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# BETWEEN INVERTER AND PCC

## AC Side Challenges and Solutions

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Robin Grab

Knowledge Exchange Seminar

Photovoltaic Solar Generation

Florianópolis

9<sup>th</sup> Nov. 2018

[www.fraunhofer.cl](http://www.fraunhofer.cl)

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# AGENDA

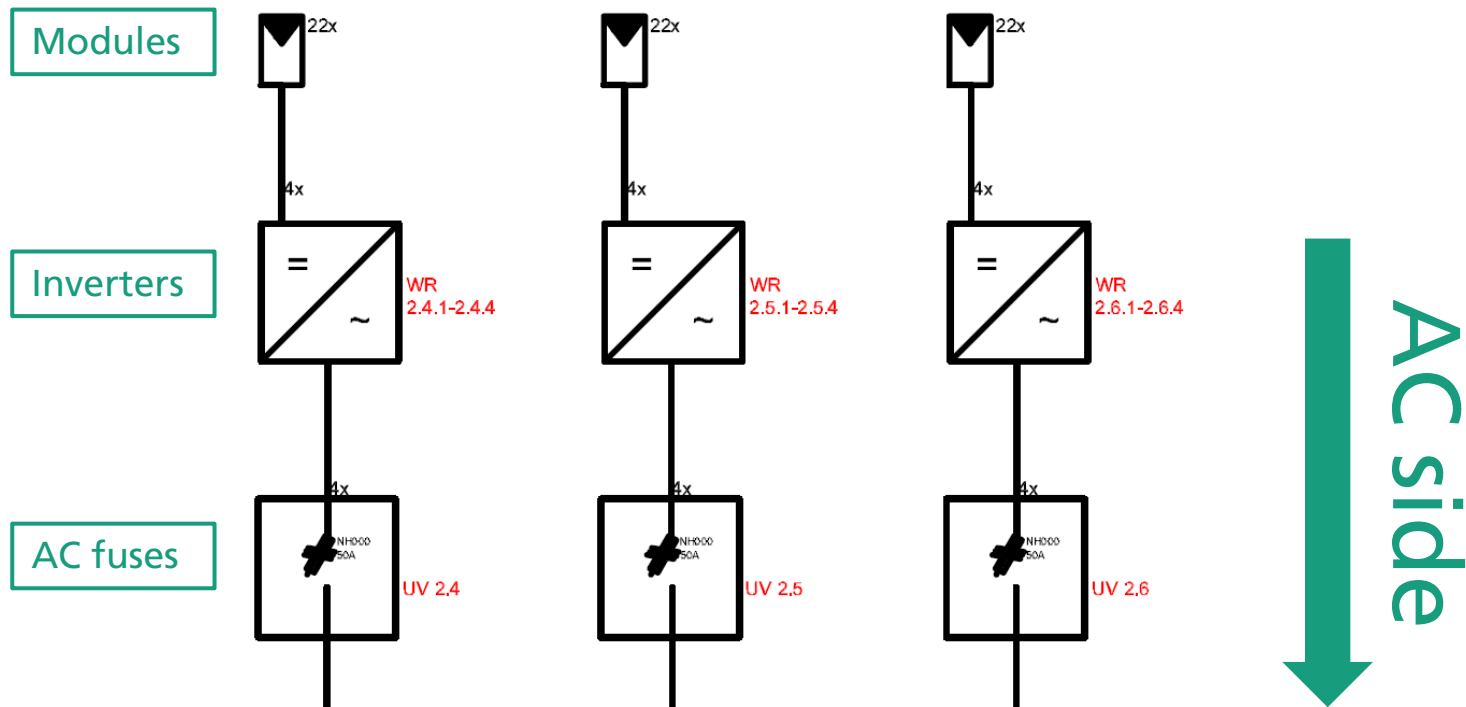
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- AC challenges
  - Defects
  - Underperformance, oscillations
  - Compliance with grid requirements
- Analyses at Fraunhofer
  - AC Measurements
  - Modelling
- Solutions
  - Controller Optimization
  - Third party opinion



