Project memo AN 03.12.12

Active damping of filter oscillations.

Implementation and laboratory measurements

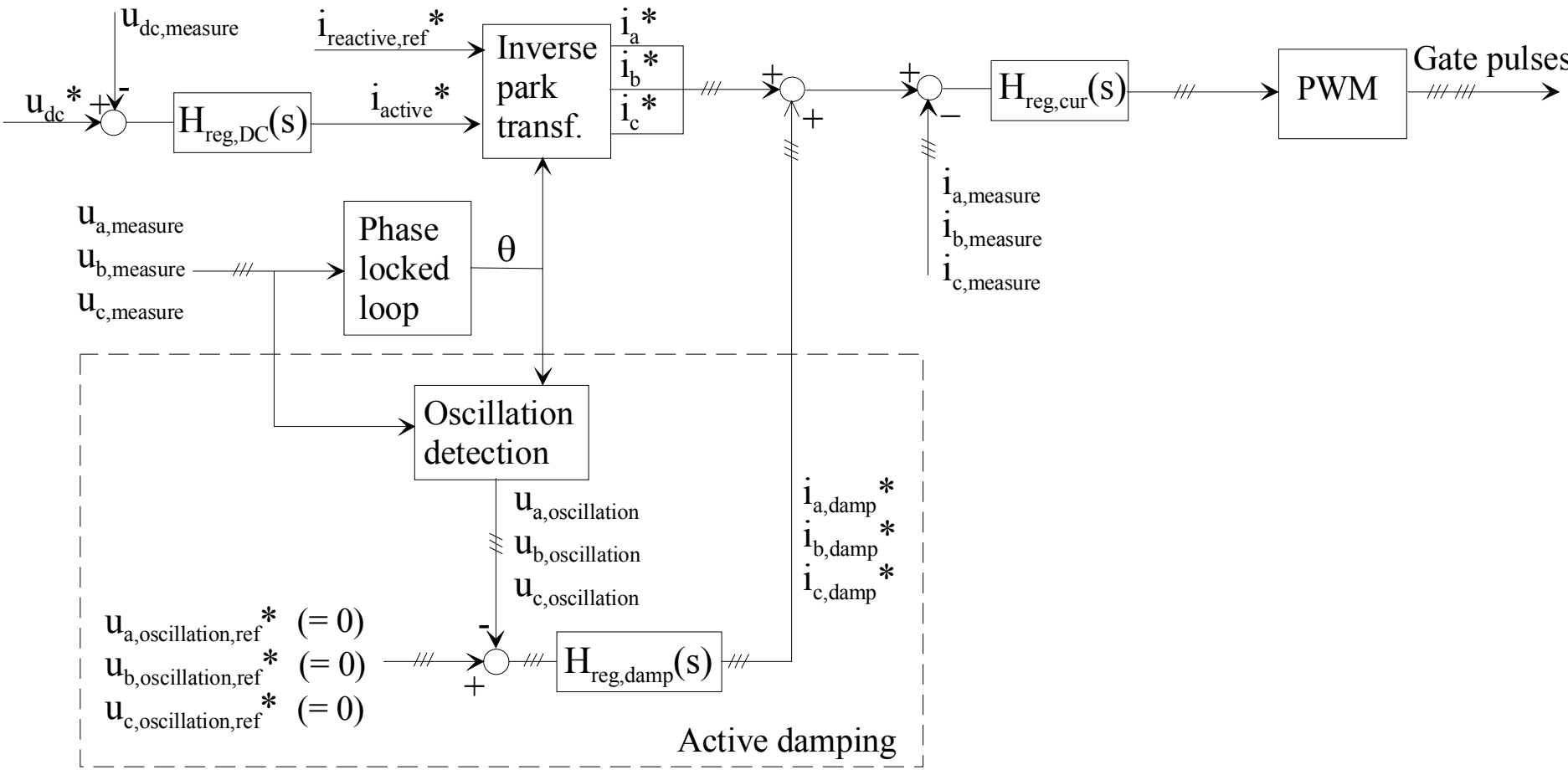
Objectives

Laboratory verification of a method for active damping of oscillations between line reactance and filter capacitors in LC-filter for line connected PWM voltage source converters.

