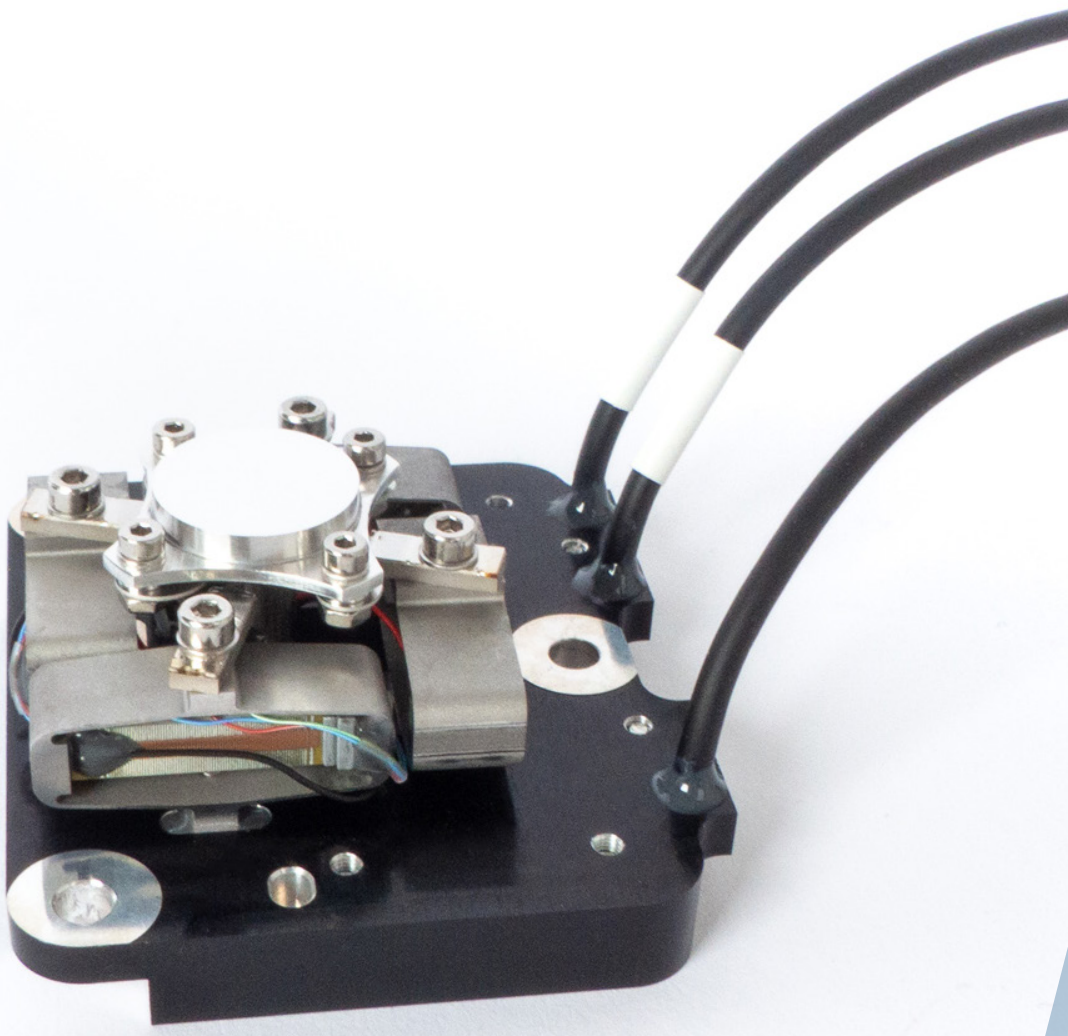
PIEZO & MAGNETIC MECHANISMS

COMPACT - DYNAMIC - PRECISE



CEDRAT TECHNOLOGIES
Innovation in Mechatronics

PIEZO & MAGNETIC MECHANISMS

1. SELECTION GUIDE

CEDRAT TECHNOLOGIES (CTEC) offers piezo and magnetic actuators based mechanisms to provide the user with motion over several degrees of freedom as well as advanced mechatronic functions.

These mechanisms integrate position sensors (see dedicated webpage) for higher positioning accuracy thanks to closed loop control.

