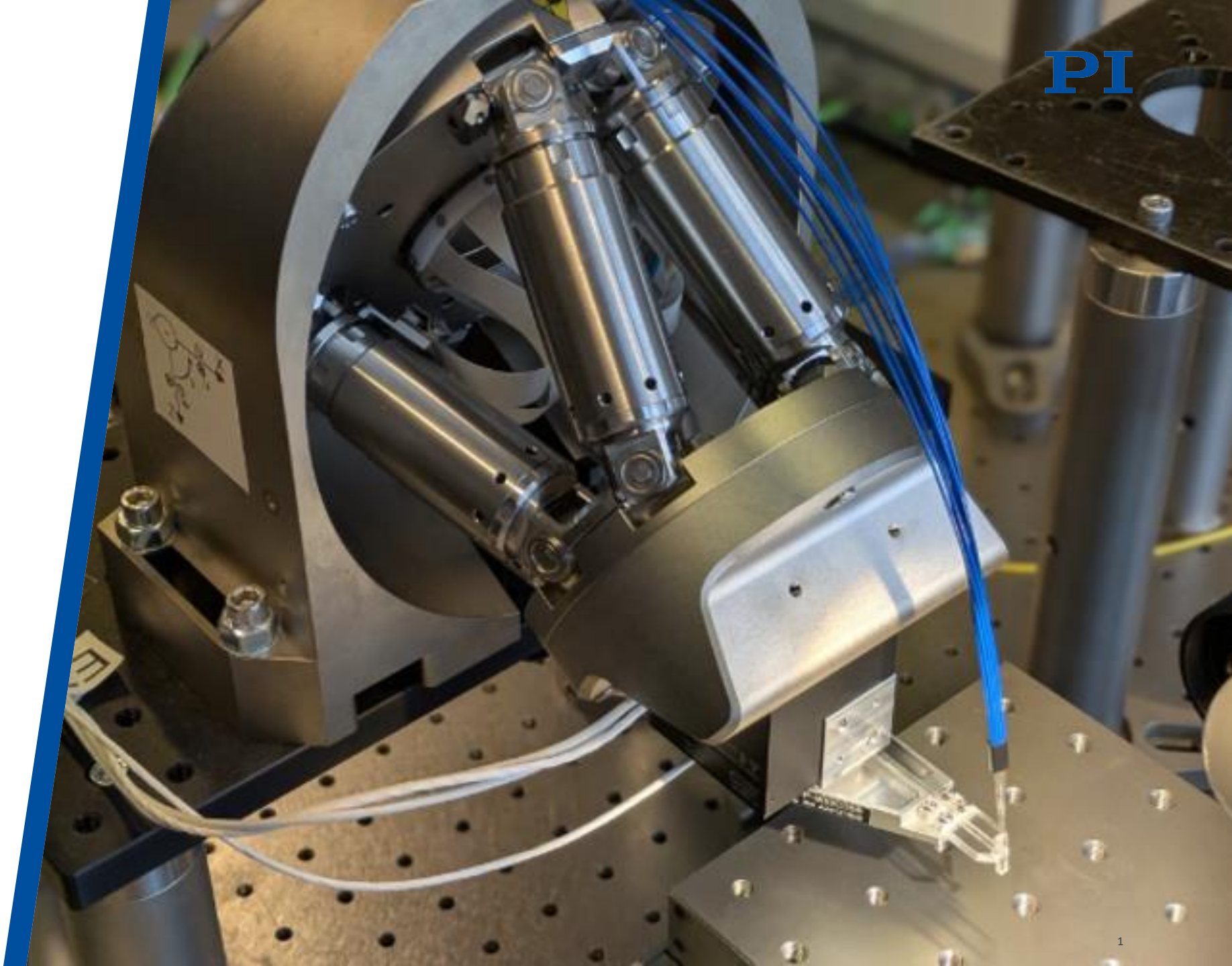
PHYSIK INSTRUMENTE

Product Launch - Piezo Gripper P-606.1P



Product Management – Division Components
Karlsruhe, Germany
September 2026

Agenda

P-606.1P

- Introduction
- Functional Description
- ß Customers
- Current Market Situation
- Targeted Market
- Competitive Analysis
- Force Stroke Diagram - Examples

Introduction

Modular Gripper for High Dynamic Photonics Manufacturing Applications

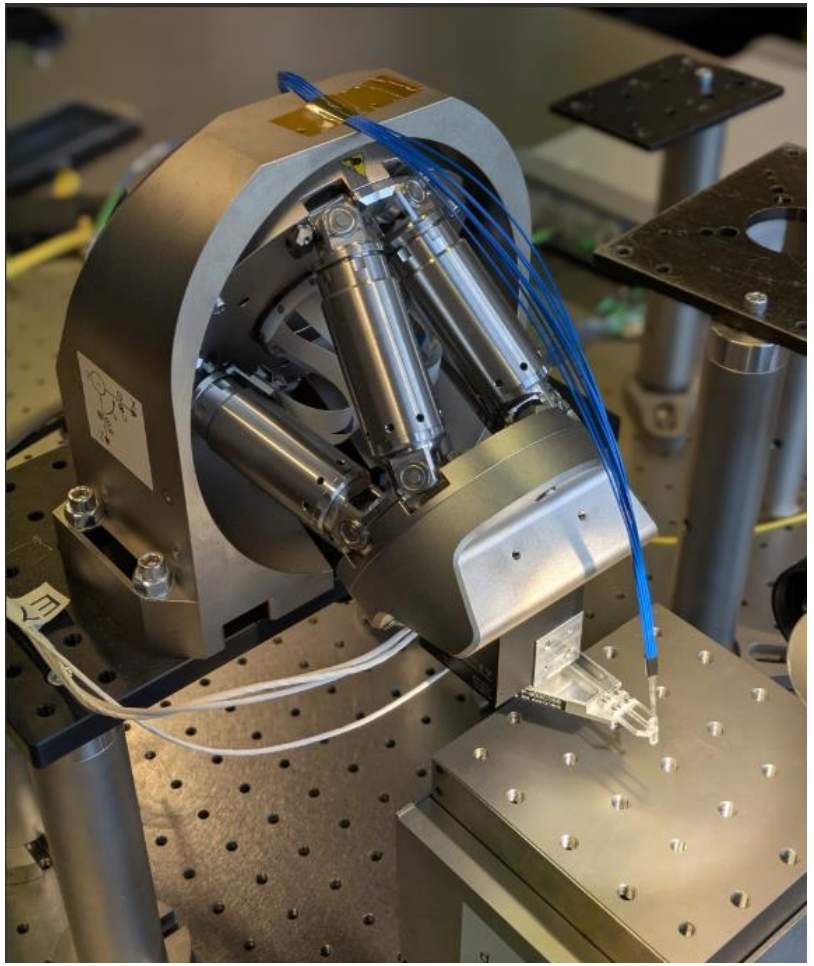
- Missing element for construction tooling for photonics manufacturing is any sort of commercially available gripper with
  - necessary gripping force
  - Structural rigidity
- To hold photonics elements stably during high-dynamic actuation
- Keep the object steady while a process happens – alignment (optical fiber), (surgery (tissue))
- Deposit the object at a certain location and orientation – assembly (components)
- (Hold and manipulate an object to accomplish a task – suture (needle))

- Our motivation:
  - ‘Stop directing sales of grippers to Smaract, who then turn around and steal the alignment business.’
  - Low volume, but strategic or necessary accessory for other products (FMPA)
  - Opens new opportunities/businesses

Introduction

Applications

- Alignment:
  - Probing/Inspection
  - Fiber manipulation/alignment
  - PCB Stencil
  - Lens and camera (automotive)
- Pick and Place
- Micromanipulation
- Microelectronics Assembly
- Microscope slide holder



Introduction

Product Description

- The gripper prototype (PN: P-900C056), originally designed by PI's team in Hopkinton, is based on a monolithic flexure structure that provides excellent rigidity, low mass, force feedback, and modular jaws.
- The gripper is commercially available to help photonics manufacturing applications to pick, place and hold elements stably during high-dynamic actuation, for example during alignment in packaging and inspection applications.
- Piezo actuated micro grippers provide fast response, high force and nanometer precision for handling delicate optical devices.

- **Pricing & Lead times:**
  - Recommended End Customer Pricing: 5.600 EUR
  - 16 weeks (incl. lead time of controller)

Production Site:
PI Karlsruhe

Perspective:

- The piezo gripper in its current form is intended as a supplement to our existing portfolio, specifically to address photonics applications. Additional gripper variants are not planned at this stage; however, they may be considered upon request, provided a viable business case exists.

Introduction

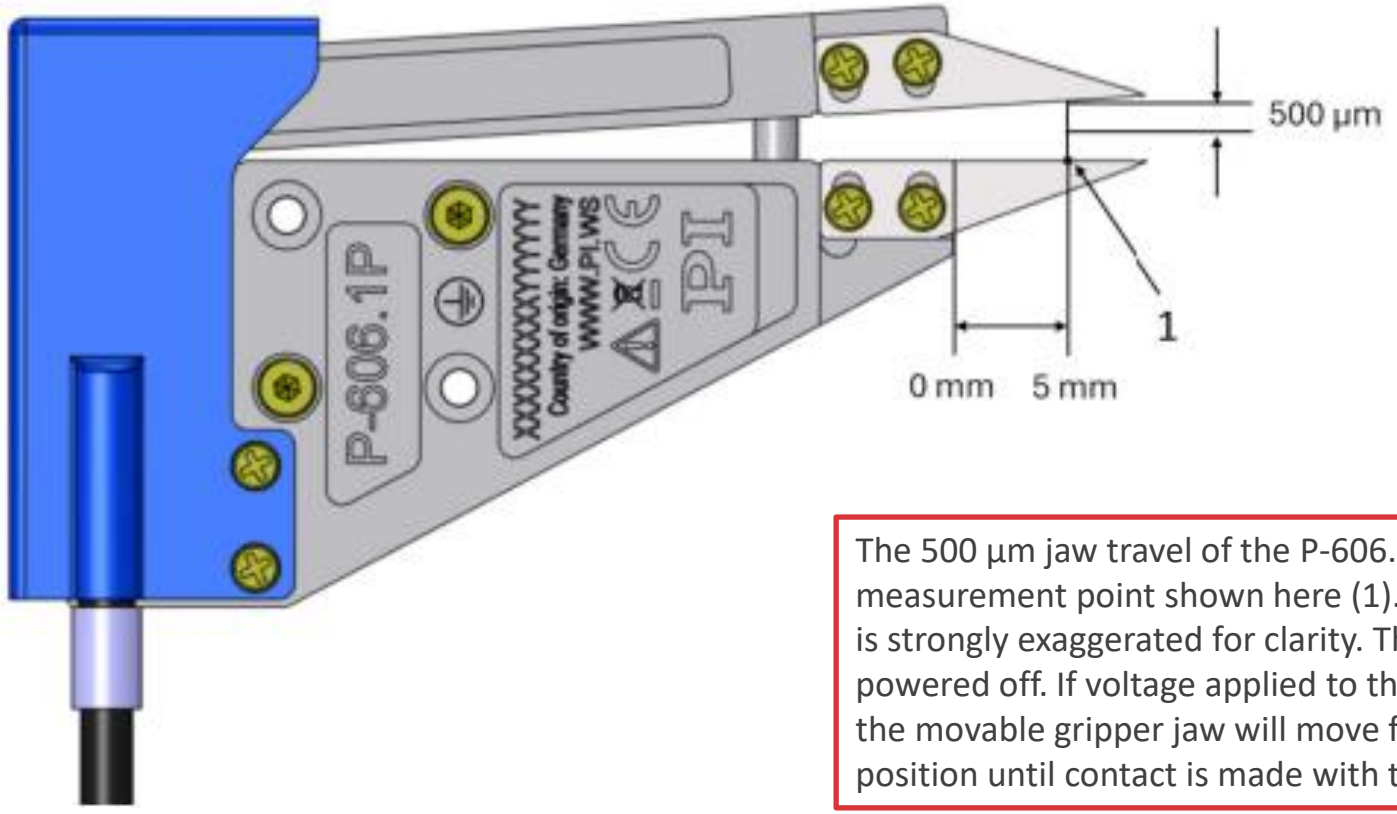
Technical Specifications

Specification	P-606.1P	Unit	Tolerance
Active axes	X	-	-
Jaw travel	500	µm	typ.
Opening width	0.5 – 1.9	mm	-
Clamping force	4	N	typ.
Integrated sensor	Piezoresistive force sensor	-	-
Motion execution	Unsymmetrical	-	-

