

Semester Project

LVPS capacitive load tests

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Overview

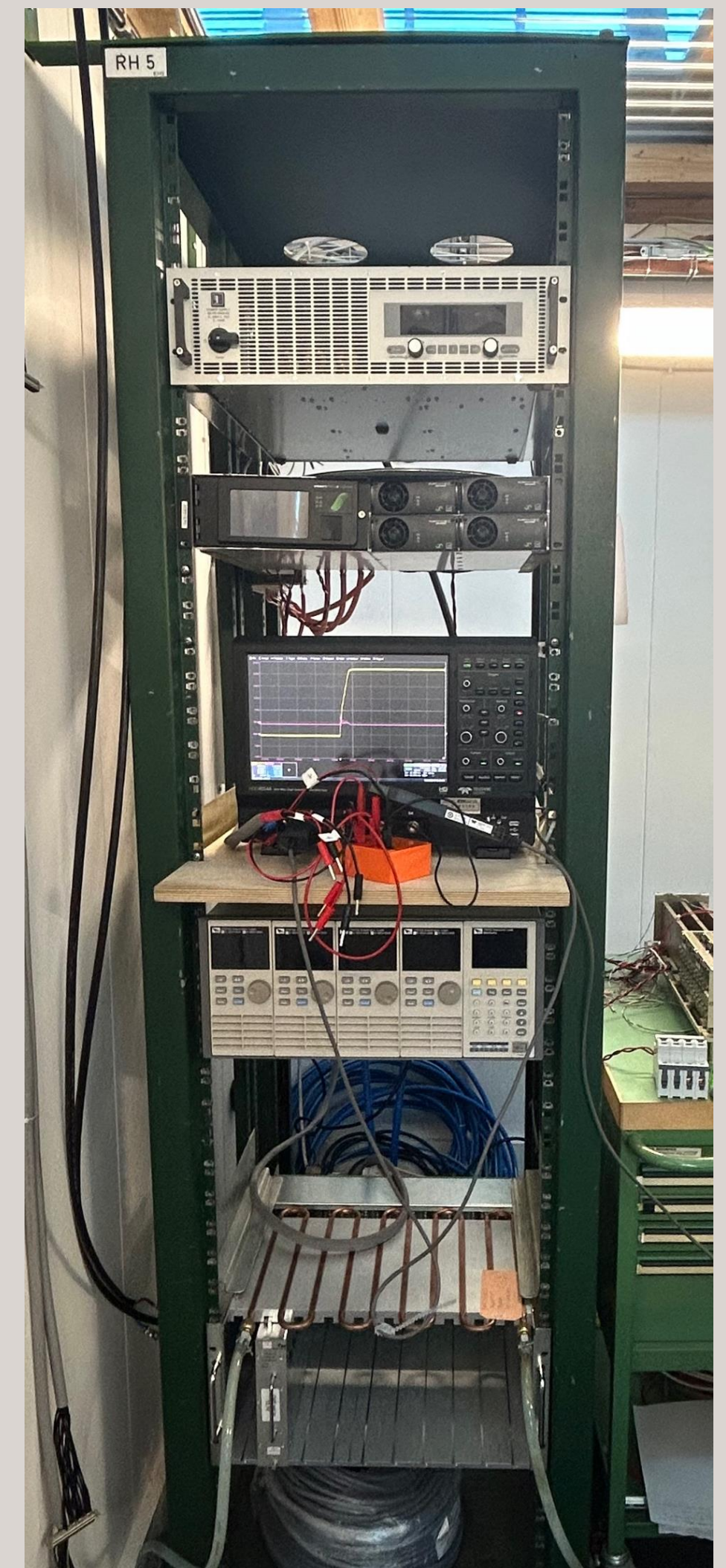
- LVPS
- Measurement setup
- Ramp up speed measurements
 - Ramp up parameter vs. risetime
 - Derivative of ramp up voltage
- Capacitive load measurements
 - First tests
 - Python script
 - Capacitive load tests
- Summary

LVPS

- Second conversion step in the powering concept
- Convert 380 V DC to 12 V DC
- Located in a hazardous environment (radiation and magnetic field)
- Needs strict and redundant OVP

