

PACKAGED  
STEPPER  
SYSTEMS



**API** Controls



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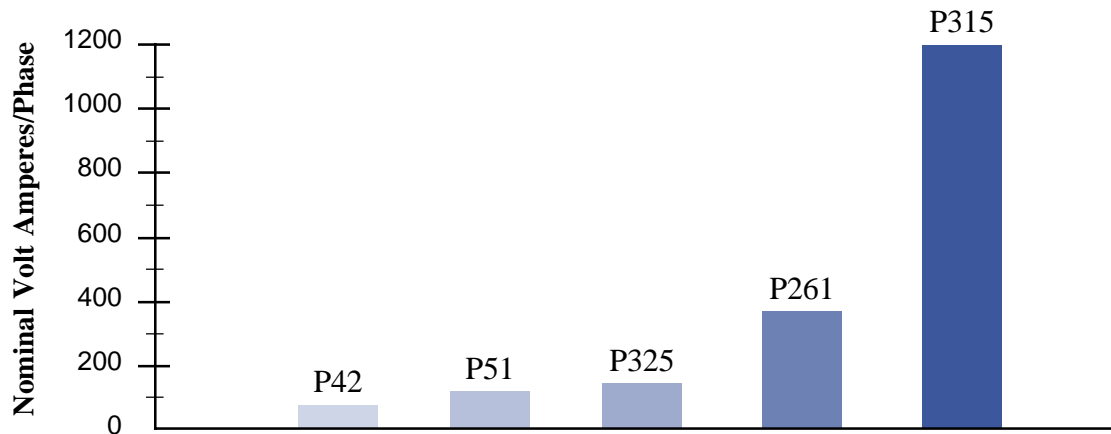
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# PACKAGED SYSTEMS

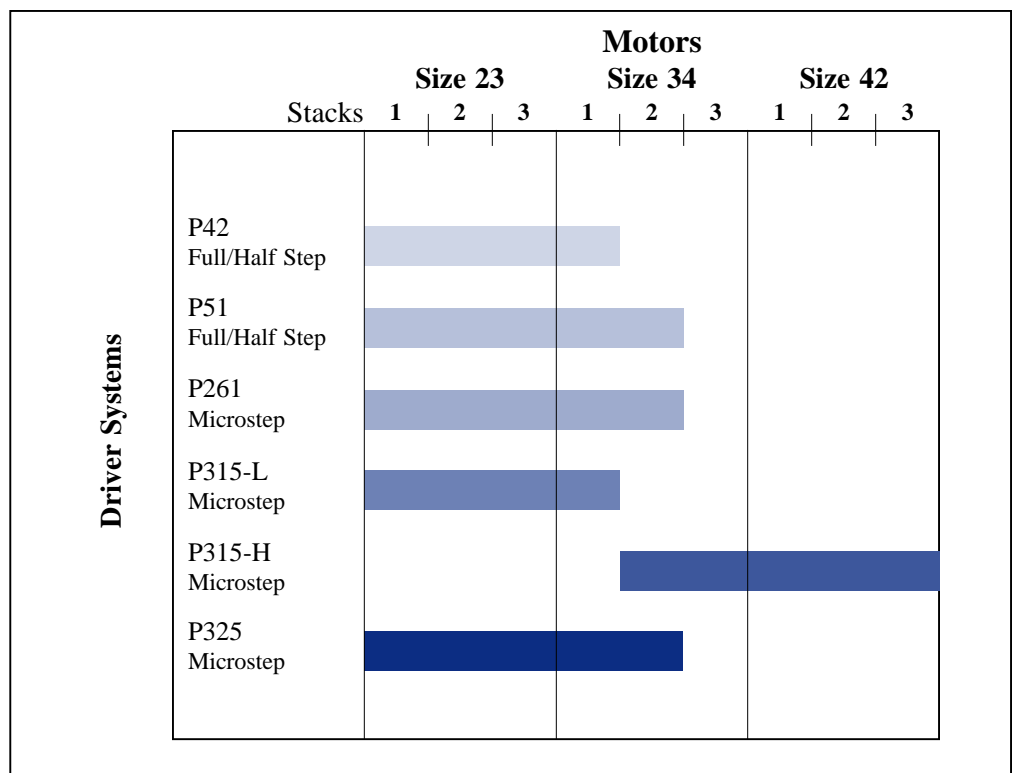
Packaged Systems are pre-configured to include a power supply and a drive in a single package, requiring the user to simply supply AC line voltage for power. Some packaged modules can also be ordered with a built-in indexer. All packaged systems have plug-type

connectors, connect to an AC power source, and include mounting brackets for quick and easy installation. Motor models have been pre-selected to ensure optimal performance and simplify the selection process for the system designer.

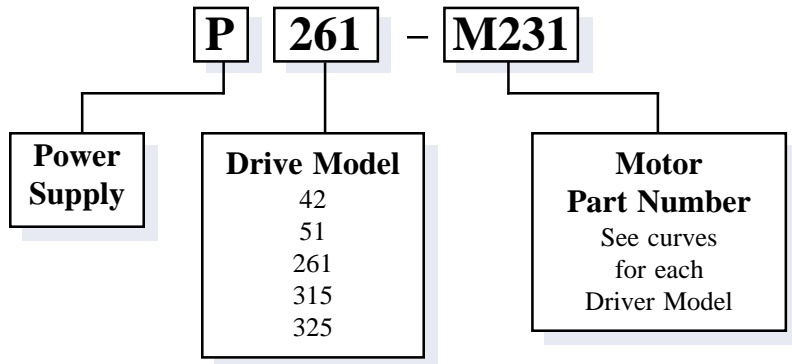
## POWER COMPARISON



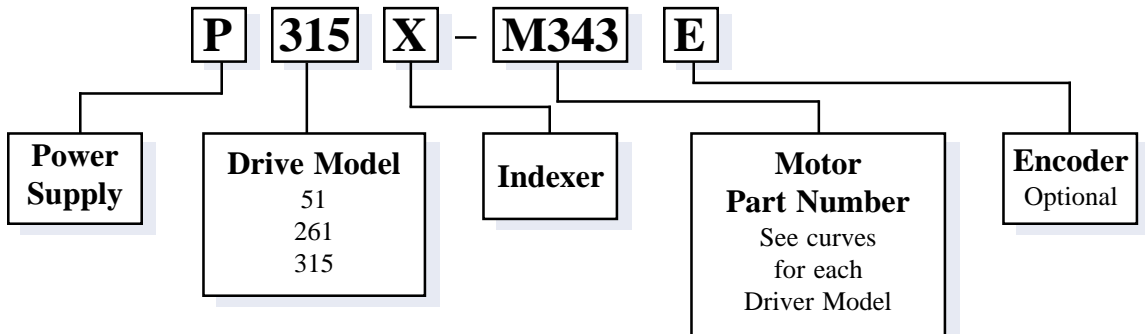
## DRIVER SYSTEMS BY MOTOR SIZE



**POWER/DRIVE PART NUMBER/CONFIGURATION:**



**POWER/DRIVE/INDEXER PART NUMBER/CONFIGURATION:**



**PACKAGED SYSTEMS**

## FULL/HALF STEP PACKAGES

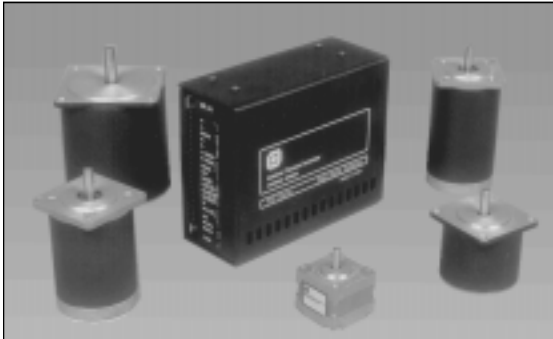
### P42 Series



### Compact Dual-Axis Full/Half Step Systems

- Dual-Axis package includes motors, drives, and power supply.
- Torques from 15 to 150 oz-in.
- Switch selectable 115/230 VAC 50/60 Hz input.
- Optically isolated logic inputs - provides noise immunity. Separate +5VDC supply not required.

### P51 Series

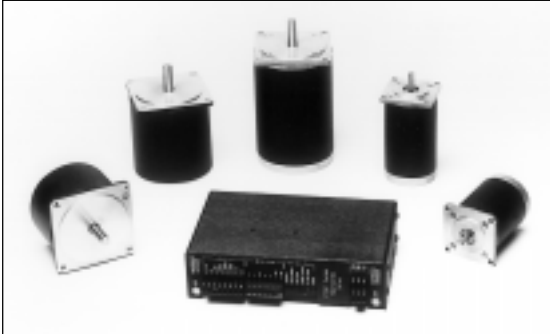


### Compact Full/Half Step Systems

- Compact package includes motor, driver, and power supply.
- Torques from 15 to 300 oz-in.
- Switch selectable 115/230 VAC 50/60 Hz input.
- Optically isolated logic inputs - provides noise immunity. Separate +5VDC supply not required.
- Optional built-in indexer (P51X).

## MICROSTEP PACKAGES

### P261 Series



### Compact Microstep Systems

- Torques from 15 to 300 oz-in.
- Speeds up to 3,000 RPM continuous.
- Dip switch selectable resolutions up to 50,800 steps per revolution.
- Optional built-in indexer (P261X).
- Current to 5 Amps.

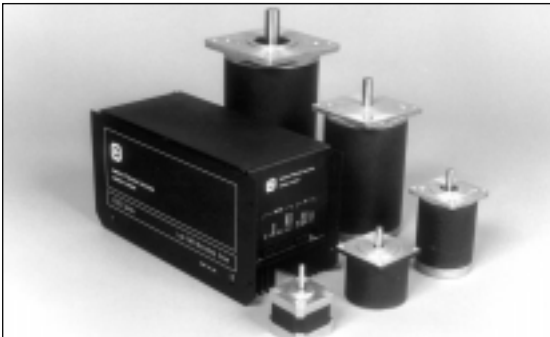
### P315 Series



### High Performance Microstep Systems

- Torques from 65 to 3000 oz-in.
- Speeds up to 3,000 RPM continuous.
- Dip switch selectable resolutions up to 50,800 steps per revolution.
- Optional built-in indexer (P315X).
- Available DB-25 pin logic connector (add suffix -DB25).
- Current to 8.2 Amps.

### P325 Series



### Low EMI Microstep Systems

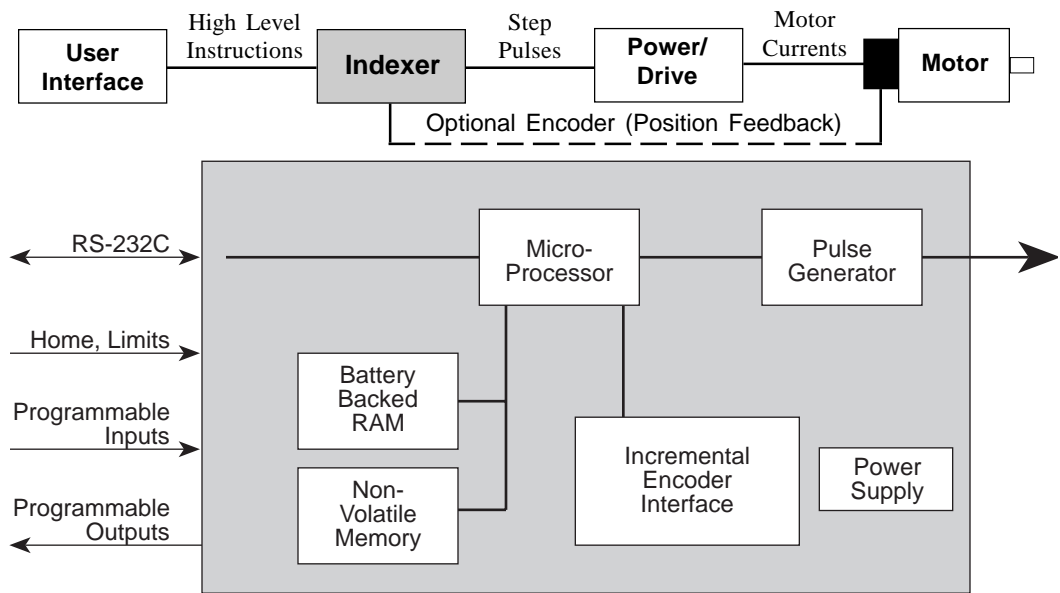
- Torques from 20 to 300 oz-in.
- Speeds up to 3,000 RPM.
- Step resolutions up to 50,000 steps per revolution.
- Available DB-25 pin logic connector (add suffix -DB25).
- Current to 3.5 Amps.

# PACKAGED STEPPER SYSTEMS / INDEXERS

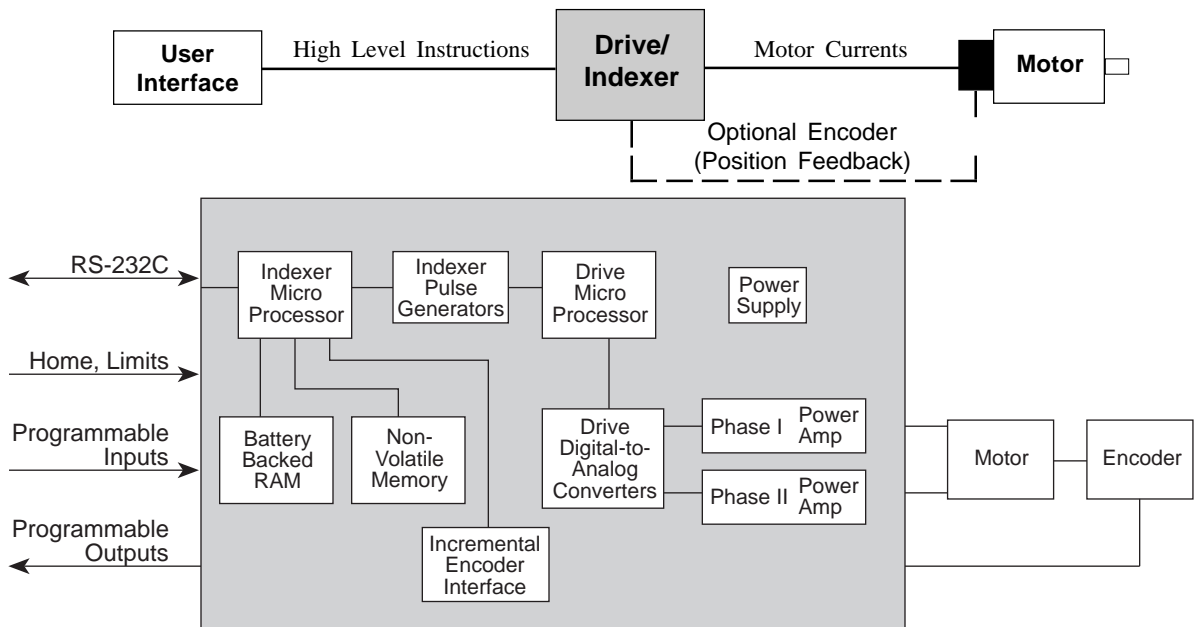
An essential part of any motion control system is the controlling device called the **Indexer**. The indexer can interface to the users' environment/ equipment through a data communications line and/or through hardwired Input/Output (I/O) lines. In addition, the indexer provides the speed, direction, distance, and the acceleration rate information required to generate motion within the application. API Indexers all utilize a plain English command set called **Intelli-Command Language** or **ICL** for short.

This powerful command language was structured for use by system designers/implementors in terminology they understand for quick and simple installation. As indicated by the following block diagrams, API indexers can be purchased as Modular stand-alone devices, or pre-packaged with the motor driver. This flexibility of choice provides the system designer with an optimal fit in satisfying their application needs.

## STAND-ALONE INDEXER



## PACKAGED SYSTEMS (INTEGRAL INDEXERS)





### SAC-560



### Stand Alone Indexer

- Intelli-Command Language, powerful, yet easy to learn English-like instruction set with built-in Editor, Help facilities and RS-232 communications.
- Home, End-of-Travel, Jog, Stop, 6 Programmable Inputs and 5 Programmable Outputs.
- Encoder capabilities include position correction and maintenance for closed-loop positioning.
- Control up to 36 SAC-560's on the RS-232 port.

### P51X Series



### Full/Half Step Drive/Indexer System

- Intelli-Command Language, powerful, yet easy to learn English-like instruction set with built-in Editor, Help facilities and RS-232 communications.
- Includes a Full/Half Step Driver and power supply.
- Home, End-of-Travel, 5 Programmable Inputs and 3 Programmable Outputs.
- Encoder capabilities include position correction and maintenance for closed-loop positioning.

### P261X Series



### Compact Microstep Drive/Indexer System

- Intelli-Command Language, powerful, yet easy to learn English-like instruction set with built-in Editor, Help facilities and RS-232 communications.
- Includes a Microstep Driver and power supply.
- Home, End-of-Travel plus 13 programmable inputs and 8 programmable outputs.
- Encoder capabilities include position correction and maintenance for closed-loop positioning.

### P315X Series



### High Performance Microstep Drive/Indexer System

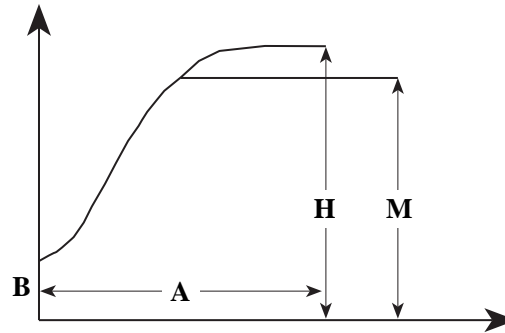
- Intelli-Command Language, powerful, yet easy to learn English-like instruction set with built-in Editor, Help facilities and RS-232 communications.
- Includes a High Performance Microstep Driver and power supply.
- Home, End-of-Travel plus 13 programmable inputs and 8 programmable outputs.
- Encoder capabilities include position correction and maintenance for closed-loop positioning.



Here is how API's optimal non-linear ramping is generated. The ICL Command Language utilizes five parameters to define the motion profile. They are listed to the right. Refer to the ICL Software pages beginning on page C4 of the INDEXERS section.

A = Acceleration Time  
 B = Base Velocity  
 D = Deceleration Time  
 H = Highest Velocity Limit  
 M = Maximum Velocity

### OPTIMAL NON-LINEAR



The parameters A, B, D, and H are utilized to pre-calculate the acceleration and deceleration math tables. The parameter "M" defines how far up the acceleration ramp table the ICL system is allowed. The graph on this page depicts the effects of selected values for **A**, **B**, **D**, and **H** upon the motion profile, general guidelines for selecting values are also suggested below.

Base velocity is the instantaneous, stop-start speed of your step motor system. A low base speed will reduce overshoot when coming to a full stop. Utilizing both **H**, (highest velocity limit) and **M** (maximum velocity) allows API to control its ramping better than just straight sinusoidal motion. For more information, consult API's application department.

#### General Guidelines

Listed below are guidelines when selecting values for motion parameters, (A, B, D, H and M). Note that parameter MR is the number of motor steps per revolution.

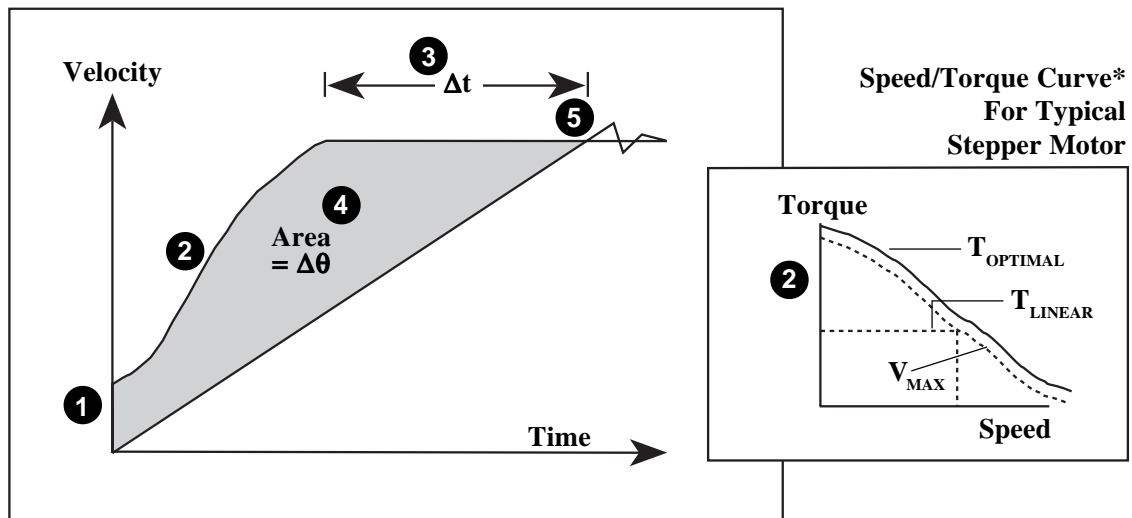
- **Base Velocity.** Select a starting base velocity at about 1/5 revolution per second and adjust per application demands. Remember base speed is an instant stop/start condition.
- **Maximum Velocity.** Select the maximum velocity desired, in this case 10 revolutions per second. *i.e.* -  $M = MR \times 10$  ^ SELECT 10 RPS
- **Highest Velocity.** For a smooth S-curve type acceleration (jerk-free), try to keep the value of parameter "H" close to the value of parameter "M". For a quick, short movement use a higher "H" value. *i.e.* -  $H = M$
- **Acceleration/Deceleration.** Adjust the parameters for acceleration and deceleration times, "A" and "D", to as low as possible without the system stalling. These parameters do NOT need to be the same.
- Increasing "H" will allow for quicker acceleration and deceleration. In most applications, "H" is up to 20% higher than "M" (maximum velocity).