Jaw travel: Travel range of the movable gripper jaw, for a voltage range from -20 to 120, depending on distance between measurement point and base body, see "Drawings and images"

Dimensions

Gripper Anatomy

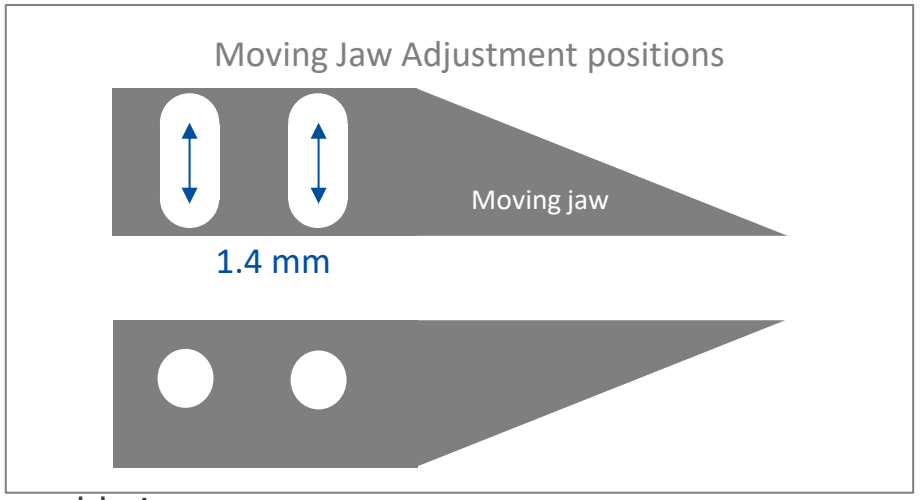


The 500 µm jaw travel of the P-606.1P is relative to the measurement point shown here (1). The displacement shown is strongly exaggerated for clarity. The gripper is open when powered off. If voltage applied to the P-606.1P is increased, the movable gripper jaw will move from the open starting position until contact is made with the object to be gripped.

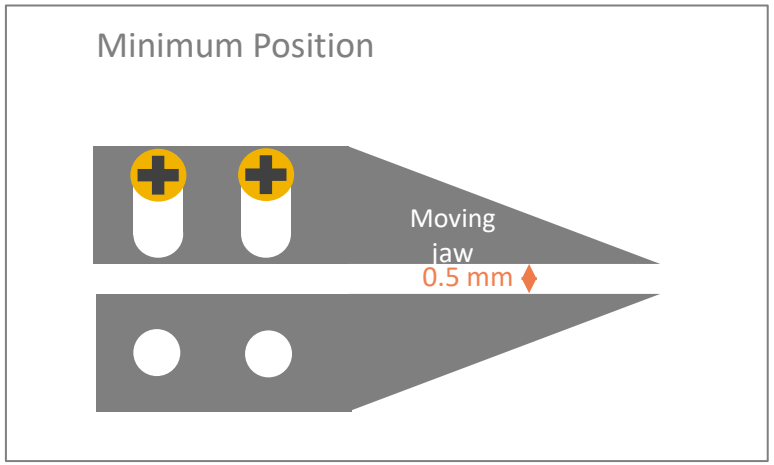
Functional Description

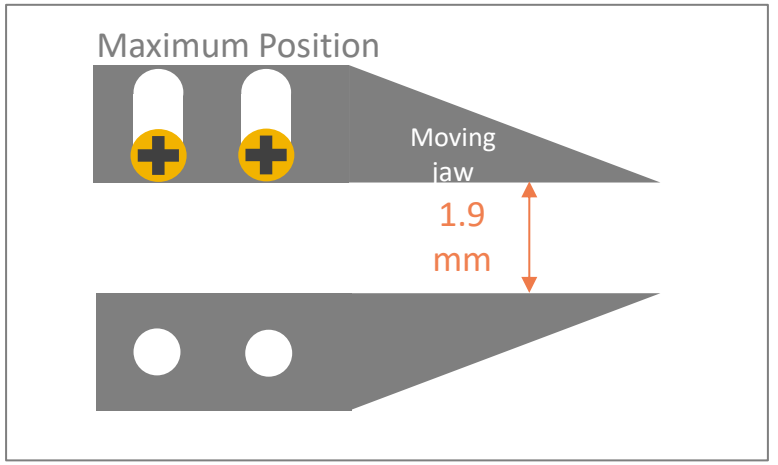
Jaw Adjustment – Min./Max. Range

- Assumptions:
  - Stroke while applying -20 … +120 V: 600 µm
  - Force while applying -20 … +120 V: 4 N
  - The values shown are to be expected, but not measured!



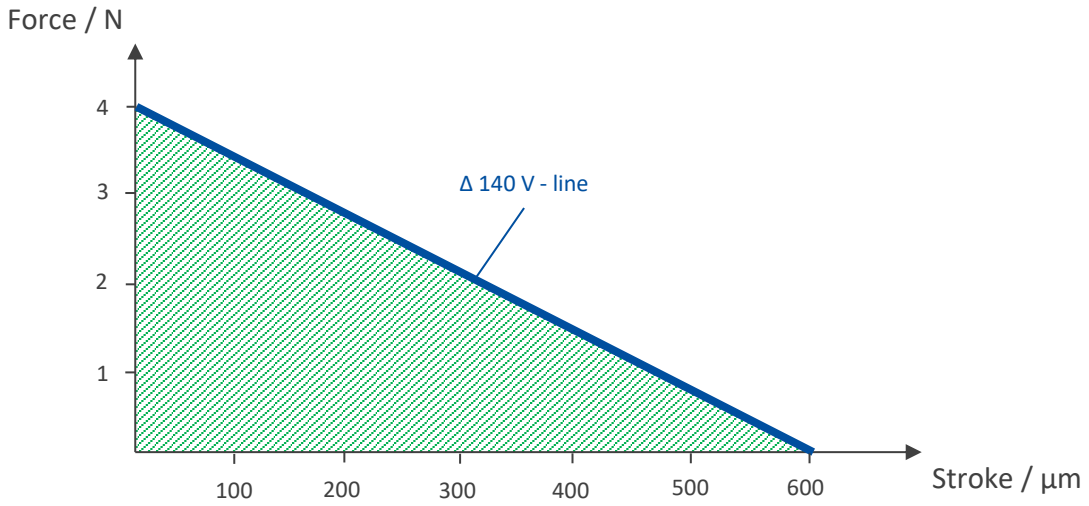
- Total adjustment range of Standard PI-Jaw set 1.4 mm
- The adjustment can be done with the slotted hole in the base body and movable jaw
- Jaw-Set can be replaced by customer set





Functional Description

Force Stroke Diagram****



Legend:

- Δ 140 V – line: maximum achievable force / stroke combination
- Achievable force / stroke combination with less than Δ 140 V.

ß Customers

- Coherent Finisar

  They use camera feedback to identify part location and then also if the jaws are closed to pick up the part. They use a 6-axis motion system to place the part and then UV cure. They make small adjustments with the grippers and the motion system during the curing process.

- IMEC

  Grip and release fiber arrays for epoxy attachment to Photonics Integrated Circuits

- SMART Photonics

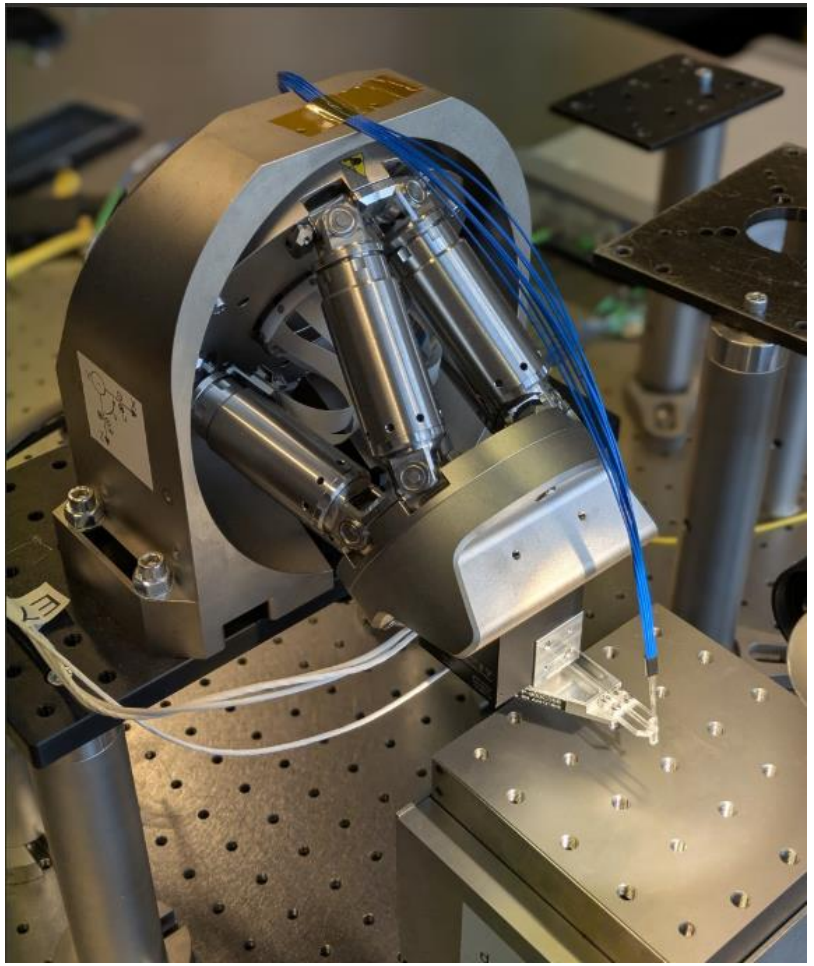
  Need: Reliably fix the (thin) fiber during active alignment.

Current Market Situation

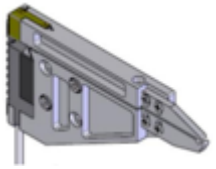
- Very few automation-friendly grippers are openly sold.
- Some players like **Percipio Robotics** and **Tegema** have regarded their gripper solutions as differentiators and do not offer them for external sale.
- Of those available for order, none seem well-suited to high-dynamic actuation of small photonic parts.
- In particular, many utilize thin and springy flexure-based gripper mechanisms that allow components to wobble and ring.
- Offering a rigid and stable gripper for high dynamic applications enables PI to offer a **more complete alignment solution to silicon photonics applications**.

Targeted Market

- **Photonics manufacturing applications** for positioning components with high resolution perfect for high dynamic scanning and gradient search operations
  (e.g. as a component in the F-713 systems
  → compatibilty with 3D NanoCube)

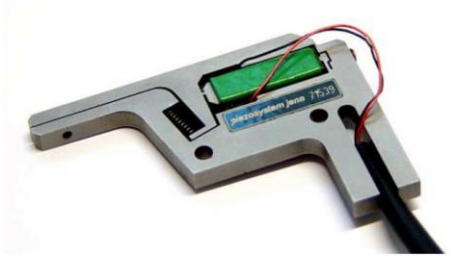


Competitive Comparison



	Smaract SGE-17	**Smaract SGP-17F**	**PI**	**PS Jena**
Opening	< 1 mm	< 20.5 mm	~ 0.5 µm	**See next slide**
Gripping Force	1 N	3.5 N	~ 4 N	
Dimensions	17 mm x 32 mm x 10 mm	30 mm x 35 mm x 14 mm	57 mm x 35 mm x 7.5 mm	
Weight	14 g	40 g	< 25 g	
Jaw Types	Exchangeable, thin, metallic	Exchangeable, can be thick	Exchangeable, customizable	
Sensor Types	Force and Position	Force and Position	Piezoresistive Force Sensor	
Gripping Resolution	< 10 nm	< 10 nm	-	
Motor	Linear piezomotor stage drives a flexure-design gripper of thin spring stock (not very stable)	Stick-slip piezomotors actuation (This may generate particles and should be of significant concern in photonic test and assembly applications)	PICMA Plus	
HV	Yes	Yes	No	

Competitive Comparison



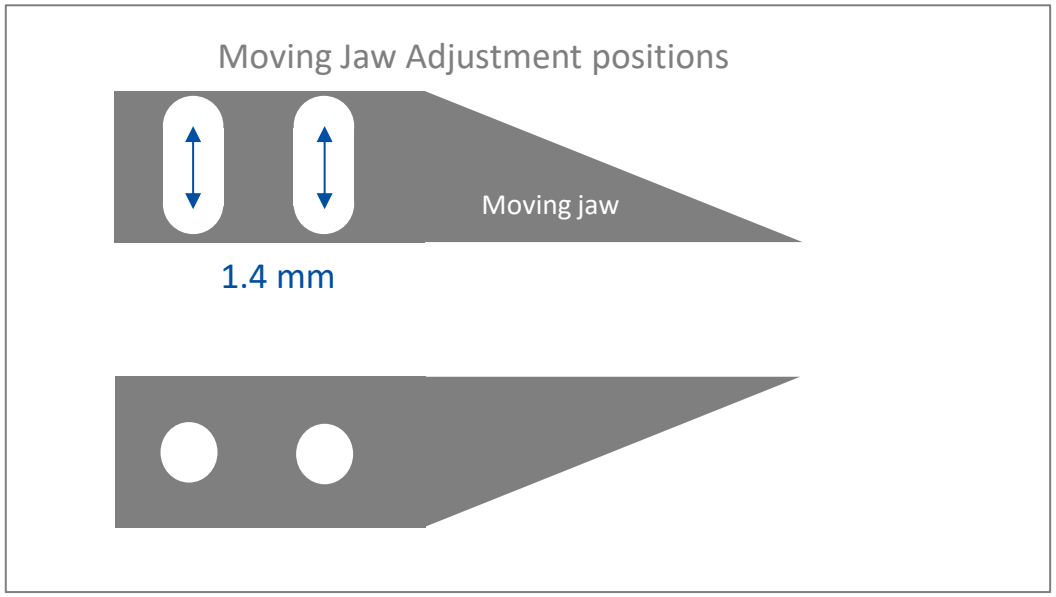
	PS Jena Grippy 3 S-805-00	**Grippy 4 S-805-50**	**Fiber Gripper O-400-00**
Opening	0.3 mm	0.7-1-4 mm	Depending on fiber
Gripping Force	adjustable grip force	adjustable grip force	adjustable grip force
Dimensions	54.5 mm x 38 mm x 8 mm	54.5 mm x 32 mm x 8 mm	58 mm x 12 mm x 15 mm
Weight	29 g	40 g	23 g
Jaw Types			
Sensor Types	-	-	-
Gripping Resolution	-	-	-
Motor	Piezo actuator	Piezo actuator	Piezo actuator
HV	-	-	-

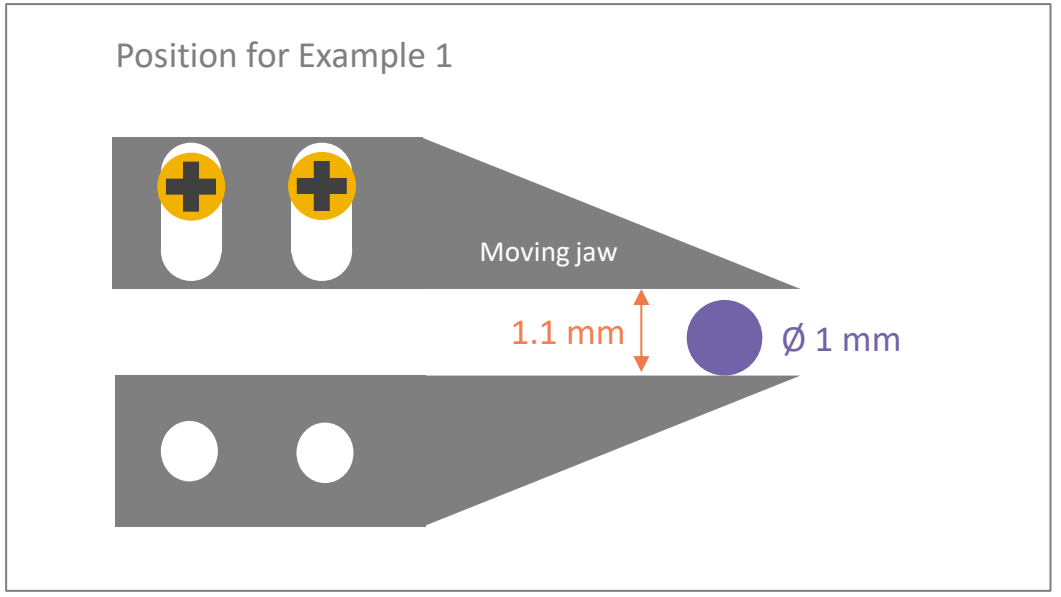
Force Stroke Diagram - Examples

Example 1

Jaw Adjustment Range

- Total adjustment range of Standard PI-Jaw set 1.4 mm.
- The adjustment can be done with the slotted hole in the base body and movable jaw
- Jaw-Set can be replaced by customer set



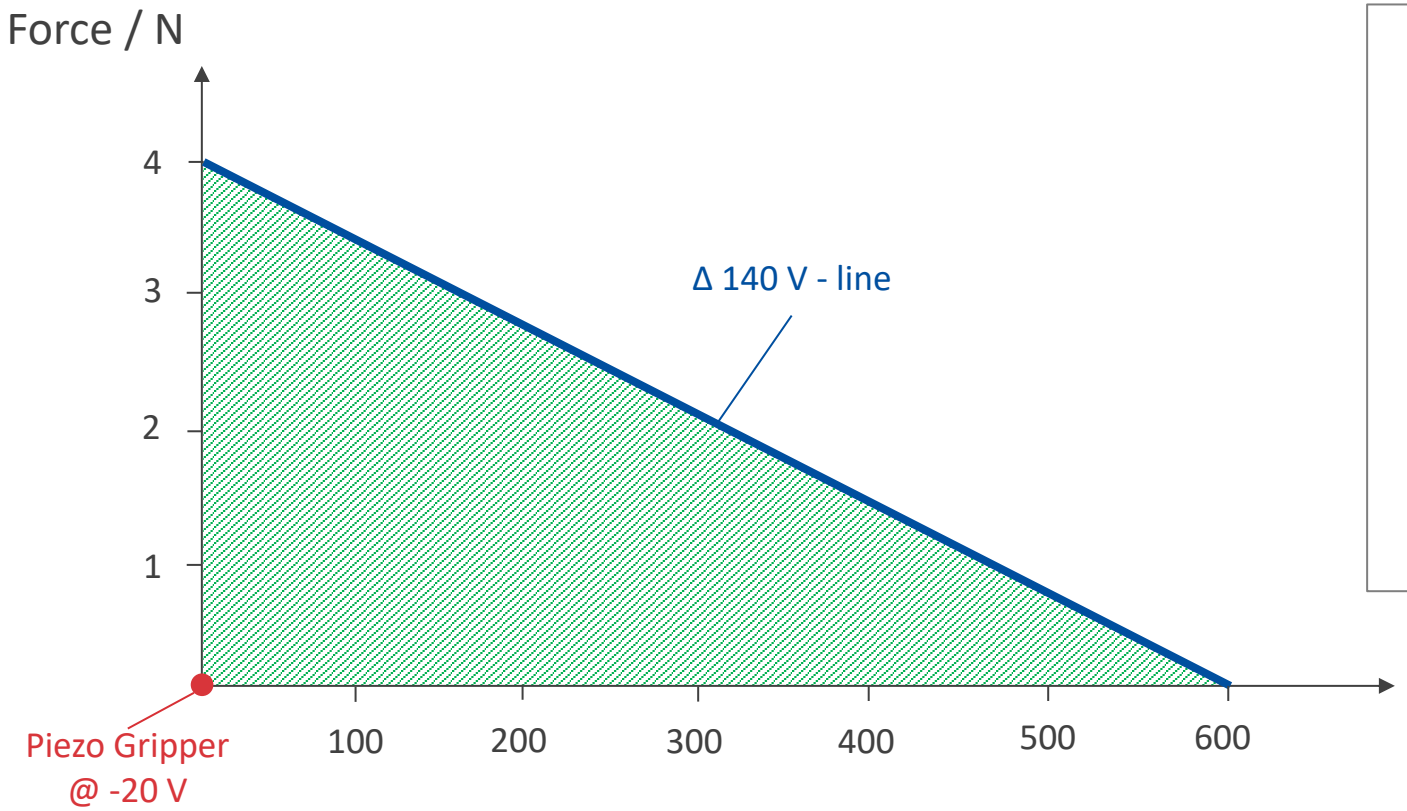


Example 1, **Phase 1**

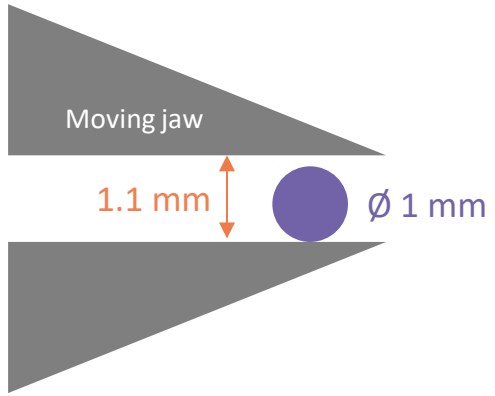
Force Stroke Diagram

Legend:

- Δ 140 V – line: maximum achievable force / stroke combination
- Achievable force / stroke combination with less than Δ 140 V.