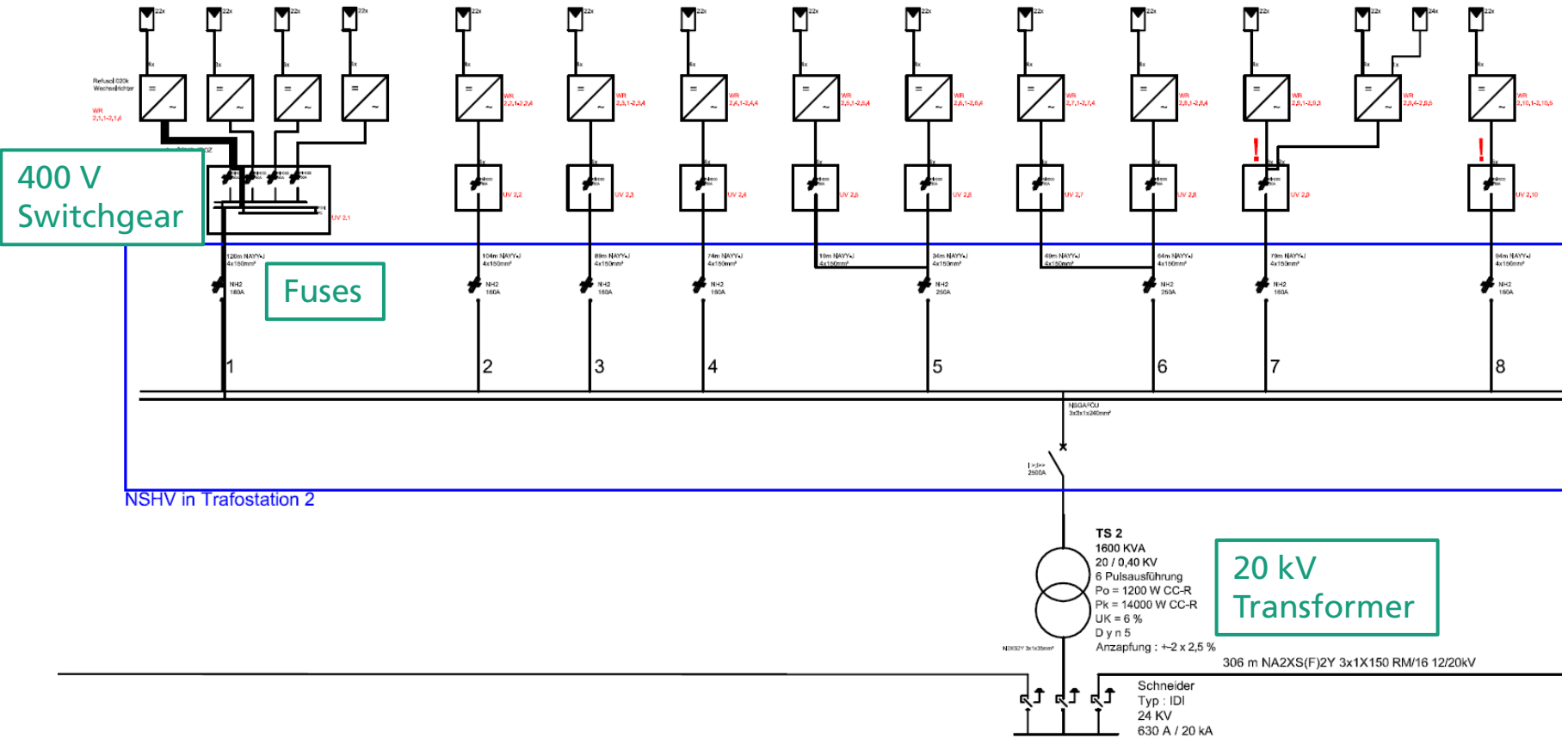
# Why does the AC side matter?