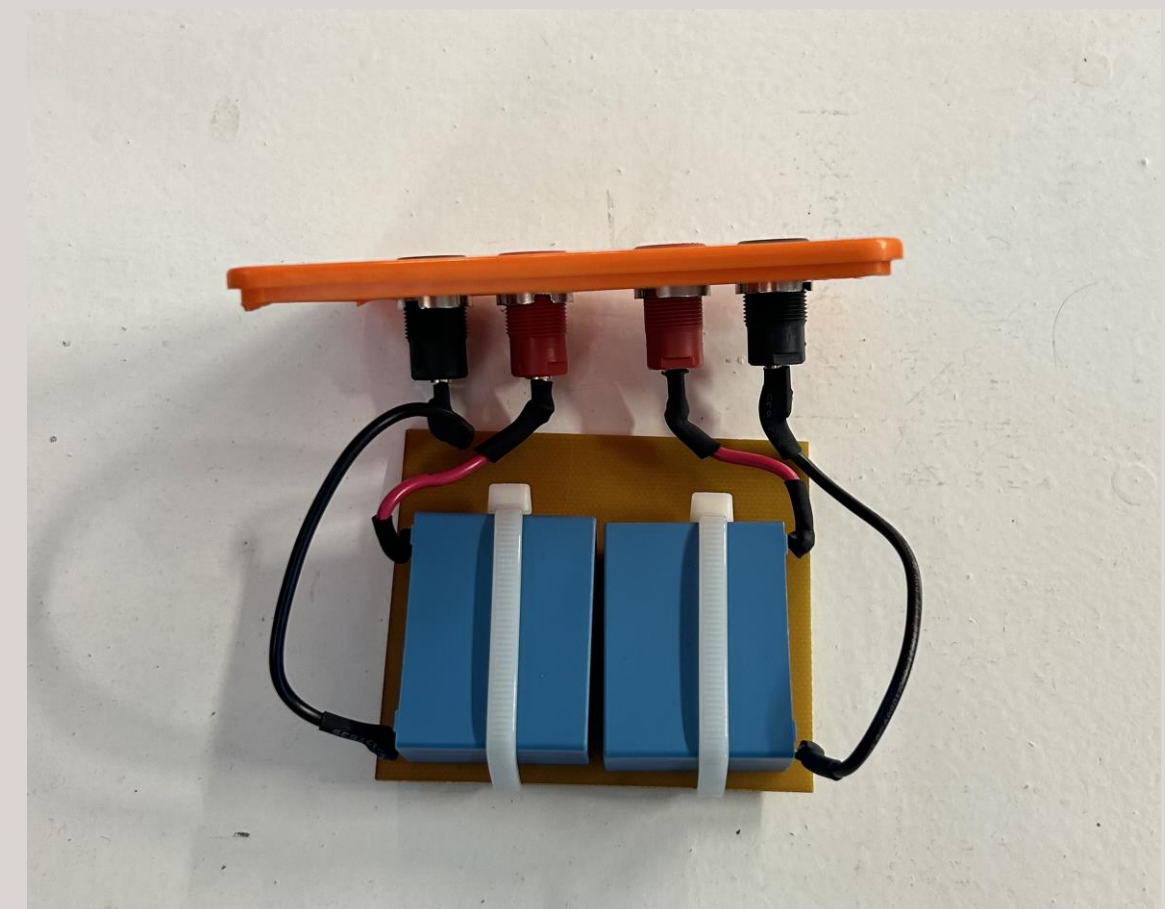
Measurement Setup

- 380 V DC power supply
- Oscilloscope
- LVPS module
- Water cooling

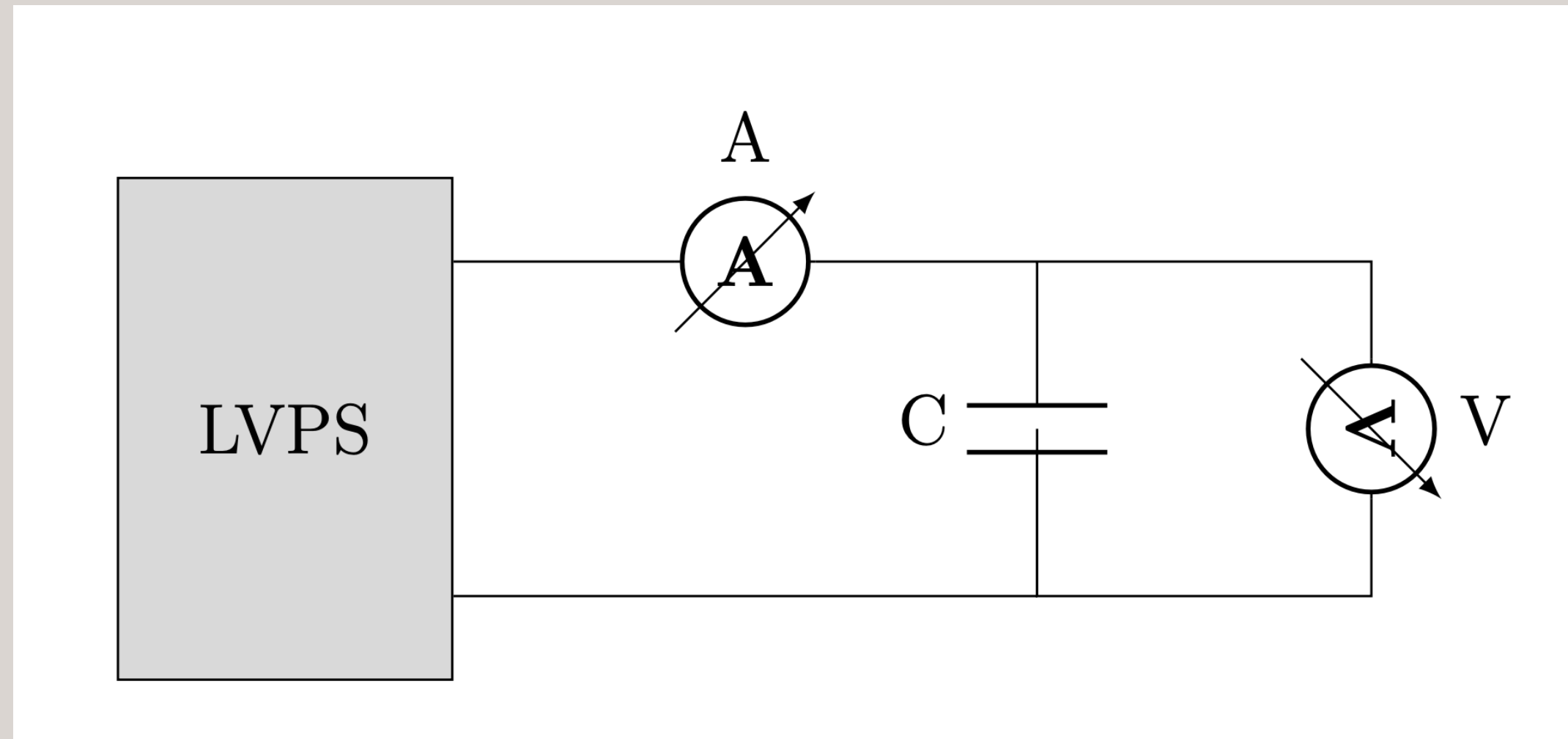


Measurement Setup

- Cable to connect oscilloscope to Module
- Two capacitors with a load of $100\ \mu\text{F}$ connected to banana cable output, can be connected individually, in series ($50\ \mu\text{F}$) or parallel ($200\ \mu\text{F}$)



Measurement Setup

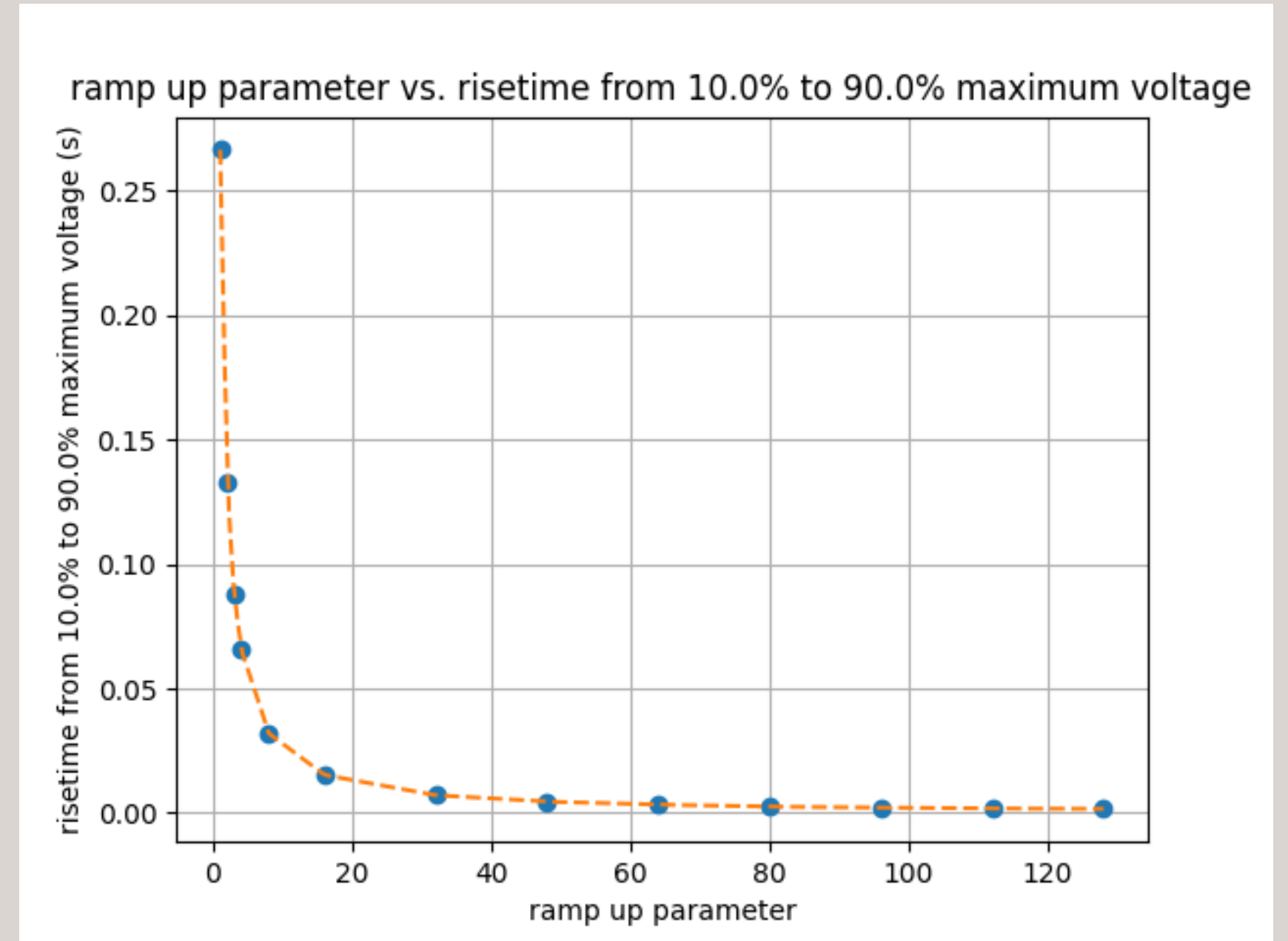
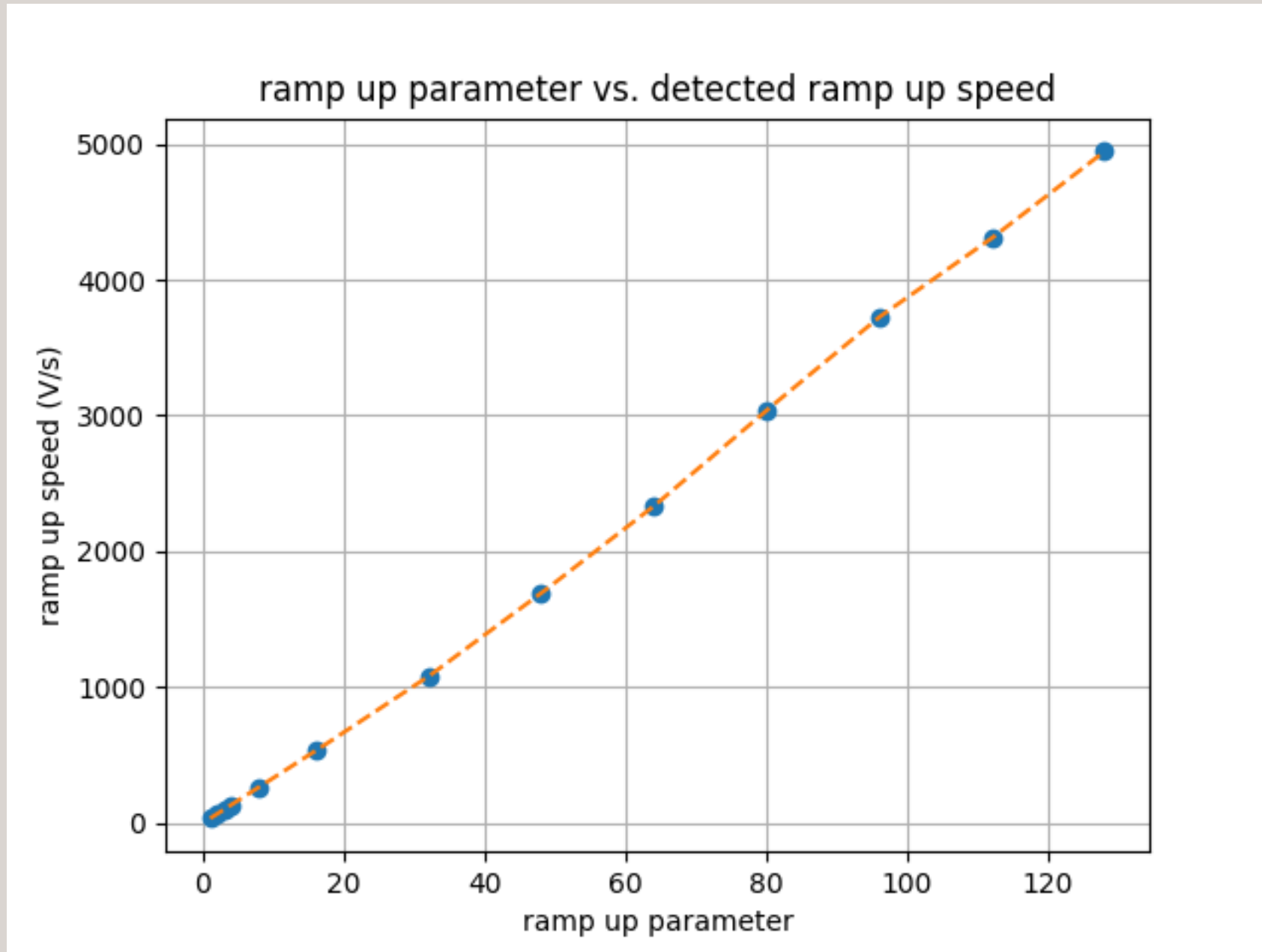