Phase 1: Gripper jaw fully opened (-20 V)

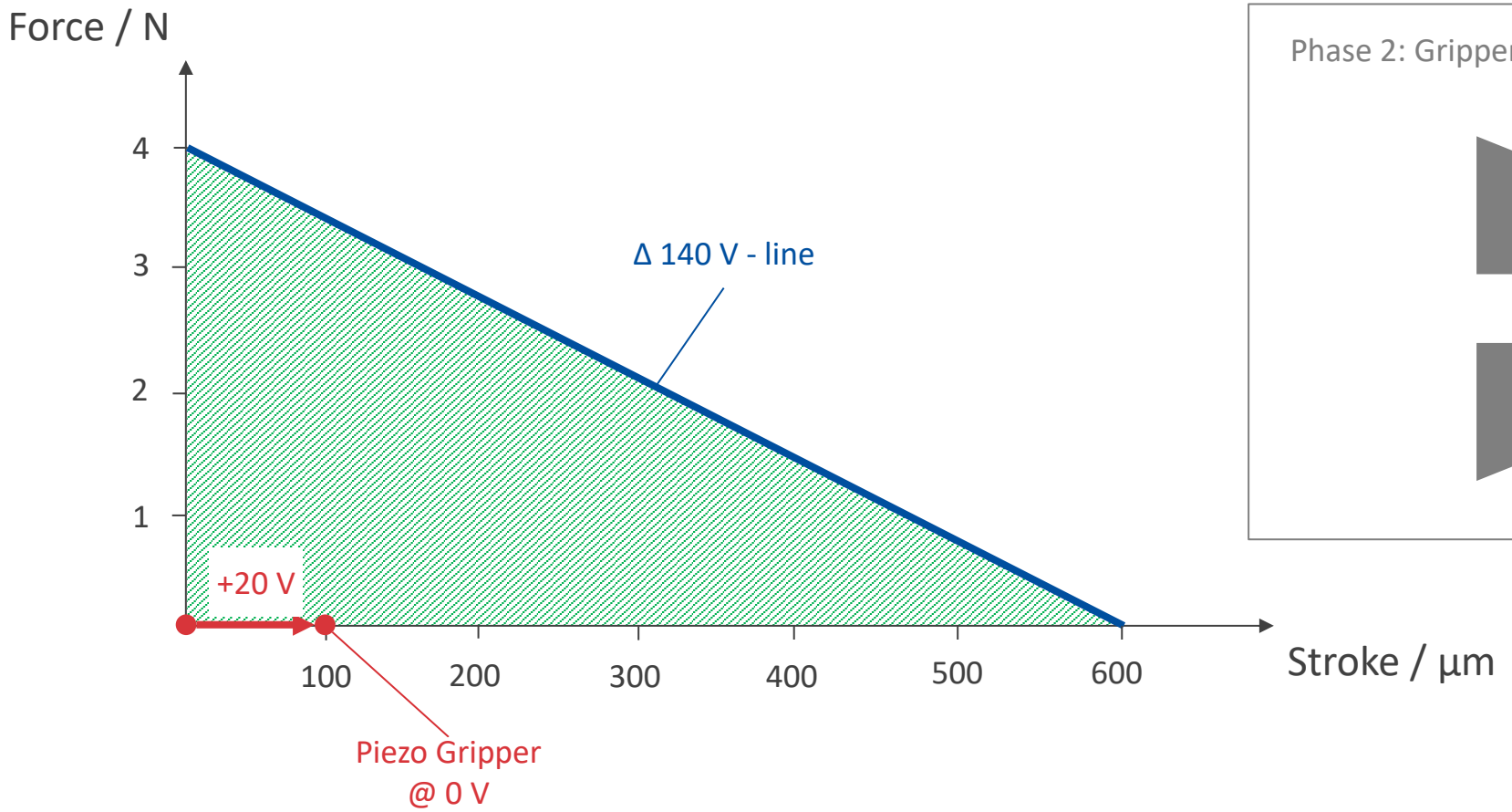


Example 1, **Phase 2**

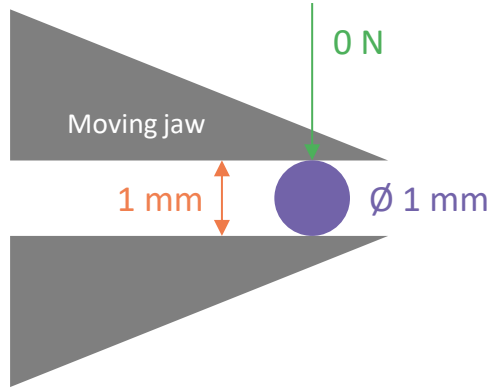
Force Stroke Diagram

Legend:

- Δ 140 V – line: maximum achievable force / stroke combination
- Achievable force / stroke combination with less than Δ 140 V.

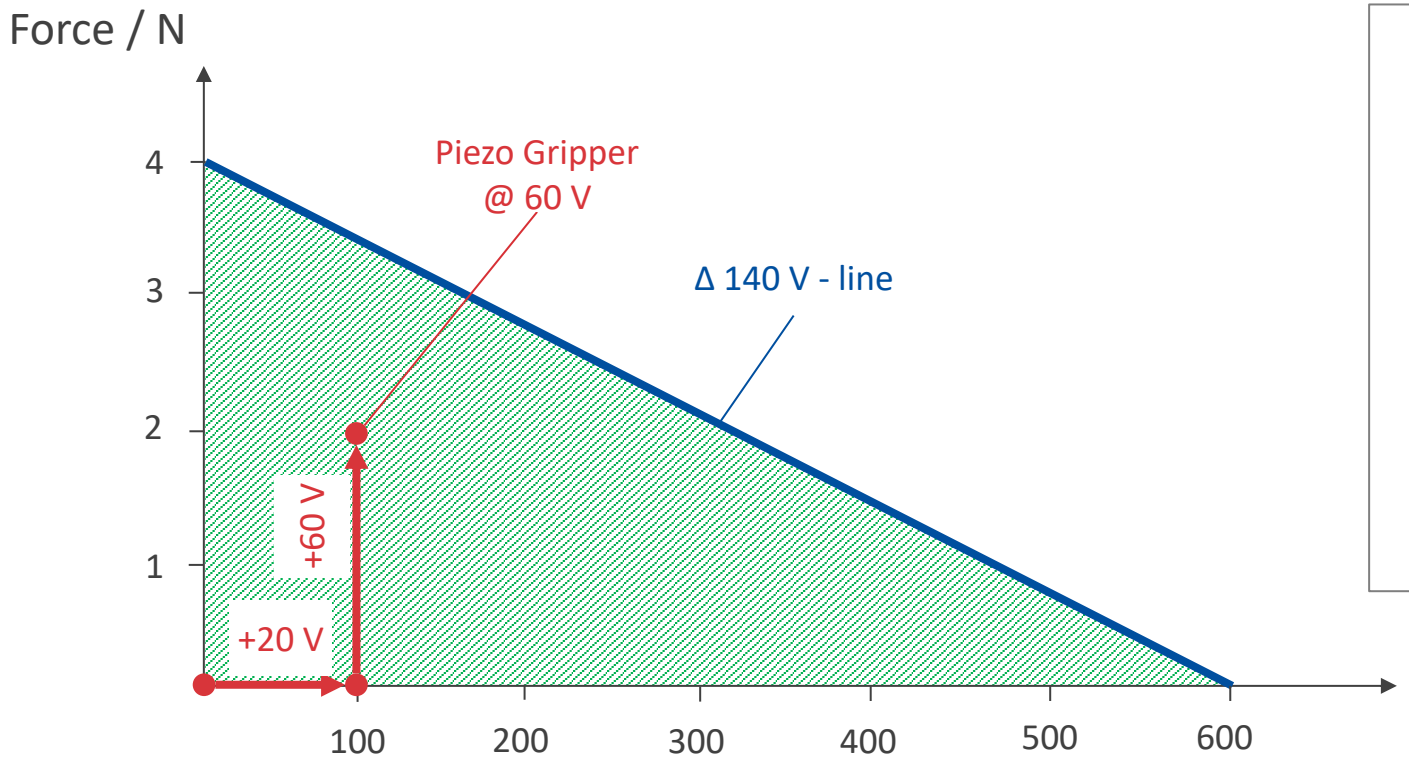


Phase 2: Gripper jaw in contact with object (0 V)



Example 1, **Phase 3**

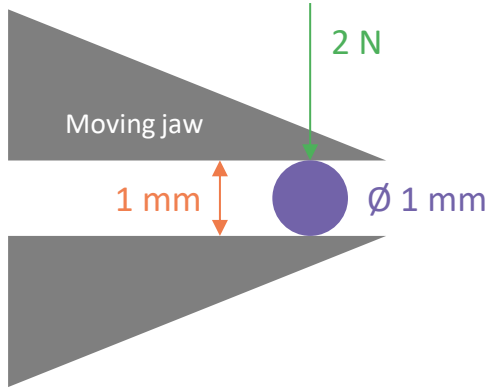
Force Stroke Diagram



Legend:

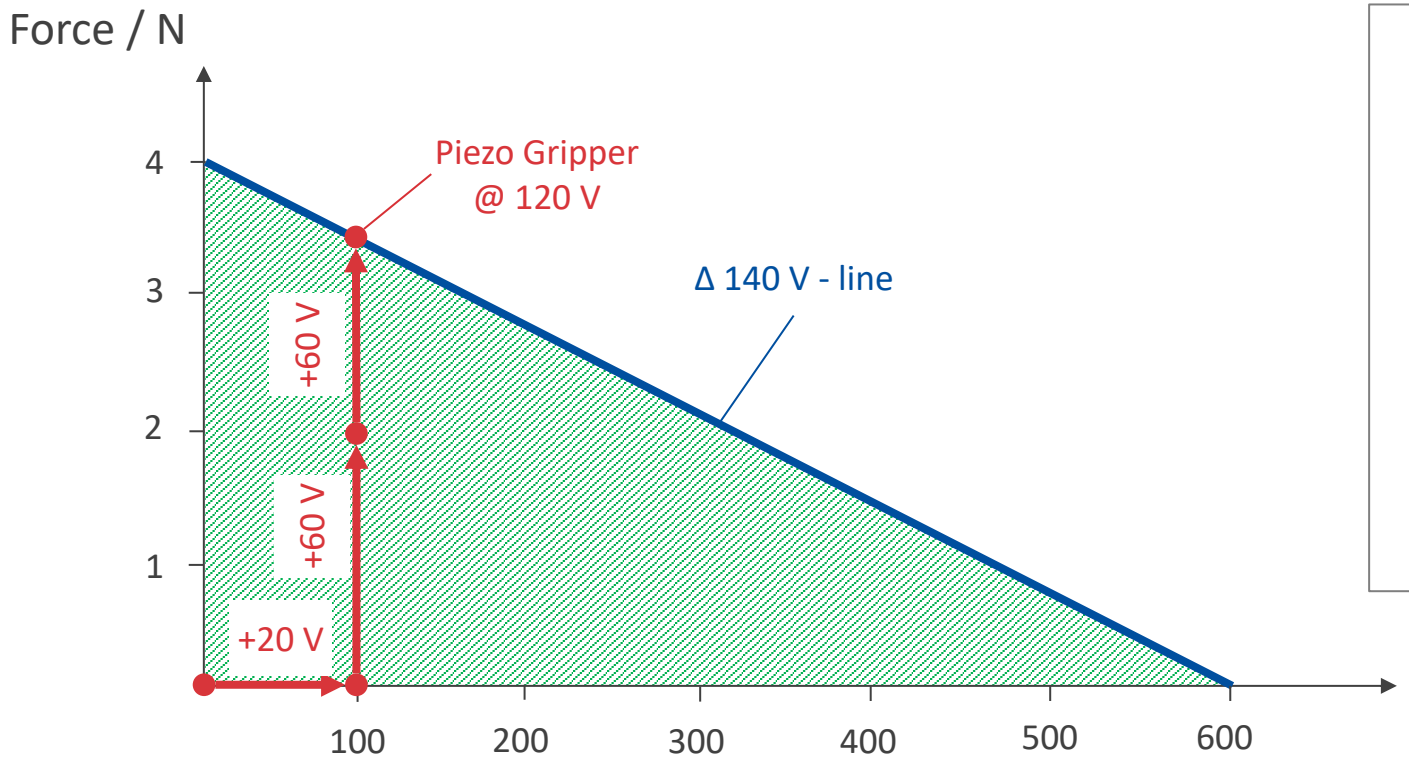
- Δ 140 V – line: maximum achievable force / stroke combination
- Achievable force / stroke combination with less than Δ 140 V.

Phase 3: Gripper voltage set to 60 V. Force to object increases.



Example 1, **Phase 4**

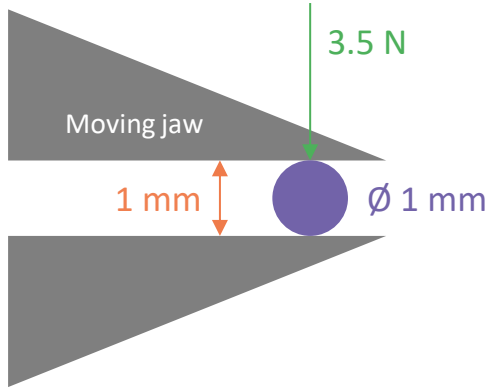
Force Stroke Diagram



Legend:

- Δ 140 V – line: maximum achievable force / stroke combination
- Achievable force / stroke combination with less than Δ 140 V.

Phase 4: Gripper set to maximum voltage (120 V).
Force to object further increases.

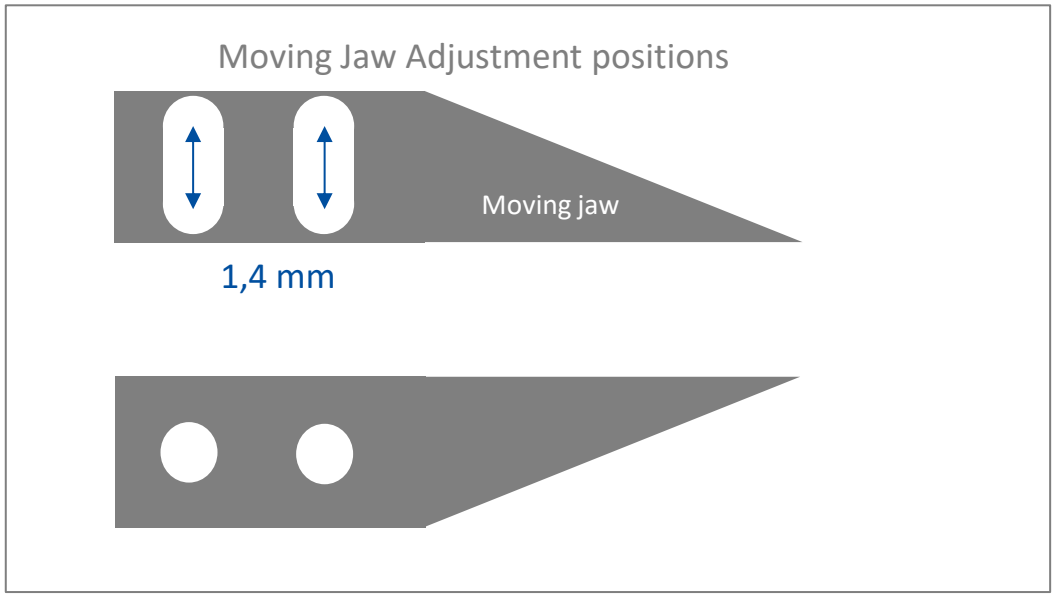


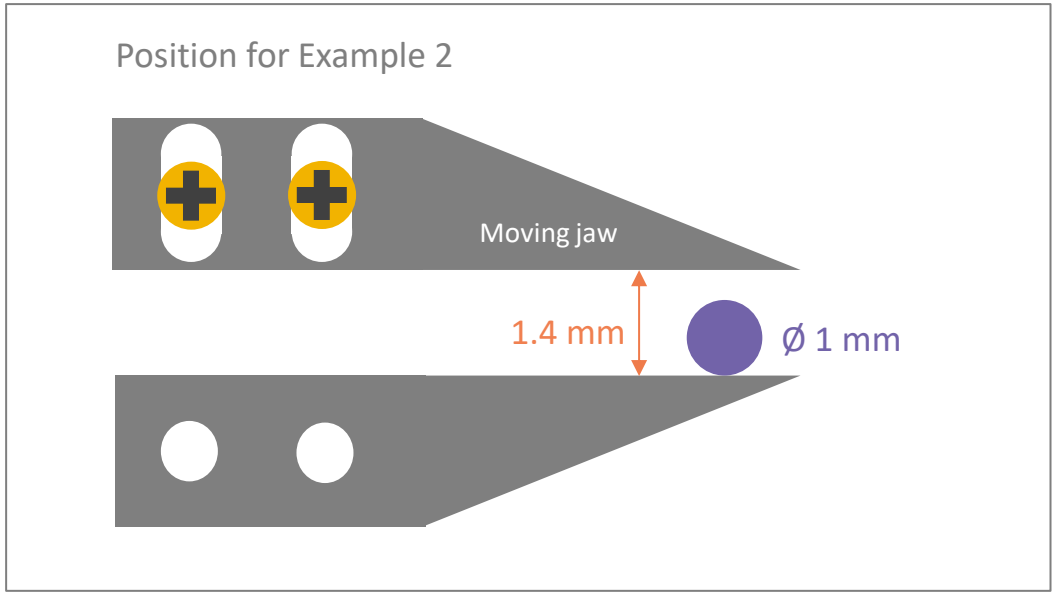
Example 2

Jaw Adjustment Range

The moving jaw can be adjusted via a slotted hole to accommodate smaller or larger workpieces.

- Adjustment range of standard PI-jaw set 1.4 mm.





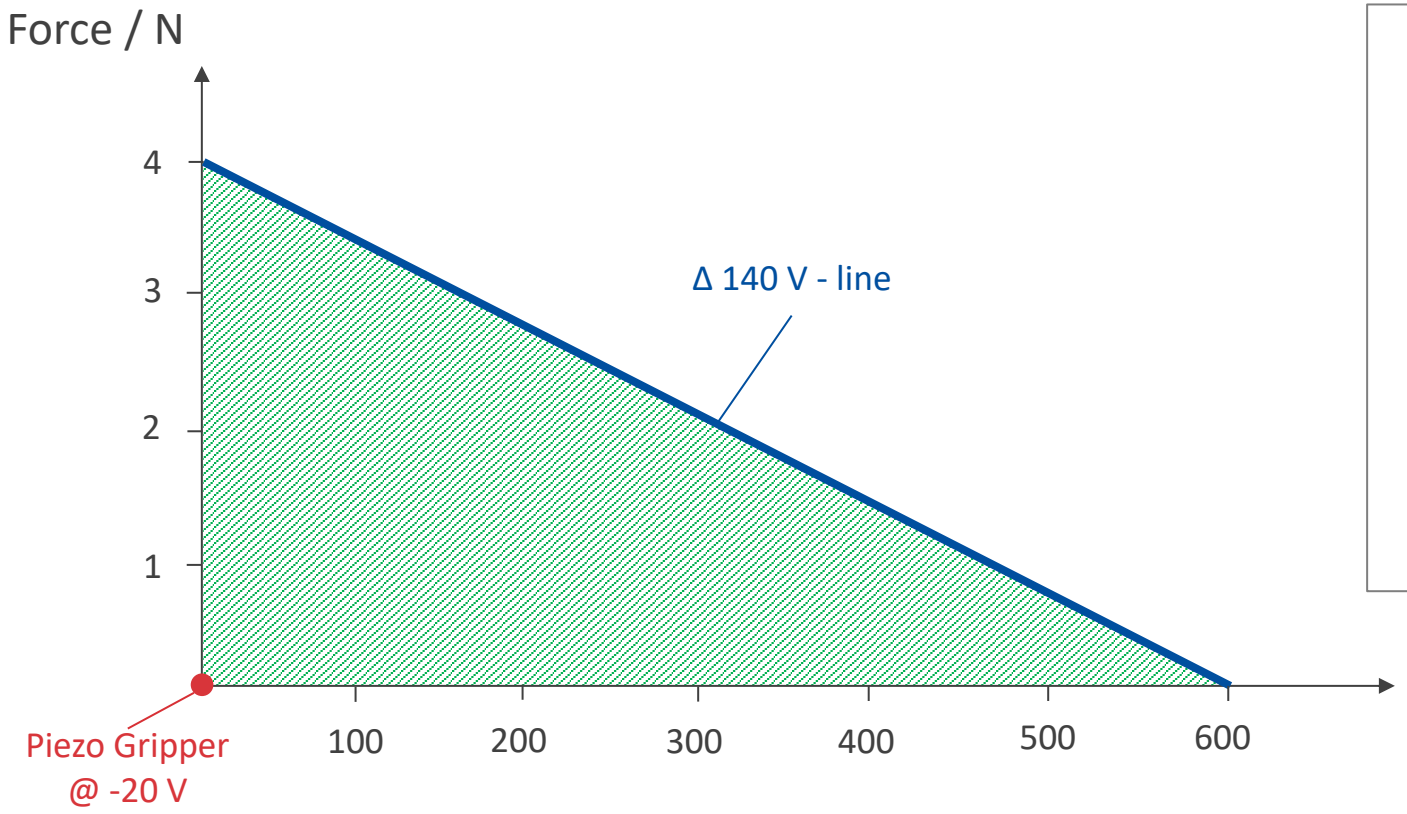
This side is fixed and has no slotted hole.

