



PIEZOMOTION

# INSTRUCTION MANUAL

Rotary Piezoelectric Motor  
Evaluation Kit

**RAS Series Motor**  
**with and without Factory-Fitted Encoder**

Discover **affordable precision** with piezoelectric **innovation**.

Table of Contents

1.0 Introduction.....2

2.0 Properties.....4

3.0 Unpacking and Preparation.....4

4.0 Technical Specifications .....5

    4.1 Combined Specifications for RAS Series rotary Motors.....5

    4.2 Mechanical Drawings of RAS rotary motor series.....6

5.0 Operation and Control of the Piezo motor .....7

    5.1 Connecting the Power Supply.....7

    5.2 Connecting the Driver Board.....7

    5.3 Operation of the Motor and Driver Board .....7

    5.4 Motor Demonstration Mode .....8

    5.5 Open loop mode control.....9

    5.6 Stepping and Continuous Modes.....9

    5.7 Recommended settings to avoid overheating.....10

    5.8 Closing the loop for RAS with installed encoder.....11

6.0 Technical Support.....12

7.0 Warranty.....12

# OEM Evaluation Kit Instruction Manual

## 1.0 Introduction

This manual covers instructions for the use and operation of the RAS Series of rotary piezo motors with factory fitted encoder. The RAS Series represents a quantum leap in design of small size high-performance rotary motors. Injection-molded using extremely durable, but lightweight engineered reinforced thermoplastics, the RAS Series motors provides superior precision and functionality with ultra-fast response/start-stop characteristics. Highly energy efficient, the RAS Series motors consume zero power in hold position while still providing necessary torque. Available in a variety of configurations (including non-magnetic) they are the ideal choice for high volume demanding OEM applications where superior performance and economical unit cost are important factors.

The contents of this kit are intended to be used as an evaluation tool for engineers interested in learning more about the performance and operation of Piezo Motion's RAS Series piezoelectric motors (piezomotors).

The electronic driver PCB for the RAS piezomotor is included in the evaluation kit, together with cables and a 5 VDC power supply.

