Piezo LEGS® Linear Twin 40N

- **Direct drive – backlash free**
- **Nanometer resolution**
- **Simple drive electronics**
- **No power draw in hold position**
- **Quick response and high speed dynamics**

The LT40 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 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 nanometer 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 or lead screws are needed to create linear motion. The motor has no mechanical play or backlash. The LT40 linear motor is available in a standard version and in a vacuum version.

Mechanical connection

The motor is easily integrated in your application using the drive rod mechanical adapter. Drive rods are supplied in different lengths (40, 50, 60 and 100.8 mm).

Operating modes

The motor can move in full steps (waveform-steps), or partial steps (micro-steps) giving positioning resolution in the nanometer range. Speed is adjustable from single 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 nanometer 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.

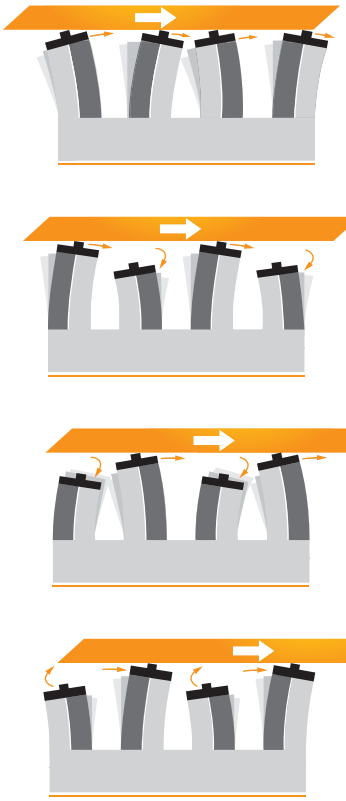
Ordering information	
Motors	
LT4010A-/20A-	Stainless steel
LT4010B-/20B-	Stainless steel vacuum
Drivers and Controllers	
PMCM21	Hand-held push button driver
PMD101	1-axis micro-stepping driver
PMD206	6-axis micro-stepping driver
DMC-30019	Controller
Linear Encoders	
See separate data sheet	

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).

Micro-stepping 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 20 N load the typical wfm-step length with waveform *Delta* is ~4.5 µm, and with 8192 discrete points in the waveform the micro-step 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 repositioned 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.*