Ramp up speed measurements

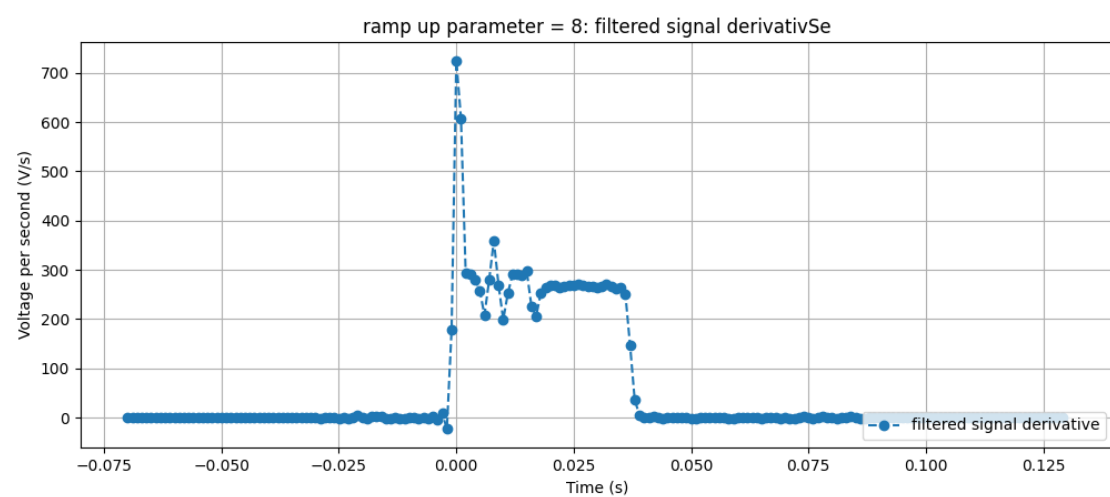
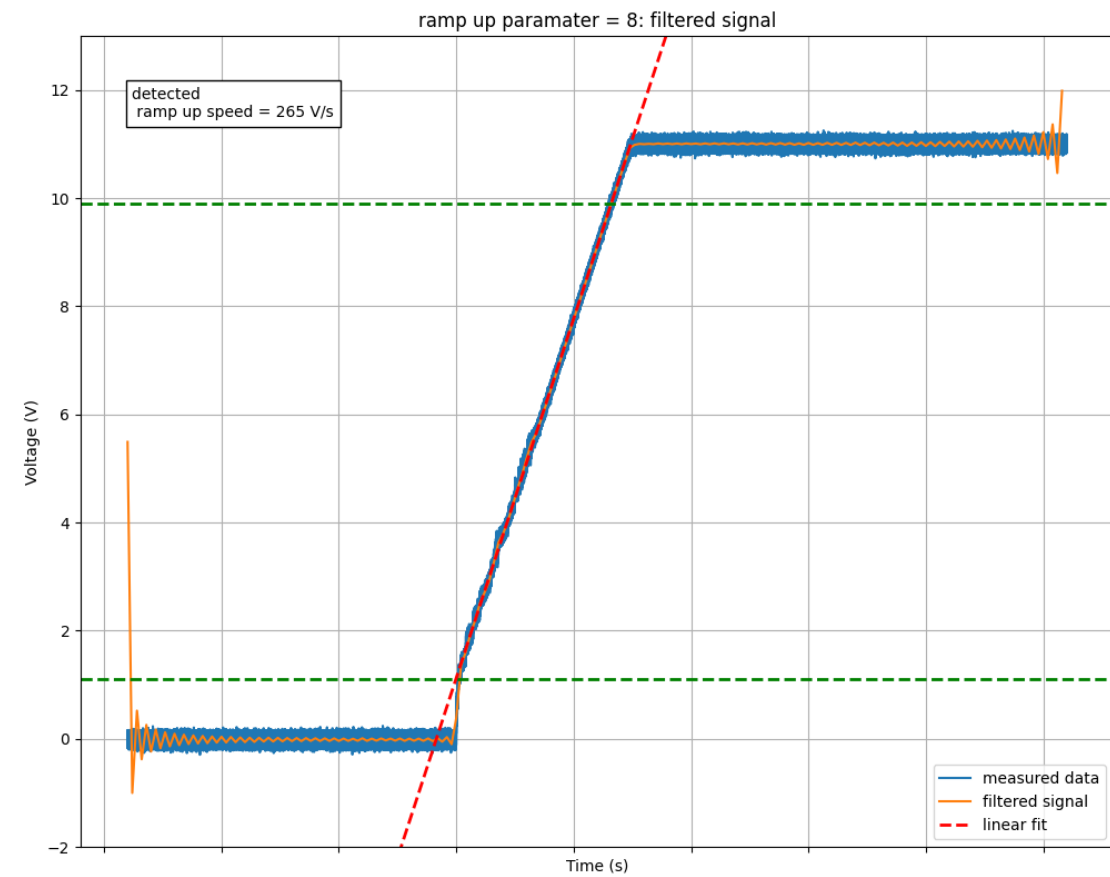
- Measuring voltage waveform at ramp up for 13 ramp up parameters from 1 to 128
- Linear fit for ramp up speed and risetime
- Resample voltage signal to 200 samples
- Derivative of filtered voltage signal using finite differences

Ramp up speed measurements

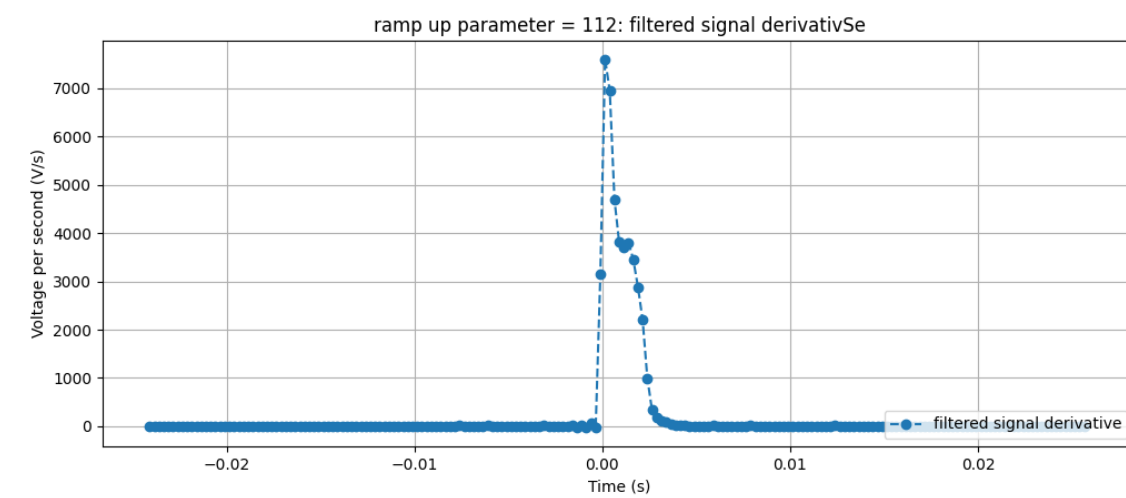
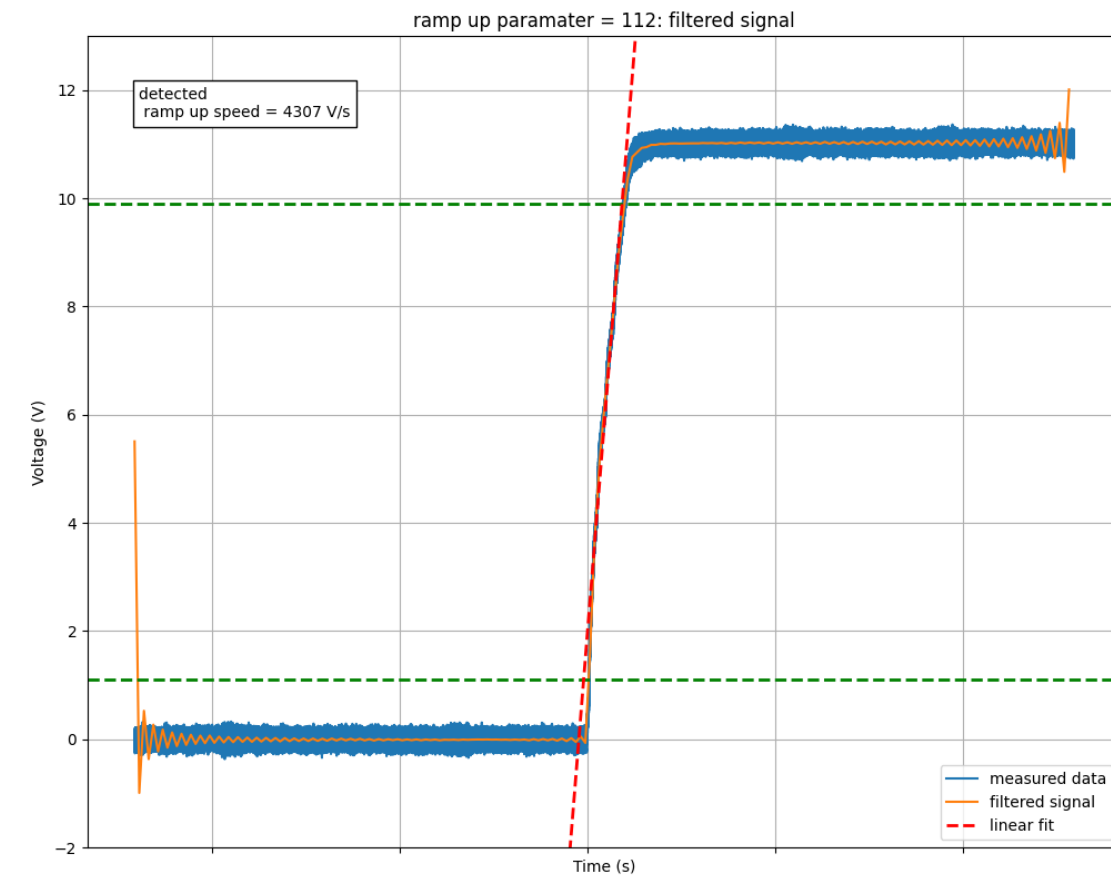
Ramp up parameter vs. risetime



