

Fast Piezo X-Ray Shutters FPS 200M & FPS 400M

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 Cipriani from EMBL, the fast piezoelectric X-ray shutter FPS 200M (Fig.1a) is made of two Amplified Piezo Actuators (APA 200M) facing each other with a special optical head*(fig 1.b). Similarly, the FPS 400M is constituted by two APA 400M. 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 (fig. 2) is 0.3 x 5 mm (FPS 200M) and 0.7 x 5 mm (FPS 400M).

* 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 SP 75A-2 (Fig.3) from CEDRAT TECHNOLOGIES. The SP 75A delivers a TTL signal: -20 or 150V.

Performances

Typical performances are given in the following table. The table 1 is not exhaustive as many other Fast Piezo X-ray Shutter 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
Heigth (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 Shutter.

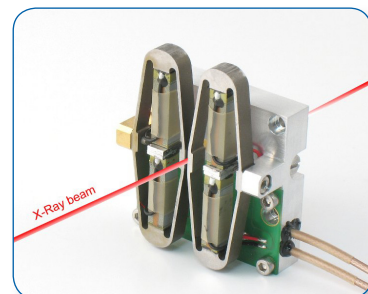


Figure 1a: FPS 200M.

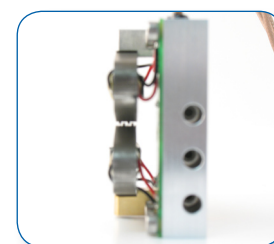


Figure 1b: FPS 200M side view.

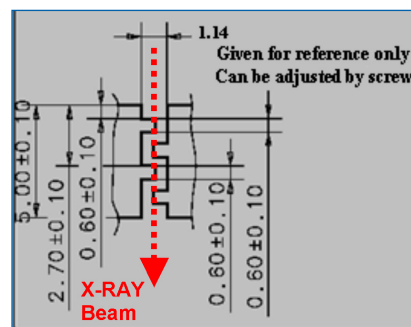
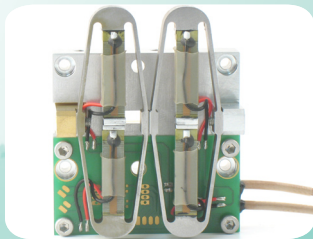


Figure 2: Dimensional view of aperture.



Figure 3: SP 75A ON/OFF Amplifier.



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The mechanical response times (natural response) of FPS 200M and FPS 400M are indicated inside the technical data sheet, respectively 0.56 ms and 1.01 ms. Nevertheless, the shorter response time values in open loop obtained with SP 75A-2 are shown in table 1. For faster response times and controllable aperture, a LA 75C linear amplifier can be used in closed loop (figure 4 and table 1).

	FPS 200M	FPS 400M
Very low jitter (μ s)	< 100	< 100
Response time with SP75A-2 (ms)	2	4
Response time with LA75C (ms)	1.25	5
Life time (cycles)	> 10^{10}	> 10^{10}

Table 1 : Performances

In summary, the FPS technology offers:

Advantages:

- Very good jitter
- Vacuum compatible
- Proportional aperture
- Extremely reliable
- Immune to magnetic fields
- Very compact
- No particles generated

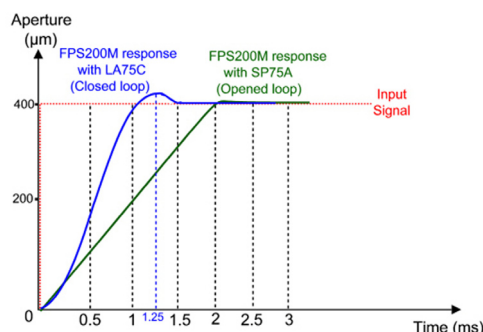


Figure 4: Response of the FPS 200M in opened and closed loop.

References

Fast Piezo Shutter presently operating successfully in below mentioned Beamlines:

- 7 Beamlines at ERSF - ID14-1, ID14-2, ID14-3, ID14-4, ID23-1, ID23-2 & ID29 - France (Fig.5).
- 1 Beamline at Soleil - PROXIMA 1 - 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
- 1 Beamline at Spring 8 - Japan

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 TECHNOLOGIES is a high technology French SME company with 18 years of experience in designing and developing Piezo based mechanisms.



Figure 5: FPS 200M on a XY stage on a MX Beamline (Courtesy ESRF)

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