PIEZOMOTION

INSTRUCTION MANUAL

Linear Piezoelectric Motor
Evaluation Kit

LAS Series Motor
with and without Factory-Fitted Encoder

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

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LAS Encoder Series OEM Evaluation Kit Instruction Manual

1.0 Introduction

This manual covers instructions for the use and operation of the LAS Series of linear piezomotors. The LAS Series represents a quantum leap in design of small size high-performance linear motors. Injection-molded using extremely durable, but lightweight engineered reinforced thermoplastics, the LAS Series motors provides superior precision and functionality with ultra-fast response/start-stop characteristics. Highly energy efficient, the LAS Series motors consume zero power in hold position while still providing necessary force. Available in a variety of configurations (including with factory fitted encoder) 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 LAS Series piezomotors.

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

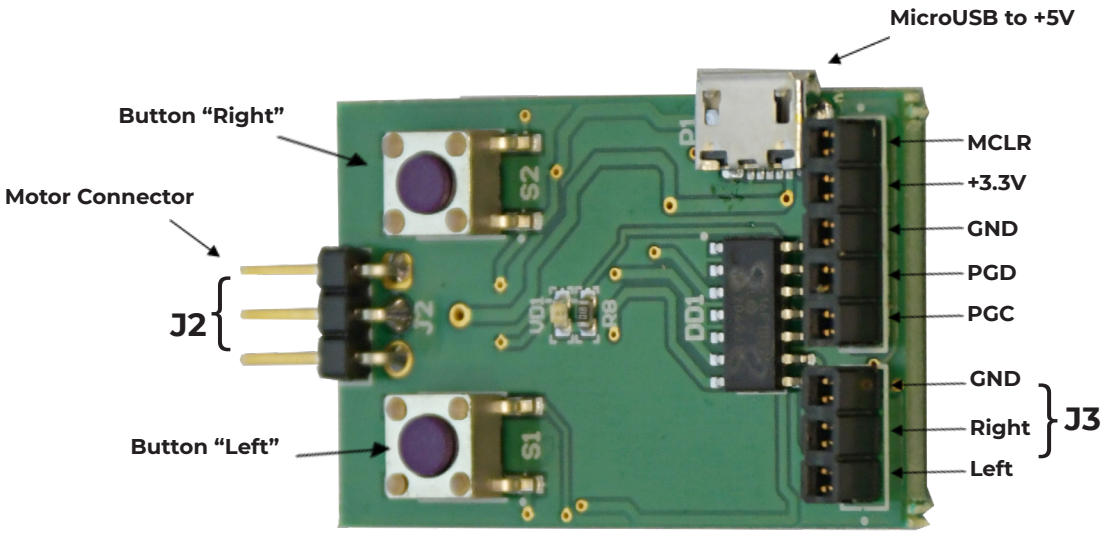


Figure 1. Electronic PCB Driver for LAS piezomotor

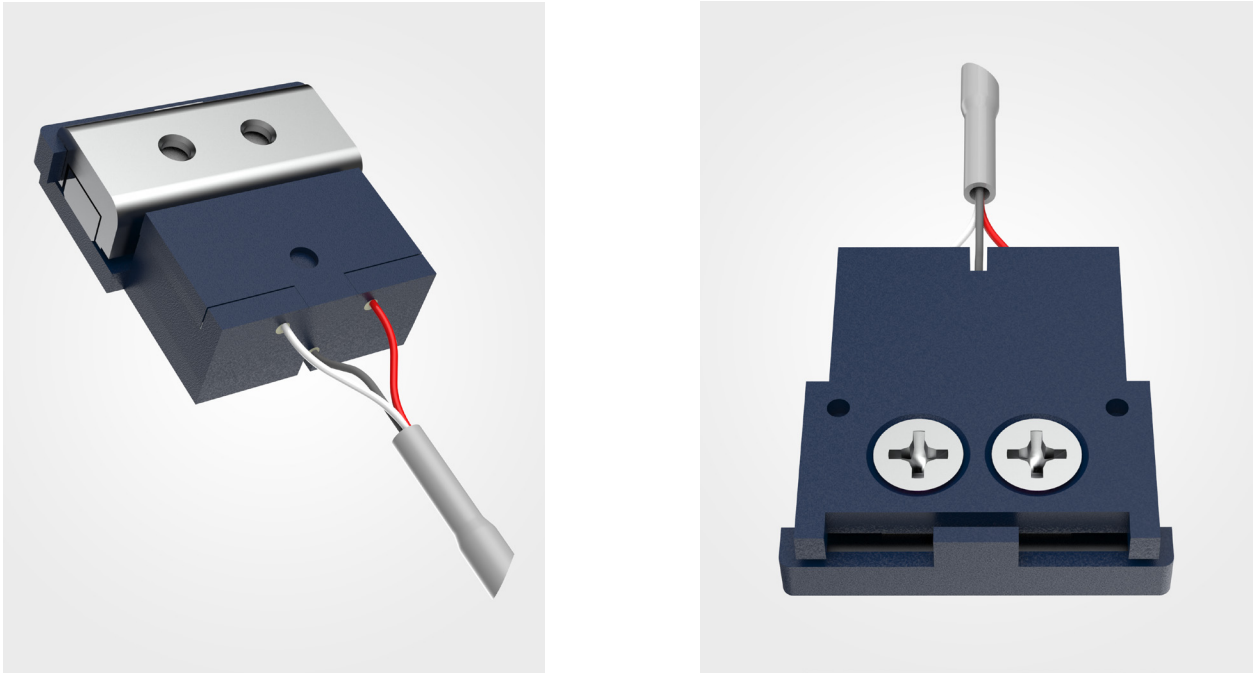