Example 2, **Phase 1**

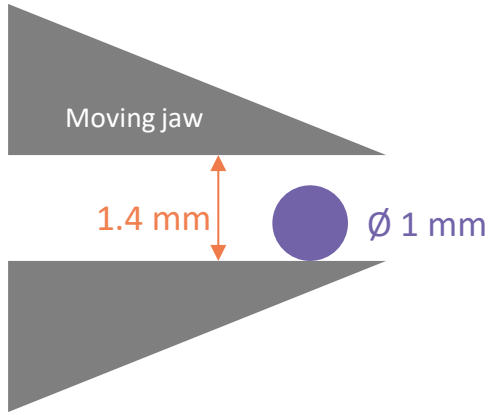
Force Stroke Diagram

Legend:

- Δ 140 V – line: maximum achievable force / stroke combination
- Achievable force / stroke combination with less than Δ 140 V.



Phase 1: Gripper jaw fully opened (-20 V)

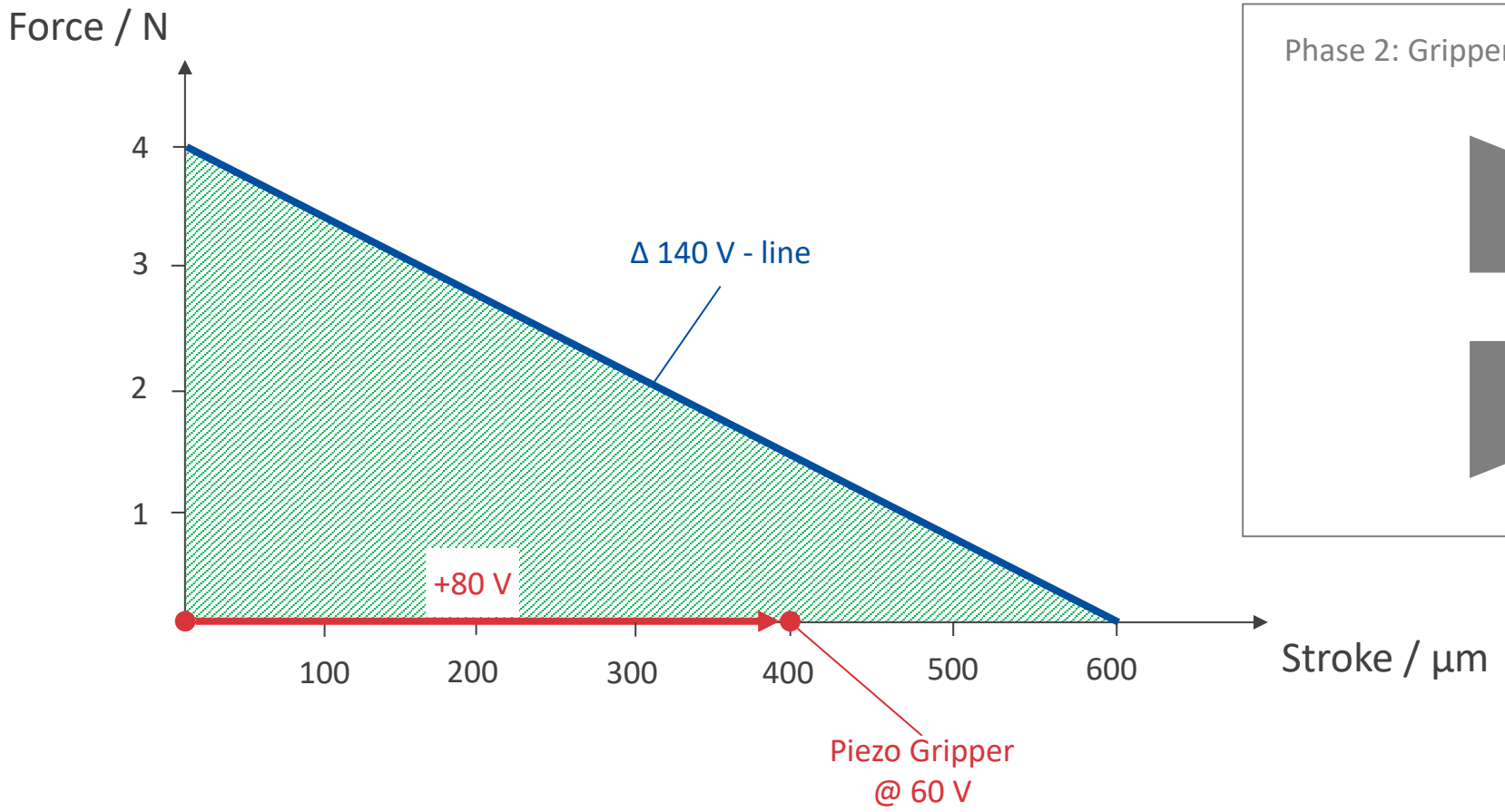


Example 2, **Phase 2**

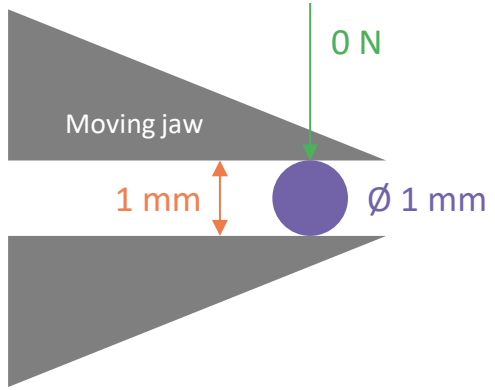
Force Stroke Diagram

Legend:

- Δ 140 V – line: maximum achievable force / stroke combination
- Achievable force / stroke combination with less than Δ 140 V.



Phase 2: Gripper jaw in contact with object (60 V)



Example 2, **Phase 3**

Force Stroke Diagram

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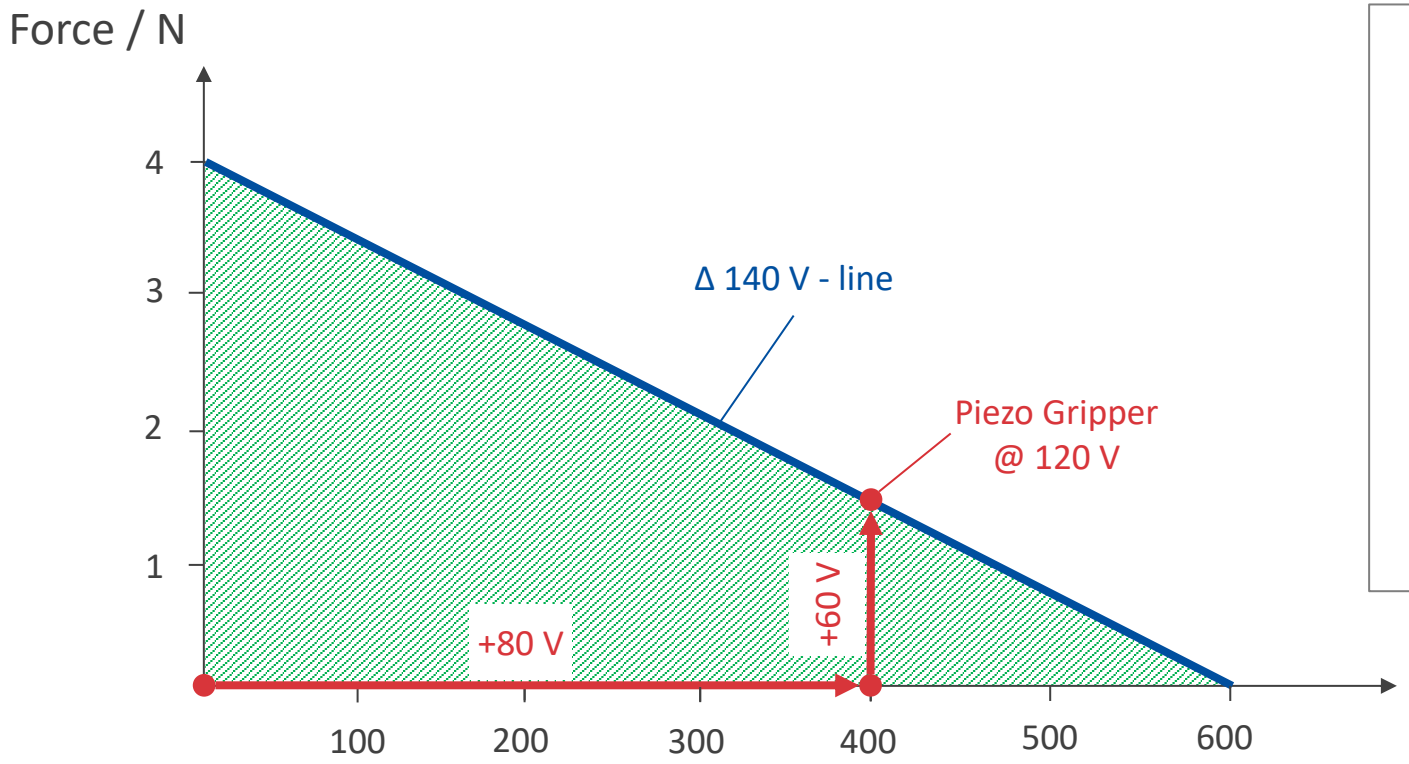
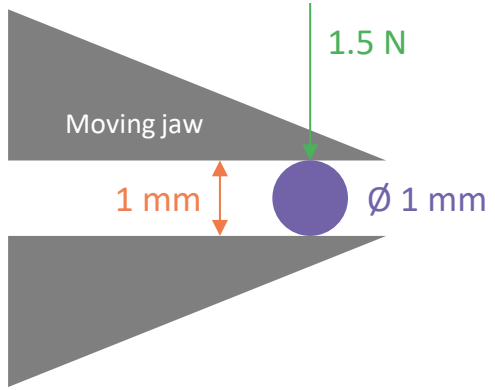
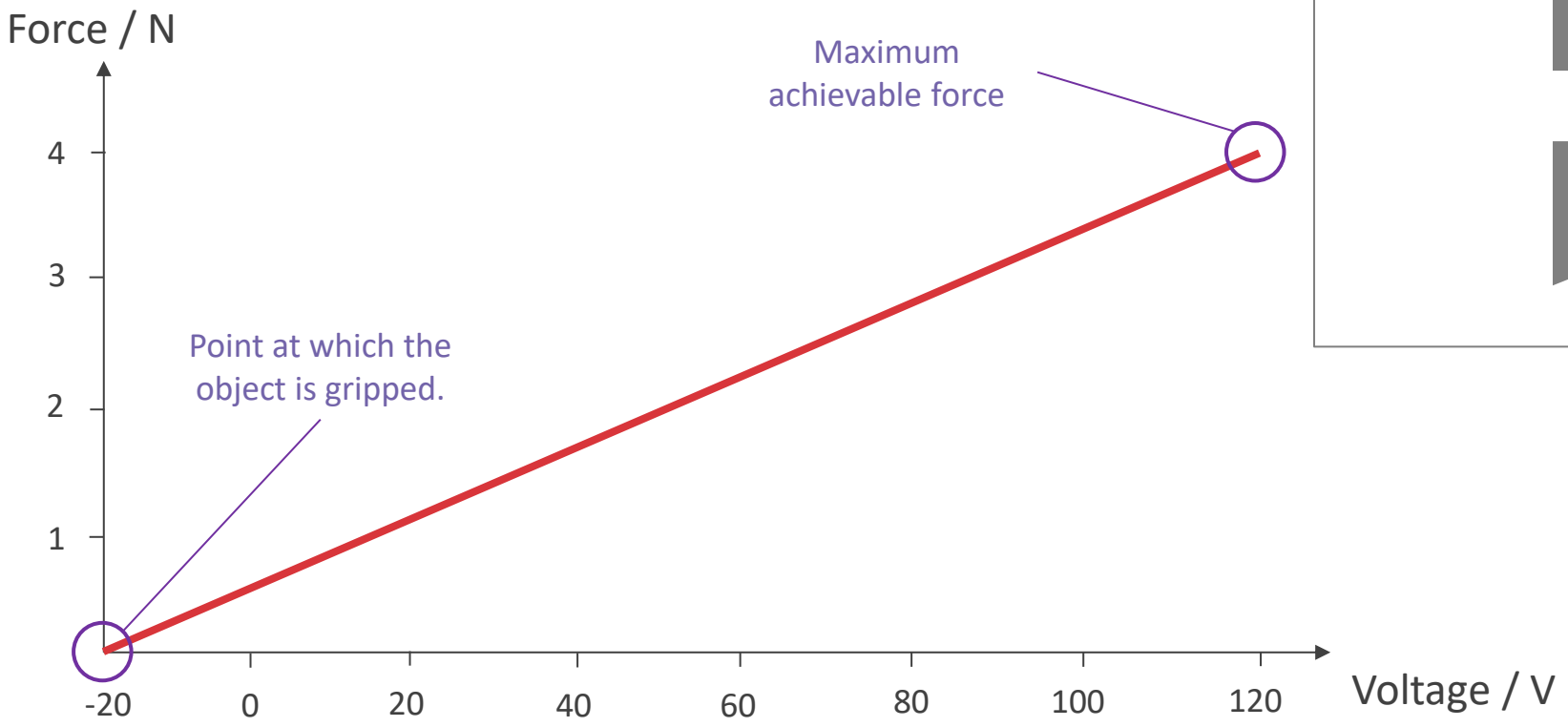