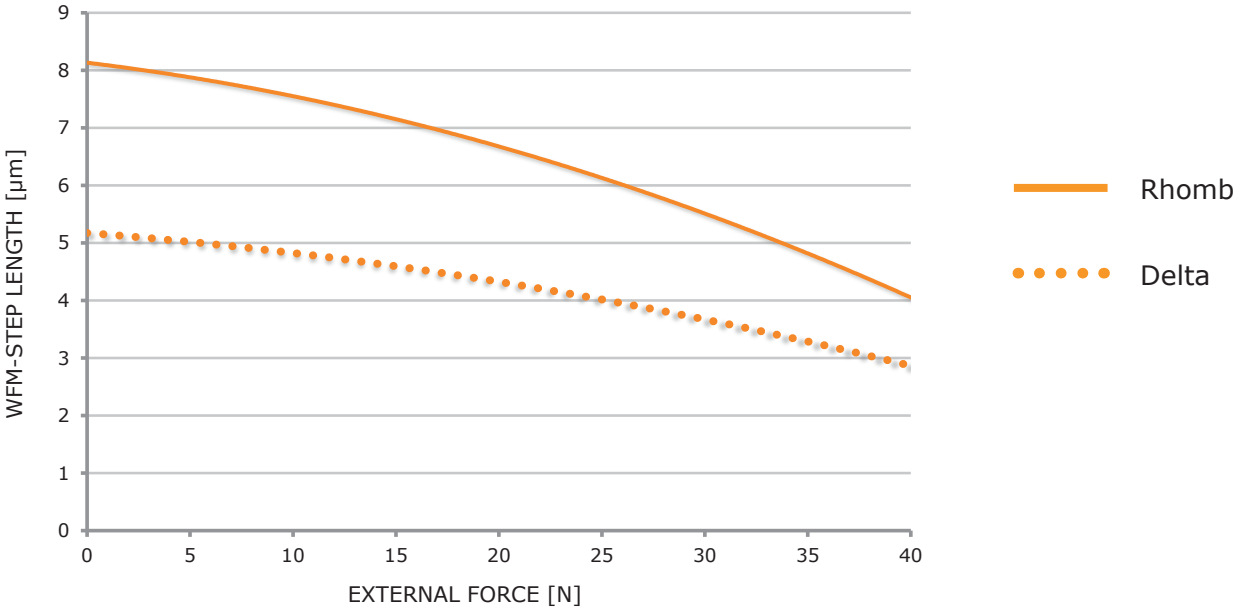
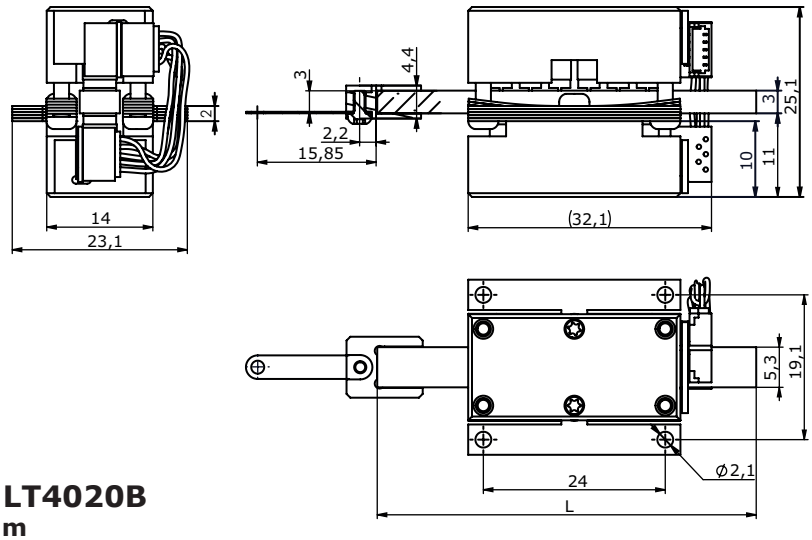
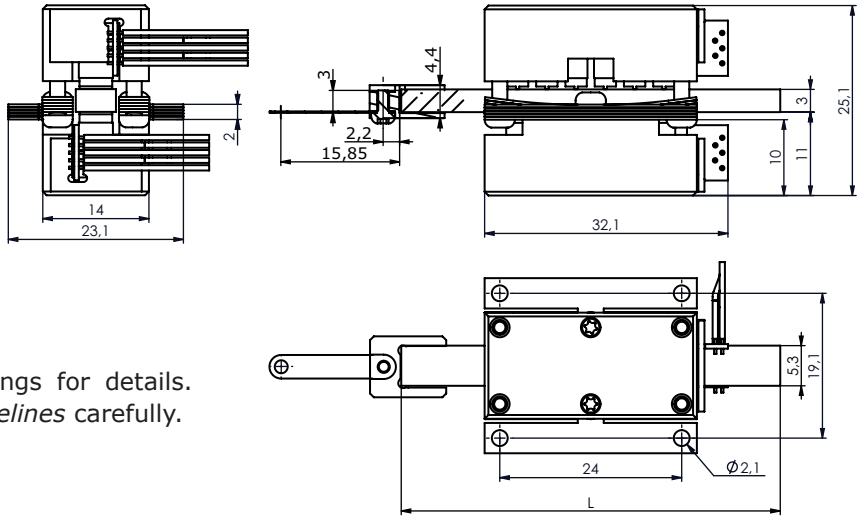


Figure 1 *Motor performance with waveform Rhomb (filled) and waveform Delta (dotted). Wfm-step length is the average distance the drive rod moves when the legs take one wfm-step (i.e. for one waveform cycle). Note: Standard deviation σ of 0.5 µm should be taken into account. Typical values are given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

Main Dimensions LT4020A
Stainless Steel



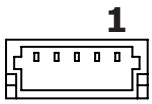
Main Dimensions LT4020B
Stainless Steel Vacuum



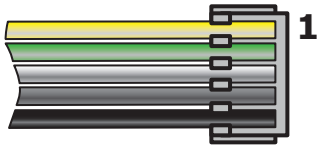
Note: Refer to drawings for details. Read *Installation Guidelines* carefully.

