

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

The LT20 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 LT20 linear motor is available in standard version, vacuum version, and non-magnetic vacuum version.

Mechanical and electrical connection

The motor is easily integrated in your application using the drive rod mechanical adapter. Drive rods are supplied in different lengths (30, 40, 50, 60, 70 and 100.8 mm).

The motor has two electrical connectors which are connected in parallel to the driver.

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. More advanced alternatives are 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

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 Types

LT2010A-/20A-	Stainless steel
LT2010B-/20B-	Stainless steel vacuum
LT2010D-/20D-	Non-magnetic vacuum

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

Linear Encoders

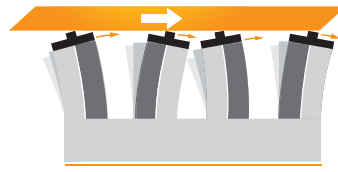
See separate data sheet

Operating Principle

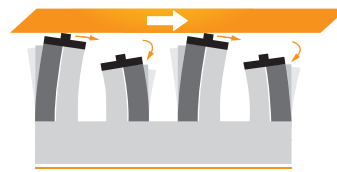
The Piezo LEGS walking principle is of the non-resonant type, i.e. the position of the drive legs is known at any given moment. This assures very good control of the motion over the whole speed range.

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* ($\sim 5 \mu\text{m}$ 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 ($5 \mu\text{m} \times 2 \text{ kHz} = 10 \text{ mm/s}$).

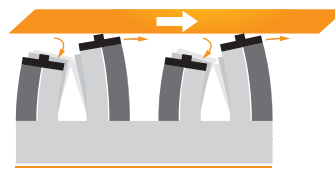
Microstepping is achieved by dividing the *wfm-step* into discrete points. The resolution will be a combination of the the number of points in the waveform, and the load. Example: at 10 N load the typical *wfm-step* length with waveform *Delta* is $\sim 2.5 \mu\text{m}$, and with 8192 discrete points in the waveform the microstep resolution will be $\sim 0.3 \text{ nm}$.



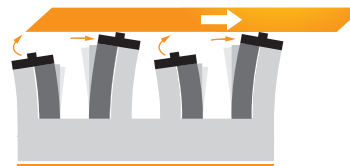
1 When all four legs are electrically activated they are elongated and bending. As we shall see below, alternate legs move as pairs. Arrows show the direction of motion of the tip of each leg.



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.

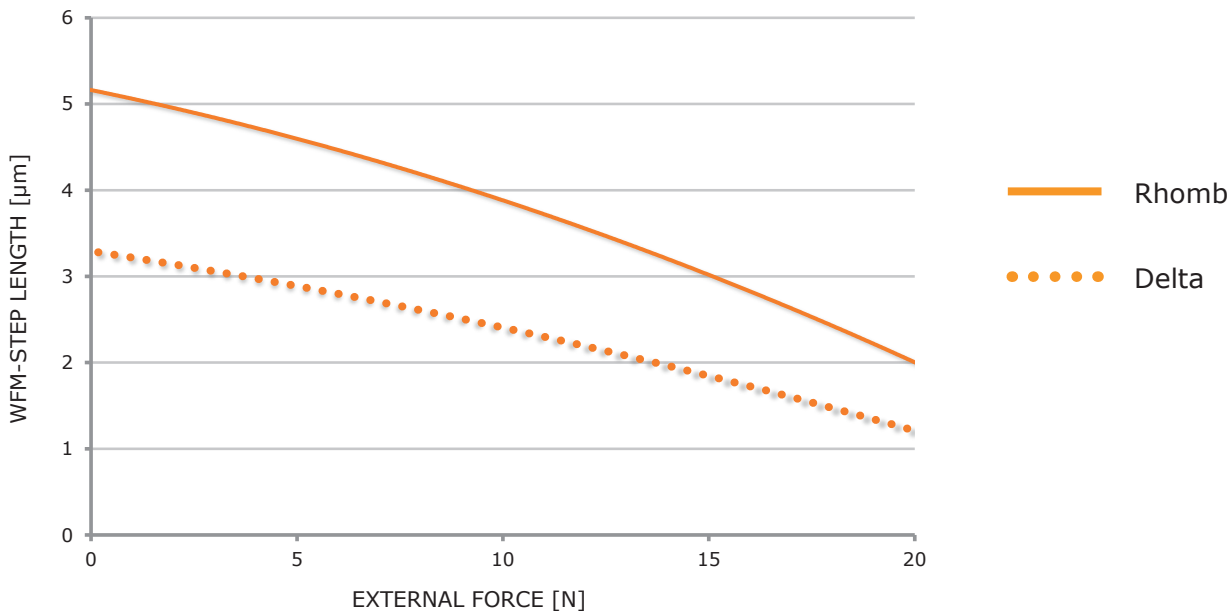
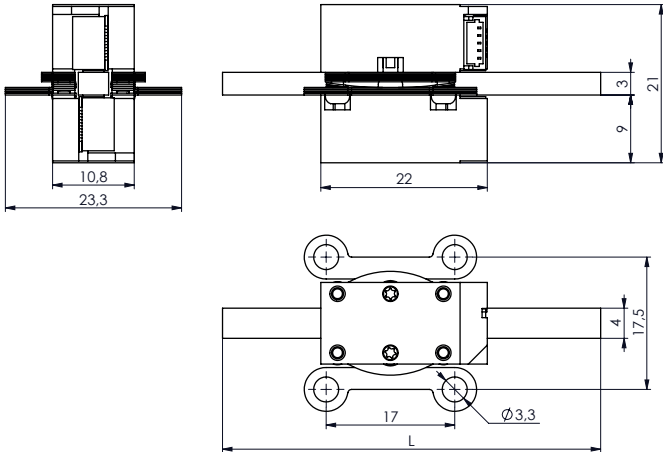
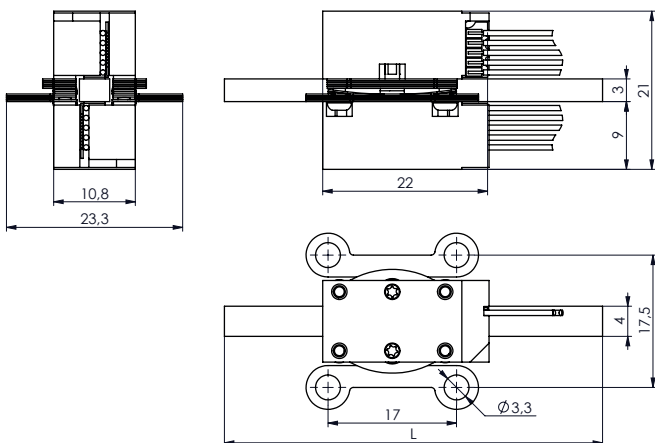


