emergency response. It is also very useful for training and installation assistance. The absolute best thing our network of engineering support can do for you is help you reexamine your machine design with an eye for leveraging the unique features of our integrated motion systems. They can also show you how to approach your design so any part of the machine is serviceable anywhere, any time, by anyone with a screw driver. Leverage this design approach and learn how your customer can enjoy effectively ZERO downtime.

Available Software

SmartMotor Interface (SMI™) is your window to the SmartMotor and it is available free-of-charge. It is Microsoft Windows compatible, and together with a desktop or laptop computer equipped with an RS-232 port, you have everything you need to converse with anywhere from 1 to 120 SmartMotor servos.

What’s New

This catalog features the new **Class 5 SmartMotor technology** offering significant industry advancements in programmable integrated servo systems. New modes of operation and capabilities such as stand-alone coordinated motion open up infinite new applications for Moog Animatics' fully integrated motion control solutions.

The new **Combitronic™** high speed transparent communications over CAN bus provide all the benefits of distributed machine control without the traditional limitations and drawbacks. The new line of rugged **IP65/IP67-rated** NEMA 23 and 34 frame DC-input servos provides new solutions for harsh and demanding environments.

Animatics.com Website

Download software, check for the latest product information and updates, view literature, product manuals, application videos and ideas, get technical support, and locate your nearest representative on Moog Animatics' user-friendly website.

Commitment to the Environment & Sustainability

Moog Animatics deeply believes in being a responsible caretaker of our natural environment and conserving scarce resources. SmartMotors are made in the same shaft and frame dimensions as open-loop step motors, but use a small fraction of the electrical draw because they only use as much power as the load physically needs.

Although step motors have a lower initial purchase cost, the use of large amounts of power from a single step motor will cost hundreds of dollars more in electricity alone through the life of a machine. Selecting a single size 34 SmartMotor instead of a step motor, for example, could spare the release of as many as 10 tonnes (metric tons) of CO_2 into the atmosphere over its life.

Because SmartMotors are made a fraction of the size of a traditional control system, and with considerably less cabling, the manufacturer who utilizes the SmartMotor consumes far less material. Its self-contained nature means the SmartMotor is better than recyclable; it's reusable. Most machines will reach the end of their useful lives long before the SmartMotor will, and transferring them to another machine is easy because the components are in one integrated component and the cabling is simple.

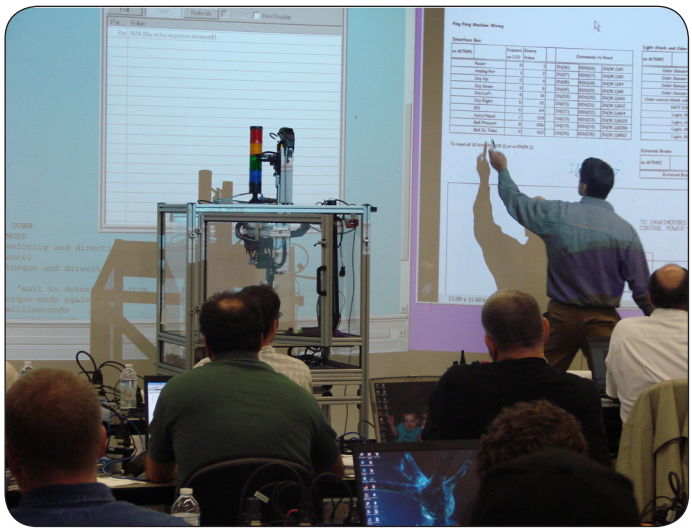
Moog Animatics Institute

Training for the Moog Animatics SmartMotor™ product is conducted by the Moog Animatics Institute, which offers a variety of training programs and seminars for Automation Solution Providers (ASPs), consultants, distributors, engineers, machine builders, OEMs, system integrators, and users of Moog Animatics rotary and linear products and systems. The training programs include:

- Application solutions that lower costs, improve reliability and speed up your time to market. Covers a variety of machine types and systems as well as a variety of markets. Opportunities to do machine design in real time at our headquarters
- Basic principles of machine and system economics
- Economics of machine and system design including comparative analysis, time-to-market values and more : the key to winning in the marketplace.
- Essential information about the SmartMotor and how it works including field bus options, introduction to programming, avoiding common problems, and trouble-shooting.
- Master/Slave solutions: when to use them and when to avoid them
- PLC-free systems
- Sales and marketing strategies for Smart products and systems
- SmartTechnologies™ and how to get the most out of them

Certificates are awarded upon satisfactory completion of courses. Programs cover more than one topic and typically last five days with opportunities for 2-week sessions.

Call (650) 960-4216 and ask for Sales for additional information.



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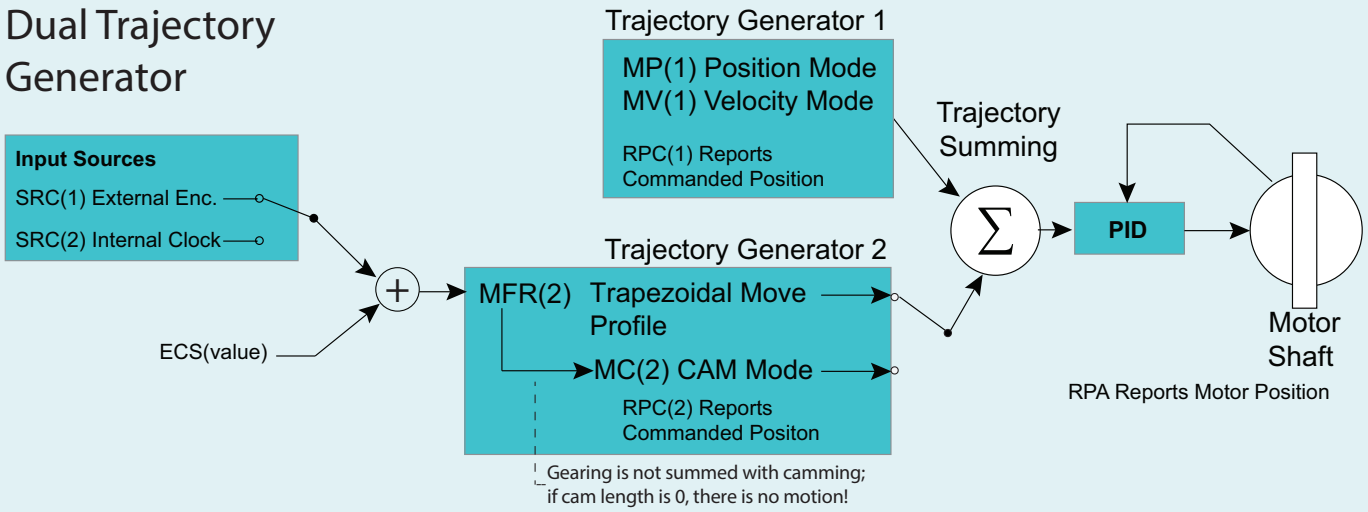
New in Class 5: Dual Trajectory Path Generators

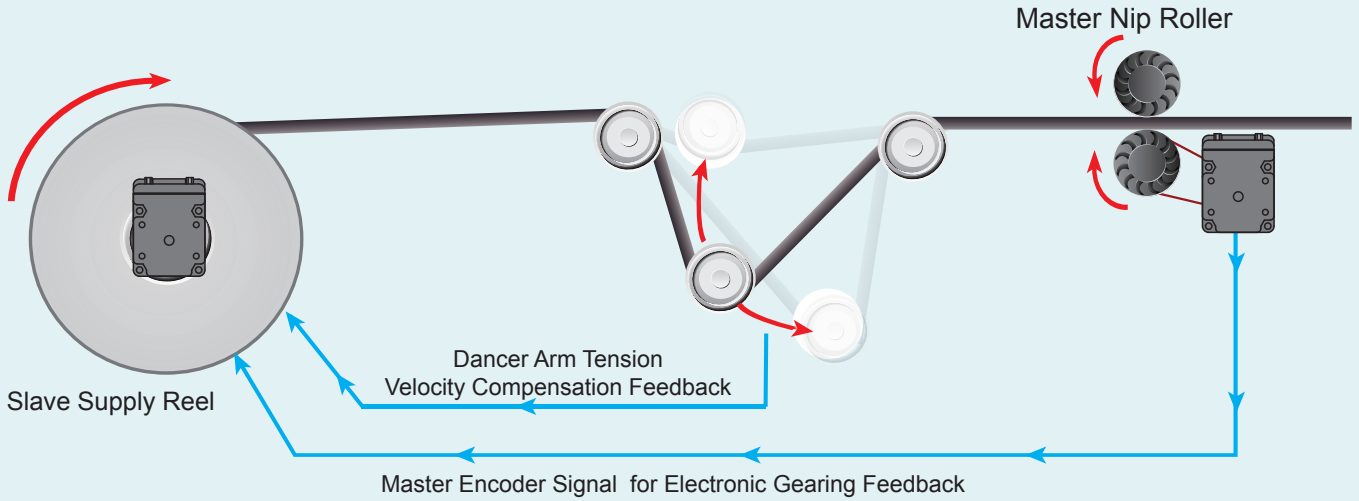
The processor now has the ability to sum in Positioning, Velocity, or Contouring Mode profiles on top of electronic gearing or camming profiles.

This also includes virtual axis gearing and camming where independent profiles may be run off of a virtual time base separate from Position or Velocity Modes or summed in on top of them.

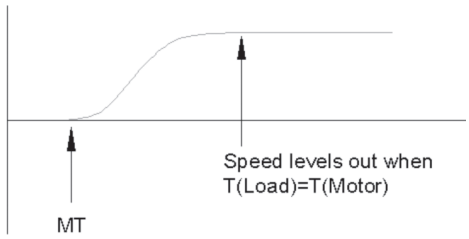


Velocity Mode and Electonic Gearing Summed Together:

Electronic gearing ensures instant response to master nip roller speed while Velocity Mode is controlled by the tension arm. The net effect is assurance of constant tension over the change in supply reel radius.

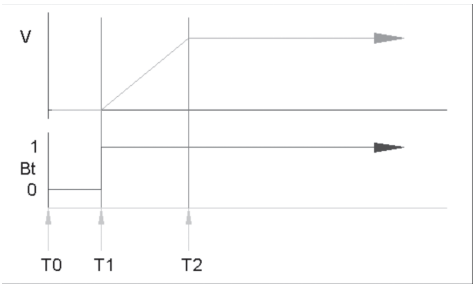


Torque Mode:



Open loop directional control of power to the motor windings. In this mode the motor has knowledge of encoder position but does not use it for motion. The motor will increase speed until its commanded torque equalizes with load torque. If load torque decreases, shaft speed will increase. If load torque increases, shaft speed will decrease. In a static condition, force applied will be proportional to commanded torque.

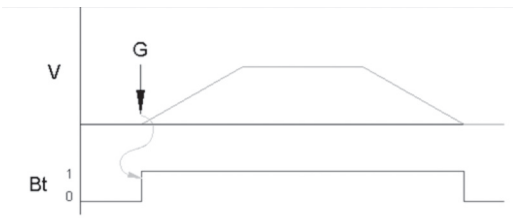
Velocity Mode:



Closed loop speed control based on position over time, not frequency. This means that from the initial command to begin motion, the controller keeps track of what the actual position should be.

If load momentarily increases beyond the limits of the motor, shaft speed will be slightly reduced. If the load decreases back to within the capabilities of the motor, the shaft speed will increase beyond commanded speed in order to catch up to where it should have been had a constant velocity been maintained.

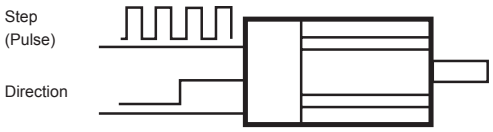
Position Mode:



Closed loop control based on encoder feedback. All position mode moves are classified as either Relative or Absolute Mode. Relative Mode means the motor is commanded to move to a set distance in either direction relative to where the shaft is at the time.

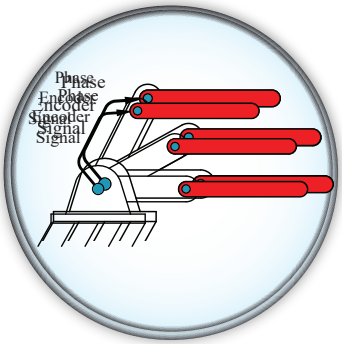
Absolute Mode means the motor is commanded to move to a specific location regardless of initial position.

Mode Step (Step and Direction Input):



The motor will follow a standard step and direction input signal. A ratio of internal encoder counts to incoming pulses may be used. The step input can also be used as a high speed counter.

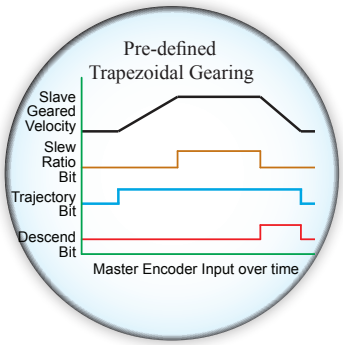
Phase Adjust Mode



Enables applications such as product tracking where moves must be applied over a target in motion, automatically stabilizes pan & tilt applications, or allows arm end effectors to remain parallel to base while the mid arm section moves.

Phased Origin stays referenced to base allowing commanded moves to be DYNAMICALLY independent of the phase axis.

Expanded Electronic Gearing Functionality

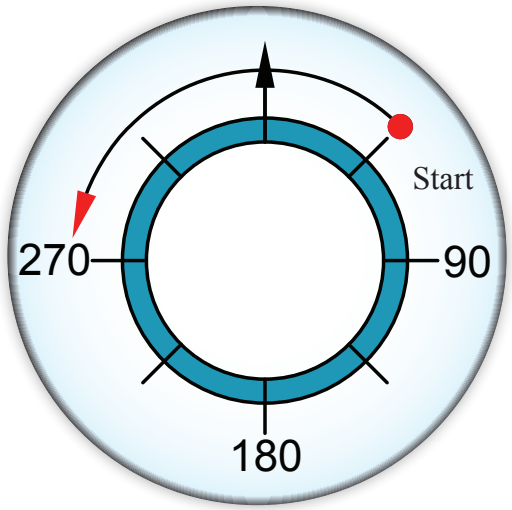


Now includes separate ascend, slew and descend pre-defined distances that may be defined off of either master or slave encoder values for enhancing applications such as high speed winders.

With an array of status bits available, all portions of the move may be used for I/O triggering. Automatic transitions in and out are ideal for high speed labeling applications.

Modulo Count Mode

Modulo Count Mode allows the user to define maximum position counter rollover. Normally the shaft position counter can run anywhere from zero to +/- 2^{31}. This means the motor counter will continuously increase in the positive direction and when it hits its maximum, it will instantly go negative and begin counting down to zero. With Modulo Count Mode, the user can alternately set up a counter that will increase up to a given value and then roll directly over to zero and start counting up again. The count will never go negative, it will always be 0<=modulo value<= (Modulo Limit-1). This mode is especially useful in rotary pan or azimuth controls for targeting systems, radar, and Camera bases. Combined with the Combitronic™ interface, multi Camera surveillance systems may more easily pass off subject tracking from one pan & tilt to the next.




```
PML= 360 (Position Modulo Limit) maintain counts
between 0 and 359

PMT= 270 (Position Modulo Target) take shortest
path to Target Position.
```

DE/Dt: Rate of Change of Following Error Limit (Dervative Error Limit)

DEL (Derivative Error Limit) provides the safest fast-means to fault a motor on sudden changes in load or detection of human interference.

The purpose of this Limit is to act as a look ahead on following error. Instead of just triggering on a raw following error of how far behind in a move the motor may be, the processor is looking at how fast that following error changes.

DE/Dt refers to the dynamic rate of change of following error. This results in an instant release of energy and safer operation and less chance of damage to equipment or injury to machine operators. Under normal servo control following error limits, if the load collides against an object, the motor will not fault until the following error limit is reached. As a result, current and torque applied will increase until that condition is met. By adding an additional derivative limit on following error, the servo will fault out within microseconds of contact with the object.

Example:

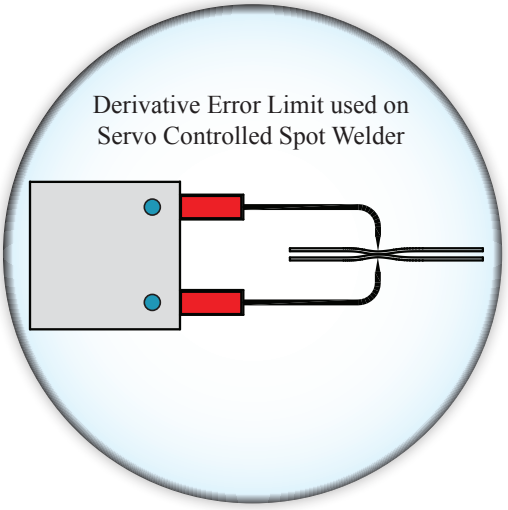
```
DEL=VT 'Set limit to commanded speed
```

If DE/Dt equals commanded velocity, then the motor just hit a hard stop. Normally, the motor would have to continue applying torque until the normal following error is exceeded. However, if DEL (DE/Dt limit) is set to target velocity (VT), then the controller would error out immediately upon hitting a hard stop without any wind-up whatsoever.

Derivative Error Limit

(Rate of change of following error limit)

This feature quickly detects jams for safer operation and less chance of damage to equipment or injury to machine operators.

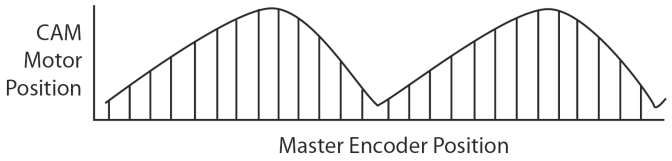



```
Jaw stops immediately upon making contact with
metal for minimal product deflection and maximum
balance to each side.
```

Cam Mode with Advanced Capabilities

Cam Mode

Electronic camming is similar to mechanical cams in that for a given master rotating device, a slave device tracks the speed and moves through a fixed profile of positions. In electronic camming, the profile is a look-up table of data stored in the slave motor. Cam data can run from CPU RAM or Flash. Extra cam data may



be stored in EEPROM as well. Cam Mode data may be run using either Fixed master segment length or variable master segment length.

- RAM storage: 1 Cam table
  - 52 fixed length data points, 35 variable length data points
- Flash storage: 9 Cam tables
  - 750 fixed length data points, 500 variable length data points
- EEPROM: Up to 8000 points total may be stored and moved to flash or RAM.

Powerful & Advanced Capabilities

- Multiple profile tables may be stored & called upon when required
- Dynamic tables can be created in real time for cases where amplitude or frequency and even actual specific points may need to be changed on the fly
- The master signal may be either an external encoder input from another motor, or it may be from an internal virtual axis encoder signal

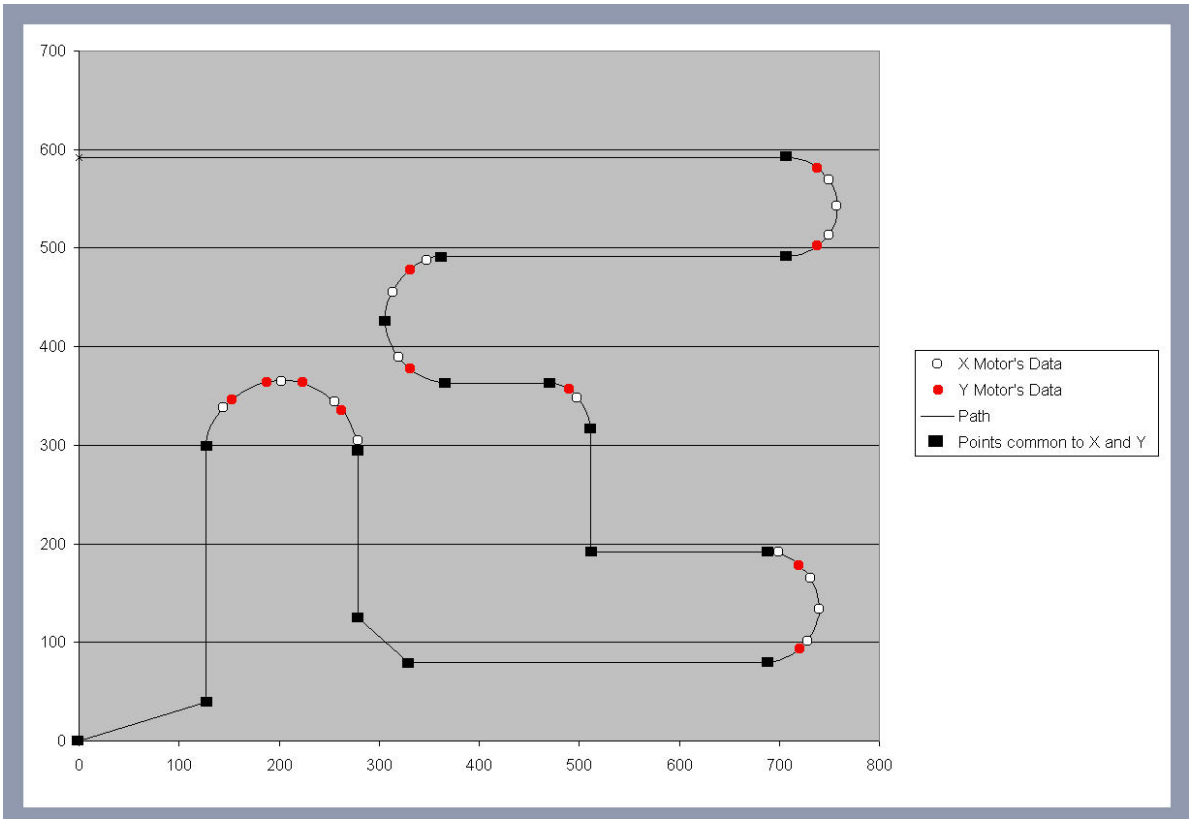
Use Cam Table to Control Entire Machine Process

Data is in the form of slave positions and master position deviations. Table data may be fixed Master position deviation where only slave data is stored or may be variable segment master data and slave data combined. In addition, each cam data point has an additional 8 points of control data. This control data may used to define interrupt Status Bits for controlling I/O or move events, as well as defining a given point as linear, or curvilinear spline points.

All cam tables may be run as standard linear interpolation or a modifided spline algorithm. When running in Spline Mode, the data points may be greatly reduced. The sample diagram (Fig. 1) shows an X Y plot of cam tables running on two motors. While the original data was over 700 points, the final data was around 30 points in each motor.

Fig. 1

In Spline Mode, only 30 data points in each SmartMotor™ were required to control the entire path of motion.



Cam Mode with Advanced Capabilities

Cam Mode may be used for complete stand-alone coordinated motion

Fig. 2

The example data for motor 1 is shown below

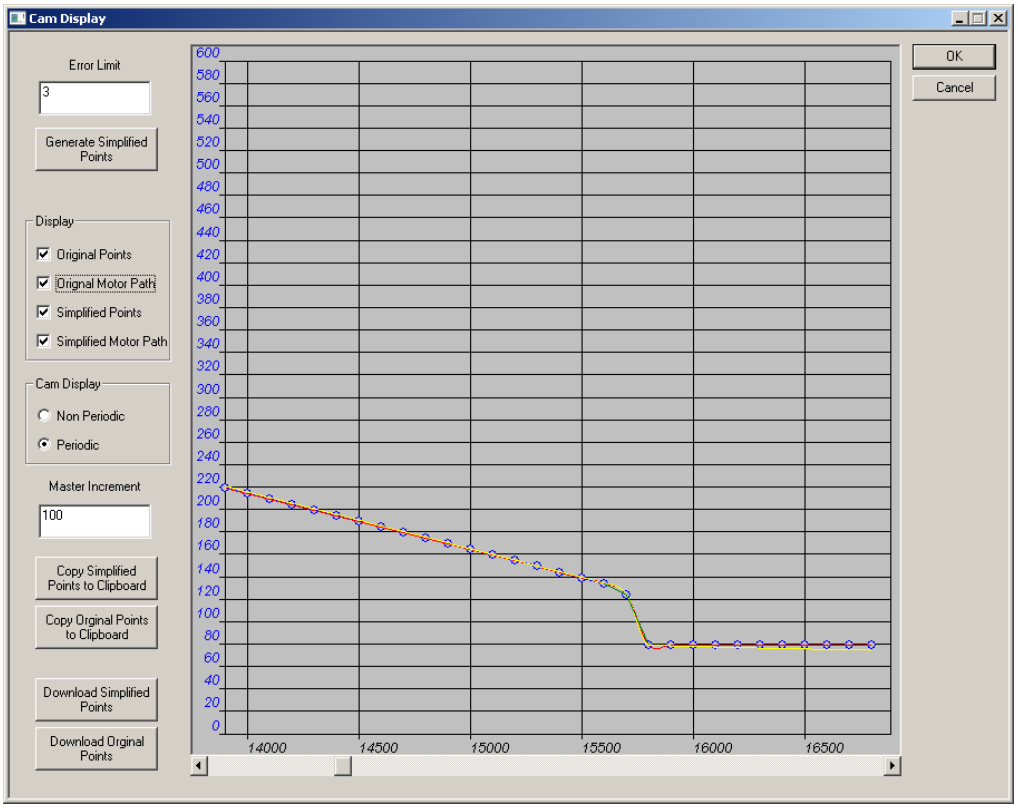
CTE(1)	CTW(511,29900)
CTA(30,0)	CTW(509,32600)
CTW(0,0)	CTW(498,33100)
CTW(126,2600)	CTW(456,34000)
CTW(130,8200)	CTW(334,36500)
CTW(156,9100)	CTW(312,37200)
CTW(253,11200)	CTW(306,37900)
CTW(273,11900)	CTW(323,38700)
CTW(279,12500)	CTW(372,39800)
CTW(279,15700)	CTW(740,47200)
CTW(329,15800)	CTW(756,47800)
CTW(717,23600)	CTW(756,48400)
CTW(737,24300)	CTW(743,48900)
CTW(739,24800)	CTW(687,50100)
CTW(727,25400)	CTW(0,63900)
CTW(699,26100)	CTW(0,75600)

Flexible Approach

- Cam table data may be directly imported from a tab delimited text file or spread sheet
- Imported data in SMI can be written into a program, copied to the clipboard or directly written (live) into a motor
- Import funtion allows for optimizing data points for cubic spline interpolation

Fig. 3

Below is the Cam Display window in SMI you see when importing data. Clicking the "Copy Simplified Points to Clipboard" button on the bottom left side of the Cam Display window in SMI results in Fig. 2 above.



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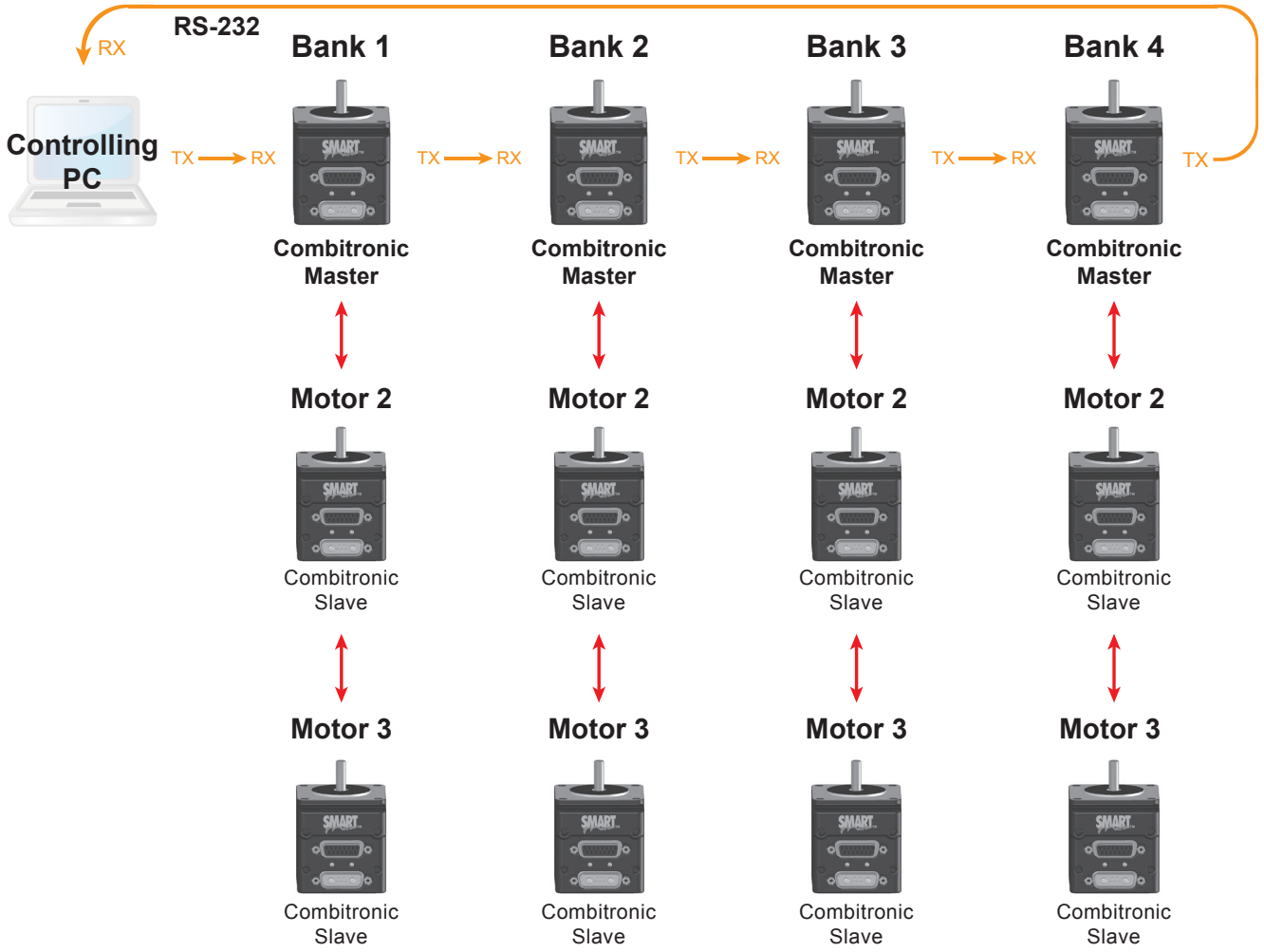
Combitronic™ with RS-232 Interface

In the event that a PC or HMI is desired to control a large number of SmartMotors, but RS-232 is desired to save the cost of direct CAN bus interfacing to the network, any SmartMotor may be used as master access via RS-232 to all Combitronic motors on its network. The following demonstrates 12 motors in a network where four SmartMotors are in a serial daisy chain over RS-232. Each of those four may have up to 119 motors on its Combitronic network.

The controlling PC may freely access and control all motors via a single standard RS-232 serial port.



Example of RS-232 commands from Host PC using SMI software for above system layout:

2PT:3=1234	*Motor 2 sets target position of Motor 3 in its group to 1234*
3PT:0=0	*Motor 3 sets target position of all motors in its group to zero*
4PT=345	*Just Motor 4 gets its own target position set to 345*
0G	*Motor 1, 2, 3, and 4 get Go command*
0G:0	*All motors on RS-232 and all network Combitronic motors receive Go command*

Linear Interpolation

New Stand Alone Linear Interpolation Utilizing COMBITRONIC™ Protocol and our New Class 5 SmartMotor:

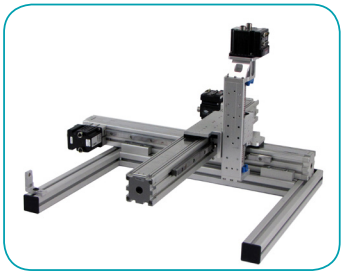
Moog Animatics has broken down the barrier between multiple integrated motors and introduced a simple command structure that allows any one SmartMotor to command linear interpolated paths across multiple motors at once. The new synchronized motion command set opens the door to direct control without the need for any centralized processor. The user may command path velocity, acceleration, deceleration and target points in 3 cartesian dimensions.

Dual Axis Example (Absolute Move)

```
a=1 b=2          'Motor addresses, x and y
x=123000         'X Axis Target Position
y=20000          'Y Axis Target Position
VTS=100000       'set path velocity
ATS=1000         'set path acceleration
DTS=100          'set path deceleration
PTS(x;a,y;b)     'set 2-axis synchronized target position
GS               'Go, 2-axis linear interpolation
TSWAIT           'Wait until 2 axis move is complete
```

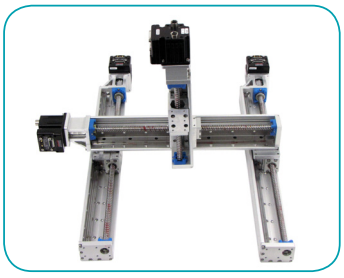
Dual Axis Example (Relative Move Syntax)

```
PTRS(x;a,y;b)   'set 2-axis synchronized Relative Target position
```



Three Axis XYZ Example

```
a=1 b=2 c=3        'Motor addresses, x, y and z
x=123000           'X Axis Target Position
y=20000            'Y Axis Target Position
z=8000             'Z Axis Target Position
PTS(x;a,y;b, z;c)  'set 3-axis synchronized target position
GS                 'Go, 3-axis linear interpolation
TSWAIT             'Wait until 3 axis move is complete
```



Four Axis X1, X2, Y, Z Example

```
a=1 b=2 c=3      'Motor addresses, x, y and z
u=4              'Motor address, x slave (parallel X axis)
x=123000         'X Axis Target Position
y=20000          'Y Axis Target Position
z=8000           'Z Axis Target Position
PTS(x;a;u,y;b,z;c) 'set 4-axis including x slave
GS               'Go, 3-axis +slave X axis
TSWAIT           'Wait until all axis move is complete
```

Synchronized commands allow up to 3 pairs of motors for X, Y and Z for large parallel axis gantry systems with 2 motors per axis:

```
PTS(x;a;u,y;b;v,z;c;z) 'set 6-axis including x slave, y slave, z slave
GS                     'Go, 3-axis primaries x, y, z, + slaves: u, v, and w
TSWAIT                 'Wait until all axis move is complete
```

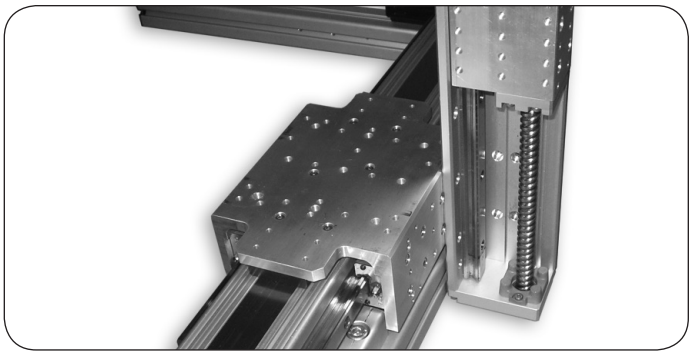
Supplemental Axis syntax allows for additional motors above and beyond that will start and stop and the exact same time as the main motors: These motors could be rotary axis, pumps, etc….

```
PTS(x;a,y;b,z;c)       'set 3-axis X, Y, Z
PTSS(j,q)              'set supplemental axis q to j absolute position
PRTSS(k,r)             'set supplemental axis r,  k relative distance
GS                     'Go, all 5 motors
TSWAIT                 'Wait until all moves are complete
```

Multi-Axis Configurations

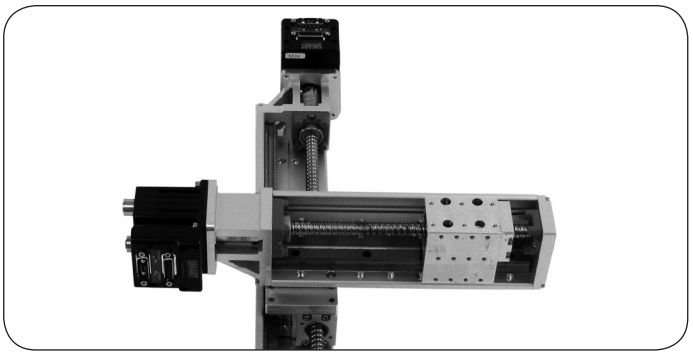
HLD60 Twin Rails with L70 2 Axis System

The configuration shown below includes one HLD actuator with twin external rails and one L70 actuator. This is a close up of the mounting plate which is available. Mounting plates are also available for mounting an XL100 to an HLD actuator.



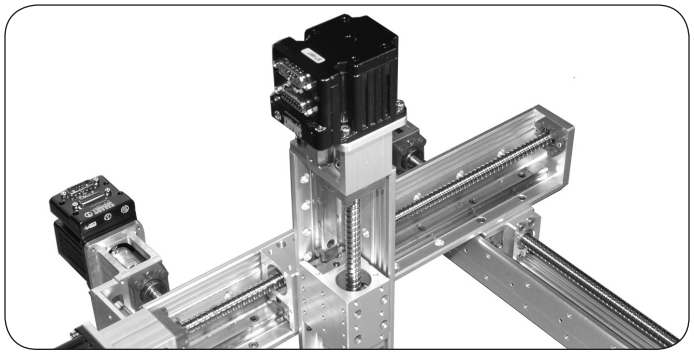
L70 Series 2 Axis X-Y

The L70 series is designed with mounting holes for easy X-Y setup. The “L” shape provides a means to mount to either top or side of the carriage for up to four configurations of X-Y mounting.



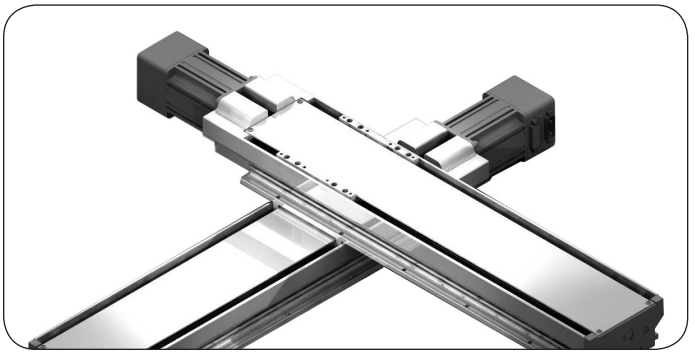
L70 Series 3 Axis X-Y-Z

The configuration shown below includes four L70 ball screw actuators. No mounting brackets are needed when mounting an L70 actuator to itself. SmartMotors™ have a mode follow option, which will allow a master and slave axis.



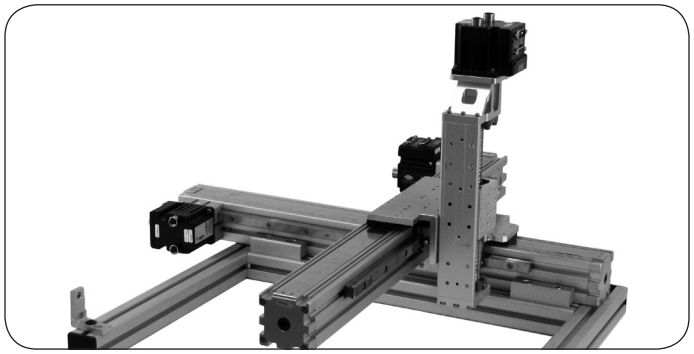
XL100 series 2-Axis X-Y

The XL100 series has mounting holes along the base of the extrusion to allow easy stacking without the need for a transition plate. Given the twin rail extended moment loading capabilities, one axis can be fully cantilevered off of the other with <0.2 mm deflection at full load at 500 mm.



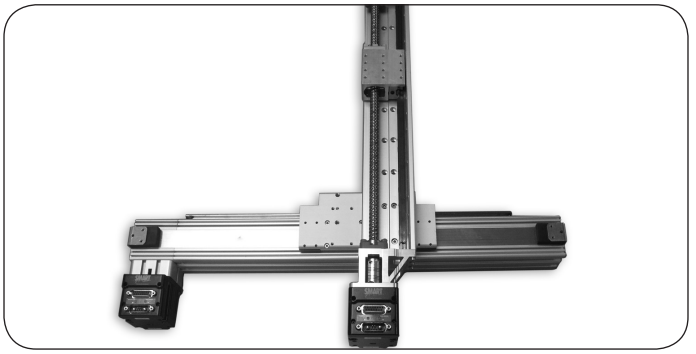
HLD60 with L70 3 Axis System

The configuration shown below includes two HLD actuators – one with a single external rail and one HLD actuator with twin external rails. Toe clamps are available for mounting the HLD actuators together. In this picture, there are two different sizes of toe clamps used.



HLD60 with L70 2-Axis System

Direct mounting of an L70 actuator to an HLD actuator (except internal rollers) provides a compact secondary axis. This same setup can be in an X-Y or X-Z configuration.



NOTE: We highly recommend all stand-alone multi-axis systems be ordered with Combitronic CAN interface option via –C or –DN part number add-in

Industries & Applications

For over 20 years, Moog Animatics has been providing customers of numerous industries with the products and customer service to help them succeed. Moog Animatics' products are at the heart of applications ranging from process tension control to parallel axis gantry, and our returning customers in old and new industries are a testament to our innovation. So many unique applications feature our products that we have recently begun compiling our own library of success stories. Is your story next?

Each SmartMotor™ can freely move between modes of operations including:

- Velocity Mode
- Torque Mode
- Relative Position Mode
- Absolute Position Mode
- Electronic Gearing
- Electronic Camming

Industries Using the SmartMotor™:

- Aerospace
- Agricultural
- Automotive
- Autonomous vehicles
- Biomedical
- Chemical
- Cryogenics

- Government
- Life sciences
- Marine sciences
- Material handling
- Metal working machines
- Military
- Nuclear
- Oil industry
- Packaging
- Quality assurance inspection
- Security
- Testing and metrology
- Wood working machines

And more

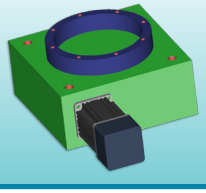
Applications Using SmartMotor™ Technology:

- Anode wire welding
- Automatic Web tensioning/alignment
- Auto-progression adjusting parts indexers
- Bearing inserters/presses
- Capacitor manufacturing
- Cappers
- Centrifuges
- Compression/tension testing
- Coordinate measuring machines
- Cut-to-length gage stops
- Dashboard controls button/switch testers
- Destructive testing
- Dicers
- Fillers
- Gimble mount accelerometer testing
- Glass tube cutting
- Glue dispensers
- GPS guided steering/drive control
- High-speed indexing labelers
- Hydroelectric turbine nozzle control
- Infeed/outfeed stackers
- Manual handwheel override
- Nut/bolt/screw drivers
- Pan & tilt bases
- Paper feeders/folders
- Parts redirectors
- Phase gearhead adjusting
- Pick & place palletizers
- Positive displacement pumps
- Shock load testing
- Step/tapered spool winders
- Tactile switch testing
- Tire tread grinding
- Topographical mapping
- Transformer coil winders
- Turbine blade grinding
- Vision inspection
- Voice coil winders
- Wafer handlers
- Web guide
- Web tensioning
- Wire bonding
- and more

Concepts and Capabilities of the Moog Animatics Product Range:

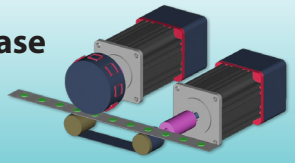
Programmable Rotary Index Table

Modulo Position Mode



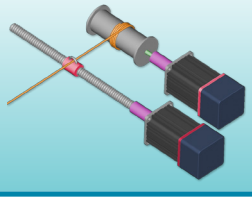
Print & Die Cut Alignment

Follow Mode with Phase Offset Electronic Gearing



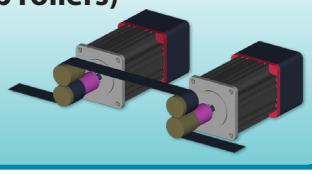
Traverse & Take-up Spool Winders

Velocity Mode & Electronic Gearing Summed Together



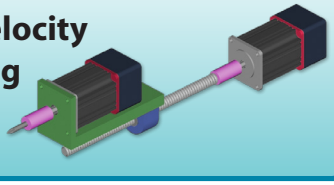
Process Tension Control
(with one or multiple nip rollers)

Follow Mode with Phase Offset



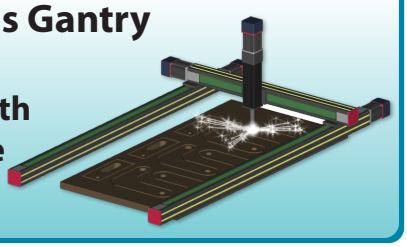
Drill & Tap/Nut Runner

Follow Mode with Velocity Mode and Monitoring Position Error



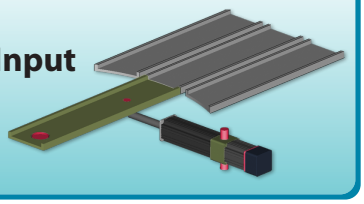
Parallel Axis Gantry

Position Mode with Contouring Mode



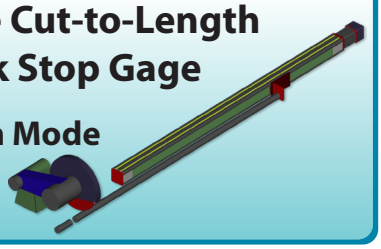
3-Position Parts Diverter

Position Mode BCD Input Absolute Position Mode



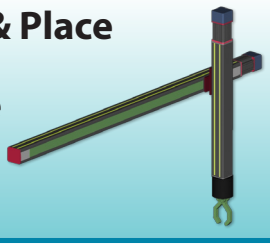
Programmable Cut-to-Length Stop or Back Stop Gage

Index with Position Mode



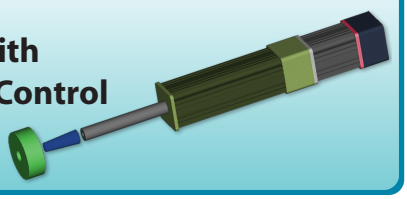
Multi-Axis Pick & Place

Position Mode Absolute Position Mode



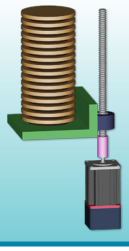
Programmable Force Press to Fit

Position Mode with Derivative Error Control



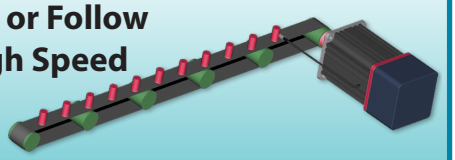
Input/Output Stacker

Position Mode
Absolute Position Mode
Relative Position Mode



High Speed Parts Counter & Verification

Velocity Mode or Follow Mode with High Speed Counter Input



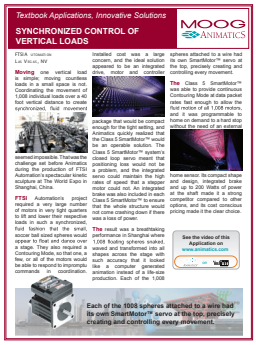
Case Studies	Related Industry
Automotive Modular Machine Control	Automotive
Ultrasound Testing	Medical
CNC Training Tool for Brazilian Higher Education	Education
Semiconductor Heat Chamber Automation	Semiconductor
Aircraft Skin Processing	Aerospace
Linear and Rotary Motion in Digital Architecture	Architecture
PID Style Antenna Pedestal	Aerospace
Motion Control for Maximum A/V Experience	Entertainment
Automated Laser Marking for Produce Traceability	Agriculture
Foam Sculpting CNC Router	Signage / Architectural Forms
High Speed Pharma Inspection	Pharmaceutical/ Packaging
CNC Plasma Cutter	Metal Working Machines
CNC Surfboard Shaper	Wood Working Machines
High Axis Count Coordinated Motion	Art & New Media
Precision Positioning System	Military Autonomous Vehicles
Synchronized Control of Vertical Loads	Entertainment
Traverse Take Up Winding	Material Handling
Alaskan Pipe Crawler	Oil Industry

Case Studies

Moog Animatics' case studies showcase just a few of the many success stories featuring the SmartMotor™ and other Moog Animatics products. To read or download the complete case studies, visit www.animatics.com/applications.

Synchronized Control of Vertical Loads (Entertainment)

The Moog Animatics SmartMotor was integral in the production of 1,008 axes at The World Expo in Shanghai, China. Partnering with an entertainment automation company, a SmartMotor was attached to each of the 1,008 spheres and programmed to raise and lower in quick, smooth succession. The SmartMotor was able to provide Contouring Mode at data packet rates fast enough to allow for the fluid movement of all components of the performance, resulting in a breathtaking kinetic sculpture.


Textbook Applications, Innovative Solutions
SYNCHRONIZED CONTROL OF VERTICAL LOADS
MOOG ANIMATICS
Each of the 1008 spheres attached to a wire had its own SmartMotor™ servo at the top, precisely creating and controlling every movement.

Precision Positioning System (Military)

Burchfield Automation used the SmartMotor to fit a video camera onto an ATV travelling over rough terrain. The SmartMotor utilized the Phase Offset feature to dampen the vibration of the pan & tilt system and allow the camera to stay focused on the horizon despite the terrain change. The Phase Offset feature creates a differential velocity between the external gyroscopic measurement of the Pan & Tilt system and the motor's internal encoder, which allows the physical measurement of the gyroscopic position sensors to tie in directly with the closed loop of the servo.


Textbook Applications, Innovative Solutions
PRECISION POSITIONING SYSTEMS
MOOG ANIMATICS
"The fact that SmartMotors™ are true servos, allows the highest degree of accuracy, smoothness, and precision all while contained in a compact unit."

CNC Surfboard Shaper (Woodworking)

Typical surfboard shaping machines are large, incredibly heavy and much too expensive. With the HLD60-H3 actuator and Moog Animatics' SMNC™ software, a surfboard manufacturer combined both a CAD/CAM and motion control software package into a unique graphical user interface to control multiple SmartMotors on the linear motion systems in true 3-D coordinated motion. The compact, low maintenance machine went to market in record time.

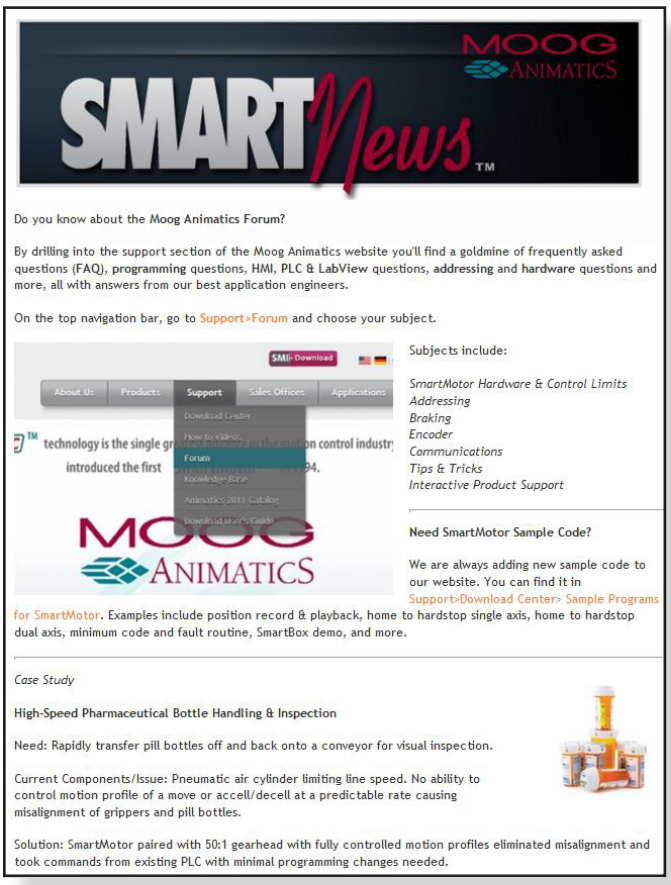

Textbook Applications, Innovative Solutions
CNC SURFBOARD SHAPER
MOOG ANIMATICS
Benefits Summary:
• Reduced system costs through part elimination
• Faster time-to-market through shorter product development cycle
• Greater reliability and less maintenance
• Elimination of costly field service
• Greater machine simplicity and ease-of use
• More compact, lighter, yet rugged design
• Greater customer ROI

SmartNews - Moog Animatics'

Application-Focused Email Newsletter

SmartNews, Moog Animatics' application-focused email newsletter, is sent out 1-2 times per month, giving recipients the latest information regarding Moog Animatics' products information, case studies and application notes, new videos and more. Is sent out to recipients before it's published on the website, and company announcements are sent exclusively through this medium. Below are a few examples of SmartNews coverage and emails. Sign up and receive the latest information from Moog Animatics through SmartNews by emailing animatics_sales@moog.com.

- Product Announcements & Releases
- Firmware Updates
- New Case Studies
- New Application Notes
- SmartMotor Tutorials & Videos
- Specific Sample Code for SmartMotors
- New Industries & Applications, including:
  - Firmware Upgrades
  - New Products
  - Product Improvements
- Company Announcements
- Website Additions
- Industry & Tradeshow Information



MOOG ANIMATICS

SMART News™

Do you know about the Moog Animatics Forum?

By drilling into the support section of the Moog Animatics website you'll find a goldmine of frequently asked questions (FAQ), programming questions, HMI, PLC & LabView questions, addressing and hardware questions and more, all with answers from our best application engineers.

On the top navigation bar, go to Support>Forum and choose your subject.

Subjects include:

SmartMotor Hardware & Control Limits
Addressing
Braking
Encoder
Communications
Tips & Tricks
Interactive Product Support

Need SmartMotor Sample Code?

We are always adding new sample code to our website. You can find it in Support>Download Center> Sample Programs for SmartMotor. Examples include position record & playback, home to hardstop single axis, home to hardstop dual axis, minimum code and fault routine, SmartBox demo, and more.

Case Study

High-Speed Pharmaceutical Bottle Handling & Inspection

Need: Rapidly transfer pill bottles off and back onto a conveyor for visual inspection.

Current Components/Issue: Pneumatic air cylinder limiting line speed. No ability to control motion profile of a move or accell/decell at a predictable rate causing misalignment of grippers and pill bottles.

Solution: SmartMotor paired with 50:1 gearhead with fully controlled motion profiles eliminated misalignment and took commands from existing PLC with minimal programming changes needed.

The option of adding additional axes quickly and without hassle, minimized cabling and fewer components are a few reasons for SmartMotors continued use in packaging applications. One example was high speed inspection of pharmaceutical bottles. Previously using a 3-position pneumatic cylinder, flow control and accuracy were problems on the line and severely limited the throughput speed. The accuracy could be improved by reducing the air pressure, but line speed was sacrificed.

The SmartMotor was programmed to take existing I/O or serial commands without needing a new control system, saving large system update costs. Since the SmartMotor has motion control electronics, drive-amplifier, encoder and communications in one, the only accessories were power/comm cables and a gearhead.

Download the complete case study "High-Speed Package Inspection" here

Animatics has also created package tracking systems for international shipping services such as FedEx. One application used a laser to measure the distance from the end of an actuator to a box, and then move the actuator within centimeters of the box and apply shipping labels to packages regardless of the size of the package coming down the line. You can see a video of the development of this application below.

Shadi Sharokhi is blending industrial capability and aesthetic design to create every man's entertainment fantasy with the SmartMotor™ at the heart of the movement...literally. Trak-kit™ frees your high definition flat screen television from the anchored tyranny of archaic and bulky wall mounts and instead, customizable tracks mount to the ceiling and house the integrated A/V wires, components and SmartMotor servos overhead while your entertainment glides effortlessly from living room to kitchen to bedroom, or disappears completely flush into the wall. From residential penthouse suites to multinational pharmaceutical telepresence systems in boardrooms, Trak-kit trusts their high-end automation projects to the SmartMotor.

"With these applications, we couldn't afford to play around with something unreliable. We also needed a servo motor that simply sent out DC voltage with minimal cabling, because too many cables lead to artifacts in the video signal" said Shadi. "The fact that all those components sit inside the SmartMotor was also key in the buying decision. All the code stored in the motor's internal memory meant if there was power lost, all our programming wasn't lost with it."

NOTE: If you have a successful application using any of Moog Animatics' products and would like to be featured in SmartNews or work with our marketing department to promote your products, please email all inquiries to animatics_sales@moog.com.

Industry: Medical

Application: Multi-Axis Ultrasound Transducer Testing Machine

Challenges:

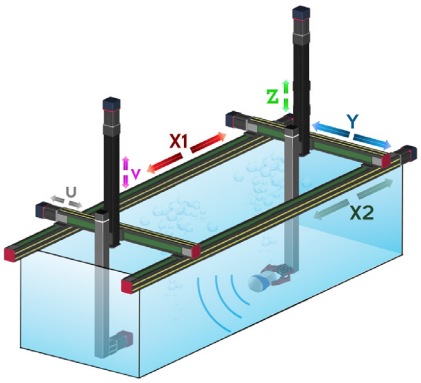
- Highly accurate automated control of multi-axis gantry
- Electrical noise attenuation
- Multi-axis position recording

Situation

A large OEM manufacturer of medical equipment needed motion control system for testing their ultrasound equipment: specifically the transducer wand. Ultrasound transducers send and receive sound waves, converting the electrical potential into energy and back. Manufacturers test, change and categorize the focus of the ultrasound beam to image different structures based on their composition and their distance from the transducer, and then catalog that data for end users.

Problem

Each transducer is placed in a tank of saline solution that has a two-axis to five-axis gantry at either end. The ultrasound transducer is placed on the gantry at one end and a hydrophone is placed on the gantry at the other end of the tank, also immersed in the saline solution. Positioning of the transducer and the hydrophone must be very accurate to find the most intense beam strength. In addition, electrical interference from any motion control equipment had to be minimized to reduce interference with the ultrasound waves during the testing.



Solution

The manufacturer chose the SmartMotor paired with a high precision ball screw linear actuator to obtain the highest accuracy motion. The SmartMotors were networked over a serial bus to the host PC.

The SmartMotor also caused the least amount of electrical interference from low voltage signals compared to conventional motion control systems as well as other integrated servos. Because the advanced controller is integrated onto the servo drive, motor, encoder and communication buses, there is significantly less cabling between systems and maximum electrical noise attenuation. SmartMotors have been used on this ultrasound transducer testing machine since 1999.

Industry: Textile

Application: Traverse Take-Up Winding (Spooling)

Challenges:

- Improper traverse points
- Over travel
- Tension control between feeder spool and winding spool

Situation

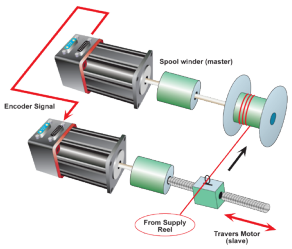
Spooling is the most effective way to conveniently package materials of very long length, such as thread, film, labels, cable and thermoplastics. Material is fed from a large spool at a certain rate onto another spool, with a traversing mechanism between the two spools to create the desired pattern or evenly wind onto an flanged spool or cylindrical core despite the core shape. The integrity of the spool is often based on precise patterns and proper tension control throughout the winding process.

Problem

Selection of proper traverse type for different materials is crucial, especially for profile materials that cannot twist or tolerate excessive stress. Creating a wind where the exterior of the wind is tapered even while the core is a straight, cylindrical spool is a common problem with spooling where traverse points are improperly set and over travel occurs within the winging spool.

Solution

Traversing position can be electronically geared to the rotational velocity of the winding spool. The SmartMotor uses customizable electronic gearing dwell control to achieve the desired spool shape, and closed-loop servo control ensure no over travel. Real-time monitoring of the position error with advanced PID control maintains high speed precision winding.



In addition, multiple nodes of complex winding machines are easily networked together with SmartMotor Combitronic communications.

Industry: Architecture

Application: Linear and Rotary Motion

Challenges:

- Minimize cabling to eliminate artifacts in the video signal
- No program loss upon power loss
- Strict deadline for complete system integration

Situation

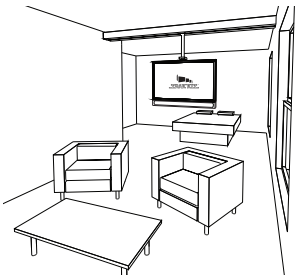
Advancements in digital architecture allow TV's, monitors and other digital displays to move freely on a mounted, customizable track system in residential and commercial settings. The track can be installed in nearly any shape and any length, allowing for linear movement and vertical movement, as well as 360 degree rotation. Motion controllers integrated onto servo motors allow the user to conveniently rotate and move their panel to a desired position anywhere on the track.

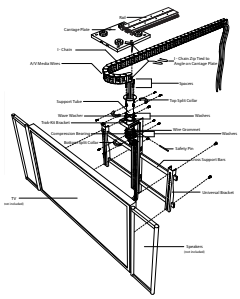
Problem

Combining video feed with motion required a servo motor that sent out DC voltage with minimal cabling because too many cables lead to artifacts in the video signal. The controller must also be able to retain the program upon power loss. The entire system integration was on a strict deadline, so installation and programming time had to be extremely efficient.

Solution

The manufacturer chose the SmartMotor because its integrated nature allowed for minimal cabling and the program could be stored within the internal memory. In addition, design and installation time was minimized and the deadline was met because of the ability of the machine builder to program the SmartMotor before it was installed in the system, and while the rest of the system was being designed. Ultimately the user was able to control their system through a remote and a smartphone application.





Industry: Aerospace

Application: PID-style Antenna Pedestal

Challenges:

- Accuracy over azimuth, elevation, and polar axes
- Precise and quick rotary movement of heavy structures

Situation

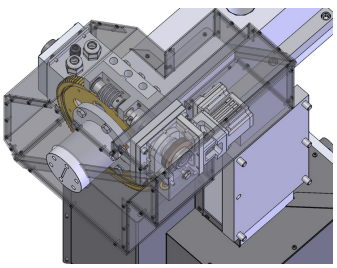
PID (proportional, integral and derivative algorithm based) style antenna pedestals are used to control three axes of movement of an antenna: azimuth, elevation, and polarity. These pedestal systems are created for everything from researching planets in space to tracking satellites for the military or government. For projects needing more accurate tracking, a bigger reflector dish can be used to create a tighter beam width and more concentrated power. Consequently, the tighter beam width creates a smaller radius to connect with its target, forcing the antenna position to be extremely accurate.

Problem

Antenna pedestals need to support up to a 12-foot antenna reflector that can weigh nearly 200 pounds and be able to move at a velocity of 4-6 degrees per second in each of its three axes. In the past M², who manufactures the tracking pedestals for antenna dishes, had installed a DC motor and a closed loop system which created an accuracy of 0.25 degrees in one direction. The accuracy of each axis was critical in order to control the narrow beam width for antennas, however the DC motors M² used were not precise enough for their goals and the results were weak and lost signals.

Solution

M² switched to Moog Animatics' SmartMotor integrated servo motor and ran it through two separate worm gear sets in order to achieve maximum velocity and accuracy. The result was improvement over the unidirectional stepper motor in all three axes, bringing the accuracy down from 0.25 degrees to 0.02 degrees. The implementation also elicited the opportunity for improvement, with the SmartMotor being capable of moving a 1,500 pound, 20-ft diameter dish up to 30 degrees/sec all while maintaining pinpoint accuracy.



The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

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D-Style Motor Comparison Chart

The information in this section has been superseded.
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D-Style Motor Comparison Chart

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Now With CAN Bus through D-Sub Connector

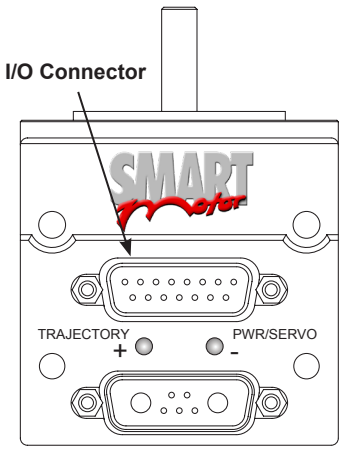
- Get your SmartMotor with CAN & brake
- More compact design decreases required space in machine
- Low cost OEM means of connecting CAN through the DB15 connector

Example SmartMotor Part Numbers Compatible with New –CDS Option*

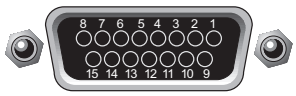
- SM23165D-CDS
- SM23165DT-CDS
- SM23165D-BRK-CDS
- SM23165DT-BRK-CDS
- SM23165D-CDS-AD1
- SM23165DT-CDS-AD1
- SM23165D-DE-CDS
- SM23165DT-DE-CDS
- SM23165D-DEBRK-CDS
- SM23165DT-DEBRK-CDS
- SM23165D-DE-CDS-AD1
- SM23165DT-DE-CDS-AD1
- SM34165D-CDS
- SM34165D-DE-CDS
- SM34165D-BRK-CDS
- SM34165D-DEBRK-CDS
- SM34165D-DE-CDS-AD1
- SM34165DT-DE-CDS-AD1

*Consult the factory for the complete list.

PIN	I/O CONNECTOR (5VTTL I/O)	Specifications:	
1	I/O – 0 General Purpose or Enc. A or Step Input	25mAmp Sink or Source 10Bit 0-5VDC A/D	1.5MHz max as Enc or Step input
2	I/O – 1 General Purpose or Enc. B or Dir. Input	25mAmp Sink or Source 10Bit 0-5VDC A/D	1.5MHz max as Enc or Dir. Input
3	I/O – 2 Positive Over Travel or GP	25mAmp Sink or Source 10Bit 0-5VDC A/D	
4	I/O – 3 Negative Over Travel or GP	25mAmp Sink or Source 10Bit 0-5VDC A/D	
5	I/O – 4 General Purpose or RS-485 A Channel(1)	25mAmp Sink or Source 10Bit 0-5VDC A/D	115.2KBaud Max
6	I/O – 5 General Purpose or RS-485 B Channel(1)	25mAmp Sink or Source 10Bit 0-5VDC A/D	115.2KBaud Max
7	I/O – 6 General Purpose or "G" command	25mAmp Sink or Source 10Bit 0-5VDC A/D	Redundant connection on Main Power Connector
8	Phase A Encoder Output		
9	Phase B Encoder Output		
10	CAN-Low	1MBaud (max, non-isolated)	115.2KBaud Max
11	CAN-Hi	1MBaud (max, non-isolated)	115.2KBaud Max
12	+5VDC Out	50mAmps Max (total)	
13	SIG Ground		
14	Ground		
15	Main Power: +20-48VDC	if -DE option, control power separate from main power	

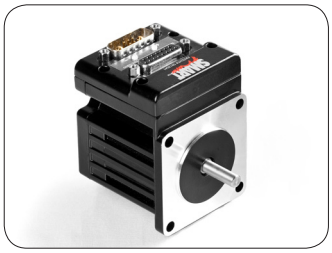


DB-15 D-sub Connector



WARNING: Proper bus biasing and termination must be incorporated into system wiring to ensure quality communications over any industrial bus. Failure to do so could result in loss of communications. Please consult the associated bus standard organizations for details.

Moog Animatics is releasing a new option to their popular NEMA 23 frame SmartMotors, the SM23165D-CDS and SM23165DT-CDS.



This motor option allows users to employ CAN communications through the D-sub connector on the top of the motor instead of through the 5-pin connector on the back of the motor. This change allows for the integrated brake option to be used with CAN, opening the door to numerous applications requiring SmartMotor on their vertical axis.

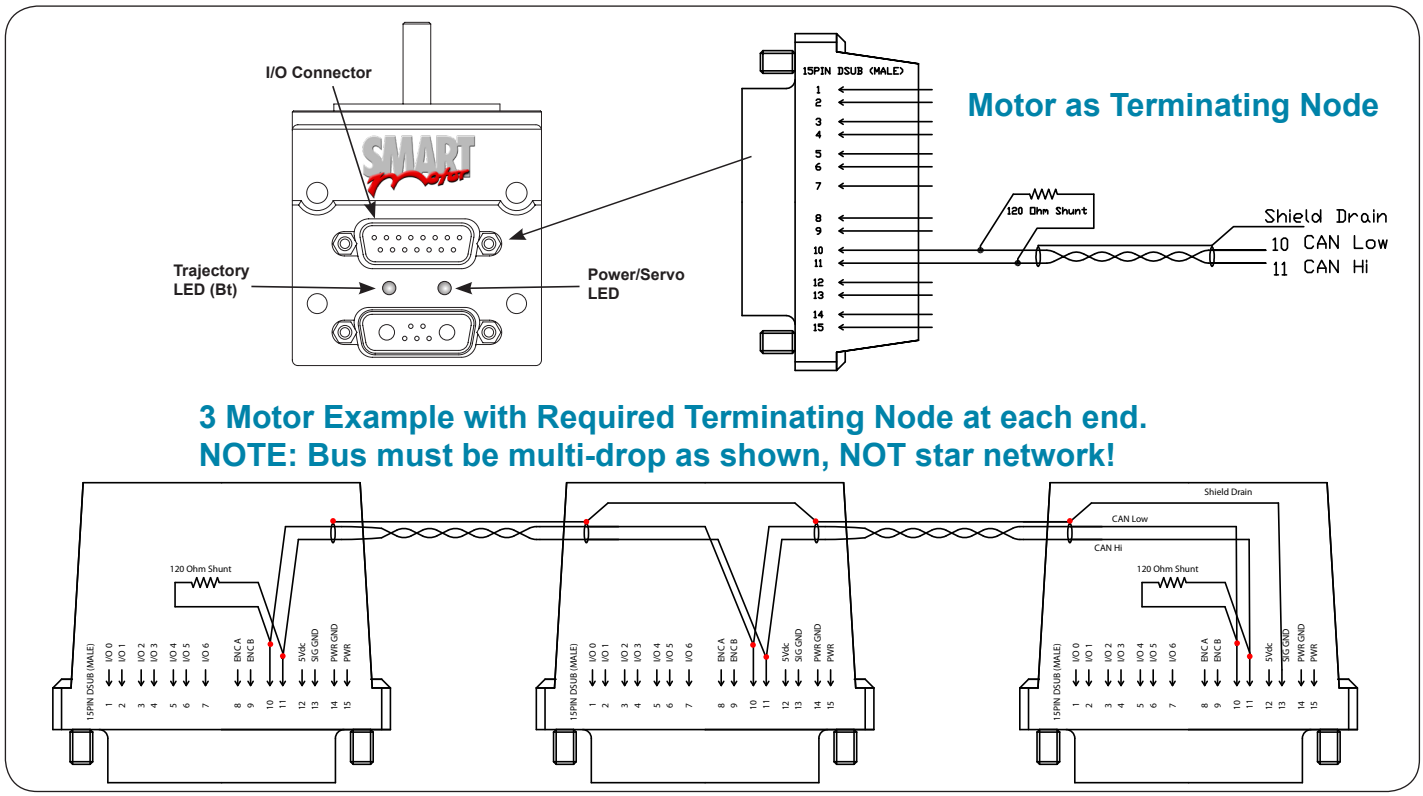
SmartMotor products from Moog Animatics are advanced motion controllers with an integrated servo motor, drive and encoder inside one package. Each SmartMotor is able to be a slave or a master with the ability to link over 120 SmartMotors together over one CAN bus.

NOTE: 24V CAN bus power connection is not required at the motor. DeviceNet bus power monitor and fault are over ridden and bypassed.

LED Indications are as standard Class 5 D-style SmartMotors with added indications for CAN bus condition.

Condition	**Indication**
Bt=0, CAN bus OK,	Trajectory LED = OFF
Bt=1, CAN bus OK,	Trajectory LED = GREEN
Bt=0, CAN bus fault	Trajectory LED = Red flashing
Bt=1, CAN bus fault	Trajectory LED = Red/Green alternating

Bt refers to Busy Trajectory Status Bit. When the motor is actively pursuing a trajectory, the Bt bit will be set to 1.



The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

SM17205D		
Continuous Torque	2.08	in-lb
	33	oz-in
	0.24	N-m
Peak Torque	3.82	in-lb
	61	oz-in
	0.43	N-m
Nominal Continuous Power	145	Watt
No Load Speed	7,900	RPM
Max. Continuous Current* @ 6000 RPM	3.81	Amps
Peak Power @ 4200 RPM	185	Watts
Voltage Constant	6.506	V/kRPM
Inductance	1.4	mH
Encoder Resolution	4,000	Counts/Rev
Rotor Inertia	0.00217	oz-in-sec^2
	1.5325	10^{-5} Kg-m^2
Weight	1.2	lb
	0.55	kg
Shaft Diameter	0.197	in
	5.00	mm
Shaft, Radial Load	7	lb
	3.18	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

Operating temperature range: 0°C–85°C

Storage temperature range: -10°C–85°C, noncondensing

NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

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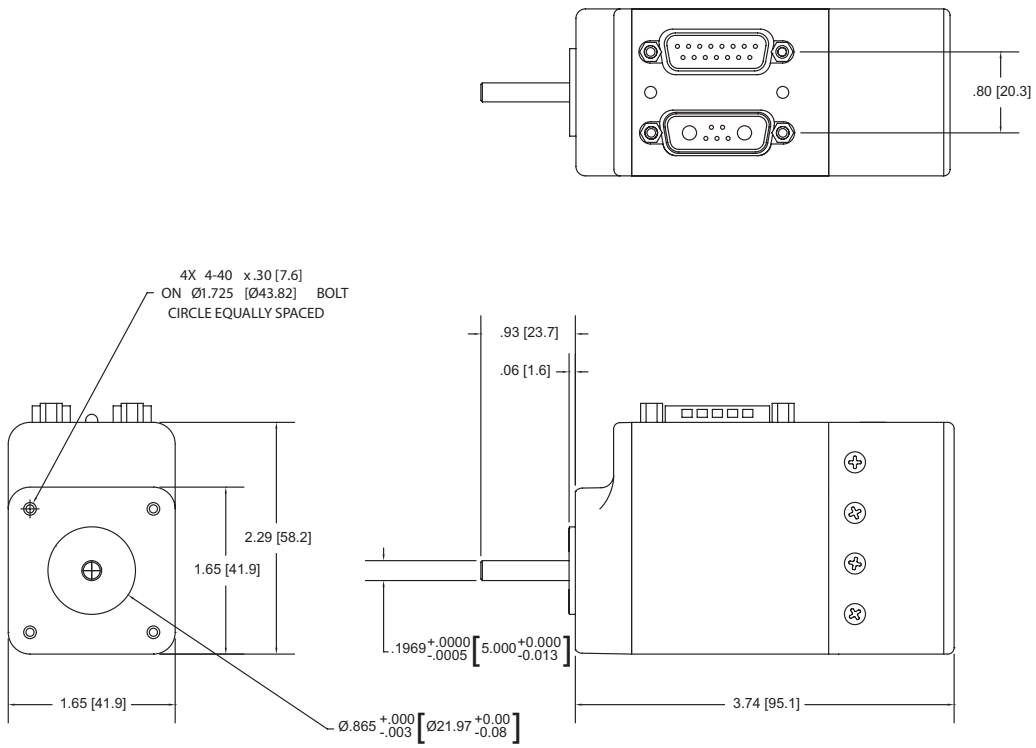
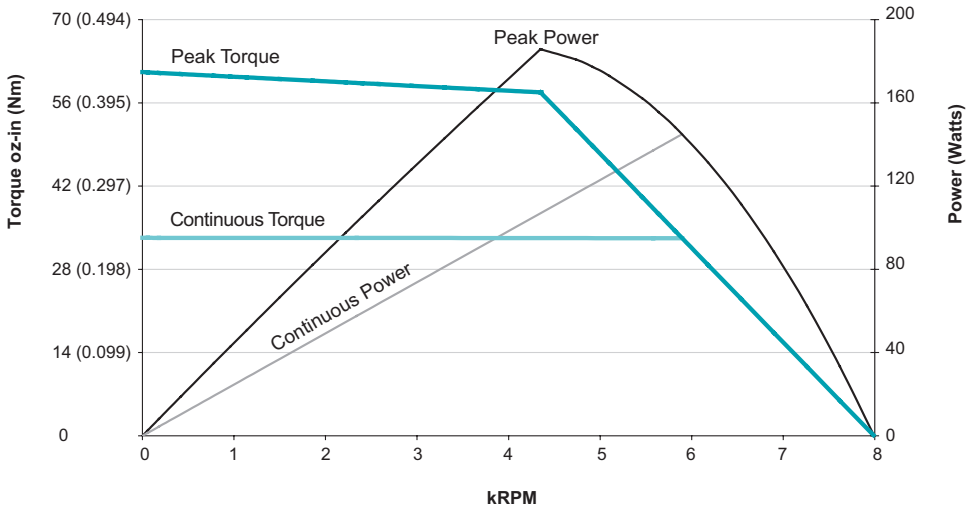
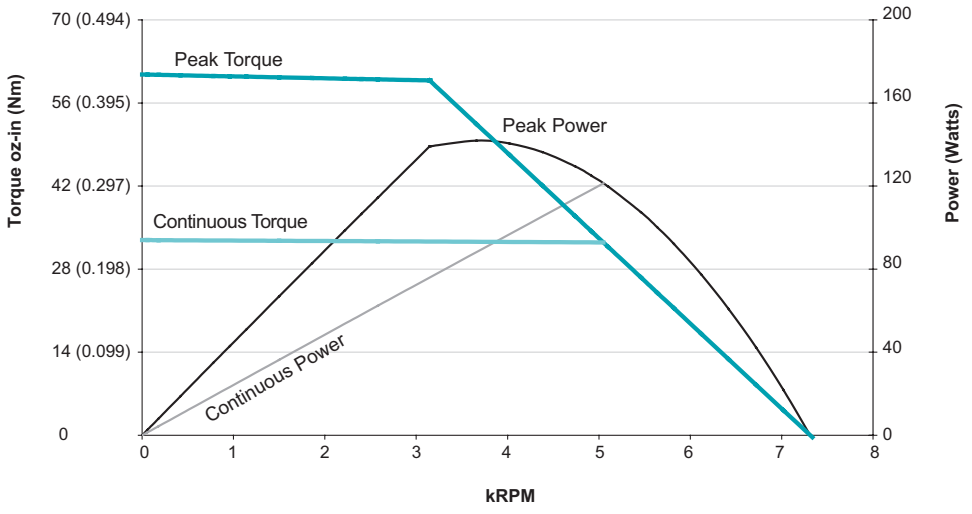
Moog Animatics SmartMotor™ SM17205D (No Options) CAD Drawing

in [mm]

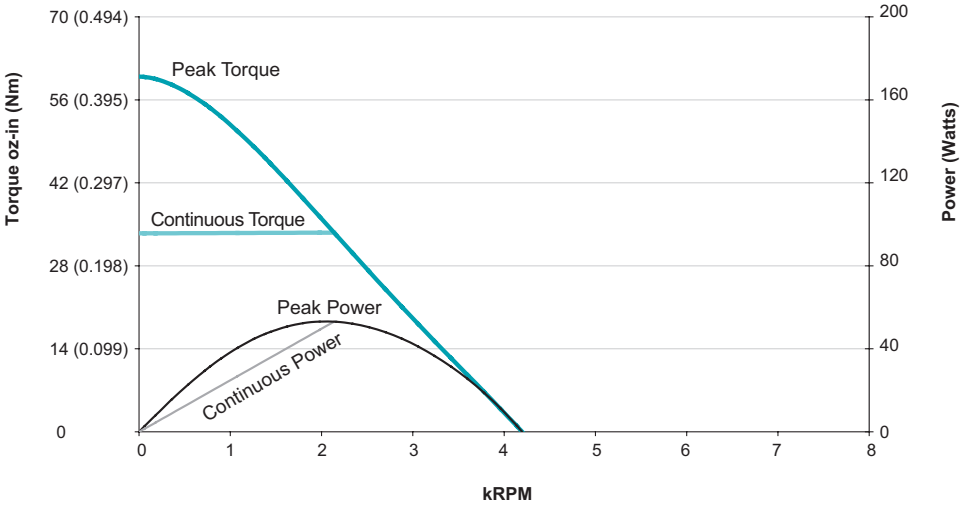




SM17205D
at 48 VDC
at rise to 85°C



SM17205D
at 42 VDC
at rise to 85°C



SM17205D
at 24 VDC
at rise to 85°C

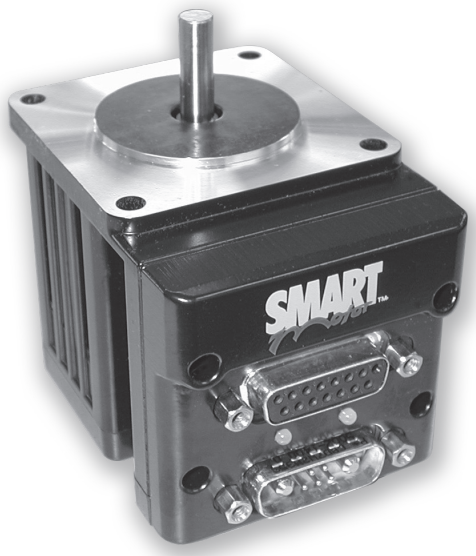
All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM23165D		
Continuous Torque	2.50	in-lb
	40	oz-in
	0.28	N-m
Peak Torque	4.00	in-lb
	64	oz-in
	0.45	N-m
Nominal Continuous Power	181	Watt
No Load Speed	10,400	RPM
Max. Continuous Current* @ 6500 RPM	4.70	Amps
Peak Power @ 6100 RPM	183	Watts
Voltage Constant	4.45	V/kRPM
Inductance	0.829	mH
Encoder Resolution	4,000	Counts/Rev
Rotor Inertia	0.00099	oz-in-sec^2
	0.6991	10^{-5} Kg-m^2
Weight	1.0	lb
	0.45	kg
Shaft Diameter	0.250	in
	6.35	mm
Shaft, Radial Load	7	lb
	3.18	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available	Yes	
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.



