

Rotary Piezomotor **RAS Series**

Piezo Motion's novel series of rotary piezoelectric motors represent a quantum leap in the design and construction of compact, high-precision performance rotary motor technologies. Manufactured from modern lightweight, reinforced thermoplastics, this new range of rotary motors combine superior angular precision and ultrafast response.



Performance and Benefits of RAS Series Rotary Motors

1,000 TIMES GREATER PRECISION

With a minimum step size of just 30 μ rad at full torque, these motors offer >200000 steps per revolution of control.

FASTER REACTION TIME

Within 10 to 30 μ s, the piezo motor has made its first step and motion has commenced, compared to a stepper motor with a typical 5 ms to start motion.

HIGHER SPECIFIC POWER STALL TORQUE

For the same power as a comparable sized stepper motor, the piezo motor has a stall torque of up to 10x greater for the same power rating.

ENERGY AND COST SAVINGS

Piezo Motion's rotary motors consume zero power at holding torque and very low power at slow speed (0.1 W at 1 RPM); yielding the possibility of very efficient overall duty.

SPECIAL PROPERTIES

Piezo Motion motors are immune to EMI and RF interference and have no emissions, making them ideal for a range of sensitive applications. For specialized applications (including MRI) please contact our technical team.

ECONOMICAL DESIGN

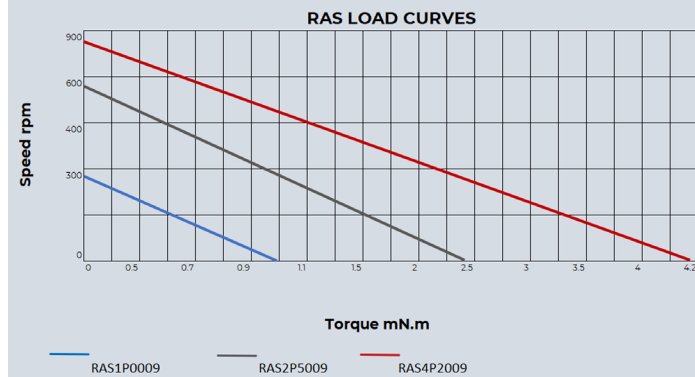
The innovative design and patent-protected technology packaged in stable reinforced thermoplastic make this high-performing automation affordable for OEM equipment designers.

LIGHTWEIGHT

This piezo motor contains no copper windings, iron laminations, or permanent magnets and is significantly more powerful by weight than EM solutions. This makes them ideally suited to weight-critical applications.

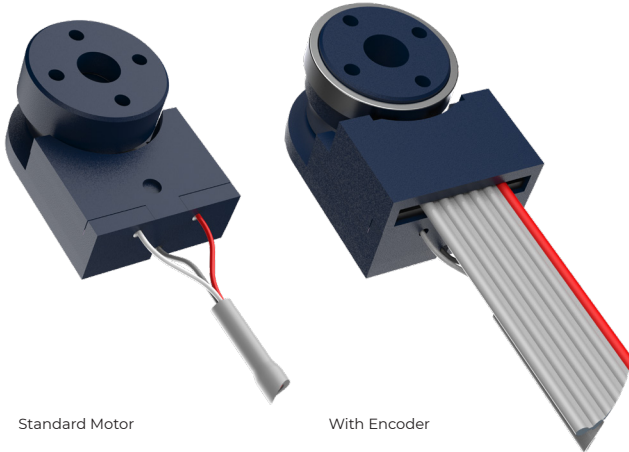
UNIQUE PROPERTIES

- Ultra-Lightweight
- Low voltage
- >200,000 steps per revolution
- Direct drive with range of torques
- Six orders of magnitude speed dynamic range
- Ultra-fast response time (<30 μ s) with superior start-stop characteristics
- 900 rpm max speed
- Silent and vibration-free operation
- High torque for size
- Energy efficient, zero power consumption in hold mode
- Stepping and Continuous mode of operation



