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DRV181 - February 25, 2015

Item # DRV181 was removed from our e-commerce site on February 25, 2015 For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

MODULAR PIEZOELECTRIC ACTUATORS

- Modular Connectivity
- Piezo Travel with Optional Feedback
- Compatible with MAX300 and MAX600 Stages

Hide Overview

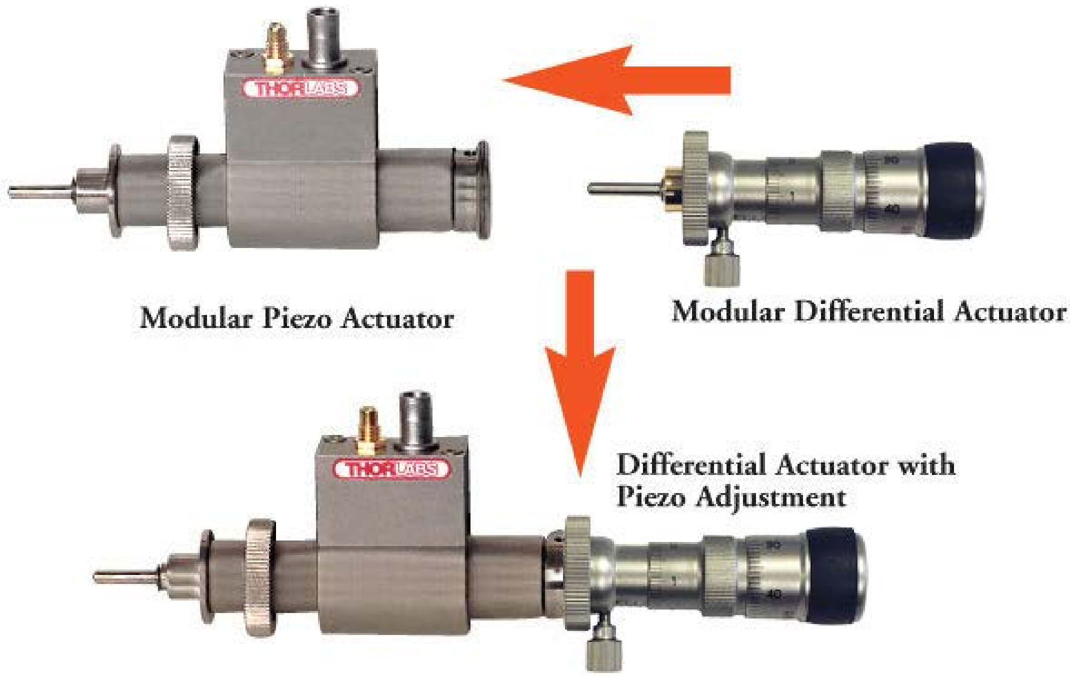
OVERVIEW

These piezo actuators are designed to add additional travel range and control to our NanoMax™ Flexure Stages (DRV001, DRV3, or DRV004). Compatible piezo controllers, available separately, are listed in the table to the right. In addition, when used with our Modular Quick-Connect Adapters, they can be fitted to any of our stages accepting a Ø9.5 mm (Ø3/8") or Ø10 mm (Ø.39") mounting barrel. These externders are ideal for applications requiring high-resolution movements over a small range. The DRV120 offers 20 µm of travel with feedback position sensing. The DRV181 offers 80 µm of travel without feedback and provides a convenient electrical parallel feedthrough for daisy chaining multiple piezo extenders together using a single controller if bandwidth is not a significant factor.

Actuator Item #	Compatible Piezo Controllers	
DRV120[a]	BPC301 TPZ001 Combined with TSG001	MPZ601
DRV181	BPC301 MPZ601	MDT693B TPZ001

a. The DRV120, as well as all other closed-loop piezo actuators and stages, includes a PAA622 piezo control cable.

The piezo actuators fit between the stage and existing actuator (see diagram below). A DRV3 differential actuator is shown in the example below.



