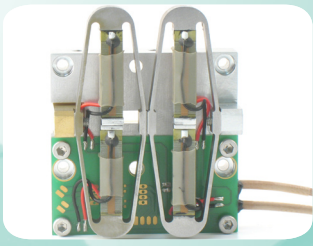


# Fast Piezo Shutters FPS200M & FPS400M



The precise exposure of samples to X-ray beam is needed for reliable data acquisition. With modern synchrotron sources, the exposure times get shorter and the coordination between spindle movement and shutter opening needs to be accurate in order to get reproducible exposed images.

## Objective

Developed in collaboration with Mr. Florent Capriani from EMBL, the fast piezoelectric shutter FPS200M (Fig.1a) is made of two Amplified Piezo Actuators (APA200M) facing each other with a special optical head\*(fig 1.b). Similarly, the FPS400M is constituted by two APA400M. They are mounted on a solid stage to cut a laser or a X-Ray beam. When voltage is applied the two APA's contract and the shutter opens. The aperture size is 0.3 x 5 mm (FPS200M) and 0.7 x 5 mm (FPS400M), see fig. 2.

\* made of stainless steel

Under request, the optical head can be made of tungsten (W) teeth for higher energy beam stopping.

This normally close shutter is driven by a standard electronic board SP75A-2 (Fig.3) from CEDRAT TECHNOLOGIES.

## Performances

Typical performances are given in the following table. The table 1 is not exhaustive as many other Fast Piezo Shutters can be designed by CEDRAT TECHNOLOGIES starting with other standard amplified piezo actuators.

References	Unit	FPS200M	FPS400M
Item Code		V-FPSM200	V-FPSM400
Notes		-	-
Sensors option		SG	SG
Active axis		TX	TX
Max. No-load displacement (Tx)	μm	400	800
Max. beam diameter	mm	0,3	0,7
Voltage range	V	-20 ... 150	-20 ... 150
Stiffness	N/μm	3,17	0,10
Height (Z axis)	mm	21,0	21,0
Dimensions (X & Y axis)	mm	60 * 44	60 * 44
Mass	g	300	300
Unloaded resonance frequency (in the actuation's direction)	Hz	900	495
Response time	ms	0,56	1,01
Capacitance (per electrical port)	μF	3,15	3,15
Mechanical interfaces (payload)		4 slits (width 0.6 mm)	4 slits (width 0.6 mm)
Mechanical interfaces (frame)		4 holes Ø 3mm on [] 24*38 mm	4 holes Ø 3mm on [] 24*38 mm
Electrical interfaces		2 RG178B/U coaxial cables	2 RG178B/U coaxial cables

Table 1: Characteristics of the Fast Piezo Shutters.

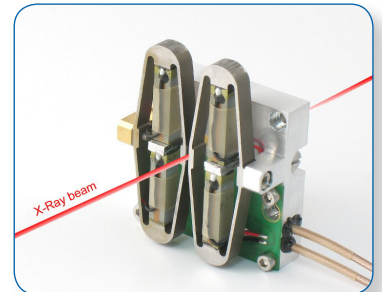


Figure 1a: FPS200M.

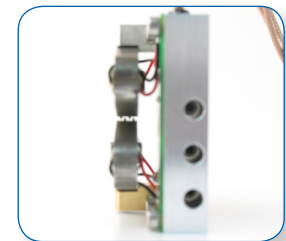


Figure 1b: FPS200M aperture optical head (zoom).

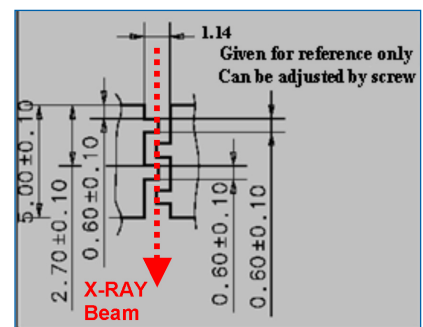
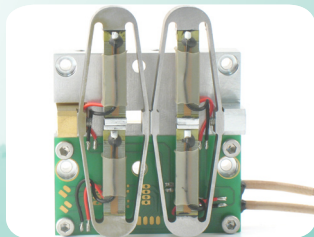


Figure 2: Dimensional view of aperture.



