

4. Selection guide for piezo actuators

4.1 Selection guide

4.1.1 Introduction

CEDRAT TECHNOLOGIES offers a wide range of standard Actuators: Conventional Multilayer Actuators (MLAs), Parallel Pre-Stressed Actuators (PPAs) and Amplified piezoelectric actuators (APA®). Several options are available and most of the Actuator's functional properties, mechanical or electrical interfaces can be modified to meet the customer's needs. Please do not hesitate to contact CEDRAT TECHNOLOGIES for more information about an actuator's additional features.

To offer you the "state of the art" of Piezo Actuators, some new Actuators are given with "preliminary data", which means that the Actuator has been designed but has not been tested as much as requested by CEDRAT TECHNOLOGIES quality standards at the time the catalogue is printed.

Model series	Unity	APA uXS - XXS	APA XS	APA S	APA SM	APA M
<i>Note</i>						
Blocking force	(N)	2 - 6	18	40 - 100	100 - 200	110-800
No-load stroke	(μm)	30-150	50-80	60 - 120	40 - 80	16 - 184
S.G. option			* <i>(except 50XS)</i>	*	*	*
N.M. option			*	*		* <i>(except 400M 900M)</i>
H.T. option				*	*	*
T.C. option				*		
Mechanical Interface option		FI-H-SI	FI - H - TH - SI	FI - H - TH - SI	FI - H - TH - SI	FI - H - TH - SI
Electrical Interface option		Single Cu wire	Two wires AWG32	Two wires AWG30	Two wires AWG30	Two wires AWG30
<i>Note</i>		Smallest actuator			Stiff serie	
Model series	Unity	APA MML	APA ML	APA L	APA XL	
<i>Note</i>						
Blocking force	(N)	190-250	1400 - 1900	600 - 1300	700 - 1100	
No-load stroke	(μm)	280-360	90 - 120	250 - 500	500 - 1000	
S.G. option		*	*	*	*	
N.M. option				*		
H.T. option		*	*	*	*	
T.C. option		*				
Mechanical Interface option		FI - H - TH - SI	FI - H - SI	FI - H - TH - FF - SI	FI - H - TH - SI	
Electrical Interface option		Two wires AWG30	Two wires AWG26	Two wires AWG26	Two wires AWG26	
<i>Note</i>		Medium serie	Stiff serie		Larger actuator	

Table 4.1: Selection guide of Amplified piezoelectric actuators

Model series	Unity	PPA M	PPA L	PPA XL
<i>Note</i>				
Blocking force	(N)	800	3500	7000
No-load stroke	(μm)	10 - 40	40 - 80	40 - 120
S.G. option		*	*	*
N.M. option		*		
H.T. option		*	*	*
T.C. option				
Mechanical Interface option		TH	TH	TH
Electrical Interface option		Two wires AWG30	Two wires AWG26	Two wires AWG26
<i>Note</i>				Larger actuator

Table 4.2: Selection guide of Parallel Pre-stressed Actuators

4.1.2 Options

S.G. option:

The S.G. (Strain Gauges) option refers to an Actuator equipped with Strain Gauges. The Strain Gauges signal should be monitored with a SG75 electronic board.

N.M. option:

The Actuator is made from non-magnetic material: it does not disturb the magnetic field and/or is thus completely insensitive to an external applied magnetic field. **Some properties (e.g. thermo-mechanical behaviour, mass, width) may differ from the standard Actuator's features.**

VAC (Vacuum) option:

This option refers to an actuator able to bear Ultra High Vacuum environment.

H.T. Option

The High Temperature (HT) option refers to special piezo material and processes (bonding) that can be used to build High Temperature Amplified piezoelectric actuators.

T.C. option:

The Thermo-compensated (TC) option is a special construction which allows the improvement of the behaviour within a wide temperature range, especially at the liquid nitrogen temperature (77° K).

S.V. Option

In some cases, the change of mechanical interfaces or the change of piezo components leads to a modification of the functional properties. In that case, the Specific Version of an existing standard actuator is called the S.V. option. For any question regarding mechanical integration, please contact CEDRAT TECHNOLOGIES.

N.M. and T.C. options are not compatible.

