- **Motor for linear stage mount**
- **Direct drive - backlash free**
- **Nanometer resolution**
- **No power draw in hold position**
- **Quick response and high speed dynamics**

The Piezo LEGS 15N linear motor is intended for a large range of OEM applications. Design focus has been for ease of integration. The very high speed dynamics and nanometer resolution makes it ideal for numerous applications.

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 nanometer resolution the technology is quite unique.

The motor is ideally suited for move and hold applications or for automatic adjustments of a linear stage unit. When the motor is in hold position it does not consume any power. The drive technology is direct, meaning no gears or lead screws are needed to create linear motion. This means the motor has no mechanical play or backlash. The Piezo LEGS 15N linear motor is vacuum compatible.

Mechanical connection

The motor is mounted next to a guided linear stage. The stage must have a high quality drive rod attached to the side. Drive rods are supplied in different lengths (40-150 mm). The spring tension is released, and the Piezo LEGS actuators are pushed against the drive rod.

Operating modes

The motor can move in full steps (waveform-steps), or partial steps (microsteps) giving positioning resolution in the nanometer range. Speed is adjustable from single 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 ±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 nanometer range. The PMD units are straight forward to use, supports quadrature and serial sensors, and have multiple I/O ports.

PMD101

PMD206

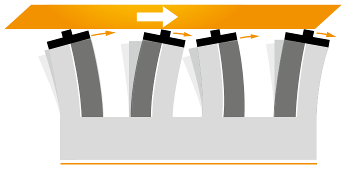
Ordering information	
Motors	
LS1510B-B15	Stainless steel vacuum
Drive rods	
100361-40	Drive rod 40 mm
100361-50	Drive rod 50 mm
100361-60	Drive rod 60 mm
100361-101	Drive rod 100.8 mm
100361-150	Drive rod 150 mm
Drivers and Controllers	
PMCM21	Handheld push button driver
PMCM31	Analogue driver
PMD101	1-axis microstepping driver
PMD206	6-axis microstepping driver
PMD236	36-axis microstepping driver
DMC-300019	Controller
Linear Encoders	
See separerate data sheet	

Operating Principle

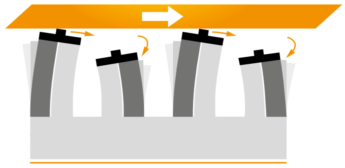
The Piezo LEGS walking principle is of the non-resonant type, i.e. the position of the drive legs is known at any given moment. This assures very good control of the motion over the whole speed range.

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 rod. You cannot rely on each step being equal to the next. This is especially true if the motor is operated under varying loads, 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* (~8 µm at no load with waveform *Rhomb*). In the schematic illustrations to the right, you can see one step being completed. The velocity of the drive rod is wfm-step length multiplied with waveform frequency (8 µm x 2 kHz = 16 mm/s).

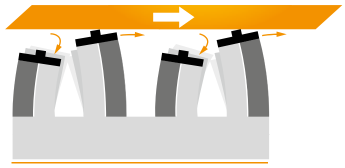
Microstepping is achieved by dividing the *wfm-step* into discrete points. The resolution will be a combination of the the number of points in the waveform, and the load. Example: at 10 N load the typical wfm-step length with waveform *Delta* is ~4.5 µm, and with 8192 discrete points in the waveform the microstep resolution will be ~0.5 nm.



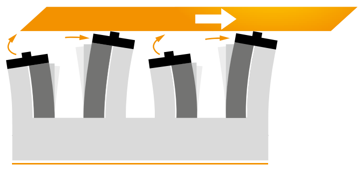
1 *When all four legs are electrically activated they are elongated and bending. As we shall see below, alternate legs move as pairs. Arrows show the direction of motion of the tip of each leg.*



2 *The first pair of legs maintains contact with the rod 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 re-positioned in contact with the rod. 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 rod.*