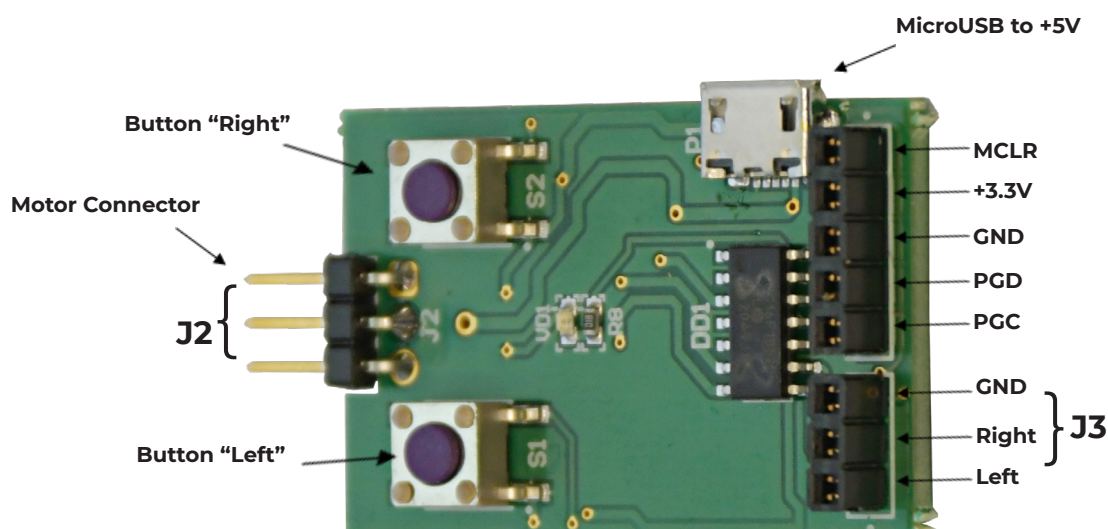
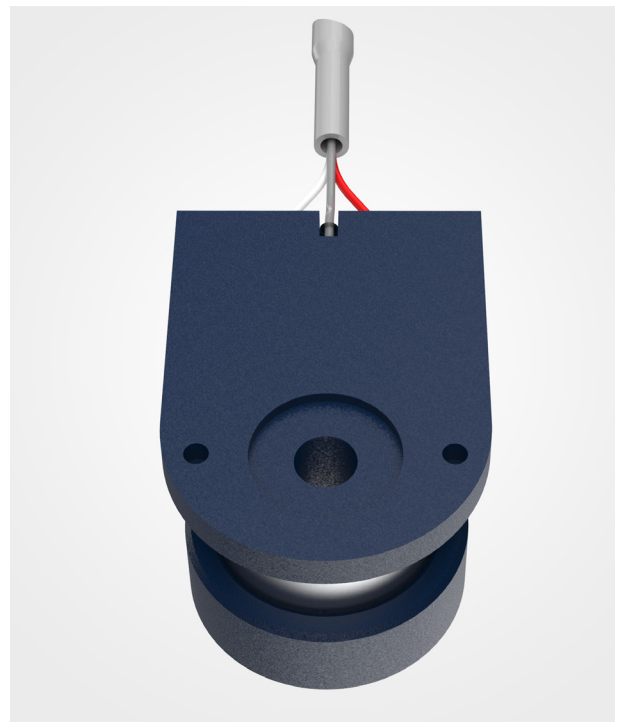
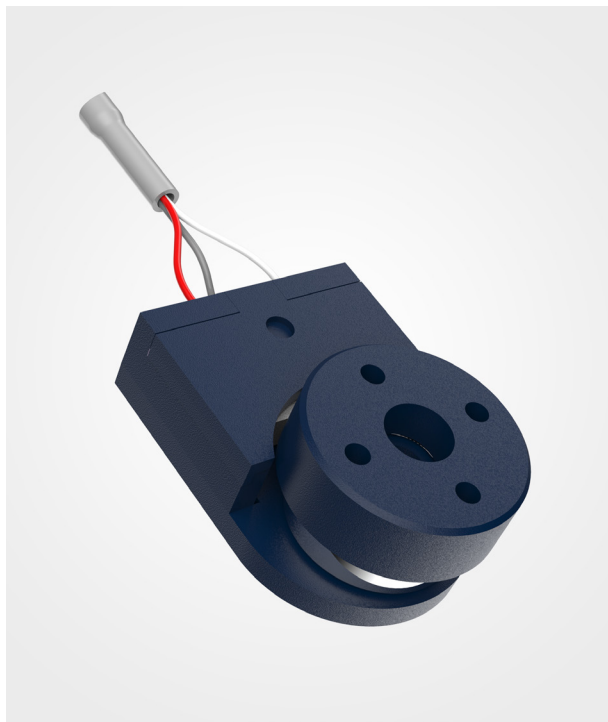