4.1.3 Mechanical interface options

F.I. option:

The Amplified piezoelectric actuator has two identical flat interfaces that can be bonded.

H. option:

The Amplified piezoelectric actuator has two identical mechanical interfaces: a flat interface with a non threaded hole(s).

T.H. option:

The Amplified piezoelectric actuator has two identical mechanical interfaces: a flat interface with a centered threaded hole(s).

F.F. option:

The “free-free” interface means that the Actuator is hold in a way that enables symmetric movements (Figure 4.1). The free-free configuration gives a noticeably higher bandwidth, but only one half of the stroke. However, the piezo stacks can be subjected to higher transverse forces in this case. Please contact CEDRAT TECHNOLOGIES to discuss your application.

Guiding option:

To obtain a better dynamic movement, it is possible to add a flexible guiding to the actuator’s shell. This can be added at the application integration level or designed monolithically with the shell (Figure 4.2). Please contact CEDRAT TECHNOLOGIES to discuss your application.

TW twin option:

The twin option consists in two Actuator monolithically staked in serie for some redundancies (Figure 4.3). Please contact CEDRAT TECHNOLOGIES to discuss your application.

S.I. option:

In order to make the mechanical integration of its actuators easier as OEM products, CEDRAT TECHNOLOGIES can design and machine a Specific Interface on top of its actuators to meet the customer’s needs. For any question regarding mechanical integration, please contact CEDRAT TECHNOLOGIES.

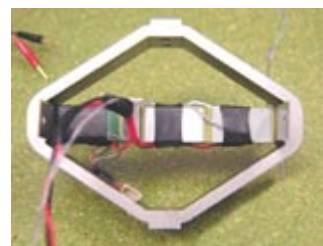


Figure 4.1: View of an APA™ in free – free configuration: APA 95ML-FF



Figure 4.2a : Single blade guided Amplified Piezoelectric Actuator APA™



Figure 4.2b : Double blades guided Amplified Piezoelectric Actuator APA™



Figure 4.3 : Twin Amplified Piezoelectric Actuator APA™

4.1.4 Additional data

Some of these Actuators are space-qualified: this means that the Actuator underwent several tests:

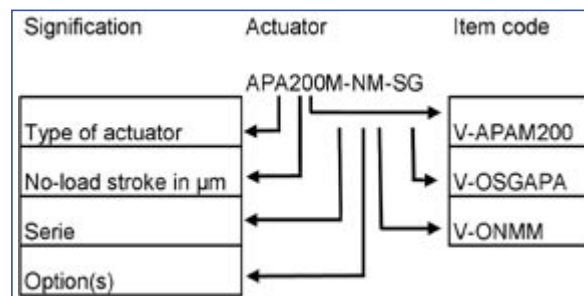
- ◆ Random vibrations,
- ◆ Thermal vacuum,
- ◆ Radiations,
- ◆ Life-time test.

Please contact CEDRAT TECHNOLOGIES for more information about an actuator’s additional features.

4.1.5 How to order ?

Items can be ordered thanks to the item code mentioned on the characteristics table. Codes for optional item have to be added. Please do not hesitate to take a look at our web site, where you can download:

- ◆ The technical data sheet,
- ◆ The mechanical interface drawing,
- ◆ The 3D edrawings file.



4. SELECTION GUIDE FOR PIEZO ACTUATORS

4.2 Amplified Piezoelectric Actuators APA® uXS & XXS Series

The Amplified Piezoelectric Actuators, APA®, developed by CEDRAT TECHNOLOGIES cover an area of performances, in terms of forces and displacements, that are not in the range of direct or bimorph Piezo Actuators. The microXS and XXS models are the newest and smallest Actuators manufactured by CEDRAT TECHNOLOGIES and produce displacements up to 150 µm.

References	Unit	APA30uXS	APA150XXS
Item Code		V-APAUXS30	V-APAXXS150
Notes		-	-
Displacement	(µm)	30.0	120.0
Blocked force	(N)	3.3	2.7
Stiffness	(N/µm)	0.11	0.023
Resonance frequency (free-free)	(Hz)	26350	4720
Response time (free-free)	(ms)	0.02	0.11
Resonance frequency (blocked-free)	(Hz)	4770	1045
Response time (blocked-free)	(ms)	0.10	0.48
Force limit (0-pk)	(N)	1.65	0.68
Max. displacement at resonance (pk-pk)	(µm)	27	54
Voltage range	(V)	-20 ... 150	-20 ... 150
Capacitance	(µF)	0.05	0.15
Resolution	(nm)	0.30	1.20
Thermo-mechanical behaviour	(µm/°K)	0.29	1.38
Height H (in actuation direction)	(mm)	3.9	4.5
Length	(mm)	8.6	13.1
Width (incl. edges, wires)	(mm)	5.0	9.0
Mass	(g)	0.15	1.3
Standard mechanical interface		2 flat surfaces 1*2.5 mm ² with a Ø 0.8 mm hole	2 flat surfaces 1.5*3 mm ² with a Ø 0.8 mm hole
Standard electrical interface		2 single Cu wires 80 mm long with Ø 1 banana plug	2 PFTE insulated AWG32 wires 80 mm long with Ø 1 banana plug

Table 4.3: Characteristics of the APA™ uXS & XXS Actuators



Figure 4.4: View of the APA 150XXS Actuator

Available option(s): VAC
Available interface option(s): FI, SI

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4.3 Amplified Piezoelectric Actuators APA® XS Series

The Amplified Piezoelectric Actuators, APA®, developed by CEDRAT TECHNOLOGIES cover an area of performances, in terms of forces and displacements, that are not in the range of direct or bimorph Piezo Actuators. The XS models produce displacement up to 80 µm.

References	Unit	APA35XS	APA50XS
Item Code		V-APAXS35	V-APAXS50
Notes		-	-
Displacement	(µm)	55.0	80.0
Blocked force	(N)	27.0	18.0
Stiffness	(N/µm)	0.49	0.23
Resonance frequency (free-free)	(Hz)	18600	12450
Response time (free-free)	(ms)	0.03	0.04
Resonance frequency (blocked-free)	(Hz)	3883	2700
Response time (blocked-free)	(ms)	0.13	0.19
Force limit (0-pk)	(N)	13.50	4.50
Max. displacement at resonance (pk-pk)	(µm)	50	36
Voltage range	(V)	-20...150	-20...150
Capacitance	(µF)	0.25	0.25
Resolution	(nm)	0.55	0.80
Thermo-mechanical behaviour	(µm/°K)	0.67	0.94
Height H (in actuation direction)	(mm)	5.5	4.7
Length	(mm)	13.3	12.8
Width (incl. edges, wires)	(mm)	9.0	9.0
Mass	(g)	2.0	2.0
Standard mechanical interface [TH]		2 flat surfaces 1.25*5 mm ² with M1 threaded hole	2 flat surfaces 1.5*5 mm ² with M1 threaded hole
Standard electrical interface		2 PTFE insulated AWG32 wires 80 mm long with Ø 1 banana plug	2 PTFE insulated AWG32 wires 80 mm long with Ø 1 banana plug

Table 4.4: Characteristics of the APA™ XS Actuators

Available option(s): SG (except 50XS), NM, VAC
Available interface option(s): FI, H, TH, SI



Figure 4.5: View of the APA 35XS Actuator

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4.4 Amplified Piezoelectric Actuators APA® S Series

The Amplified Piezoelectric Actuators, APA®, developed by CEDRAT TECHNOLOGIES cover an area of performances, in terms of forces and displacements, that are not in the range of direct or bimorph Piezo Actuators. The S series are small Actuators manufactured by CEDRAT TECHNOLOGIES and produce displacements between 60 µm and 120 µm.

