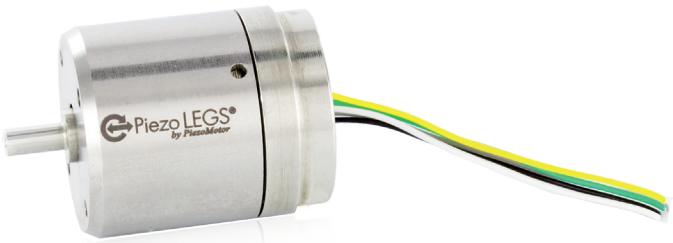
Piezo LEGS® Rotary 50 mNm



- **Non-magnetic**
- **Direct drive – backlash free**
- **Micro-radian resolution**
- **No power draw in hold position**
- **Quick response**

The LR50 motor is non-magnetic. It is intended for a large range of applications where there is demand for non-magnetic material in motor. The very high speed dynamics and micro radian precision makes it ideal for numerous applications. High torque output in a small package is also beneficial.

The Piezo LEGS technology is characterized by its outstanding precision. Fast speed and quick response time, as well as long service life are other benefits. In combination with the micro radian resolution the technology is quite unique.

The motor is ideally suited for move and hold applications or for automatic adjustments. When in hold position it does not consume any power. The drive technology is direct, meaning no gears are needed to create motion. The motor has no mechanical play or backlash. LR50 non-magnetic motor is available in a standard version, and in a vacuum version.

Operating modes

The motor can move in full steps (waveform-steps), or partial steps (micro-steps) giving positioning resolution in the micro-radian range. Speed is adjustable from micro-steps per second up to max specified.

Controlling the motor

PiezoMotor offers a range of drivers and controllers. The most basic one is a hand-held push button driver. Another option is an analogue driver that regulates the motor speed by means of an ±10 V analogue interface. More advanced alternatives are micro-step drivers/ controllers in the 100- and 200-series. These products allow for closed loop control and precise positioning. The micro-stepping feature divides the wfm-step into thousands of small increments which results in micro-steps in the micro-radian range. The PMD units are straight forward to use, supports quadrature and serial sensors, and have multiple I/O ports.

PMD101

PMD206

Design your own driver

Some customers prefer to design their own driver for ease of integration. PiezoMotor provides information to assist in the design.

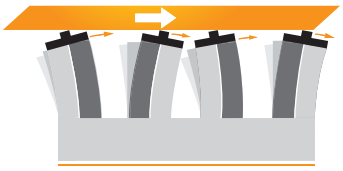
Ordering information	
Motor	
LR5012D-00B10	Non-magnetic vacuum
Drivers and Controllers	
PMCM21	Hand-held push button driver
PMD101	1-axis micro-stepping driver
PMD206	6-axis micro-stepping driver
DMC-30019	Controller

Operating Principle

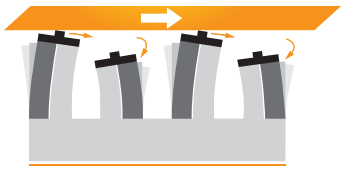
The Piezo LEGS walking principle is of the non-resonant type, i.e. the position of the drive legs is known at any given moment. This assures very good control of the motion over the whole speed range.

The performance of a Piezo LEGS motor is different from that of a DC or stepper motor in several aspects. A Piezo LEGS motor is friction based, meaning the motion is transferred through contact friction between the drive leg and the drive disc. You cannot rely on each step being equal to the next. This is especially true if the motor is operated under varying torques, as shown in the diagram below. For each waveform cycle the Piezo LEGS motor will take one full step, referred to as one *wfm-step* (~0.9 mrad at no load with waveform *Rhomb*). In the schematic illustrations to the right, you can see one step being completed. The rotational velocity of the drive axle is the wfm-step angle multiplied with the waveform frequency (0.9 mrad x 2 kHz = 1.8 rad/s = 100 °/s).

