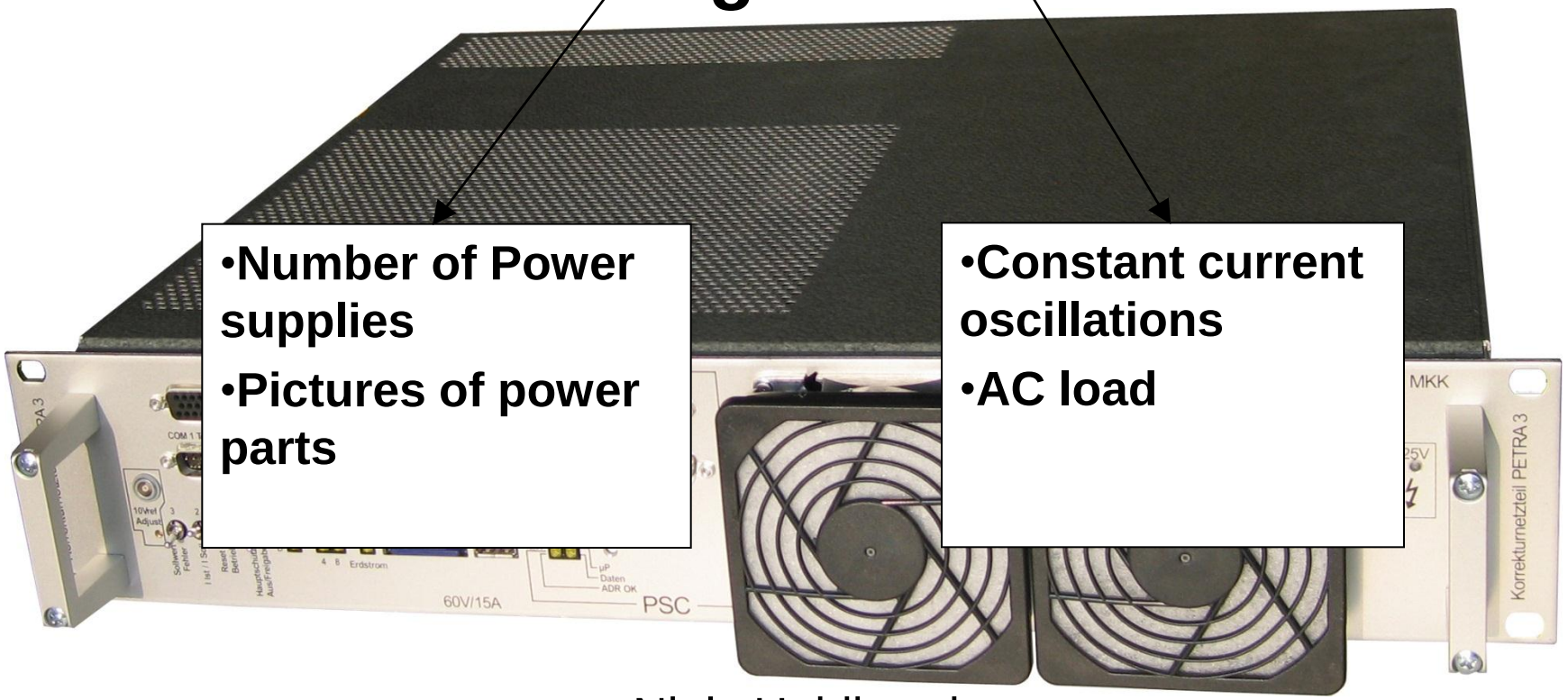
3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