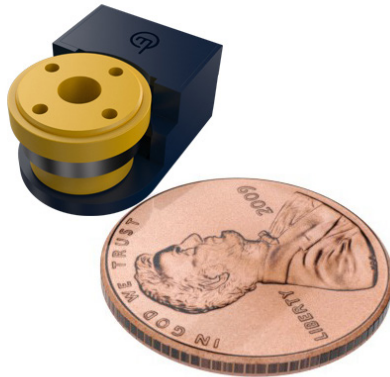
Speed-Force Curves for RAS Series Rotary Motor

RAS Series



Standard Motor

With Encoder



Principle of operation

Piezo Motion's rotary piezo motors work on a patented principle of excitation of ultrasonic standing waves within a piezoelectric resonator. The resulting superposition of two orthogonal ultrasonic waves causes elliptical movement of the resonator tip which drives the rotor (for more details visit piezomotion.com). Piezo Motion's electronic driver's have been designed to provide an economical user-control interface. Each driver PCB is pre-programmed for the specific motor model and is software configurable to provide optimization of drive signals and integrated controls. Closed-loop control of the motor is achieved via an encoder mounted on the motor.

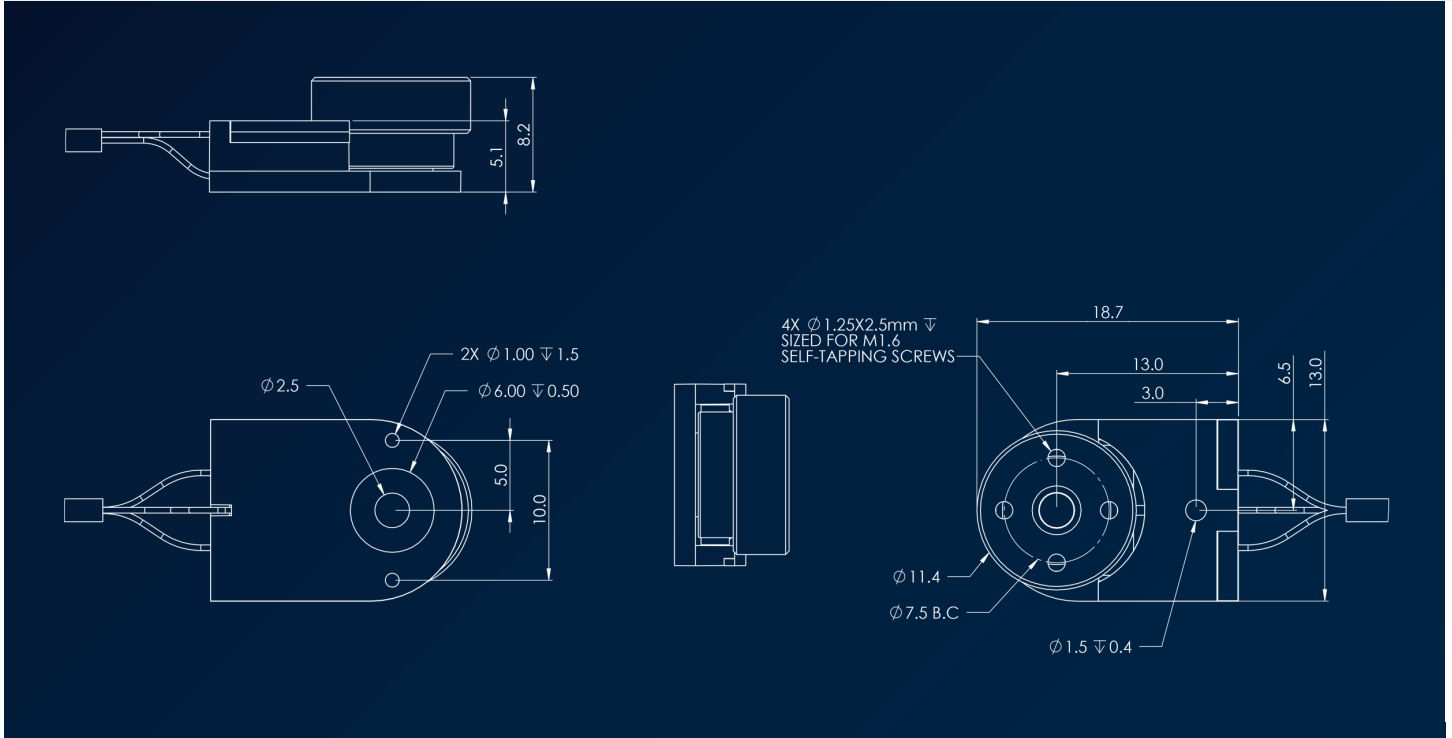
MOTOR SPECIFICATIONS

Product Number *	RAS1P0009	RAS1P0009-E	RAS2P5009	RAS2P5009-E	RAS4P2009	RAS4P2009-E
Driver Board P/N	EDA50V016BB	EDA50V016BB	EDA50V002BB	EDA50V002BB	EDC50V002BB	EDC50V002BB
Power Supply Voltage	5 V	5 V	5 V	5 V	7.5 V	7.5 V
Power Supply US	ELE-000361	ELE-000361	ELE-000361	ELE-000361	WSU075-1000	WSU075-1000
Power Supply International	ELE-000362	ELE-000362	ELE-000362	ELE-000362	WSX075-3200	WSX075-3200
Stall Torque	≥ 1.0 mNm	≥ 1.0 mNm	≥ 2.5 mNm	≥ 2.5 mNm	≥ 4.2 mNm	≥ 4.2 mNm
Self-Braking Torque	≥ 1.1 mNm	≥ 1.1 mNm	≥ 2.8 mNm	≥ 2.8 mNm	≥ 4.5 mNm	≥ 4.5 mNm
Motor Response Time	≈30µs	≈30µs	≈30µs	≈30µs	≈30µs	≈30µs
