



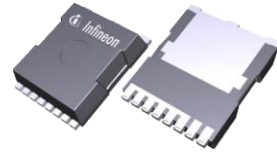
Dual Gate MOSFET 48 V switch board Quick introduction Board V2.2

IFAG ATV MOS
24.09.2024



SOA and RDSON comparison

Dual Gate trench vs. Standard trench vs. Planar



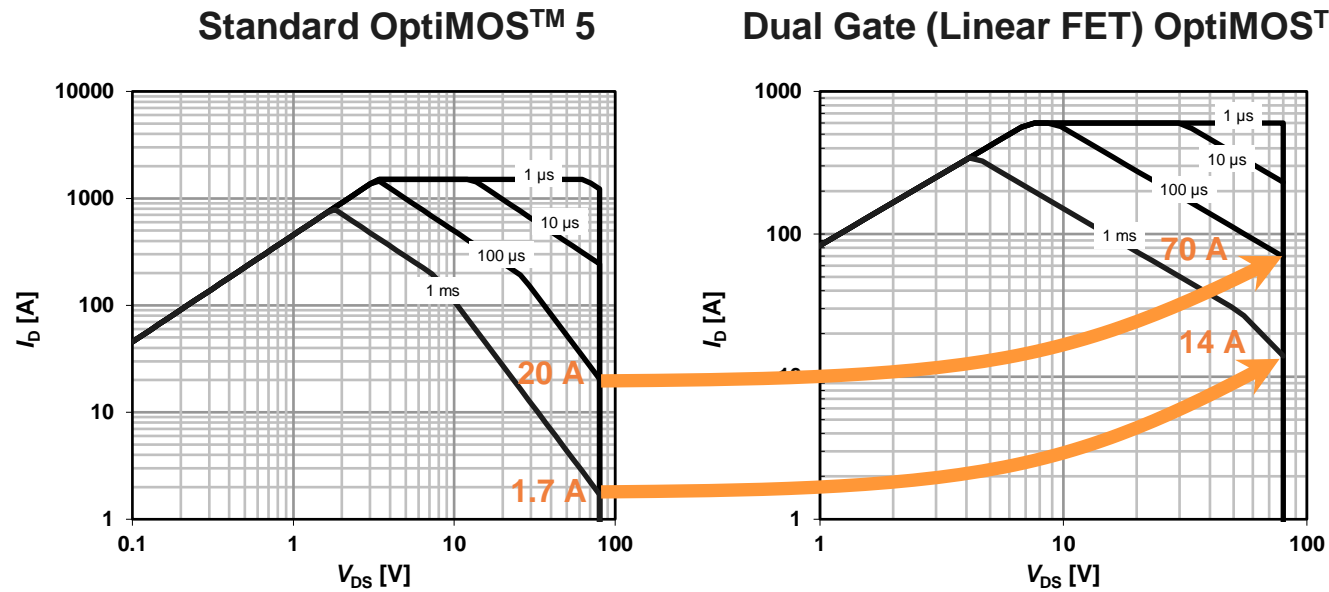
	IAUTN08S5N012L Dual Gate 80 V OptiMOS™ 5 Trench technology	IAUT300N08S5N011 Standard 80 V OptiMOS™ 5 Trench technology	IPB80N08S2-07 Standard 80 V OptiMOS™ Planar technology
SOA 1 ms at max V_{DS} , $T_C = 25^\circ\text{C}$	14 A (Linear MOSFET)	1.7 A	14 A
$R_{DS(on)}$ at $V_{GS} = 10\text{ V}$, $T_J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

Combining the best of 2 worlds with Dual Gate

Reaching levels of Planar MOSFET SOA, maintain low $R_{DS(on)}$ and small solution size of trench technology

SOA comparison

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



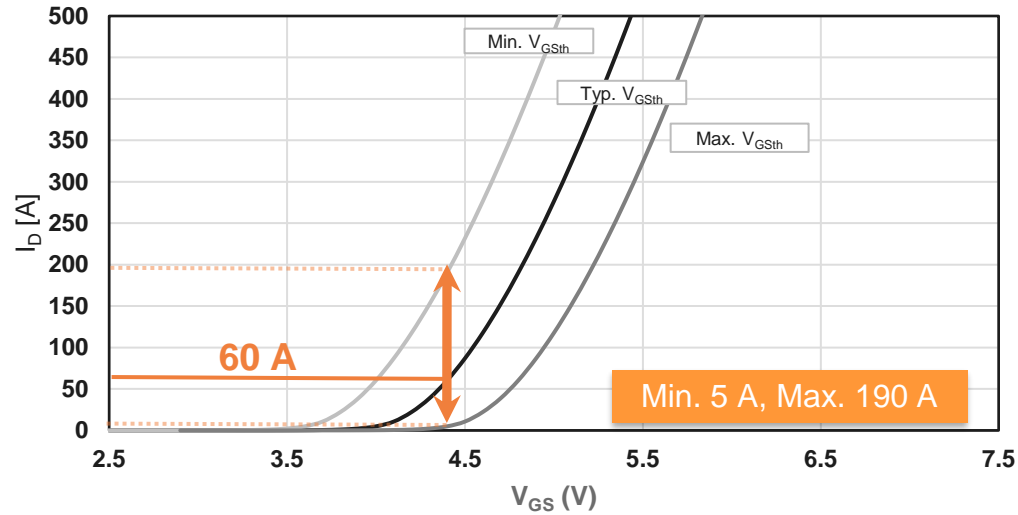
Dual Gate (Linear FET) SOA significantly larger at high V_{DS}