Ramp up speed measurements



Ramp up parameter 8



Ramp up parameter 112

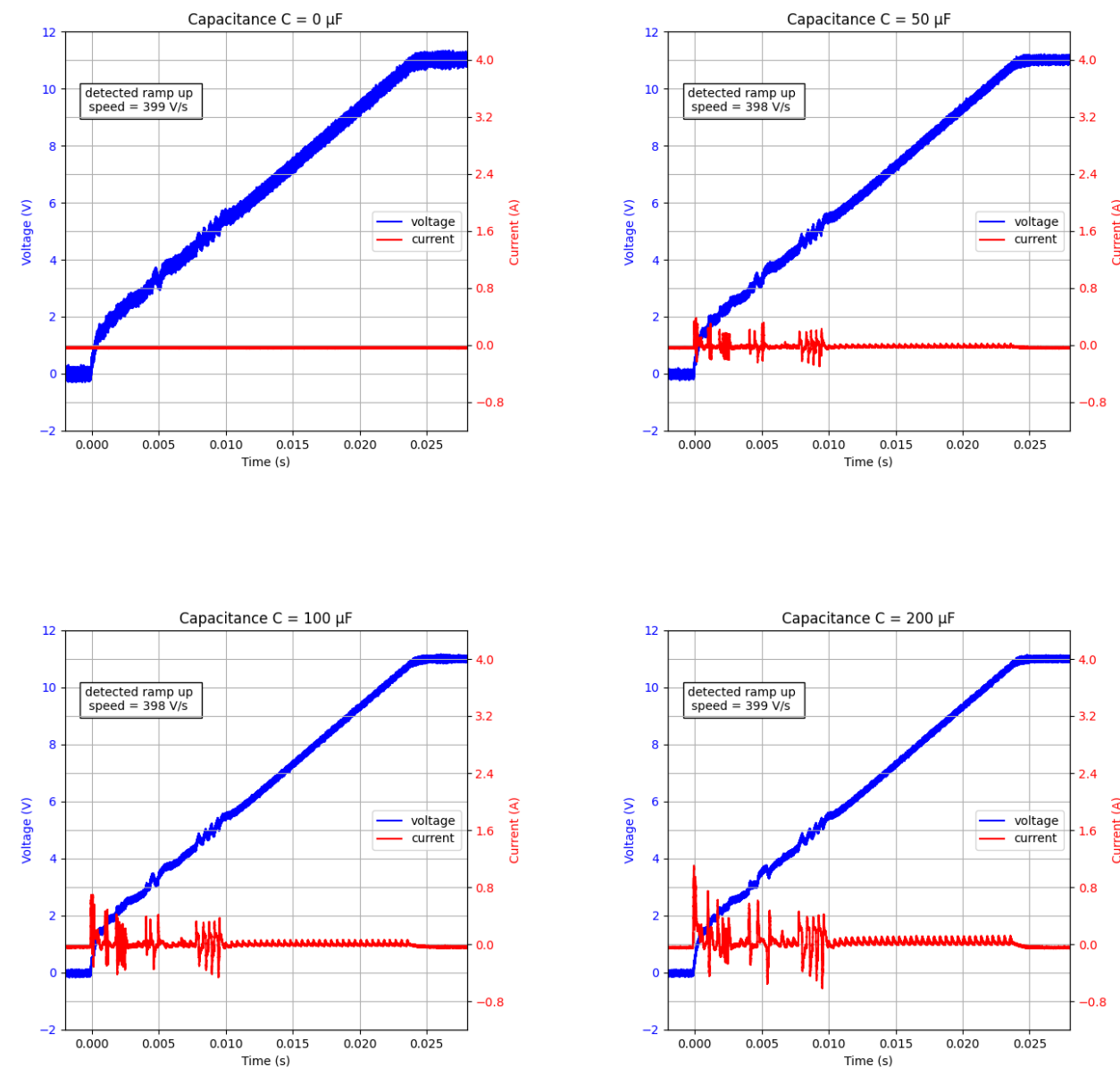
Capacitive load measurements

- First capacitive load tests on channel 1 of module M2
- Python script
- Module M2 tests at two different temperatures
- Module M6 tests

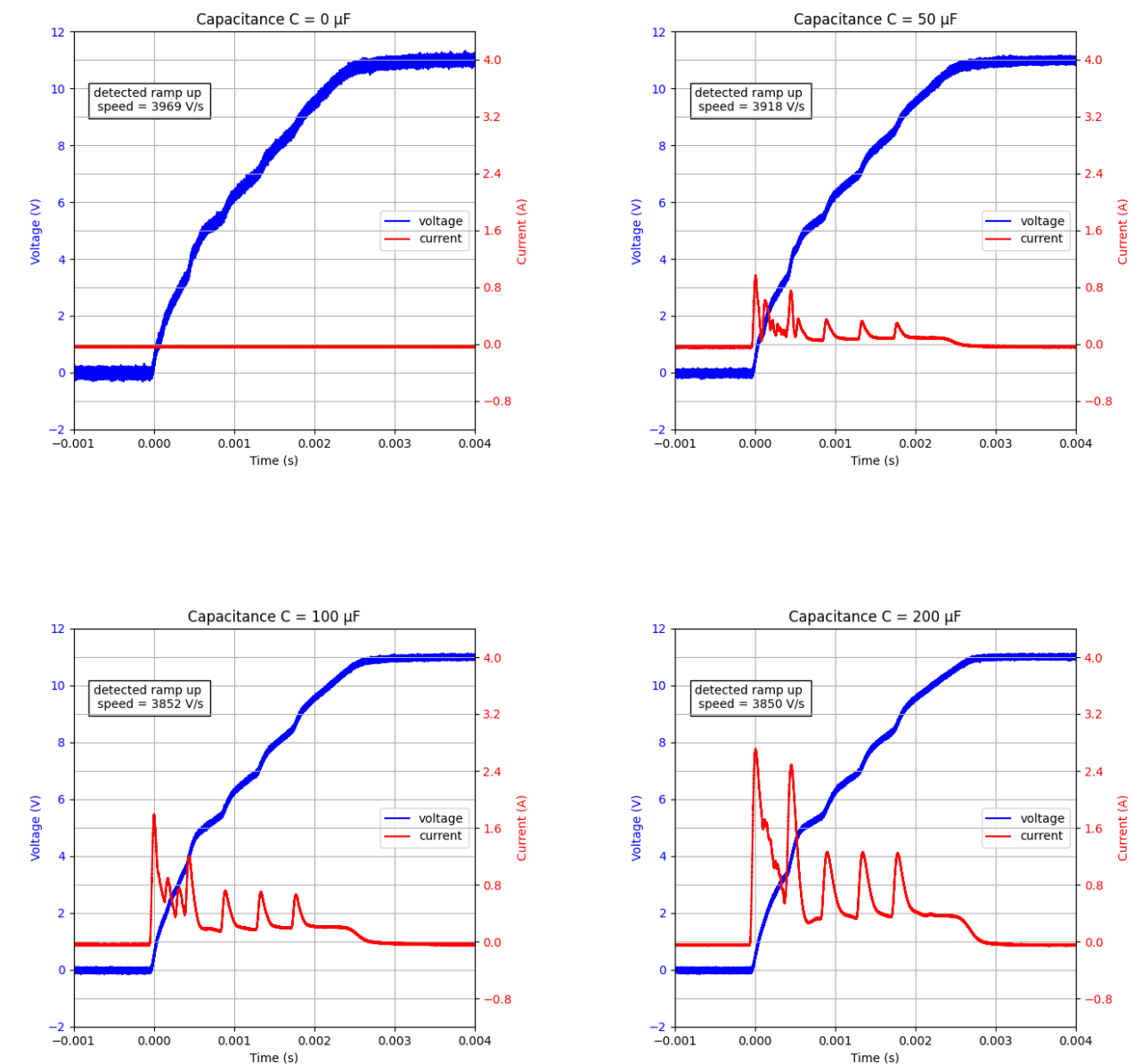
Capacitive load measurements

First capacitive load tests on channel 1 of module M2

rup = 12 Voltage and Current Measurements



rup = 101 Voltage and Current Measurements



Capacitive load measurements

Python script

- Set trigger and panel settings on oscilloscope remotely
- Remotely turn on channels for chosen parameters (output voltage, ramp up parameter, OCP)
- Plot voltage and current waveform and computed ramp up speed for channels that did not trip