These mechanisms are driven and controlled either by the powered rack or OEM controllers from CTEC (see dedicated webpage).

Different product lines are available off-the-shelf:

- **X:** single axis X guided stage,
- **XY:** two axis orthogonal XY stage,
- **XYZ:** three axis orthogonal XYZ stage,
- **TT:** single axis Tilt Translator,
- **DTT:** Dual (two axis) Tip Tilt,
- **P-FSM:** Dual axis Piezo based Fast Steering Mirror,
- **M-FSM:** Dual axis Magnetic based Fast Steering Mirror,
- **FPS:** Fast Piezo Shutter.

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 e-drawings file.

The mechanisms shown in this section can be tuned to your specific requirements: dedicated optical payload, environmental & operating conditions, etc. Please contact us to discuss about your requirements.

7.2. PIEZO STEERING PLATFORMS

The piezo steering platforms are either tilt (single rotational axis) or Tip Tilt (dual rotational axis) mechanisms to move a mirror payload. Each rotational axis includes a pair of APA® driven in push pull. Each platform axis is equipped with a Strain gauge positioning sensor and is combined with OEM controllers like CCBu20 and CCBu40 for an accurate & dynamic motion control.

These piezo steering platform models have a mechanical support to bond different type and size of mirror payload. As an option for COTS Tilt or Tip/Tilt platforms, CTEC can propose to outsource and to integrate a suitable mirror defined in collaboration with the customer. CTEC can even design customized mirrors (Silicon Carbide SiC, Fused Silica SiO2, ...).

Their functions and applications include optical & laser communication link, pointing, micro-scanning, D- scanning, anti-blurring, tracking, beam wander correction and line of sight stabilization.

The **TT60SM-SG model** is a single axis steering platform with more than 1° angular motion. The **DTT15XS-SG, DTT35XS-SG & DTT60SM-SG** models have a max angular stroke of 2, 5 & 11 mrad respectively.

Fig. a: View of the Tilt Translator TT60SM

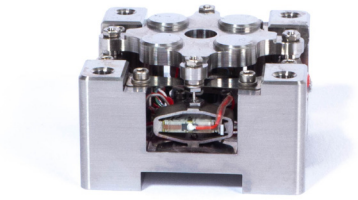


Fig. b: View of the Double Tilt Translator DTT15XS-SG

Fig. c: View of the Double Tilt Translator DTT35XS-SG

Fig. d: View of the Double Tilt Translator DTT60SM-SG

PARAMETER	UNIT	TT60SM-SG	DTT15XS-SG	DTT35XS-SG	DTT60SM-SG
Active axis	-	RX	RX, RY	RX, RY	RX, RY
Angular displacement	mrad (+/-)	24	1,8	4,8	11
Unloaded resonance frequency	Hz	2000	3000	2450	1800
Angular resolution	µrad	0,24	1	5	10
Voltage range	V	-20...150			
Capacitance (per electrical port)	µF	2,8	0,7	0,7	2,8
Dimensions (Ø×Z)	mm	55x35	40x40x24	45x22	65x40
Mass	g	141	110	65	310
Sensor Option	-	SG, ECS	SG	SG	SG

Table 7.a: Characteristics of Steering Platforms

7.3. FAST STEERING MIRRORS

A Fast-Steering Mirror (FSM) is an opto-mechanical solution including a Mirror integrated on a steering platform (Tilt or Tip/Tilt) with positions sensors and a controller. CTEC COTS FSM are either piezo (P-FSM) or magnetic (M-FSM) actuator-based opto-mechanisms. They are controlled with either piezo controllers or magnetic controllers. Their sensors are either Strain Gauges (SG) for P-FSM or Eddy Current Sensors (ECS) for M-FSM.

The **P-FSM150S-SG, M-FSM45, M-FSM45-HPL & M-FSM62 models** have large angular stroke respectively of 18 mrad (>1°), 50 mrad (>2.5°), 90 mrad (>5°) and 140 mrad (>8°). They have SiC mirrors with respectively 15 & 30 mm clear aperture and high reflectivity coating.

