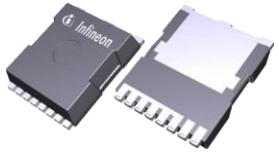
Dual Gate MOSFET 48 V switch board
Quick introduction Board V2.2

IFAG ATV MOS

24.09.2024

SOA and RDSON comparison
Dual Gate trench vs. Standard trench vs. Planar

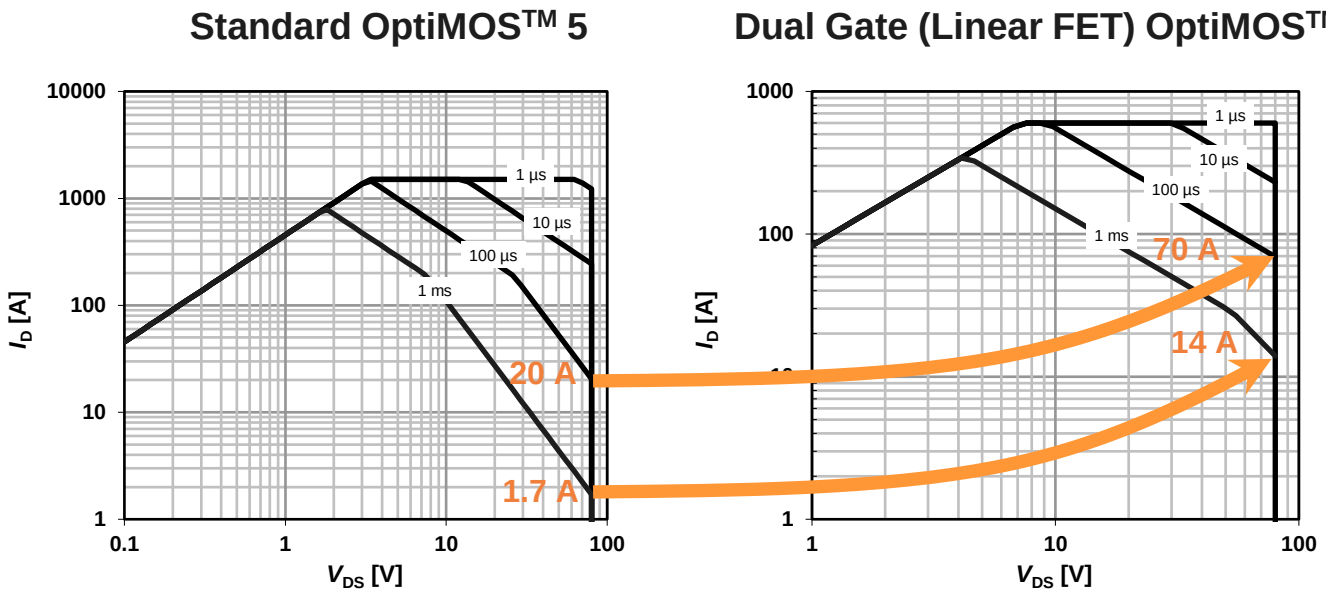


	IAUTN08S5N012L Dual Gate 80 V OptiMOS™ 5 Trench technology	IAUT300N08S5N011 Standard 80 V OptiMOS™ 5 Trench technology	IPB80N08S2-07 Standard 80 V OptiMOS™ Planar technology
SOA 1 ms at max V_{DS}, T_C = 25°C	14 A (Linear MOSFET)	1.7 A	14 A
R_{DSON} at V_{GS} = 10 V, T_J = 25°C	1.15 mΩ (Linear and On MOSFET)	1.10 mΩ	7.1 mΩ
Package footprint	TOLL (10x12x2.3 mm³)	TOLL (10x12x2.3 mm³)	D2PAK (15x11x4.4 mm³)

Combining the best of 2 worlds with Dual Gate

Reaching levels of Planar MOSFET SOA, maintain low R_{DSON} and small solution size of trench technology

SOA comparison
Standard OptiMOS™ 5 vs. Dualgate Linear FET OptiMOS™ 5

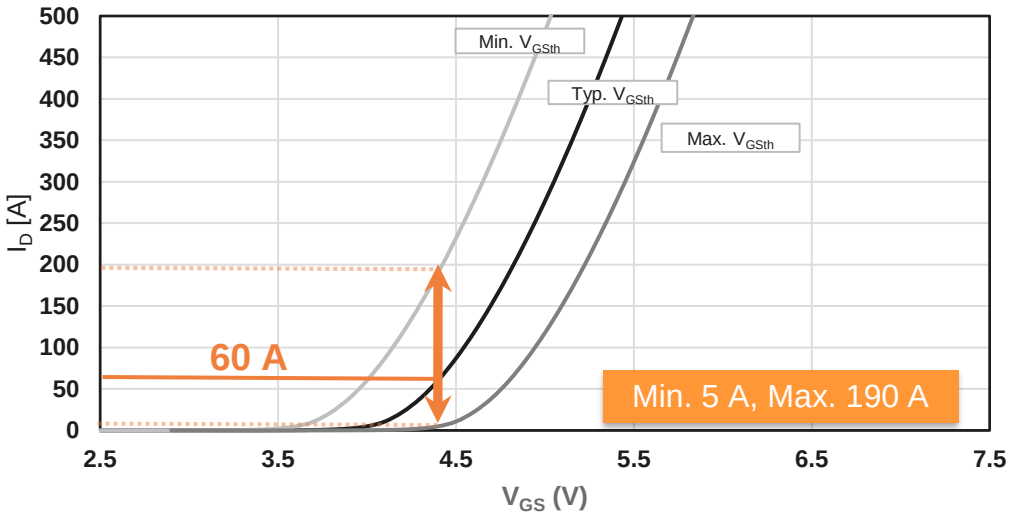


Dual Gate (Linear FET) SOA significantly larger at high V_{DS}

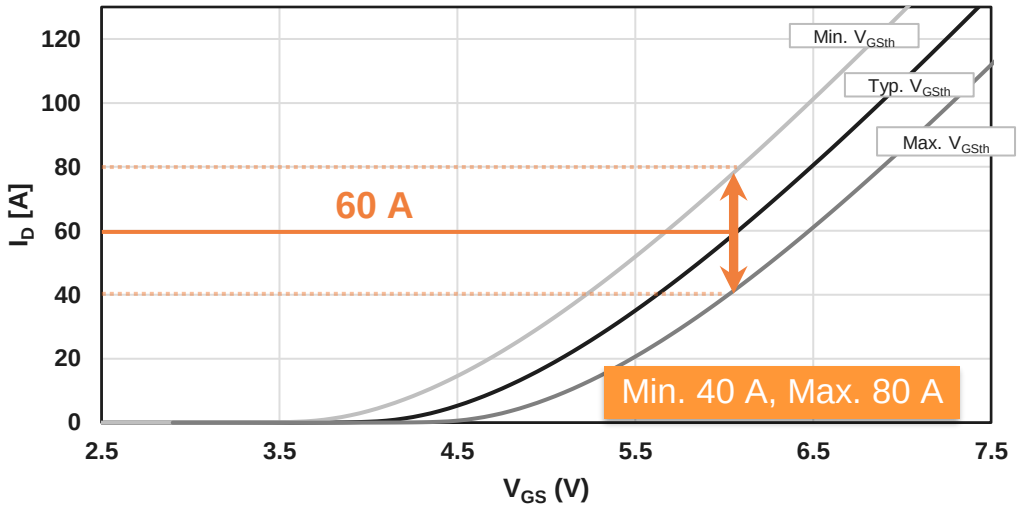
Enabling new applications as e.g. in-rush current limitation, short circuit clamping and slow switching

Transfercharacteristics comparison
Standard OptiMOS™ 5 vs. Dualgate Linear FET OptiMOS™ 5

Standard OptiMOS™ 5



Dual Gate (Linear FET) OptiMOS™ 5



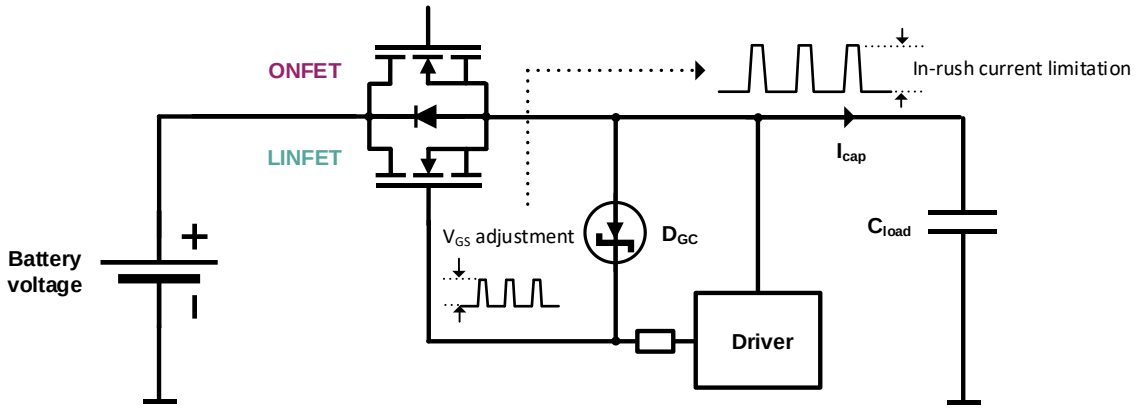
Dual Gate (Linear FET) improved current accuracy due to low transconductance and process variation

