PiezoMotor

Piezo LEGS® Rotary Ø17

- **Direct drive - backlash free**
- **Integrated Absolute Encoder**
- **Microradian resolution**
- **No power draw in hold position**
- **Quick response**

The LR17 is a high precision motor in the second generation of Piezo LEGS Rotary. It is intended for a large range of applications where high speed dynamics and positioning with precision is crucial. 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. Because of this the motor has no mechanical play or backlash.

The motor comes with an integrated high resolution magnetic encoder. With feedback from the encoder you can run in closed loop with a remarkable resolution of 0.2 mrad (0.01º). Even more impressive is the open loop resolution of the motor which is 0.1 µrad (0.000006º).

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. The motor can be operated with feedback from the integrated magnetic encoder, or have the control loop closed using an external sensor with even higher resolution.

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 ±10 V analog interface. The more advanced alternatives are the microstep drivers/controllers in the 100- and 200-series*. These products allow for closed loop control and precise positioning. The microstepping feature divides the wfm-step into thousands of small increments which results in microsteps in the microradian 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. In this case PiezoMotor can provide information to assist in the design.

Ordering information	
Motor	
LR17	Standard version, stainless steel
Drivers and Controllers	
PMCM31	Analogue driver
PMD101	1-axis microstepping driver
PMD206*	6-axis microstepping driver
PMD236*	36-axis microstepping driver

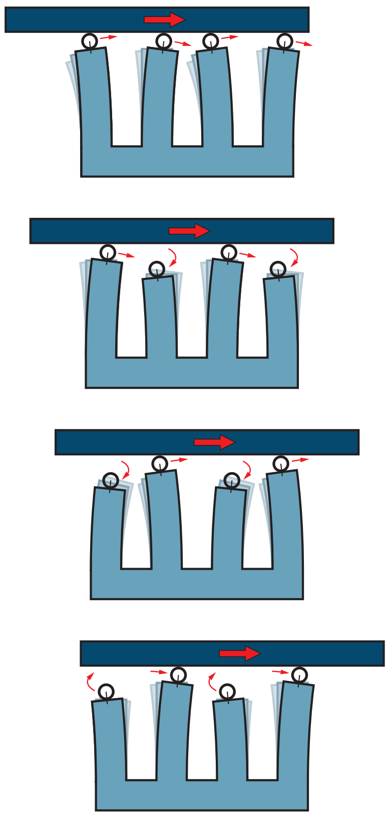
*** The PMD206 / PMD236 are not yet available**

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* (~1.5 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 axis is the wfm-step angle multiplied with the waveform frequency (1.5 mrad x 2 kHz = 3 rad/s = 170 °/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 15 mNm torque the typical wfm-step angle is ~1.1 mrad (with waveform *Rhomb*), and with 8192 discrete points in the waveform the microstep resolution will be ~0.1 µrad.



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.*

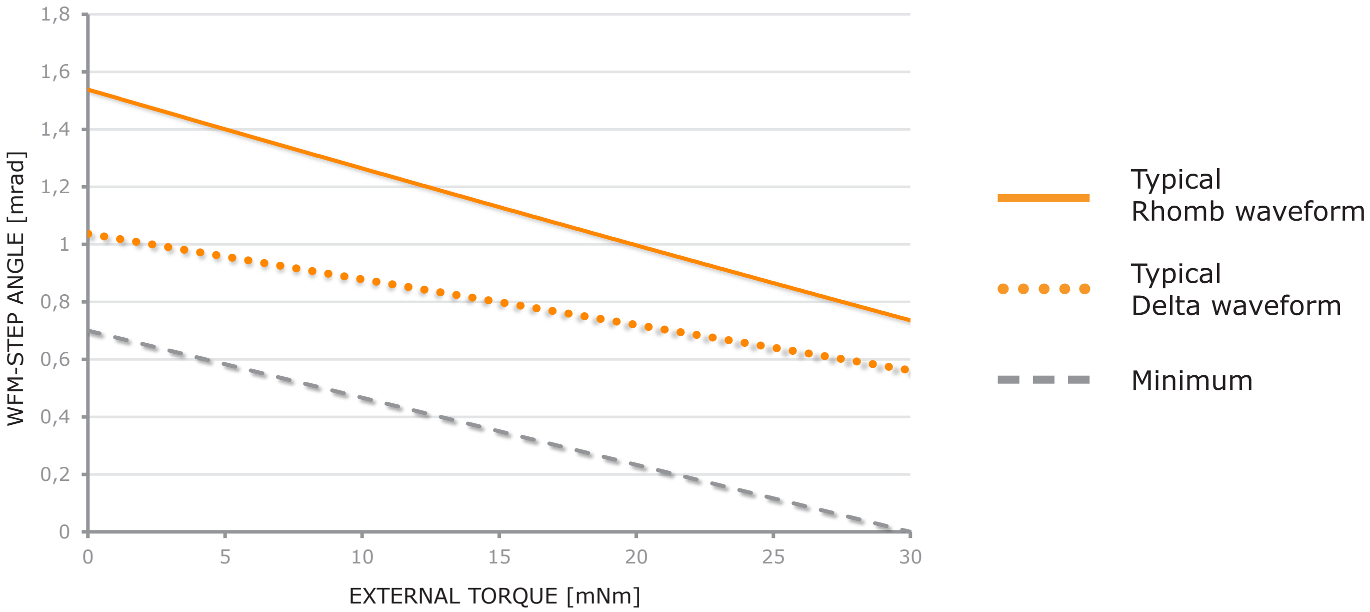
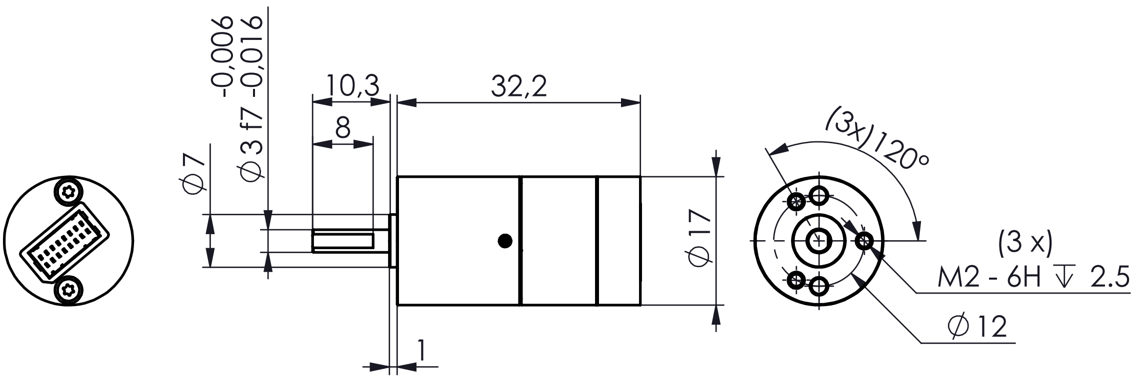


