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WARNER ELECTRIC®

# SL0-SYN® PACKAGED STEP MOTOR CONTROLLER AND DRIVE

## WARPDRIVE™ SERIES



SERVO CONTROLS STEPPER CONTROLS VOLTAGE CONDITIONING ENGINEERED SYSTEMS AC/DC DRIVES

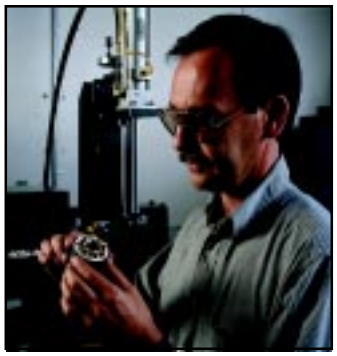
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# SLO-SYN® PACKAGED STEP MOTOR CONTROLLER AND DRIVE WARPDRIVE™ SERIES

## Leader In Technology

Warner Electric Motors and Controls puts you ahead of the game by developing products and systems to help the performance of your machinery. Our AC synchronous and DC motors, controllers, adjustable speed drives, voltage control and conditioning product lines, and engineered systems are designed to provide next generation solutions to today's applications.

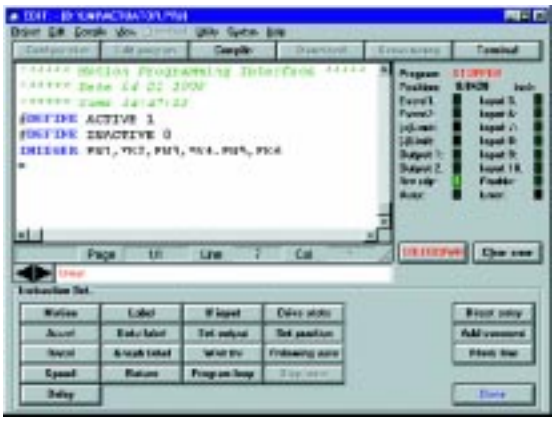


Formerly known as The Superior Electric Company, the Warner Electric Motors and Controls Division of Dana Corporation boasts a reputation for quality and service. Coupled with unparalleled engineering capabilities, we can help you develop product lines for both new and existing high-technology markets.

Our SLO-SYN® Packaged Step Motor Controllers and Drives are designed to offer optimum performance in a full range of step motor positioning applications. The WARPDRIVE Series is another addition to the SLO-SYN family of components and systems that offers features that will help you invest wisely.

## Basic-Like Language for Easy Programming

Programmers have the competitive advantage of mixing powerful English-like text with time-saving, graphical "point and click" tools in familiar MS Windows® environments. For motion control developers familiar with Warner Electric's programming language used in the SLO-SYN family of MX2000 motion controls and TDC servo controllers, or familiar with BASIC, the WARPDRIVE requires no new programming skills. New users will find the language easy to learn since it uses intuitive commands.



## Convenient, Compact Packaged System

The SLO-SYN WARPDRIVE Series step motor position system provides a controller and microstepping drive in one convenient, compact package. The microstepping indexer/drive package requires less panel volume and is priced at a savings compared to previous generations of controllers and drives sold separately.




## Technology for Smoother Performance

The integral programmable controller uses a patent pending digital microstepping current control technique to provide smooth motor performance.



## Compatible with SLO-SYN® Standard and High Torque Motors

SLO-SYN M & KM Series motors complete this step motor positioning system. The WARPDRIVE Series is compatible with standard SLO-SYN motors in sizes ranging from NEMA 23 to NEMA 42 and SLO-SYN high torque motors in sizes NEMA 23 and 34.

## More I/O for Greater Versatility

- 8 Inputs, 4 Outputs Optically Isolated
- 8 Inputs, 4 Outputs Non-Isolated
- One 0-10V Analog Input (10 Bits)
- Encoder Input for Closed Loop Operation (differential or single-ended)
- 12V DC I/O Power Supply



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# WARPDRIVE™ SERIES FEATURES
# MODEL SS2000D6i

### Greater Flexibility in One Package

The SLO-SYN WARPDRIVE Series offers features normally found on the most expensive drives. These features enable the WARPDRIVE to be used in a broad range of applications. Features include:

- 100-120V +/-10% AC Input
- Motor Phase Current from 1-6 Amps Selectable
- Robust SS2000D6 Drive Design
- Short Circuit Protection (phase-to-phase and phase-to-ground)
- 16-Bit Micro-Processor
- Built-In BCD Interface with Separate Connector
- 2 Serial Ports, RS232/485 up to 38K Baud
- RS485 Daisy Chaining, up to 32 Units
- An RS232 Communication Cable Used to Program the WARPDRIVE™
- Built-In AC Line Filter and MOVs
- IEC 1000-4-4 Standards for Electrical Noise Compliant
- Graphical User Interface Software Available
- UL Recognized and CE Pending
- Optional Terminal Board for Easy Wiring
- All Mounting Hardware Included

**Reduce Current** capability allows setting standstill current from 0% to 100% in 10% increments. (Allows the motor to cool down at standstill, prolonging the life of the motor.)

**Boost Current** capability allows setting current during acceleration and deceleration from 100% to 200% in 10% increments up to a maximum level of 6 amperes. (Provides additional torque during acceleration and deceleration.)

### Microstepping Resolution

The resolution of this drive is internally set to 1/64 of a step or 12,800 microsteps/rev. This resolution will give you a very smooth motion at slow speeds. An adjustable smoothing factor also improves low speed smoothness.

All program distances and speeds are programmed in engineering units. Achieving different increments can be done by setting USER UNITS to the appropriate increment needed for a particular application.