Enabling paralleling in linear mode operation

Dual Gate MOSFET 80 V
Application examples

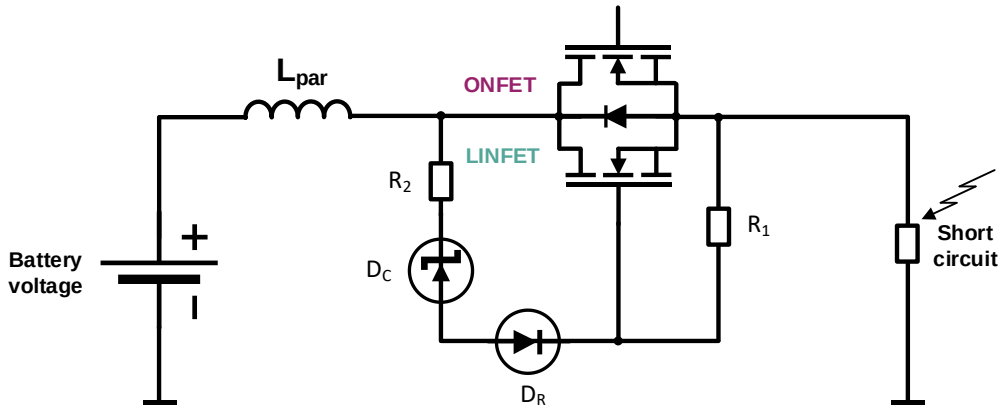
Capacitor charging

- LINFET current limited via V_{GS} adjustment according to transfer-characteristics.
- Pulsed capacitor charging to limit self-heating.
- Flexible control of PWM and switching speed.
- ONFET can be turned on to minimize steady state losses after capacitor is fully charged.



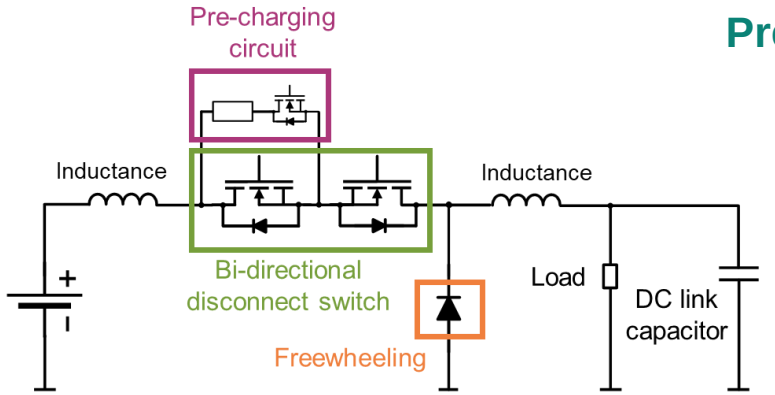
Short circuit clamping

- D_C limits the V_{DS} voltage to avoid avalanche and instead the MOSFET operates in linear mode.
- LINFET allows higher currents in linear mode and paralleling for clamp circuit designs. Protection components (e.g. TVS diodes) can be saved.
- ONFET can be turned on to minimize steady state losses during normal operation.

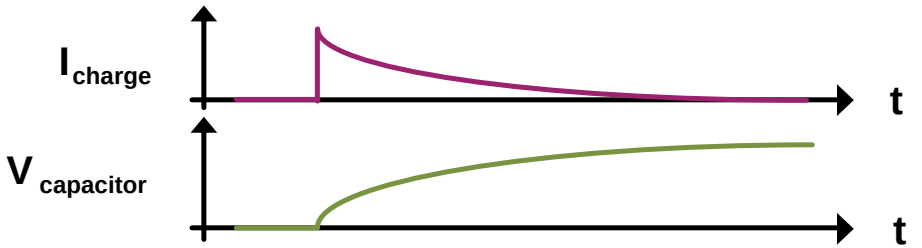


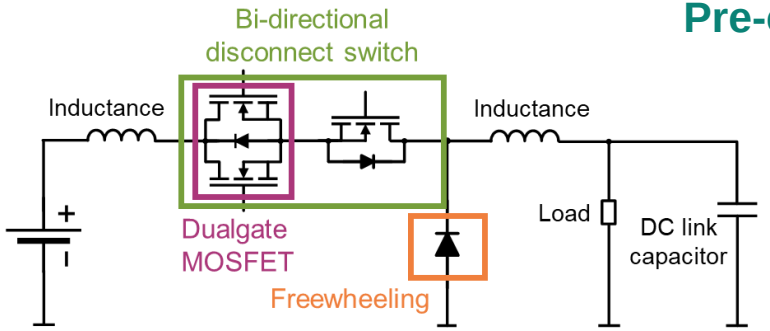
Dual Gate MOSFET 80 V
Capacitor pre-charging with power resistor vs. Dual Gate MOSFET

Reduction of system cost (no pre-charge circuit needed) and acceleration of capacitor charging

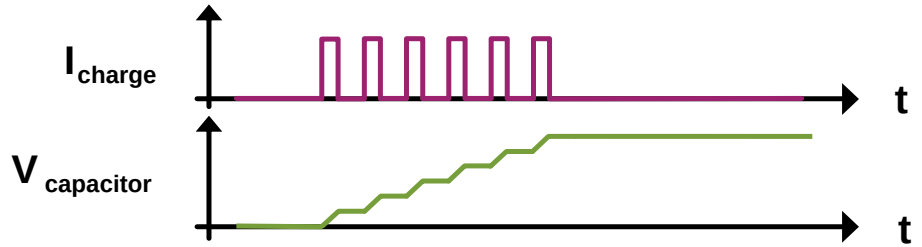


Pre-charging with power resistor





Pre-charging with Dual Gate MOSFET



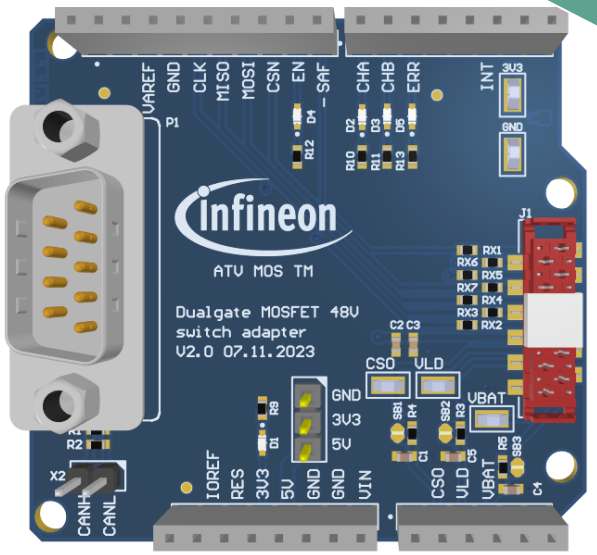
Dual Gate MOSFET 80 V
48 V switch board (uni-directional) overview

2 channel 48V high-side driver IC 2ED4820

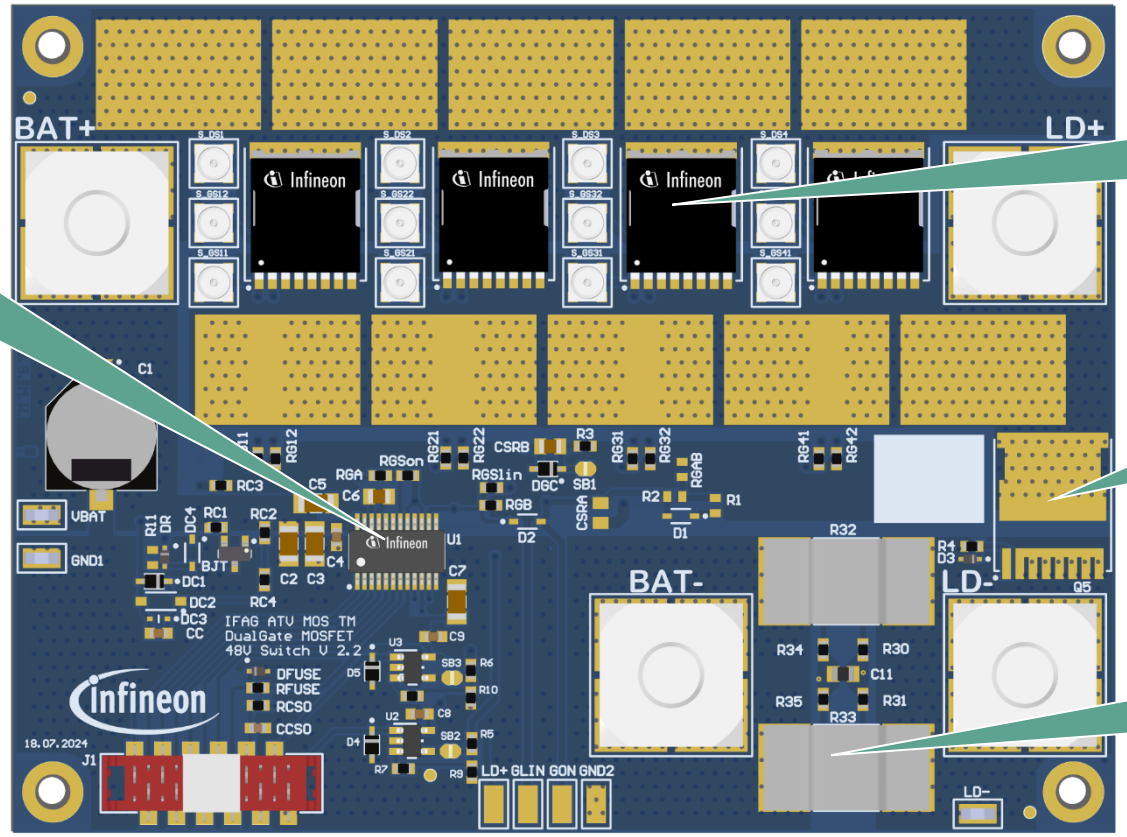
4 parallel IAUTN08S5N012L max. 1.15 mΩ each

Freewheeling MOSFET (optional)

100 µΩ shunts (each)



Adapter Board



Main Board

48V DISCONNECT SWITCH

A 48V disconnect switch with 80V OptiMOS™ 5 Dual Gate MOSFETs

The 48V switch evaluation board **supports fast pulsed capacitor charging** with Dual Gate MOSFETs, to **minimize system costs** (no separate pre-charging path needed). The board **is active clamping capable** to **dissipate inductive energy from cable harness**. **The Dual Gate MOSFET operates in linear mode** instead of avalanche to increase short circuit robustness.