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

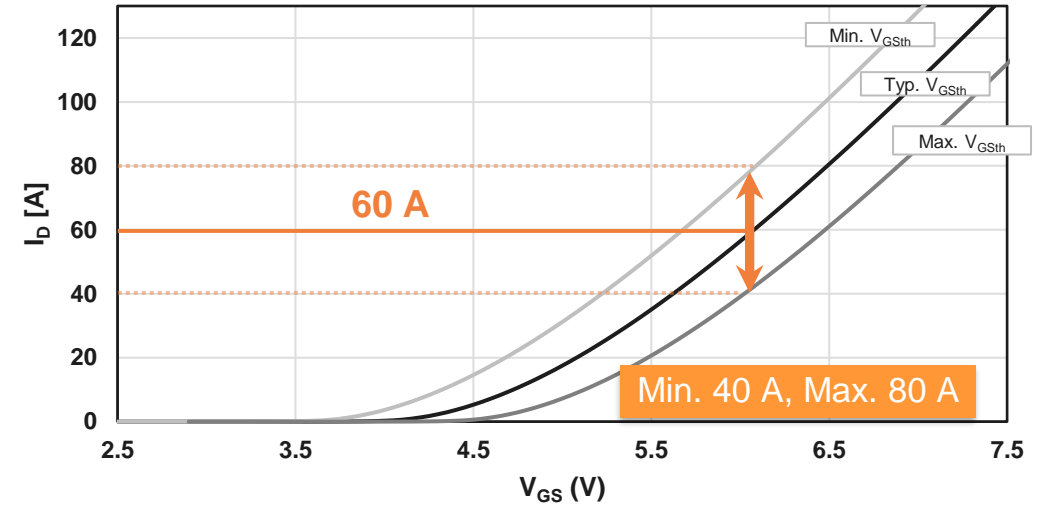
Transfer characteristics comparison

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

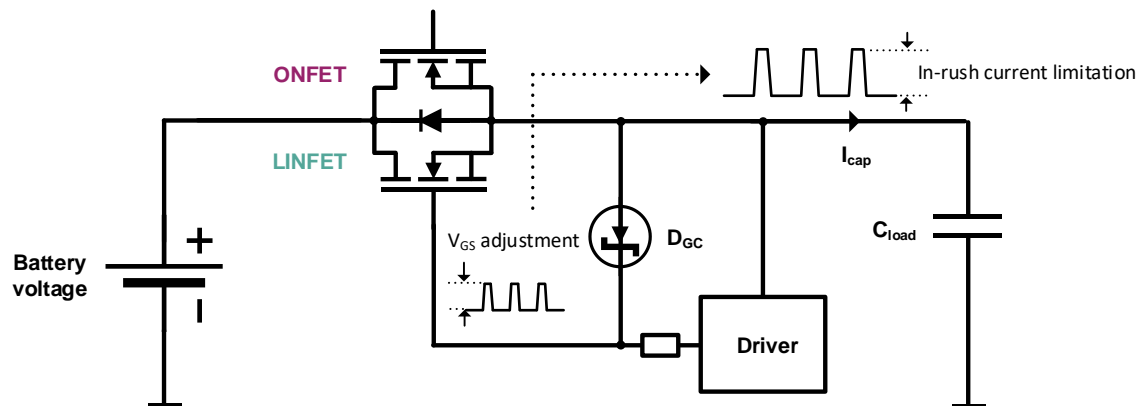
Enabling paralleling in linear mode operation

Dual Gate MOSFET 80 V

Application examples

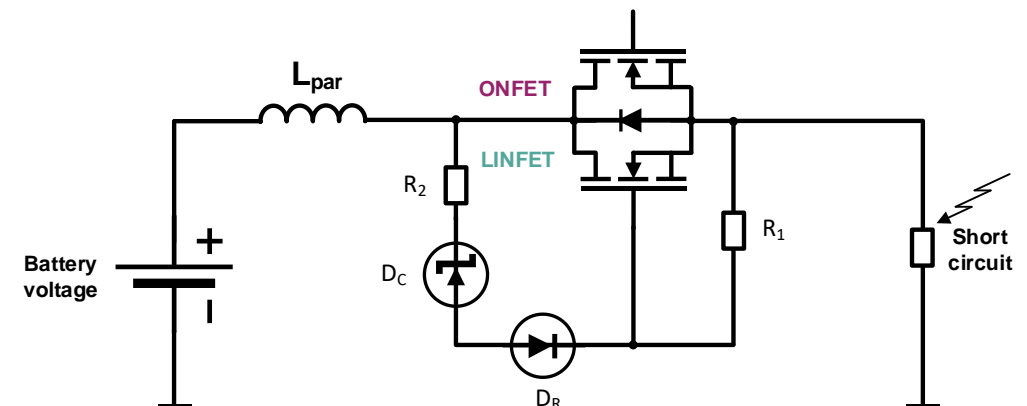
Capacitor charging

- 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.



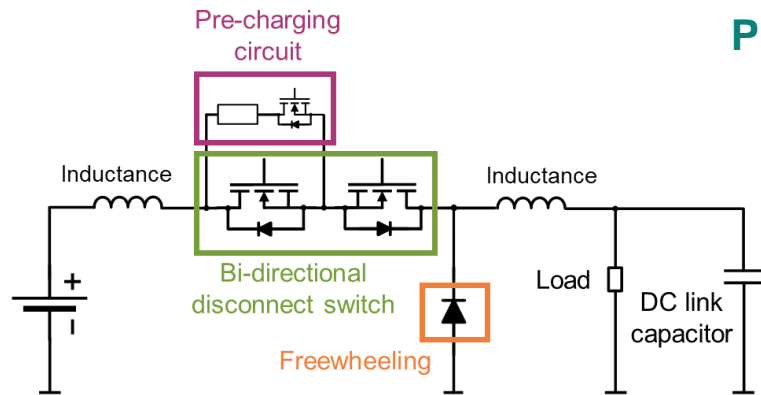
Short circuit clamping

- 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.

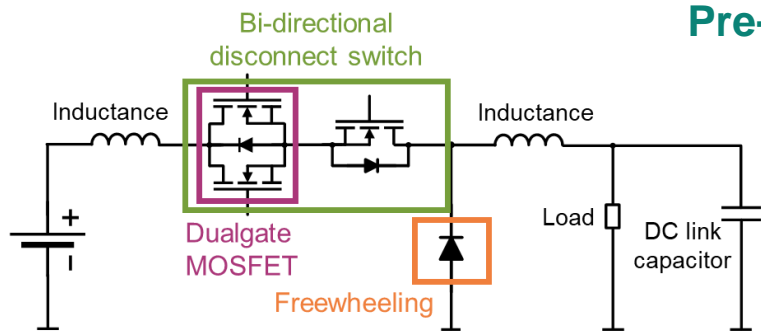
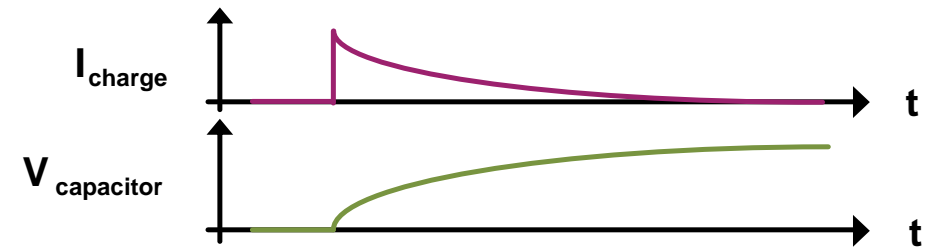


Capacitor pre-charging with power resistor vs. Dual Gate MOSFET

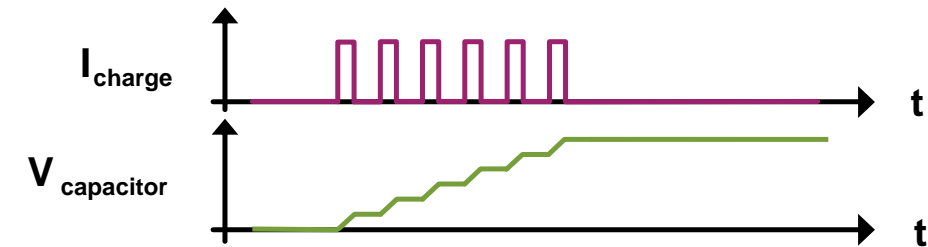
Reduction of system cost (no pre-charge circuit needed) and acceleration of capacitor charging



