Piezo LEGS® Rotary 50 mNm

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

The Piezo LEGS Rotary 50mNm 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 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 the motor is in hold position it does not consume any power. The drive technology is direct, meaning no gears are needed to create motion. This means the motor has no mechanical play or backlash. The Piezo LEGS 50 mNm non-magnetic motor is available in a standard version, and in a vacuum version.

Operating modes

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

Controlling the motor

PiezoMotor offers a range of drivers and controllers. The most basic one is a handheld push button driver. Another option is an analogue driver that regulates the motor speed by means of an ±7 V analogue interface. One of the more advanced alternatives is the PMD101 Microstep Driver/Controller. This product enables the user to vary the waveform as well as speed. The PMD101 is equipped with encoder signal inputs for close loop control. The microstepping feature divides full step cycle into maximum 2048 increments which results in microsteps as small as ~0.5 microradians.

PMD101

Design your own driver

Some customers prefer to design their own driver control for ease of integration or for even higher waveform resolution. In this case PiezoMotor can provide information to assist in the design.

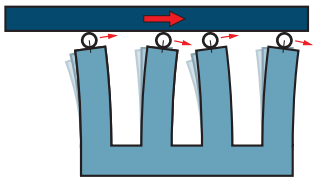
Ordering information	
Motor	
LR5012C-	Non-magnetic
LR5012D-	Non-magnetic vacuum
Drivers and Controllers	
PMCM21-01	Handheld push button driver
PMCM31-01	Analogue driver
PMD101	Microstepping driver
Accessories	
102431-05	Motor cable 0.5 m
102431-15	Motor cable 1.5 m

Operating Principle

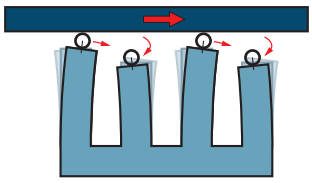
The Piezo LEGS walking principle is of the non-resonant type, i.e. the position of the drive legs is known at any given moment. This assures very good control of the motion over the whole speed range.

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 LEGS motor will take one full step, referred to as one *wfm-step* (~0.95 mrad at no load). 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 (0.95 mrad x 2 kHz = 1.9 rad/s = 110 °/s).

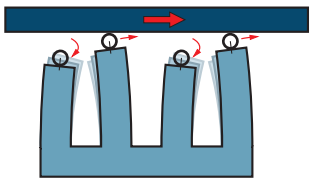
Microstepping is achieved by dividing the *wfm-step* into discrete points. The resolution will be a combination of the number of points in the waveform, and the torque. Example: at 25 mNm torque the typical wfm-step angle is ~0.8 mrad, and with 2048 discrete points in the waveform the microstep resolution will be ~0.4 µrad. In analog bending mode or with higher resolution D/A converter it is possible to position with even higher resolution.



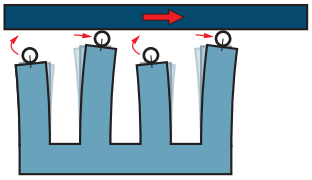
1 *When all legs are electrically activated they are elongated and bending. As we shall see below, alternate legs move as pairs. Arrows show the direction of motion of the tip of each leg.*