Figure 1 *Typical motor performance with waveforms Rhomb S and Delta at 650 Hz drive frequency. Wfm-step angle is the average distance the drive disc rotates when the legs take one step (i.e. for one waveform cycle). Using other waveforms than rhombic will give a different curve. Dotted line is guaranteed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

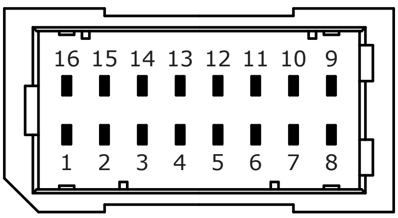
Main Dimensions LR17



Note: Refer to drawings for details.

Electrical Connector Type

The connector on the motor is a 16 pin dual row *CviLux* connector CI1116M2VD0, which mates with socket from the *CviLux* CI1116 family.



Pin Assignment

Pin	Terminal	Note
1	Sensor +5V/+3V3	Cable Color TBD
2	-	Do not connect
3	-	Do not connect
4	Motor Phase 3	White
5	Motor Phase 4	Grey
6	-	Do not connect
7	-	Do not connect
8	-	Do not connect
9	Motor Phase 2	Green
10	Motor Phase 1	Yellow
11	Sensor DO/DI	Cable Color TBD
12	Sensor CLK	Cable Color TBD
13	-	Do not connect
14	Sensor Ground (GND)	Cable Color TBD
15	-	Do not connect
16	Motor Ground (GNDM)	Black or brown

150063-01

Technical Specification			
Type	**LR17**	**Unit**	**Note**
Diameter	17	mm	
Angular Range	360	º	continuous
Speed Range	0-170	º/s	recommended, no load
Step Angle	0.0001[a] 0.7	mrad	- microstep, 8192[a] per wfm-step, no load - wfm-step, no load
Open Loop Resolution [a]	< 0.0001	mrad	
Closed Loop Resolution [b]	0.2	mrad	32768 CPR (15 bit)
Encoder Accuracy	3.1	mrad	2048 CPR (11 bit)
Encoder Type	Magnetic		SSI
Recommended Operating Range	0-15	mNm	for best microstepping performance and life time
Stall Torque	30	mNm	
Holding Torque	> 30	mNm	
Shaft Load, Max.	< 1 < 2	N N	- radial (6.5 mm from mounting face) - axial
Shaft Press Fit Force, Max.	< 5	N	
Maximum Voltage	48	V	
Connector	CviLux CI1116M2VD0		Mates with socket CviLux CI1116S
Material in Motor Housing	Stainless Steel		
Weight	35	gram	
Operating Temperature	0 to +50	ºC	

a. Driver dependent - given values using driver in PMD200-series.*
b. Closed loop resolution using the integrated rotary encoder.

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

Item no. LR17-030A20E1___

Family name
LR = LEGS Rotary

Diameter
17 = Ø 17 mm

Stall torque
030 = 30 mNm

Motor type
A = SS / Stainless Steel

Version

Encoder
E1 = Magnetic 15 bit SSI encoder

Connector/Cable
A00 = Connector, no cable
A15 = 1.5 m cable - does not connect to either PM driver
K15 = 1.5 m cable - for driver PMD101 and PMCM31
L15 = 1.5 m cable - for driver PMD206* and PMD236*

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

www.piezomotor.com

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