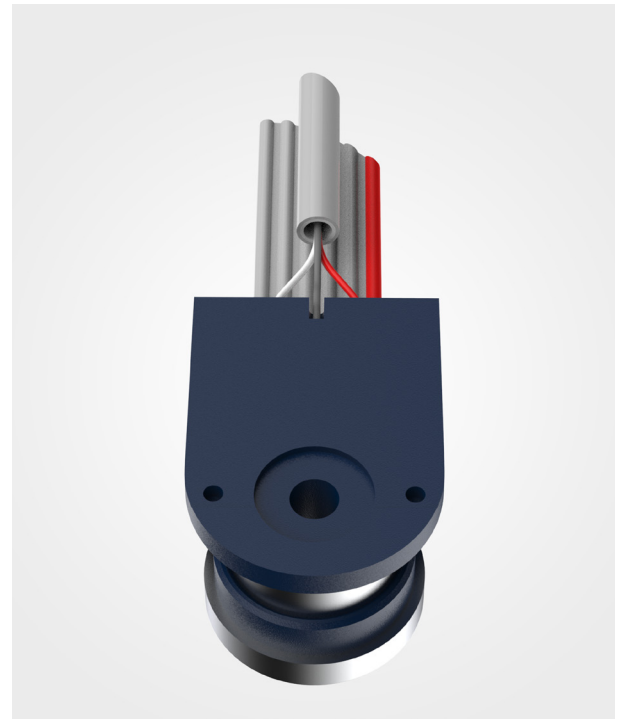
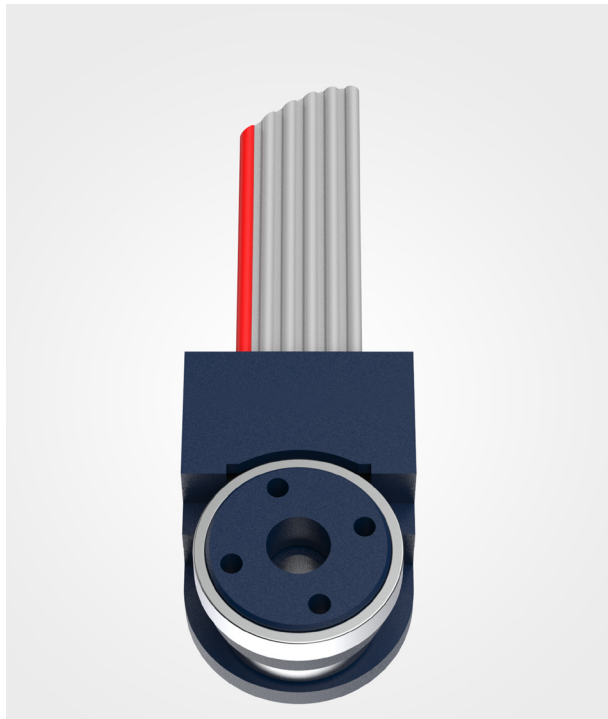


