

REINHOLD ENVIRONMENTAL Ltd.



2011 APC Round Table & Expo Presentation

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

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

PCUG/Round Table
Reinhold Environmental

Per Ranstad
Anders Karlsson

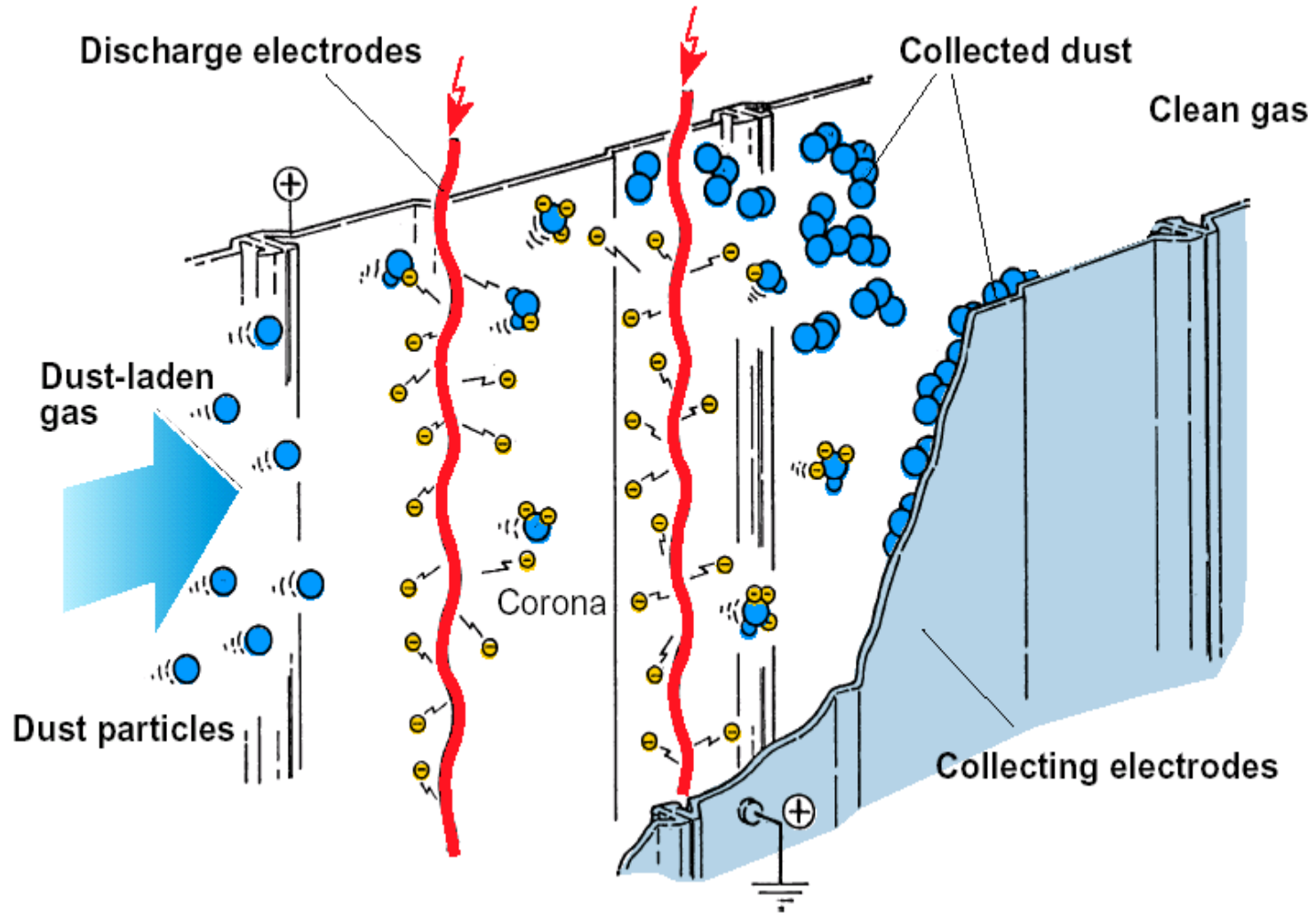
Cleveland, July 12th, 2011

POWER

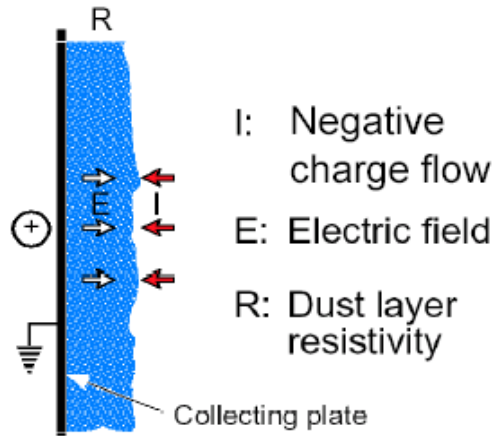
ALSTOM

- Introduction
- Measured waveforms
- Circuit analysis
- Summary

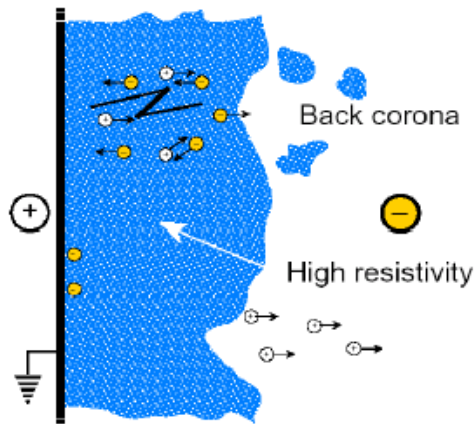
ESP dust collection