Capacitive load measurements

Module M2 tests at two different temperatures

- Output voltages:

- 10 V
- 11 V
- 12 V*

- Ramp up parameters:

- 12
- 101

- OCP limits:

- 0.5 A
- 1 A
- 1.5 A
- 2.5 A

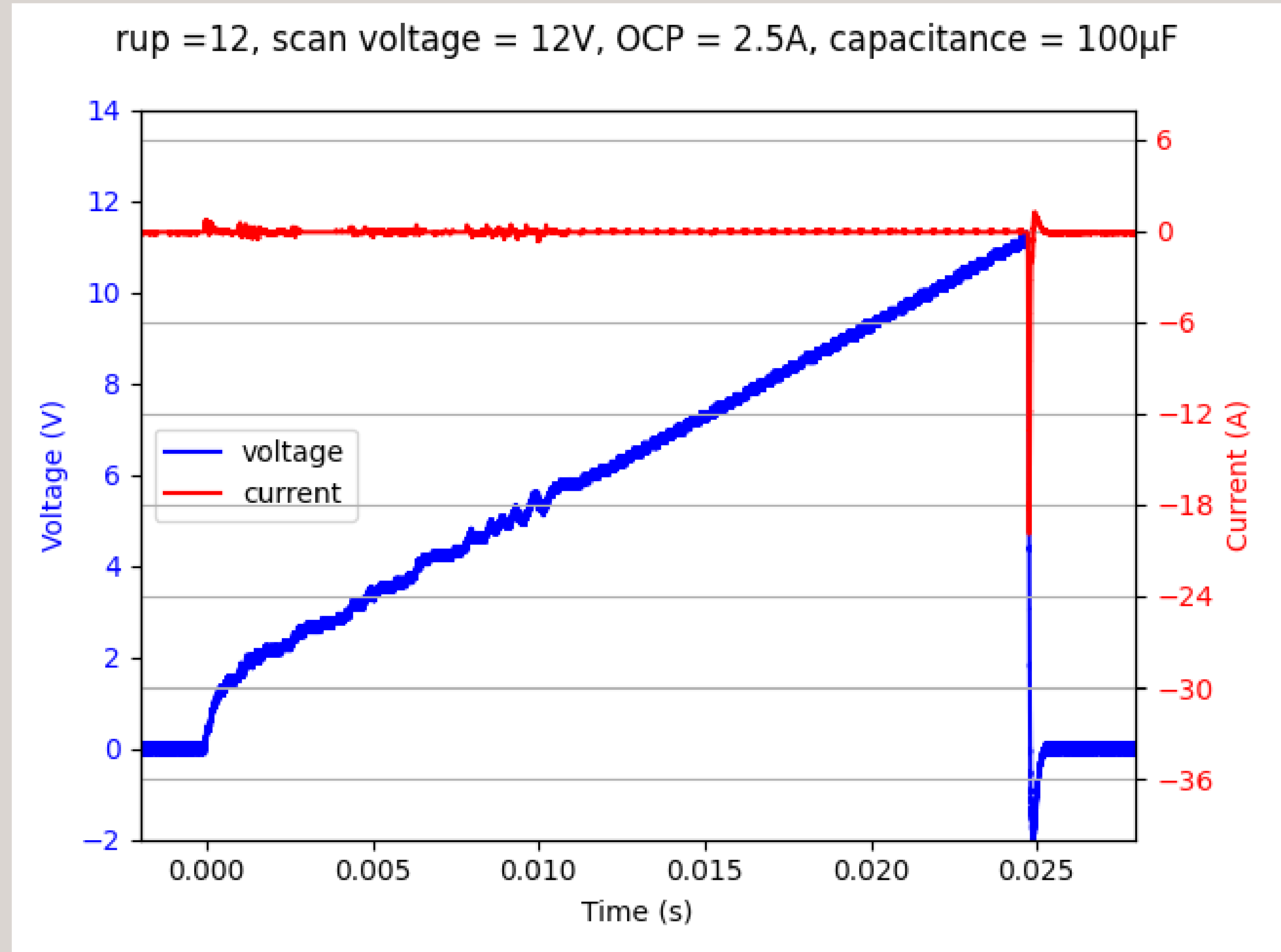
Capacitive load measurements

- Measure all channels for a capacitive load of 200 μF
- For those parameters for which the channel didn't manage to turn on, lower capacitance to 100 μF
- Do the same again for 50 μF

Capacitive load measurements

- Sudden voltage drop before 12 V was reached

-> OVP



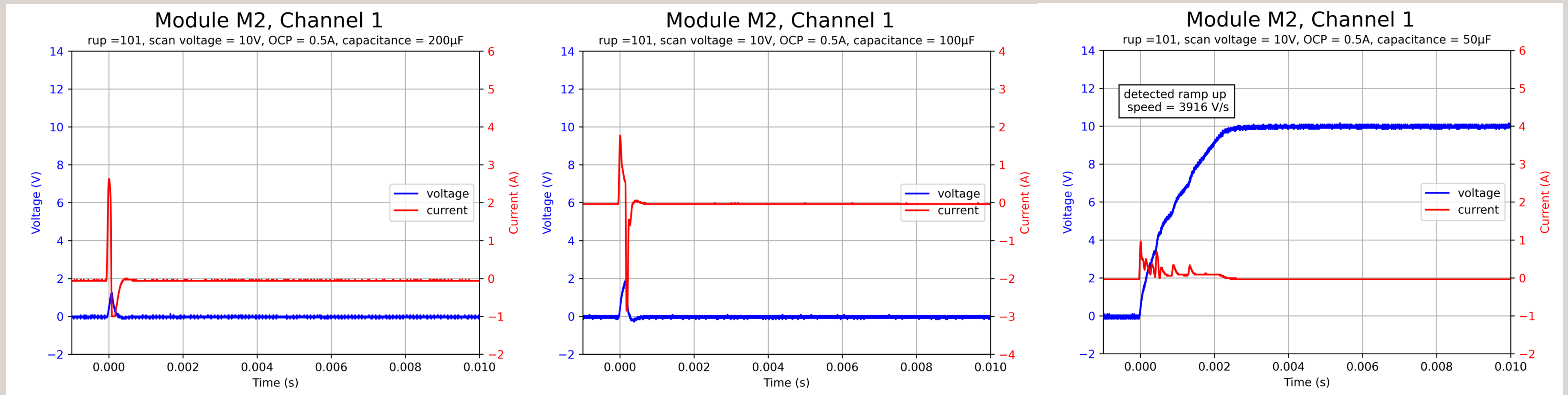
Capacitive load measurements

Module M2 measurements at room temperature

- Load of 200 μF :
 - Ramp up parameter 101 and OVP 0.5 A and 1 A fail
- Load of 100 μF :
 - Ramp up parameter 101 and OVP 0.5 A still fails
- Load of 50 μF :
 - All channels turn on for all parameter settings