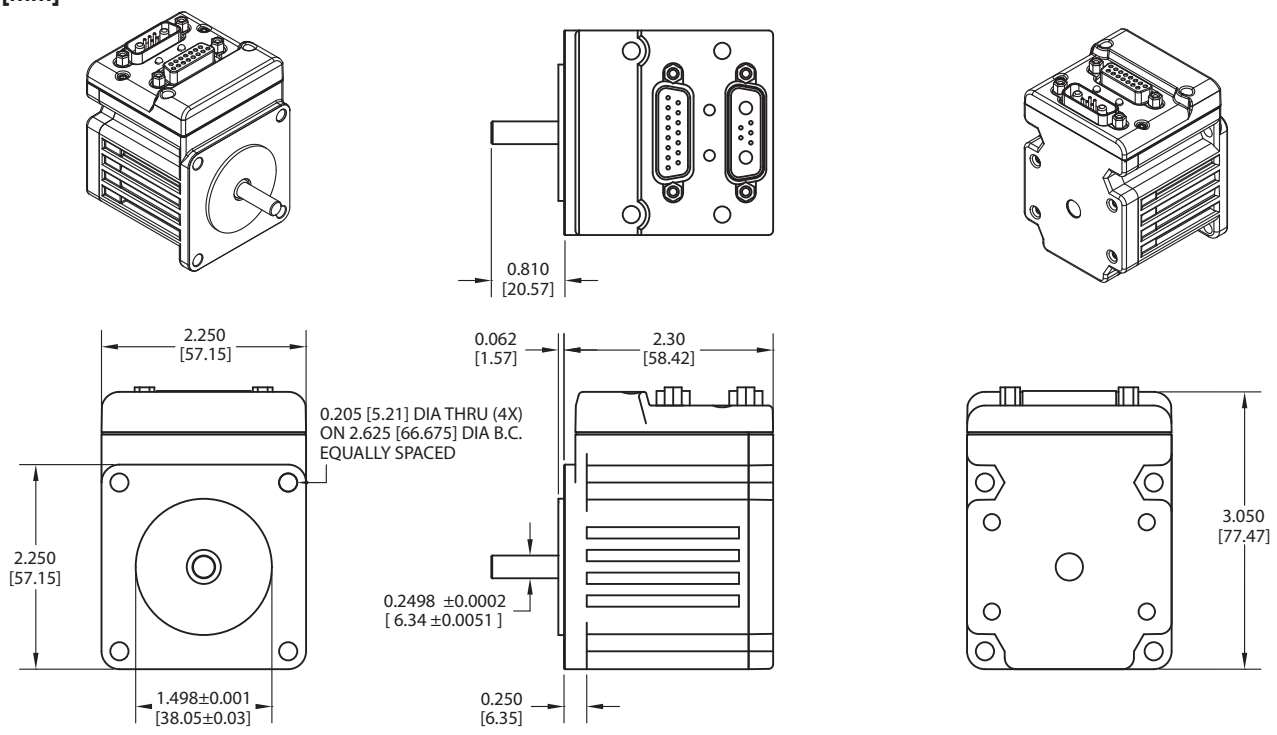
Operating temperature range: 0°C–85°C

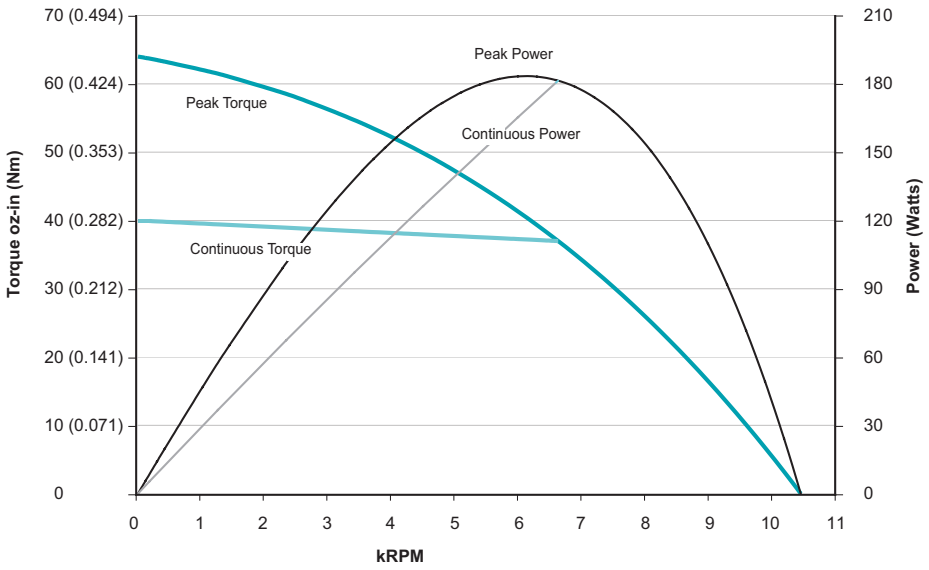
Storage temperature range: -10°C–85°C, noncondensing

NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

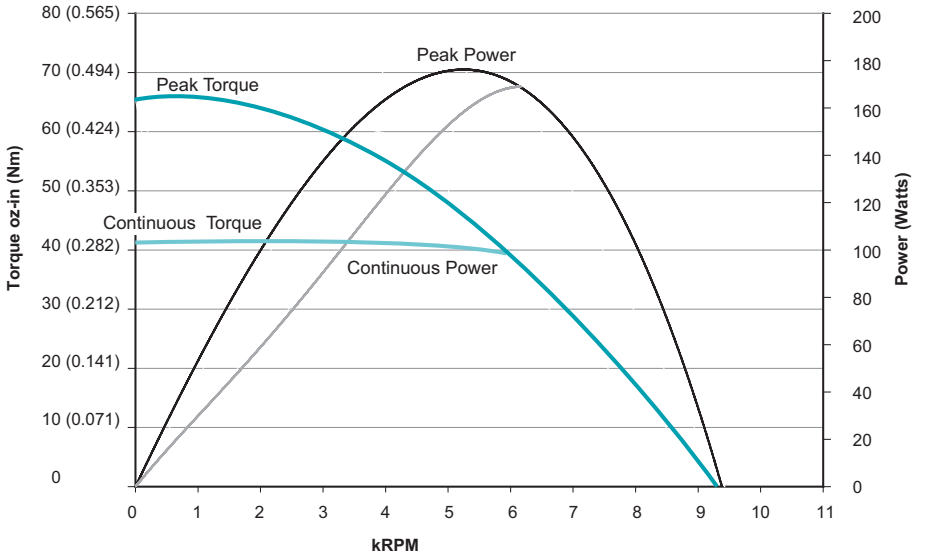
Moog Animatics SmartMotor™ SM23165D (No Options) CAD Drawing

in [mm]

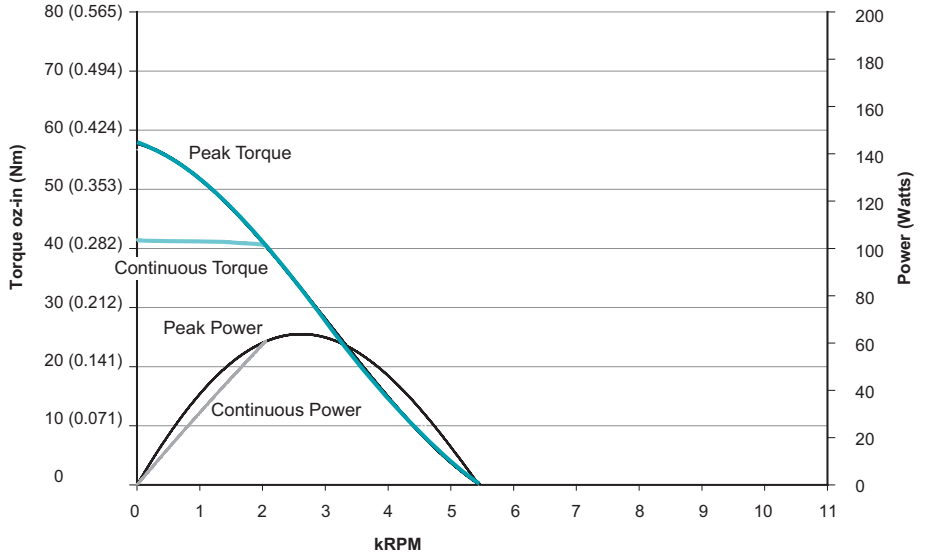




SM23165D
at 48 VDC
at rise to 85°C



SM23165D
at 42 VDC
at rise to 85°C



SM23165D
at 24 VDC
at rise to 85°C

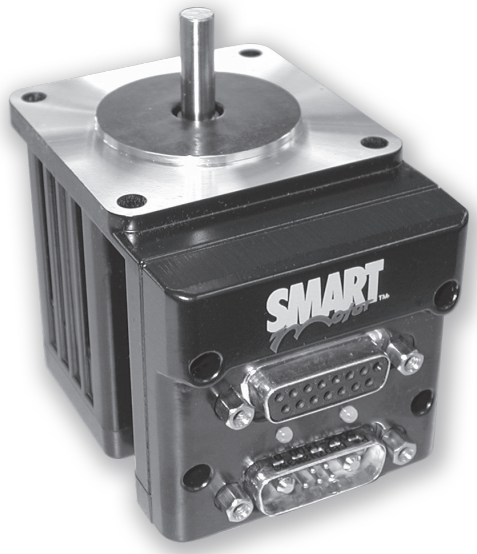
All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM23165DT		
Continuous Torque	4.61	in-lb
	74	oz-in
	0.52	N-m
Peak Torque	7.40	in-lb
	118	oz-in
	0.84	N-m
Nominal Continuous Power	204	Watt
No Load Speed	5,200	RPM
Max. Continuous Current* @ 3800 RPM	5.074	Amps
Peak Power @ 3400 RPM	210	Watts
Voltage Constant	9.08	V/kRPM
Inductance	1.31	mH
Encoder Resolution	4,000	Counts/Rev
Rotor Inertia	0.001	oz-in-sec^2
	0.706	10^{-5} Kg-m^2
Weight	1.3	lb
	0.59	kg
Shaft Diameter	0.250	in
	6.35	mm
Shaft, Radial Load	7	lb
	3.18	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available	Yes	
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.



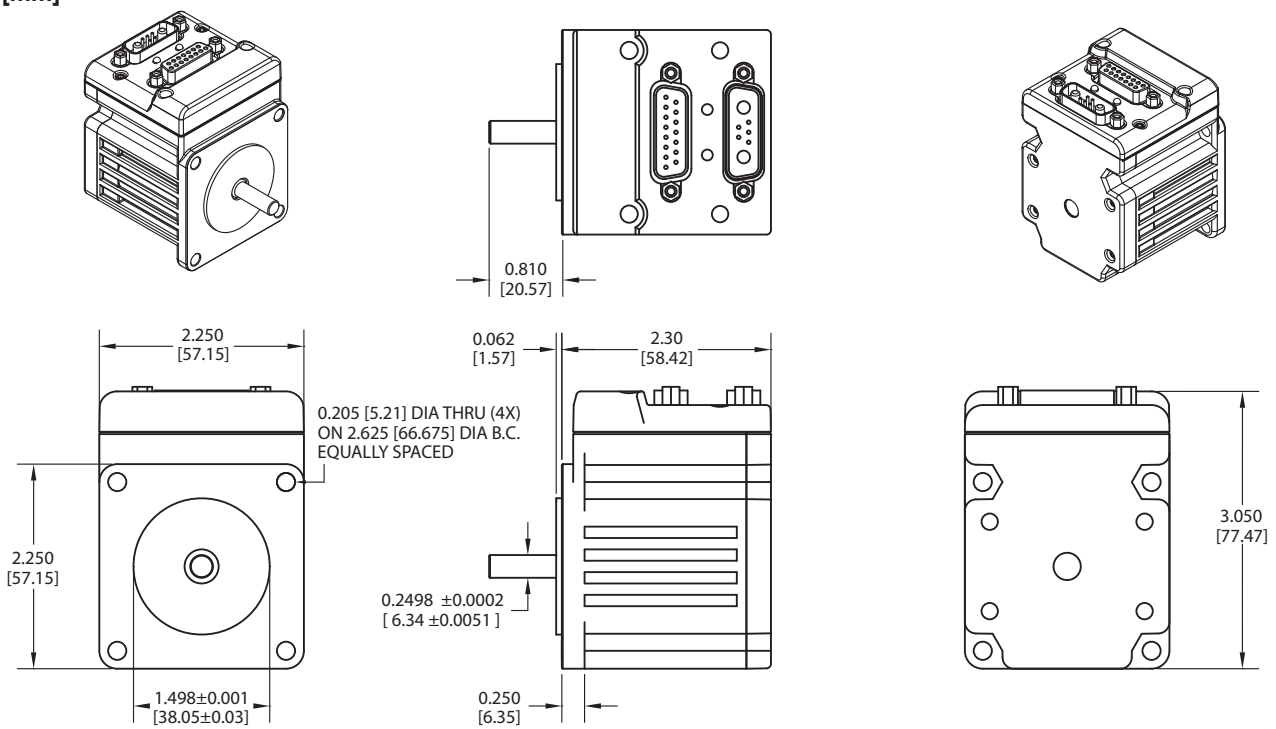
Operating temperature range: 0°C–85°C

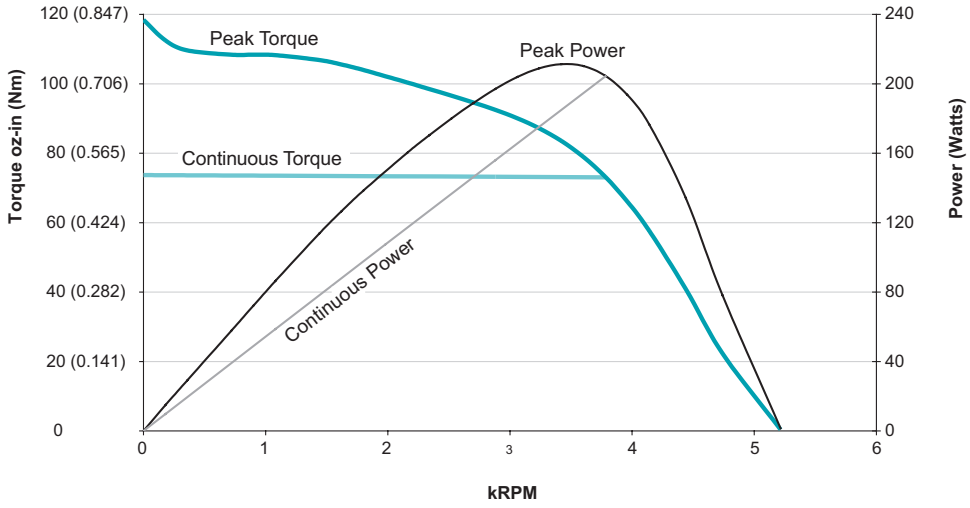
Storage temperature range: -10°C–85°C, noncondensing

NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

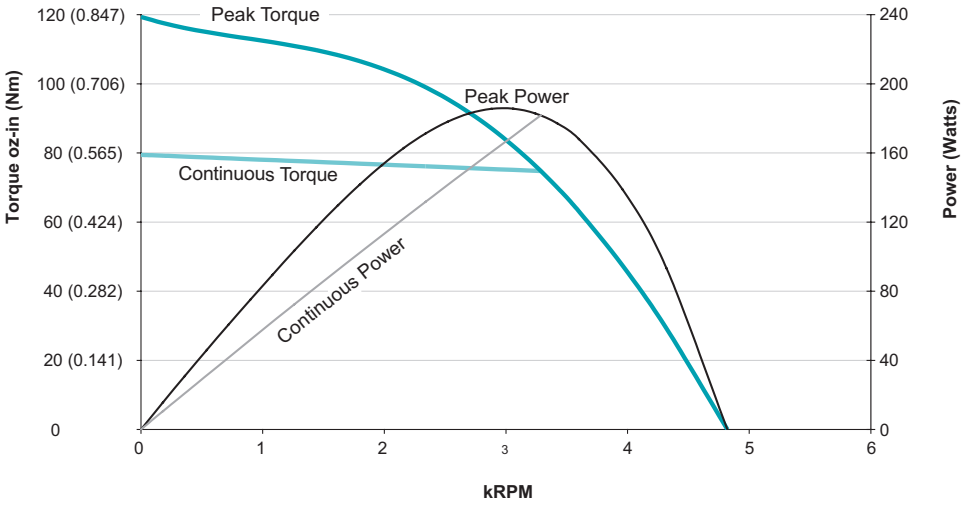
Moog Animatics SmartMotor™ SM23165DT (No Options) CAD Drawing

in [mm]

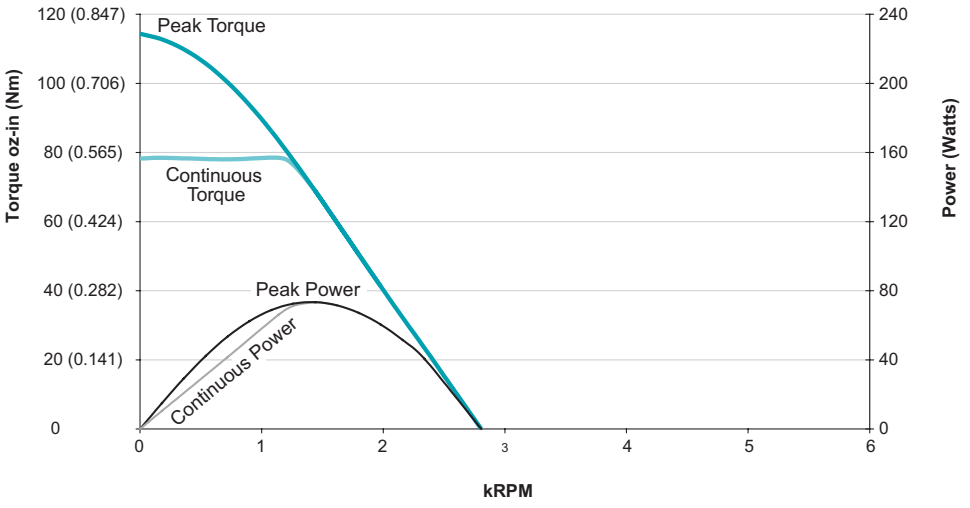




SM23165DT
at 48 VDC
at rise to 85°C



SM23165DT
at 42 VDC
at rise to 85°C



SM23165DT
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM23375D		
Continuous Torque	2.86	in-lb
	46	oz-in
	0.32	N-m
Peak Torque	5.00	in-lb
	80	oz-in
	0.57	N-m
Nominal Continuous Power	191	Watt
No Load Speed	8,000	RPM
Max. Continuous Current* @ 6000 RPM	5.072	Amps
Peak Power @ 4750 RPM	220	Watts
Voltage Constant	5.62	V/kRPM
Inductance	0.770	mH
Encoder Resolution	4,000	Counts/Rev
Rotor Inertia	0.0019	oz-in-sec^2
	1.342	10^{-5} Kg-m^2
Weight	2.1	lb
	0.95	kg
Shaft Diameter	0.250	in
	6.35	mm
Shaft, Radial Load	7	lb
	3.18	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

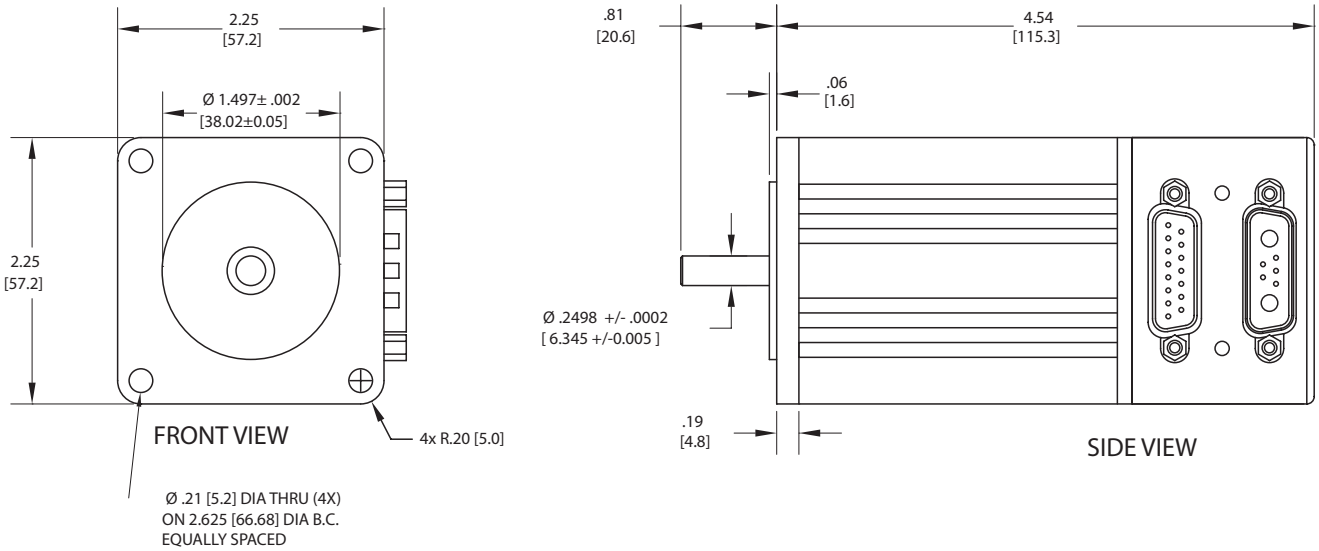
Operating temperature range: 0°C–85°C

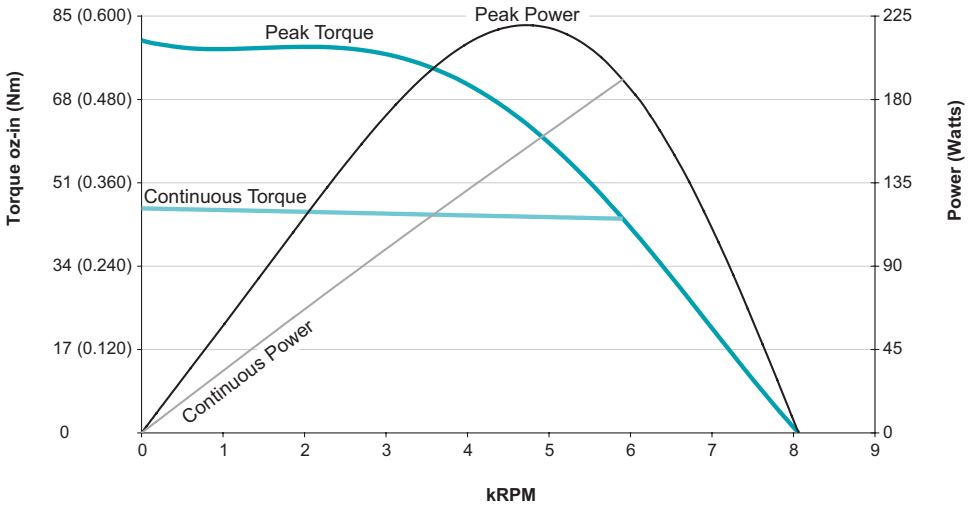
Storage temperature range: -10°C–85°C, noncondensing

NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

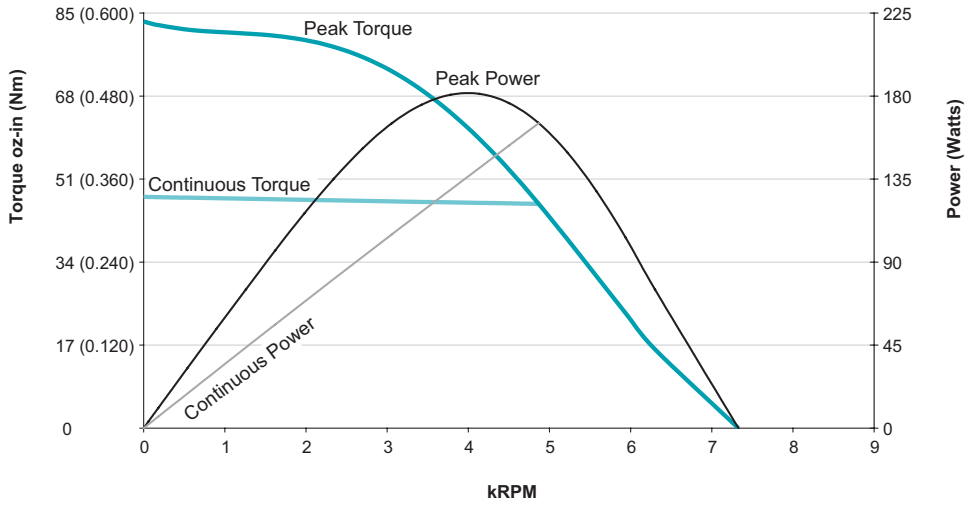
Moog Animatics SmartMotor SM23375D (No Options) CAD Drawing

in [mm]

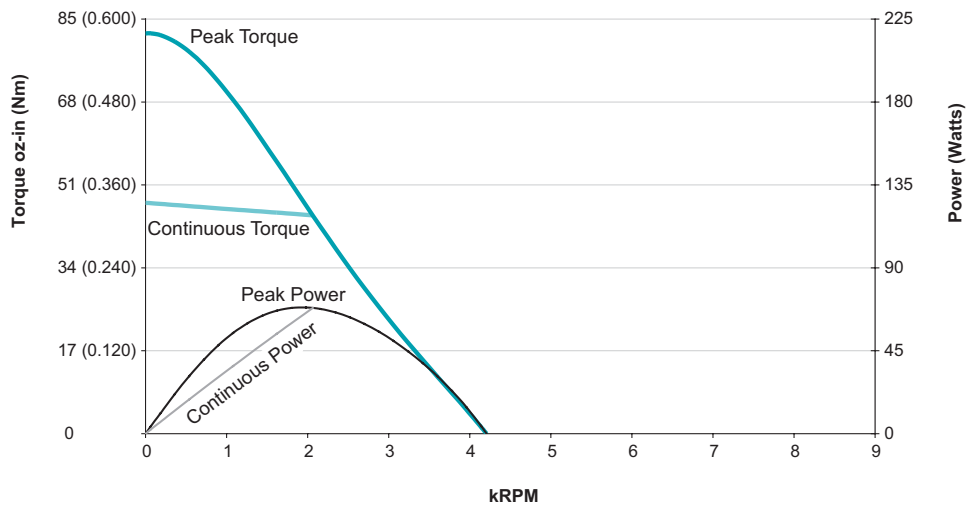




SM23375D
at 48 VDC
at rise to 85°C



SM23375D
at 42 VDC
at rise to 85°C



SM23375D
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM23375DT		
Continuous Torque	5.18	in-lb
	83	oz-in
	0.59	N-m
Peak Torque	9.80	in-lb
	157	oz-in
	1.11	N-m
Nominal Continuous Power	186	Watt
No Load Speed	4,000	RPM
Max. Continuous Current* @ 3250 RPM	4.52	Amps
Peak Power @ 2450 RPM	235	Watts
Voltage Constant	10.95	V/kRPM
Inductance	0.906	mH
Encoder Resolution	4,000	Counts/Rev
Rotor Inertia	0.0019	oz-in-sec^2
	1.342	10^{-5} Kg-m^2
Weight	2.2	lb
	0.98	kg
Shaft Diameter	0.250	in
	6.35	mm
Shaft, Radial Load	7	lb
	3.18	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

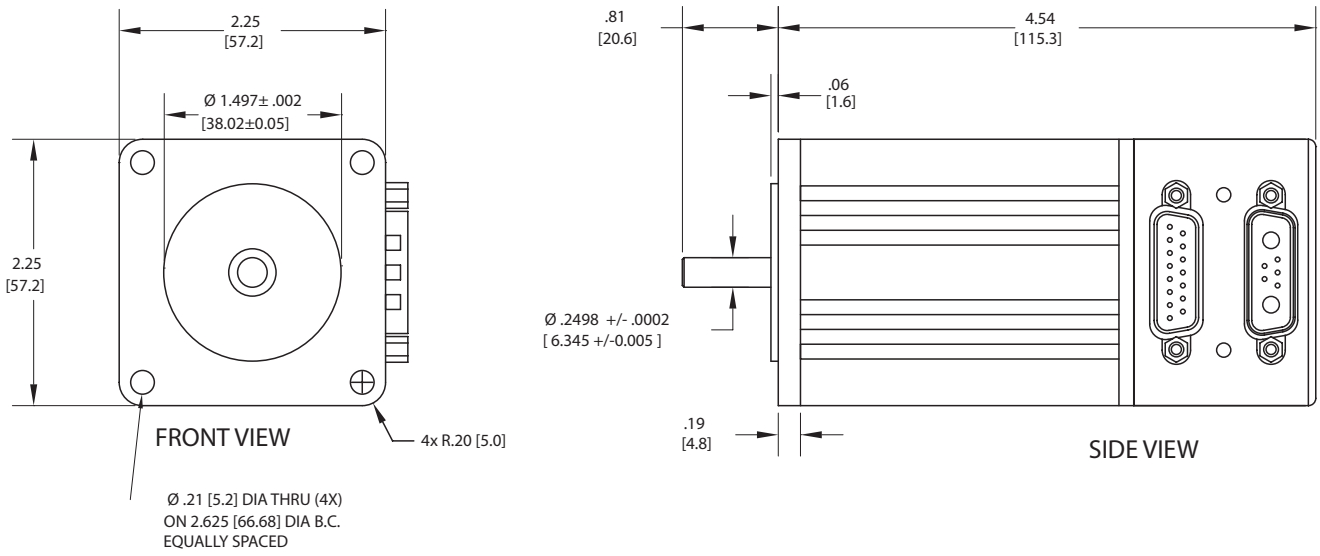
Operating temperature range: 0°C–85°C

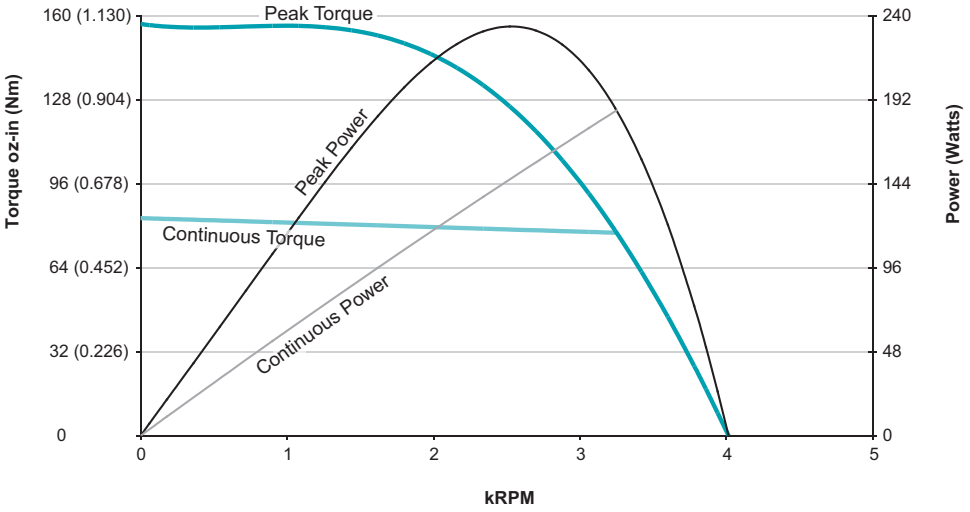
Storage temperature range: -10°C–85°C, noncondensing

NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

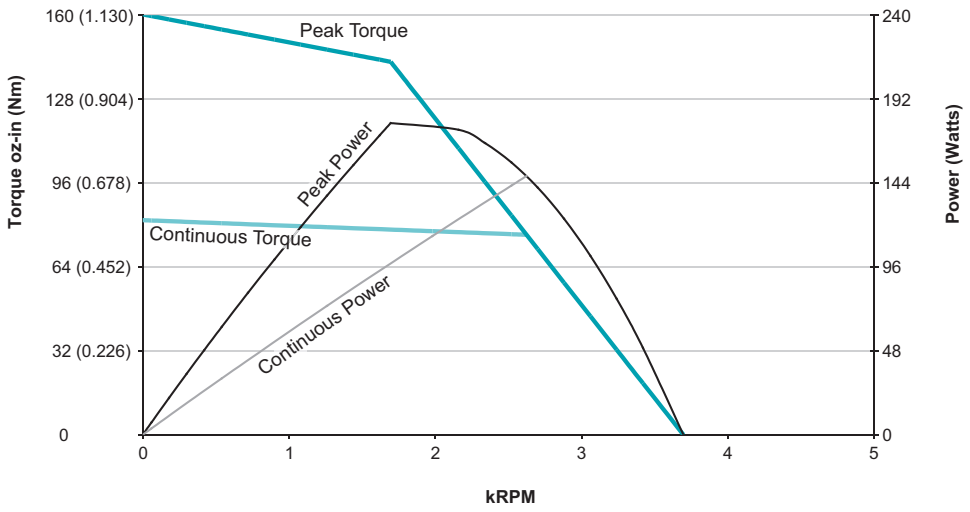
Moog Animatics SmartMotor SM23375DT (No Options) CAD Drawing

in [mm]

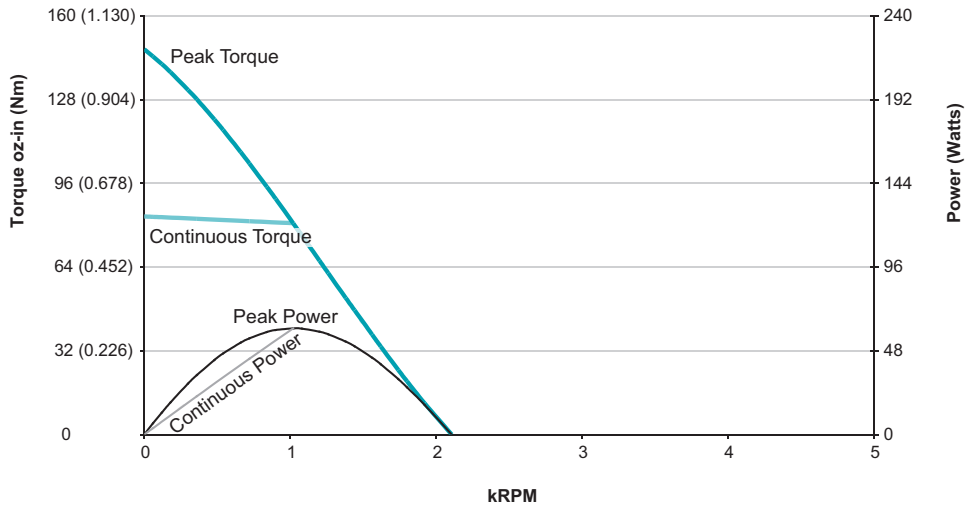




SM23375DT
at 48 VDC
at rise to 85°C



SM23375DT
at 42 VDC
at rise to 85°C



SM23375DT
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM23205D		
Continuous Torque	2.96	in-lb
	47	oz-in
	0.33	N-m
Peak Torque	5.03	in-lb
	80	oz-in
	0.57	N-m
Nominal Continuous Power	226	Watt
No Load Speed	8,100	RPM
Max. Continuous Current* @ 6900 RPM	6.02	Amps
Peak Power @ 5995 RPM	335	Watts
Voltage Constant	6.137	V/kRPM
Inductance	0.40	mH
Encoder Resolution	4,000	Counts/Rev
Rotor Inertia	0.00224	oz-in-sec^2
	1.582	10^{-5} Kg-m^2
Weight	1.7	lb
	0.79	kg
Shaft Diameter	0.250	in
	6.35	mm
Shaft, Radial Load	7	lb
	3.18	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

Operating temperature range: 0°C–85°C

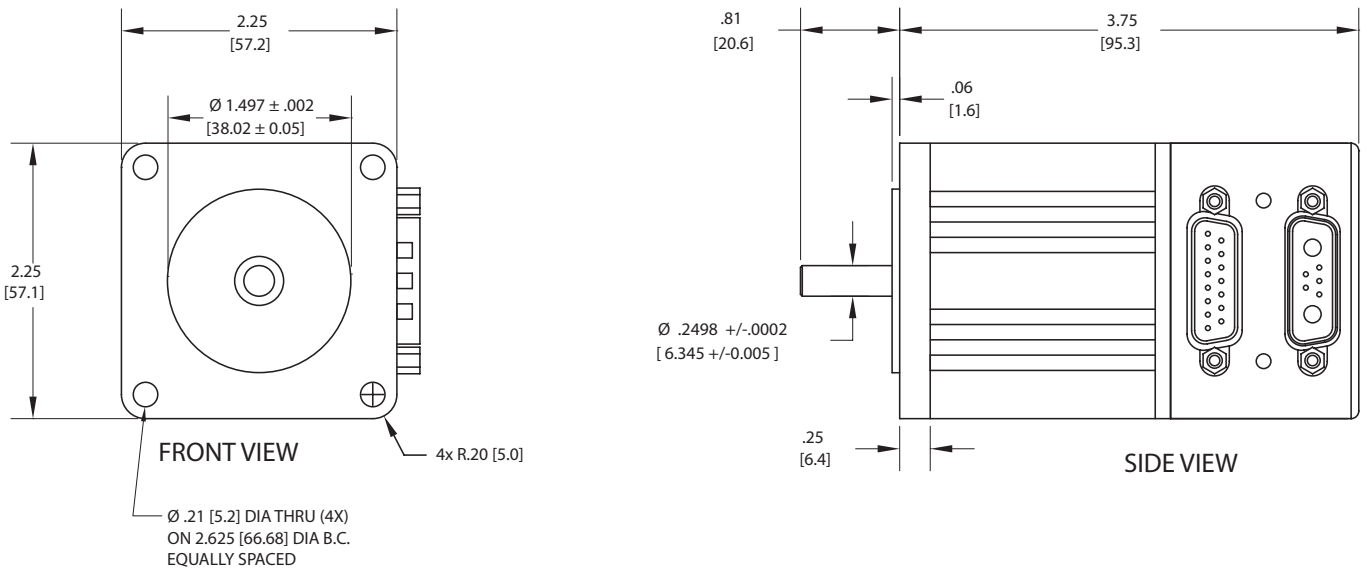
Storage temperature range: -10°C–85°C, noncondensing

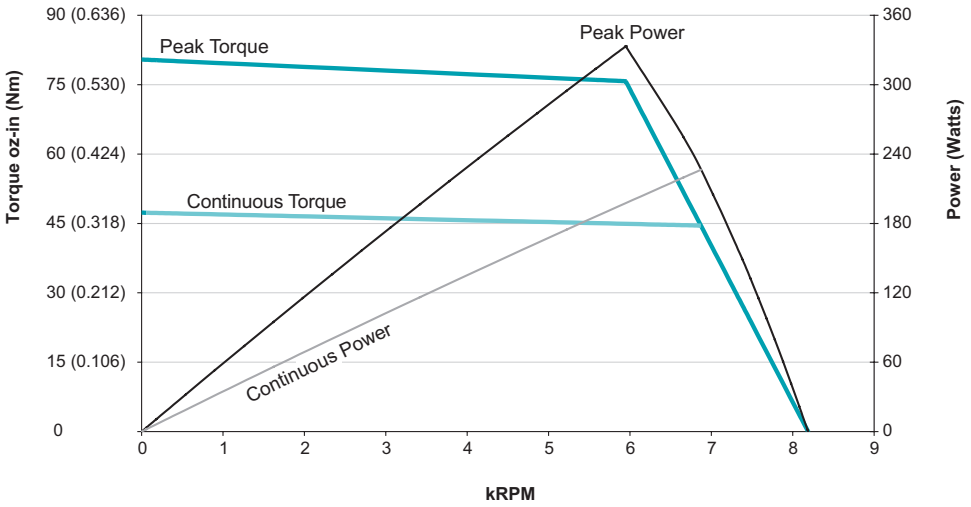
NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

CE RoHS COMPLIANT

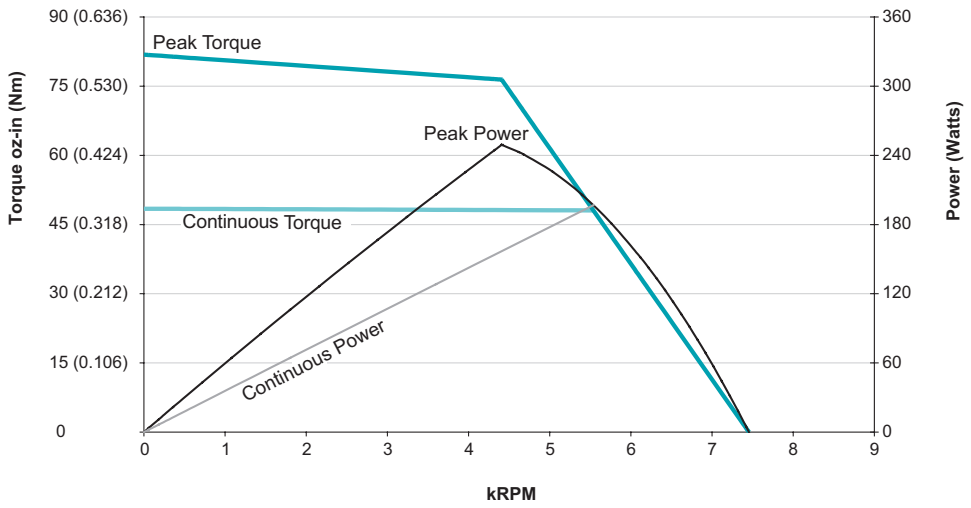
Moog Animatics SmartMotor SM23205D (No Options) CAD Drawing

in [mm]

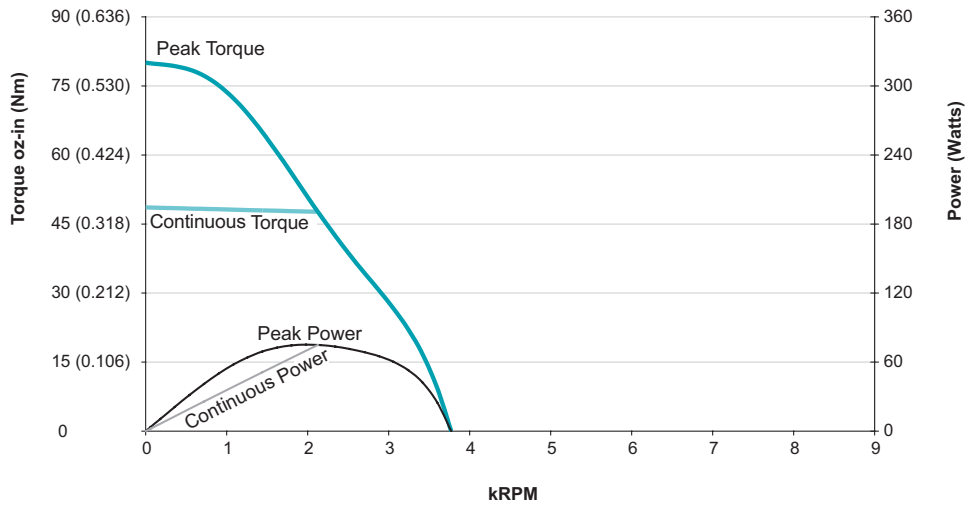




SM23205D
at 48 VDC
at rise to 85°C



SM23205D
at 42 VDC
at rise to 85°C



SM23205D
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM23305D		
Continuous Torque	3.98	in-lb
	64	oz-in
	0.45	N-m
Peak Torque	6.86	in-lb
	110	oz-in
	0.77	N-m
Nominal Continuous Power	220	Watt
No Load Speed	5,600	RPM
Max. Continuous Current* @ 4750 RPM	5.57	Amps
Peak Power @ 4100 RPM	325	Watts
Voltage Constant	8.873	V/kRPM
Inductance	0.61	mH
Encoder Resolution	4,000	Counts/Rev
Rotor Inertia	0.00332	oz-in-sec^2
	2.344	10^{-5} Kg-m^2
Weight	2.3	lb
	1.03	kg
Shaft Diameter	0.250	in
	6.35	mm
Shaft, Radial Load	7	lb
	3.18	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

Operating temperature range: 0°C–85°C

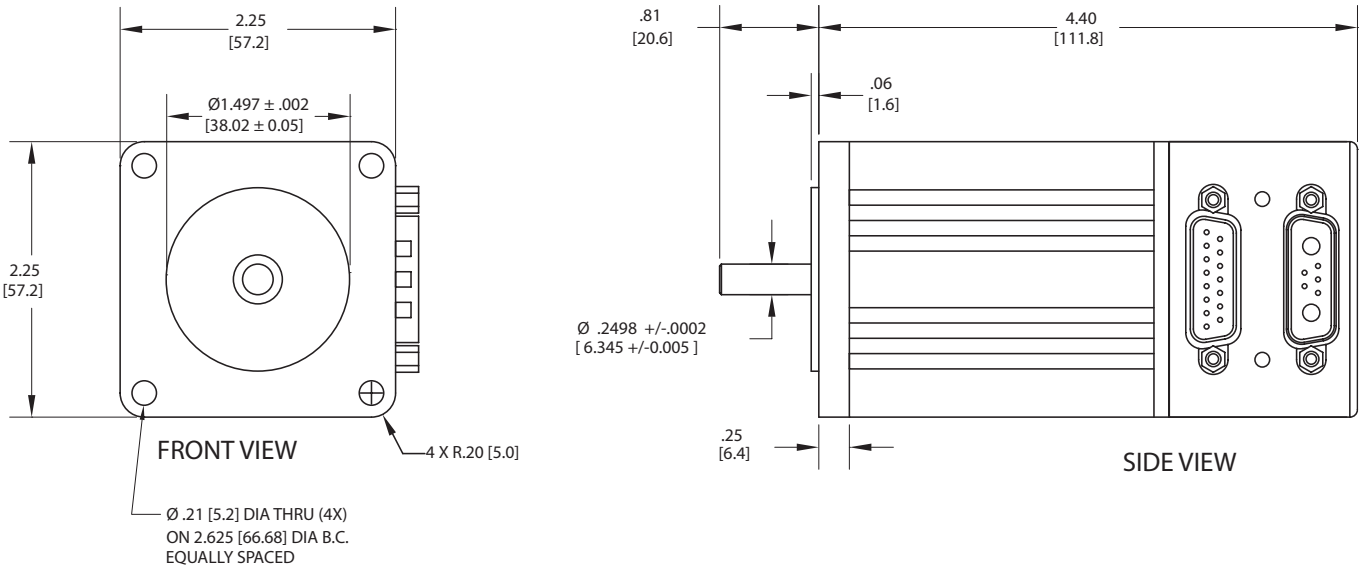
Storage temperature range: -10°C–85°C, noncondensing

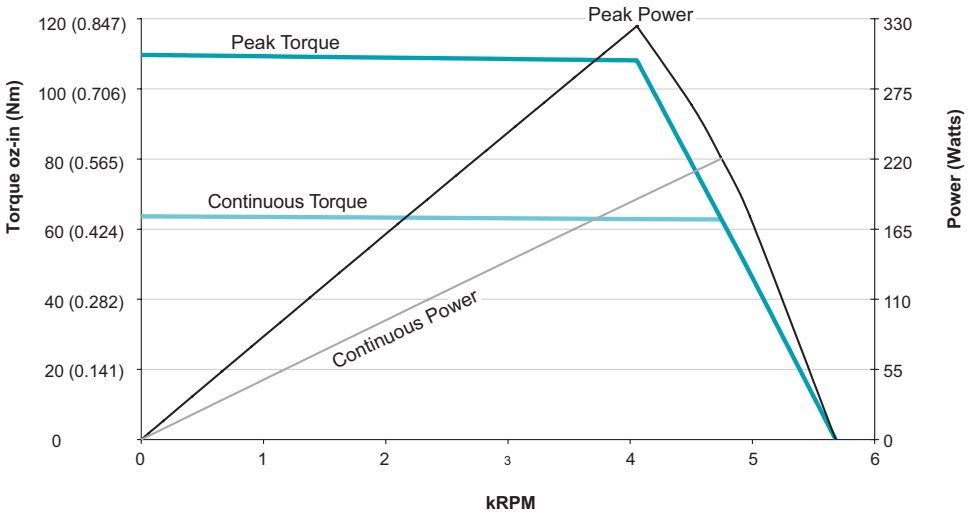
NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

CE RoHS COMPLIANT

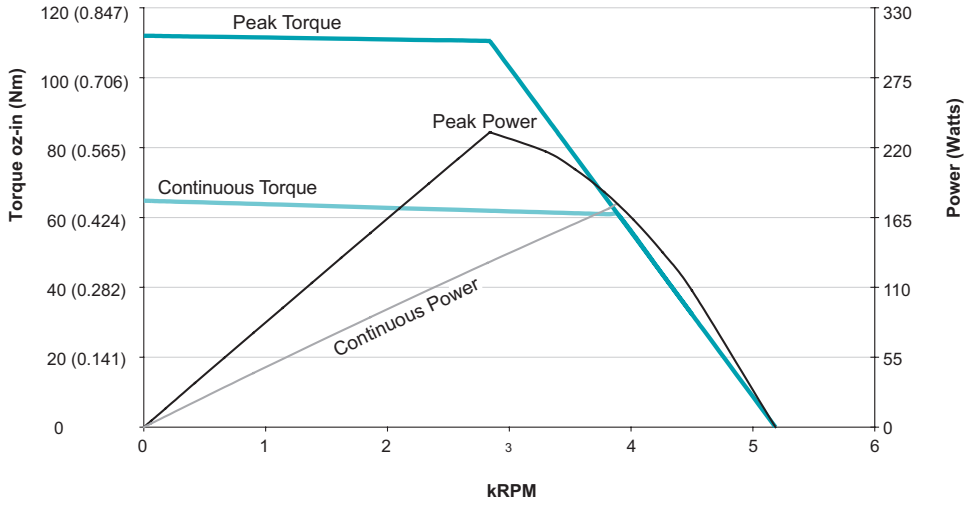
Moog Animatics SmartMotor SM23305D (No Options) CAD Drawing

in [mm]

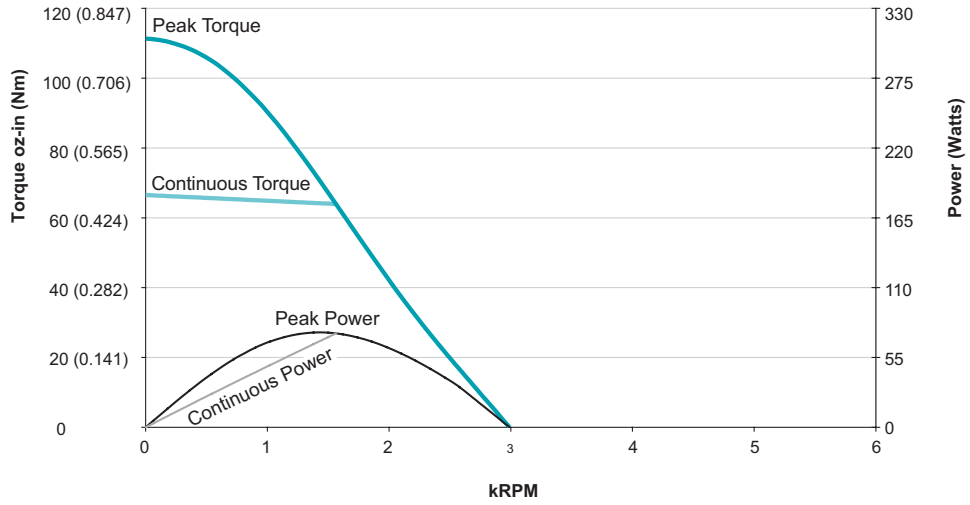




SM23305D
at 48 VDC
at rise to 85°C



SM23305D
at 42 VDC
at rise to 85°C



SM23305D
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM23405D		
Continuous Torque	4.88	in-lb
	78	oz-in
	0.55	N-m
Peak Torque	8.04	in-lb
	129	oz-in
	0.91	N-m
Nominal Continuous Power	253	Watt
No Load Speed	5,300	RPM
Max. Continuous Current* @ 4500 RPM	6.76	Amps
Peak Power @ 4000 RPM	345	Watts
Voltage Constant	9.612	V/kRPM
Inductance	0.49	mH
Encoder Resolution	4,000	Counts/Rev
Rotor Inertia	0.00439	oz-in-sec^2
	3.100	10^{-5} Kg-m^2
Weight	2.8	lb
	1.27	kg
Shaft Diameter	0.250	in
	6.35	mm
Shaft, Radial Load	7	lb
	3.18	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

Operating temperature range: 0°C–85°C

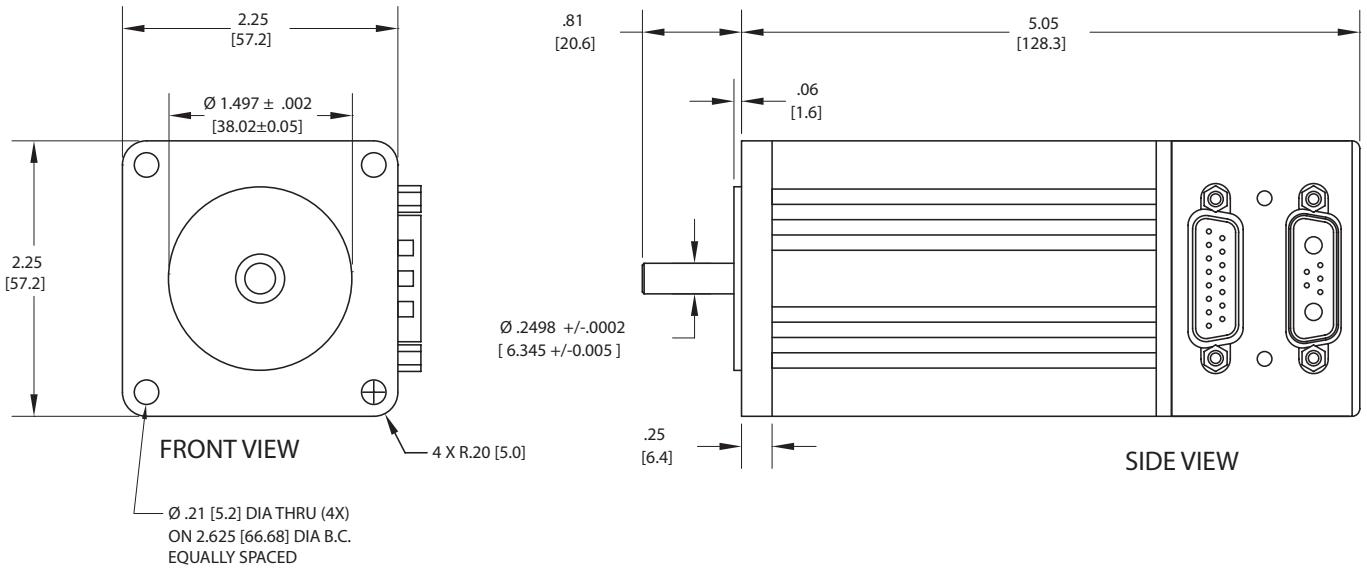
Storage temperature range: -10°C–85°C, noncondensing

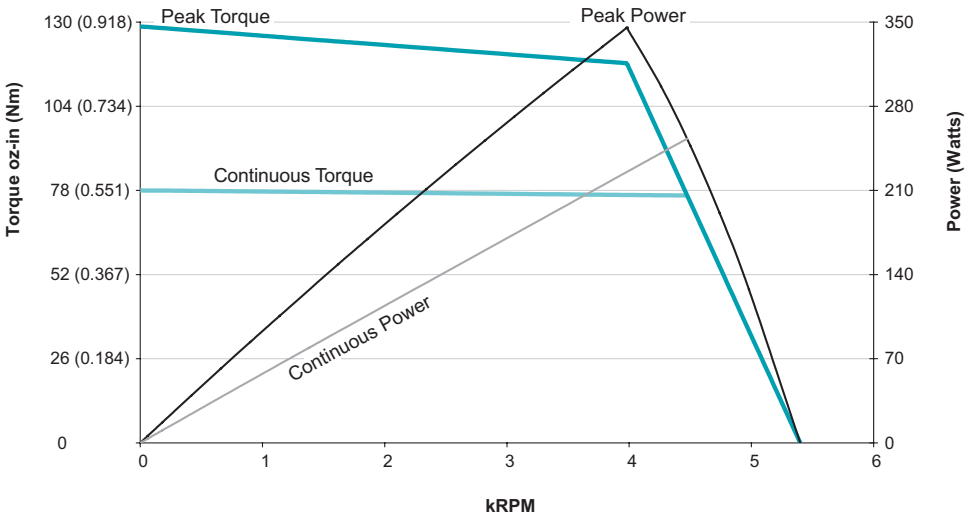
NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

CE RoHS COMPLIANT

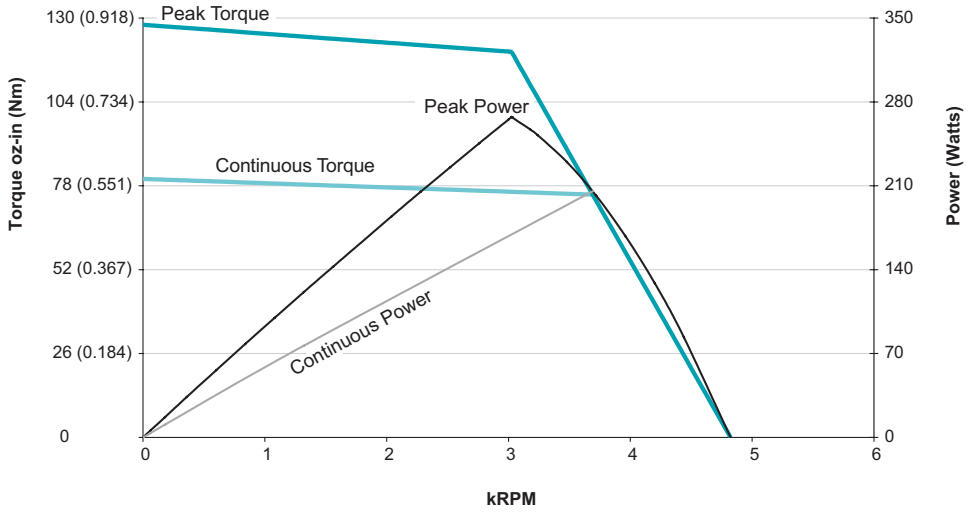
Moog Animatics SmartMotor SM23405D (No Options) CAD Drawing

in [mm]

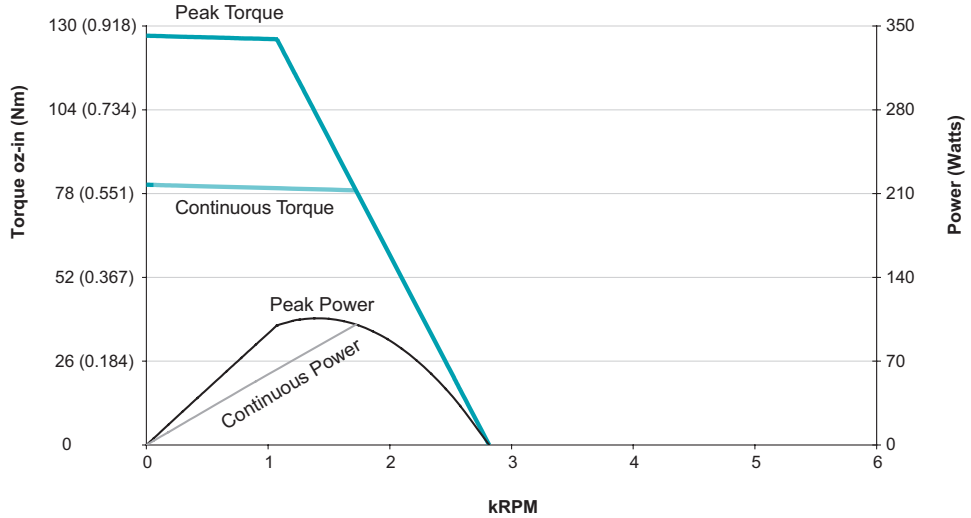




SM23405D
at 48 VDC
at rise to 85°C



SM23405D
at 42 VDC
at rise to 85°C



SM23405D
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM34165D		
Continuous Torque	9.67	in-lb
	155	oz-in
	1.09	N-m
Peak Torque	14.12	in-lb
	226	oz-in
	1.60	N-m
Nominal Continuous Power	235	Watt
No Load Speed	3,100	RPM
Max. Continuous Current* @ 2400 RPM	6.02	Amps
Peak Power @ 1900 RPM	265	Watts
Voltage Constant	14.98	V/kRPM
Inductance	1.72	mH
Encoder Resolution	8,000	Counts/Rev
Rotor Inertia	0.014	oz-in-sec^2
	9.890	10^{-5} Kg-m^2
Weight	5.0	lb
	2.27	kg
Shaft Diameter	0.375	in
	9.53	mm
Shaft, Radial Load	15	lb
	6.80	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available	Yes	
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

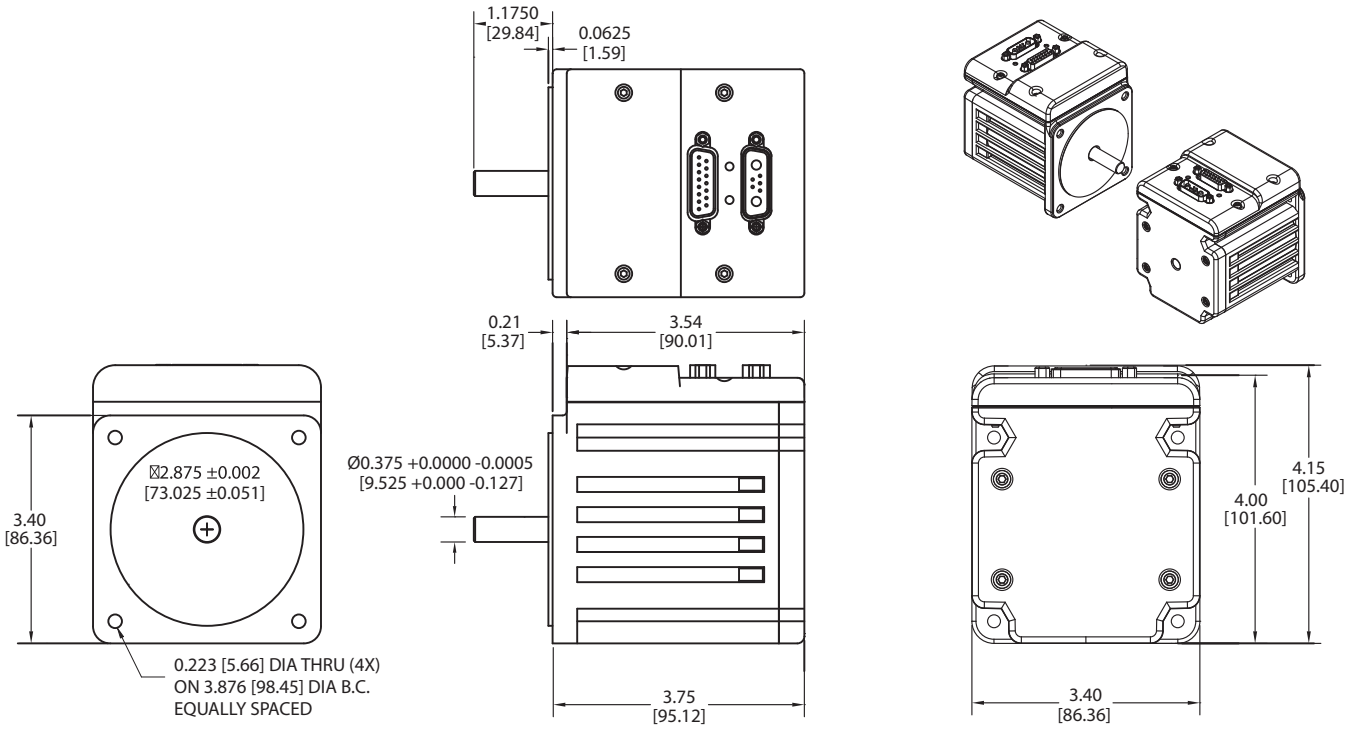
Operating temperature range: 0°C–85°C

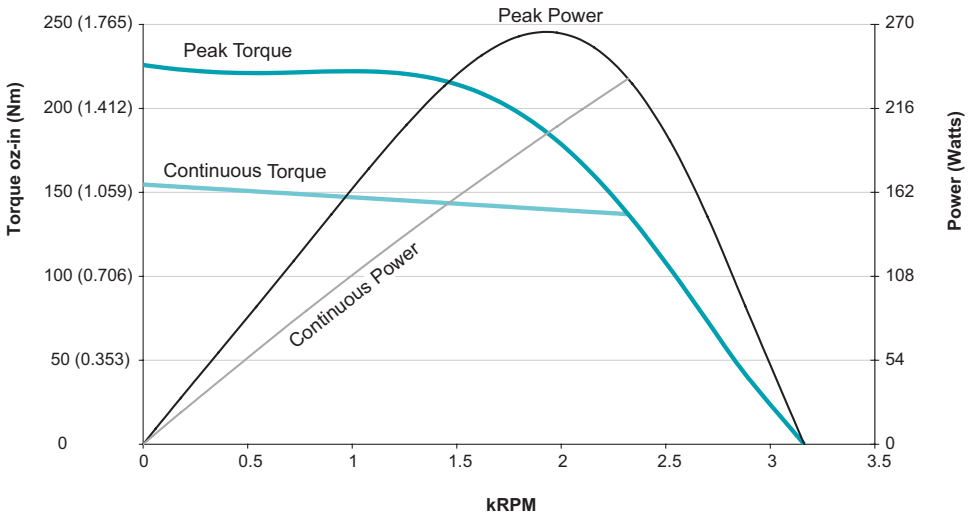
Storage temperature range: -10°C–85°C, noncondensing

NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

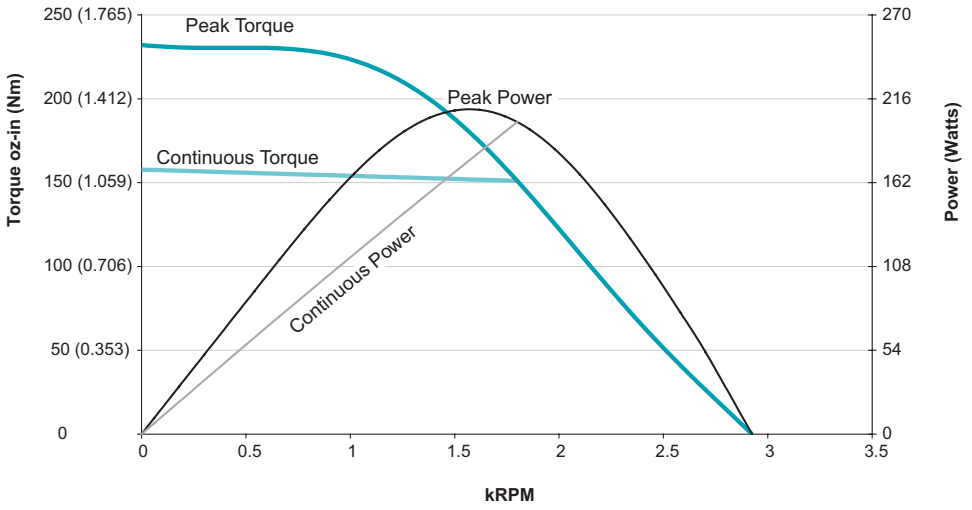
Moog Animatics SmartMotor™ SM34165D (No Options) CAD Drawing

in [mm]

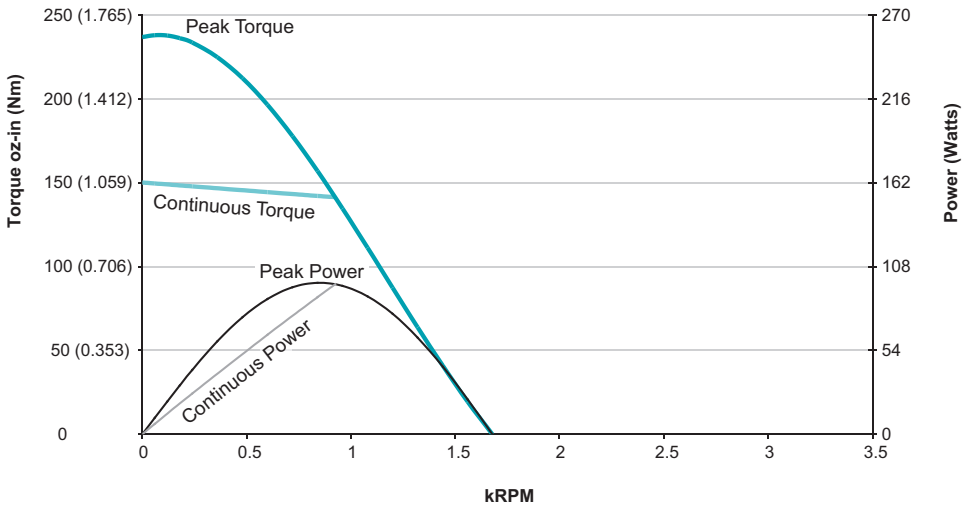




SM34165D
at 48 VDC
at rise to 85°C



SM34165D
at 42 VDC
at rise to 85°C



SM34165D
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM34165DT		
Continuous Torque	12.83	in-lb
	205	oz-in
	1.45	N-m
Peak Torque	30.00	in-lb
	480	oz-in
	3.39	N-m
Nominal Continuous Power	615	Watt
No Load Speed	5,100	RPM
Max. Continuous Current* @ 4500 RPM	16.93	Amps
Peak Power @ 3400 RPM	930	Watts
Voltage Constant	8.9	V/kRPM
Inductance	0.32	mH
Encoder Resolution	8,000	Counts/Rev
Rotor Inertia	0.0142	oz-in-sec^2
	10.031	10^{-5} Kg-m^2
Weight	5.5	lb
	2.49	kg
Shaft Diameter	0.500	in
	12.70	mm
Shaft, Radial Load	30	lb
	13.61	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available	Yes	
CANopen Available	Yes	

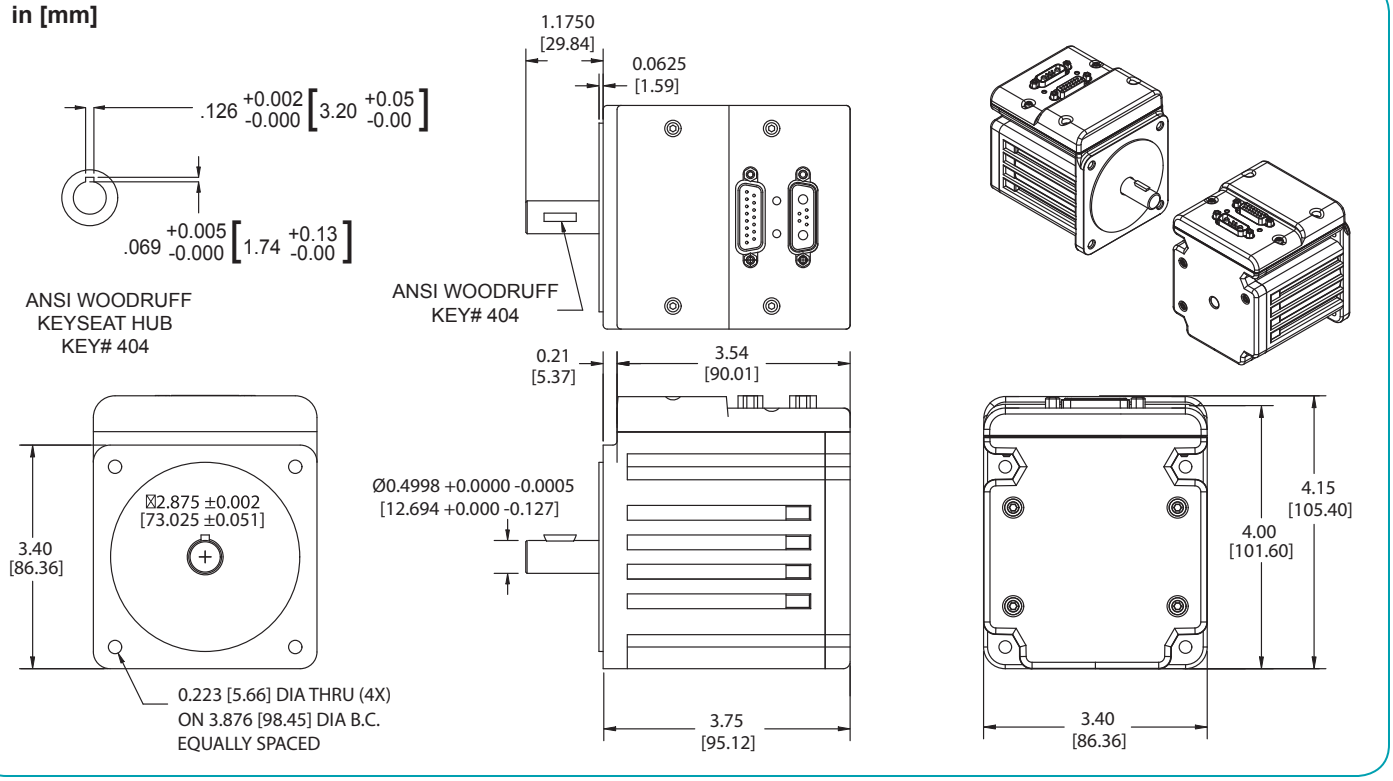
*Default voltage is 48V. See graphs for additional voltages.

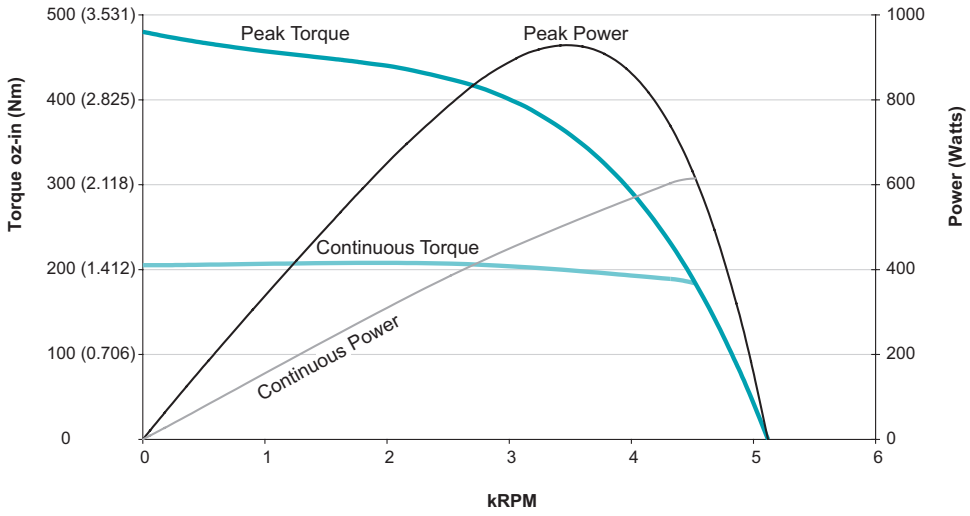
Operating temperature range: 0°C–85°C

Storage temperature range: -10°C–85°C, noncondensing

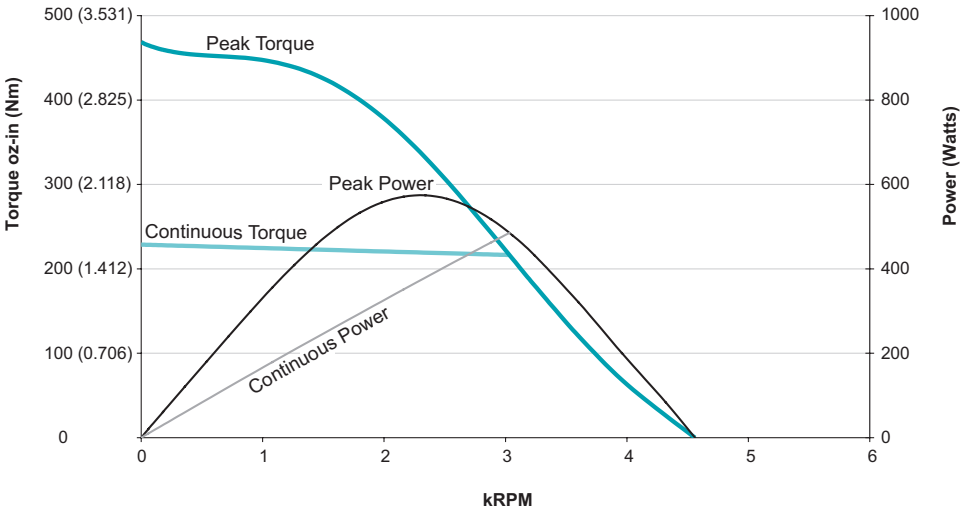
NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

Moog Animatics SmartMotor™ SM34165DT (No Options) CAD Drawing

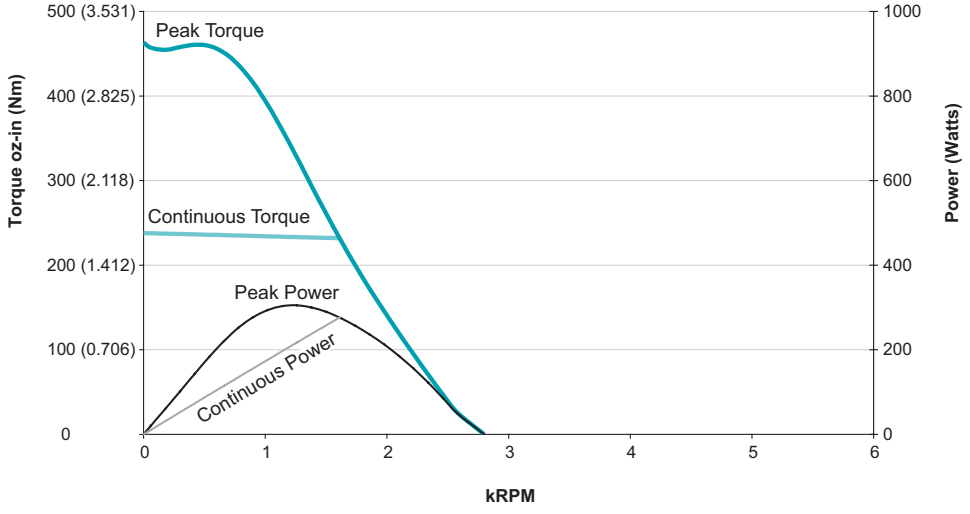




SM34165DT
at 48 VDC
at rise to 85°C



SM34165DT
at 42 VDC
at rise to 85°C



SM34165DT
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM34205D		
Continuous Torque	7.91	in-lb
	126	oz-in
	0.89	N-m
Peak Torque	24.91	in-lb
	399	oz-in
	2.81	N-m
Nominal Continuous Power	324	Watt
No Load Speed	4,500	RPM
Max. Continuous Current* @ 3750 RPM	8.28	Amps
Peak Power @ 2250 RPM	455	Watts
Voltage Constant	10.8	V/kRPM
Inductance	0.596	mH
Encoder Resolution	8,000	Counts/Rev
Rotor Inertia	0.012	oz-in-sec^2
	8.448	10^{-5} Kg-m^2
Weight	3.5	lb
	1.59	kg
Shaft Diameter	0.375	in
	9.53	mm
Shaft, Radial Load	15	lb
	6.80	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

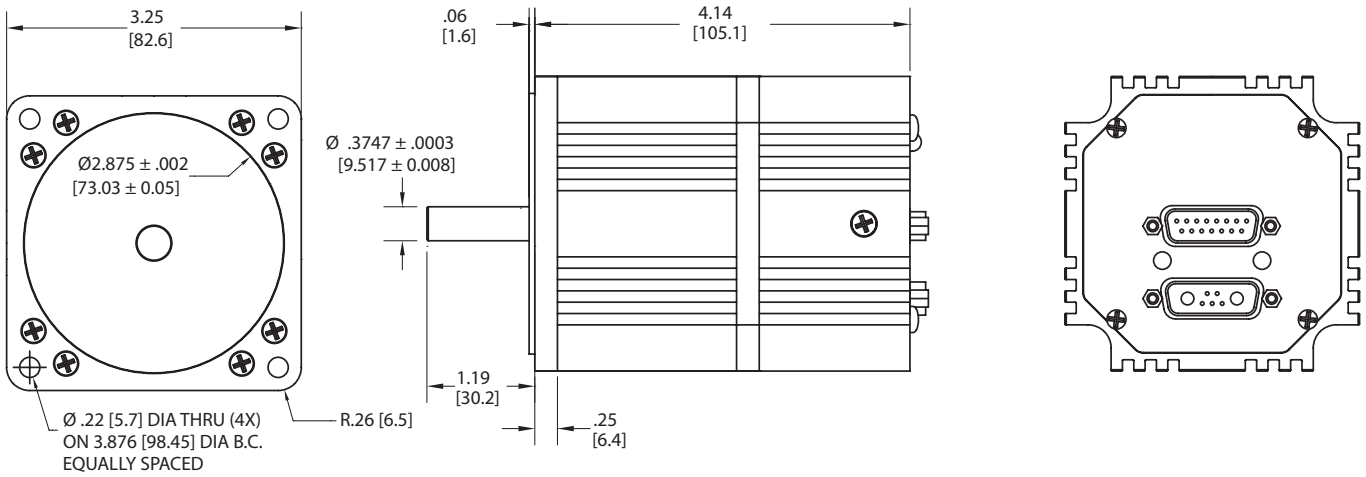
Operating temperature range: 0°C–85°C

Storage temperature range: -10°C–85°C, noncondensing

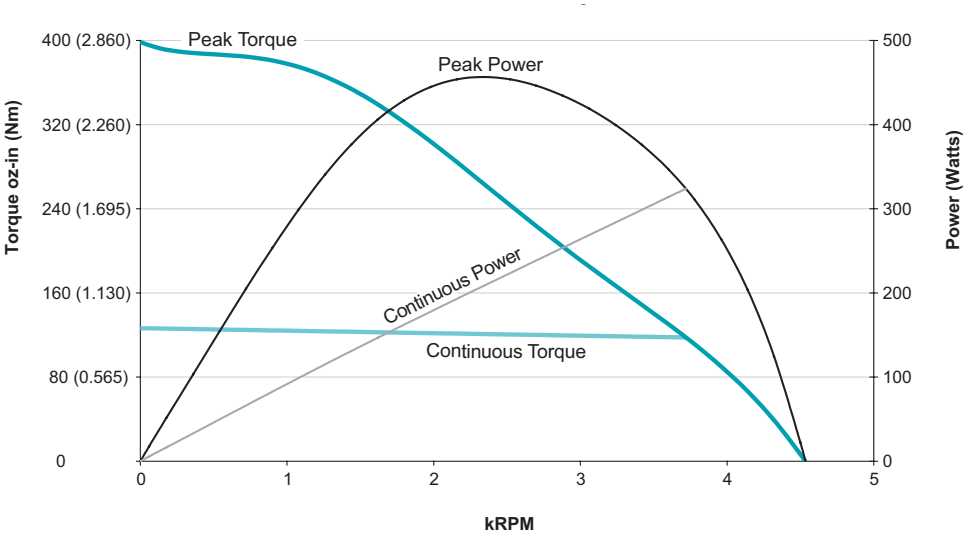
NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

Moog Animatics SmartMotor SM34205D (No Options) CAD Drawing

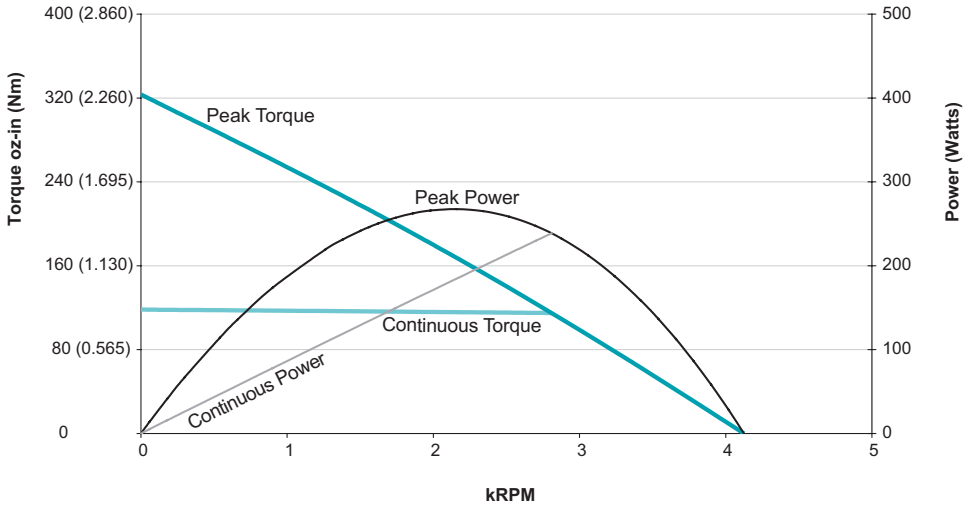
in [mm]