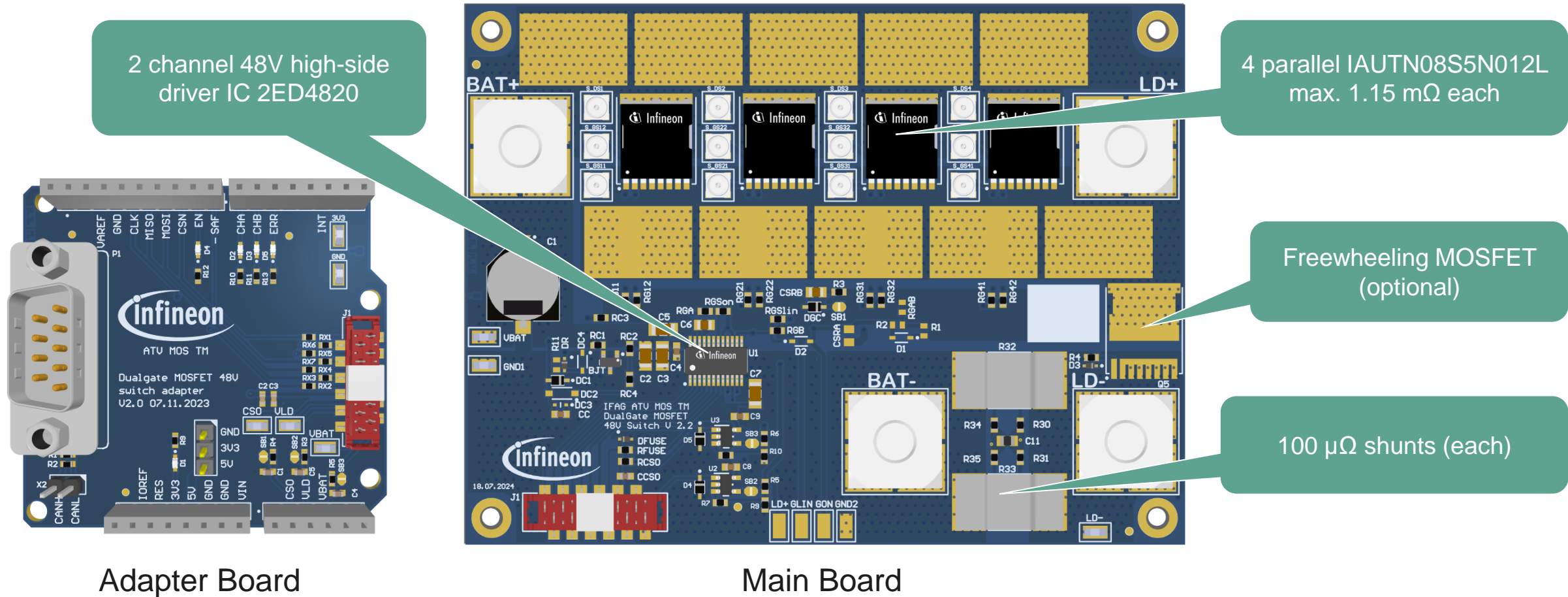
Pre-charging with power resistor



Pre-charging with Dual Gate MOSFET



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

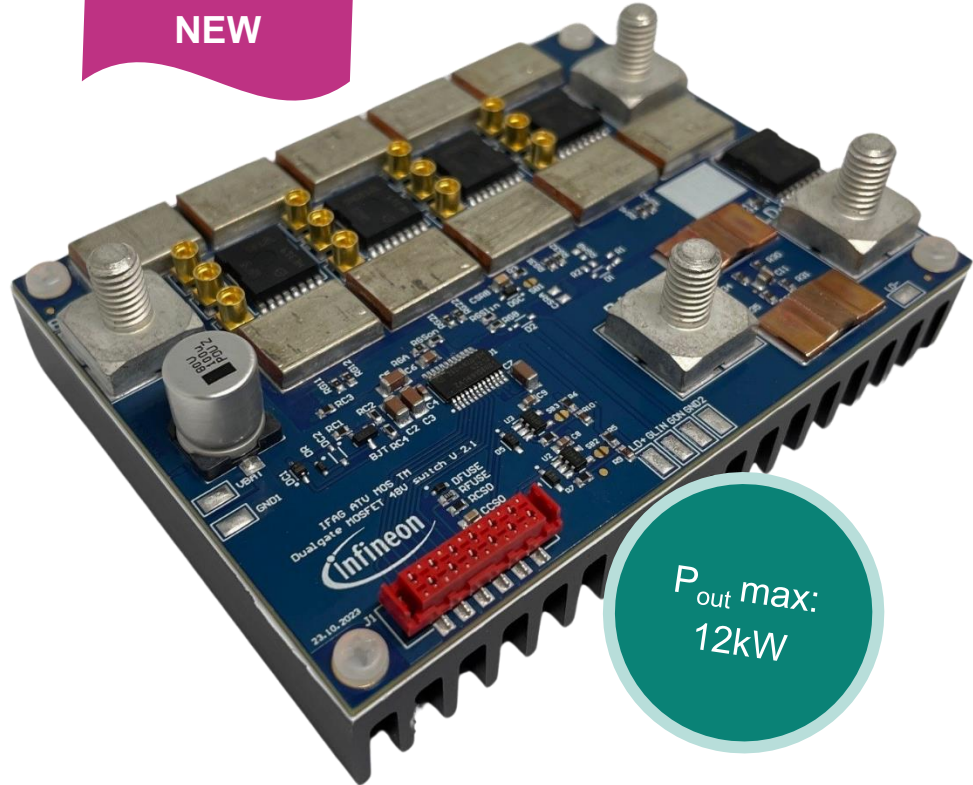



48V DISCONNECT SWITCH

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.

NEW




Summary of Features 