Capacitive load measurements

Module M2 measurements at room temperature



200 μF

100 μF

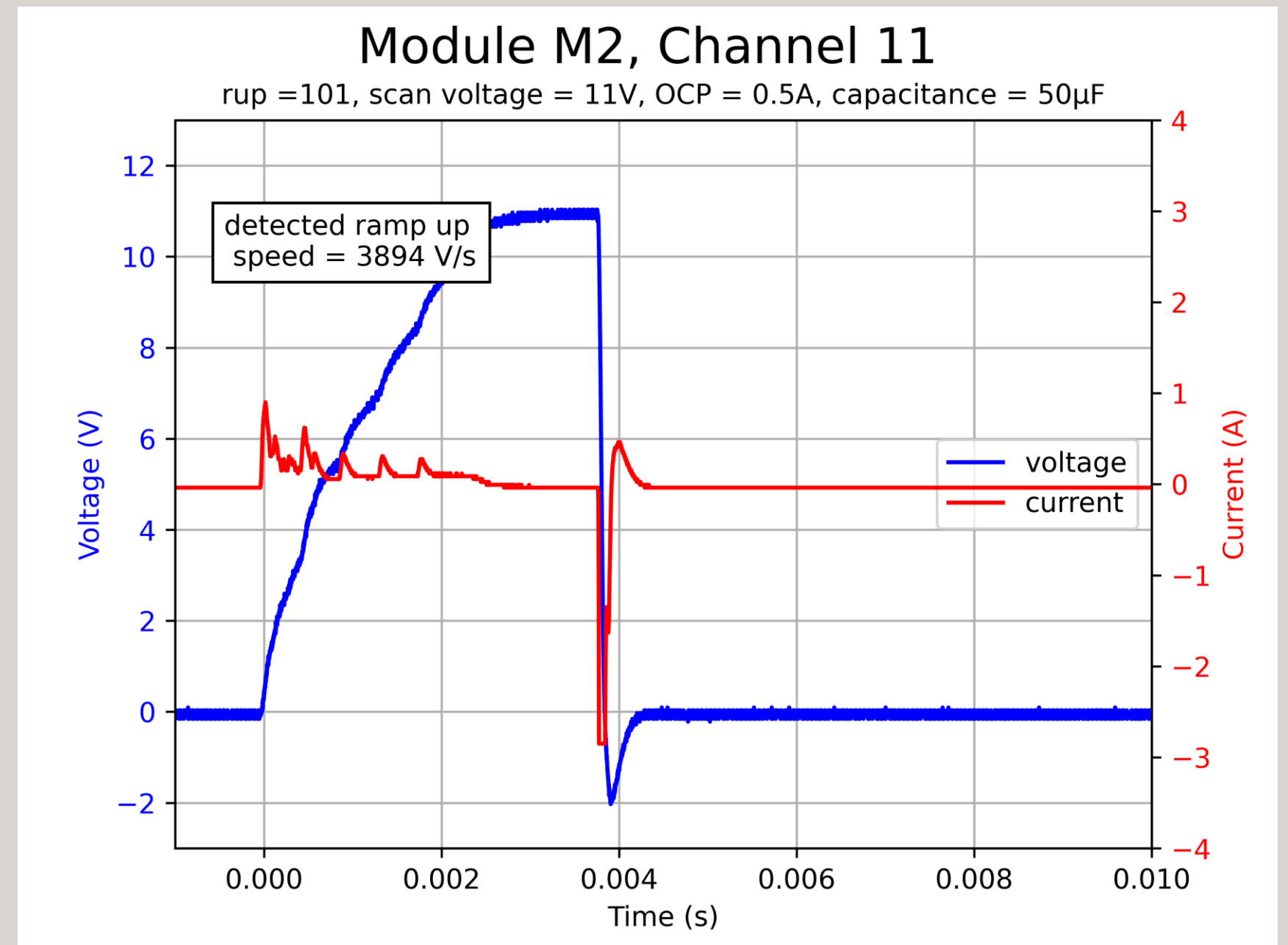
50 μF

Capacitive load measurements

Module M2 measurements at room temperature

- Channel 11 trips for 11 V and OCP 0.5 A at every capacitive load

→ OVP lower than for other channels



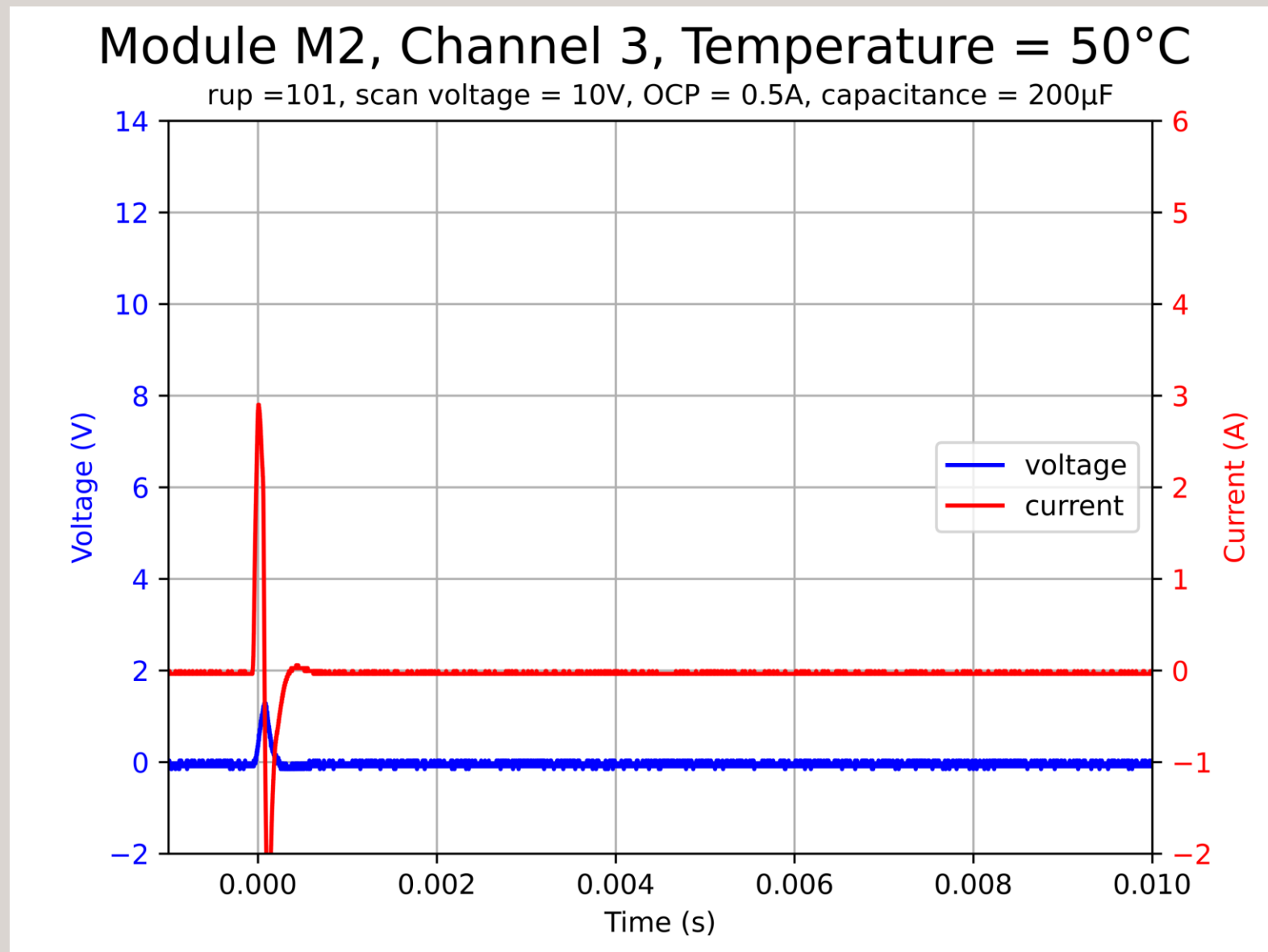
Capacitive load measurements

Module M2 measurements at $\sim 50^{\circ}\text{C}$

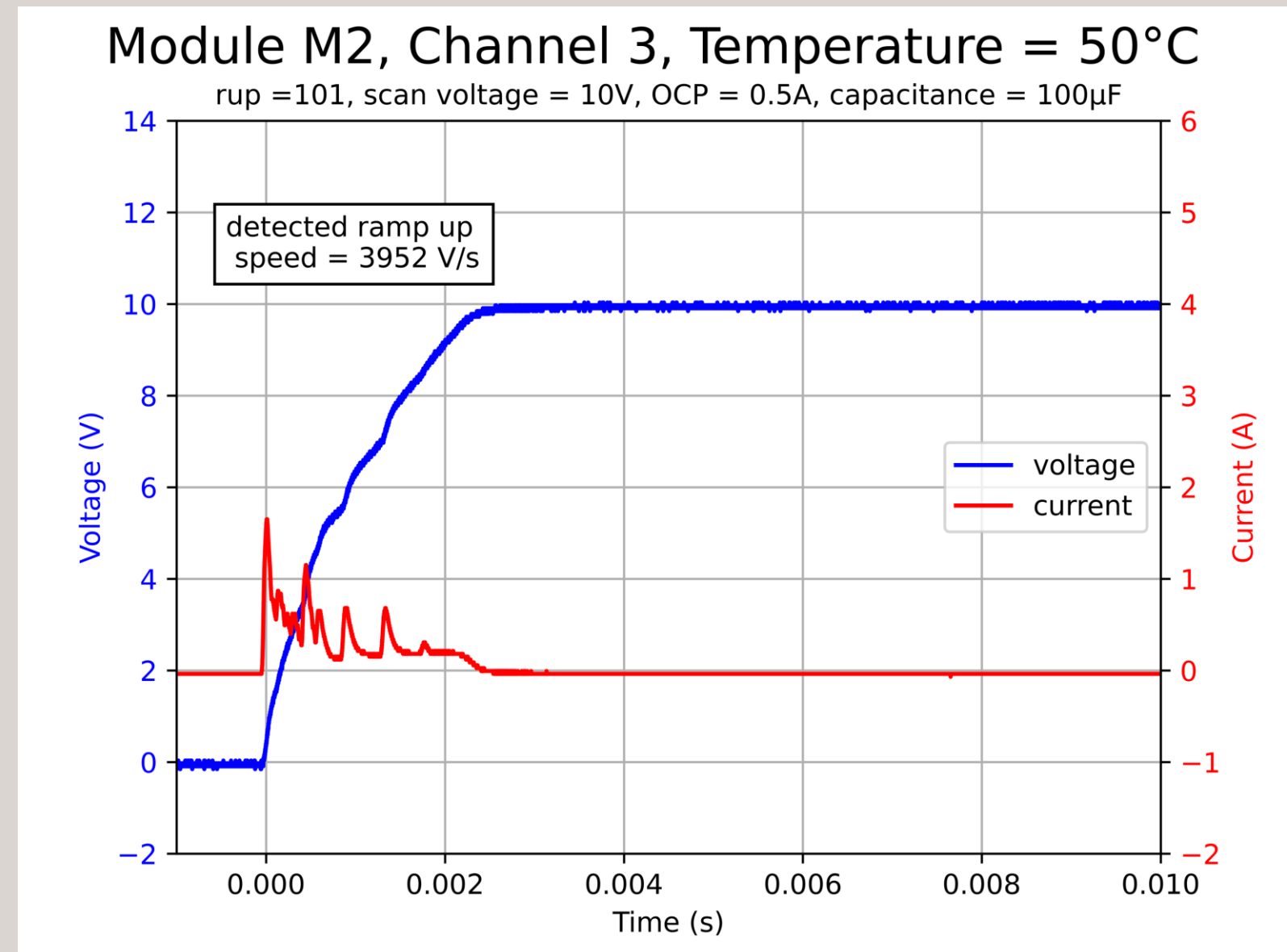
- Load of $200\ \mu\text{F}$:
 - No difference to 20°C
 - (Ramp up parameter 101 and OCP 0.5 A and 1 A fail)
- Load of $100\ \mu\text{F}$:
 - Channel 3, 4, 8, 9, 10, 11, 12 turned on at $100\ \mu\text{F}$ for every parameter setting
- Load of $50\ \mu\text{F}$:
 - No difference to 20°C
 - (All channels turn on for all parameter settings)