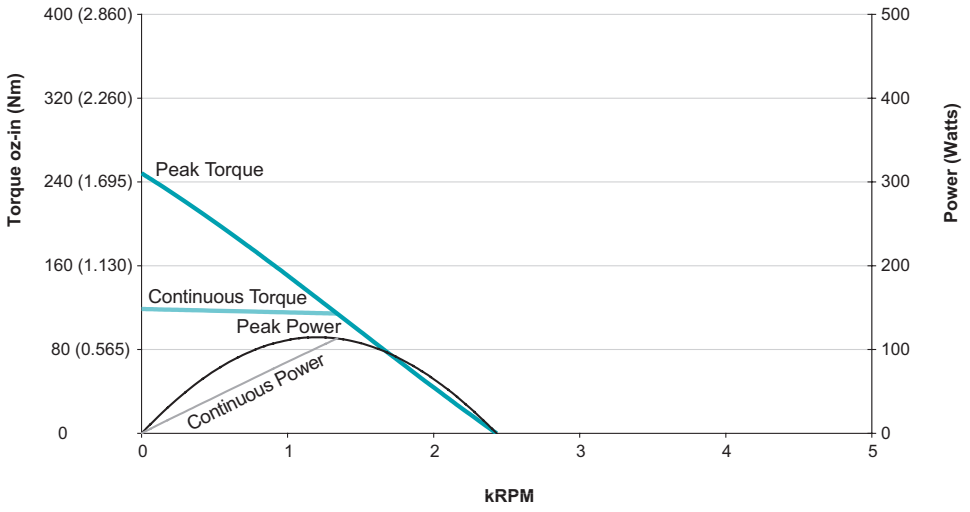
FRONT VIEW SIDE VIEW REAR VIEW



SM34205D
at 48 VDC
at rise to 85°C



SM34205D
at 42 VDC
at rise to 85°C



SM34205D
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM34305D		
Continuous Torque	10.87	in-lb
	174	oz-in
	1.23	N-m
Peak Torque	34.75	in-lb
	556	oz-in
	3.93	N-m
Nominal Continuous Power	400	Watt
No Load Speed	4,100	RPM
Max. Continuous Current* @ 3600 RPM	10.31	Amps
Peak Power @ 2500 RPM	725	Watts
Voltage Constant	12.1	V/kRPM
Inductance	0.490	mH
Encoder Resolution	8,000	Counts/Rev
Rotor Inertia	0.018	oz-in-sec^2
	12.56	10^{-5} Kg-m^2
Weight	4.5	lb
	2.04	kg
Shaft Diameter	0.375	in
	9.53	mm
Shaft, Radial Load	15	lb
	6.80	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

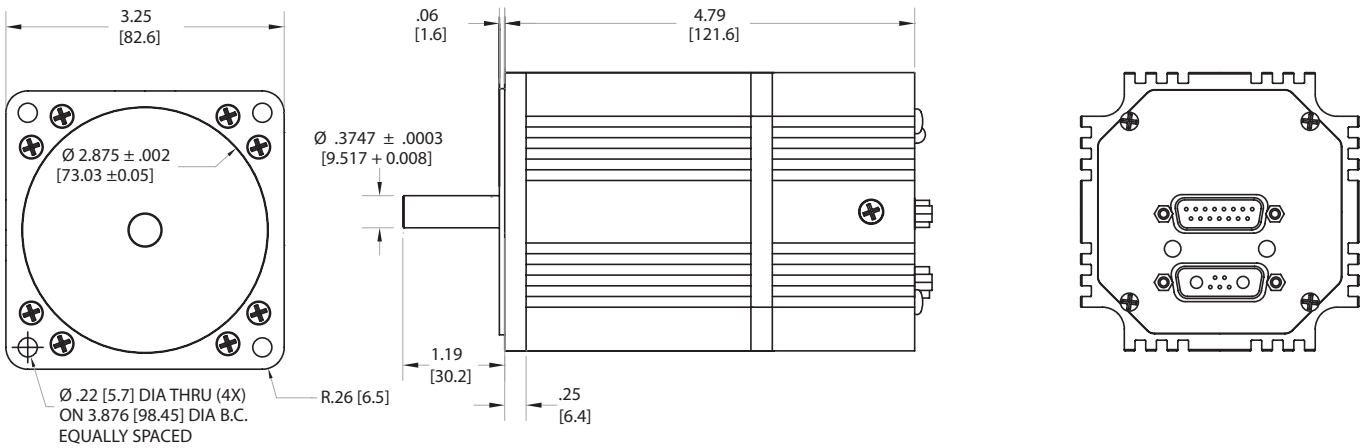
Operating temperature range: 0°C–85°C

Storage temperature range: -10°C–85°C, noncondensing

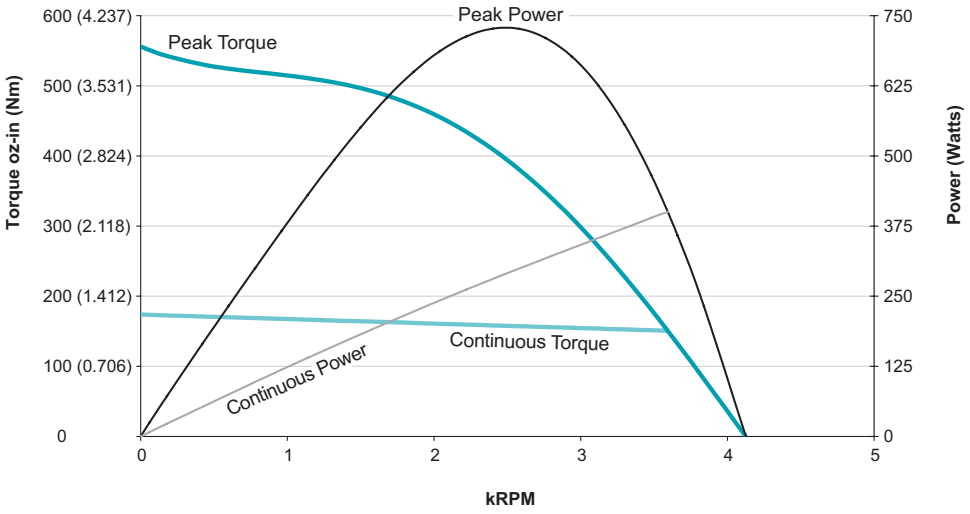
NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

Moog Animatics SmartMotor SM34305D (No Options) CAD Drawing

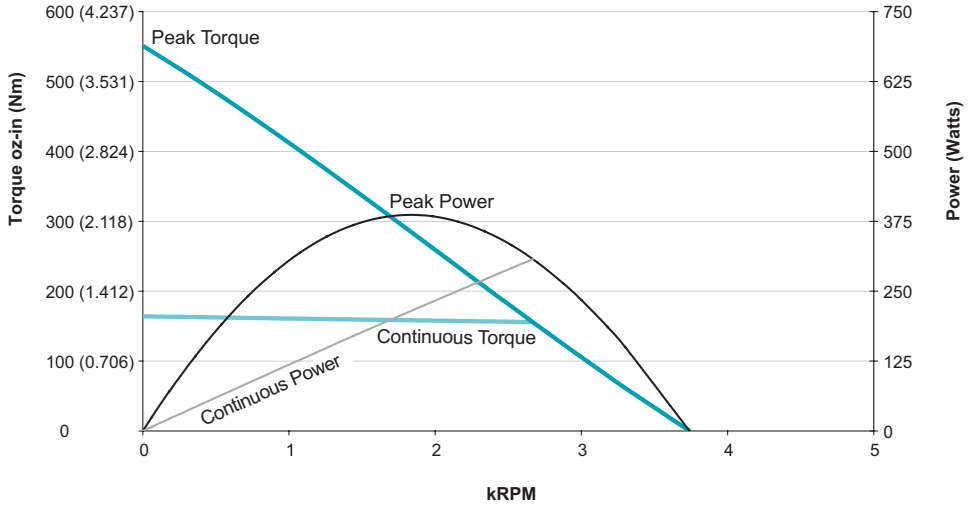
in [mm]



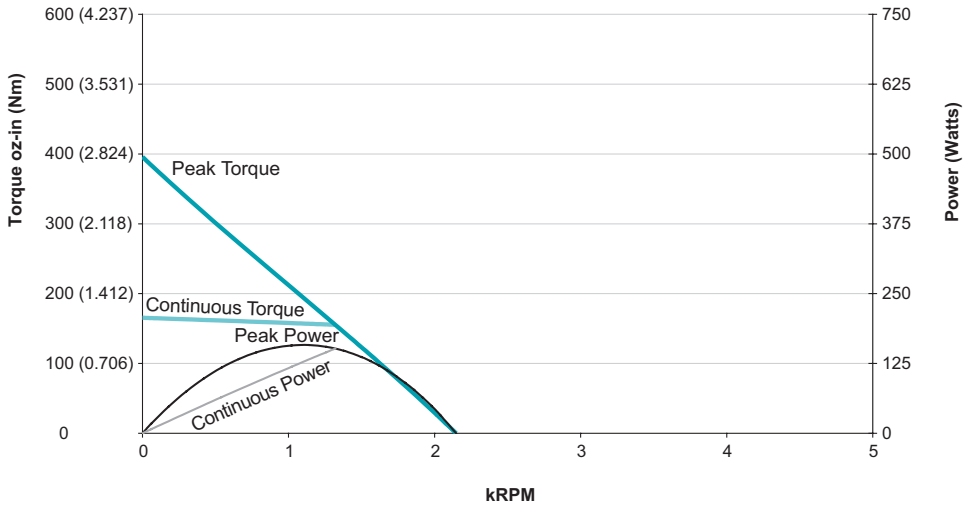
FRONT VIEW SIDE VIEW REAR VIEW



SM34305D
at 48 VDC
at rise to 85°C



SM34305D
at 42 VDC
at rise to 85°C



SM34305D
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM34405D		
Continuous Torque	12.94	in-lb
	207	oz-in
	1.46	N-m
Peak Torque	40.38	in-lb
	646	oz-in
	4.56	N-m
Nominal Continuous Power	438	Watt
No Load Speed	3,800	RPM
Max. Continuous Current* @ 3300 RPM	11.69	Amps
Peak Power @ 2350 RPM	820	Watts
Voltage Constant	12.9	V/kRPM
Inductance	0.913	mH
Encoder Resolution	8,000	Counts/Rev
Rotor Inertia	0.024	oz-in-sec^2
	17.020	10^{-5} Kg-m^2
Weight	5.5	lb
	2.49	kg
Shaft Diameter	0.375	in
	9.53	mm
Shaft, Radial Load	15	lb
	6.80	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

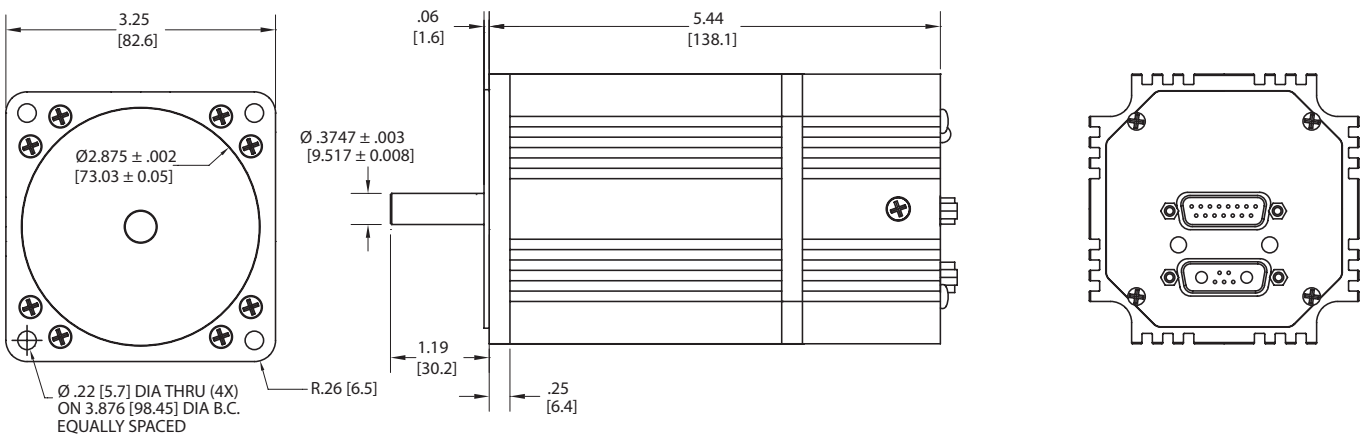
Operating temperature range: 0°C–85°C

Storage temperature range: -10°C–85°C, noncondensing

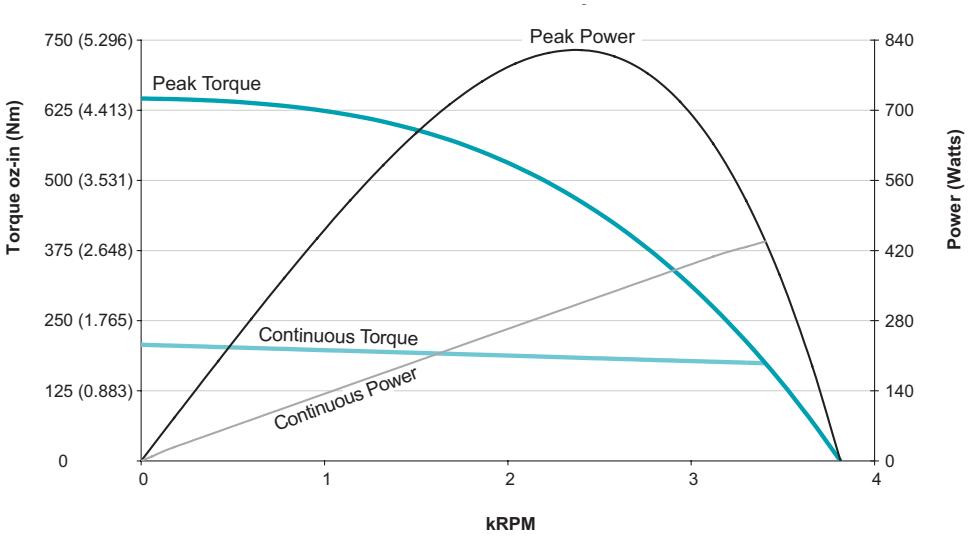
NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

Moog Animatics SmartMotor SM34405D (No Options) CAD Drawing

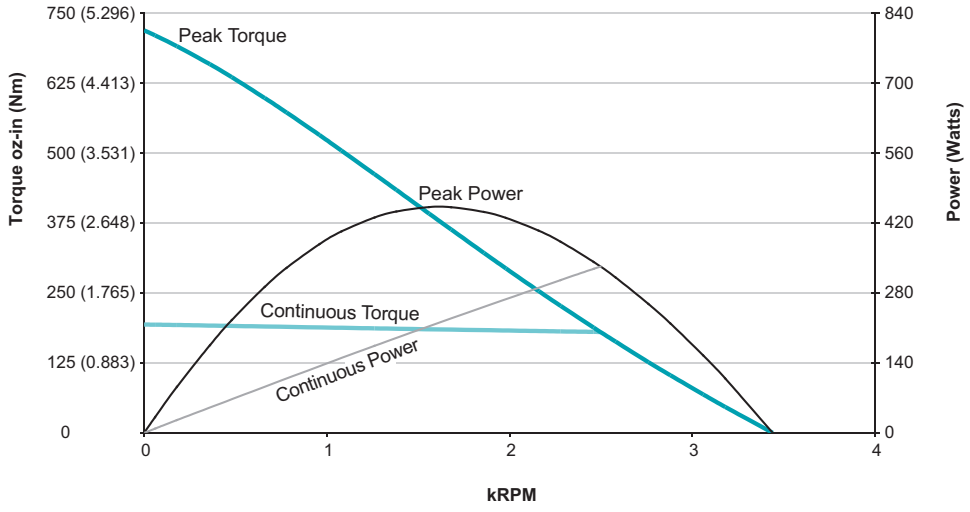
in [mm]



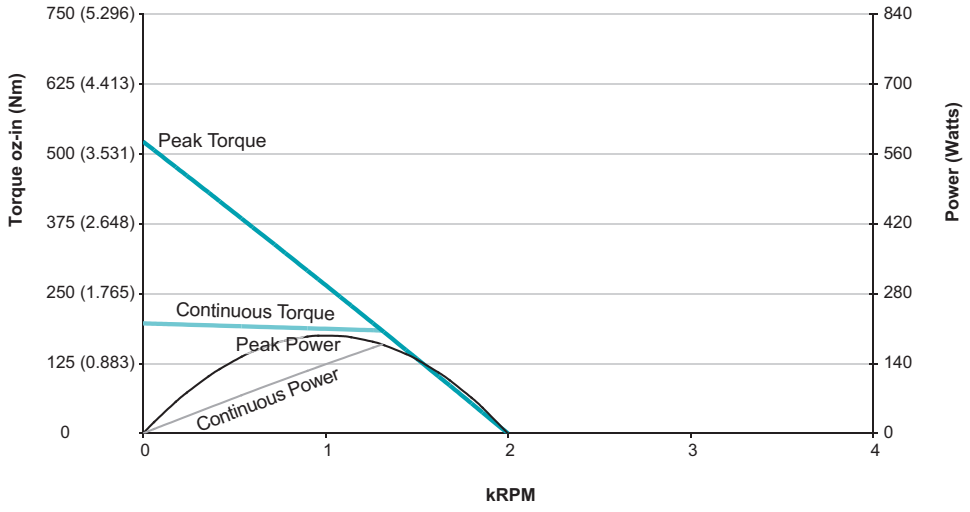
FRONT VIEW SIDE VIEW REAR VIEW



SM34405D
at 48 VDC
at rise to 85°C



SM34405D
at 42 VDC
at rise to 85°C



SM34405D
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SM34505D		
Continuous Torque	16.34	in-lb
	261	oz-in
	1.85	N-m
Peak Torque	48.19	in-lb
	771	oz-in
	5.44	N-m
Nominal Continuous Power	527	Watt
No Load Speed	3,300	RPM
Max. Continuous Current* @ 3100 RPM	14.37	Amps
Peak Power @ 2250 RPM	925	Watts
Voltage Constant	14.049	V/kRPM
Inductance	0.871	mH
Encoder Resolution	8,000	Counts/Rev
Rotor Inertia	0.03	oz-in-sec^2
	20.92	10^{-5} Kg-m^2
Weight	6.5	lb
	2.95	kg
Shaft Diameter	0.375	in
	9.53	mm
Shaft, Radial Load	15	lb
	6.80	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Yes	
PROFIBUS Available		
CANopen Available	Yes	

*Default voltage is 48V. See graphs for additional voltages.

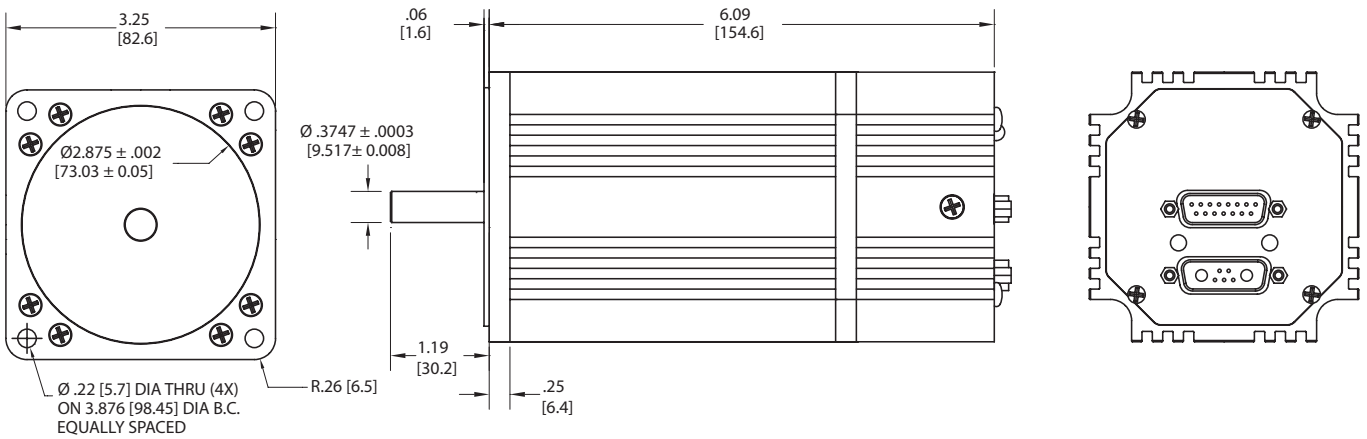
Operating temperature range: 0°C–85°C

Storage temperature range: -10°C–85°C, noncondensing

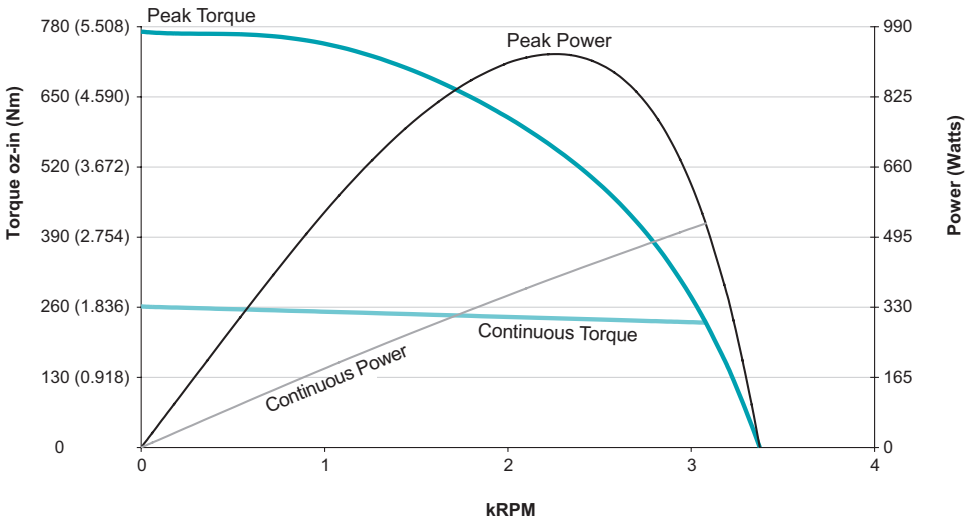
NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

Moog Animatics SmartMotor SM34505D (No Options) CAD Drawing

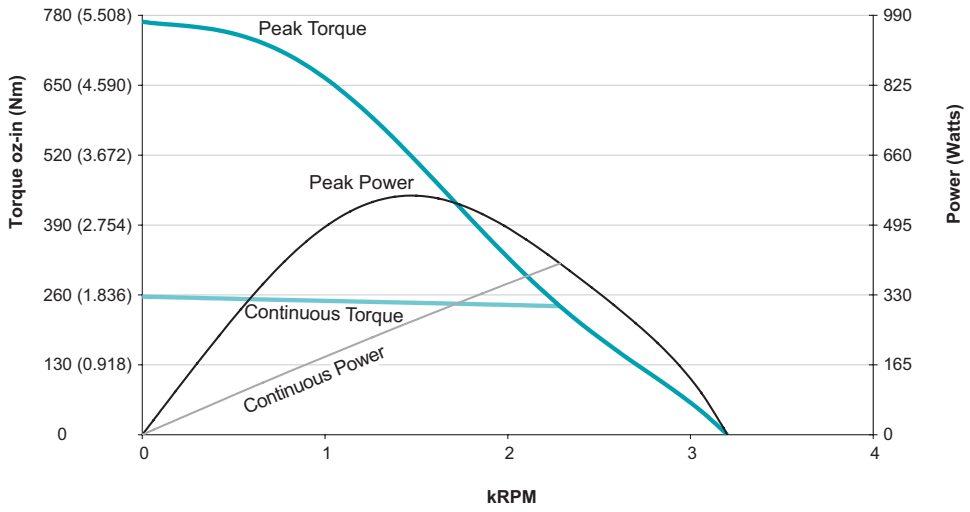
in [mm]



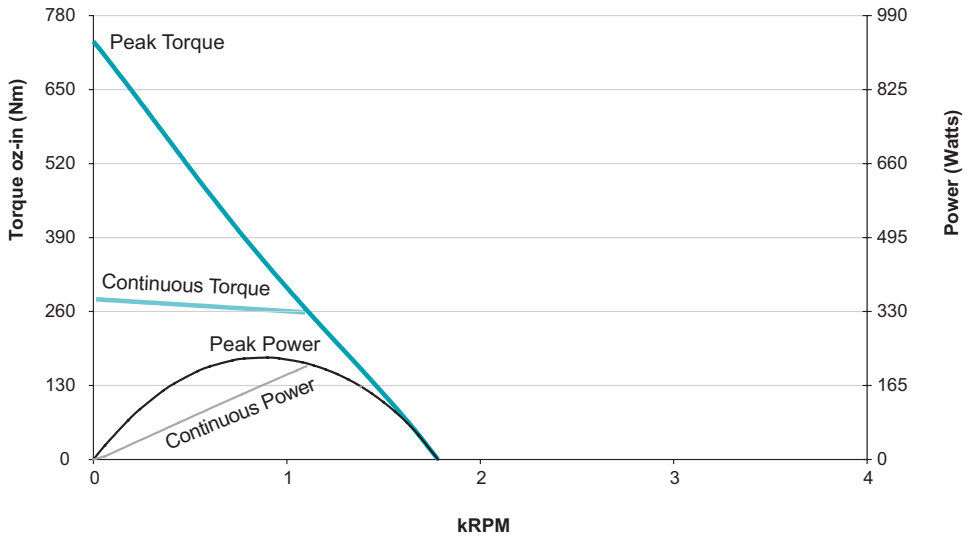
FRONT VIEW SIDE VIEW REAR VIEW



SM34505D
at 48 VDC
at rise to 85°C



SM34505D
at 42 VDC
at rise to 85°C



SM34505D
at 24 VDC
at rise to 85°C

All torque curves based on 25°C ambient.

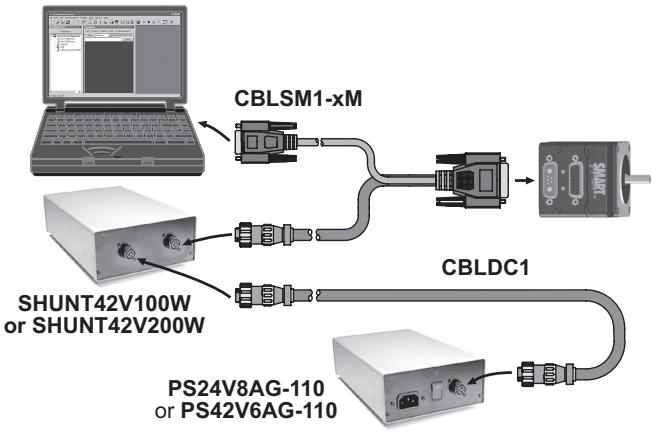
Motors were operated using MDT (Trapezoidal Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

Power:

Each SmartMotor™ is operated from 24 to 48VDC. Some of the larger SmartMotor servos can draw high current.

It is highly recommended to use heavy gage wire to connect the larger motors. As a result, the "Add-A-Motor" cable is recommended for the 17 and 23 frame series only.



Communications:

Each SmartMotor has a primary RS-232 serial port and a secondary RS-485 port by re-assignment of ports E and F of the seven I/O points. Up to 120 SmartMotor servos may be separately addressed and are identifiable on either RS-232 or RS-485.

The most common and cost effective solution is typically RS-232 serial communications. Under this structure, each motor is placed in an electrical serial connection such that the transmit line of one motor is connected to the receive line of the next. Each motor will be set to "echo" the incoming data to the next motor down with approximately 1 millisecond propagation delay. There is no signal integrity loss from one motor to the next, which results in highly reliable communications.

The following cables/devices are used for RS-232 and Power connectivity:

CBLPWRCOM2-xM	Power and communications cable with flying leads or in conjunction with DIN-RS232 8 channel isolated communications board
CBLSM1-xM	Power and communications cable with DB-9 serial connector and power supply connector that fits our enclosed power supplies
CBLSM1-DEMO	Testing cable used with our PWR116 "laptop" type power supply
CBLSM1-x-y-z	Custom length multi-drop RS-232 daisy chain cable

The following cables are used for RS-485 and Power connectivity:

RS485-ISO	Converts primary RS-232 to isolated RS-485 (NOTE: uses Port G I/O pin)
CBLSM2-x-y-z	Custom multi drop isolated RS-485 (multiple RS485-ISO adapters)

Interfacing with I/O devices:

Each SmartMotor has 7 TTL level user-configurable I/O. Each can be used as either inputs or outputs.
The following is a quick review of I/O interfacing connectivity options:

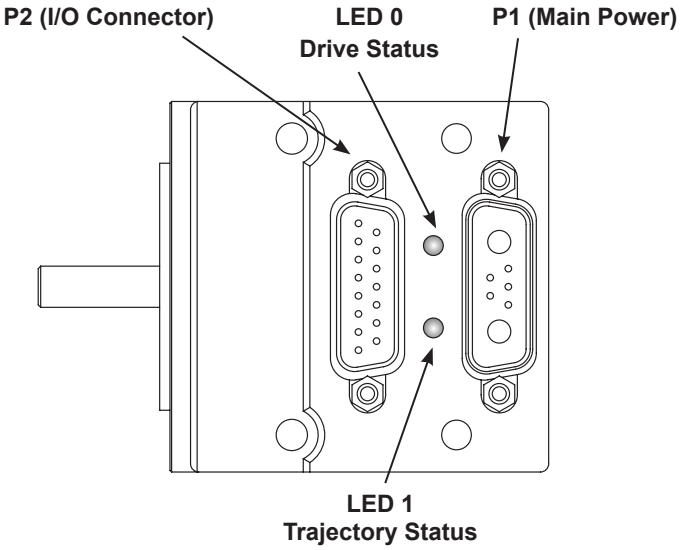
CBLIO5V-xM	Direct connection to 5V TTL I/O
CBLIO5V-xM via OPTO2	24VDC isolation and conversion of 5V signals
CBLIO5V-xM via DINIO7	Motor breakout board to industry standard OPTO relays
CBLIO-ISO1-xM	Isolated 24VDC logic conversion cable

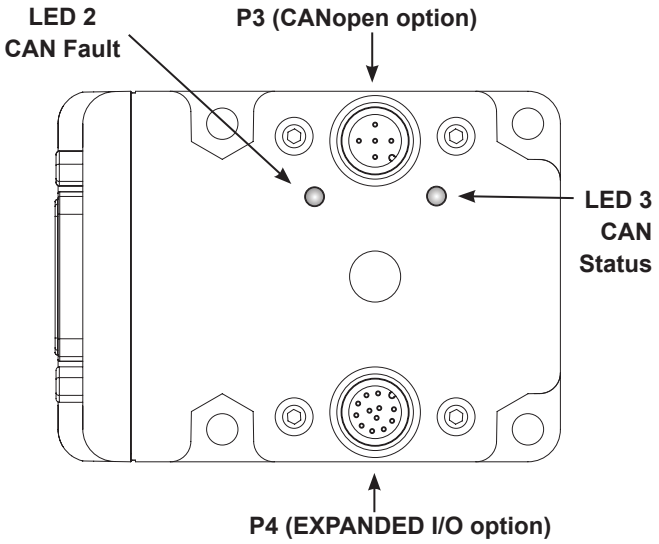
The following pages are a roadmap to motor connectivity. These pages show the physical layout of how cables are used including power, communications and I/O interconnection.

WARNING: Failure to protect against bus over voltage greater than 48VDC could cause immediate and irreparable damage to the electronics.

The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

Class 5 D-Style LEDs and Connectors





LED0: Drive Status Indicator

Off	No Power
Solid green	Drive On
Flashing green	Drive Off
Flashing red	Watchdog Fault
Solid red	Major Fault
Alt. red/green	In Boot Load, Needs Firmware

LED1: Trajectory Status Indicator

Off	Not Busy
Solid green	Drive On, Trajectory In Progress

LED2 CAN Bus Network Fault (Red LED)

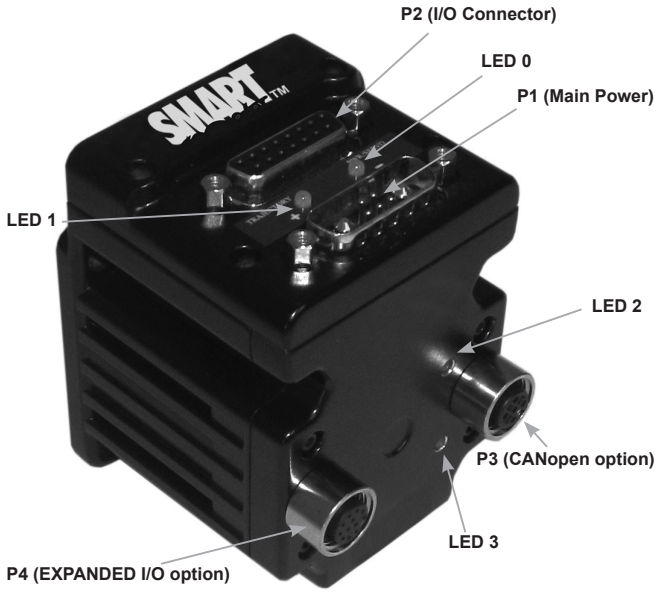
Off	No Error
Single Flash	At least One Error exceeded Limit
Double Flash	Heartbeat or Guard Error
Solid	Busy Off State

LED3: CAN Bus Network Status (Green LED)

Blinking	Pre-Operational State, (during boot-up)
Solid	Normal Operation
Single	Device is in Stopped State

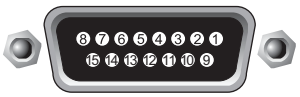
LED Status on Power-up:

- With no program and travel limit inputs are not grounded:
  LED0 will be solid red indicating the motor is in a fault state due travel limit fault.
  LED1 will be off
- With no program and travel limit inputs are not grounded:
  LED0 will be solid red for 500 milliseconds and then begin flashing green.
  LED1 will be off
- With no program and travel limit inputs are not grounded:
  LED0 will be solid red for 500 milliseconds and then begin flashing green.
  LED1 will be off

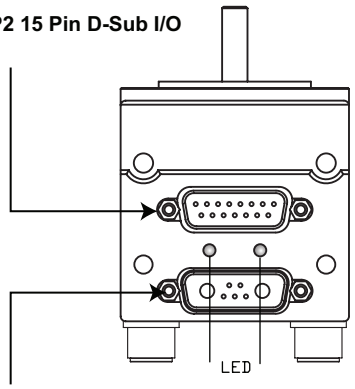


WARNING: Pins 15 and 14 are intended for use with DE series motors for powering the controller only. Attempts to power a non-DE motor through those pins for use as the main servo drive power could result in immediate damage to the electronics and will void the warranty.

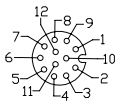
PIN	DESCRIPTION
1	I/O 0
2	I/O 1
3	I/O 2
4	I/O 3
5	I/O 4
6	I/O 5
7	I/O 6
8	Encoder A Out
9	Encoder B Out
10	RS232 Transmit
11	RS232 Receive
12	+5V Out
13	Ground
14	Power Ground
15	Power



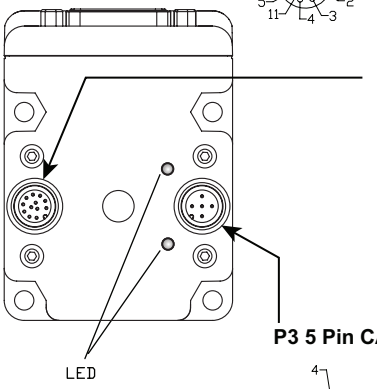
P2 15 Pin D-Sub I/O



P4 12 Pin Expanded I/O Connector

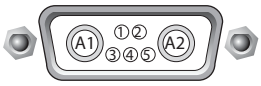


PIN	DESCRIPTION
1	I/O-16 GP
2	I/O-17 GP
3	I/O-18 GP
4	I/O-19 GP
5	I/O-20 GP
6	I/O-21GP
7	I/O-22 GP
8	I/O-23GP
9	I/O-24 GP
10	I/O-25 GP
11	+24 Volts Input
12	GND I/O

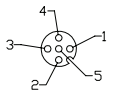


PIN	DESCRIPTION
A1	+20V to +48V DC
A2	Power Ground
1	Sync or I/O
2	+5V Out
3	RS232 Transmit
4	RS232 Receive
5	RS232 Ground

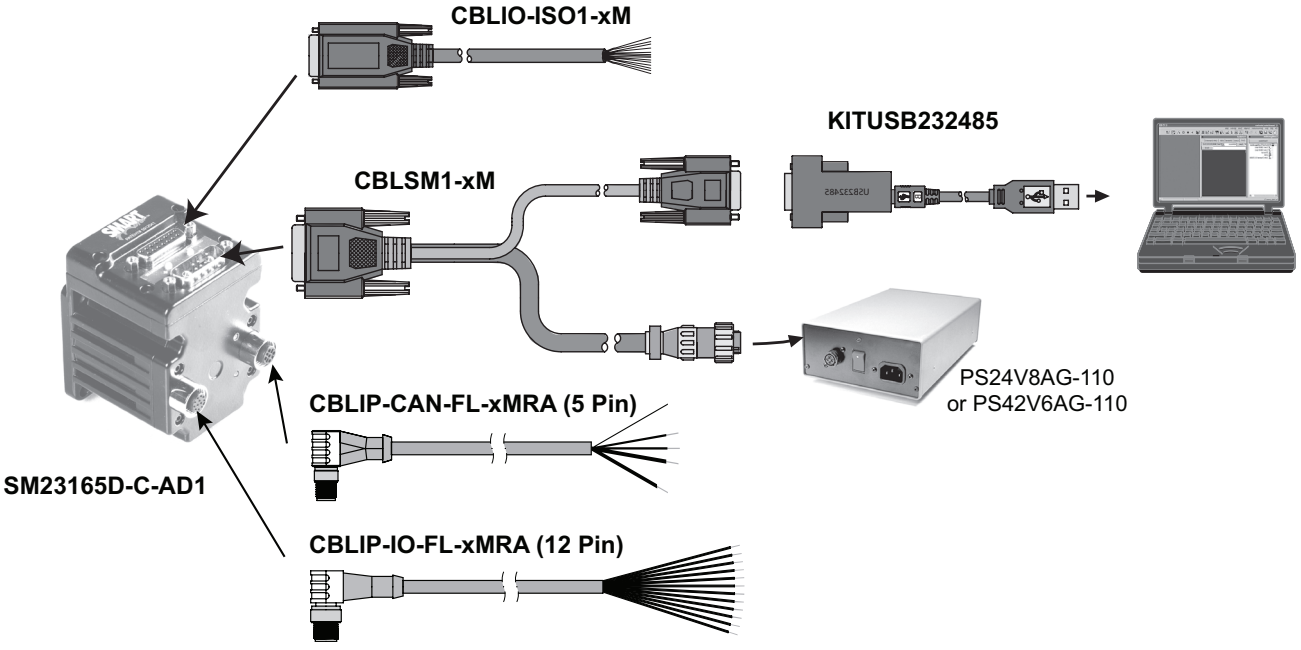
P1 7 Pin Combo D-Sub Power & I/O



P3 5 Pin CAN



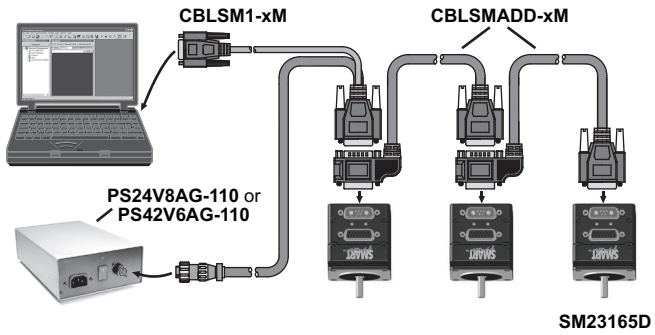
PIN	DESCRIPTION
1	NC
2	NC
3	GND CAN
4	CAN-H
5	CAN-L



WARNING: Pins 15 and 14 are intended for use with DE series motors for powering the controller only. Attempts to power a non-DE motor through those pins for use as the main servo drive power could result in immediate damage to the electronics and will void the warranty.

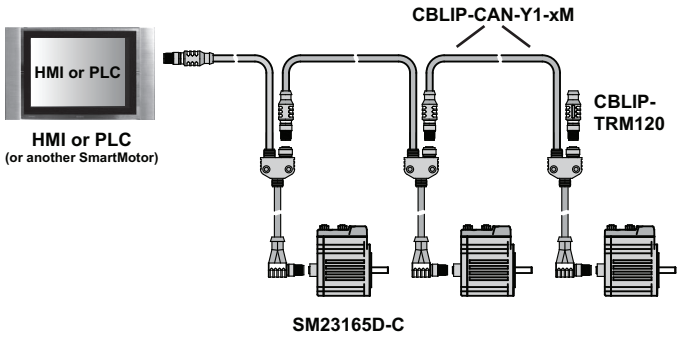
Class 5 Multi-Axis Connection Maps

RS-232 Multidrop using Add-A-Motor Cable



15 Amps maximum continuous load

CAN Bus Multidrop using CAN Bus Y Cables



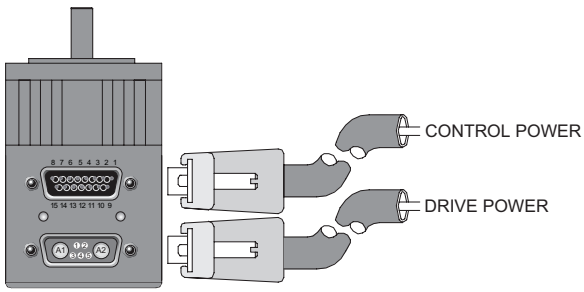
HIGHLY RECOMMENDED OPTION. PLEASE READ!

Hardware "DE" Option:

The DE option for D-Style SmartMotors allows the controller and drive-amplifier to be powered from separate 24-48VDC power supplies.

- Controller can be powered from a standard 24VDC supply
- **Position will not be lost on loss of drive-power**
- **No need to re-home**
- Load surges will not cause power surge on controller
- Standard battery options are made simpler

NOTE: This power option applies only to D-Style SmartMotors with the DE option.



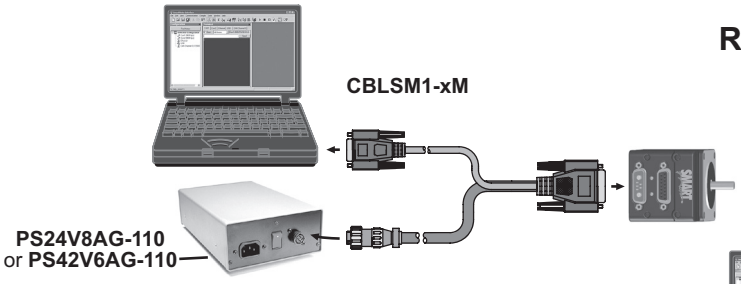
Please see the *SmartMotor Installation & Startup Guide* for the schematic diagram and installation details.

See pages 184–186 for details on protective shunts.

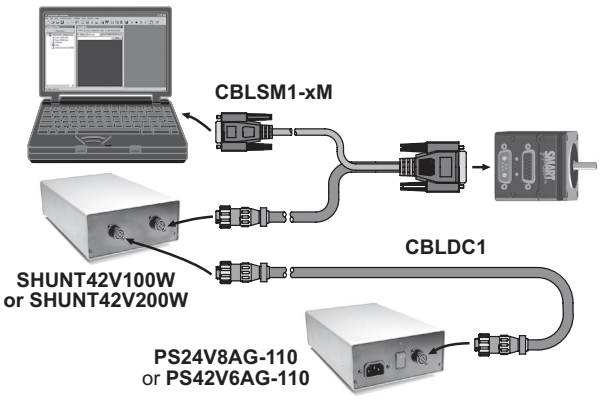
WARNING: Pins 15 and 14 are intended for use with DE option D-Style SmartMotors for powering the controller only. Attempts to power a non-DE D-Style SmartMotor through those pins for use as the main servo drive power could result in immediate damage to the electronics and will void the warranty.

WARNING: If an E-stop contact is placed between the motor drive input and power supply, a shunt or shorting contact into the drive power connection must be installed to ensure protection against bus overvoltage when the E-stop contacts open.

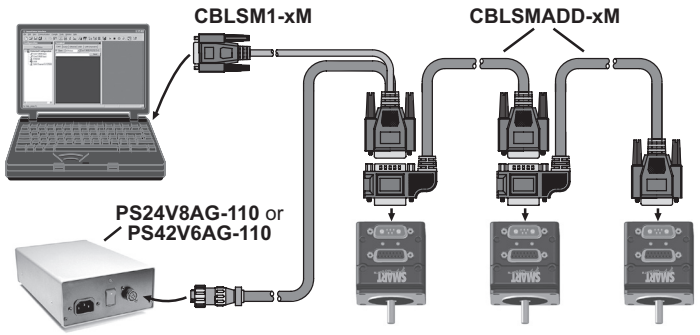
RS-232 Communications Using USB Adapter



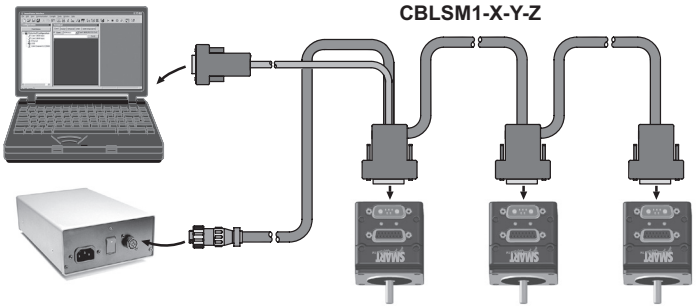
RS-232 Communications with Power Supply & Protective Shunt



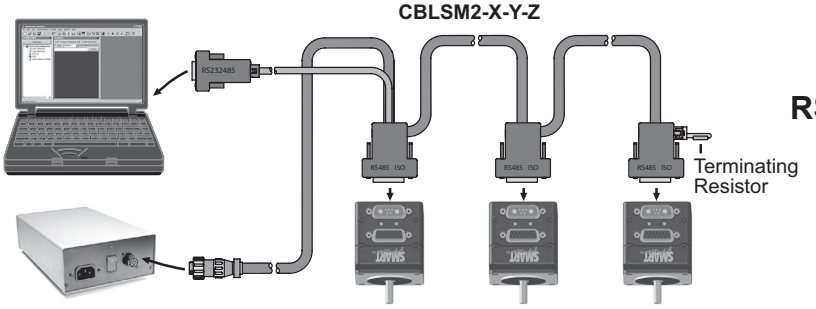
RS-232 Multidrop using Add-A-Motor™ Cables



RS-232 Multidrop using Custom Order Cable

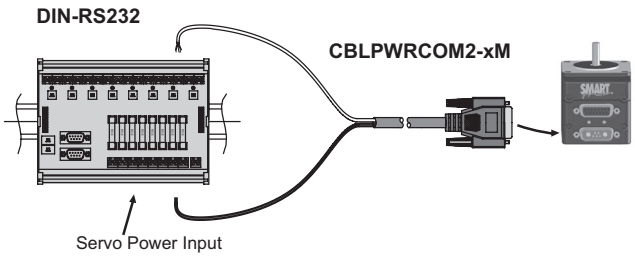


RS-485 Isolated Communications Using Custom Order Cable



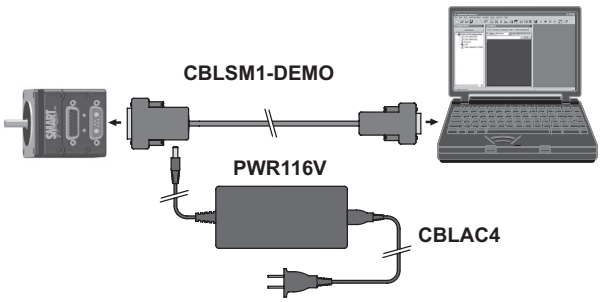
Serial to USB converter KITUSB232485 is available for computers without a serial port. See page 86 for more details.

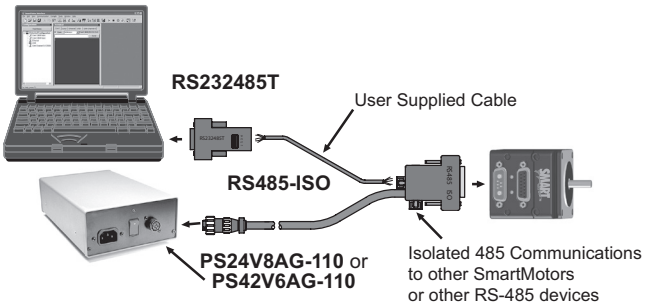
Class 5 D-Style Connection Maps (Continued)



Isolated RS-232 Communications for up to 8 SmartMotor servos

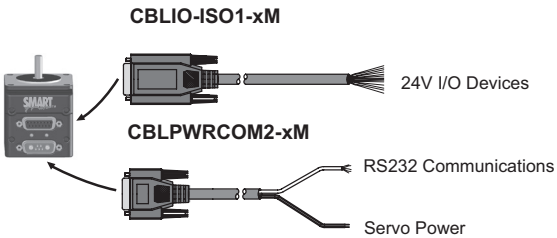
Demonstration & Development Configurations

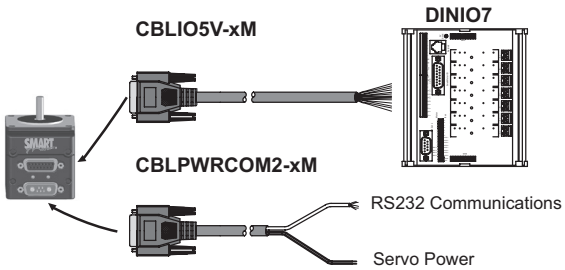


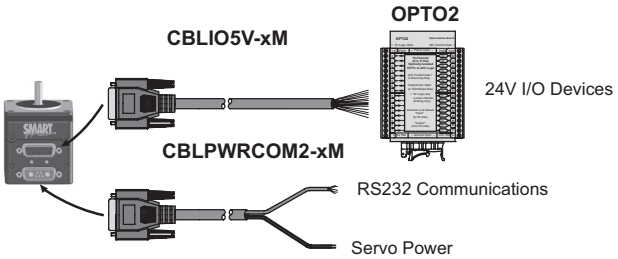


Isolated RS-485 Communications

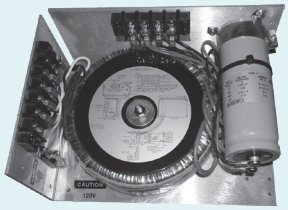
Interfacing with 24V I/O Devices







Recommended Power Supply



PS42V20AF series

Recommended Shunts

SHUNT42V100W-OF

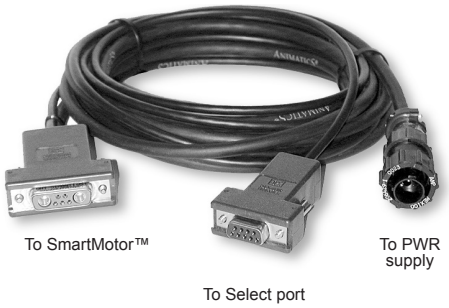
SHUNT42V200W-OF

CBLSM1-3M

Power and Communications Cable for Main 7W2 Connector on Moog Animatics SmartMotor™

CBLSM1 series is the main power and communications cable consisting of a 7W2 main motor connector split out to a pre-wired RS-232 DB-9 connector to plug directly into any standard PC serial port.

The power is split off and has a connector that plugs into our enclosed frame power supplies.



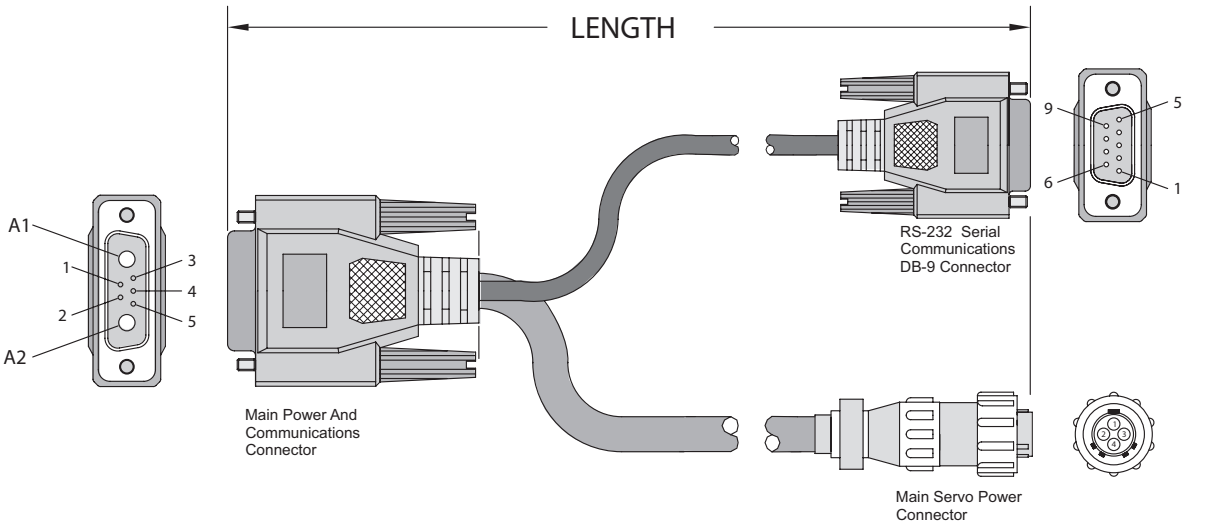
Standard Length

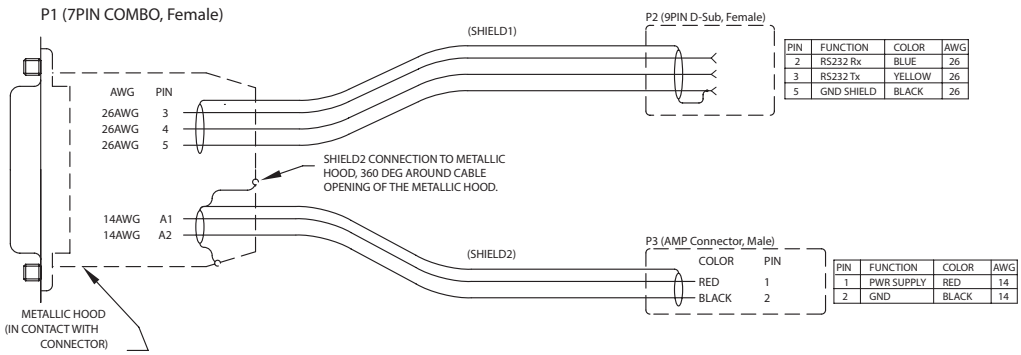
Part Number	Length
CBLSM1-3M	3 meters
CBLSM1-10M	10 meters

Custom Length

Part Number	Length
CBLSM1-x	x (in feet)

NOTE: Communications Shield is connected at the DB-9 end, but NOT the motor end. The power cable is connected at the motor connector shell but electrically isolated from the any internal electronic components.



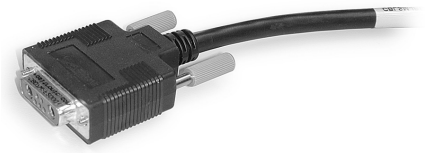


PIN	FUNCTION	COLOR	AWG
2	RS232 Rx	BLUE	26
3	RS232 Tx	YELLOW	26
5	GND SHIELD	BLACK	26

PIN	FUNCTION	COLOR	AWG
1	PWR SUPPLY	RED	14
2	GND	BLACK	14

CBLPWRCOM2-xM

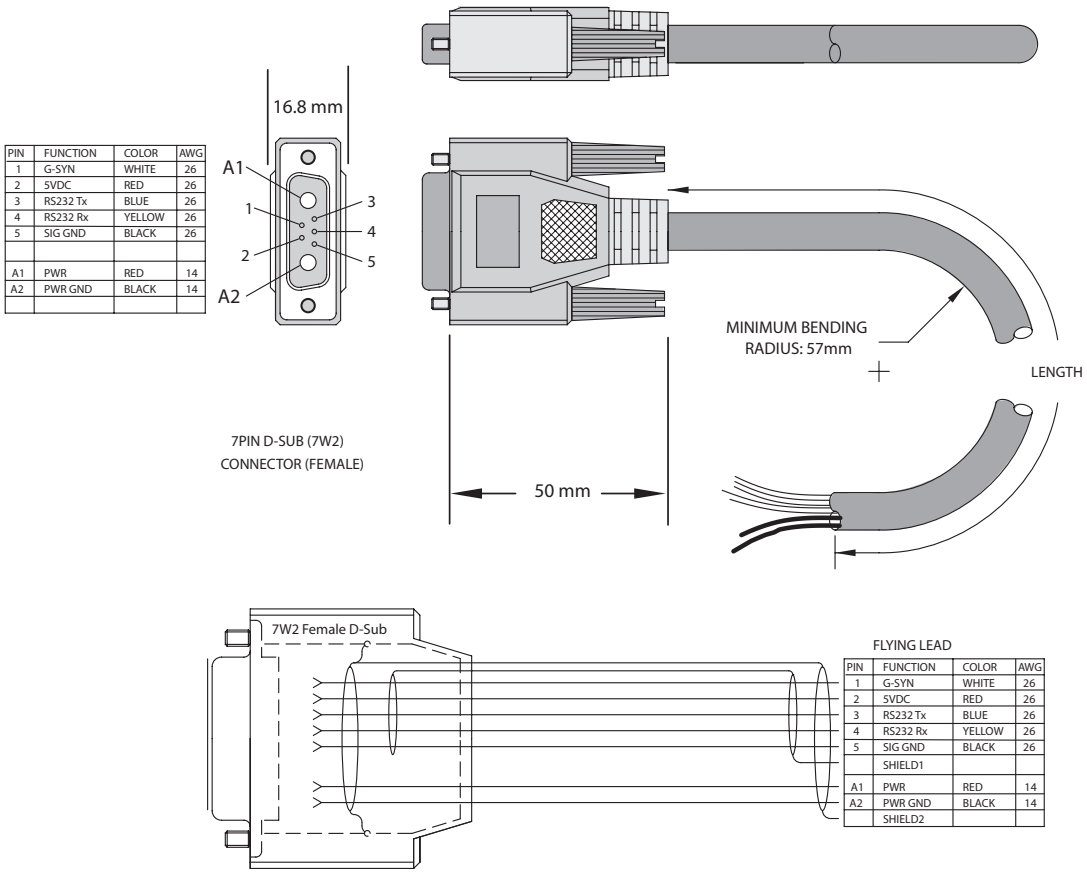
Power and Communications Cable (Flying Leads) for Main 7W2 Connector on Moog Animatics SmartMotor™



CBLPWRCOM2 series is a power and communications cable consisting of a 7W2 main motor connector with communications internally shielded from power and a full shield over entire length terminating at a metal jacket inside the over-molded connector.

Part Number	Length
CBLPWRCOM2-3M	3 meters
CBLPWRCOM2-5M	5 meters
CBLPWRCOM2-10M	10 meters

NOTE: Communications shield is connected at the DB-9 end, but NOT the motor end. The power cable is connected at the motor connector shell but electrically isolated from the any internal electronic components.



PIN	FUNCTION	COLOR	AWG
1	G-SYN	WHITE	26
2	5VDC	RED	26
3	RS232 Tx	BLUE	26
4	RS232 Rx	YELLOW	26
5	SIG GND	BLACK	26
A1	PWR	RED	14
A2	PWR GND	BLACK	14

PIN	FUNCTION	COLOR	AWG
1	G-SYN	WHITE	26
2	5VDC	RED	26
3	RS232 Tx	BLUE	26
4	RS232 Rx	YELLOW	26
5	SIG GND	BLACK	26
	SHIELD1		
A1	PWR	RED	14
A2	PWR GND	BLACK	14
	SHIELD2		

CBLSMADD-xM (Moog Animatics "Add-A-Motor™" Cable)

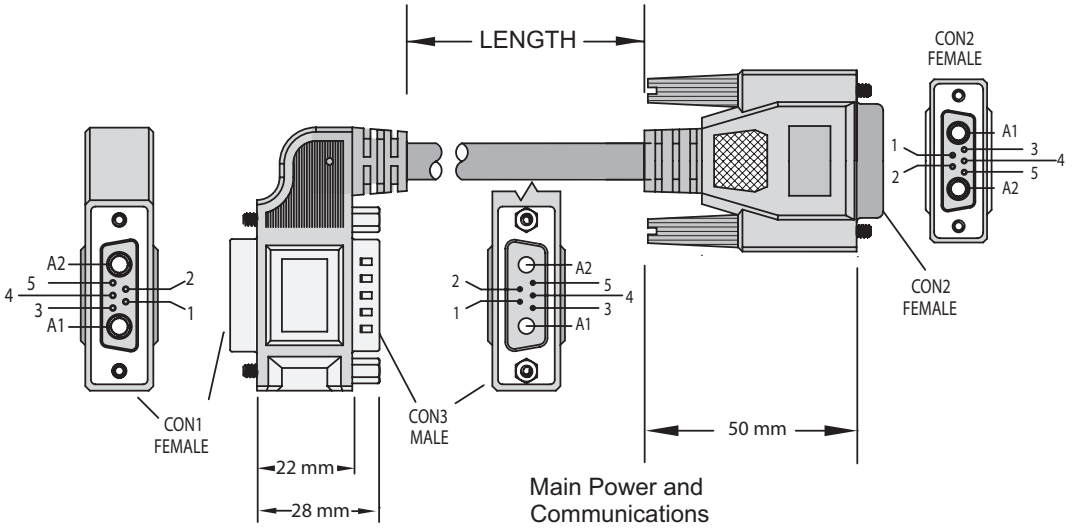
Power and Communications Daisy Chain Cable for Networking Power and Communications to Multiple Moog Animatics SmartMotor Servos

CBLSMADD series is the main power and communications cable consisting of a feed-through 7W2 main motor connector split out to a single second motor 7W2 connector.

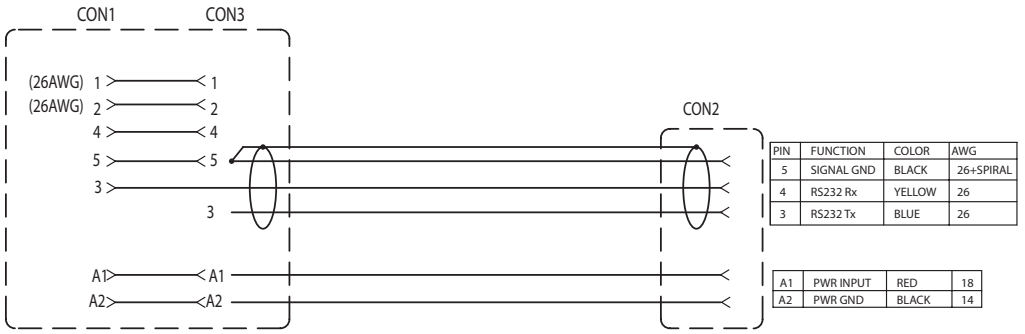
The cable is designed to allow ease of connection to multiple motors in a single RS-232 serial daisy chain network. The Main Power Ground wire is of a larger gauge to decrease noise emissions at the ground-plane level. The RS-232 Communications lines are internally shielded from the power lines.

Part Number	Length
CBLSMADD-0.3	0.3 meters
CBLSMADD-1.0	1 meters
CBLSMADD-3.0	3 meters
CBLSMADD-7.5	7.5 meters

NOTE: Due to gauge of the main power lines, it is not recommended to use the "Add-A-Motor" cables with the larger 34 frame SmartMotor. If there is just one 34 frame SmartMotor in a system design, then it should be the first motor in the chain so as to minimize voltage drop effects over the entire network.



Main Power and Communications Connectors at each point

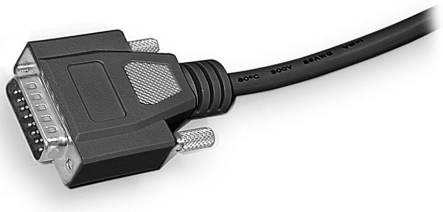


PIN	FUNCTION	COLOR	AWG
5	SIGNAL GND	BLACK	26+SPIRAL
4	RS232 Rx	YELLOW	26
3	RS232 Tx	BLUE	26

A1	PWR INPUT	RED	18
A2	PWR GND	BLACK	14

CBLIO5V 5V TTL I/O Interface Cable

Main I/O Connector Cable (Flying Leads) for DB-15 Connector on Moog Animatics SmartMotor™

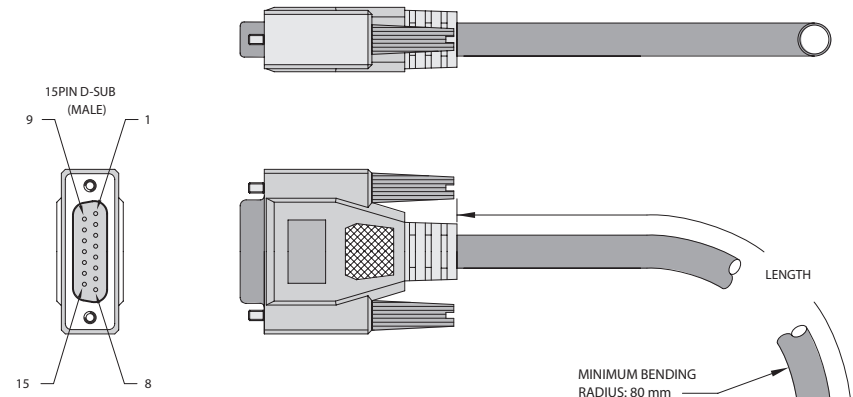


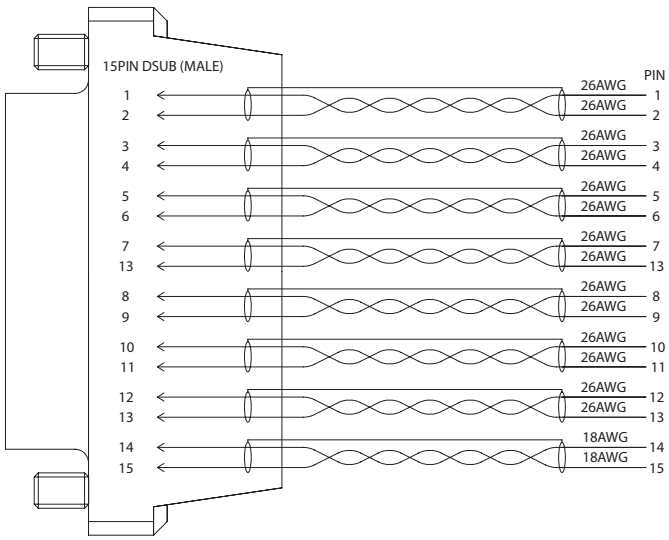
CBLIO5V series is for all 5VTTL I/O, communications, encoder output, and control power input (when needed for –DE option motors).

The cable is organized in separately shielded twisted pairs to provide better noise immunity and lower emissions.

Part Number	Length
CBLIO5V-3M	3 meters
CBLIO5V-5M	5 meters
CBLIO5V-10M	10 meters

NOTE: The shields DO NOT have electrical contact with each other or the connector shell. This allows for proper grounding in the control cabinet or at termination point determined by user thereby eliminating ground loops.





FLYING LEAD

FUNCTION	COLOR
I/O A	BLUE
I/O B	BROWN
I/O C	GRAY
I/O D	GREEN
I/O E	ORANGE
I/O F	WHITE
I/O G	YELLOW
SIG GND	BLACK/WHITE
ENC A	BLUE/WHITE
ENC B	BROWN/WHITE
RS232 Tx	BLUE/BLACK
RS232 Rx	YELLOW/BLACK
5Vdc	RED/WHITE
SIG GND	BLACK/WHITE
PWR GND	BLACK
PWR	RED

WARNING: Pins 15 and 14 are intended for use with DE series motors for powering the controller only. Attempts to power a non-DE motor through those pins for use as the main servo drive power could result in immediate damage to the electronics and will void the warranty.

CBLIO-ISO1 24VDC TTL I/O Converter Cable

The CBLIO-ISO1 cable provides optically isolated 24VDC I/O interface to the controller.

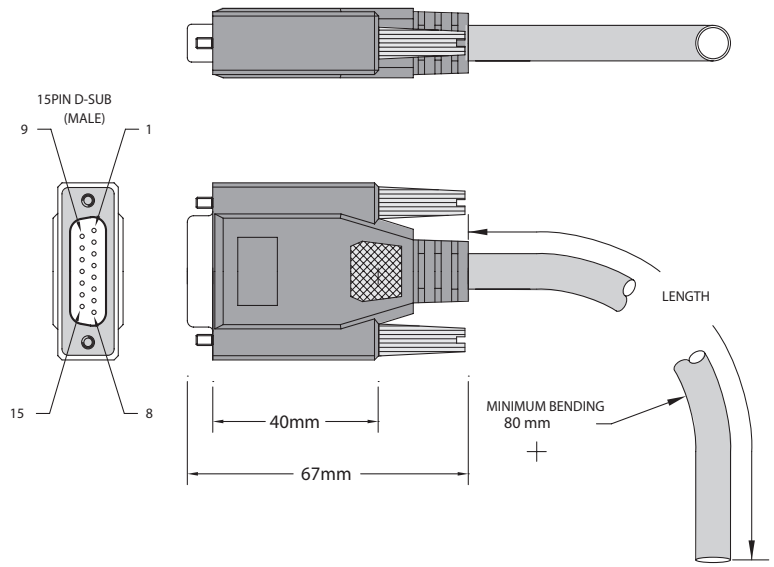
The cable is user configurable as 4 inputs and 3 outputs OR 5 inputs and 2 outputs.

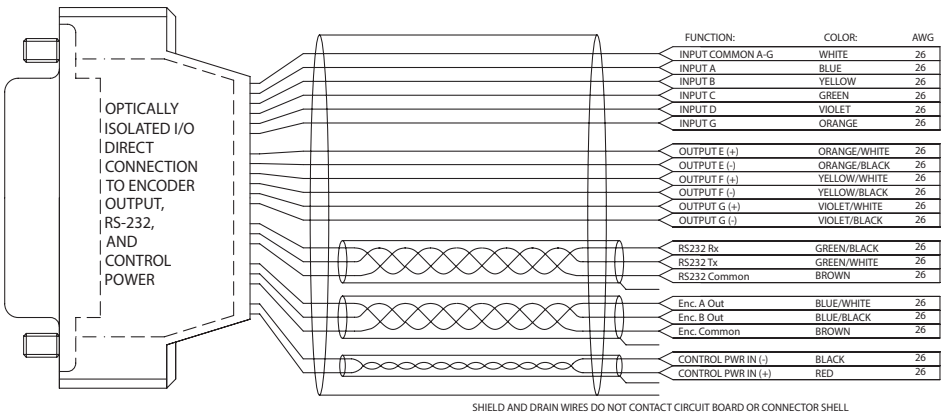
Additionally, this cable provides direct connection to:

- RS-232 Primary Communications Port (Ch. 0)
- Encoder Output
- Control Power Input

Part Number	Length
CBLIO-ISO1-3M	3 meter
CBLIO-ISO1-5M	5 meter
CBLIO-ISO1-10M	10 meter

It can be used with standard or DE option Moog Animatics SmartMotor™





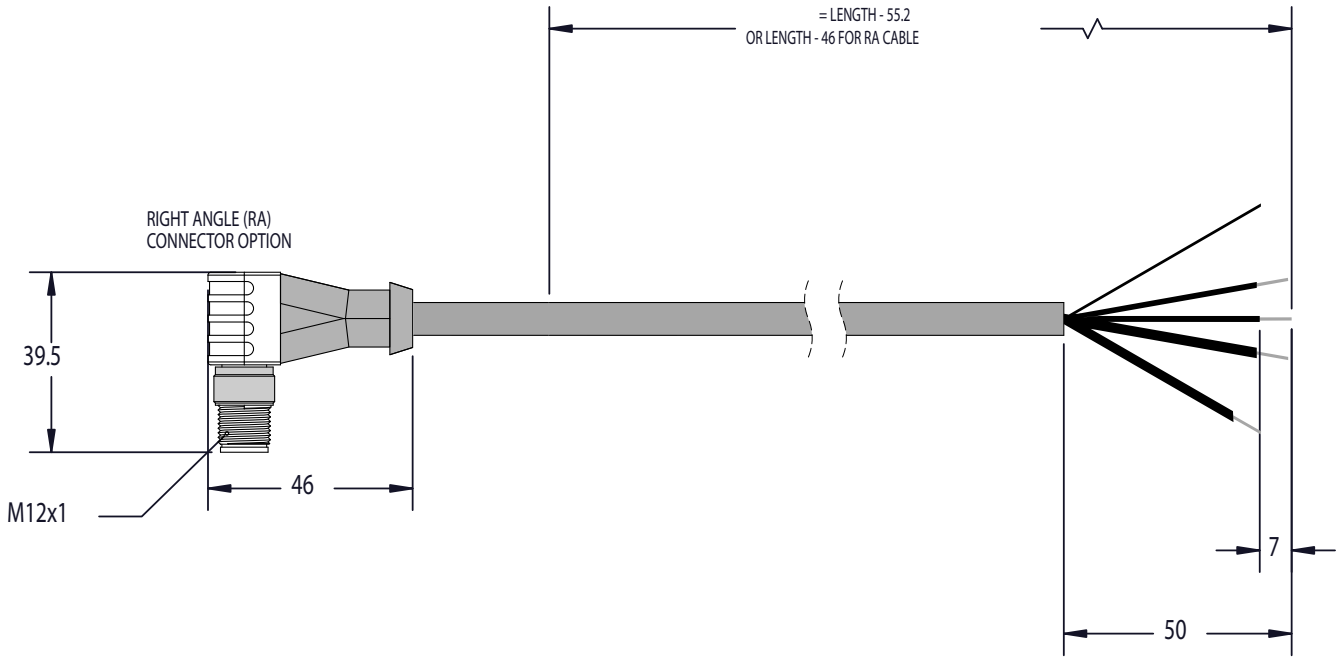
WARNING: Pins 15 and 14 are intended for use with DE series motors for powering the controller only. Attempts to power a non-DE motor through those pins for use as the main servo drive power could result in immediate damage to the electronics and will void the warranty.

CAN Bus Flying Lead Cables, Right Angle Connector

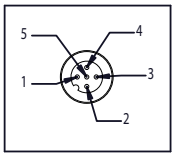
The CAN FL cables are standard CAN bus communications cables rated to >1MB data transmission rate.

CBLIP series cables are sealed M12 threaded connector brass pins with gold plating, maximum 4.0A 250V foil shield with black PVC jacket ~7.4mm diameter.

Part Number	Description	Length
CBLIP-CAN-FL-1MRA	Flying Lead Right Angle Connector	1 meter
CBLIP-CAN-FL-3MRA	Flying Lead Right Angle Connector	3 meters
CBLIP-CAN-EXT-1M	CAN Bus Extension Cable	1 meter
CBLIP-CAN-EXT-2M	CAN Bus Extension Cable	2 meters
CBLIP-CAN-EXT-3M	CAN Bus Extension Cable	3 meters



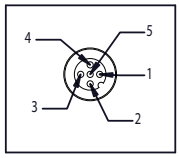
MALE END VIEW:



CONNECTIONS

PIN #	NAME	COLOR
1	SHIELD	BARE
2	+ VOLTAGE	RED
3	- VOLTAGE	BLACK
4	CAN_H	WHITE
5	CAN_L	BLUE

FEMALE END VIEW:

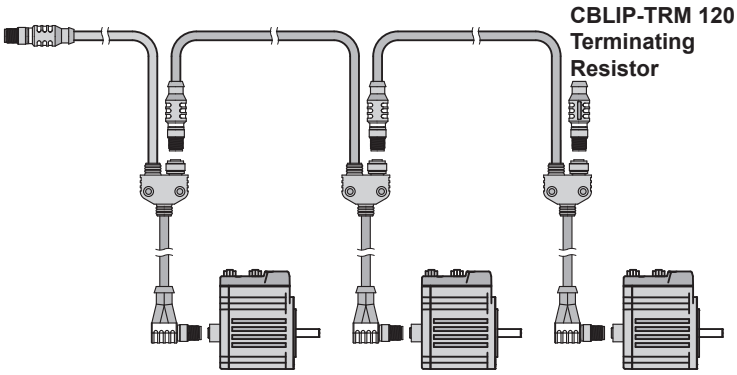


CAN Bus Y Cables, Right Angle Connector

The CAN Y1 series is intended for CAN bus communications connectivity between two motors with addition of a T-connector in line. Rated to >1MB data transmission rate.

This allows for cascading of multiple SmartMotor servos and the addition of a shunt resistor when required.

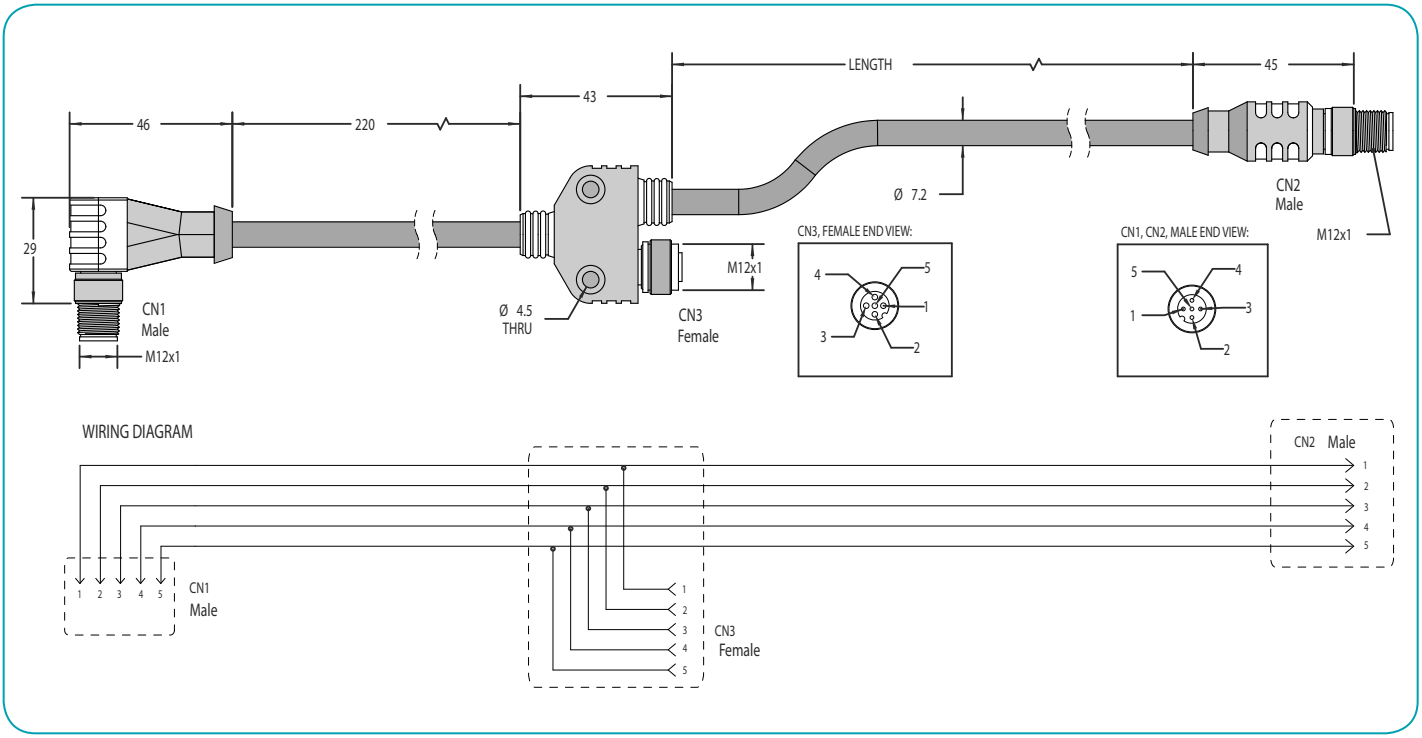
CBLIP series cables are sealed M12 threaded connector brass pins with gold plating, maximum 4.0A 250V foil shield with black PVC jacket ~7.4mm diameter.



CBLIP-TRM 120 Terminating Resistor

Right Angle Connector

Part Number	Length
CBLIP-CAN-Y1-0.5MRA	0.5 meters
CBLIP-CAN-Y1-1MRA	1 meters
CBLIP-CAN-Y1-3MRA	3 meters



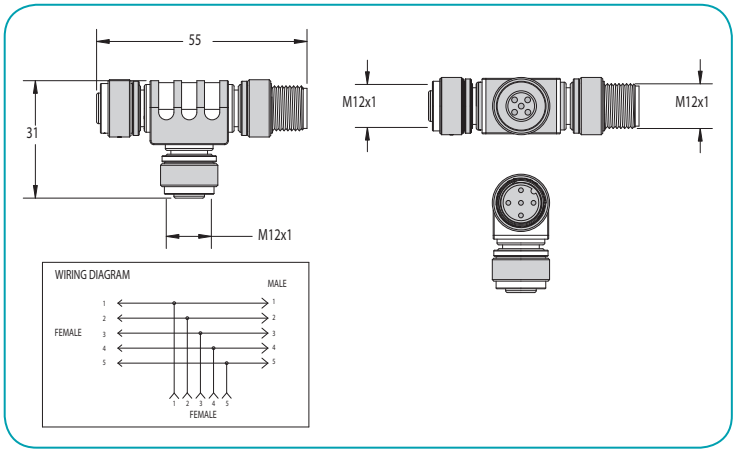
NOTE: At least one shunt resistor is required on ALL CAN bus networks. Please consult the factory for additional information.

"T" CONNECTOR FEMALE-FEMALE-MALE CBLIP-T-FFM

T connectors may be used in place of Y cables and in conjunction with CAN bus extension cables.

Shunt resistors MUST BE used to allow proper biasing of CAN Bus cables.

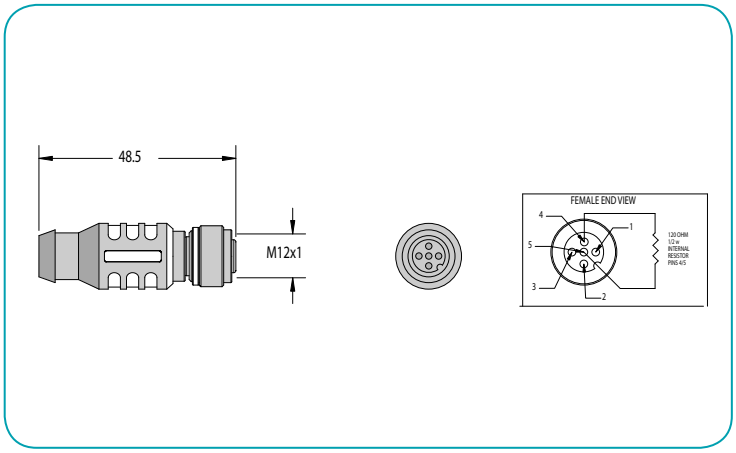
It is suggested to have at least one at furthest end of bus. Two may be required at opposing ends.



Female Terminating Resistor, 120 Ohms CBLIP-TRF120

Shunt resistors MUST BE used to allow proper biasing of CAN Bus cables.

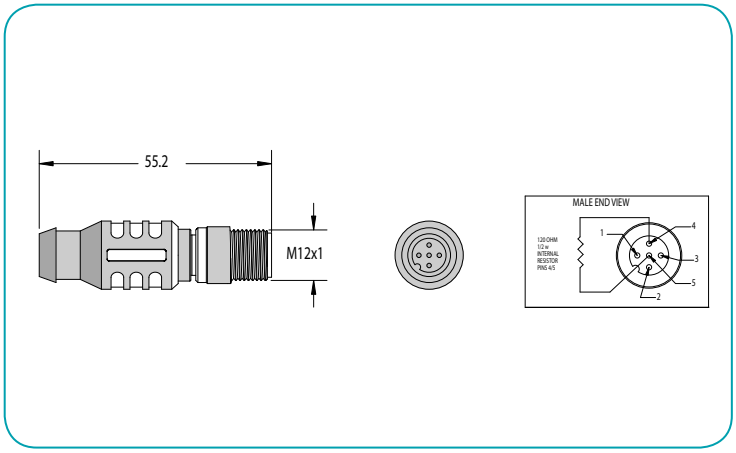
It is suggested to have at least one at furthest end of bus. Two may be required at opposing ends.



Male Terminating Resistor, 120 Ohms CBLIP-TRM120

Shunt resistors MUST BE used to allow proper biasing of CAN Bus cables.

It is suggested to have at least one at furthest end of bus. Two may be required at opposing ends.