Hide Specs

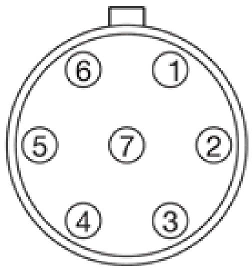
SPECS

DRV120[a]	
Travel	20 µm
Piezo Voltage	0 - 75 V
Resolution	5 nm[b]
Feedback (DRV120)	Strain Gauge
Capacitance	7.2 µF
Compatible Controllers	BPC301 MPZ601 TPZ001 Combined with TSG001
DRV181	
Travel	80 µm
Piezo Voltage	0 - 75 V
Piezo Blocking Force	1000 N
Resolution	20 nm
Capacitance	40 µF ± 30%
Compatible Controllers	BPC301 MPZ601 MDT693B TPZ001

a. The DRV120, as well as all other closed-loop piezo actuators and stages, includes a PAA622 piezo control cable.
b. Closed Loop

PIN DIAGRAMS

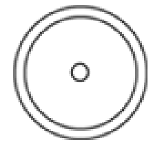
Strain Gauge Pin Out



Pin	Designation
1	+ 15 V
2	Oscillator +
3	0 V
4	Signal Out -
5	Singal In +
6	- 15 V
7	Travel

Piezo Inputs

SMC



0 - 75 V

PIEZO BANDWIDTH

Piezo Driver Bandwidth Tutorial

Knowing the rate at which a piezo is capable of changing lengths is essential in many high-speed applications. The bandwidth of a piezo controller and stack can be estimated if the following is known:

1. The maximum amount of current the controllers can produce. This is 0.5 A for our BPC Series Piezo Controllers, which is the driver used in the examples below.
2. The load capacitance of the piezo. The higher the capacitance, the slower the system.
3. The desired signal amplitude (V), which determines the length that the piezo extends.
4. The absolute maximum bandwidth of the driver, which is independent of the load being driven.

To drive the output capacitor, current is needed to charge it and to discharge it. The change in charge, *dV/dt*, is called the slew rate. The larger the capacitance, the more current needed:

$$slew\,rate = \frac{dV}{dt} = \frac{I_{max}}{C}$$

So, for example, for a 100 µm stack, having a capacitance of 20 µF, being driven by a BPC Series piezo controller with a maximum current of 0.5 A, the slew rate is given by

$$slew\,rate = \frac{0.5\,A}{20\,\mu F} = 25\,V/ms$$

Hence, for an instantaneous voltage change from 0 V to 75 V, it would take 3 ms for the output voltage to reach 75 V.

Note: For these calculations, it is assumed that the absolute maximum bandwidth of the driver is much higher than the bandwidths calculated, and thus, driver bandwidth is not a limiting factor. Also please note that these calculations only apply for open-loop systems. In closed-loop mode, the slow response of the feedback loop puts another limit on the bandwidth.

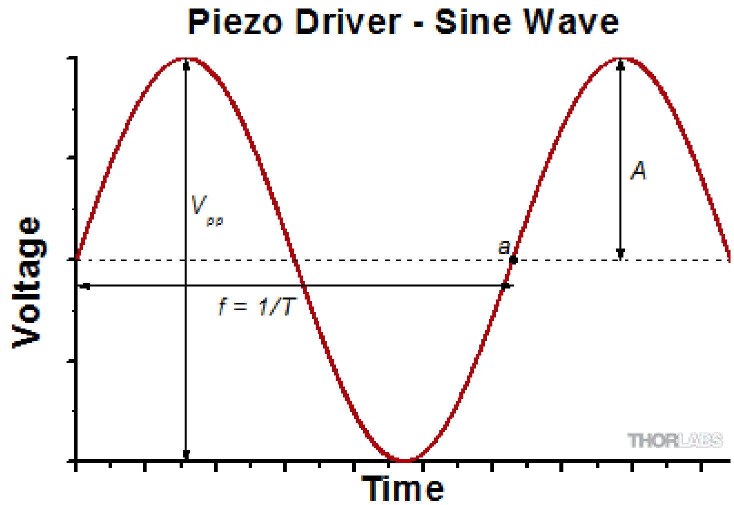
Sinusoidal Signal

The bandwidth of the system usually refers to the system's response to a sinusoidal signal of a given amplitude. For a piezo element driven by a sinusoidal signal of peak amplitude *A*, peak-to-peak voltage V_{pp}, and frequency *f*, we have:

$$V(t) = A sin(2\pi f t) + A$$

A diagram of voltage as a function of time is shown to the right. The maximum slew rate, or voltage change, is reached at *t = 2nπ, (n=0, 1, 2,...)* at point *a* in the diagram to the right:

$$\left.\frac{dV}{dt}\right|_{t\,=\,2n\pi} = 2\pi A f_{max}$$



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From the first equation, above:

$$\frac{dV}{dt} = \frac{I_{max}}{C}$$

Thus,

$$f_{max} = \frac{I_{max}}{2\pi AC} = \frac{I_{max}}{\pi V_{pp} C}$$

For the example above, the maximum full-range (75 V) bandwidth would be

$$f_{max} = \frac{I_{max}}{\pi V_{pp} C} = \frac{0.5\,A}{\pi(20\,\mu F)(75\,V)} \approx 106\,Hz$$

.