## OPTIMIZING SYSTEM RAMPING

In a single axis application, API has developed optimized non-linear ramping techniques to provide distinct advantages over both linear and sinusoidal methods. Our technique

provides the ability to maximize motor performance throughout its speed range and allows us to extend its useful speed range.

### OPTIMAL NON-LINEAR Vs. LINEAR RAMPING



#### Advantages

Five major advantages of API's Optimal Non-Linear Ramping (illustrated above) follows:

- 1 **Base Speed.** A base speed allows API to bypass low speed ranges where problems with resonance can occur.
- 2 **Optimal Ramping.** The acceleration rate is continuously changed as a function of speed. This can result in over 80% utilization of the motors available torque across its speed range. The  $T_{OPTIMAL}$  curve illustrates this advantage over  $T_{LINEAR}$ , see inset Speed/Torque Curve\*. Because the Optimal Non-Linear Ramping maximizes our use of the motor's available torque, the user is not required to continuously change the acceleration rate to optimize performance (linear).
- 3 **Reduced Acceleration** Times. At speeds of 10 RPS and greater, we provide 30-60% faster acceleration to final velocity ( $\Delta t$ ), than standard linear ramping.
- 4 **More Distance**, Less Time. The extra area beneath the curve is the extra distance ( $\Delta\theta$ ), traveled during the same amount of time, resulting in increased throughput of your machine.
- 5 **Jerk-Free Motion.** Once a step motor gets to maximum velocity, there is a tendency to have jerk resulting in overshoot and velocity variations. The resulting overshoot can cause stalling of the step motor and is much more pronounced with linear ramping. Jerk-Free motion will also prevent potential damage to mechanical components.

## Intelli-Command Language (ICL) Software

The key feature of API's indexer product line is that its Intelli-Command Language (ICL) software was designed for use by individuals without computer programming experience. Through the use of plain English type commands, your motion application will be up and running quickly, providing you with dividends

long before other motion control systems. Please note that only the number of characters that make the command unique are required to be entered for command execution. It is recommended that three characters be used in motion programs to allow for future software upgrades.

### Motion Profile Definition Commands

These commands define the motion profile.

Command	Description
A=n	Sets the motion profile acceleration time (n) in milliseconds, to reach the speed defined in parameter H.
B=n	Sets the base/start speed (n) of the motor in motor pulses/sec.
D=n	Sets the motion profile deceleration time (n) in milliseconds.
H=n	Sets the high speed limit (n), in motor pulses/second, that is used to establish the slope of the acceleration curve.
M=n	Sets the maximum motor velocity in motor pulses/second.

### Motion Units Specification

These commands define encoder, motor, and user resolutions, and establish the units that will be active during motion execution.

Command	Description
ER=n	Defines the encoder resolution (n) after quadrature.
MR=n	Defines motor resolution (n) in motor steps/revolution.
UR=n	Defines the number of user units (n) per shaft revolution.
EUNits	Establishes motion commands to be interpreted as encoder units
MUNits	Establishes motion commands to be interpreted as motor units.
UUNits	Establishes motion commands to be interpreted as user units.

## Motion Execution/Termination Commands

These commands cause the actual execution of motion. Motion will occur as defined by the "Motion Profile" and "Motion Units" specifications.

Command	Description
HOME	Move to the "Home reference" position of the system.
MOVE n	Move the distance (n).
POSITION n	Go to the absolute system position (n).
RUN	Run the motor at base/start speed until commanded to STOP.
SLEW	Accelerate and run the motor at the defined maximum velocity until commanded to STOP.
ABORT	Aborts/Stops the execution of motion immediately.
STOP	Stops the execution of motion initiated by the RUN command immediately, or by the SLEW command after decel.

## Motion Program Creation, Maintenance and Execution

These commands allow the creation, maintenance, listing, and execution of motion programs.

Command	Description
CALL pgm	Execute the program named (pgm) in RAM.
COPY old, new	Copy the program named (pgm) to (newpgm) in RAM.
DELETE pgm	Delete the program named (pgm) in RAM.
DIRECTORY	Provides a directory of all programs in RAM.
EDIT pgm	Create or modify the program name (pgm) in RAM.
LIST pgm	List the program named (pgm) on the host device.
RENAME old, new	Rename the program named (pgm) to (newpgm) in RAM.

## Motion Program Flow and Conditional Operators

These commands allow the flow within a motion program to be controlled. The status of I/O, Variables and Flags can be verified and used to conditionally control program flow.

Command	Description
<, <=, =, <>, =>, >	Comparison operators for variables.
\	Compares for a not condition of Flags and I/O.
AND, OR	Boolean operators allowed for all compares.
IF (condition) ccc	IF a "TRUE" condition exists THEN branch to the label "ccc" within the current motion program.
JUMp ccc	Unconditionally branch to the label "ccc" within the program.
LOOp n ccc	Loop "n" times to label "ccc".

## I/O Commands and Status

These commands allow manipulation and testing of I/O.

Command	Description
ID1=xxxxxxx	Sets the default condition of Inputs 1-8 as active high (1) or low (0).
ID2=xxxxxxx	Sets the default condition of Inputs 9-16 as active high (1) or low (0).
OD1=xxxxxxx	Sets the default condition of Outputs 1-8 as active high (1) or low (0).
IO	Returns the status of all I/O as either on or off.
RESet n	Resets Output (n) to off or flag F(n) to off.
SET n	Sets Output (n) to on or flag F(n) to on.
SYNc n	Polls input "n" at high speed to synchronize the indexer to an external event.
VERify p	Sends the value of the specific parameter (p) requested to the host device.
VER ID1	Returns the default state of Inputs 1-8 to the host.
VER I1	Returns the status of Inputs 1-8 to the host.
VER ID2	Returns the default state of Inputs 9-16 to the host.
VER I2	Returns the status of Inputs 9-16 to the host.
VER OD1	Returns the default state of Outputs 1-8 to the host.
VER O1	Returns the status of Outputs 1-8 to the host.

## Encoder Functions Setup and Status

These commands establish setup and functioning of encoder capabilities.

Command	Description
ER=n	Defines the encoder resolution (n) after quadrature.
MR=n	Defines motor resolution (n) in motor steps/revolution.
EF=10000000	Sets "Stall Detection" feature on.
EF=01000000	Sets "Position Maintenance" feature on.
EF=00010000	Sets "Home on Z Channel" feature on.
CG=n	"Correction Gain" value to move within the deadband window.
CV=n	Maximum "Correction Velocity" used during correction.
DW=n	"Deadband Window" is the number of encoder counts within which the motor is considered in position.
PE=n	Maximum "Position Error" in encoder pulses before the motor is considered stalled.
SP=n	Defines the "Stall Detect Program" that will execute when a stall condition has been detected.
VERify p	Sends the value of the specific parameter (p) requested to the host device.
VER E	Returns encoder position in encoder pulses.
VER ME	Returns motor position error in motor units (steps).
VER P	Returns motor position in motor units (steps).

## Data Transmission and Entry Commands

These commands provide communications between devices and allow data to be entered by an operator.

Command	Description
PROMpt "msg" Vn	Send a message "msg" to the operator and prompt for data input into Variable Number "n".
SEND d "msg"	Send a message "msg" to the device address "d".
REPort	Sends a motion complete message to the host device.

## Mathematical Operators

These commands provide math functions to the user.

Command	Description
+	Addition of variables.
-	Subtraction of variables.
/	Division of variables.
*	Multiplication of variables.
%	Modulo operator. Provides the remainder from integer division.

## General System Control

These commands provide control of various parameters and operating modes available within your system.

Command	Description
AUTostart	Results in the program # stored in Parameter "G" to be executed.
CONTinue	Allows non-motion commands to be executed while motion is occurring. (Reverse command: PAUse).
ECHo [ON/OFF]	Turns echo on/off to host.
EXPert	Error message #'s only will be sent to host (Reverse command: NOVice).
NOVice	Error number and text will be sent to host.
PASsword	Enables/disables password protection of motion programs.
PAUse	System will wait until the motion is complete prior to executing another command (Reverse command: CONTinue).
param=value	Any system parameter can be assigned a value using the syntax shown on the right. Examples include: G= Autostart program number. SC= Characters per line on the host device. T= Lines to Transmit at one time before pausing. U= Sets the address name of this indexer.

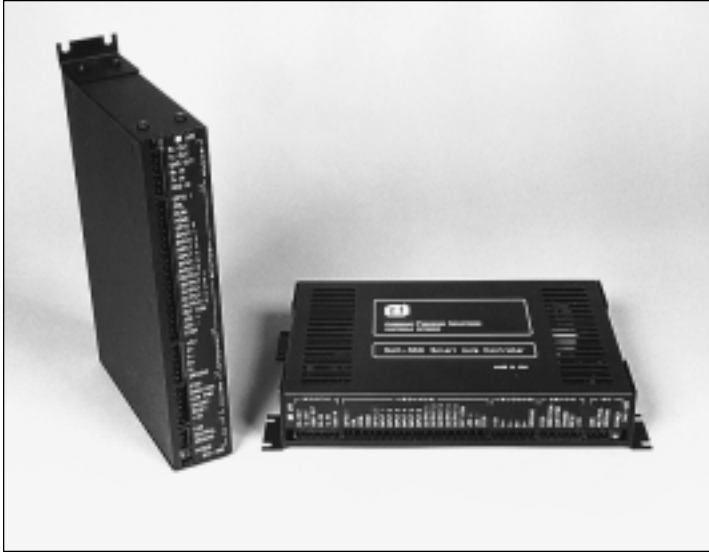


## System Status

These commands allow you to obtain information on the current status of your system.

Command	Description
DIRectory	Sends a directory of motion programs stored within the indexers memory to the host.
IO [-n/n]	Sends the current state of IO to the host.
SHOW	Sends the value of all non blank variables to the host.
STAtus	Sends the value of all parameters to the host.
TIMe	Reports the time in milliseconds for the last motion to complete.
VERify Fx	Sends the status of the user flag (x) to the host device.
VERify p	Sends the value of the specific parameter (p) requested to the host device.
VER E	Returns encoder position in encoder pulses.
VER F	Returns the free space, in bytes, in user RAM.
VER P	Returns motor position in motor units (steps).
VER U	Returns the address name of this indexer to the host.
VER UA	Returns the unit of measure currently utilized to perform motion. 1: Motor, 2: User; 3: Encoder.
VERify Vn	Sends the status of user variable (n) to the host device.

# SAC-560 Microstep Controller



## Features

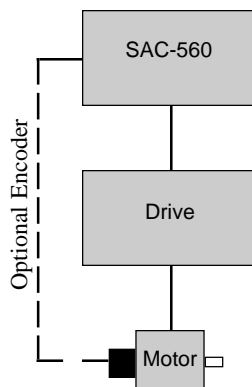
- Intelli-Command Language, powerful, yet easy to learn English-like instruction set with built-in Editor and Help facilities.
- Create, modify and store up to 88 different motion programs in battery backed Random Access Memory.
- Automatically generate efficient non-linear velocity profiles or insert your own user velocity profiles.
- Daisy chain up to thirty-six SAC-560's on the built-in RS-232 port.
- Home, End of Travel, Jog+, Jog-, and Stop inputs also included.
- Full optical isolation of all inputs and outputs for high electrical noise immunity.
- Regulated 5 VDC supply provided for encoders or other devices.

## Description

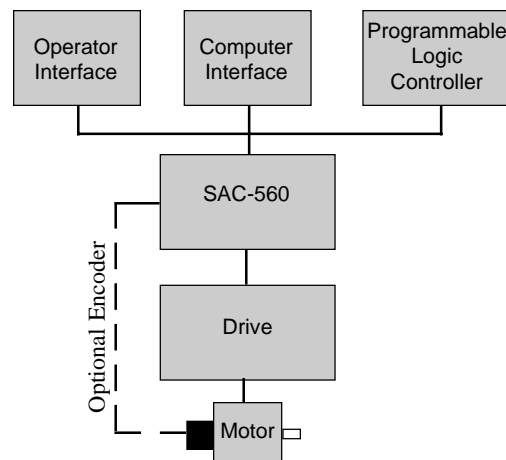
The Smart Axis Controller, SAC-560, is a high speed microprocessor based controller that will interface to virtually any step motor drive. With its Intelli-Command Language (ICL), on board Editor and RS-232 communications port, a user can easily create, store, and modify up to 88 motion programs in the SAC-560's battery backed random access memory (RAM). Other features include optical isolation of Home, CWL, CCWL, Stop, Jog(+), Jog(-) plus 6 programmable inputs and 5 programmable outputs; the ability to daisy-chain up to 36 controllers on a single RS-232 port; and encoder feedback capabilities.

A motion control program is defined on the SAC-560 by using English-like ICL Commands and ICL Parameters. Commands tell the system "WHAT TO DO" while the parameters tell the system "HOW TO DO IT". Parameters are initialized and changed as required, to provide information about the application including base speed, slew speed, acceleration time, etc. The SAC-560 then utilizes the parameter values to automatically generate the acceleration and deceleration curves required by your application.

### Stand Alone Configuration



### User Interface Configuration



**SPECIFICATIONS:**

**POWER** ..... 95-132 VAC or 190-264 VAC, 50/60 Hz, 24 Watts max.

**ENVIRONMENTAL**

Operating Temperature ..... 32°F (0°C) to 122°F (50°C).

Storage Temperature ..... -40°F (-40°C) to 185°F (85°C).

**OPERATIONAL**

Acceleration ..... Optimal non-linear mathematical function.

Step Accuracy .....  $\pm 0$  steps.

Position Range .....  $\pm 2.1$  billion steps.

Speed Range ..... 0 to 750,000 pulses/second.  $\pm 1\%$  maximum speed.

**COMMUNICATIONS**

Type ..... RS-232C serial, 3 wire implementation (Tx, Rx, Gnd).

Baud Rates ..... 1200, 2400, 4800 and 9600.

Mode ..... Full Duplex.

Format ..... 8 data bits; 1 stop bit, no parity; ASCII Characters.

Multi-Axis ..... Daisy chain up to 36 indexers from a single host RS-232C port.

**STORED PROGRAMS**

Number of Programs ..... 88 programs maximum.

RAM Capacity ..... 32K.

Auto-Start Program ..... Selectable by program number.

**INPUTS**

Active State ..... High or low. Software selectable.

Type ..... Optically isolated. TTL or 5-15VDC.

Limits ..... CW, CCW, HOME.

Programmable ..... Six.

Jog (+) ..... Jog positive direction.

Jog (-) ..... Jog negative direction.

Stop ..... Stop motion/program.

Hold ..... Software assignable to programmable inputs 1-6.

**PROGRAMMABLE OUTPUTS**

Type ..... Optically isolated. Open collector 5-15VDC, 25 milliamp max.

Programmable ..... Five. (Active high or low. Software selectable.)

Two sourcing outputs. (Outputs #1,2)

Three sinking outputs. (Outputs #3,4,5)

**DRIVE OUTPUTS**

Type ..... TTL compatible.

“High” 2.5-5.0VDC (Sourcing 20mA max.)

“Low” 0.0-0.5VDC (Sinking 48mA max.)

Step ..... Pulsed “High” to signal the drive to Step. The “High” pulse width range is 1.25-32 microseconds.

Direction ..... Default “High” (CW Direction). Taken “Low” for CCW Direction.

Low Power ..... Default “High” (Full Power). Taken “Low” for Low Power Mode.

Enable ..... Default “High” (Enabled). Taken “Low” for No Power Mode.

Reset ..... Pulsed low on power up.

+5VDC ..... Provides +5VDC for optically isolated inputs of users drive.

200 milliamp maximum.

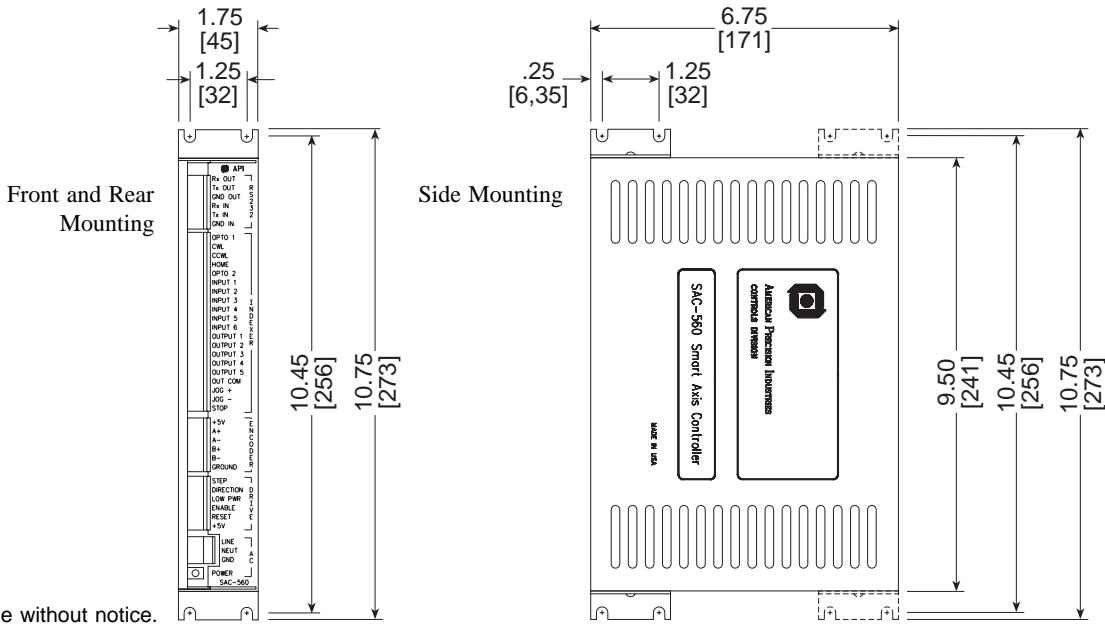
**ENCODER**

Channels ..... Complementary A & B channel in quadrature.

Maximum input frequency rate of 256 kHz on A & B Channel (pre-quadrature).

**DIMENSIONS:** [-] denotes millimeters

Unit should be mounted vertically with a 3" horizontal and 2" vertical clearance.



Subject to change without notice.

**SAC-560 CONNECTIONS/LED**

**RS-232**

Rx OUT	⊖	1	Receive
Tx OUT	⊖	2	Transmit
GND OUT	⊖	3	Ground
Rx IN	⊖	4	Receive
Tx IN	⊖	5	Transmit
GND IN	⊖	6	Ground

**ENCODER**

+5V	⊖	1	5VDC Supply to Encoder
A+	⊖	2	TTL Diff. Signal From Ch. A+
A-	⊖	3	TTL Diff. Signal From Ch. A-
B+	⊖	4	TTL Diff. Signal From Ch. B+
B-	⊖	5	TTL Diff. Signal From Ch. B-
GND	⊖	6	Encoder Ground

**I/O**

OPTO1	⊖	1	Optical Isolation User Input (5-15 VDC)
CWL	⊖	2	Clockwise Travel Limit
CCWL	⊖	3	Counter Clockwise Travel Limit
HOME	⊖	4	Home Position Reference Input
OPTO 2	⊖	5	Optical Isolation User Input
IN 1	⊖	6	Programmable Input #1
IN 2	⊖	7	Programmable Input #2
IN 3	⊖	8	Programmable Input #3
IN 4	⊖	9	Programmable Input #4
IN 5	⊖	10	Programmable Input #5
IN 6	⊖	11	Programmable Input #6
OUT 1	⊖	12	Programmable Output #1 (Sourcing)
OUT 2	⊖	13	Programmable Output #2 (Sourcing)
OUT 3	⊖	14	Programmable Output #3 (Sinking)
OUT 4	⊖	15	Programmable Output #4 (Sinking)
OUT 5	⊖	16	Programmable Output #5 (Sinking)
OUT COM	⊖	17	Reference Ground For All Outputs
JOG +	⊖	18	Jog Clockwise
JOG -	⊖	19	Jog Counter Clockwise
STOP	⊖	20	Stop Motion

**DRIVE OUTPUTS**

STEP	⊖	1	Step Signal to Drive
DIRECTION	⊖	2	Direction Signal to Drive
LOW PWR	⊖	3	Low Power Signal to Drive
ENABLE	⊖	4	No Power/Enable Signal to Drive
RESET	⊖	5	Reset Signal to Drive
+5VDC	⊖	6	5 VDC Supply Output to Drive

**AC POWER**

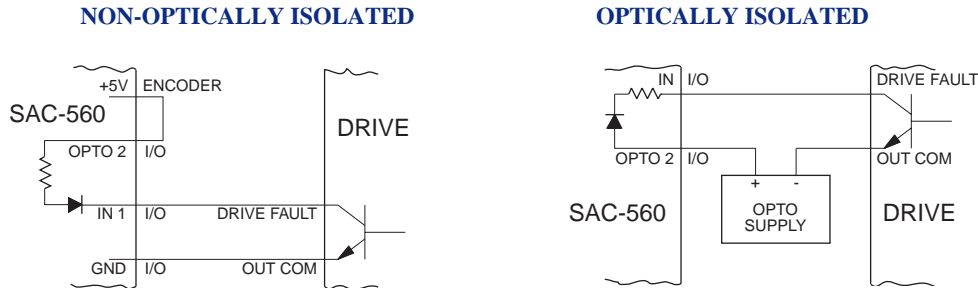
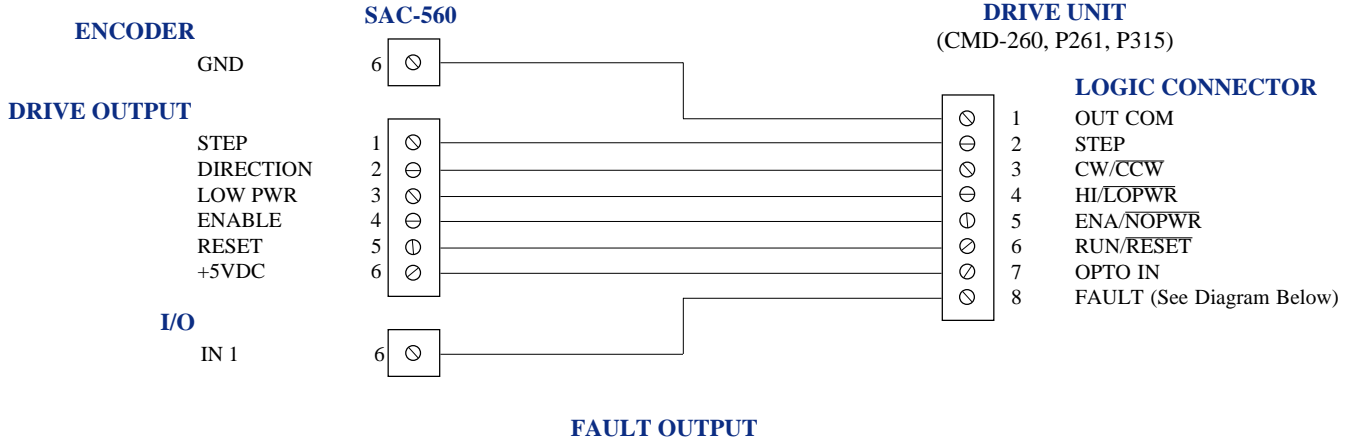
LINE	⊖	1	AC Input Black Wire (Line)
NEUT	⊖	2	AC Input White Wire (Neutral)
GND	⊖	3	AC Input Green Wire (Ground)

**STATUS LED**

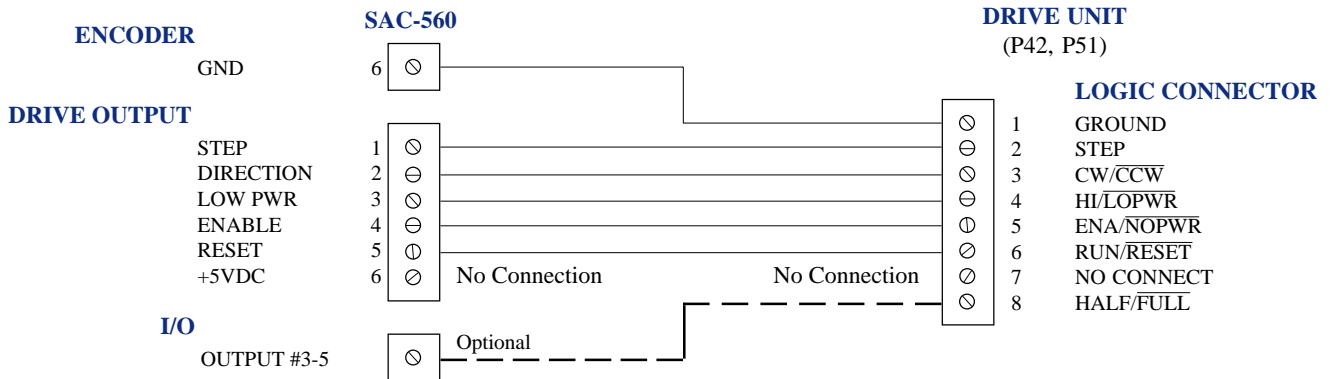
POWER	⊙	1	LED indicating power on
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## CONNECTING THE SAC-560 TO API DRIVES

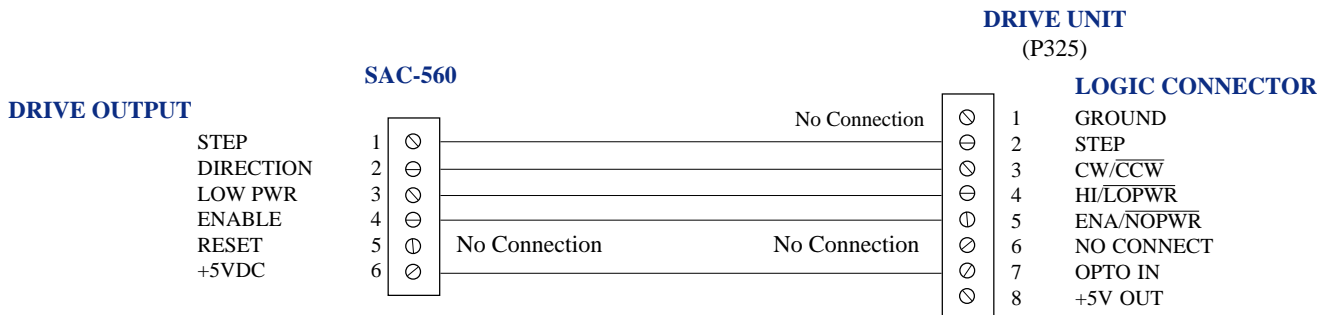
### DRIVE CONNECTIONS (CMD-260, DM-226, P261, P315)



### DRIVE CONNECTIONS (P42, P51)



### DRIVE CONNECTIONS (P325)



INDEXERS

## CONNECTING THE SAC-560 TO API DRIVES

### DRIVE CONNECTIONS (CMD-50)

#### DRIVE UNIT (CMD-50)

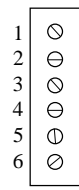
#### DRIVE OUTPUT

- STEP
- DIRECTION
- LOW PWR
- ENABLE
- RESET
- +5VDC

#### I/O

- OUTPUT #3-5

#### SAC-560



Optional



#### TERMINAL 1

- COMMON GROUND
- STEP IN
- CW/ $\overline{\text{CCW}}$
- CIR/ $\overline{\text{NON}}$
- ENA/ $\overline{\text{NOPWR}}$
- RUN/ $\overline{\text{RESET}}$
- +5VDC IN
- ROI
- ROI
- HALF/ $\overline{\text{FULL}}$

### DRIVE CONNECTIONS INCLUDING CIR/ $\overline{\text{NON}}$ AND ENA/ $\overline{\text{NOPWR}}$ (CMD-50)

#### ENCODER

- GND

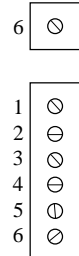
#### DRIVE OUTPUT

- STEP
- DIRECTION
- LOW PWR
- ENABLE
- RESET
- +5VDC

#### I/O

- OUTPUT #3
- OUTPUT #4
- OUTPUT #5

#### SAC-560



Optional

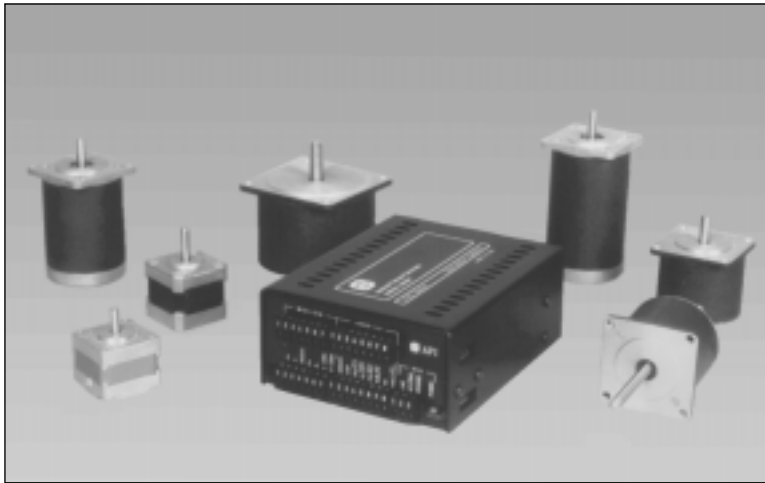
#### DRIVE UNIT (CMD-50)



#### TERMINAL 1

- COMMON GROUND
- STEP IN
- CW/ $\overline{\text{CCW}}$
- CIR/ $\overline{\text{NON}}$
- ENA/ $\overline{\text{NOPWR}}$
- RUN/ $\overline{\text{RESET}}$
- +5VDC IN
- ROI
- ROI
- HALF/ $\overline{\text{FULL}}$

# Compact Dual-Axis Full/Half Step Systems



## Features

- Dual-Axis package includes motors, drives, and power supply.
- Torques from 15 to 150 oz-in.
- State-of-the-art bipolar chopper design.
- Optically isolated logic inputs - provides high noise immunity. Separate +5VDC supply not required.
- Selectable 115 or 230 VAC input.
- DIP switch selectable current settings from 0.3-2.0 Amps.
- Low Power and No Power modes built in.
- Plug type connectors for quick and simple installation.
- Full short circuit protection.

## Description

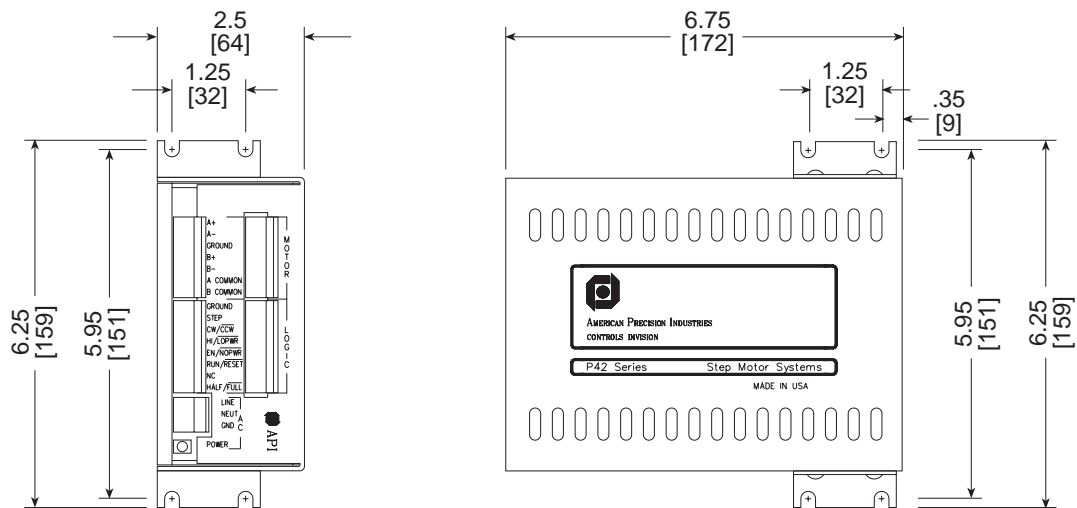
The P42 Series of step motor packages provides two axis of control in a compact, user friendly package. The design combines state-of-the-art bipolar chopper drive technology with an integral power section to provide optimal system performance. Each P42 model includes two motors, two drives, power supply, integral heatsink, mounting brackets, power cord, connectors, and a full enclosure. Since all components have been designed together as a package, the need for the user to size all components individually and assemble them together has been eliminated.

To begin operation the user needs to couple the motors to their loads, switch select either 115 or 230 VAC, plug-in to an AC power source, and provide control signals to operate the system. Since the P42 internally generates +5VDC, a separate +5VDC power supply for logic inputs is not required. The P42 Series packages provides the user the flexibility to select the best control option for the application. Control options include user supplied pulse and direction inputs or full programmable control using a step motor controller.

PACKAGED SYSTEMS

## DIMENSIONS [-] denotes millimeters

Unit should be mounted vertically with a 3" horizontal and 2" vertical clearance.



Subject to changes without notice.



**DRIVE CONNECTIONS**

Motor Phase A+ .....	A+	} MOTOR
Motor Phase A- .....	A-	
Motor Ground .....	GROUND	
Motor Phase B+ .....	B+	
Motor Phase B- .....	B-	
Motor Phase A Common .....	A COMMON	
Motor Phase B Common .....	B COMMON	} LOGIC
Drive Input Signal Ground .....	GROUND	
Step Signal .....	STEP	
Direction Signal .....	CW/CCW	
High/Low Power Signal .....	HI/LO PWR	
Enable/No Power Signal .....	ENA/NO PWR	
Run/Reset Signal .....	RUN/RESET	
No Connection .....	NC	
Half/Full Step Signal .....	HALF/FULL	
AC Input Black Wire (Line) .....	LINE	
AC Input White Wire (Neutral) .....	NEUTRAL	
AC Input Green Wire (Ground) .....	GROUND	
LED Indicating Power-On .....	POWER	

**DRIVE TYPE** ..... Half/Full step, 2 phase, bipolar, constant current, 20KHz chopper drive.

**POWER**

Input ..... 115 or 230 VAC ±10%, 50/60 Hz.

Output ..... Current of 0.3-2.0 amps/phase, Dip switch selectable.

Internal ..... Separate +5VDC for optical isolation circuitry.

**PROTECTION** ..... Short circuit phase to phase, phase to ground.

**LOGIC INPUTS** ..... Optically isolated utilizing a separate internal +5VDC supply. TTL compatible.

**STEP INPUT** ..... Requires 10µS min. width, 50KHz max. pulse rate, steps on trailing edge.

**LOW POWER MODE** ..... Selectable utilizing the High/Low Power signal input line. Current drops to 50% of selected value.

**ENVIRONMENTAL**

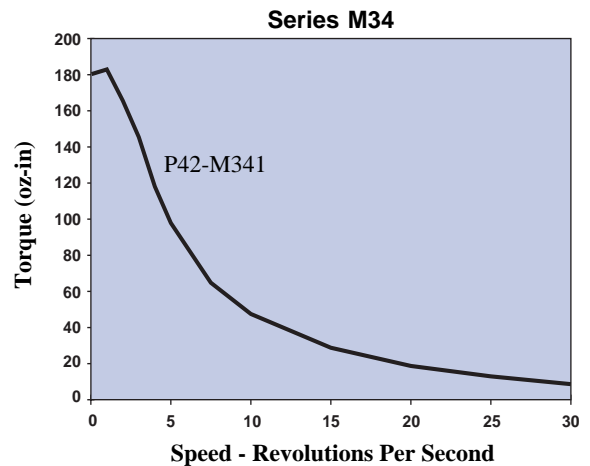
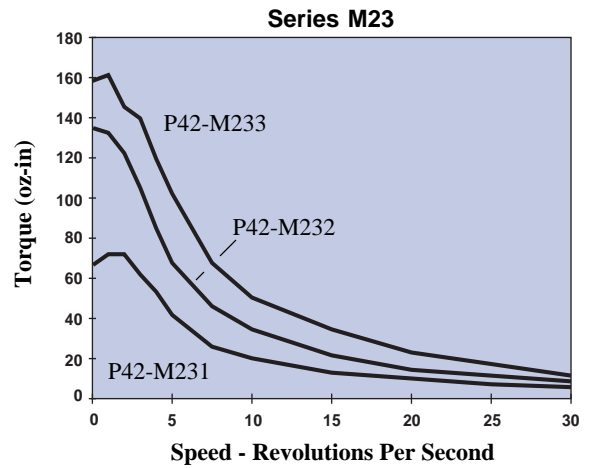
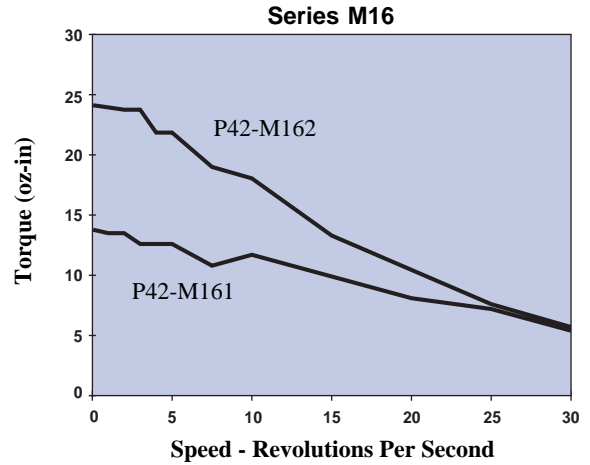
Temperature ..... Drive operating: 32-122° F (0-50° C) Drive heatsink max. 140° F (60° C) Motor case max. 212° F (100° C) Storage -40° to 185° F (-40° to 85° C)

Humidity ..... 0-95%, non-condensing.

**SYSTEM SELECTIONS**

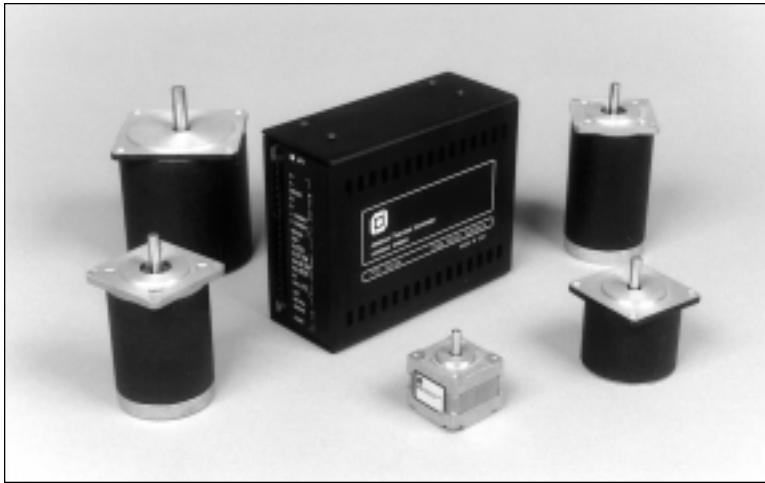
System Part Number	Static Torque Oz-in (N-m)	Motor Width in. (mm)	Motor Length in. (mm)	Motor Model
P42-A231	**	2.23 (57)	2.00 (51)	A231-02
P42-M161	15 (0.11)	1.60 (41)	1.34 (34)	M161-02
P42-M162	25 (0.18)	1.60 (41)	1.54 (39)	M162-03
P42-M231	60 (0.42)	2.23 (57)	2.00 (51)	M231-02
P42-M232	100 (0.71)	2.23 (57)	3.25 (83)	M232-04
P42-M233	150 (1.06)	2.23 (57)	4.00 (102)	M233-06
P42-M341	150 (1.06)	3.25 (83)	2.45 (62)	M341-06

**SPEED/TORQUE CURVES**



Pullout curves generated utilizing 115VAC input, 200 steps per revolution, and the SAC-560 Smart Axis Controller to provide ramping routines and step pulses.

# Compact Full/Half Step Systems



## Common Features

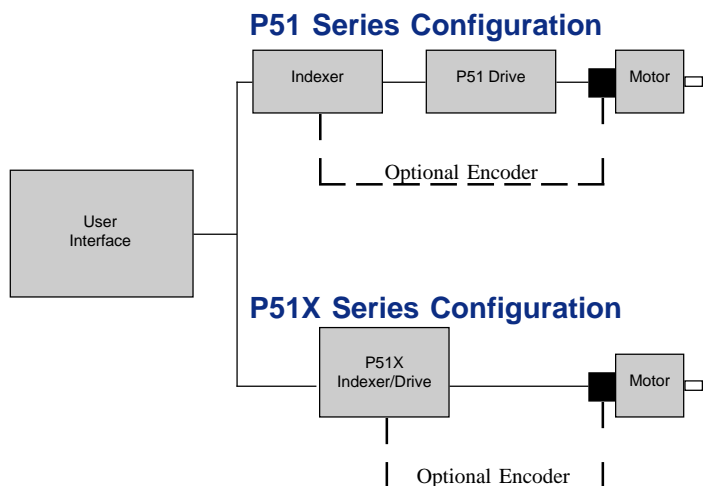
- Torques from 15 to 300 oz-in.
- Compact package includes motor, driver, and power supply.
- State-of-the-art bipolar chopper design.
- Optically isolated logic inputs - provides high noise immunity. Separate +5VDC supply not required.
- Selectable 115 or 230 VAC input.
- DIP switch selectable current settings from 0.3-3.5 Amps.
- Low Power and No Power modes built in.
- Plug type connectors for quick and simple installation.
- Full short circuit protection.

## Description

The P51 Series of Drives and the P51X Series of Drive/Indexer Systems are compact Full/Half step systems that provide cost effective solutions for most motion control applications.

The P51 Series of step motor packages combines state-of-the-art bipolar chopper drive technology with an integral power selection to provide output torques up to 300 oz-in. Each P51 model includes a motor, drive, power supply, integral heatsink, mounting brackets, power cord, connectors, and a full enclosure.

The P51X Indexer section automatically generates precise ramping routines; interfaces to your environment through the use of RS-232 communications, limit inputs, and programmable I/O; and for applications utilizing encoder capabilities, position maintenance and stall detection are available. Best of all, API's Intelli-Command Language (ICL) indexer software was designed for use by individuals without computer programming experience. Through the use of plain English type commands, your motion application will be up and running quickly, providing you with dividends long before other motion control systems.



## P51X Additional Features:

- Includes a powerful built-in indexer.
- Easy to learn "Plain English" instructions.
- RS-232 communications to 19,200 Baud allows daisy chaining of multiple devices.
- Home, End-of-Travel plus 5 programmable inputs and 3 programmable outputs.
- Encoder capabilities include position maintenance and stall detection for closed loop positioning.
- Built-in editor allows creation of up to 88 different motion programs.

**COMMON SPECIFICATIONS FOR P51 AND P51X:**

**DRIVE TYPE** ..... 2 phase, bipolar, constant current, MOSFET chopper, 20 KHz fixed.

**RESOLUTIONS** ..... 200 and 400. (Software selectable P51X).

**POWER**

Inputs ..... 115 or 230 VAC,  $\pm 10\%$ , 50/60 Hz.

Output ..... 0.3-3.5 amps/phase, dip switch selectable.

**PROTECTION**

Short Circuit ..... Phase to phase, phase to ground.

**LOW POWER MODE** ..... Selectable utilizing the High/Low power signal input lines.

**ENVIRONMENTAL**

Temperature ..... Drive heatsink max. 140° F (60° C); Motor case max. 212° F (100° C);

Storage -40° to 185° F (-40° to 85° C)

Humidity ..... 0-95%, non-condensing.

**P51 ADDITIONAL SPECIFICATIONS:****INPUTS**

TYPE ..... Optically isolated. TTL compatible.

GROUND ..... Logic input signal ground.

STEP ..... Requires 10 $\mu$ S min. width, 50KHz max. pulse rate, steps on trailing edge.