PETRAIII Extension digital regulation

- Number of Power supplies
- Pictures of power parts

- Constant current oscillations
- AC load



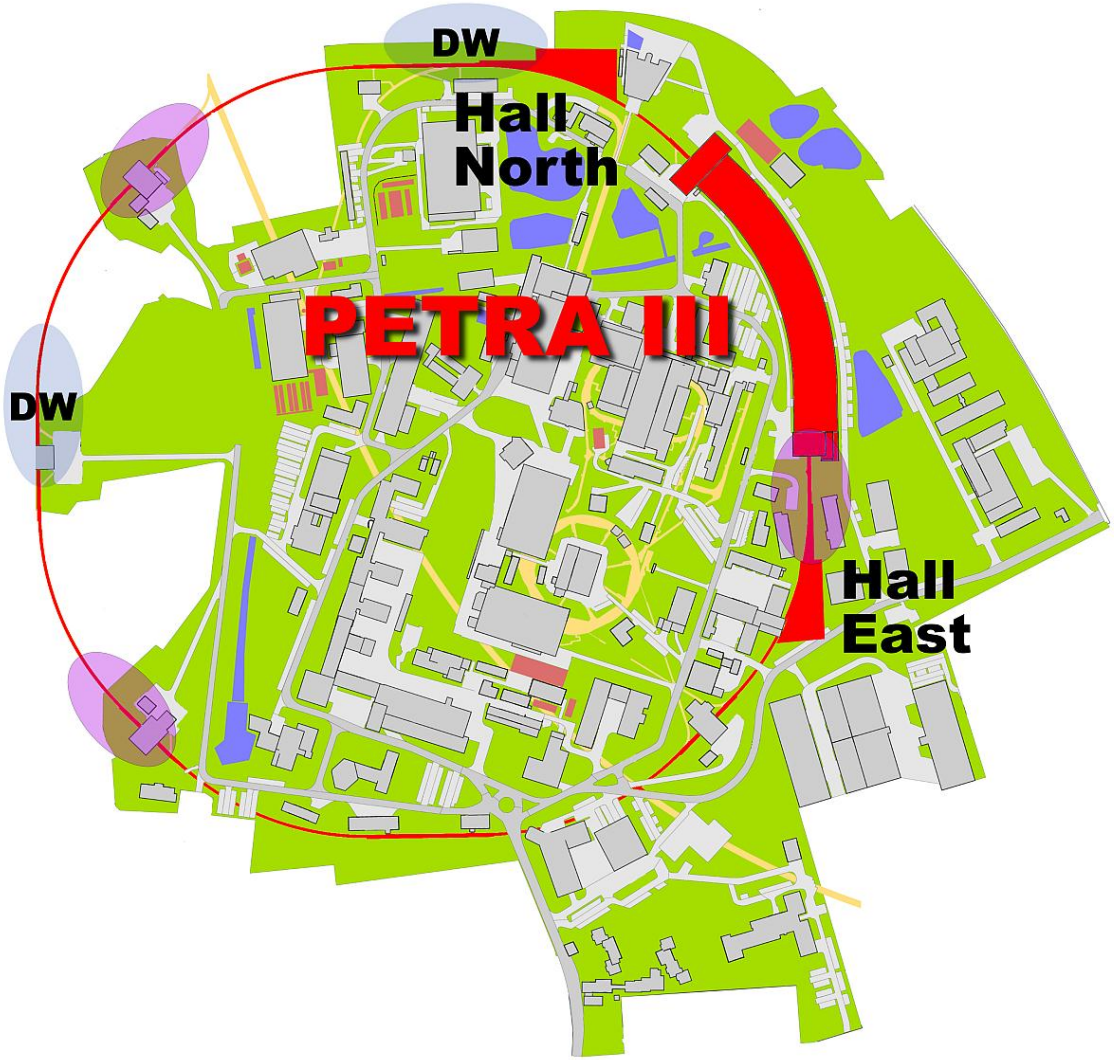
Niels Heidbrook
DESY

3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

Petra III

2,3km length



3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

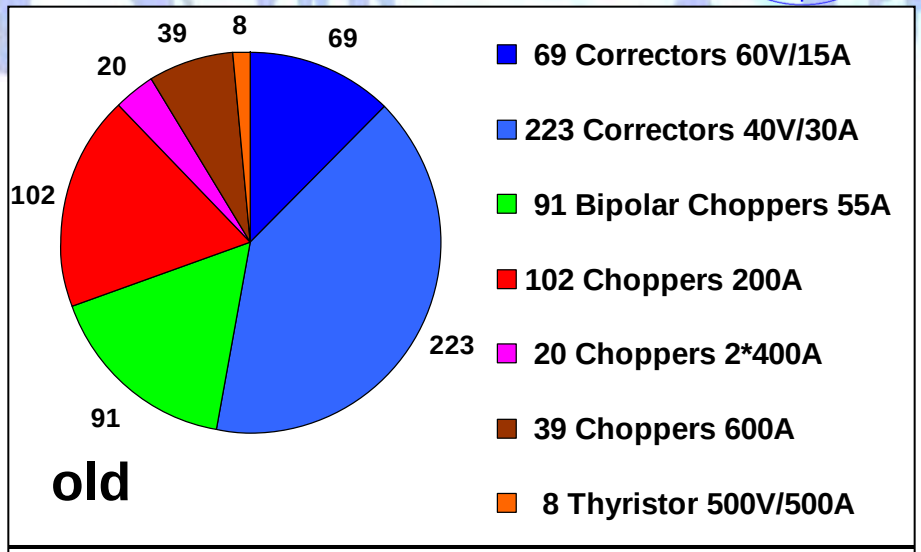
556 power supplies

252 choppers 292 correctors

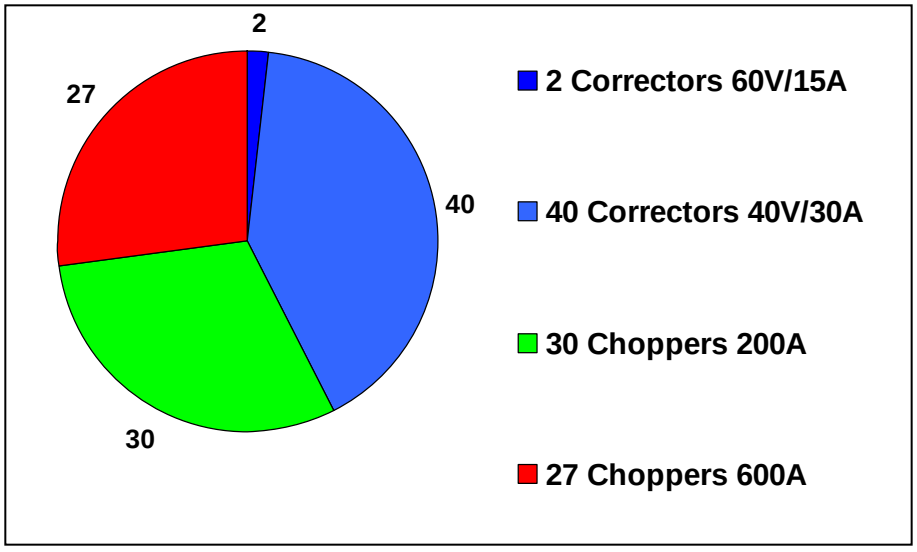
Petra III Extension

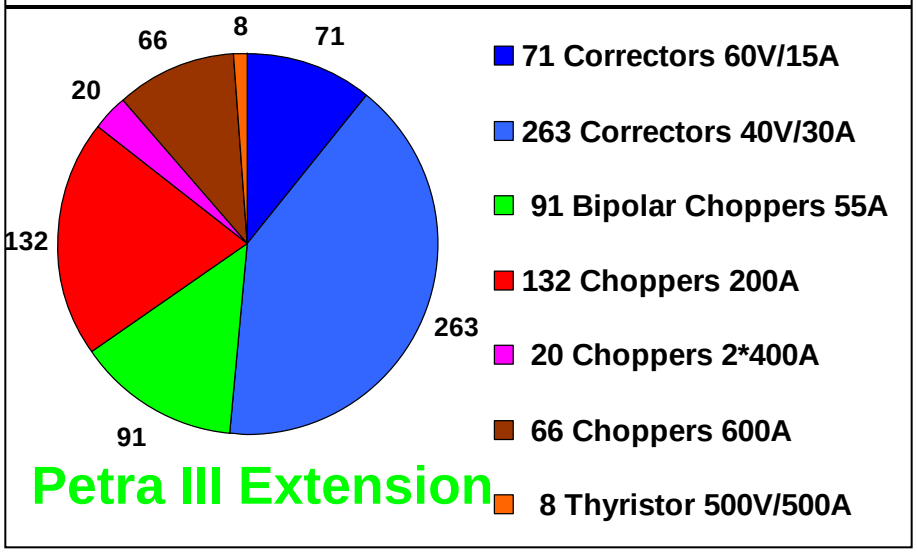
309 choppers 334 correctors

655 power supplies



old





Petra III Extension

3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

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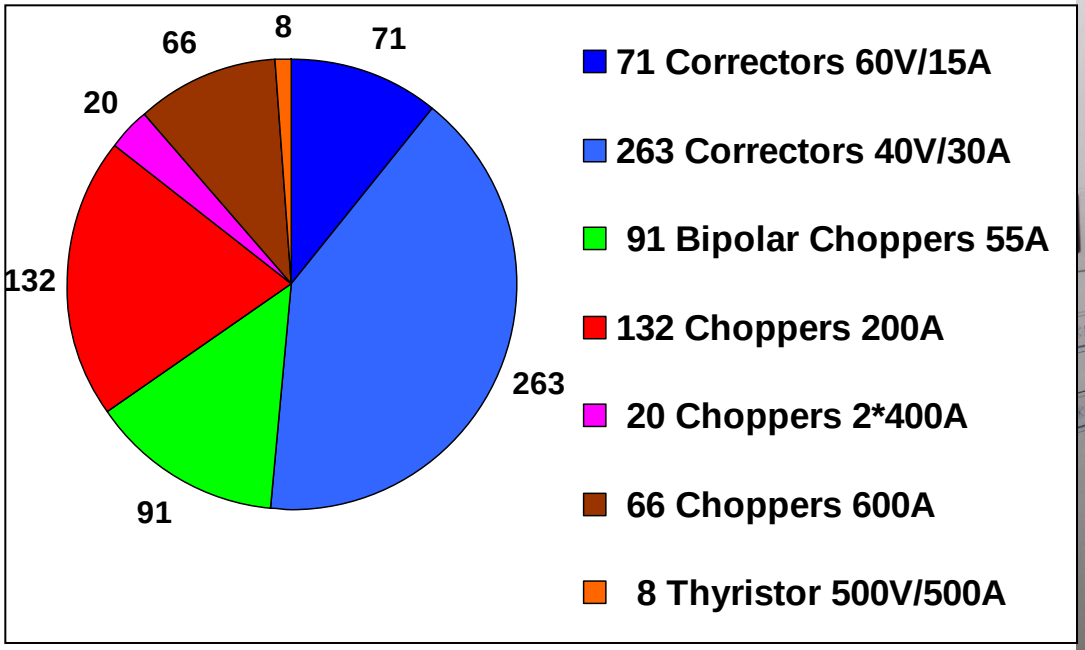
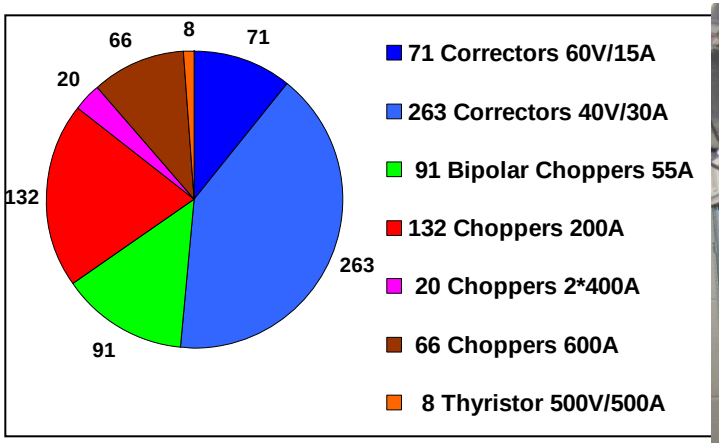
334 Correctors