Capacitive load measurements

Module M2 measurements at $\sim 50^\circ\text{C}$



$200\ \mu\text{F}$

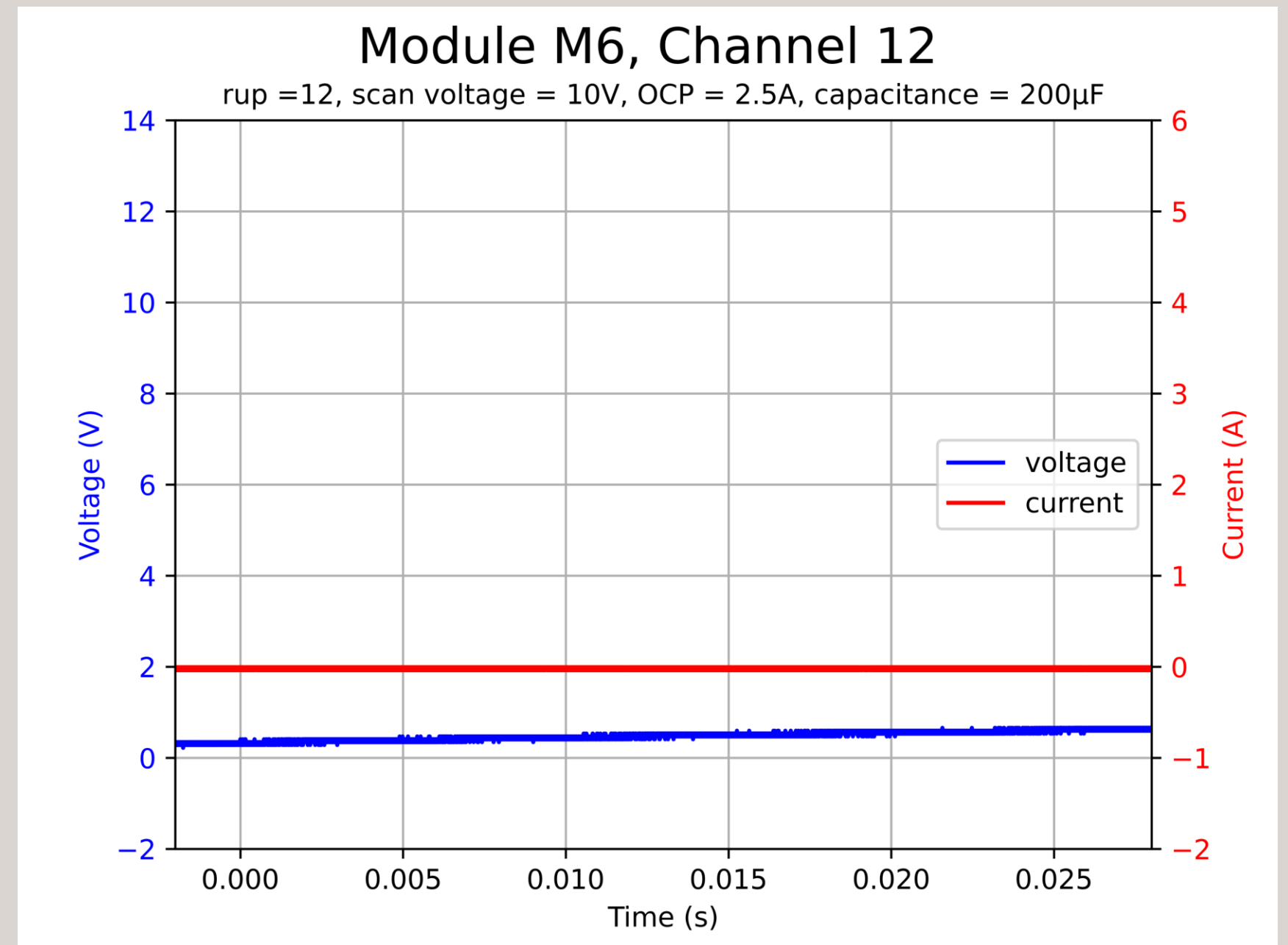


$100\ \mu\text{F}$

Capacitive load measurements

Module M6 measurements at room temperature

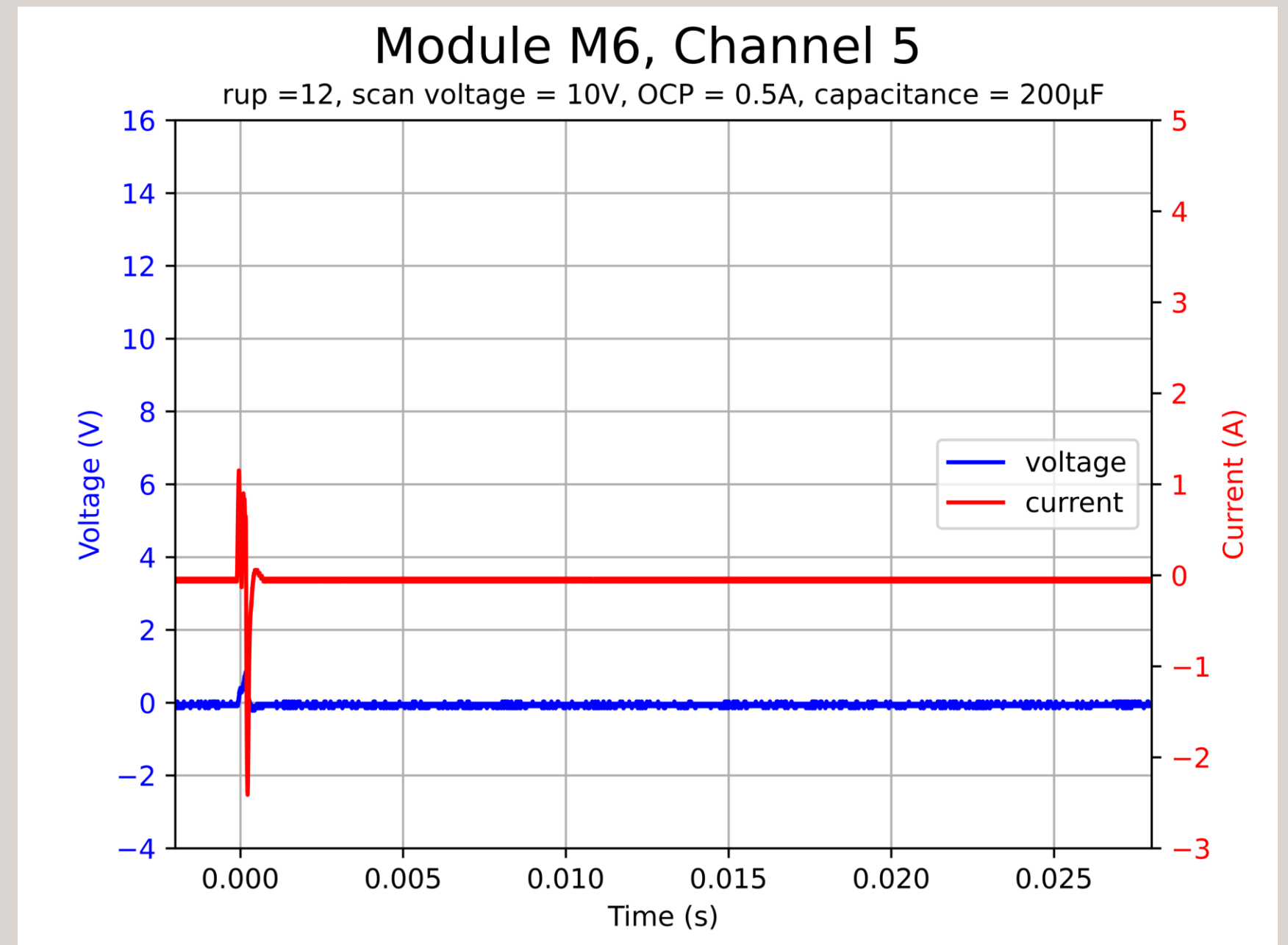
- It was confirmed that Channel 12 is broken