**Accessories for SLO-SYN WARPDRIVE Series**

| ACCESSORY | DESCRIPTION | ORDERING PART NUMBER |
|---|---|---|
| **Man-Machine Interface** | Provides the ability to print statements on the terminal and receive input from a terminal. | **IWS30SE**<br>**IWS120SE** |
| **External Wiring Card** | A screw terminal breakout board provides easy access to wire I/O and RS232/485 communications. It easily plugs into the connectors on front of the unit. | **XWC-D6i** |
| **BCD Switch** | A BCD switch can be connected to a WARPDRIVE controller for entry of BCD data. Applications for this function include moving to a set position, selecting move distance, or a speed. | **221157-002**<br>(This kit includes a seven-digit plus sign BCD switch and an 18-inch long ribbon cable. |
| **Encoder Cable** | For closed loop operation, the following encoder cables can be used with an encoder motor and a WARPDRIVE. | For a 9-pin "D" male connector on both ends, use part numbers:<br>**215851-002** 10-ft. encoder cable<br>**215851-003** 25-ft. encoder cable<br>For a 9-pin "D" male connector on one end, unterminated leads on the other, use part numbers:<br>**220170-001** 10-ft. encoder cable<br>**220170-002** 25-ft. encoder cable |
| **Motor Cable** | A 10-ft. motor cable is shipped with every WARPDRIVE SS2000D6i. For other lengths, use the following part numbers: | **216022-031** 10-ft. motor cable<br>**216022-032** 25-ft. motor cable<br>**216022-033** 50-ft. motor cable<br>**216022-034** 75-ft. motor cable<br>**216022-035** 100-ft. motor cable |



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# PROGRAMMING COMMANDS GROUPED BY FUNCTION

## Motion

| | |
|---|---|
| BOOST | Enables or disables the boost current feature of a stepper or returns the boost status. |
| BUSY | Returns the motion status of the axis. |
| EVENT1 | Sets enable/disable and trigger state of event1. |
| EVENT2 | Sets enable/disable and trigger state of event2. |
| JOG | Runs continuously in the specified direction. |
| MOVEA | Initiates an absolute indexed move. |
| MOVEHOME | Runs until the home input is activated. |
| MOVEI | Initiates an incremental indexed move. |
| MOVEREG | Runs until the registration input is activated, then moves the specified distance. |
| REDUCE | Enables or disables the reduce current feature of a stepper or returns the reduce status. |
| STOP | Brings any motion to a controlled stop. |
| STOPERR | Sets or returns the maximum position error allowed when motion is stopped. |
| WAITDONE | Waits for motion to be done. |
| WNDGS | Enables/disables drive. |

## Trajectory Parameters

| | |
|---|---|
| ABSPOS | Sets or returns the absolute position. |
| ACCEL | Sets or returns the acceleration rate in units/sec/sec. |
| DECEL | Sets or returns the deceleration rate in units/sec/sec. |
| DIST | Returns the distance moved from the start of the last commanded motion or changes the move distance during indexed (MOVEA, MOVEI) motion. |
| ENCPOS | Returns the encoder absolute position. |
| ENCSPD | Returns the current speed. |
| FOLERR | Sets or returns the position error limit for a closed-loop stepper. |
| LOWSPD | Sets or returns the starting speed value of a stepping motor. |
| SPEED | Sets or returns the commanded target speed. |

## I/O

| | |
|---|---|
| ANALOG | Returns the analog input voltage. |
| BCD | Returns the BCD switch value. |
| IN | Returns the discrete input state of the defined input. |
| OUT | Sets or returns the discrete output state of the defined output. |

## String Manipulation

| | |
|---|---|
| ASC | Returns the ASCII code of character. |
| CHR$ | Returns a one-character string for the given ASCII code. |
| GETCHAR | Waits for a character to be received via the serial port. |
| HEX$ | Returns the hex string of an integer. |
| HVAL | Returns the hex value of a string. |
| INCHAR | Returns a character from the serial port. |
| INPUT | Reads a line of data from the serial port. |
| INSTR | Returns the first occurrence of a character in a string. |
| LCASE$ | Converts a string to lower case letters. |
| LEFT$ | Returns the leftmost characters of a string. |
| LEN | Returns the number of characters in a string. |
| MID$ | Returns the designated middle number of characters in a string. |
| PRINT | Transmits data via the serial port. |
| PRINT USING | Prints string characters or formatted numbers. |
| RIGHT$ | Returns the rightmost characters of a string. |
| STR$ | Returns a string representation of a numeric expression. |
| STRING$ | Returns a string of characters. |
| UCASE$ | Converts a string to upper case letters. |
| VAL | Returns the value of a string. |

## Relational Operators

| | |
|---|---|
| = | equal to |
| < | less than |
| <= or =< | less than or equal to |
| <> | not equal to |
| > | greater than |
| => or >= | greater than or equal to |

## Arithmetic Operators

| | |
|---|---|
| + | addition |
| - | subtraction or unary minus |
| * | multiplication |
| / | division |

## Variable Definitions

| | |
|---|---|
| INTEGER | var, ... , var |
| REAL | var, ... , var |
| INTEGER | var(x), ... , var(x,y) |
| REAL | var(x), ... , var(x,y) |

## Over Travel Limit

| | |
|---|---|
| HARDLIMOFF | Disables hard limits. |
| HARDLIMON | Enables hard limits. |
| REGLIMIT | Sets or returns the move registration limit distance. |
| SOFTLIMNEG | Sets or returns the absolute negative travel limit position. |
| SOFTLIMOFF | Disables soft limits. |
| SOFTLIMON | Enables soft limits. |
| SOFTLIMPOS | Sets or returns the absolute positive travel limit position. |

## Time Functions

| | |
|---|---|
| TIMER | Sets or returns timer value. |
| WAIT | Waits (dwells) for the period of time to expire. |

## Program Flow Control

| | |
|---|---|
| DO...EXIT DO...LOOP... LOOP...UNTIL...WHILE | Begins a repeatable block of statements. |
| END | Ends program. |
| FOR...TO...EXIT FOR...NEXT | Begins a repeatable block of statements. |
| GOSUB...RETURN | Branches to a subroutine and returns. |
| GOTO | Branches unconditionally to the specified label. |
| IF...THEN...ELSE...END IF | Begins a conditional block of statements. |