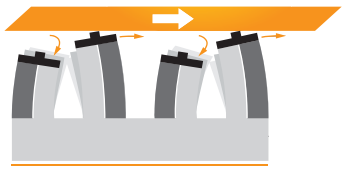
Micro-stepping is achieved by dividing the *wfm-step* into discrete points. The resolution will be a combination of the number of points in the waveform, and the torque. Example: at 25 mNm torque the typical wfm-step angle with waveform *Delta* is ~0.55 mrad, and with 8192 discrete points in the waveform the micro-step resolution will be ~70 nrad (nano-radians).



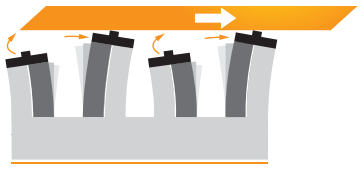
1 *When all legs are electrically activated they are elongated and bending. As we shall see below, alternate legs move as pairs. Arrows show the direction of motion of the tip of each leg.*



2 *The first pair of legs maintains contact with the drive disc and moves towards the right. The second pair retracts and their tips begin to move left.*



3 *The second pair of legs has now extended and repositioned in contact with the drive disc. Their tips begin moving right. The first pair retracts and their tips begin to move left.*



4 *The second pair of legs has moved right. The first pair begins to elongate and move up towards the drive disc.*

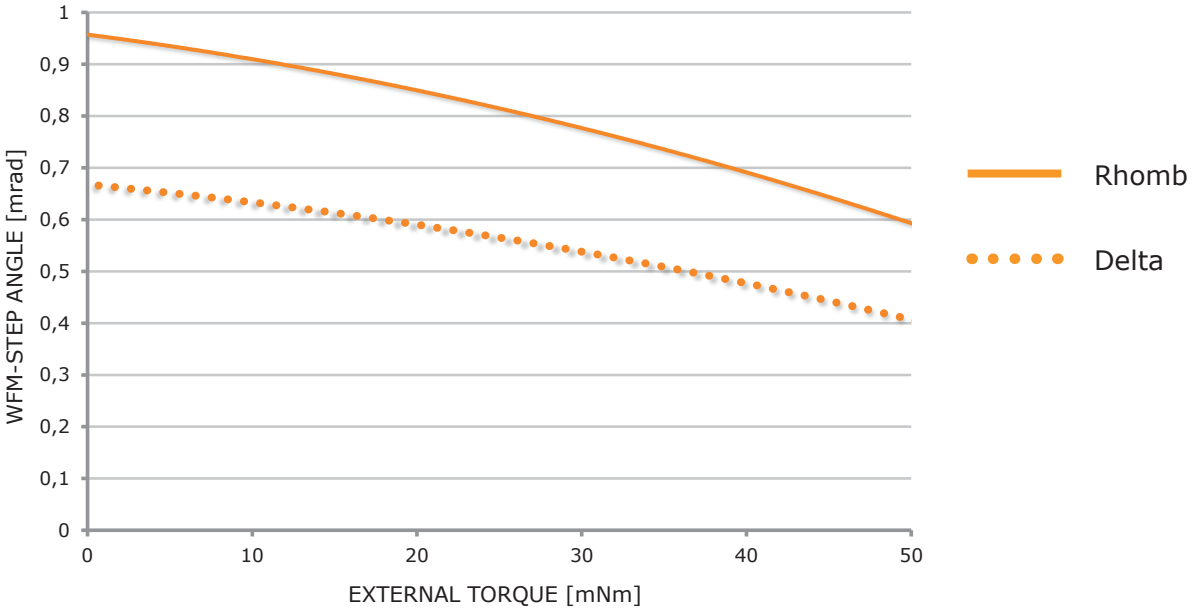
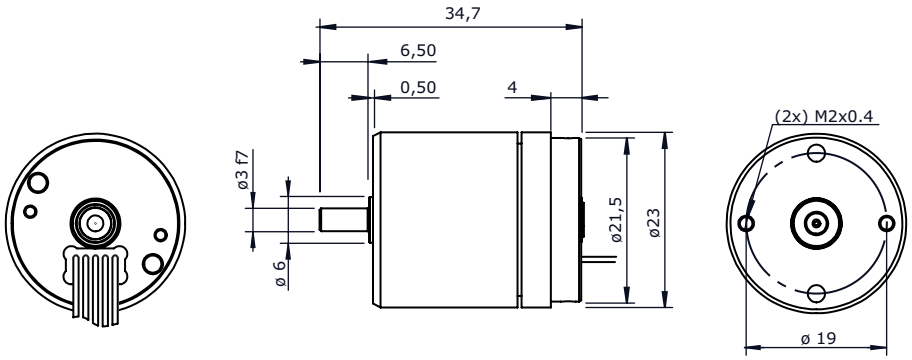