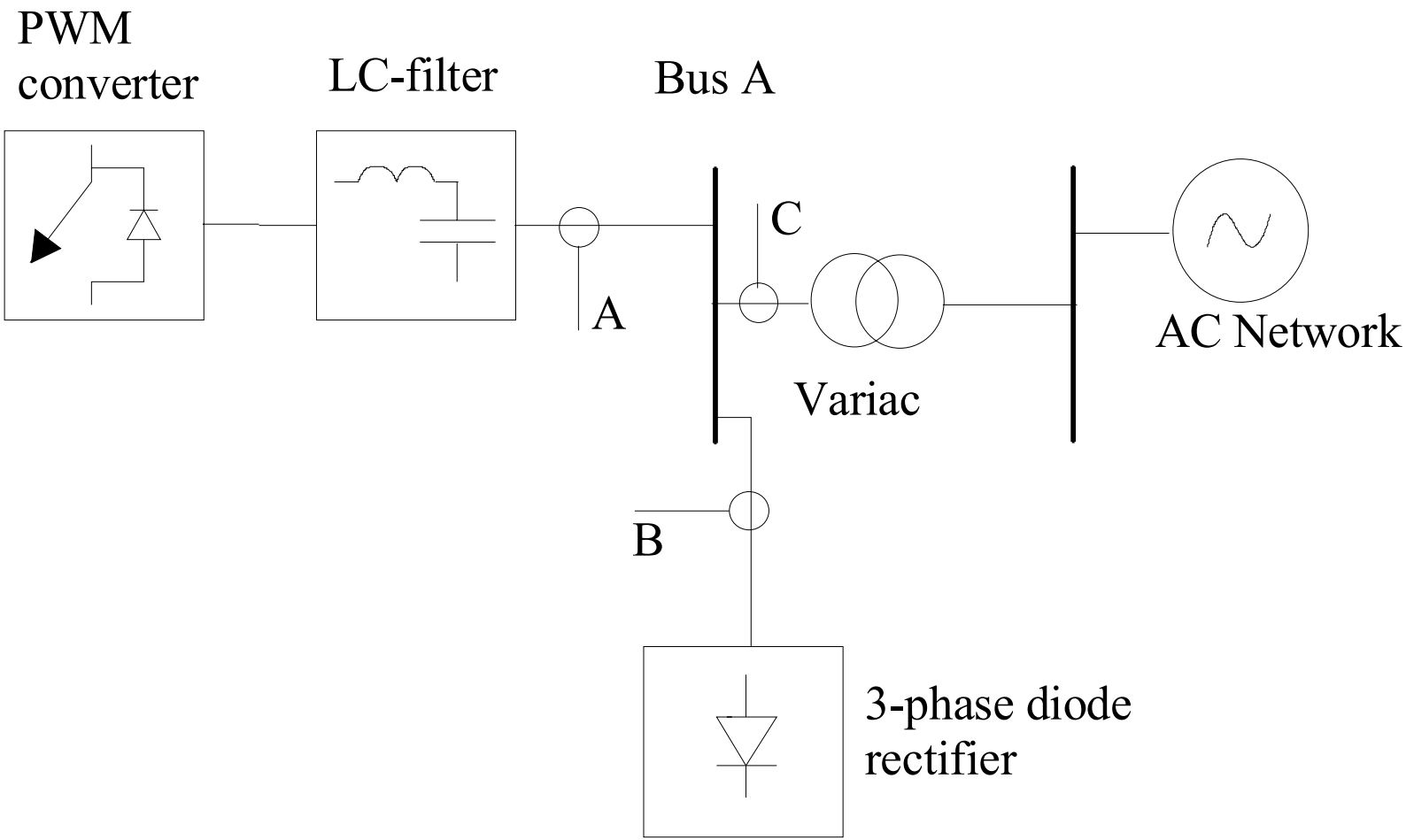
The purpose of the active damping is to avoid that the introduction of an active front-end converter with LC-filter on the AC-side reduces the voltage quality at the point of connection.

Documentation of how the active damping method have been implemented in the SINTEF laboratory prototype

Block diagram of control system



Laboratory set-up

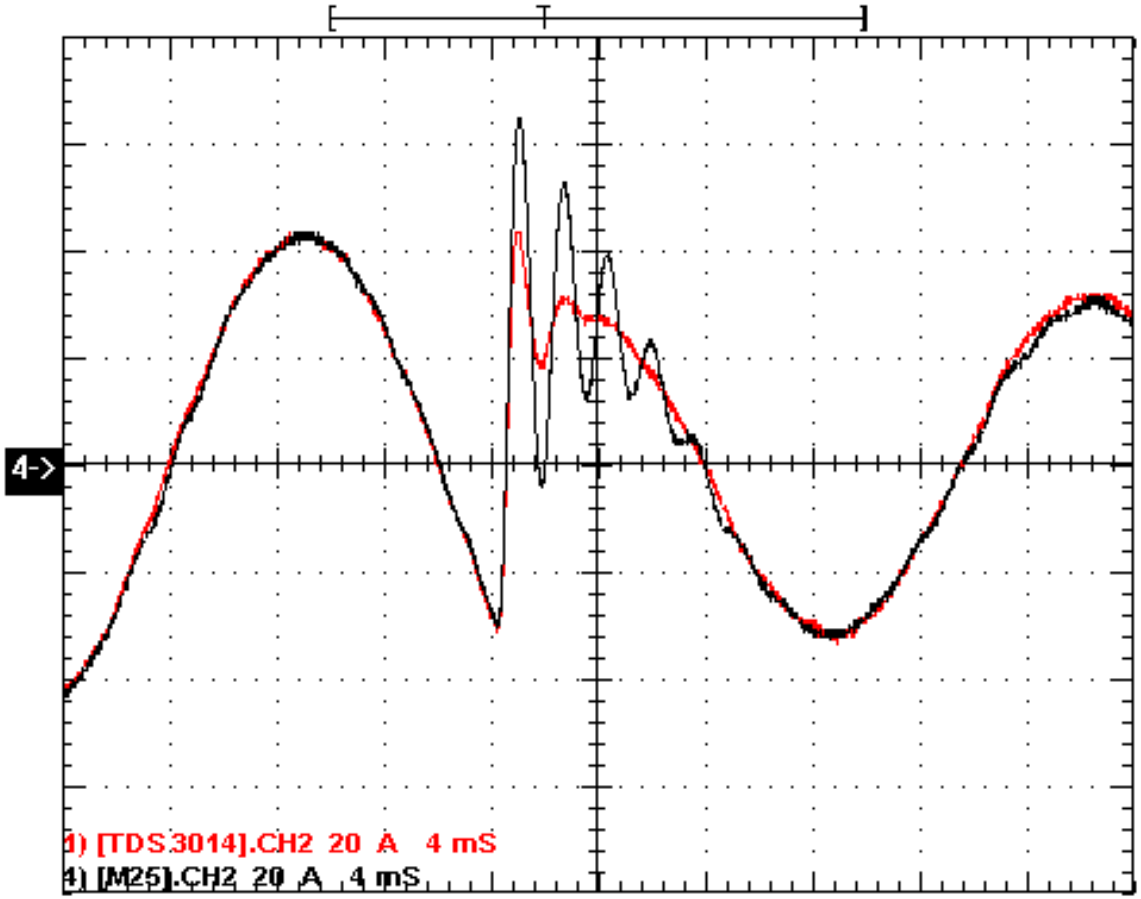


Case I
Step reversal of reactive current

- Diode rectifier disconnected
- Reference for reactive output converter current is initially 35A (peak) lagging
- Reference is stepped from lag to lead (same amplitude)
- The step provokes filter oscillations
- Active damping reduces oscillations

(illustarted on next slide)