DIRECTION ..... CW/CCW.

LOW POWER ..... HI/LOPWR. Reduces motor current to 50% of selected value.

NO POWER ..... ENA/NOPWR. Turns off motor current.

RESET ..... RUN/RESET. Resets logic and establishes zero phase condition.

STEP RESOLUTION ..... HALF/FULL. Sets stepping mode to full or half step.

**P51X ADDITIONAL SPECIFICATIONS:****OPERATIONAL**

Acceleration ..... Optimal non-linear mathematical function.

Step Accuracy .....  $\pm 0$  steps.

Position Range .....  $\pm 2.1$  billion steps.

Speed Range ..... 0 to 50,000 pulses/second.  $\pm 1\%$  maximum speed.

**COMMUNICATIONS**

Type ..... RS-232C serial, 3 wire implementation (Tx, Rx, Gnd).

Baud Rates ..... 1200, 2400, 4800, 9600 and 19200.

Mode ..... Full Duplex.

Format ..... 8 data bits; 1 stop bit, no parity; ASCII Characters.

Multi-Axis ..... Daisy chain up to 36 indexers from a single host RS-232C port.

**INPUTS**

Type ..... Optically isolated. TTL or 5-24VDC.

Limits ..... CW, CCW, HOME.

Programmable ..... Five.

Jog, Hold, Stop ..... Software assignable to programmable inputs.

Active State ..... High or low. Software selectable.

**OUTPUTS**

Type ..... Optically isolated. Open collector 5-24VDC, 35 milliamp max.

Fault ..... Overtemp, Undervoltage or Overcurrent.

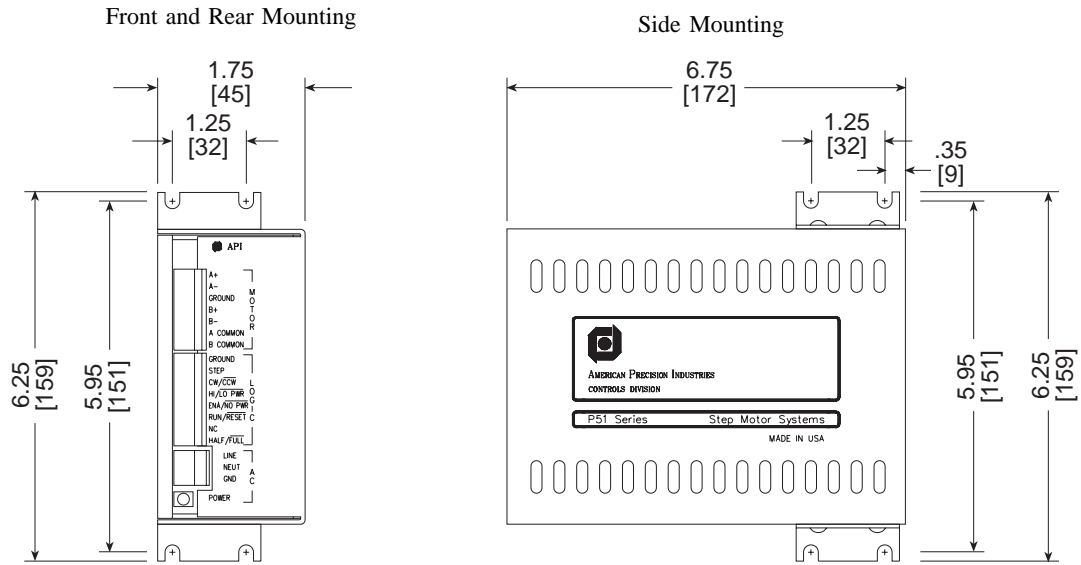
Programmable ..... Three. Active high or low. Software selectable.

**ENCODER**

Channels ..... Complementary A & B Channel in quadrature with Z (index) channel.

Maximum input frequency rate of 256 kHz on A & B Channel (pre-quadrature).

Unit should be mounted vertically with a 3" horizontal and 2" vertical clearance.



Subject to change without notice.

**P51 DRIVE CONNECTIONS/LED**

**DRIVE/LOGIC**

GROUND	⊖	1	Logic Ground
STEP	⊖	2	Step Signal
CW/CCW	⊖	3	Direction Signal
HI/LOPWR	⊖	4	High/Low Power Signal
ENA/NOPWR	⊖	5	Enable/No Power Signal
RUN/RESET	⊖	6	Run/Reset
NC	⊖	7	No Connection
HALF/FULL	⊖	8	Half/Full Step

**MOTOR**

A+	⊖	1	Motor Phase A+
A-	⊖	2	Motor Phase A-
GND	⊖	3	Motor Phase Ground
B+	⊖	4	Motor Phase B+
B-	⊖	5	Motor Phase B-
A COM	⊖	6	Motor Phase A Common
B COM	⊖	7	Motor Phase B Common

**AC POWER**

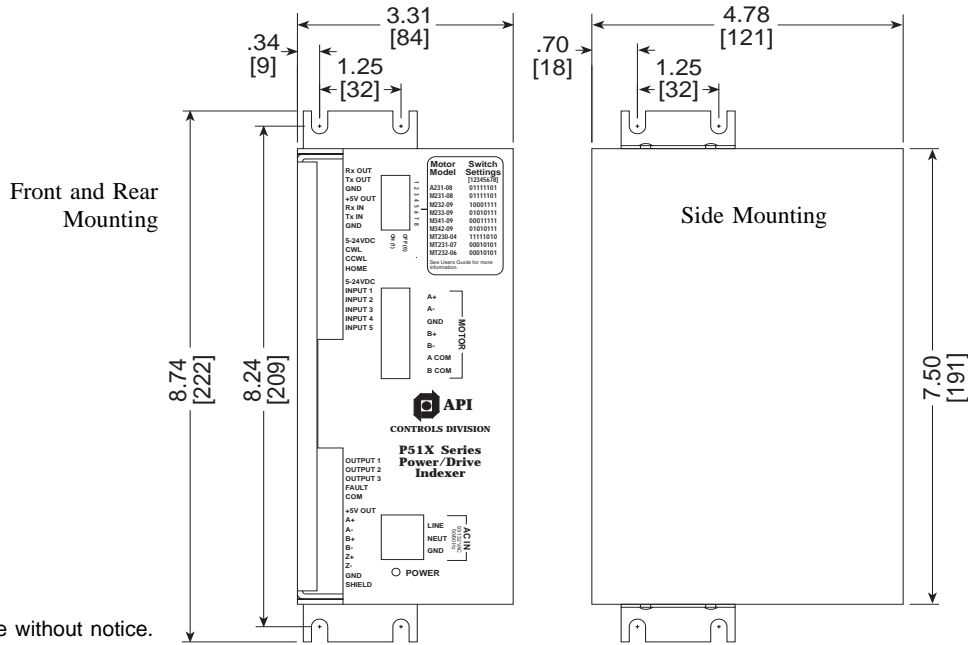
LINE	⊖	1	AC Input Black Wire (Line)
NEUT	⊖	2	AC Input White Wire (Neutral)
GND	⊖	3	AC Input Green Wire (Ground)
POWER	⊗		LED indicating power on

**PACKAGED SYSTEMS**

**DIMENSIONS: P51X SERIES**

[-] denotes millimeters

Unit should be mounted vertically with a 3" horizontal and 2" vertical clearance.



Subject to change without notice.

**P51X DRIVE CONNECTIONS/LED**

**RS-232**

Rx OUT	⊗	1	Receive Out
Tx OUT	⊗	2	Transmit Out
GND	⊗	3	Ground Out
+5V OUT	⊗	4	+5V Out
Rx IN	⊗	5	Receive In
Tx IN	⊗	6	Transmit In
GND	⊗	7	Ground In

**LIMITS**

5-24VDC	⊖	1	5-24VDC
CWL	⊗	2	Clockwise Travel Limit
CCWL	⊗	3	Counter Clockwise Travel Limit
HOME	⊗	4	Home Position Reference Input

**INPUTS**

5-24VDC	⊗	1	5-24VDC
INPUT 1	⊖	2	Programmable Input #1
INPUT 2	⊗	3	Programmable Input #2
INPUT 3	⊗	4	Programmable Input #3
INPUT 4	⊗	5	Programmable Input #4
INPUT 5	⊗	6	Programmable Input #5

**OUTPUTS**

OUTPUT 1	⊖	1	Programmable Output #1
OUTPUT 2	⊗	2	Programmable Output #2
OUTPUT 3	⊗	3	Programmable Output #3
FAULT	⊗	4	Fault Output
COM	⊗	5	Reference Ground For Outputs

**ENCODER**

+5V OUT	⊖	1	5VDC Supply to Encoder
A+	⊖	2	TTL Diff. Signal From Ch. A+
A-	⊗	3	TTL Diff. Signal From Ch. A-
B+	⊗	4	TTL Diff. Signal From Ch. B+
B-	⊗	5	TTL Diff. Signal From Ch. B-
Z+	⊗	6	TTL Diff. Signal From Ch. Z+
Z-	⊗	7	TTL Diff. Signal From Ch. Z-
GND	⊗	8	Encoder Ground
SHIELD	⊗	9	Shield Connection to Encoder

**MOTOR**

A+	⊗	1	Motor Phase A+
A-	⊗	2	Motor Phase A-
GND	⊗	3	Motor Phase Ground
B+	⊗	4	Motor Phase B+
B-	⊗	5	Motor Phase B-
A COM	⊗	6	Motor Phase A Common
B COM	⊗	7	Motor Phase B Common

**AC POWER**

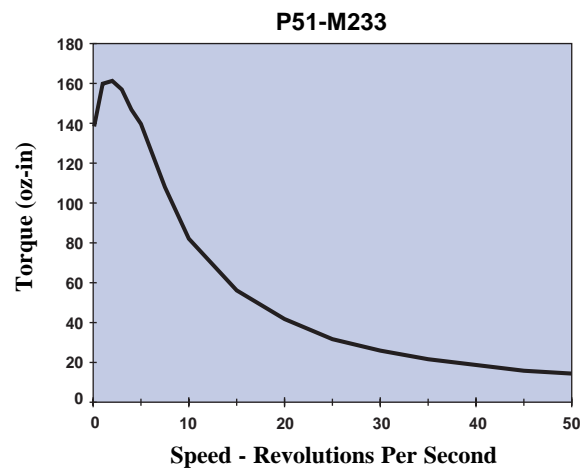
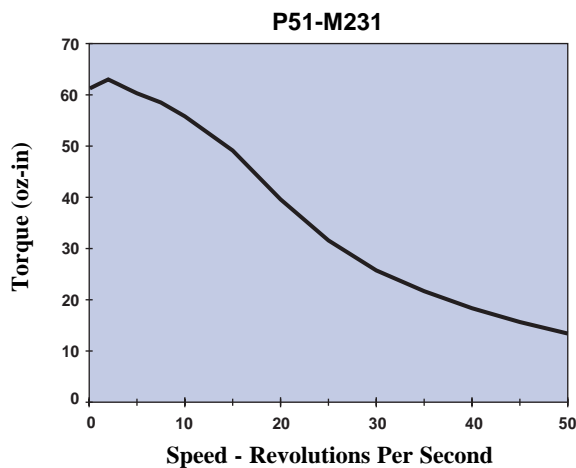
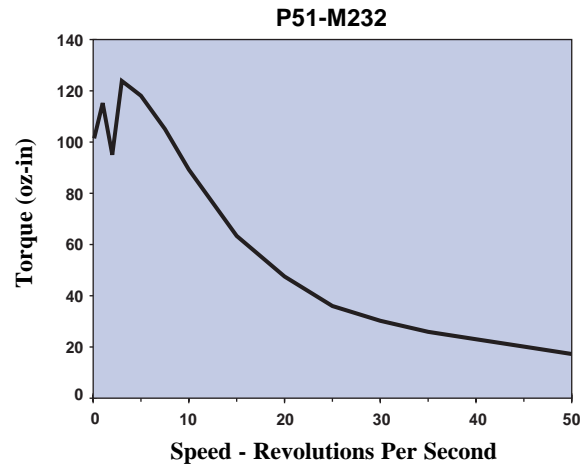
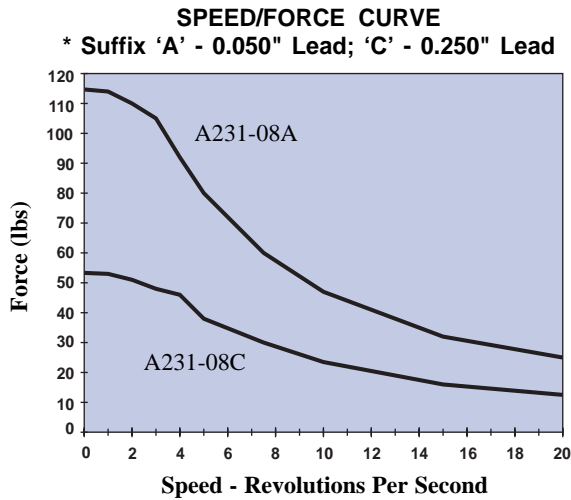
LINE	⊗	1	AC Input Black Wire (Line)
NEUT	⊗	2	AC Input White Wire (Neutral)
GND	⊗	3	AC Input Green Wire (Ground)
POWER	⊗		LED indicating power on

**SYSTEM SELECTIONS / MOTOR DIMENSIONS**

Each system includes a Power Supply, Drive, and Motor.

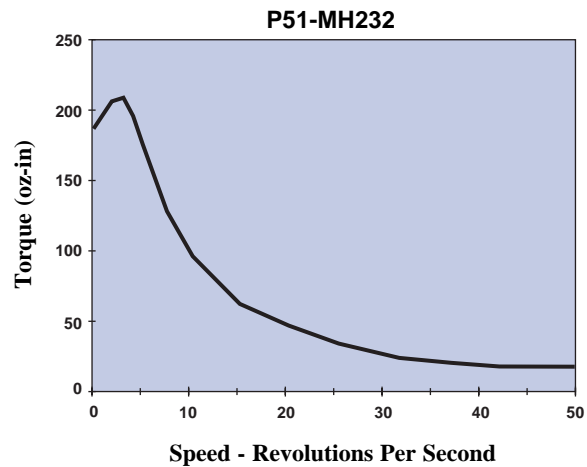
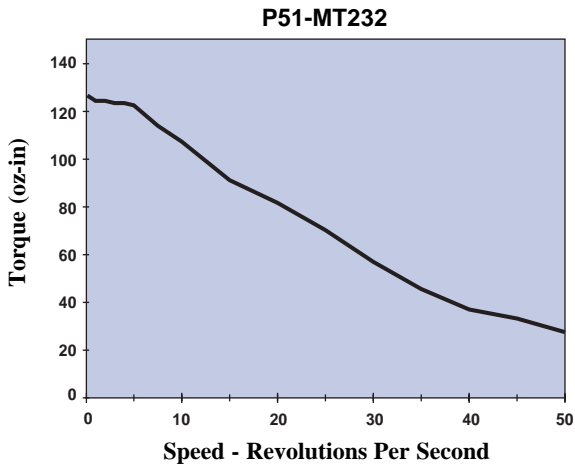
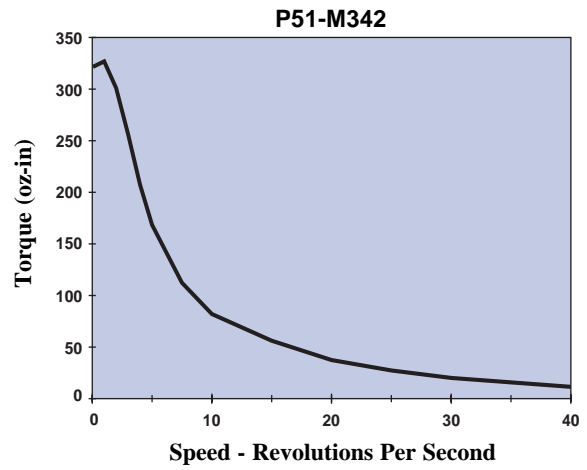
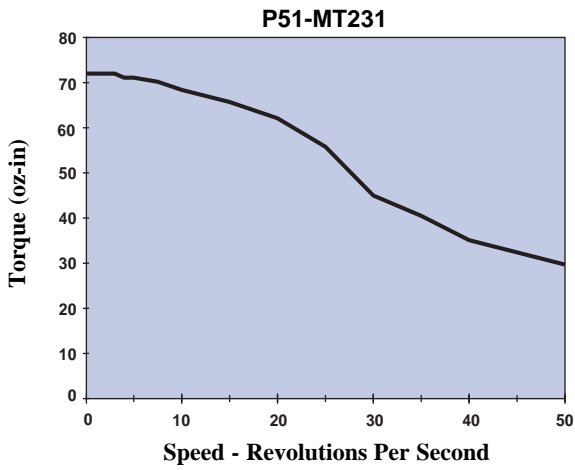
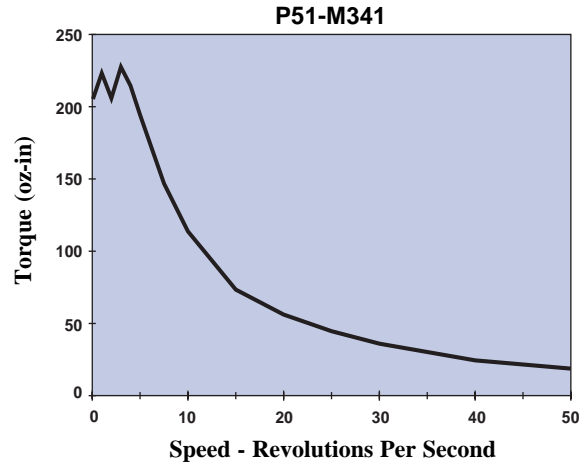
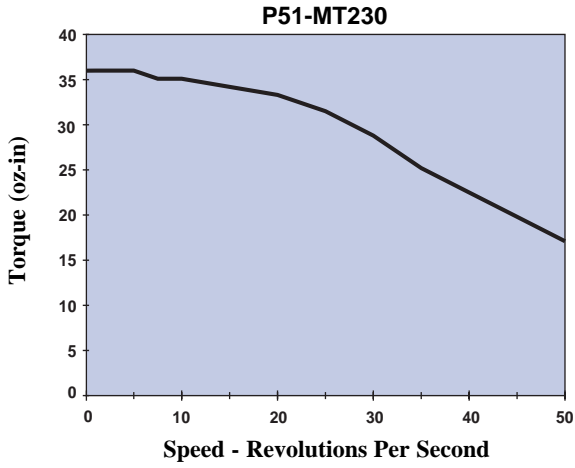
Base System	With Indexer	With Indexer/Encoder	Static Torque Oz-in (N-m)	Motor Width in. (mm)	Motor Length in. (mm)	Motor Model
P51-A231*	P51X-A231*	----	N/A	2.23 (57)	2.00 (51)	A231-08*
P51-M231	P51X-M231	P51X-M231E	60 (0.42)	2.23 (57)	2.00 (51)	M231-08
P51-M232	P51X-M232	P51X-M232E	100 (0.71)	2.23 (57)	3.25 (83)	M232-09
P51-M233	P51X-M233	P51X-M233E	150 (1.06)	2.23 (57)	4.00 (102)	M233-09
P51-M341	P51X-M341	P51X-M341E	150 (1.06)	3.35 (85)	2.45 (62)	M341-09
P51-M342	P51X-M342	P51X-M342E	300 (2.12)	3.35 (85)	3.70 (93)	M342-09
P51-MT230	P51X-MT230	P51X-MT230E	50 (0.35)	2.25 (57)	1.50 (38)	MT230-04
P51-MT231	P51X-MT231	P51X-MT231E	100 (0.71)	2.25 (57)	2.00 (51)	MT231-07
P51-MT232	P51X-MT232	P51X-MT232E	150 (1.06)	2.25 (57)	3.10 (79)	MT232-06
P51-MH232	P51X-MH232	P51X-MH232E	230 (1.62)	2.25 (57)	3.10 (79)	MH232-04

**SPEED/TORQUE CURVES**



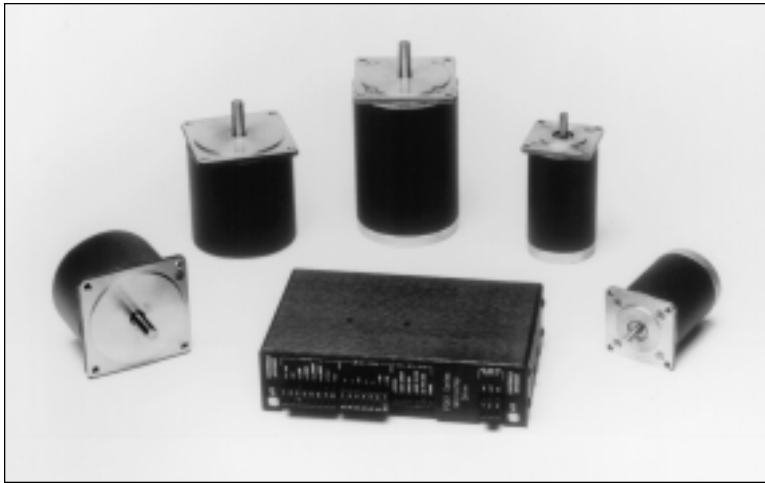
PACKAGED SYSTEMS

SPEED/TORQUE CURVES





# Compact Microstep Systems



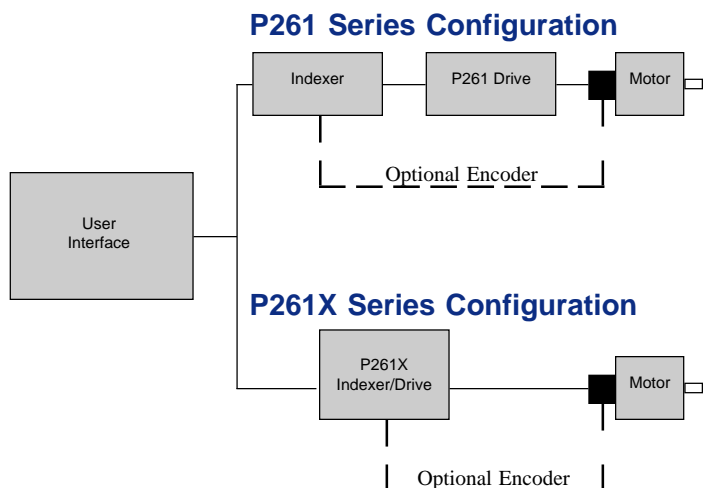
## Common Features

- Torques from 15 to 300 oz-in.
- Speeds to 3,000 RPM continuous.
- Dip switch selectable resolutions up to 50,800 steps per revolution.
- Mid range stabilization prevents loss of motor synchronization.
- Dip switch selectable automatic low power feature.
- Optical isolation of all inputs and outputs provides high noise immunity.
- Full short circuit protection.
- DIP switch selectable current settings from 0.2-5.0 Amps.
- Accepts 95-135 VAC 50/60 Hz input.
- Status/Fault LED indicators.

