Kinitics Linear Actuator

05 Frame

The Kinitics Linear Actuator (KLA) is a shape memory-alloy based actuator that uses Bundled Wire technology to deliver high force and precision in a compact package. The KLA can be easily configured to produce a pushing or pulling force without backlash. Position control is possible through the addition of a linear sensor while force control is possible through the use of a strain gauge.

Features

- High force-to-size ratio
- Forces up to 650 N [146 lb·f]
- Strokes up to 6.7 mm [0.264”]
- Available in push, pull, and through-rod
- Controllable position and force
- Flexible AC and DC power options
- Flying lead or SJOOW cable hook-up
- -40° C to 60° C operating range
- Rod is the only moving part
- IP67 environmental protection
- Compatible with ISO 21287 hardware

Accessory Add-ons

- Rod-ends attachments
- Wide range of mounting brackets
- Adjustable home position switch

Possible Applications

- Valve actuation
- Pressing
- Positioning

Product Code

KLA **05** - **3** **S** - **A1** - **PL** **R1** - **M** - **C** **10** - **E** - **S**

Frame Size	Travel Modifier	Actuation Type	Coolant	Cable Length	Special
05 - 500N Nominal Force	**S - Standard (Default)** O - Over-travel M - Maximum †	PS - Push PL - Pull TR - Through Rod	A - Air **M - Oil (Default)**	03 - 30cm **10 - 100cm (Default)** 20 - 200cm XX - XX*10cm (Max 4m)	**Blank - None (Default)** S - Custom

Nominal Stroke	Nom. Voltage	Rod End	Cable Type	Proximity Switch
2 - 2 mm 3 - 3 mm 4 - 4 mm 5 - 5 mm	D1- 12V DC D2- 24V DC A1- 120V AC	R0 - Unthreaded **R1 - Male (Default)** R2 - Female	N - None H - Flying Leads **C - SJOOW (Default)**	N - None **E - End-of-travel (EoT) (Default)** B - EoT and Home

† - External biasing force provided by customer

KLA05 Mechanical:

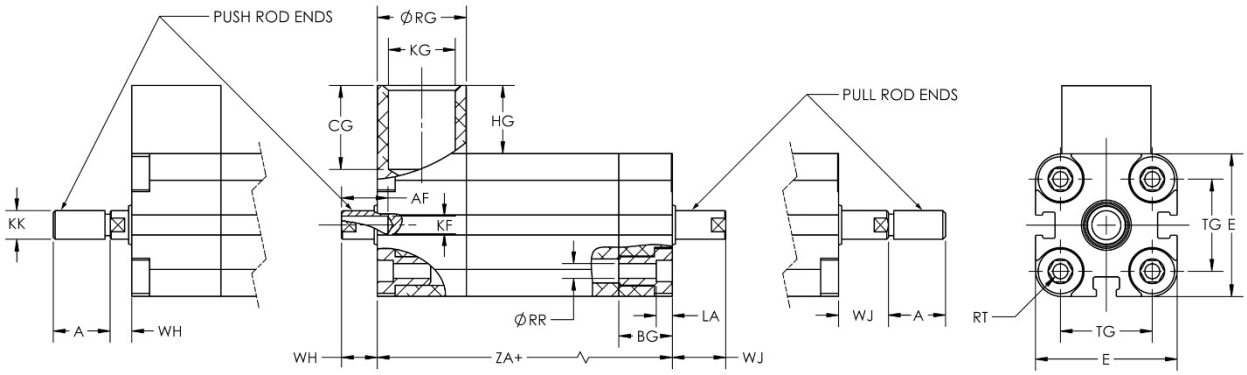

Figure 1 - KLA Dimensions

Nominal Stroke	ZA	AF (Female Ends)	A (Male Ends)	WH ⇈	WJ ⇈	KF (Female Ends)	KK (Male Ends)	BG	RR	TG	E	RT	LA
2	137	10	16	6	16	M6	M8 X 1.25	32.5	4.1	26 ±0.4	40	M5	5.25
3	177												
4	217												
5	257												

Flying Leads wiring port dimensions:

KG	CG	HG	ØRG
1/2-14 NPSM	9	20.6	25

All dimensions in mm

KLA05 Electrical:

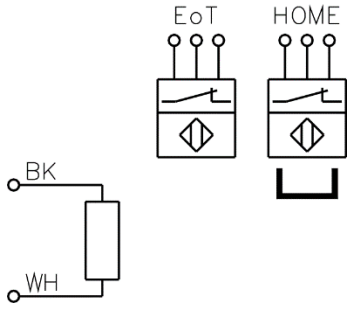

Figure 2 - DC Wiring Diagram

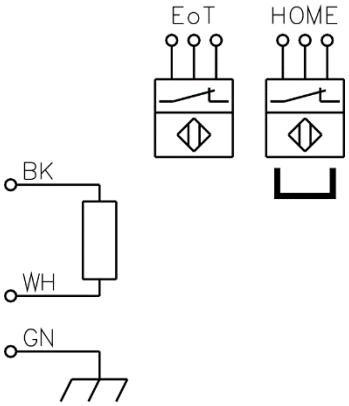

Figure 3 - AC Wiring Diagram

⇈ - Subject to Actuator Temperature Effect. See notes for additional information.

Product Specifications

Parameter	Option	Product Code	Units	Value(s)			
Rated Force	**S**tandard	KLA05-□S-□-□□-□-□□-□	N [lb(f)]	500 [112]			
	Overtravel	KLA05-□O-□-□□-□-□□-□	N [lb(f)]	360 [81]			
	Maximum †	KLA05-□M-□-□□-□-□□-□	N [lb(f)]	650 [146]			
Maximum Rated Voltage	**D1** - 12VDC	KLA05-□□-D1-□□-□-□□-□	V (DC)	12			
	D2 - 24VDC	KLA05-□□-D2-□□-□-□□-□	V (DC)	24			
	A1 - 120VAC	KLA05-□□-A1-□□-□-□□-□	V (AC)	120			
Positional Accuracy ††††		KLA05-□□-□-□□-□-□□-□	µm [mil]	±5 [±0.2]			
Nominal Stroke		KLA05-#□-□-□□-□-□□-□	mm	2	3	4	5
Rated Stroke	**S**tandard	KLA05-□S-□-□□-□-□□-□	mm [INCH]	2 [0.079]	3 [0.118]	4 [0.157]	5 [0.197]
	Overtravel	KLA05-□O-□-□□-□-□□-□	mm [INCH]	2.7 [0.106]	4 [0.158]	5.4 [0.211]	6.7 [0.264]
	Maximum †	KLA05-□M-□-□□-□-□□-□	mm [INCH]	2.7 [0.106]	4 [0.158]	5.4 [0.211]	6.7 [0.264]
Response Time (@ Maximum Rated Voltage)	**D1** - 12VDC	KLA05-□□-D1-□□-□-□□-□	ms	348	190	332	513
	D2 - 24VDC	KLA05-□□-D2-□□-□-□□-□	ms	196	190	332	513
	A1 - 120VAC	KLA05-□□-A1-□□-□-□□-□	ms	125	273	478	185
Maximum Duty Cycle	**D1** - 12VDC	KLA05-□□-D1-□□-□-□□-□		23%	14%	23%	31%
	D2 - 24VDC	KLA05-□□-D2-□□-□-□□-□		15%	14%	23%	31%
	A1 - 120VAC	KLA05-□□-A1-□□-□-□□-□		10%	19%	30%	14%
Resistance	**D1** - 12VDC	KLA05-□□-D1-□□-□-□□-□	Ω	0.26	0.10	0.13	0.16
	D2 - 24VDC	KLA05-□□-D2-□□-□-□□-□	Ω	0.58	0.39	0.52	0.65
	A1 - 120VAC	KLA05-□□-A1-□□-□-□□-□	Ω	9.3	13.9	18.6	5.8
Maximum Current Draw (@ Maximum Rated Voltage) ††††	**D1** - 12VDC	KLA05-□□-D1-□□-□-□□-□	A	47	124	93	74
	D2 - 24VDC	KLA05-□□-D2-□□-□-□□-□	A	41	62	47	37
	A1 - 120VAC	KLA05-□□-A1-□□-□-□□-□	A	12.9	8.6	6.5	20.7
Maximum Power (@ Maximum Rated Voltage) ††††	**D1** - 12VDC	KLA05-□□-D1-□□-□-□□-□	W	558	1,488	1,116	893
	D2 - 24VDC	KLA05-□□-D2-□□-□-□□-□	W	992	1,488	1,116	893
	A1 - 120VAC	KLA05-□□-A1-□□-□-□□-□	W	1,550	1,033	775	2,480
Weight	Air Cooled	KLA05-□□-□-□□-A-□□-□	kg [lb]	0.51 [1.1]	0.62 [1.4]	0.76 [1.7]	0.86 [1.9]
	Oil Cooled	KLA05-□□-□-□□-M-□□-□	kg [lb]	0.54 [1.2]	0.66 [1.5]	0.81 [1.8]	0.94 [2.1]
Moving Mass	Push	KLA05-□□-□-PS□-□-□□-□	g [oz]	76 [2.7]	92 [3.3]	108 [3.8]	125 [4.4]
	Pull	KLA05-□□-□-PL□-□-□□-□	g [oz]	76 [2.7]	92 [3.3]	109 [3.8]	125 [4.4]
	Through	KLA05-□□-□-TR□-□-□□-□	g [oz]	91 [3.2]	107 [3.8]	123 [4.3]	139 [4.9]
Operating Temperature Range	Air Cooled	KLA05-□□-□-□□-A-□□-□	°C [°F]	-40 to 60 [-40 to 140]			
	Oil Cooled	KLA05-□□-□-□□-M-□□-□	°C [°F]	-20 to 60 [-4 to 140]			
Storage Temperature Range		KLA05-□□-□-□□-□-□□-□	°C [°F]	-40 to 80 [-40 to 176]			
Ingress Protection Rating		KLA05-□□-□-□□-□-□□-□		IP67			

† - External biasing force provided by customer. See Return Force term.

†††† - See Positional Accuracy term.

†††† - See Power, Current Draw, and Holding Current terms.

End-of-Travel and Home Proximity Switch Specifications (p/n: PSC-050-030-001)

Parameter	Units	Value(s)
Operating Voltage Range	V	10 - 30 (DC)
Rated Operating Voltage	V	24 (DC)
Rated Operating Current	A	0.2
Switching Output		PNP Normally Closed
Repeatability	µm [mil]	±100 [±4]
Operating Temperature Range	°C [°F]	-25 to 85 [-13 to 185]
Ingress Protection Rating		IP67
Cable Length	m [INCH]	2 [79]

Behavior Curves:

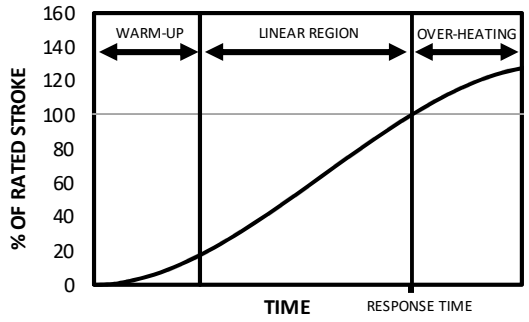

Figure 4 – Response Time @ 20°C [68°F]

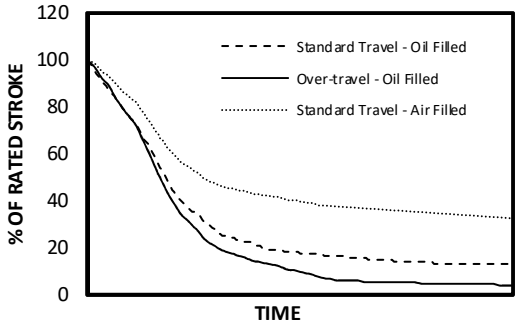

Figure 5 - Return Time

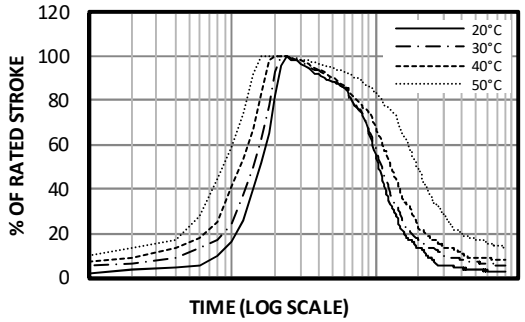

Figure 6 - Actuator Temperature Effect

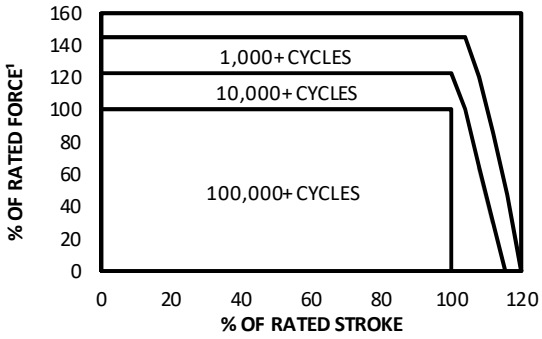

Figure 7 - Cycle Life

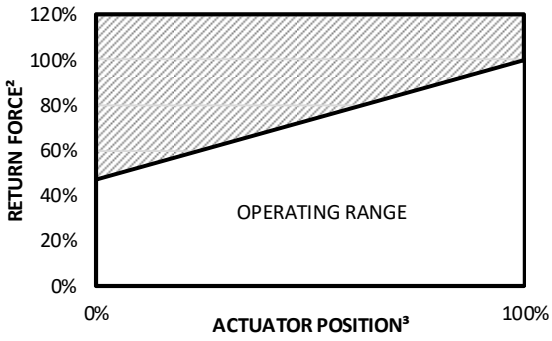

Figure 8 - Standard Operating Range

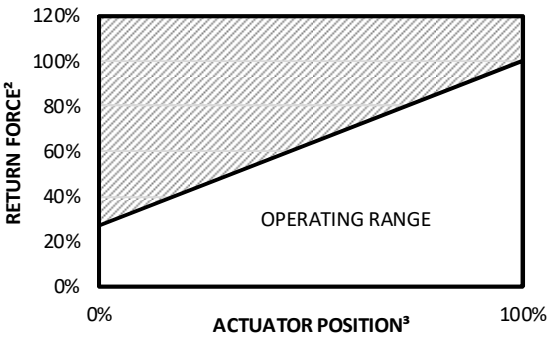

Figure 9 - Over-travel Operating Range

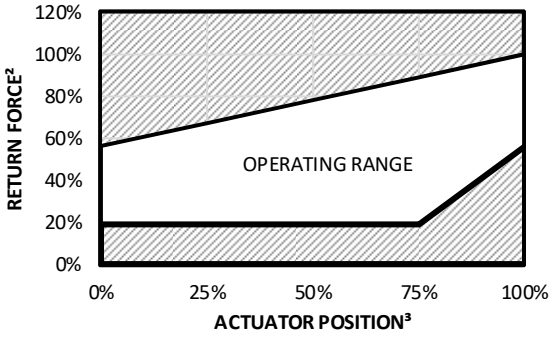

Figure 10 - Maximum Operating Range

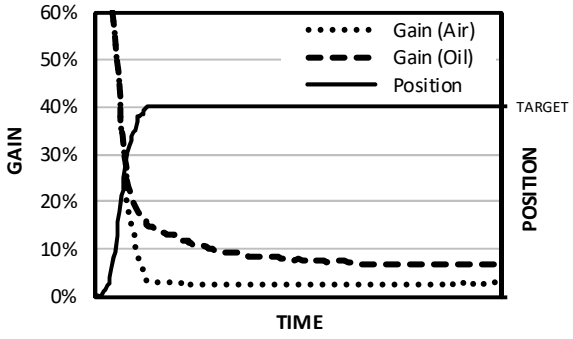

Figure 11 - Holding Current

[1] - Maximum force applied during stroke, including acceleration and shock loading
[2] - Return force as a percentage of rated force
[3] - Actuator position as a percentage of rated stroke

Glossary of Terms:

Actuation Type:

Push actuators feature a rod end to push a load away from the frame. P*ull* actuators feature a rod end to pull a load towards the frame. *Through Rod* actuators feature a single rod that extends through both ends of the frame.

Actuator Temperature Effect and Operating Temperature Range:

The actuator is a thermo-mechanical device and its performance is affected by changes in the ambient temperature as illustrated in the Actuator Temperature Effect figure. Increasing the ambient temperature will reduce the power needed to actuate, reduce the available stroke, and increase the return time. Decreasing the ambient temperature will increase the power needed to actuate, increase the available stroke, and reduce the return time.

Cable Type:

The two primary cable types are *SJOOW* and *Flying Leads*. *SJOOW* is a heavy-duty flexible cord that is oil and water resistant. *Flying leads* are loose hook-up wire that exit out of a ½" NPT port that permits connections to conduit or a terminal box. *None* means no electrical connections are provided and the user must physically control the core temperature of the actuator to effect movement. Body ports to circulate temperature regulating fluid through the actuator body may be added through a *special* order in combination with the *N - none* option.

Coolant:

Coolant type has a large impact on return time and power consumption during continuous operation. *A – Air* coolant slows down the return time and is appropriate for long duration holding and positioning applications. *M – Oil* coolant speeds up the return time as is appropriate for rapid cycling and pumping applications. Forced cooling may be used in conjunction with oil coolant to increase cycle rate while insulation may be used in conjunction with air coolant to reduce continuous power draw.

Cycle Life:

The Cycle Life figure provides an approximate estimation of cycle life for reoccurring actuations. As noted in the figure it is possible to over-stroke and over-load the actuator at the expense of cycle life. Rapid cycling beyond the actuator's maximum duty cycle will also reduce cycle life. The actuator's cycle life can be extended by minimizing shock loads and providing some margin between operating and rated force and stroke.

Holding Current

Holding current is the average current needed to hold the actuator at a fixed position. The Holding Current figure illustrates gain over time for actuators using Air and Oil coolants in a 20°C [68°F] ambient environment. It is the product of the nominal current and the gain needed to hold position and can be calculated as:

$$I_{holding}[A] = Gain_{holding}[\%] \cdot I_{nominal}[A]$$

See the *Coolant* and *Resistance and Current Draw* terms for more information.

Maximum Duty Cycle:

Maximum duty cycle is the ratio of on time versus total time between cycles in a repetitive cycling application. It is not applicable to continuous duty applications. The maximum duty cycle is based on driving an actuator at its Maximum Rated Voltage, with oil coolant, to its rated stroke and then waiting for it to return close to its home position in a 20°C [68°F] ambient environment without forced cooling. Actuator temperature, ambient temperature, coolant type, applied voltage, return position, and power gain will affect the maximum possible duty cycle.

$$Maximum\ Duty\ Cycle = \frac{Time_{Response}}{Time_{Response} + Time_{Return}}$$

Maximum Rated Voltage:

The Maximum Rated Voltage is the maximum voltage that can be applied to the actuator. Both *D1 – 12V DC* and *D2 -24V DC* options are intended for use with direct current. The *A1 – 120V AC* option is intended for use with alternating current. The applied voltage, also referred to as actual voltage or operating voltage, can be less than the Maximum Rated Voltage. See the *Resistance and Current Draw* term for more information.

Positional Accuracy:

Position accuracy may be achieved using a position feedback device in combination with closed-loop control techniques. Target positions can be established between the actuator's home and end-of-travel positions. For applications that require a higher degree of accuracy and precision the use of DC power is recommended over AC.