Figure 2. LAS Series motor (front and back) non-encoder version

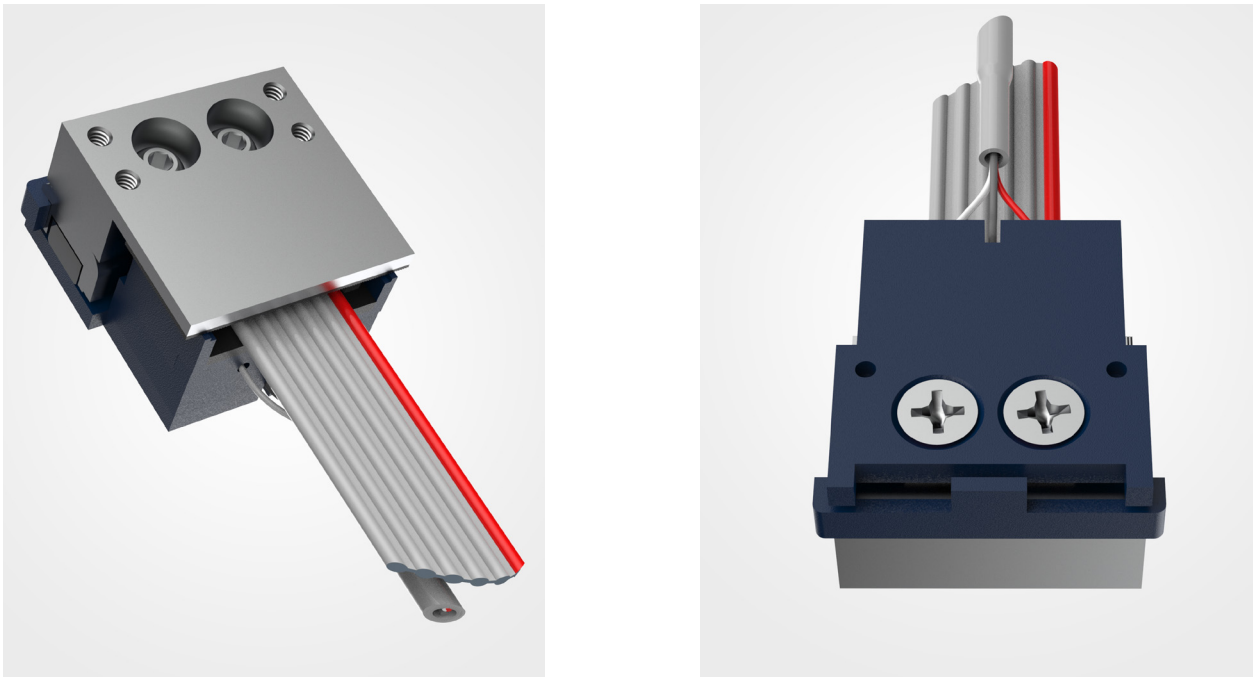


Figure 3. LAS Series motor (front and back) fitted with factory installed encoder

NOTE – *Moving carriage on all motor models has mounting holes for M2 size self-tapping screw (e.g. see https://us.screwerk.com*

2.0 Properties

Some of the unique properties of the LAS 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 force 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 LAS 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 LAS Series linear motors with and without factory-installed encoder

Power Supply Voltage	5 V
Power Supply US	ELE-000361
Power Supply International	ELE-000362
Push/Pull Force	≥ 0.2 N
Self Braking Force	>0.25 N
Motor Response Time	≈30µs
Max Speed	200 mm/s
Travel Range	9.0 mm
Minimum Linear Step	<0.04 µm
Encoder Resolution (after quadrature)	2.66 µm
Minimum Controlled Linear Step	2.66 µm
Uni-directional Repeatability	2.66 µm
Linear Backlash at Change of Direction	≤ 0.1 µm
Elastic stiffness	≈ 20 mN/µm
Linear Hysteresis	≤ 2.0 µm
Pitch*	<1 mrad
Maximum Moment Mx*	0.07 Nm
Roll*	<0.5 mrad
Maximum Moment My*	0.12 Nm
Yaw*	<1 mrad
Maximum Moment Mz*	0.9 Nm
Vertical Runout*	3.0 µm
Horizontal Runout*	6.0 µm