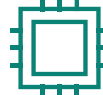
- For 48 V disconnect switch application
- Acceleration of capacitor charging
- Reduction of system cost

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

Click [here](#) for further information

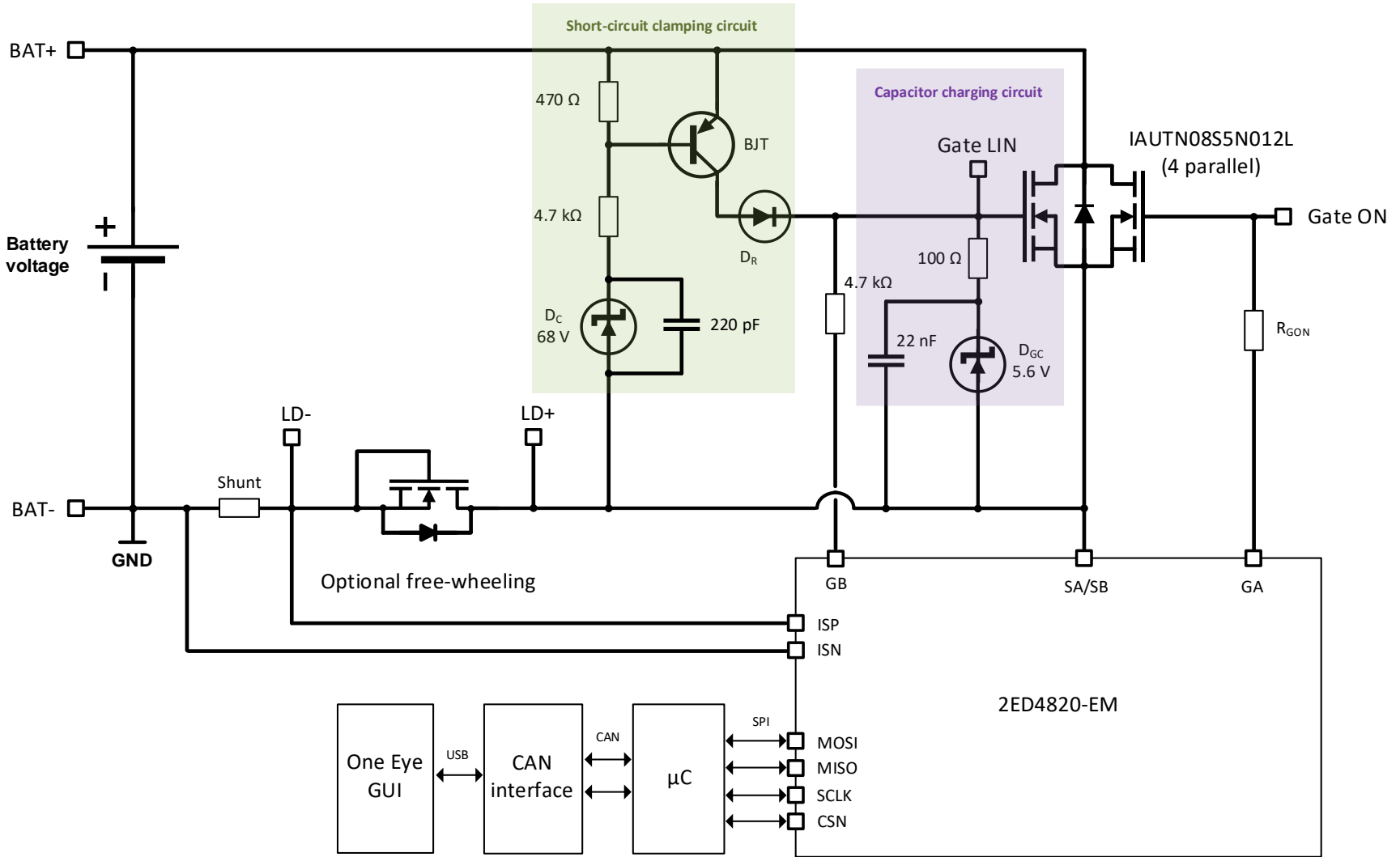
Simplified schematic Dual Gate 48V switch board

