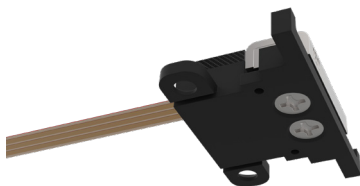


Miniature Piezoelectric Linear Actuators LRMO, LRMO-E, LRMO-E-CL

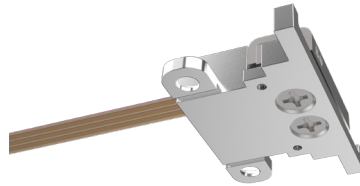
Introducing our new range of compact, lightweight linear piezoelectric actuators, with factory-fitted optical encoder designed to deliver superior precision and expanded functionality for advanced applications.

Performance and Benefits of LRMO Series Linear Actuators

- New US patented design.
- Superior stability of velocity control.
- Flexible pcb electrical connection facilitates system integration.
- Economical construction using thermoplastics or machined metal for reliability and affordability.
- Unmatched precision and resolution.
- Ultra-fast response times and exceptional start-stop capabilities.
- High force density relative to size, provides excellent alternative to stepper lead screw designs.
- Stepping and continuous modes of operation with silent operation.
- Low power and low voltage requirement.



LRMO Series Linear Actuators
Plastic Enclosure



LRMO Series Linear Actuators
Metal Enclosure

UNIQUE PROPERTIES

- Superior Resolution: > 40 nm = 25,000 steps per mm of travel
- Energy efficient: Zero power consumption in hold mode
- Optical Encoder Resolution: 2.66 μ m
- Low Power: 1.5 W (@ max speed) or 0.15 W (@ 10 mm/s PWM mode)
- Max Speed: >0.15 m/s
- Fast Response Time: \approx 30 μ s
- Low Voltage Design: 5 V DC

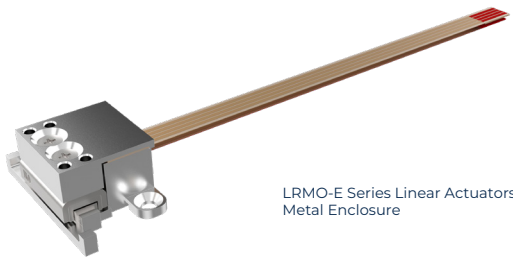
LRMO Series Motor Specifications

| Model No.s Plastic or Metal Enclosures | LRMO (Plastic) LRMO-M (Metal) | |
|---|----------------------------------|--------|
| Power Supply Voltage | 5.0 V DC | |
| Push/Pull Force | \geq 0.2 N | |
| Self-Braking Force | \geq 0.25 N | |
| Motor Response Time | \approx 30 μ s | |
| Travel Range | 9.0 mm | |
| Max Speed (continuous mode) | \geq 150 mm/s | |
| Minimum Linear Step | <0.04 μ m (<40 nm) | |
| Optical Encoder Resolution (after quadrature) * | 2.66 μ m | Note 1 |
| Minimum Controlled Linear Step* | 2.66 μ m | Note 1 |
| Uni-directional Repeatability | 2.66 μ m | |
| Linear Backlash at Change of Direction | <0.1 μ m | |
| Elastic Stiffness | \approx 200 mN/ μ m | |
| Linear Hysteresis | <2.0 μ m | |
| 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 μ m | |
| Horizontal Runout | 6.0 μ m | |
| Frequency Response | 4 kHz | |
| Operating Temperature | -20 °C to 80 °C | |
| Maximum Load (at listed specification) | 20 g | |
| Maximum Tolerable Load | 4.2 kgf | |
| Max Current (continuous mode) | 300 mA | |
| Max. Current at the velocity 10mm/s (PWM mode) | 30-40 mA | |
| Motor Weight Plastic and Metal enclosure | 5.7 g or 6.7 g (metal) | |
| Motor Dimensions | 16.3x16.6x10.4 mm | |
| Driver PCB Dimensions | 31x28x9.6 mm | |
| Drive PCB Weight | 4.3 g | |

Note 1: *Model with factory installed optical encoder

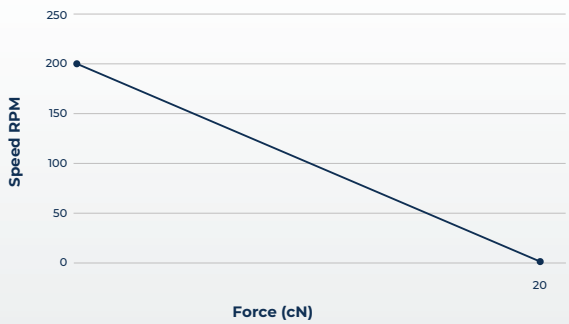


LRMO-E Series Linear Actuators
Plastic Enclosure



LRMO-E Series Linear Actuators
Metal Enclosure

LRMO SPEED-FORCE CURVE



Python API Closed-Loop Control System

LRMO-E is available as a closed-loop system (using PMC's proprietary Python API). Contact your sales representative for further details.