Power:

Power draw is the average power draw of the actuator when actuated at its operating voltage at full gain. Voltage drop and in-line resistance of additional cabling and electrical connections will affect the average power draw. When operating at voltages other than Maximum Rated Voltage the average power draw can be calculated as:

$$P_{nominal}[W] = V_{actual}[V_{RMS}] \cdot I_{nominal}[A]$$

or

$$P_{nominal}[W] = \frac{(V_{actual}[V_{RMS}])^2}{R_{actuator}[\Omega]}$$

Proximity Switch:

The *E - End-of-travel (EoT)* option provides the actuator with a proximity switch that is factory set to switch at the actuator's rated stroke. Set inside of a T-slot the EoT proximity switch is primarily used for end-of-travel protection. The *B – EoT and Home* option provides the EoT proximity switch, as described above, in addition to a second proximity switch that is factory set at the actuator home position. Set inside of a T-slot the home position proximity switch may be adjusted to switch before the actuator positon reaches home. This can be done to speed up the cycle rate of the actuator. The *N – None* options means that no proximity switches are provided and the user should provide

other means to prevent the actuator from stroking past its rated stroke.

Rated Force

The actuator's force rating is based on its ability to develop a pushing or pulling force that is in-line with the actuator. For through rod type actuators the rated load is the sum total of the loads applied at both ends. The actuator is capable of generating more than its rated force but this will reduce cycle life and/or cause internal damage to the actuator. See the Cycle Life figure for more information. The rated force is inclusive of shock loading and mass acceleration forces. See the *return force* term for more information.

Rod Loading:

While internal bushings will tolerate moderate side, or lateral, loading applied to the rod end these forces should be minimized to reduce friction and stiction effects and losses. The rod is a non-rotating type.

Rated Stroke:

The rated stroke of the actuator is the maximum recommended stroke distance for the actuator at 20°C [68°F]. The actuator is capable of stroking past its rated stroke distance but this will reduce cycle life and/or cause internal damage to the actuator. See the Cycle Life figure for more information. Utilization of the factory set end-of-travel proximity switch is strongly recommended to prevent over stroking. If the stroke required by the application is close to the rated stroke of the actuator the designer is encouraged to select an actuator configuration with a higher stoke rating to provide some operating margin.

Resistance and Current Draw:

The actuator is a resistive device and will ship from the factory with a wire-to-wire resistance approximate (±10%) to the resistance value shown in the Product Specifications table. This value is based on an actuator in its home position, with 100cm of cable length, at 20°C [68°F]. This resistance will vary slightly during actuation and is influenced by the applied load. The actuators resistance can be altered, within a range, as a special order. Specifying a custom resistance value will affect the actuators nominal current draw and response time. The actuator behaves according to Ohm's law. Its nominal current draw can be calculated as:

$$I_{nominal}[A] = \frac{V_{actual}[V_{RMS}]}{R_{actuator}[\Omega]}$$

See the *Holding Current* term for more information.

Response Time:

The response time is the time required for an actuator at 20°C [68°F] to reach its rated stroke when Maximum Rated Voltage is applied. Changes in actuator temperature, operating voltage, resistance, and power gain will affect the actuator's response time. After a warm-up phase the actuator will operate inside of a linear region, as illustrated in the Response Time figure.

Return Force:

During the return stroke a return force may be applied to the rod. To maximize actuator life this return force should be limited to the operating range as illustrated in the appropriate Standard, Over-travel, and Maximum Operating Range figure. When using an actuator that uses the Maximum Travel Modifier an external force must be applied to achieve the actuator's rated stroke.

Return Time:

The actuator is a thermo-mechanical device that will reject heat to its environment during the return phase of its operating cycle. An actuator with oil coolant will return faster than one with air coolant as illustrated in the Return Time figure. The travel modifier selection, external return force, actuator temperature, and ambient temperature will also influence return time. Forced cooling may be used to lower the actuator temperature.

Special:

Typically left blank, a custom actuator can be specified by selecting the *S – Custom* option. Details of the custom feature should be included in the order comments. Examples of a custom order include custom actuator resistance, non-standard cable lengths, body ports, and non-standard rod end thread sizes.

Travel Modifier:

A travel modifier option can be used to extend the stroke of the actuator past the standard nominal stroke. The *over-travel* option extends the available stroke of the actuator at the expense of its rated force. The *maximum* option extends the available stroke of the actuator provided an external biasing force is applied to return the actuator to its home position. See the *return force* term for more information.

Document Version

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