Figure 1. Electronic PCB Driver for RAS piezomotor



**Figure 1. RAS Series Motor (front and back) Non-Encoder Version**



**Figure 2. RAS Series Motor with Factory-Fitted Encoder**

## 2.0 Properties

Some of the unique properties of the RAS Series motors include:

- Modern reinforced engineered thermoplastic design provides reliability and low cost
- Superior precision and resolution
- Ultra-Fast response time with superior start-stop characteristics
- High torque for size
- Designed for direct drive applications
- Stepping and Continuous mode of operation
- Six orders of magnitude speed dynamic range
- When not energized, the motor serves as a brake and consumes zero power
- Silent operation in continuous mode
- Low voltage and decreased possibility for electrical arcing

## 3.0 Unpacking and Preparation

After unpacking the RAS series motor evaluation kit, check the contents against the items listed in the table below. If any items are missing contact Piezo Motion immediately for replacement parts.

DESCRIPTION
Model RAS Series piezomotors
Electronic Driver PCB
Interconnect cables
Power Supply (5V DC)

**Table 1 – Description**

## 4.0 Technical Specifications

### 4.1 Specification for RAS Series Rotary Motors

Weight	4 g
Dimensions	13x18.7x8.2 mm
Nominal Outside Diameter	9 mm
Torque Options	2.5 mN.m
Self Braking Torque Options	2.8 mN.m
Speed Options	≥300 rpm
Torque	>2.5 mN.m
Rotational Speed	>300 rpm
Driver Supply Voltage	5 V
Current Options	300 mA
Driver Output Voltage	50 V
Response Time Range	10 μs to 30 μs
Minimum Angular Step	< 30 μrad
Angular Hysteresis at Direction Change	< 30 arc.min
Operating Temperature Range	-20 to 80°C
Shaft Type	Hollow Shaft
Shaft Style	Plain
Connection Type	Molex connector
Wire Length	10 cm
Encoder	No Encoder

