REINHOLD ENVIRONMENTAL Ltd.

2011 APC Round Table
& Expo Presentation

July 11-12, 2011, in Cleveland, OH / Hosted by FirstEnergy

Pulse-mode operation of high-frequency power supplies for ESPs

PCUG/Round Table
Reinhold Environmental

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Anders Karlsson

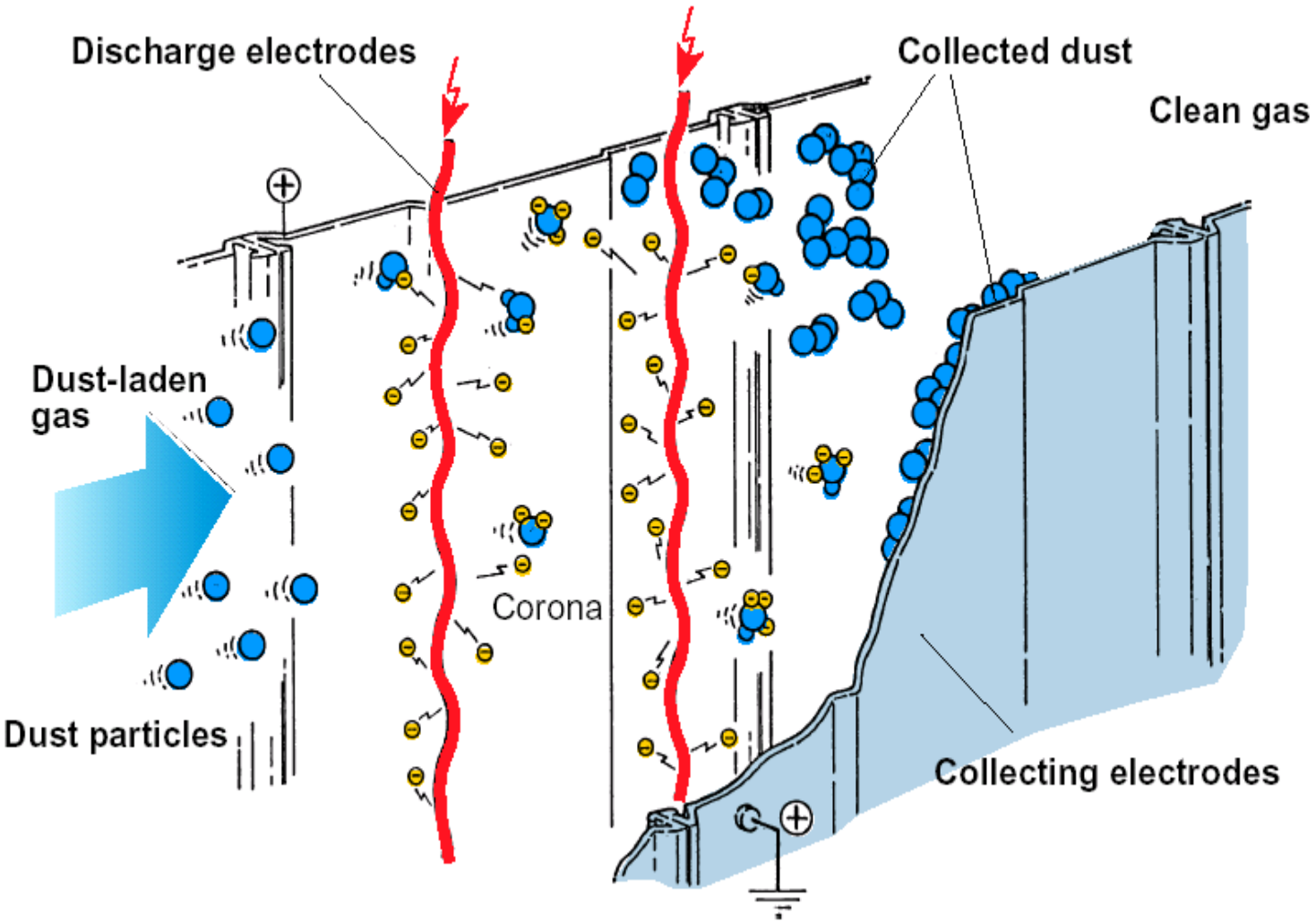
Cleveland, July 12th, 2011

POWER | ALSTOM

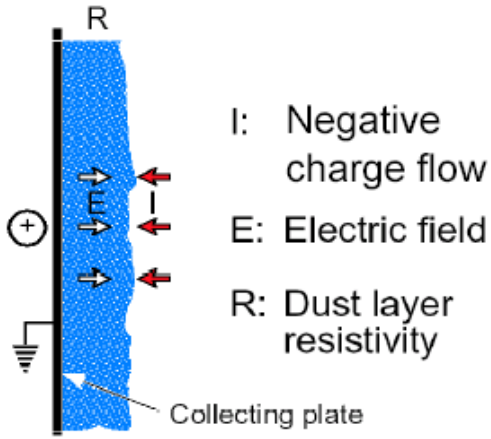
Outline of the presentation

- Introduction
- Measured waveforms
- Circuit analysis
- Summary

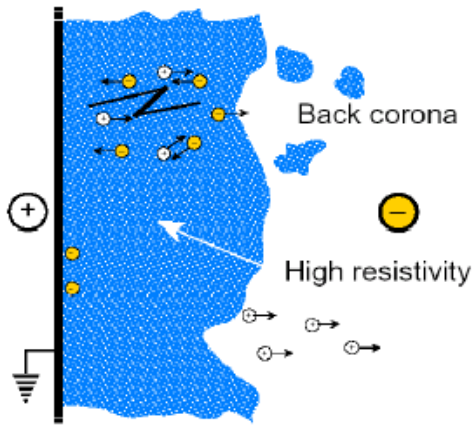
ESP dust collection



Back corona