- **Closed-Loop Feedback Control:**
Utilizes encoder feedback for precision control. Run Python scripts for precise motion control.
- **Low Voltage & Low Current:**
5 V DC, 30 mA to 300 mA (max)
- **Versatile Operation:**
Supports stepping and continuous modes.
- **High Performance:**
Ultra-fast $<30 \mu\text{s}$ Response Time, $\geq 0.25 \text{ N}$ Self-Braking Force, Motor Resolution 40 nm, Encoder Resolution 2.66 μ , Max speeds $> 150 \text{ mm/s}$
- **Easy Integration:**
Connect driver PCB/Piezomotor to computer via USB.

EXAMPLE PYTHON API COMMANDS:

Home (direction) – Moves the motor to the zero position.

getPosition() – Retrieves current motor position in encoder pulses.

Velocity(value) – Sets motor speed (0.01 – 150 mm/s).

Move(action) – Moves motor Left/Right or Stops.

Position(value) – Moves motor to a specific position in microns (μ) (encoder resolution 2.6 μ).

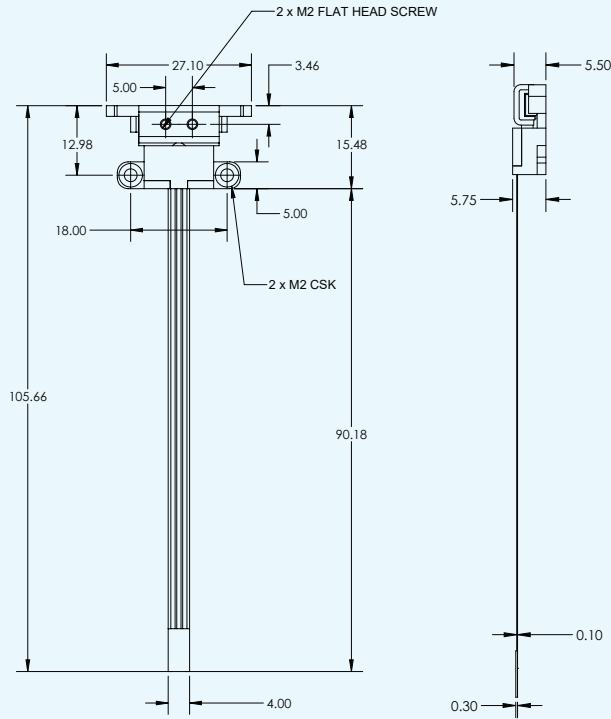
setPWMsettings(duty_cycle_percent, frequency_Hz) – Configures velocity by PWM parameters.

Principle of operation

The LRMO-E Linear piezo actuator operates based on a US patented technology. Electrical excitation of its piezoceramic body, or resonator, induces simultaneously two independent longitudinal and bending ultrasonic standing waves in two perpendicular directions. This action generates elliptical vibrations at the resonator's center, resulting in linear motion of the motor, which is passively in contact with the resonator body.