**Table 2 – RAS Series Specifications**

Weight	6 g
Dimensions	13x18.7x9.1 mm
Minimum Controlled Linear	.0061 μrad
Nominal Outside Diameter	9 mm
Torque Options	1 mN.m   1 mN.m   0.6 mN.m
Self Braking Torque Options	1.1 mN.m   1.1 mN.m   1.1 mN.m
Speed Options	≥600 rpm   ≥300 rpm   ≥150 rpm
Minimum Controlled Angular Step	.0061 μrad
Uni-directional Repeatability	±40 arc.min
Torque	>1 mN.m
Driver Supply Voltage	5 V
Current Options	300 mA   100 mA   50 mA
Driver Output Voltage	50 V
Response Time Range	10 μs to 30 μs
Minimum Angular Step	< 30 μrad
Angular Hysteresis at Direction Change	< 30 arc.min
Operating Temperature Range	-20 to 80°C
Shaft Type	Hollow Shaft
Shaft Style	Plain
Connection Type	Flying lead
Wire Length	10 cm
Encoder	Magnetic

**Table 3 – RAS Series with factory-installed encoder Specifications**

## 4.2 Mechanical Drawings of RAS Series rotary motor series

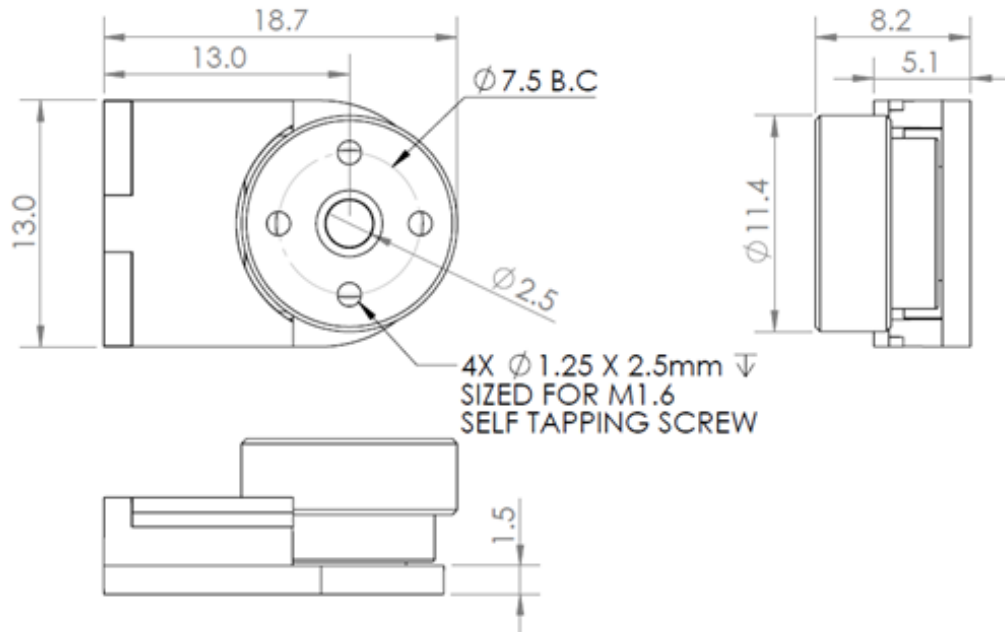


Figure 3. Mechanical Drawing (mm) of RAS Rotary Motor Non-Encoder Version

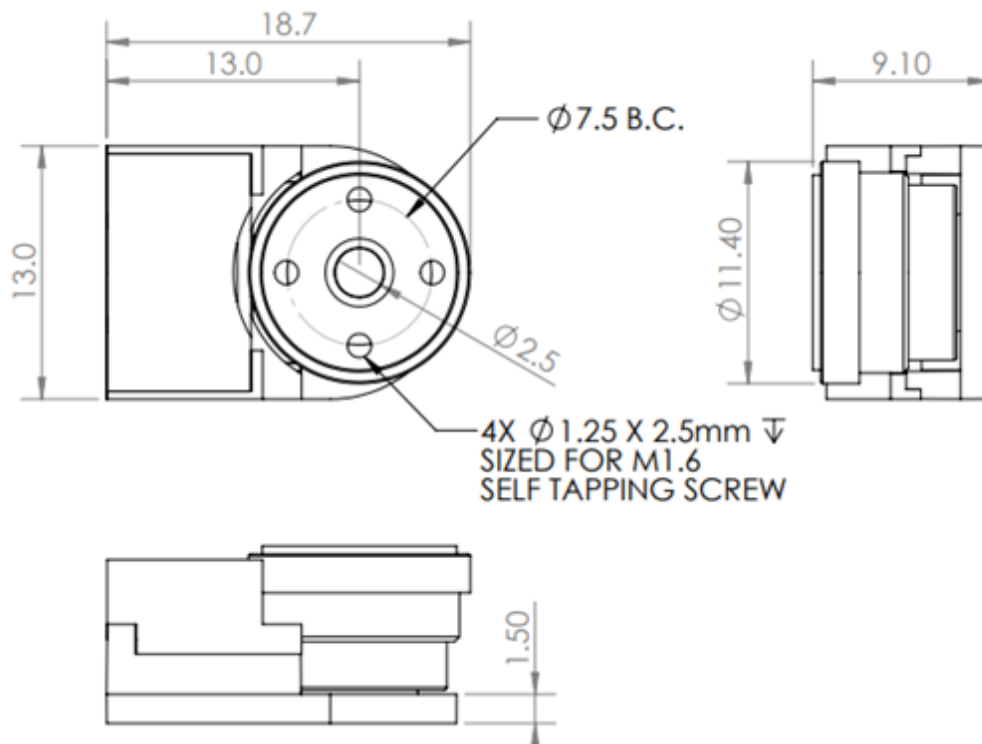


Figure 4. Mechanical Drawings of RAS Series Rotary Motor with Factory-Fitted Encoder

## **5.0 Operation and Control of the Piezo Motor**

### **5.1 Connecting the Power Supply**

Connect the 5 VDC Power Supply to the Micro USB connector on power supply connector located on the electronic driver PCB (Figure 1). Connect the other end of the Power Supply to an appropriate wall power socket (110-240 V AC).

### **5.2 Connecting the Driver Board**

The piezo motor connects to the driver board by a connector on the end of the motor wire. This connector mates with the corresponding connector on the electronic driver PCB. The connectors can only be joined in one possible orientation. Press the connector gently in place so that it is flush with the edges of the receptacle on the driver PCB.

### **5.3 Operation of the Motor and Driver Board**

The electronic driver PCB generates the drive signals required by the piezo motor. Motion is created causing the rotor to rotate. The design enables travel in both directions. Manual control of rotation is achieved by pushing alternatively the two buttons on the driver board.



## 5.4 Motor Demonstration Mode

The driver PCB is factory programmed with a useful demonstration program that is designed to familiarize the user with the versatility, performance, and capabilities of the RAS motor.

The demonstration mode is initiated by pressing and holding down the “Right” (S2) and “Left” (S1) buttons simultaneously for a few seconds. This will cause the RAS motor to run through a series of motion control exercises during which it will demonstrate fast continuous rotation, fast stepping and slow stepping mode.

