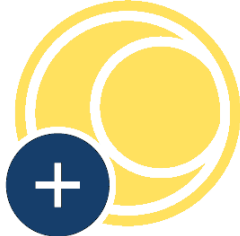


# Fast Impedance Matching using Semiconductor Switches



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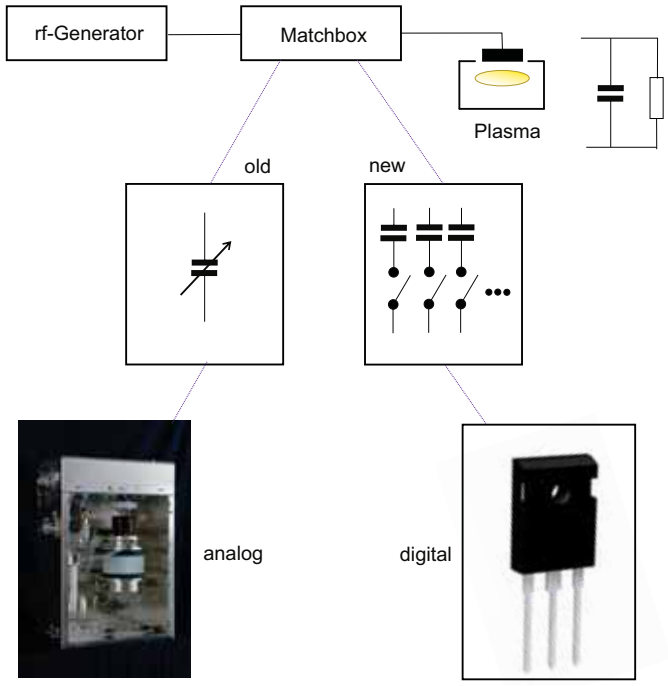
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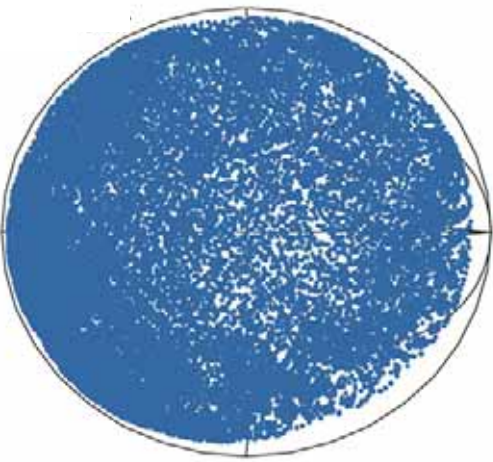
## Introduction

Impedance matching is a crucial problem in rf plasma process control. Today's matchboxes are using adjustable capacitors. They have low losses and allow fine adjustments. Drawbacks are moving parts with limited lifetime as well as slow operation, limited process options, particularly for fast and pulsed processes. Increasing demands on tuning speed, stability and reproducibility can barely be fulfilled by the existing concepts.

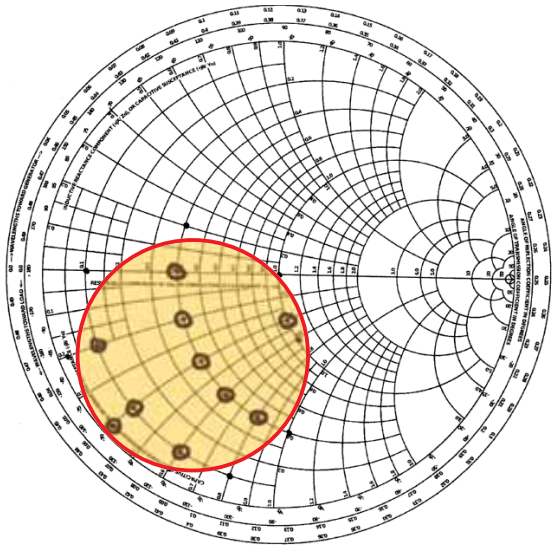
High power semiconductor switches, which became available just recently, allow to design an electronically switched digital impedance tuning where mechanically adjustable capacitors are replaced by semiconductor switched reactances. This leads to new tuning circuit topologies and new autotuning strategies.



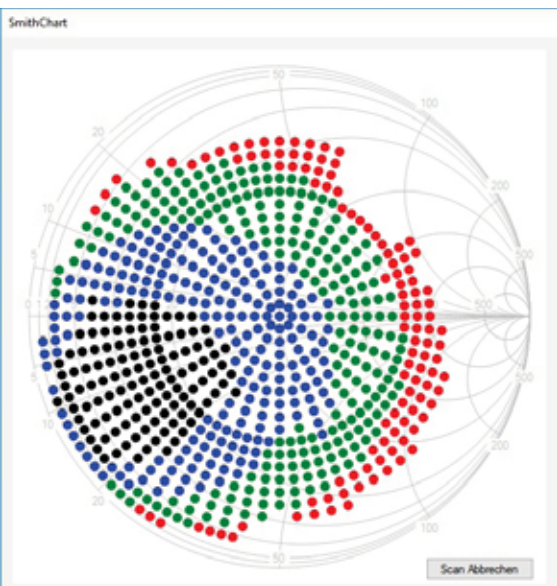
Old and new RF-matching systems



Calculated matchable load impedances of a 16 bit digital tuner



Measured tunable impedance region of a 12 bit prototype



Calculated power limits depending on load impedance

## Process evaluation

- Several sputtering tests with several materials have been done using a 125 mm circular magnetron source (PK 125).
- A suitable matching could be achieved with reflections of a few percent.
- Power efficiency is slightly lower compared to adjustable vacuum capacitors (70 % - 90 %, depending on load impedance)
- DC bias and sputter rates are ok, as expected by results of rf measurements.