Piezo LEGS® Linear Twin-C 20N

- **Direct drive – backlash free**
- **Nanometer resolution**
- **Optical mount interface**
- **Quick response and high speed dynamics**

The LTC20 enclosed linear motor is intended for use in a large range of applications; laser and optics applications, moving mirror mounts, replacement for micrometer screws etc. 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 LTC20 linear motor is available in two different mounting versions.

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.

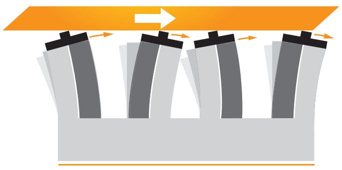
Ordering information	
Motors	
LTC2013-013	Clamp mount, shaft w. M2.5
LTC2014-013	Nut mount, shaft w. M2.5
Drivers and Controllers	
PMCM21	Hand-held push button driver
PMD101	1-axis micro-stepping driver
PMD206	6-axis micro-stepping driver
DMC-30019	Controller
Linear Encoders	
See separate data sheet	

Operating Principle

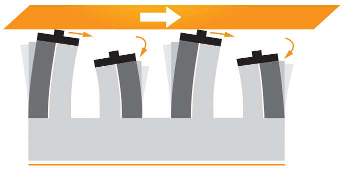
The Piezo LEGS walking principle is of the non-resonant type, i.e. the position of the drive legs is known at any given moment. This assures very good control of the motion over the whole speed range.

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* (~5 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 (5 µm x 2 kHz = 10 mm/s).

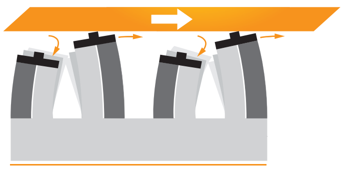
Micro-stepping is achieved by dividing the *wfm-step* into discrete points. The resolution will be a combination of the the number of points in the waveform, and the load. Example: at 10 N load the typical wfm-step length with waveform *Delta* is ~2.5 µm, and with 8192 discrete points in the waveform the micro-step resolution will be ~0.3 nm.



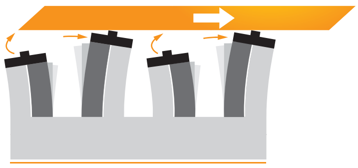
1 *When all four legs are electrically activated they are elongated and bending. As we shall see below, alternate legs move as pairs. Arrows show the direction of motion of the tip of each leg.*