Summary of Features

- For 48 V disconnect switch application
- Acceleration of capacitor charging
- Reduction of system cost

Benefits

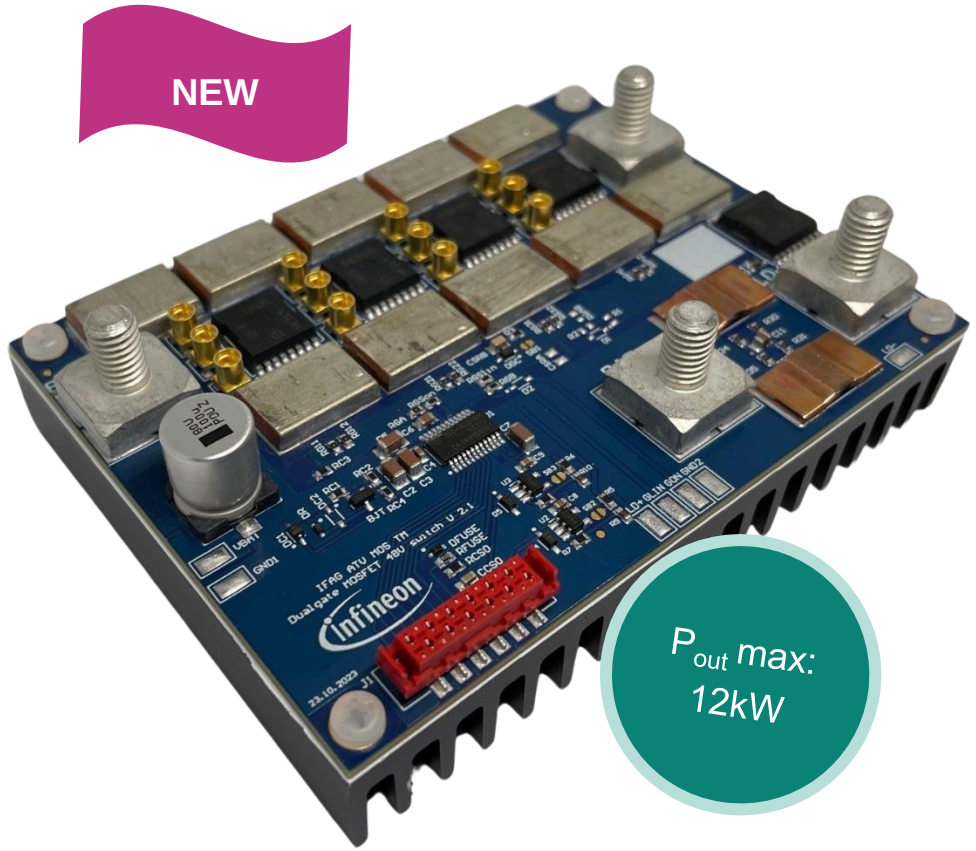
- Fast pulsed capacitor charging
- No separate pre-charging path needed
- Active clamping capable
- Linear mode operation
- Increased short circuit robustness

Potential Applications

- Power distribution
- Battery management
- Electrically heated catalyst

Components

- Dual Gate MOSFET 80V IAUTN08S5N012L
- 48 V high-side driver: 2ED4820-EM



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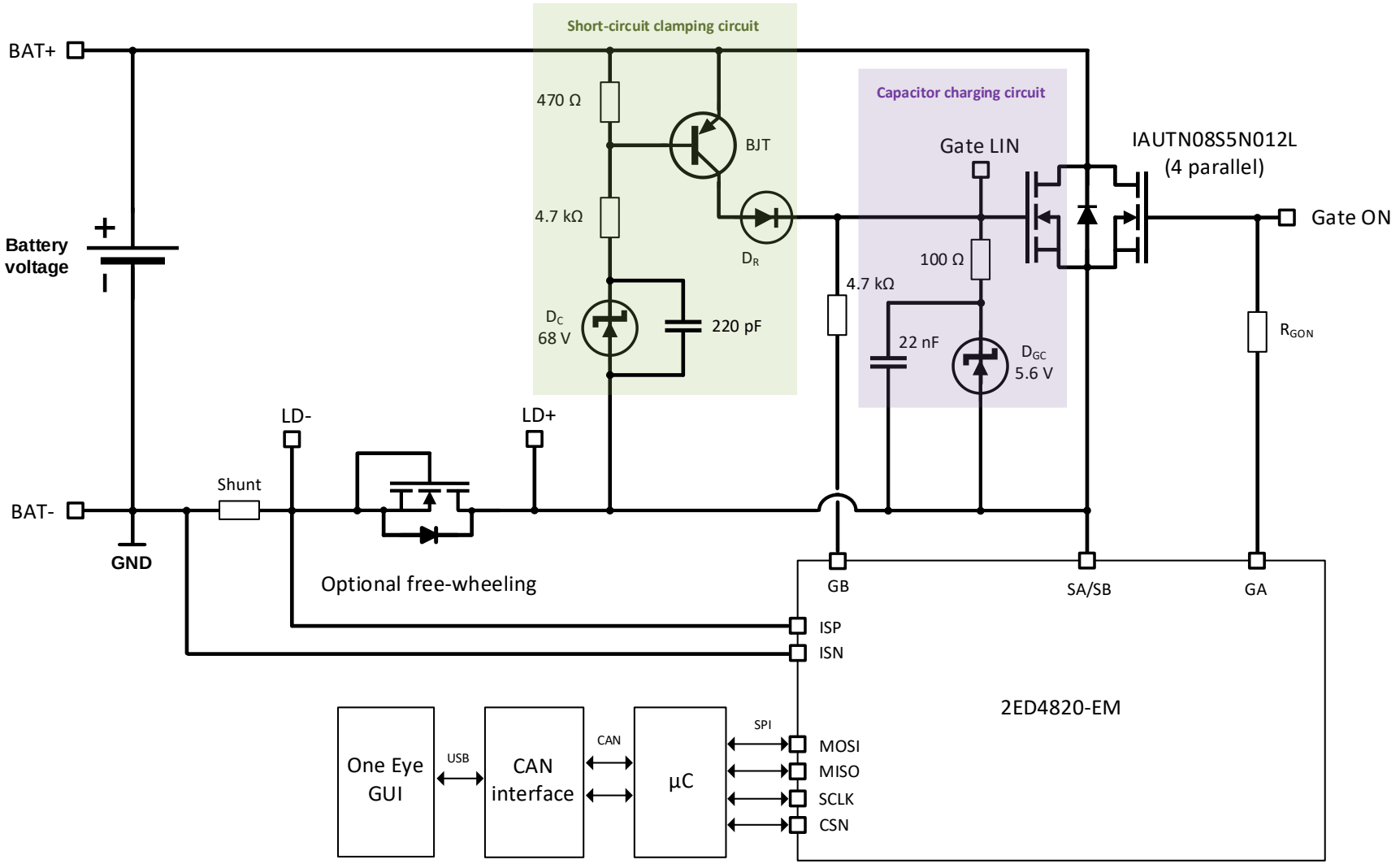
Simplified schematic Dual Gate 48V switch board