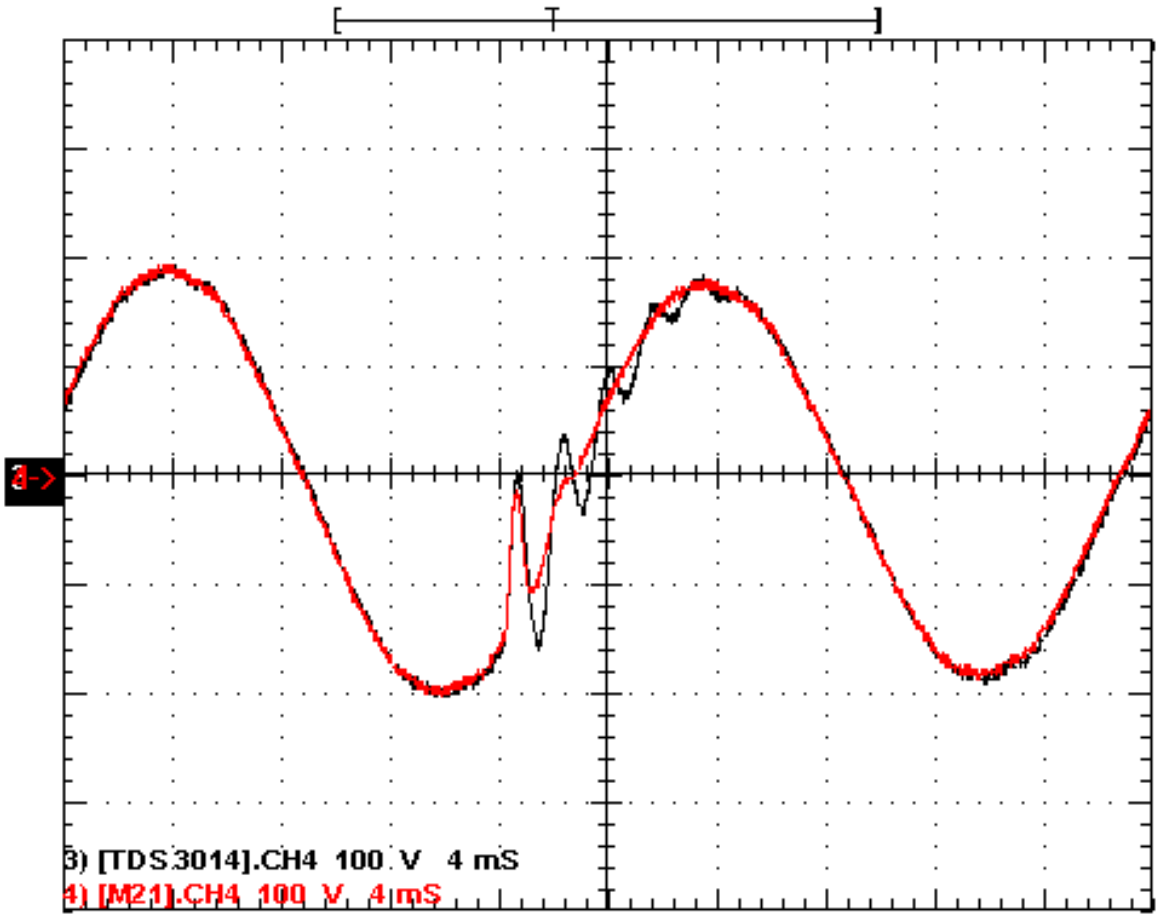
Laboratory measurements case I



Current C (supply line) if active damping is:

- disabled (black)
- enabled (red)

Laboratory measurements case I



Voltage at bus A if active damping is:

- disabled (black)
- enabled (red)