References	Unit	APA60S	APA120S
Item Code		V-APAS60	V-APAS120
Notes		-	-
Displacement	(µm)	80	140
Blocked force	(N)	102	39.0
Stiffness	(N/µm)	1.28	0.28
Resonance frequency (free-free)	(Hz)	13400	7100
Response time (free-free)	(ms)	0.04	0.07
Resonance frequency (blocked-free)	(Hz)	2860	1300
Response time (blocked-free)	(ms)	0.17	0.38
Force limit (0-pk)	(N)	51	9.75
Max. displacement at resonance (pk-pk)	(µm)	72	63
Voltage range	(V)	-20 ... 150	-20 ... 150
Capacitance	(µF)	1.55	1.55
Resolution	(nm)	0.8	1.4
Thermo-mechanical behaviour	(µm/°K)	1.04	1.69
Height H (in actuation direction)	(mm)	15.0	13.0
Length	(mm)	29.2	28.7
Width (incl. edges, wires)	(mm)	9.0	9.0
Mass	(g)	8.5	7.2
Standard mechanical interface [TH]		2 flat surfaces 2.5*5 mm ² with M2 threaded hole	2 flat surfaces 2.5*5 mm ² with M2 threaded hole
Standard electrical interface		2 PTFE insulated AWG30 wires 100 mm long with Ø 1 banana plug	2 PTFE insulated AWG30 wires 100 mm long with Ø 1 banana plug

Table 4.5: Characteristics of the APA™ S Actuators



Figure 4.6: View of the APA 60S actuator

Available option(s): SG, NM, VAC, HT, TC (except 120S)
Available interface option(s): FI, H, TH, SI

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4.5 Amplified Piezoelectric Actuators APA® SM Series

The Amplified Piezoelectric Actuators, APA®, developed by CEDRAT TECHNOLOGIES cover an area of performances, in terms of forces and displacements, that are not in the range of direct or bimorph Piezo Actuators. The SM series are small Actuators manufactured by CEDRAT TECHNOLOGIES; they are especially designed to obtain stiff Actuators and produce higher displacements than Direct Piezo Actuators. Consequently, they have a high bandwidth and can be used in several dynamic applications.

References	Unit	APA40SM	APA60SM
Item Code		V-APASM40	V-APASM60
Notes		-	-
Displacement	(μm)	52	80
Blocked force	(N)	194	110
Stiffness	(N/ μm)	3.73	1.38
Resonance frequency (free-free)	(Hz)	16000	10400
Response time (free-free)	(ms)	0.03	0.05
Resonance frequency (blocked-free)	(Hz)	4100	2800
Response time (blocked-free)	(ms)	0.12	0.18
Force limit (0-pk)	(N)	97	55
Max. displacement at resonance (pk-pk)	(μm)	47	72
Voltage range	(V)	-20 ... 150	-20 ... 150
Capacitance	(μF)	1.55	1.55
Resolution	(nm)	0.5	0.8
Thermo-mechanical behaviour	($\mu\text{m}/^\circ\text{K}$)	0.73	1.02
Height H (in actuation direction)	(mm)	15.0	13.0
Length	(mm)	27.2	26.9
Width (incl. edges, wires)	(mm)	11.5	11.5
Mass	(g)	11.0	10.0
Standard mechanical interface [TH]		2 flat surfaces 5*10 mm ² with M2.5 threaded hole	2 flat surfaces 5*10 mm ² with M2.5 threaded hole
Standard electrical interface		2 PTFE insulated AWG30 wires 100 mm long with \varnothing 1 banana plug	2 PTFE insulated AWG30 wires 100 mm long with \varnothing 1 banana plug

Table 4.6: Characteristics of the APA™ SM Actuators

Available option(s): SG, VAC, HT
Available interface option(s): FI, H, TH, SI



Figure 4.7: View of the APA 60SM actuator

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4.6 Amplified Piezoelectric Actuators APA® M Series

The Amplified Piezo Actuators, APA®, developed by CEDRAT TECHNOLOGIES cover an area of performances, in terms of forces and displacements, that are not in the range of direct or bimorph Piezo Actuators. The M series are medium sized Actuators which are about 20 mm-high , weigh about 20 g and produce max displacements between 100 µm and 200 µm.