Clamping circuit

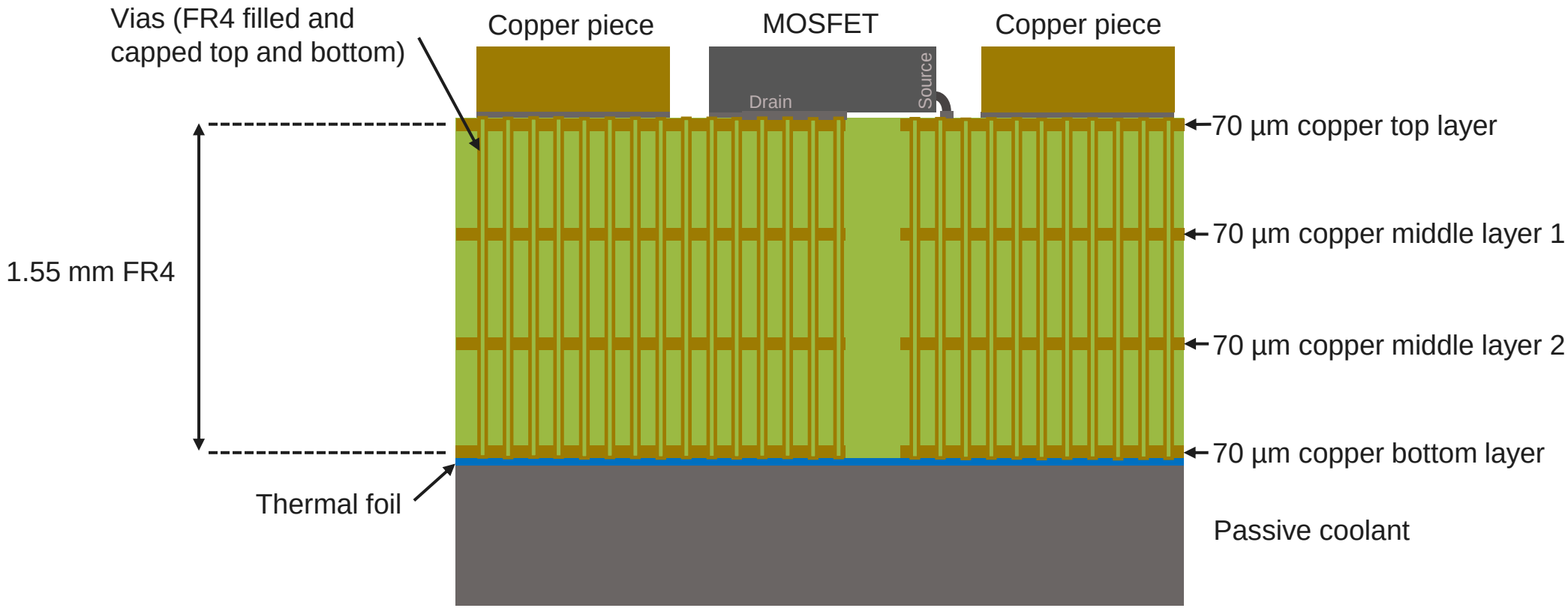
- Drain-source voltage clamp of typically 71 V.
- Drain-source voltage slope limited to typically 5 V/µs to ensure smooth clamp transition.
- BJT circuit for optimized clamping speed and high V_{DS} clamp accuracy (no dependency on MOSFET gate voltage).
- Reverse diode D_R to avoid reverse currents.

Capacitor charging circuit

- Gate voltage limited by Zener diode D_{GC} 5.6 V to limit in-rush current.
- 22 nF for slow switching.
- 100 Ω resistance to decouple the capacitor charging circuit from the clamping circuit.