## Module string and inverter



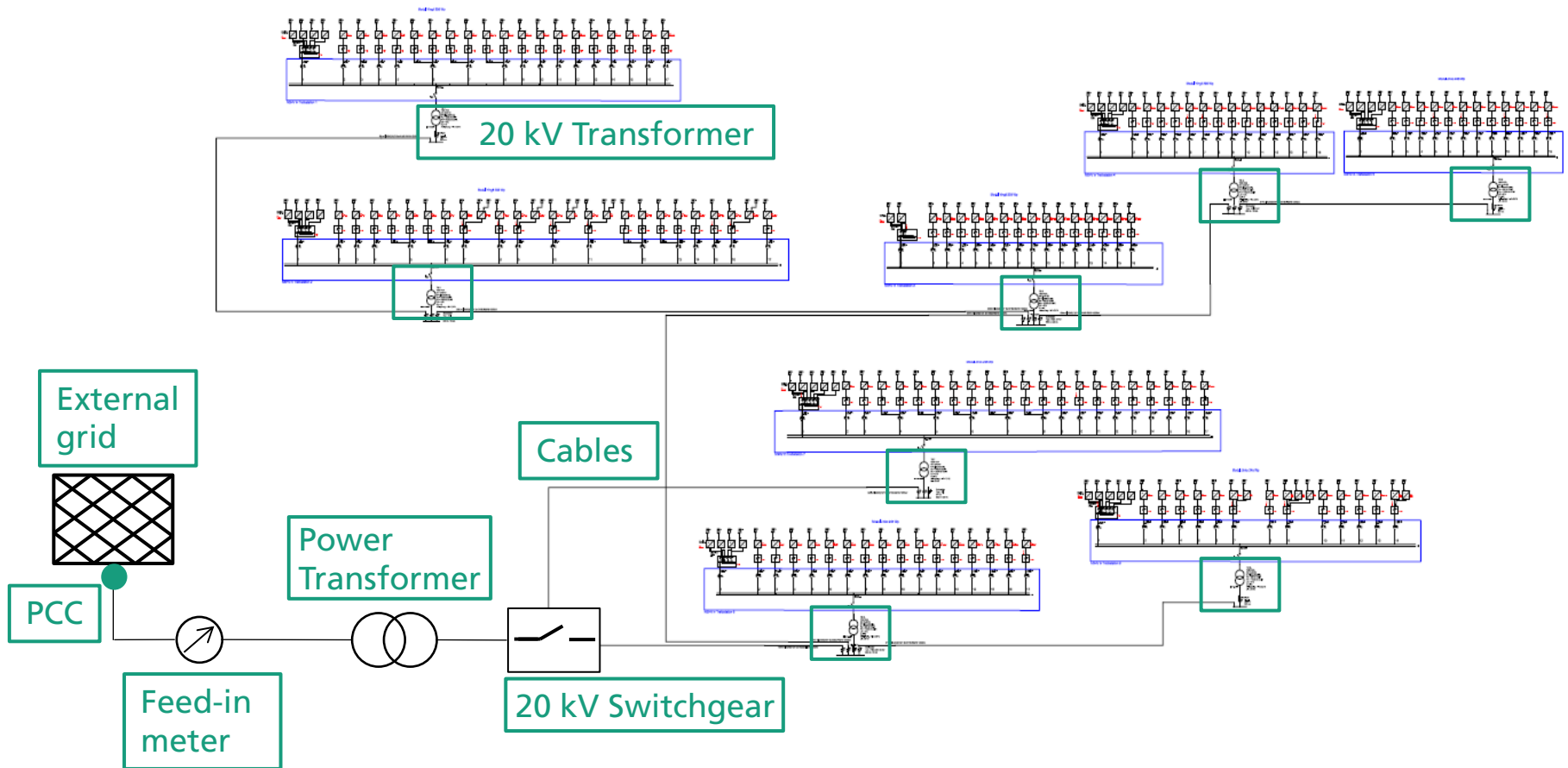
# Why does the AC side matter?