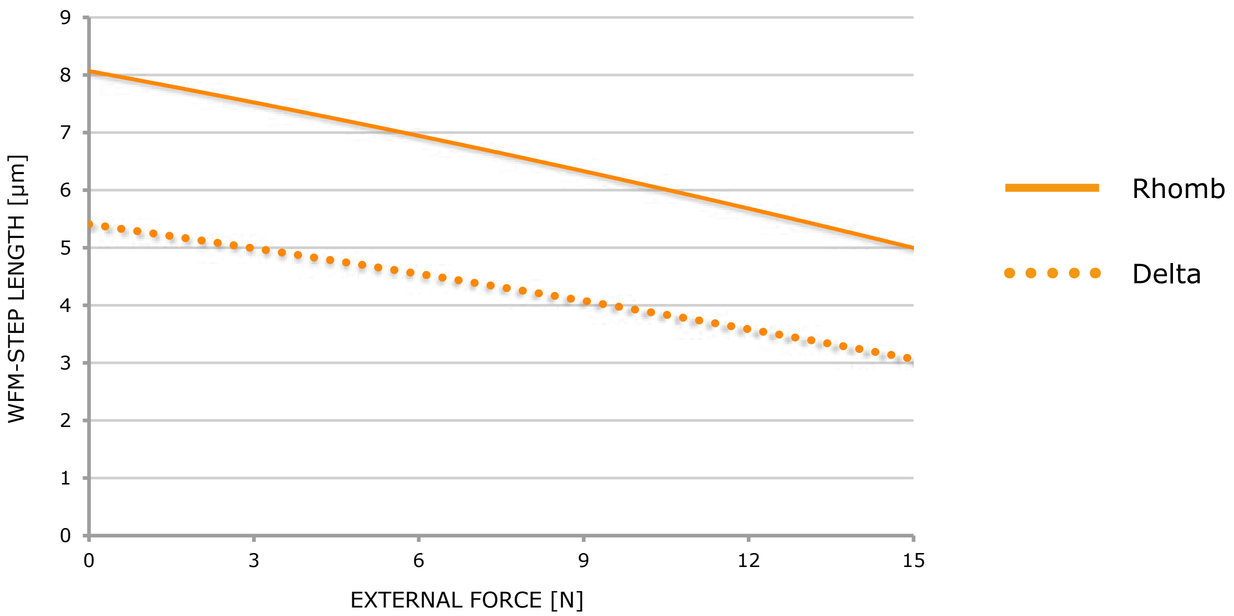
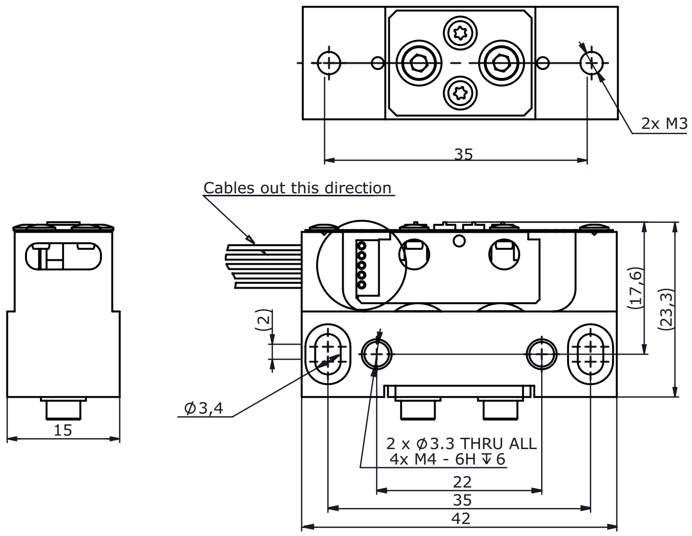
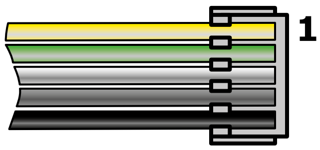


Figure 1 *Motor performance with waveform Rhomb (filled) and waveform Delta (dotted). Wfm-step length is the average distance the drive rod moves when the legs take one wfm-step (i.e. for one waveform cycle). Note: Standard deviation σ of 0.5 µm should be taken into account. Typical values are given for 20ºC.*

Main Dimensions LS1510 B
Stainless Steel Vacuum



Electrical Connector Type
Motor has soldered cable with onnector 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

150053-03

Technical Specification			
Type	**LS1510B (vacuum)**	**Unit**	**Note**
Speed Range [a]	0-16	mm/s	recommended, no load
Step Length [b]	4.5	µm	one wfm-step
	0.0005 [c]	µm	one microstep [c]
Resolution	< 1	nm	driver dependent
Recommended Operating Range	0-8	N	for best microstepping performance and life time
Stall Force	15	N	
Holding Force	> 15	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 Teflon wires w. JST 05SR-3S		
Mechanical Size	42 x 23.3 x 15	mm	see drawing for details
Material in Motor Housing	Stainless Steel		
Weight	70	gram	approximate, without cables
Operating Temp.	−20 to +70	ºC	

a. Max value is typical for waveform *Rhomb* at 2 kHz, no load, temperature 20ºC.
b. Typical values for waveform *Delta*, 7.5 N load, temperature 20ºC.
c. Driver dependent; 8192 microsteps 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. **LS1510B-B15**

Family name
LEGS Linear Spring

Stall force
15 = 15 N

Version
10

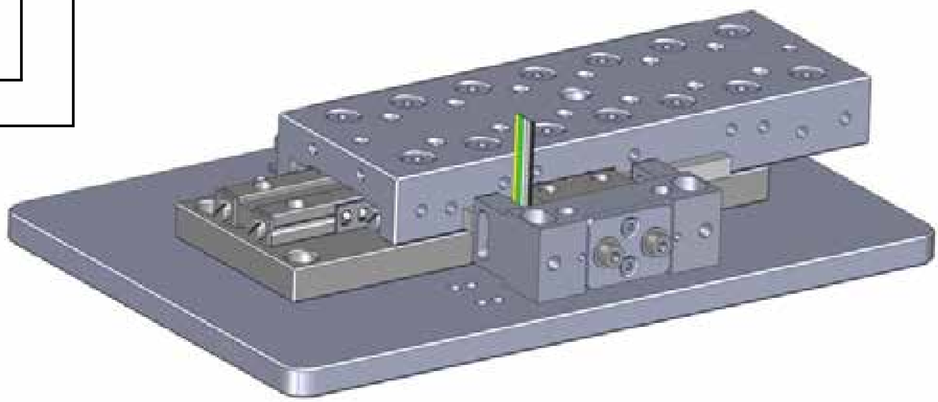
Motor type
B = SSV / Stainless Steel Vacuum

Connector/Cable
B15 = 1.5 m Teflon flying wires PTFE AWG28*

*=Connects directly with driver PMD101 and PMCM31

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

Note: Drive rod has to be ordered separately.



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PiezoMotor

PiezoMotor Uppsala AB
Stålgatan 14
SE-754 50 Uppsala, Sweden

Telephone: +46 18 489 5000
Fax: +46 18 489 5001

info@piezomotor.com
www.piezomotor.com