

# FAST SHUTTER

## TECHNICAL SPECIFICATION

### ULTRA-FAST ELECTROMAGNETIC SHUTTER SYSTEM

#### GENERAL DESCRIPTION

The Fast Shutter is an eddy-current-accelerated electromagnetic actuator designed to rapidly block a 40 mm aperture. Its moving components are fully metallic, employing contactless electromagnetic acceleration and deceleration to ensure extremely high durability and reproducibility. The system is intended for high-radiation, high-magnetic-field fusion environments.

The EDV is not operational on its own; it requires an external high-voltage driver (recommended: **CE Fusion EddyDriver®**).

#### FUNCTIONAL PROPERTIES

- The shutter closes a **40 mm orifice** within **2 ms** after receiving the trigger signal.
- The shutter supports **≥ 10,000 operational cycles** without requiring maintenance.
- The shutter provides a **leak rate of ~20 mbar·L/s**, sufficient for short-term gas retention in pulsed operation.
- Minimum cycle time: ~20 seconds
- No measurable degradation in closure time or dynamics shall occur over 1000+ cycles, including operation in high static magnetic field (300 mT).

#### MECHANICAL DESIGN

##### MOVING COMPONENT

- Full-aluminium moving mass
- No mechanical impact during operation
- No observed material degradation during testing

##### DECELERATION SYSTEM

- Permanent-magnet Halbach array
- Non-contact electromagnetic braking
- No mechanical wear components

##### HOME POSITION & MONITORING

- Radiation-hard rotary feedthrough and piezo motor ensure home position reset
- Inductive end-position sensor ensures reliable closure detection

#### ENVIRONMENTAL CONSTRAINTS

##### MAGNETIC FIELD

- Device performance is practically insensitive to external static magnetic fields.
- No performance degradation observed in 275 mT field over 1000+ shots.

## RADIATION

- Permanent magnet materials sustain 2–5 years irradiation before expected replacement.
- All other components selected for radiation hardness.

## VACUUM

- Short-term VQC-compatible leak rate performance ( $\sim 20$  mbar·L/s).
- Polyimide sealing surface
- Ultra-high vacuum compatible
- Full metallic sealing options available

## INTEGRATION

- Suitable for complex fusion systems (ITER DMS, SPI lines)
- Compatible with external cooling or standalone operation depending on cycle rate
- Modular moving assembly for rapid maintenance of magnetic components

## SUMMARY

The Fast Shutter is a proven, ultra-fast, contactless electromagnetic actuator with exceptional durability, radiation robustness, and magnetic-field immunity. Its performance, precision, and reliability make it suitable not only for fusion applications but also for any system that requires millisecond-scale isolation in extreme environments.