## Interrupt

| | |
|---|---|
| INTROFFn | Disables interrupt n, where n is 1-4. |
| INTRONn | Enables interrupt n, where n is 1-4. |
| ON...INTRn | On condition, goes to interrupt n, where n is 1-4. |

## Miscellaneous

| | |
|---|---|
| DEFINE | Defines a symbolic name to be a particular string of characters. |
| ERR | Returns error code number. |
| INCLUDE | Includes a file name with defined statements in a user task. |

## Boolean Expression Operators

| | |
|---|---|
| AND | Logical conjunction operator. |
| NOT | Logical complement operator. |
| OR | Logical inclusive operator. |



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## Mechanical and Environmental Specifications

Size ..... 3.67W x 9.5H x 5.98D
Operating Temperature ..... +32°F to +122°F (0°C to +50°C)
Storage Temperature ..... -40°F to +167°F (-40°C to +75°C)
Humidity ..... 95% maximum, non-condensing
Altitude ..... 10,000 feet (3,048 meters) max.
Weight ..... 7.75 lbs. (3.52 kg)

## Electrical Specifications

AC Input Range ..... 90 to 132 VAC, 50/60 Hz
AC Current ..... 7 amperes
Fuse Rating ..... 250 volts, 8 amperes
Drive Power Dissipation (Worst Case) ..... 50 watts

### Isolated Digital I/O

**12V DC Internal I/O Power:** .... 11.5 to 14V DC @ 100mA
**or User Supplied I/O Power** ..... 5-24V DC

**Inputs (IN1 - IN8):**

**Sink Mode: (+Vopto = 12V DC)**
On State Voltage Range ($V_{IN}$) ..... 0V to +6V DC
Input Current ($V_{IN}$ = 0V) ..... -6mA

**Source mode:**
On State Voltage Range ($V_{IN}$) ..... 4.5V to 24V
Input Current ($V_{IN}$ = 12V DC) ..... 6mA

**Response Time (sink or source):**
Opto Turn On Delay ..... 10uS typical
Opto Turn Off Delay ..... 75uS typical

**Programmable Outputs (OUT1-OUT4):**

**Sink Mode:**
Continuous Current Rating per Output ..... 250mA max.
Maximum Collector Voltage ..... 25V max.
On State Voltage @ 250mA ..... 1.5V max.

**Non-Isolated I/O (or BCD Interface):**

**IN9 - IN 16:** These inputs may be used with open collector outputs without an external supply by connecting the output device common (ground) to signal ground on the unit, and the open collector to the input pin. An internal pullup resistor to +5V DC is provided.

Logic High Input Level ..... 25V > Vsource > 4.5V, or open circuit
Logic Low Input Level ..... 1.2V max.
Logic Low Current with Input @ GND ..... -1mA max.

**OUT5 - OUT8:** These are open-collector, sink only TTL outputs, and are NOT isolated from the unit's +5V logic supply. Proper care must be taken to ensure noise is not injected onto these signals. The user's I/O supply must be referenced to GND on the controller.

Active Output Voltage ..... 0.6V max. @ 20mA
Permissible Output Current ..... 20mA
Permissible Output Voltage ..... 24V DC

**Serial Communications:**

**Port 1:** Configurable for RS-232C or RS-485 four wire communications via a switch. Port 1 is designated as the HOST communications port and can be used to daisy chain up to 32 units in RS485 mode.

**Port 2:** Serial port 2 is used for differential RS485 four wire USER communications.

**Encoder Connections:**

Encoder connections provide power and inputs for a digital encoder interface to indicate motor position to the controller.

Encoder +5V DC
- Power Supply Output ..... +5V DC (±5%) @ 100mA current.
- Encoder Signal Inputs ..... TTL level Single-ended or differential; channels A and B in phase quadrature.
- Input Current A+, A-, B+, B-, Z+, Z- ..... ±5mA min.