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.*

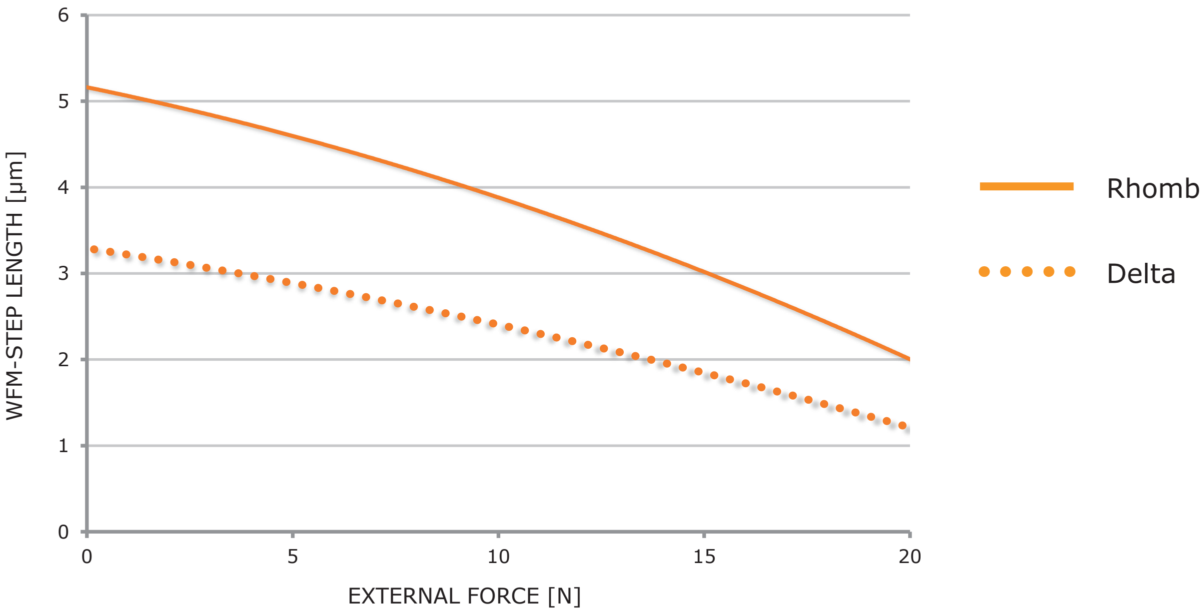
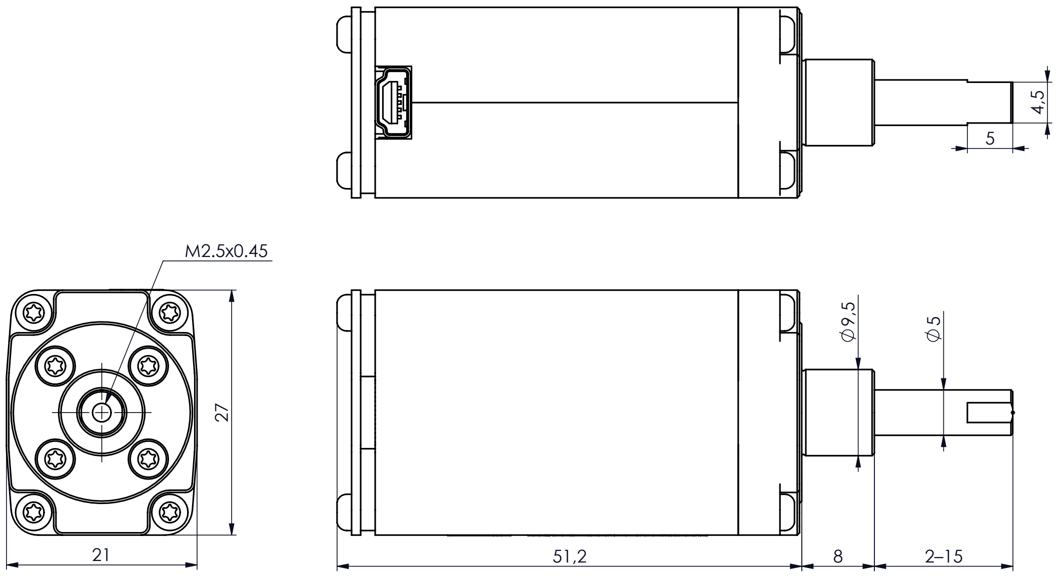
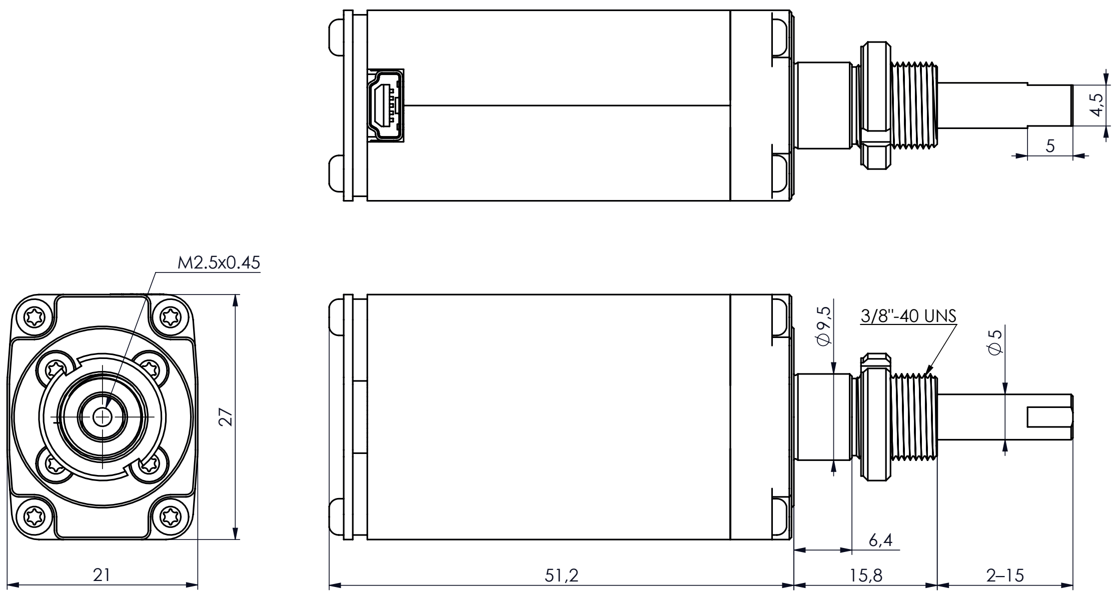