1. 2 cycles \* [ Continuous mode\_ CW (0.5s) – pause ( 0.5s) - Continuous mode CCW (0.5s) – pause ( 0.5s) ] – Current 100mA (300 mA)
2. 30 cycles \* [ PWM\_CW-pulse (10 ms) – pause (200 ms)] – Average current 5 mA (10 mA)
3. 30 cycles \* [ PWM\_CCW-pulse (10 ms) – pause (200 ms)] – Average current 5 mA (10 mA)
4. 1 cycle \* [ Continuous mode\_ CW (0.5s) – pause ( 0.5s) - Continuous mode CCW (0.5s) – pause ( 0.5s) ] – Current 100mA (300 mA)
5. 90 cycles \* [ PWM\_CW-pulse (0.5 ms) – pause (32 ms)] – Average current 1.5 mA (3 mA)
6. 90 cycles \* [ PWM\_CCW-pulse (0.5 ms) – pause (32 ms)] – Average current 1.5 mA (3 mA)
7. 1 cycle \* [ Continuous mode\_ CW (0.5s) – pause ( 0.5s) - Continuous mode CCW (0.5s) – pause ( 0.5s) ] – Current 100mA (300 mA)
8. 30 cycles \* [ PWM\_CW-pulse (1 ms) – pause (200 ms)] – Average current 0.5 mA (1 mA)
9. 30 cycles \* [ PWM\_CCW-pulse (0.5 ms) – pause (32 ms)] – Average current 1.5 mA (3 mA)
10. 1 cycle \* [ Continuous mode\_ CW (0.5s) – pause ( 0.5s) - Continuous mode CCW (0.5s) – pause ( 0.5s) ] – Current 100mA (300 mA)
11. 60 cycles \* [ PWM\_CW-pulse (10 ms) – pause (50 ms) \_CCW-pulse (10 ms) – pause (50 ms)] – Average current 20 mA (50 mA)
12. 10 cycles \* [ PWM\_CW-pulse (10 ms) – pause (300 ms) \_CCW-pulse (10 ms) – pause (300 ms)] – Average current 3 mA (5 mA)
13. 1 cycle \* [ Continuous mode\_ CW (0.5s) – pause ( 0.5s) - Continuous mode CCW (0.5s) – pause ( 0.5s) ] – Current 100mA (300 mA)
14. 10 cycles \* [ PWM\_CW-pulse (100 ms) – pause (200 ms)] – Average current 50 mA (150 mA)
15. 10 cycles \* [ PWM\_CCW-pulse (100 ms) – pause (200 ms)] – Average current 50 mA (150 mA)

The demonstration program can be stopped at any time by pressing either the “Right” or “Left” button once.

## 5.5 Open loop mode control

The motor can be controlled by applying a PWM (Pulse Width Modulation) control signals to either “J3 Right” (CW rotation) or “J3 Left” (CCW rotation) on the driver board, depending on the desired direction of travel. J3 GND is the common wire. A TTL “high” level voltage (2.0 to 5 Volts) enables travel, a TTL “low” level voltage (0 to 0.8 Volts) disables travel. The unused wire must be held at TTL “low” or be left open.

## 5.6 Stepping and Continuous Modes

The mode of travel, stepping or continuous, depends on the type of signal applied to the PCB inputs at J3. 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 mode), the size of each step is determined by the pulse duration, and the speed of travel is determined by the pulse repetition rate. The minimum pulse duration is around 10-15  $\mu$ s. The maximum repetition rate F, measured in Hertz, is determined by the Dynamic range of the piezo motor and it is 4 kHz for all Piezo Motion rotary motors.

*Example setting for stepping (PWM) mode operation with 50% duty cycle*

- Set repetition rate/frequency = 100 Hz (period of 10 ms)
- Set pulse duration = 5 ms.
- Duty cycle = 50%.

**Note:** Although the maximum operating repetition rate of the motor is 4 kHz, for operating repetition rates above 2 kHz, phase synchronization of the input signals on both channels is required for optimal performance of the motor.

## 5.7 Recommended settings to avoid overheating

Piezo Motion's range of piezomotors are designed for precise control applications using a duty cycle. They are not designed for prolonged operation in Continuous (non-stepping) Mode, which can lead to overheating of the motor and possible internal damage not protected under warranty.

To avoid overheating of the motor please follow the guidelines in the table below and ensure that motion control settings for Continuous Mode and/or Stepping (PWM) Mode are within the limits specified in the table below.

For applications requirements exceeding the recommended guideline, please contact Piezo Motion's Technical Support.

Model/Series #	Max. Operating Power (W)	Max. Operating Power (W)	Recommended PWM Duty Cycle	Maximum Duration in Continuous Mode
RBS Series	4.32 W	1.8W	40%	30s
LBS004	4.2 W	1.7W	40%	20s
LCS004	4.2 W	1.7W	40%	20s
LCS010 (10N)	19.2 W	5.8W	30%	15s
RAS(300mA)	1.5 W	0.5 W	30%	10 sec.
RAS(100mA)	0.5 W	0.25 W	50%	30 sec.
RAS(50mA)	0.25 W	0.13 W	50%	60 sec.
LAS(100mA)	0.5 W	0.25 W	50%	30 sec.