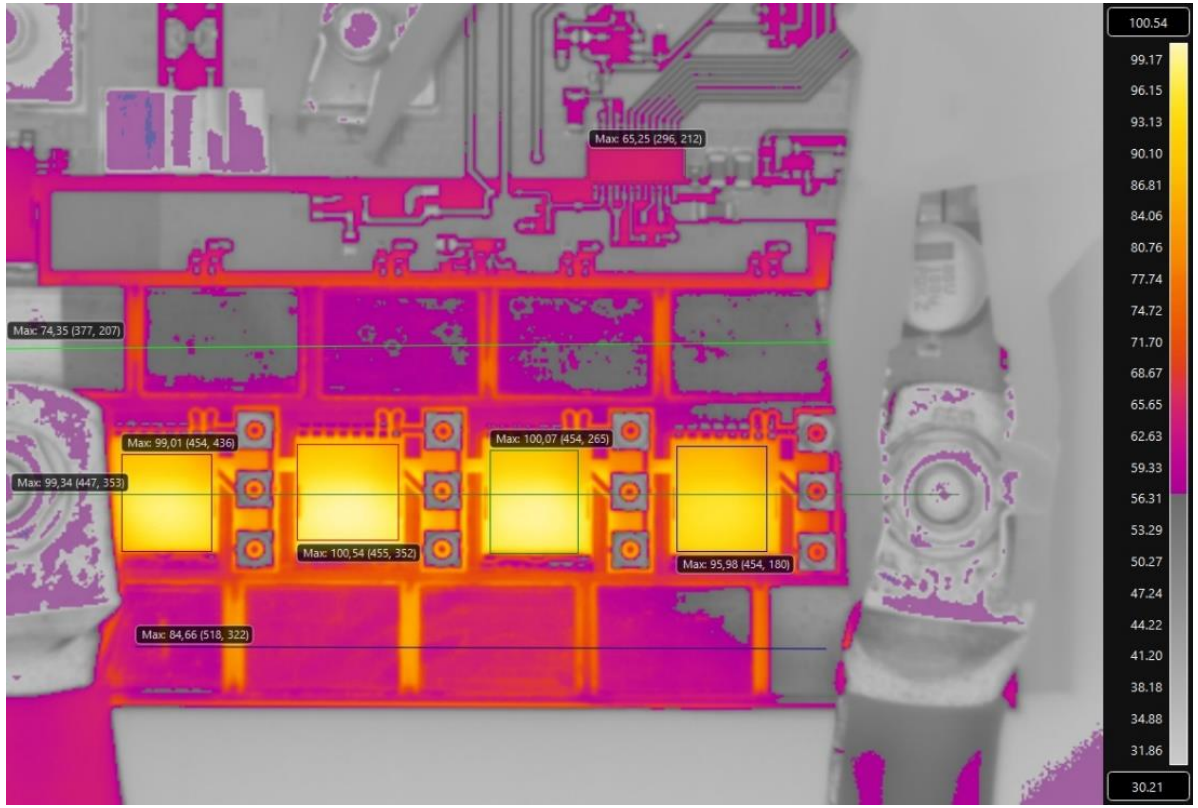


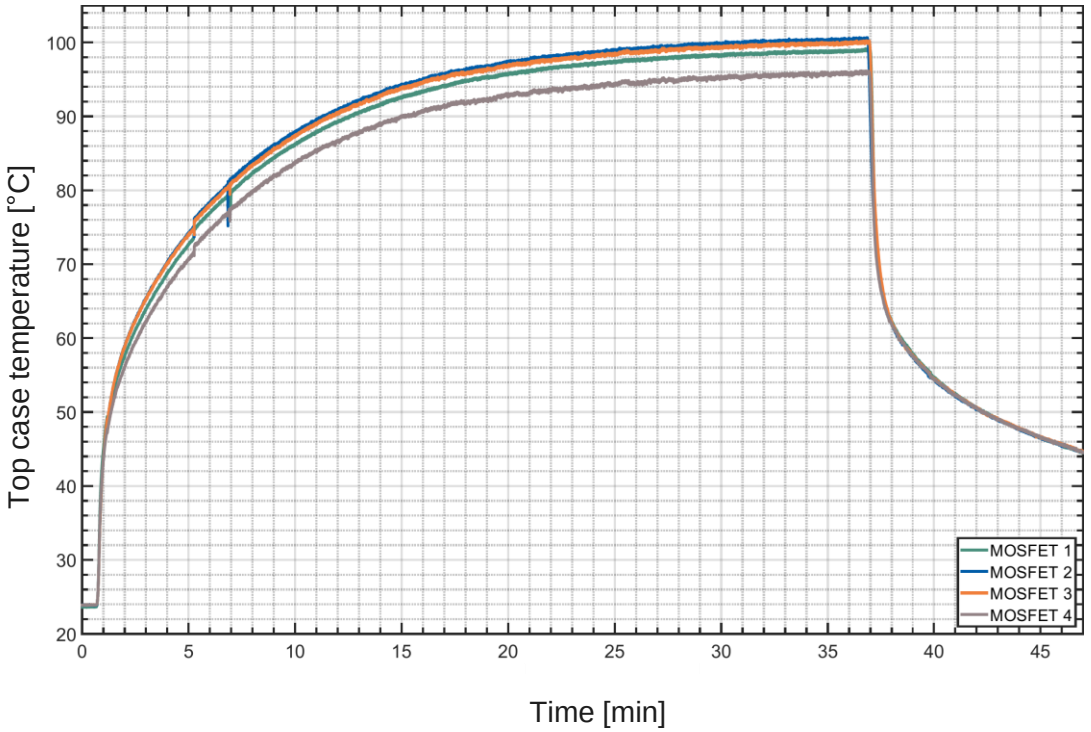
PCB stack and thermal design



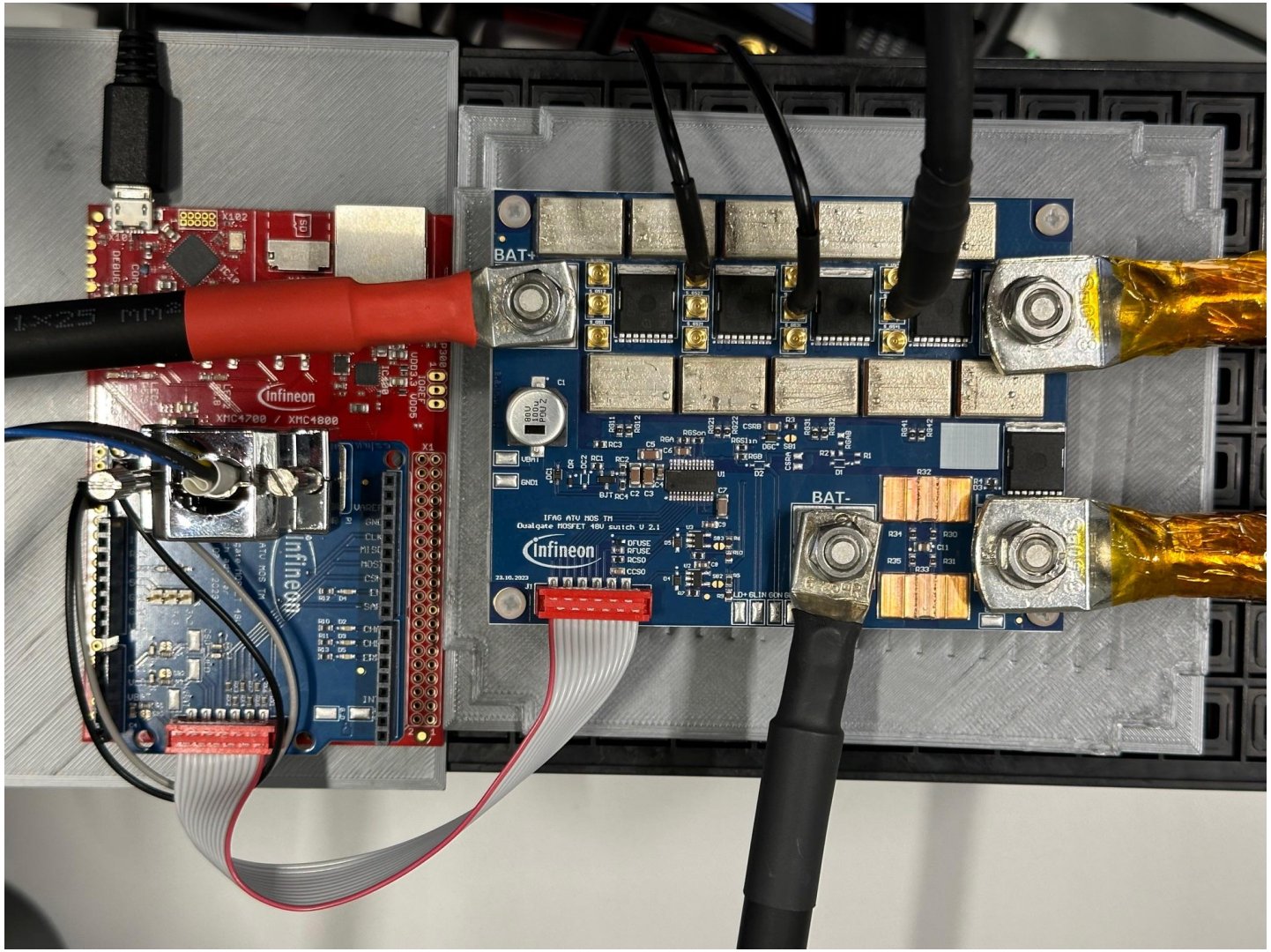
Top case temperature thermal camera measurement

T_a = 25°C, natural convection, 35 minutes loading at I_D = 250 A

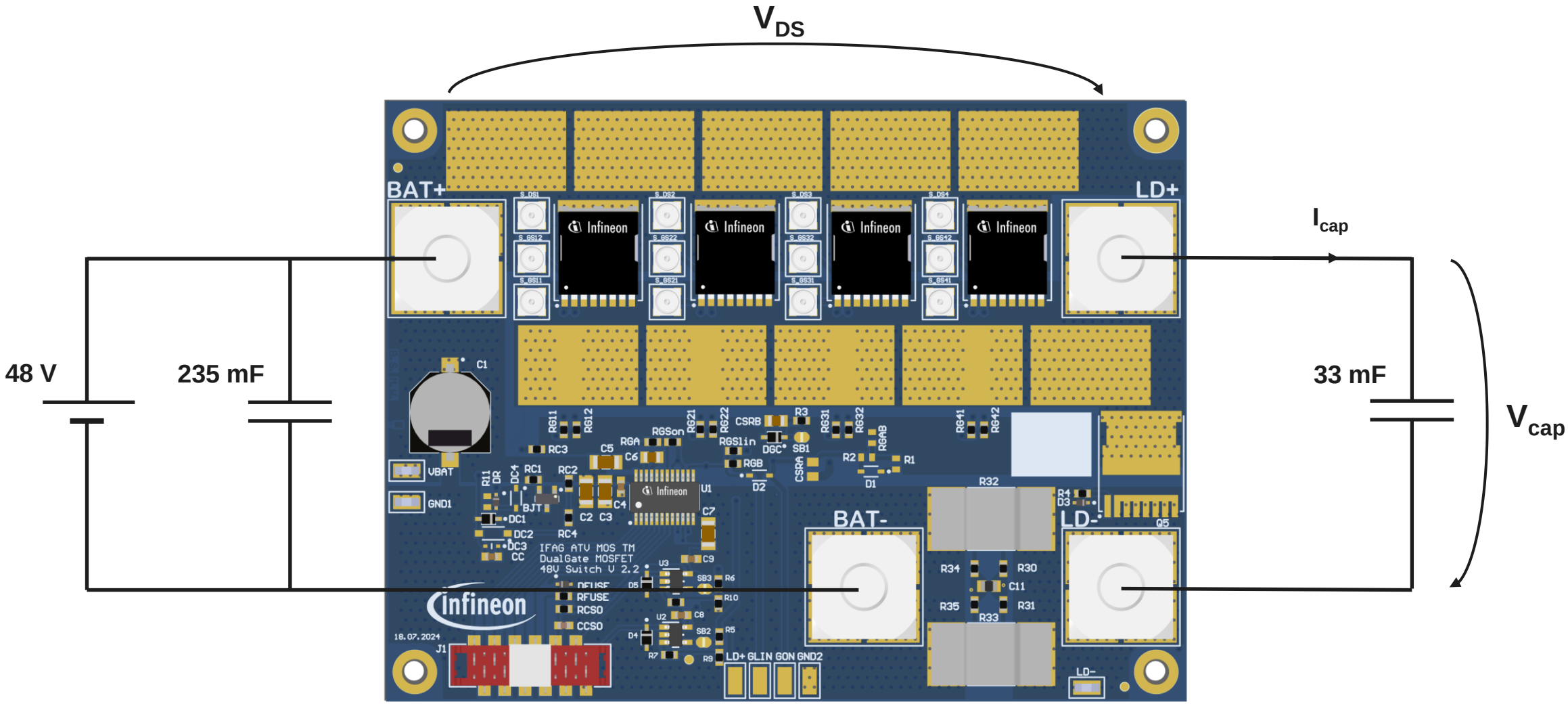




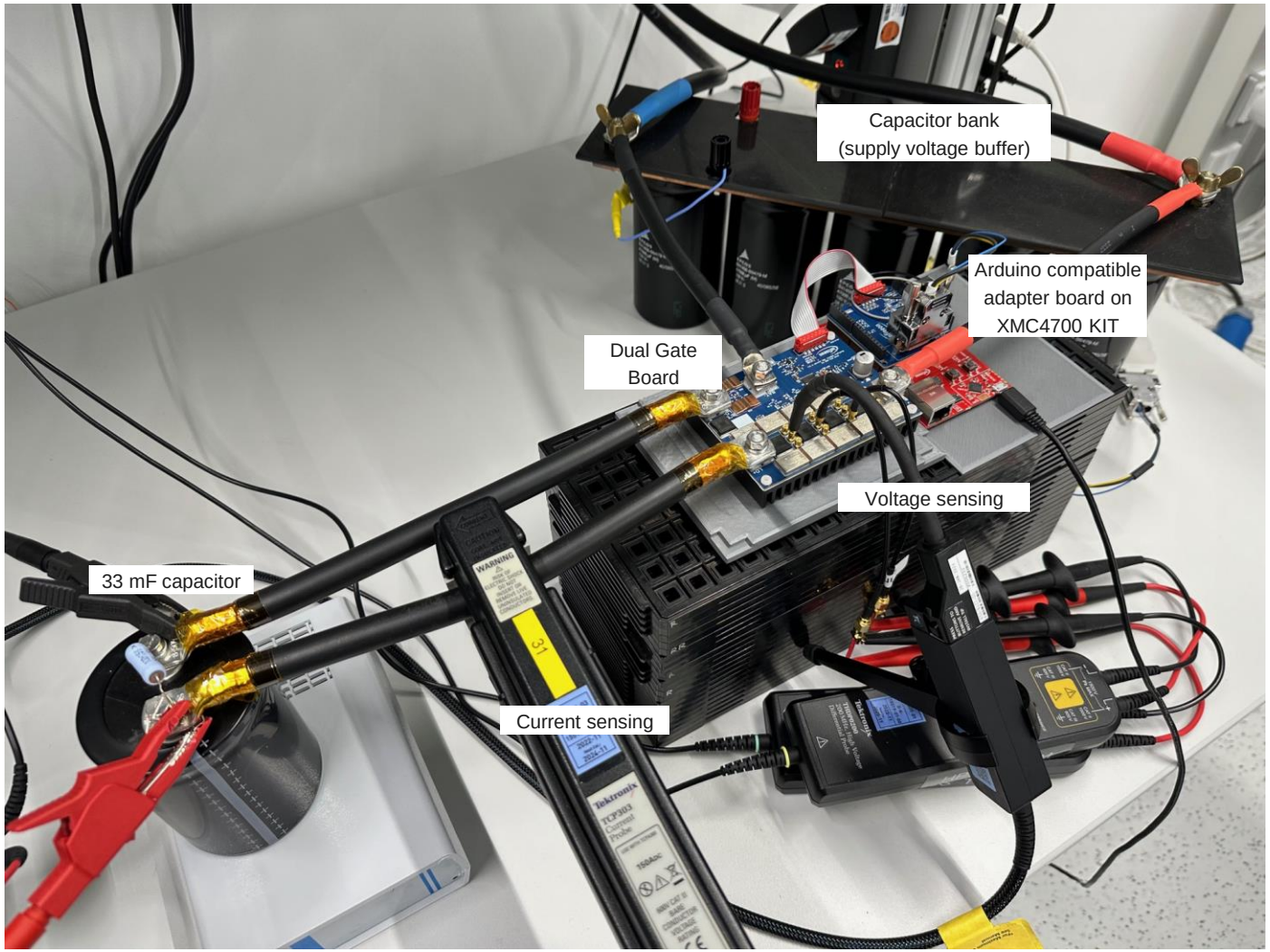
Dual Gate 48 V switch board with µC control



