Switched mode Current Limiter

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July 26th 2021

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What is a current limiter

How to limit current in a DC grid?

- Inrush limiting resistor
- Inrush limiting active linear circuit
- Inrush limiting active SMPS circuit

Inrush current 400Volt, 100uF

Caspoc

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Inrush current

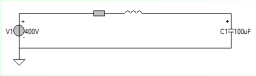
Nominal voltage	V	400	[V]
Cable inductance	L	1	[µH]
Cable resistance	R	0.1	[Ω]
Device input capacitance	C	100	[µF]

Calculate

Numerical Waveform Documentation

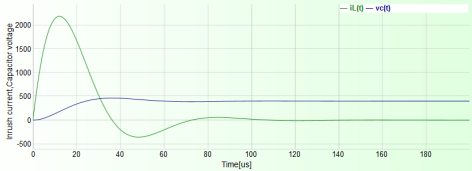
Inrush current

Critical resistance	R_c	0.2 [Ω]
Damping	α	50000 [1/s]
Damping ratio	ζ	0.5 [1/s]
Resonant frequency	wr	100000 [Rad/s]
Natural frequency	β	86602.54 [Rad/s]
Q-factor	Q	1 [ ]
pole s1	s1	0 [ ]
pole s2	s2	0 [ ]



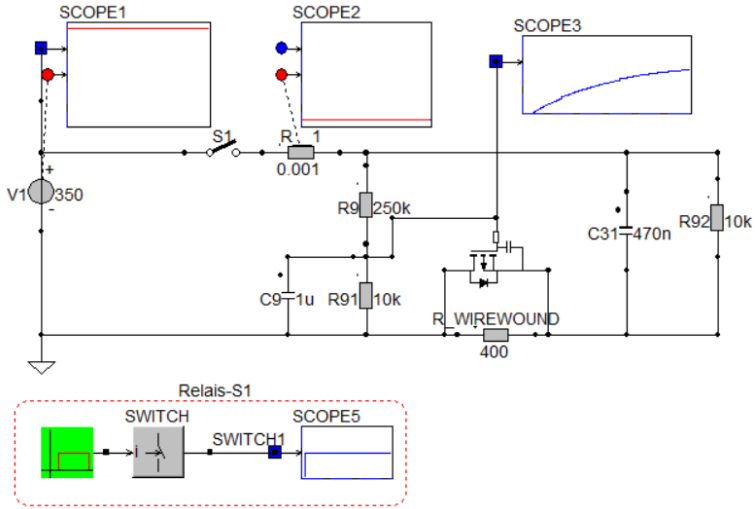
V0, R0

R_c=0.2[Ω] α=50000[1/s] ζ=0.5[1/s] wr=100000[Rad/s] β=86602.54[Rad/s] Q=1[ ]

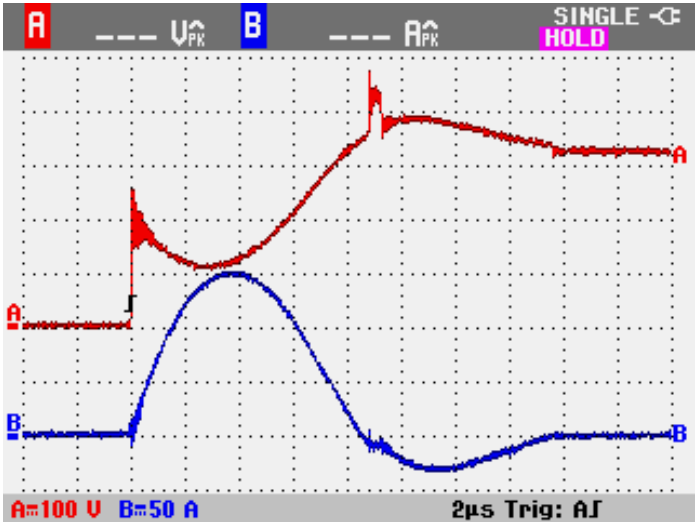


Passive inrush limiter

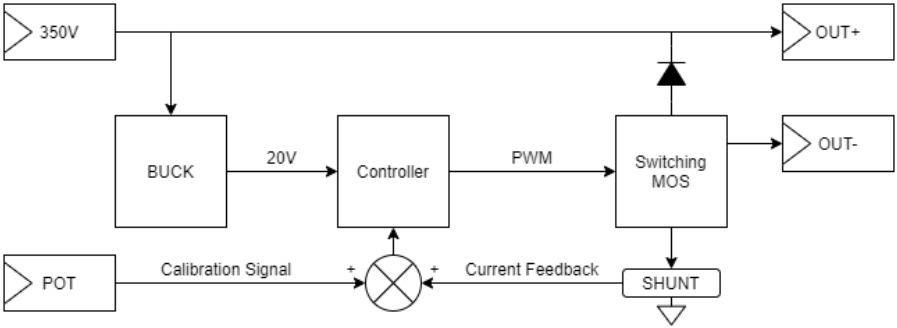
Simulation of inrush protection using Caspoc Simulation[8]



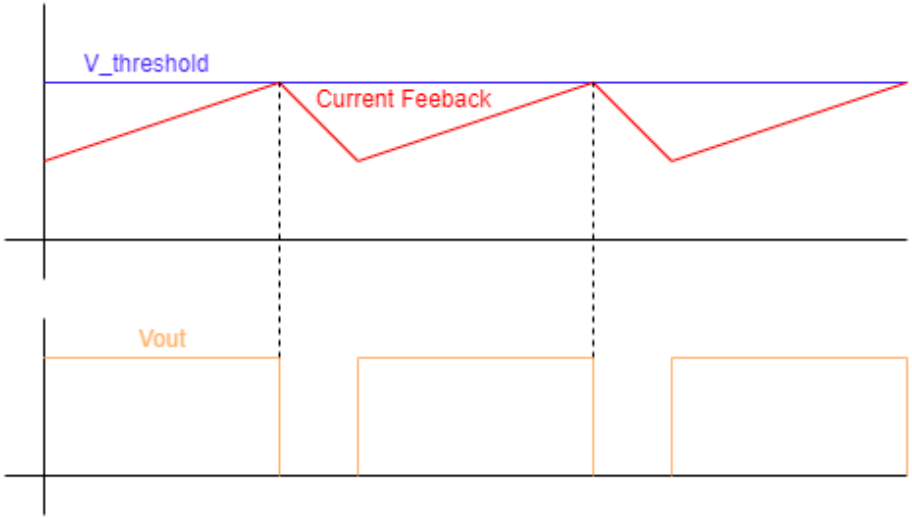
Inrush of the current limiter, where signal B is the inrush current and signal A, the voltage drop during inrush.