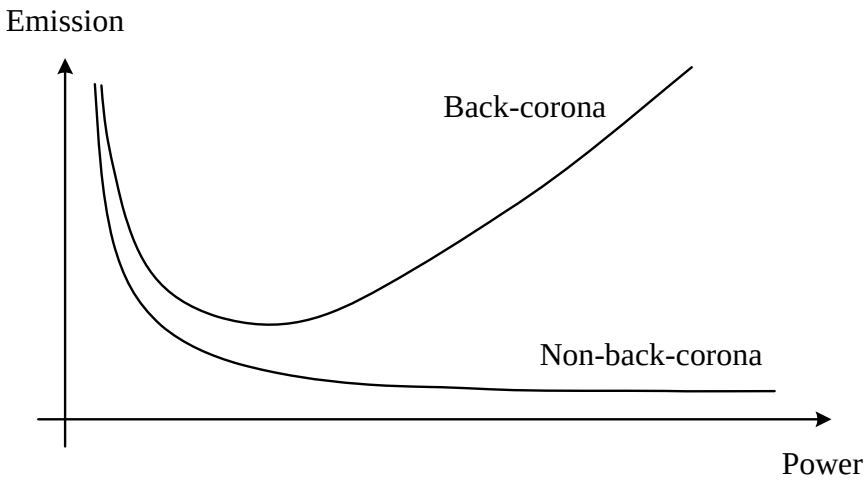


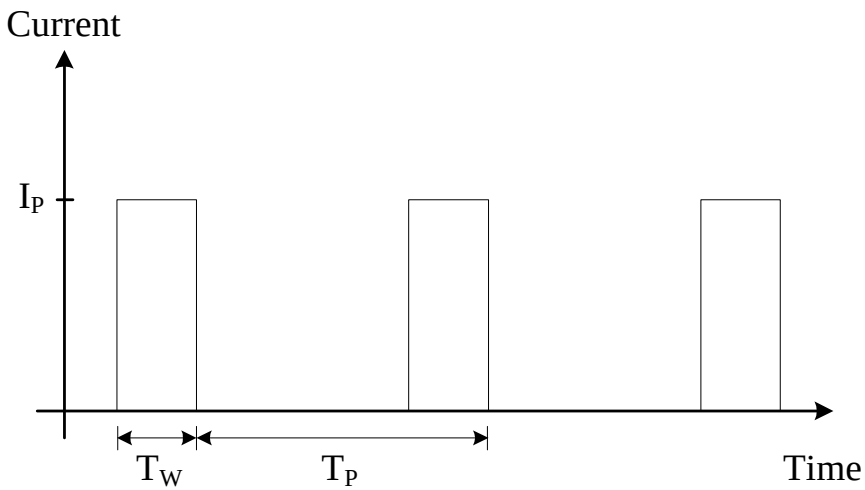
$$E = I\,R$$



- *Flue gas conditioning*
- *Pulsing, intermittent energization*

Pulse mode

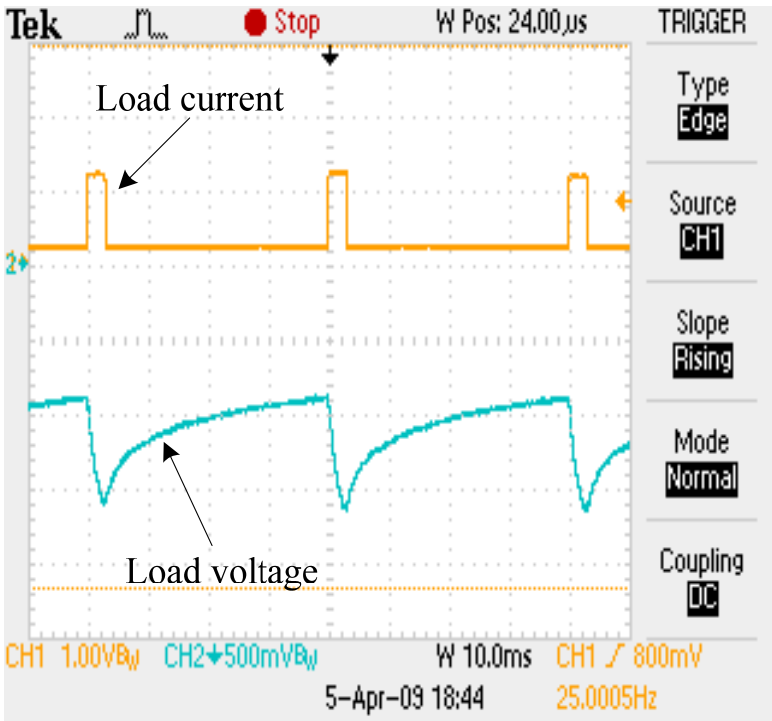


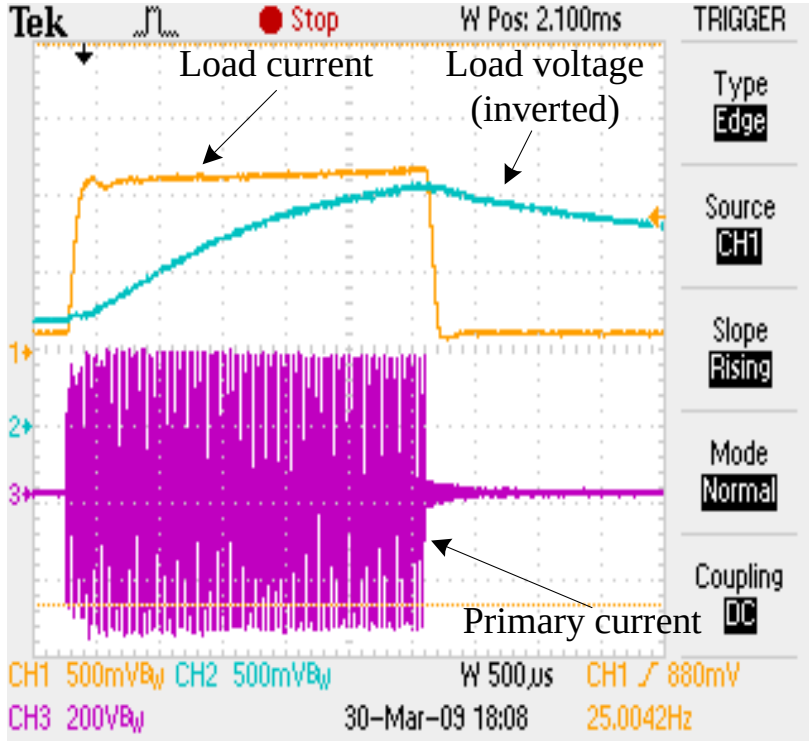


- Low average current
- High peak voltage