Capacitive load measurements

Module M6 measurements at room temperature

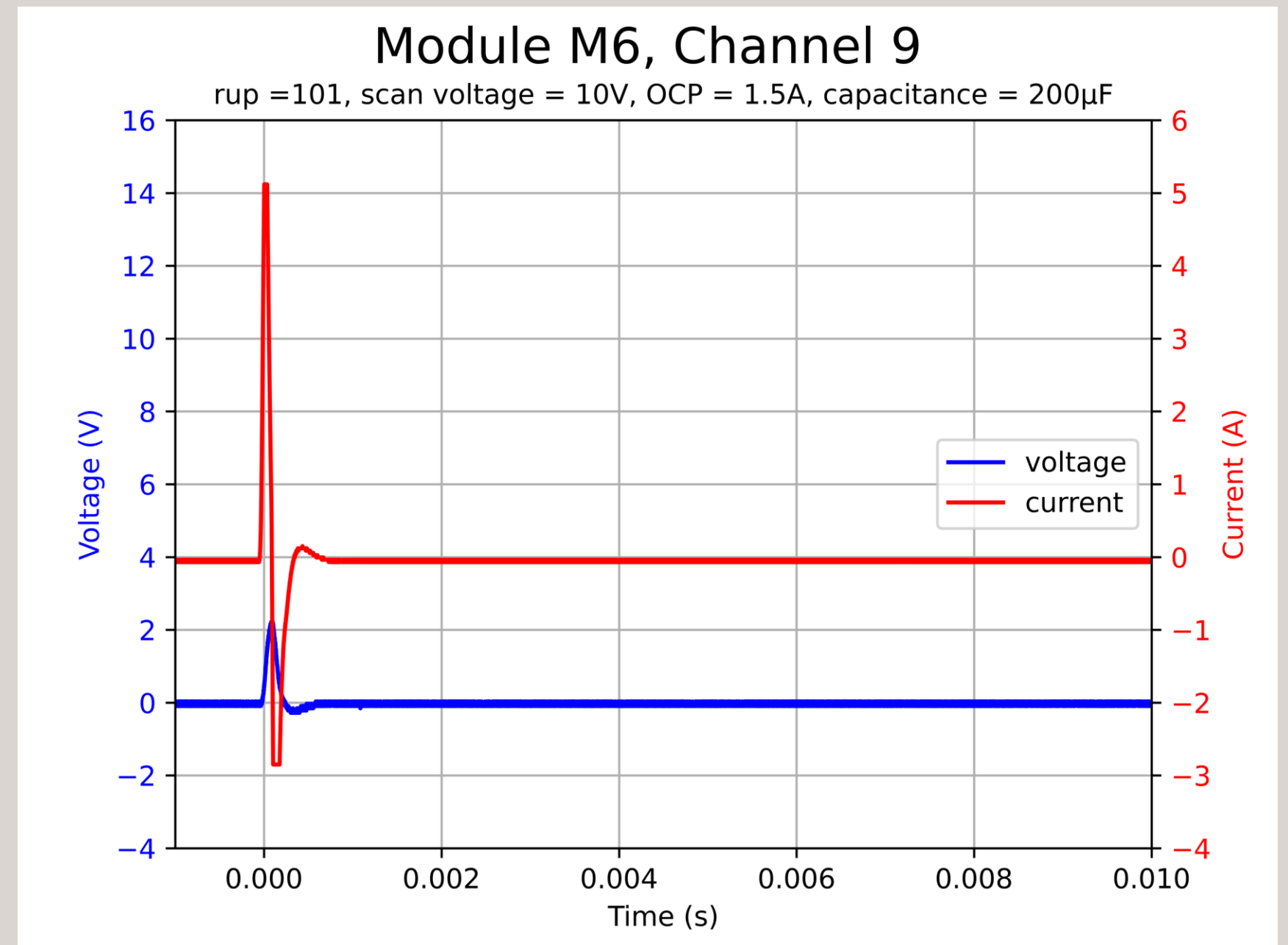
- Channel 5 tripped at lower ramp up parameter 12 for OCP limit 0.5 A and 200 μF



Capacitive load measurements

Module M6 measurements at room temperature

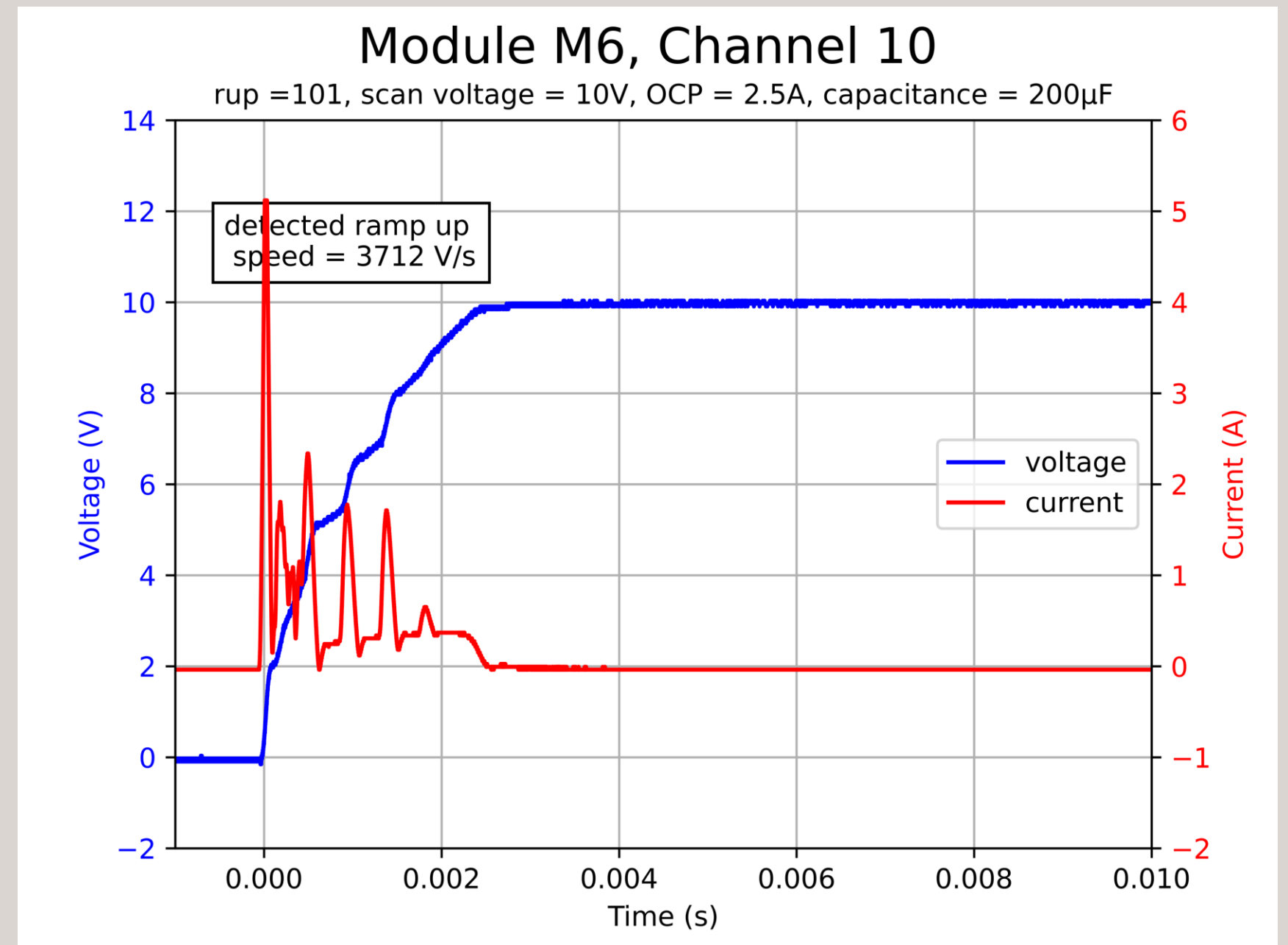
- Channel 9 tripped at ramp up parameter 101 for OCP 1.5 A and 200 μF



Capacitive load measurements

Module M6 measurements at room temperature

- Higher inrush current for channels 5, 9 and 10



Summary

- Script which scales ramp up parameters to standard units is ready to be reused in the future
- Script to remotely acquire waveforms from oscilloscope
- OCP is temperature dependent and at higher temperature higher inrush current is permitted
- OCP may trip due to inrush current, if the current is 3 times higher than the OCP settings

Thank you!