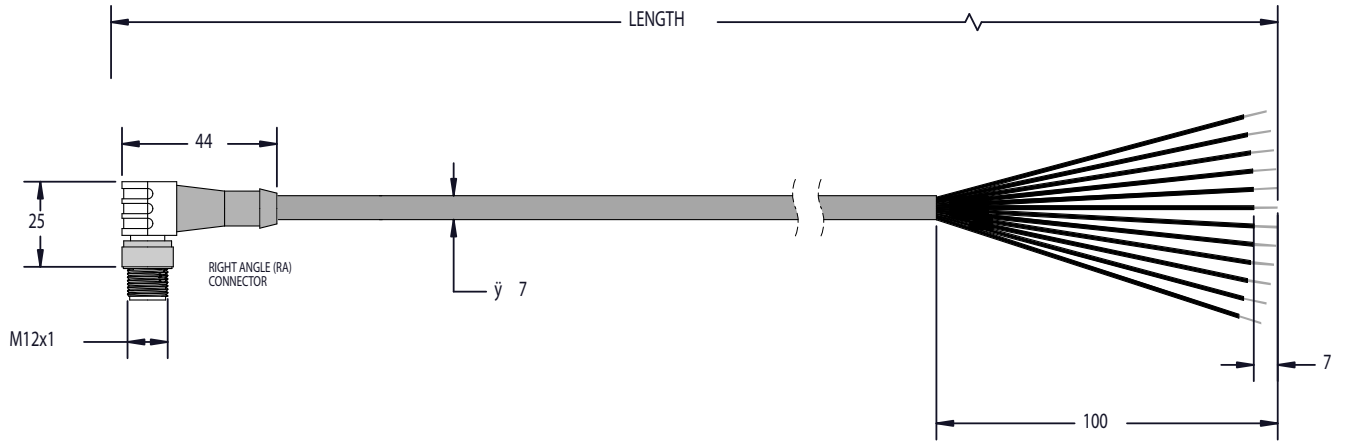
NOTE: At least one shunt resistor is required on ALL CAN bus networks. Please consult the factory for additional information.

CBLIP-IO 24VDC TTL I/O Cable

The expanded I/O cables are for use with the -AD1 expanded I/O option on all Class 5 non-sealed SmartMotor™ servos. Each cable is a 12-conductor shielded cable. 2 conductors are for +24VDC I/O power. The other 10 are for 10 channels of I/O.

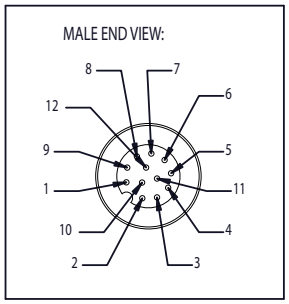
CBLIP series cables are sealed M12 threaded connector brass pins with gold plating, maximum 4.0A 250V foil shield with black PVC jacket ~7.4mm diameter.

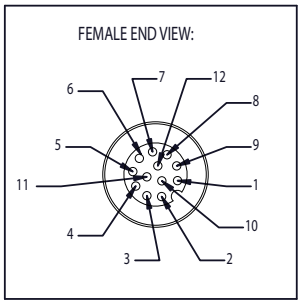
Part Number	Description	Length
CBLIP-IO-FL-1MRA	Flying Lead Right Angle Connector	1 meter
CBLIP-IO-FL-3MRA	Flying Lead Right Angle Connector	3 meters
CBLIP-IO-EXT-1M	I/O Extension Cable	1 meter
CBLIP-IO-EXT-2M	I/O Extension Cable	2 meters
CBLIP-IO-EXT-3M	I/O Extension Cable	3 meters



CONNECTIONS

PIN #	NAME
1	GREEN
2	VIOLET
3	PINK
4	WHITE
5	TAN
6	GRAY
7	BLACK
8	ORANGE
9	RED
10	YELLOW
11	BROWN
12	BLUE





CBLSM1-X-Y-Z (Moog Animatics Custom Build-to-Order)

Custom Multi-Motor Power and Communications Daisy Chain Cable for Networking Power and Communications to Multiple Moog Animatics SmartMotor Servos

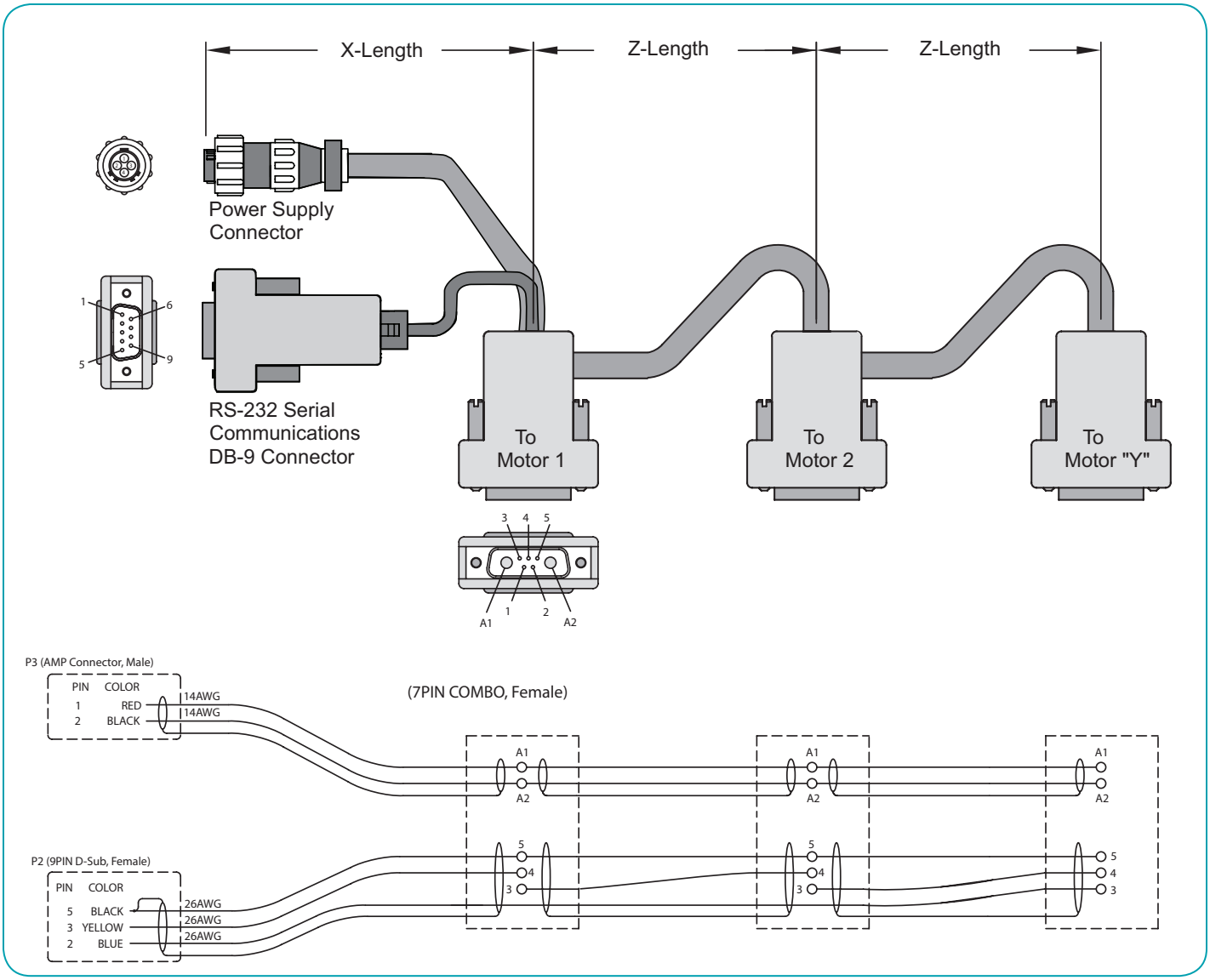
These cables are made to order where:

X = Cable length in Feet from the first motor to the Power and Serial connectors
Y = Number of Motors
Z = Distance in feet from one motor to the next

NOTE: This part numbering system does not allow for different length between each motor daisy chain network.
The RS-232 Communications lines are in a separate shielded cable from the main power cable for optimum noise immunity.

Example:
CBLSM1- 10- 3- 5 would give you a 3-motor cable with 10 feet to the first motor and 5 feet between each motor.

Example of 3-Motor CBLSM1-X-Y-Z shown



CBLSM2-X-Y-Z (Custom Build-to-Order)

Isolated RS-485 Multi-Drop Custom Cable

This cable makes use of the RS232485 converter at the host and a single RS485-ISO adapter at each motor.

The adapters have power hard wired and RS-485 wired together via jumper cables with a 4-pin G-grid Molex connector at each end.

As a result, it is easy to add or remove a given motor on the bus for setup and troubleshooting.

Since the RS485-ISO adapters are used, the entire bus is isolated and shielded for maximum noise immunity in electrically harsh environments.

These cables are made to order where:

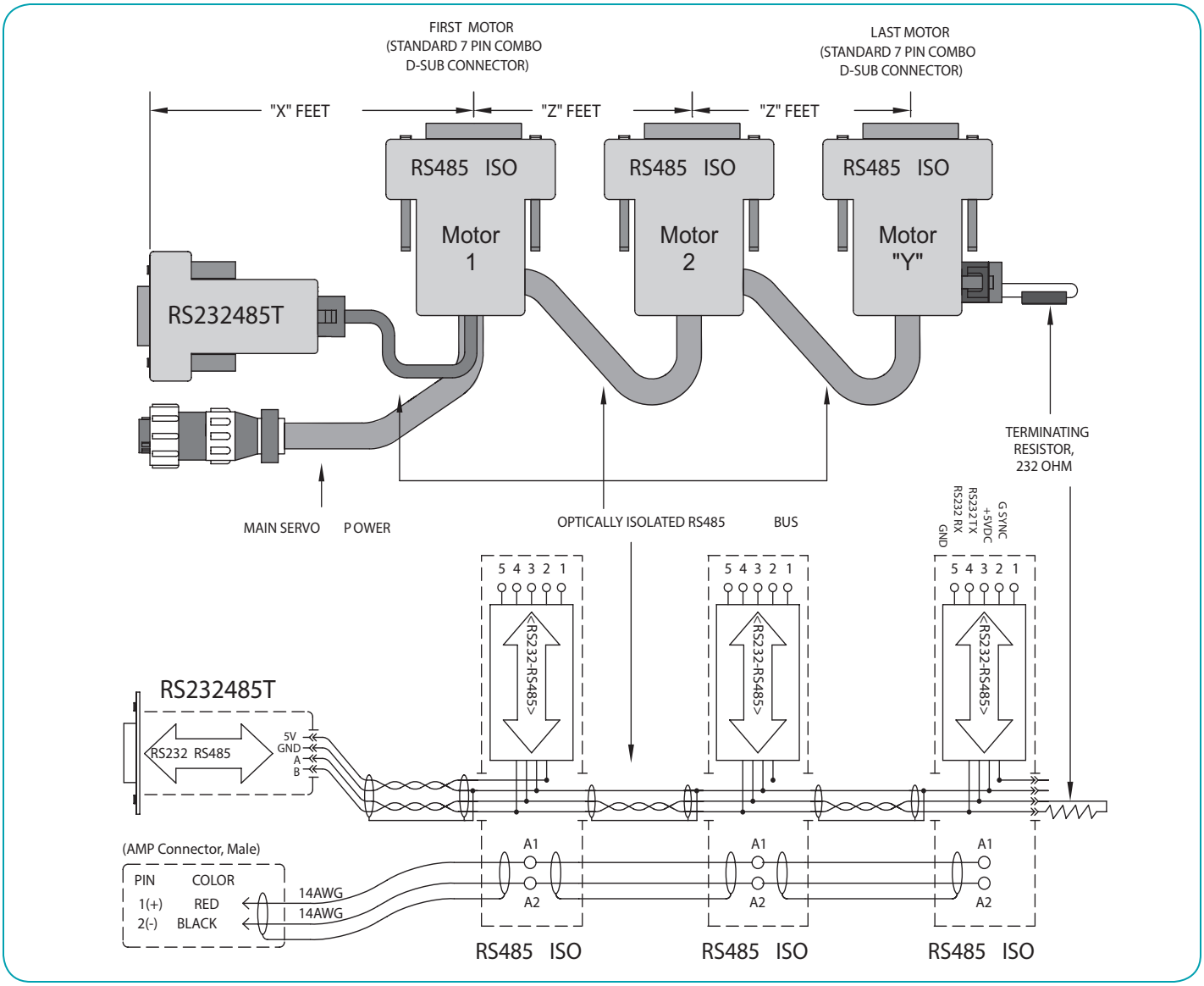
X = Cable length in feet from the first motor to the power and serial connectors
Y = Number of motors
Z = Distance in feet from one motor to the next

NOTE: This part numbering system does not allow for different length between each motor daisy chain network.

Example:

CBLSM2- 10- 3- 5 would give you a 3-motor cable with 10 feet to the first motor and 5 feet between each motor

NOTE: At least one shunt resistor is required on ALL CAN bus networks. Please consult the factory for additional information.



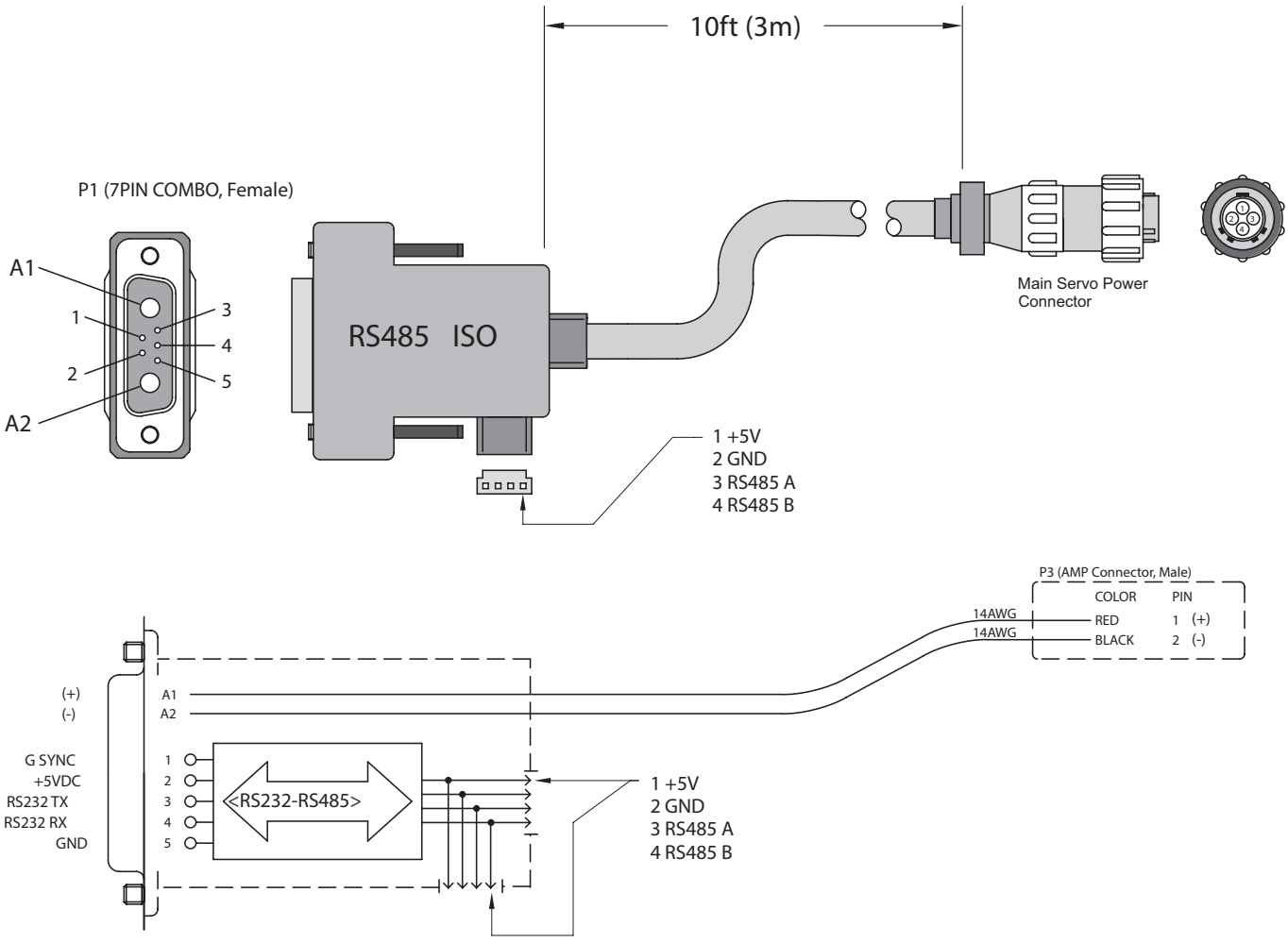
RS485-ISO

The RS485-ISO adapter provides electrically isolated conversion from RS-232 on the main 7W2 connector to RS-485. The adapter comes standard with a 10-foot power cable and two parallel 4 pin Molex RS-485 connectors.

RS-485 provides improved noise immunity over cable lengths of up to 1,000 ft (305m). It also allows you to operate a network of up to 120 SmartMotor servos in parallel, rather than daisy-chaining the communications from one motor to the next.

The adapter draws power and ground from the SmartMotor main connector (pins 2 and 5). It does require the use of the main connector G-Sync line (pin 1) for read-write control of the 485 transceiver.

The RS485-ISO communications adapter can be ordered with or without the power cable (no cable P/N: RS485ISO-NOCBL).

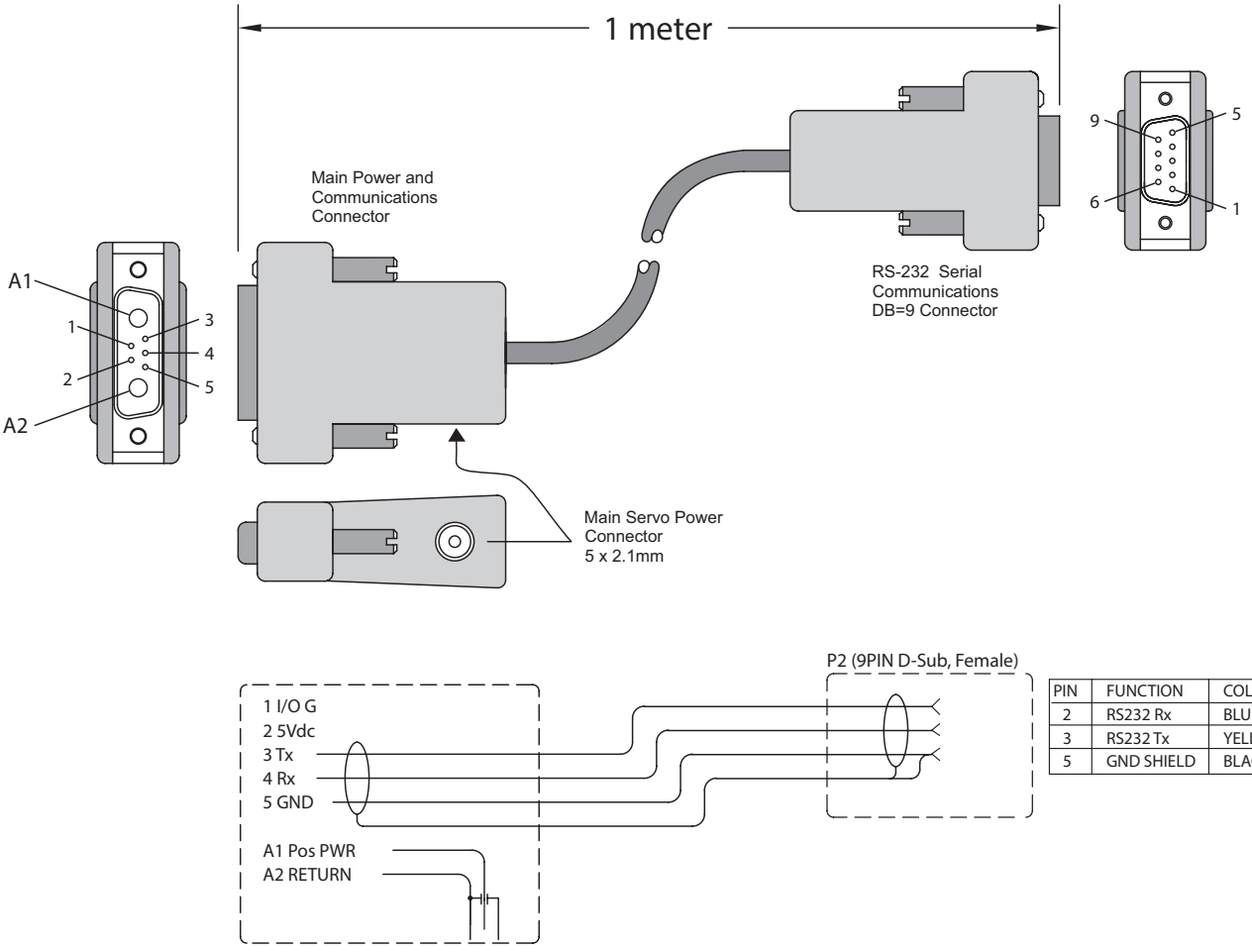


CBLSM1-DEMO

Training/Testing Power and Communications Cable for Main 7W2 Connector on Moog Animatics SmartMotor™

CBLSM1-Demo cable is only available in a fixed length of ~1 Meter. Similar to the CBLSM1-xM series, it consists of a 7W2 main motor connector split out to a pre-wired RS-232 DB-9 connector to plug directly into any standard PC serial port. The power to the motor is provided via a single 5mm diameter 2.1 mm center pin DC connector.

This connector accepts Moog Animatics PWR116V 24VDC power supply.



PIN	FUNCTION	COLOR	AWG
2	RS232 Rx	BLUE	26
3	RS232 Tx	YELLOW	26
5	GND SHIELD	BLACK	26

Notes

RS232485T

RS232485T is a non-isolated RS-232 to RS-485 communications adapter. It requires no drivers because it is hardware based only. The DB-9 connector can be plugged directly into a standard PC Serial port allowing the user to easily connect to and communicate with RS-485 devices.

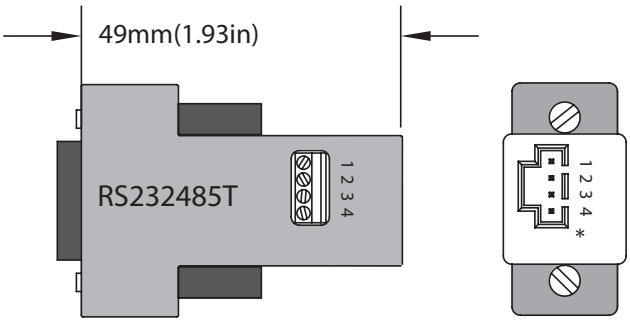
NOTE: The 4-pin Molex connector is designed to match the RS485-ISO adapters on page 83.

The connector can be removed to allow direct screw terminal connection as well.

Includes two KITDC3.

(Proper RS-485 biasing must be used.)

PIN#	FUNCTION:
1	5VDC
2	GND
3	RS485 A
4	RS485 B



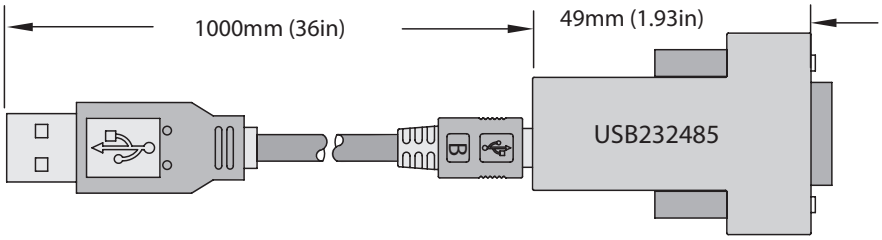
KITUSB232485

USB232485 is a non-isolated USB to RS-232 and RS-485 adapter. Available with Windows 98/2K/XP/Vista/Win 7&8 drivers.

This adapter plugs into standard USB port and provides either RS-232 or RS-485 communications. It is provided with ~1 meter standard USB cable.

NOTE: This is a single port device, it does not facilitate the use of both RS-232 AND RS-485 at the same time.

(Proper RS-485 biasing must be used.)



PIN#	FUNCTION:
1	RS485 A
2	RS232 Rx
3	RS232 Tx
4	+5Vdc
5	GND
9	RS485 B

SMDEVPACK-D

SMDEVPACK-D is the introductory development package for the Moog Animatics SmartMotor™. It is highly recommended for first time users and developers alike.

SMDEVPACK-D includes:

- UG-SM: Moog Animatics SmartMotor User's Guide
- CD-SMI: SMI (SmartMotor Interface) software CD
- CBLSM1-3M: Power-Communications Cable
- KITSMDC3: D-Sub Connector kit
- KITDC1: DC power supply connector kit

NOTE: Connector kits above include all parts below on this page with the exception of KITDC3.

Description	Qty.
Connector, Male, 15-Pin D-sub NOTE: for I/O Connector	1
Pin Contact Contact Size 20 Crimp Type, 24-20 AWG	20
Connector, 7W2 Combination 7-Pin DB-15 Shell Size 2	1
Socket Contact Solder Cup 14 AWG for 7W2 Combo Connector	2
Connector Hood For DB-15 Shell Size, EMI/Magnetic Shielded	1
Pin Contact, Female Contact Size 20 Crimp Type, 24-20 AWG	20
Connector, Female 9-Pin D-Sub	1
Connector Hood For DB-9 Shell Size EMI/Magnetic Shielded	2

Description	Qty.
Connector Shroud/Hood	1
4-Pin Connector NOTE: For enclosed Power Supplies & Shunts	1
Pin, Crimp Type, Male 16-18AWG	4

Description	Qty.
4-Pin Molex Communication Connector Kit NOTE: Includes 4 female crimp pins	1

WARNING: Pins 15 and 14 are intended for use with DE series motors for powering the controller only. Attempts to power a non-DE motor through those pins for use as the main servo drive power could result in immediate damage to the electronics and will void the warranty.

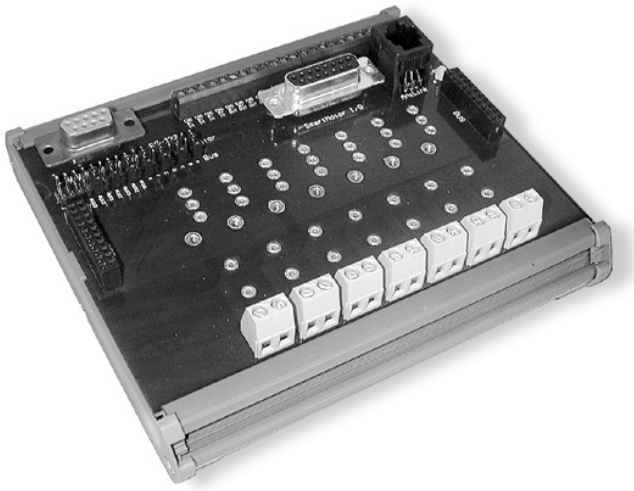
DINIO7

The **DINIO7** is a DIN rail mount adapter that allows the Moog Animatics SmartMotor™ to easily interface with popular Input/Output blocks like those produced by Gordos, Grayhill, OPTO-22™ and other manufacturers.

The DINIO7 has slots for seven industry standard OPTO Modules and can be used with either input or output modules.

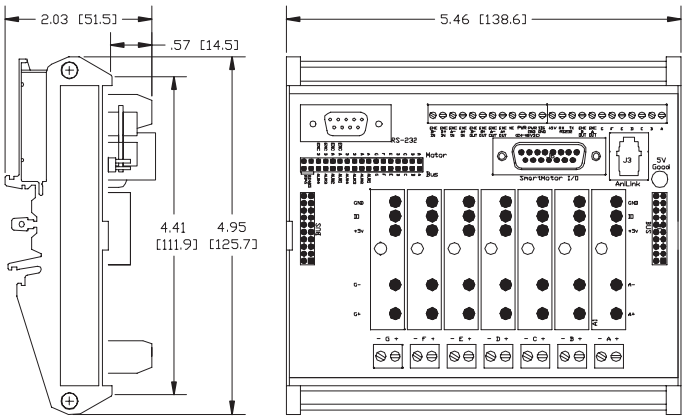
The DINIO7 has a 9-pin connector for direct connection to a personal computer serial RS-232 communications port and an AniLink™ network connector. It is also equipped with an expansion bus to allow it to interface with other Moog Animatics DIN rail mount adapters. Wiring Input/Output up to your Moog Animatics SmartMotor™ is made simple with the DINIO7 breakout board.

* Please consult with appropriate manufacturer for details



Cross Reference to Compatible Opto Modules

Mfg.*	DC Input	DC Output	AC Input	AC Output
Opto-22	G4-IDC5	G4-ODC5	G4-IAC5	G4-OAC5A
Grayhill	70G-IDC5	70G-ODC5A	70G-IAC5A	70G-OAC5A
Crydom	X4IDC5	X4ODC5	X4IAC5	X4OAC5
Gordos/ Crouzet	C4-IDC5	C4-ODC5	C4-IAC5	C4-OAC5
	(3-32VDC high side)		(120VAC high side)	



** All sizes are given in inches, sizes in brackets are in mm*

Features	Benefits
DB-15 or screw terminal access to your SmartMotor	Easy connection for panel environment
AniLink port for expansion to other AniLink devices	Cascadable
7 main I/O buses to cross connect I/O to other motors	Flexible use
Aux buses to interconnect encoders between motors	Simplifies encoder connections
Jump-in RS-485 terminal resistors	No added parts necessary for RS-485 termination
Onboard DB-9 for fast RS-232 access	May be used with standard RS-232 extension cables

WARNING: Pins 15 and 14 are intended for use with DE series motors for powering the controller only. Attempts to power a non-DE motor through those pins for use as the main servo drive power could result in immediate damage to the electronics and will void the warranty.

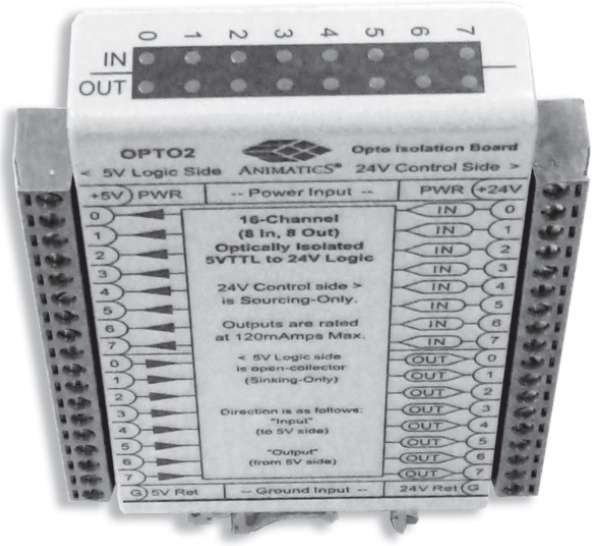
This product is no longer available.
Please see the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

Moog Animatics OPTO2 — 16 Channel Opto-isolator Board

Optically isolates and converts signals between:

5VTTL logic and 24VDC Control Logic Systems

- 8 Input Channels
- 8 Output Channels
- Red Fail-Safe LED Indications
- Plug-in connectors
- DIN Rail Mount
- Only 0.84 Inches of rail space
- Shunt Diode protection for Inductive loads



5VDC Logic Side:

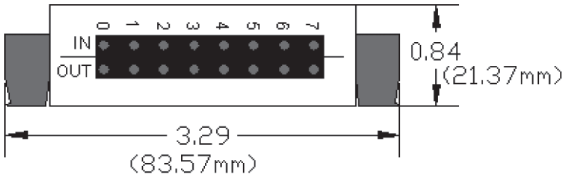
- Darlington Output Sinking
- 6.8VDC max input
- 120mAmp Max. 5VDC Load

24VDC Control Side:

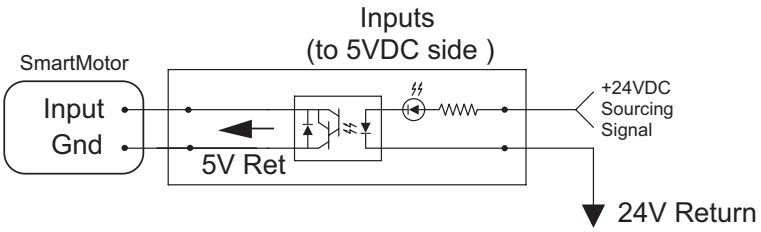
- Darlington Output Sourcing
- 12 to 32VDC Working Range
- 120mAmp Max. Load @24VDC

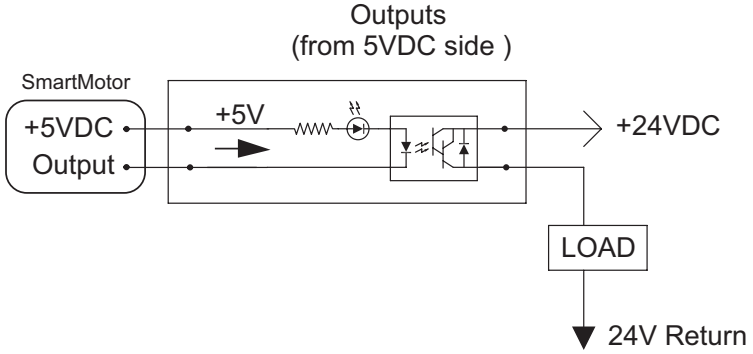
Timing:

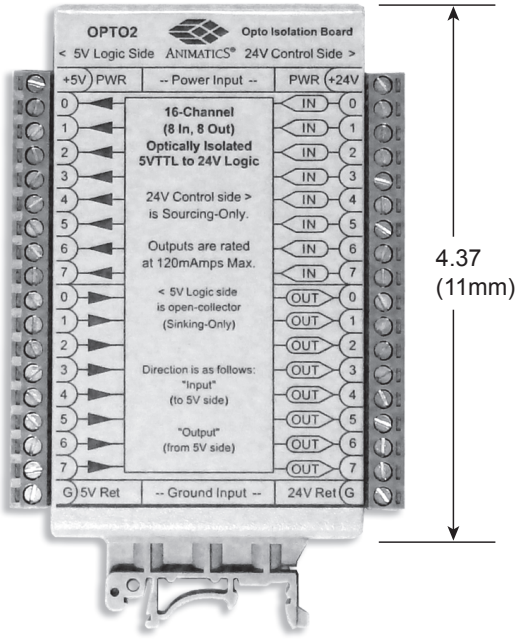
- 100 µSecond On/Off max.
- Max. continuous throughput:
  250KHz @50% duty cycle square wave.



Sample Schematic of Inputs and Outputs:







SmartBox™: This handheld diagnostics and testing interface is designed as an aid in test and development of Moog Animatics SmartMotor™ applications. The SmartBox™ is small and compact in size but it offers big returns in convenience and time savings. Its portability and simple operation make it ideal for use at remote locations to run SmartMotor™ functions and for onsite testing.

The SmartBox hardware consists of:

- Two-Color LED connected to Port C output can be programmed for three states: OFF, ON (Green), or ON (Red)
- Three position toggle switch (Go)-Off-(Sel.) spring return to center
- Analog input potentiometer connected to Port D
- External encoder input with1000 line encoder
- Four red LEDs, in two sets wired reverse parallel to Ports E and F to allow for any or all to be turned on or off.
- Cable with 15-pin D-sub I/O connector
- Power input jack on side (2.1x5mm)

Sample SmartMotor™ program available:

Select from a variety of pre-programmed modes using the Selector switch with LED indication of mode corresponding to the label on the side of the unit. This program allows simulation of the following:

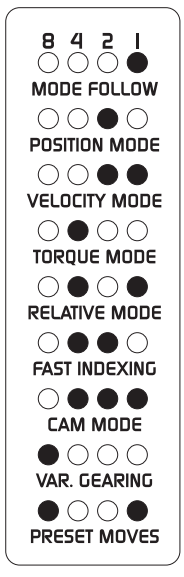
- Mode Follow at 1:1 counts following encoder knob
- Position Mode (Adjustable absolute commanded position)
- Velocity Mode (Continuously variable, bidirectional)
- Torque Mode (Continuously variable, bidirectional)
- Relative Mode (Adjustable distance)
- Fast Indexing (Self triggered with adjustable distance and dwell)
- Cam Mode
- Variable Gearing (Continuously adjustable gear ratio)
- Preset Moves (Pre-programmed multi-move profiles)

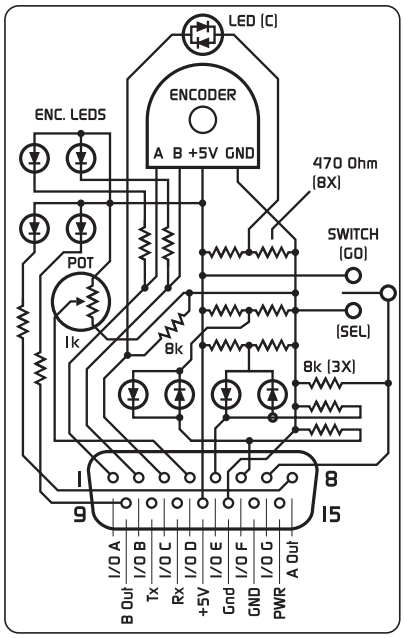
The SmartBox can test and demonstrate the following hardware connections including:

- Analog input
- Digital I/O
- Step and direction input
- Encoder I/O

NOTE: Demonstration programs available for download at www.animatics.com.

Side and Back Cover Labels:





Mode Indicator Legend and schematic are printed on the SmartBox for easy reference

SmartBoxBCD™: Designed for use with SmartSelect™ Software, the Handheld Diagnostics and Testing Interface is similar to standard Moog Animatics SmartBox, but is geared towards PLC I/O handshake simulation. It is intended for use as a means to simulate five inputs from a PLC and two outputs back to the PLC to aid in development of applications where only On/Off I/O triggering is used to control the SmartMotor™.

The SmartBoxBCD Hardware consists of:

- Two bi-color LEDs; one each connected to Ports E and F. Each can be set one of three states: OFF, ON (Green), or ON (Red)
- Five three-position toggle switches (on)-off-(Momentary-On.) where center position is off. Connected to Ports A, B, C, D, and G
- Cable with 15-pin D-sub I/O connector
- Power input jack on side (2.1x5mm)

When Used with SmartSelect™ Software:

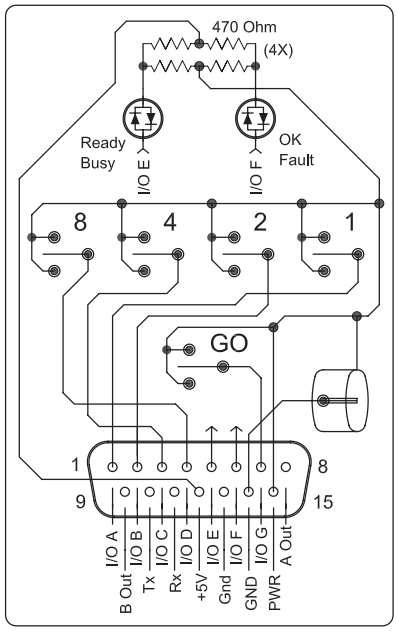
The SmartBoxBCD interface simulates:

4-bit binary Input from a PLC	on ports A, B, C, and D
"Go" input from a PLC	on Port G
Busy Output to PLC	on Port E
Fault Output to PLC	on Port F

When the Motor receives a "Go" signal, the program responds to 1 of 16 preset move profiles as determined by the 4-bit binary input state of Ports A, B, C, and D. While moving, the "Busy" LED is red, once done, it switches to green. If a fault occurs, the fault LED switches from green to red.

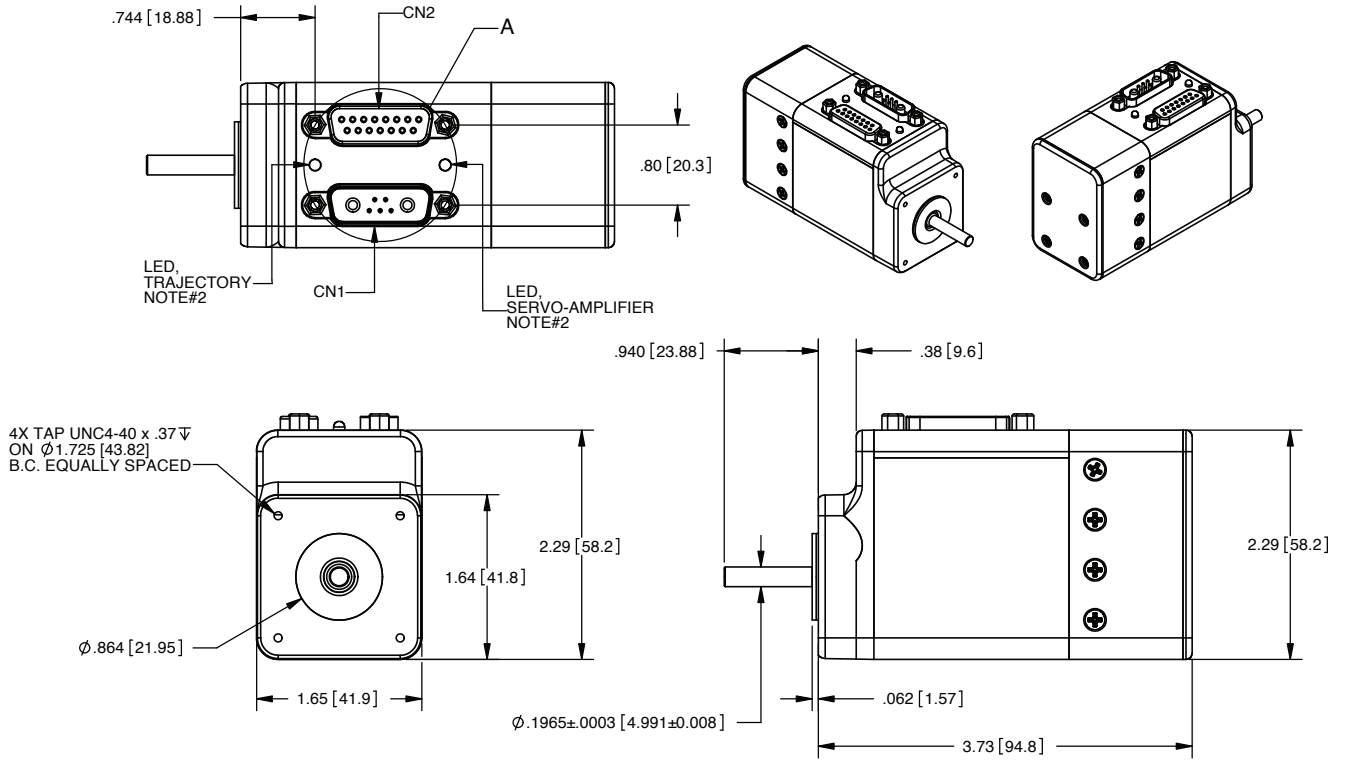
The SmartBoxBCD allows complete set-up and test of a SmartMotor™ in conjunction with the point-And-click SmartSelect™ programming tool. In doing so, the entire servo control of a system can be set up and tested prior to PLC programming or I/O connections. As a result, machine development time is reduced to a minimum.

Back Cover Label Shows internal Schematic:

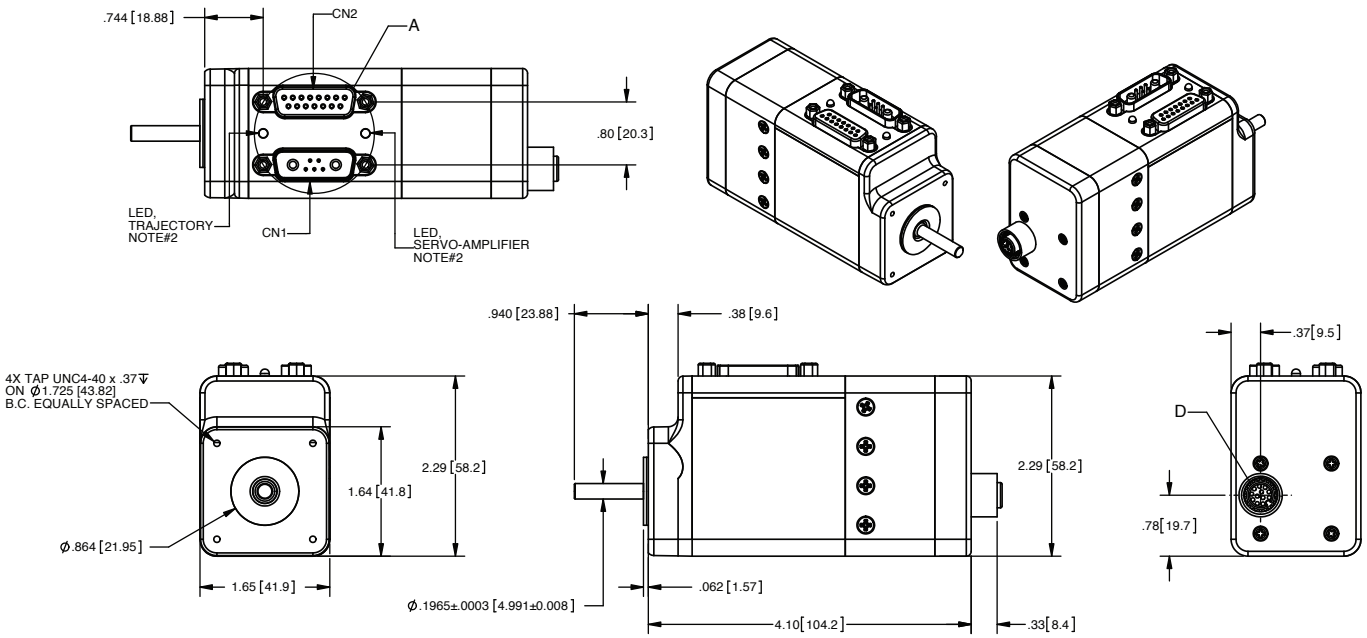


Notes

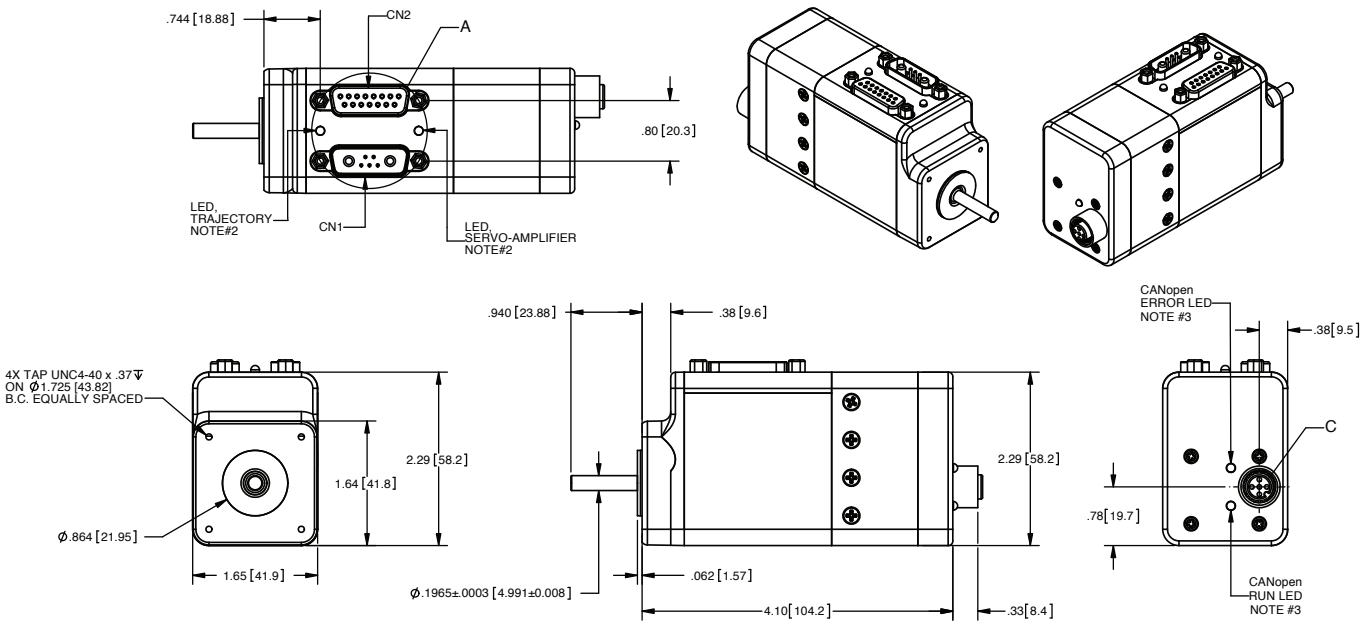
Moog Animatics SmartMotor™ SM17205D



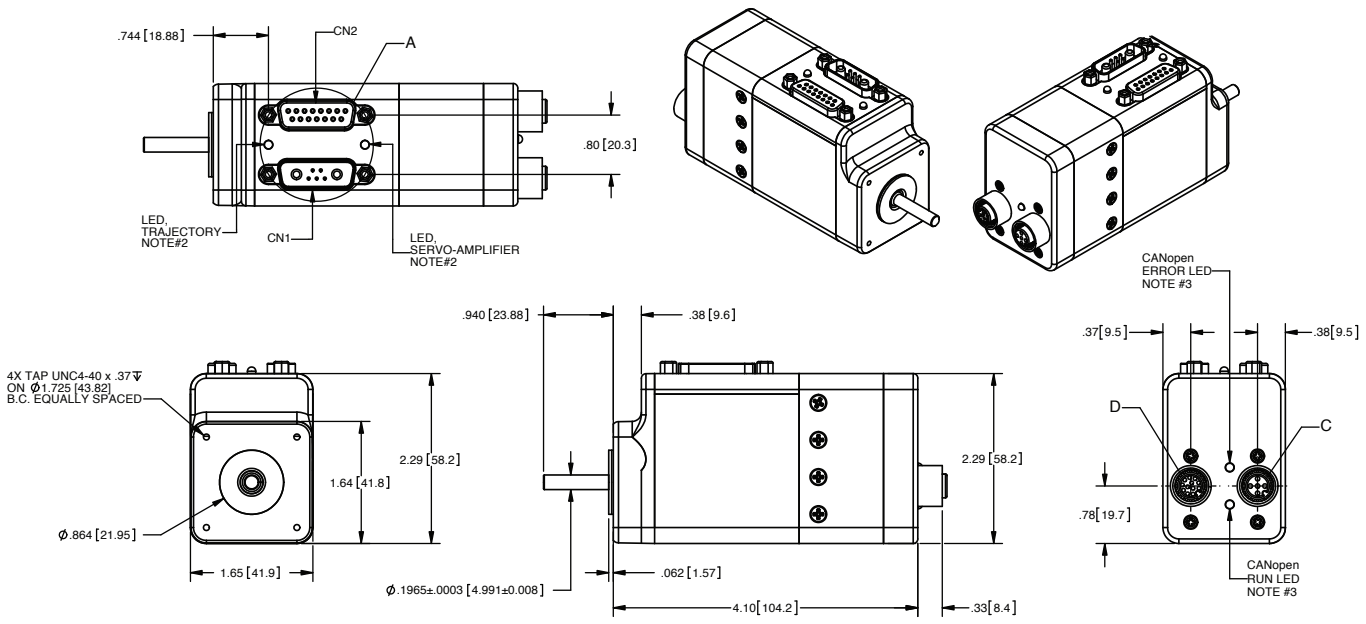
Moog Animatics SmartMotor™ SM17205D-AD1



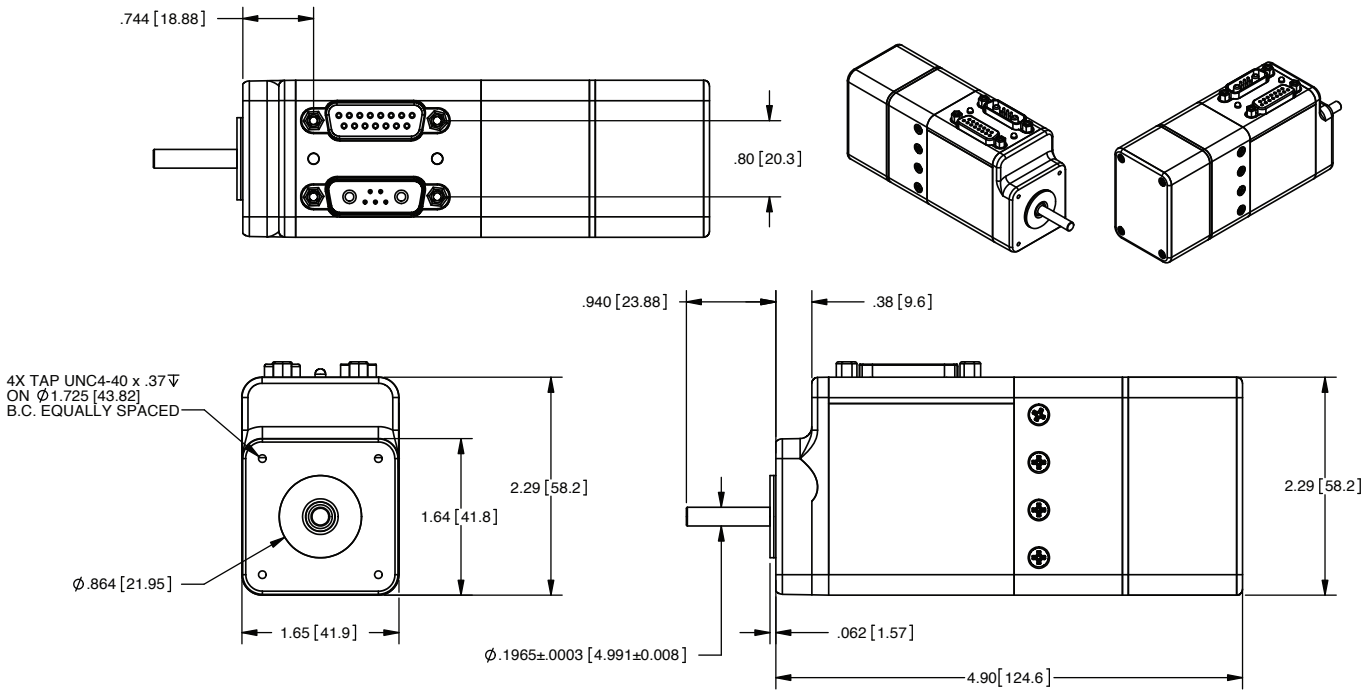
Moog Animatics SmartMotor™ SM17205D-C



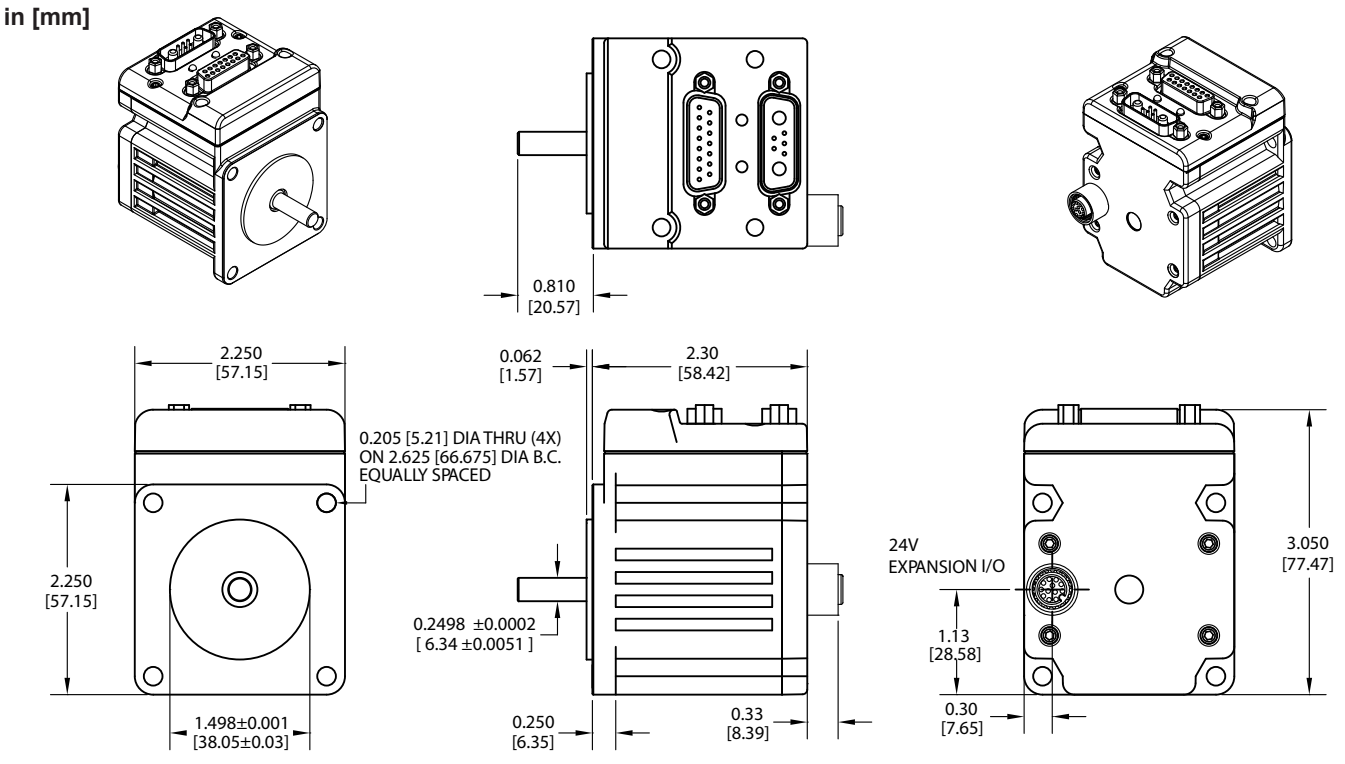
Moog Animatics SmartMotor™ SM17205D-C-AD1



Moog Animatics SmartMotor™ SM17205D-BRK



Moog Animatics SmartMotor™ SM23165D/DT-AD1



Moog Animatics SmartMotor™ SM23165D/DT-C

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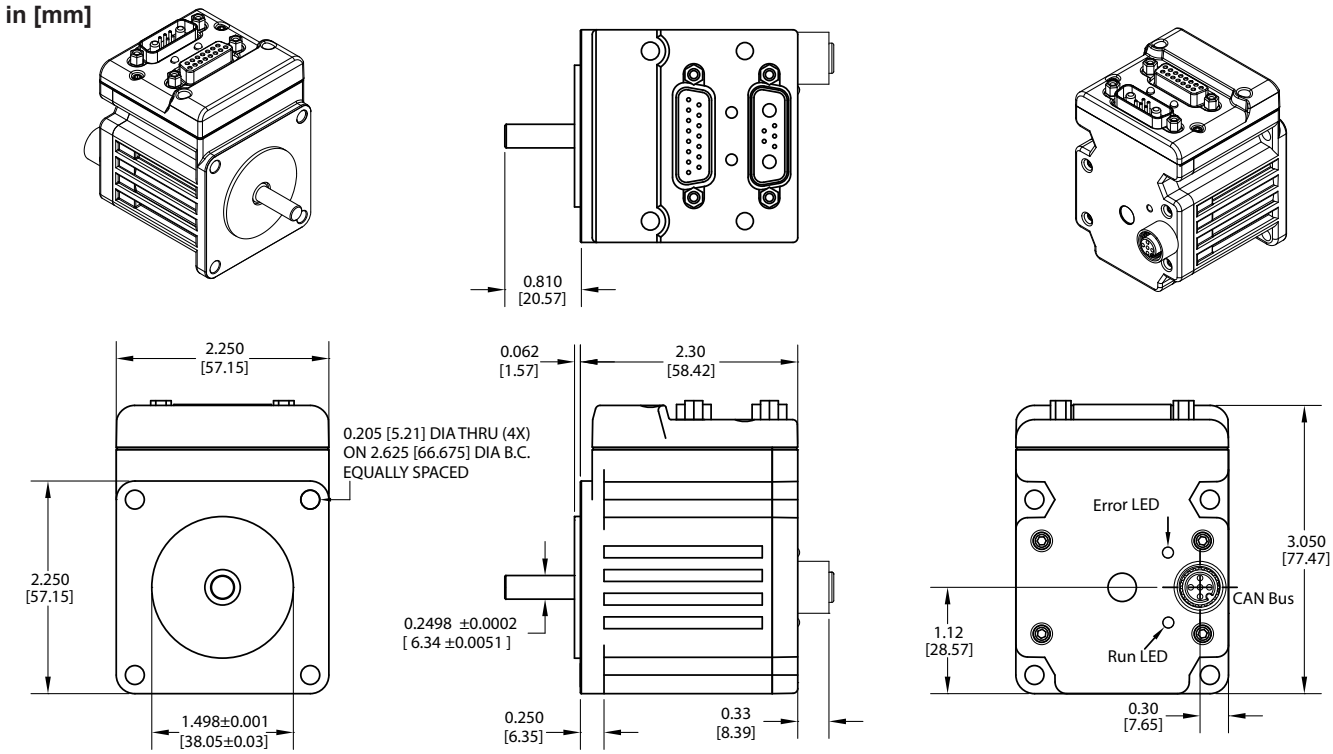
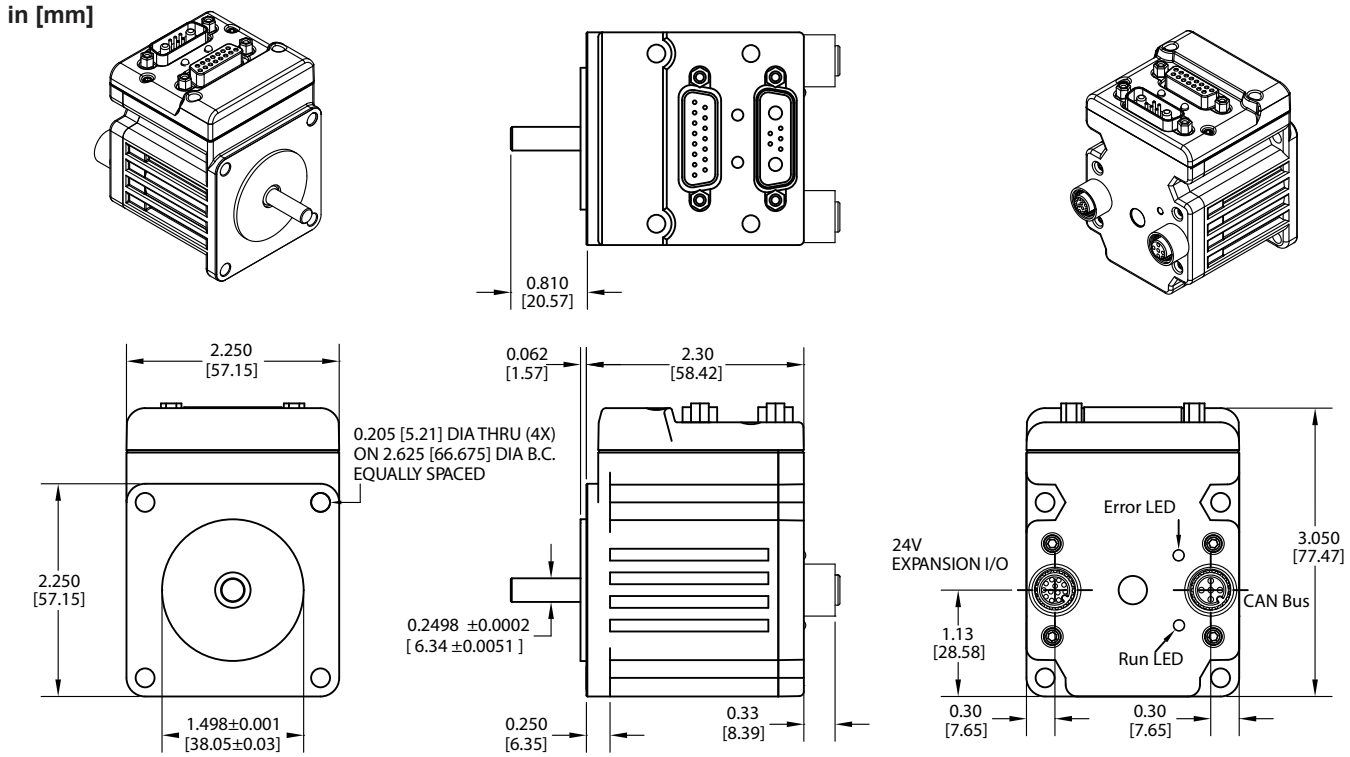


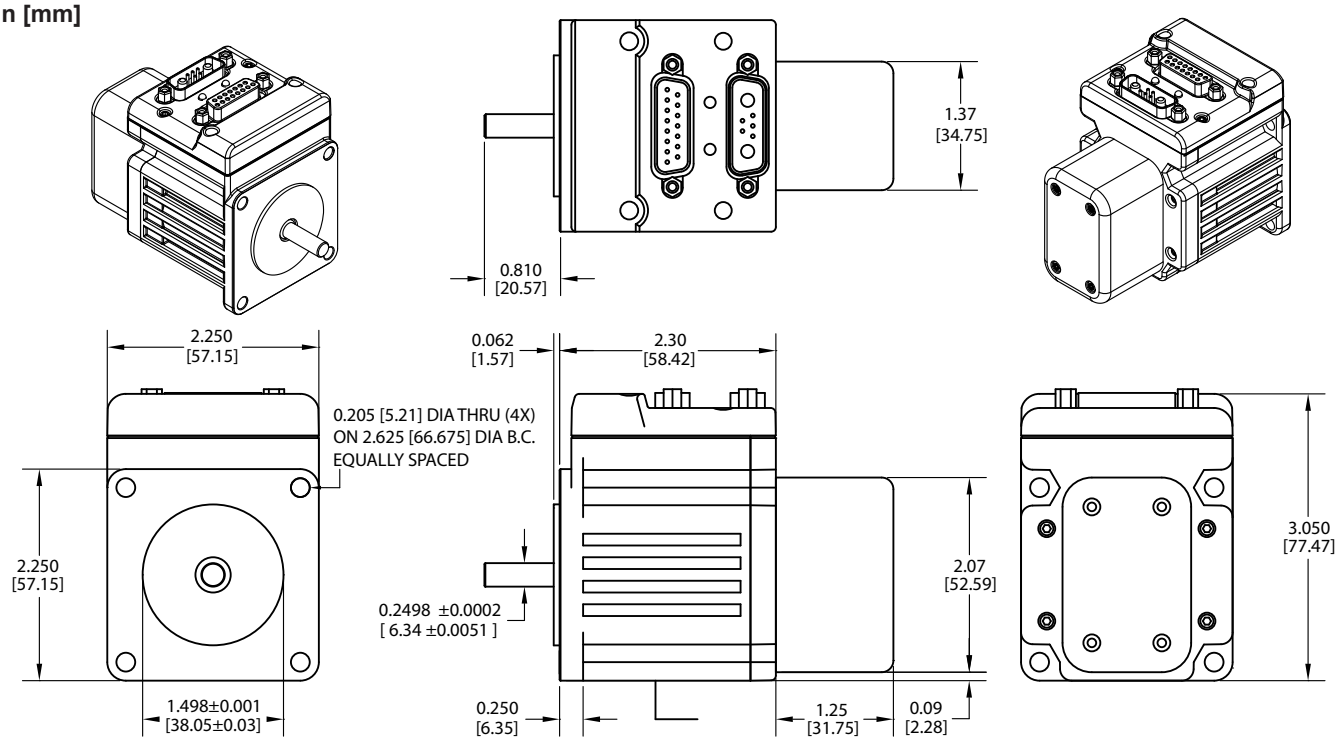
Moog Animatics SmartMotor™ SM23165D/DT-C-AD1

in [mm]



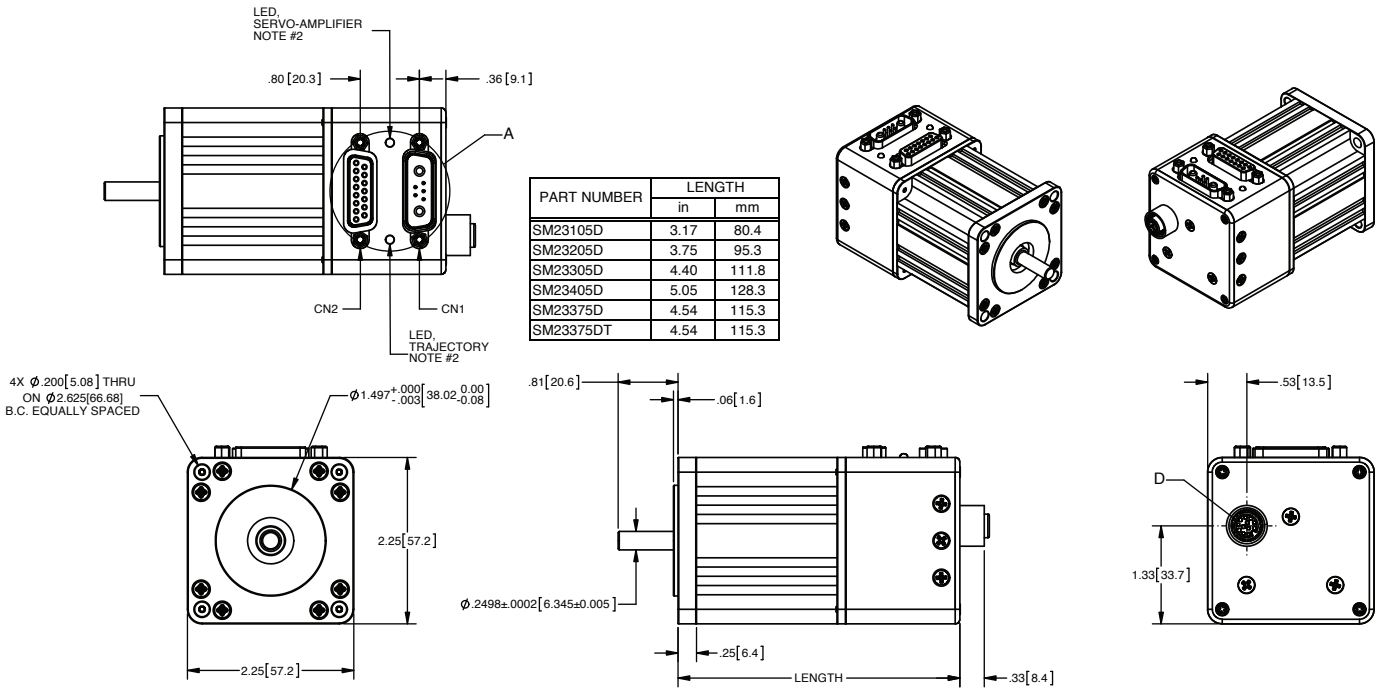
Moog Animatics SmartMotor™ SM23165D/DT-BRK & CDS Option

in [mm]



Moog Animatics SmartMotor™ SM23x05D-AD1

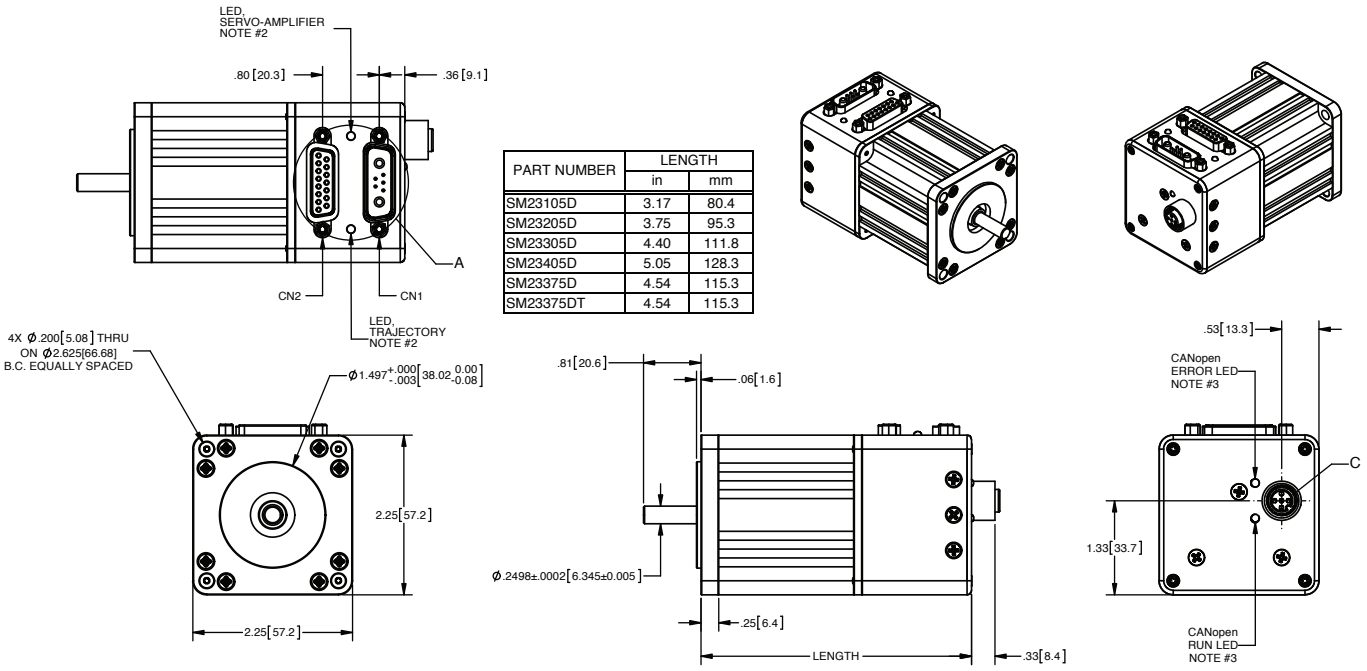
in [mm]



PART NUMBER	LENGTH	
	in	mm
SM23105D	3.17	80.4
SM23205D	3.75	95.3
SM23305D	4.40	111.8
SM23405D	5.05	128.3
SM23375D	4.54	115.3
SM23375DT	4.54	115.3

Moog Animatics SmartMotor™ SM23x05D-C

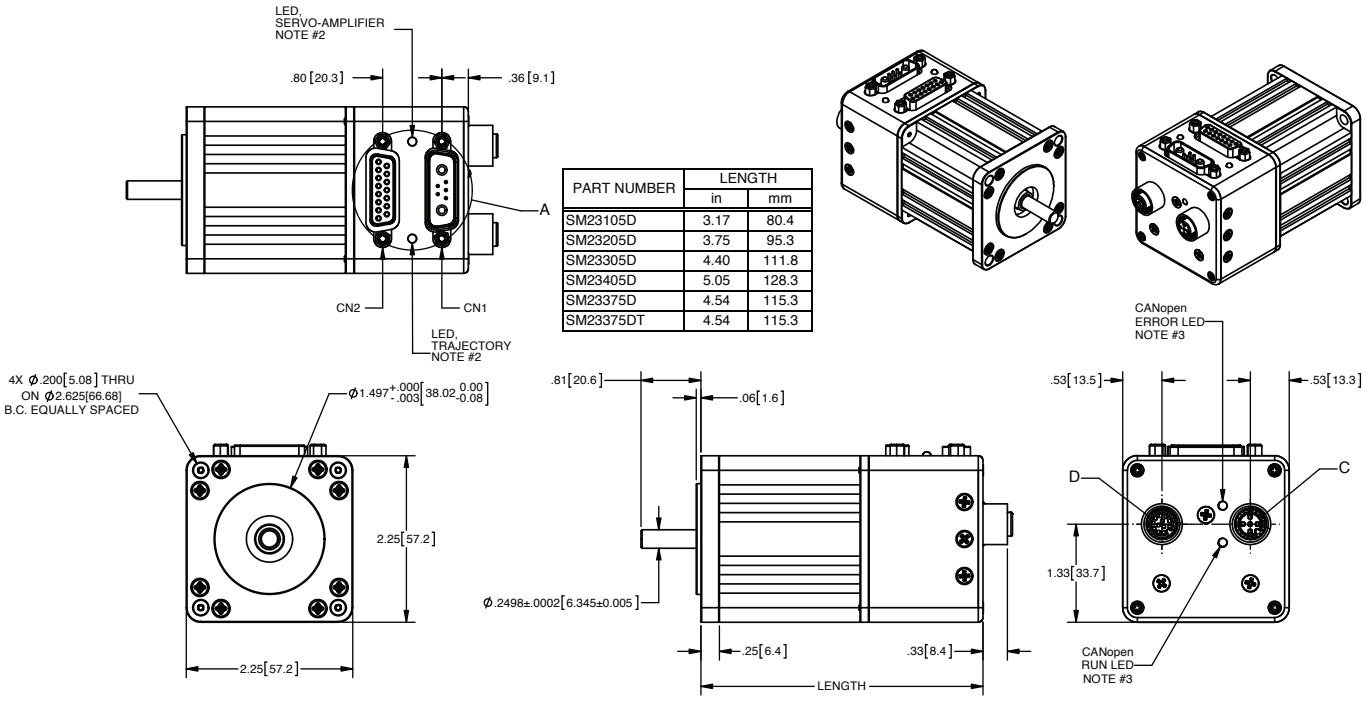
in [mm]



PART NUMBER	LENGTH	
	in	mm
SM23105D	3.17	80.4
SM23205D	3.75	95.3
SM23305D	4.40	111.8
SM23405D	5.05	128.3
SM23375D	4.54	115.3
SM23375DT	4.54	115.3

Moog Animatics SmartMotor™ SM23x05D-C-AD1

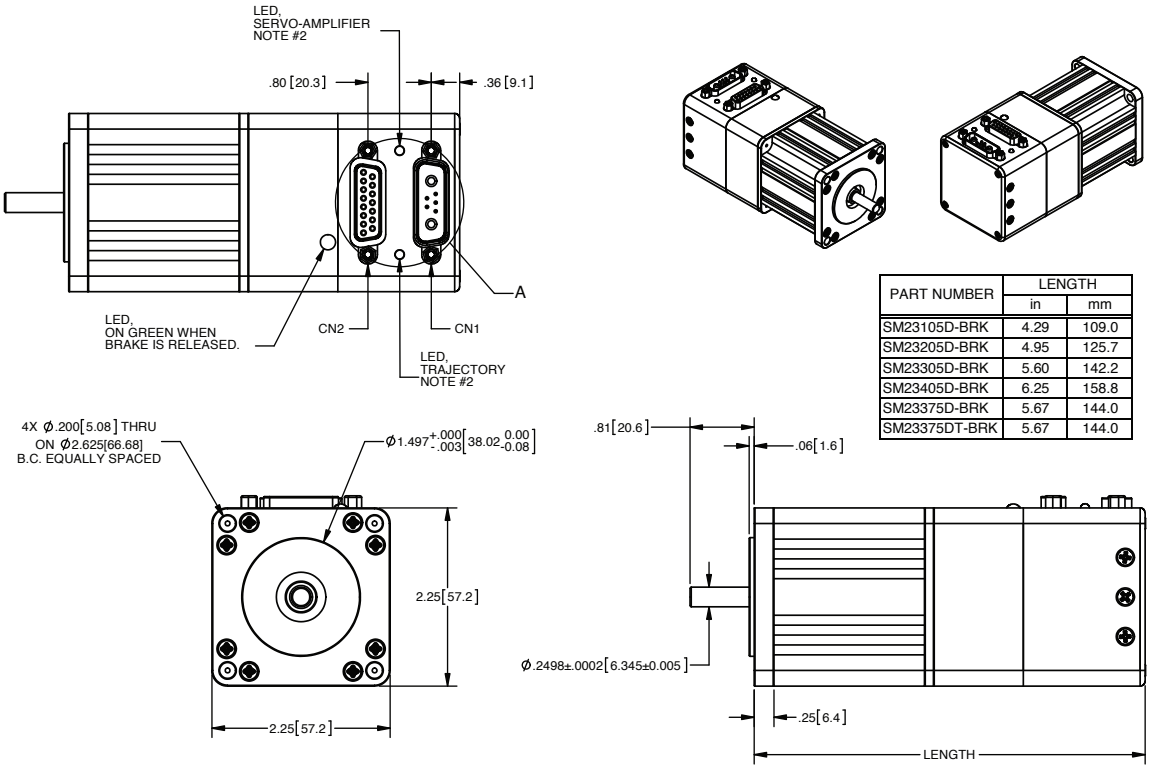
in [mm]



PART NUMBER	LENGTH	
	in	mm
SM23105D	3.17	80.4
SM23205D	3.75	95.3
SM23305D	4.40	111.8
SM23405D	5.05	128.3
SM23375D	4.54	115.3
SM23375DT	4.54	115.3

Moog Animatics SmartMotor™ SM23x05D-BRK

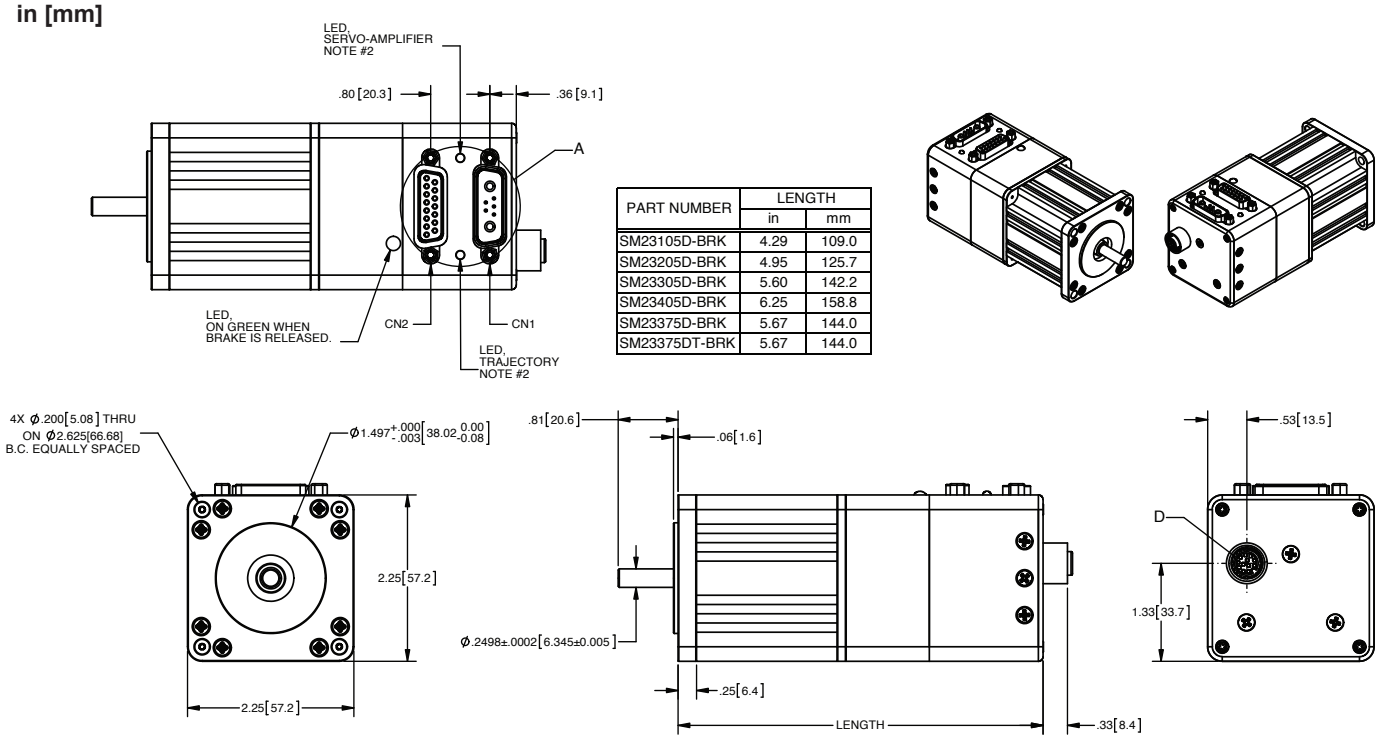
in [mm]