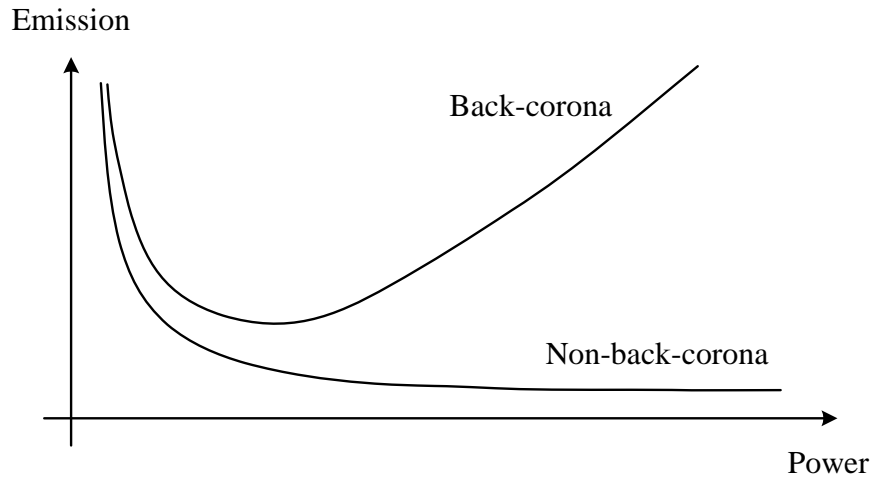
2.2



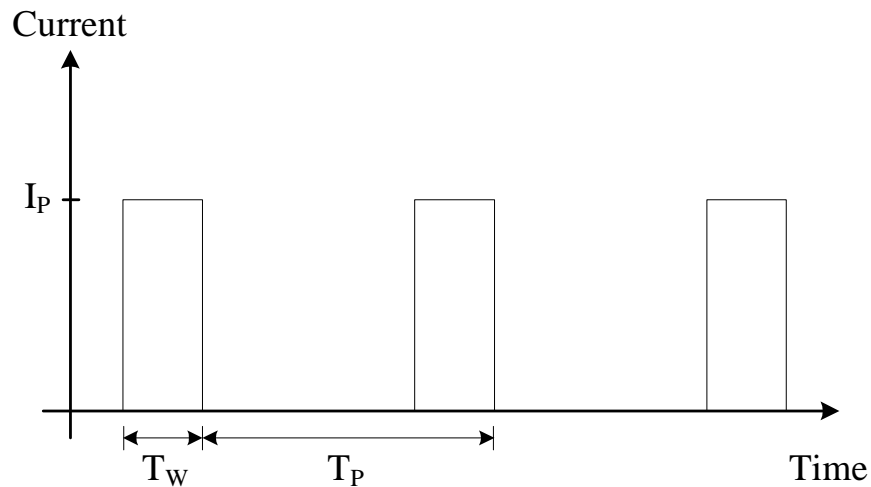
$$E=I R$$



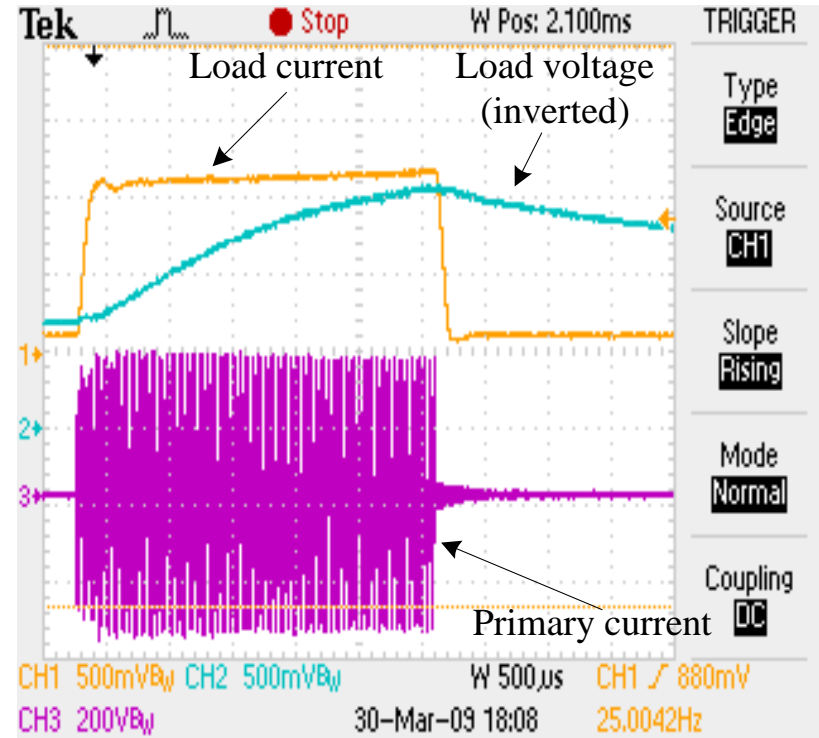
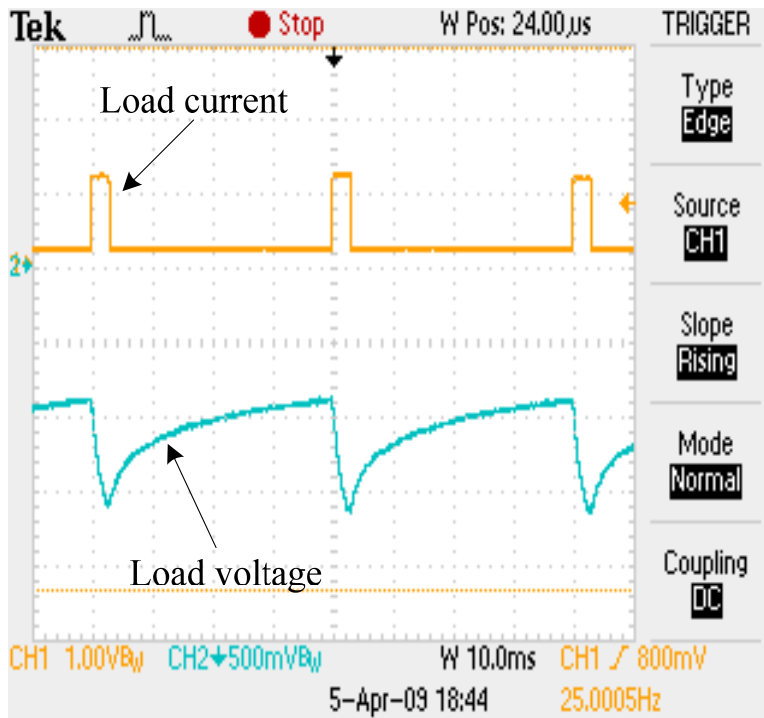
- *Flue gas conditioning*
- *Pulsing, intermittent energization*



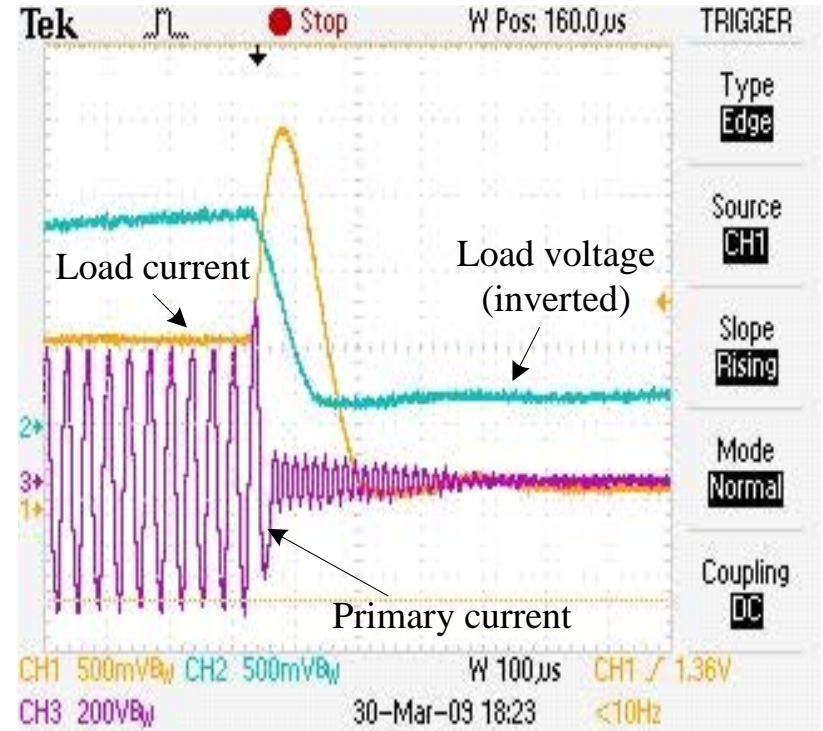
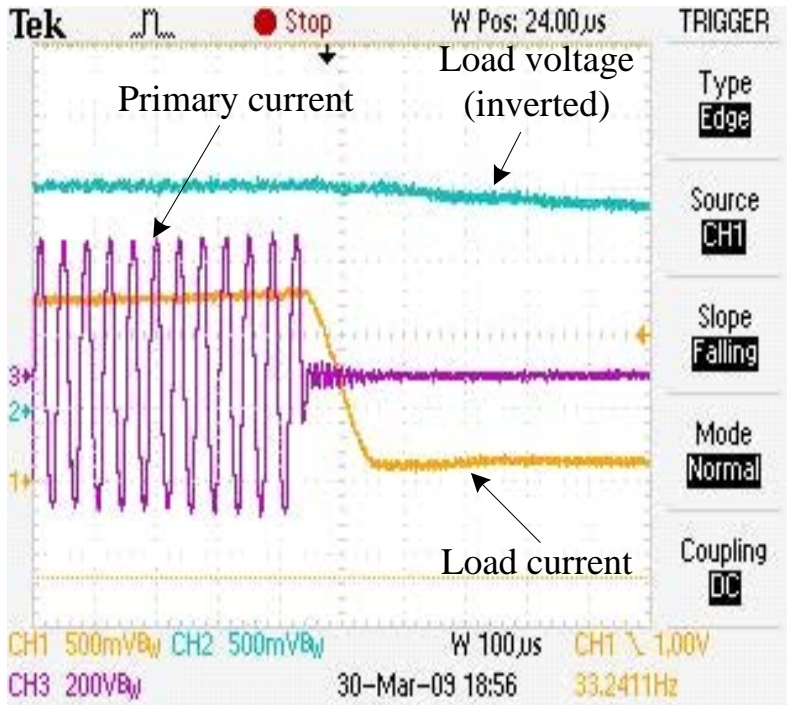
- Low average current
 - High peak voltage
- => Current pulsing