Clamping circuit

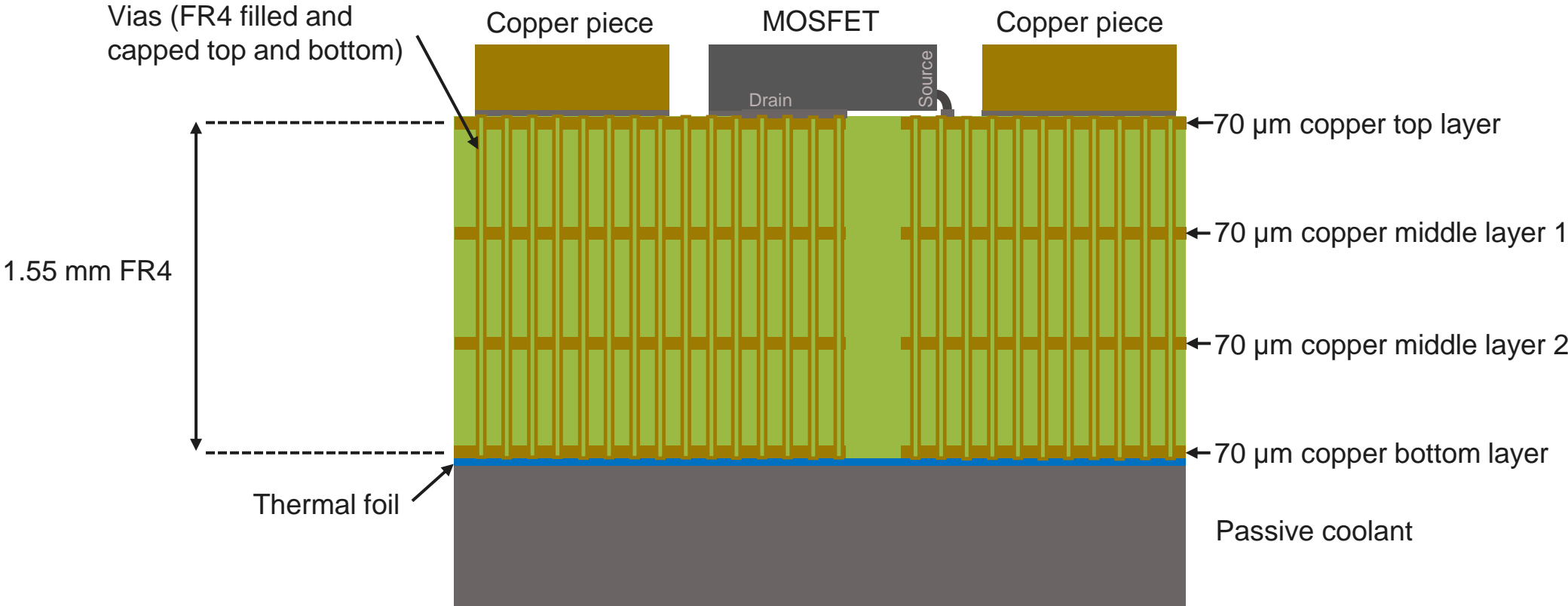
- Drain-source voltage clamp of typically 71 V.
- Drain-source voltage slope limited to typically 5 V/ μ s to ensure smooth clamp transition.
- BJT circuit for optimized clamping speed and high V_{DS} clamp accuracy (no dependency on MOSFET gate voltage).
- Reverse diode D_R to avoid reverse currents.

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.

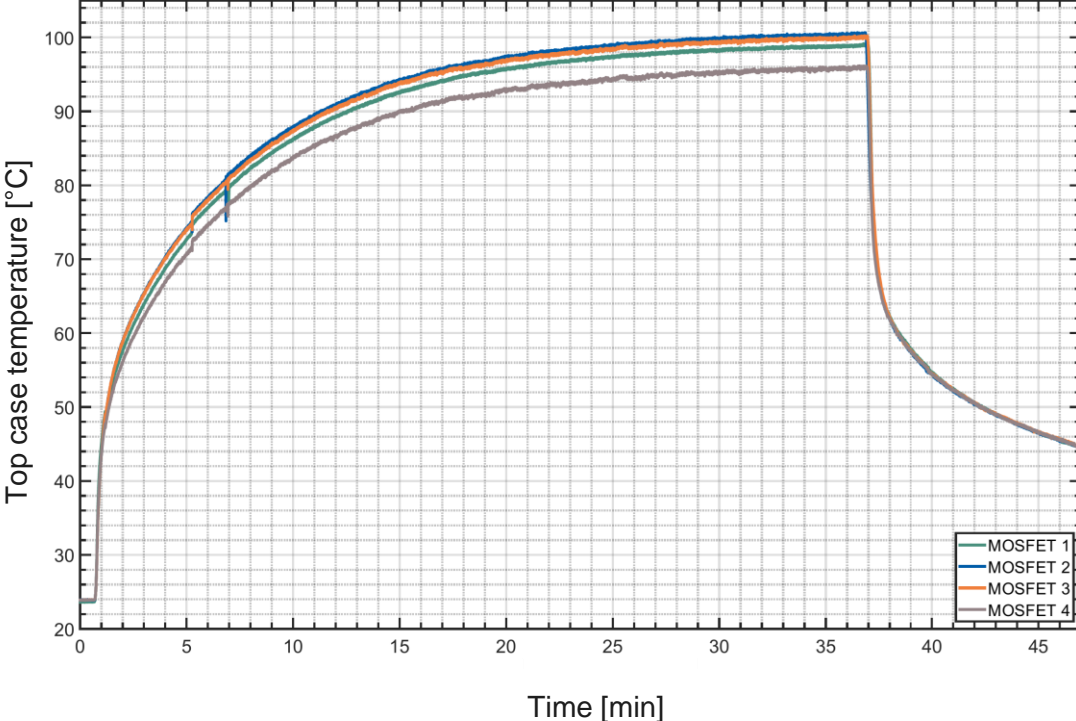
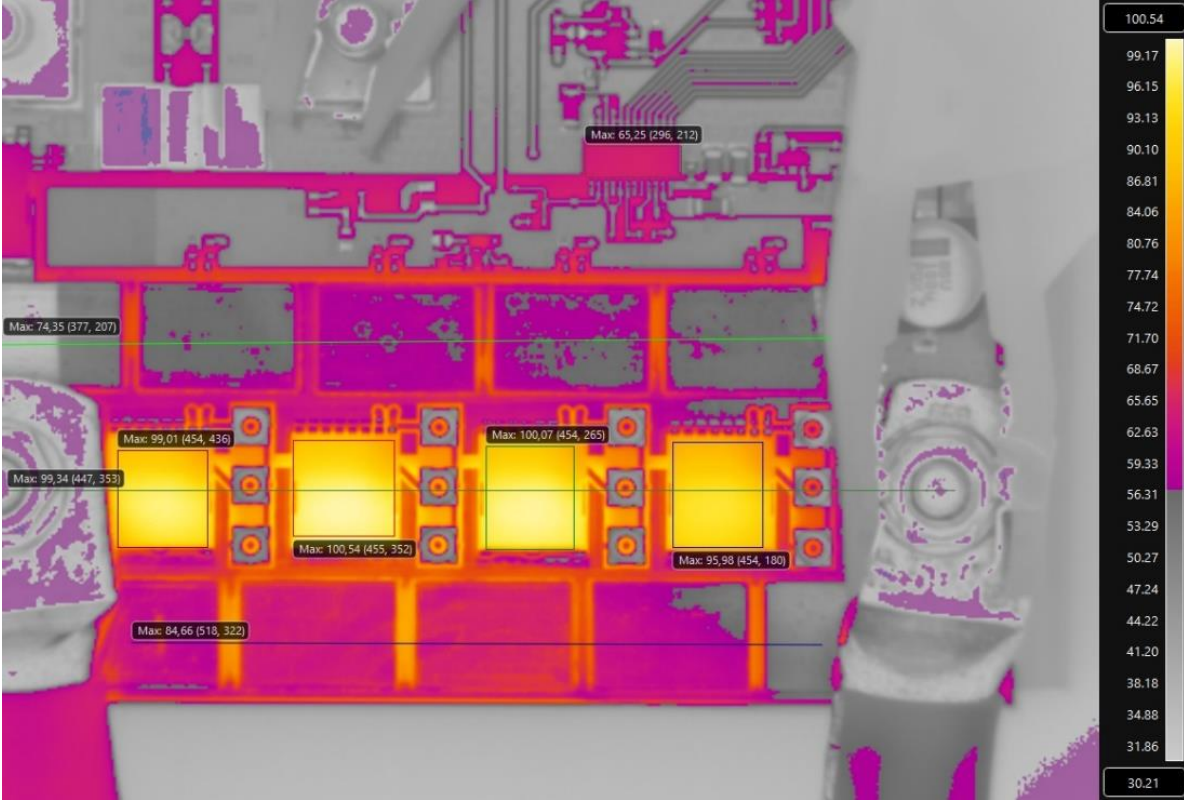