## The bigger picture...



# Why does the AC side matter?

## The even bigger picture...



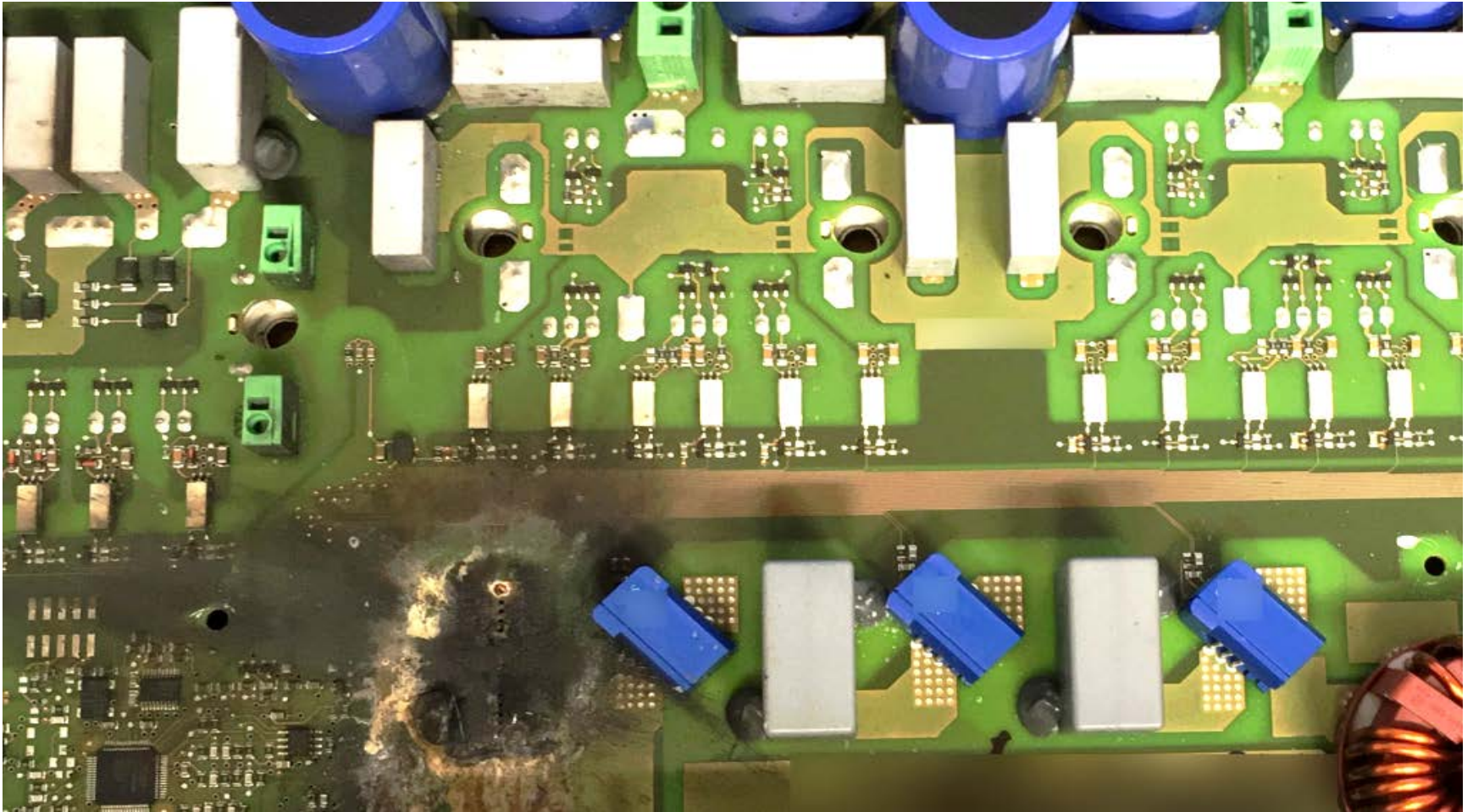
# AC challenges

## Defects



# AC challenges

## Defects



# AC challenges

## Oscillations and underperformance

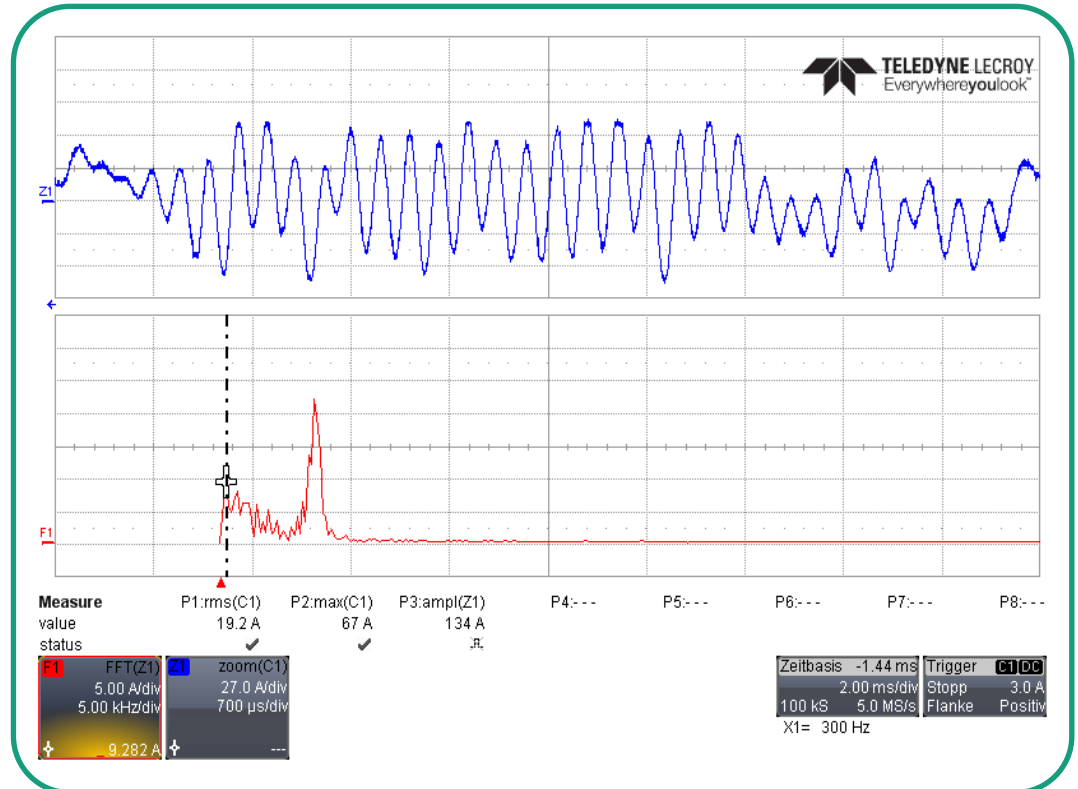
Underperformance of  
inverters observed



Oscillations between  
inverters and passive  
elements detected



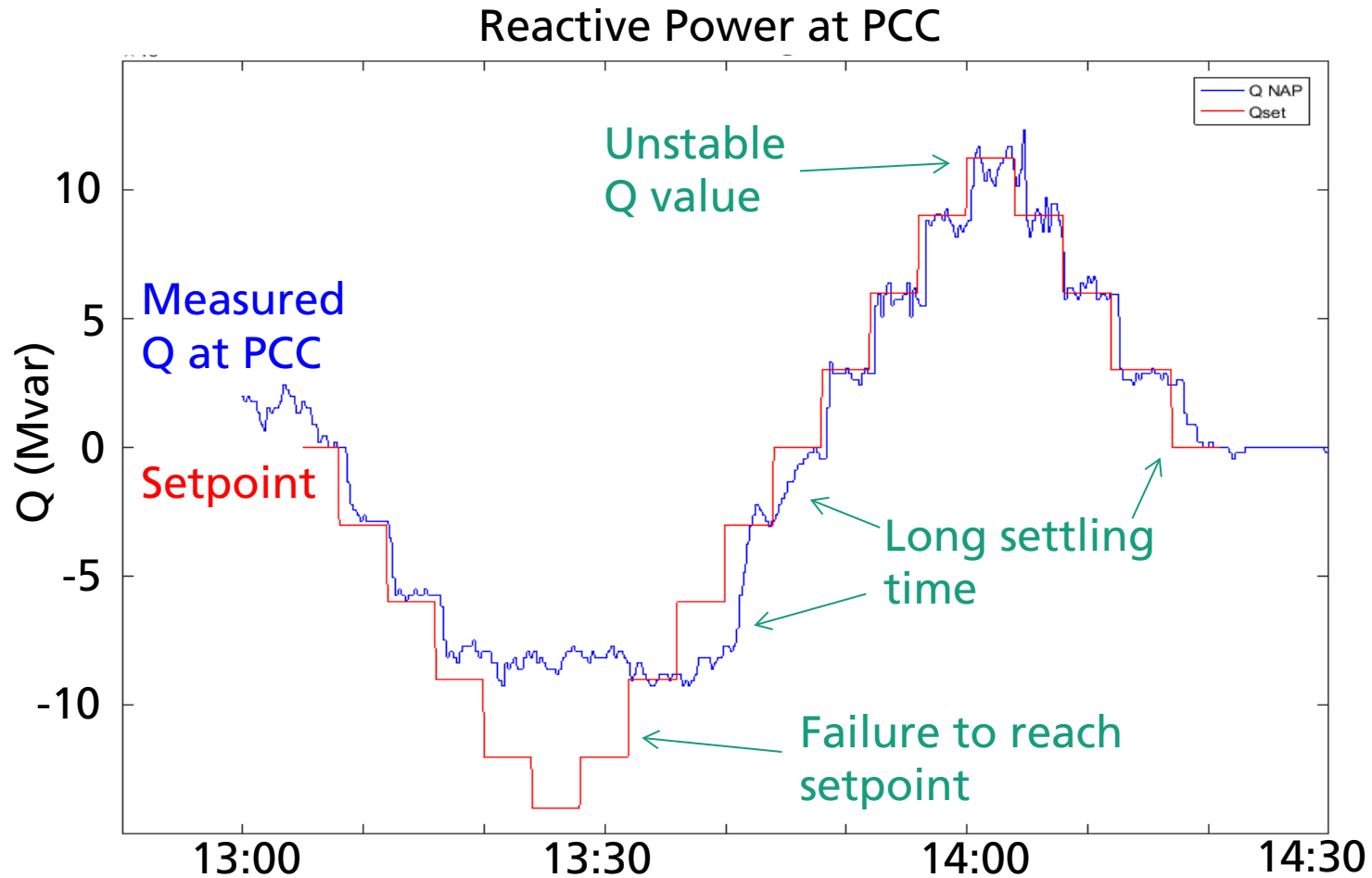
Hardware defects possible



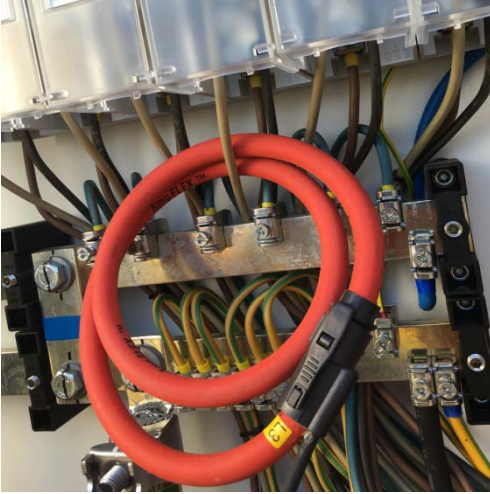


# AC challenges

## Compliance with grid requirements



# Analyses at Fraunhofer AC Measurements

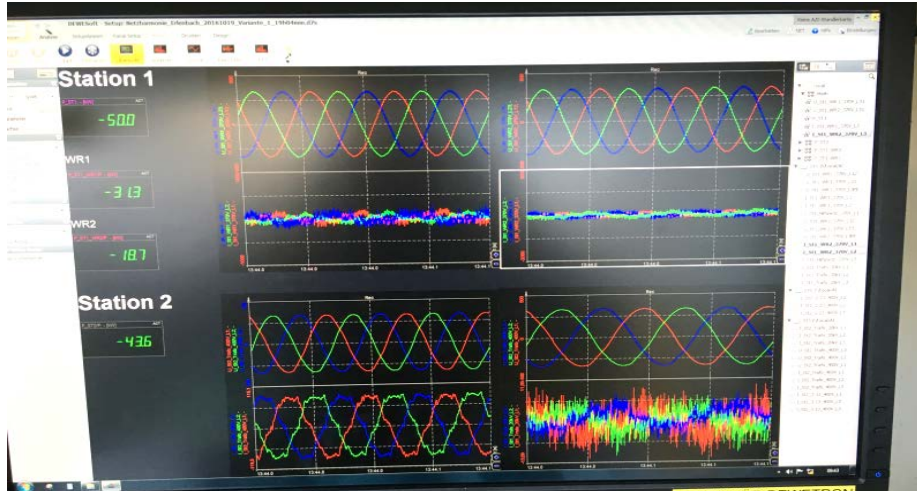