## Description

The P261 Series of Drives and the P261X Series of Drive/Indexer Systems are compact microstep systems that provide cost effective solutions for most motion control applications. The P261 packaged drive section is a state-of-the-art microstep drive utilizing surface mount technology with the translating and power stages needed to control virtually any hybrid step motor. By combining the ultra efficient MOSFET amplifiers, versatile H-bridge technology, and microprocessor controlled logic, the P261 provides outstanding speed/torque performance.

The P261X Indexer section automatically generates precise ramping routines; interfaces to your environment through the use of RS-232 communications, limit inputs, and programmable I/O; and for applications utilizing encoder capabilities, position maintenance and stall detection are available. Best of all, API's Intelli-Command Language (ICL) indexer software was designed for use by individuals without computer programming experience. Through the use of plain English type commands, your motion application will be up and running quickly, providing you with dividends long before other motion control systems.



## P261X Additional Features:

- Includes a powerful built-in indexer.
- Easy to learn "Plain English" instructions.
- RS-232 communications to 19,200 Baud allows daisy chaining of multiple devices.
- Home, End-of-Travel plus 13 programmable inputs and 8 programmable outputs.
- Encoder capabilities include position maintenance and stall detection for closed loop positioning.
- Built-in editor allows creation of up to 88 different motion programs.

**COMMON SPECIFICATIONS FOR P261 AND P261X:**

<b>DRIVE TYPE</b> .....	2 phase, bipolar, constant current, MOSFET chopper, 20 kHz fixed.
<b>RESOLUTIONS</b> .....	200, 400, 1000, 2000, 5000, 10000, 18000, 20000, 21600, 25000, 25400, 25600, 36000, 50000, 50800.
<b>WAVEFORMS</b> .....	Sine wave. Mid-range stabilization prevents loss of motor synchronization.
<b>POWER</b>	
Inputs .....	90-135 VAC 50/60 Hz, +5vdc for Logic 100mA min.
Output .....	0.2-5.0 amps/phase, dip switch selectable.
<b>PROTECTION</b>	
Short Circuit .....	Phase to phase, phase to ground.
Over Temperature .....	Internal air temp exceeds 140° F (60° C).
<b>FAULT OUTPUT</b> .....	Sinking output to OUTCOM, 5-24 VDC, 35mA max. Disable LED on.
<b>LOW POWER MODE</b>	
Auto Reduce .....	DIP switch enabled. Current drops to 50% of selected value if no step pulses are received in one second.
<b>ENVIRONMENTAL</b>	
Temperature .....	Drive heatsink max. 140° F (60° C); Motor case max. 212° F (100° C); Storage -40° to 185° F (-40° to 85° C)
Humidity .....	0-95%, non-condensing.

**P261 ADDITIONAL SPECIFICATIONS:****INPUTS**

TYPE .....	Optically isolated. TTL compatible.
OPTO IN .....	Optical isolation power. User supplies +5VDC at 100 milliamps min.
STEP .....	Requires 0.5 usec min. width, 1 MHz max. pulse rate, steps on trailing edge.
DIRECTION .....	CW/CCW.
LOW POWER .....	HI/LOPWR. Reduces motor current to 50% of selected value.
NO POWER .....	ENA/NOPWR. Turns off motor current.
RESET .....	RUN/RESET. Resets logic and establishes zero phase condition.

**P261X ADDITIONAL SPECIFICATIONS:****OPERATIONAL**

Acceleration .....	Optimal non-linear mathematical function.
Step Accuracy .....	± 0 steps.
Position Range .....	± 2.1 billion steps.
Speed Range .....	0 to 1,000,000 pulses/second. ± 1% maximum speed.

**COMMUNICATIONS**

Type .....	RS-232C serial, 3 wire implementation (Tx, Rx, Gnd).
Baud Rates .....	1200, 2400, 4800, 9600 and 19200.
Mode .....	Full Duplex.
Format .....	8 data bits; 1 stop bit, no parity; ASCII Characters.
Multi-Axis .....	Daisy chain up to 36 indexers from a single host RS-232C port.

**INPUTS**

Type .....	Optically isolated. TTL or 5-24VDC.
Limits .....	CW, CCW, HOME.
Programmable .....	Thirteen.
Jog, Hold, Stop .....	Software assignable to programmable inputs.
Active State .....	High or low. Software selectable.

**OUTPUTS**

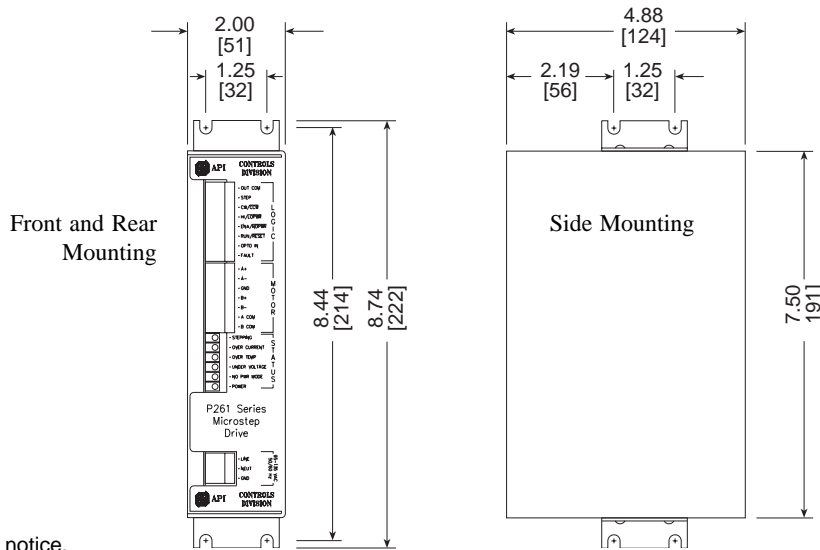
Type .....	Optically isolated. Open collector 5-24VDC, 35 milliamp max.
Fault .....	Overtemp, Undervoltage or Overcurrent.
Programmable .....	Eight. Active high or low. Software selectable.

**ENCODER**

Channels .....	Complementary A & B channel in quadrature with Z (index) channel. Maximum input frequency rate of 256 kHz on A & B Channel (pre-quadrature).
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**DIMENSIONS: P261 SERIES** [-] denotes millimeters

Unit should be mounted vertically with a 3" horizontal and 2" vertical clearance.



Subject to change without notice.

**P261 DRIVE CONNECTIONS/LED'S**

**STATUS LED'S**

STEPPING	1	Motor Stepping
OVER CURRENT	2	Drive Over Current
OVER TEMP	3	Drive Over Temperature
UNDER VOLTAGE	4	Drive Under Voltage
NO PWR MODE	5	Drive in No Power Mode
POWER	6	LED indicating power on

**MOTOR**

A+	1	Motor Phase A+
A-	2	Motor Phase A-
GND	3	Motor Phase Ground
B+	4	Motor Phase B+
B-	5	Motor Phase B-
A COM	6	Motor Phase A Common
B COM	7	Motor Phase B Common

**DRIVE/LOGIC**

OUT COM	1	Output Common
STEP	2	Step Signal
CW/CCW	3	Direction Signal
HI/LOPWR	4	High/Low Power Signal
ENA/NOPWR	5	Enable/No Power Signal
RUN/RESET	6	Run/Reset
OPTO IN	7	Opto Input (5VDC)
FAULT	8	Fault Output (5-24 VDC)

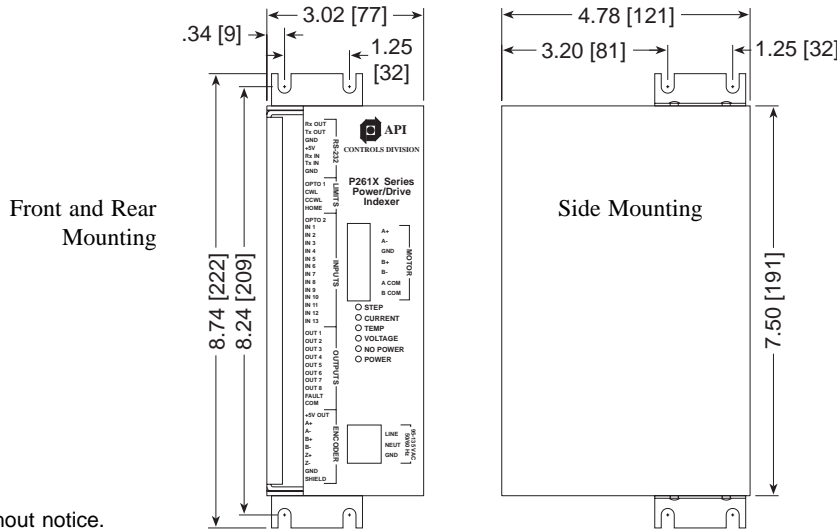
**AC POWER**

LINE	1	AC Input Black Wire (Line)
NEUT	2	AC Input White Wire (Neutral)
GND	3	AC Input Green Wire (Ground)

PACKAGED SYSTEMS

**DIMENSIONS: P261X SERIES** [-] denotes millimeters

Unit should be mounted vertically with a 3" horizontal and 2" vertical clearance.



Subject to change without notice.

**P261X DRIVE CONNECTIONS/LED'S**

**STATUS LED'S**

STEP	1	Motor Stepping
CURRENT	2	Drive Over Current
TEMP	3	Drive Over Temperature
VOLTAGE	4	Drive Under Voltage
NO PWR	5	Drive in No Power Mode
POWER	6	LED indicating power on

**RS-232**

Rx OUT	1	Receive Out
Tx OUT	2	Transmit Out
GND OUT	3	Ground Out
+5V OUT	4	+5V Out
Rx IN	5	Receive In
Tx IN	6	Transmit In
GND IN	7	Ground In

**LIMITS**

OPTO 1	1	Optical Isolation Input (5-24VDC)
CWL	2	Clockwise Travel Limit
CCWL	3	Counter Clockwise Travel Limit
HOME	4	Home Position Reference Input

**INPUTS**

OPTO 2	1	Optical Isolation Input (5-24VDC)
IN 1	2	Programmable Input #1
IN 2	3	Programmable Input #2
IN 3	4	Programmable Input #3
IN 4	5	Programmable Input #4
IN 5	6	Programmable Input #5
IN 6	7	Programmable Input #6
IN 7	8	Programmable Input #7
IN 8	9	Programmable Input #8
IN 9	10	Programmable Input #9
IN 10	11	Programmable Input #10
IN 11	12	Programmable Input #11
IN 12	13	Programmable Input #12
IN 13	14	Programmable Input #13

**OUTPUTS**

OUT 1	1	Programmable Output #1
OUT 2	2	Programmable Output #2
OUT 3	3	Programmable Output #3
OUT 4	4	Programmable Output #4
OUT 5	5	Programmable Output #5
OUT 6	6	Programmable Output #6
OUT 7	7	Programmable Output #7
OUT 8	8	Programmable Output #8
FAULT	9	Fault Output
OUT COM	10	Reference Ground For Outputs

**ENCODER**

+5V	1	5VDC Supply to Encoder
A+	2	TTL Diff. Signal From Ch. A+
A-	3	TTL Diff. Signal From Ch. A-
B+	4	TTL Diff. Signal From Ch. B+
B-	5	TTL Diff. Signal From Ch. B-
Z+	6	TTL Diff. Signal From Ch. Z+
Z-	7	TTL Diff. Signal From Ch. Z-
GND	8	Encoder Ground
SHIELD	9	Shield Connection to Encoder

**MOTOR**

A+	1	Motor Phase A+
A-	2	Motor Phase A-
GND	3	Motor Phase Ground
B+	4	Motor Phase B+
B-	5	Motor Phase B-
A COM	6	Motor Phase A Common
B COM	7	Motor Phase B Common

**AC POWER**

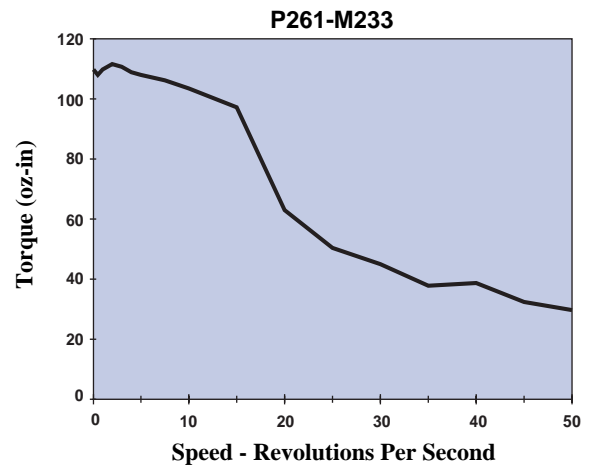
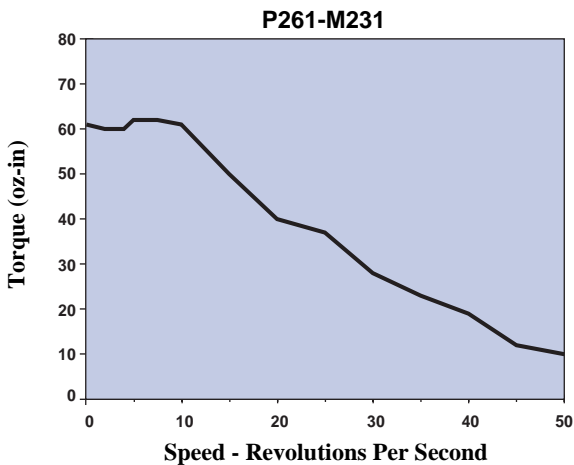
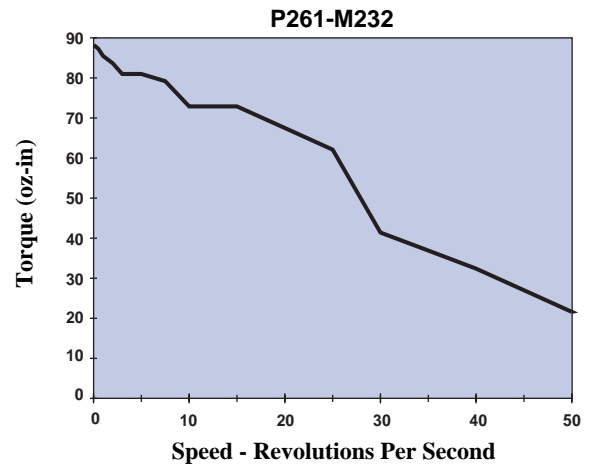
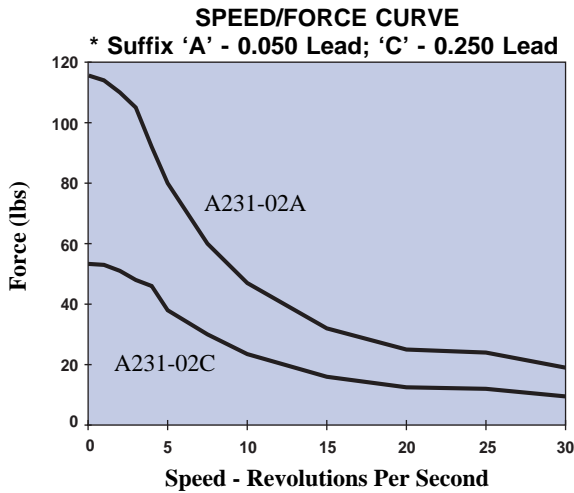
LINE	1	AC Input Black Wire (Line)
NEUT	2	AC Input White Wire (Neutral)
GND	3	AC Input Green Wire (Ground)

**SYSTEM SELECTIONS / MOTOR DIMENSIONS**

Each system includes a Power Supply, Drive, and Motor.

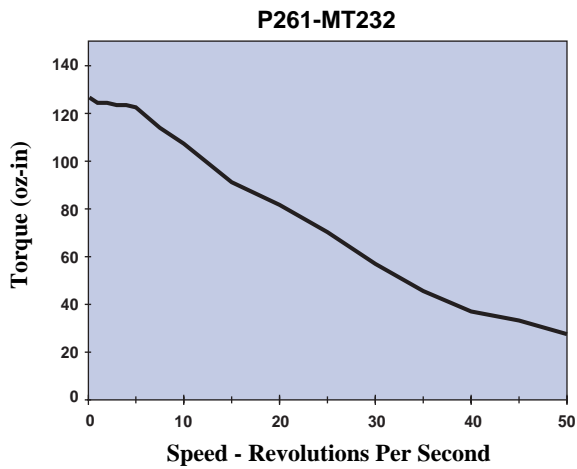
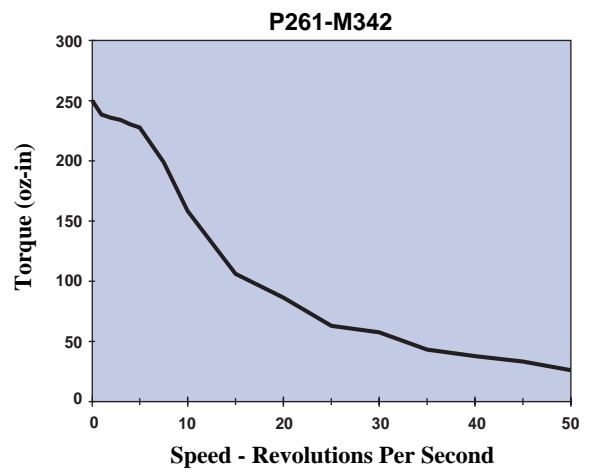
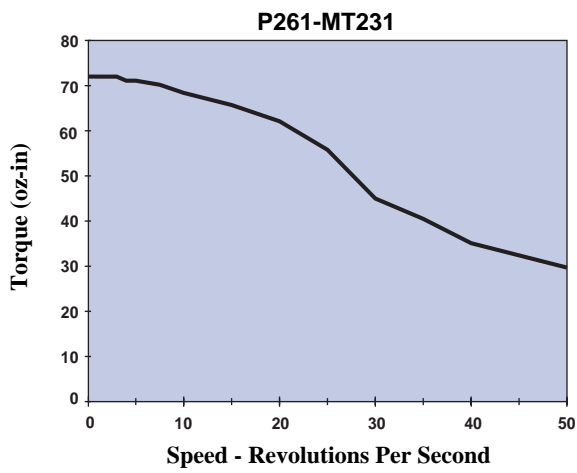
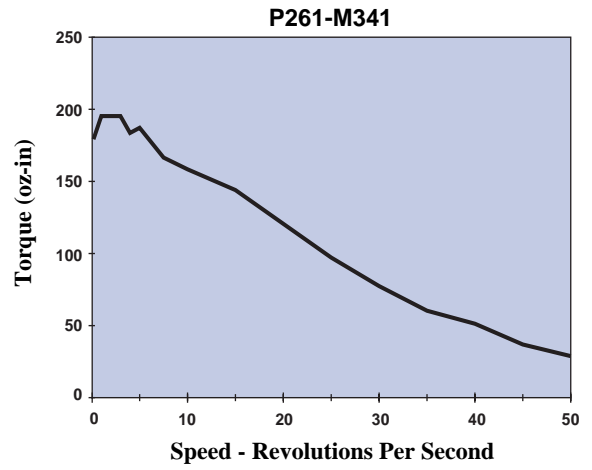
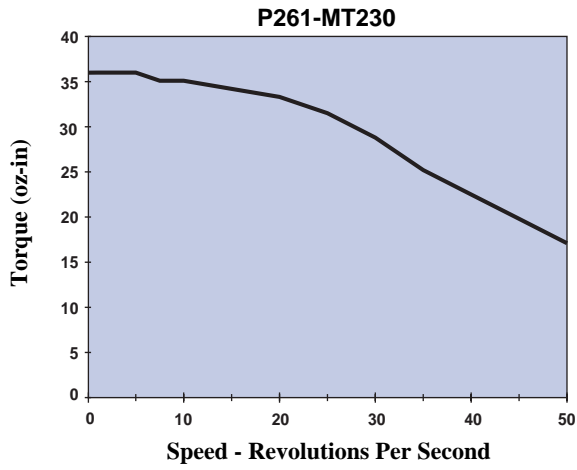
Base System	With Indexer	With Indexer/Encoder	Static Torque Oz-in (N-m)	Motor Width in. (mm)	Motor Length in. (mm)	Motor Model
P261-A231*	P261X-A231*	----	N/A	2.23 (57)	2.00 (51)	A231-02*
P261-M231	P261X-M231	P261X-M231E	60 (0.42)	2.23 (57)	2.00 (51)	M231-03
P261-M232	P261X-M232	P261X-M232E	100 (0.71)	2.23 (57)	3.25 (83)	M232-09
P261-M233	P261X-M233	P261X-M233E	150 (1.06)	2.23 (57)	4.00 (102)	M233-09
P261-M341	P261X-M341	P261X-M341E	150 (1.06)	3.25 (83)	2.45 (62)	M341-09
P261-M342	P261X-M342	P261X-M342E	300 (2.12)	3.25 (83)	3.70 (93)	M342-09
P261-MT230	P261X-MT230	P261X-MT230E	50 (0.35)	2.25 (57)	1.50 (38)	MT230-04
P261-MT231	P261X-MT231	P261X-MT231E	100 (0.71)	2.25 (57)	2.00 (51)	MT231-07
P261-MT232	P261X-MT232	P261X-MT232E	150 (1.06)	2.25 (57)	3.00 (76)	MT232-06