Frequency Response	4 kHz
Operating Temperature	-20 to 80 °C
Maximum Load (at listed specification)	20 g
Maximum Tolerable Load*	4.2 kgf
Max Current over velocity range	150 mA
Motor Weight	4.7 g
Motor Dimensions	16.3×16.5×5.7 mm
Driver PCB Dimensions	40x25x14 mm
Driver PCB Weight	6.4 g

Table 2 – LAS Series Specifications

Power Supply Voltage	5 V
Power Supply US	ELE-000361
Power Supply International	ELE-000362
Push/Pull Force	≥ 0.2 N
Self Braking Force	>0.25 N
Motor Response Time	≈30µs
Max Speed	100 mm/s
Travel Range	9.0 mm
Minimum Linear Step	<0.04 µm
Encoder Resolution (after quadrature)	N/A
Minimum Controlled Linear Step	N/A
Uni-directional Repeatability	N/A
Linear Backlash at Change of Direction	≤ 0.1 µm
Elastic stiffness	≈ 20 mN/µm
Linear Hysteresis	≤ 2.0 µm
Pitch*	<1 mrad
Maximum Moment Mx*	0.07 Nm
Roll*	<0.5 mrad
Maximum Moment My*	0.12 Nm
Yaw*	<1 mrad
Maximum Moment Mz*	0.9 Nm
Vertical Runout*	3.0 µm
Horizontal Runout*	6.0 µm
Frequency Response	4 kHz
Operating Temperature	-20 to 80 °C
Maximum Load (at listed specification)	20 g
Maximum Tolerable Load*	4.2 kgf
Max Current over velocity range	150 mA
Motor Weight	8.5 g
Motor Dimensions	16.3×16.5×10.4 mm
Driver PCB Dimensions	40x25x14 mm
Driver PCB Weight	6.4 g