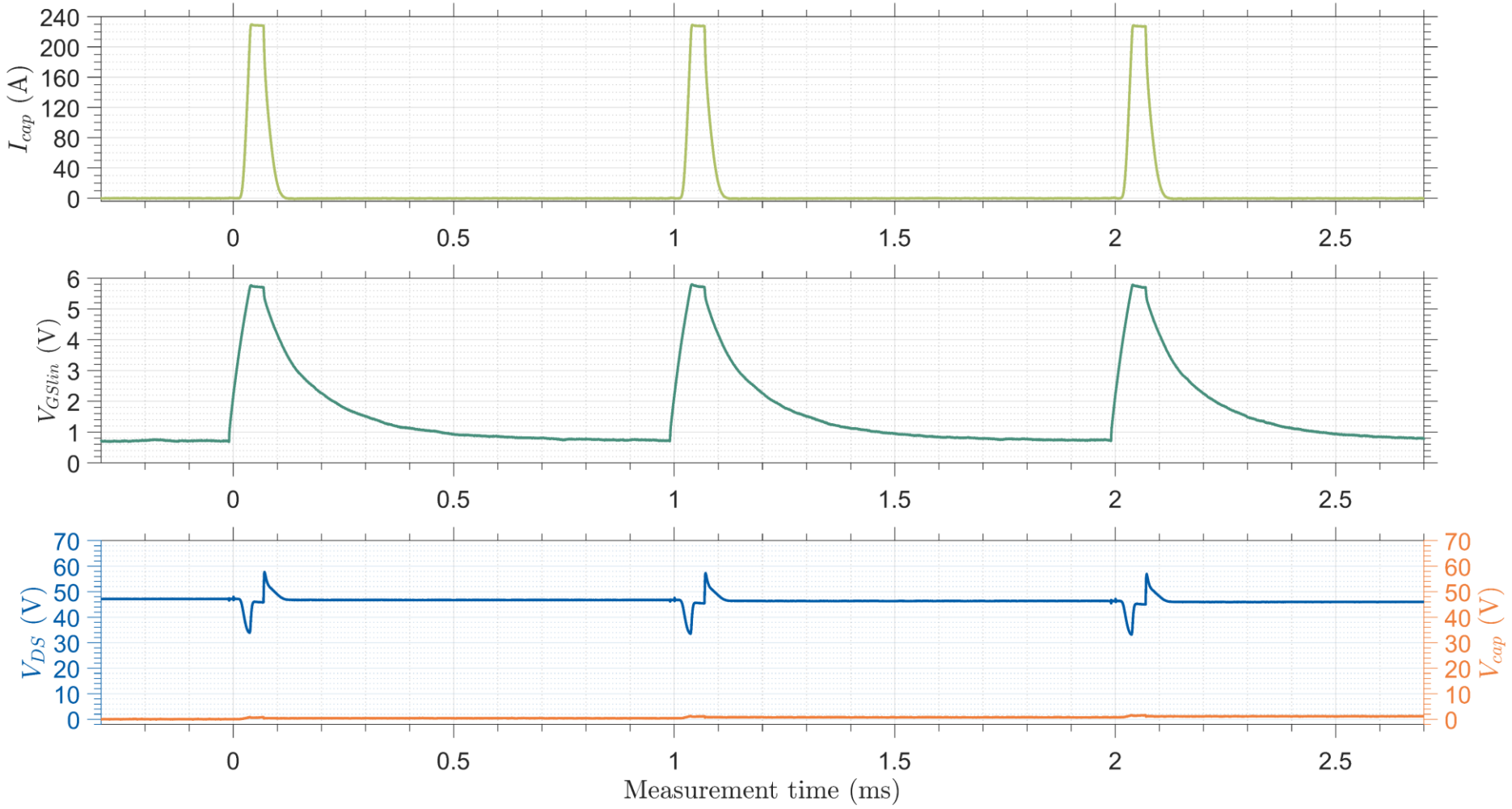
Capacitor charging setup – simplified schematic



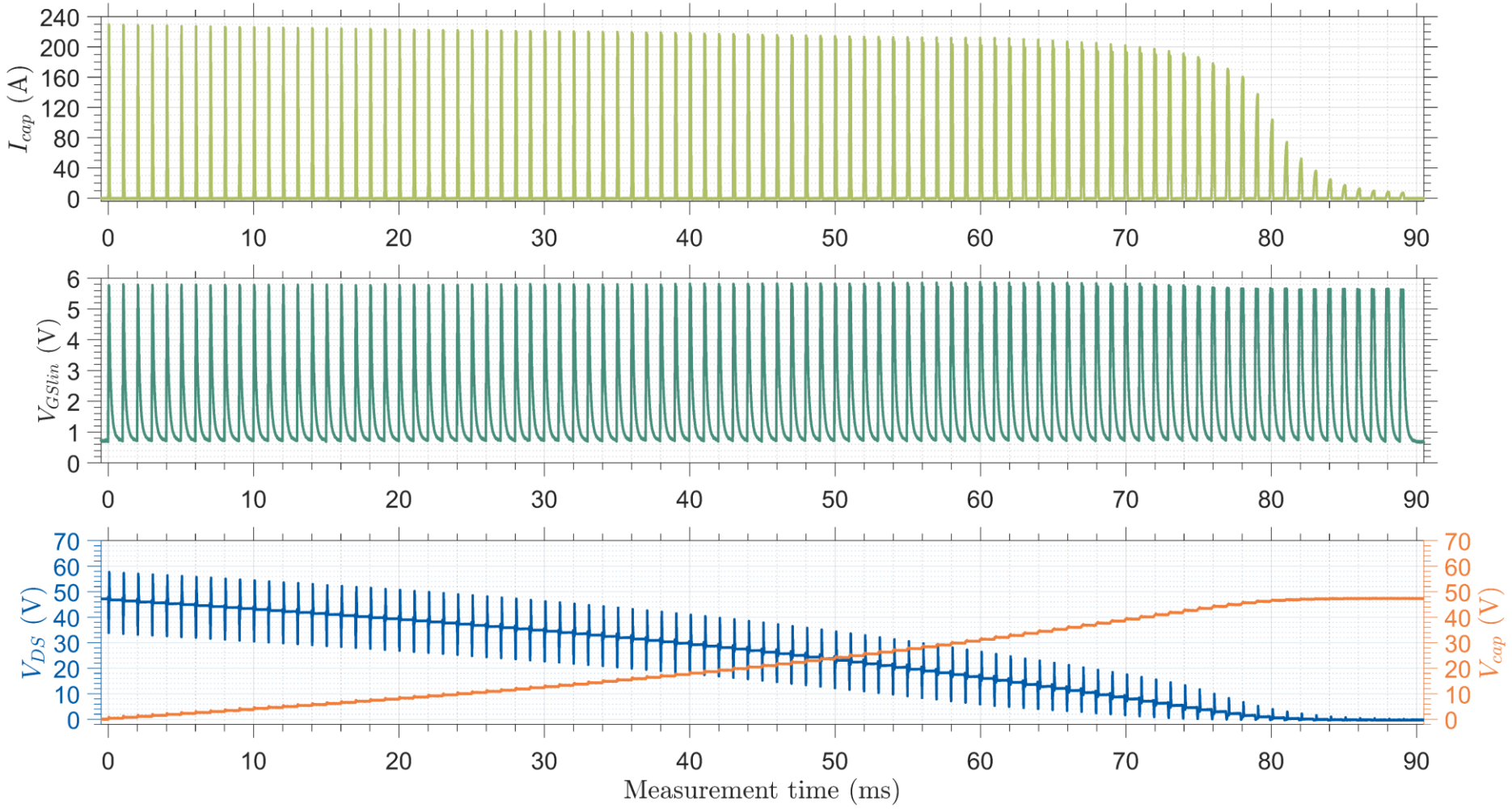
Capacitor charging 33 mF measurement setup