Figure 1 *Motor performance with waveform Rhomb (filled) and waveform Delta (dotted). Wfm-step length is the average distance the drive rod moves when the legs take one wfm-step (i.e. for one waveform cycle). Note: Standard deviation σ of 0.5 µm should be taken into account. Typical values are given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

Main Dimensions LTC2013-013

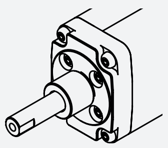
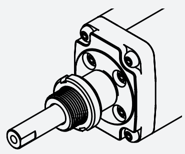


Main Dimensions LTC2014-013



Note:
Refer to drawings for details. Drive shaft has only limited bending moment capability, and absolutely no rotational torque is allowed. In order to safely mount an end piece in the threaded hole, you must first release the motor completely (it must not be fixed in position). Thereafter, hold on only to the flat part of the shaft and fasten end piece tightly.

150030-06

Technical Specification				
Type	**LTC2013-013 (clamp mount)**	**LTC2014-013 (nut mount)**	**Unit**	**Note**
Stroke	12.8	12.8	mm	
Speed Range [a]	0-10	0-10	mm/s	recommended, no load
Step Length [b]	2.5	2.5	µm	one wfm-step
	0.0003 [c]	0.0003 [c]	µm	one micro-step [c]
Resolution	< 1	< 1	nm	driver dependent
Recommended Operating Range	0-10	0-10	N	for best micro-stepping performance and life time
Stall Force	20	20	N	
Holding Force	22	22	N	
Maximum Voltage	48	48	V	
Power Consumption [d]	10	10	mW/Hz	=1 W at 100 Hz wfm-step frequency
Connector	USB mini-B	USB mini-B		
Mechanical Size	51.2 x 27 x 21	51.2 x 27 x 21	mm	see drawing for details
Material in Motor Housing	Stainless Steel, Aluminium	Stainless Steel, Aluminium		
Mounting	Clamp 	Nut 		
Weight	95	95	gram	approximate
Operating Temp.	0 to +50	0 to +50	ºC	

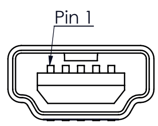
a. Max value is typical for waveform *Rhomb* at 2 kHz, no load, temperature 20ºC.
b. Typical values for waveform *Delta*, 10 N load, temperature 20ºC.
c. Driver dependent; 8192 micro-steps per wfm-step for driver in the PMD200-series.
d. At temperature 20ºC, intermittent runs.

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

Connector Type

The motor connector is USB mini-B. Motor cable is included (2 m with USB mini-B to JST 05SR-3S). Cable connects directly to driver PMD101 and PMCM31. For connection to driver PMD206 and PMD236 you also need a D-sub adapter (p/n CK6280).

Pin Assignment		
Pin	**Terminal**	**Cable Color**
1	Ground (GND)	Black or brown
2	Phase 4	Grey
3	Phase 3	White
4	Phase 2	Green
5	Phase 1	Yellow



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