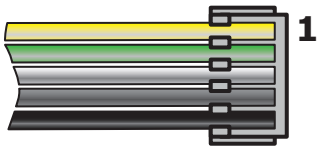
Figure 1 *Motor performance with waveform Rhomb (filled) and waveform Delta (dotted). Wfm-step angle is the average distance the drive disc rotates when the legs take one wfm-step (i.e. for one waveform cycle). Note: Standard deviation σ of 0.1 mrad should be taken into account. Typical values are given for 20ºC.*

Main Dimensions LR5012D
Non-Magnetic Vacuum



Note: Refer to drawings for details.

Electrical Connector Type
Motor type D (non-magnetic vacuum) have soldered cables with connector of type JST 05SR-3S.



Pin Assignment		
Pin	**Terminal**	**Cable Color**
1	Phase 1	Yellow
2	Phase 2	Green
3	Phase 3	White
4	Phase 4	Grey
5	Ground (GND)	Black or brown

Technical Specification			
Type	**LR5012D** **non-magnetic vacuum**	**Unit**	**Note**
Angular Range	360	º	continuous
Speed Range [a]	0-100	º/s	recommended, no load
Step Angle [b]	550	µrad	one wfm-step
	0.07 [c]	µrad	one micro-step [c]
Resolution	< 0.1	µrad	driver dependent
Recommended Operating Range	0-25	mNm	for best micro-stepping performance and life time
Stall Torque	50	mNm	
Holding Torque	55	mNm	
Shaft Load, Max.	3	N	radial (5 mm from mounting face)
	2	N	axial
Shaft Press Fit Force, Max.	5	N	
Vacuum	10^{-7}	torr	
Maximum Voltage	48	V	
Power Consumption [d]	7	mW/Hz	=0.7 W at 100 Hz wfm-step frequency
Connector	soldered cable with JST 05SR-3S		
Mechanical Size	Ø23 x 34.1	mm	see drawing for details
Material in Motor Housing	Non-magnetic		
Weight	60	gram	
Operating Temperature	−20 to +70	ºC	

150062-05

a. Max value is typical for waveform *Rhomb* at 2 kHz, no load, temperature 20ºC.
b. Typical value for waveform *Delta*, 25 mNm torque, temperature 20ºC.
c. Driver dependent; 8192 micro-steps per wfm-step for driver in the PMD200-series.
d. At temperature 20ºC, intermittent runs.

Note: *All specifications are subject to change without notice.*

Item no. **LR5012D-00B10**

Family name
LEGS Rotary

Stall torque
50 = 50 mNm

Version

Motor type
D = NMV / Non-Magnetic Vacuum

Encoder
00 = No Encoder (only option)

Connector/Cable
B10 = 1.0 m Teflon flying wires PTFE AWG28 for connection to driver PMD101 and PMCM31

For connection to driver PMD206 or PMD236 you need a D-sub adapter, p/n CK6280.

Visit our website for application examples, CAD files, videos and more...

www.piezomotor.com

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