3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

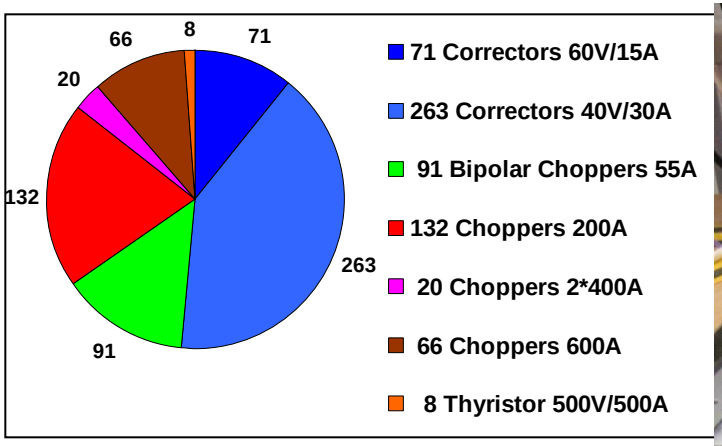
91 Bipolar Choppers 55A

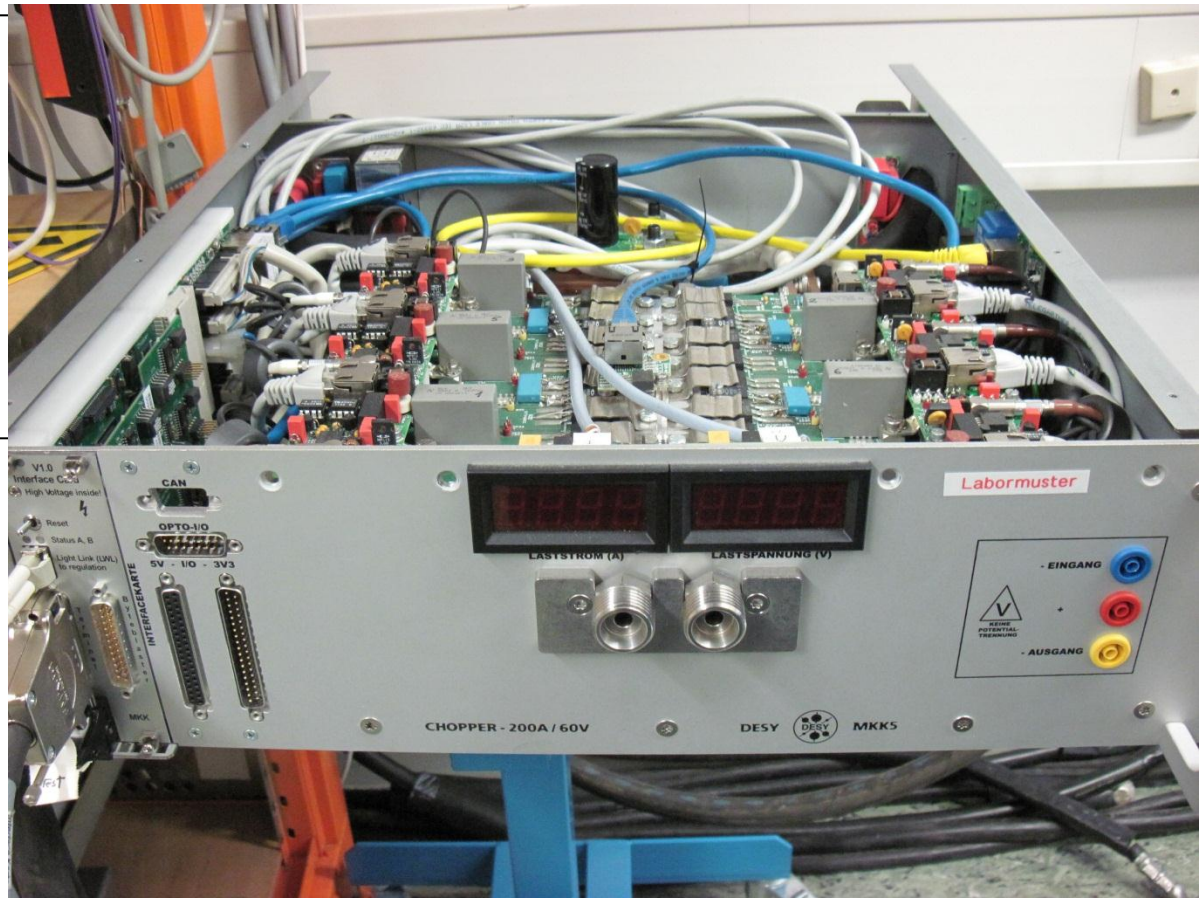


3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

132 Choppers 200A

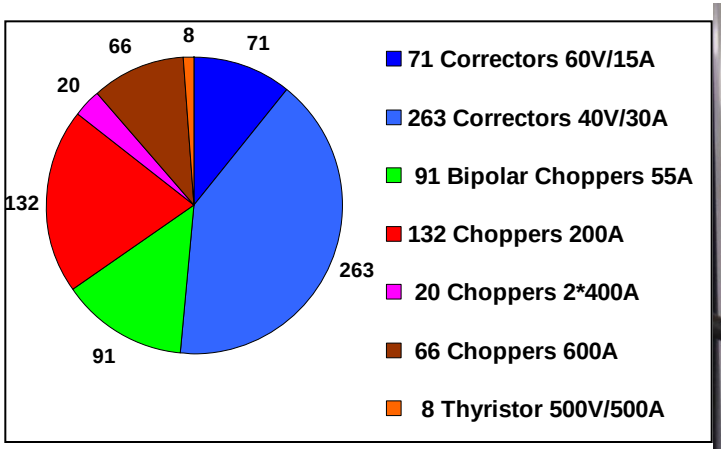




3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

20 Choppers 2*400A



3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

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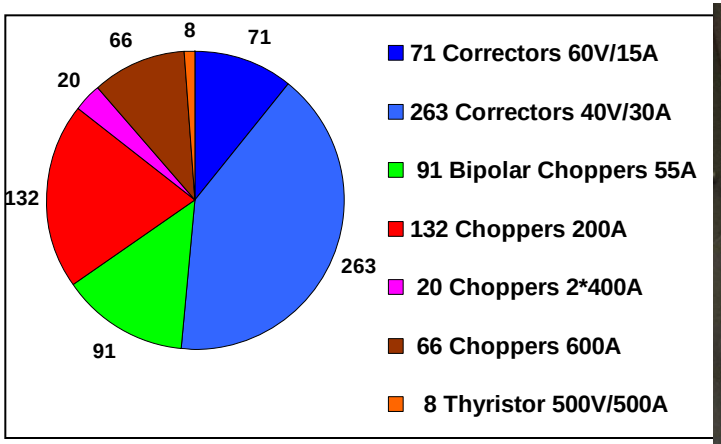
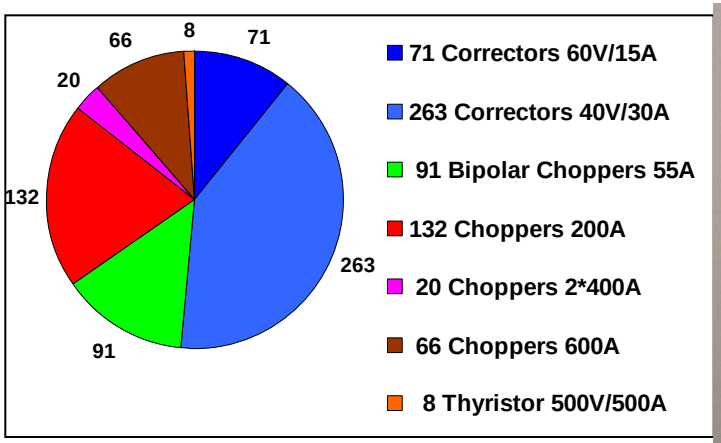
66 Choppers 600A



3rd Workshop on Power Converters for Particle Accelerators (POCPA)

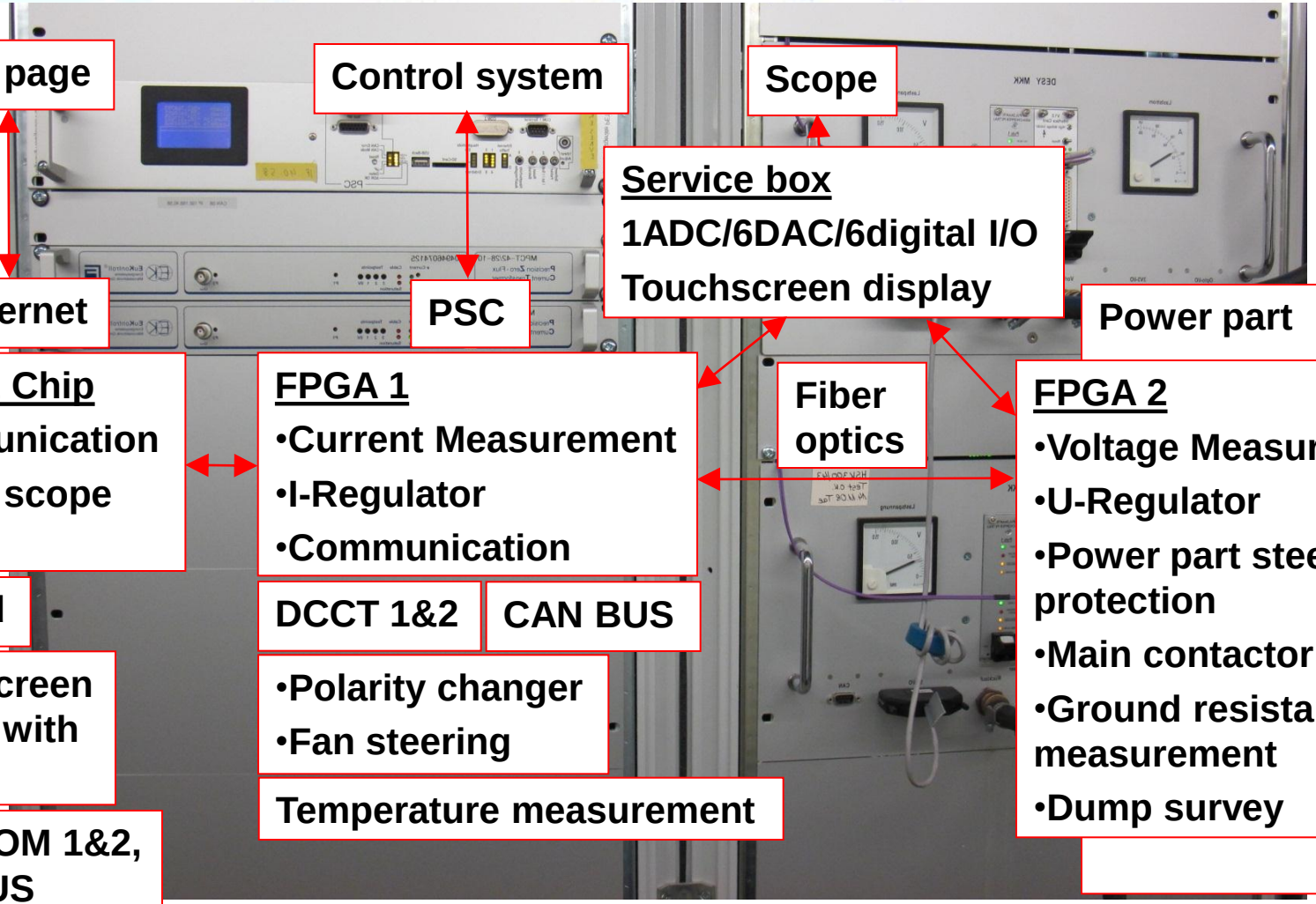
2012

8 Thyristor 500V/500A



3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012



Web page

Control system

Scope

Ethernet

PSC

Service box
1ADC/6DAC/6digital I/O
Touchscreen display

Power part

Internet Chip
- Communication
- Online scope
- Mail

FPGA 1
- Current Measurement
- I-Regulator
- Communication

Fiber optics

FPGA 2
- Voltage Measurement
- U-Regulator
- Power part steering and protection
- Main contactor steering
- Ground resistance measurement
- Dump survey

SD card

DCCT 1&2

CAN BUS

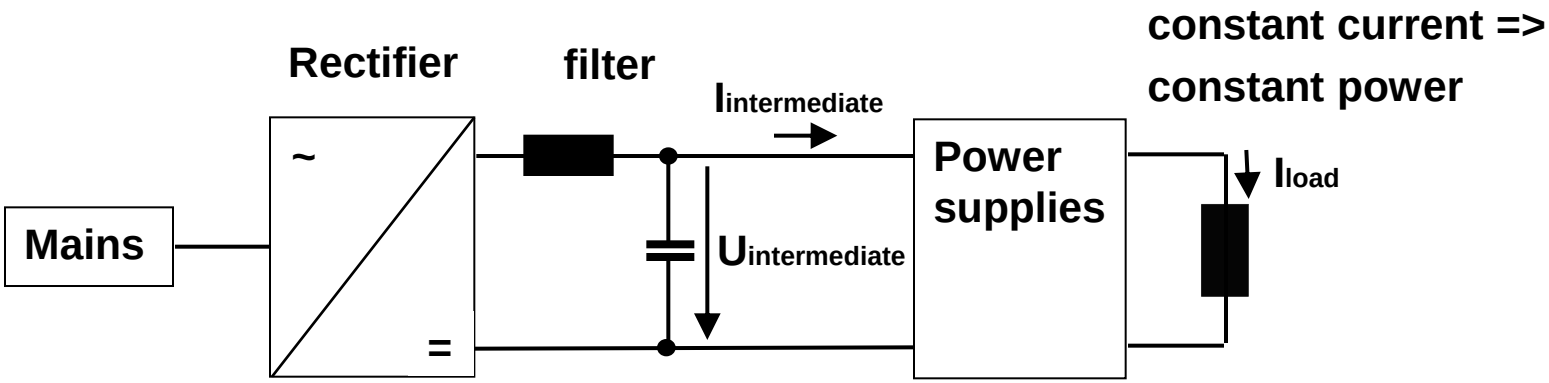
Touchscreen display with scope

- Polarity changer
- Fan steering

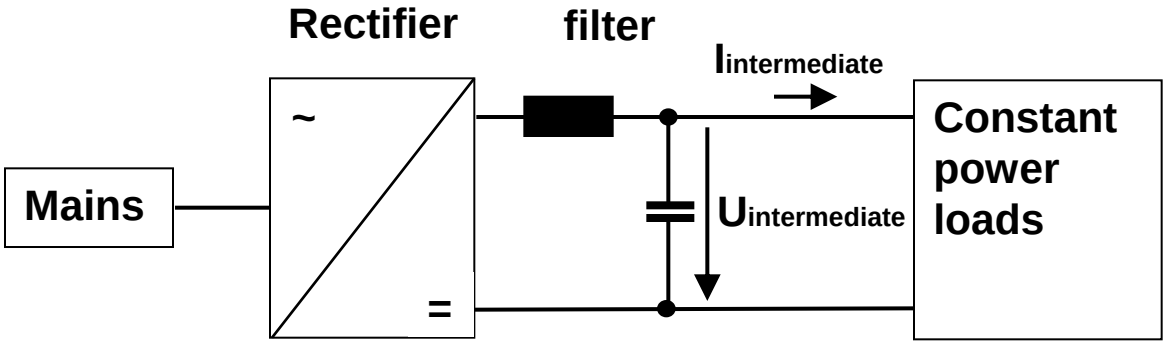
Temperature measurement

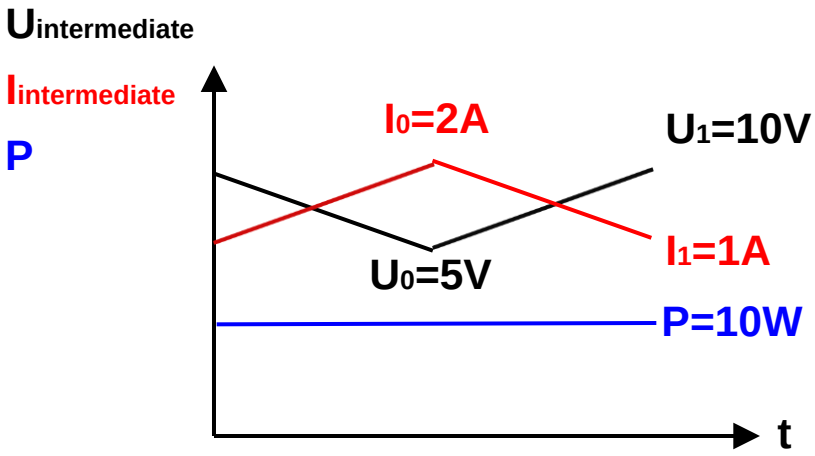
USB, COM 1&2, CAN BUS

Constant current oscillations



Constant current oscillations



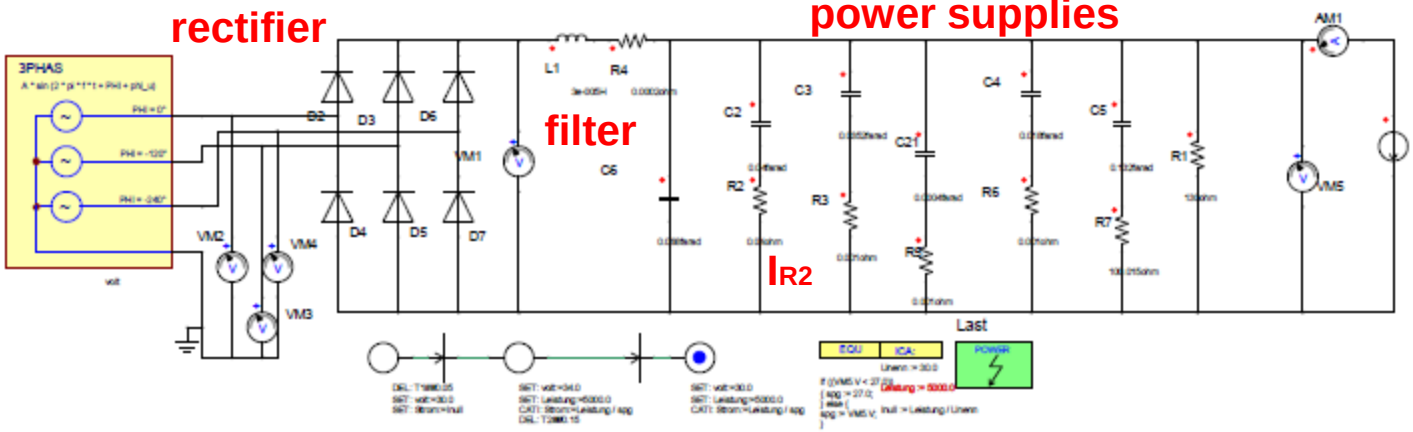


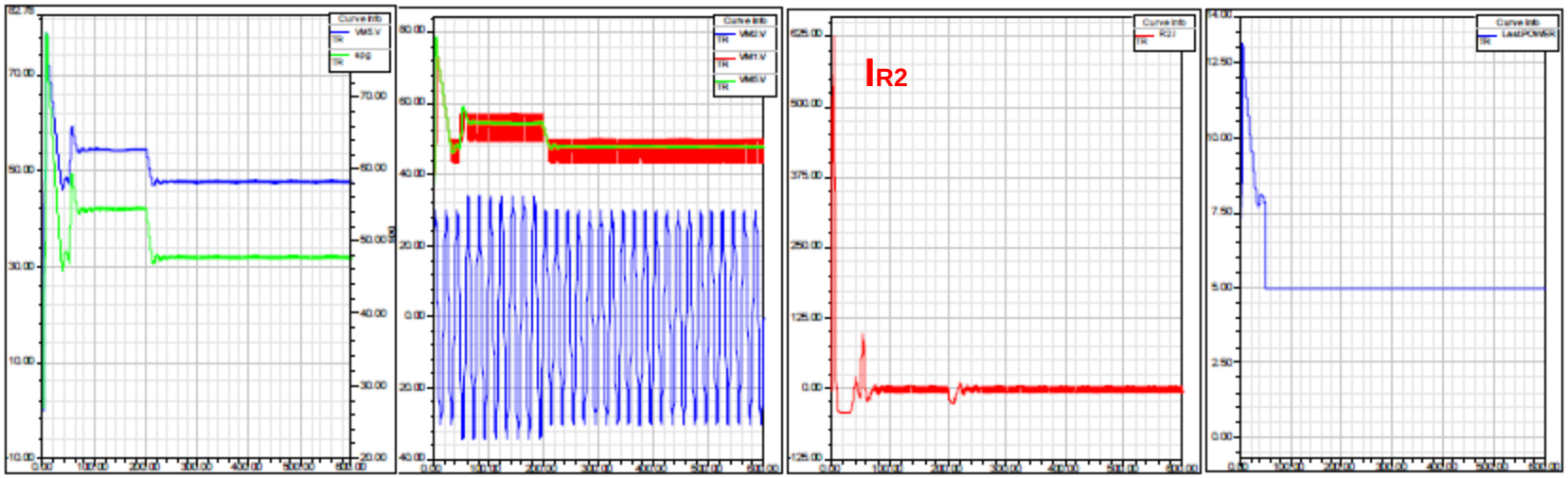
$$\Delta R = \frac{\Delta U}{\Delta I} = \frac{10V-5V}{2A-1A} = \frac{-5V}{1A} = -5\Omega$$

3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

Constant current oscillations





3rd Workshop on Power Converters for Particle Accelerators (POCPA)

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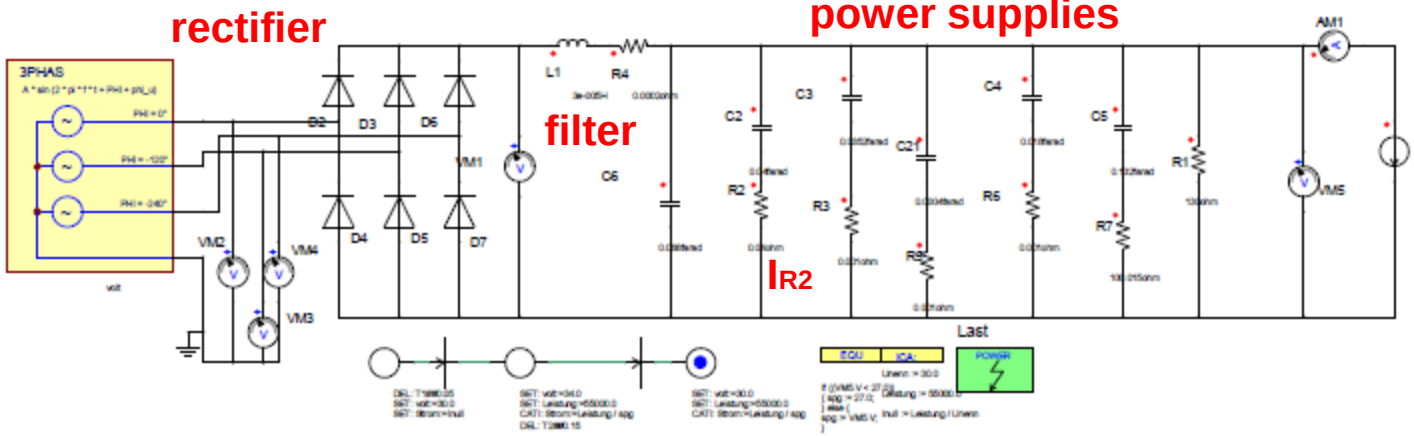
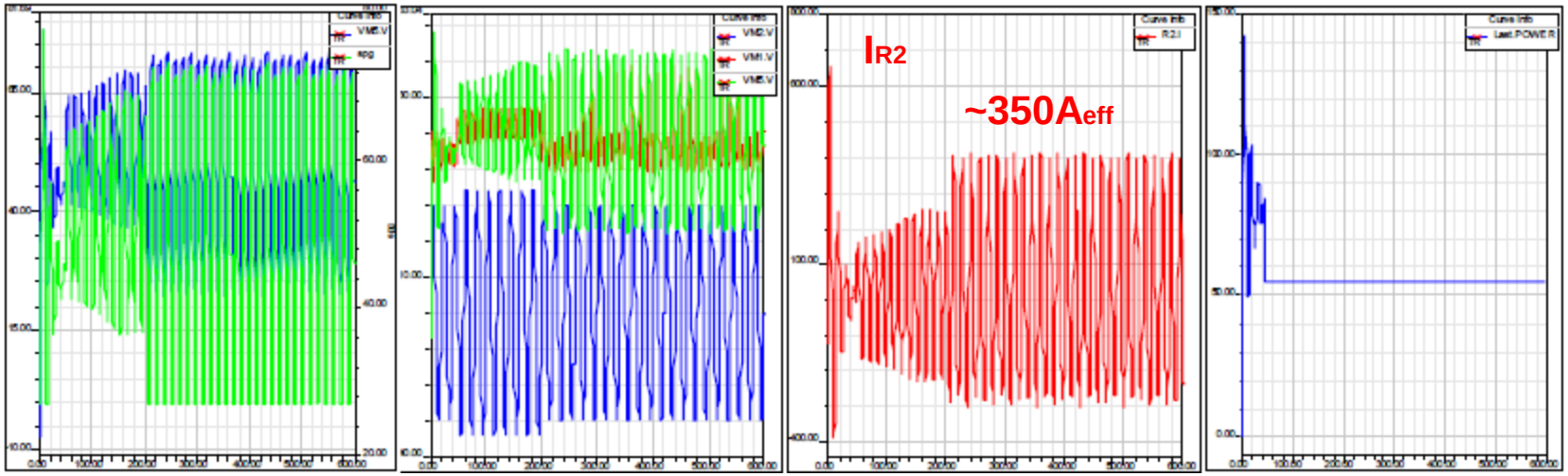
Constant current oscillations