The **P-FSM150S-SG model** has been developed and space qualified for both point ahead & fast steering mirror functions inside Optical Communication Terminal (OCT) used for Optical Inter-Satellite Link of space constellations. The P-FSM150S-SG design has been optimized to meet both the harsh environments and low recurrent cost demands of the New-space market.

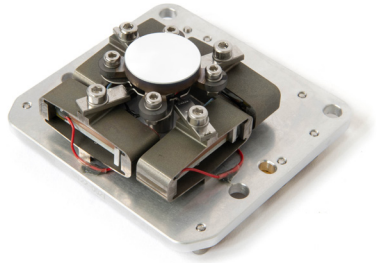


Fig. e: View of the Fast Steering Mirror P-FSM150S

Fig. f: View of the Fast Steering Mirror M-FSM45

Fig. h: View of the Fast Steering Mirror M-FSM45-HPL

Fig. g: View of the Fast Steering Mirror M-FSM62

PARAMETER	UNIT	P-FSM150S	M-FSM45	M-FSM45-HPL	M-FSM62
Status	-	Standard	Standard	Preliminary	Preliminary
Active axis	-	RX, RY	RX, RY	RX, RY	RX, RY
Angular displacement	mrad (+/-)	18	50	90	140
Loaded resonance frequency	Hz	700	100	80	100
Angular resolution	µrad	20	2	2	20
Dimensions	mm	63x61x30	Ø45x40	Ø45x58	Ø62x60
Mass	g	135	200	400	500
Sensor Option	-	SG	ECS	ECS	ECS

Table 7.b Characteristics of Fast Steering Mirrors

7.4. PIEZO STAGES

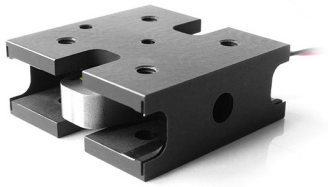


Fig. i: View of the X60S stage

Fig. j: View of the XY25XS stage

Fig. k: View of the XYZ200M stage

CEDRAT TECHNOLOGIES (CTEC) piezo stage product line includes models with 1, 2 or 3 translation axis. All the models take advantage from the characteristics of APA® actuators and flexure guiding, in order to offer excellent compactness, robustness, bandwidth and resolution. It can be equipped with strain gauges for very fine positioning or closed loop control. Parasitic translations and rotations as well as cross talk are very limited.

The **X60S & X120S models** are single axis piezoelectric stages. Their moving frame can be custom designed (attachment points, holes...) and 2 stages can be stacked for XY motion.

The **XY25XS, XY200M & XY400M models** are 2 push pull orthogonal axis stages with a centered moving frame for fixing the payload (Optical lens for instance). Thanks to this symmetric design, these XY stages have a self-compensated thermo-mechanical behavior.

These XY stages are usually combined with OEM controllers like CCBu20 or CCBu40.

Their applications include mask, lens or detector positioning, micro scanning, pixel shifting, dithering and line of sight stabilization.

The **XYZ200M model** is actually a 2 axis stage XY200M model with an additional vertical axis based on 3 guided APA200M to provide the user with 200 um motion over the three orthogonal degrees of freedom.

The XYZ200M stage is able to bear loads up to 3 kg.

Applications include confocal microscopy, mask positioning and inspection.

PARAMETER	UNIT	X60S	X120S	XY25XS	XY200M	XY400M	XYZ200M
Status	-	Preliminary	Preliminary	Standard	Standard	Preliminary	Standard
Active axis	-	TX	TX	TX, TY	TX, TY	TX, TY	TX, TY, TZ
Displacement (unloaded)	µm	55	110	25	200	400	200
Stiffness	N/µm	1,2	0,26	2,5	0,59	0,14	0,59
Unloaded resonance frequency	Hz	1840	850	3000	580	260	380
Resolution	nm	5,5	11	3	20	40	20
Voltage range	V	-120...150					
Capacitance (per electrical port)	µF	1,55	1,55	0,5	6,3	6,3	6,3
Dimensions (XxYxZ)	mm	30x30x12	30x30x12	50x50x16	100x100x22	100x100x27	100x100x49
Mass	g	23	23	80	450	500	540
Sensor option	-	SG	SG	SG, ECS	SG, ECS	SG, ECS	SG, ECS

Table 7.c: Characteristics of piezoelectric stages

7.5. FAST PIEZO SHUTTERS

The Fast & Amplified Piezo Shutters (FPS & FAPS) are beam shutter mechanisms using two APA® actuators to open and close a slit, up to 3 mm in less than 10 ms. They are particularly suited to applications requiring low jitter, high repeatability or long lifetime.