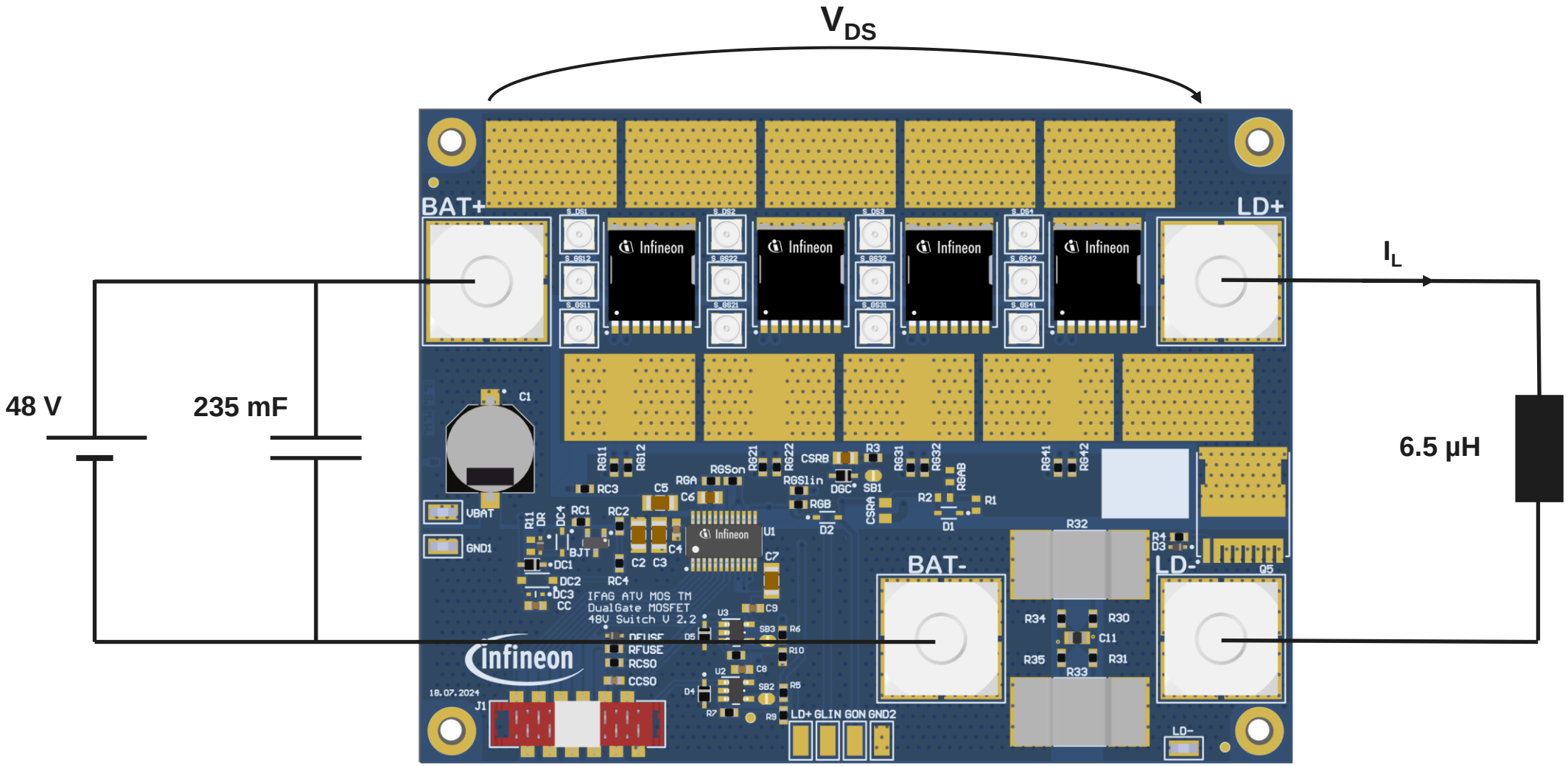
Capacitor charging 33 mF (first three pulses)



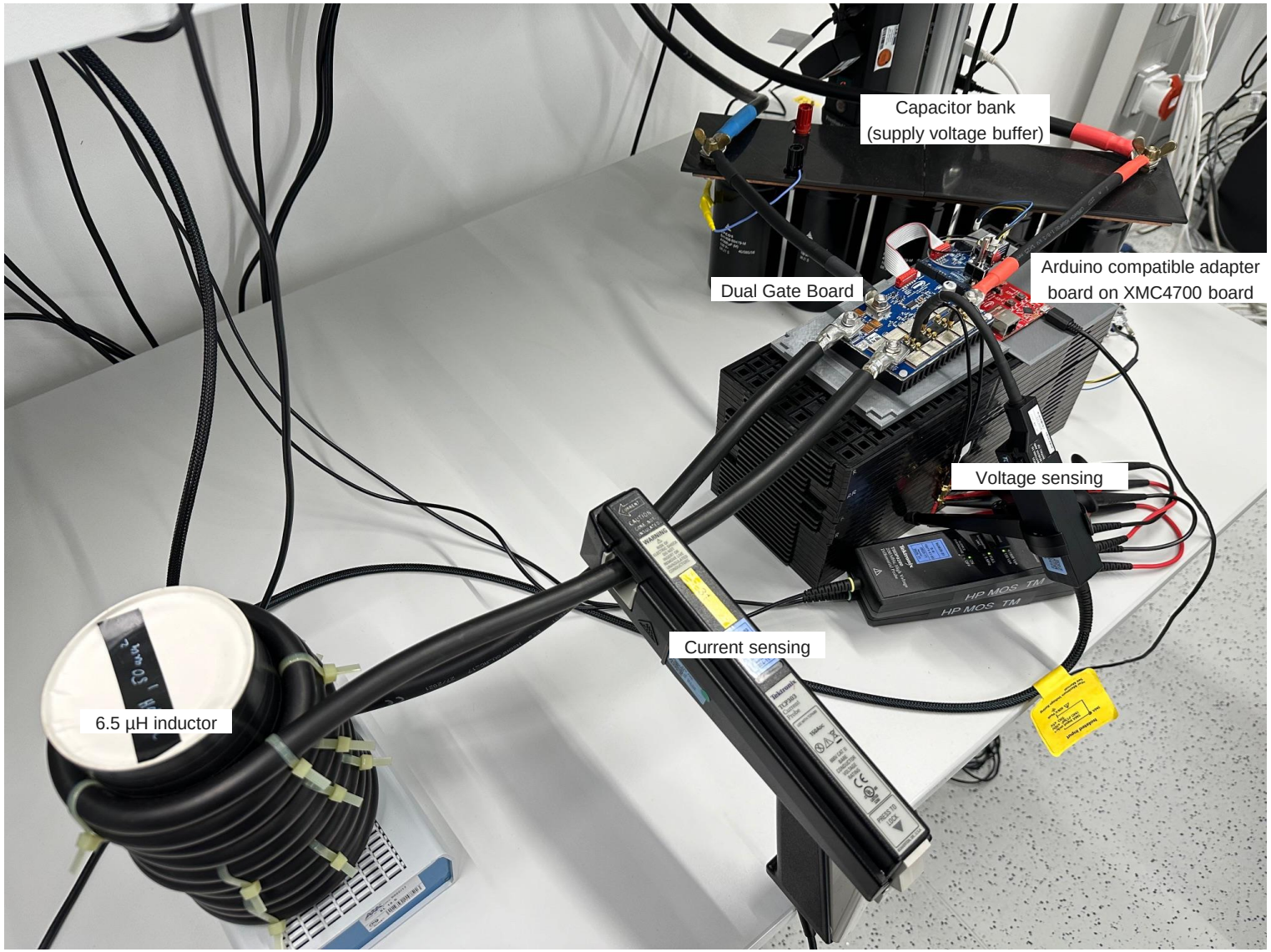
Capacitor charging 33 mF (whole charging wave-form)



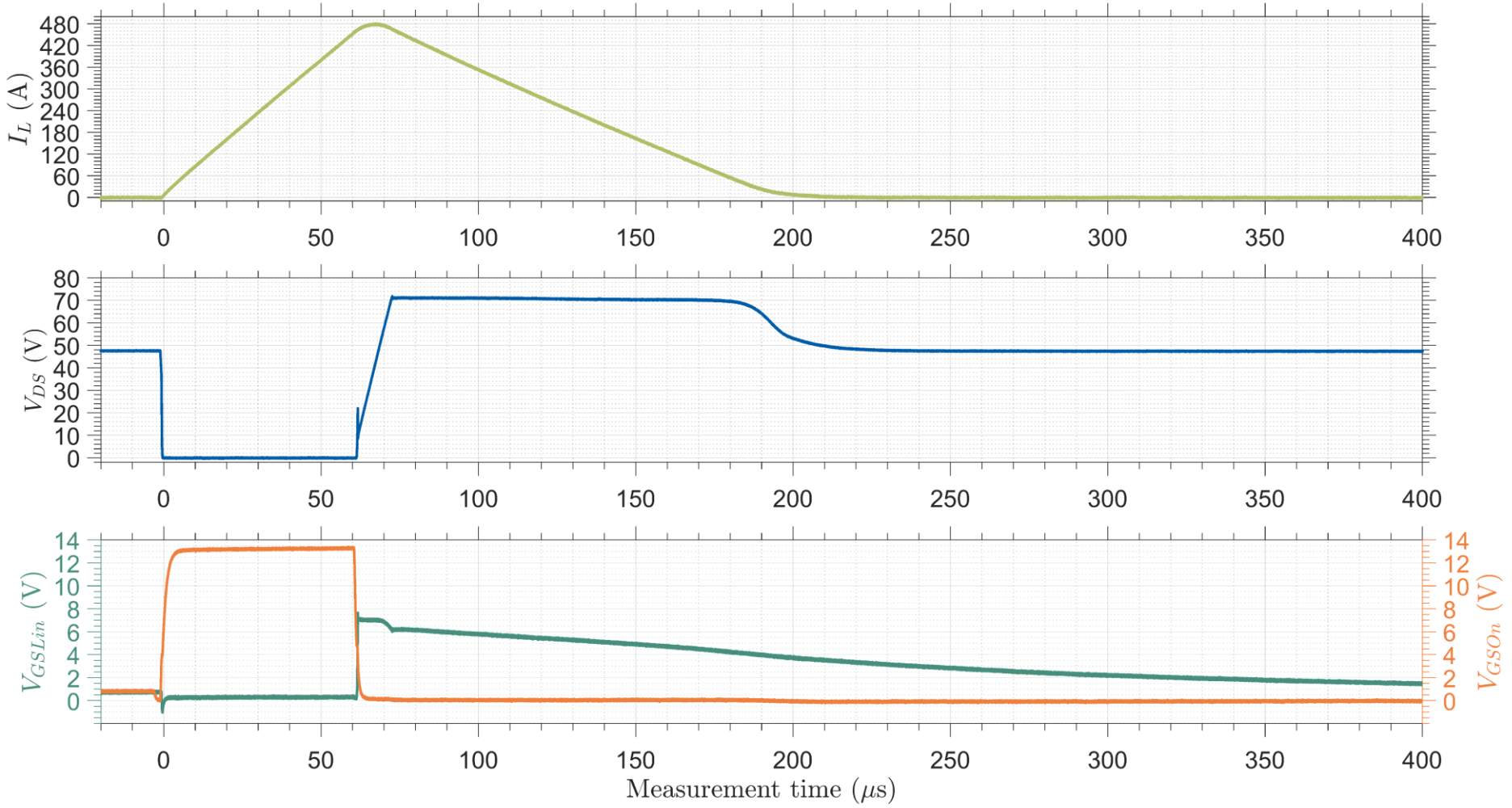
Short circuit clamping setup – simplified schematic