PART NUMBER	LENGTH	
	in	mm
SM23105D-BRK	4.29	109.0
SM23205D-BRK	4.95	125.7
SM23305D-BRK	5.60	142.2
SM23405D-BRK	6.25	158.8
SM23375D-BRK	5.67	144.0
SM23375DT-BRK	5.67	144.0

Moog Animatics SmartMotor™ SM23x05D-BRK-AD1

in [mm]



PART NUMBER	LENGTH	
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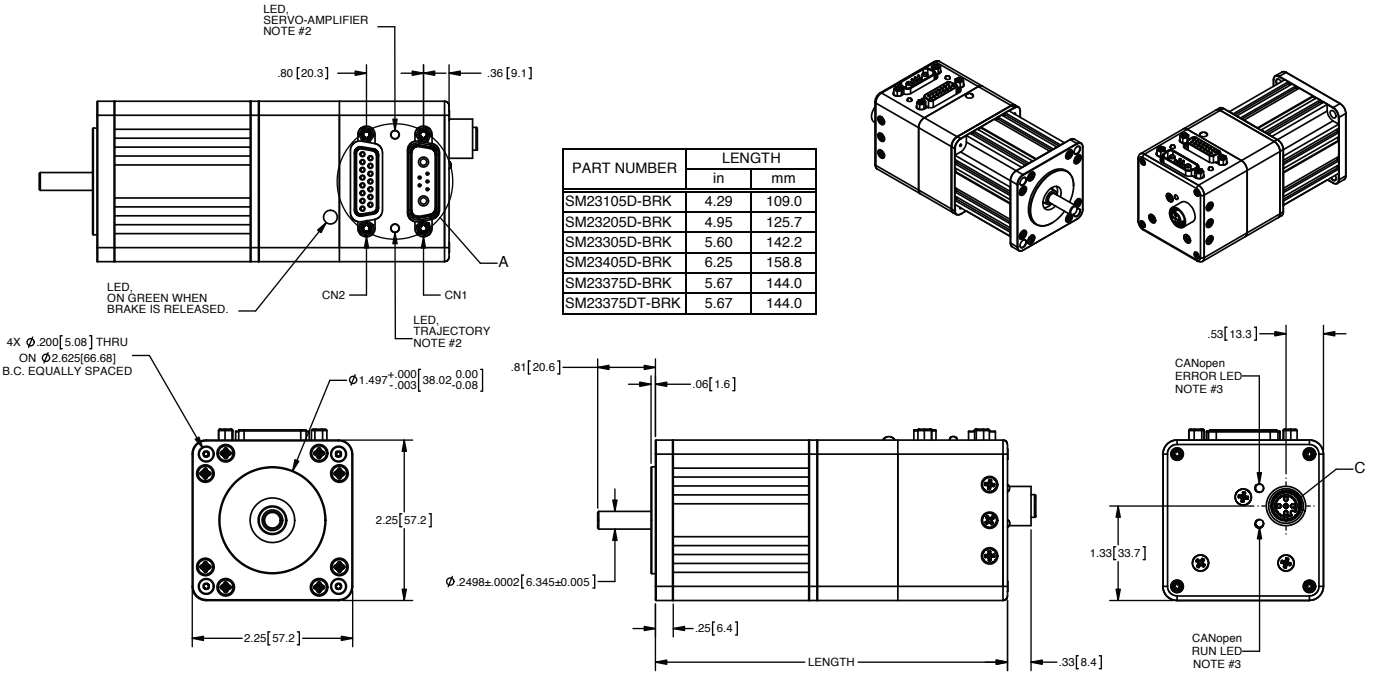
SM23205D-BRK	4.95	125.7
SM23305D-BRK	5.60	142.2
SM23405D-BRK	6.25	158.8
SM23375D-BRK	5.67	144.0
SM23375DT-BRK	5.67	144.0

Moog Animatics SmartMotor™ SM23x05D-BRK-C

in [mm]



PART NUMBER	LENGTH	
	in	mm
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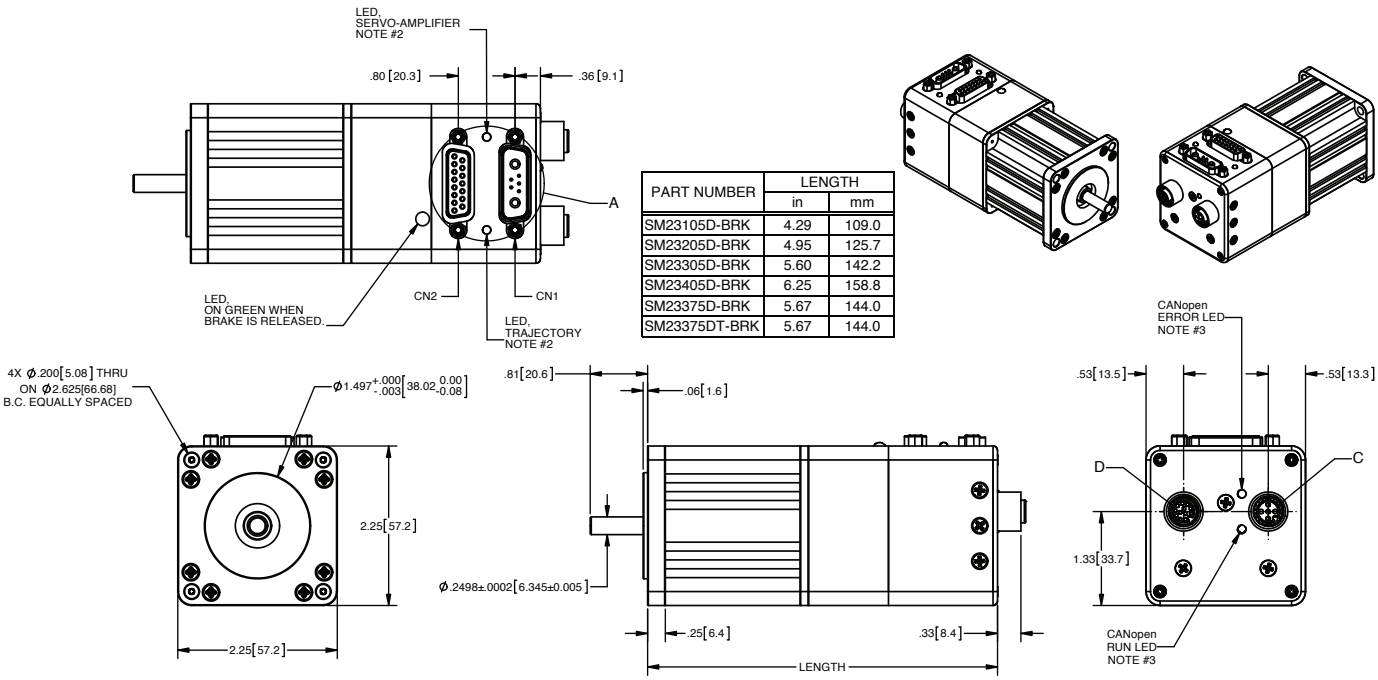
SM23205D-BRK	4.95	125.7
SM23305D-BRK	5.60	142.2
SM23405D-BRK	6.25	158.8
SM23375D-BRK	5.67	144.0
SM23375DT-BRK	5.67	144.0

Moog Animatics SmartMotor™ SM23x05D-BRK-C-AD1

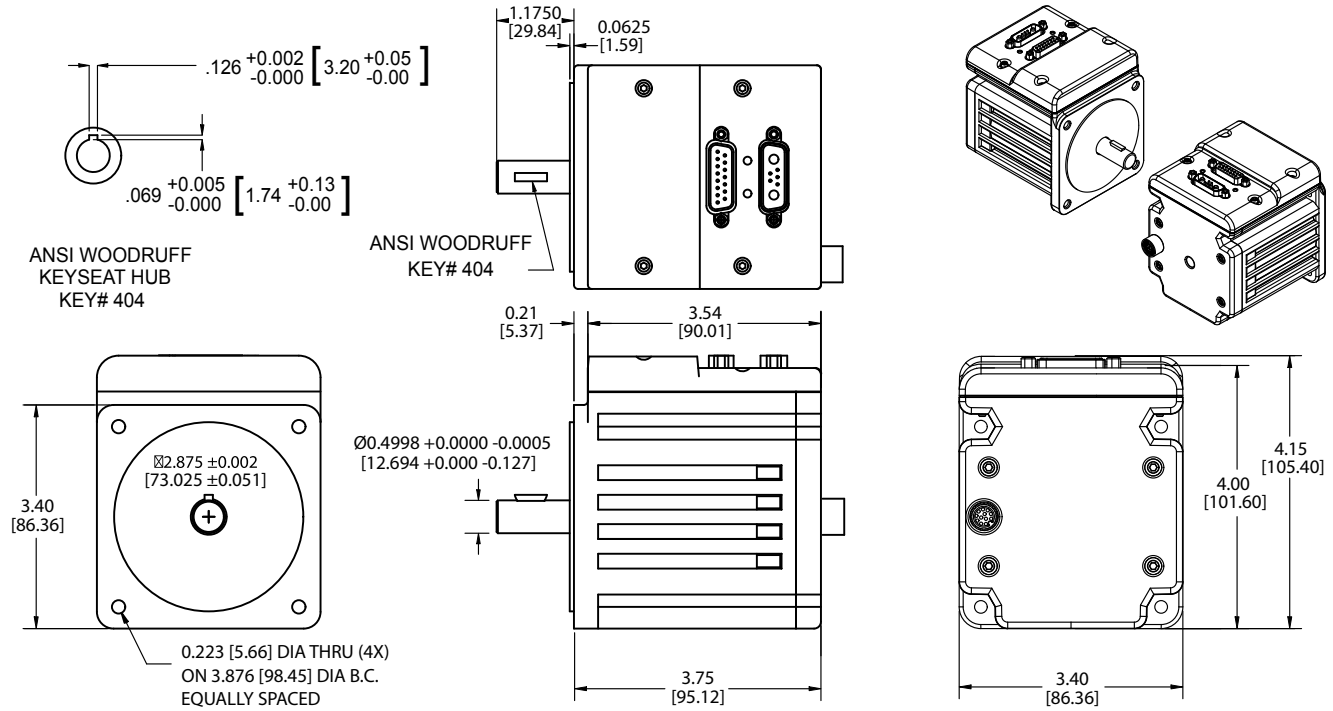
in [mm]



PART NUMBER	LENGTH	
	in	mm
SM23105D-BRK	4.29	109.0
SM23205D-BRK	4.95	125.7
SM23305D-BRK	5.60	142.2
SM23405D-BRK	6.25	158.8
SM23375D-BRK	5.67	144.0
SM23375DT-BRK	5.67	144.0

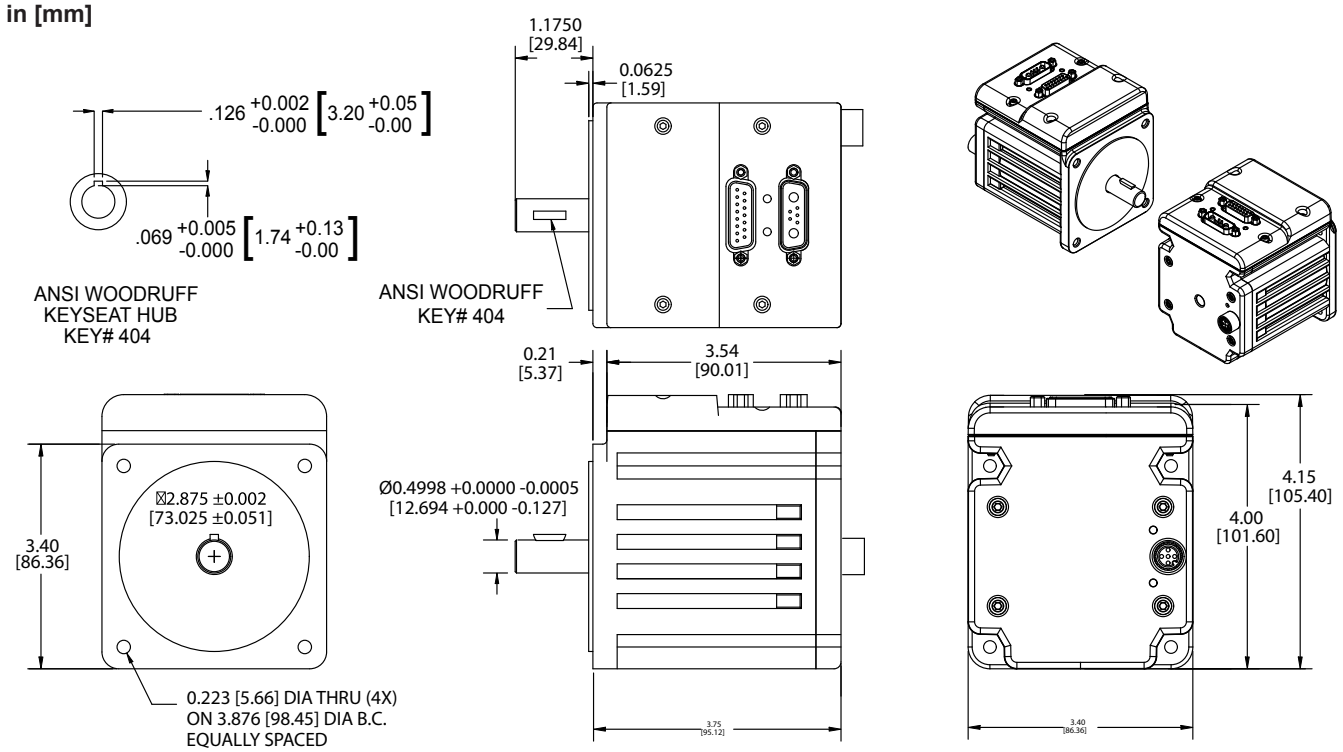
Moog Animatics SmartMotor™ SM34165DT-AD1

in [mm]



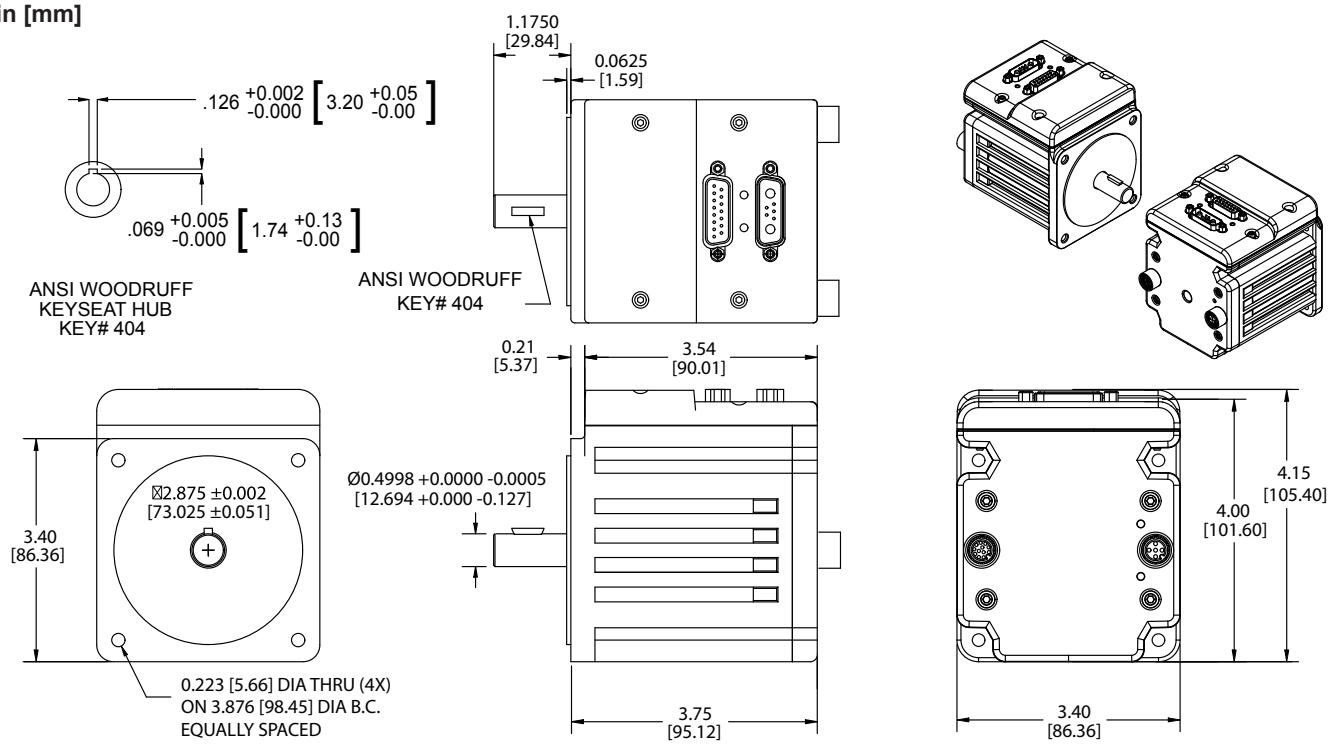
Moog Animatics SmartMotor™ SM34165DT-C

in [mm]



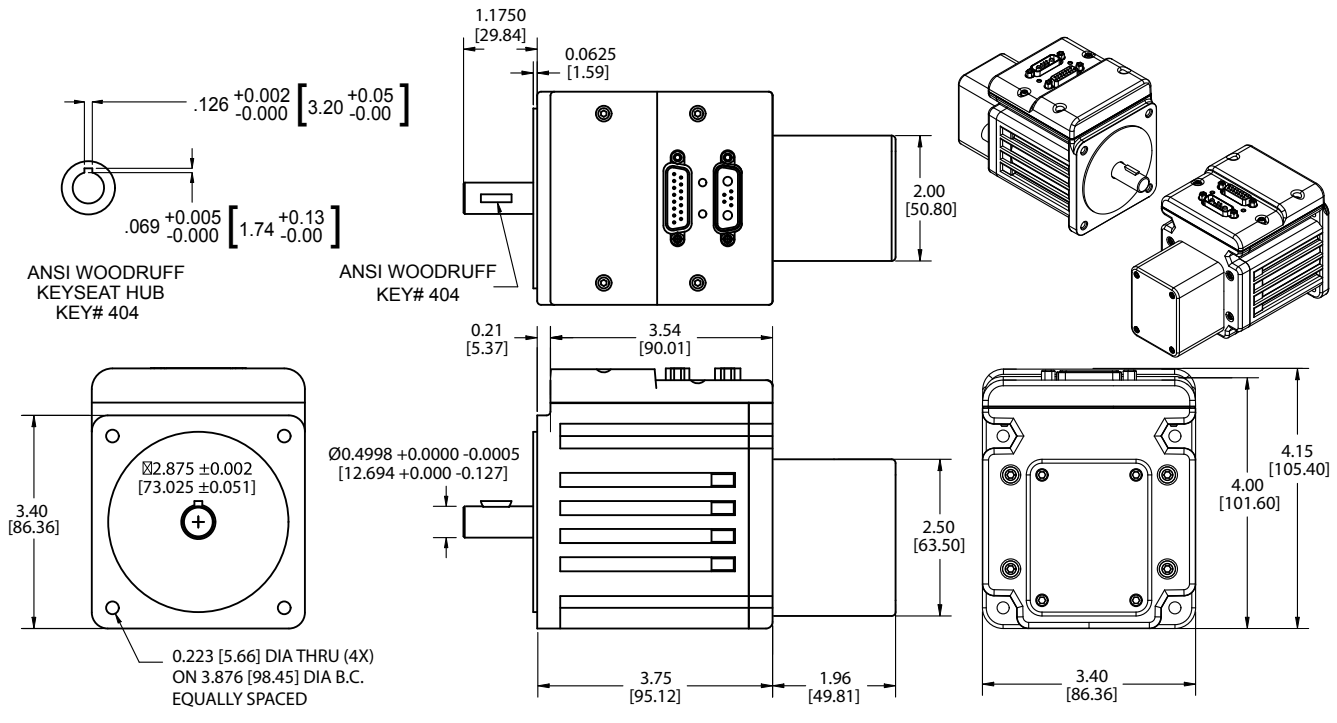
Moog Animatics SmartMotor™ SM34165DT-C-AD1

in [mm]



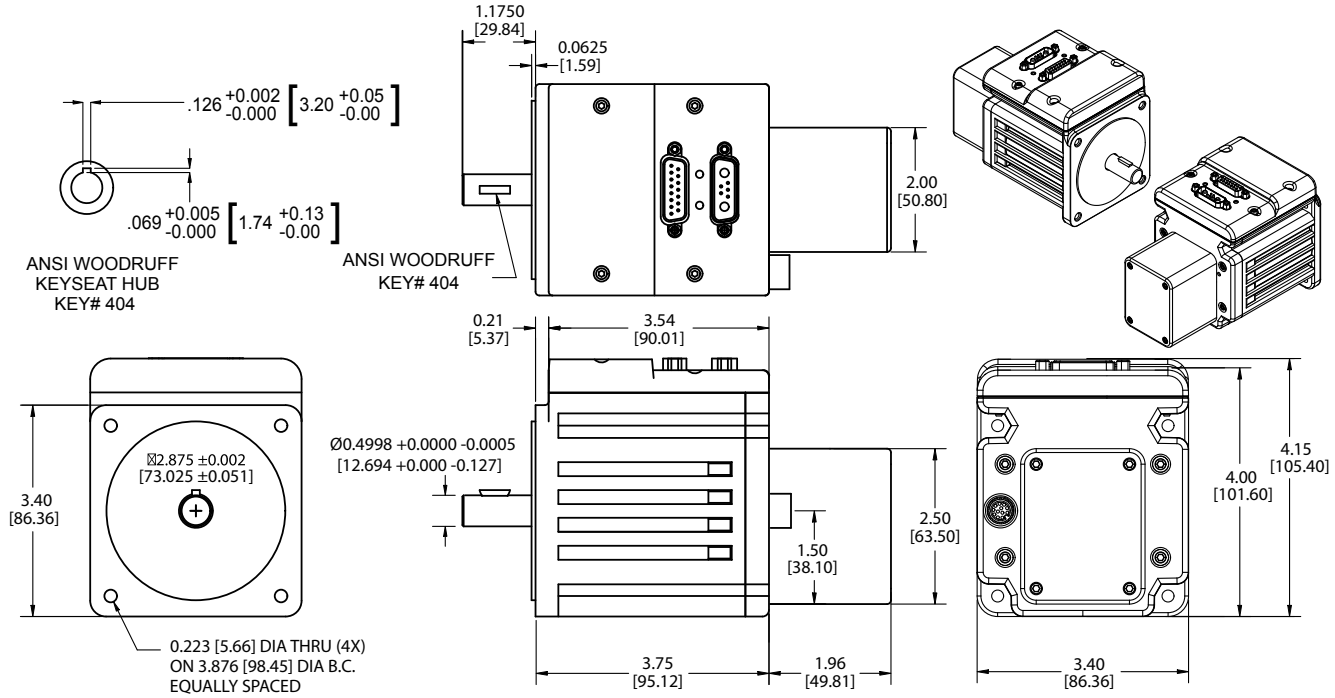
Moog Animatics SmartMotor™ SM34165DT-BRK

in [mm]



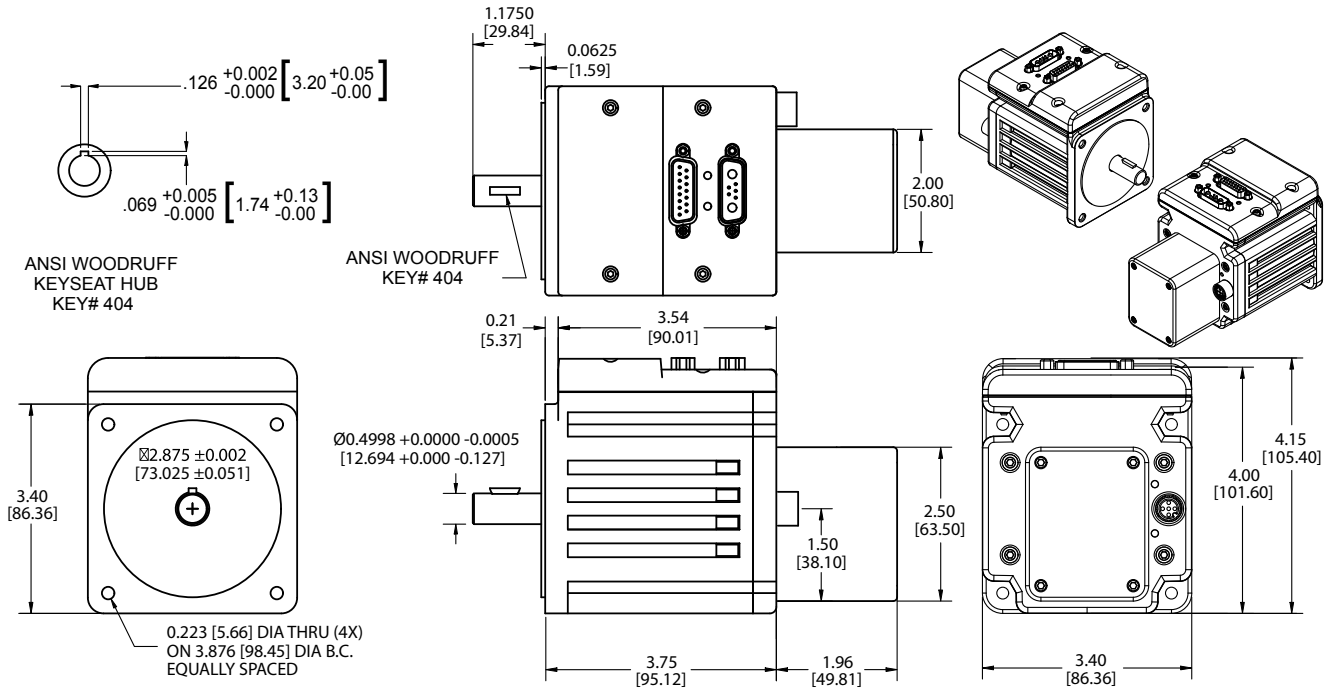
Moog Animatics SmartMotor™ SM34165DT-BRK-AD1

in [mm]



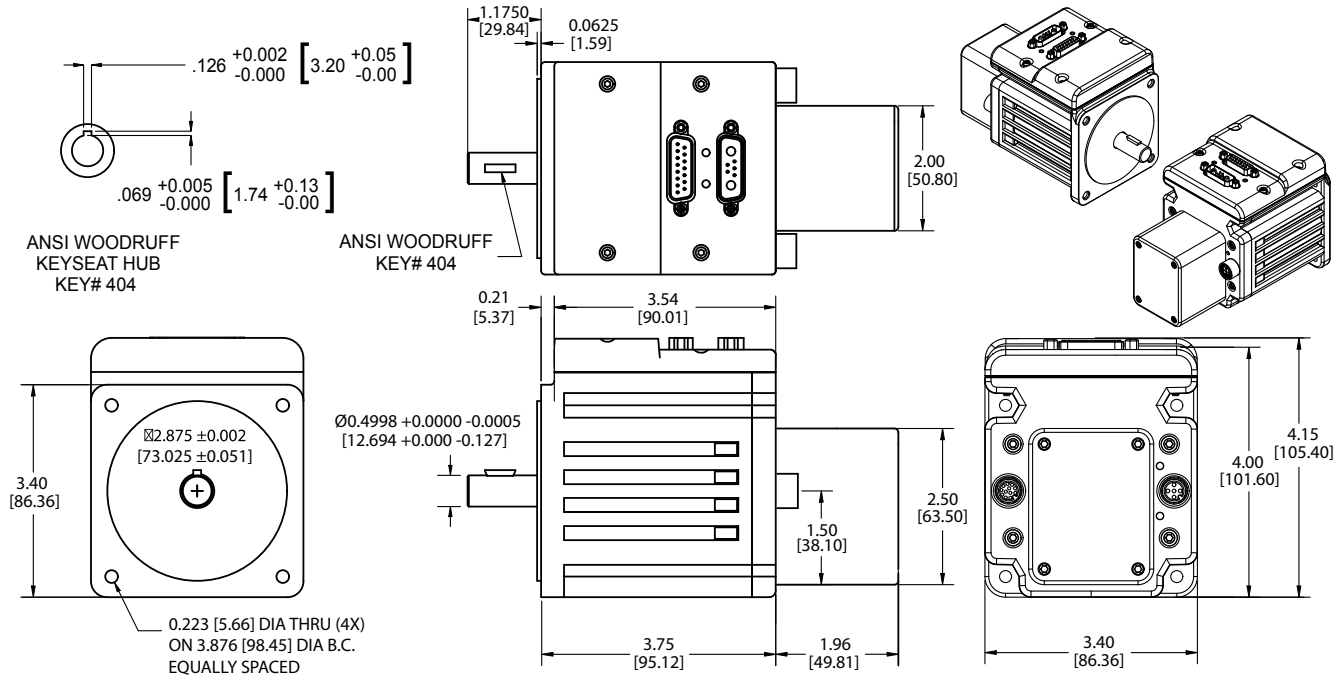
Moog Animatics SmartMotor™ SM34165DT-BRK-C

in [mm]



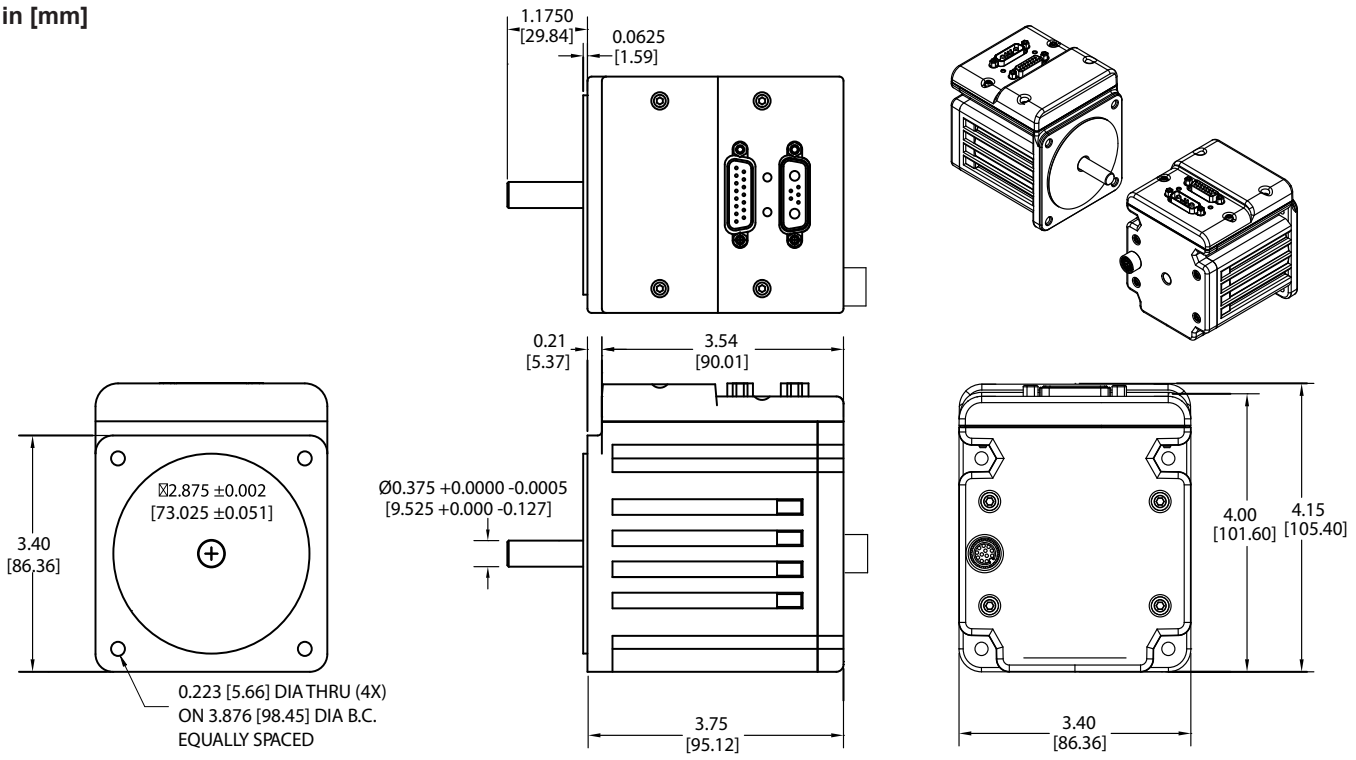
Moog Animatics SmartMotor™ SM34165DT-BRK-C-AD1

in [mm]



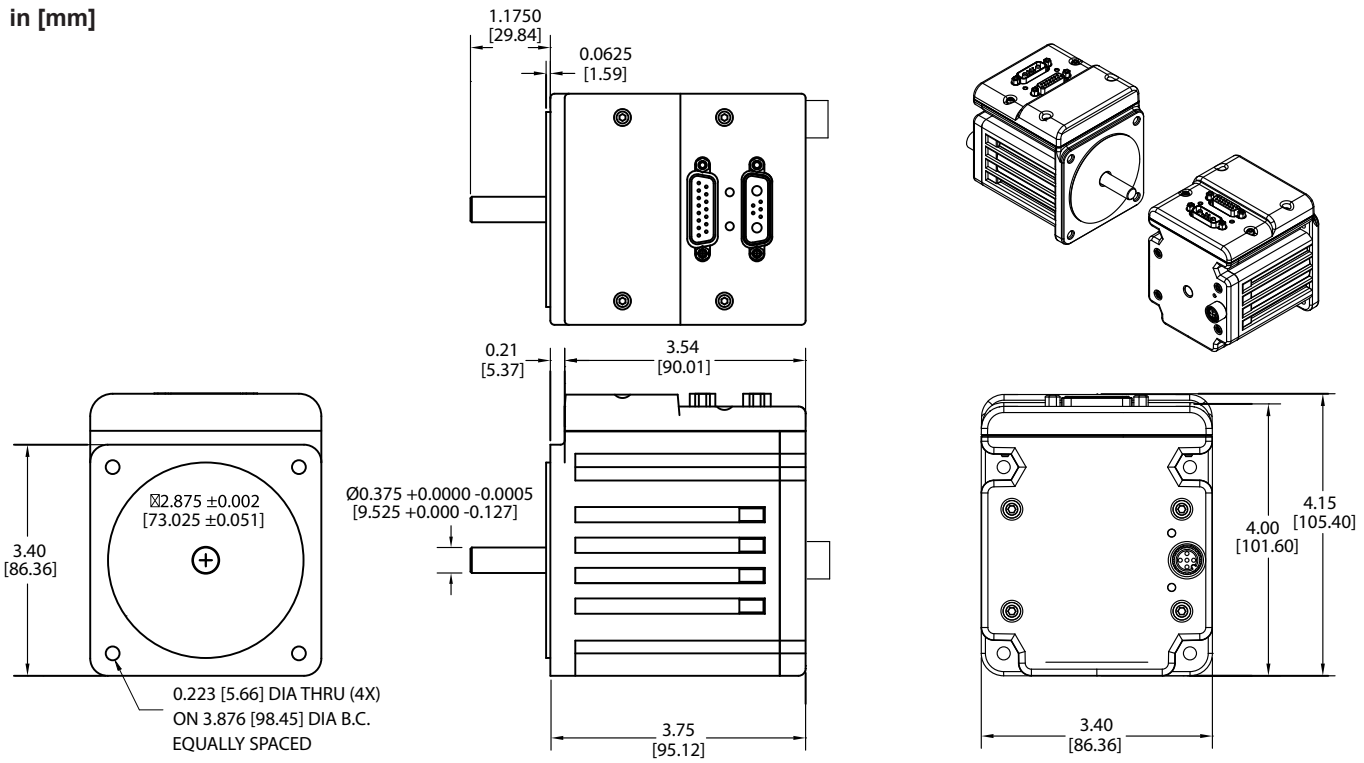
Moog Animatics SmartMotor™ SM34165D-AD1

in [mm]



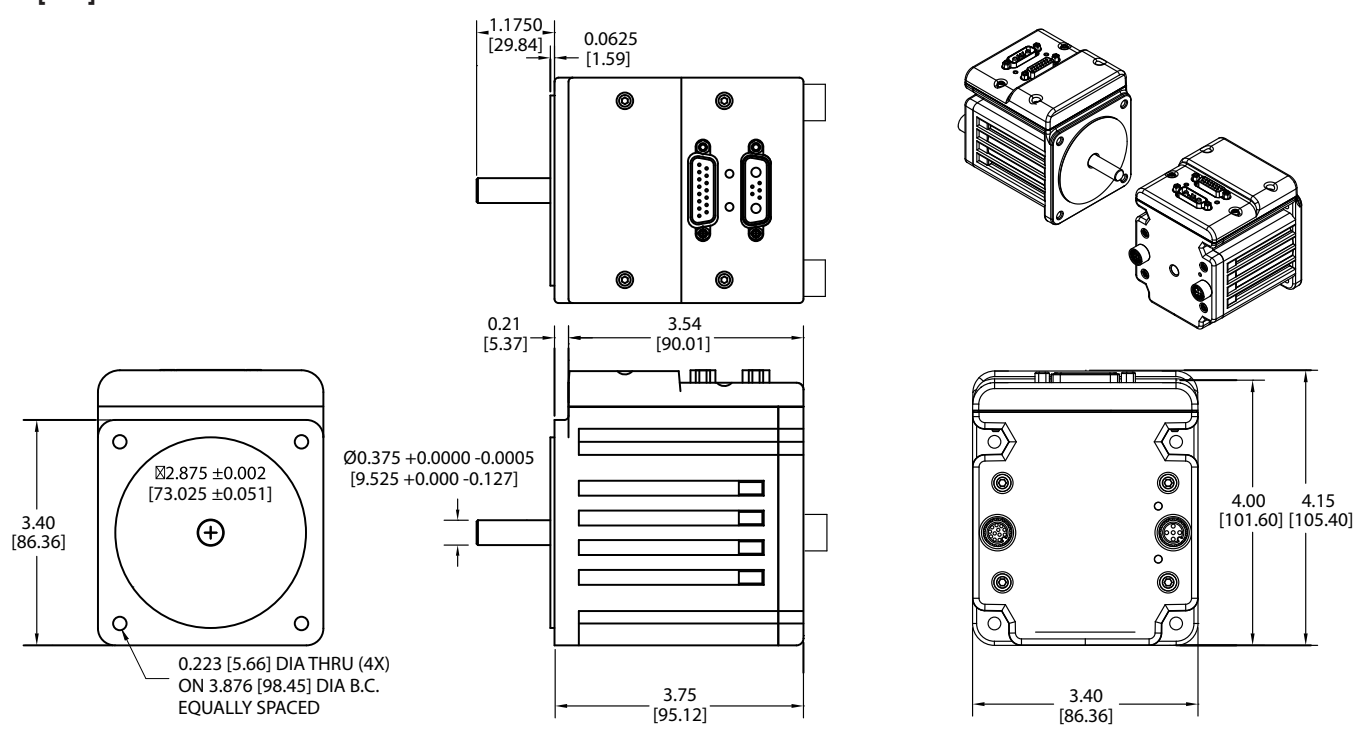
Moog Animatics SmartMotor™ SM34165D-C

in [mm]



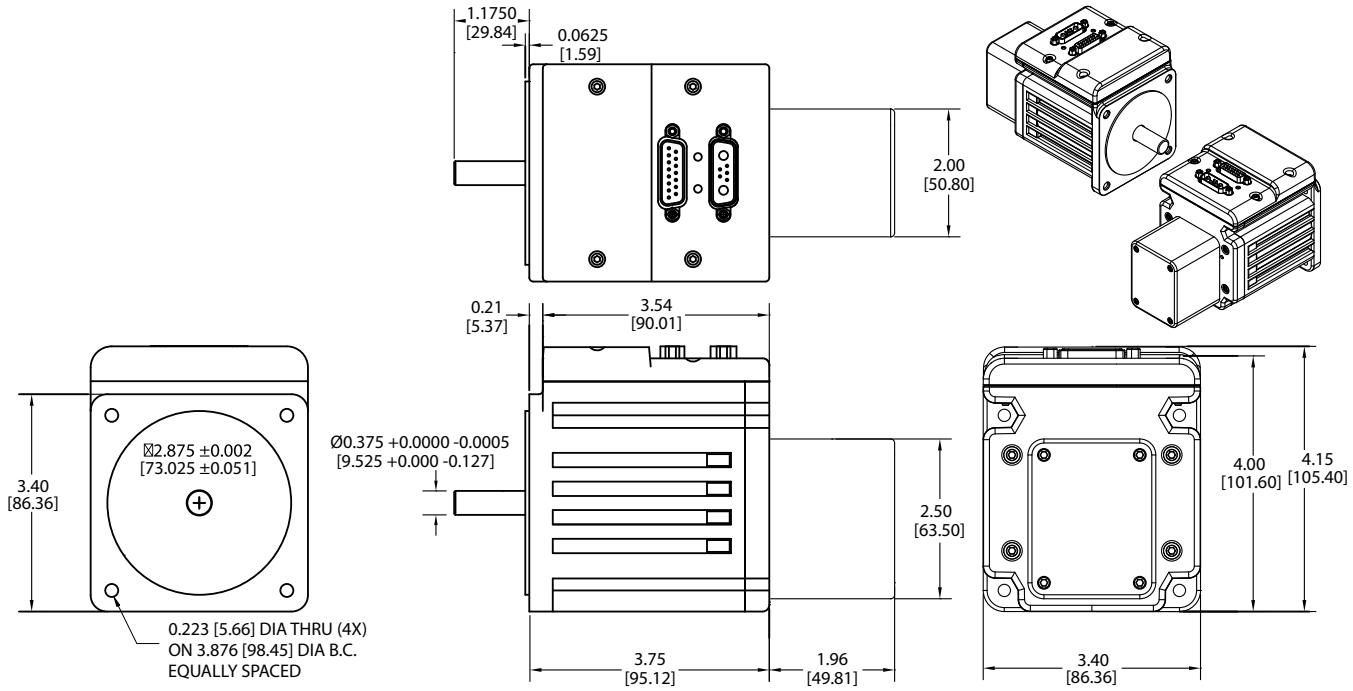
Moog Animatics SmartMotor™ SM34165D-C-AD1

in [mm]



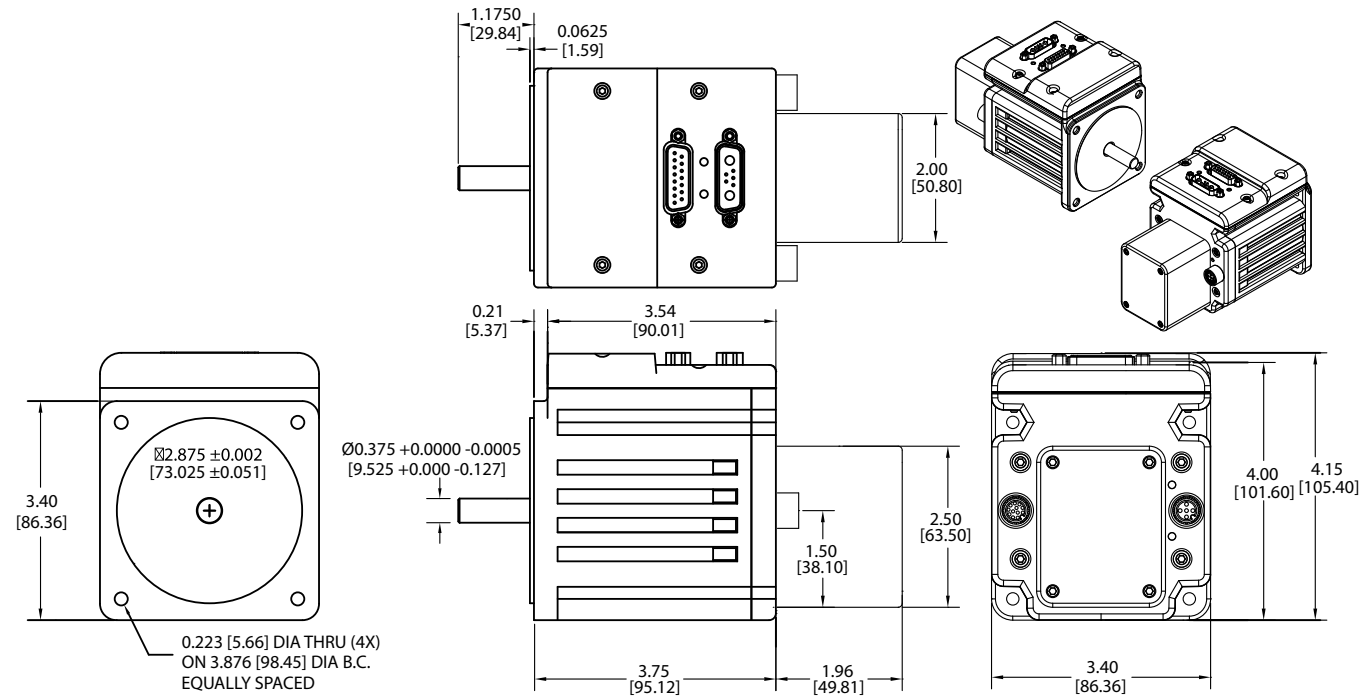
Moog Animatics SmartMotor™ SM34165D-BRK

in [mm]



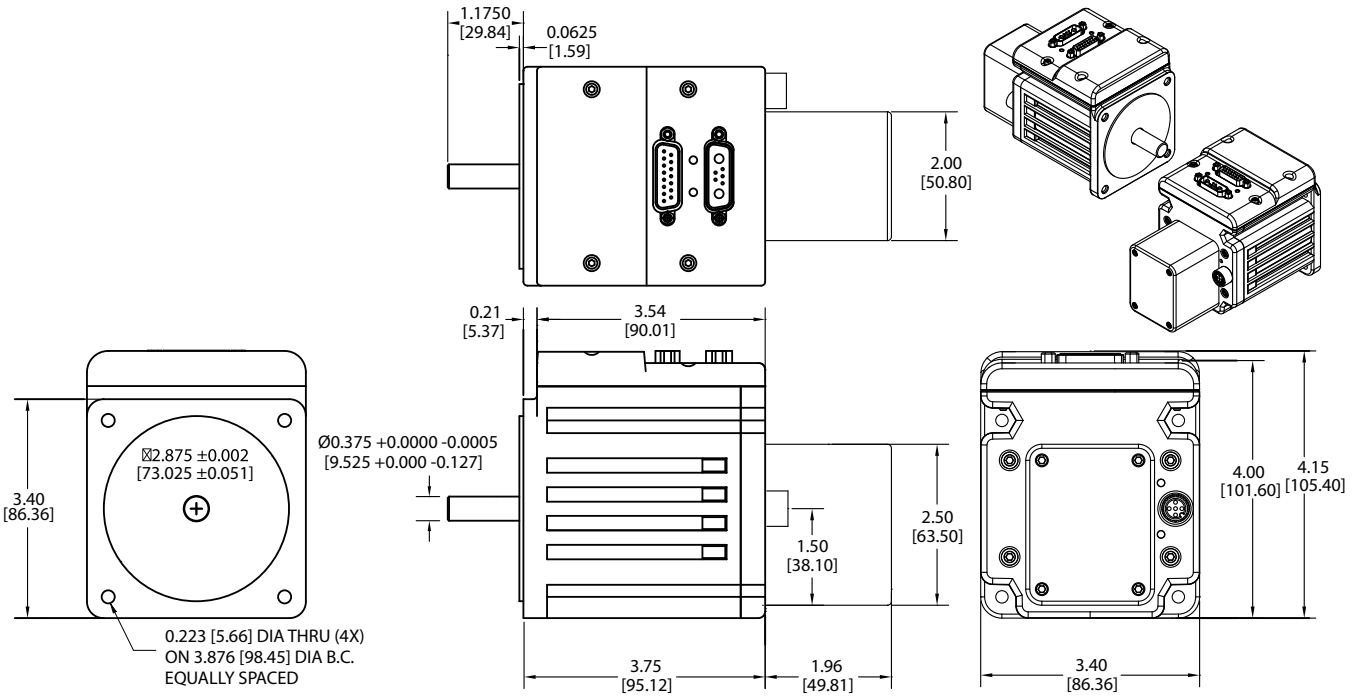
Moog Animatics SmartMotor™ SM34165D-BRK-C-AD1

in [mm]



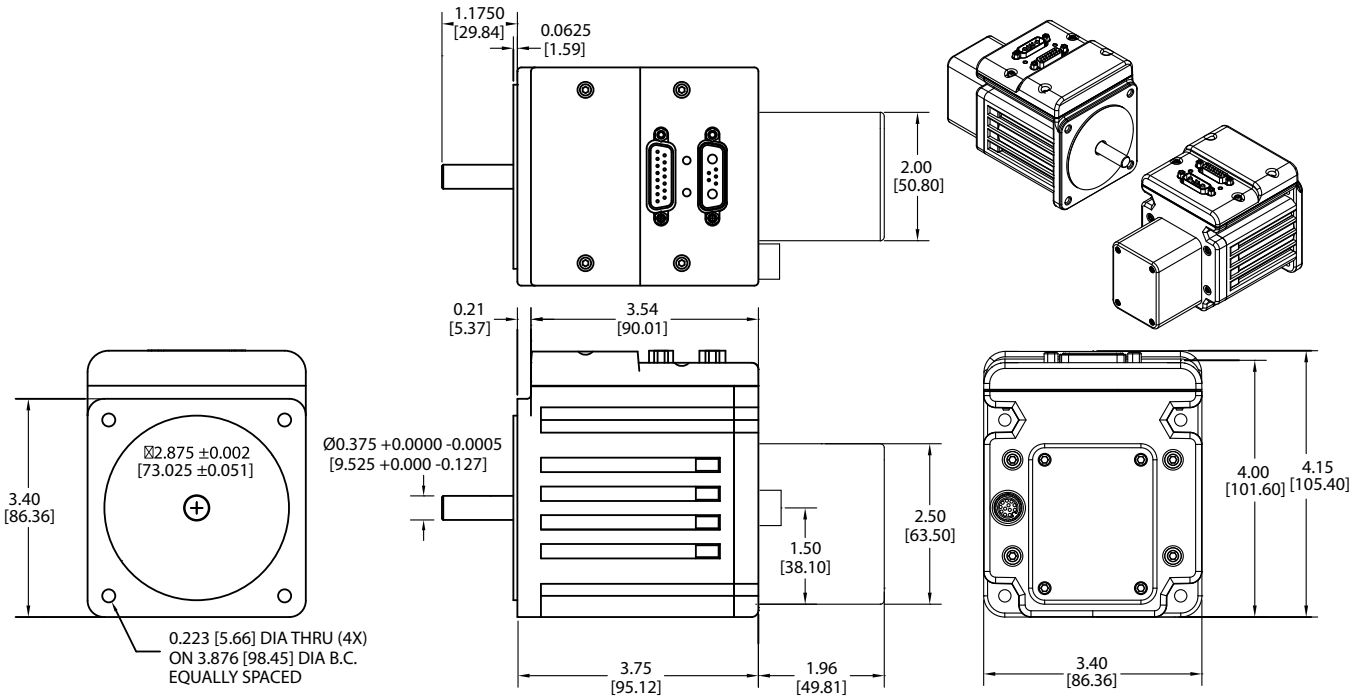
Moog Animatics SmartMotor™ SM34165D-BRK-C

in [mm]



Moog Animatics SmartMotor™ SM34165D-BRK-AD1

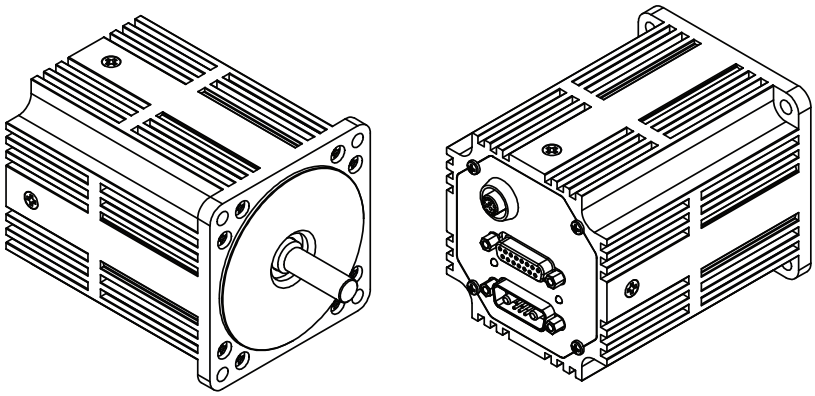
in [mm]

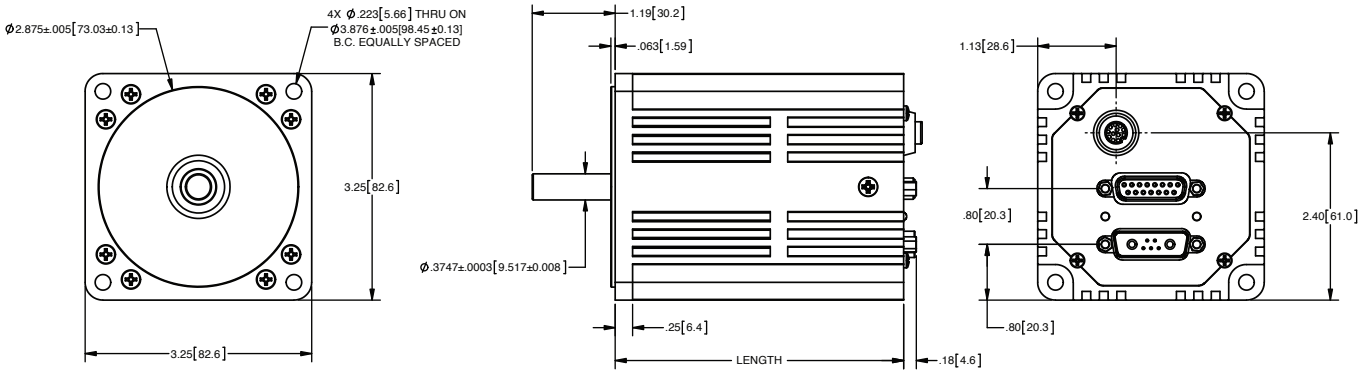


Moog Animatics SmartMotor™ SM34x05D-AD1

in [mm]

PART NUMBER	LENGTH	
	in	mm
5M34105D	3.49	88.6
5M34205D	4.14	105.1
5M34305D	4.79	121.6
5M34405D	5.44	138.1
5M34505D	6.09	154.6

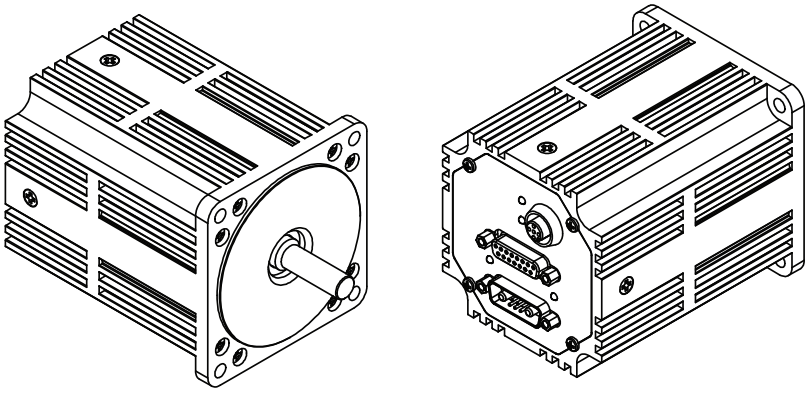


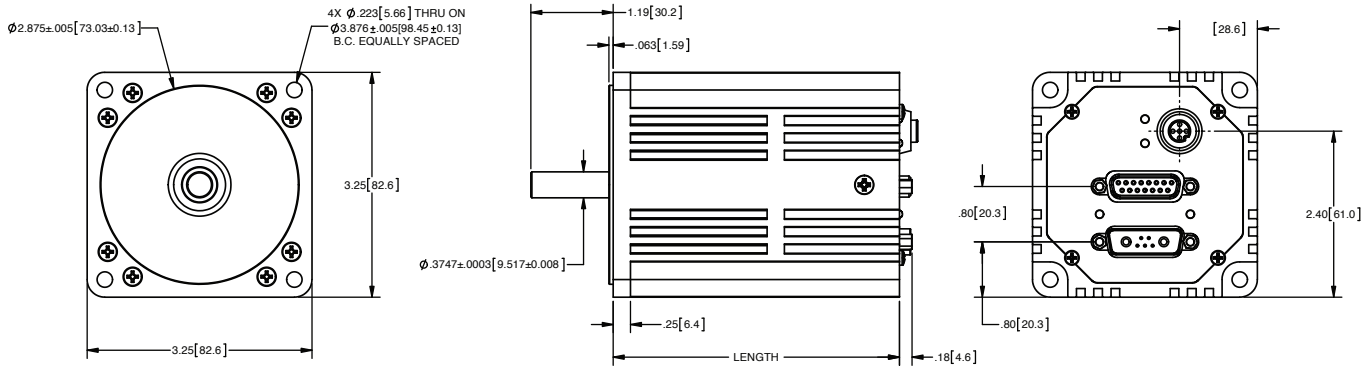


Moog Animatics SmartMotor™ SM34x05D-C

in [mm]

PART NUMBER	LENGTH	
	in	mm
5M34105D	3.49	88.6
5M34205D	4.14	105.1
5M34305D	4.79	121.6
5M34405D	5.44	138.1
5M34505D	6.09	154.6

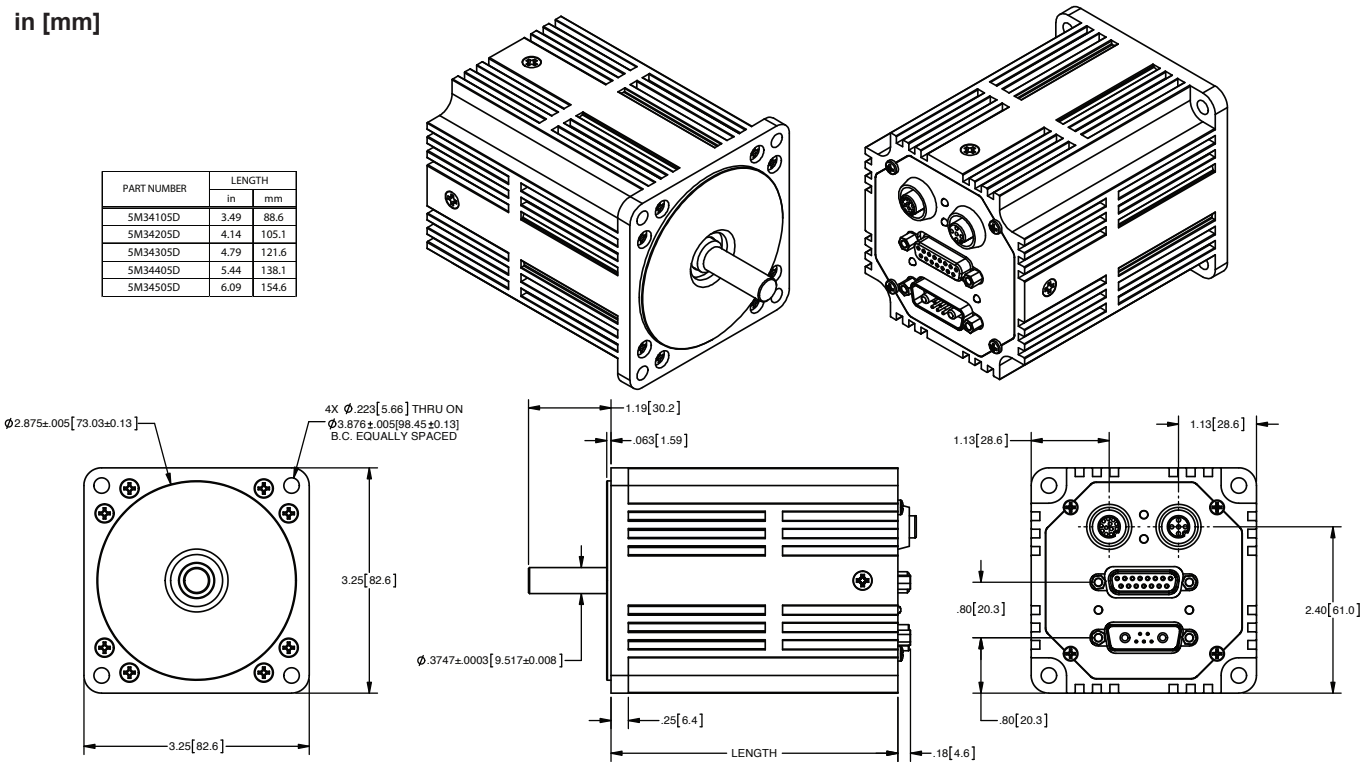




Moog Animatics SmartMotor™ SM34x05D-C-AD1

in [mm]

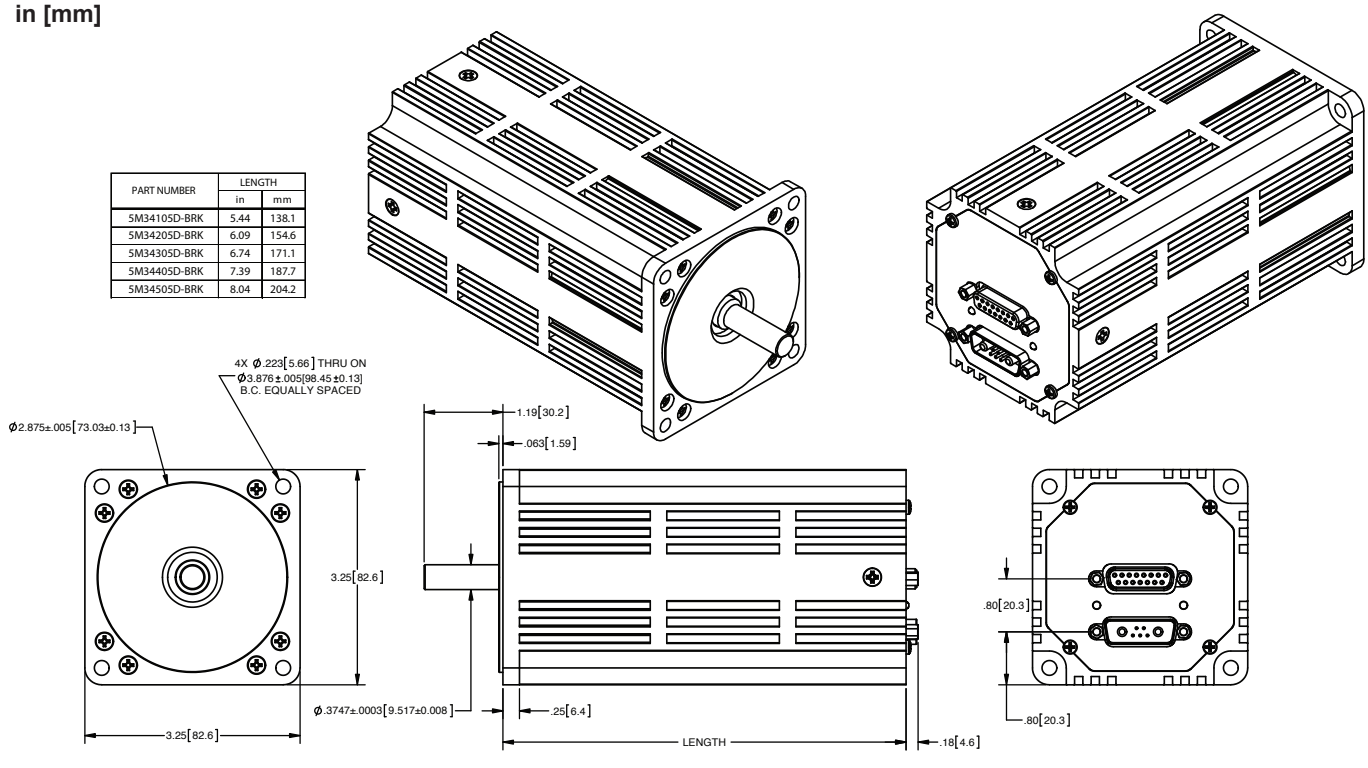
PART NUMBER	LENGTH	
	in	mm
5M34105D	3.49	88.6
5M34205D	4.14	105.1
5M34305D	4.79	121.6
5M34405D	5.44	138.1
5M34505D	6.09	154.6



Moog Animatics SmartMotor™ SM34x05D-BRK

in [mm]

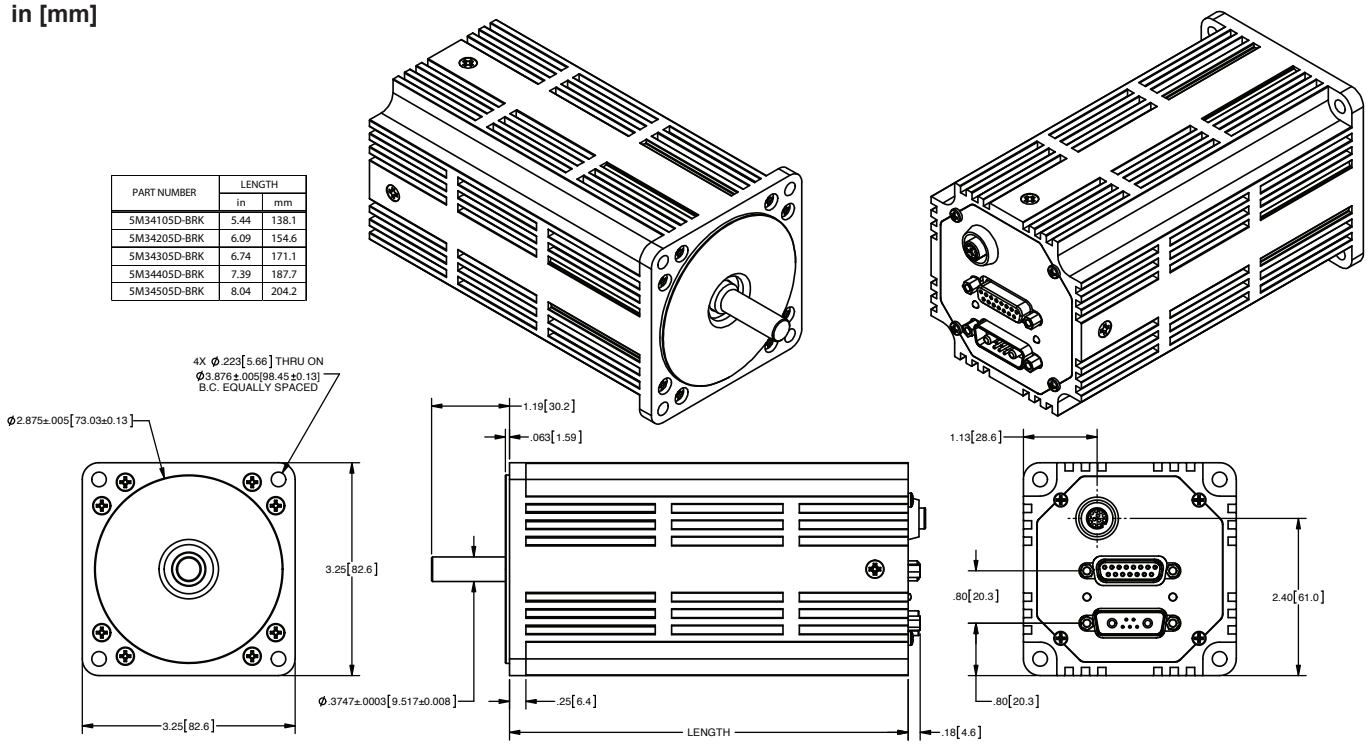
PART NUMBER	LENGTH	
	in	mm
5M34105D-BRK	5.44	138.1
5M34205D-BRK	6.09	154.6
5M34305D-BRK	6.74	171.1
5M34405D-BRK	7.39	187.7
5M34505D-BRK	8.04	204.2



Moog Animatics SmartMotor™ SM34x05D-BRK-AD1

in [mm]

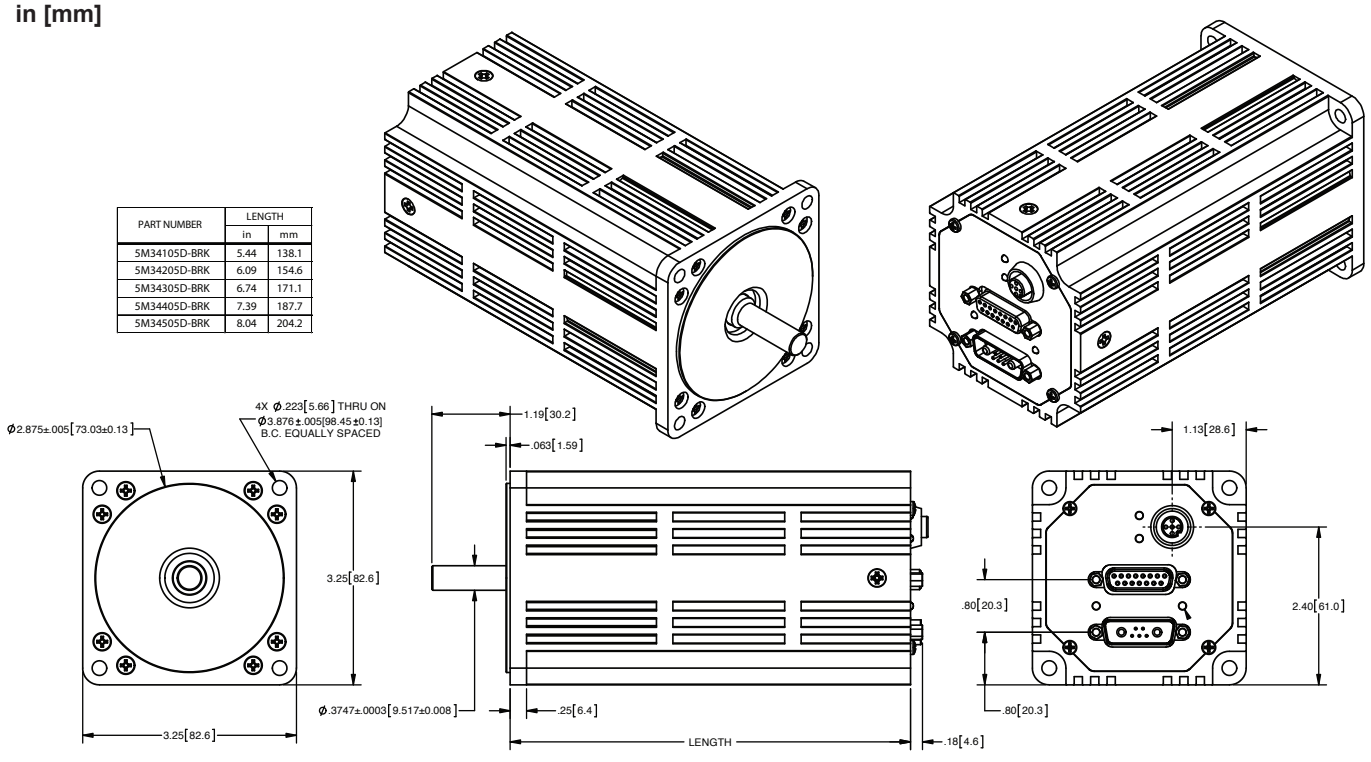
PART NUMBER	LENGTH	
	in	mm
SM34105D-BRK	5.44	138.1
SM34205D-BRK	6.09	154.6
SM34305D-BRK	6.74	171.1
SM34405D-BRK	7.39	187.7
SM34505D-BRK	8.04	204.2



Moog Animatics SmartMotor™ SM34x05D-BRK-C

in [mm]

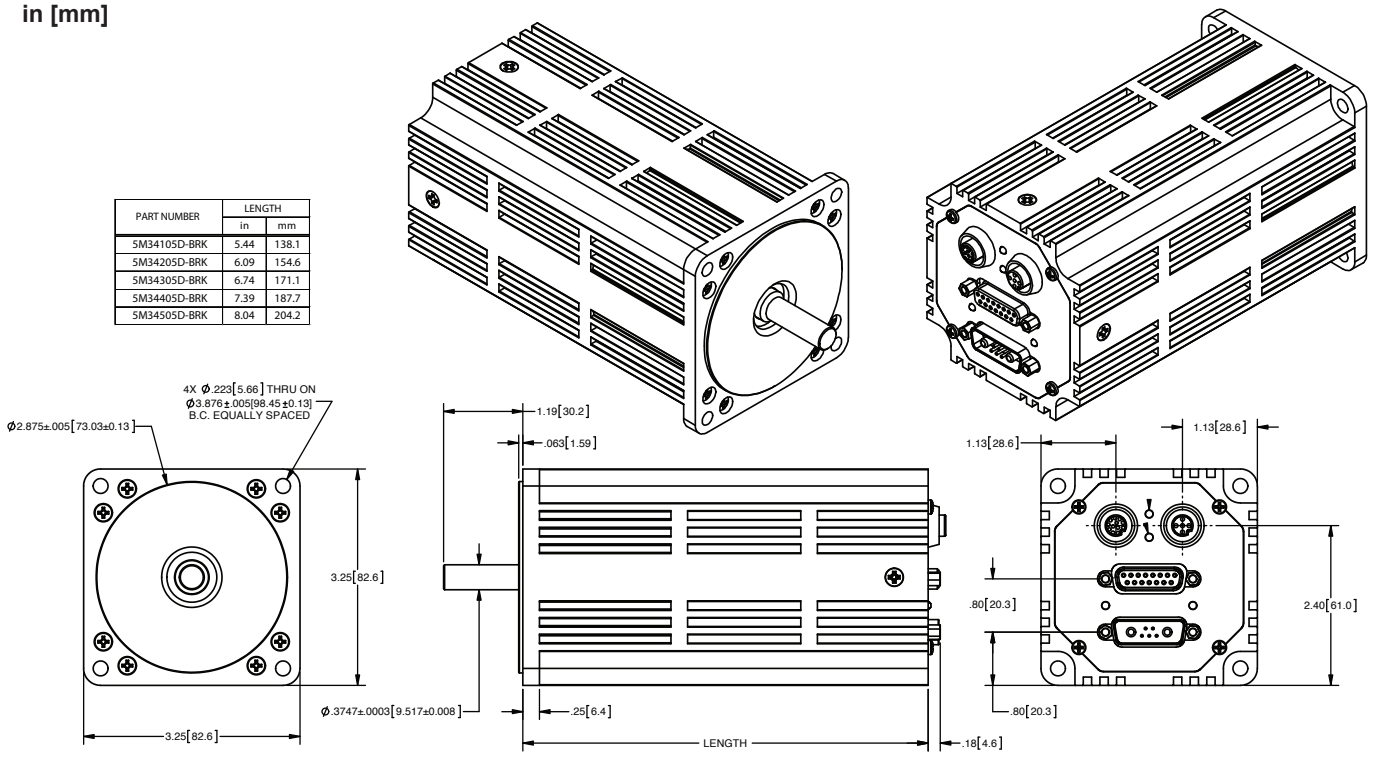
PART NUMBER	LENGTH	
	in	mm
SM34105D-BRK	5.44	138.1
SM34205D-BRK	6.09	154.6
SM34305D-BRK	6.74	171.1
SM34405D-BRK	7.39	187.7
SM34505D-BRK	8.04	204.2



Moog Animatics SmartMotor™ SM34x05D-BRK-C-AD1

in [mm]

PART NUMBER	LENGTH	
	in	mm
SM34105D-BRK	5.44	138.1
SM34205D-BRK	6.09	154.6
SM34305D-BRK	6.74	171.1
SM34405D-BRK	7.39	187.7
SM34505D-BRK	8.04	204.2



The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

M-Style Motor Comparison Chart

The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

SmartMotor™ Series	SM23165MT	
Continuous Torque @ 48V	4.25	in-lb
	68	oz-in
	0.48	N-m
Peak Torque	9.45	in-lb
	151	oz-in
	1.07	N-m
Nominal Continuous Power	189	Watt
No Load Speed	5,000	RPM
Max. Continuous Current* @ 3700 RPM	6.4	Amps
Peak Power @ 2800 RPM	255	Watts
Voltage Constant	9.6	V/kRPM
Inductance	2.01	mH
Encoder Resolution	4,000	Counts/Rev
Rotor Inertia	0.001	oz-in-sec^2
	0.706	10^{-5} Kg-m^2
Weight	1.5	lb
	0.68	kg
Shaft Diameter	0.375	in
	9.53	mm
Shaft, Radial Load	15	lb
	6.80	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Firmware Option	
PROFIBUS Available		
CANopen Available	Standard	

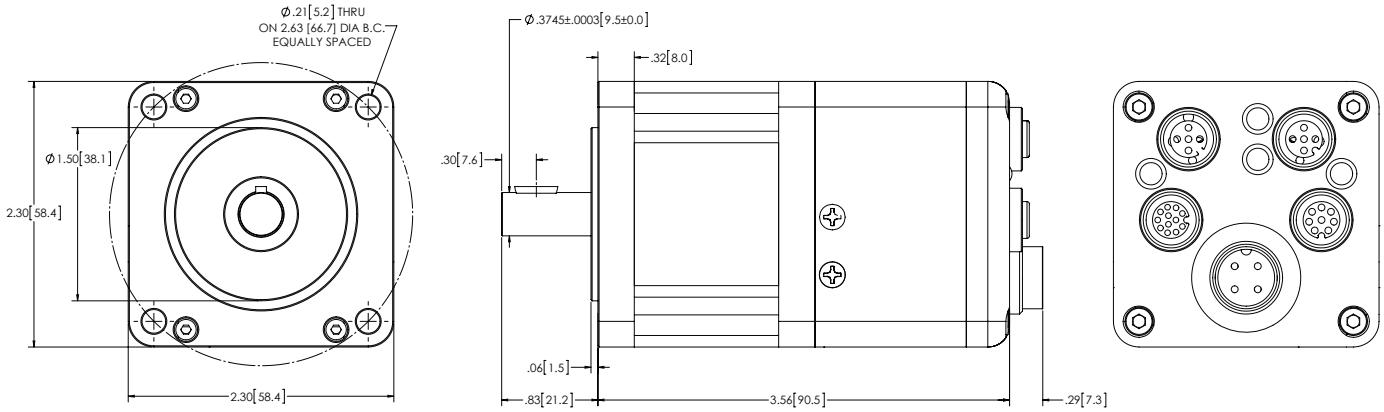
Operating temperature range: 0°C–85°C

Storage temperature range: -10°C–85°C, noncondensing

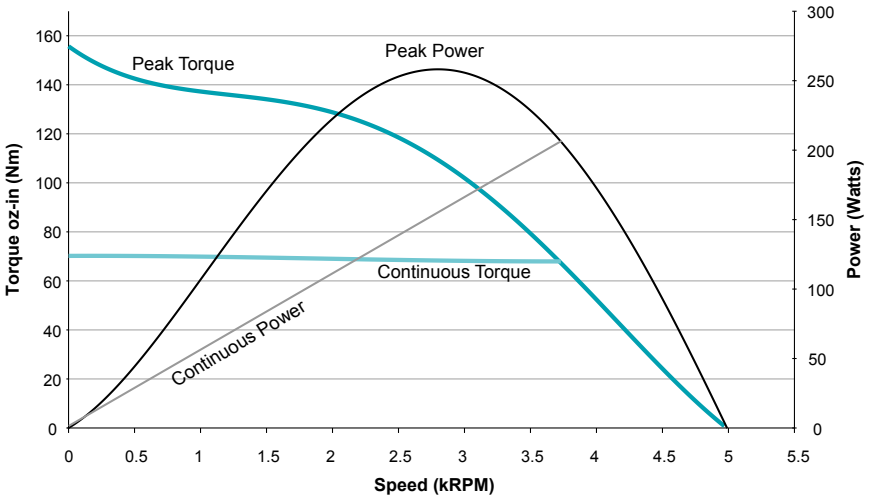
IP rating depends on motor options. IP rating may affect motor performance.

NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

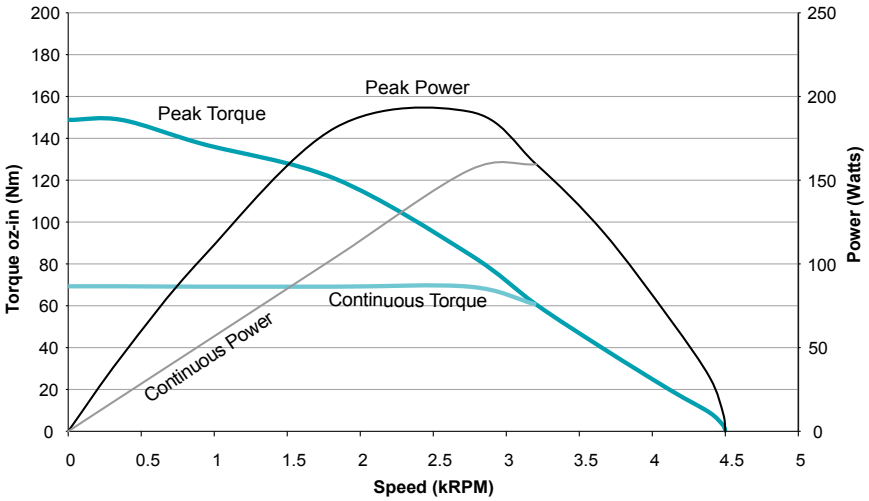
Moog Animatics SmartMotor SM23165MT (No Options) CAD Drawing



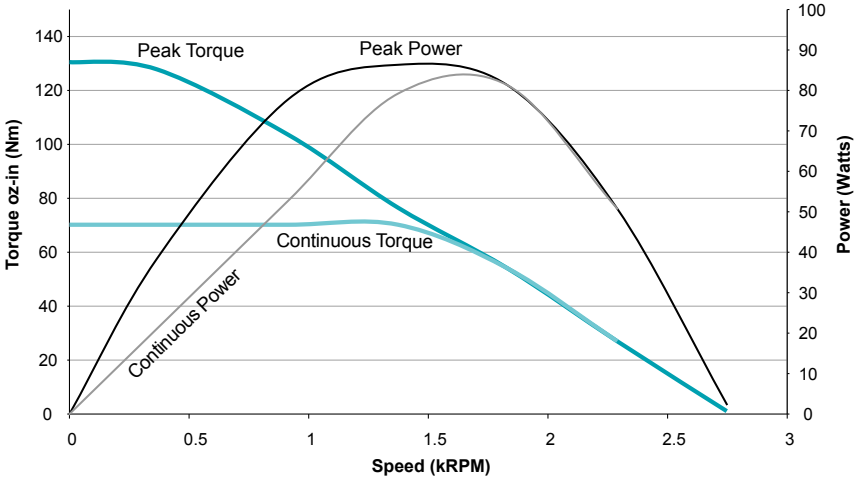
Drive Power and Control Power are Separate Inputs. Control Power is rated to a range of 18 to 32VDC max. Drive Power is from 18 to 48VDC max.



SM23165MT MDE Mode
at 48 VDC
at rise to 85°C
with PFC1500W-48V



SM23165MT MDE Mode
at 42 VDC
at rise to 85°C
with PS42V20AF110



SM23165MT MDE Mode
at 24 VDC
at rise to 85°C
with PS24V8A-110G

All torque curves based on 25°C ambient.

Motors were operated using MDE (Enhanced Drive Mode) Commutation.

