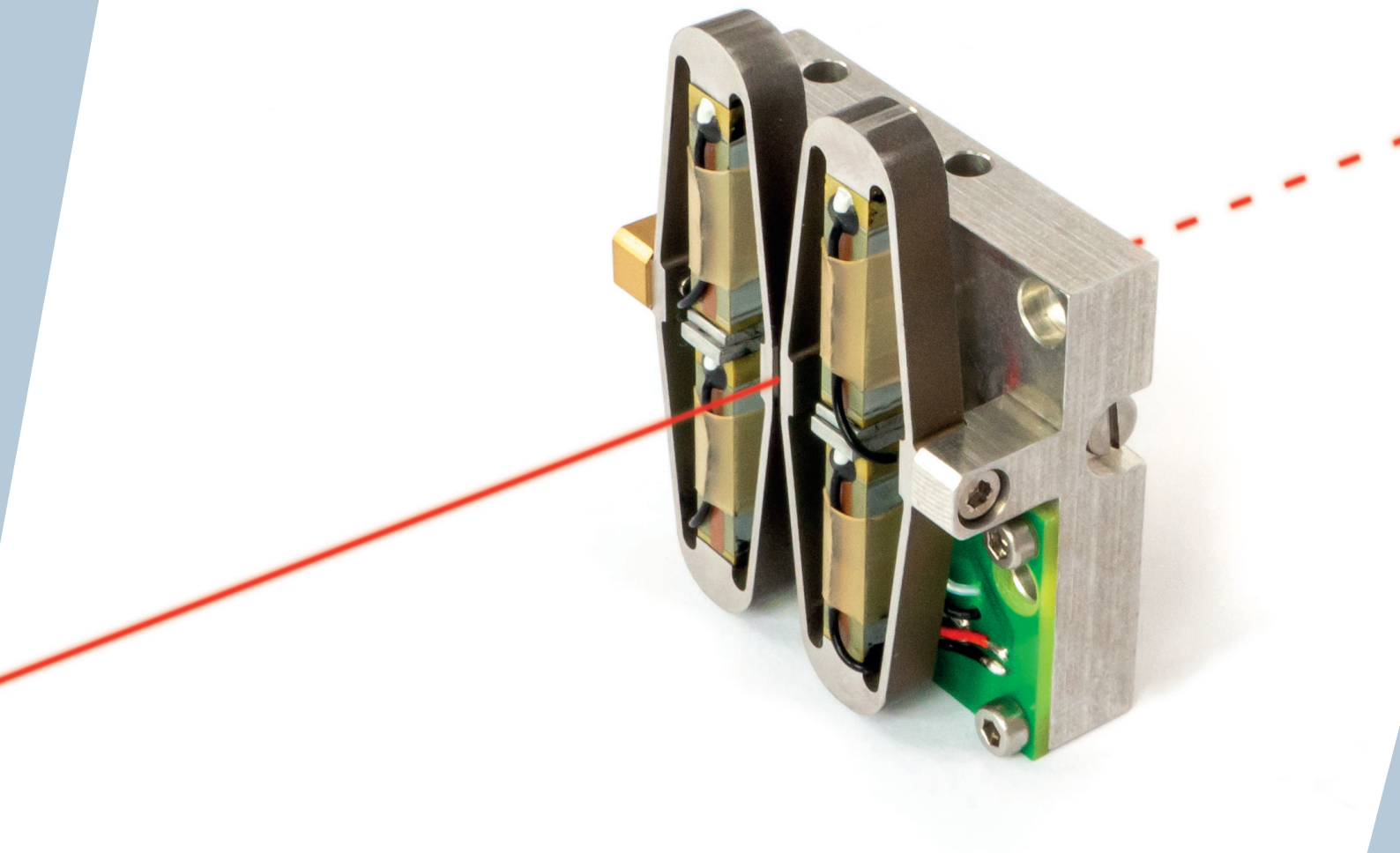
MECHANISMS FOR SYNCHROTRON

COMPACT - DYNAMIC - PRECISE



CEDRAT TECHNOLOGIES
Innovation in Mechatronics

CEDRAT TECHNOLOGIES MECHANISMS FOR SYNCHROTRON

Cedrat Technologies (CTEC) specialized in mechatronics systems has developed a specific products range for the synchrotron applications:

ENVIRONMENT	Synchrotron					
APPLICATIONS	Fast Shutter		Beam shapper / Active slits	Samples positioning		Fast attenuation device
CTEC PRODUCTS	FPS	FAPS	Microslits	Nano positioning Stages X, XY, XYZ	X - Tripod	Active filter positioning array

