S-WAVE
Surface Wave Plasma Source

S-Wave is a compact plasma torch designed for industrial and laboratory applications from $10^{-2}$ mbar to atmospheric pressure

The plasma is created in a dielectric tube placed inside the source. The microwave electric field propagates longitudinally at the dielectric/plasma interface (plasma behaves as an electrical conductor). Radially the wave is strongly attenuated at skin depth.

This principle allows to create and sustain plasma columns with lengths which depend on the operating pressure, microwave power and gas nature.

The S-Wave plasma source is inductively coupled, thus only two tuning adjustments are provided to match the impedance. Generally, nearly 0 % of reflected power is achieved using the integrated tuners.

In addition, for given operator-set discharge conditions, the plasma is fully reproducible without any need for retuning at start-up.

MAIN APPLICATIONS

LABORATORY APPLICATIONS
- Biological applications: sterilization, disinfection, bacterial inactivation, reduction of bacterial adhesion, treatment of chronic wounds and infected skin ...

PLASMA APPLICATIONS
- Atomic Layer Deposition
- Decapsulation / failure analysis: Ar/O$_2$/CF$_4$ plasma
- Surface activation

CHEMISTRY APPLICATIONS
- Analytical chemistry
**S-WAVE**

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**KEY BENEFITS**

**DESIGN**
- Compact plasma torch
- Quick connectors for water cooling and gas connection
- 6 / 8 mm diameters dielectric tubes

**TECHNOLOGY**
- Integrated ignition system
- Operates between $10^{-2}$ mbar to atmospheric pressure

![Image of 200 W solid state generator with Ignition System and N coaxial cable]
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KEY SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
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<tbody>
<tr>
<td><strong>Reference</strong></td>
<td>S-WAVE 6, S-WAVE 8</td>
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<tr>
<td><strong>Frequency</strong></td>
<td>2450 MHz ± 50 MHz</td>
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<tr>
<td><strong>Microwave power</strong></td>
<td>Max. 450 W</td>
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<tr>
<td><strong>Working pressure range</strong></td>
<td>A few 10² mbar to atmospheric pressure</td>
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<tr>
<td><strong>Discharge gas</strong></td>
<td>Argon or argon-based gas mixture at atmospheric pressure</td>
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<tr>
<td><strong>Pure argon for ignition at atm pressure. All gases at reduced pressure</strong></td>
<td></td>
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<tr>
<td><strong>Gas flow</strong></td>
<td>At atm pressure: 1 to 30 l/min (min. 5 l/min is recommended to ignite)</td>
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<tr>
<td><strong>Discharge tube</strong></td>
<td>6 or 8 mm diameter (to be specified at order)</td>
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<tr>
<td><strong>external diameter</strong></td>
<td>2 quartz tubes of different lengths are provided</td>
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<tr>
<td><strong>Microwave connection</strong></td>
<td>Via coaxial cable, N-type (female)</td>
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<td><strong>Cooling connections</strong></td>
<td>Water, quick connectors for 6 mm OD hose</td>
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<tr>
<td><strong>Gas connection</strong></td>
<td>Swagelok 6 mm connector</td>
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<tr>
<td><strong>Ignition system</strong></td>
<td>On demand – Argon flow should be high enough to allow ignition. Remote ignition with a 0-5 V TTL signal</td>
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<td><strong>Weight</strong></td>
<td>Approx. 1 kg</td>
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QUICK TIPS

- At atmospheric pressure, air cooling of the tube is strongly recommended to dissipate the heat
- Water cooling is strongly recommended particularly at high power and/or reduced pressure
- To reduce the level of external microwave leakage, a small Faraday cage can be attached to the S-Wave via the two M6 bolts located on the source body. The cage should be long enough to enclose not only the plasma column but also the dielectric tube in its full length.

RECOMMENDATIONS FOR IGNITION AT ATM PRESSURE

- Use pure Argon (at least 4.5 i.e. 99.995 vol. %)
- Recommended argon gas flow > 5 l/min (more power requested at lower gas flow)
- Use stainless steel gas feeding tube and max 2 m flexible tube (the shorter the better)
- To ignite at low power (25 W) the sliding short circuit should be positioned on the nozzle side
- To ignite at high power (> 100 W) the sliding short-circuit should be positioned on the rear side
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MAIN DIMENSIONS
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