References	Unit	APA100M	APA150M	APA200M
Item Code		V-APAM100	V-APAM150	V-APAM200
Notes		-	-	-
Displacement	(µm)	110	169	230
Blocked force	(N)	184	100	73
Stiffness	(N/µm)	1.7	0.59	0.32
Resonance frequency (free-free)	(Hz)	7600	5300	4600
Response time (free-free)	(ms)	0.07	0.09	0.11
Resonance frequency (blocked-free)	(Hz)	1900	1300	900
Response time (blocked-free)	(ms)	0.26	0.38	0.56
Force limit (0-pk)	(N)	92	50	27
Max. displacement at resonance (pk-pk)	(µm)	99	152	155
Voltage range	(V)	-20 ... 150	-20 ... 150	-20 ... 150
Capacitance	(µF)	3.2	3.2	3.2
Resolution	(nm)	1.1	1.7	2.3
Thermo-mechanical behaviour	(µm/°K)	1.47	2.10	2.72
Height H (in actuation direction)	(mm)	25.0	22.0	17.0
Length	(mm)	55.1	55.1	55.0
Width (incl. edges, wires)	(mm)	9.0	9.0	9.0
Mass	(g)	19.5	17.4	15.7
Standard mechanical interface [TH]		2 flat surfaces 5*5 mm ² with M2.5 threaded hole	2 flat surfaces 5*5 mm ² with M2.5 threaded hole	2 flat surfaces 5*5 mm ² with M2.5 threaded hole
Standard electrical interface		2 PTFE insulated AWG30 wires 100 mm long with Ø 1 banana plug	2 PTFE insulated AWG30 wires 100 mm long with Ø 1 banana plug	2 PTFE insulated AWG30 wires 100 mm long with Ø 1 banana plug

Table 4.7: Characteristics of the APA™ M Actuators



Figure 4.8: View of the APA 150M Actuator

Available option(s): SG, NM, VAC, HT
Available interface option(s): FI, H, TH, FF, SI

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4.7 Super Amplified Piezoelectric Actuators APA® M Series

CEDRAT TECHNOLOGIES enlarges the M series by pushing the limits of the stroke up to 900 µm with the APA 900M model. The APA 400M is suitable for quasi-static applications requiring the displacement of light objects such like mirror, lenses, CCD or needles. The APA900M, with a stroke close to 1000 µm, shall be used under static conditions.

References	Unit	APA400M	APA900M
Item Code		V-APAM400	V-APAM900
Notes		-	Use limited to static operation
Displacement	(µm)	400	800
Blocked force	(N)	38	16
Stiffness	(N/µm)	0.10	0.02
Resonance frequency (free-free)	(Hz)	1900	1100
Response time (free-free)	(ms)	0.26	0.45
Resonance frequency (blocked-free)	(Hz)	495	248
Response time (blocked-free)	(ms)	1.01	2.02
Force limit (0-pk)	(N)	9.50	0.79
Max. displacement at resonance (pk-pk)	(µm)	180	72
Voltage range	(V)	-20...150	-20...150
Capacitance	(µF)	3.15	3.15
Resolution	(nm)	4.0	8.0
Thermo-mechanical behaviour	(µm/°K)	4.57	8.98
Height H (in actuation direction)	(mm)	13.0	10.0
Length	(mm)	48.4	49.0
Width (incl. edges, wires)	(mm)	11.5	11.5
Mass	(g)	19.0	18.0
Standard mechanical interface [TH]		2 flat surfaces 5*10 mm ² with M2.5 threaded hole	2 flat surfaces 5*10 mm ² with M2.5 threaded hole
Standard electrical interface		2 PTFE insulated AWG30 wires 100 mm long with Ø 1 banana plug	2 PTFE insulated AWG30 wires 100 mm long with Ø 1 banana plug

Table 4.8: Characteristics of the Super APA™ M Actuators

Available option(s): SG, VAC
Available interface option(s): FI, H, TH, FF, SI



Figure 4.9: View of the APA 400M Actuator

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4.8 Amplified Piezoelectric Actuators APA® MML Series

The Amplified Piezoelectric Actuators, APA®, developed by CEDRAT TECHNOLOGIES cover an area of performances, in terms of forces and displacements, that are not in the range of direct or bimorph Piezo Actuators. The MML series are Actuators manufactured by CEDRAT TECHNOLOGIES and are especially designed to obtain medium stiff Actuators and produce much higher displacements than Direct Piezo Actuators. Consequently, they have a high bandwidth and can be used in several dynamic applications.