PCB stack and thermal design

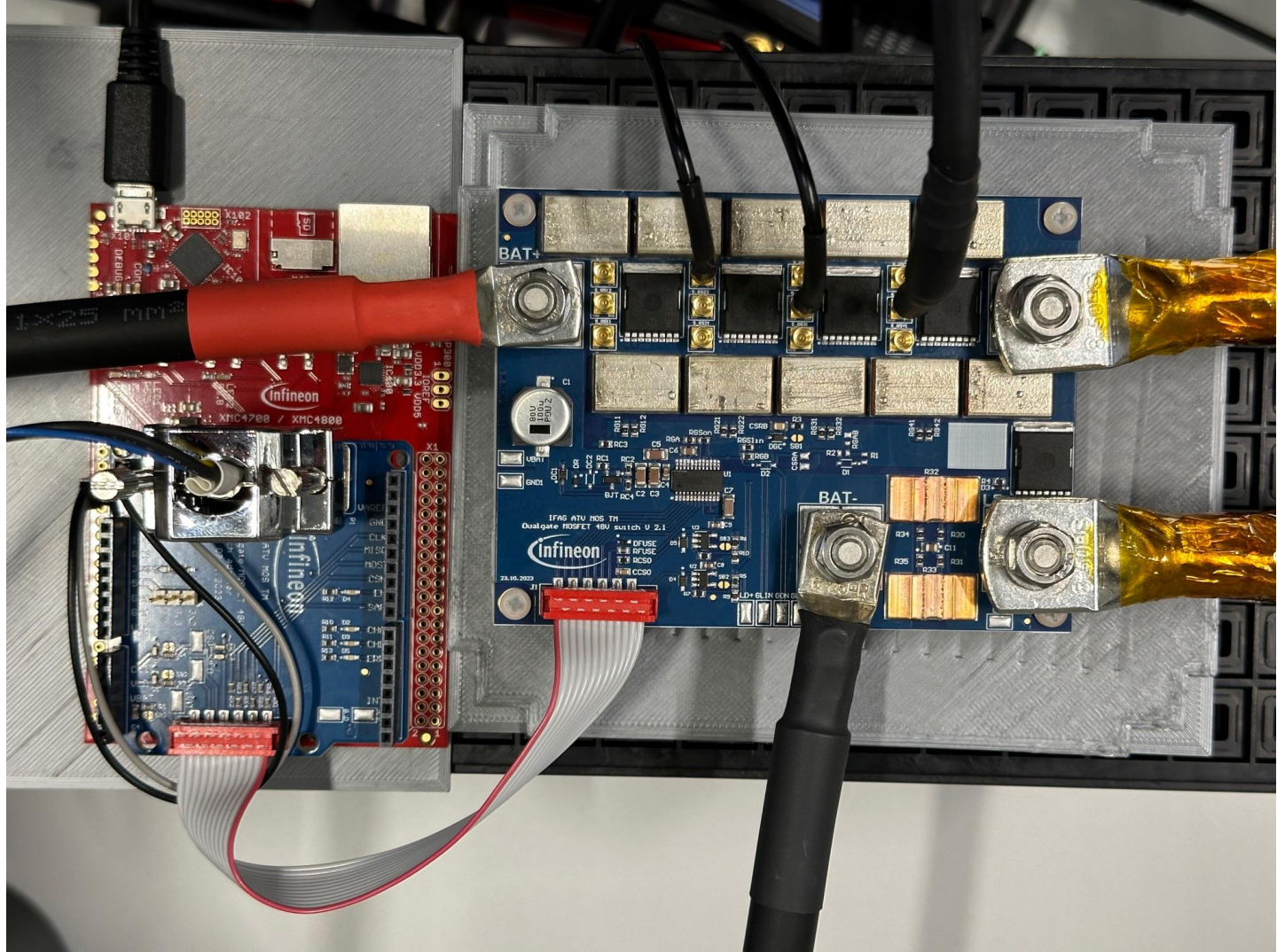


Top case temperature thermal camera measurement

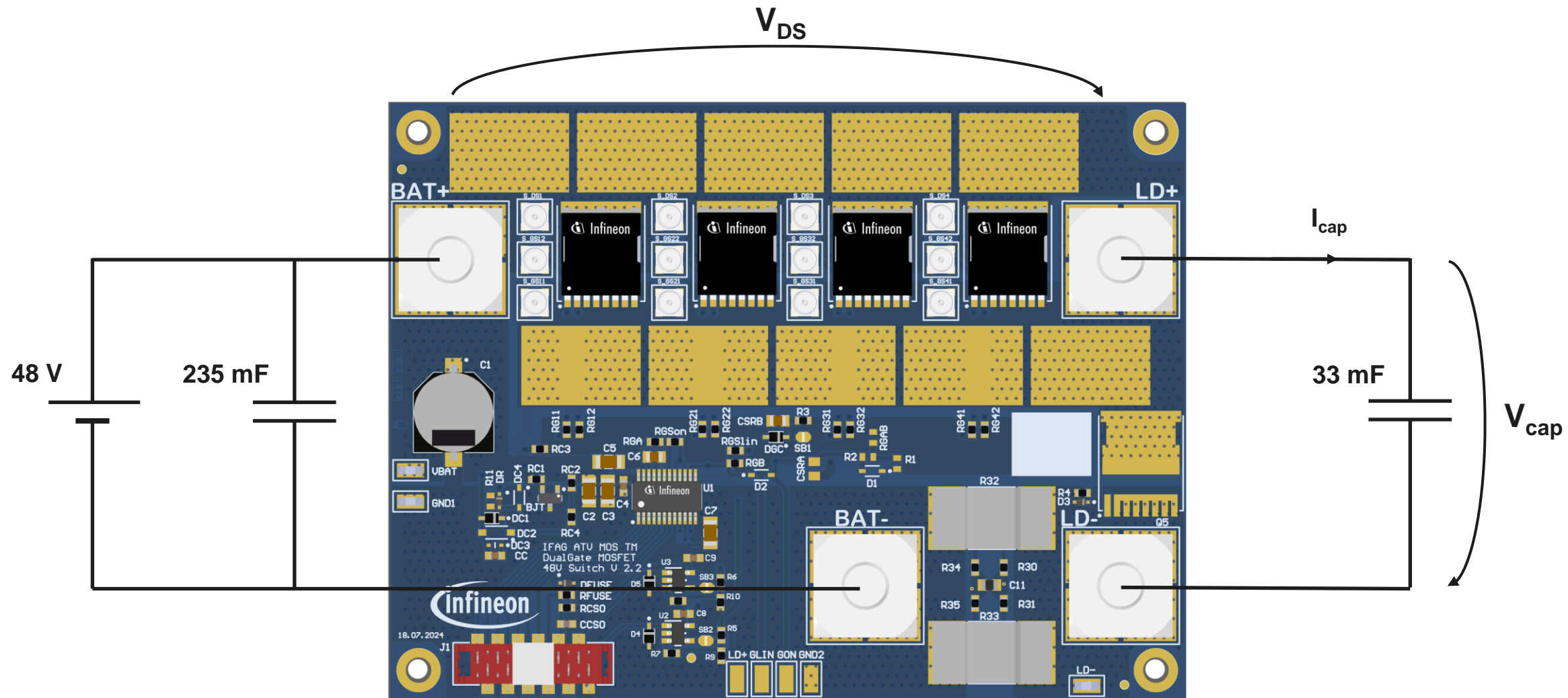
$T_a = 25^\circ\text{C}$, natural convection, 35 minutes loading at $I_D = 250\text{ A}$