- High precision power measurements up to 5.000 A / 1.000 V
- Sampling rate up to 1.000 kHz
- GPS coordination of up to 96 measurement channels
- Access to Fraunhofer ISE's measurement equipment and expertise

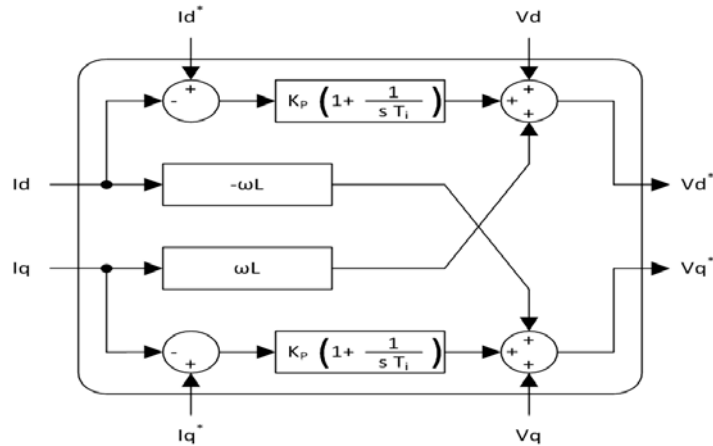
# Analyses at Fraunhofer AC Measurements