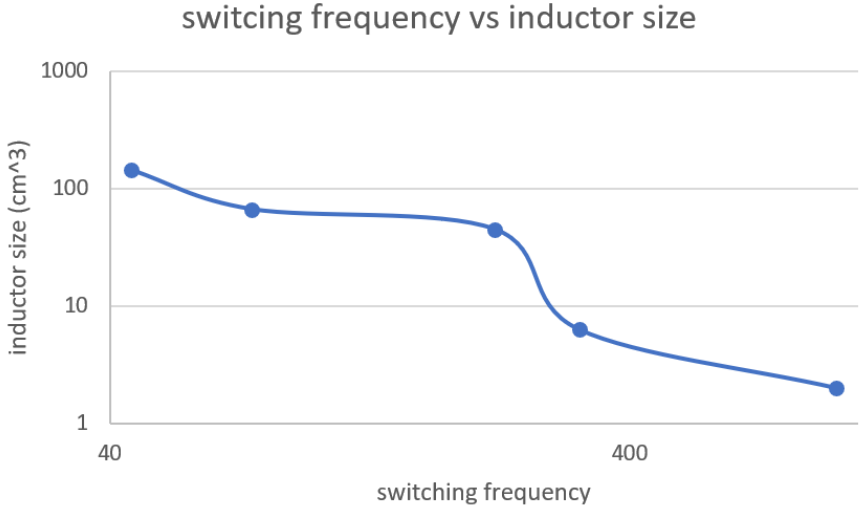
Switched Peak Current Mode Limiter



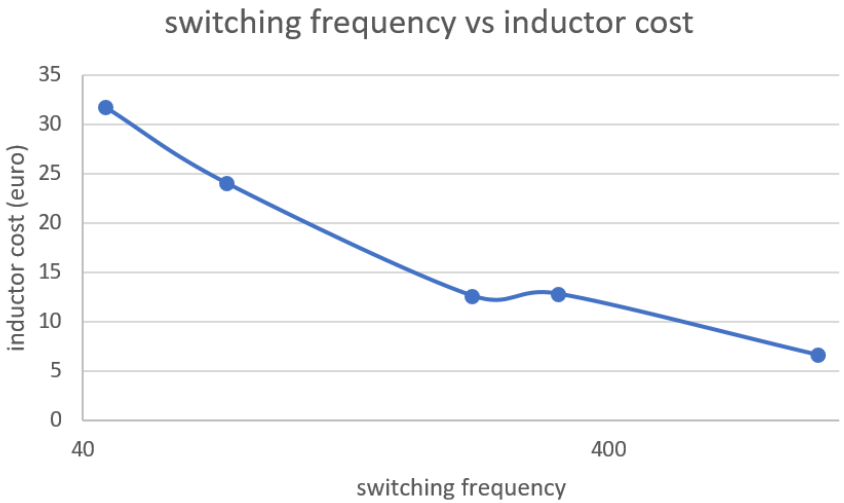
Maximum current, peak current control method



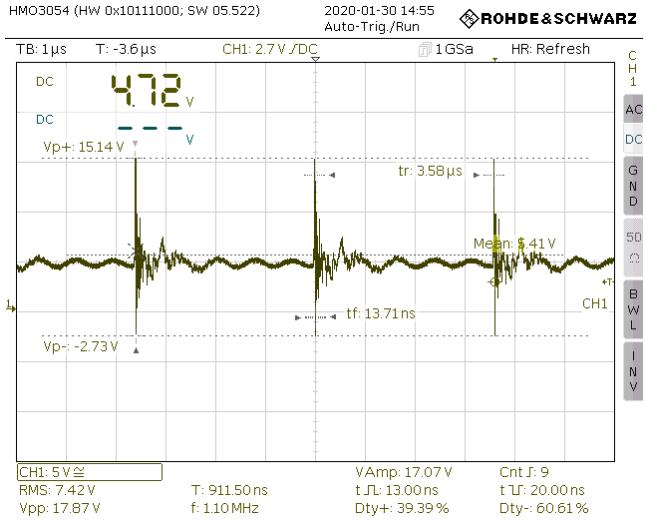
Inductor size in cm3 to the switching frequency of the current limiter.



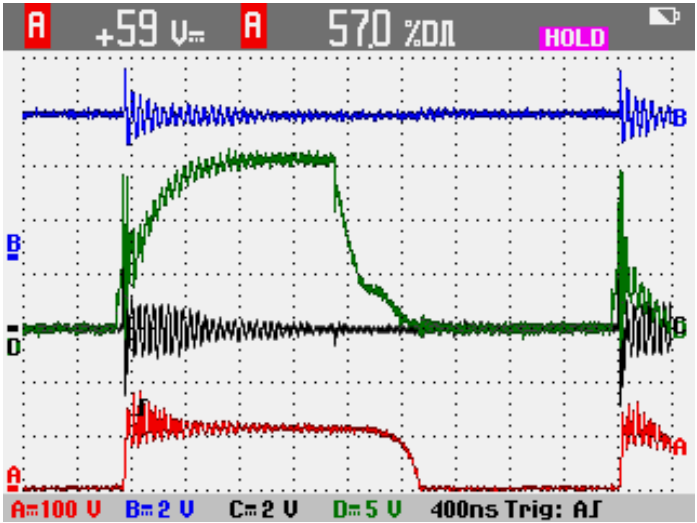
Inductor cost in Euro to the switching frequency of the current limiter.