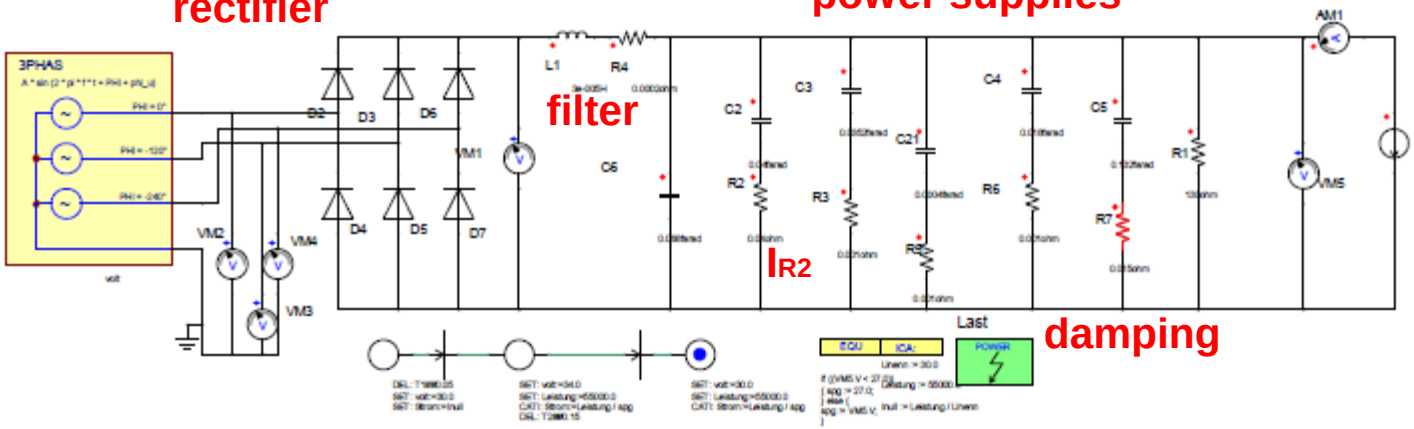
3rd Workshop on Power Converters for Particle Accelerators (POCPA)