References	Unit	APA100MML	APA400MML
Item Code		V-APAMML100	V-APAMML400
Notes		-	-
Displacement	(μm)	100	364
Blocked force	(N)	855	189
Stiffness	(N/ μm)	8.6	0.5
Resonance frequency (free-free)	(Hz)	5800	2738
Response time (free-free)	(ms)	0.09	0.18
Resonance frequency (blocked-free)	(Hz)	1730	634
Response time (blocked-free)	(ms)	0.29	0.79
Force limit (0-pk)	(N)	428	95
Max. displacement at resonance (pk-pk)	(μm)	90	328
Voltage range	(V)	-20... 150	-20...150
Capacitance	(μF)	10.0	10.0
Resolution	(nm)	1.0	3.6
Thermo-mechanical behaviour	($\mu\text{m}/^\circ\text{K}$)	1.51	3.57
Height H (in actuation direction)	(mm)	58.0	20.0
Length	(mm)	78.0	78.0
Width (incl. edges, wires)	(mm)	11.5	11.5
Mass	(g)	50.0	47.5
Standard mechanical interface [H]		2 flat surfaces 6*10 mm ² with M3 threaded hole	2 flat surfaces 6*10 mm ² with M3 threaded hole
Standard electrical interface		2 PTFE insulated AWG30 wires 100 mm long with \varnothing 1 banana plug	2 PTFE insulated AWG30 wires 100 mm long with \varnothing 1 banana plug

Table 4.9: Characteristics of the APA™ MML Actuators



Figure 4.10: View of the APA 400MML actuator

Available option(s): SG, VAC, HT
Available interface option(s): FI, H, TH, FF, SI

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4.9 Amplified Piezoelectric Actuators APA® ML Series

The Amplified Piezoelectric Actuators, APA®, developed by CEDRAT TECHNOLOGIES under a CNES contract, cover an area of performances, in terms of forces and displacements, that are not in the range of direct or bimorph Piezo Actuators. The ML series are Actuators manufactured by CEDRAT TECHNOLOGIES and are especially designed to obtain very stiff Actuators and produce higher displacements than Direct Piezo Actuators. Consequently, they have a very large bandwidth and can be used in several dynamic applications.

References	Unit	APA95ML	APA120ML
Item Code		V-APAML95	V-APAML120
Notes		-	-
Displacement	(μm)	94	130
Blocked force	(N)	1900	1400
Stiffness	(N/ μm)	20.2	10.8
Resonance frequency (free-free)	(Hz)	7000	6450
Response time (free-free)	(ms)	0.07	0.08
Resonance frequency (blocked-free)	(Hz)	2000	1750
Response time (blocked-free)	(ms)	0.25	0.29
Force limit (0-pk)	(N)	950	700
Max. displacement at resonance (pk-pk)	(μm)	85	117
Voltage range	(V)	-20 ... 150	-20 ... 150
Capacitance	(μF)	20.0	20.0
Resolution	(nm)	0.9	1.3
Thermo-mechanical behaviour	($\mu\text{m}/^\circ\text{K}$)	1.48	1.66
Height H (in actuation direction)	(mm)	60.0	45.0
Length	(mm)	80.1	78.9
Width (incl. edges, wires)	(mm)	22.5	22.5
Mass	(g)	164.0	160.0
Standard mechanical interface [H]		2 flat surfaces 9*20 mm ² with 2 \varnothing 3.2 mm holes, centred at 5 mm from the side	2 flat surfaces 9*20 mm ² with 2 \varnothing 3.2 mm holes, centred at 5 mm from the side
Standard electrical interface		2 PTFE insulated AWG26 wires 300 mm long with \varnothing 1 banana plug	2 PTFE insulated AWG26 wires 300 mm long with \varnothing 1 banana plug

Table 4.10: Characteristics of the APA™ ML Actuators

Available option(s): SG, VAC, HT
Available interface option(s): FI, H, TH, FF, SI



Figure 4.11: View of the APA 120ML Actuator

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4.10 Amplified Piezoelectric Actuators APA® L Series

The Amplified Piezoelectric Actuators, APA®, developed by CEDRAT TECHNOLOGIES cover an area of performances, in terms of forces and displacements, that are not in the range of direct or bimorph Piezo Actuators. The L series are large Actuators manufactured by CEDRAT TECHNOLOGIES and produce displacements up to 1 mm.