Max Speed	≈300 rpm	≈300 rpm	≈600 rpm	≈600 rpm	≈900 rpm	≈900 rpm
Minimum Angular Step	30 µrad	30 µrad	30 µrad	30 µrad	30 µrad	30 µrad
Encoder Resolution (after quadrature)	N/A	1,024 ppr	N/A	1,024 ppr	N/A	1,024 ppr
Minimum Controlled Angular Step	N/A	6.1 mrad	N/A	6.1 mrad	N/A	6.1 mrad
Uni-directional Repeatability	N/A	6.1 mrad	N/A	6.1 mrad	N/A	6.1 mrad
Angular Backlash	<30 µrad	<30 µrad	<30 µrad	<30 µrad	<30 µrad	<30 µrad
Angular Hysteresis	<30 µrad	<30 µrad	<30 µrad	<30 µrad	<30 µrad	<30 µrad
Frequency Response	4 kHz	4 kHz	4 kHz	4 kHz	4 kHz	4 kHz
Operating Temperature	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C	-20 to 80 °C
Maximum Axial Load	200 g	200 g	200 g	200 g	200 g	200 g
Maximum Radial Load	200 g	200 g	200 g	200 g	200 g	200 g
Moment Inertia (with metal rotor)	26.1 g·mm ²	29.2 g·mm ²	26.1 g·mm ²	29.2 g·mm ²	26.1 g·mm ²	29.2 g·mm ²
Moment Inertia (with plastic rotor)	21.2 g·mm ²	24.4 g·mm ²	21.2 g·mm ²	24.4 g·mm ²	21.2 g·mm ²	24.4 g·mm ²
Max Current over velocity range	150 mA	150 mA	150 mA	150 mA	150 mA	150 mA
Motor Runout (with metal rotor)	≤ 50µm	≤ 50µm	≤ 50µm	≤ 50µm	≤ 50µm	≤ 50µm
Motor Runout (with plastic rotor)	≤ 80µm	≤ 80µm	≤ 80µm	≤ 80µm	≤ 80µm	≤ 80µm
Motor Weight	3.5 g	6.3 g	3.5 g	6.3 g	3.5 g	6.3 g
Motor Dimensions	13x18.7x8.2 mm	13x18.7x9.1 mm	13x18.7x8.2 mm	13x18.7x9.1 mm	13x18.7x8.2 mm	13x18.7x9.1 mm
Driver PCB Dimensions	40x25x14 mm	40x25x14 mm	40x25x14 mm	40x25x14 mm	40x25x14 mm	40x25x14 mm
Driver PCB Weight	6.4 g	6.4 g	6.4 g	6.4 g	6.4 g	6.4 g