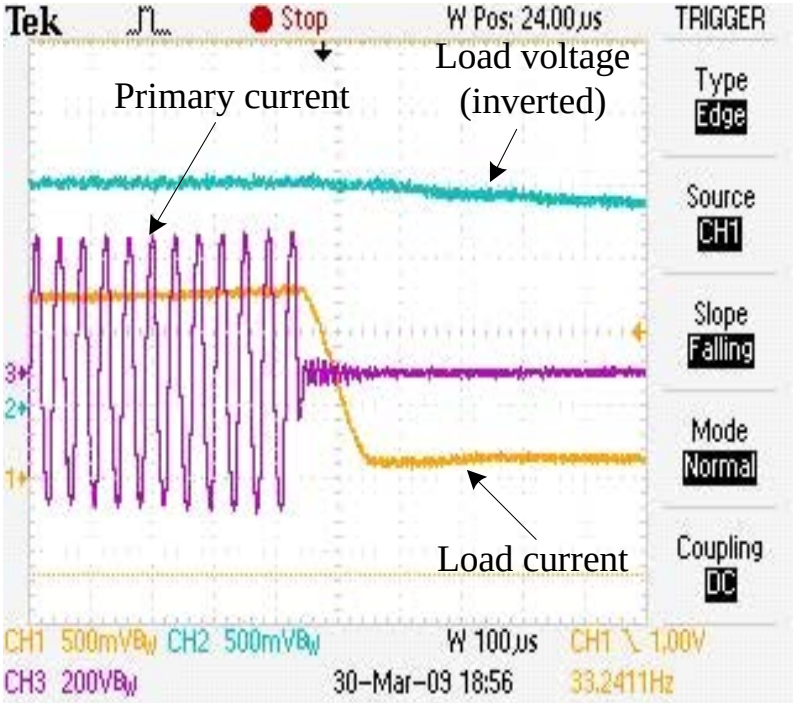
=> Current pulsing

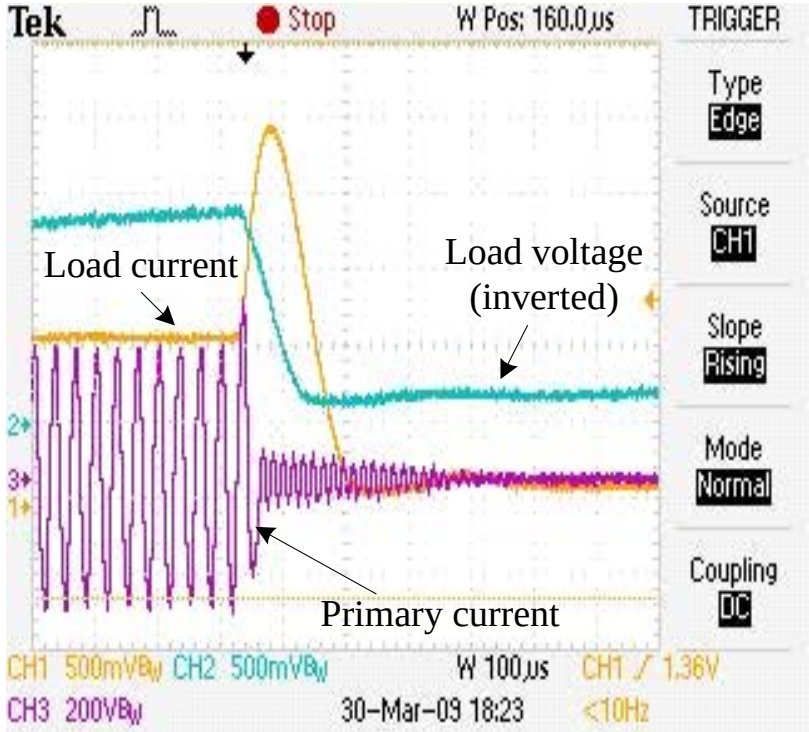
Pulse mode, measured waveforms



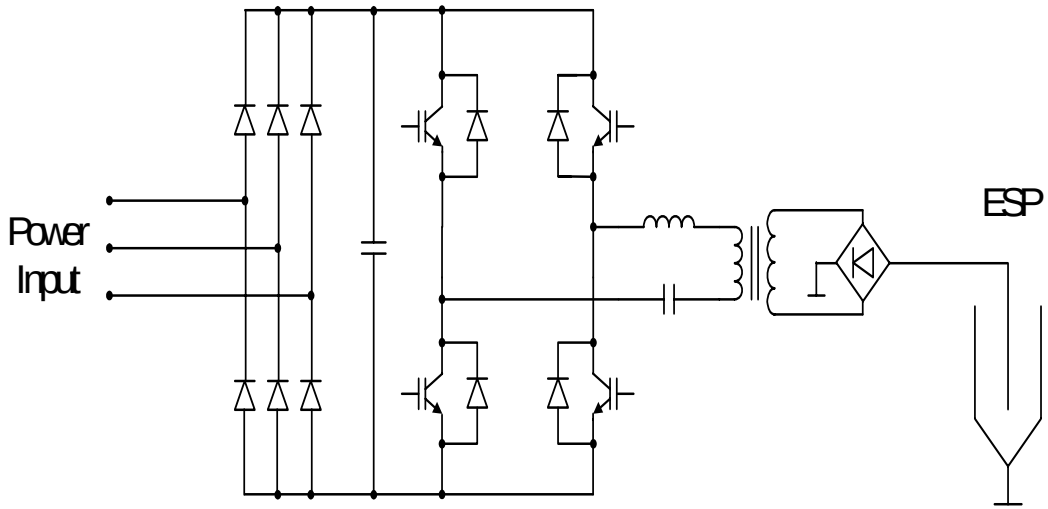


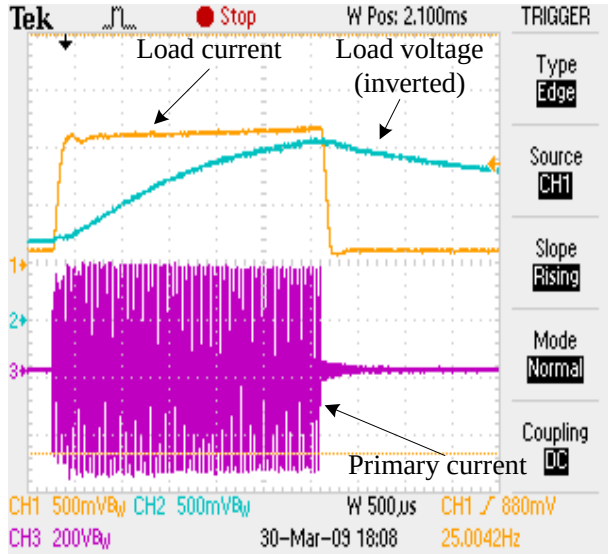
Pulse mode, measured waveforms

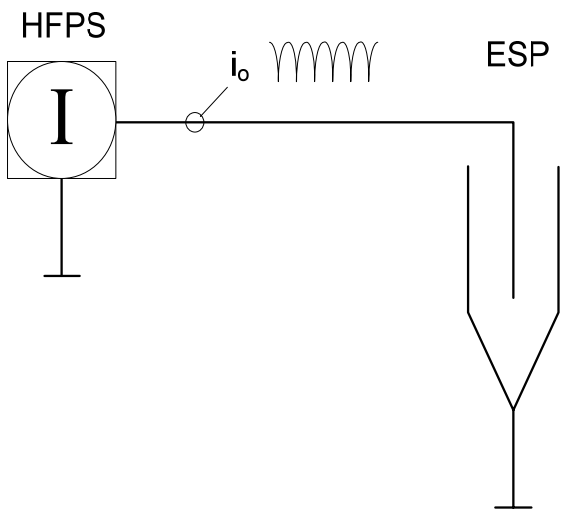




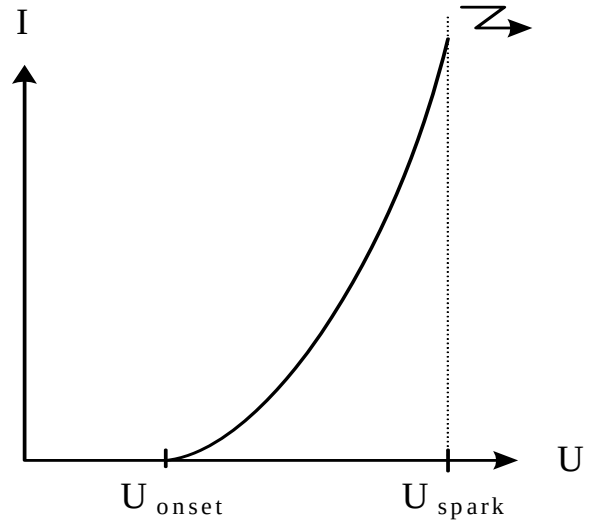