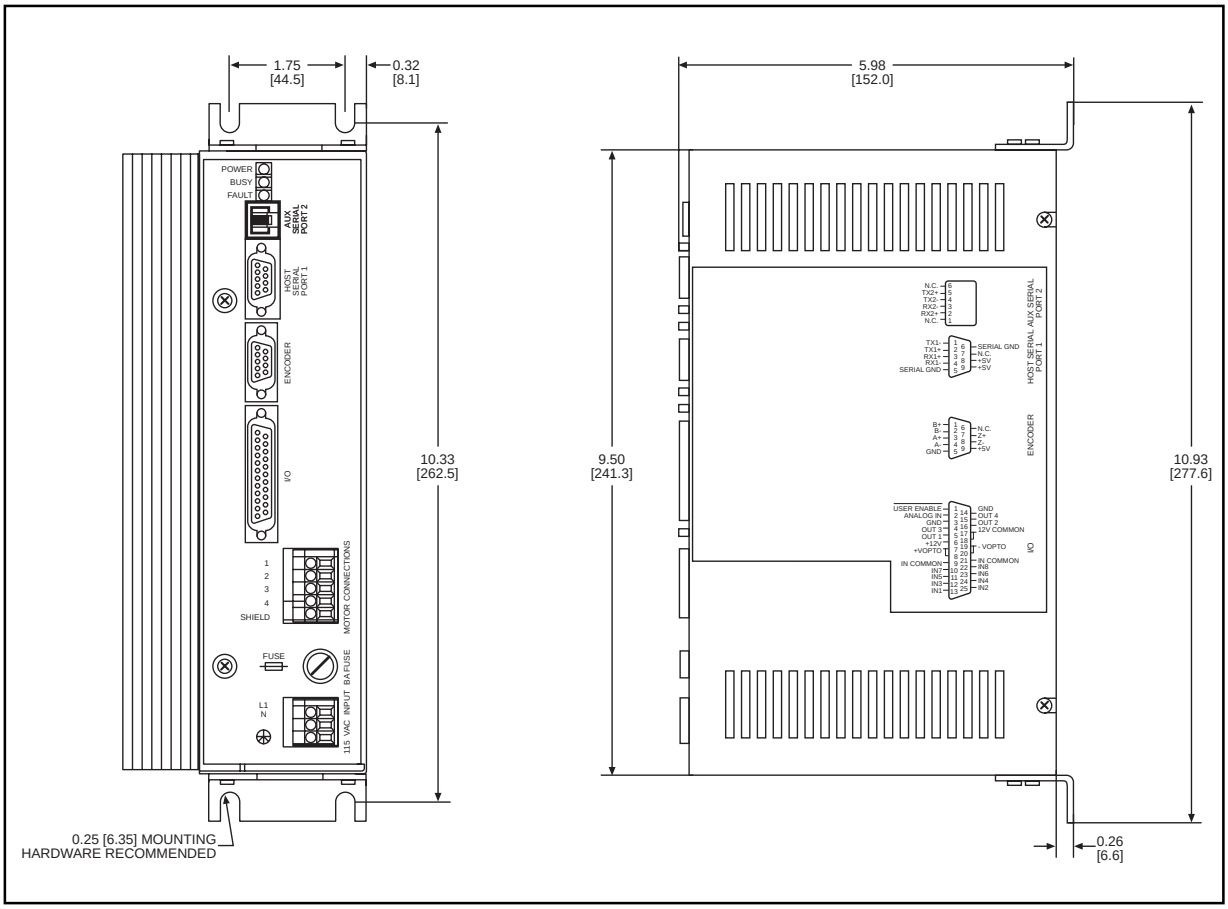
**Analog Input:**

Voltage Range ..... 0-10V referenced to GND
Resolution ..... 10 bits or 9.77mV
Absolute Accuracy ..... ±0.3V worst case
Sample Rate ..... 500 Hz min.
Bandwidth ..... 100 Hz max.



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# WARPDRIVE™ SERIES DIMENSIONS
# MODEL SS2000D6i




## MOTOR COMPATIBILITY

| | |
|---|---|
| Motor Types | Warner Electric M and KM Series |
| Frame Sizes | M061 through M112*, KML060 through KML093 |

### Other Motor Capability Specifications

| | |
|---|---|
| Number of Connections | 4, 6, 8 |
| Minimum Inductance | 8 millihenrys |
| Maximum Inductance | 64 millihenrys |
| Maximum Resistance | 2 ohms at 6 ampere setting |

**Note: Maximum resistance is the total of the motor and the cable.**

**CAUTION: Do not use larger frame size motors than those listed, or the drive may be damaged.**

Motors for use with the SS2000D6i Controller:

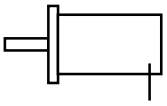
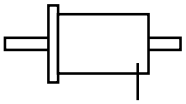
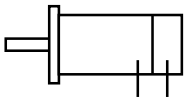
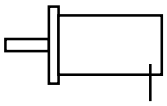
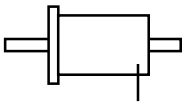
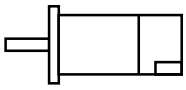
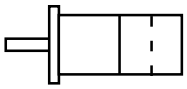
| M Series Motors | | KM Series Motors | |
|---|---|---|---|
| PN | Amperes | Current PN | Current Amperes |
| M061-FF-206 | 1 | KML060F02 | 1.5 |
| M062-FF-206 | 1.5 | KML061F03 | 1.5 |
| M063-FF-206 | 1.5 | KML062F03 | 1.5 |
| M091-FF-206 | 3 | KML063F04 | 2 |
| M092-FF-206 | 4 | KML091F05 | 3 |
| M093-FF-206 | 4 | KML091F07 | 3 |
| M111-FF-206 | 5 | KML092F07 | 4 |
| M112-FF-206 | 6 | KML093F08 | 4 |
| MH112-FF-206 | 6 | KML093F10 | 6 |



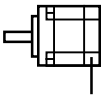
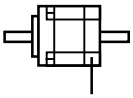
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# MOTOR CONFIGURATIONS

## M Series Motor Configurations

| Sizes | Leaded | Double End with Leads | | Single End with Leads and Encoder |
|---|---|---|---|---|
| 60<br>NEMA 23 | <br>M061-FF-206<br>M062-FF-206<br>M063-FF-206 | <br>M061-FF-206E<br>M062-FF-206E<br>M063-FF-206E | | <br>M061-FF-206Cn<br>M062-FF-206Cn<br>M063-FF-206Cn |
| **Sizes** | **Leaded** | **Double End with Leads** | **Single End with Terminal Box** | **Single End with Terminal Box and Encoder** |
| 90, 110<br>NEMA 34 and 42 | <br>M091-FF-206<br>M092-FF-206<br>M093-FF-206 | <br>M091-FF-206E<br>M092-FF-206E<br>M093-FF-206E | <br>M091-FF-206T<br>M092-FF-206T<br>M093-FF-206T<br>M111-FF-206T<br>M112-FF-206T<br>MH112-FF-206T | <br>M091-FF-206Cn<br>M092-FF-206Cn<br>M093-FF-206Cn<br>M111-FF-206Cn<br>M112-FF-206Cn<br>MH112-FF-206Cn |

## KML Motor Configurations

| Sizes | Leaded | Double End with Leads | |
|---|---|---|---|
| 60, 90<br>NEMA 23 and 34 |  |  | |

KM_0

L - Lead
T - Terminal Box

Frame Size
6 = 60mm (NEMA Size 23)
9 = 90mm (NEMA Size 34)

0 = .5 stack
1 = 1 stack
2 = 2 stack
3 = 3 stack

Current rating with 2 phases on

F = four lead - bipolar
S = six lead - unipolar

KML060F02
KML061F03
KML062F03
KML063F04

KML091F05
KML091F07
KML092F07
KML093F08
KML093F10

**Note: All M090 series motors with encoders and all M111, M112, and M112H motors have terminal boxes.**

**Options** – Use appropriate suffix as listed. Standard encoder is 500-line (C5). Other encoder counts:

C2 = 200-line ..... (800 quadrature counts)
C4 = 400-line ..... (1,600 quadrature counts)
C5 = 500-line ..... (2,000 quadrature counts)
C12 = 1,250-line ..... (5,000 quadrature counts)