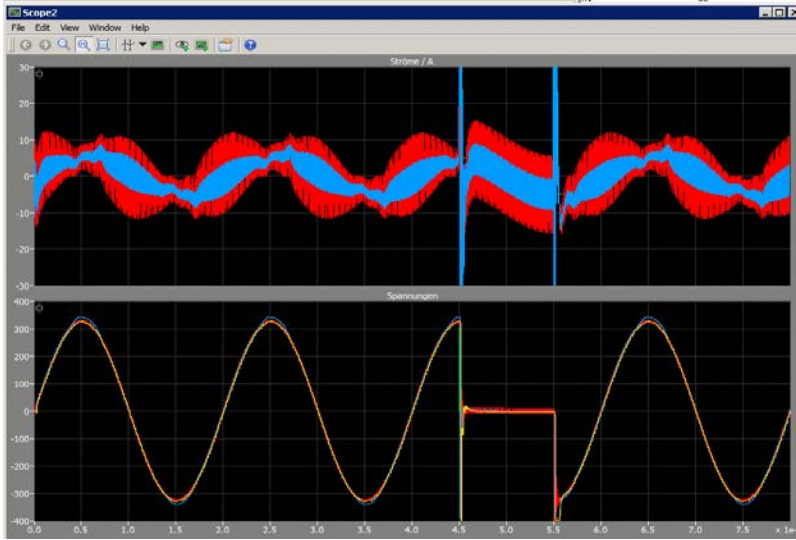
- High precision power measurements up to 5.000 A / 1.000 V
- Resolution up to 1.000 kHz
- GPS coordination of up to 96 measurement channels
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# Analyses at Fraunhofer Modelling

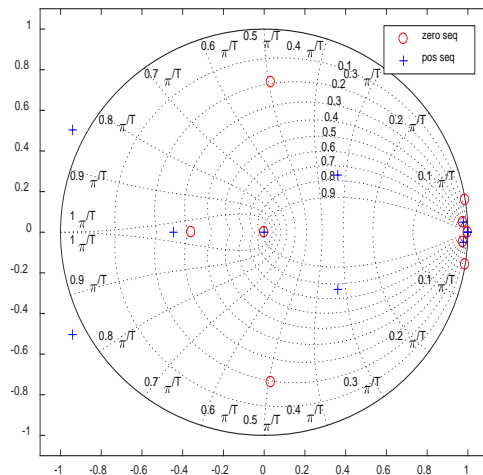
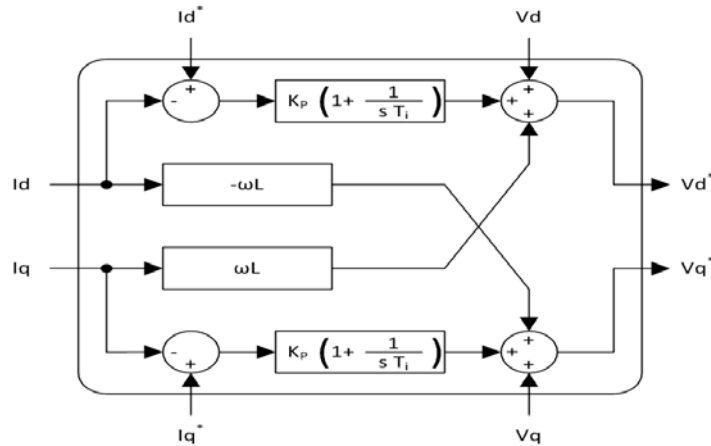


- Stability studies for internal park grids
- Modelling of passive components, power electronic devices, and control



# Solutions

## Controller Optimization




Root Locus Diagram for parameter set A7

- Stability studies for internal park grids
- Modelling of passive components, power electronic devices, and control
- Development of ideal control parameters for stable operation
- Dimensioning of damping elements

# Solutions

## Third party opinion



**Confidencial**

Reporte  
Fraunhofer Chile Research Foundation -  
Center for Solar Energy Technologies (CSET)

**Análisis del comportamiento de la parte AC de**

- Expert assessments on critical topics
- Arbitration of legal disputes and warranty issues
- Neutral expertise, world-wide reputation



## For a Solar Future of Chile

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