Table a : Products range for the synchrotron applications

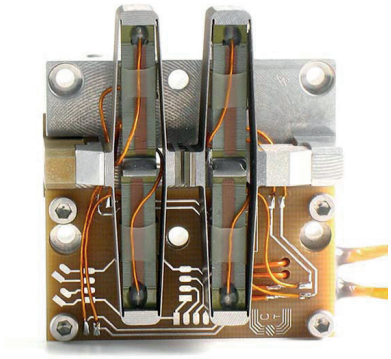


Fig. 1 : FPS900M option UHV

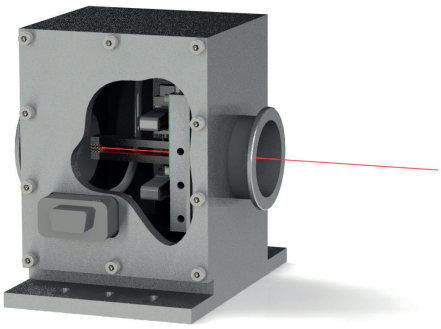


Fig. 2 : Option vacuum box

1. FAST PIEZO SHUTTERS

The Cedrat Technologies (CTEC) Fast Piezoelectric Shutters FPS have been developed to solve the Magnetic Shutters reliability issues.

Standards products have been designed (see technical sheet below) but if you have a specific need we are able to design custom shutters.

Options

- Tungsten teeth
- UHV compatibility
- Strain Gauge (SG) sensor
- Vacuum box with CF40 interteface

Advantages

- UHV compatibility
- Lifetime : > 100 million cycles
- High repeatability
- Low jitter <100 µs

Related electronics

- Amplifier SP75 for ON/OFF
- Amplifier LA75X for an high resolution position control
- Strain gauge conditioner SG75X

PARAMETER	UNIT	FPS200M	FPS400M	FPS900M	FAPS400M
Max. beam diameter	mm	0.30	0.70	1.1	3.0
Aperture & closing time	ms	2	4	10	8
Voltage range	V	-20 ... 150	-20 ... 150	-20 ... 150	-20 ... 150
Capacitance (per electrical port)	µF	3.2	3.2	3.2	3.2
Slits material	-	Stainless steel / Tungsten	Stainless steel / Tungsten	Tungsten	Tungsten
Slits depth	mm	2.4	2.4 / 4.8	4.8	3.0
SG option	-	✓	✓	✓	✓ (b.1)
Dimensions (X×Y×Z)	mm	60×44×21	60×44×21	60×44×23	73×54×65
Mass	g	150	150	150	150

Table b : Characteristics of piezo shutters

b.1 Included, not optional

1.1. FPS PRODUCT

Developed in collaboration with M. CAPRIANI from EMBL (European Molecular Biology Laboratory), the fastest piezoelectric X-Ray shutter FPS200M as well as the other shutters of this products range are made of two Amplified Piezo Actuators (APA®) facing each other with a special optical head. They are mounted on a solid stage to cut a beam. When voltage is applied, the two APA® retract and the shutter opens.

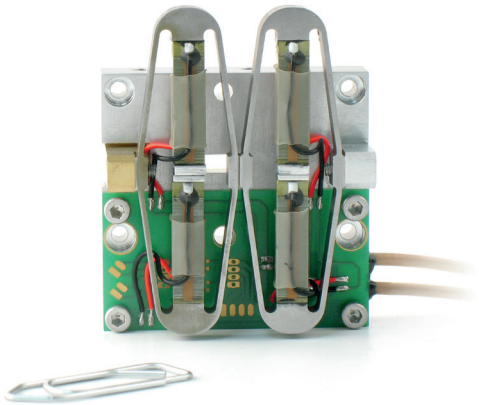


Fig. 3 : FPS200M

1.2. FAPS PRODUCT

To tackle apertures more than 1 mm, we developed a new product range: the Fast Amplified Piezoelectric Shutter FAPS. The optical heads for these shutters are mounted on a lever arm to amplify the APA® movement.