2012

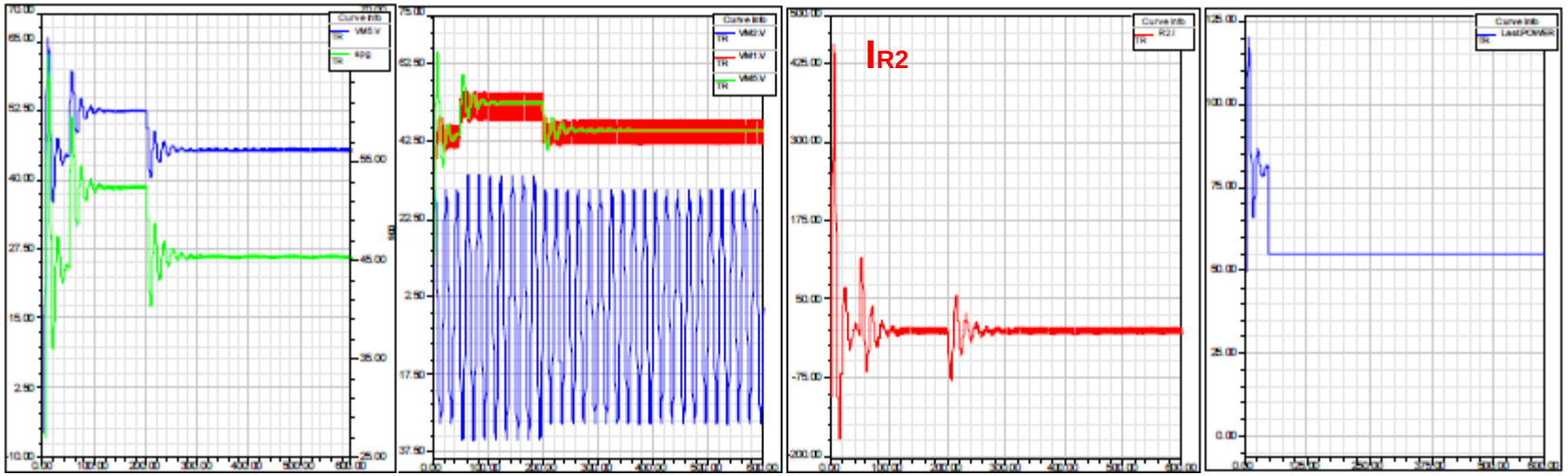
Constant current oscillations

rectifier

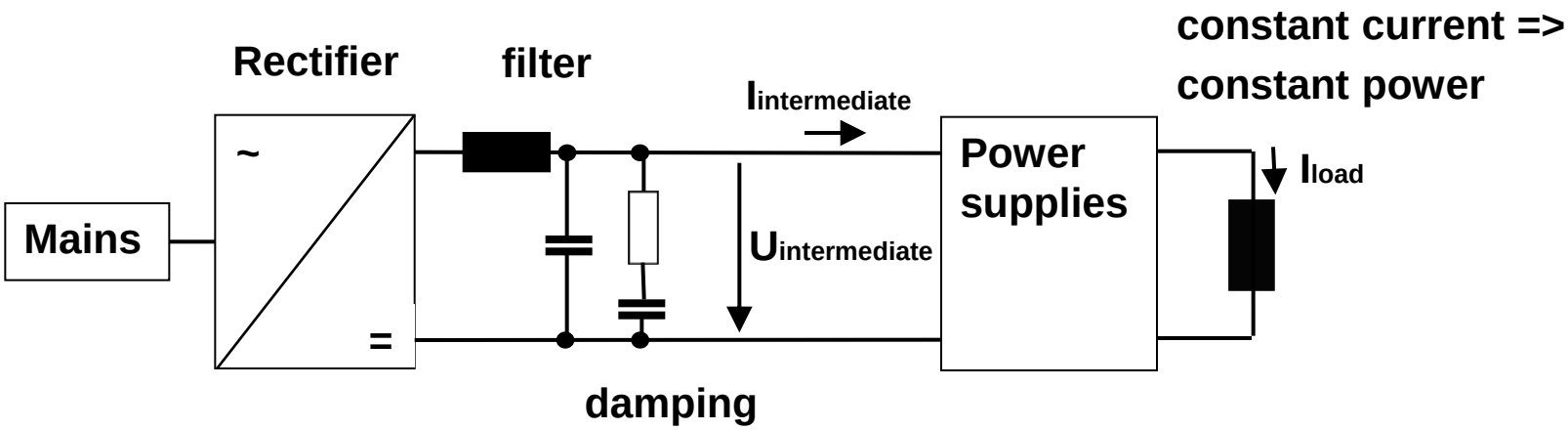
power supplies



constant power 55KW



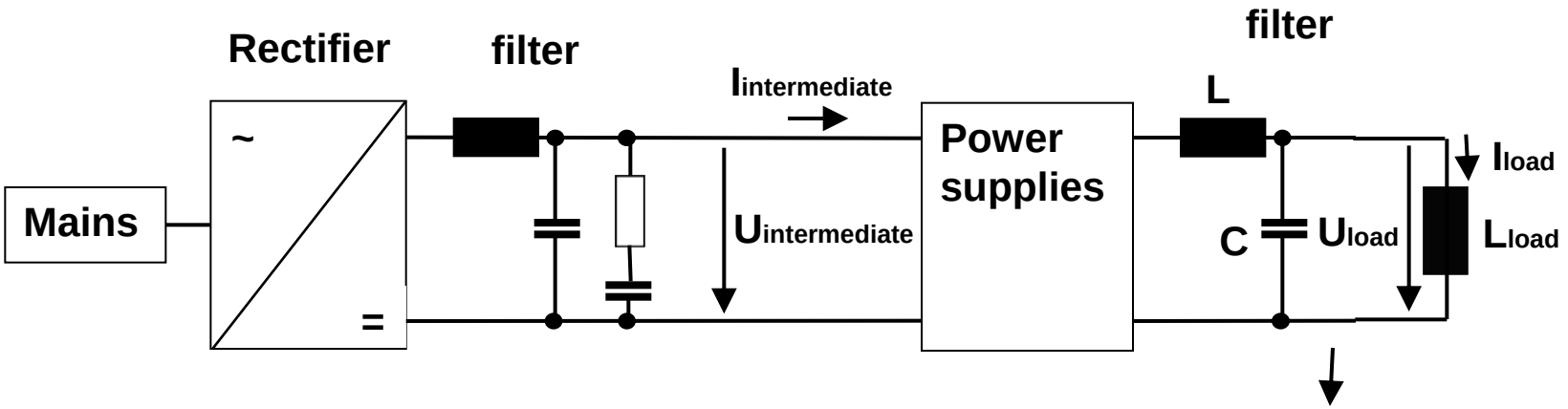
Constant current oscillations



Conclusion:

Extension => check damping

Constant current oscillations



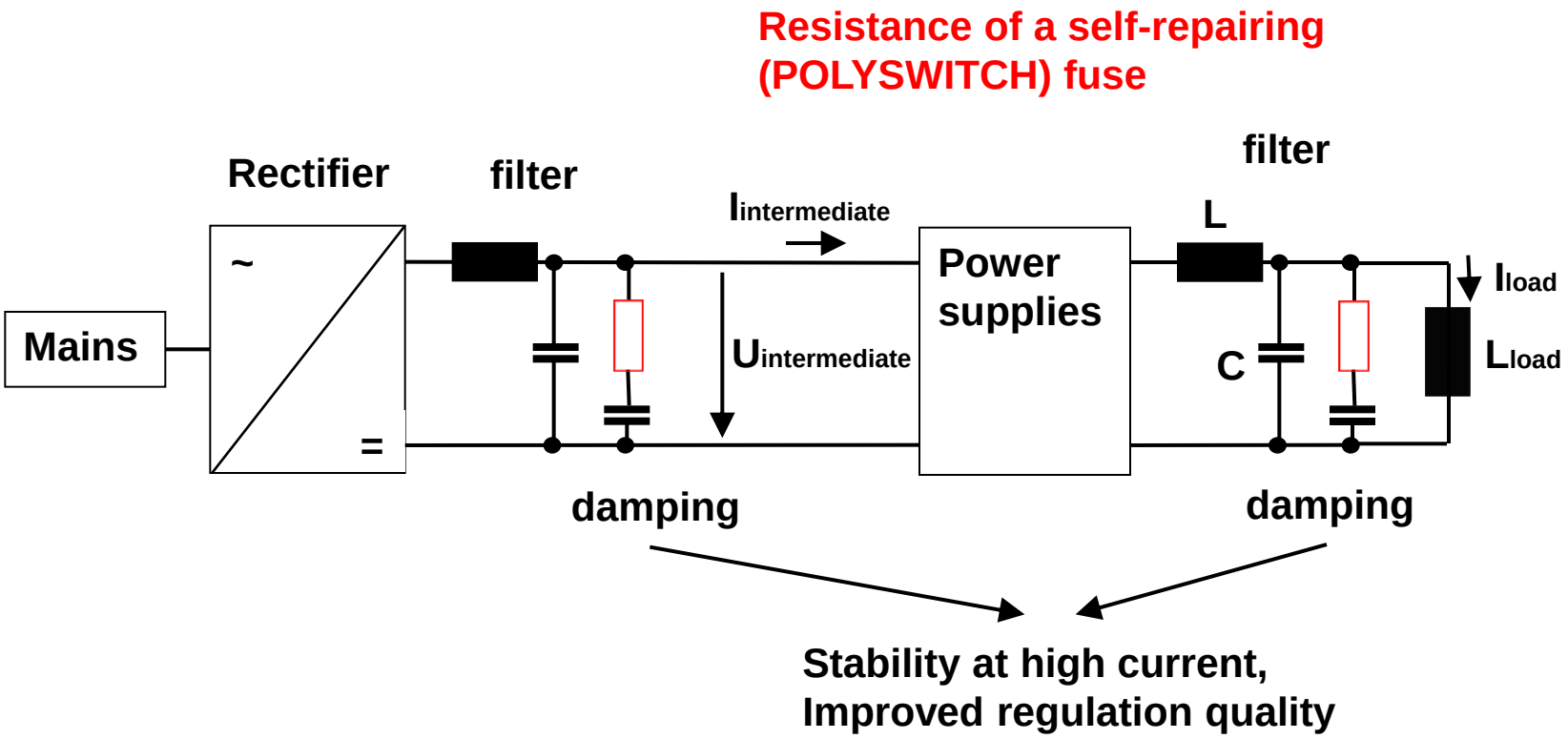
L, C, L_{load} => system order is 3

U_{load}, I_{load} => 2 values for regulation

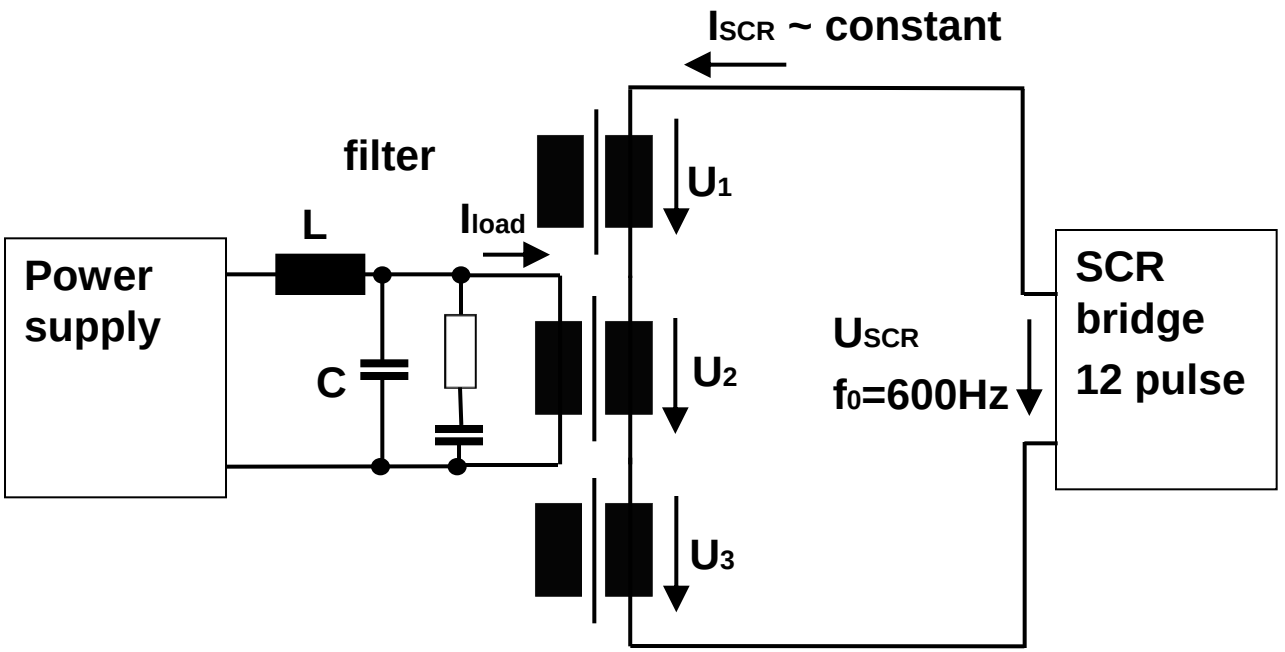
⇒ Regulation is under-determined for full pole setting