Phase 3: Gripper set to maximum voltage (120 V).
Force to object further increases.

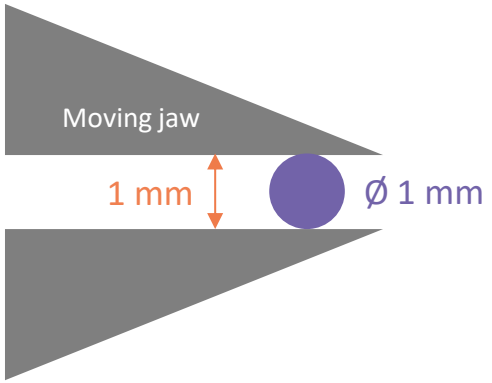


Gripper jaw contacts the object at -20 V.

Force Voltage Diagram

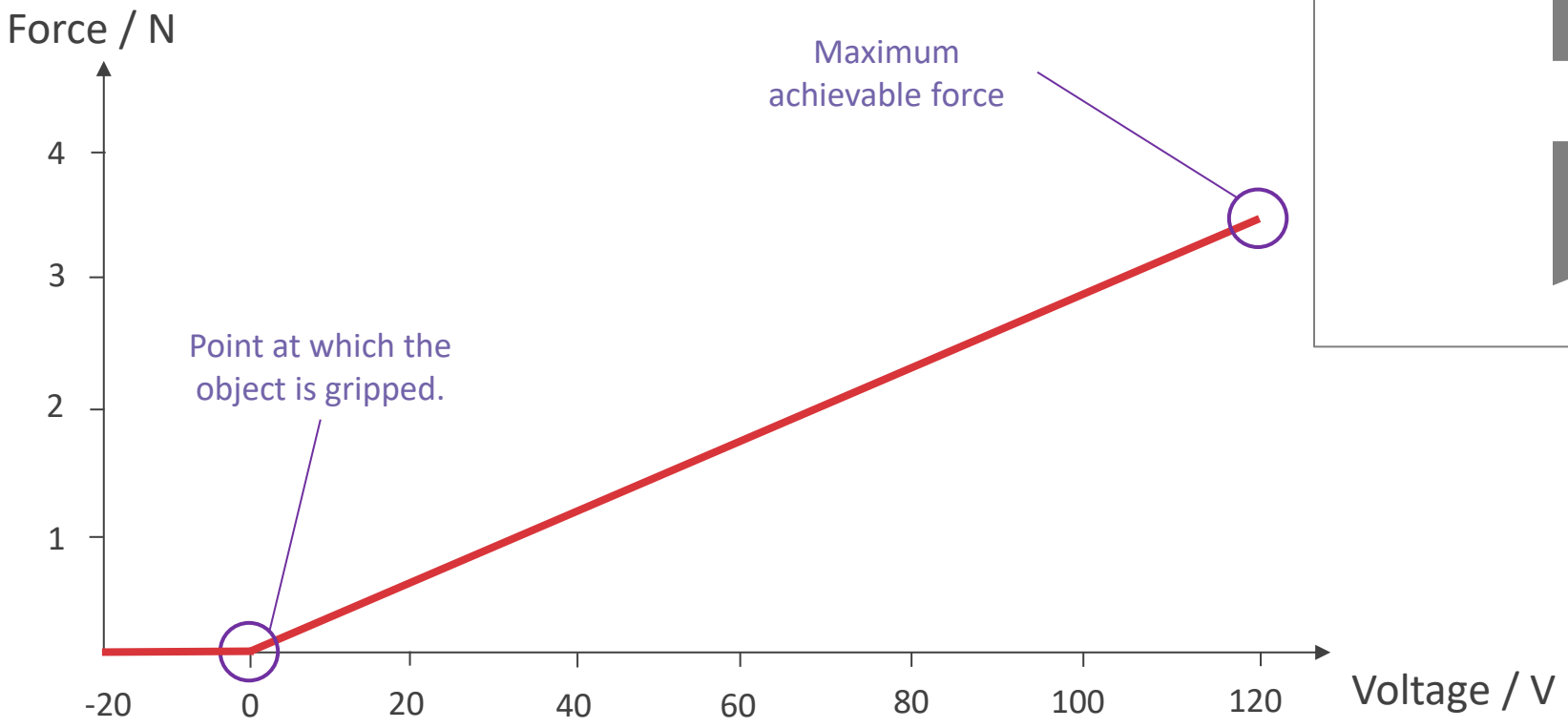


How the fully opened Piezo Gripper (-20 V) looks like



Gripper jaw contacts the object at 0 V.

Force Voltage Diagram



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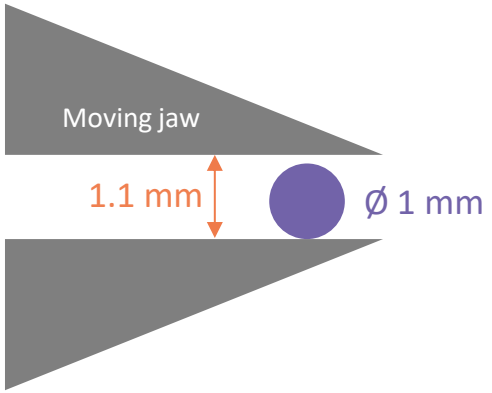
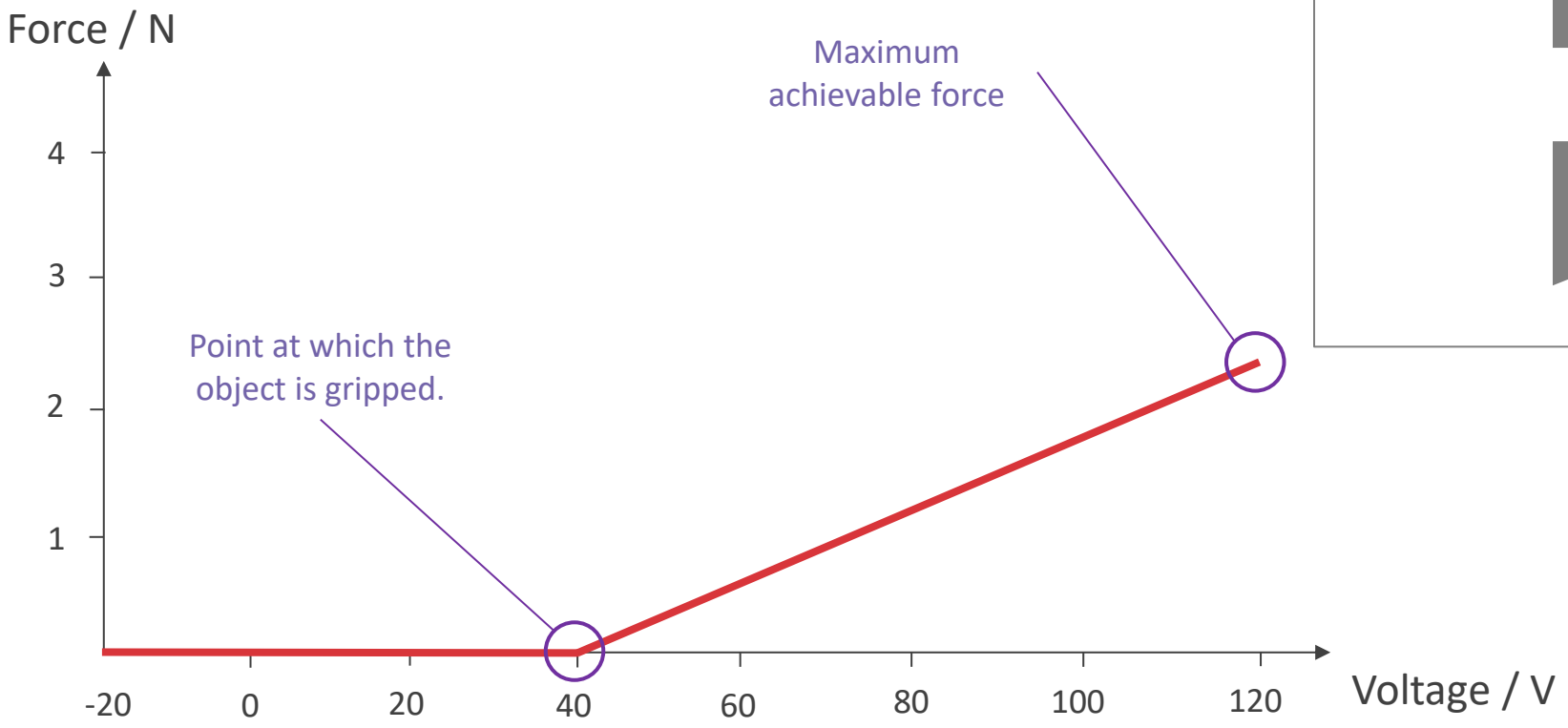
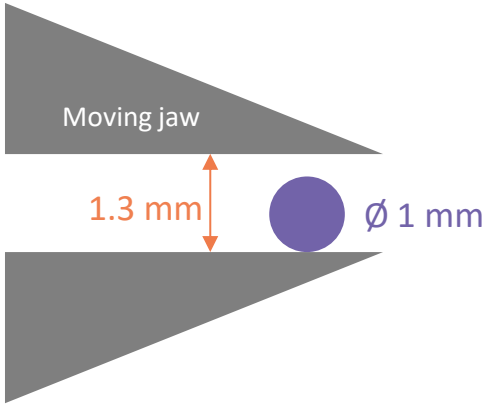


Gripper jaw contacts the object at 40 V.