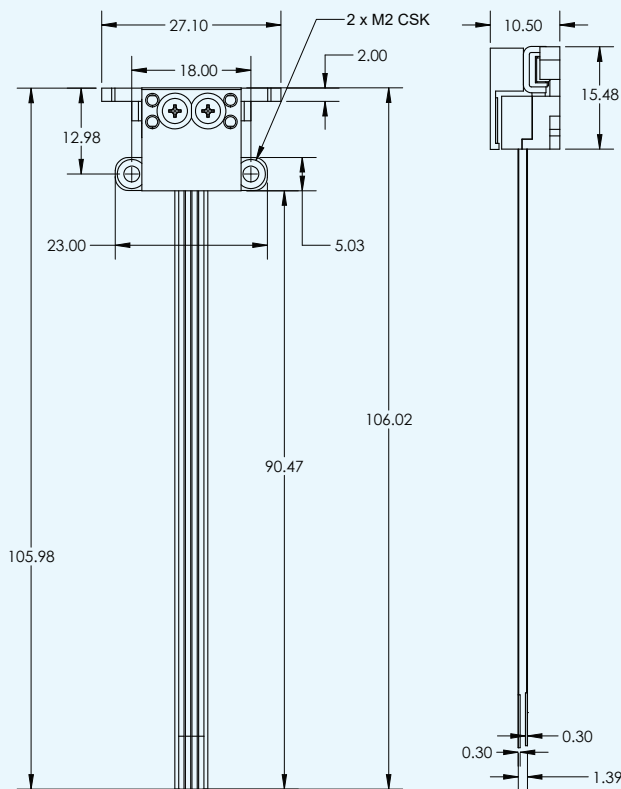
LRMO Series dimensional drawings

STANDARD MODEL



Dimensions in mm

ENCODER MODEL



Dimensions in mm

Motor control

The electronic driver is designed to offer an economical interface for user control. Motion of the motor is achieved via PWM (Pulse Width Modulation) control signals via the J1 connector on the driver. The driver PCB also supports UART and I2C interfaces. Each driver PCB is pre-programmed for the specific motor model and allows for software configurability, optimizing drive signals and integrating controls. Motor operation can be finely regulated through closed-loop control using outputs available from the flexible PCB encoder cable.

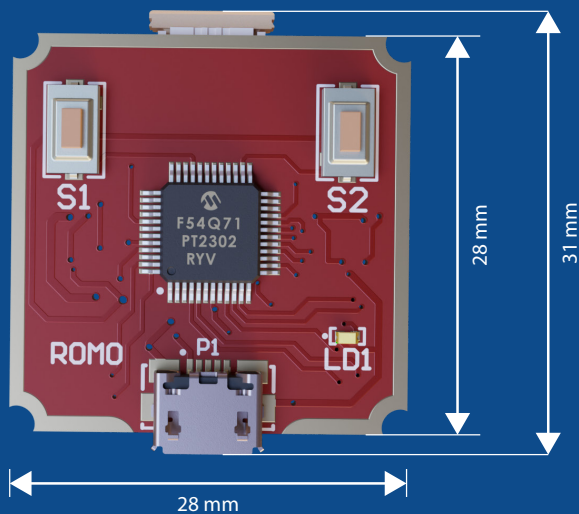
OPEN LOOP

The driver board can be controlled using an external signal source PWM (Pulse Width Modulation) mode. Control signals are applied to the External Signal Connector to generate the desired rotation and speed. Control of speed using PWM is implemented by varying the pulse duration and repetition rate of input signals onto the two directional control pins. Size of step is determined by the pulse duration, and speed is determined by pulse rate. The minimum pulse duration is approximately 30 μ s.

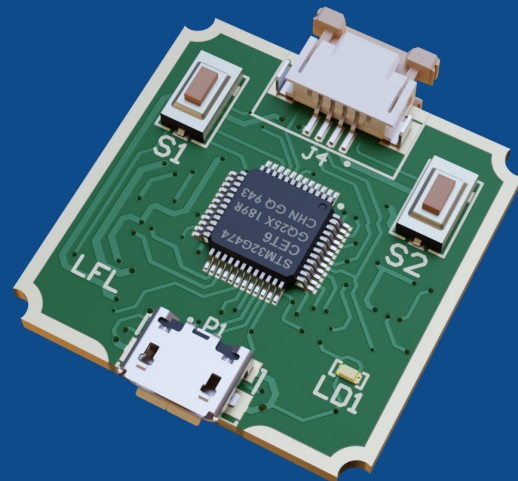
CLOSED-LOOP

Pre-programmed motion control algorithms enable the implementation of several commands for specific motion control. The key commands are for defining the speed and the movement to a defined position. These commands are resident within a library which can be accessed using either Piezo Motor Company's control software or via the serial port using TTL serial commands. Motor Control can also be implemented with Python commands using Piezo Motor Company's Motor API.