Table 3 – LAS Series with factory-installed encoder Specifications

4.2 Mechanical Drawings of LAS Series linear motors

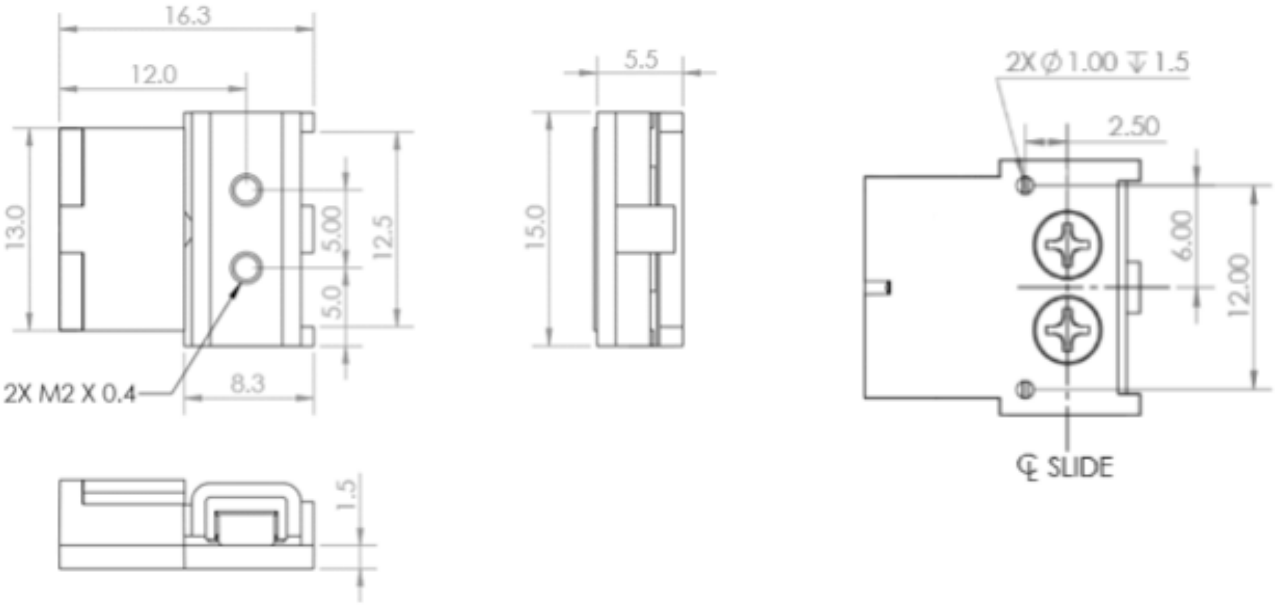


Figure 4. Drawings of LAS Series linear motors non-encoder version

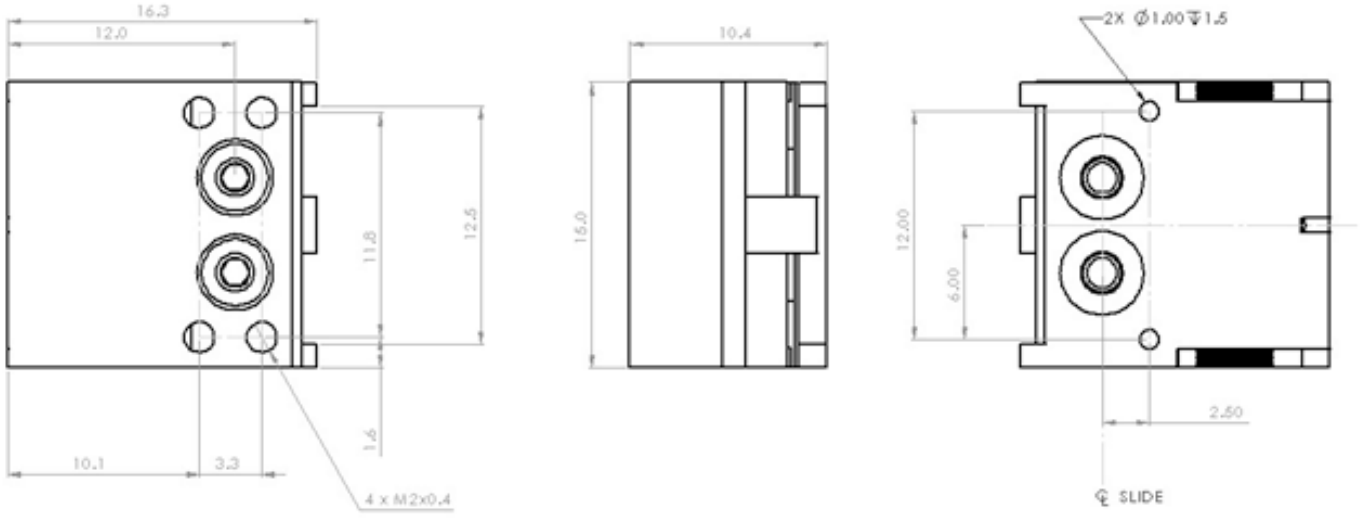


Figure 5. Mechanical Drawings of LAS Series linear motors with factory-installed integrated encoder

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 (J2) 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 motion is achieved by pushing alternatively the two buttons on the driver board.

5.4 Open loop mode control

The motor can be controlled by applying a PWM (Pulse Width Modulation) control signals to either “J3 Right” or “J3 Left” 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.

5.5 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 µs. 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 motors.

Example PWM Control Setting for Minimum Step (approx. 0.04 µm)

- Set Pulse Duration to between 30 µs - 40 µs
- Set Frequency to between 100 Hz - 150 Hz

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: Maximum Permitted Frequency for PWM is 150 Hz

The maximum permitted frequency (repetition rate) for PWM control of the motor is 150 Hz using the standard driver PCB supplied with your motor. Attempting to use the standard driver at PWM frequencies exceeding 150 Hz can result in inferior motion control, excessive noise, and unstable operation of the motor.

Please contact Piezo Motion technical support for available driver options offering PWM frequencies >150 Hz and up to 4KHz

5.6 Factory Installed Open-Loop Demonstration Mode

The LAS 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 LAS motor.

The demonstration mode is initiated by simultaneously pressing and holding down both of the Manual Control Buttons on the driver PCB for a few seconds. This will cause the LAS motor to run through a series of motion control exercises during which it will demonstrate fast continuous rotation, fast stepping and slow stepping modes.

The demonstration program runs through the following steps:

1. 4 cycles * [Continuous mode_ CW (0.1s) – pause (0.5s) - Continuous mode CCW (0.1s) – pause (0.5s)] – Average current 50 mA

2. Pause -1s

3. 10 cycles * [Continuous mode_ CW (0.1s) - Continuous mode CCW (0.1s)] – Average current 110 mA

4. Pause -1s

5. 10 cycles * [PWM_CW-pulse (10 ms) – pause (200 ms)] – Average current 5 mA

6. 10 cycles * [PWM_CCW-pulse (10 ms) – pause (200 ms)] – Average current 5 mA

7. 10 cycles * [PWM_CW-pulse (10 ms) – pause (200 ms)] – Average current 5 mA

8. 10 cycles * [PWM_CCW-pulse (10 ms) – pause (200 ms)] – Average current 5 mA

9. 90 cycles * [PWM_CW-pulse (0.5 ms) – pause (32 ms)] – Average current 1.5 mA

10. 90 cycles * [PWM_CCW-pulse (0.5 ms) – pause (32 ms)] – Average current 1.5 mA

11. 90 cycles * [PWM_CW-pulse (0.5 ms) – pause (32 ms)] – Average current 1.5 mA

12. 90 cycles * [PWM_CCW-pulse (0.5 ms) – pause (32 ms)] – Average current 1.5 mA

13. 30 cycles * [PWM_CW-pulse (1 ms) – pause (209 ms)] – Average current 0.5 mA

14. Pause -1s

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.