For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

SmartMotor™ Series	SM34165MT	
Continuous Torque @ 48V	12.58	in-lb
	201	oz-in
	1.42	N-m
Peak Torque	34.88	in-lb
	558	oz-in
	3.94	N-m
Nominal Continuous Power	472	Watt
No Load Speed	4,900	RPM
Max. Continuous Current* @ 4500 RPM	13	Amps
Peak Power @ 3300 RPM	1,120	Watts
Voltage Constant	9.8	V/kRPM
Inductance	0.315	mH
Encoder Resolution	8,000	Counts/Rev
Rotor Inertia	0.0142	oz-in-sec^2
	10.031	10^{-5} Kg-m^2
Weight	6.0	lb
	2.72	kg
Shaft Diameter	0.500	in
	12.70	mm
Shaft, Radial Load	30	lb
	13.61	kg
Shaft, Axial Thrust Load	3	lb
	1.36	kg
DeviceNet Available	Firmware Option	
PROFIBUS Available		
CANopen Available	Standard	

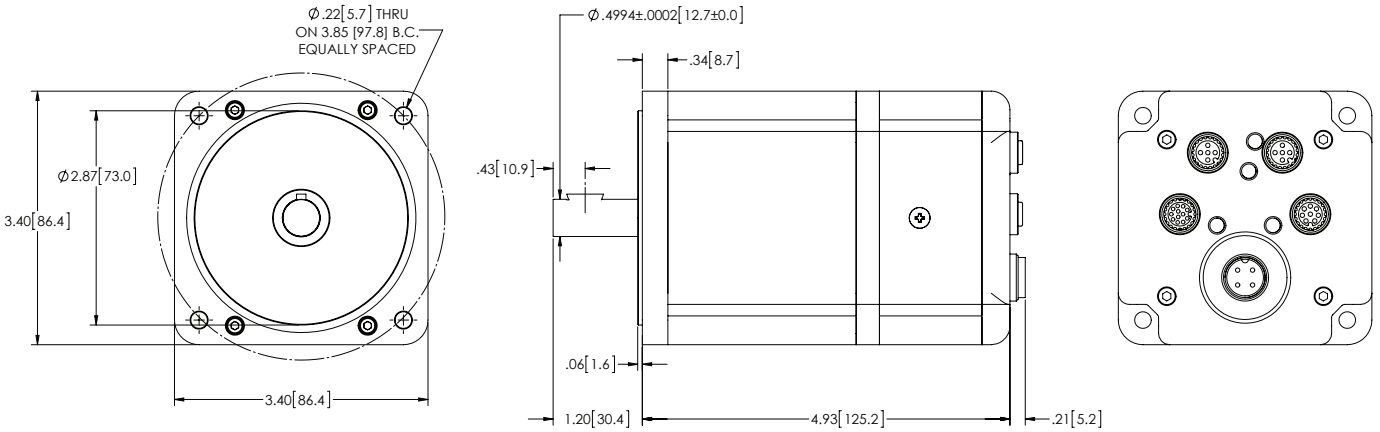
Operating temperature range: 0°C–85°C

Storage temperature range: -10°C–85°C, noncondensing

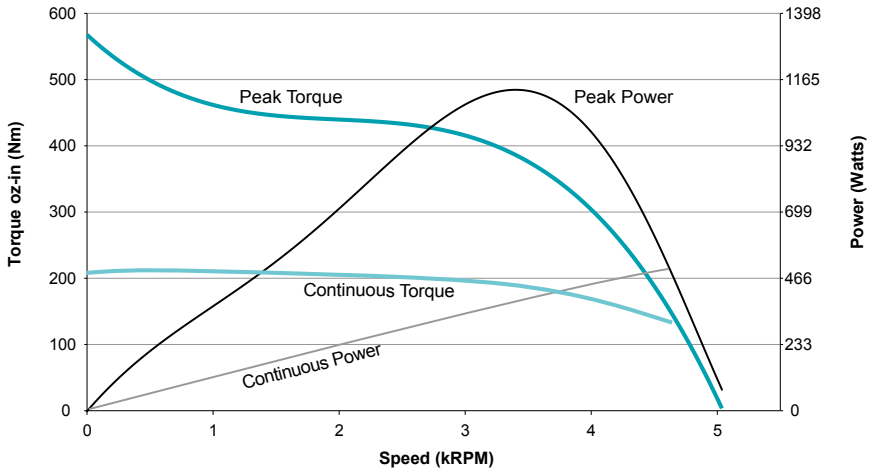
IP rating depends on motor options. IP rating may affect motor performance.

NOTE: Motor specifications are subject to changes without notice. Consult website and factory for latest data.

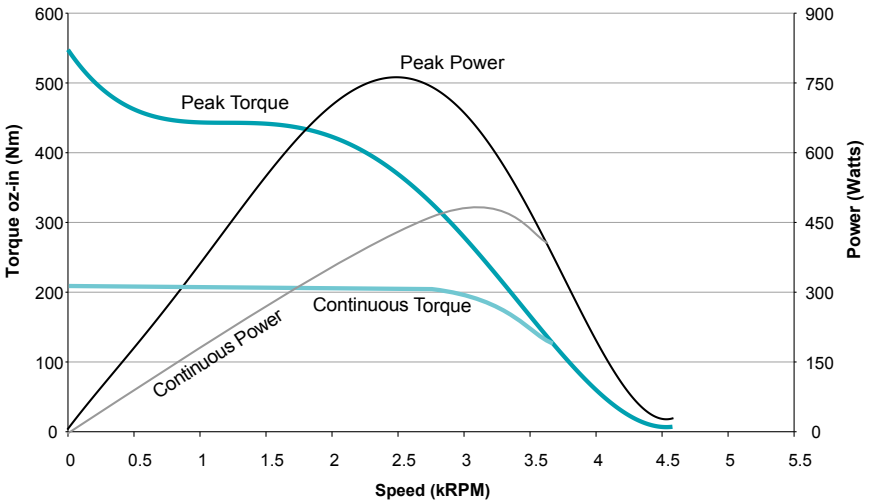
Moog Animatics SmartMotor SM34165MT (No Options) CAD Drawing



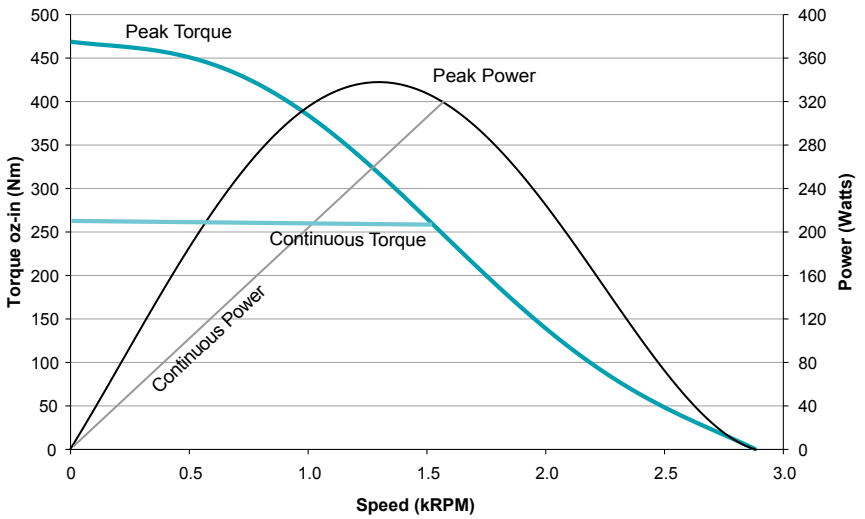
Drive Power and Control Power are Separate Inputs. Control Power is rated to a maximum range of 18 to 32VDC. Drive Power is from 18 to 48VDC max.



SM34165MT MDE Mode
at 48 VDC
at rise to 85°C
with PFC1500W-48V



SM34165MT MDE Mode
at 42 VDC
at rise to 85°C
with PS42V20A



SM34165MT MDE Mode
at 24 VDC
at rise to 85°C
with PS24V8AG-110

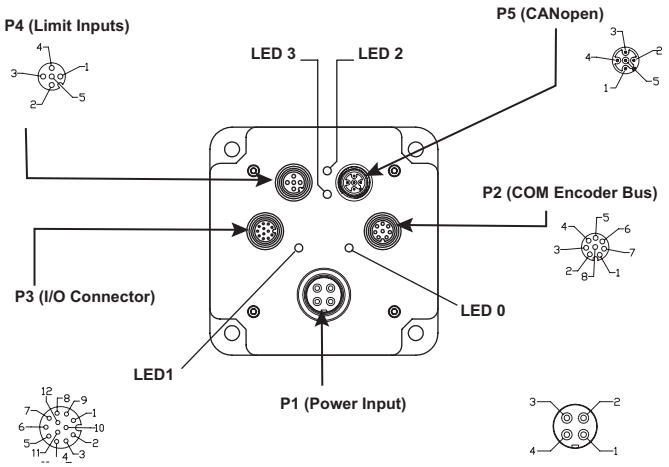
All torque curves based on 25°C ambient.

Motors were operated using MDE (Enhanced Drive Mode) Commutation.

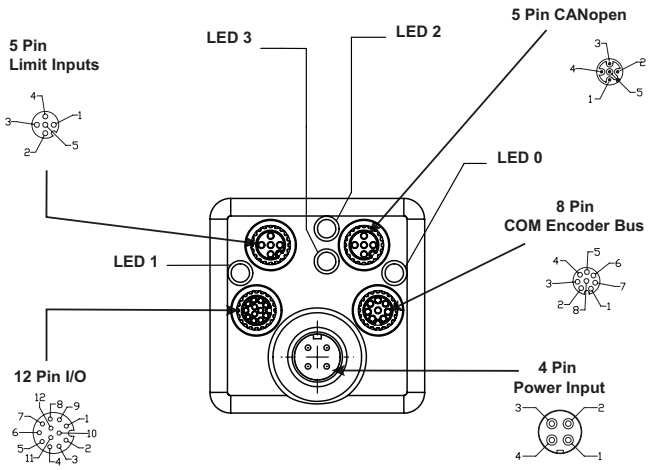
For ambient temperatures above 25°C, Continuous Torque must be linearly derated to 0% at 85°C.

The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

SM34165MT



SM23165MT



NOTE: LED operation for IP-sealed motors is the same as for standard motors.

LED 0: Drive Status Indicator

Off	No Power
Solid green	Drive On
Flashing green	Drive Off
Flashing red	Watchdog Fault
Solid red	Major Fault
Alt. red/green	In Boot Load, Needs Firmware

LED 1: Trajectory Status Indicator

Off	Not Busy
Solid green	Drive On, Trajectory In Progress

LED 2: CAN Bus Network Fault (Red LED)

Off	No Error
Single Flash.	At least One Error exceeded Limit
Double Flash	Heartbeat or Guard Error
Solid	Busy Off State

LED 3: CAN Bus Network Status (Green LED)

Blinking	Pre-Operational State, (during boot-up)
Solid	Normal Operation
Single	Device is in Stopped State

LED Status Power-up:

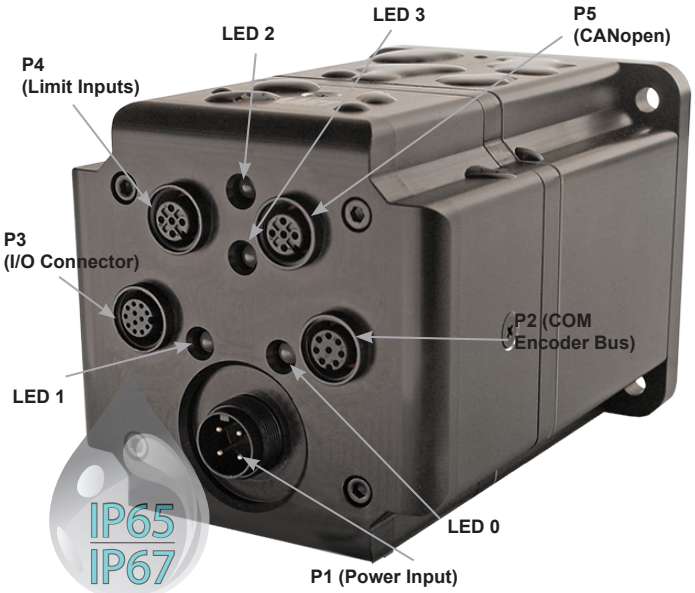
- With no program the travel limit inputs are low:
  LED0 will be solid red indicating the motor is in a fault state due travel limit fault.
  LED1 will be off

LED Status Power-up:

- With no program and the travel limits are high:
  LED0 will be solid red for 500 milliseconds and then begin flashing green.
  LED1 will be off

LED Status Power-up:

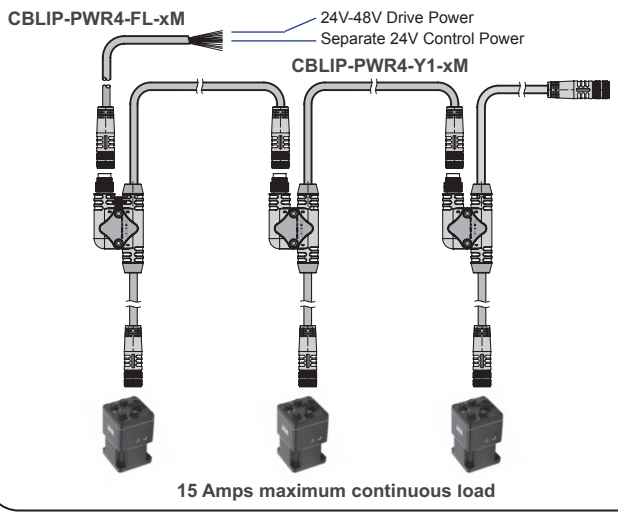
- With a program that only disables travel limits and nothing else
  LED0 will be solid red for 500 milliseconds and then begin flashing green.
  LED1 will be off



IP rating depends on motor options.

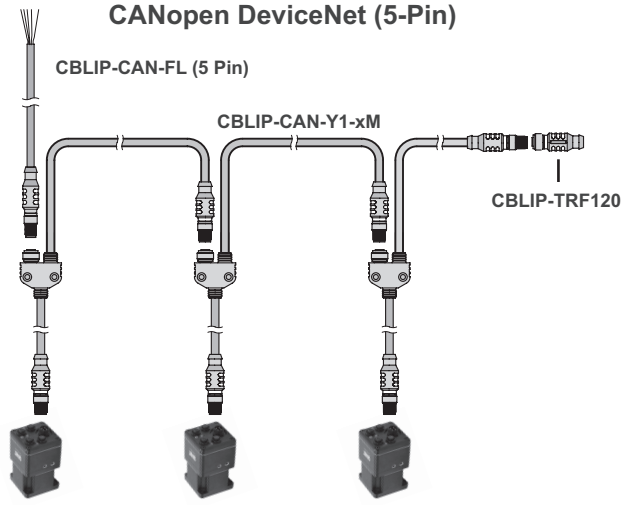
Class 5 Multi-Axis Connection Maps (M-Style Models)

Main Servo Power (4-Pin)

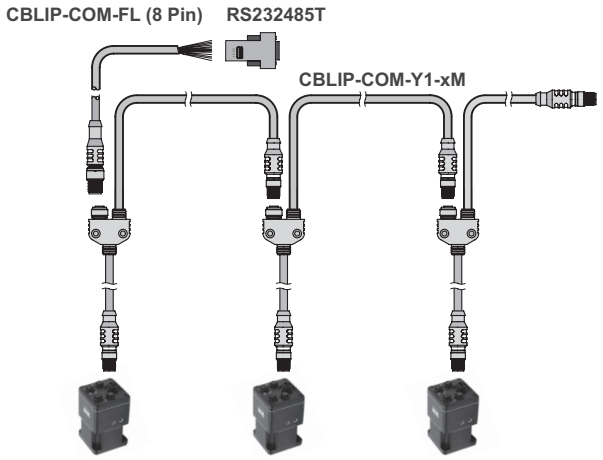


15 Amps maximum continuous load

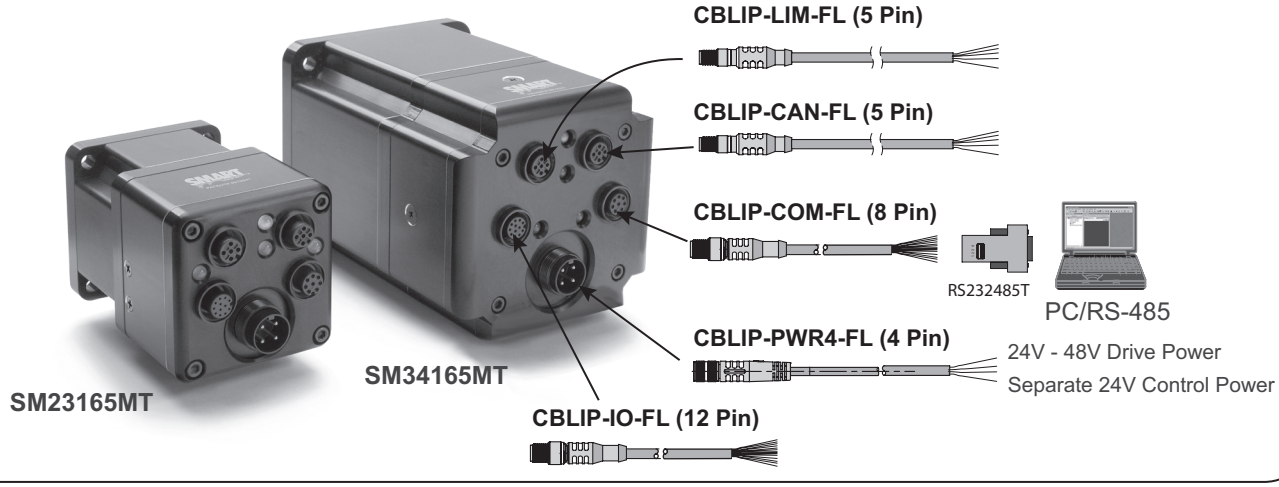
CANopen DeviceNet (5-Pin)



RS-485 Communication and Encoder Bus (8-Pin)



IP rating depends on motor options.

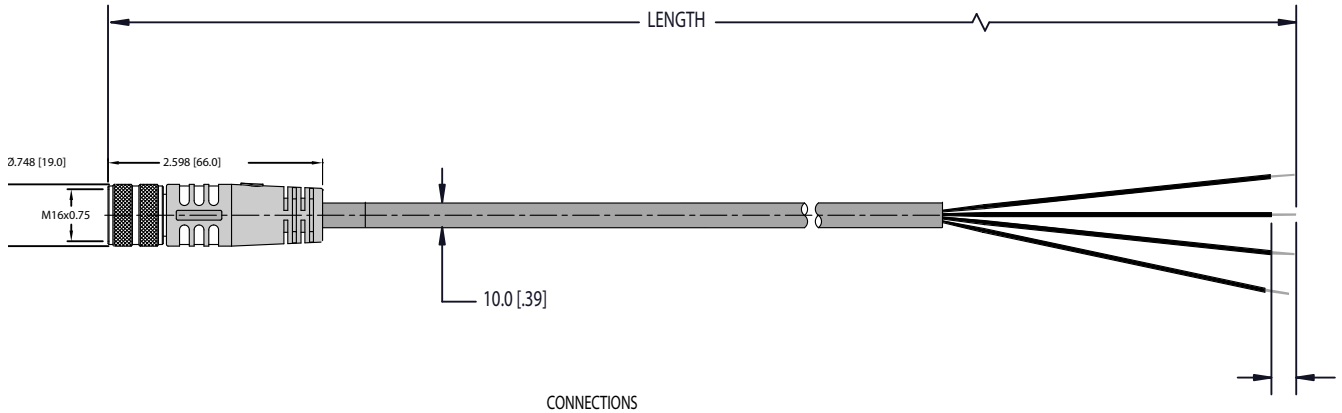


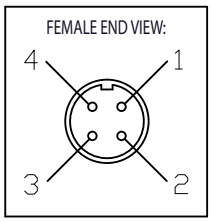
NOTE: User can download their choice of CANopen or DeviceNet firmware from the Moog Animatics website. 24V I/O and CAN or DN are standard on all M-Style SmartMotors.

Drive and Control Power Cable

Main Power Input Cable supplies connection point to drive power and control power. This cable is required to power up all DC input sealed motors. Standard M16 threaded connector, brass pins with gold plating, maximum 12.0A, foil shield with black PVC jacket, ~7.4mm diameter.

Part Number	Description	Length
CBLIP-PWR4-FL-1M	Flying Lead Straight Connector	1 meter
CBLIP-PWR4-FL-3M	Flying Lead Straight Connector	3 meters
CBLIP-PWR4-FL-5M	Flight Lead Straight Connector	5 meters
CBLIP-PWR4-FL-10M	Flight Lead Straight Connector	10 meters
CBLIP-PWR4-FL-1MRA	Right Angle Connector	1 meter
CBLIP-PWR4-FL-3MRA	Right Angle Connector	3 meters
CBLIP-PWR4-FL-5MRA	Right Angle Connector	5 meters





CONNECTIONS

PIN #	COLOR	SIGNAL
1	WHITE	CONTROL POWER 24VDC*
2	GREEN	CHASSIS GND/EARTH
3	BLACK	GND COMMON
4	RED	DRIVE POWER 48V MAX

NOTE: Drive Power and Control Power are Separate Inputs. Control power is rated to a maximum range of 18 to 32VDC. Drive Power is from 18 to 48VDC max.

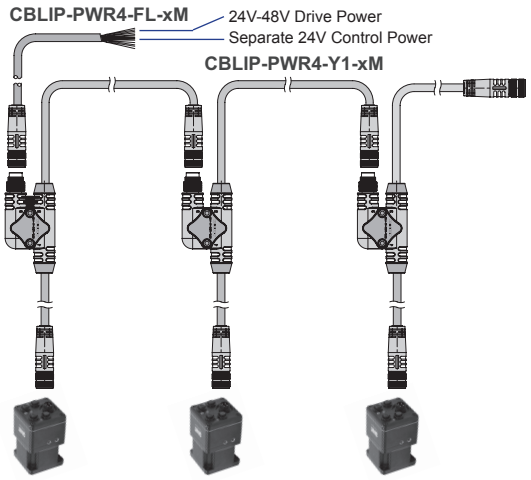
WARNING: Exceeding 32VDC into control power or any of the +24V pins could cause immediate damage to internal electronics. Exceeding a sustained voltage of 48V to pin 4 of the P1 Power pin could cause immediate damage to internal electronics. Exceeding these voltage limits will void the warranty.

CBLIP-PWR4-Y1-xM

CBLIP-PWR4-Y1-xM Add-A-Motor cable for IP65 series motor Drive and Control Power Daisy chain cable for power distribution to multiple motors.

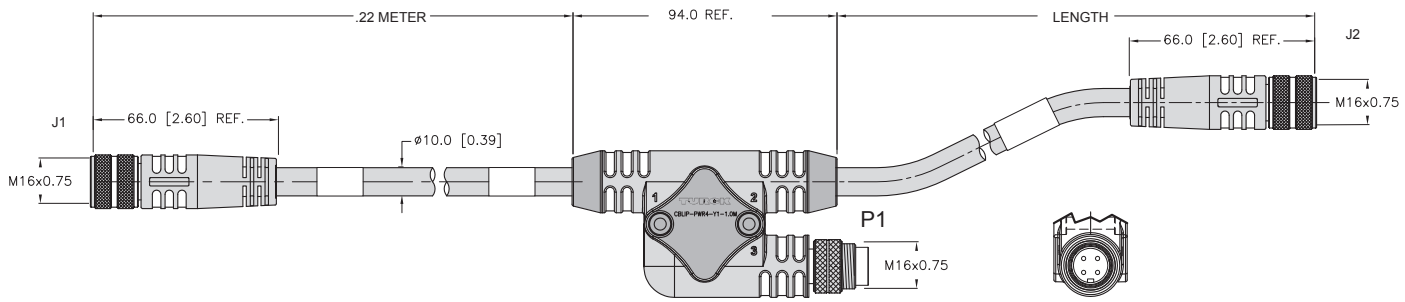
CBLIP-PWR4-Y1-xM series is the main power cable for IP65 motors featuing easy daisy chaining of both drive and control power to multiple motors.

This cable plugs into the M16 4-pin connector allowing split off to another cable and motor.

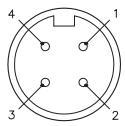


Part Number	Length
CBLIP-PWR4-Y1-0.5M	0.5 meters
CBLIP-PWR4-Y1-1.0M	1 meter
CBLIP-PWR4-Y1-3.0M	3 meters
CBLIP-PWR4-Y1-0.5MRA	0.5 meters
CBLIP-PWR4-Y1-3.0MRA	3 meters

NOTE: Maximum of 15 Amps continuous RMS load per total daisy chain transmission line.

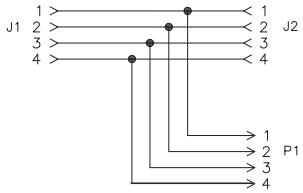


J1, J2 Female

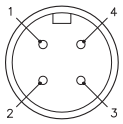


1 = WHITE
2 = GREEN
3 = BLACK
4 = RED

WIRING DIAGRAM



P1, Male



1 = WHITE
2 = GREEN
3 = BLACK
4 = RED

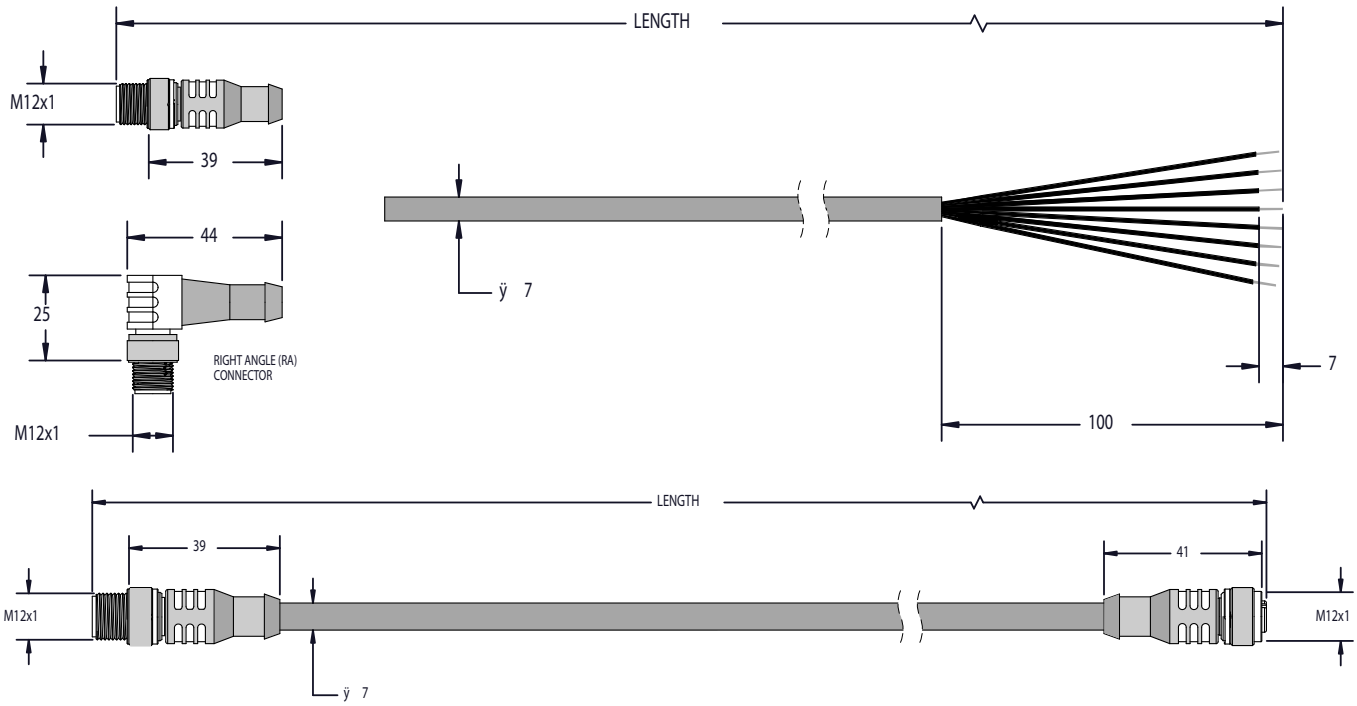
NOTE: Drive Power and Control Power are Separate Inputs. Control power is rated to a maximum range of 18 to 32VDC. Drive Power is from 18 to 48VDC max.

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

Communications and Encoder Bus Flying Lead Cable

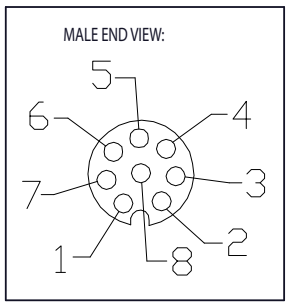
This cable is required for basic communications to the main RS-485 port. The communications port also contains pins for the bidirectional encoder bus. Rated to >1MHz data transmission rate. CBLIP-COM series cables are sealed M12 threaded connector, brass pins with gold plating, maximum 2.0A, foil shield with black PVC jacket, ~7.4mm diameter.

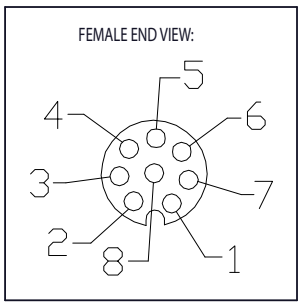
Part Number	Description	Length
CBLIP-COM-FL-1M	Flying Lead Straight Connector	1 meter
CBLIP-COM-FL-3M	Flying Lead Straight Connector	3 meters
CBLIP-COM-FL-1MRA	Flying Lead Right Angle Connector	1 meter
CBLIP-COM-FL-3MRA	Flying Lead Right Angle Connector	3 meters
CBLIP-COM-EXT-1M	Comm. Extension Cable	1 meters
CBLIP-COM-EXT-2M	Comm. Extension Cable	2 meters
CBLIP-COM-EXT-3M	Comm. Extension Cable	3 meters



CONNECTIONS

PIN #	NAME	DESCRIPTION
1	WHITE/BLUE	GND COMM
2	WHITE/BROWN	RS485B CH0
3	BROWN	RS485A CH0
4	ORANGE (-TX)	ENC A+ (IN/OUT)
5	WHITE/GREEN (+RX)	ENC B- (IN/OUT)
6	WHITE/ORANGE (+TX)	ENC A- (IN/OUT)
7	BLUE	5VDC
8	GREEN (-RX)	ENC B+ (IN/OUT)





Communications and Encoder Bus Y Cable

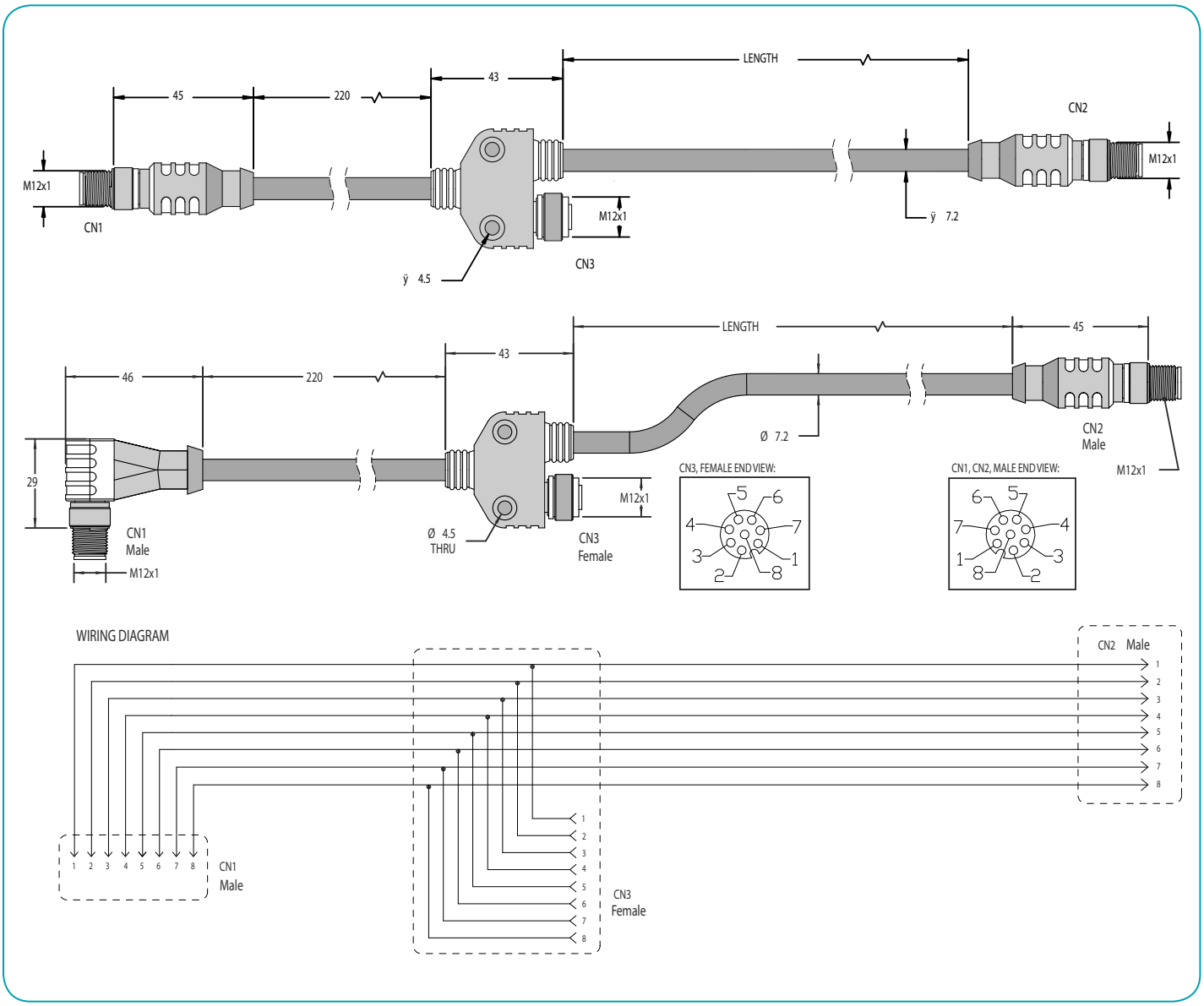
This cable is allows for daisy chain connection from one motor to the next. The communications port also contains pins for the bidirectional encoder bus. Rated to >1MHz data transmission rate. CBLIP-COM series cables are sealed M12 threaded connector brass pins w /gold plating, maximum 2.0A. foil shield with black PVC jacket ~7.4mm diameter.

Straight Connector

Part Number	Length
CBLIP-COM-Y1-0.5M	0.5 meters
CBLIP-COM-Y1-1M	1 meters
CBLIP-COM-Y1-3M	3 meters

Right Angle Connector

Part Number	Length
CBLIP-COM-Y1-0.5MRA	0.5 meters
CBLIP-COM-Y1-1MRA	1 meters
CBLIP-COM-Y1-3MRA	3 meters

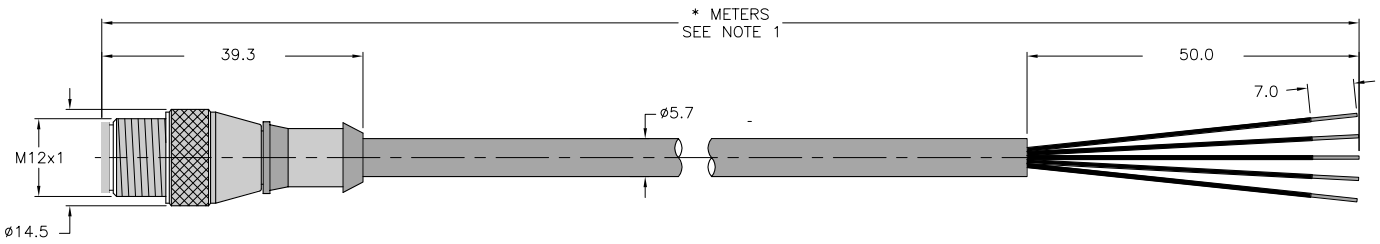


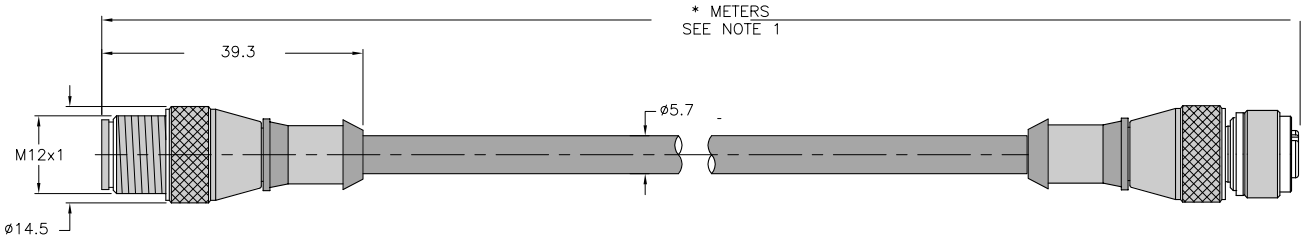
Travel Limit Input Cables

The Limit FL cables are standard unshielded cables intended for use with I/O signals only.

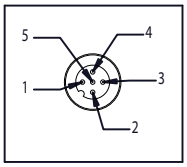
CBLIP series cables are sealed M12 threaded connector, brass pins with gold plating, maximum 4.0A 250V, foil shield with black PVC jacket, ~7.4mm diameter.

Part Number	Description	Length
CBLIP-LIM-FL-1M	Flying Lead Straight Connector	1 meter
CBLIP-LIM-FL-3M	Flying Lead Straight Connector	3 meters
CBLIP-LIM-EXT-1M	Limit Bus Extension Cable	1 meter
CBLIP-LIM-EXT-2M	Limit Bus Extension Cable	2 meters
CBLIP-LIM-EXT-3M	Limit Bus Extension Cable	3 meters





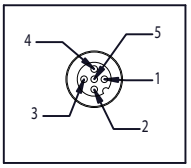
MALE END VIEW:



CONNECTIONS

PIN #	NAME	COLOR
1	+ 24V OUT	BROWN
2	-LIMIT IN	WHITE
3	GROUND	BLUE
4	+LIMIT IN	BLACK
5	INPUT8	GRAY

FEMALE END VIEW:

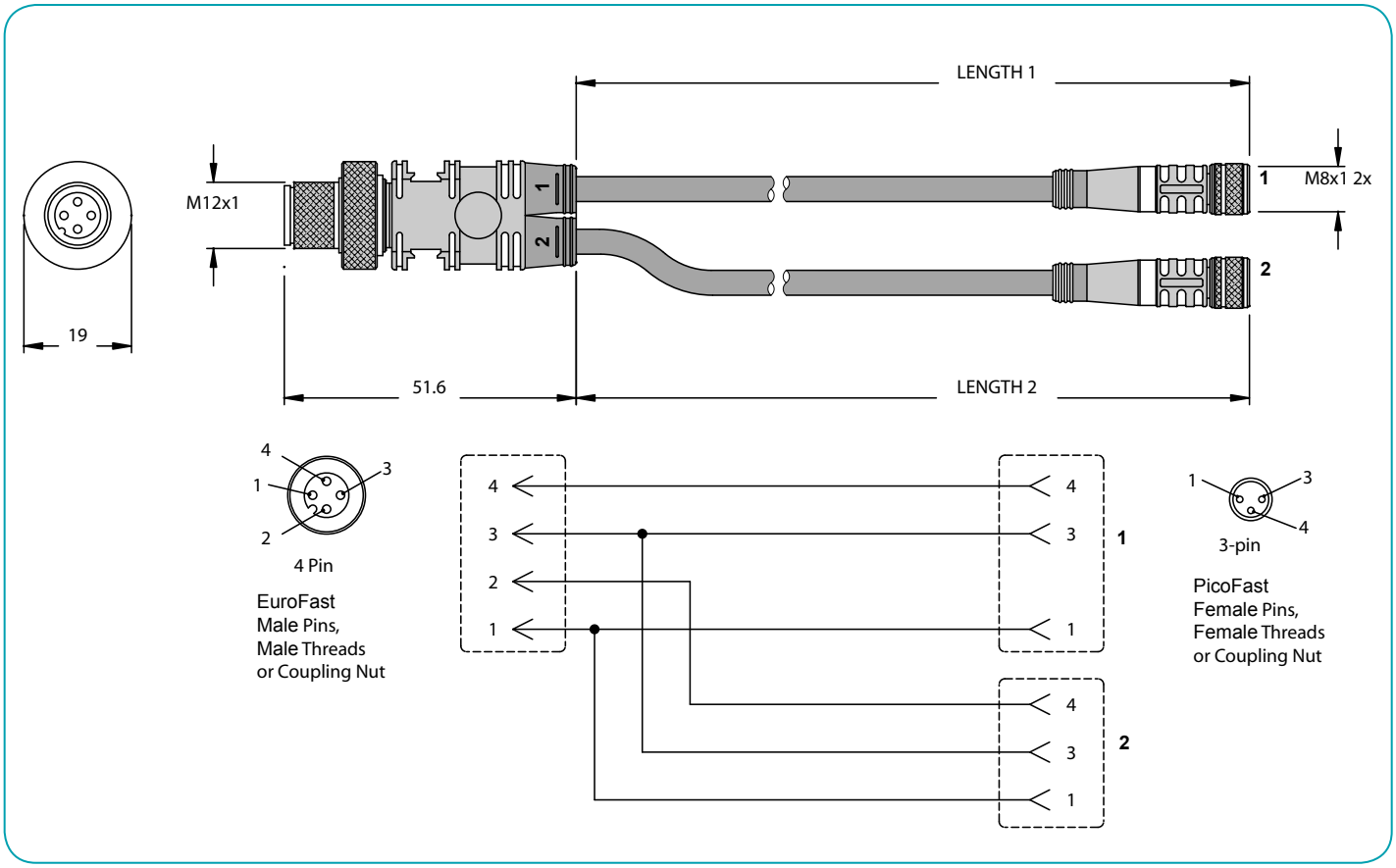


CBLIP-LIM-Y1-xM-xm (Travel Limit Breakout Cables)

CBLIP-LIM-Y1 series cables are intended as a break out cable for the travel limit input connectors of the M-Style SmartMotors. As seen below, this cable terminates to two PicoFast standard sensor connectors allowing direct field connection to various proximity sensors on the market.

Length options are based on connector 1 and 2 where the first length is for cable length to connector 1 and the second is for length to connector 2.

Part Number	Length
CBLIP-LIM-Y1-0.5M-1M	IP Limit Y Cable, 0.5 X 1.0 Meter
CBLIP-LIM-Y1-0.5M-2M	IP Limit Y Cable, 0.5 X 2.0 Meter
CBLIP-LIM-Y1-3M-3M	IP Limit Y Cable, 3.0 M X 3.0 Meter

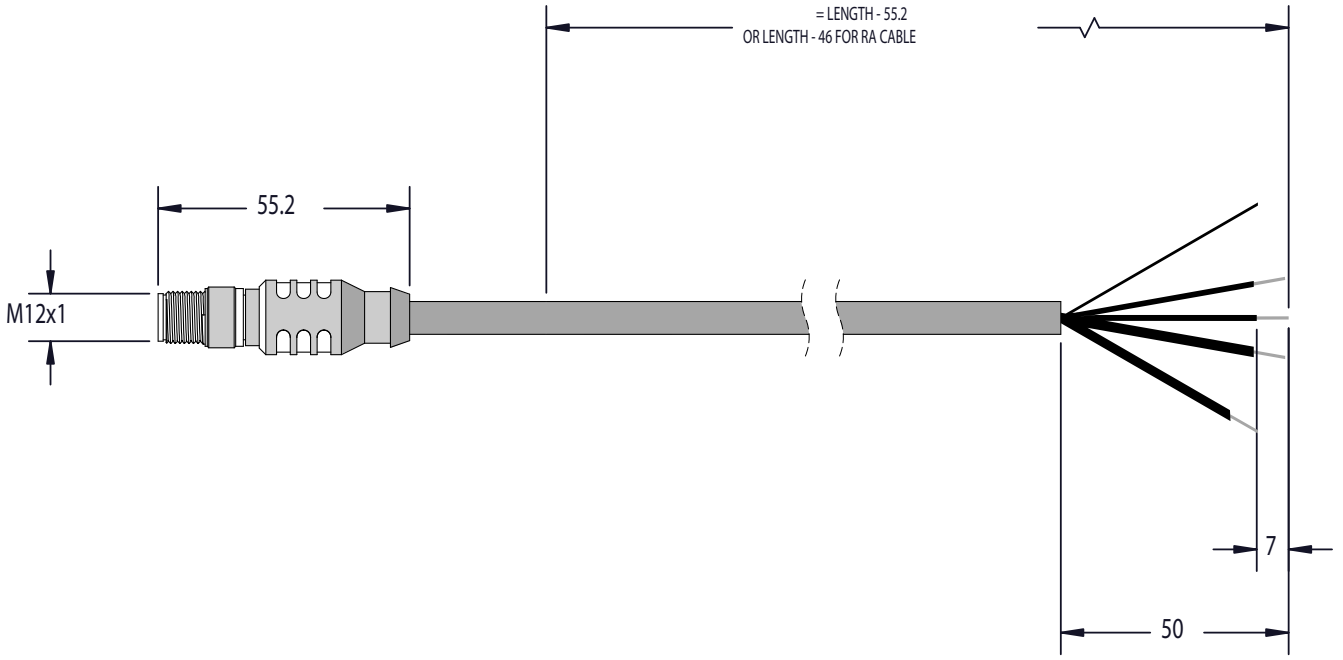


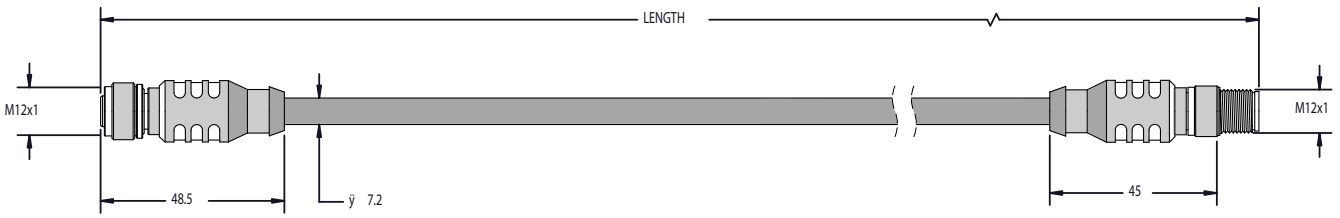
CAN Bus Flying Lead Cables, Straight

The CAN FL cables are standard CAN bus communications cables rated to >1MB data transmission rates.

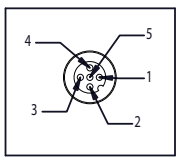
CBLIP series cables are sealed M12 threaded connector brass pins with gold plating, maximum 4.0A. 250V foil shield with black PVC jacket ~7.4mm diameter.

Part Number	Description	Length
CBLIP-CAN-FL-1M	Flying Lead Straight Connector	1 meter
CBLIP-CAN-FL-3M	Flying Lead Straight Connector	3 meters
CBLIP-CAN-EXT-1M	CAN Bus Extension Cable	1 meter
CBLIP-CAN-EXT-2M	CAN Bus Extension Cable	2 meters
CBLIP-CAN-EXT-3M	CAN Bus Extension Cable	3 meters





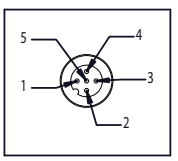
FEMALE END VIEW:



CONNECTIONS

PIN #	NAME	COLOR
1	SHIELD	BARE
2	+ VOLTAGE	RED
3	- VOLTAGE	BLACK
4	CAN_H	WHITE
5	CAN_L	BLUE

MALE END VIEW:



CAN Bus Y Cables, Straight Connector

The CAN Y1 series is meant for CAN Bus communications connectivity between two motors with the addition of a T-connector in line. Rated to >1MB data transmission rates.

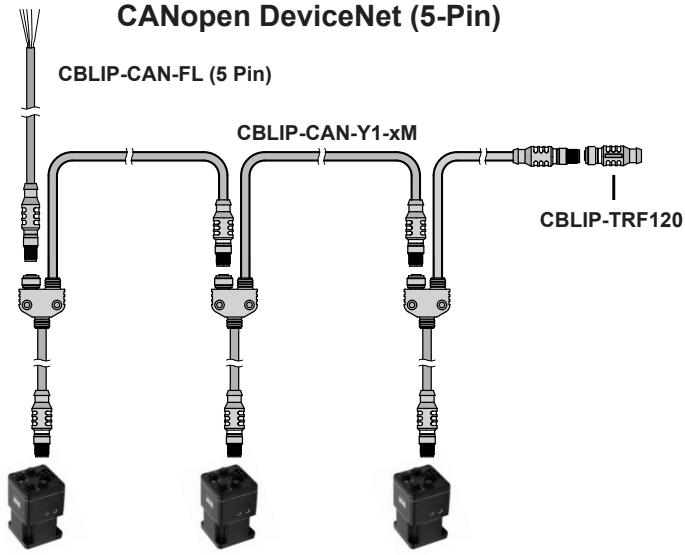
This allows for cascading of multiple SmartMotor servos and the addition of a shunt resistor when required.

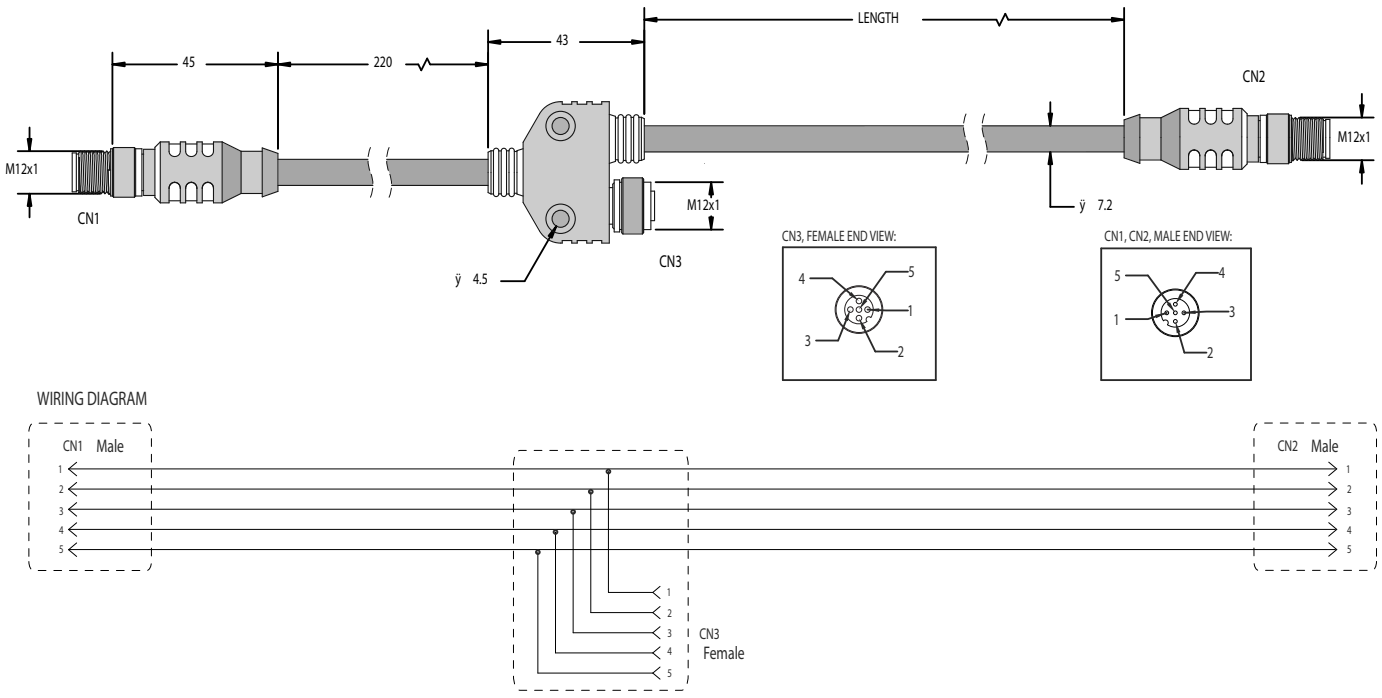
CBLIP series cables are sealed M12 threaded connector
brass pins w / gold plating, maximum 4.0A. 250V
foil shield with black PVC jacket ~7.4mm diameter.

Straight Connector

Part Number	Length
CBLIP-CAN-Y1-0.5M	0.5 meters
CBLIP-CAN-Y1-1M	1 meters
CBLIP-CAN-Y1-3M	3 meters

CANopen DeviceNet (5-Pin)





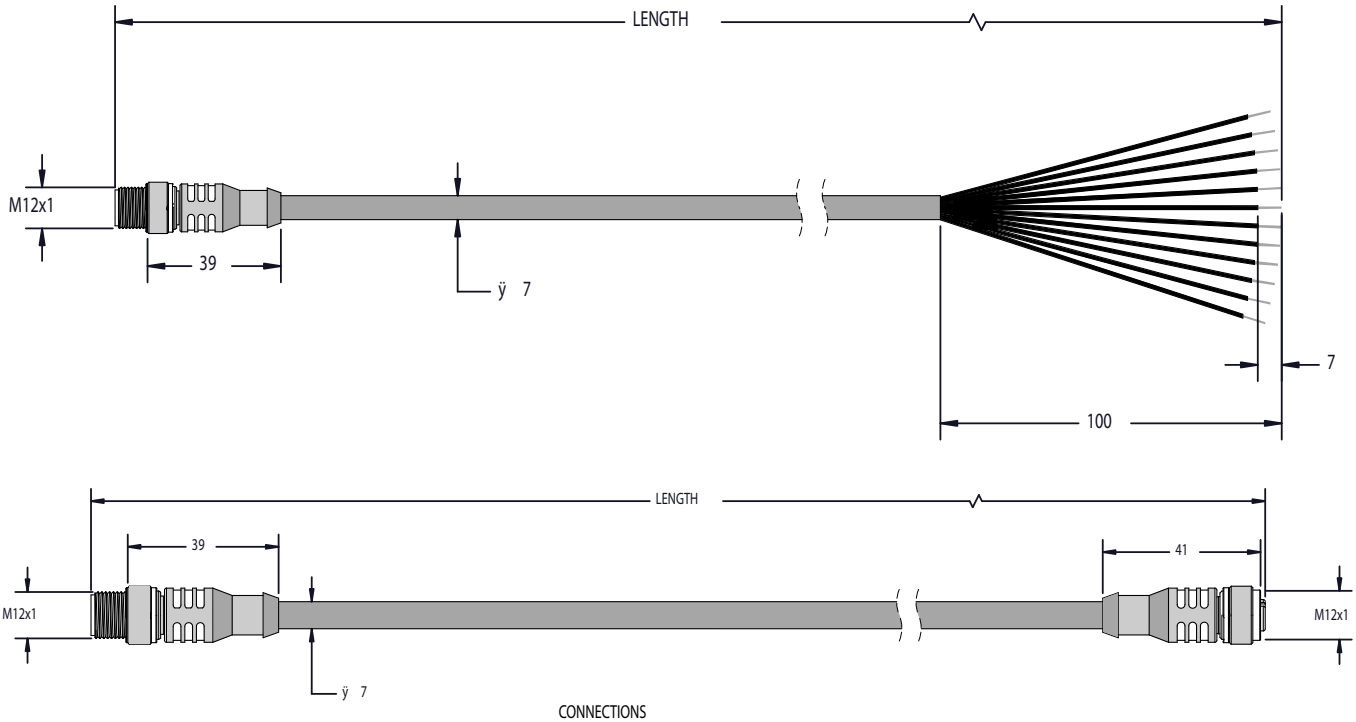
NOTE: At least one shunt resistor is required on ALL CAN bus networks. Please consult the factory for additional information.

CBLIO-IO 24VDC TTL I/O Cable

The expanded I/O cables are for use with the -AD1 expanded I/O option on all Class 5 IP sealed SmartMotors. Each cable is a 12-pin conductor shielded cable. 2 conductors are for +24VDC I/O power. The other 10 are for 10 channels of I/O.

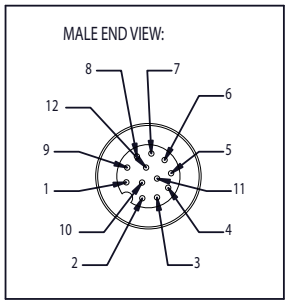
CBLIP series cables are sealed M12 threaded connector brass pins w / gold plating, maximum 4.0A. 250V foil shield with black PVC jacket ~7.4mm diameter.

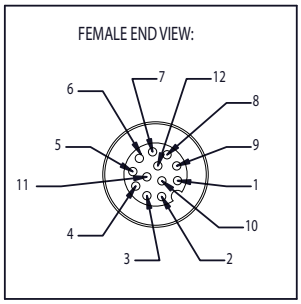
Part Number	Description	Length
CBLIP-IO-FL-1M	Flying Lead Straight Connector	1 meter
CBLIP-IO-FL-3M	Flying Lead Straight Connector	3 meters
CBLIP-IO-EXT-1M	I/O Extension Cable	1 meters
CBLIP-IO-EXT-2M	I/O Extension Cable	2 meters
CBLIP-IO-EXT-3M	I/O Extension Cable	3 meters



CONNECTIONS

PIN #	NAME
1	GREEN
2	VIOLET
3	PINK
4	WHITE
5	TAN
6	GRAY
7	BLACK
8	ORANGE
9	RED
10	YELLOW
11	BROWN
12	BLUE





The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

Actuator Comparison Chart

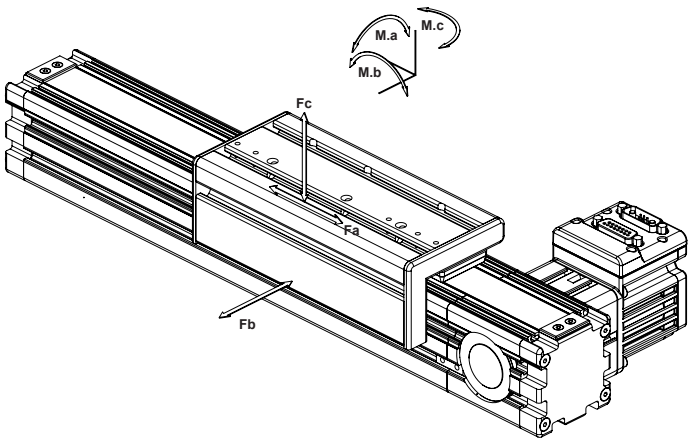
The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

The information in this section has been superseded.
Please see the information in the latest product catalog at:
www.animatics.com/support/moog-animatics-catalog.html

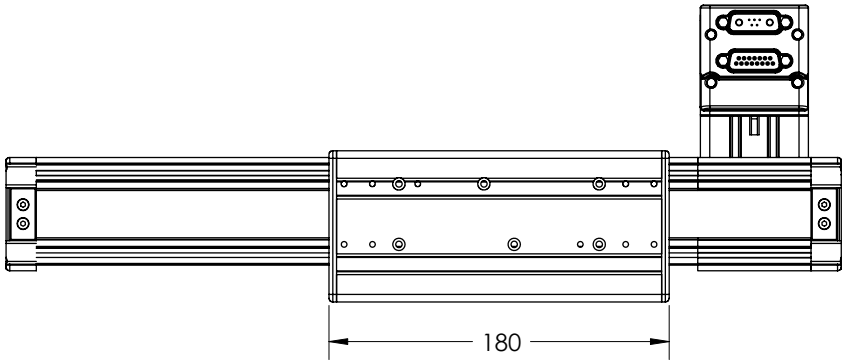
HLD60 with Internal Roller Specifications

Parameter	Value				Units
Configuration & Physical Parameters					
Motor	23 Frame SmartMotors, D and M series				-
Coupling	Flexible Jaw				-
Displacement/rev	2.5, 5, 10, 12.5				mm/rev
Position sensors	Optional Home & EOT limits				-
Stroke	100 – 600mm in 50mm steps 600 – 1000mm in 100mm steps 1000 – 2200mm in 200mm steps Custom lengths are available				mm
Overall length (L)	Stroke + 332				mm
Overtravel	25				mm
Unit mass	2.3 + 0.0031 x (stroke, mm) + (motor mass, kg)				kg
Performance					
Unidirectional repeatability	<20				µm
Bidirectional repeatability	60 – 180 (belt tension dependent)				µm
Linear Accuracy*	0.5/300				mm/mm
Displacement/rev	**2.5**	**5**	**10**	**12.5**	**mm/rev**
Max linear speed (no load)*	200	391	782	977	mm/s
Payload Mass**	45	42	18	13	kg
Continuous Thrust (Fa)					
SM23165D @ 48V @ 4500RPM	270	120	35	-	N
SM23165DT @ 48V @ 3800RPM	450	420	185	135	N
SM23375D @ 48V @ 4500RPM	175	70	10	-	N
SM23375DT @ 48V @ 3200 RPM	450	290	125	90	N
Load Rating, Dynamic (Static)**					
Fb	56 (110)	44 (110)	35 (110)	33 (110)	N
Fc	56 (200)	44 (200)	35 (200)	33 (200)	N
Carriage moments, Dynamic (Static)**					
M.a***	1.0 (2.4)	0.8 (2.4)	0.6 (2.4)	0.55 (2.4)	Nm
M.b***	3.2 (8)	2.5 (8)	2.0 (8)	1.9 (8)	Nm
M.c***	3.2 (12)	2.5 (12)	2.0 (12)	1.9 (12)	Nm

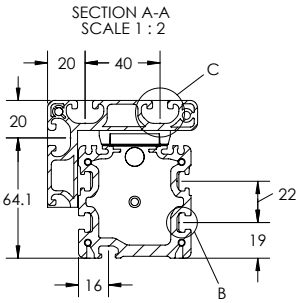
*Based on using SM23165DT @ 48V @ 4200 RPM no load.
**Based on a 15000HR service life @ 75/150/300 & 375mm/s (1800 RPM) average speed at given payload, subject to routine lubrication.
***Moment capacities given about center of carriage mounting surface.



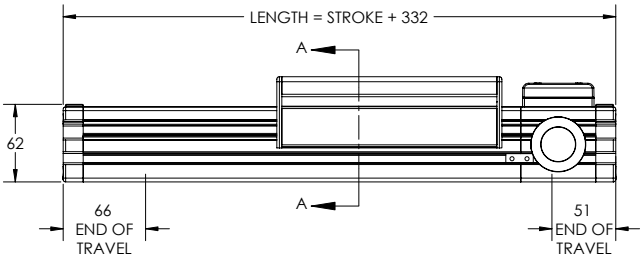
WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.



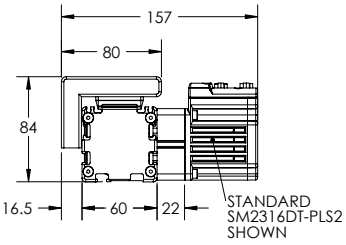
TOP VIEW



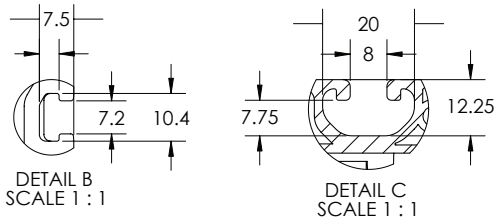
SIMPLE END VIEW



RIGHT SIDE VIEW



MOTOR END VIEW



DETAILED END VIEW

Dimensions in millimeters

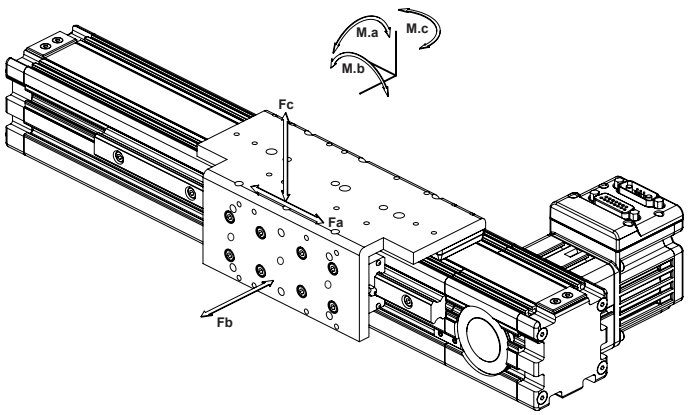
NOTE: For part numbers please refer to our website at www.animatics.com

For Thrust Curve performance data, see pages 158–173.

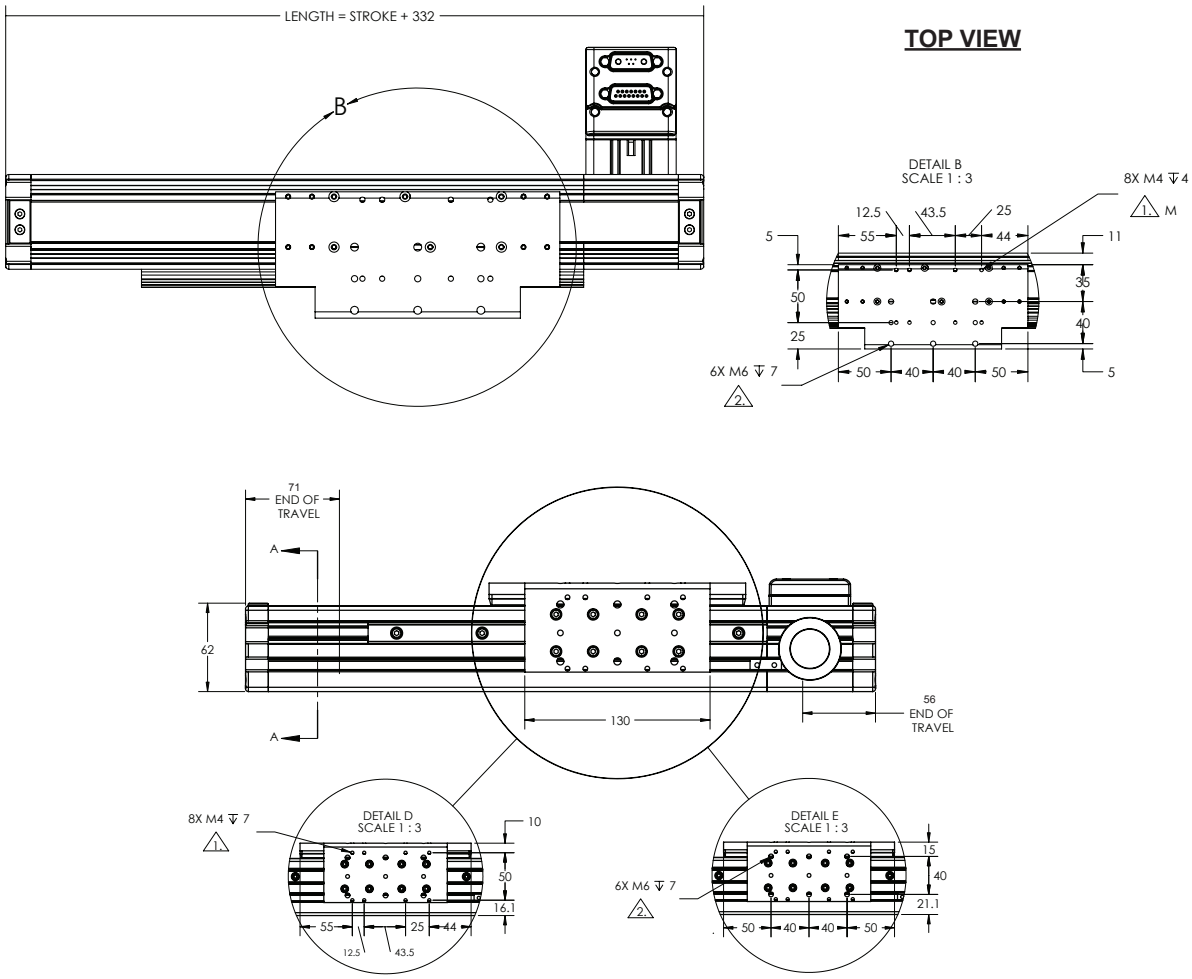
HLD60 with External Rail Specifications

Parameter	Value				Units
Configuration & Physical Parameters					
Motor	23 Frame SmartMotors, D and M series				-
Coupling	Flexible Jaw				-
Displacement/rev	2.5, 5, 10, 12.5				mm/rev
Position sensors	Optional Home & EOT limits				-
Stroke	100 – 600mm in 50mm steps 600 – 1000mm in 100mm steps 1000 – 2200mm in 200mm steps Custom lengths are available				mm
Overall length (L)	Stroke + 332				mm
Overtravel	25				mm
Unit mass	2.7 + 0.0044 x (stroke, mm) + (motor mass, kg)				kg
Performance					
Unidirectional repeatability	<20				µm
Bidirectional repeatability	60 – 180 (belt tension dependent)				µm
Linear Accuracy*	0.5/300				mm/mm
Displacement/rev	**2.5**	**5**	**10**	**12.5**	**mm/rev**
Max linear speed (no load)*	200	391	782	977	mm/s
Payload Mass**	45	42	18	13	kg
Continuous Thrust (Fa)					
SM23165D @ 48V @ 4500RPM	270	120	35	-	N
SM23165DT @ 48V @ 3800RPM	450	420	185	135	N
SM23375D @ 48V @ 4500RPM	175	70	10	-	N
SM23375DT @ 48V @ 3200 RPM	450	290	125	90	N
Load Rating, Dynamic (Static)**					
Fb	730 (1200)	580 (1200)	460 (1200)	430 (1200)	N
Fc	730 (1200)	580 (1200)	460 (1200)	430 (1200)	N
Carriage moments, Dynamic (Static)**					
M.a***	19 (24)	15 (24)	12 (24)	11 (24)	Nm
M.b***	72 (200)	57 (200)	45 (200)	42 (200)	Nm
M.c***	72 (150)	57 (150)	45 (150)	42 (150)	Nm

*Based on using SM23165DT @ 48V @ 4200 RPM no load.
**Based on a 15000HR service life @ 75/150/300 & 375mm/s (1800 RPM) average speed at given payload, subject to routine lubrication.
***Moment capacities given about center of carriage mounting surface.



WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.



NOTES:

1. M4 x 50 x 12.5 and M4 x 25 x 50 for mounting L70 actuator.
2. M6 x 40 x 40 standard bolt pattern for optional mounting accessories.

Dimensions in millimeters

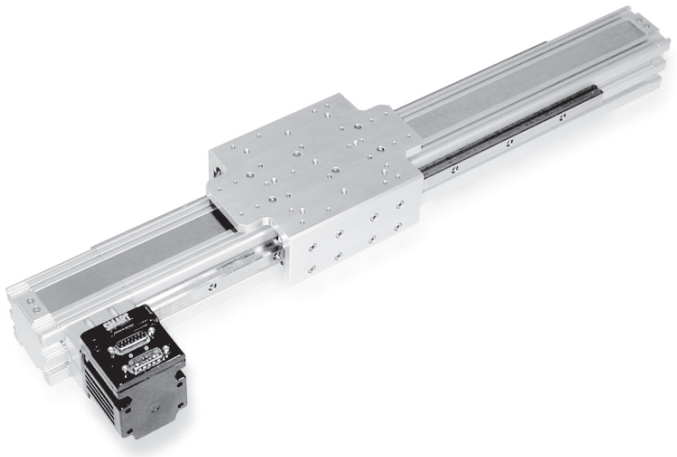
NOTE: For part numbers please refer to our website at www.animatics.com

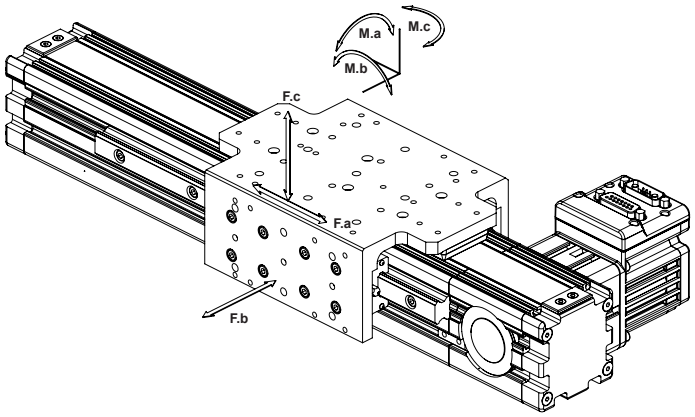
For Thrust Curve performance data, see pages 158–173.

HLD60 with Twin External Rails Specifications

Parameter	Value				Units
Configuration & Physical Parameters					
Motor	23 Frame SmartMotors, D and M series				-
Coupling	Flexible Jaw				-
Displacement/rev	2.5, 5, 10, 12.5				mm/rev
Position sensors	Optional Home & EOT limits				-
Stroke	100 – 600mm in 50mm steps 600 – 1000mm in 100mm steps 1000 – 2200mm in 200mm steps Custom lengths are available				mm
Overall length (L)	Stroke + 332				mm
Overtravel	25				mm
Unit mass	3.4 + 0.0057 x (stroke, mm) + (motor mass, kg)				kg
Performance					
Unidirectional repeatability	<20				µm
Bidirectional repeatability	60 – 180 (belt tension dependent)				µm
Linear Accuracy*	0.5/300				mm/mm
Displacement/rev	**2.5**	**5**	**10**	**12.5**	**mm/rev**
Max linear speed (no load)*	200	391	782	914	mm/s
Payload Mass**	45	40	16	10	kg
Continuous Thrust (Fa)					
SM23165D @ 48V @ 4500RPM	260	100	-	-	N
SM23165DT @ 48V @ 3800RPM	450	400	160	135	N
SM23375D @ 48V @ 4500RPM	165	50	-	-	N
SM23375DT @ 48V @ 3200 RPM	450	275	105	65	N
Load Rating, Dynamic (Static)**					
Fb	3000 (3000)	3000 (3000)	3000 (3000)	2800 (3000)	N
Fc	3000 (3000)	3000 (3000)	3000 (3000)	2800 (3000)	N
Carriage moments, Dynamic (Static)**					
M.a***	180 (200)	144 (200)	114 (200)	106 (200)	Nm
M.b***	144 (200)	113 (200)	89 (200)	84 (200)	Nm
M.c***	144 (200)	113 (200)	89 (200)	84 (200)	Nm

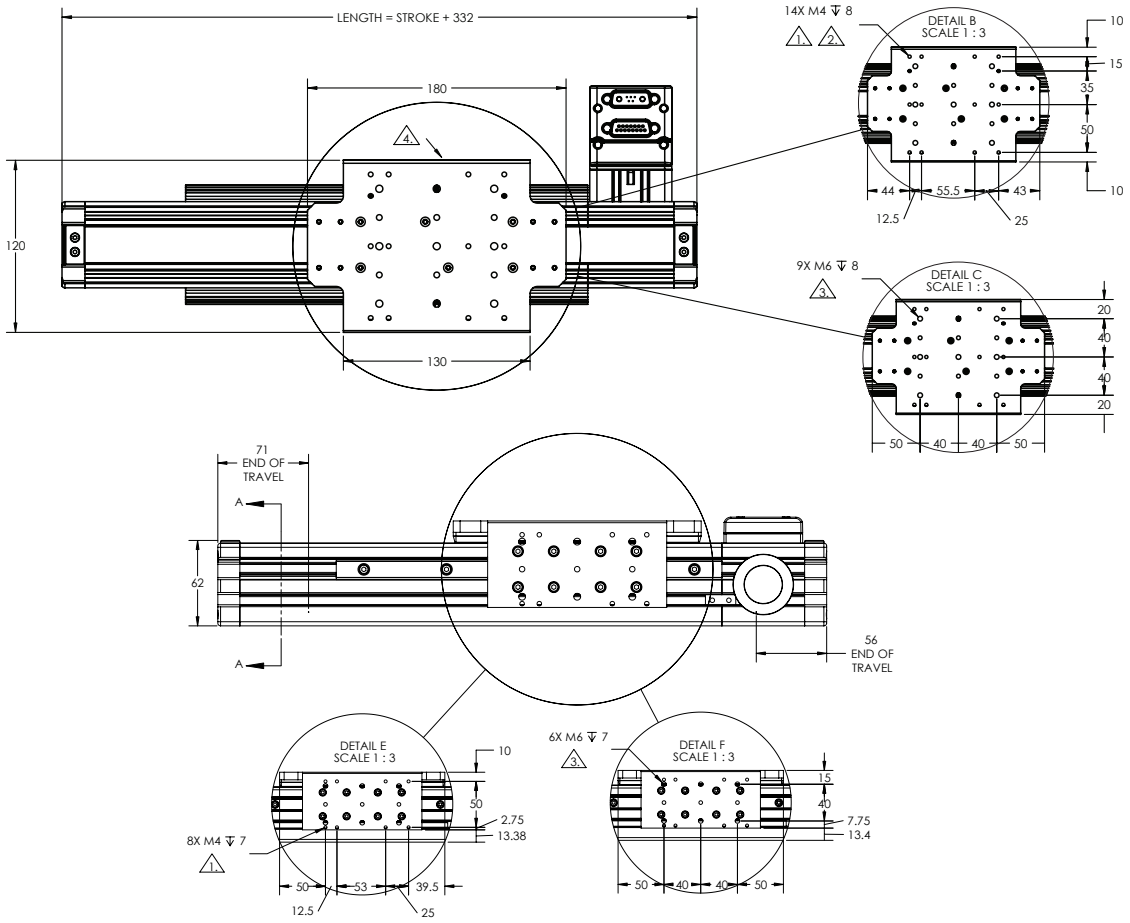
*Based on using SM23165DT @ 48V @ 4200 RPM no load.
**Based on a 15000HR service life @ 75/150/300 & 375mm/s (1800 RPM) average speed at given payload, subject to routine lubrication.
***Moment capacities given about center of carriage mounting surface.



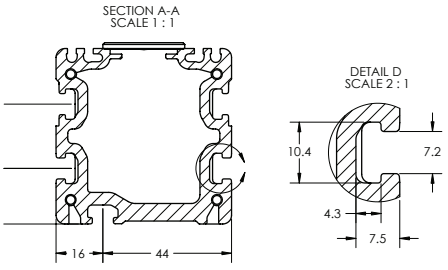


WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.

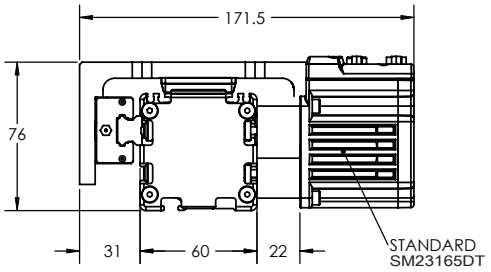
TOP VIEW



LEFT SIDE VIEW



SIMPLE END VIEW



MOTOR END VIEW

NOTES:

1. M4 x 12.5 x 50 and M4 x 25 x 50 mounting holes for L70 actuator.
2. M4 x 85 x 93 mounting holes for XL100 actuator.
3. M6 x 40 x 40 standard bolt pattern for optional mounting accessories.
4. Simple end (motor-side) has no mounting holes.

Dimensions in millimeters

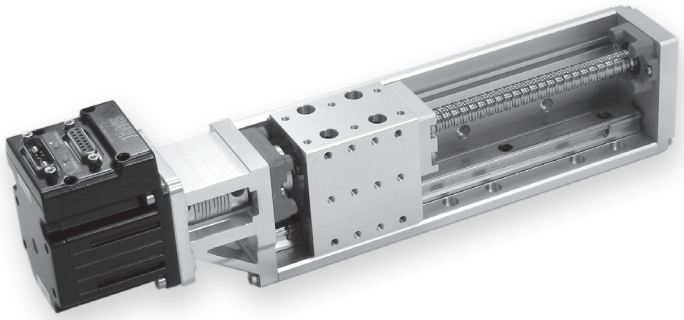
NOTE: For part numbers please refer to our website at www.animatics.com

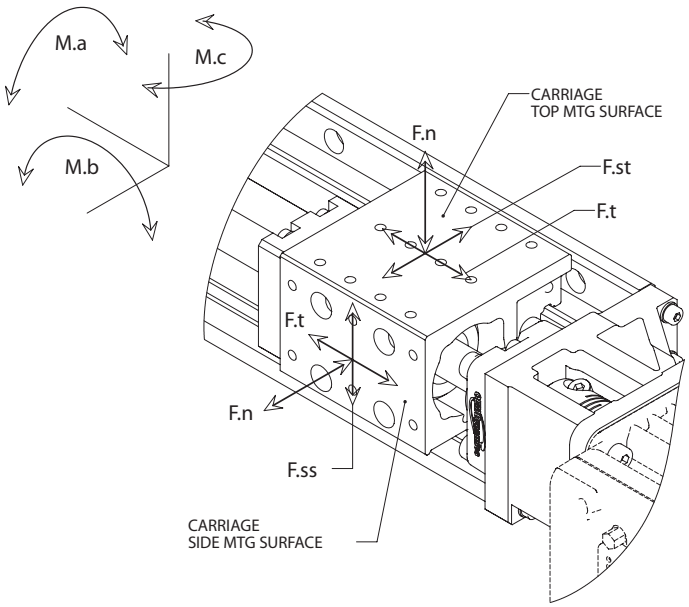
For Thrust Curve performance data, see pages 158–173.

L70 Product Specifications

Parameter	Value	Units
Configuration & Physical Parameters		
Motor	23 Frame SmartMotors, D and M series	-
Coupling	Beam	-
Displacement/rev	5, 10	mm/rev
Position Sensors	Adjustable (3 max) NPN N/O or N/C	-
Stroke Lengths	Standard in 50mm increments to 600 Custom in 1mm increments to 600	mm
Overall Length	Stroke + 182.5 + Motor	mm
Overtravel	24.5	mm
Unit Mass	1.29 + 0.00414 x (stroke, mm) + (motor mass, kg)	kg
Performance		
Unidirectional Repeatability	3	µm
Bidirectional Repeatability	16	µm
Linear Accuracy	0.21/300	mm/mm
Continuous Thrust*	587 or 294 (5 or 10 mm/rev lead)	N
Load Rating, Dynamic (Static)**		
Payload Mass	25 or 20 (5 or 10 mm/rev lead)	kg
F. t, Thrust	200 (1140)	N
F.n, Carriage Normal	200 (400)	N
F.st, Carriage Side	200 (400)	N
F.ss, Carriage Side	100 (400)	N
Carriage moments, Dynamic (Static)**		
M.a, Carriage Moment***	5 (20)	Nm
M.b, Carriage Moment***	5 (20)	Nm
M.c, Carriage Moment***	5 (20)	Nm

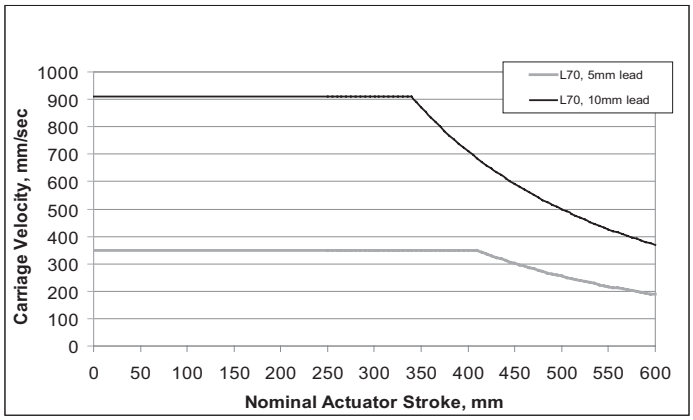
*Based on using SM23165DT @ 48V @ 2000 RPM. Refer to corresponding thrust curves for details.
**Based on a basic desired service life of 15,000hr (7.5yrs single shift) @ 167 mm/s and 333mm/s (2000 RPM) average speed at given payload, subject to routine lubrication.
Consult the factory if your application exceeds these values.
***Moment capacities given about center of carriage mounting surface.



