

New Markers Based on HF Signals For Series DC Arc Detection



Series DC Arc Detection



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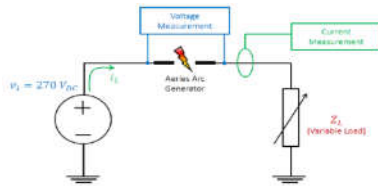
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Introduction

- The current approach in aeronautic industry towards the More-Electrical and All-Electrical Aircraft (MEA and AEA, respectively) is pulling the new designs of electric power systems to higher rated voltages.
- For these low-pressure and high-voltages environments, DC series arcs is a clear hazard in the operation.
- The detection of this phenomenon requires further research in terms of instrumentation and signal processing.

Experimental setup

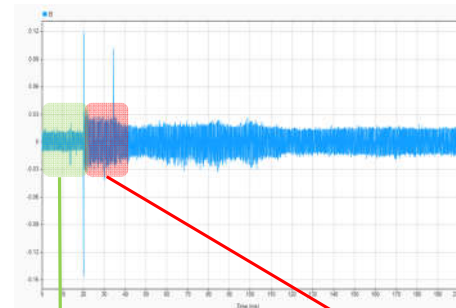
- Arcs are created interrupting a DC current flowing from a source to a load by reducing the opening speed of a switch.
- DC Power system: 270V and 5 A.
- Acquisition: inductive sensor 6V/A, lower cut-off frequency 100kHz. 25MS/s, 14 bits oscilloscope.
- Two electrode combinations: steel-steel, copper-steel.



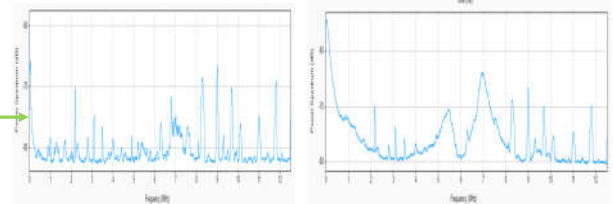
Experimental setup sketch

Arc phenomenon

- Opening event.
- Initial transient followed by big sustained increase of signals magnitude.



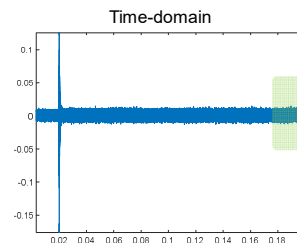
Time-domain



Average spectral powers (dB) vs frequency

Conventional commutation

- Closing event.
- Initial transient followed by small sustained increase of signals magnitude.



Quantification for arc detection

- The root mean square value of the acquired signal $v(t)$ is calculated for $T=20ms$ before and after initial transient.
- V_{RMS}^2 values before and after initial transient are averaged for 5 events.
- Signal to noise ratio (SNR) is calculated with the ratio of V_{RMS}^2 values after and before initial transient.

Electrodes	Phenomenon	SNR
Steel-Steel	Arc	5.4
	Commutation	1.5
Steel-copper	Arc	5.7
	Commutation	1.3

SNR for arc detection

Conclusions

- The arc event shows HF conducted emissions different from those from conventional switching.
- The sustained increase of the RMS value is a successful marker for the appropriate detection of the arc phenomenon.
- Short transient events could lead to false positives.
- There are no differences in the spectral response in HF from the arc for a change in one electrode from steel to copper