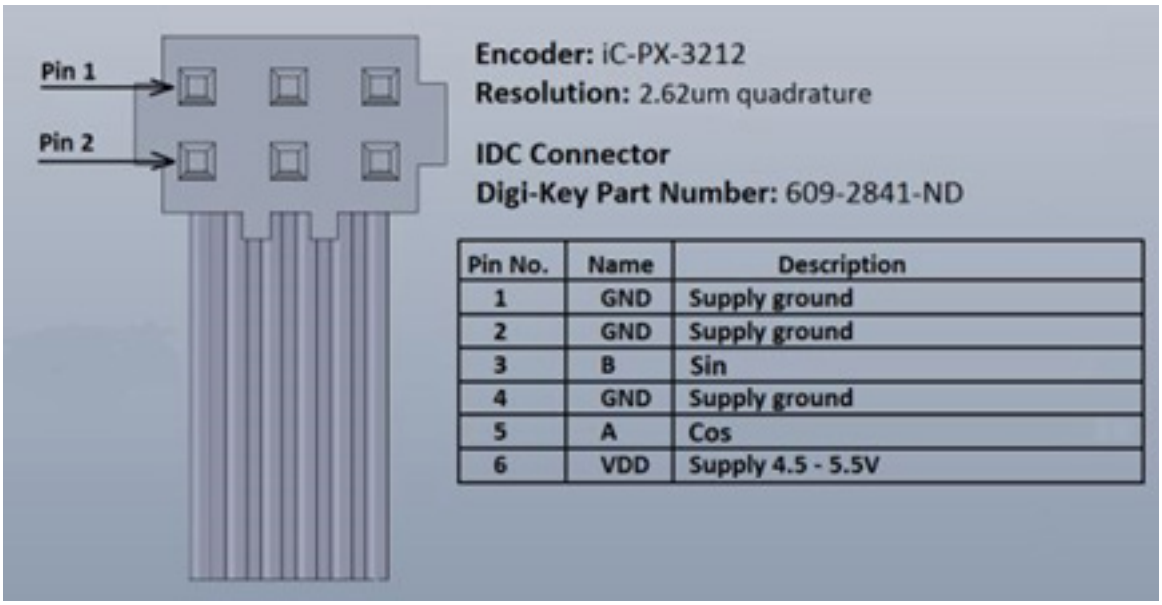
Model/Series #	Max. Operating Power Continuous mode(W)	Max. Operating Power PWM Mode(W)	Recommended PWM Duty Cycle	Maximum Duration in Continuous Mode
RBS Series	4.32 W	1.8W	<50%	30s
LBS Series	4.2 W	1.7W	<50%	20s
LCS Series (4N)	4.2 W	1.7W	<50%	20s
LCS Series (10N)	19.2 W	5.8W	<30%	15s
RAS Series (150 mA)	0.75 W	0.25W	<30%	30s
RAS Series (300 mA)	1.5 W	0.5W	<30%	10s
LAS Series (150 mA)	0.75 W	0.25W	<30%	30s

Table 4 – Recommended Guidelines for Motion Control.

5.8 Closing the loop for LAS with Piezo Motion installed encoder

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 µs. 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 motors.



Pin No.	Name	Description
1	GND	Supply ground
2	GND	Supply ground
3	B	Sin
4	GND	Supply ground
5	A	Cos
6	VDD	Supply 4.5 - 5.5V

Figure 4. Pinout of the Piezo Motion installed encoder connector for LAS motors. The model of the encoder is iC-PX3212 from iC Hous. The maximum resolution after quadrature is 2.66 µm.

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/

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