For a smaller piezo stack with 10 times lower capacitance, the results would be 10 times better, or about 1060 Hz. Or, if the peak-to-peak signal is reduced to 7.5 V (10% max amplitude) with the 100 µm stack, again, the result would be 10 times better at about 1060 Hz.

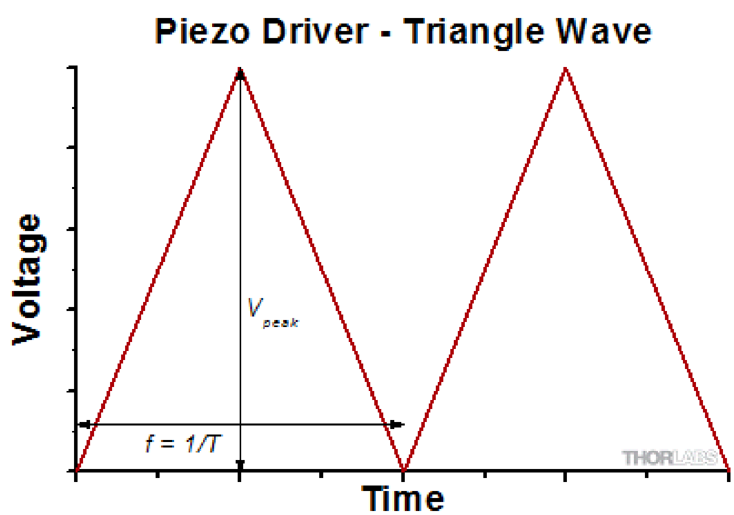
Triangle Wave Signal

For a piezo actuator driven by a triangle wave of max voltage V_{peak} and minimum voltage of 0, the slew rate is equal to the slope:

$$\frac{I_{max}}{C} = \frac{2V_{peak}}{T}.$$

Or, since *f = 1/T*:

$$f_{max} = \frac{I_{max}}{2V_{peak}C} = \frac{0.5\,A}{2(20\,\mu F)(75\,V)} \approx 167\,Hz$$



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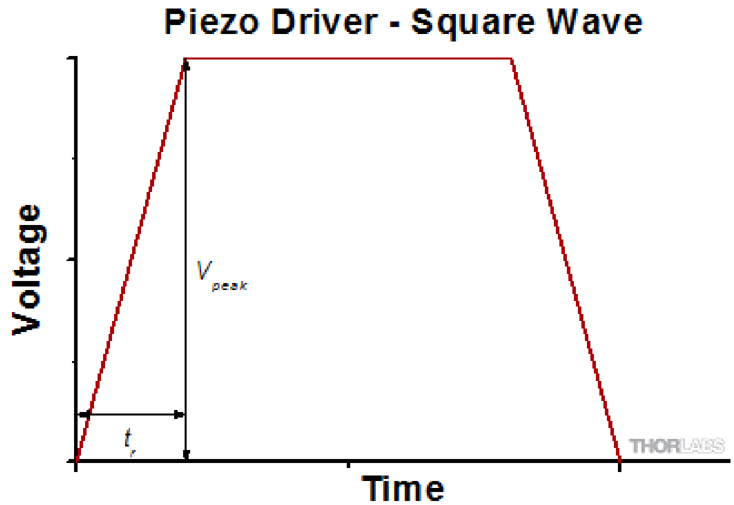
Square Wave Signal

For a piezo actuator driven by a square wave of maximum voltage V_{peak} and minimum voltage 0, the slew rate limits the minimum rise and fall times. In this case, the slew rate is equal to the slope while the signal is rising or falling. If t_r is the minimum rise time, then

$$\frac{I_{max}}{C} = \frac{V_{peak}}{t_r}$$

or

$$t_r = \frac{CV_{peak}}{I_{max}} .$$



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Hide Part Numbers

Part Number	Description	Price	Availability
DRV120	Modular NanoMax 20 µm Piezo Drive with Feedback	$1,030.00	Today
DRV181	Modular NanoMax 80 µm Piezo Drive Without Feedback	$1,030.00	Today

Visit the *Modular Piezoelectric Actuators* page for pricing and availability information:
http://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=1239