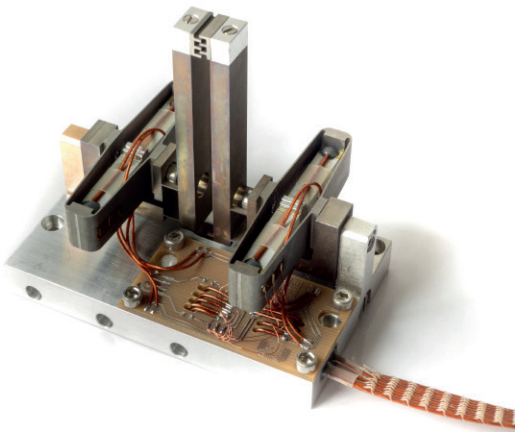


Fig. 4 : FAPS400M

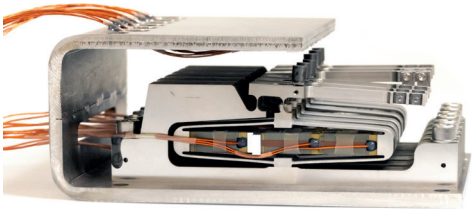


Fig. 5 : Fast positioner for filter array

2. FAST POSITIONER FOR FILTER ARRAY

Cedrat Technologies (CTEC) has designed and produced a fast positioner for filter array composed by 6 APA600MML in a monolithic structure in collaboration with SOLEIL to reach hight performances and robustness.

This project has been done in collaboration with SOLEIL for the SixS beamline to modify the energy of a beam by using a series of piezo actuated filters.

Each arm is holding a filter and can move independently up to 3.5 mm with a high resolution.

Related electronics

- Amplifier LA75 for a high resolution position control

PARAMETER	UNIT	COMB FILTER
Stroke	mm	3.5
Response time	ms	< 10
Frequency	Hz	1
Vacuum option	mbar	10-6
Filter weight	g	1.7 (f.1)

Table c : Characteristics of comb filter

g.5 For each

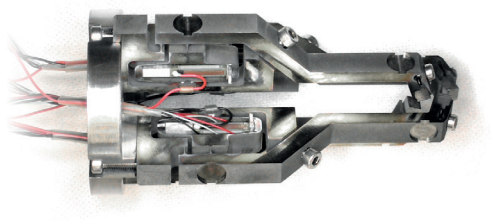


Fig. 6 : Beamshaper

3. BEAM SHAPER

CTEC has developed in collaboration with SOLEIL a beamshaper to adjust the beam shape. With this mechanism the shape of the X ray beam is a rectangle and can be adjusted.

This product is fitted with 4 piezo actuators APA50XS every 90° in a monolithic design and 4 lips at the extremeties of each arms.

The aperture is more than 1 mm.

Related electronics

- Amplifier LA75 for high resolution position control

PARAMETER	UNIT	BEAM SHAPPER
Stroke	µm	600
Resolution in closed loop	µm	> 1
Frequency	Hz	1
Vacuum option	mbar	10-6

Table d : Characteristics of beam shapper

4. SAMPLES POSITIONER

Thanks to our XY or Rotation Stages and our large angle Tip Tilt products, you will be able to position your samples accurately in the center of the beam.

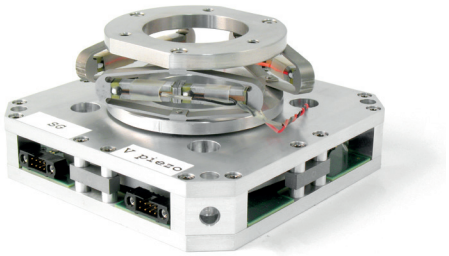


Fig. 7 : XYZ200M

4.1. TRANSLATION STAGES UP TO 3 TRANSLATIONS

Nano positioning to position samples

Advantages

- No backlash compared to ball screw devices
- Accurate positioning

Option

- Strain Gauge (SG) sensor

Related electronics

- Amplifier LA75 for a high resolution position control

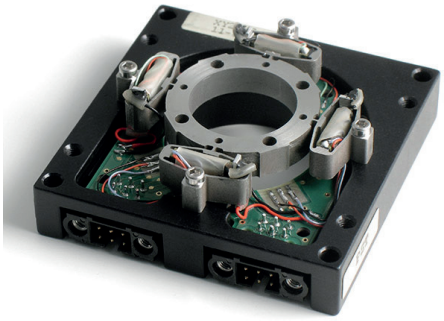


Fig. 8 : XY25XS

PARAMETER	UNIT	X60S	X120S	XY25XS	XY200M	XY400M	XYZ200M
	-	Preliminary	Preliminary	Standard	Standard	Preliminary	Standard
› Specifications							
Active axis	-	TX	TX	TX, TY	TX, TY	TX, TY	TX, TY, TZ
Displacement (unloaded)	µm	55	110	25	200	400	200
Unloaded resonance frequency	Hz	1 840	850	3 000	580	260	380
Resolution	nm	6	11	3	20	40	20
Voltage range	V	-20 ... 150	-20 ... 150	-20 ... 150	-20 ... 150	-20 ... 150	-20 ... 150
Capacitance (per electrical port)	µF	1.6	1.6	0.50	6.3	6.3	6.3
› Mechanical properties							
Stiffness	N/µm	1.2	0.26	2.5	0.59	0.14	0.59
Dimensions (X×Y×Z)	mm	30×30×12	30×30×12	50×50×19	100×100×22	100×100×27	100×100×49
Mass	g	23	23	80	450	500	540

Table e : Characteristics of piezoelectric stages

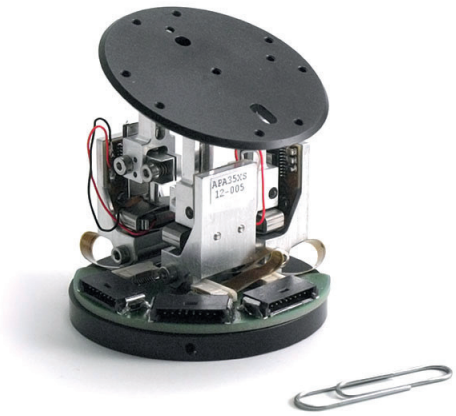


Fig. 9 : Tripod actuator TrAC

4.2. TRIPOD ACTUATOR

The Tripod Actuator (TrAC) by Cedrat Technologies is a 3 degrees of freedom mechanism (2 rotations and 1 translation).

The TraC is fitted with 3 Stepping Piezo Actuators which allow a sub-nanometer resolution and able to hold in position without power supply, a sample, a probe or a mirror for example.

Related electronics

- Amplifier SPC45 for an high resolution position control

PARAMETER	UNIT	TRIPOD ACTUATOR
Rx Ry	°	+/-35
Tz	mm	10
> Up speed		
Rx	mm/s	20
Ry	mm/s	15
Tz	mm/s	25
> Down speed		
Rx	mm/s	40
Ry	mm/s	40
Tz	mm/s	50
> Mechanical properties		
Base	mm	50
Height	mm	50

Table f : Characteristics of the Tripod Actuator TrAC

4.3. PIEZO MOTORISED LINEAR STAGE

Piezo motorised linear stage for accurate positioning (sample, lens, mirror...).

Related electronics

- Amplifier SPC45 for a high resolution position control

Fig. 10 : LSPS35XS

PARAMETER	UNIT	LSPS35XS
		Preliminary
> Stepping mode		
Travel range	mm	10
Nominal Speed (e.1) (e.2)	mm/s	10
Max speed (e.3)	mm/s	20
Typical step size (e.1) (e.2)	µm	5 ... 30
> Fine positioning mode		
Stroke (e.1) (e.3)	µm	54.0
Resolution (e.3)	nm	< 1
Stiffness	N/µm	0.50
> Forces		
Holding force without consumption	N	3
Nominal driving force (e.1) (e.2)	N	0.8
Max driving force (e.3)	N	2
> Driver		
Nominal driver		SPC45
> Mechanical properties		
Lifetime (e.4)	cycles	> 1 000 000
Heigth	mm	15.00
Width	mm	30.00
Length (in actuation direction)	mm	30.00
Mass	g	30.00

Table g : Characteristics of LSPS

g.1 Unloaded
g.2 With nominal driver
g.3 Custom version and driver
g.4 Unloaded, 2mm stroke, nominal speed, 50% duty-cycle

Technologies already approved and integrated in the following beamlines, to name but a few :

- 7 Beamlines at ESRF - ID14-1, ID14-2, ID14-3, ID14-4, ID23-1, ID23-2 & ID29 – France
- 2 Beamlines at Soleil - PROXIMA 1&2 – France
- 4 Beamlines at Diamond - I24: Microfocus MX, I22: Non-crystalline diffraction – UK
- 5 Beamlines at APS Argonne – LSCAT & 21D-B – USA
- 1 Beamline at NSRRC – BL17 – Taiwan
- 2 Beamlines at SSRF - BL17U BL18U - Shanghai Synchrotron
- 1 Beamline at Spring 8 – Japan
- 2 Beamlines at PETRA III - Germany
- 2 Beamlines at MAX IV - Sweden
- 1 Beamline at PAL-XFEL - South Korea
- 1 Beamline at PLS-II - South Korea

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