Electrical Connector Type

On motor type A (standard version) there is one external connector of type JST BM05B-SRSS-TB.



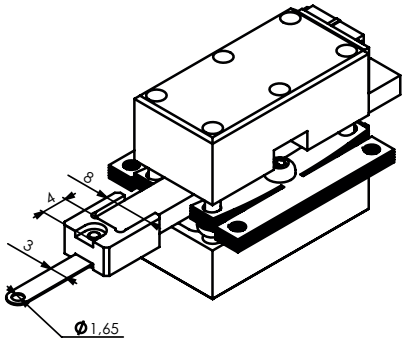
Motor type B (vacuum version) has soldered cables with two connectors of type JST 05SR-3S.



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

Mechanical Connector Type

The drive rod can be fastened using a mechanical adapter with sheet metal extender. In this figure the adapter is mounted in front end of drive rod. Please read *Installation Guidelines* carefully for notes on how to properly connect the Piezo LEGS motor. Disregarding the instructions given in the guideline document may impair both motor performance as well as life time.



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Technical Specification LT40

Type	20A stainless steel	20B vacuum	Unit	Note
Maximum Stroke	73 (L−28)	73 (L−28)	mm	100.8 mm drive rod, no mechanical adapter
Speed Range [a]	0-16	0-16	mm/s	recommended, no load
Step Length [b]	4.5	4.5	µm	one wfm-step
	0.0005 [c]	0.0005 [c]	µm	one micro-step [c]
Resolution	< 1	< 1	nm	driver dependent
Recommended Operating Range	0-20	0-20	N	for best micro-stepping performance and life time
Stall Force	40	40	N	
Holding Force	44	44	N	
Vacuum	-	10^{-7}	torr	
Maximum Voltage	48	48	V	
Power Consumption [d]	20	20	mW/Hz	=2 W at 100 Hz wfm-step frequency
Connector	JST BM05B-SRSS-TB	soldered cable w. 2 x JST 05SR-3S		
Mechanical Size	32.1 x 25.1 x 14	32.1 x 25.1 x 14	mm	see drawing for details
Material in Motor Housing	Stainless Steel	Stainless Steel		
Weight	61	61	gram	approximate
Operating Temp.	−20 to +70	−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*, 20 N load, 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. **LT40 ___ - ___ ___ ___**

Family name
LEGS Linear Twin

Stall force
40 = 40 N

Version
20 = mounts with M2 screws

Motor type
A = SS / Stainless Steel
B = SSV / Stainless Steel Vacuum

Drive rod (standard lengths)
040 = 40 mm
050 = 50 mm
060 = 60 mm
101 = 100.8 mm

Mechanical adapter
A0 = No adapter
D1 = One adapter - Front
D2 = One adapter - Back
E1 = Two adapters - Front and back

Connector/Cable

Motor type A

A00 = JST connector, no cable
K05 = 0.5 m cable for driver PMD101 and PMCM31
K15 = 1.5 m cable for driver PMD101 and PMCM31
L05 = 0.5 m cable-kit for driver PMD206 and PMD236
L15 = 1.5 m cable-kit for driver PMD206 and PMD236

Motor type B

B10 = 1.0 m Teflon flying wires PTFE AWG28

For connection to driver PMD101 or PMCM31 you need an additional cable-kit, p/n CK6281.

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

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

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

www.piezomotor.com

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