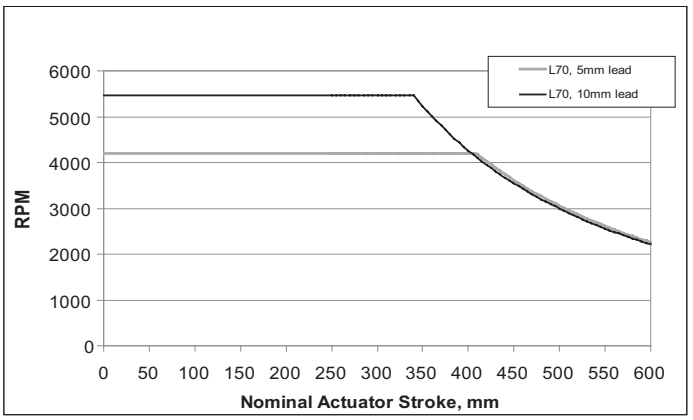


WARNING: Do not exceed these limits

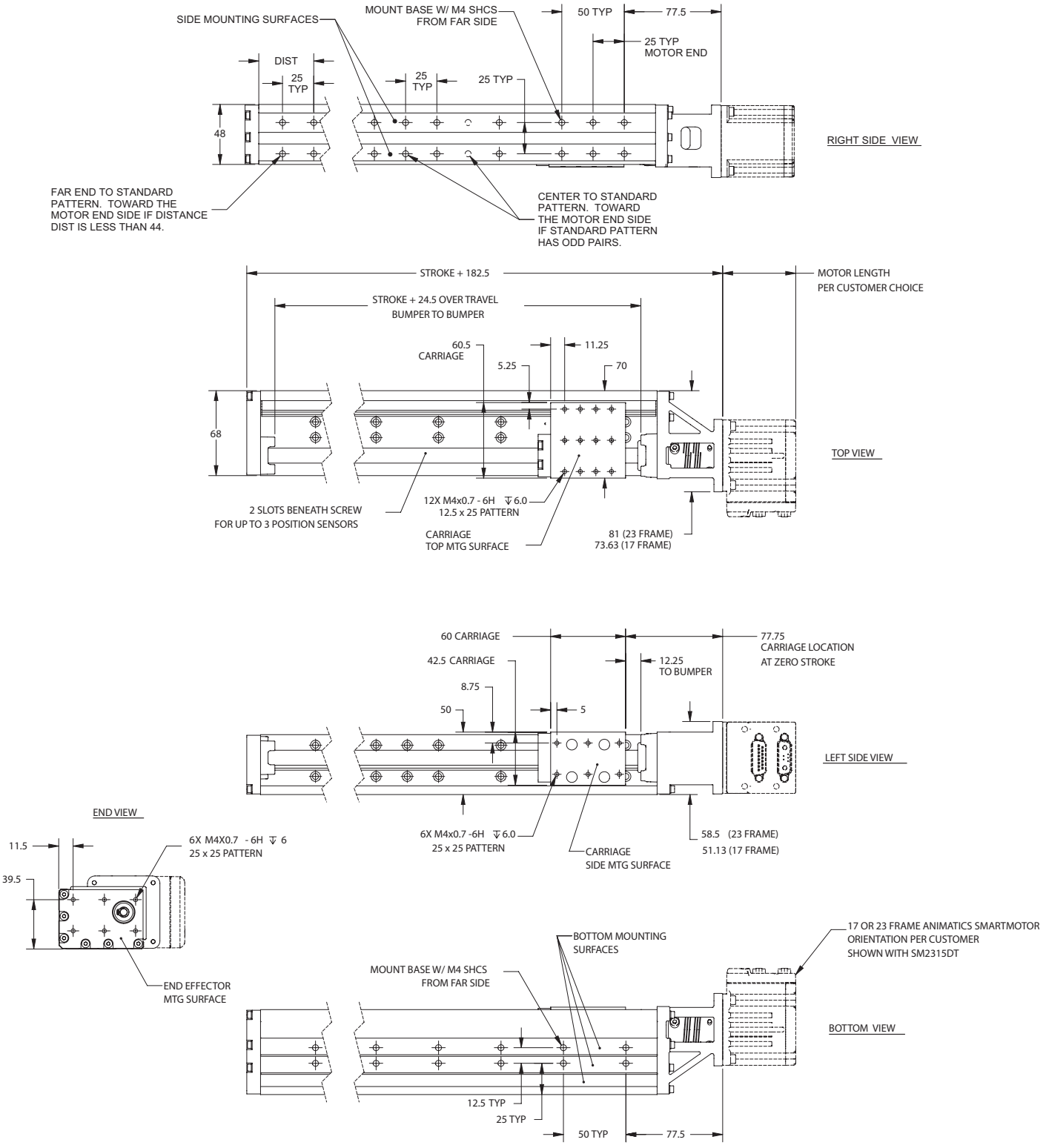
L70 - Maximum Permissible Carriage Velocity



L70 - Maximum Permissible Screw Speed



WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.



Dimensions in millimeters

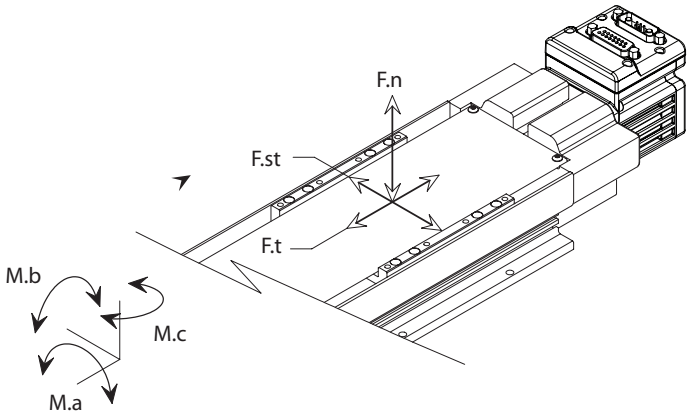
NOTE: For part numbers please refer to our website at www.animatics.com

For Thrust Curve performance data, see pages 158–173.

XL100 Product Specifications

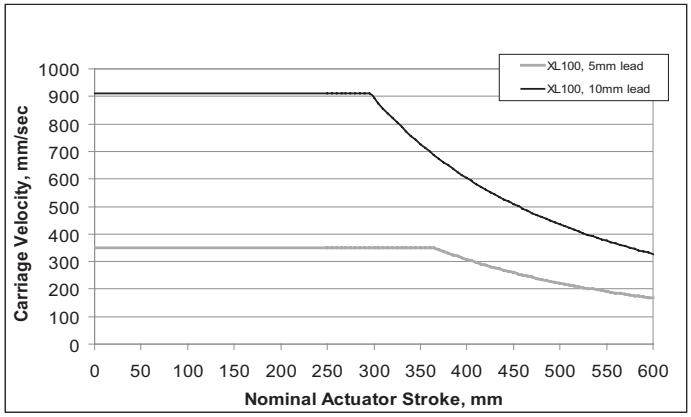
Parameter	Value	Units
Configuration & Physical Parameters		
Motor	23 Frame SmartMotors, D and M series	-
Coupling	Beam	-
Displacement/rev	5, 10	mm/rev
Position Sensors	Adjustable (3 per side - 6 max)) NPN N/O or N/C	-
Stroke Lengths	Standard in 50mm increments to 600 Custom in 1mm increments to 600	mm
Overall Length	Stroke + 223.50 + motor	mm
Overtravel	24.5	mm
Unit Mass	2.657 + 0.0049 x (stroke, mm) + (motor mass, kg)	kg
Performance		
Unidirectional Repeatability	3	µm
Bidirectional Repeatability	16	µm
Linear Accuracy	0.21/300	mm/mm
Continuous Thrust*	587 or 294 (5 or 10mm/rev lead)	N
Load Rating, Dynamic (Static)**		
Payload Mass	25 or 20 (5 or 10mm/rev lead)	kg
F. t, Thrust	200 (1140)	N
F.n, Carriage Normal	860 (15000)	N
F.st, Carriage Side	580 (1000)	N
Carriage moments, Dynamic (Static)**		
M.a, Carriage Moment***	25 (500)	Nm
M.b, Carriage Moment***	25 (500)	Nm
M.c, Carriage Moment***	25 (500)	Nm

*Based on using SM23165DT @ 48V @ 2000 RPM. Refer to corresponding thrust curves for details.
**Based on a basic desired service life of 15,000hr (7.5yrs single shift) @ 167 mm/s and 333mm/s (2000 RPM) average speed at given payload, subject to routine lubrication.
Consult the factory if your application exceeds these values.
***Moment capacities given about center of carriage mounting surface.

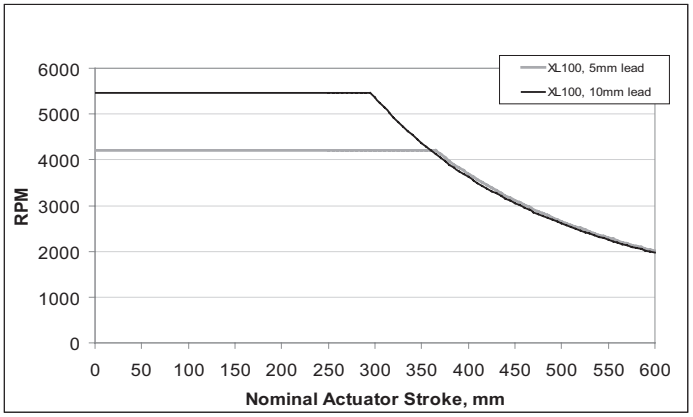


WARNING: Do not exceed these limits

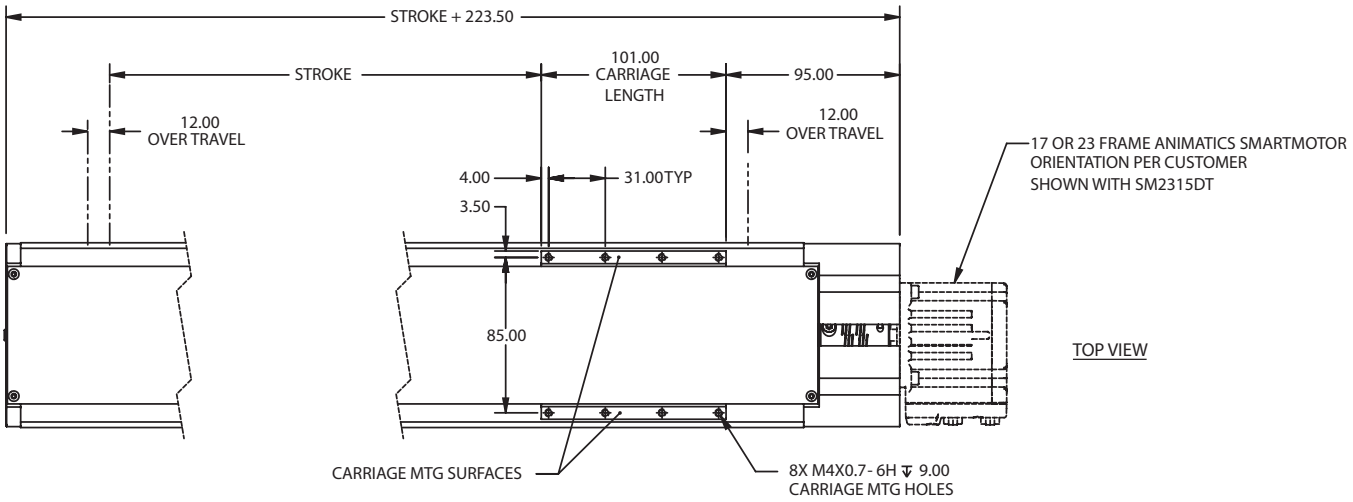
XL100 - Maximum Permissible Carriage Velocity

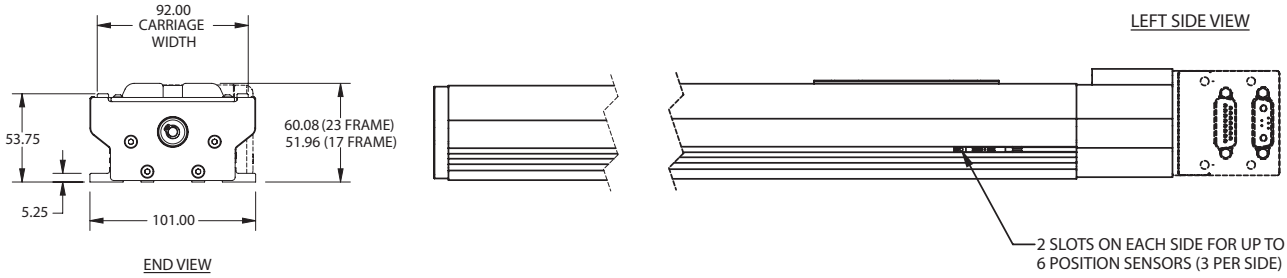


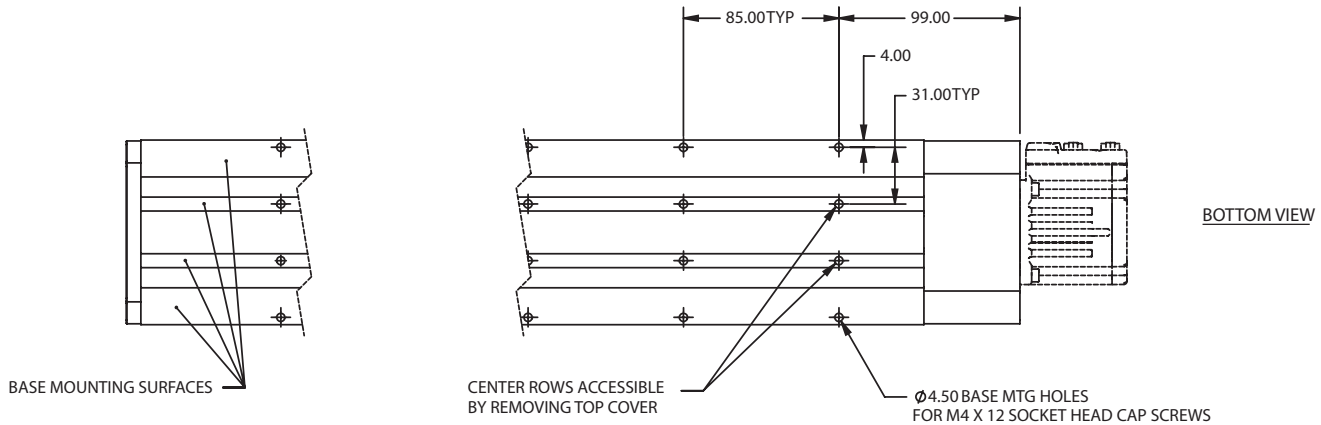
XL100 - Maximum Permissible Screw Speed



WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.







Dimensions in millimeters

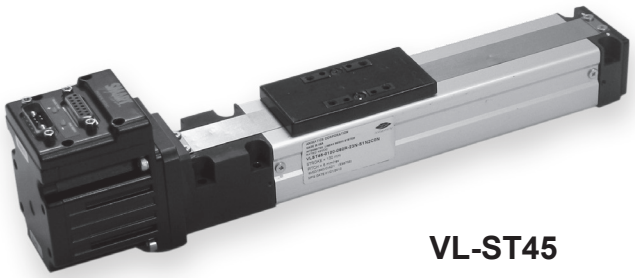
NOTE: For part numbers please refer to our website at www.animatics.com

For Thrust Curve performance data, see pages 158–173.

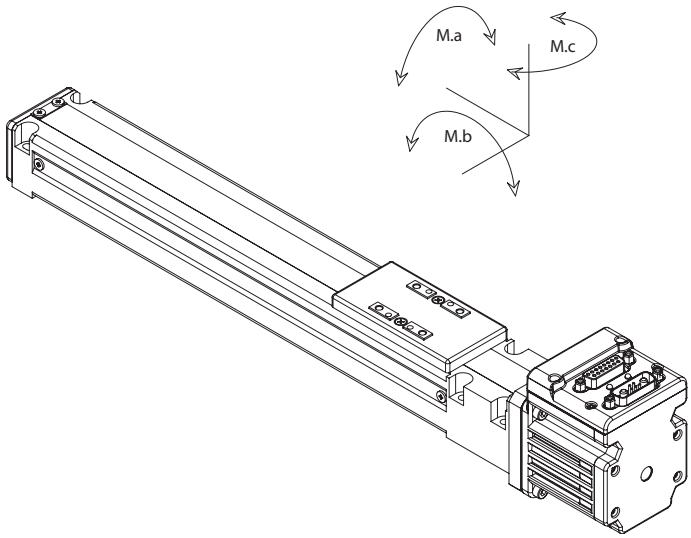
VL-ST45 Product Specifications

Parameter	Value		Units
Configuration & Physical Parameters			
Motor	23 Frame SmartMotors, D and M series		-
Coupling	Beam		-
Displacement/rev	6, 12		mm/rev
Position Sensors	Consult factory		-
Stroke Lengths	50 – 500mm in 50mm steps		mm
Overall Length	Stroke + 164 + motor		mm
Overtravel	10		mm
Unit Mass	1.38 + 0.0021 x (stroke, mm) + (motor mass, kg)		kg
Performance			
Unidirectional Repeatability	20		µm
Bidirectional Repeatability	40		µm
Linear Accuracy	0.21/300		mm/mm
Max Velocity	Up to 1000 (stroke dependent)		mm/s
Max Acceleration	0.3		G
Displacement/rev	6	12	mm/rev
Payload Mass	8	6.5	kg
Rated Velocity	200	400	mm/s
Lifetime*	15000		hr
Load Rating, Dynamic (Static)**			
Displacement/rev	**6**	**12**	**mm/rev**
Max Continuous Thrust	260	135	N
Max Peak Thrust	660	330	N
Carriage moments, Dynamic (Static)**			
M.a, Carriage Moment***	4.47 (31)	3.44 (31)	N*m
M.b, Carriage Moment***	1.64 (12)	1.33 (12)	N*m
M.c, Carriage Moment***	1.64 (12)	1.33 (12)	N*m

*Based on 15000 hr service life @ 200 mm/s and 400 mm/s (2000 RPM) average speed at the given payload, subject to routine lubrication.
**Based on using SM23165DT @ 48V @ 2000 RPM. Refer to corresponding thrust curves for details.
Consult the factory if your application exceeds these values.
***Moment capacities given about center of carriage mounting surface.

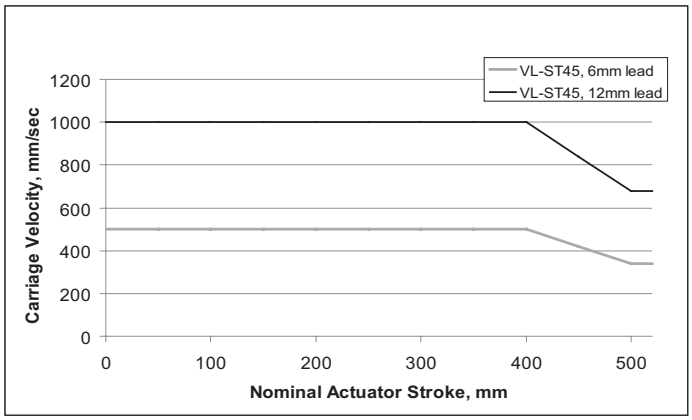


VL-ST45

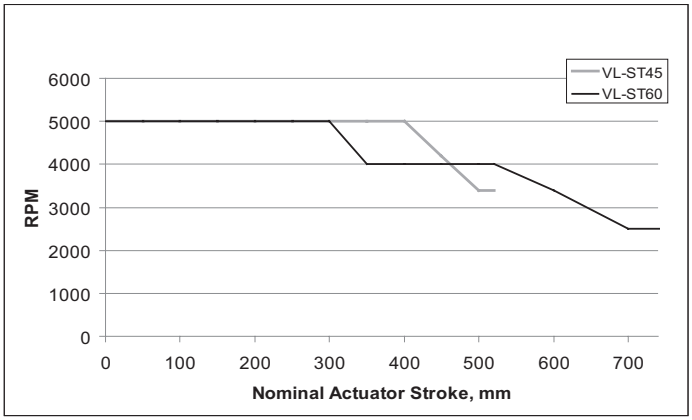


WARNING: Do not exceed these limits

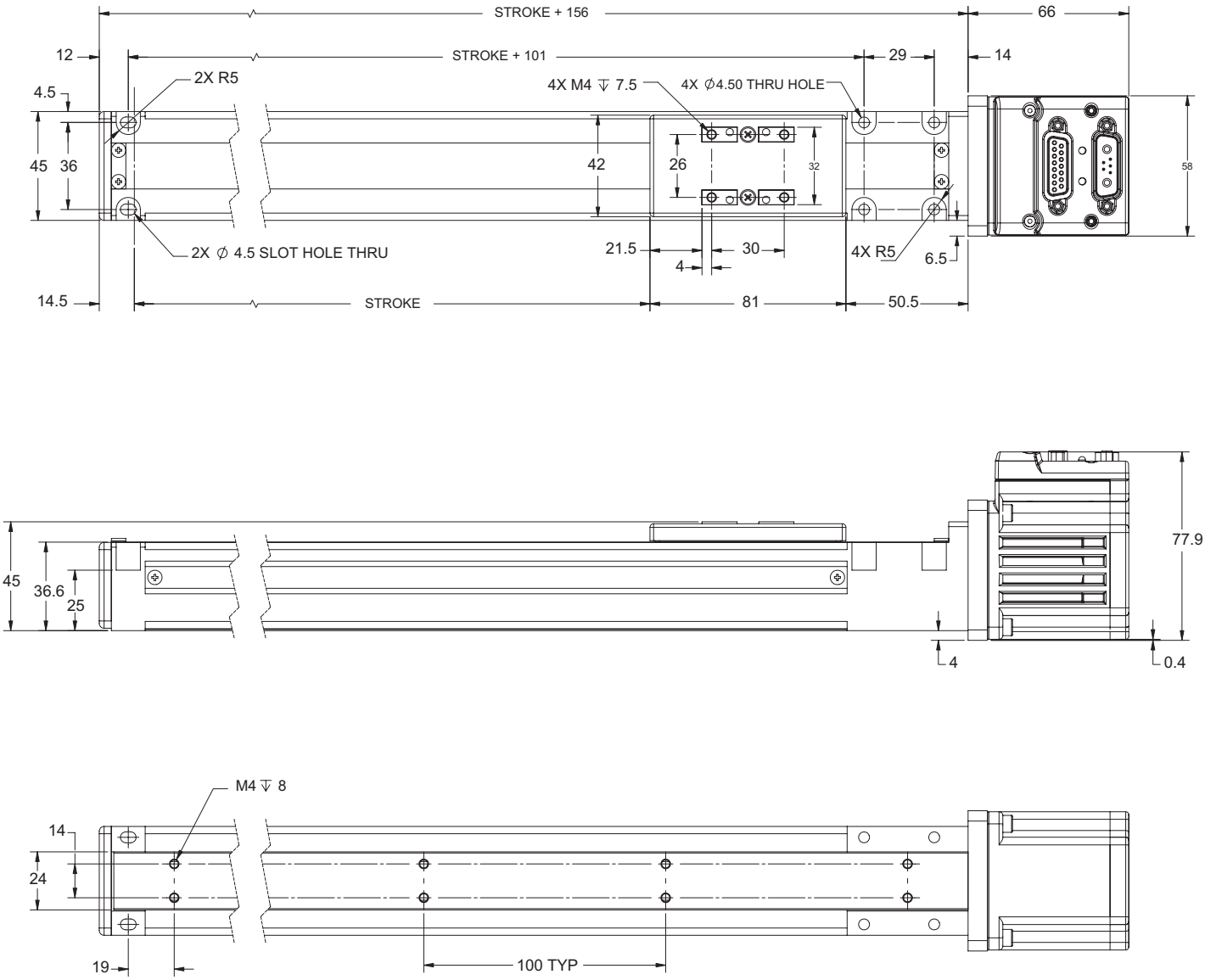
VL-ST45 - Maximum Permissible Carriage Velocity



VL-ST series - Maximum Permissible Screw Speed



WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.



Dimensions in millimeters

NOTE: For part numbers please refer to our website at www.animatics.com

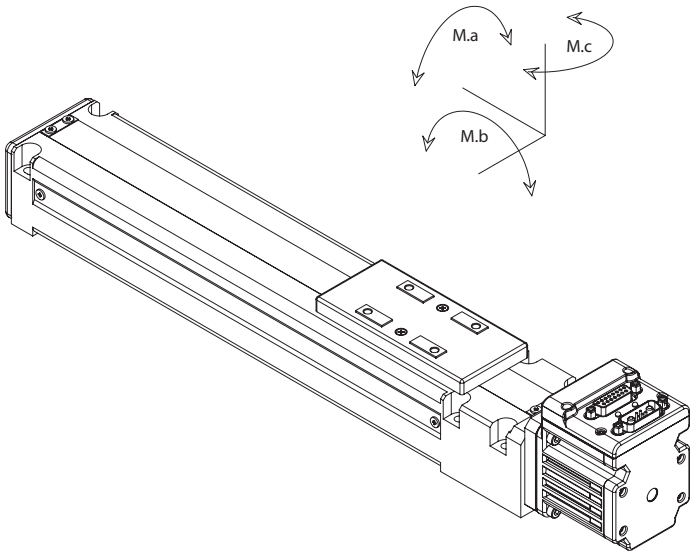
For Thrust Curve performance data, see pages 158–173.

VL-ST60 Product Specifications

Parameter	Value		Units
Configuration & Physical Parameters			
Motor	23 Frame SmartMotors, D and M series		-
Coupling	Beam		-
Displacement/rev	6, 12		mm/rev
Position Sensors	consult factory		-
Stroke Lengths	50 – 600mm in 50mm steps		mm
Overall Length	Stroke + 222 + motor		mm
Overtravel	10		mm
Unit Mass	1.3349 + 0.0039 x (stroke,mm) + (motor mass, kg)		kg
Performance			
Unidirectional Repeatability	20		µm
Bidirectional Repeatability	40		µm
Linear Accuracy	0.21/300		mm/mm
Max Velocity	up to 1000 (stroke dependent)		mm/s
Max Acceleration	0.3		G
Displacement/rev	**6**	**12**	**mm/rev**
Payload Mass	13	10	kg
Rated Velocity	200	400	mm/s
Lifetime*	15000		hr
Load Rating, Dynamic* (Static)			
Displacement/rev	**6**	**12**	**mm/rev**
Max Continuous Thrust	490	250	N
Max Peak Thrust	768	394	N
Carriage moments, Dynamic (Static)**			
M.a, Carriage Moment***	11.47 (58)	9 (58)	N*m
M.b, Carriage Moment***	3.57 (25)	2.75 (25)	N*m
M.c, Carriage Moment***	3.57 (25)	2.75 (25)	N*m

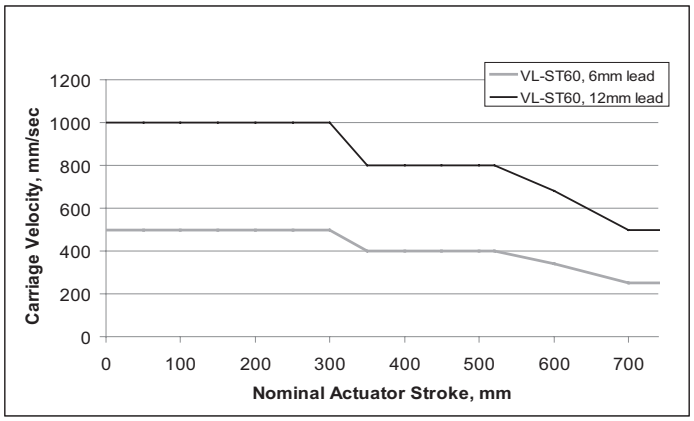
*Based on 15000 hr service life @ 200 mm/s and 400 mm/s (2000 RPM) average speed at the given payload, subject to routine lubrication.
**Based on using SM23165DT @ 48V @ 2000 RPM. Refer to corresponding thrust curves for details.
Consult the factory if your application exceeds these values.
***Moment capacities given about center of carriage mounting surface.

VL-ST60

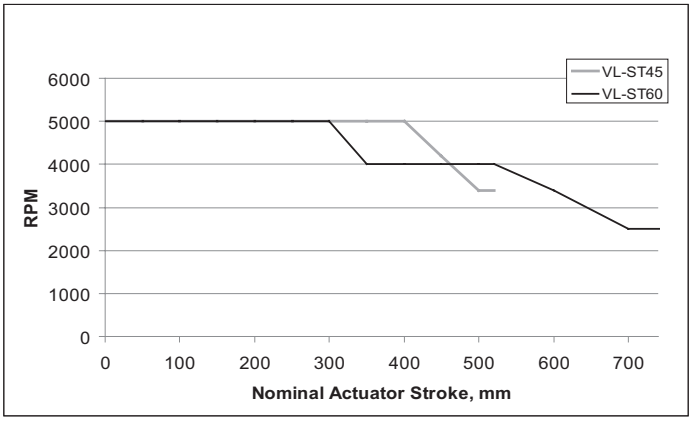


WARNING: Do not exceed these limits

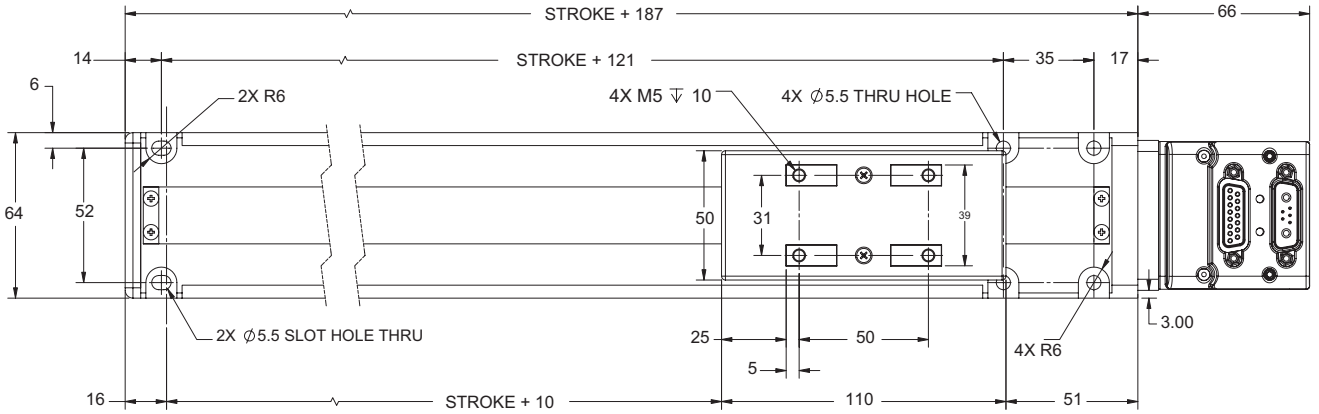
VL-ST60 - Maximum Permissible Carriage Velocity

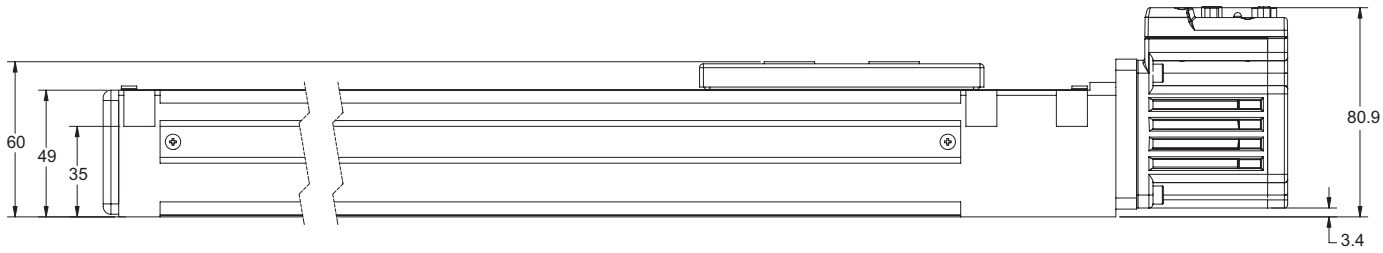


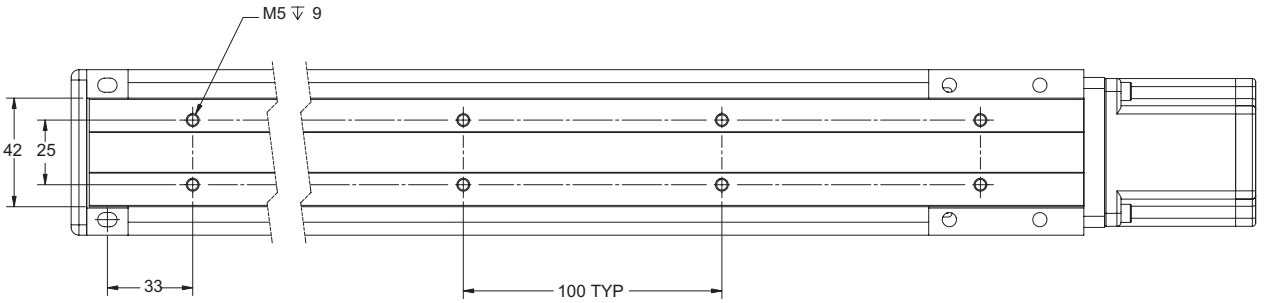
VL-ST series - Maximum Permissible Screw Speed



WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.







Dimensions in millimeters

NOTE: For part numbers please refer to our website at www.animatics.com

For Thrust Curve performance data, see pages 158–173.

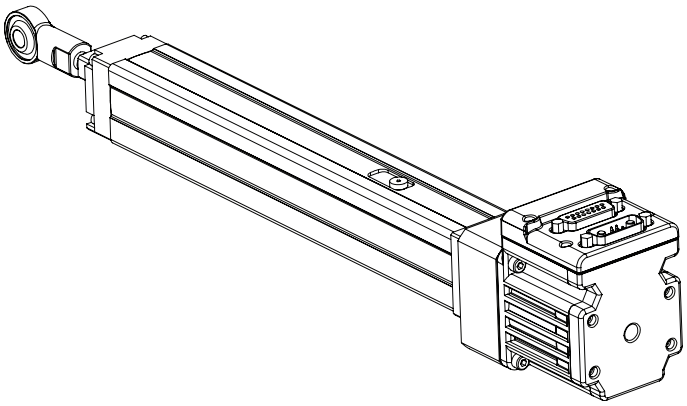
VL-CT35 Series Specifications

Parameter	Value		Value		Units
Configuration & Physical Parameters					
Motor	23 frame D-series SmartMotors ONLY				-
Coupling	Beam				-
Displacement/rev	6,12				mm/rev
Position Sensors	consult factory				-
Stroke Lengths	50, 100 and 150				mm
Overall Length	Stroke + 244.9 + motor				mm
Overtravel	None				mm
Unit Mass	1.1667 + 0.003 x (stroke, mm) + (motor mass, kg)				kg
Performance					
Unidirectional Repeatability	20				µm
Bidirectional Repeatability	40				µm
Linear Accuracy	0.21/300				mm/mm
Max Velocity	470 – 1000 (stroke dependent)				mm/s
Max Acceleration	0.3				G
Payload Mass	5.6				kg
Rated Velocity	400				mm/s
Lifetime*	15000				hr
Load Rating, Dynamic					
Using SM23165DT motor	**Direct Drive**		**2:1 pulley****		-
Displacement/rev	**6**	**12**	**6**	**12**	**mm/rev**
Max Continuous Thrust	461	231	922	461	N
Max Peak Thrust	745	372	1490	745	N

*Based on operating at an average speed of the rated velocity at the given payload. The Lifetime will be significantly reduced operating above the rated velocity and/or given payload.

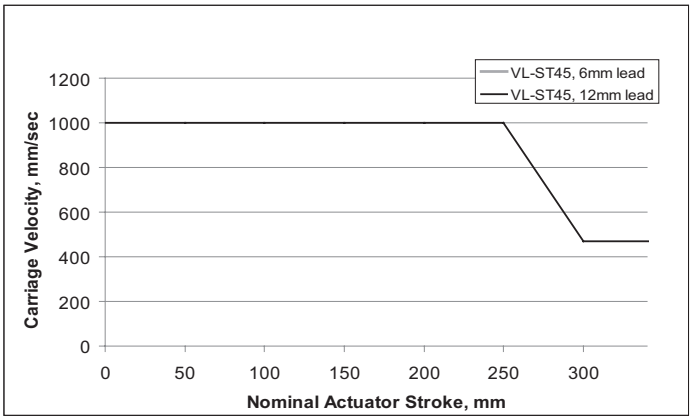
**Please see page 155 for pulley offset CAD drawings.

VL-CT35 series

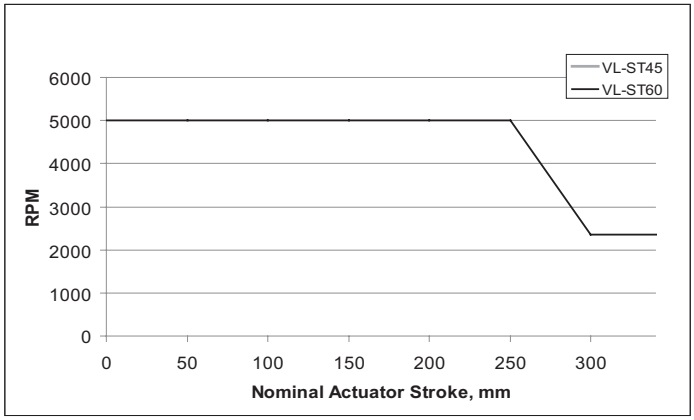


WARNING: Do not exceed these limits

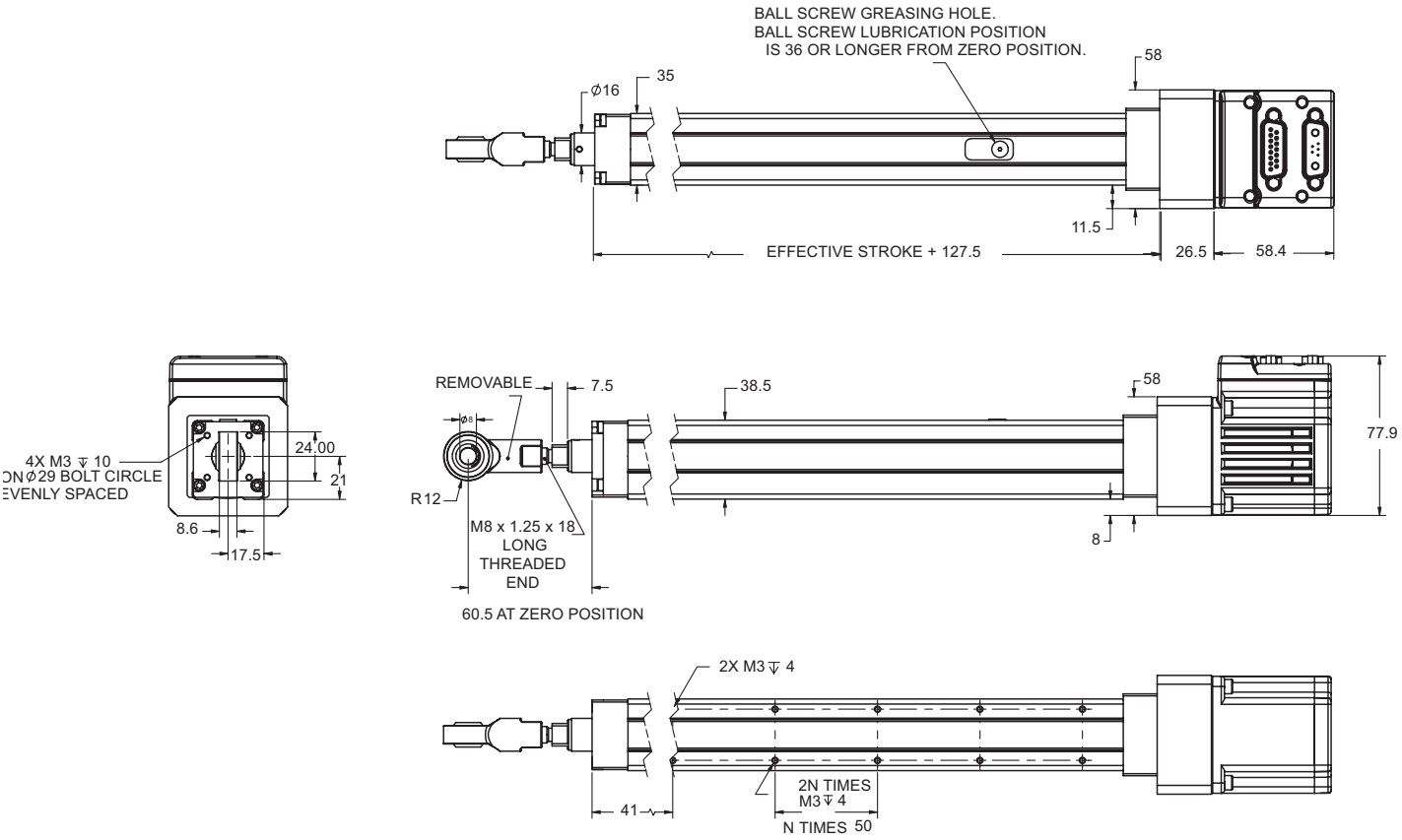
VL-CT series - Maximum Permissible Carriage Velocity



VL-CT series - Maximum Permissible Screw Speed



WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.



Dimensions in millimeters

NOTE: For part numbers please refer to our website at www.animatics.com

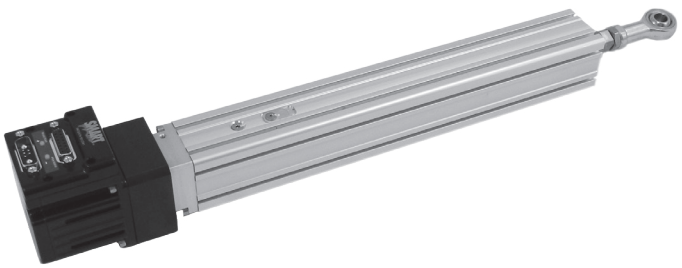
For Thrust Curve performance data, see pages 158–173.

VL-CT45 Series Specifications

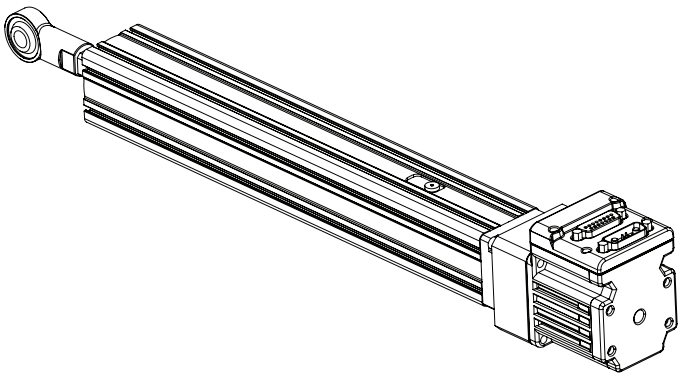
Parameter	Value		Value		Units
Configuration & Physical Parameters					
Motor	23 frame D-series SmartMotors ONLY				-
Coupling	Beam				-
Displacement/rev	6,12				mm/rev
Position Sensors	consult factory				-
Stroke Lengths	50, 100, 150 and 200				mm
Overall Length	Stroke + 251.4 + motor				mm
Overtravel	None				mm
Unit Mass	1.45 + 0.0052 x (stroke, mm) + (motor mass, kg)				kg
Performance					
Unidirectional Repeatability	20				µm
Bidirectional Repeatability	40				µm
Linear Accuracy	0.21/300				mm/mm
Max Velocity	470 – 1000 (stroke dependent)				mm/s
Max Acceleration	0.3				G
Payload Mass	5.6				kg
Rated Velocity	400				mm/s
Lifetime*	15000				hr
Load Rating, Dynamic					
Using SM23165DT motor	**Direct Drive**		**2:1 pulley****		-
Displacement/rev	**6**	**12**	**6**	**12**	**mm/rev**
Max Continuous Thrust	461	231	922	461	N
Max Peak Thrust	745	372	1490	745	N

*Based on operating at an average speed of the rated velocity at the given payload. The Lifetime will be significantly reduced operating above the rated velocity and/or given payload.

**Please see page 156 for pulley offset CAD drawings.

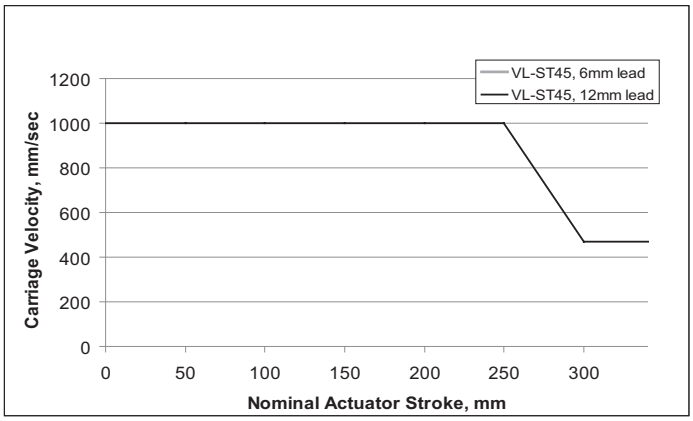


VL-CT45

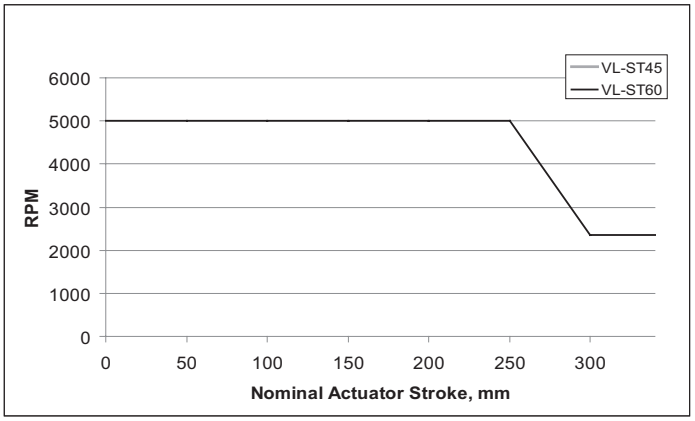


WARNING: Do not exceed these limits

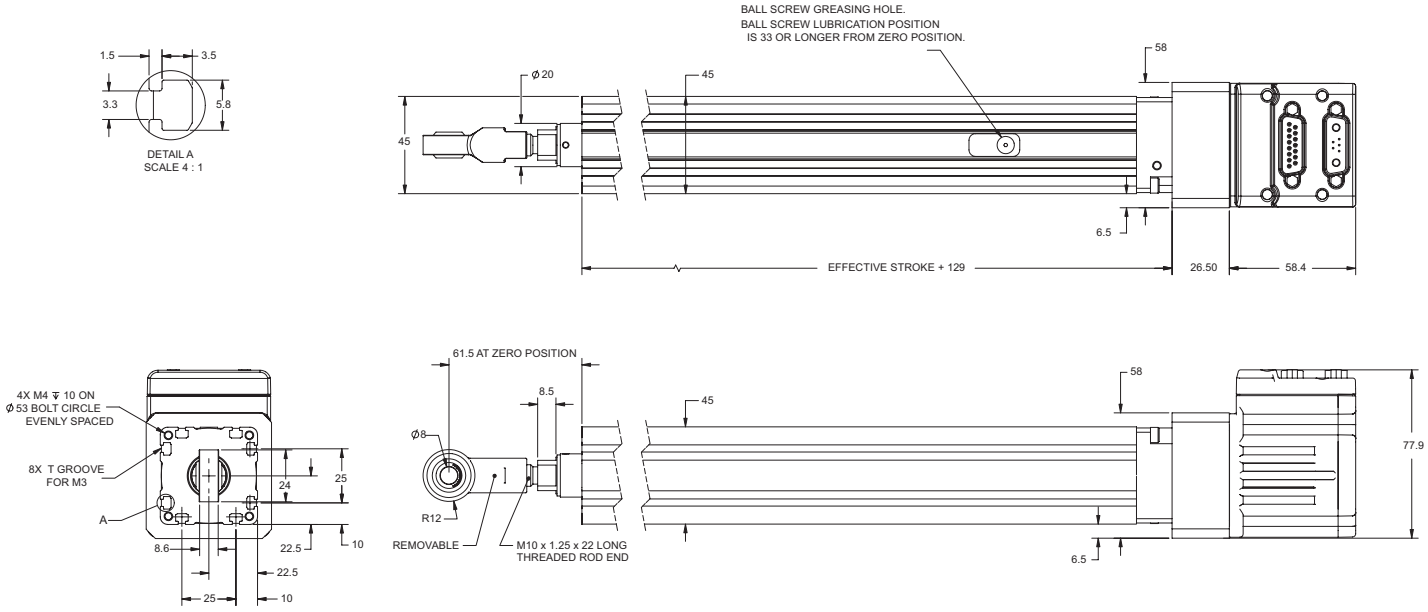
VL-CT series - Maximum Permissible Carriage Velocity



VL-CT series - Maximum Permissible Screw Speed



WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.



Dimensions in millimeters

NOTE: For part numbers please refer to our website at www.animatics.com

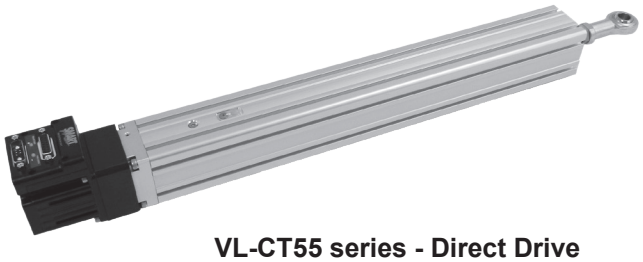
For Thrust Curve performance data, see pages 158–173.

VL-CT55 Series Specifications

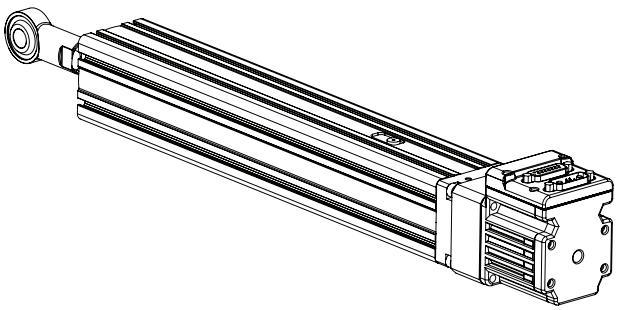
Parameter	Value						Units
Configuration & Physical Parameters							
Motor	23 frame D-series SmartMotors ONLY						-
Coupling	Beam						-
Displacement/rev	6,12						mm/rev
Position Sensors	consult factory						-
Stroke Lengths	50 – 300mm in 50mm steps						mm
Overall Length	Stroke + 274.9 + motor						mm
Overtravel	None						mm
Unit Mass	1.94 + 0.0075 x (stroke, mm) + (motor mass, kg)						kg
Performance							
Unidirectional Repeatability	20						µm
Bidirectional Repeatability	40						µm
Linear Accuracy	0.21/300						mm/mm
Max Velocity	470 – 1000 (stroke dependent)						mm/s
Max Acceleration	0.3						G
Payload Mass	22						kg
Rated Velocity	400						mm/s
Lifetime*	15000						hr
Load Rating, Dynamic							
Using SM23165DT motor	**Direct Drive**		**2:1 pulley****		**3:1 pulley****		-
Displacement/rev	**6**	**12**	**6**	**12**	**6**	**12**	**mm/rev**
Max Continuous Thrust	461	231	922	461	1383	692	N
Max Peak Thrust	745	372	1490	745	2235	1117	N

*Based on operating at an average speed of the rated velocity at the given payload. The Lifetime will be significantly reduced operating above the rated velocity and/or given payload.

**Please see page 156 for pulley offset CAD drawings.

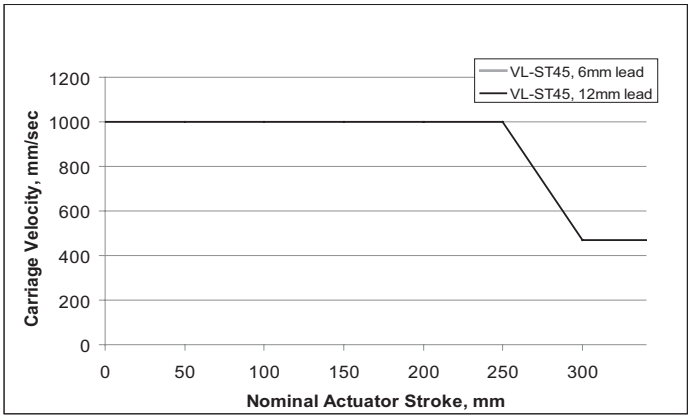


VL-CT55 series - Direct Drive

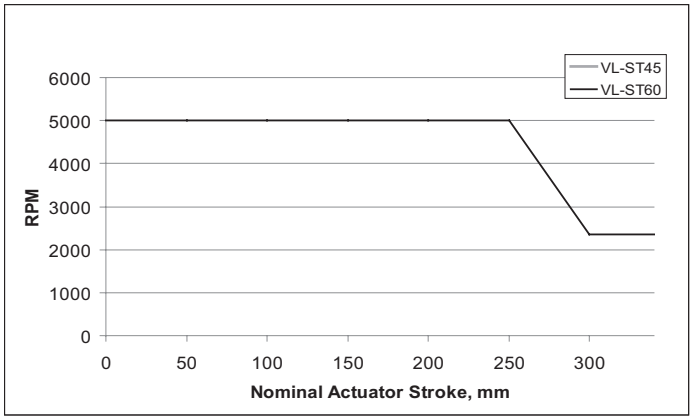


WARNING: Do not exceed these limits

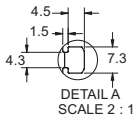
VL-CT series - Maximum Permissible Carriage Velocity

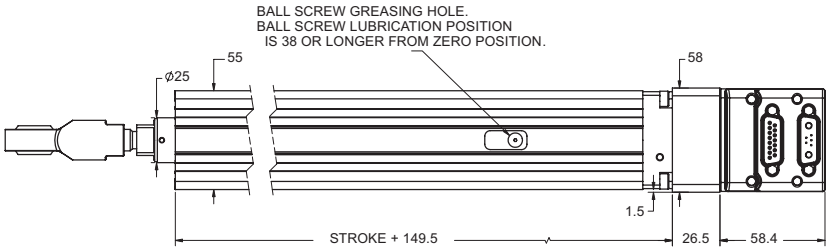


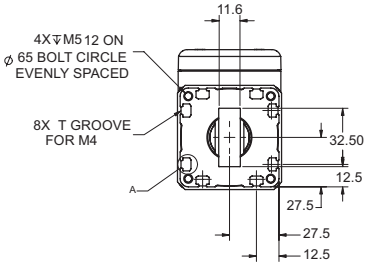
VL-CT series - Maximum Permissible Screw Speed

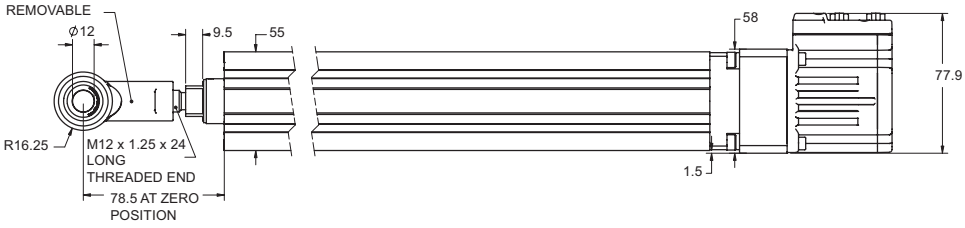


WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.





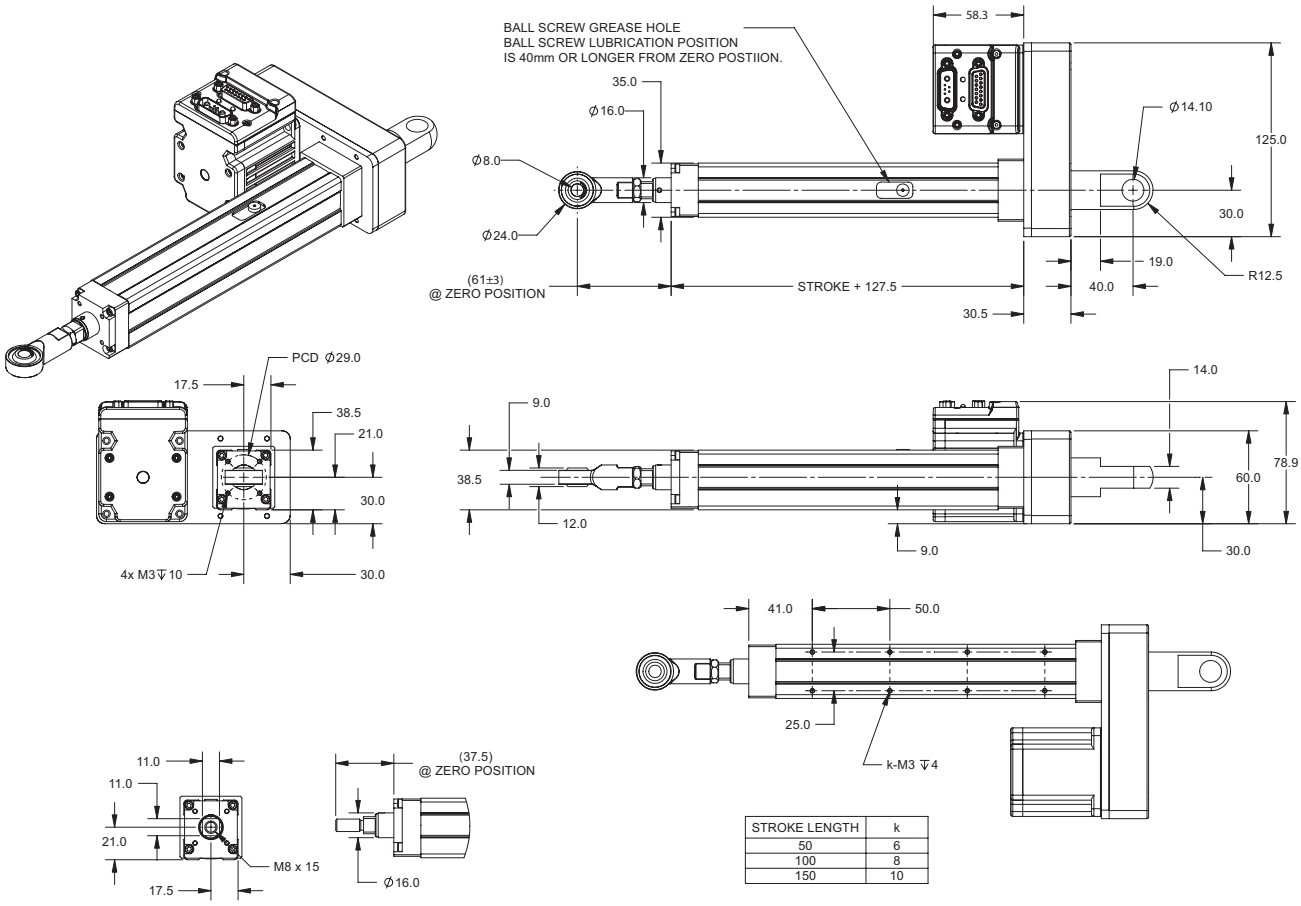




Dimensions in millimeters

NOTE: For part numbers please refer to our website at www.animatics.com

For Thrust Curve performance data, see pages 158–173.



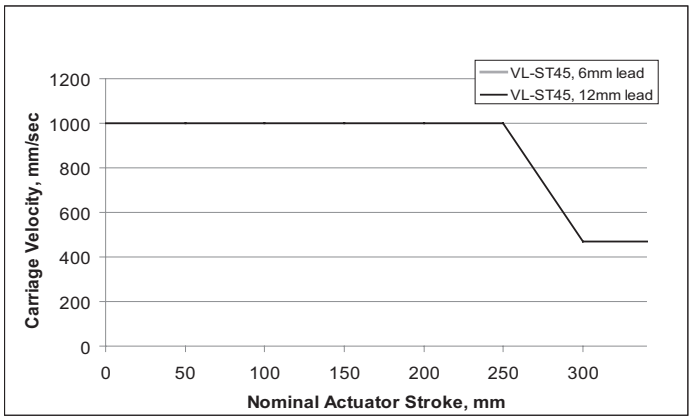
STROKE LENGTH	k
50	6
100	8
150	10

VL-CT35 with SM23165DT

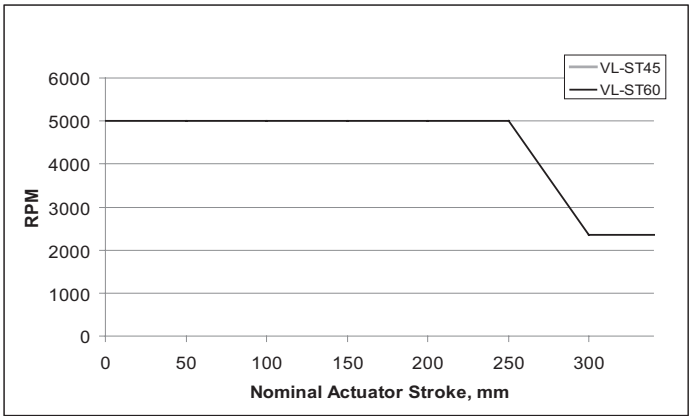
*Tie rods are available.

WARNING: Do not exceed these limits

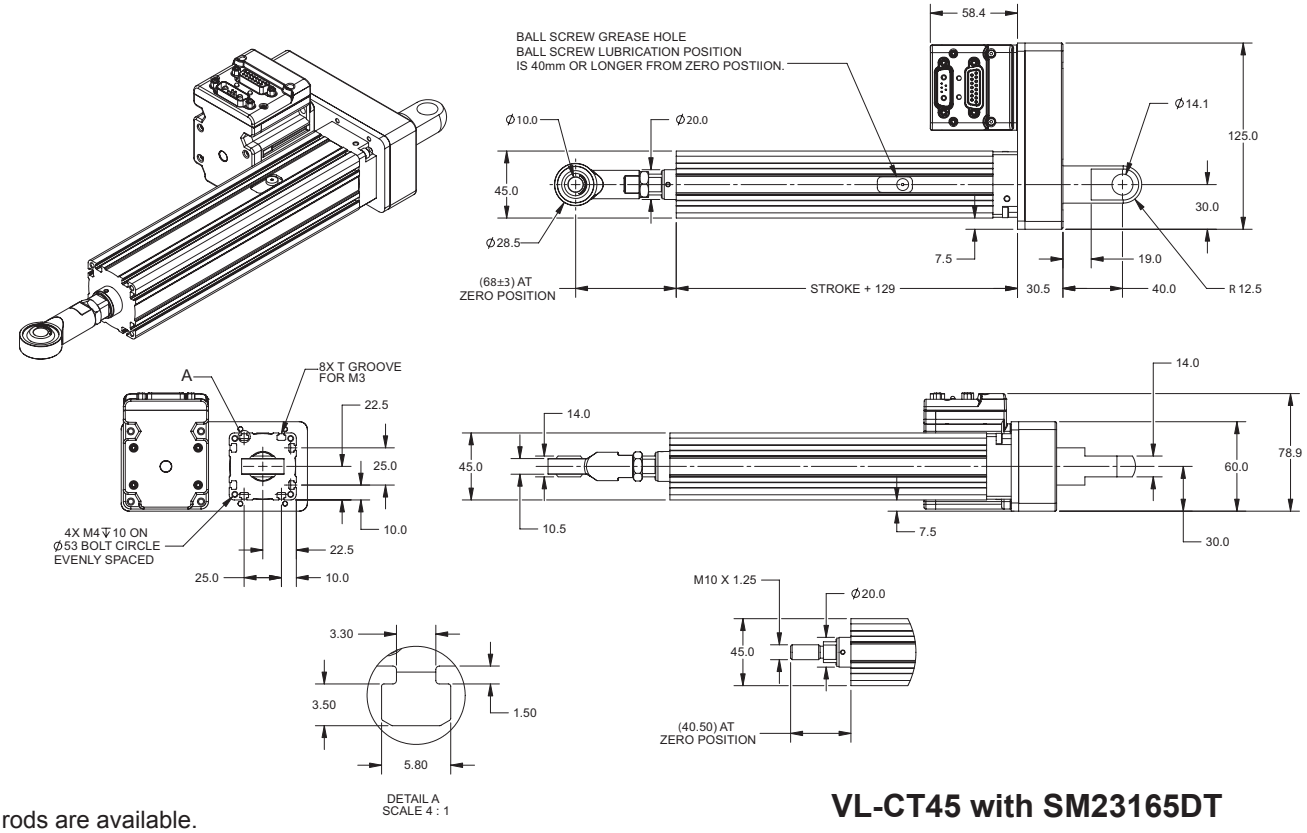
VL-CT series - Maximum Permissible Carriage Velocity



VL-CT series - Maximum Permissible Screw Speed

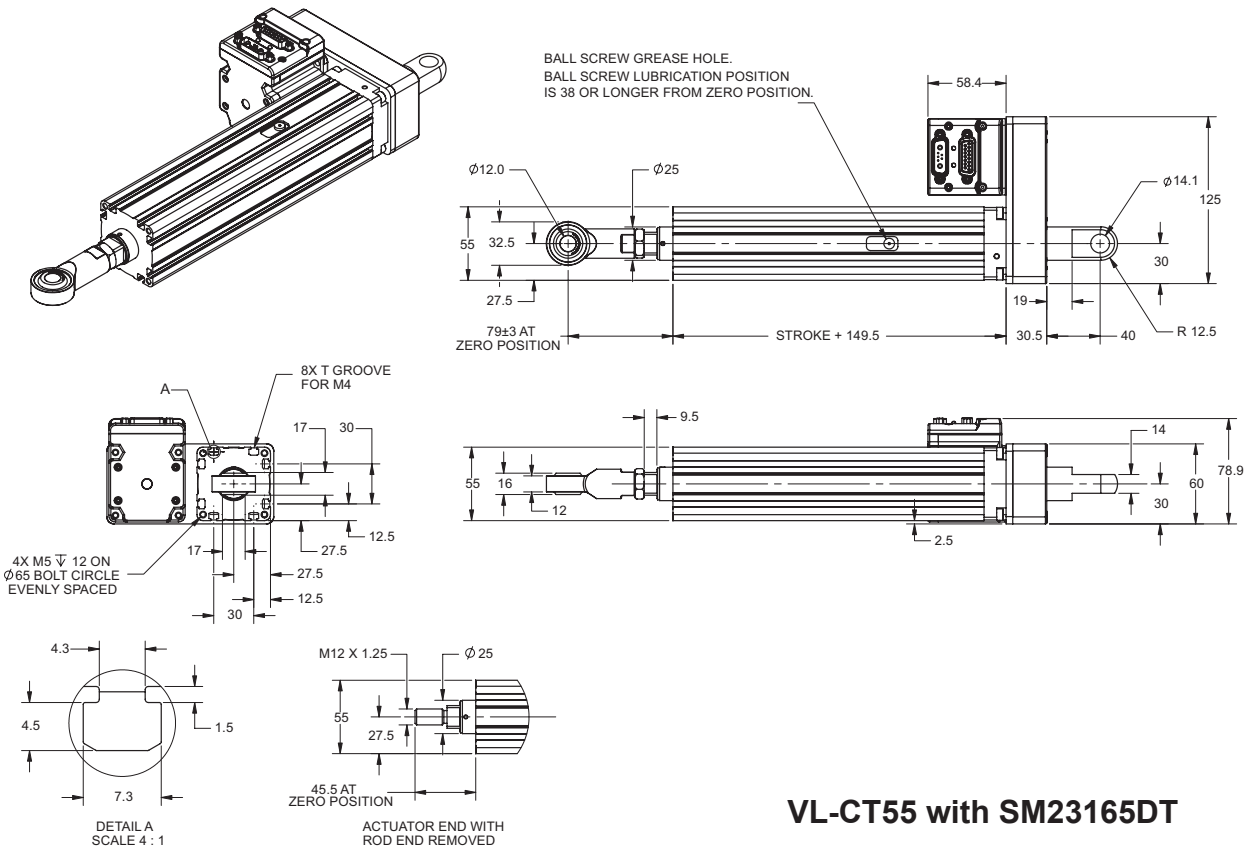


WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.



VL-CT45 with SM23165DT

*Tie rods are available.



VL-CT55 with SM23165DT

*Tie rods are available.

Considerations for Actuator Loading

Forces acting upon actuators consist of a combination of axial forces on any axis and a twisting force that may be applied due to offset loads.

Direct forces placed on the actuator

F.t. : Thrust force operating in the direction of travel.

Mechanically limiting factor: For lead screw actuators, this is typically the thrust bearings and/or lead nut.

For harmonic belt drives, the limiting factor is typically the belt. It may be based on shear strength of the belt teeth or on the actual tensile strength of the belt itself. In a welded belt, it would most likely be based on the weld strength of that belt.

F.st. : Side thrust force, acts upon the carriage from one side or the other.

The bearing support is typically the limiting factor. The choice of bearings and their orientation will greatly affect the maximum permissible force.

F.n. : Normal force downward.

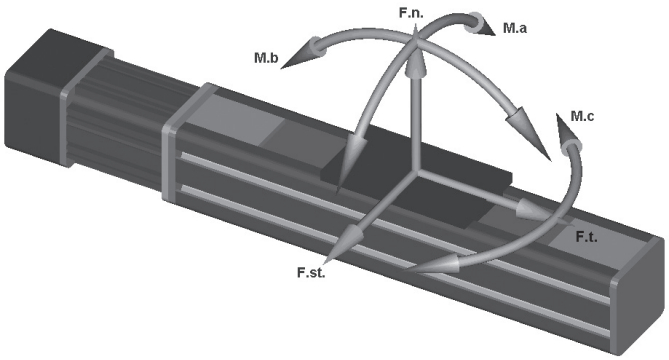
Similar to side force, the limit is based on the bearings and their orientation. It is very common to have a much higher normal downward force capacity than a side force capacity. Since gravity typically plays a role in horizontal applications, most actuators are designed to deal with downward force effectively.

Moment Loading Forces:

This is the twisting force similar to a moment arm force applying a torque to the supporting bearings.

Accessories for L70, XL100, HLD60 Only

Part Number	Description	
SEN-NO-1M	NPN magnetic sensor Normally Open with flying leads	
SEN-NC-1M †	NPN magnetic sensor Normally Closed with flying leads	
SEN-NO-5M	NPN magnetic sensor Normally Open with flying leads	
SEN-NC-5M †	NPN magnetic sensor Normally Closed with flying leads	
HLD60-TC3	Toe Clamp for HLD60 - 3 holes	
HLD60-TC2	Toe Clamp for HLD60 - 2 holes	
HLD60-TN12M	T-nuts for HLD60, 2 holes (M4) with 12 mm spacing	
HLD60-TN60M	T-nuts for HLD60, 2 holes (M4) with 60 mm spacing	
HLD60-TN12M-10PCS	T-nuts for HLD60, 2 holes (M4) with 12 mm spacing	
HLD60-TN60M-10PCS	T-nuts for HLD60, 2 holes (M4) with 60 mm spacing	



To ensure long life of the actuator it is imperative to not exceed the Moment loading specifications.

In the above diagram, three moment loads are depicted.

All three moment loading forces may exist on a given application. It is important to remember that any offset load from the center surface of the actuator carriage will induce one or more of these Moment forces.

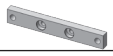
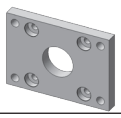
While accelerating, that moment load may increase drastically.

For example: Suppose in the above diagram, you place a load offset from the center of the carriage in upward direction. Any time the load is accelerated, the M.b. moment loading will increase.

If the load is placed horizontally offset to one side or the other, dynamic motion will increase the M.c. component of moment loading of that actuator.

The M.a. component is the only moment loading that will not typically change with the dynamics of load motion. However, offset side loading is the greatest contributor to the M.a. component.

Accessories for VL-CT Series Only

Part Number	Description	
VLCT35-BB	Bracket Base, CT-35	
VLCT45-BB	Bracket Base, CT-45	
VLCT55-BB	Bracket Base, CT-55	
VLCT35-F	Flange for CT-35	
VLCT45-F	Flange for CT-45	
VLCT55-F	Flange for CT-55	

†Use normally closed sensors for pos. and neg. travel limits.
*Please see www.animatics.com/products/actuators
Pricing subject to change without notice. All sales subject to Moog Animatics standard sales terms and conditions.

WARNING: Exceeding thrust, speed, or moment loading specifications could result in immediate damage to the actuators. Doing so will void the warranty.

Understanding Thrust Curves

Actuator thrust curves are very similar to servo torque curves, but relate to linear motion performance instead of shaft rotation performance. All thrust curves show continuous and peak performance based on the coupled system of Servo and Actuator together. The following examples show the 2 exceptions to the previous statement, where the actuators limitations are taken into account.

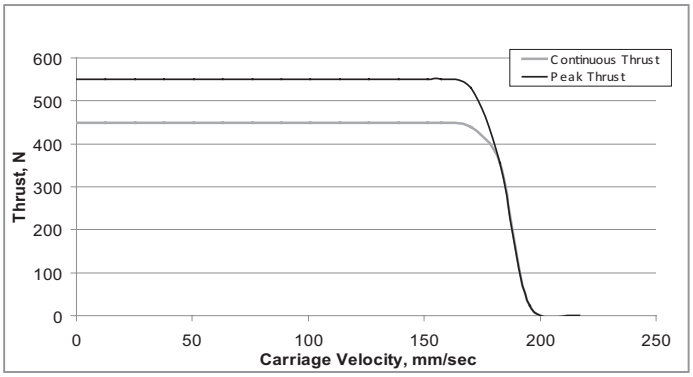
NOTE: The continuous thrust region is where the system should be operated, except for short hard accelerations required in your motion profile. Sustained operation outside the continuous region will reduce the rated life on the actuator/integrated motor system. Please check the specifications of each actuator for limiting factors such as mechanical critical speed and thrust limits.

Limitation on Thrust Output Example

The curve to the right shows that there is a maximum amount of thrust the actuator can put out continuously and peak. That is why the curve abruptly flattens out (horizontal line) at speeds less than 150 mm/sec. This curve shows that the motor can provide more input torque than the actuator can handle at speeds less than 150 mm/sec.

NOTE: In this example, the maximum allowable thrust is limited to 550 N. Exceeding that could potentially damage the actuator even if the motor limits are not exceeded.

HLD60 Single Rail/Internal Rollers
SM23165DT @ 48V, 2.5mm/rev

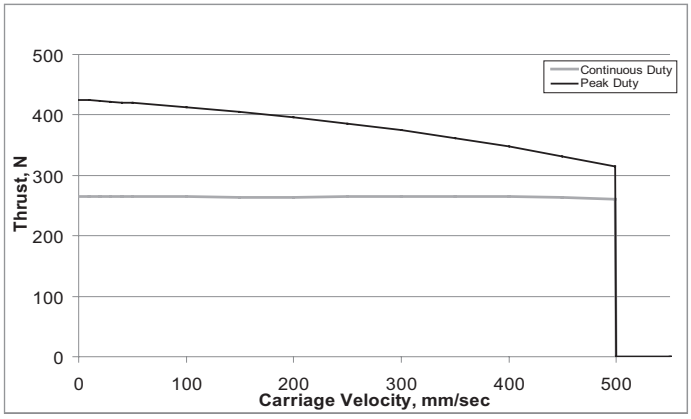


Limitation of Actuator's Speed Example

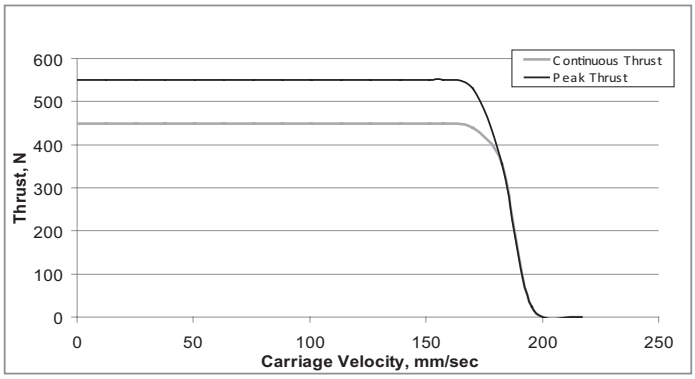
The curve to the right shows that at 500 mm/sec, the thrust abruptly goes to zero (the vertical line). This means that the actuator has a maximum carriage velocity of 500 mm/sec usually due to ball screw limitations.

NOTE: This speed limitation is mechanically based. It is possible to command a servo speed in excess of the critical speed limits of the actuator. Doing so increases risk of damage and will shorten the life of the actuator.