**Connectors***

D = 9 pin "D" connector on encoder leads (Size 60 only)
K = Flat on shaft (Size 60, 90)

**Example:** M061-FF-206C12D
M061-FF-206 motor with 1250-line encoder and connector on encoder leads

**Example:** M061-FF-206EK
M061 motor with flat on motor shaft

**Since the SS2000D6i Drive features lugless terminals, a connector on the motor is not usually required.*

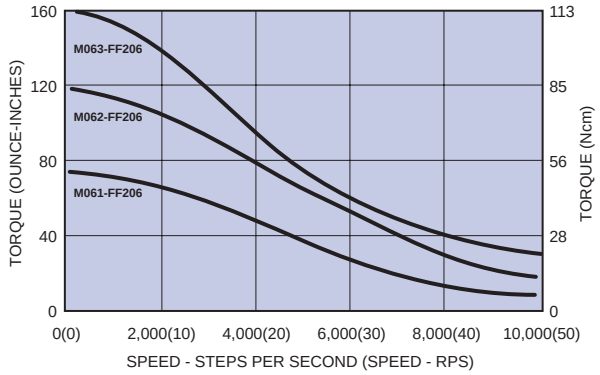


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# MOTOR OPTIONS – TORQUE VS. SPEED

**Available Options (add appropriate suffix to motor model number)**

E = Double End Shaft
Cn = Encoder Options
K = Flat On Shaft
D = Plug On Encoder

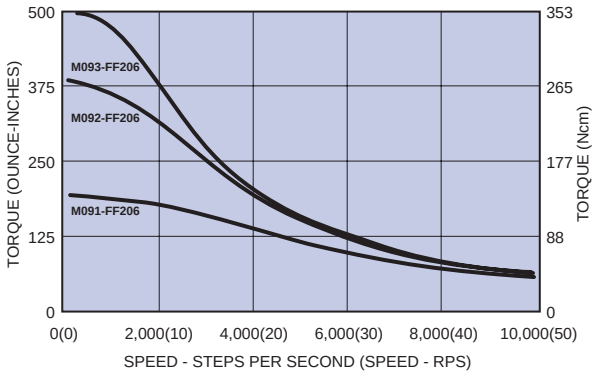



**M061-FF-206, M062-FF-206, and M063-FF-206 Motors**

**Available Options (add appropriate suffix to motor model number)**

E = Double End Shaft
T = Terminal Box
ET = Double End Shaft and Terminal Box
Cn = Encoder Option*
K = Flat On Shaft

** A terminal box is always used with the encoder option. The "T" suffix is not needed.*

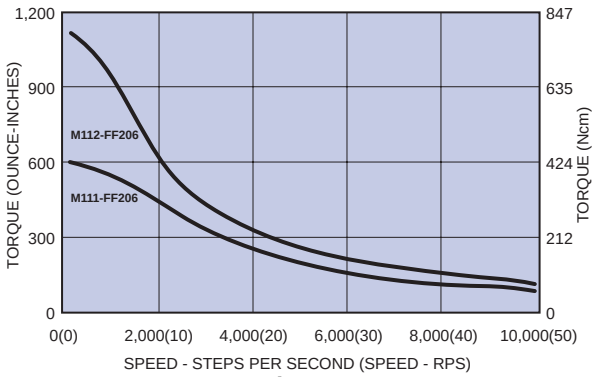



**M091-FF-206, M092-FF-206, and M093-FF-206 Motors**

**Available Options (add appropriate suffix to motor model number)**

E = Double End Shaft
Cn = Encoder Option

*Note: Shaft keyway and cast terminal box are standard on these motors.*

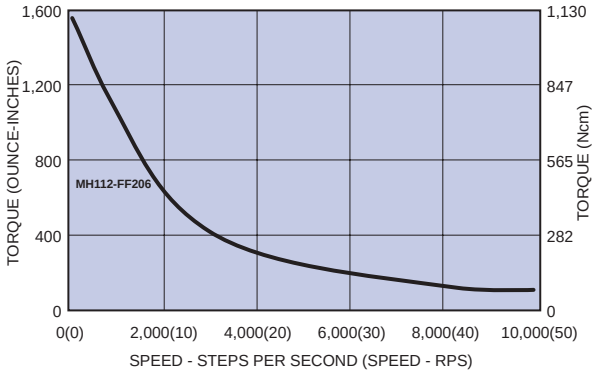



**M111-FF-206 and M112-FF-206 Motors**

**Available Options (add appropriate suffix to motor model number)**

E = Double End Shaft
Cn = Encoder Option

*Note: Shaft keyway and cast terminal box are standard on these motors.*




**MH112-FF-206 Motor**



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# MOTOR OPTIONS – TORQUE VS. SPEED

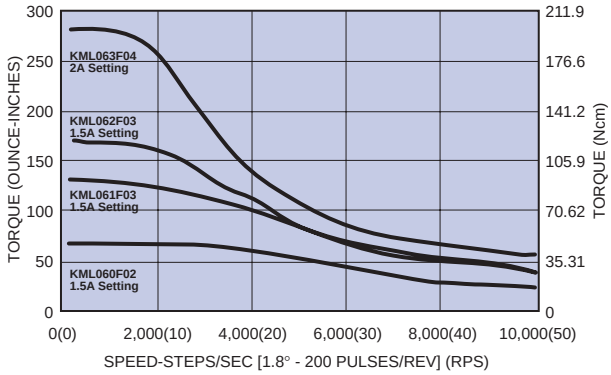
**Available Options (add appropriate suffix to motor model number)**