**Table 4 – Recommended Guidelines for Motion Control.**

5.8 Closing the loop for RAS with Piezo Motion installed encoder

For RAS with factory installed encoder, the user can close the loop by using the feedback signals from the encoder connectors as shown in Figure 4.

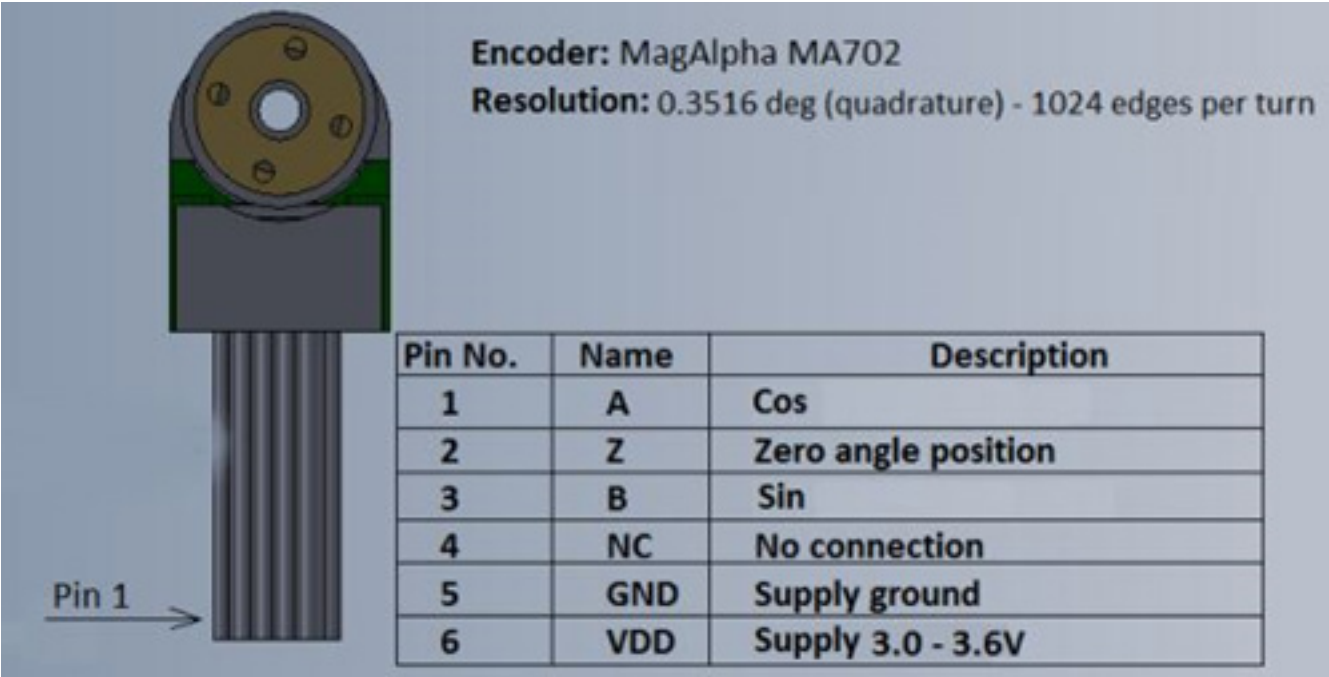


Figure 5. Pinout of the Piezo Motion installed encoder connector for RAS motors. The model of the encoder is MagAlpha MA702. The maximum resolution after quadrature is 1,024 ppr.

## 6.0 Technical Support

Technical support is available from 9 AM to 5.30 PM U.S. Eastern Time. Please refer to contact information at end of manual.

## 7.0 Warranty

All sales and deliveries are made exclusively on the basis of our general Terms and Conditions of Business. These are available to view and download on the Piezo Motion homepage at <http://piezomotion.com/terms-and-conditions/>

### **Piezo Motion Corp**

6700 Professional Parkway  
Sarasota, Florida 34240  
USA

Tel: (941) 907- 4444

Email: [info@piezomotion.com](mailto:info@piezomotion.com)  
[piezomotion.com](http://piezomotion.com)