VL-ST45 - SM2316D @ 48V, 6mm/rev lead ball screw

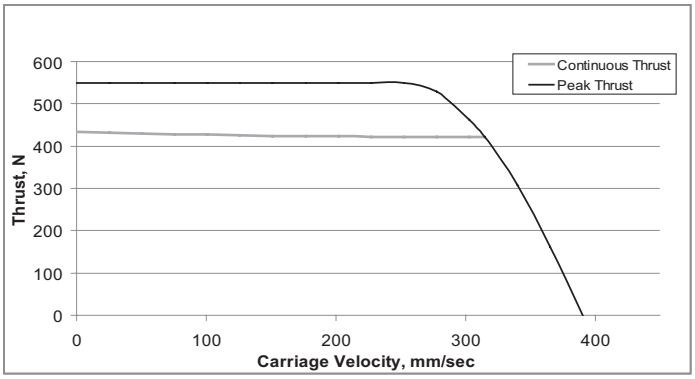


HLD60 Single Rail/Internal Rollers SM23165DT @ 48V, 2.5mm/rev



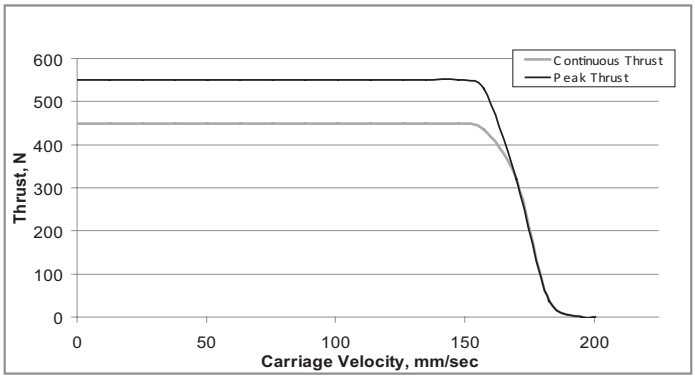
*450 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165DT @ 48V, 5mm/rev



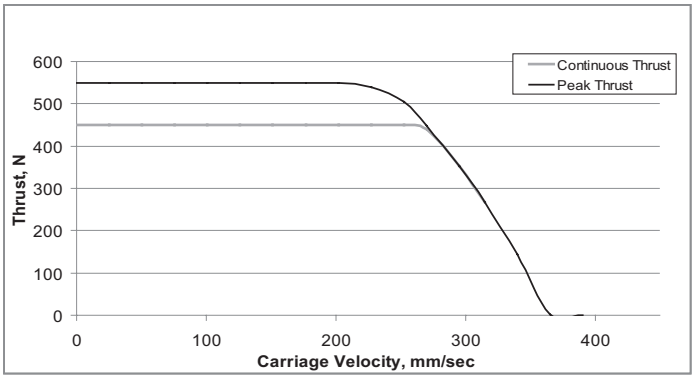
*420 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165DT @ 42V, 2.5mm/rev



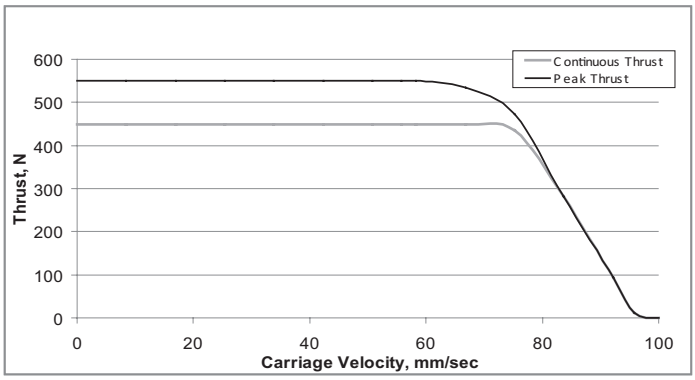
*450 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165DT @ 42V, 5mm/rev



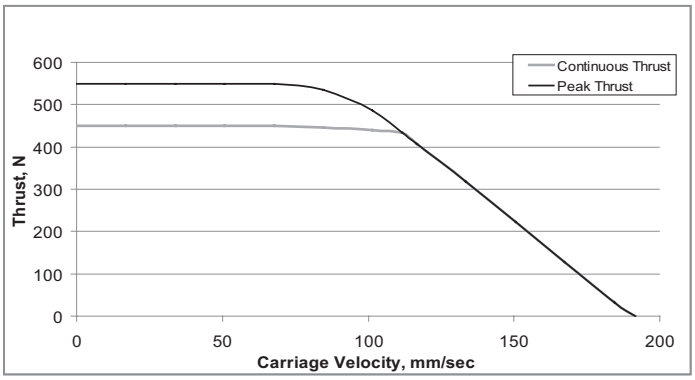
*420 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165DT@ 24V, 2.5mm/rev



*450 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

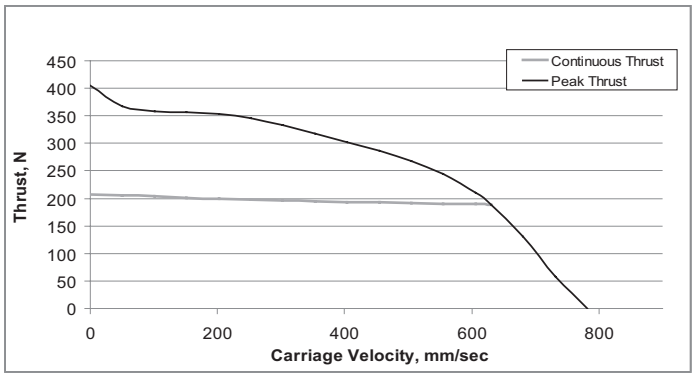
HLD60 Single Rail/Internal Rollers SM23165DT @ 24V, 5mm/rev



*420 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

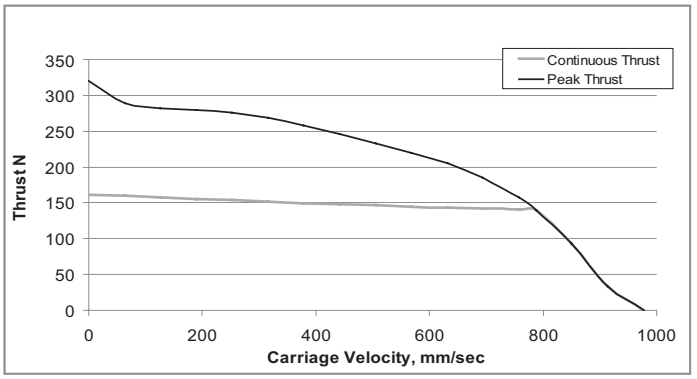
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

HLD60 Single Rail/Internal Rollers SM23165DT @ 48V, 10mm/rev



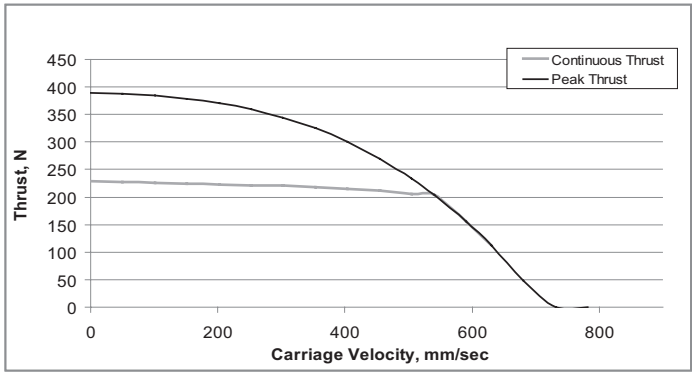
*185 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165DT @ 48V, 12.5mm/rev



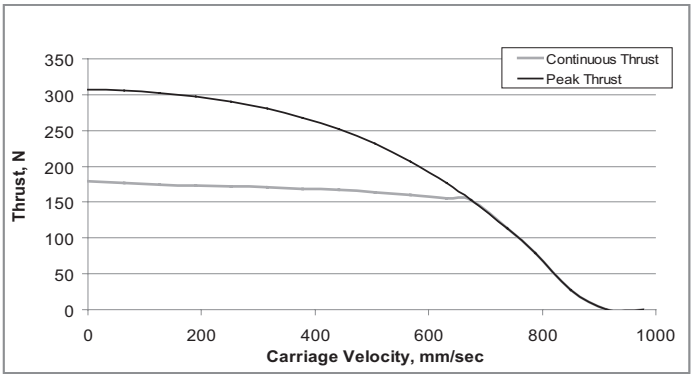
*135 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165DT @ 42V, 10mm/rev



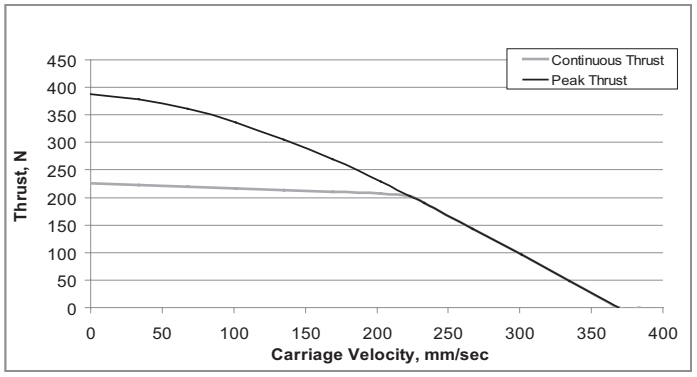
*185 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165DT @ 42V, 12.5mm/rev



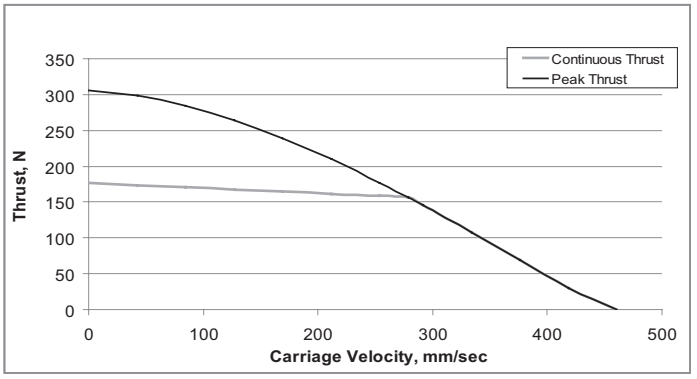
*135 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165DT @ 24V, 10mm/rev



*185 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

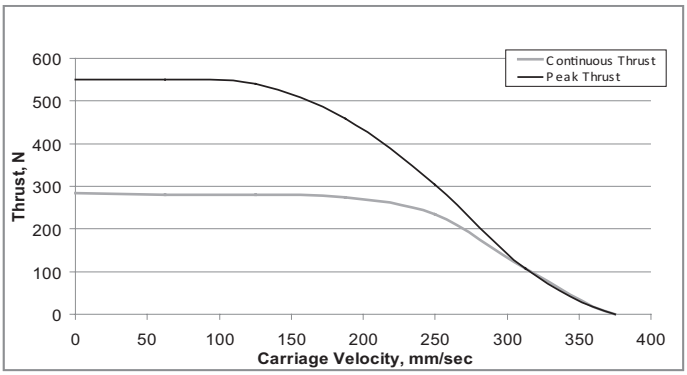
HLD60 Single Rail/Internal Rollers SM23165DT @ 24V, 12.5mm/rev



*135 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

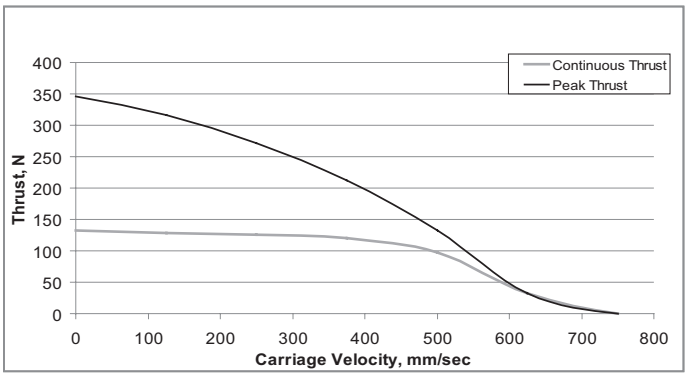
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

HLD60 Single Rail/Internal Rollers SM23165D @ 48V, 2.5mm/rev



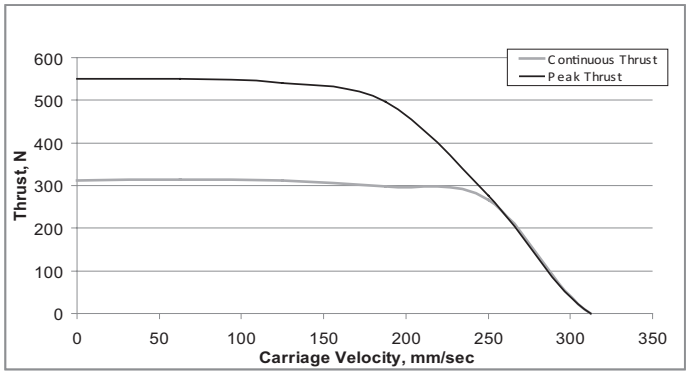
*284 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165D @ 48V, 5mm/rev



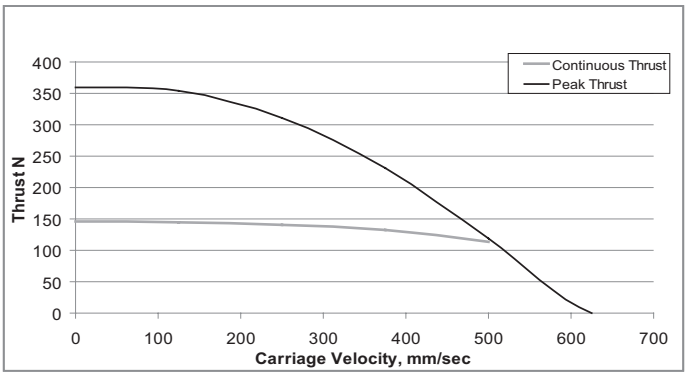
*132 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165D @ 42V, 2.5mm/rev



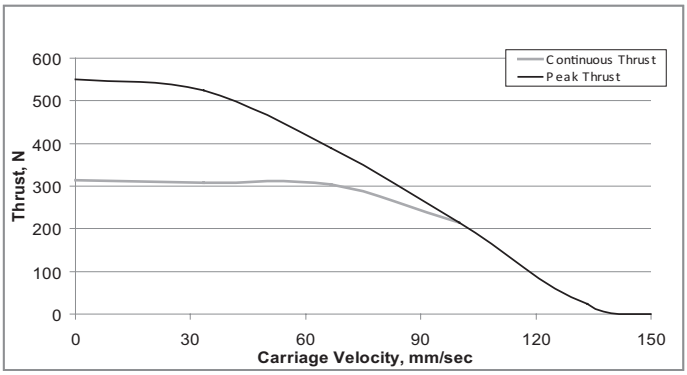
*284 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165D @ 42V, 5mm/rev



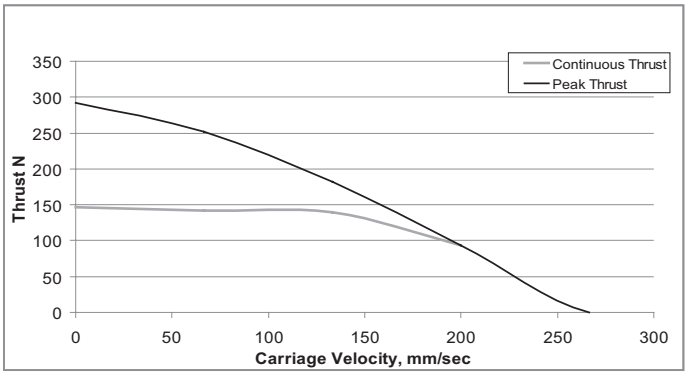
*132 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers SM23165D @ 24V, 2.5mm/rev



*284 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

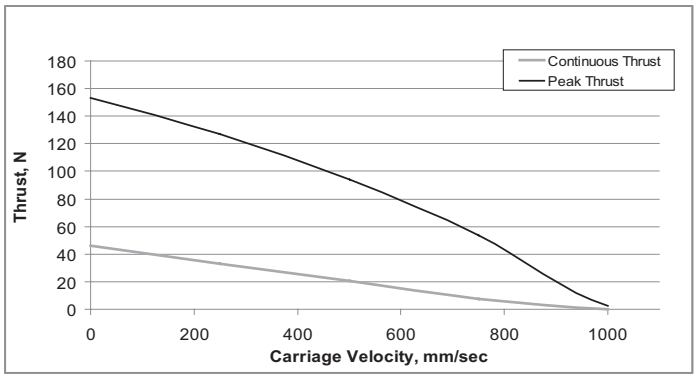
HLD60 Single Rail/Internal Rollers SM23165D @ 24V, 5mm/rev



*132 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

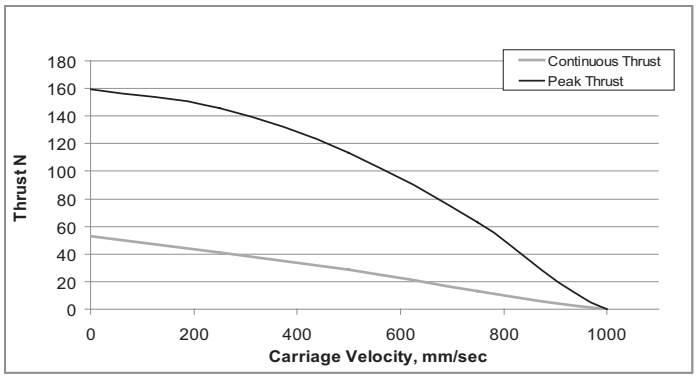
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

HLD60 Single Rail/Internal Rollers
SM23165D @ 48V, 10mm/rev



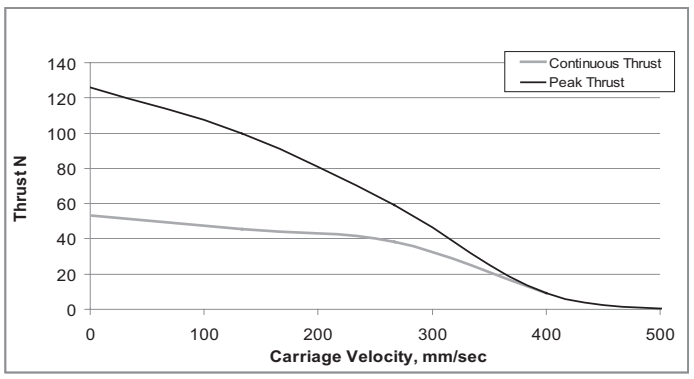
*45 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Single Rail/Internal Rollers
SM23165D @ 42V, 10mm/rev



*45 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

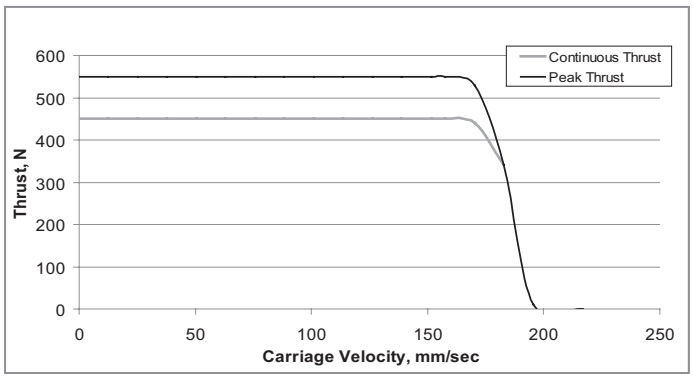
HLD60 Single Rail/Internal Rollers
SM23165D @ 24V, 10mm/rev



*45 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

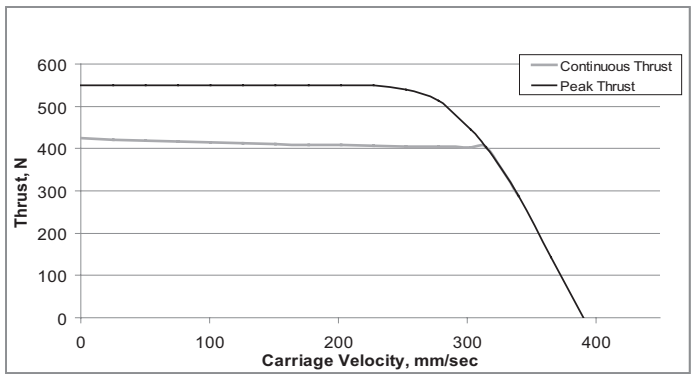
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

HLD60 Twin Rails - SM23165DT @ 48V, 2.5mm/rev



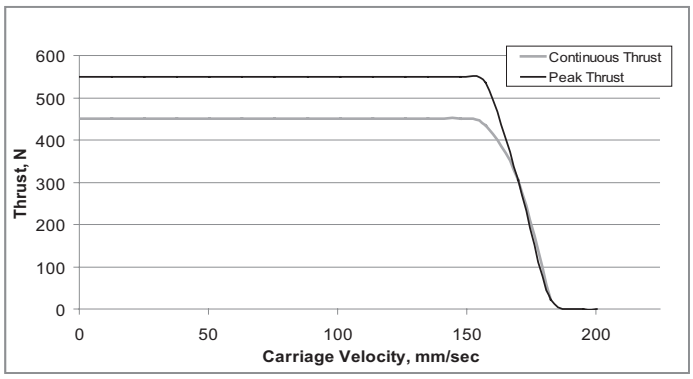
*450 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165DT @ 48V, 5mm/rev



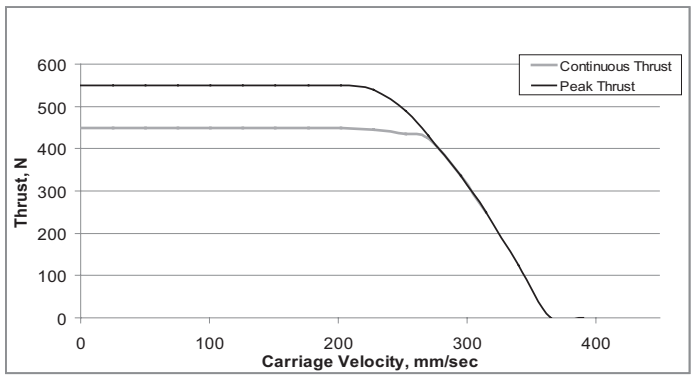
*400 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165DT @ 42V, 2.5mm/rev



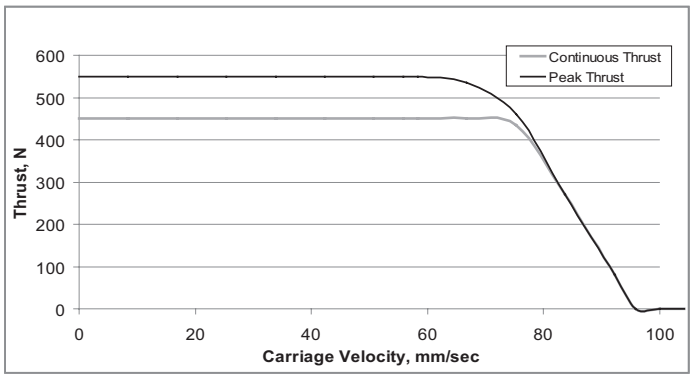
*450 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165DT @ 42V, 5mm/rev



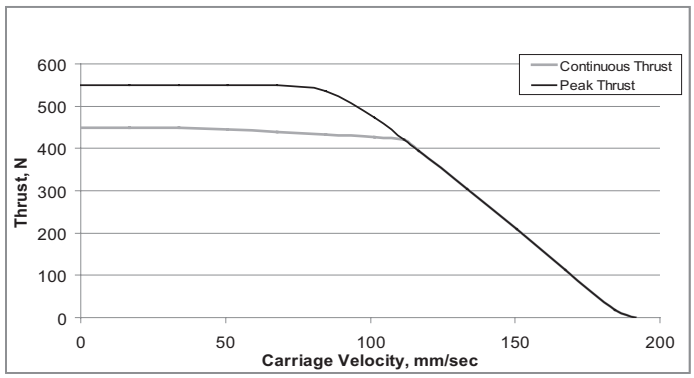
*400 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165DT @ 24V, 2.5mm/rev



*450 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

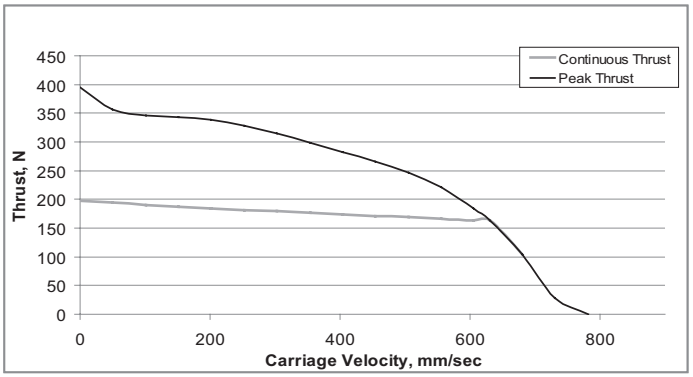
HLD60 Twin Rails - SM23165DT @ 24V, 5mm/rev



*400 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

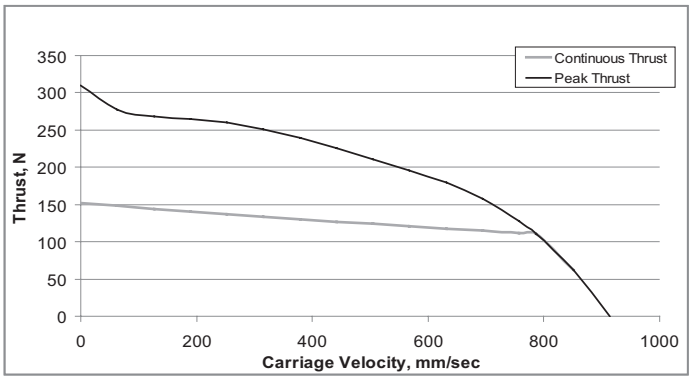
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

HLD60 Twin Rails - SM23165DT @ 48V, 10mm/rev



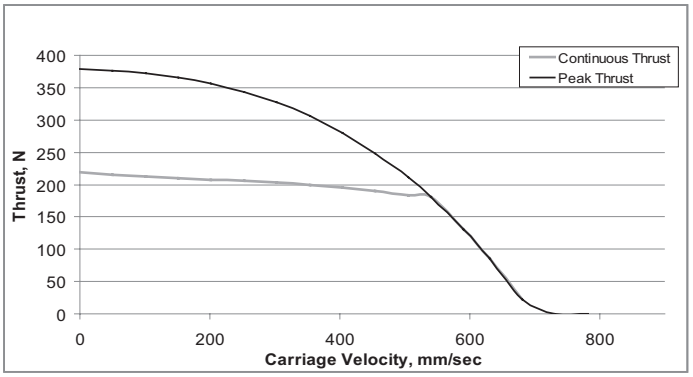
*160 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165DT @ 48V, 12.5mm/rev



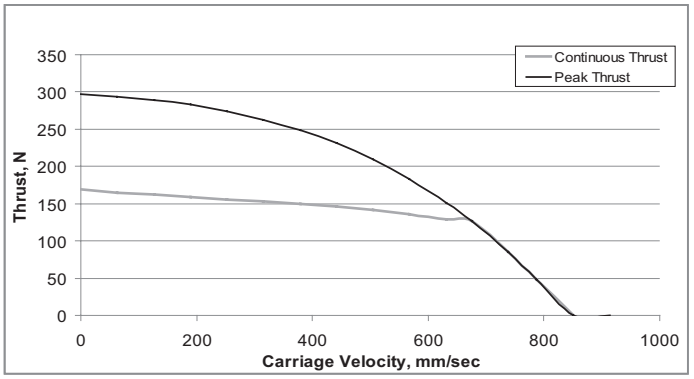
*105 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165DT @ 42V, 10mm/rev



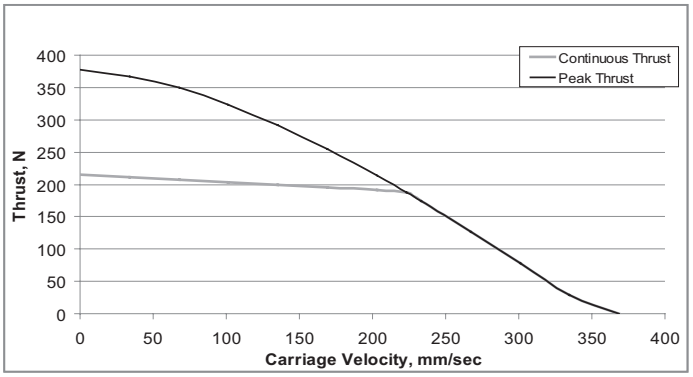
*160 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153for lifetime information.

HLD60 Twin Rails - SM23165DT @ 42V, 12.5mm/rev



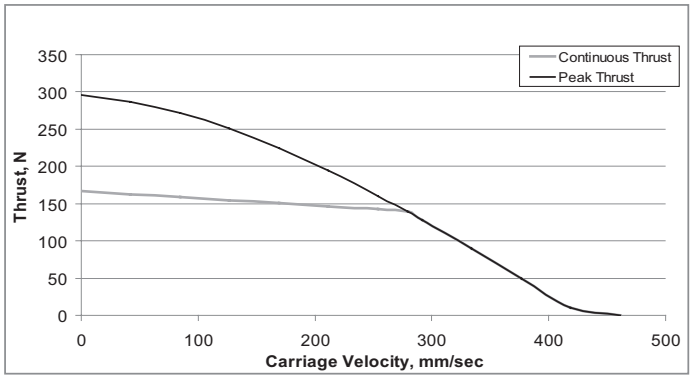
*105 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165DT @ 24V, 10mm/rev



*160 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

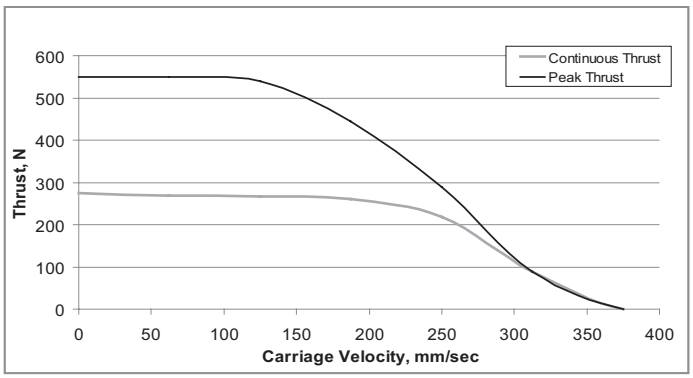
HLD60 Twin Rails - SM23165DT @ 24V, 12.5mm/rev



*105 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

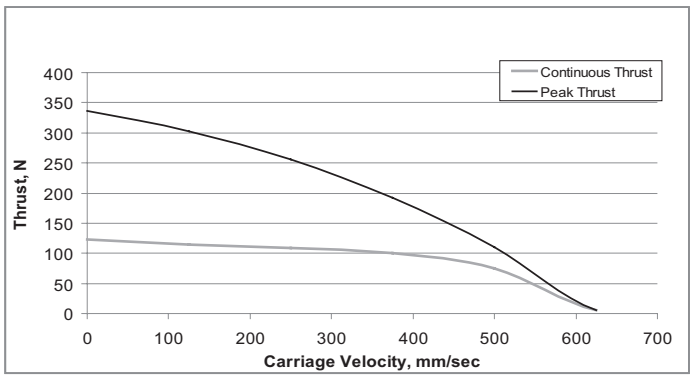
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

HLD60 Twin Rails - SM23165D @ 48V, 2.5mm/rev



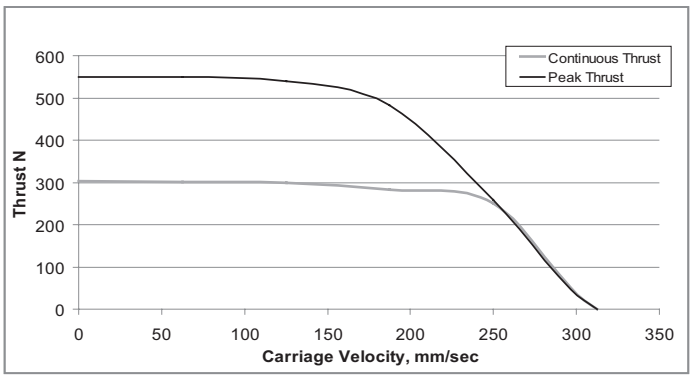
*274 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165D @ 48V, 5mm/rev



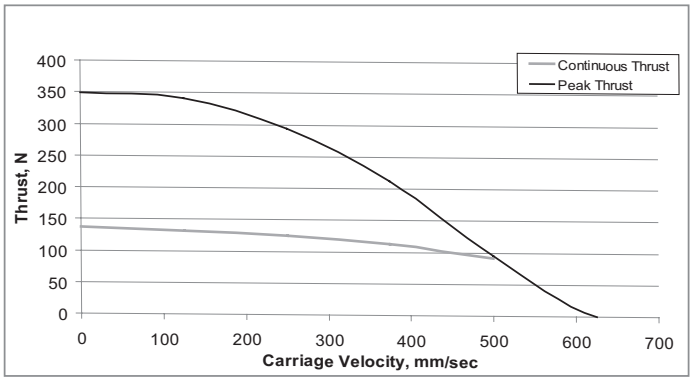
*122 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165D @ 42V, 2.5mm/rev



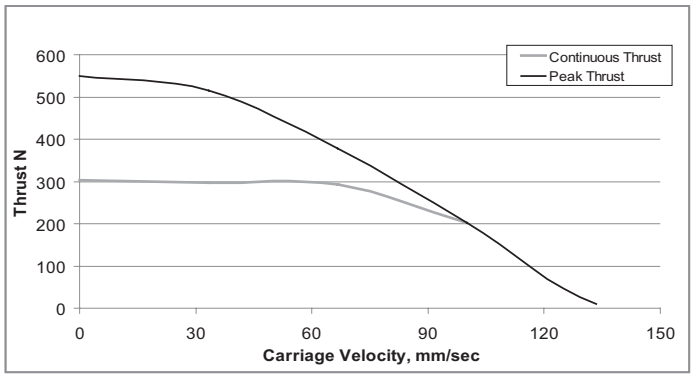
*274 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165D @ 42V, 5mm/rev



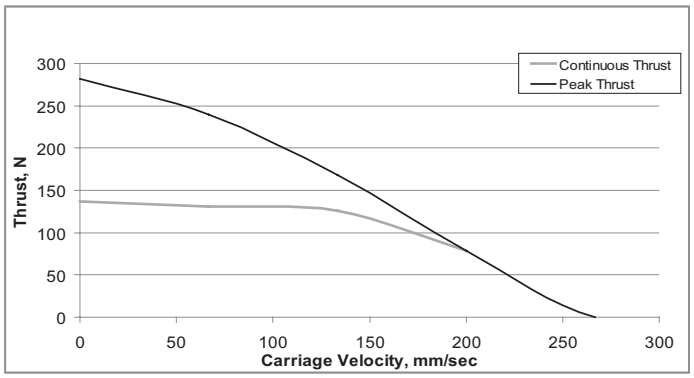
*122 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165D @ 24V, 2.5mm/rev



*274 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

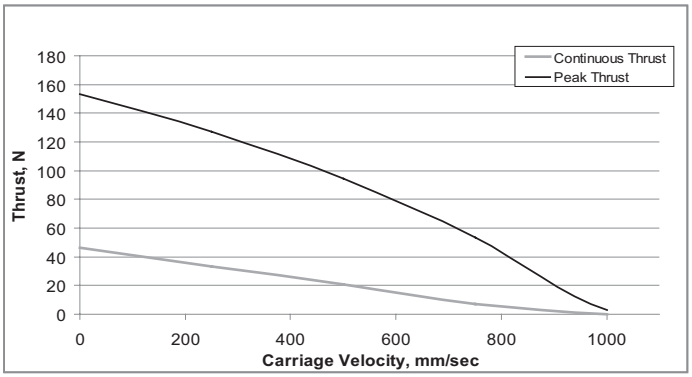
HLD60 Twin Rails - SM23165D @ 24V, 5mm/rev



*122 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

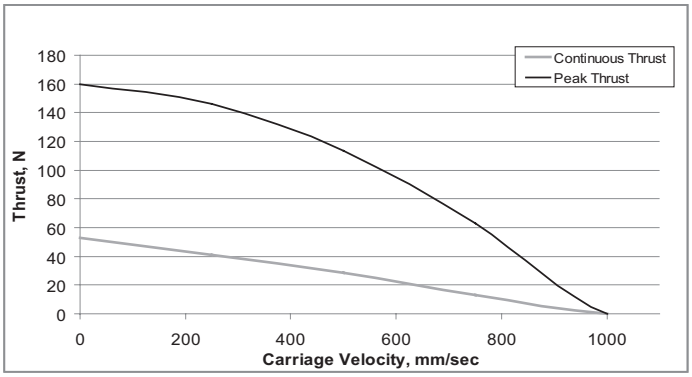
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

HLD60 Twin Rails - SM23165D @ 48V, 10mm/rev



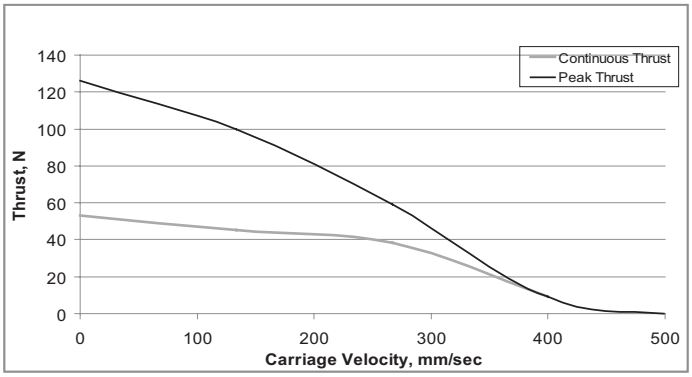
*45 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

HLD60 Twin Rails - SM23165D @ 42V, 10mm/rev



*45 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

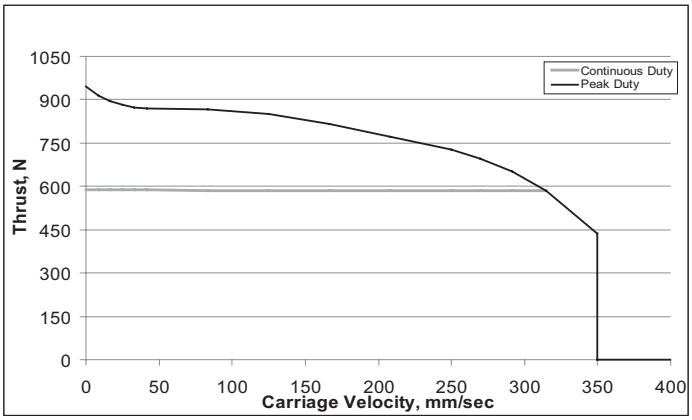
HLD60 Twin Rails - SM23165D @ 24V, 10mm/rev



*45 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

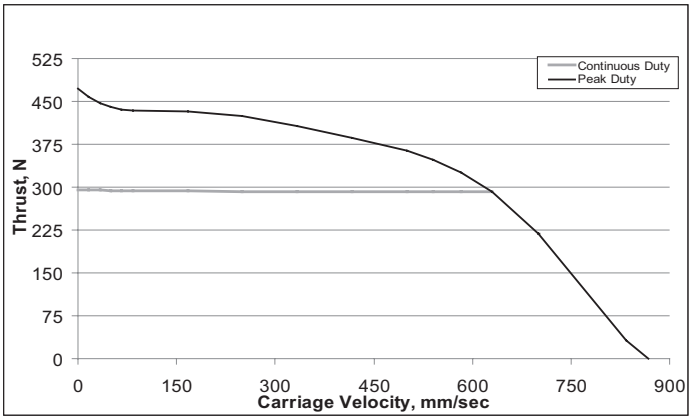
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

L70/XL100 - SM23165DT @ 48V, 5mm/rev lead ball screw



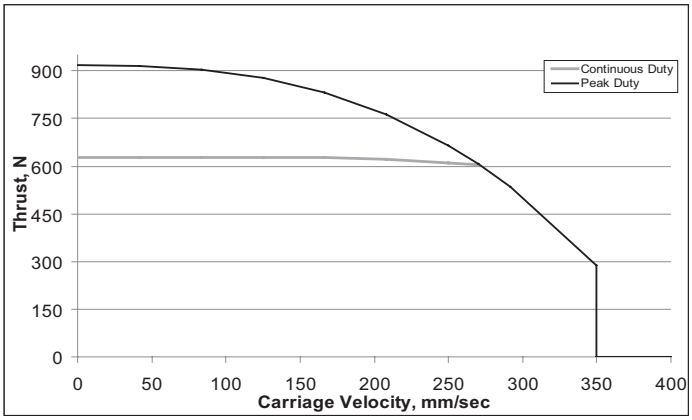
*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

L70/XL100 - SM23165DT @ 48V, 10mm/rev lead ball screw



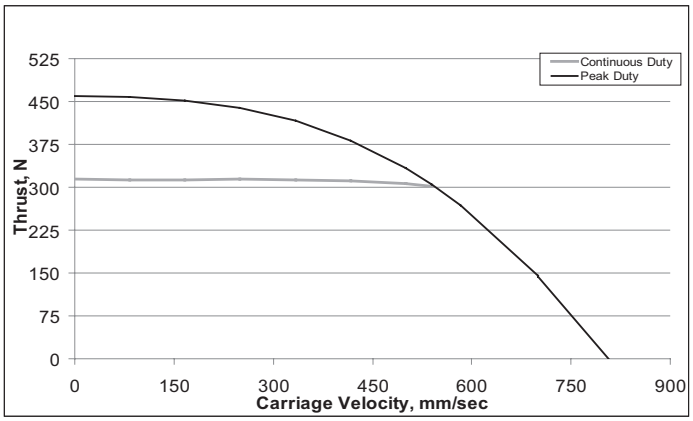
*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

L70/XL100 - SM23165DT @ 42V, 5mm/rev lead ball screw



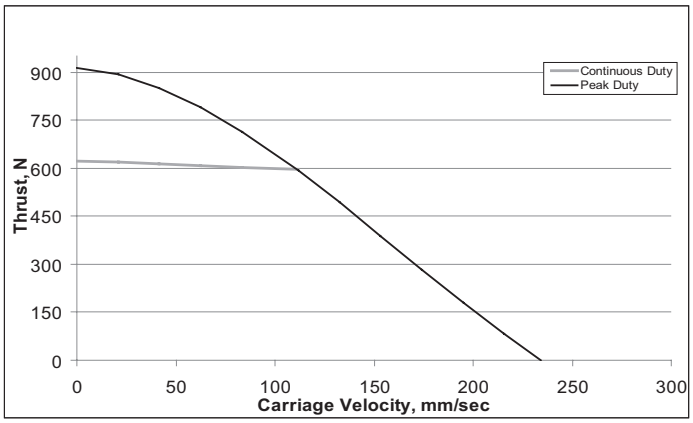
*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

L70/XL100 - SM23165DT @ 42V, 10mm/rev lead ball screw



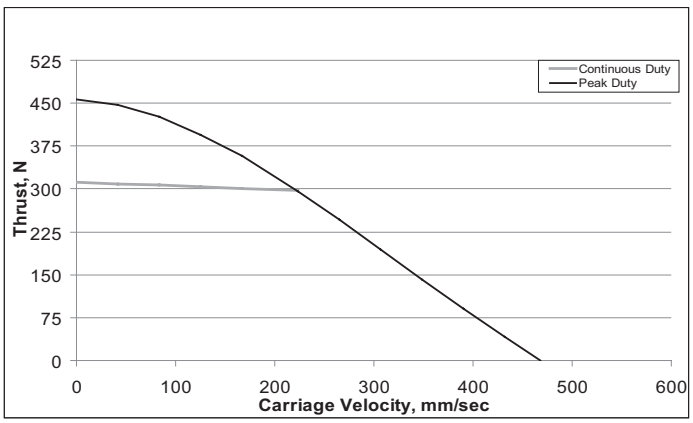
*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

L70/XL100 - SM23165DT @ 24V, 5mm/rev lead ball screw



*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

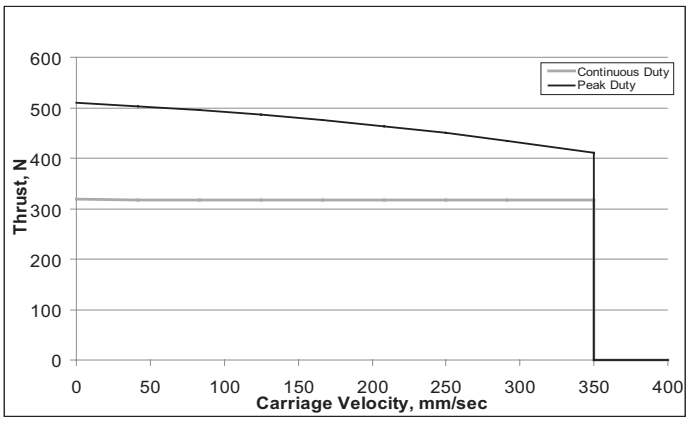
L70/XL100 - SM23165DT @ 24V, 10mm/rev lead ball screw



*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits.**Please see pages 135–153 for lifetime information.

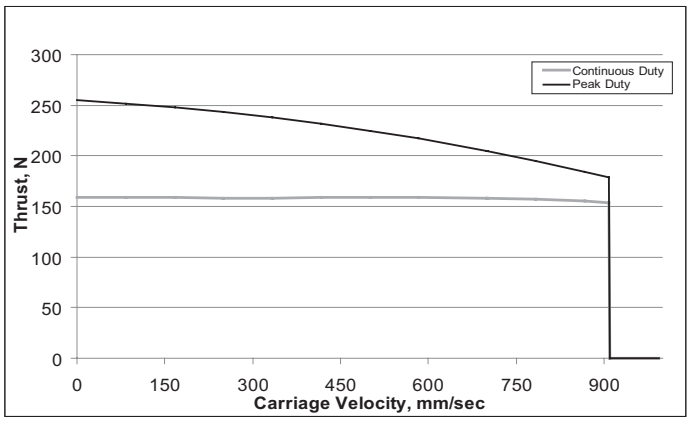
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

L70/XL100 - SM23165D @ 48V, 5mm/rev lead ball screw



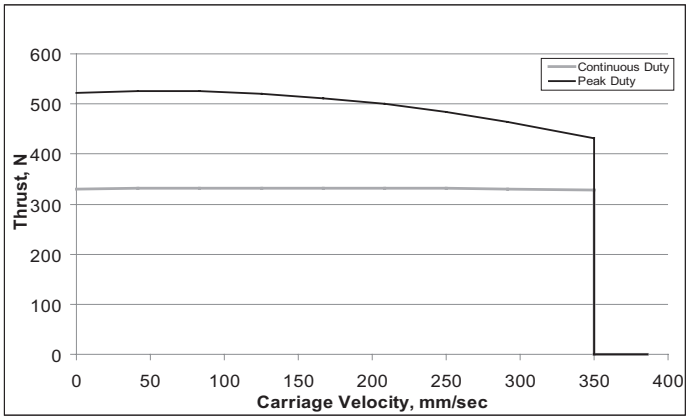
*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

L70/XL100 - SM23165D @ 48V, 10mm/rev lead ball screw



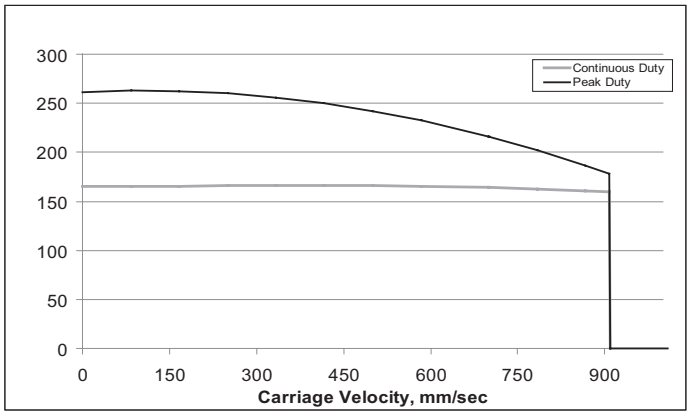
*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

L70/XL100 - SM23165D @ 42V, 5mm/rev lead ball screw



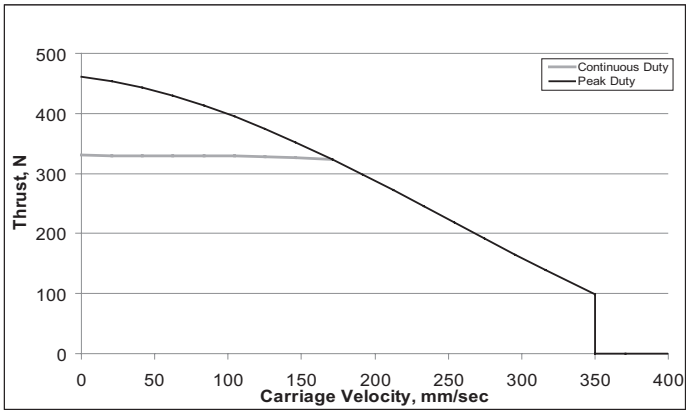
*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

L70/XL100 - SM23165D @ 42V, 10mm/rev lead ball screw



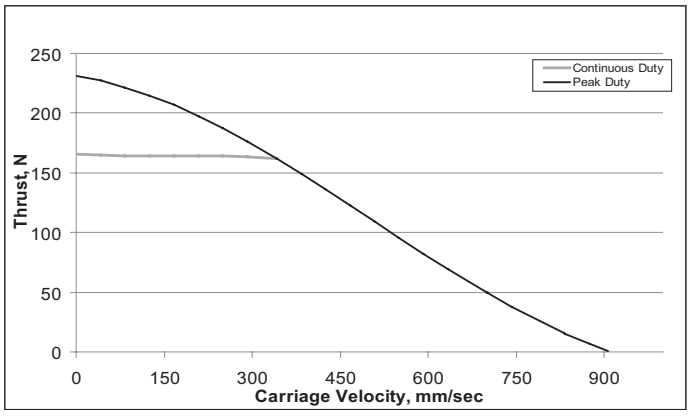
*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

L70/XL100 - SM23165D @ 24V, 5mm/rev lead ball screw



*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

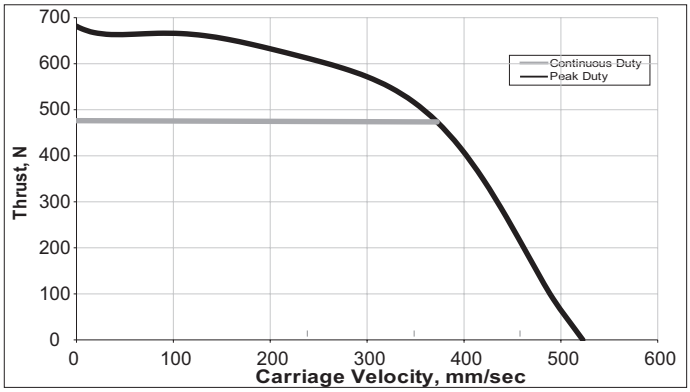
L70/XL100 - SM23165D @ 24V, 10mm/rev lead ball screw



*200 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits. **Please see pages 135–153 for lifetime information.

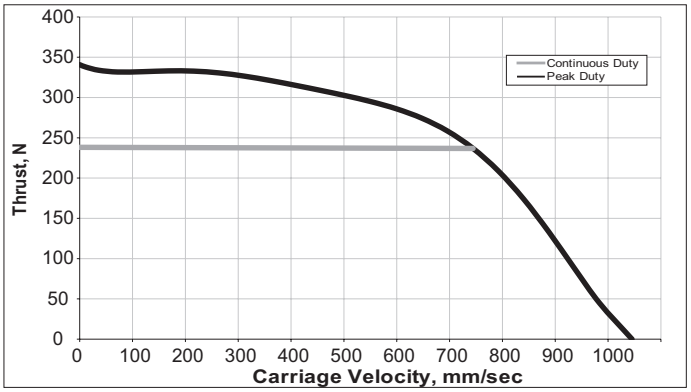
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

VL-CT series - SM23165DT @ 48V, 10A Switching, 1:1 Direct Drive, 6mm Pitch



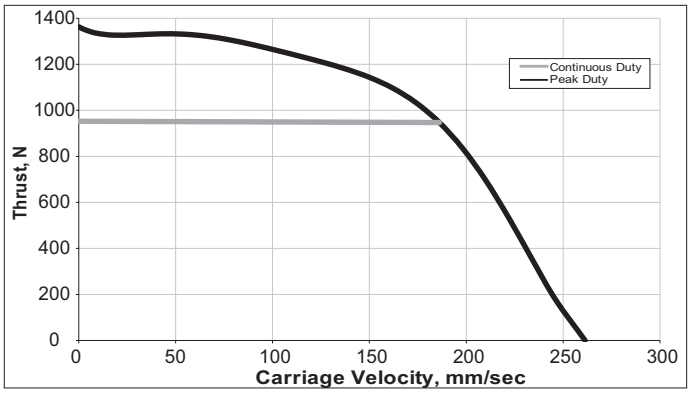
*Basic Service Life of 15000 hours when operated within continuous duty and payload ratings, and below critical speed limits. Please see page 149 –153 for full VL-CT actuator specifications.

VL-CT series - SM23165DT @ 48V, 10A Switching, 1:1 Direct Drive, 12mm Pitch



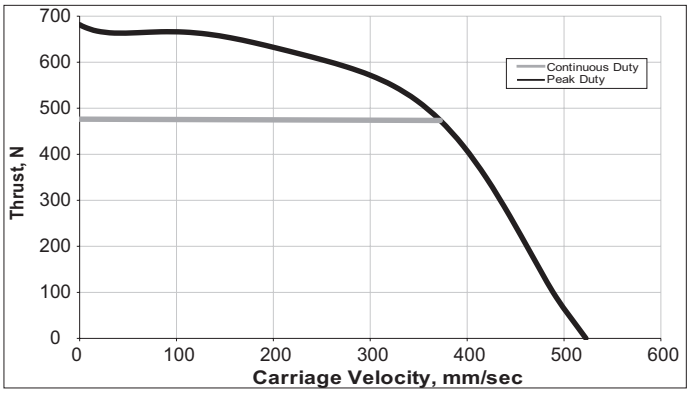
*Basic Service Life of 15000 hours when operated within continuous duty and payload ratings, and below critical speed limits. Please see page 149 –153 for full VL-CT actuator specifications.

VL-CT series - SM23165DT @ 48V, 10A Switching, 2:1 Pulley Offset, 6mm Pitch



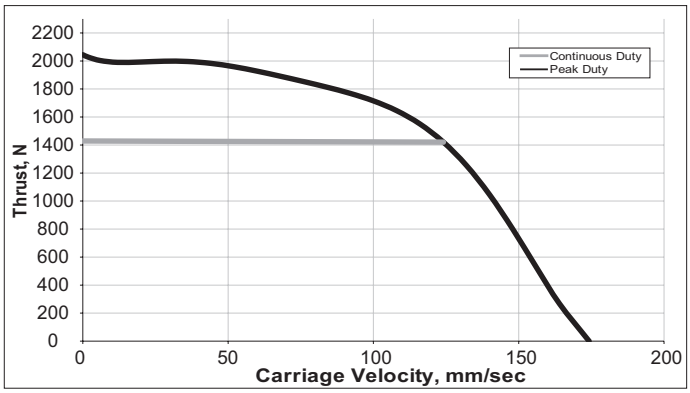
*Basic Service Life of 15000 hours when operated within continuous duty and payload ratings, and below critical speed limits. Please see page 149 –153 for full VL-CT actuator specifications.

VL-CT series - SM23165DT @ 48V, 10A Switching, 2:1 Pulley Offset, 12mm Pitch



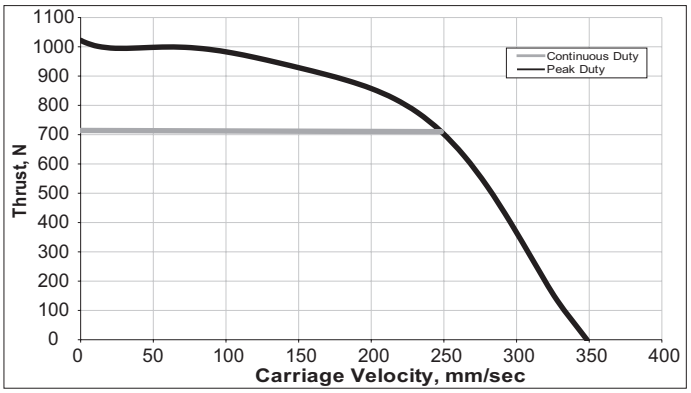
*Basic Service Life of 15000 hours when operated within continuous duty and payload ratings, and below critical speed limits. Please see page 149 –153 for full VL-CT actuator specifications.

VL-CT series - SM23165DT @ 48V, 10A Switching, 3:1 Pulley Offset, 6mm Pitch



*Basic Service Life of 15000 hours when operated within continuous duty and payload ratings, and below critical speed limits. Please see page 149 –153 for full VL-CT actuator specifications.

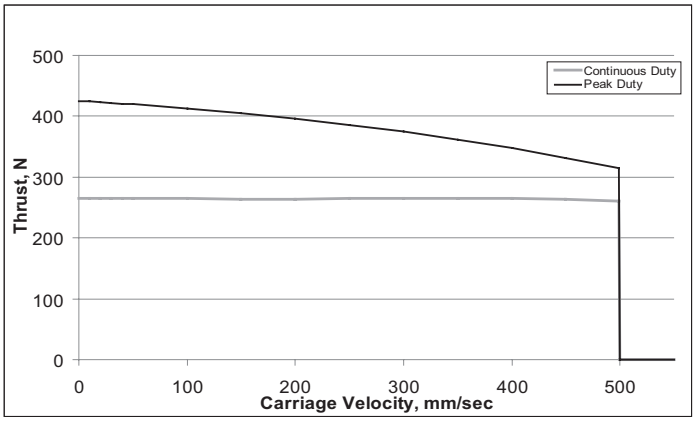
VL-CT series - SM23165DT @ 48V, 10A Switching, 3:1 Pulley Offset, 12mm Pitch



*Basic Service Life of 15000 hours when operated within continuous duty and payload ratings, and below critical speed limits. Please see page 149 –153 for full VL-CT actuator specifications.

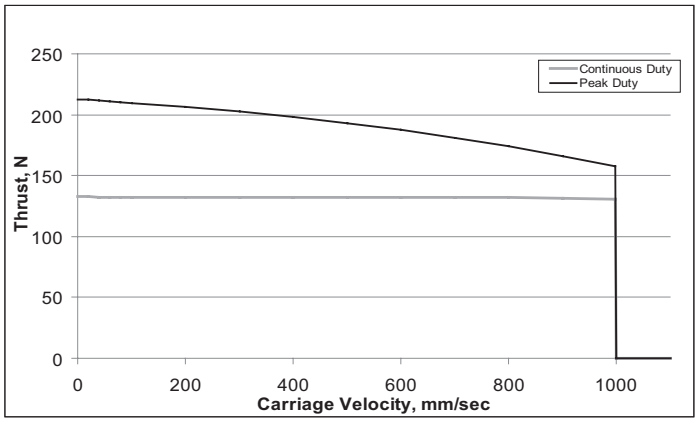
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

VL-ST45 - SM23165D @ 48V, 6mm/rev lead ball screw



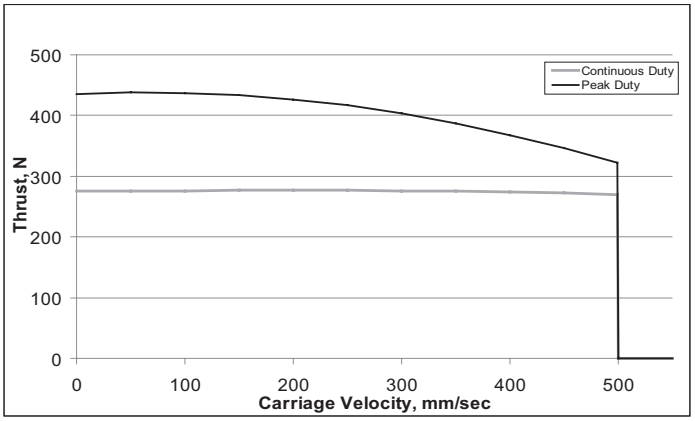
*80 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

VL-ST45 - SM23165D @ 48V, 12mm/rev lead ball screw



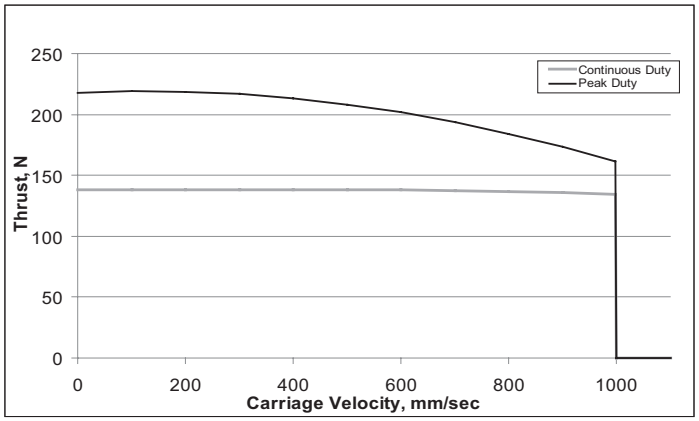
*65 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

VL-ST45 - SM23165D @ 42V, 6mm/rev lead ball screw



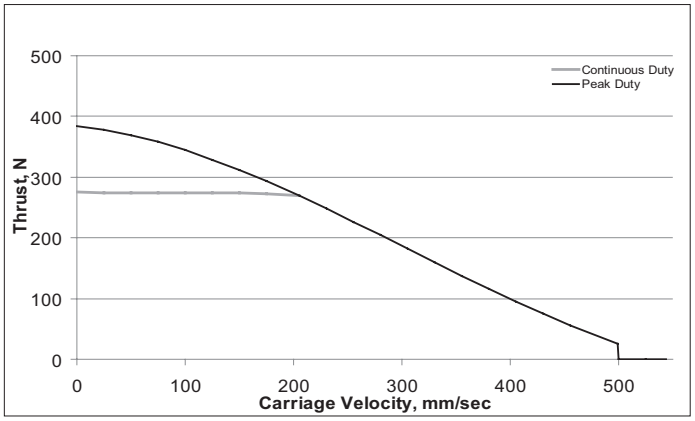
*80 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

VL-ST45 - SM23165D @ 42V, 12mm/rev lead ball screw



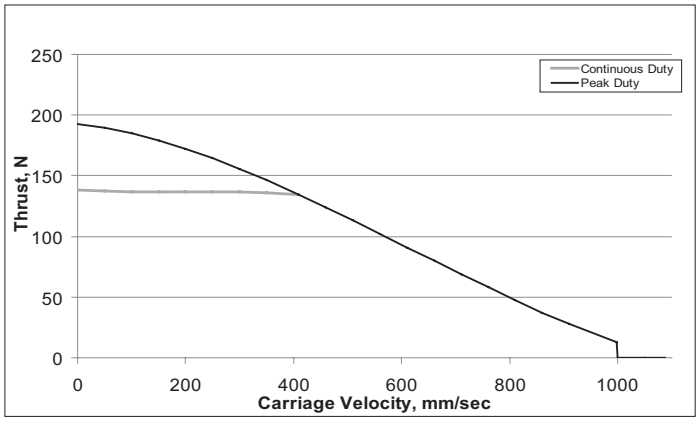
*65 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

VL-ST45 - SM23165D @ 24V, 6mm/rev lead ball screw



*80 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

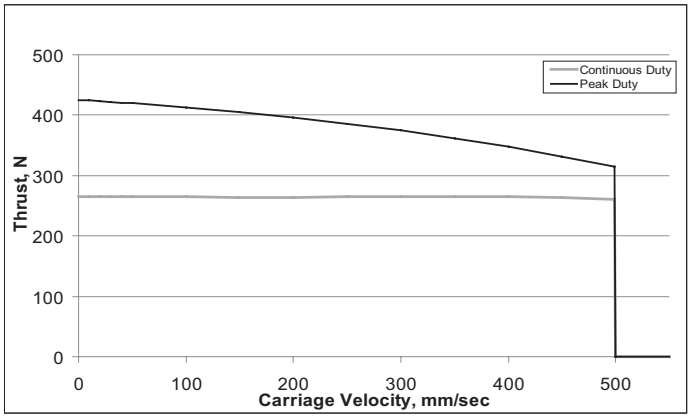
VL-ST45 - SM23165D @ 24V, 12mm/rev lead ball screw



*65 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

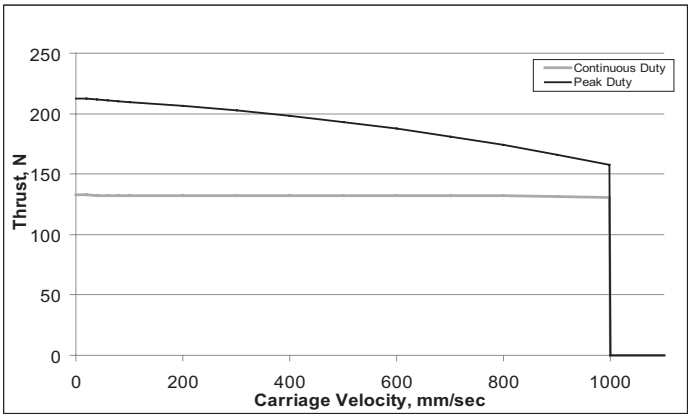
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

VL-ST45 - SM23165D @ 48V, 6mm/rev lead ball screw



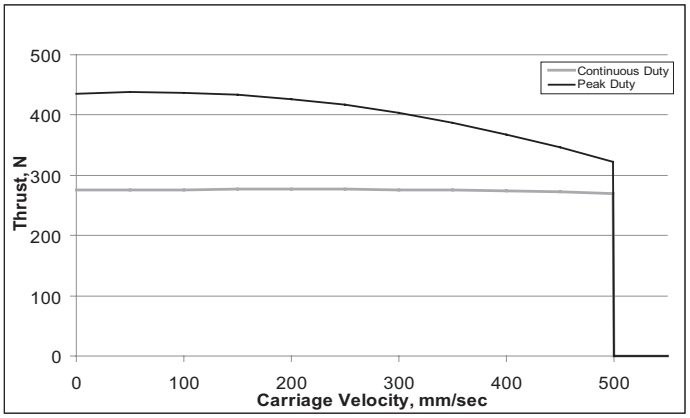
*80 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

VL-ST45 - SM23165D @ 48V, 12mm/rev lead ball screw



*65 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

VL-ST45 - SM23165D @ 42V, 6mm/rev lead ball screw



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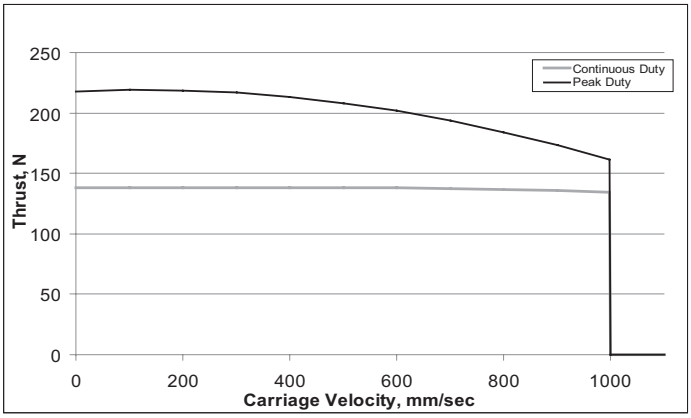
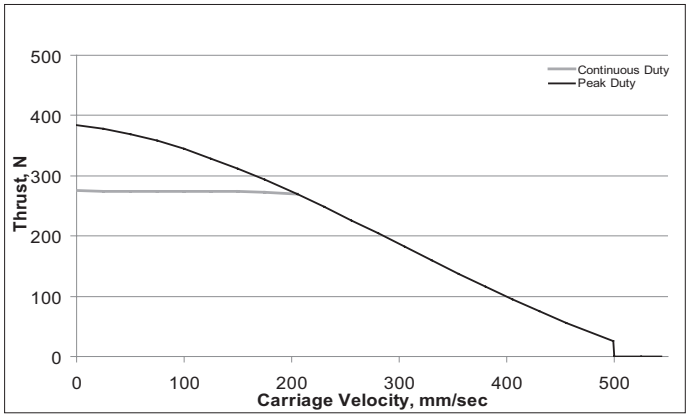
VL-ST45 - SM23165D @ 42V, 12mm/rev lead ball screw



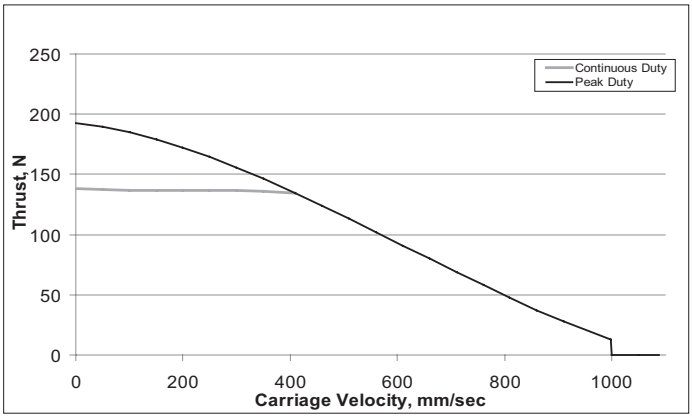
*65 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

VL-ST45 - SM23165D @ 24V, 6mm/rev lead ball screw



*80 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

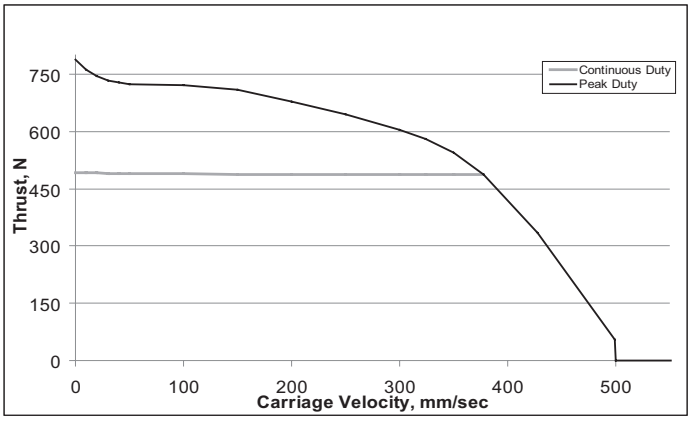
VL-ST45 - SM23165D @ 24V, 12mm/rev lead ball screw



*65 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

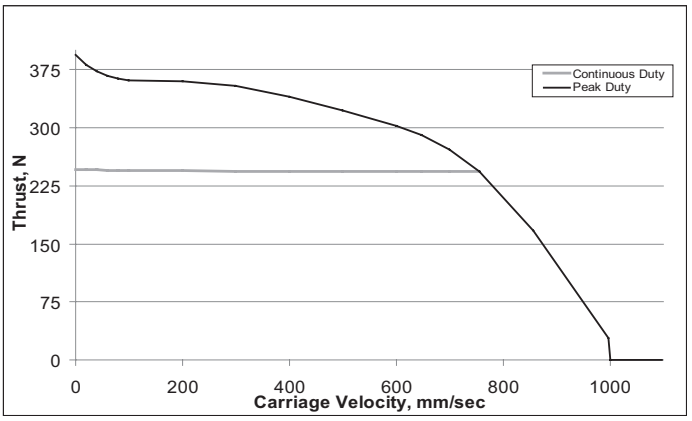
NOTE: Motor and actuator specifications are subject to changes without notice. Consult website and factory for latest data.

VL-ST60 - SM23165DT @ 48V, 6mm/rev lead ball screw



*130 N Dynamic Thrust Limit for Basic Service Life when operated at critical speed limits within average speed requirements stated on pages 135–153.

VL-ST60 - SM23165DT @ 48V, 12mm/rev lead ball screw



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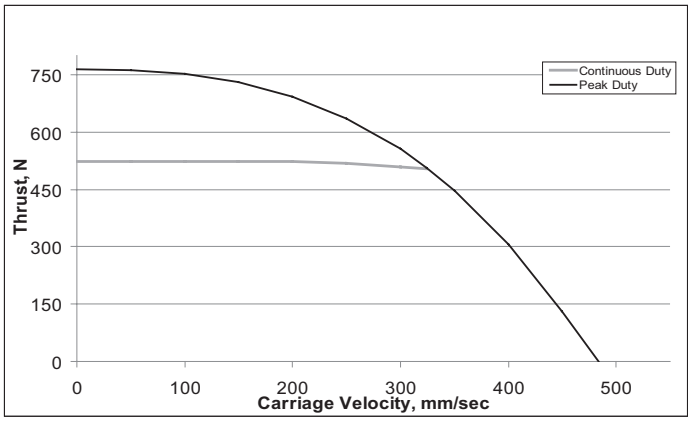

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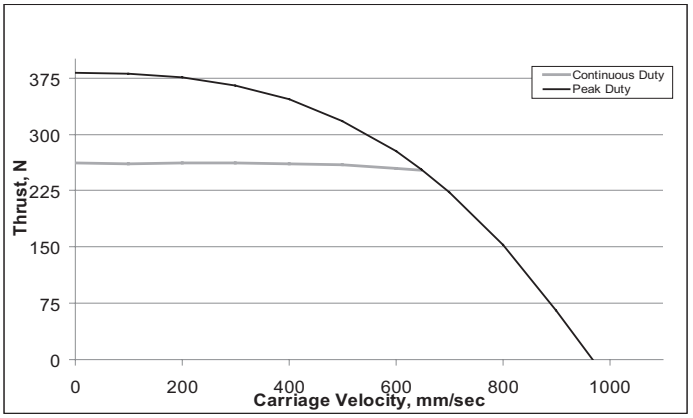
VL-ST60 - SM23165DT @ 42V, 12mm/rev lead ball screw



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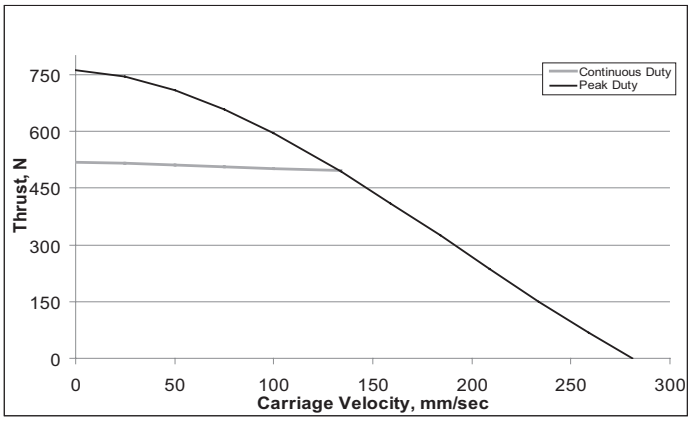

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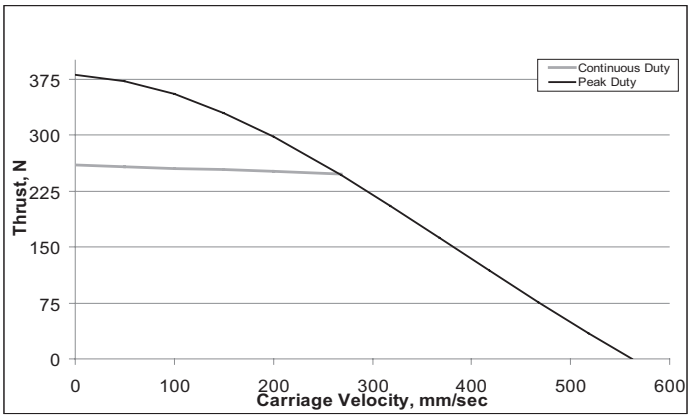

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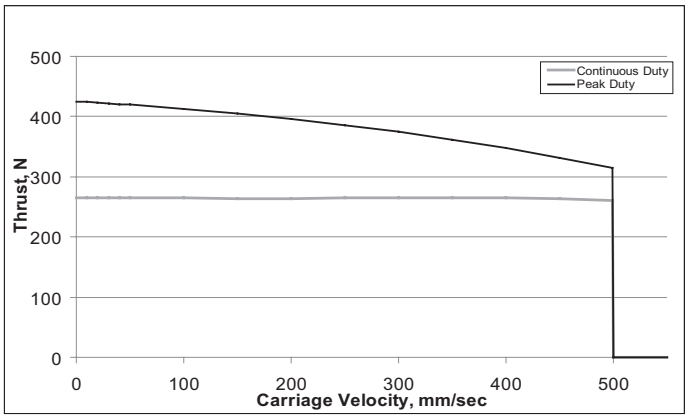

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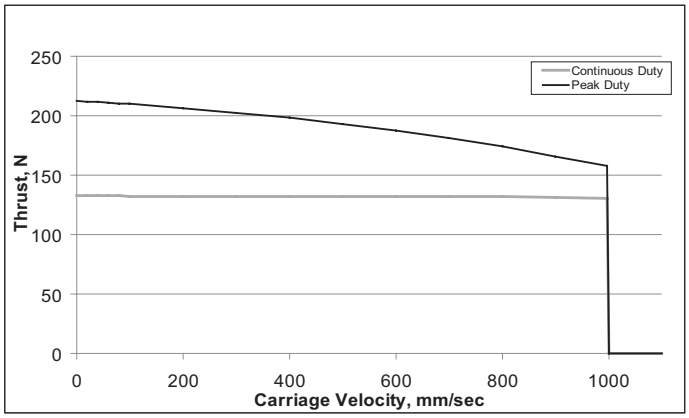

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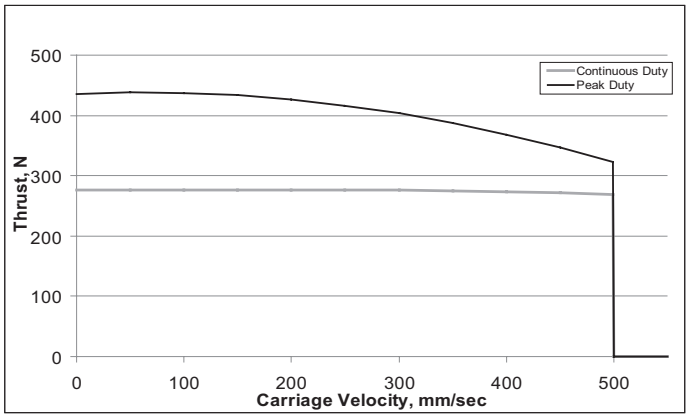

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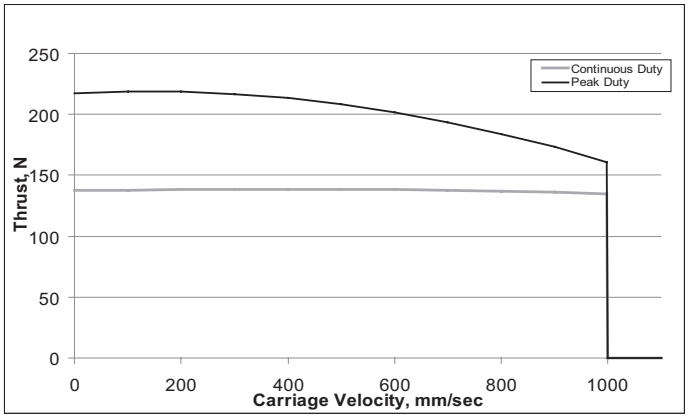

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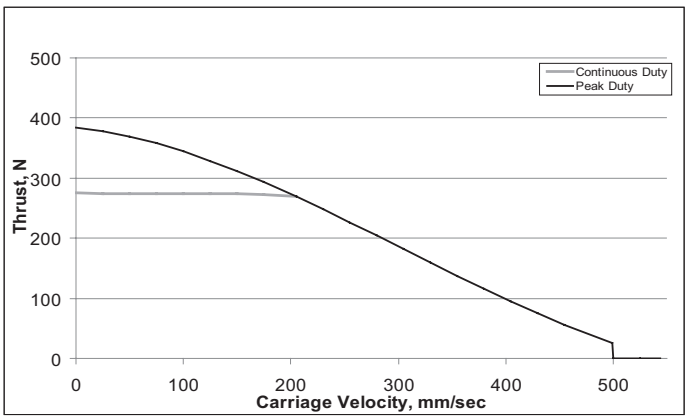

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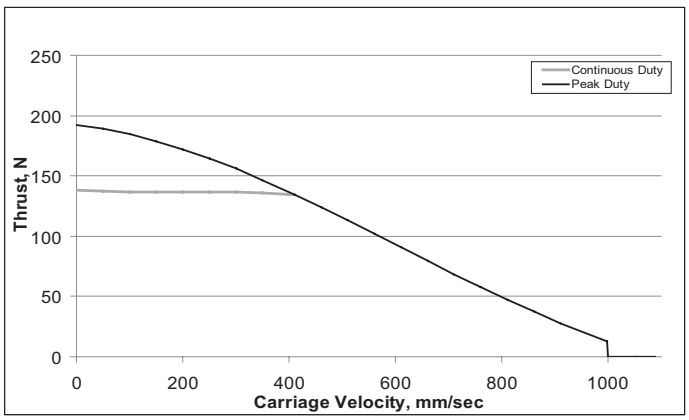

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Moment of Inertia Overview

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⚠ WARNING Important Information, please read carefully

Class 5 SmartMotor™ servos may be used as upgrades to replace older Class 4 series SmartMotor Servos. However, there are some syntax differences . The SMI software has a code converter that will convert Class 4 code for you. However, it may require manual editing to maintain proper distances, velocities and accelerations.

Additionally it may require changes to following error limits and PID tuning parameters. Please consult the User's Guide and help files as necessary.

NOTE: It is not recommended to mix Class 4 and Class 5 motors on the same serial daisy chain.

Do not run Class 4 motors in Contouring Mode with Class 5 motors on the same daisy chain. It WILL NOT WORK.

SmartMotor Hardware and Control Limitations

Each SmartMotor is an integrated motion controller, drive amplifier and motor.

As with any motion controller, care should be taken with regard to connections, communications, and control. Proper grounding and shielding techniques should be observed and utilized.

Standard SmartMotor Controller & Drive Specifications:

All standard SmartMotor servos should be powered from 18VDC to 48VDC. Under no circumstances should they be allowed to run off of any higher voltages. Lower voltages could cause a brownout shutdown of the CPU or what would appear as a down power reset under sudden load changes. If power is reversed on any standard SmartMotor, immediate damage WILL occur and the SmartMotor will no longer operate.

NOTE: During hard fast decelerations, a SmartMotor can pull up supply voltages to the point of damage if a shunt resistor pack is not used.

NOTE (FOR M-STYLE MOTORS):

Drive Power and Control Power are Separate Inputs. Control power is rate max range of 18 to 32VDC.

Drive Power is from 18 to 48VDC max.

The drive stage stage of D-style motors should not be powered through pin 15 of the DB15 connector under any circumstances. Doing so can cause damage to the internal circuitry.

CPU Power:

All SmartMotor servos have an internal 5VDC power supply to run the internal CPU. This supply can be easily damaged if an external voltage source of a higher potential is applied. Do not exceed 5VDC on and I/O pin or 5VDC pin on any SmartMotor.

I/O Restrictions and Limitations:

Each on-board I/O pin has a minimum amount of protection consisting of a 100-Ohm current limit resistor and a 5.6VDC Zener diode. Each I/O pin also has a 5Kohm pull-up resistor. When assigned as outputs, they act as a push-pull amplifier that drives hard to either the positive or negative 5VDC rail. This means they are not open-collector I/O pins. Each I/O pin can sink and source up to 25mA. Exceeding this could result in damage to the I/O port.

Communications:

Each SmartMotor has a 2 wire RS-232 port. This port meets IEEE standards with full +/- 12VDC potential on the transmit line. Proper serial ground signal referencing and shielding techniques should be used. Under no circumstances should the shield of a cable be used for the RS-232 ground reference. This could result in noise or corrupt data as well as ground loops that could damage the serial port chip set.

Each SmartMotor boots up default to the ECHO_OFF state. This means that nothing received is transmitted or echoed back out.

This is important to remember in serial "daisy-chain" set-ups. They also boot-up defaulted to base address zero meaning they will listen and respond to any incoming valid SmartMotor commands.

Hardware Protection Faults:

All Class 5 SmartMotor protection faults (over Current and over Temp) result in dynamic braking on error. This means the windings are shorted out to dissipate power as fast as possible.

⚠ WARNING

All motors WILL trip on thermal limit at 85°C. They will not reset until cooled back down below 80°C. The SmartMotor should be operated between 0 and 85°C, and stored between -10 and 85°C, non-condensing. In other words, reaching dew-point can cause moisture to condense on the encoder disk causing loss of integrity of position feedback. The SmartMotor should not be started up cold below 0°C.

Software Protection Faults:

Limit switch inputs and position error limits are both "software" protection faults. This means they are not firmware unchangeable. The effects of Limit Switches and Position Error can be changed via valid software commands or set-up parameters.

Position Error is predicated by a value set by the user and can drastically effect SmartMotor response under varying load conditions and tuning. Limit switches can be set up to cause the SmartMotor to servo in place instead of free wheel. Refer to specific firmware addenda for various limit switch options and capabilities.

Motor Torque Limits: AMPS Command and T (Torque) Command

Motor T (torque) command is only for use in Mode Torque (MT). It has no effect on motor operation outside of Mode Torque.

The AMPS command has effect over all other modes of operation. It limits absolute maximum power available from the drive amp to the motor windings as a function of percent duty cycle of PWM (Pulse Width Modulation). The AMPS command should be used when it is desired to limit motor torque to a sensitive or torque input limited load. It may also be used to reduce the chance of reaching peak over current errors on high acceleration applications.

Error Handling, Motor Status Bits & Internal Conditions:

SmartMotors have many 16 Bit status words that contain interrupt registers triggered by selected events. These events include Position Errors reached, Over Current reached, Limit Switch

⚠ WARNING Important Information, please read carefully

conditions, Syntax errors and so on. In addition, in the newer SmartMotor servos, Bus Voltage, Drive Current, and SmartMotor Temperature are also available. By proper use of these status bits very simple and very flexible error handling can be achieved. Motors can be made to respond under varying load conditions in different ways and recover from any given software or hardware fault in a controlled manner.

Switching Power Supplies:

Most switchers will go into an OFF state on over-voltage. Few of them have a buck-regulator that prevents over-voltage. The ones that do are very costly and large. Always use a Shunt when using a switching power supply to aid in suppression of bus overvoltage. Switching power supplies should be sized to provide maximum expected current for the entire motor system under the worst load considerations. This is because switchers have no "reserve" like linear power supplies do. When they reach maximum current, they shut down or reset.

⚠ **WARNING: Improper Power Supply Sizing may result it Motor Position Error Faults, Motor Resets, and Machine Faults**

Mechanical Brakes:

Any time the load can be easily back driven or is in a vertical orientation, an electromechanical fail-safe brake is highly recommended. Under no situation should a PLC or external controller be used to control a fail-safe brake on a servo. The response time will be diminished to the point of defeating protection. Instead, use the SmartMotor interrupt control features stated here:

Use the EOBK( ) command in conjunction with the BRKTRJ or BRKSRV commands:

EOBK() command can assign the brake function to any I/O pin. value is -1 to disable.

BRKENG - engage brake immediately, disable drive

BRKRLS - release brake immediately. Warning: motor may freewheel.

BRKTRJ - motor engages brake at end of trajectory. Releases when new move started.

BRKSRV - motor engages brake when drive turned off due to OFF command or fault.

In making use of selected commands from above, the brake will get a signal to engage (be de-energized) within 250 to 500 microseconds of its trip condition. Using the PLC will cause a delay of anywhere from 4 to 10 milliseconds due to scan time, process time and brake release time. By then, the current in the control could have already well exceeded limits.

Position Error Limits:

Let's suppose you have a maximum allowable position error limit of 1000 encoder counts. The SmartMotor can hit a hard stop and go up to 999 encoder counts into position error before a trip condition is met.

The time it takes to get to that position error may be slow or fast depending on the speed you are moving.

Set "EL" to the lowest value possible to allow continued machine operation without spurious position error faults occurring.

Amplifier Tuning:

Let's suppose you have "tight" tuning of KP>3000 or so and KD>20000 or so. This is just an example of slightly tight tuning, but not too high. The higher the numbers, the faster motor current will rise under a given increase in position error. Collectively, with the above mentioned facts about "E" maximum allowed position error, the current may rise much faster. It is best to ratio acceptable tuning values with good Position Error values so as to maintain the lowest running position error with the lowest value of "EL" possible. The ironic thing here is that usually to get decrease following error implies increasing tuning. This is true, but for example: KV (velocity feed forward) and KA (acceleration feed forward) are better means to achieve this goal.

These tuning values lower position error while moving without increasing motor current because they shift the motor position command forward in the trajectory for the entire move, compared to during the dynamics of changes in moves. As a result, you get lower peak currents in the motor.

Power Supply Voltage Levels:

The higher the voltage, the faster the motor can move and the faster it can accelerate. This is a good thing, but in conjunction with faster acceleration, the higher the voltage, the closer to a peak voltage for over-voltage breakdown of the controller. Also, the higher the voltage, the faster a rate of change of current can occur. It is a risk with any application to get faster response by moving towards a higher voltage. Typically speaking, it is the dynamics of sudden changes that increases risk by a "x^2" factor whereas the continuous load risk is only a direct ratio increase. This is because rate-of-change in current is proportional to acceleration which is the square of velocity, i.e. x^2. For safety sake, a 42VDC supply for a 48VDC system gives good margin with little speed losses.

NOTE (FOR M-STYLE MOTORS):

Drive Power and Control Power are Separate Inputs. Control power is rate max range of 18 to 32VDC.

Drive Power is from 18 to 48VDC max.

The drive stage of D-style motors should not be powered through pin 15 of the DB15 connector under any circumstances. Doing so can cause damage to the internal circuitry.

Firmware Safety Control Options:

The firmware has the ability to suppress Back-EMF voltages any time the calculated trajectory has been exceeded by actual motor motion. In other words, the processor is looking at where it should be compared to where it actually is. Any time the motor exceeds dynamic position per calculated trajectory, the drive amplifier shunts power to maintain dynamic position control. As a result, excessive currents are suppressed at a rate of response of ~250 micro seconds.

Additionally, if the motor faults out for either Position Error, Travel Limit, or Thermal Limits, it will automatically short out the windings and dynamically stop the shaft.

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