Electrical system

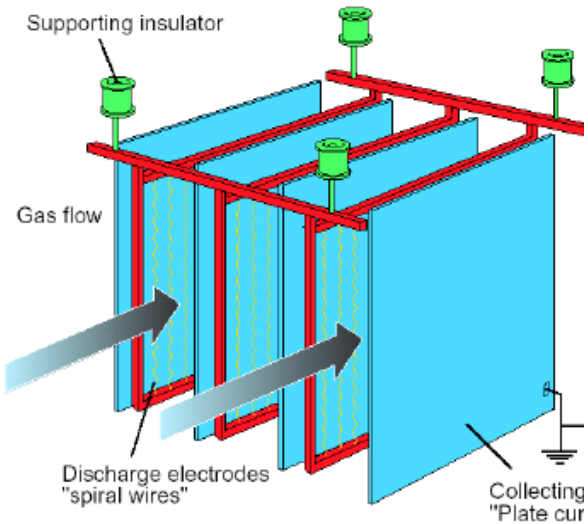


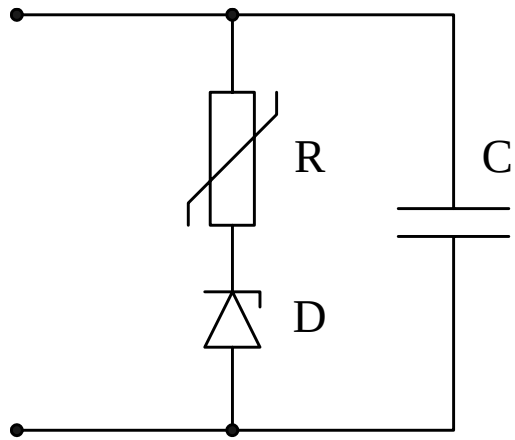




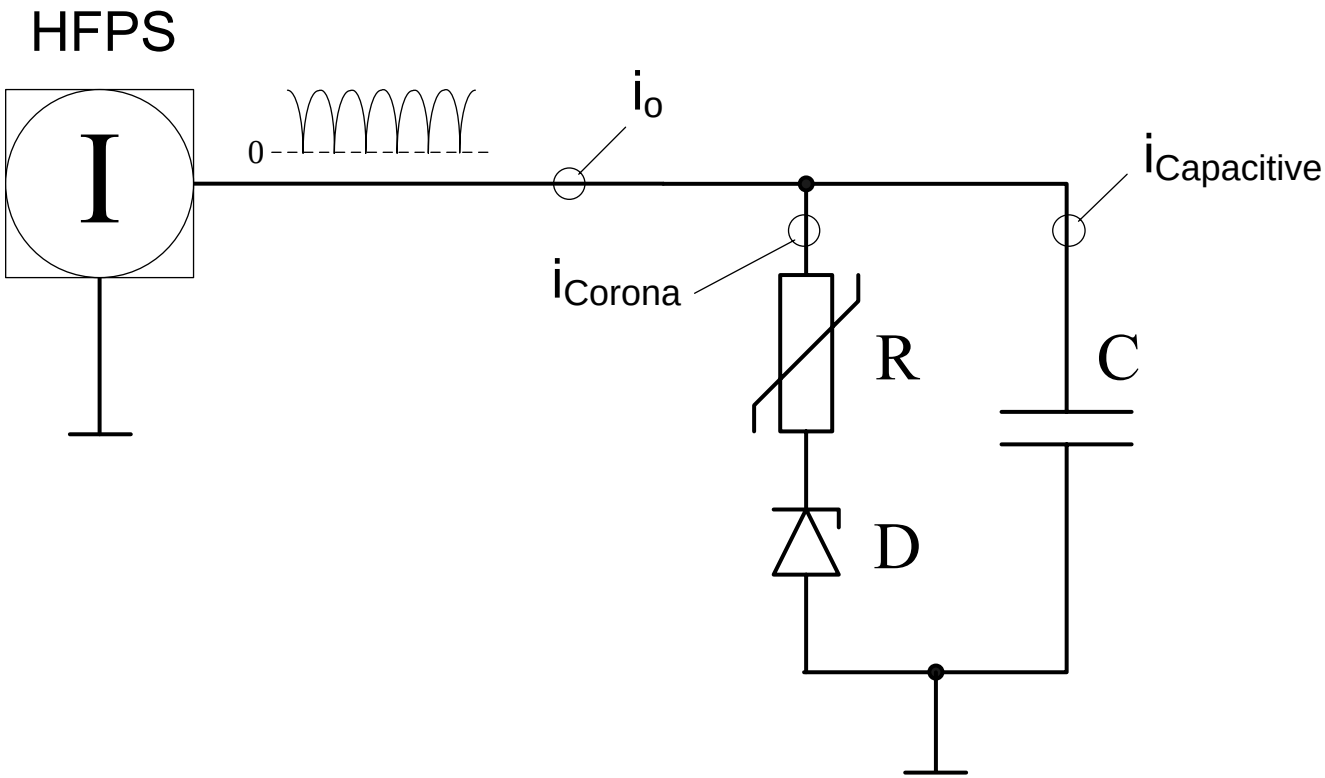
Equivalent load circuit







Equivalent circuit

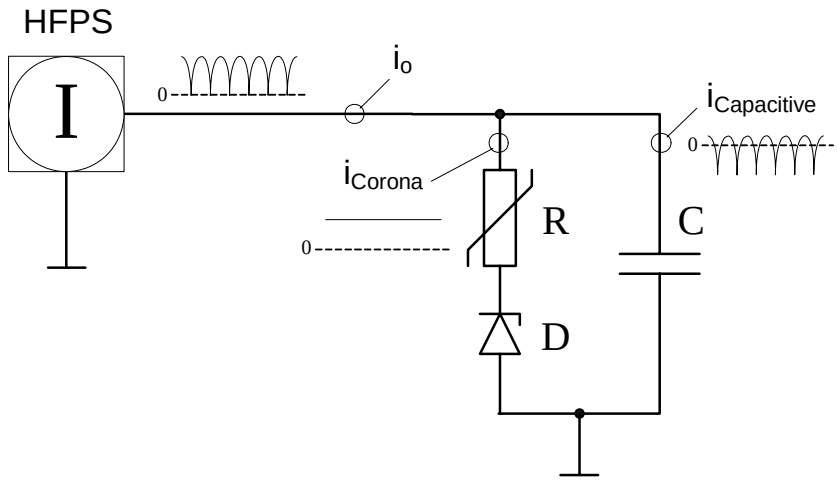


$$i_{Corona} = k \cdot (u - U_{Onset})^2$$