References	Unit	APA230L	APA500L	APA1000L
Item Code		V-APAL230	V-APAL500	V-APAL1000
Notes		-	-	-
Displacement	(μm)	236	500	950
Blocked force	(N)	1350	570	373
Stiffness	(N/ μm)	5.7	1.1	0.4
Resonance frequency (free-free)	(Hz)	3000	1900	1487
Response time (free-free)	(ms)	0.17	0.26	0.34
Resonance frequency (blocked-free)	(Hz)	850	460	290
Response time (blocked-free)	(ms)	0.59	1.09	1.72
Force limit (0-pk)	(N)	675	285	93
Max. displacement at resonance (pk-pk)	(μm)	212	450	428
Voltage range	(V)	-20 ... 150	-20 ... 150	-20 ... 150
Capacitance	(μF)	40.0	40.0	40.0
Resolution	(nm)	2.4	5.0	9.5
Thermo-mechanical behaviour	($\mu\text{m}/^\circ\text{K}$)	3.5	6.1	10.9
Height H (in actuation direction)	(mm)	85.0	55.0	35.0
Length	(mm)	145.3	145.0	145.0
Width (incl. edges, wires)	(mm)	16.0	16.0	16.0
Mass	(g)	275.0	200.0	190.0
Standard mechanical interface [TH]		2 flat surfaces 10*10 mm ² with M5 threaded hole	2 flat surfaces 10*10 mm ² with M5 threaded hole	2 flat surfaces 10*10 mm ² with M5 threaded hole
Standard electrical interface		2 PTFE insulated AWG26 wires 300 mm long with \varnothing 1 banana plug	2 PTFE insulated AWG26 wires 300 mm long with \varnothing 1 banana plug	2 PTFE insulated AWG26 wires 300 mm long with \varnothing 1 banana plug

Table 4.11: Characteristics of the APA™ L Actuators



Figure 4.12: View of the APA 500L Actuator

Available option(s): SG, VAC, HT, NM
Available interface option(s): FI, H, TH, FF, SI

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4.11 Amplified Piezoelectric Actuators APA® XL Series

The Amplified Piezoelectric Actuators, APA®, developed by CEDRAT TECHNOLOGIES cover an area of performances, in terms of forces and displacements, that are not in the range of direct or bimorph Piezo Actuators. The XL series are the largest standard piezo actuators manufactured by CEDRAT TECHNOLOGIES. They offer up to 1 mm stroke, either under static or dynamic conditions. Other models can be defined upon request.

References	Unit	APA500XL	APA1000XL
Item Code		V-APAXL500	V-APAXL1000
Notes		-	-
Displacement	(μm)	500	1050
Blocked force	(N)	1100	745
Stiffness	(N/ μm)	2.20	0.71
Resonance frequency (free-free)	(Hz)	1280	980
Response time (free-free)	(ms)	0.39	0.51
Resonance frequency (blocked-free)	(Hz)	345	210
Response time (blocked-free)	(ms)	1.45	2.38
Force limit (0-pk)	(N)	633	428
Max. displacement at resonance (pk-pk)	(μm)	450	945
Voltage range	(V)	-20 ... 150	-20 ... 150
Capacitance	(μF)	110.00	110.00
Resolution	(nm)	5.0	10.5
Thermo-mechanical behaviour	($\mu\text{m}/^\circ\text{K}$)	6.38	12.23
Height H (in actuation direction)	(mm)	82.0	57.0
Length	(mm)	214.3	214.3
Width (incl. edges, wires)	(mm)	21.0	21.0
Mass	(g)	650.0	600.0
Standard mechanical interface [TH]		2 flat surfaces 15*15 mm ² with M5 threaded hole	2 flat surfaces 15*15 mm ² with M5 threaded hole
Standard electrical interface		2 PTFE insulated AWG26 wires 300 mm long with \varnothing 1 banana plug	2 PTFE insulated AWG26 wires 300 mm long with \varnothing 1 banana plug

Table 4.12: Characteristics of the APA™ XL Actuators.

Available option(s): SG, VAC
Available interface option(s): FI, H, TH, FF, SI



Figure 4.13: View of the APA 1000XL Actuator

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