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.*

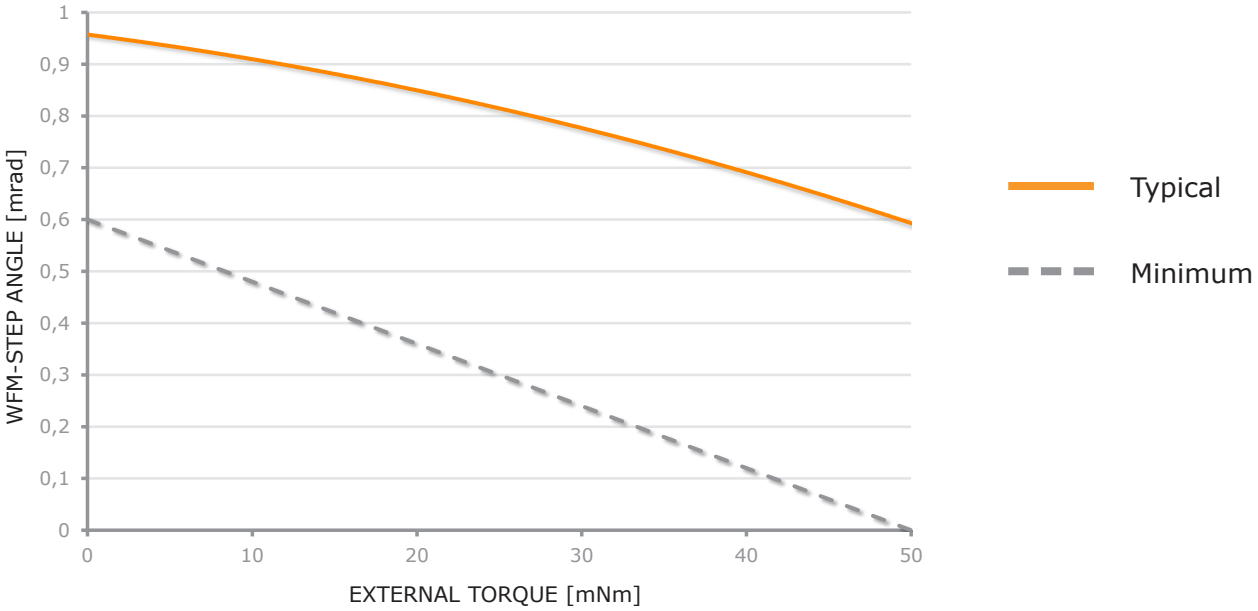
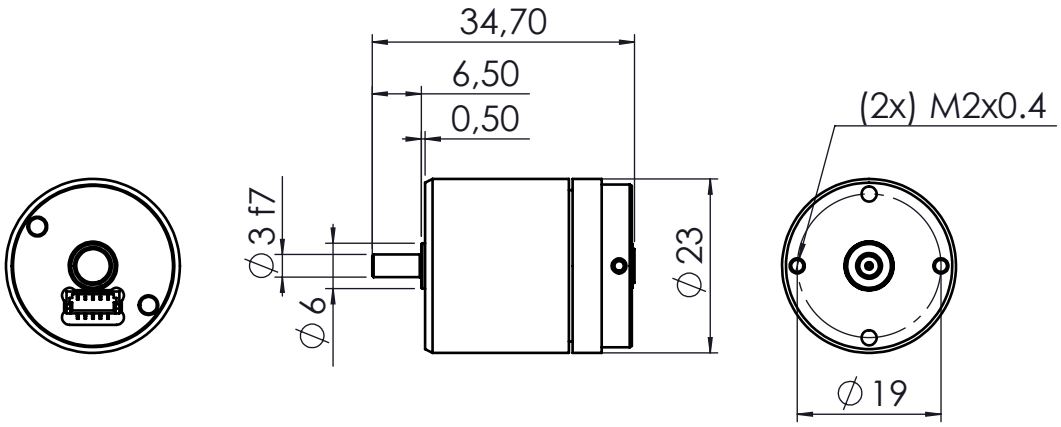
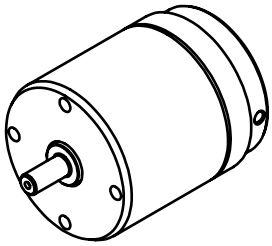


Figure 1 *Typical motor performance with rhombic waveform (Rhomb S) at 650 Hz drive frequency. Wfm-step angle is the average distance the drive disc rotates when the legs take one step (i.e. for one waveform cycle). Using other waveforms than rhombic will give a different curve. Dotted line is guaranteed minimum for these drive conditions.*

Main Dimensions LR5012C and LR5012D

Non-magnetic and Non-magnetic Vacuum

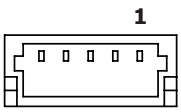




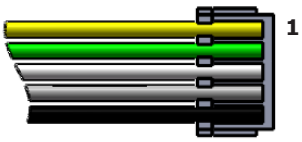
Note: Refer to drawings for details.

Electrical Connector Type

On motor type C (non-magnetic) the connector is JST BM05B-SRSS-TB.



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

150062-01

Technical Specification				
Type	**LR5012C (non-magnetic)**	**LR5012D (n-m vacuum)**	**Unit**	**Note**
Angular Range	360	360	º	continuous
Speed Range	0-100	0-100	º/s	recommended, no load
Step Angle	0.0002[a]-0.6	0.0002[a]-0.6	mrad	no load, microsteps up to full wfm-steps
Resolution [a]	< 0.2	< 0.2	µrad	
Recommended Operating Range	0-25	0-25	mNm	for best microstepping performance and life time
Stall Torque	50	50	mNm	
Holding Torque	55	55	mNm	
Vacuum	-	10^{-7}	torr	
Maximum Voltage	48	48	V	
Connector	JST BM05B-SRSS-TB	soldered cable with JST 05SR-3S		
Mechanical Size	Ø23 x 34.1	Ø23 x 34.1	mm	see drawing for details
Material in Motor Housing	Stainless Steel	Stainless Steel		
Weight	60	60	gram	
Operating Temp.	−20 to +70	−20 to +70	ºC	

a. Driver dependant

Item no. LR5012 -

Stall Torque
50 = 50 mNm

Version

Motor type
C = NM / Non-Magnetic
D = NMV / Non-Magnetic Vacuum

Encoder
00 = No encoder (only option)

Connector
A = JST connector - for motor type C
B = Teflon cable PTFE AWG28 with JST connector - for motor type D

Cable (standard lengths)
00 = No cable (JST connector only) - for motor type C
05 = 0.5 m - for motor type C
10 = 1.0 m - for motor type D
15 = 1.5 m - for motor type C

Example:
LR5012C-00A05: LEGS Rotary, 50mNm, version 12, non-magnetic, no encoder, JST connector with 0.5 m cable.

Note: All combinations are **not** possible!

Note: All specifications are subject to change without notice.

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

www.piezomotor.com

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