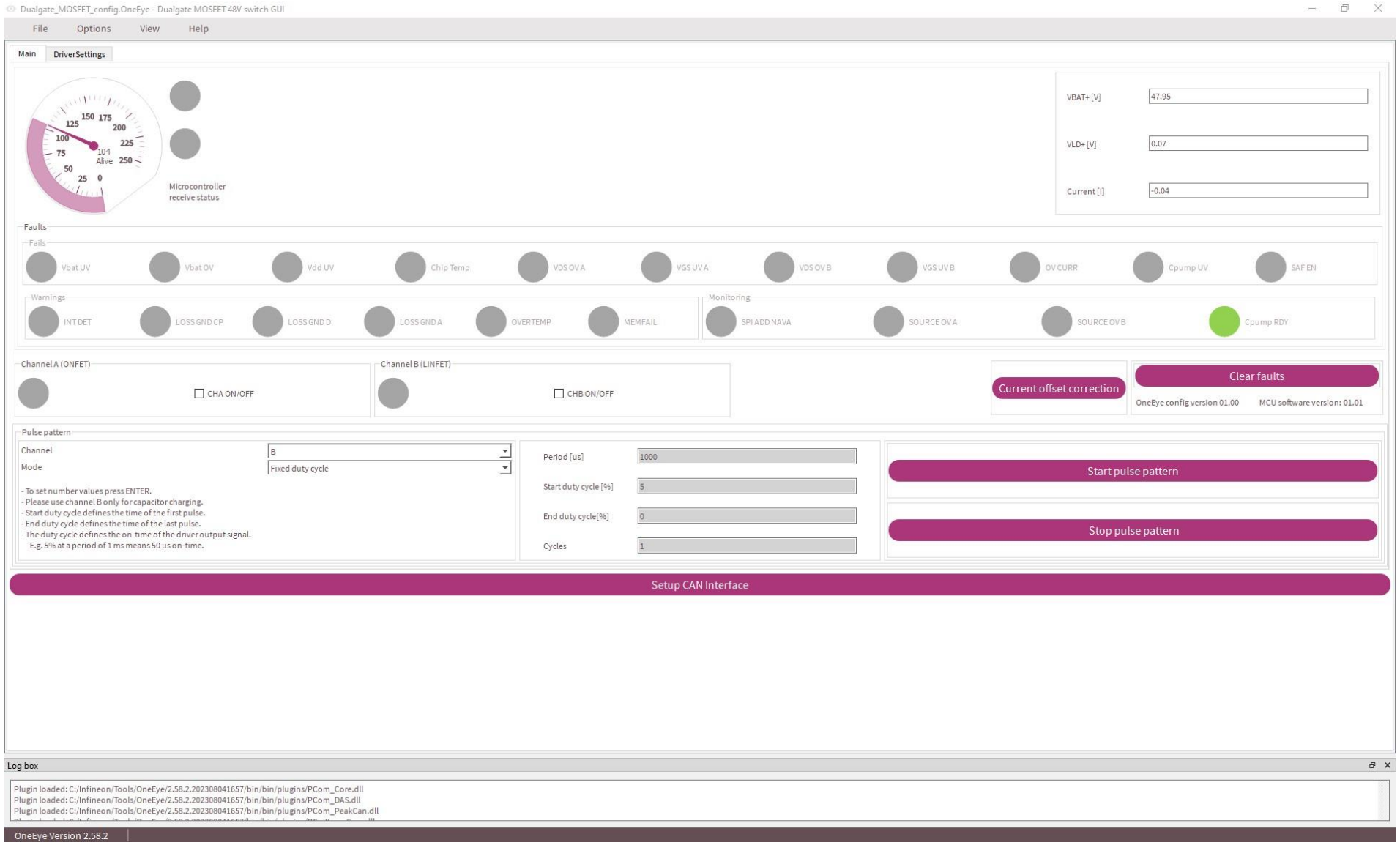
Short-circuit clamping measurement setup



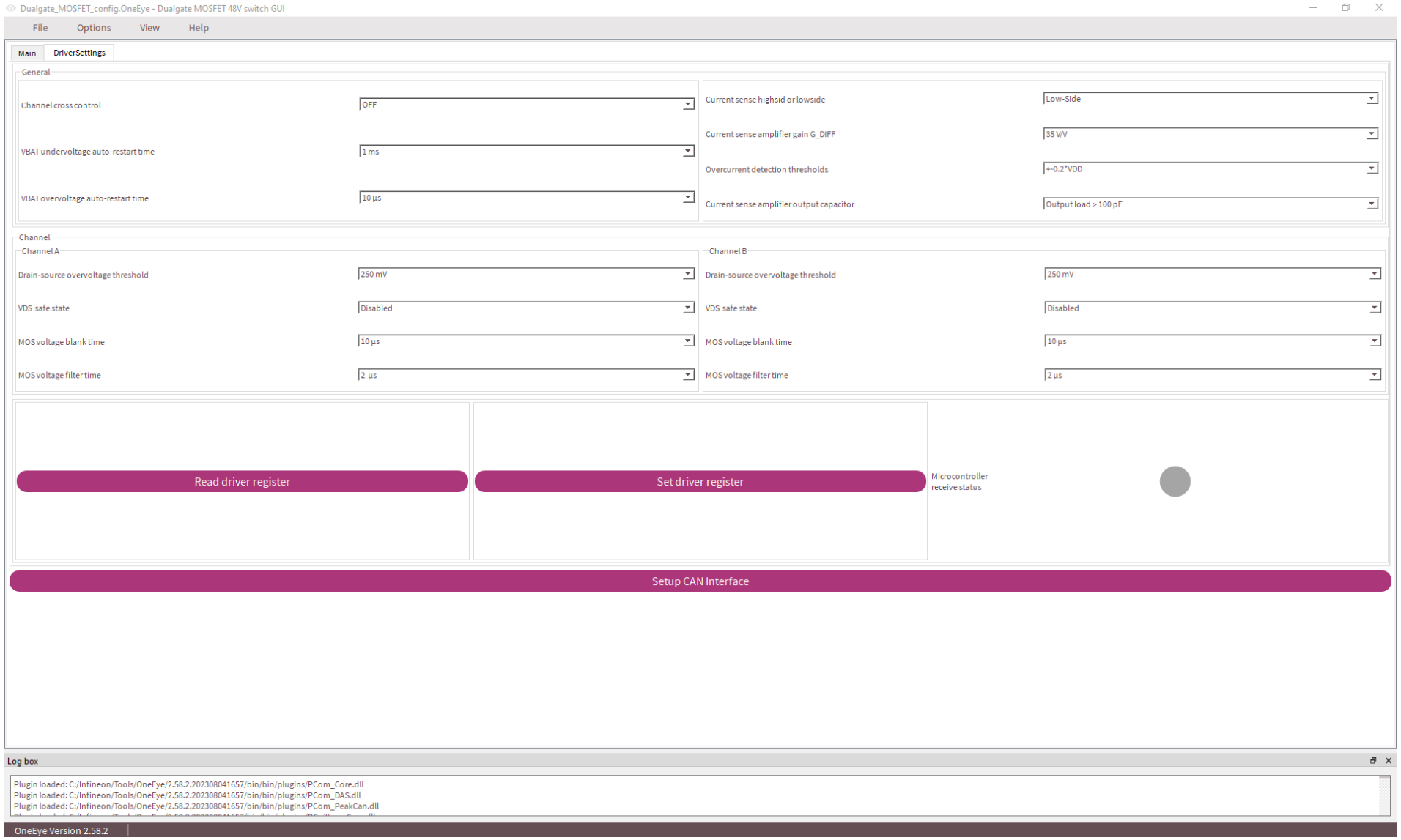
Short-circuit clamping measurement



OneEye control suite – Dual Gate MOSFET part 1



OneEye control suite – Dual Gate MOSFET part 2



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