E = Double End Shaft

Cn = Encoder Options

K = Flat On Shaft

*Note: Flat on shaft is standard on KML063 motors.*



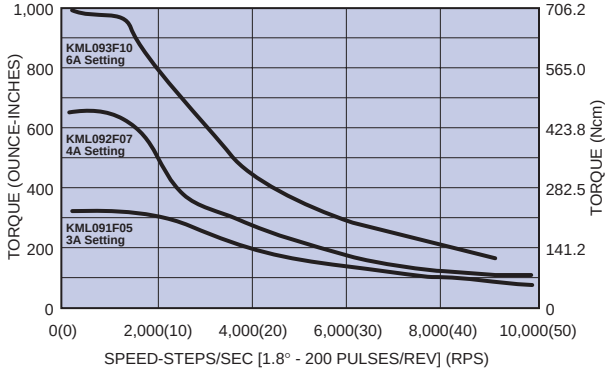

**KML060, KML061, KML062, and KML063 Motors**

**Available Options (add appropriate suffix to motor model number)**

E = Double End Shaft

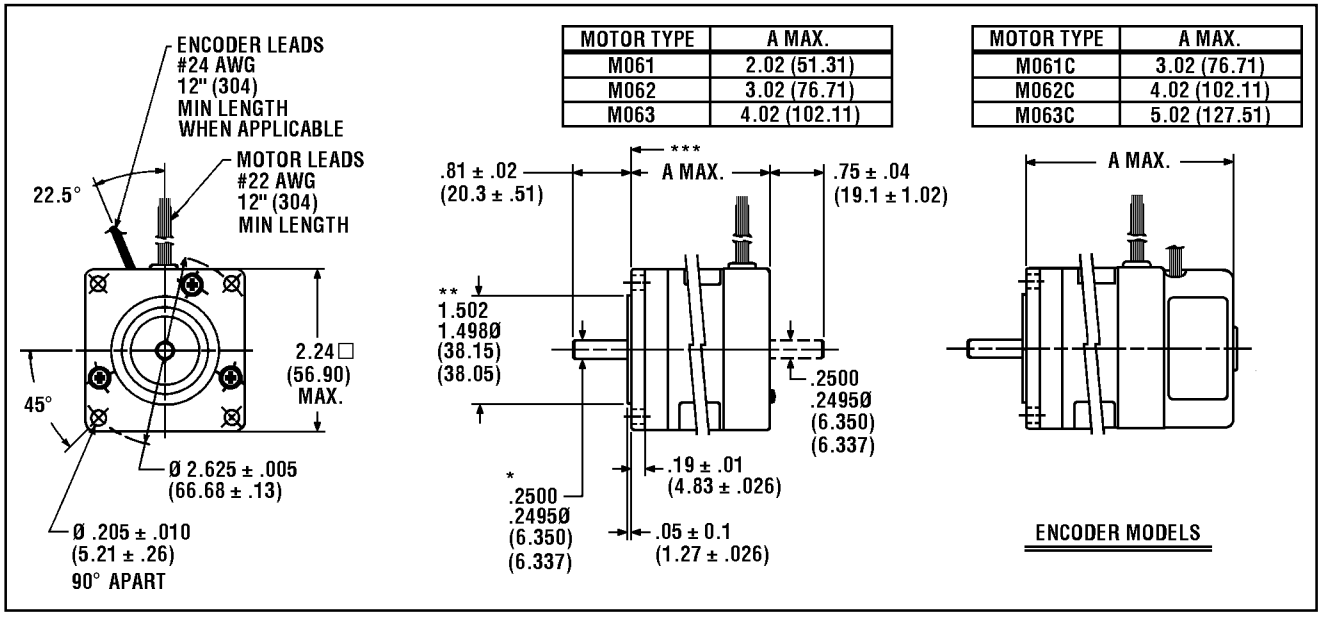
Cn = Encoder Option

*Note: Flat on shaft is standard on KML091, KML092, and KML093 motors.*




**KML091, KML092, and KML093 Motors**

# MOTOR DIMENSIONS



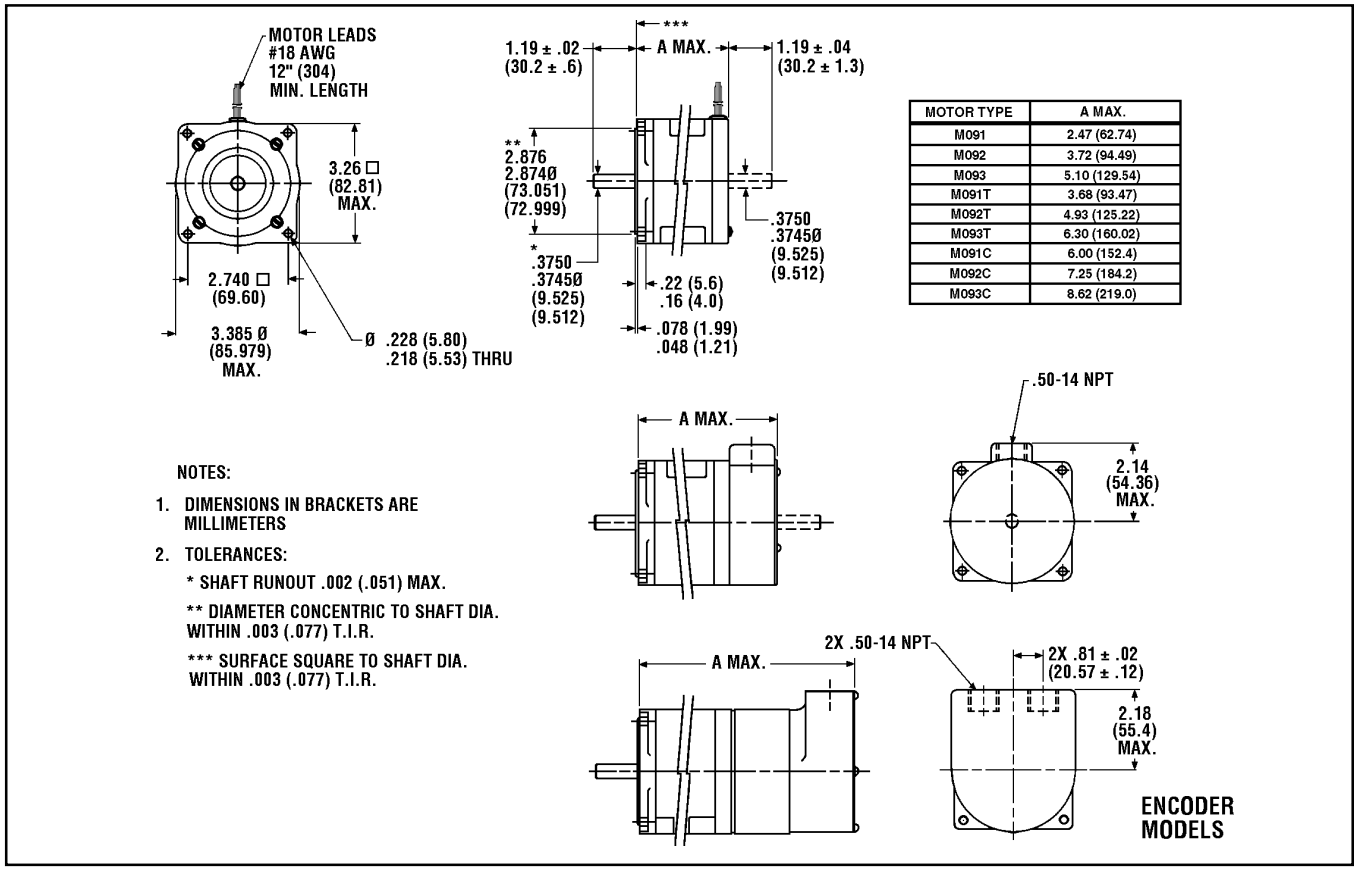