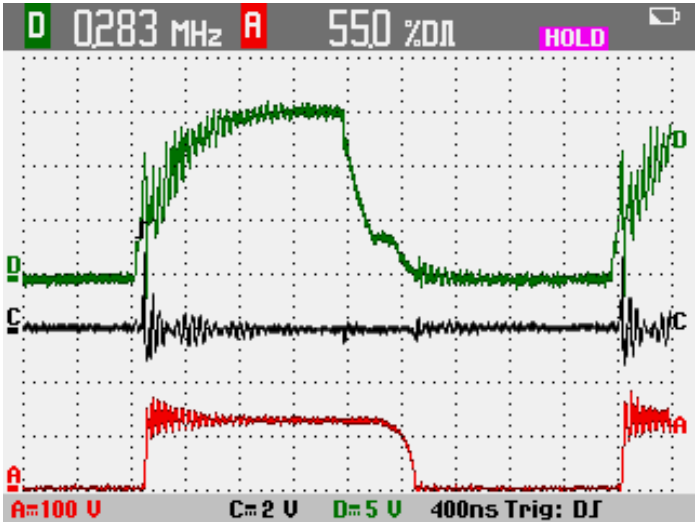
Internal comparison voltage of the current limiting IC



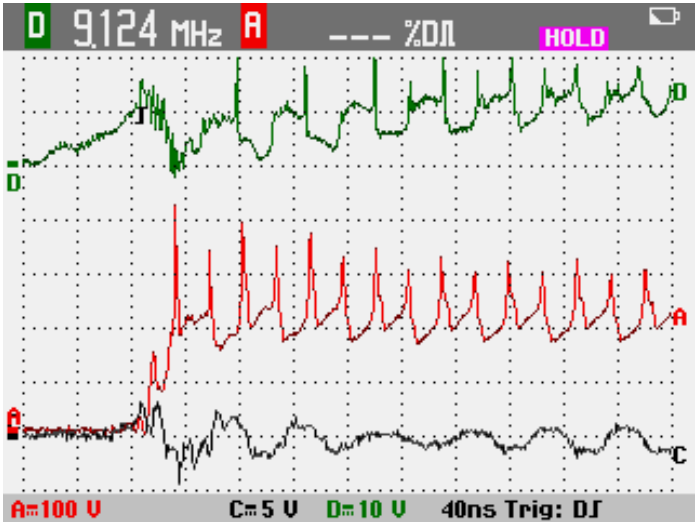
Large spike during turn-on, before adding an RC lowpass filter



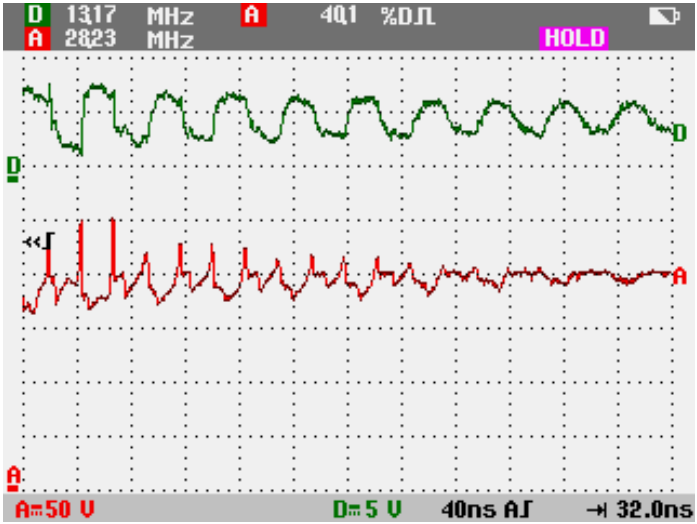
Filtered signal. Adding an RC lowpass filter, the peak is reduced



