Improving the stability of RF power systems for plasma processing

The efficiency and reliability of RF generators has dramatically improved over recent years. At the same time, new materials and improved processing demands ever greater stability from the RF system. easel technologies' VSWR Clamp© makes an important contribution in delivering stability in advanced processing systems...

Summary

The VSWR Clamp® is fitted adjacent to the generator and limits the impedance transient during plasma ignition aiding generator stability.

Processing equipment

In recent years advances in the speed and power capacity of MOSFETs has led to the development of highly efficient and cost effective switched mode power generators. They are now the first choice for the majority of plasma processing tools.

In common with all practical engineering problems, however, compromise was needed to improve efficiency. By changing the configuration of an amplifier to improve its efficiency its tolerance to a miss-matched load is reduced.

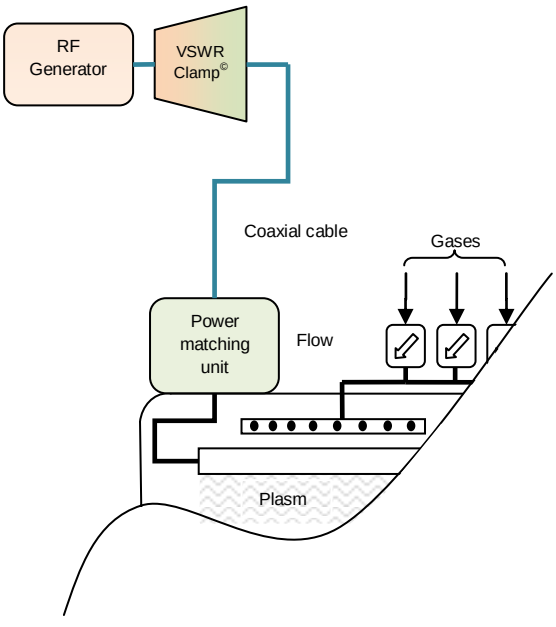
The load on a switched mode amplifier is integral to its correct operation and miss-matched conditions can result in unwanted and difficult to predict behaviour including oscillation and even latch-up.

In most applications, these shortcomings can be overcome by careful selection of the matching unit's pre-ignition setting and by selecting the length of the RF cable between generator and matching unit.

Improving stability

Adjusting individual tools can be a nuisance and introduces unwanted complexity into servicing. Stability is often dependent on subtle and ill defined parameters within the power amplifier and may vary from generator to generator.

easel technologies has studied the problem of RF system stability and developed a range of highly stable generators specifically for plasma processing. But many customers want to use existing equipment and so the VSWR Clamp® has been developed.



The solution recognises the impedance limitations of the generator and adjusts the load to ensure it is always maintained within prescribed limits.

The Clamp is fitted as close as practically possible to the generator. It monitors the Voltage Standing Wave Ratio (VSWR) at the output port and if this exceeds the set limit compensating impedances are added to the input port.

VSWR is a measure of mismatch and so the Clamp limits the impedance range seen by the generator thereby improving its stability. It is important to emphasize that its function is in restricting the range of impedance seen by the generator. The matching function, transforming the plasma impedance into 50Ω, is carried out by the automatic-matching-unit (AMU) in the normal way. During matching, when the VSWR falls below the set-level, the Clamp is deactivated and system operates as normal. No electromechanical tuning elements are used and so it operates very quickly.

Prior to ignition the impedance of a plasma tool is usually highly reactive, e.g. in a parallel plate reactor a large capacitance. The clamp is activated to ensure the generator remains stable when power is applied. Very quickly the plasma ignites and energy is absorbed so the load becomes resistive in addition to reactive. The AMU responds and transforms the impedance to 50Ω within a few seconds. As the VSWR falls below the set level the Clamp is deactivated. The generator has been protected from the ignition impedance transient.

A unique feature of the VSWR Clamp© is that it protects against both high and low impedance excursions. Put simply, the generator is protected against short and open circuit conditions.

The VSWR switching point is factory set but can be adjusted to suit particular installations if required.

If you are involved in plasma processing and would like more details on the VSWR Clamp© or on how *easel technologies'* other products and expertise can help you to deliver improved performance please contact us via our website, www.easeltechnologies.co.uk