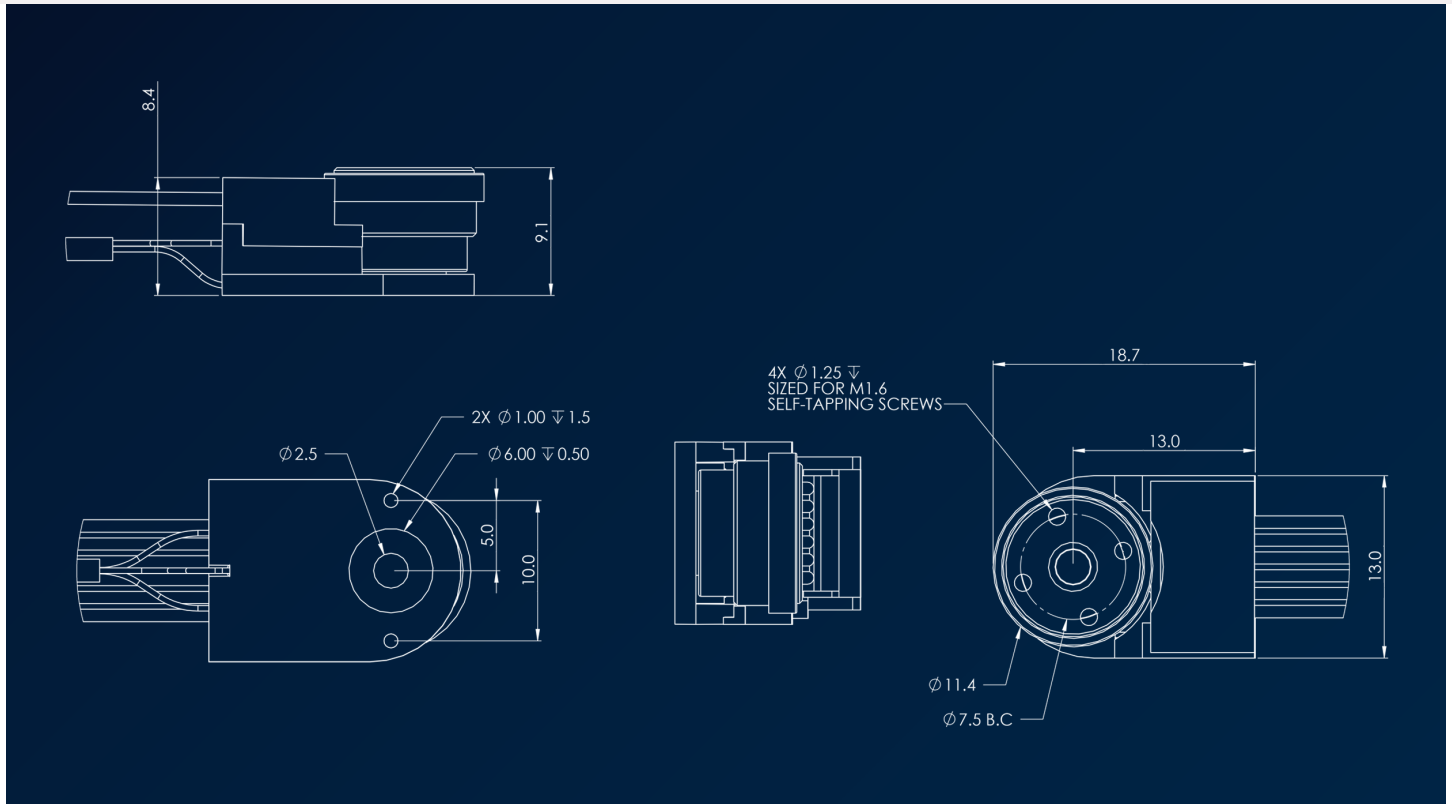
* For complete list of product numbers and custom encoder options please visit piezomotion.com or contact a member of our technical team.

RAS Series dimensional drawings

STANDARD MODEL



ENCODER MODEL



Motor control

The control of the RAS Rotary Motor is straightforward, each motor requires a driver board. This board will convert desired motion input instructions to the necessary electrical processes using specific frequency and amplitude values. This creates excitation of the piezo resonator and makes the motor perform the desired motion.

OPEN LOOP

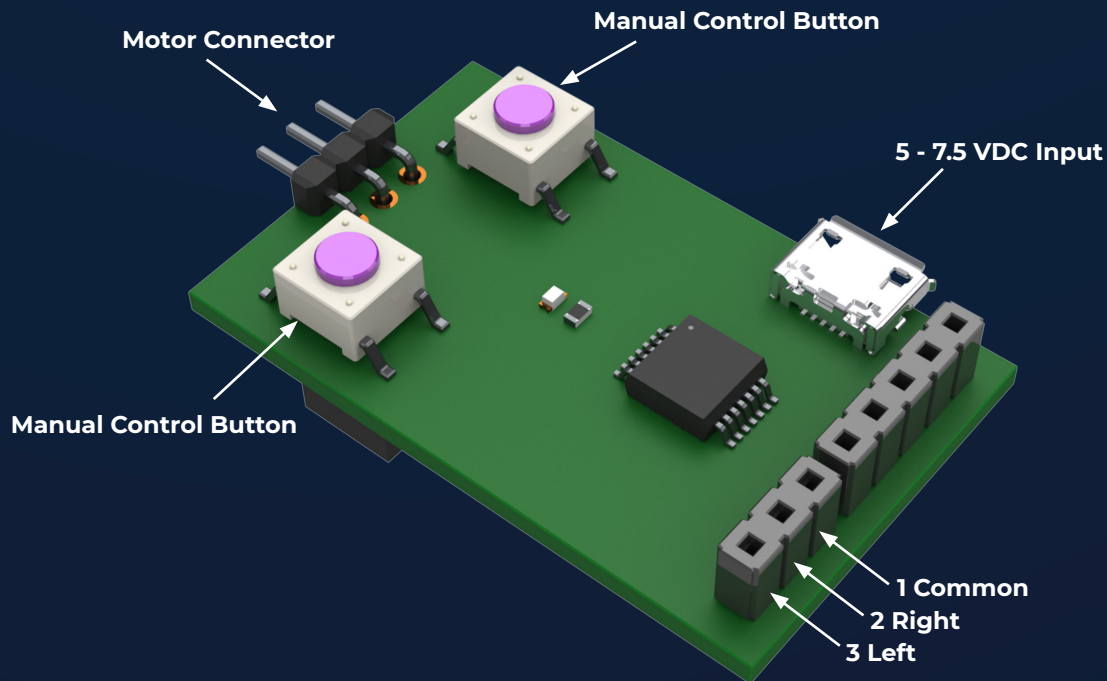
The RAS motor is designed to rotate in either direction with two push buttons on the PCB Driver. Alternatively, the motor is controlled using an external signal source via PWM (Pulse Width Modulation). Control signals are applied to Pin 2 or Pin 3 on the External Input Control Connector. The method of travel, Stepping or Continuous, depends on the type of signal applied to the External Input Connector. A constant high-level DC signal will result in continuous motion at maximum speed. A pulse or pulse train will result in a stepping operation. In the stepping mode (PWM), the size of each step is determined by the pulse duration, and the pulse repetition

rate determines the speed of travel. The minimum pulse duration is approximately 10-15 μ s. The maximum repetition rate, measured in Hertz, is determined by the motor's dynamic range, which is 4 kHz.

CLOSED-LOOP

For closed-loop control of the RAS motor with a Piezo Motion installed encoder, the user must close the loop using the feedback signals from the encoder. Motor Control can also be implemented with Python commands using Piezo Motion's Motor API. This information is provided in the RAS product user manual.

Electronic PCB Driver for RAS Series Piezo Motors



ELECTRONIC DRIVERS

EDA50V002BB Electronic Driver PCB - Open Loop

EDA50V016BB Electronic Driver PCB - Open Loop

EDC50V002BB Electronic Driver PCD - Open Loop

Control architecture & options

Piezo Motion motors are available as a basic motor or with a fitted encoder. Our electronic drivers are available as open-loop drivers. Motors can be simply controlled in open-loop mode with several options for achieving closed-loop motion control. To learn more, visit piezomotion.com/products/motors/ or scan the QR code below.

	Base Motor	Motor with Encoder
Open Loop Driver	Open Loop Control or third party controller command motor with PWM control and close control loop with external sensor	Open Loop Control or third party controller commands motor with PWM control. User must close the loop by using the feedback signals from the encoder connectors (this information is provided in the RAS product user manual).

Evaluation Kits

Full range of evaluation kits available. Each kit includes motor, driver board pcb, cables, 5 VDC or 7.5 VDC power adapter & user manual. Encoder kit version also includes factory-fitted magnetic encoder with cable and connector.

ORDERING INFORMATION

Motor Type - STANDARD	RAS2P5009HAC10-K	RAS1P0009HAC10-K	RAS4P2009HAC10-K
Description	Evaluation kit for RAS series piezo rotary motor with a plain hollow shaft and a maximum speed of ≈600 rpm. This motor has a driving torque >2.5 mN.m. It has a 10 cm cable terminated with a Molex connector. Evaluation kit includes electronic driver board, 120/220 V to 5VDC power adapter, cables and manual.	Evaluation kit for RAS series piezo rotary motor with a plain hollow shaft and a maximum speed of ≈300 rpm. This motor has a driving torque >1 mN.m. It has a 10 cm cable terminated with a Molex connector. Evaluation kit includes electronic driver board, 120/220 V to 5VDC power adapter, cables and manual.	Evaluation kit for RAS series piezo rotary motor with a plain hollow shaft and a maximum speed of ≈900 rpm. This motor has a driving torque >4.2 mN.m. It has a 10 cm cable terminated with a Molex connector. Evaluation kit includes electronic driver board, 120/220 V to 7.5 VDC power adapter, cables and manual.
Maximum Torque (mN.m)	2.5	1.0	4.2
Max Speed (rpm)	>300	>600	>900
Max Current (mA)	300	150	300
Motor Type - ENCODER	RAS2P5009HAC10-EK	RAS1P0009HAC10-EK	RAS4P2009HAC10-EK
Description	Evaluation kit for RAS series piezo rotary motor with a plain hollow shaft and a maximum speed of ≈600 rpm. This motor has a driving torque >2.5 mN.m and is fitted with a magnetic encoder (1024 ppr, 6.1 mrad). It has a 10 cm cable terminated with a Molex connector. Evaluation kit includes electronic driver board, 120/220 V to 5 VDC power adapter, cables and manual.	Evaluation kit for RAS series piezo rotary motor with a plain hollow shaft and a maximum speed of ≈300 rpm. This motor has a driving torque >1 mN.m and is fitted with a magnetic encoder (1024 ppr, 6.1 mrad). It has a 10 cm cable terminated with a Molex connector. Evaluation kit includes electronic driver board, 120/220 V to 5 VDC power adapter, cables and manual.	Evaluation kit for RAS series piezo rotary motor with a plain hollow shaft and a maximum speed of ≈900 rpm. This motor has a driving torque >4.2 mN.m and is fitted with a magnetic encoder (1024 ppr, 6.1 mrad). It has a 10 cm cable terminated with a Molex connector. Evaluation kit includes electronic driver board, 120/220 V to 7.5 VDC power adapter, cables and manual.
Maximum Torque (mN.m)	2.5	1.0	4.2
Max Speed (rpm)	>300	>600	>900
Max Current (mA)	300	150	300

For OEM and custom inquiries, contact us or our distributors for further details.

About Piezo Motion

Piezo Motion is a leader in piezo motor technology with multi-million dollar investments in research and development of affordable piezoelectric motors to meet, and exceed, the needs of today's global markets.

The company is committed to developing innovative piezoelectric technology and motion products that enhance their functionality in a multitude of applications.

Piezo Motion partners with startups, OEMs, research institutions, and industrial companies worldwide; empowering the visionaries behind their products.

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