



Technical Data Sheet

Rotary Piezomotor RAS Series

The RAS Rotary piezo motor represents a quantum leap in the design of small size high-performance DC motors. Manufactured from light weight reinforced engineering thermoplastics, this motor provides superior precision and ultrafast response/start-stop characteristics with an affordable design. Highly energy efficient, the motor consumes zero power in hold position while still providing significant torque. Available in a variety of configurations it is the ideal choice for OEM applications where superior performance and competitive unit cost are important factors.

Motor Specifications	Standard	Encoder
Mode of Operation	Stepping & Continuous	
Maximum Torque	0.6 / 1.0 / 1.0 / 2.5mN.m	Note 1
Self Braking Torque	1.1 / 1.1 / 1.1 / 2.8mN.m	Note 1
Response Time	10µs to 30µs	
Maximum Speed	150 / 300 / 600 / 300 rpm	Note 1
Minimum Angular Step (resolution)	30µrad	30µrad
Minimum controlled angular Step	N/A	6.1mrad
Uni-directional Repeatability	N/A	- 40 arc-n
Dynamic Range	4 kHz	
Angular Hysteresis of Rotational Axis at	<30µrad	<30µrad
Supply Voltage for Driver	5 VDC	
Operating Temperature	-20° to 80°C	
Max Current over velocity range	50 / 100 / 300/ 300mA	Note 2
Motor Weight	4g	6g
Motor Dimensions (mm)	13x18.7x8.2	3x18.7x11
Driver PCB Dimensions (mm)	40x25x14	40x25x14
Control	Open loop	closed loop



Note 1: Torque, Speed and Power are varied with different motor models and driver firmware

Note 2: Maximum current in continuous mode. Use of PWM with different duty cycle will proportionally reduce average current.

Principle of Operation

DTI's rotary piezomotors 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 www.dtimotors.com). DTI's electronic driver's have been designed to provide an economical user-control interface. Each driver PCB is supplied pre-programmed for the specific motor model. The RAS can be controlled in open-loop mode using PWM (pulse width modulation). Closed loop control of the motor is achieved via an optional encoder mounted on the back of the motor. Refer to the Electronic Driver 'ED' technical data sheet for full details of Electronic Drivers.

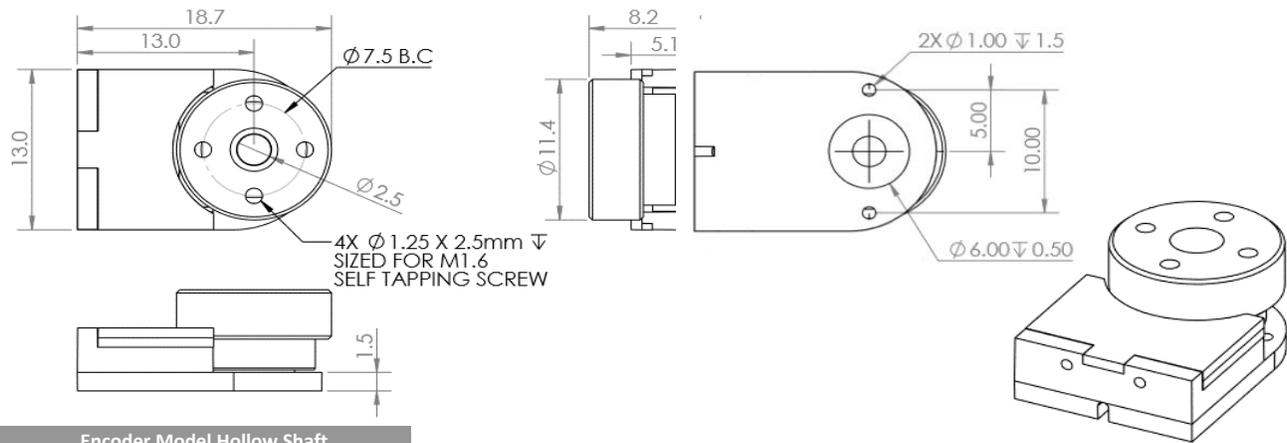
Performance and Key benefits vs. Electromagnetic Motors

Improved Resolution:	With a minimum step size of just 30µrad at full Torque these motors offer >200000 steps per revolution of control.
Faster reaction time:	Within 10µs to 30µs the Piezomotor has made its first step and motion has commenced compared to a stepper motor with typical 5ms to start motion.
Higher specific power stall torque:	For the same power as a comparable sized Stepper motor the Piezomotor has a stall torque of up to 10x greater for the same power rating.
Energy and Cost Saving	The Piezomotor consumes zero power at holding torque and very low power at slow speed (0.025W at 1 RPM), yielding the possibility of very efficient overall duty.
Special Properties	The piezomotor is immune to EM and RF interference and has no emissions.
Economical Design	The innovative design and Patent protected technology packaged in stable reinforced engineering thermoplastic makes this high performance technology affordable for OEM equipment designers.
Lightweight	The Piezomotor 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.