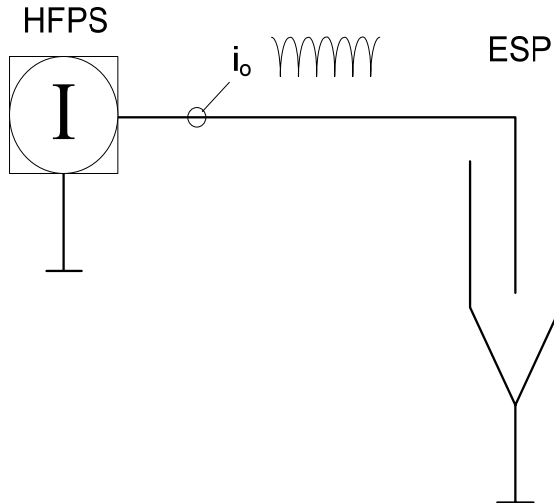
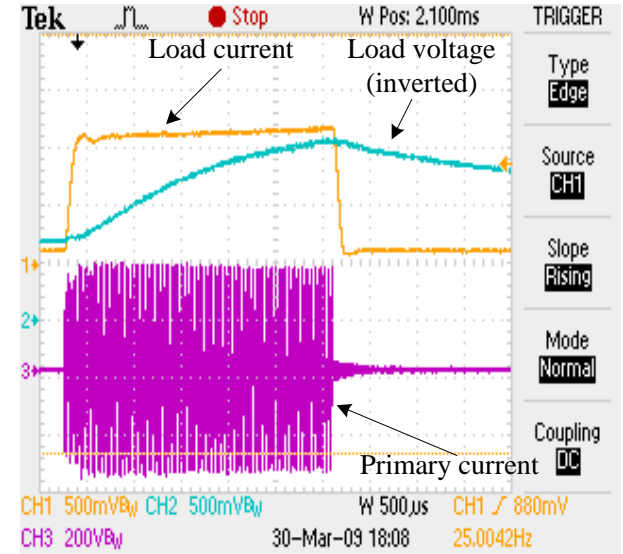
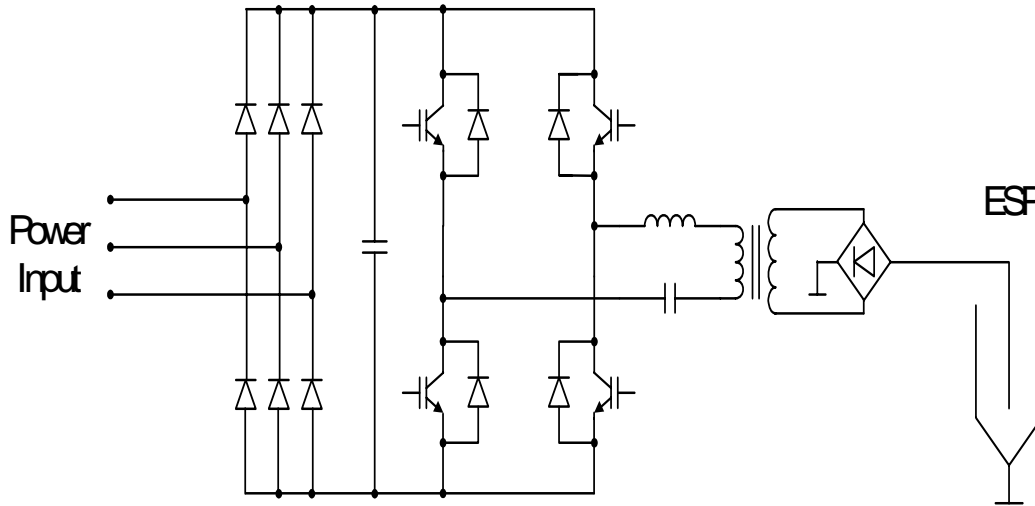
Pulse mode, measured waveforms