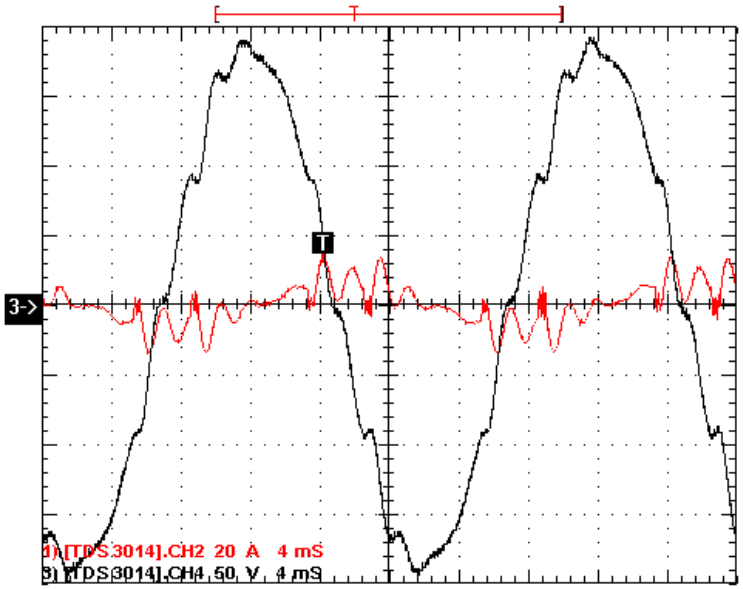
Case II
AC network with low order harmonics

- Reference for converter current is set to zero. Note however that the filter supplies reactive current to bus A
- Converter draws active current to cover losses only.
- Diode rectifier is connected and injects harmonic currents into bus A
- The low order harmonics triggers filter oscillations
- Active damping damps the oscillations

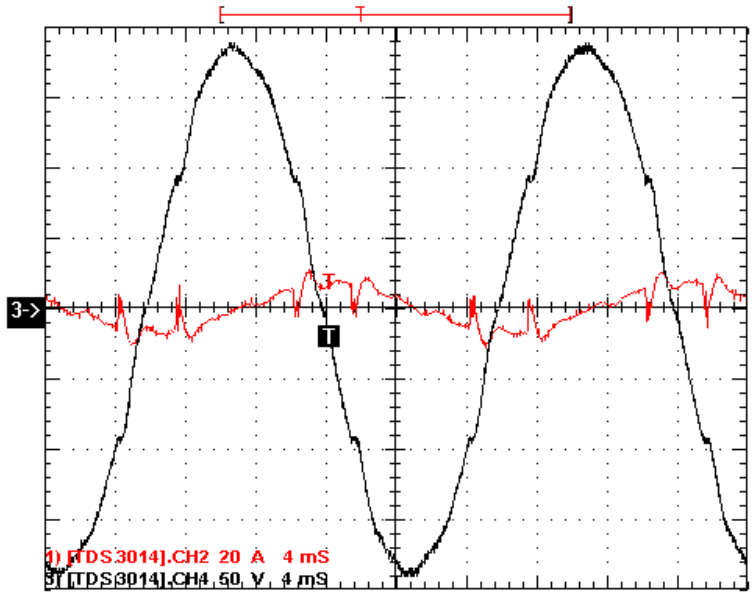
(illustrated on next slide)

Laboratory measurements case II

Active damping disabled



Active damping enabled



- voltage at bus A (black)
- current C (supply line) (red)

Conclusion

- Laboratory measurements verifies that the proposed method works as intended
- The measurements show that oscillations are damped effectively but that the voltage remains distorted. This complies to the expectations since the purpose of the implemented method is damping rather than filtering
- The voltage quality at the point of connection can be maintained at its initial level (before the introduction of the active front-end converter and the LC-filter)

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PROJECT MEMO

MEMO CONCERNS

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A method for active damping of oscillations between line reactance and filter capacitors in LC-filter for line connected PWM voltage source converters was presented in reference [4].

The basic idea presented in reference [4] is to include closed loop feedback control that gives additional damping to the capacitor voltage oscillations by adding appropriate signals to the current references.

Measurements presented in this memo shows that the previously described method works as intended when implemented on an active front-end converter.

The documentation of the active front-end converter original control system is found in reference [2]. This memo describes the additional implementation and modifications for inclusion of active damping.

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