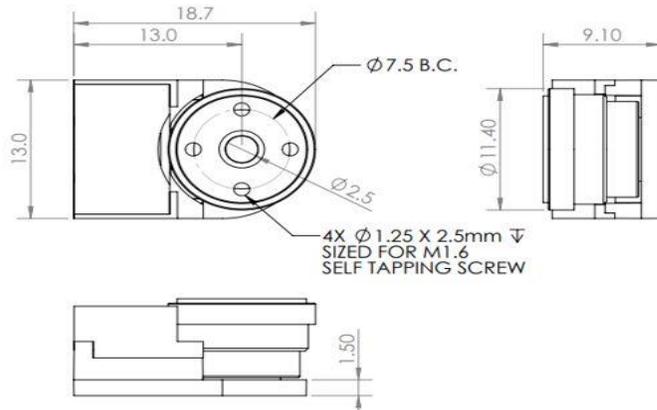
Dimensional Drawings

dimensions in mm

Standard Model Hollow Shaft



Encoder Model Hollow Shaft



Standard Model Solid Shaft

Product in Development

Encoder Model Solid Shaft

Product in Development

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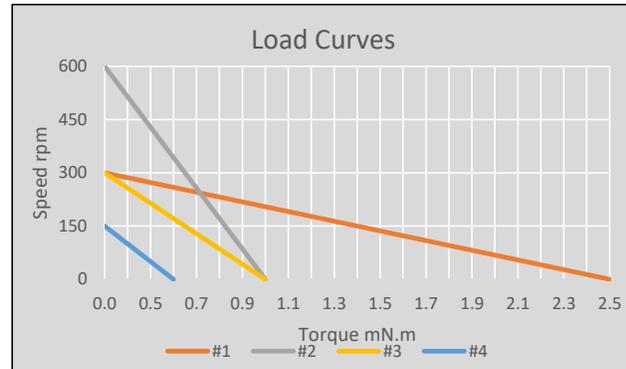


Performance Chart and Motor/Driver Part Configurations

Torque, Speed and Power are varied with different motor models and driver firmware

Motor Type:	RAS2P5	RAS1P0	RAS1P0	RAS1P0
Driver Model #'s:	EDA35V001BB	EDA35V002BB	EDA35V003BB	EDA35V004BB
Blocking Torque (mN.m)	>2.5	>1.0	>1.0	>0.6
Self Breaking Torque (mN.m)	>2.8	>1.1	>1.1	>1.1
Maximum Speed (rpm)	>300	>600	>300	>150
Max Current (mA)	300	300	100	50
Kit ordering #	1	2	3	4

Refer to this table to determine which Motor and which Driver PCB to select to achieve the desired motor performance characteristics. Evaluation Kit includes: Piezomotor, drives, PCB, cables, 5VDC adapter & USB Manual. If ordering an evaluation kit please note the kit #number which must be included after the K character in the product ordering code.



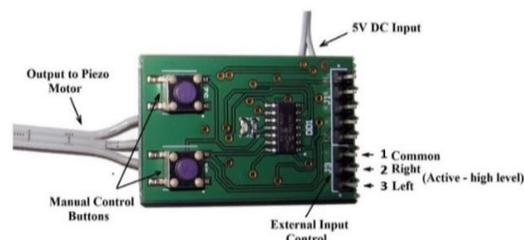
Motor Control

Control of DTI Piezomotors is straightforward. Each motor requires a driver board which will convert motion input instructions to the necessary electrical processes with specific frequency and amplitude to create excitation of the piezo resonator and make the motor perform the motion path instructed.

Open Loop Control with PWM

The RAS motor can be manually controlled to rotate in either direction with two pushbuttons on the Driver PCB. Alternatively, the motor can be controlled using an external signal source via PWM (Pulse Width Modulation) mode. Control signals are applied to Pin 2 or Pin 3 on the External Input Control Connector (see Figure). The mode of rotation, Stepping or Continuous, depends on the type of signal applied to the External Input Connector. A constant "high" level (D.C.) signal will result in continuous motion at maximum speed. A pulse or pulse train will result in stepping operation. In the stepping mode (PWM), the size of each step is determined by the pulse duration, and the speed of rotation is determined by the pulse repetition rate. The minimum pulse duration is around 10-15 μ s. The maximum repetition rate F, measured in Hertz, is determined by the Dynamic range of the piezo motor, which is 4 kHz.

For close loop control of the RAS motor with a DTI installed encoder, the user must close the loop by using the feedback signals from the encoder connectors. The encoder fitted provides a maximum resolution after quadrature of 1,024 ppr (additional information is provided in the LAS product user manual).



Electronic PCB driver for RAS piezo motors

Control Architecture

The RAS Series of rotary motors are available as a basic (open loop) motor or with a DTI fitted encoder.

The RAS motor can be simply controlled using PWM in either open loop mode or close loop control.

	Open Loop Driver
Base Motor	Open Loop Control or 3rd Party controller command motor with PWM control and close control loop with external sensor
Motor with Encoder	Open Loop Control or 3rd 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).

Ordering Information

Motor

RAS 009 -

Add all required option Codes after dash in alphabetical order

1.1mN.m Torque	1P0
2.5mN.m Torque	2P5

Hollow Shaft=	HA
Solid Shaft=	SA
Solid Shaft with Flat=	SD

C30	=Connector and 30cm
W15	=15cm Wires

K #	= Evaluation Kit including Motor, Electronic Driver, Cables, manual (Must have C30 = Connector) Refer to the Configuration table to determining the number to insert where the # sign is shown to define the desired kit.
=	Incremental

Example: RAS1P0009HAC30-EK3 is a 1.0mN.m Hollow Shaft Motor with Encoder and Connector evaluation kit for an RAS1P0 motor with an EDA35V003BB Driver

Note: An encoder motor Kit includes Motor with Encoder and an Open loop driver board. Until closed loop driver boards are developed customers must close the feedback loop with their own control software using the encoder output to determine position and the Driver to control the motor using PWM mode.

Electronic Driver

Consult Motor/Drive configuration table above for Electronic Driver part numbers

Refer to Electronic Driver 'ED' Data Sheet for further information on Piezomotor control techniques and driver electronics

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