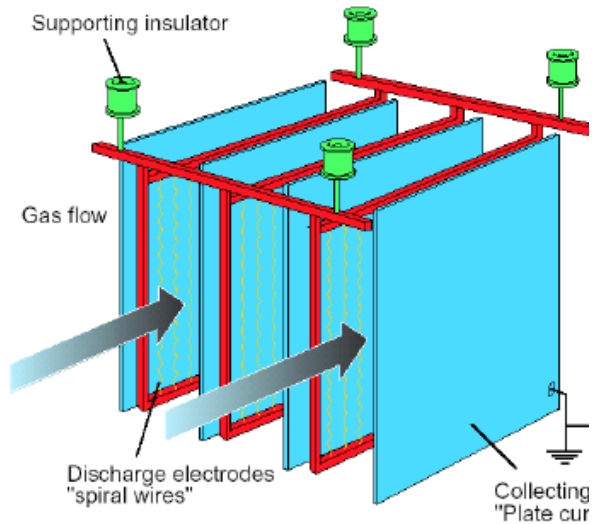
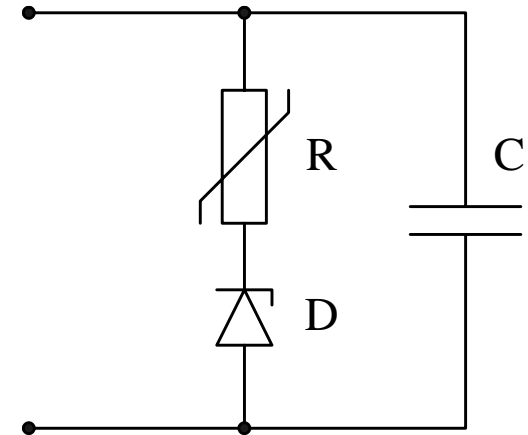
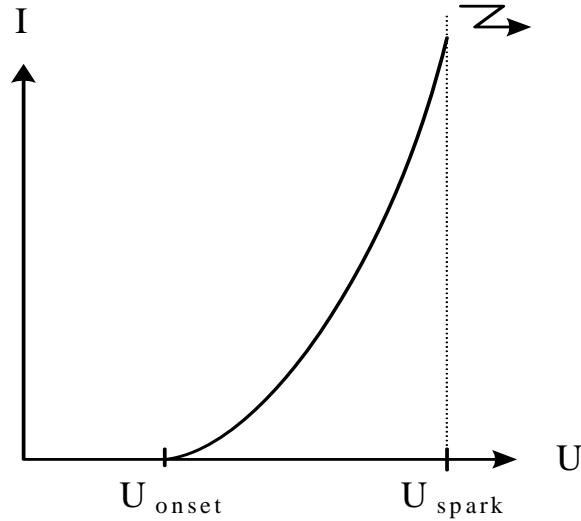
Pulse mode, measured waveforms