$$i_{Capacitive} = C \cdot \frac{du}{dt}$$

Influence from AC-current

$$Z_C = \frac{1}{2\pi \cdot f \cdot C}$$



$$U = 50kV$$
$$I = 1A$$
$$C = 100nF$$
$$f = 60kHz$$

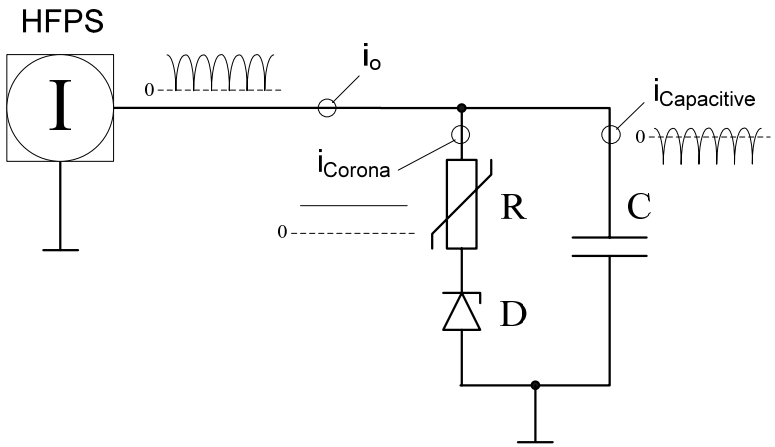
=>

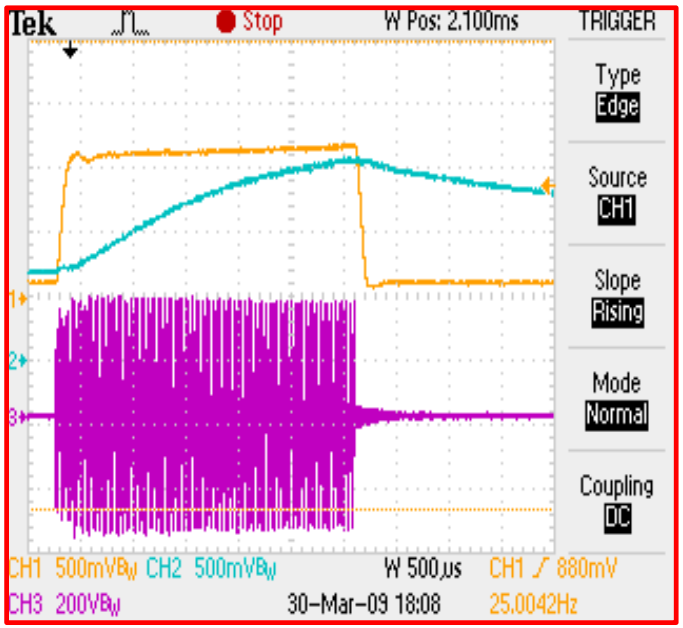
$$\Delta U' < 0{,}2\ \%$$

$$i_{Corona} = k \cdot (u - U_{Onset})^2$$

The corona current is the DC-component of the supplied current

Pulse mode





$$i_{Corona} = k \cdot (u - U_{Onset})^2$$

$$i_{Capacitive} = C \cdot \frac{du}{dt}$$

- The charging of the ESP capacitance has a significant influence on the corona-current pulse
- The charge of pulse is conserved

Summary

- Current and voltage waveforms from pulse mode operation were shown
- The influence of the ESP capacitance has been discussed
  - High frequency component
  - Pulse current
- The corona current in pulse mode has been analysed

Thanks for your attention !

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