Figure 3: SP75A-2 Rack.

# Fast Piezo Shutters FPS200M & FPS400M



If we consider the mechanical response time (natural response) of FPS200M and FPS400M, the values are as indicated inside the technical data sheet respectively 0.56 ms and 1.01 ms. Nevertheless, these shorter response time values can not be obtained with SP75A-2. A powerful driver shall be used but some overshoot can arise from this high impulse due to natural response of the shutter (fig.4). In this case, a closed loop control is necessary and is hence available as an option.

		FPS200M	FPS400M
Very low jitter ( $\mu$ s)		< 100	< 100
Short response time (ms)	Open loop	2	4
	Close loop	0.56	1.01
Large displacement ( $\mu$ m)		> 300	> 700
Life time (cycles)		> $10^{10}$	> $10^{10}$

In summary, the FPS technology offers:

Advantages:

- Very good repeatability
- Vacuum compatible
- No Backlash, Stiction or Friction
- Immune to Magnetic Fields
- Ease of implementation
- No particles generated
- Highly compact assembly

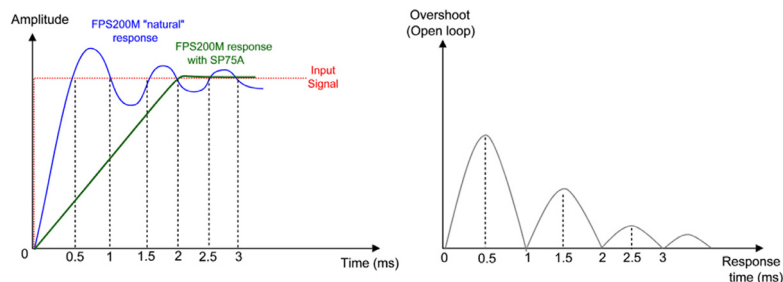


Figure 4: Response of the FPS200M + SP75A in open loop.

## References

Fast Piezo Shutter presently operating successfully in below mentioned Beamlines:

- 7 Beamlines-ID14-1, ID14-2, ID14-3, ID14-4, ID23-1, ID23-2 & ID29 at ESRF, Grenoble – France (Fig.6).
- 1 Beamline - PROXIMA 1 at Soleil - France.
- 4 Beamlines at Diamond -I24: Microfocus MX, I22: Non-crystalline diffraction – UK
- 4 Beamlines at APS Argonne.

## Remarks

- CEDRAT TECHNOLOGIES is the only company to manufacture, test and establish successfully the Fast Piezo Shutter for X - Ray beamlines application.
- CEDRAT's laboratories are equipped with a complete library of engineering software and specialized measurement apparatus.
- CEDRAT is a high technology French SME company with 18 years of experience in designing and developing Piezo based mechanisms.

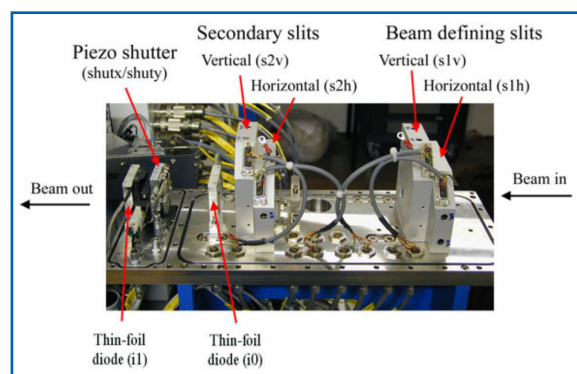


Figure 5: Experimental Table showing FPS200M (Courtesy ESRF).

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