**SPEED/TORQUE CURVES**

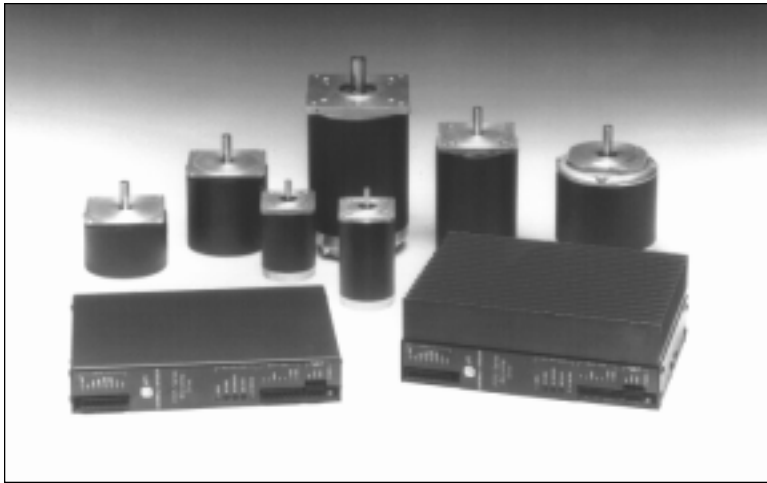


**PACKAGED SYSTEMS**

**SPEED/TORQUE CURVES**



# High Performance Microstep Systems



## Common Features

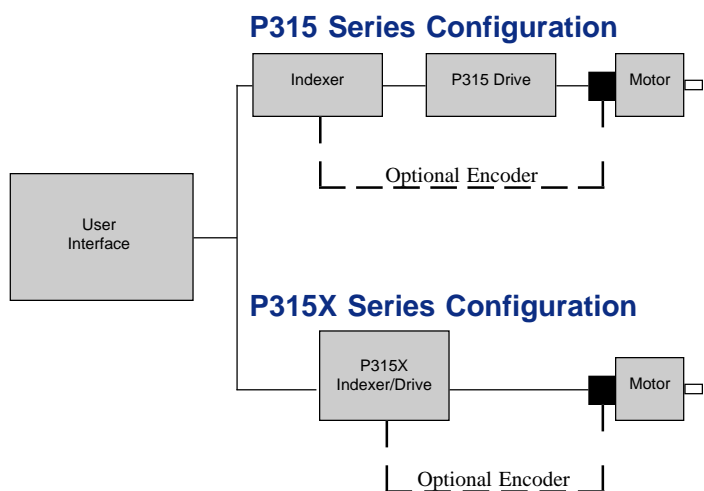
- Torques from 65 to 3,000 oz-in. with speeds to 3,000 RPM continuous.
- Dip switch selectable resolutions up to 50,800 steps per revolution.
- Mid range stabilization prevents loss of motor synchronization.
- Dip switch selectable automatic low power feature.
- Optical isolation of all inputs and output provides high noise immunity.
- Full short circuit protection.
- DIP switch selectable current settings from 0.2-8.2 Amps.
- Accepts 95-135 VAC 50/60 Hz input.
- Status/Fault LED indicators.
- Optional maximum power P315-P with fan kit.

## Description

The P315 Series of Drives and the P315X Series of Drive/Indexer Systems provide high torque, high speed and high resolution to help you solve your most demanding motion control applications.

The P315 packaged drive section is a state-of-the-art microstep drive with the translating and power stages needed to control virtually any hybrid step motor. By combining the ultra efficient MOSFET amplifiers, versatile H-bridge technology, and microprocessor controlled logic, the P315 provides outstanding speed/torque performance.

The P315X Indexer section automatically generates precise ramping routines; interfaces to your environment through the use of RS-232 communications, limit inputs, and programmable I/O; and for applications utilizing encoder capabilities, position maintenance and stall detection are available. Best of all, API's Intelli-Command Language (ICL) indexer software was designed for use by individuals without computer programming experience. Through the use of plain English type commands, your motion application will be up and running quickly, providing you with dividends long before other motion control systems.



## P315X Additional Features:

- Includes a powerful built-in indexer.
- Easy to learn "Plain English" instructions.
- RS-232 communications to 19,200 Baud allows daisy chaining of multiple devices.
- Home, End-of-Travel plus 13 programmable inputs and 8 programmable outputs.
- Encoder capabilities include position maintenance and stall detection for closed loop positioning.
- Built-in editor allows creation of up to 88 different motion programs.



**COMMON SPECIFICATIONS FOR P315 AND P315X:**

<b>DRIVE TYPE</b> .....	2 phase, bipolar, constant current, MOSFET chopper, 20 KHz fixed.
<b>RESOLUTIONS</b> .....	200, 400, 1000, 2000, 5000, 10000, 18000, 20000, 21600, 25000, 25400, 25600, 36000, 50000, 50800.
<b>WAVEFORMS</b> .....	Switch selectable microstep shaping. Pure Sine; $\pm 2\%$ , $\pm 5\%$ , or $-8\%$ 3rd harmonic included. Mid-Range stabilization prevents loss of motor synchronization.
<b>POWER</b>	
Inputs .....	90-135 VAC 50/60 Hz, +5VDC for Logic 100mA min.
Output .....	P315-L 0.2-6.2 amps/phase. P315-H and P315-P 2.0-8.2 amps/phase. Dip switch selectable.
<b>PROTECTION</b>	
Short Circuit .....	Phase to phase, phase to ground.
Over Temperature .....	Internal air temp exceeds 140° F (60° C).
Fan Kit .....	Optional fan kit available (FK-P315).
<b>FAULT OUTPUT</b> .....	Sinking output to OUTCOM, 5-24 VDC, 60mA max. Disable LED on.
<b>LOW POWER MODE</b>	
Auto Reduce .....	DIP switch enabled. Current drops to 50% of selected value if no step pulses are received in one second.
<b>ENVIRONMENTAL</b>	
Temperature .....	Drive heatsink max. 140° F (60° C); Motor case max. 212° F (100° C); Storage -40° to 185° F (-40° to 85° C)
Humidity .....	0-95%, non-condensing.

**P315 ADDITIONAL SPECIFICATIONS:****INPUTS**

TYPE .....	Optically isolated. TTL compatible.
OPTO IN .....	Optical isolation power. User supplies +5VDC at 100 milliamps min.
STEP .....	Requires 0.5 microsecond minimum width, 1 MHz max. pulse rate, steps on trailing edge.
DIRECTION .....	CW/CCW.
LOW POWER .....	HI/LOPWR. Reduces motor current to 50% of selected value.
NO POWER .....	ENA/NOPWR. Turns off motor current.
RESET .....	RUN/RESET. Resets logic and establishes zero phase condition.

**P315X ADDITIONAL SPECIFICATIONS:****OPERATIONAL**

Acceleration .....	Optimal non-linear mathematical function.
Step Accuracy .....	$\pm 0$ steps.
Position Range .....	$\pm 2.1$ billion steps.
Speed Range .....	0 to 750,000 pulses/second. $\pm 1\%$ maximum speed.

**COMMUNICATIONS**

Type .....	RS-232C serial, 3 wire implementation (Tx, Rx, Gnd).
Baud Rates .....	1200, 2400, 4800, 9600 and 19200.
Mode .....	Full Duplex.
Format .....	8 data bits; 1 stop bit, no parity; ASCII Characters.
Multi-Axis .....	Daisy chain up to 36 indexers from a single host RS-232C port.

**INPUTS**

Type .....	Optically isolated, 5-24VDC, (P315X-L: 5-15VDC).
Limits .....	CW, CCW, HOME.
Programmable .....	Thirteen.
Jog, Hold, Stop .....	Software assignable to programmable inputs.
Active State .....	High or low. Software selectable.

**OUTPUTS**

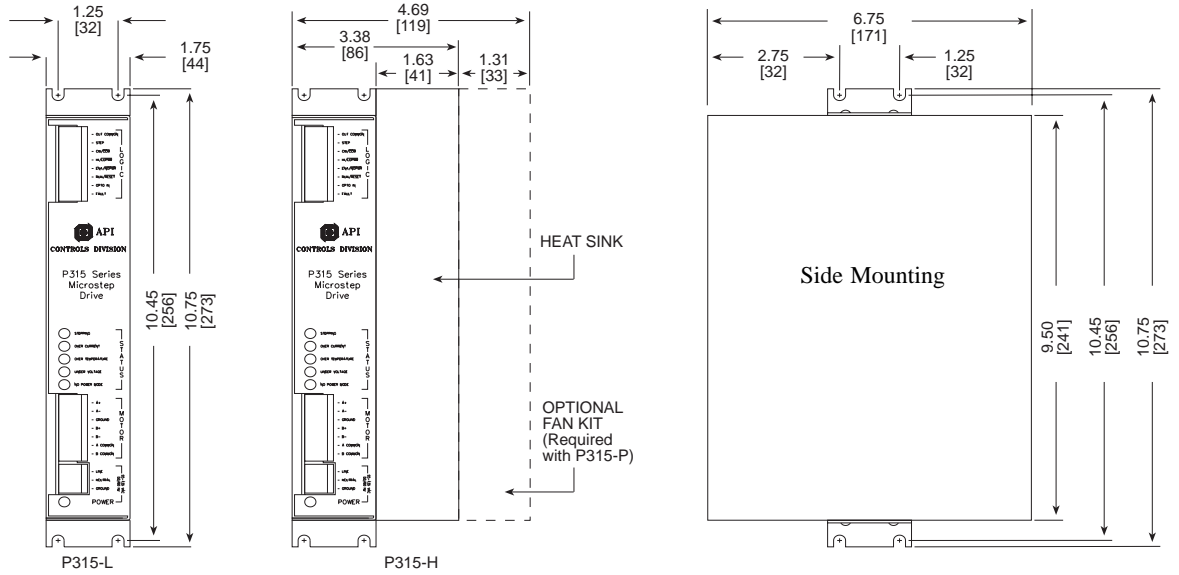
Type .....	Optically isolated. Open collector 5-24VDC, (P315X-L: 5-15VDC), 25 milliamp max.
Fault .....	Overtemp, Undervoltage or Overcurrent.
Programmable .....	Eight. Active high or low. Software selectable.

**ENCODER**

Channels .....	Complementary A & B Channel in quadrature with Z (index) channel. Maximum input frequency rate of 256 kHz on A & B Channel (pre-quadrature).
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**DIMENSIONS: P315 SERIES** [-] denotes millimeters

Unit should be mounted vertically with a 3" horizontal and 2" vertical clearance.



Subject to change without notice.

**P315 DRIVE CONNECTIONS/LED'S**

**STATUS LED'S**

STEP	1	Motor Stepping
CURRENT	2	Drive Over Current
TEMP	3	Drive Over Temperature
VOLTAGE	4	Drive Under Voltage
NO PWR	5	Drive in No Power Mode
POWER	6	LED indicating power on

**MOTOR**

A+	1	Motor Phase A+
A-	2	Motor Phase A-
GND	3	Motor Phase Ground
B+	4	Motor Phase B+
B-	5	Motor Phase B-
A COM	6	Motor Phase A Common
B COM	7	Motor Phase B Common

**DRIVE/LOGIC**

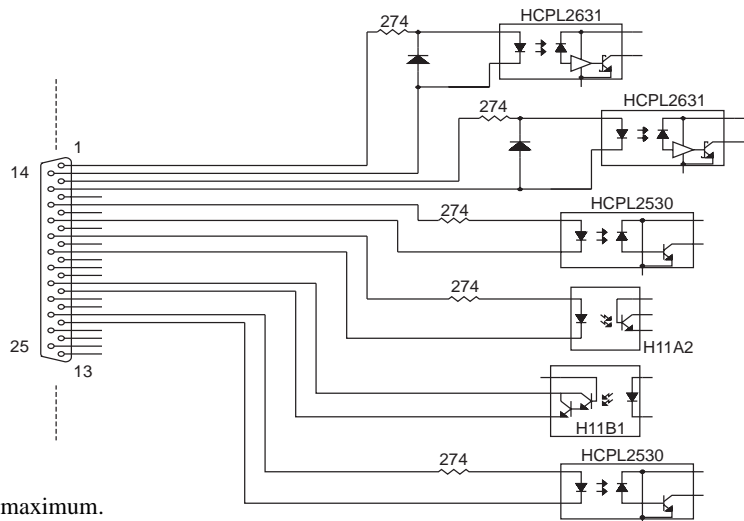
OUT COM	1	Output Common
STEP	2	Step Signal
CW/CCW	3	Direction Signal
HI/LOPWR	4	High/Low Power Signal
ENA/NOPWR	5	Enable/No Power Signal
RUN/RESET	6	Run/Reset
OPTO IN	7	Opto Input (5VDC)
FAULT	8	Fault Output (5-24 VDC)

**AC POWER**

LINE	1	AC Input Black Wire (Line)
NEUT	2	AC Input White Wire (Neutral)
GND	3	AC Input Green Wire (Ground)

**OPTIONAL DB-25 CONNECTOR**

- 1. (+) STEP
- 2. (+) DIRECTION
- 9. FAULT COLL.
- 11. (+) RESET
- 14. (-) STEP
- 15. (-) DIRECTION
- 16. (+) SHUTDOWN
- 17. (-) SHUTDOWN
- 18. (-) LOW PWR
- 19. (+) LOW PWR
- 21. FAULT EMIT.
- 23. (-) RESET

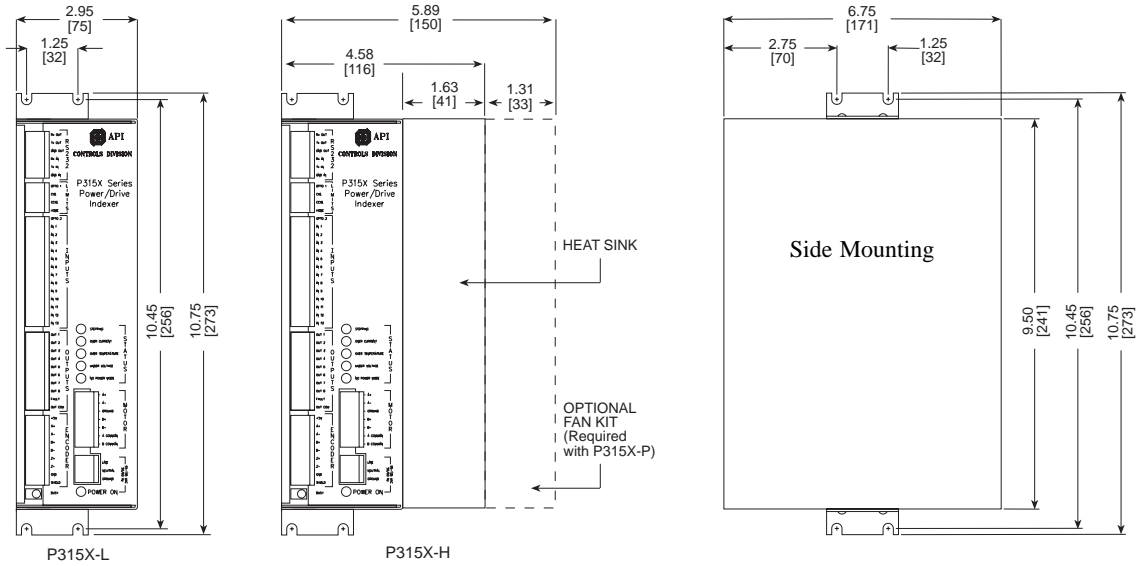


Note: DB25 Input is 15mA maximum.

PACKAGED SYSTEMS

**DIMENSIONS: P315X SERIES** [-] denotes millimeters

Unit should be mounted vertically with a 3" horizontal and 2" vertical clearance.



Subject to change without notice.

**P315X DRIVE CONNECTIONS/LED'S**

**STATUS LED'S**

STEP	1	Motor Stepping
CURRENT	2	Drive Over Current
TEMP	3	Drive Over Temperature
VOLTAGE	4	Drive Under Voltage
NO PWR	5	Drive in No Power Mode
POWER	6	LED indicating power on

**RS-232**

Rx OUT	1	Receive Out
Tx OUT	2	Transmit Out
GND OUT	3	Ground Out
Rx IN	4	Receive In
Tx IN	5	Transmit In
GND IN	6	Ground In

**LIMITS**

OPTO 1	1	Optical Isolation Input (5-24VDC)
CWL	2	Clockwise Travel Limit
CCWL	3	Counter Clockwise Travel Limit
HOME	4	Home Position Reference Input

**INPUTS**

OPTO 2	1	Optical Isolation Input (5-24VDC)
IN 1	2	Programmable Input #1
IN 2	3	Programmable Input #2
IN 3	4	Programmable Input #3
IN 4	5	Programmable Input #4
IN 5	6	Programmable Input #5
IN 6	7	Programmable Input #6
IN 7	8	Programmable Input #7
IN 8	9	Programmable Input #8
IN 9	10	Programmable Input #9
IN 10	11	Programmable Input #10
IN 11	12	Programmable Input #11
IN 12	13	Programmable Input #12
IN 13	14	Programmable Input #13

**OUTPUTS**

OUT 1	1	Programmable Output #1
OUT 2	2	Programmable Output #2
OUT 3	3	Programmable Output #3
OUT 4	4	Programmable Output #4
OUT 5	5	Programmable Output #5
OUT 6	6	Programmable Output #6
OUT 7	7	Programmable Output #7
OUT 8	8	Programmable Output #8
FAULT	9	Fault Output
OUT COM	10	Reference Ground For Outputs

**ENCODER**

+5V	1	5VDC Supply to Encoder
A+	2	TTL Diff. Signal From Ch. A+
A-	3	TTL Diff. Signal From Ch. A-
B+	4	TTL Diff. Signal From Ch. B+
B-	5	TTL Diff. Signal From Ch. B-
Z+	6	TTL Diff. Signal From Ch. Z+
Z-	7	TTL Diff. Signal From Ch. Z-
GND	8	Encoder Ground
SHIELD	9	Shield Connection to Encoder

**MOTOR**

A+	1	Motor Phase A+
A-	2	Motor Phase A-
GND	3	Motor Phase Ground
B+	4	Motor Phase B+
B-	5	Motor Phase B-
A COM	6	Motor Phase A Common
B COM	7	Motor Phase B Common

**AC POWER**

LINE	1	AC Input Black Wire (Line)
NEUT	2	AC Input White Wire (Neutral)
GND	3	AC Input Green Wire (Ground)

**SYSTEM SELECTIONS / MOTOR DIMENSIONS**

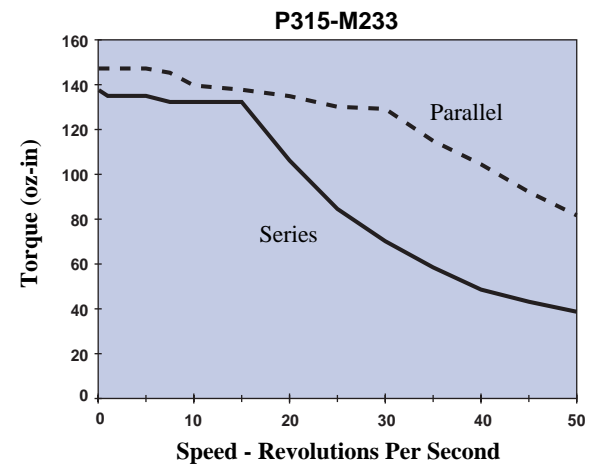
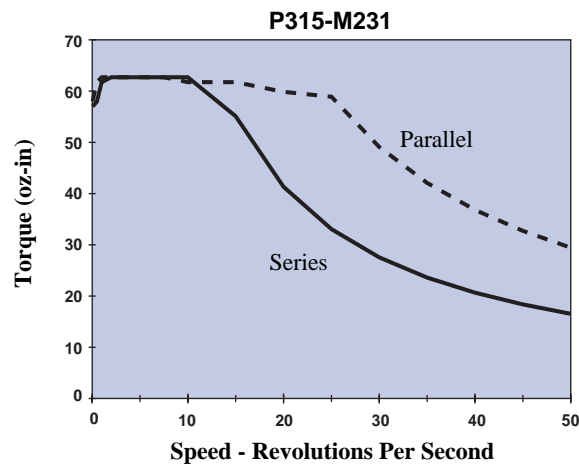
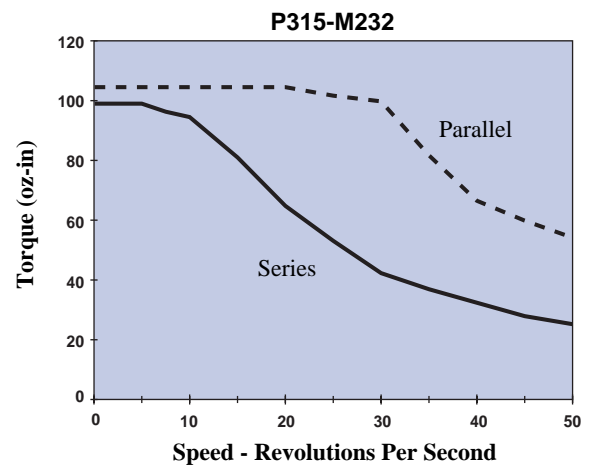
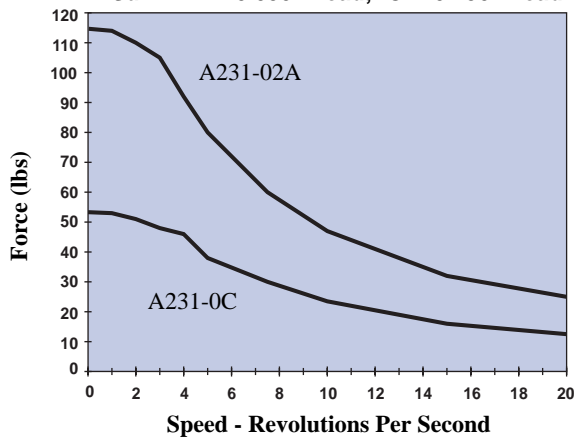
Each system includes a Power Supply, Drive, and Motor.