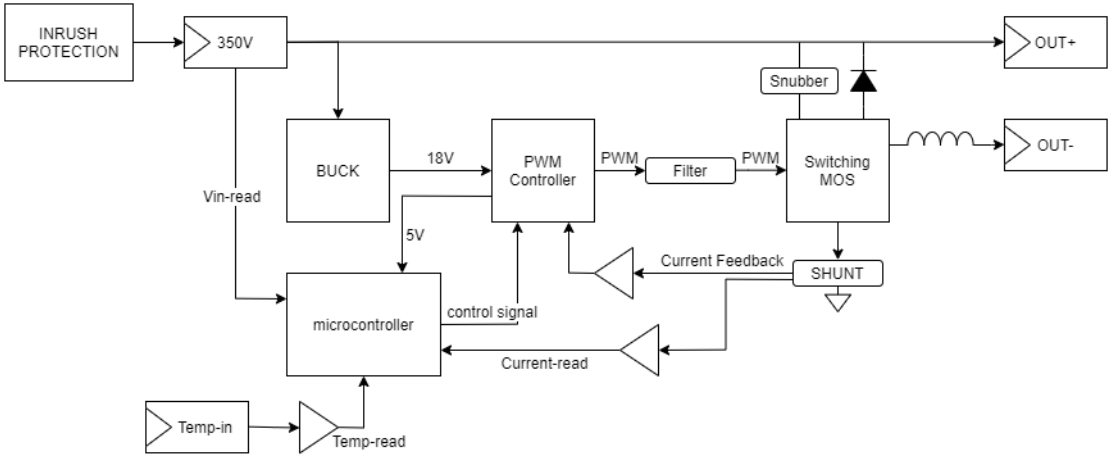
Ringing measured across the Mosfet to calculate the snubber circuit parameters from the ringing frequency.



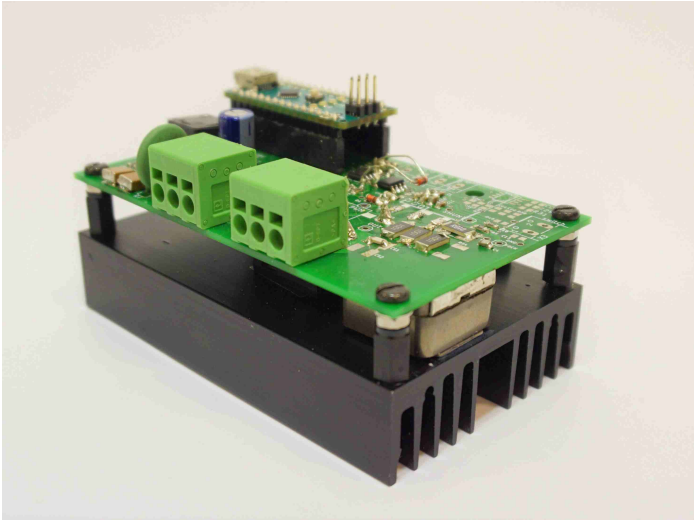
Ringing measured across the Mosfet after adding the snubber.



Block diagram of the smart current limiter



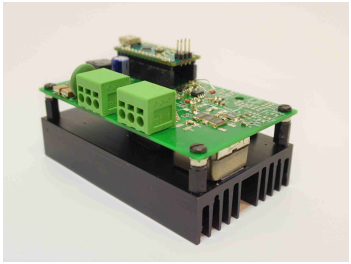
Realization of the smart current limiter



Conclusion

- Passive inrush limiting is expensive and limited in DC grids
- Active linear inrush limiting burns energy
- Switched mode inrush limiting is controllable and efficient

Thank you!



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