Force Voltage Diagram

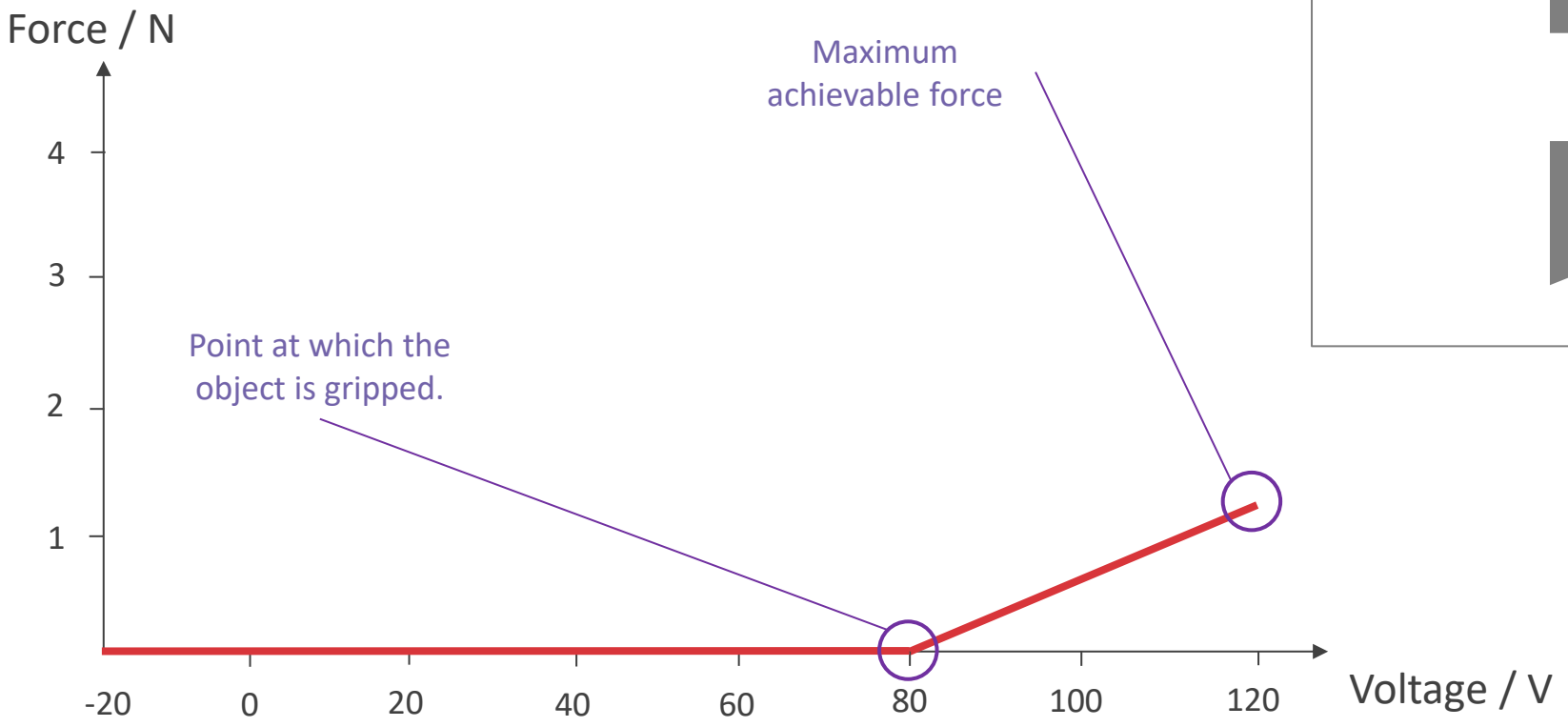


How the fully opened Piezo Gripper (-20 V) looks like

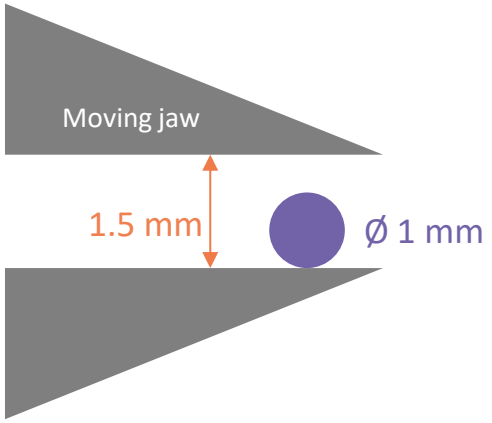


Gripper jaw contacts the object at 80 V.

Force Voltage Diagram

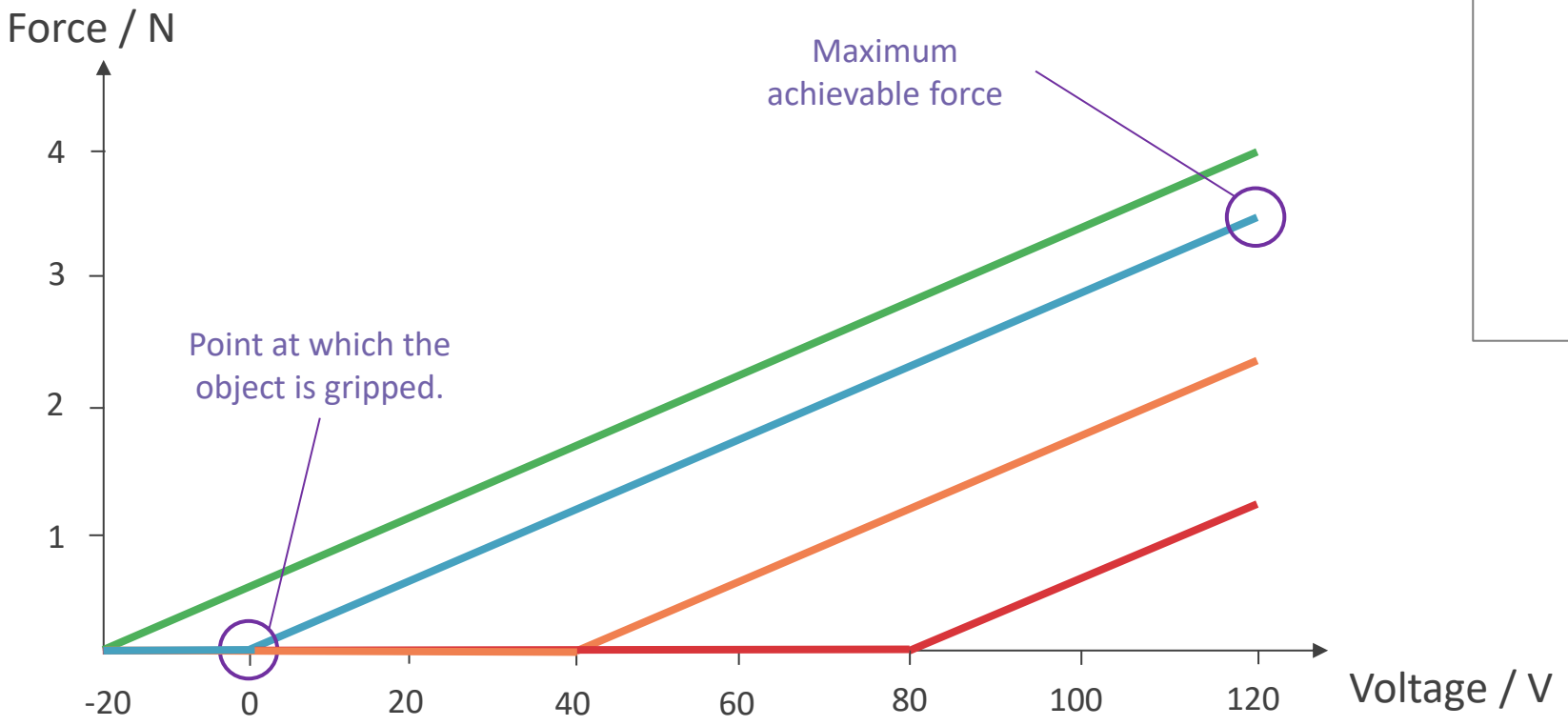


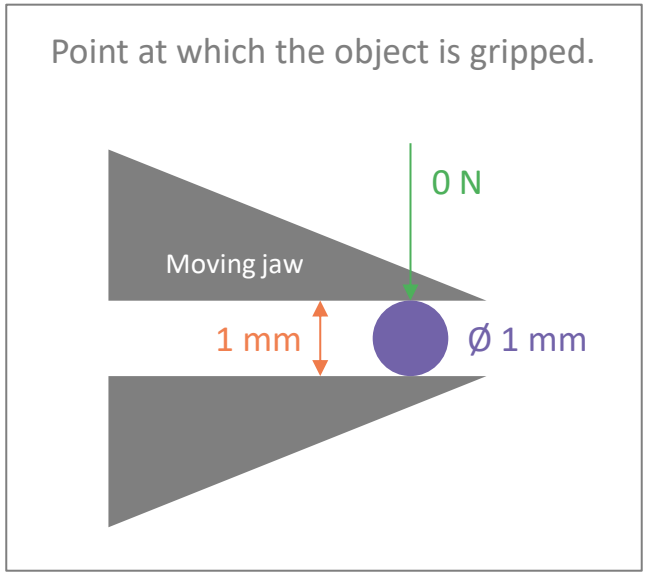
How the fully opened Piezo Gripper (-20 V) looks like



Force Voltage Diagram at several contact points

Piezo Gripper Functionality





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