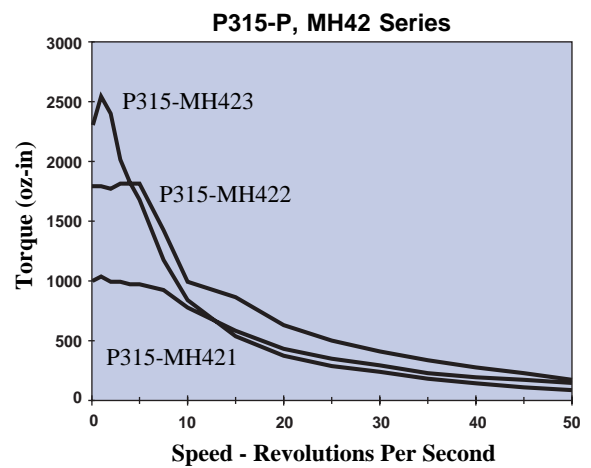
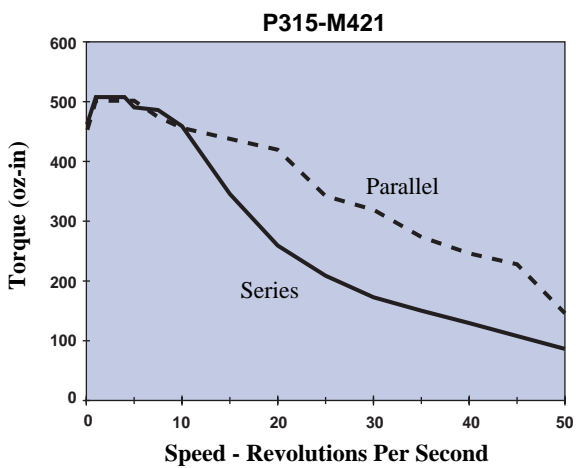
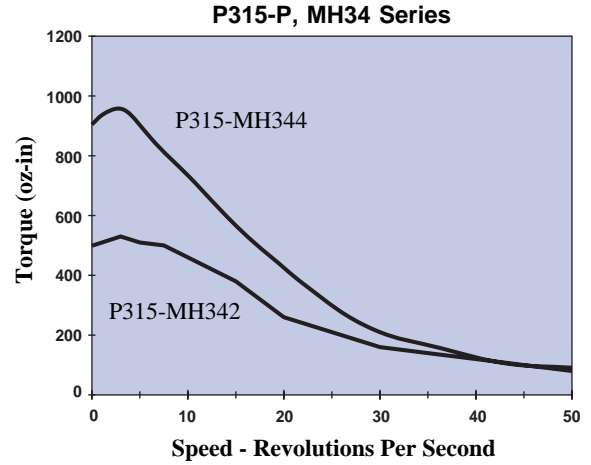
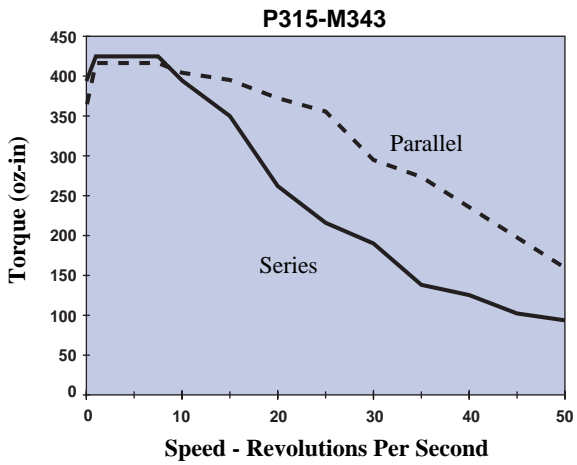
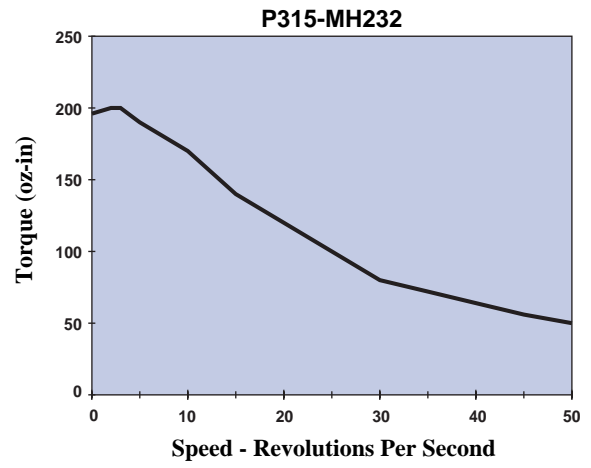
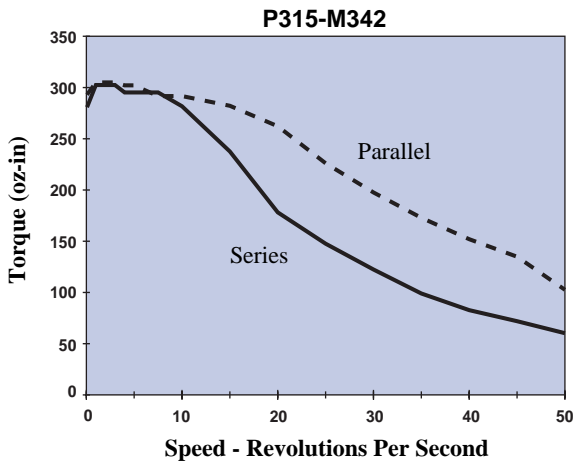
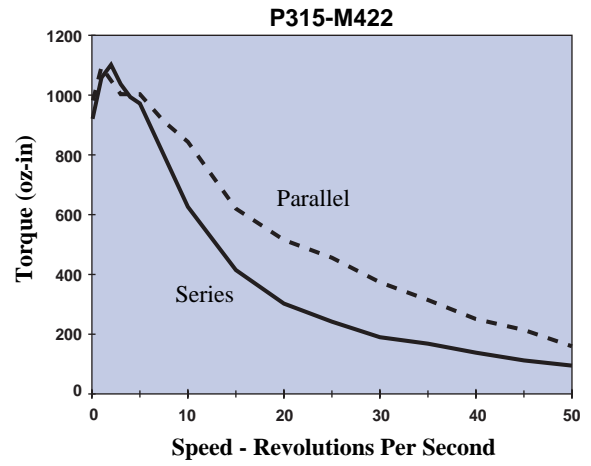
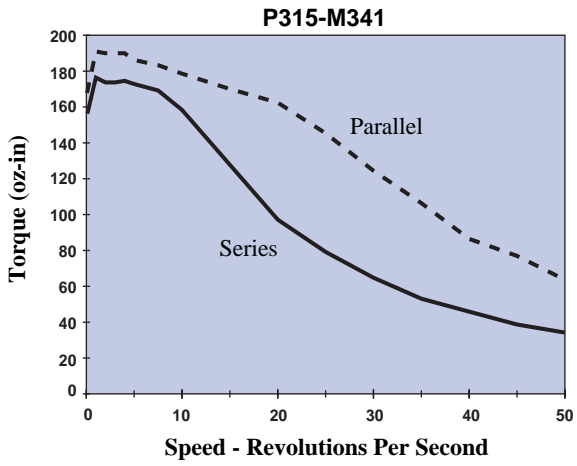
Base System	With Indexer	With Indexer/Encoder	Static Torque Oz-in (N-m)	Motor Width in. (mm)	Motor Length in. (mm)	Drive Version	Motor Model
P315-A231*	P315X-A231*	----	N/A	2.23 (57)	2.00 (51)	P315-L	A231-02*
P315-M231	P315X-M231	P315X-M231E	60 (0.42)	2.23 (57)	2.00 (51)	P315-L	M231-02
P315-M232	P315X-M232	P315X-M232E	100 (0.71)	2.23 (57)	3.25 (83)	P315-L	M232-04
P315-M233	P315X-M233	P315X-M233E	150 (1.06)	2.23 (57)	4.00 (102)	P315-L	M233-06
P315-M341	P315X-M341	P315X-M341E	150 (1.06)	3.25 (83)	2.45 (62)	P315-L	M341-06
P315-M342	P315X-M342	P315X-M342E	300 (2.12)	3.25 (83)	3.70 (93)	P315-H	M342-09
P315-M343	P315X-M343	P315X-M343E	450 (3.18)	3.25 (83)	5.31 (135)	P315-H	M343-11
P315-M421	P315X-M421	P315X-M421E	650 (4.59)	4.20 (106)	4.74 (120)	P315-H	M421-12
P315-M422	P315X-M422	P315X-M422E	1100 (7.77)	4.20 (106)	7.00 (178)	P315-H	M422-12
P315-MH232	P315X-MH232	P315X-MH232E	230 (1.62)	2.25 (57)	3.10 (79)	P315-L	MH232-04
P315-MH342	P315X-MH342	P315X-MH342E	650 (4.59)	3.38 (86)	4.77 (121)	P315-P	MH342-10
P315-MH344	P315X-MH344	P315X-MH344E	1150 (8.12)	3.38 (86)	7.62 (194)	P315-P	MH344-11
P315-MH421	P315X-MH421	P315X-MH421E	1200 (8.47)	4.28 (108)	6.20 (158)	P315-P	MH421-11
P315-MH422	P315X-MH422	P315X-MH422E	2400 (16.95)	4.28 (108)	8.63 (219)	P315-P	MH422-16
P315-MH423	P315X-MH423	P315X-MH423E	3600 (25.42)	4.28 (108)	11.15 (248)	P315-P	MH423-16

PACKAGED SYSTEMS

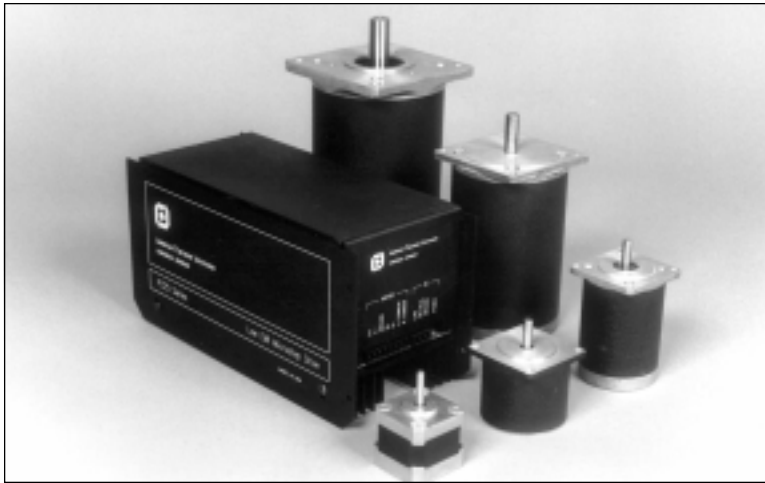
**SPEED/FORCE CURVE**

\* Suffix 'A' - 0.050" Lead; 'C' - 0.250" Lead





# Low EMI Microstep Systems



## Common Features

- Torques from 20 to 300 oz-in.
- Step resolutions up to 50,000 steps per revolution.
- Bi-level drive technique - generates minimum electrical noise.
- Factory configurable for 115 or 230 VAC input.
- Fuse overload protection.
- DIP switch selectable current settings from 0.9-3.5 Amp.
- Packaged with motor, drive, linear power supply and heatsinks.
- Optional DB-25 logic connector (P325-DB25).

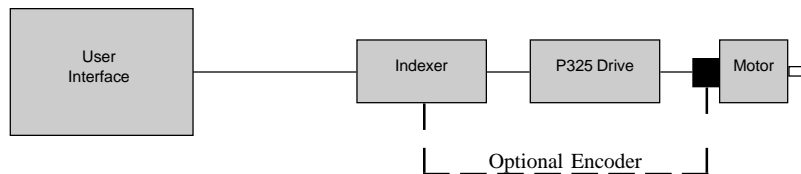
## Description

The P325 Series linear power supply and bi-level voltage drive technique generates a minimum of electromagnetic interference (EMI), while still offering outstanding speed/torque performance. Another key element is microstepping, a technique where each mechanical full step of the motor is electrically broken down into many finer steps. The use of finer steps smooths out low speed jitter, minimizes resonances, improves positioning ability and reduces audible noise.

Each package includes a motor, drive, linear power supply, integral heatsink, power cord and plug type connectors for quick and simple installation.

To begin operation the user needs to couple the motor to the load, plug-in to AC power source and provide control signals to operate the system. The P325 Series package provides the user the flexibility to select the best control option for the application.

## P325 Series Configuration



**COMMON SPECIFICATIONS FOR P325:**

**DRIVE TYPE** ..... 4 phase, unipolar, linear FET.

**RESOLUTIONS** ..... 800, 1600, 3200, 6400, 12800, 25000, 25600.  
50,000 is special and not available with the other resolutions. (P325-50K)

**WAVEFORMS** ..... Switch selectable current profile settings.

**POWER**

Inputs ..... 115 or 230 VAC 50/60 Hz factory set, +5VDC for Logic 100mA min.  
Output ..... 0.9-3.5 amps/phase.  
Dip switch selectable.

**PROTECTION** ..... Fuse overload.

**LOW POWER MODE** ..... Selectable utilizing the High/Low power signal input line. Current drops to 33% of selected value.

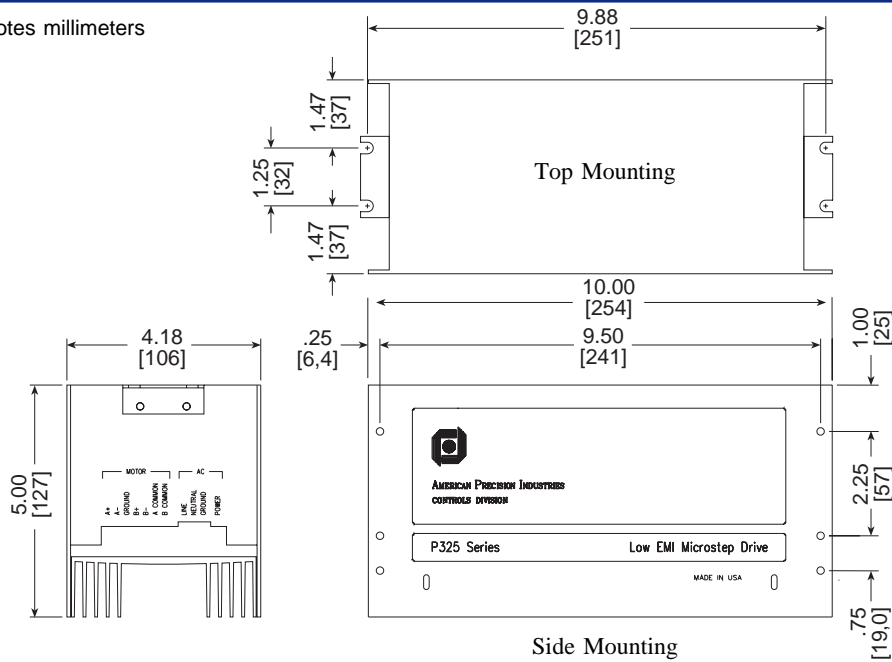
**ENVIRONMENTAL**

Temperature ..... Drive heatsink max. 140° F (60° C); Motor case max. 212° F (100° C);  
Storage -40° to 185° F (-40° to 85° C)  
Humidity ..... 0-95%, non-condensing.

**P325 ADDITIONAL SPECIFICATIONS:****INPUTS**

TYPE ..... Optically isolated. TTL compatible.  
OPTO IN ..... Optical isolation power. User supplies +5VDC at 100 milliamps min.  
STEP ..... Requires 0.5 microsecond minimum width, 1 MHz max. pulse rate, steps on trailing edge.  
DIRECTION ..... CW/CCW.  
LOW POWER ..... HI/LOPWR. Reduces motor current to 33% of selected value.  
NO POWER ..... ENA/NOPWR. Turns off motor current.

**P325 DIMENSIONS:** [-] denotes millimeters



Subject to change without notice.

**P325 CONNECTIONS/LED**

**DRIVE/LOGIC**

GROUND	⊖	1	+5VDC Ground
STEP	⊙	2	Step Signal
CW/CCW	⊙	3	Direction Signal
HI/LOPWR	⊖	4	High/Low Power Signal
ENA/NOPWR	⊙	5	Enable/No Power Signal
NC	⊙	6	No Connection
OPTO IN	⊙	7	Opto Input (5VDC)
+5V OUT	⊖	8	+5VDC Output

**MOTOR**

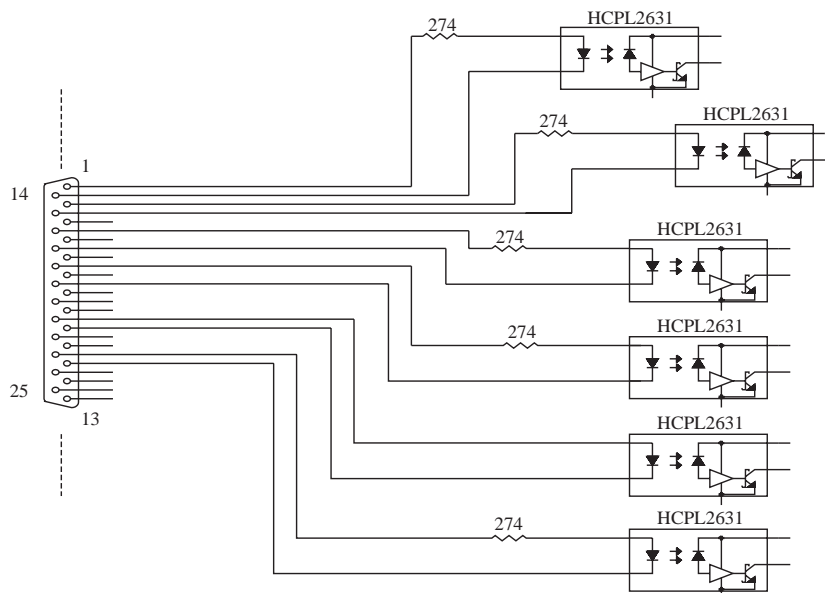
A+	⊙	1	Motor Phase A+
A-	⊙	2	Motor Phase A-
GROUND	⊖	3	Motor Phase Ground
B+	⊙	4	Motor Phase B+
B-	⊙	5	Motor Phase B-
A COMMON	⊙	6	Motor Phase A Common
B COMMON	⊖	7	Motor Phase B Common

**AC POWER**

LINE	⊖	1	AC Input Black Wire (Line)
NEUTRAL	⊙	2	AC Input White Wire (Neutral)
GROUND	⊖	3	AC Input Green Wire (Ground)
POWER	⊙		LED indicating power on

**OPTIONAL DB-25 CONNECTOR**

- 1 - (+) STEP
- 2 - (-) DIRECTION
- 5, 6 - GROUND
- 10, 22 - +5V OUT
- 11 - OPTO IN
- 14 - (-) STEP
- 15 - (-) DIRECTION
- 16 - (+) SHUTDOWN
- 17 - (-) SHUTDOWN
- 18 - (-) LOW POWER
- 19 - (+) LOW POWER
- 23 - N.C.



PACKAGED SYSTEMS



**SYSTEM SELECTIONS / MOTOR DIMENSIONS**

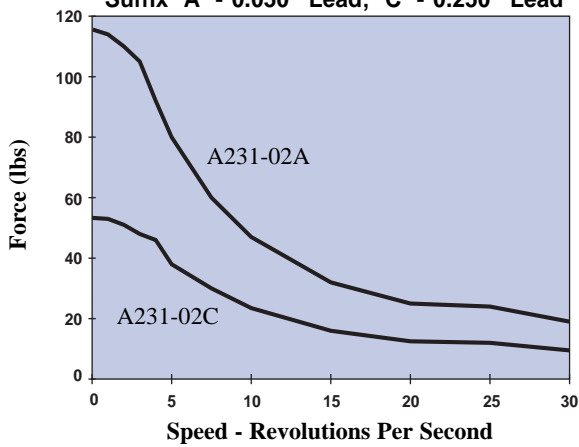
Each system includes a Power Supply, Drive, and Motor.

