

Fast Piezo Shutter

Bruker ASC and CEDRAT Technologies are closely cooperating in the integration of the CEDRAT Fast Piezo Shutter into Synchrotron Endstations.

Precise exposure of samples to x-ray beams is needed for reliable data acquisition. With modern synchrotron sources the exposure times may get extremely short and the coordination between endstation controls and shutter opening needs to be accurate in order to reliably get reproducible exposure times.

Objective

Developed in collaboration with Mr. Florent Cipriani from EMBL Grenoble, the CEDRAT fast piezoelectric shutter FPS200M (Fig.1a) consists of two Amplified Piezo Actuators (APA200M) facing each other with a special optical head made of stainless steel (Fig 1.b). Similarly, the FPS400M is constituted by two APA400M. The two APA are mounted on a solid stage and when voltage is applied the two APA's contract and the shutter opens. The typical aperture size is 0.3 x 5 mm (FPS200M) and 0.7 x 5 mm (FPS400M), see Fig. 2.

Under request, the optical head can be made of tungsten (W) for higher stopping power. This normally closed shutter is driven by a standard electronic board SP75A-2 (Fig.3) from CEDRAT TECHNOLOGIES.

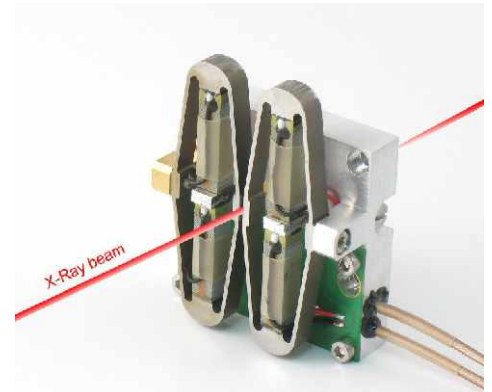


Figure 1a



Figure 1b FPS200M aperture optical head

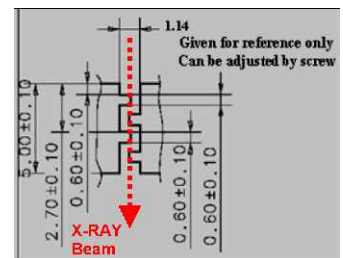


Figure 2: Dimensional view of aperture.

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 standard Fast Piezo Shutters.

Performances:

Typical performances of the standard models are given in the following table (fig. 4). Customized designs are possible. Typical closing/opening times for the full stroke of the shutter are reported in Fig. 4 – please refer to the Open loop values. If requested, even shorter response times can be obtained, by driving the devices with a upgraded electronics and under closed loop control; both these features are available as an option.



Figure 3: SP75A-2 Rack.

In Summary, the FPS technology offers the following advantages:

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

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

Figure 4: Summary of main performances.

Integration:

In addition to the Fast Piezo Shutter Bruker ASC can provide:

- A specifically designed high vacuum suitable housing (Fig. 5) for the shutter. This housing is equipped with 2 connecting flanges DN40KF for the implementation of the shutter into the vacuum path. It is sealed by O-rings for easy maintenance and is equipped with additional small flanges for venting and pumping. A suitable electrical feedthrough is mounted on the cover lid.
- the required motorized adjustments necessary to precisely position the shutter in the X-ray beam.
- The X-ray diagnostics needed to facilitate and expedite the shutter alignment



Figure 5: Vacuum Housing

References:

Fast Piezo Shutters are currently operating successfully at:

- ESRF, Grenoble – France: 7 systems (Fig.6).
- Soleil – France: 1 system
- Diamond – UK : 4 systems
- APS Arbonne – USA: .4 systems

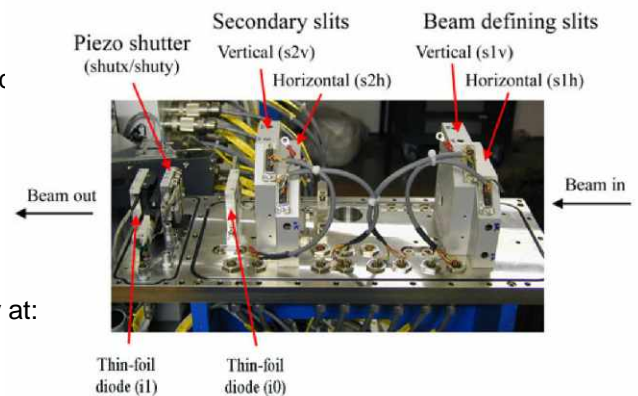


Figure 6: Experimental Table showing FPS200M (Courtesy ESRF).

Please contact: