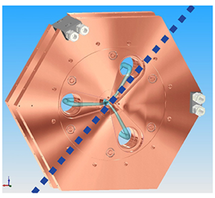
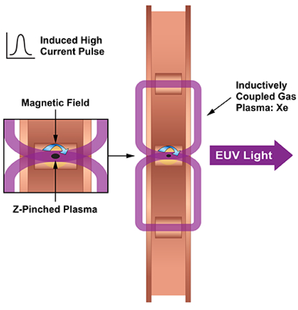
# EQ-10 Series Electrodeless Z-Pinch™ EUV Sources


## Introduction

Energetiq's unique technology is based on a Z-pinch plasma, but it avoids electrodes by inductively coupling the current into the plasma. The plasma in the Energetiq source is magnetically confined away from the source walls, minimizing the heat load and reducing debris. Energetiq's Electrodeless Z-Pinch™ technology results in excellent spatial stability, and stable repeatable power output.






## Design and Principle of Operation

In the basic design, the transformer primary circuit consists of two copper plates connected by a conductive tube at the center (shown left). The primary current flows radially in on one plate, axially through the central connection, and radially outward through the second plate. The induced secondary currents flow in a plasma through three electrically parallel paths that pierce the primary structure in three places, and then combine in the central bore.

In operation, a capacitor bank (not shown) is connected symmetrically to each of the six facets of the copper plates. An electrical pulse is applied to the plates causing the capacitors to begin to charge. In parallel, current flows through the copper structure radially into one plate, through the bore, and out the other plate. A magnetic switch core sandwiched between the plates near the outer radius of the device acts as a high impedance in series with the copper short circuit during this charging process, allowing only a small leakage current to flow– until the switch core saturates. At this point the core becomes essentially zero inductance, allowing the now charged capacitor bank to appear across a second inner induction core sandwiched between the plates closely surrounding the central bore.

The current and magnetic field in the core ramps, generating an EMF that drives current in the plasma through the bore and plasma return holes. The plasma current flowing through the bore of the device generates its own local magnetic field, which acts to compress the plasma current channel. When this field becomes intense enough, a dynamic Z-pinch occurs, which collapses the current channel to less than 1-mm diameter in a few tens of nanoseconds, thus compressing and heating the plasma to the point where EUV emission occurs.

| MODEL | EQ-10 | EQ-10HP | EQ-10HR | EQ-10SXR |
|---|---|---|---|---|
| **General Characteristics** | Compact, Reliable EUV Light Source | High Power EUV Light Source | High Repetition Rate EUV Light Source | Compact, Easy-to-use Soft X-Ray Source |
| **Typical Output Power** | 10W* | 20W* | 2W* | 400mW† |
| **Typical Brightness** | 5 W/mm$^2$.sr | 8 W/mm$^2$.sr | N/A | N/A |
| **Pulse Rate** | Up to 2 kHz | Up to 2.5 kHz | 10 kHz | Up to 2 kHz |
| **Target Gas** | Xenon | Xenon | Xenon | Nitrogen |

*Power into 2π steradians (13.5nm ±1% bandwidth).
†Power into 2π steradians (2.8nm line emission).

## Typical Applications and Installations

The EQ-10 series sources are uniquely suited for metrology and research applications. With over 30 delivered and installed around the world, they have been established as the workhorse sources of the EUV community, through their proven reliability, ease of use, and low cost of ownership.

**Proven Applications Include:**

- EUV Mask Blank Inspection
- Aerial Imaging for EUV Patterned Masks
- EUV Optics Testing
- EUV Pellicle R&D
- EUV Photoresist R&D (shown right)
- EUV Materials and Sensor Characterization

**Manually Loaded Open Frame Resist Exposure R&D Tool Using EQ-10HP**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