Design of FPS & FAPS series is based on either APA200M, APA400M and APA900M actuators. The moving jaw can be made of tungsten to offer very high X-Ray stopping power. The FPS & FAPS embed a Strain Gauge (SG) sensor to feedback the open / close status. Vacuum (VAC) and Ultra High Vacuum (UHV) options are also available on request.

FPS technology, initially developed by CEDRAT TECHNOLOGIES (CTEC) on an initiative of Mr Cipriani from EMBL and qualified at ESRF Grenoble (France), are now used by synchrotron facilities all around the word.

The FPS & FAPS family is driven and controlled by a dedicated electronic rack mounted RK42F3U-LC75B + SP75A-2 + SG75-1.

Fig. m: View of the FPS400M (courtesy of EMBL)

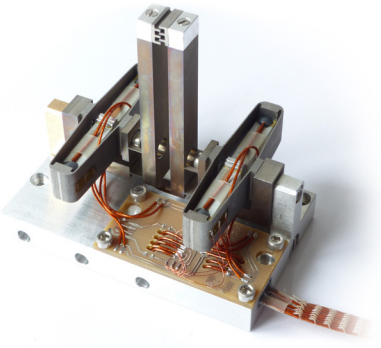


Fig. n: View of the FAPS400M-SIW-SG-UHV

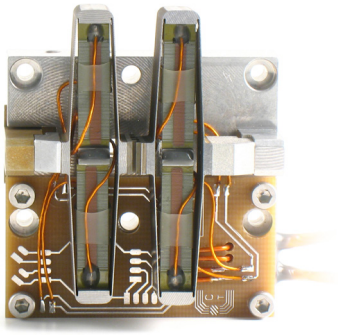


Fig. l: View of the FPS900M

PARAMETER	UNIT	FPS400M	FPS900M	FAPS400M
Max. beam diameter	mm	0,7	1,1	3
Aperture & closing time	ms	4	10	8
Voltage range	V			
Capacitance (per electrical port)	µF			
Dimensions (X x Y x Z)	mm	60x44x21	60x44x23	73x54x65
Mass	g	84	82	152
Teeth material	-			
Total teeth depth	mm	2,4 / 4,8	4,8	3
Sensor option	-	SG	SG	SG

Table 7.d Characteristics of piezo shutters

7.6. CUSTOMISED PIEZO MECHANISMS

The range of Commercially Off The Shelves (COTS) mechanisms shown in the previous paragraphs is indeed the tip of the iceberg in terms of sales revenue and manufacturing volume at CTEC. Usually a COTS product is hardly ready for a friendly plug and play inside the customer system for any application. More and more customer's requests are demanding in terms of integration and functionality. To answer to that reality CTEC has been demonstrating its capability to deliver customized & OEM solutions for more than 25 years.

A customized solution is the possibility for a customer to optimize the performances, the reliability and the cost of ownership for the requested product or function to be integrated inside his system or application. This customized solution is either built from building blocks deriving from existing COTS solution or built through engineering development including design, prototyping and testing phases.

The purpose of this paragraph is to show (without being exhaustive) the diversity of the customized solutions in terms of piezo mechanisms developed and manufactured by CTEC for various industrial field. Some of these customized mechanisms have been delivered together with their controllers in order to provide the customer with a full plug & play integrated function.

Two brochures present the CTEC heritage in customized solutions for Fast Steering Mirrors and XY stages.

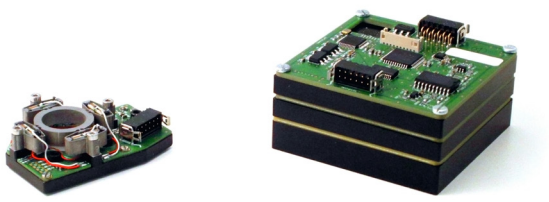


Fig. o: Piezo XY stage (+/- 10 um stroke) and its controller box for Image stabilization

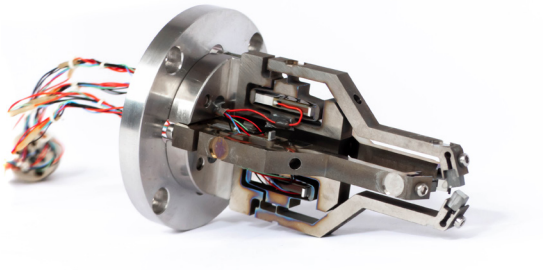


Fig. q: Active slits (> 700 µm aperture) for X ray beam shaper designed with SOLEIL for the SWING beamline

Fig. p: Piezo FSM (+/- 1 mrad stroke) and its controller box for fine laser pointing & stabilization

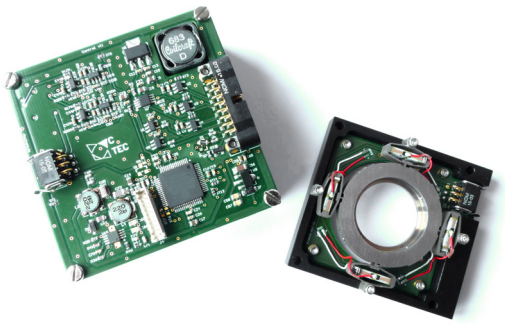


Fig. r: Micro scanning piezo XY stage (+/- 10 um stroke) and its driver box for image resolution enhancement

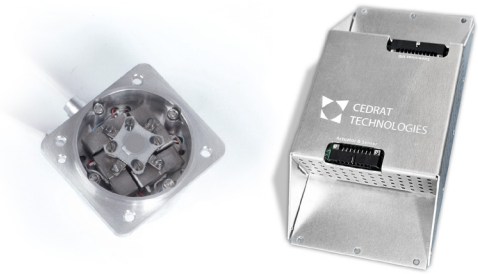


Fig. t: Mini P-FSM35XS-SG (angular stroke: 12 mrad) with its CCBu20-SV controller

Fig. s: Piezo activated arms (3 mm stroke for X-ray filter holder 10 ms switching time

7.7. P-FSM150S DEMOKIT

This new demokit has been created to show the implementation of our Piezo Fast Steering Mirror (P-FSM). It utilizes a P-FSM150S, a laser, and mirrors to amplify the laser deflection, making it visible on a screen within a confined space. The electronic used is the Compact Controller Board CCBu20 (see *page 127*) which is an embedded all-in-one controller designed for piezo actuators. It includes everything necessary to drive and control a 2-axis piezo mechanism in a closed loop. As a standard feature, its integrated dual-channel SG conditioner enables the reading of the position of the two axes of the mechanism.

Both axes of the FSM are actuated at different frequencies, creating a visual effect of a rotating rosette due to retinal persistence.

This kit includes:

- A piezo Fast Steering Mirror
- A compact driver CBBu20
- A laser
- 2 static mirrors
- An adjustable mirror
- A screen
- An optical support plate
- A driver power supply
- A laser power supply
- A transport case

Upon request, this demo kit can be adapted and equipped with an alternative tip-tilt mechanism from CTEC.

Fig. u: View of the P-FSM150S demokit

Fig. v: Rosette figure produced by the FSM actuation

CEDRAT TECHNOLOGIES (CTEC) offers off-the-shelf mechatronics products including piezoelectric & magnetic actuators, motors, mechanisms, transducers and sensors with corresponding drivers & controllers. These mechatronics products are used for scientific and industrial applications requiring fonctions such as: micro and nano positioning, generation of vibrations, micro-scanning, fast & precise motion control, active control of vibrations, and energy harvesting

Most of the products are available in OEM versions for low cost and high volume industrial applications. CTEC also offers services including, design, R&D under contract and training

You can request our e-catalogue on
cedrat-technologies.com/en/catalogue

CTEC is a SME located in Meylan, Inovallée, the French Innovation Valley near Grenoble. CTEC is recognised as a highly innovative company and has received several awards

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