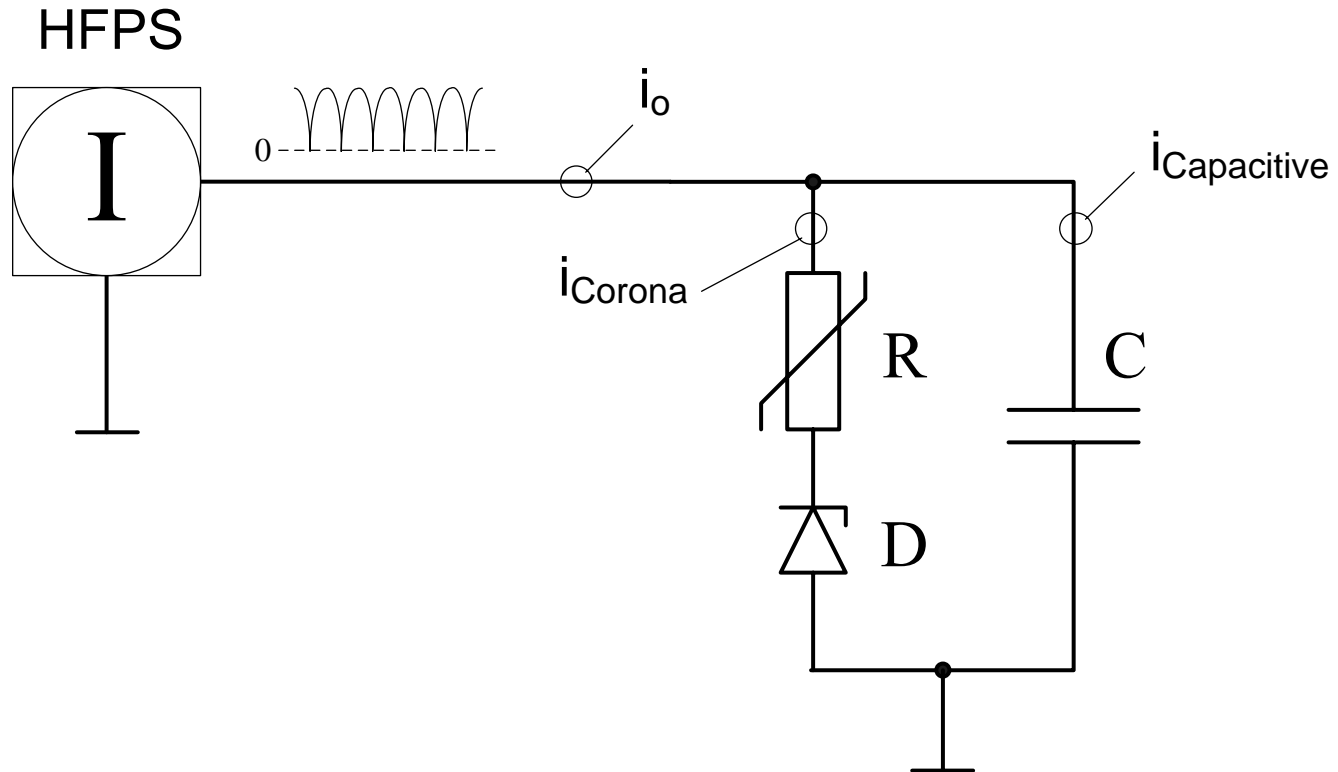
Electrical system



Equivalent load circuit



Equivalent circuit



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

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

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

$$U = 50kV$$

$$I = 1A$$

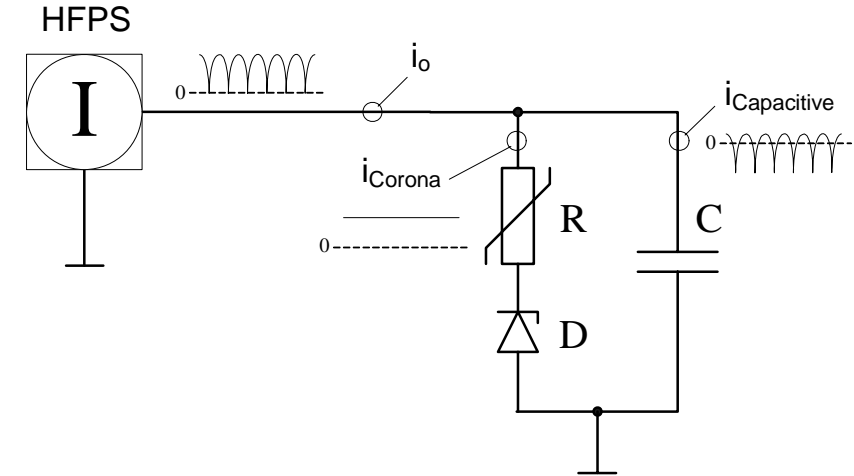
$$C = 100nF$$

$$f = 60kHz$$

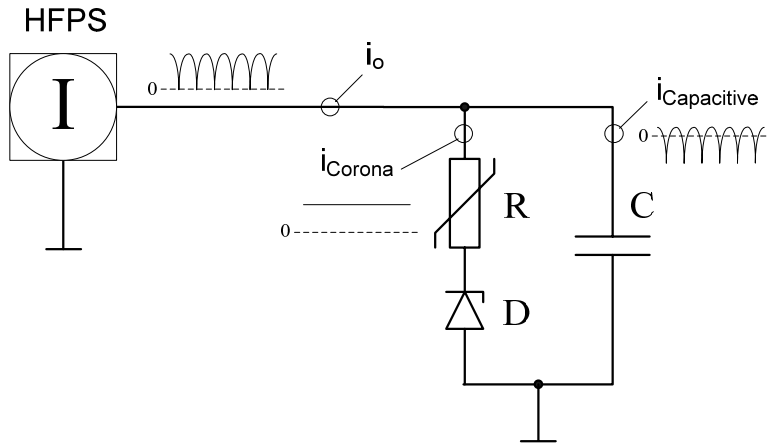
\Rightarrow

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