Electronic PCB Driver for LRMO Series Piezo Actuators



**LRMO & LRMO-E
Electronic Driver PCB**



**LRMO-E-CL
Electronic Driver PCB**



Control architecture & options

Piezo Motor Company motors are available as a basic motor or with a fitted encoder. Piezo Motor Company electronic drivers are available as open-loop or closed-loop drivers. Motors can be simply controlled in open-loop mode with several options for achieving closed-loop motion control. To learn more, visit <https://piezomotors.com/products/>

| | Open-Loop Driver | Closed-Loop Driver with Encoder board |
|--------------------|--|---|
| Base Motor | Open-Loop Control or third party controller command motor with PWM control and close control loop with external sensor | |
| Motor with Encoder | Open-Loop control or third party controller commands motor with PWM control and closes loop via encoder signal output. | Motor Control with: Piezo Motor Company's Control Software on Windows OS device or Piezo Motor Company Python API on third party controller or TTL Serial Port Commands |

DRIVER BOARDS LRMO, LRMO-E, LRMO-E-CL SERIES

| Model | LRMO, LRMO-E Series | LRMO-E-CL Series |
|-------------|---|--|
| Part Number | ROLR-PCB-001 | LRMO-E-PCB-002 |
| Description | Electronic Driver Board (5.0 – 7.5 VDC) for use with ROMO & LRMO motors | Close-Loop Driver PCB (5 VDC) for use with LRMO-E-CL |

Performance Chart and Motor/Driver Part Configurations

| Motor Type | LRMO Series | | LRMO-E Series | | LRMO-E-CL Series | |
|---------------------|---|---|---|---|---|---|
| | LRMO | LRMO-M | LRMO-E | LRMO-E-M | LRMO-E-CL-KIT | LRMO-E-M-CL-KIT |
| Model | LRMO | LRMO-M | LRMO-E | LRMO-E-M | LRMO-E-CL-KIT | LRMO-E-M-CL-KIT |
| Part Number | LRMO-011-0270 | LRMO-012-0270 | LRMO-011-1270 | LRMO-012-1270 | LRMO-011-1271-CL | LRMO-012-1271-CL |
| Encoder | Without Encoder | Without Encoder | With Encoder | With Encoder | With Encoder | With Encoder |
| Enclosure | Plastic | Metal | Plastic | Metal | Plastic | Metal |
| Resolution | > 40 nm = 25,000 steps per mm of travel | > 40 nm = 25,000 steps per mm of travel | > 40 nm = 25,000 steps per mm of travel | > 40 nm = 25,000 steps per mm of travel | > 30 µRad = 200,000 steps per rotation | > 30 µRad = 200,000 steps per rotation |
| Max speed | ≈0.15 m/s | ≈0.15 m/s | >0.15 m/s | >0.15 m/s | >600 RPM | >600 RPM |
| Supply | 5.0 V DC | 5.0 V DC | 5.0 V DC | 5.0 V DC | 5.0 to 7.5 V DC | 5.0 to 7.5 V DC |
| Kit Ordering Number | LRMO-KIT | LRMO-M-KIT | LRMO-E-KIT | LRMO-E-M-KIT | LRMO-E-CL-KIT | LRMO-E-M-CL-KIT |
| Part | LRMO-011-0271 | LRMO-012-0271 | LRMO-011-1271 | LRMO-012-1271 | LRMO-011-1271-CL | LRMO-012-1271-CL |
| Includes | Linear motor with plastic enclosure Evaluation Kit* | Linear motor with metal enclosure Evaluation Kit* | Linear motor with encoder plastic enclosure Evaluation Kit* | Linear motor with encoder metal enclosure Evaluation Kit* | Linear motor with encoder, closed-loop System Evaluation Kit. Includes: motor/encoder with plastic enclosure, electronic driver PCB, Micro USB to USB (5 V) adapter cable, cables and Python API software | Linear motor with encoder, closed-loop System Evaluation Kit. Includes: motor/encoder with metal enclosure, electronic driver PCB, Micro USB to USB (5 V) adapter cable, cables and Python API software |

*Evaluation Kit: LRMO motor, Electronic Driver PCB, cables, 120/240 VAC to 5.0 VDC wall power adapter

For custom inquiries, contact us at info@piezomotorco.com

About Piezo Motor Company LLC

Founded in 2024, Piezo Motor Company is at the forefront of innovation in the design and manufacturing of piezoelectric motors. Headquartered in the USA, we have a global reach through a network of international distributors, delivering cutting-edge technology to clients worldwide.

Our team comprises highly skilled experts with extensive experience in piezoelectric motor and actuator design and physics. We are passionate about harnessing the unique properties of piezoelectric materials to create motors that offer unmatched precision, efficiency, and reliability. Our solutions are tailored to meet the diverse needs of industries ranging from medical devices to aerospace and robotics.

We pride ourselves on our commitment to excellence and innovation, continuously pushing the boundaries of what piezoelectric technology can achieve. Our dedication to research and development ensures that we remain leaders in this dynamic field, providing our clients with the most advanced and effective solutions available. Join us on our journey as we revolutionize the world of motion control with piezoelectric technology.