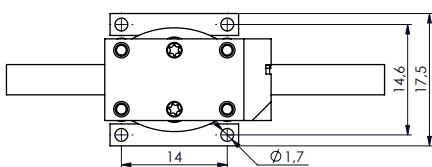
Figure 1 Motor performance with waveform *Rhomb* (filled) and waveform *Delta* (dotted). *Wfm-step* length is the average distance the drive rod moves when the legs take one *wfm-step* (i.e. for one waveform cycle). Note: Standard deviation σ of $0.5 \mu\text{m}$ should be taken into account. Typical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

**Main Dimensions LT2010 A
Stainless Steel**

**Main Dimensions LT2010 B/D
Stainless Steel Vacuum / Non-Magnetic Vacuum**


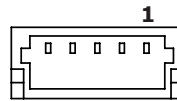
Note: Refer to drawings for details. Read *Installation Guidelines* carefully.

Mounting Options

There are two mounting options available, either for M3 screws (Ø3.3 mm holes), as seen above, or a slim version for M1.6 screws (Ø1.7 mm holes), see below.


Electrical Connector Types

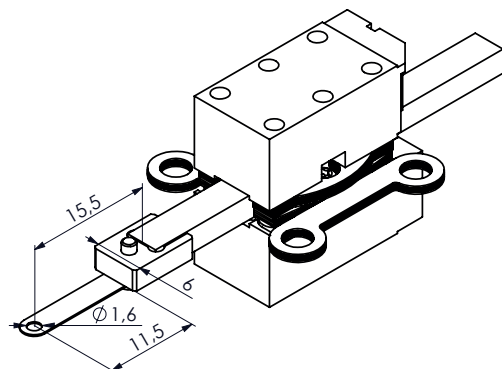
On motor type LT2010A (standard version) there are two connectors of type JST BM05B-SRSS-TB.



Motor type LT2010B (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 Adapter


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.

Technical Specification LT20

Type	10A/20A stainless steel	10B/20B vacuum	10D/20D non-magnetic vac.	Unit	Note
Maximum Stroke	80 (L-20.8)	80 (L-20.8)	80 (L-20.8)	mm	100.8 mm drive rod, no mechanical adapter
Speed Range ^a	0-10	0-10	0-10	mm/s	recommended
Step Length ^b	2.5	2.5	2.5	µm	one wfm-step
	0.0003 ^c	0.0003 ^c	0.0003 ^c	µm	one microstep ^c
Resolution	< 1	< 1	< 1	nm	driver dependent
Recommended Operating Range	0-10	0-10	0-10	N	for best microstepping performance and life time
Stall Force	20	20	20	N	
Holding Force	22	22	22	N	
Vacuum	-	10 ⁻⁷	10 ⁻⁷	torr	
Maximum Voltage	48	48	48	V	
Power Consumption ^d	10	10	10	mW/Hz	=1 W at 100 Hz wfm-step frequency
Connector	2 x JST BM05B- SRSS-TB	soldered cable w. 2 x JST 05SR-3S	soldered cable w. 2 x JST 05SR-3S		
Mechanical Size	22 x 21 x 10.8	22 x 21 x 10.8	22 x 21 x 10.8	mm	see drawing for details
Material in Motor Housing	Stainless Steel	Stainless Steel	Non-magnetic		
Weight	29	29	29	gram	approximate
Operating Temp.	-20 to +70	-20 to +70	-20 to +70	°C	

- a. Max value is typical for waveform *Rhomb* at 2 kHz, no load, temperature 20°C.
b. Typical values for waveform *Delta*, 10 N load, temperature 20°C.
c. Driver dependent; 8192 microsteps per wfm-step for driver in the PMD200-series.
d. At temperature 20°C, intermittent runs.

Note: All specifications are subject to change without notice.

Item no.

LT20 -

Family name

LEGS Linear Twin

Stall force

20 = 20 N

Version10 = mounts with M3 screws
20 = mounts with M1.6 screws**Motor type**A = SS / Stainless Steel
B = SSV / Stainless Steel Vacuum
D = NMV / Non-Magnetic Vacuum**Drive rod (standard lengths)**030 = 30 mm 060 = 60 mm
040 = 40 mm 070 = 70 mm
050 = 50 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 connectors, no cables
A05 = 0.5 m cables *
A15 = 1.5 m cables *
K05 = 0.5 m cable-kit for driver PMD101 and PMCM31
K15 = 1.5 m cable-kit 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

* = does not connect directly to either PM driver

Motor type B and D

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...

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