⇒ Ringing problems => less regulation quality

Constant current oscillations

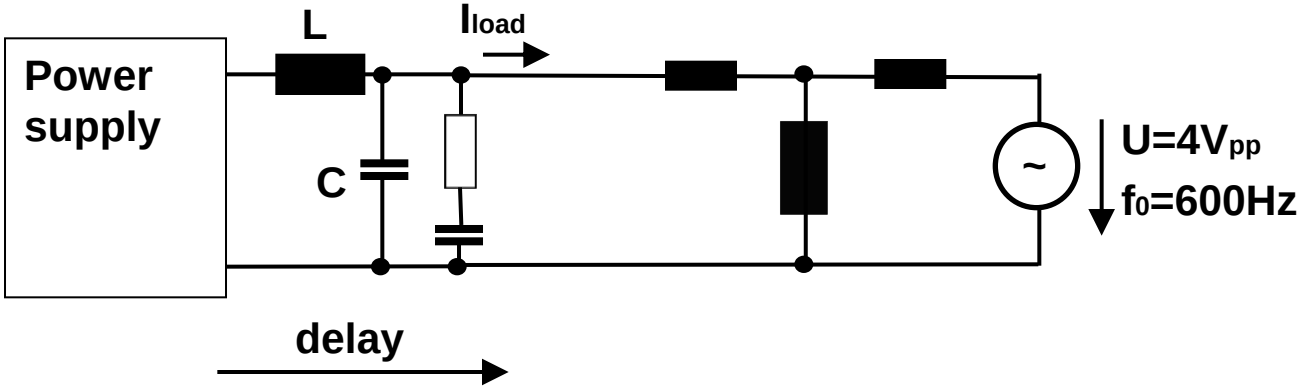


AC load

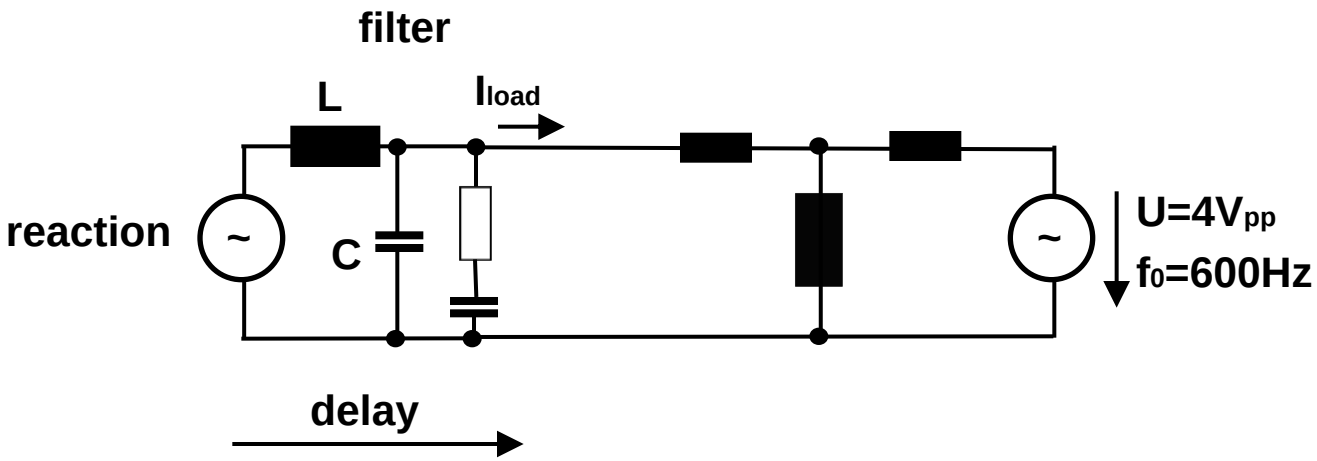

ISCR ~ constant
filter
L
Iload
U1
Power supply
C
U2
USCR
f0=600Hz
SCR bridge 12 pulse
U3

AC load

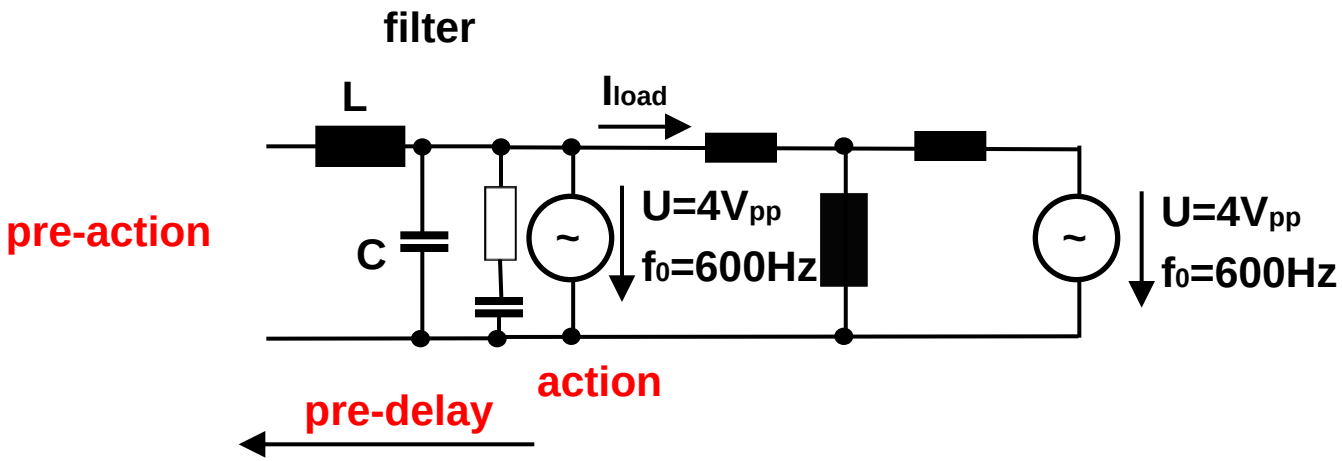
(I_{load} Delta-Sigma ADC delay = 1ms)



AC load



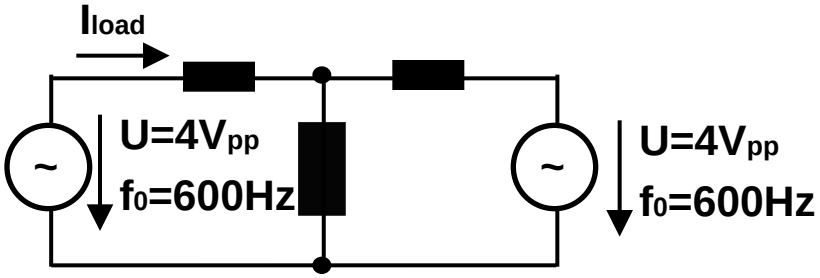
AC load


filter
L
Iload
pre-action
C
U=4Vpp
f0=600Hz
U=4Vpp
f0=600Hz
action
pre-delay

AC load

600Hz @ $4V_{pp}$ => High internal filter current

Power supply =
Frequency generator



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Conclusion

About 3.5 Years experience
556 new designed power supplies in operation
655 power supplies including the Extension

The MTBF is satisfying, i.e. limited by:
Auxiliary power supplies fail sometimes 12V/4A (1.2A load)
There are still some software bugs
Overcurrent after cycling of the magnets caused by the old learning function