Base System	Static Torque Oz-in (N-m)	Motor Width in. (mm)	Motor Length in. (mm)	Motor Model
P325-A231*	N/A	2.23 (57)	2.00 (51)	A231-02*
P325-M161	15 (0.11)	1.60 (39)	1.34 (34)	M161-02
P325-M162	25 (0.18)	1.60 (39)	1.54 (39)	M162-03
P325-M231	55 (0.42)	2.23 (57)	2.00 (51)	M231-02
P325-M232	90 (0.71)	2.23 (57)	3.25 (83)	M232-04
P325-M233	120 (1.06)	2.23 (57)	4.00 (102)	M233-06
P325-M341	150 (1.06)	3.25 (83)	2.45 (62)	M341-06
P325-M342	300 (2.12)	3.25 (83)	3.70 (93)	M342-08

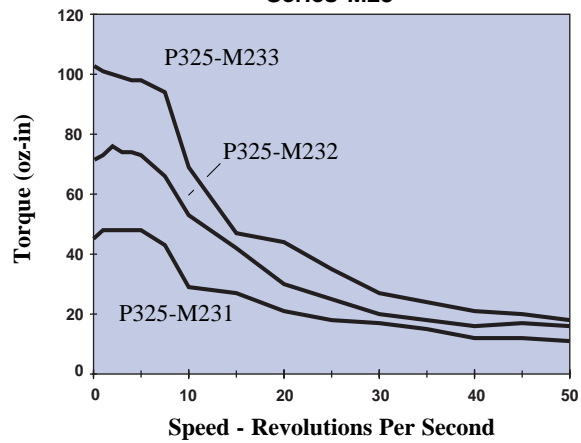
**SPEED/TORQUE CURVES**

**SPEED/FORCE CURVE**

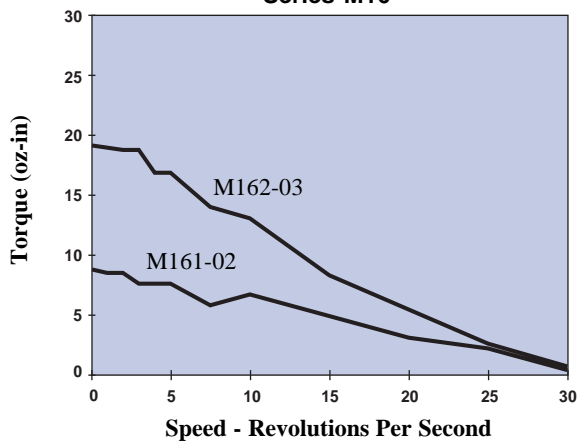
\*Suffix 'A' - 0.050" Lead; 'C' - 0.250" Lead



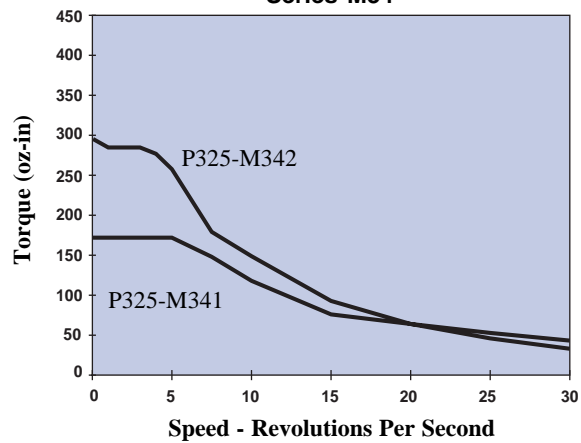
**Series M23**



**Series M16**



**Series M34**

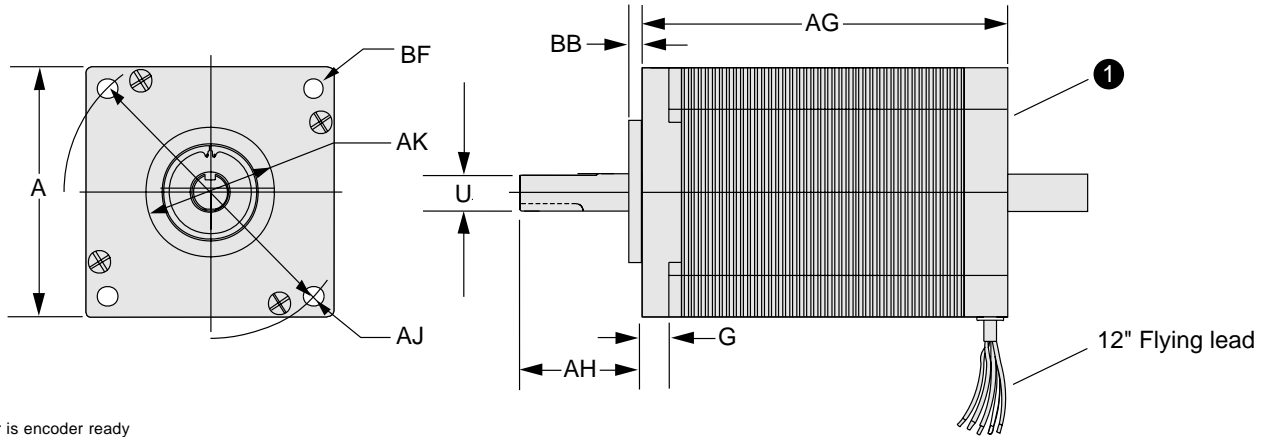


# Turbo Stepper® Motors

The new API Turbo Stepper motors have been designed for the best possible torque-to-size ratio. They offer

outstanding value for all applications where very high torque combined with normal step motor speed levels are

required. Nine Turbo Stepper models are available to mate with the Intelligent Microstepping Drives.



1 Motor is encoder ready

Model	Holding Torque oz-in (Nm)	Inertia oz-in <sup>2</sup> (kgm <sup>2</sup> )	Rated Current Amps	A in (mm)	AG in (mm) max.	AH in (mm)	AJ in (mm)	AK in (mm)	BB in (mm)	BF in (mm) thru	U* in (mm)	Weight lb (kg)
MST-T170-CF00	24 (0.17)	.22 (4×10 <sup>-6</sup> )	1.83	1.69 (42.8)	1.47 (37.3)	.75 (19.1)	2.000 (50.80)	.875 (22.225)	0.060 (1.524)	.149 (3.78)	.2500 (6.350)	1.2 (.6)
MST-T171-CF00	40 (0.28)	.34 (6.18×10 <sup>-6</sup> )	1.95	1.69 (42.8)	1.64 (41.7)	.75 (19.1)	2.000 (50.80)	.875 (22.225)	0.060 (1.524)	.149 (3.78)	.2500 (6.350)	1.6 (.8)
MST-T172-CF00	87 (0.61)	.39 (7.1×10 <sup>-6</sup> )	1.91	1.69 (42.8)	2.33 (59.2)	.75 (19.1)	2.000 (50.80)	.875 (22.225)	0.060 (1.524)	.149 (3.78)	.2500 (6.350)	2.0 (.9)
MST-T230-CF00	85 (0.60)	.55 (1×10 <sup>-5</sup> )	2.18	2.25 (57.2)	1.97 (50.0)	.81 (20.6)	2.625 (66.68)	1.50 (38.1)	0.060 (1.524)	.200 (5.08)	.2500 (6.350)	2.2 (1.0)
MST-T231-CF00	150 (1.06)	.80 (1.46×10 <sup>-5</sup> )	2.24	2.25 (57.2)	2.43 (61.7)	.81 (20.6)	2.625 (66.68)	1.50 (38.1)	0.060 (1.524)	.200 (5.08)	.2500 (6.350)	2.8 (1.3)
MST-T232-CF00	265 (1.87)	1.70 (3.09×10 <sup>-5</sup> )	2.78	2.25 (57.2)	3.56 (90.4)	.81 (20.6)	2.625 (66.68)	1.50 (38.1)	0.060 (1.524)	.200 (5.08)	.2500 (6.350)	3.4 (1.6)
MST-T341-CF00	650 (4.59)	7.80 (1.42×10 <sup>-4</sup> )	3.25	3.38 (85.9)	3.13 (79.5)	1.25 (31.8)	3.875 (98.43)	2.875 (73.025)	0.060 (1.524)	.221 (5.61)	.5000 (12.700)	6.2 (2.8)
MST-T342-CF00	1200 (8.47)	14.70 (2.68×10 <sup>-4</sup> )	4.91	3.38 (85.9)	4.65 (118.1)	1.25 (31.8)	3.875 (98.43)	2.875 (73.025)	0.060 (1.524)	.221 (5.61)	.5000 (12.700)	10.7 (4.8)

Models specified are unifilar windings only. \*Size 17, 23 with flat, size 34 with keyway

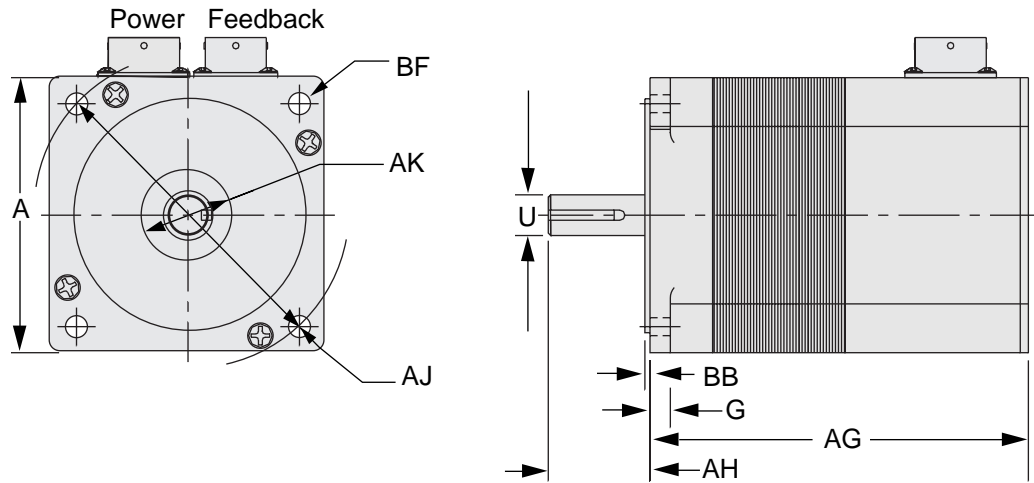
PACKAGED SYSTEMS

# Turbo Stepper® Motors

The new API Turbo Stepper motors have been designed for the best possible torque-to-size ratio. They offer

outstanding value for all applications where very high torque combined with normal step motor speed levels are

required. Nine Turbo Stepper models are available to mate with the Intelligent Microstepping Drives.



Model	Holding Torque oz-in (Nm)	Inertia oz-in <sup>2</sup> (kgm <sup>2</sup> )	Rated Current Amps	A in (mm)	AG in (mm) max.	AH in (mm)	AJ in (mm)	AK in (mm)	BB in (mm)	BF in (mm) thru	U* in (mm)	Weight lb (kg)
MST-T340-CM00	450 (3.18)	5.60 (1.02×10 <sup>-4</sup> )	3.00	3.38 (85.9)	4.17 (105.9)	1.25 (31.8)	3.875 (98.4)	2.875 (73.0)	0.060 (1.52)	0.221 (5.61)	0.500 (12.7)	4.10 (1.9)
MST-T341-CM00	650 (4.59)	7.80 (1.43×10 <sup>-4</sup> )	3.25	3.38 (85.9)	4.65 (118.1)	1.25 (31.8)	3.875 (98.4)	2.875 (73.0)	0.060 (1.52)	0.221 (5.61)	0.500 (12.7)	6.20 (2.8)
MST-T342-CM00	1200 (8.47)	14.70 (2.69×10 <sup>-4</sup> )	4.91	3.38 (85.9)	6.17 (156.7)	1.25 (31.8)	3.875 (98.4)	2.875 (73.0)	0.060 (1.52)	0.221 (5.61)	0.500 (12.7)	10.70 (4.9)
MST-T421-CM00	1630 (11.51)	30.20 (5.52×10 <sup>-4</sup> )	5.20	4.29 (109.0)	5.22 (132.6)	2.19 (55.6)	4.950 (125.7)	2.190 (55.6)	0.060 (1.52)	0.328 (8.33)	0.625 (15.88)	14.00 (6.4)
MST-T422-CM00	3120 (22.03)	59.70 (1.09×10 <sup>-3</sup> )	8.02	4.29 (109.0)	7.24 (183.9)	2.19 (55.6)	4.950 (125.7)	2.190 (55.6)	0.060 (1.52)	0.328 (8.33)	0.625 (15.88)	24.00 (10.9)

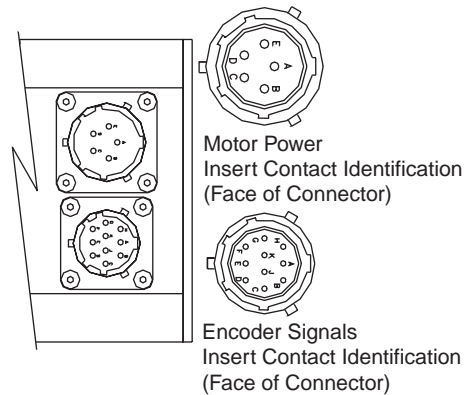
All motors are 4-wire models. All motors set for "mounting only" of encoders.

Motor Power Connections	
Pin	Function
A	Phase A+
B	Phase A-
C	Phase B+
D	Phase B-
E	Ground

Encoder Connections (Reference Pinout Only)	
Pin	Function
A	Data A+
B	Data A-
C	Data B+
D	Data B-
E	Index Z+
F	Index Z-
G	Power (+5V)
H	Ground
J	Shield

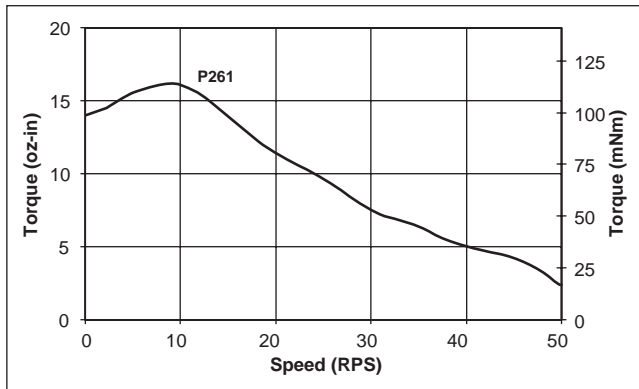
Connector Style  
PT02E-14-5P  
(MS3112E14-5P)

Connector Style  
PT02E-12-10P  
(MS3112E12-10P)

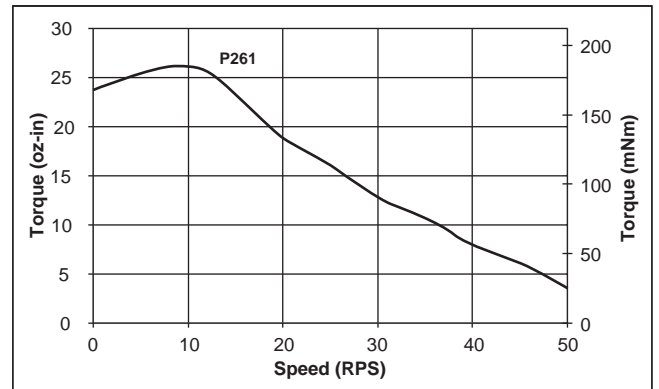


## Turbo Stepper® Performance with P261 & P315

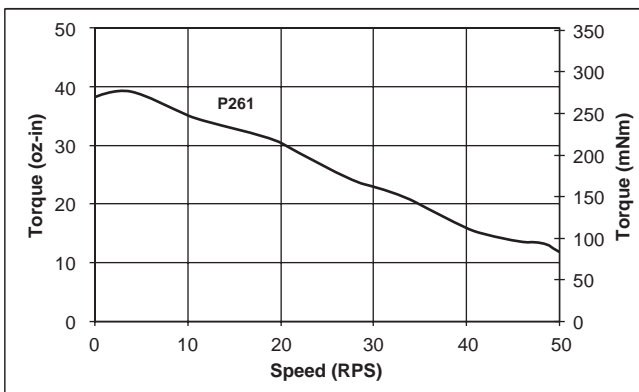
MST-T170-CF00



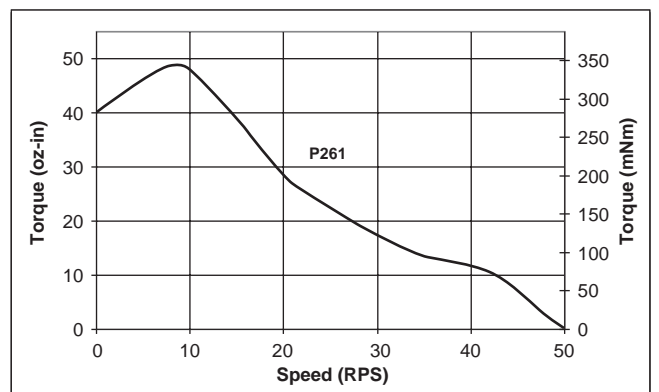
MST-T171-CF00



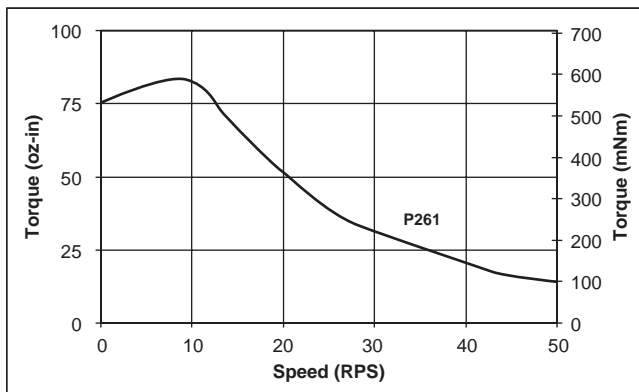
MST-T172-CF00



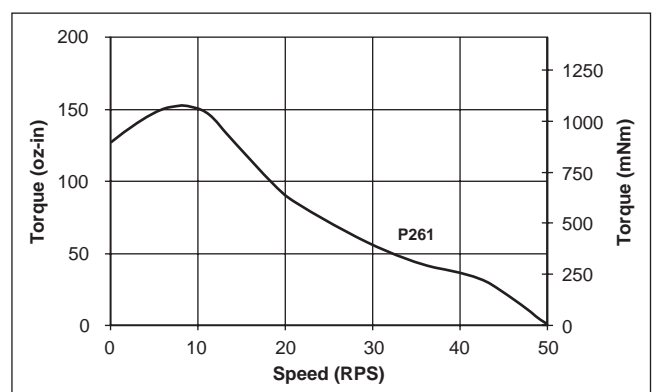
MST-T230-CF00



MST-T231-CF00



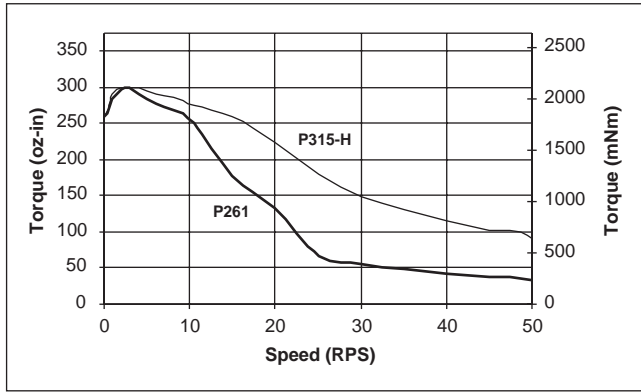
MST-T232-CF00



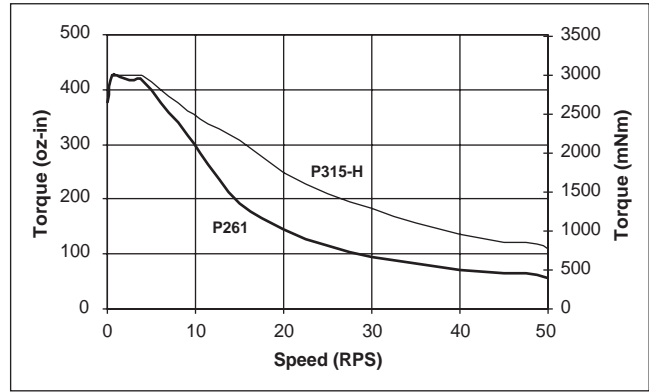
PACKAGED SYSTEMS

### Turbo Stepper® Performance with P261 & P315

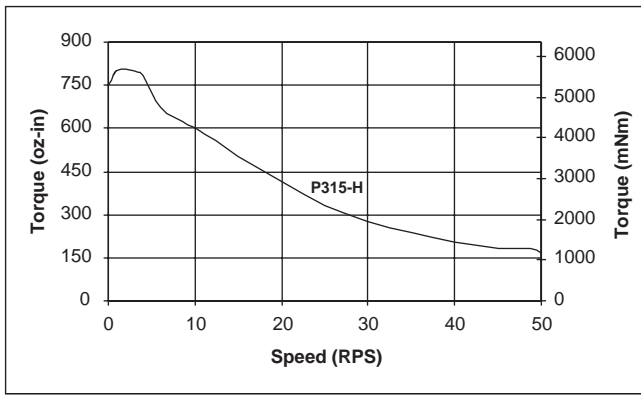
MST-T340-CM00



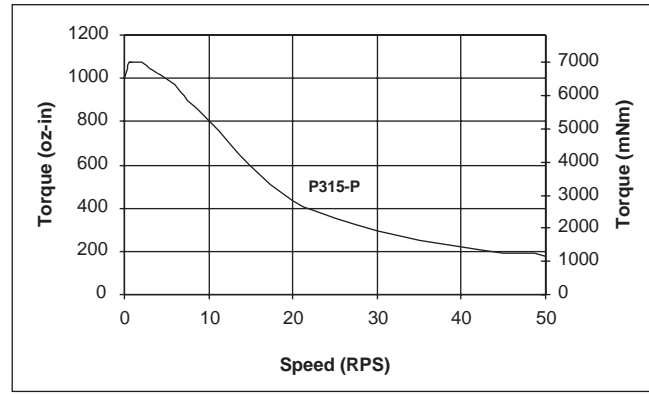
MST-T341-CM00



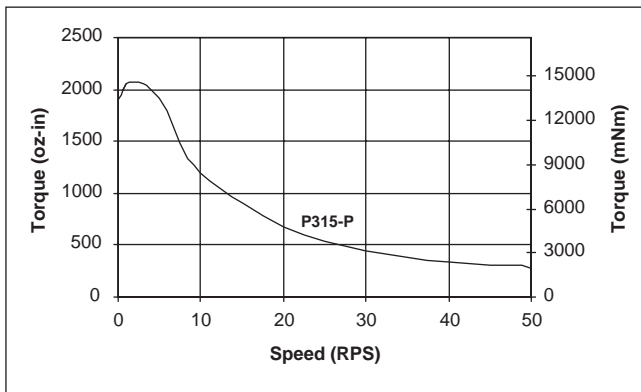
MST-T342-CM00



MST-T421-CM00



MST-T422-CM00



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