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



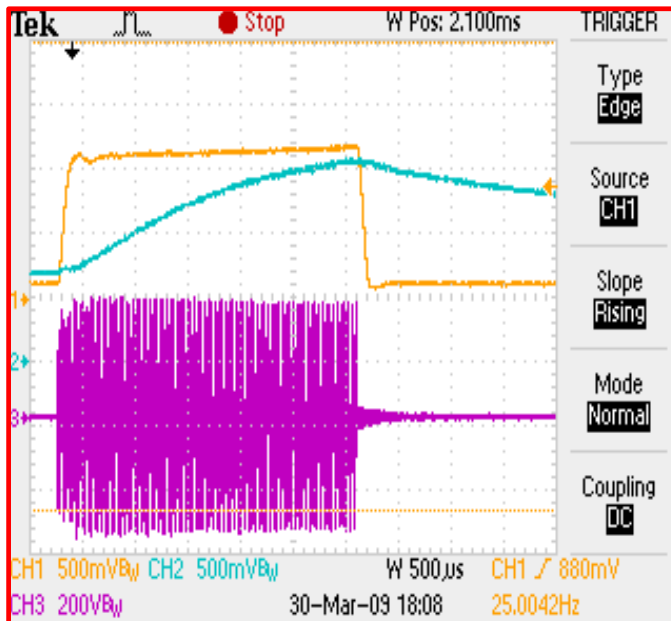
The corona current is the DC-component of the supplied current



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

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

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



- 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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