*M061-FF-206, M062-FF-206, and M063-FF-206 Motors*

*Many configurations available, consult motor catalog.*



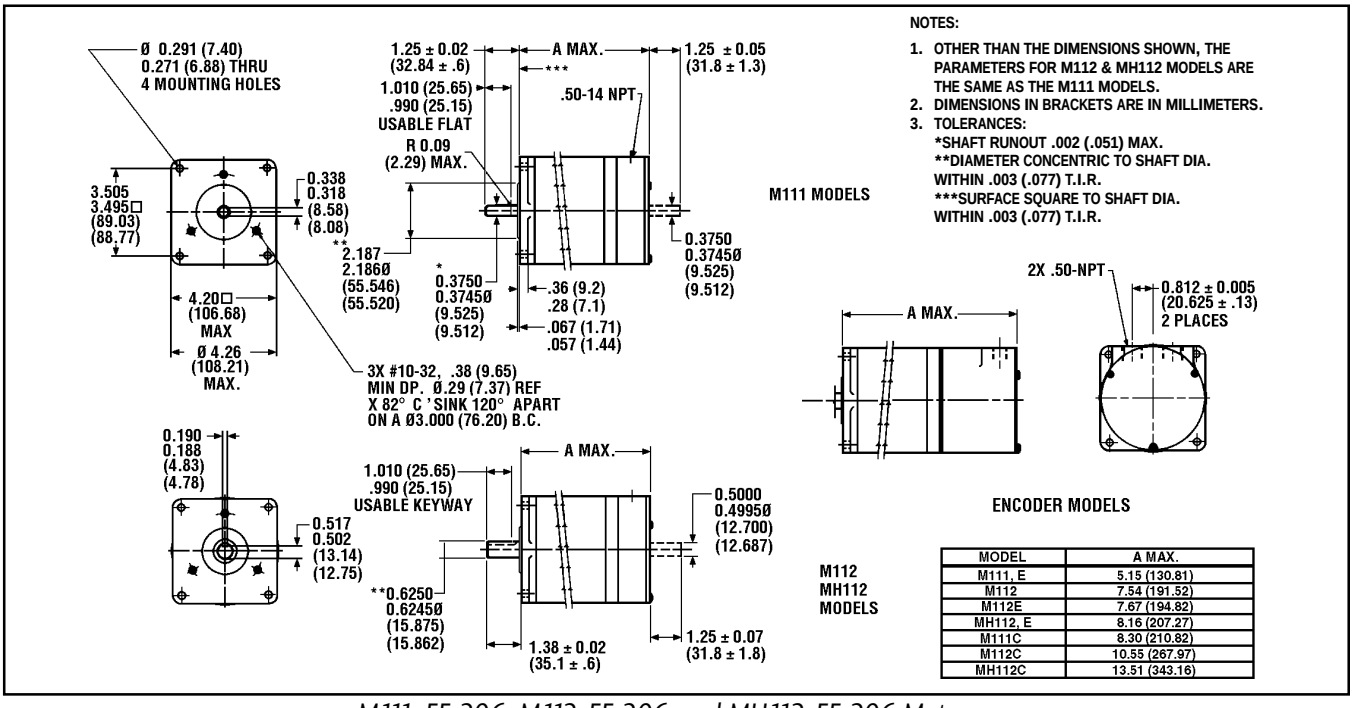
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# MOTOR DIMENSIONS




| MOTOR TYPE | A MAX. |
|---|---|
| M091 | 2.47 (62.74) |
| M092 | 3.72 (94.49) |
| M093 | 5.10 (129.54) |
| M091T | 3.68 (93.47) |
| M092T | 4.93 (125.22) |
| M093T | 6.30 (160.02) |
| M091C | 6.00 (152.4) |
| M092C | 7.25 (184.2) |
| M093C | 8.62 (219.0) |

*M091-FF-206, M092-FF-206, and M093-FF-206 Motors*



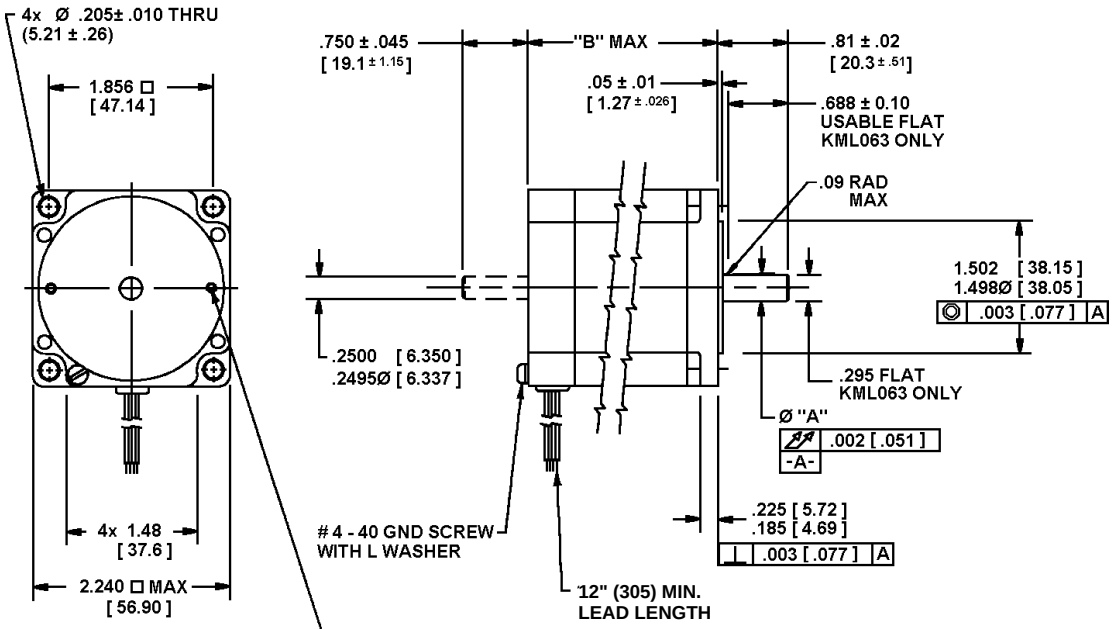

| MODEL | A MAX. |
|---|---|
| M111, E | 5.15 (130.81) |
| M112 | 7.54 (191.52) |
| M112E | 7.67 (194.82) |
| MH112, E | 8.16 (207.27) |
| M111C | 8.30 (210.82) |
| M112C | 10.55 (267.97) |
| MH112C | 13.51 (343.16) |

*M111-FF-206, M112-FF-206, and MH112-FF-206 Motors*

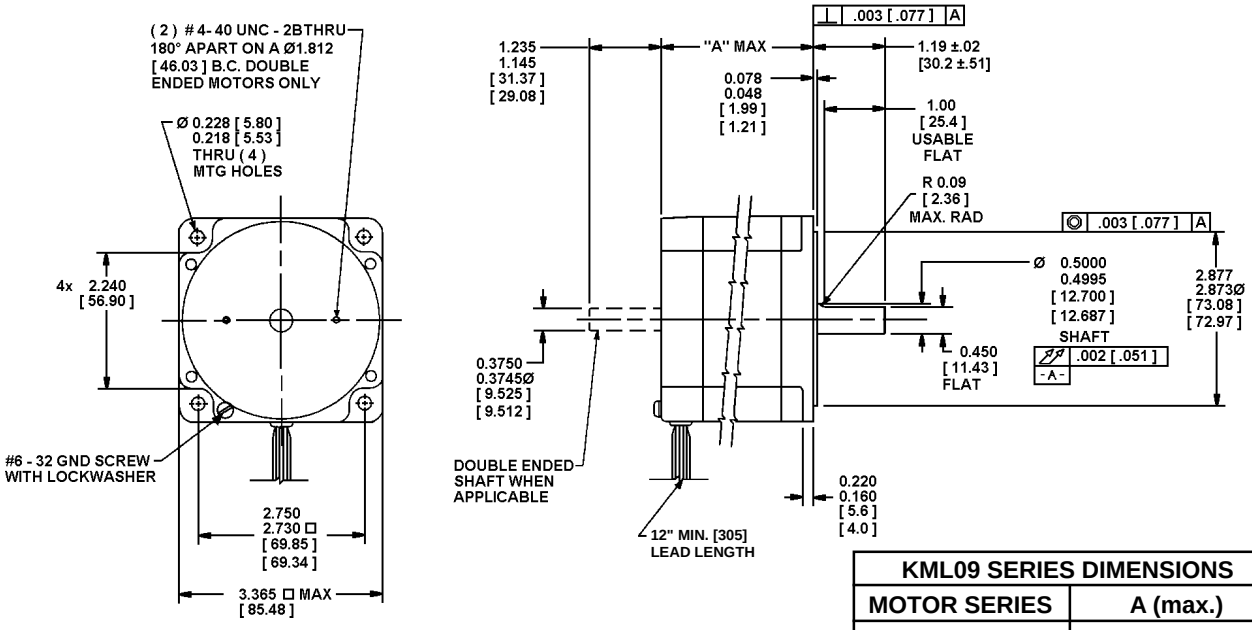


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# KML MOTOR DIMENSIONS




| KML06 SERIES DIMENSIONS | | |
|---|---|---|
| MOTOR SERIES | A (max.) | B (max.) |
| KML060 | .2500/.2495 (6.350/6.337) | 1.64 (44.7) |
| KML061 | .2500/.2495 (6.350/6.337) | 2.21 (56.2) |
| KML062 | .2500/.2495 (6.350/6.337) | 3.06 (77.8) |
| KLM063 | .3125/.3120 (7.938/7.924) | 4.06 (103.2) |




| KML09 SERIES DIMENSIONS | |
|---|---|
| MOTOR SERIES | A (max.) |
| KML091 | 2.57 (65.3) |
| KML092 | 3.77 (95.8) |
| KML093 | 4.97 (126.3) |

*Dimensions in brackets are in millimeters.*



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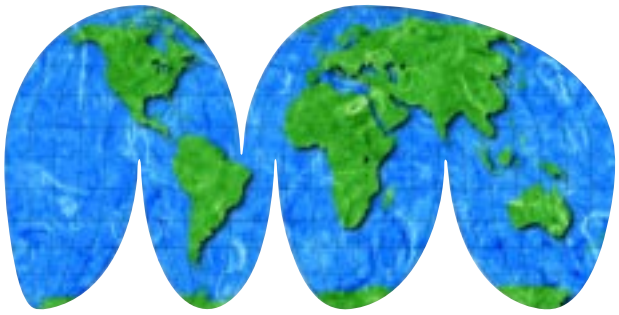
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