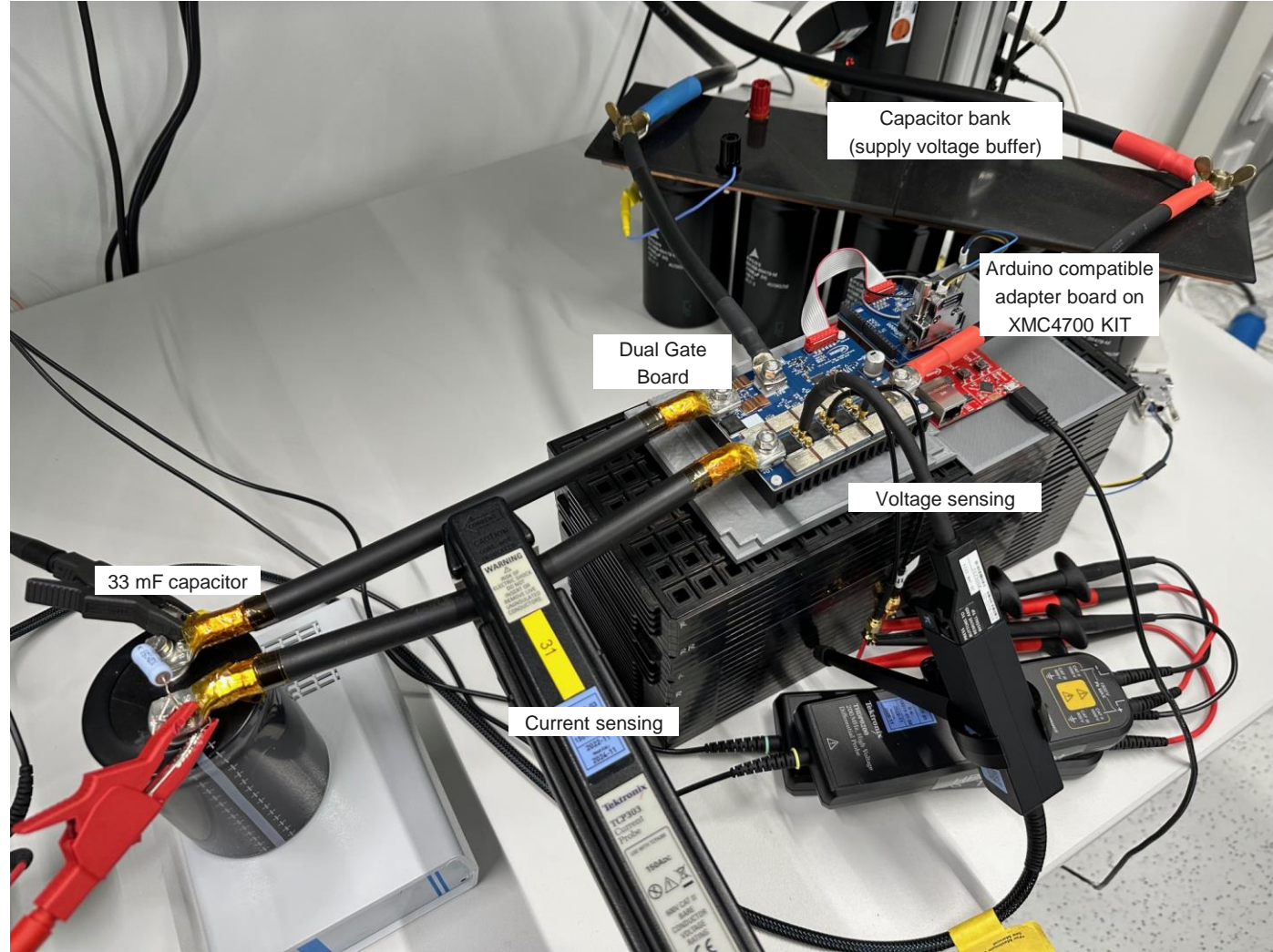
Dual Gate 48 V switch board with μ C control



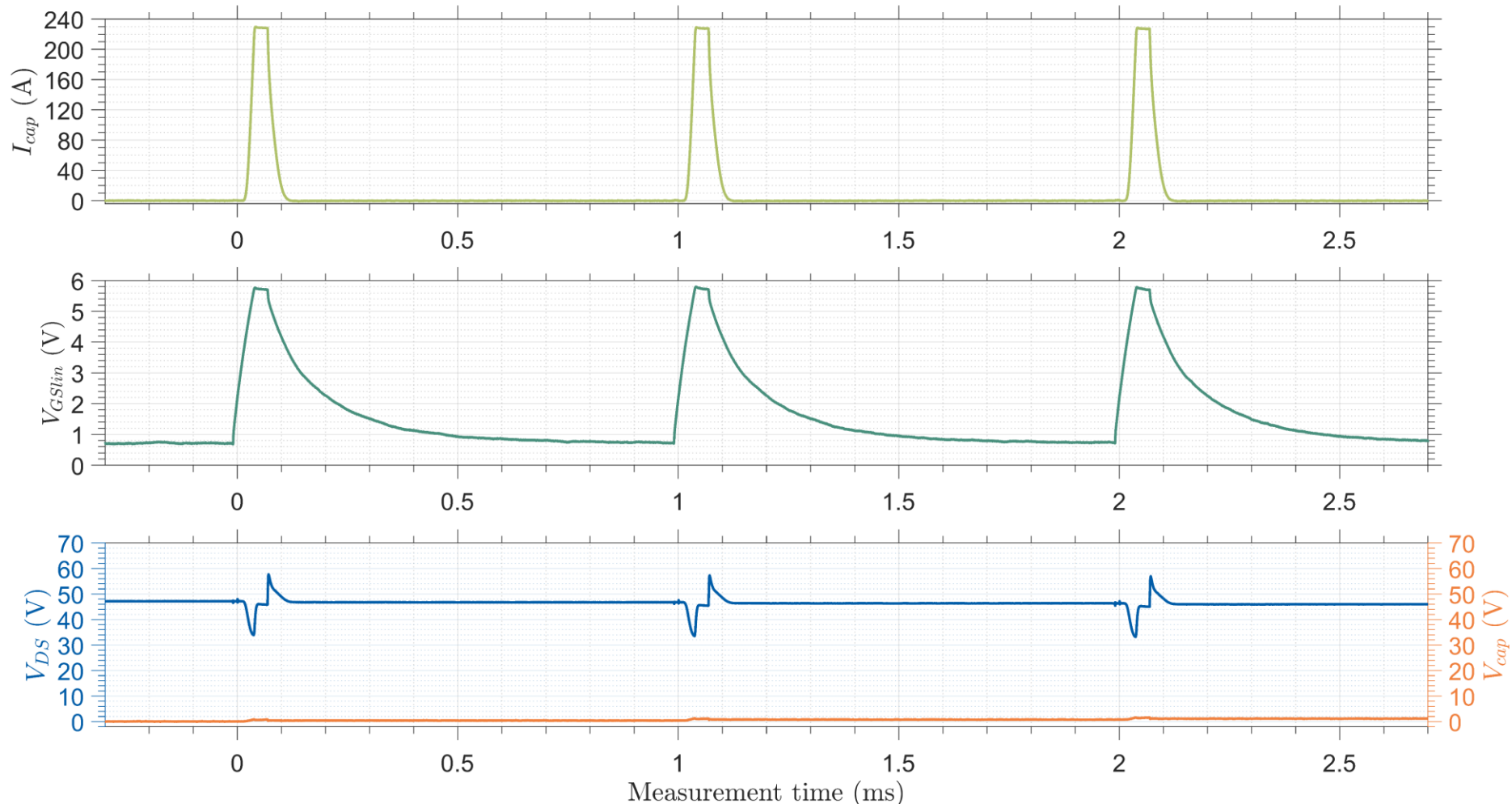
Capacitor charging setup – simplified schematic



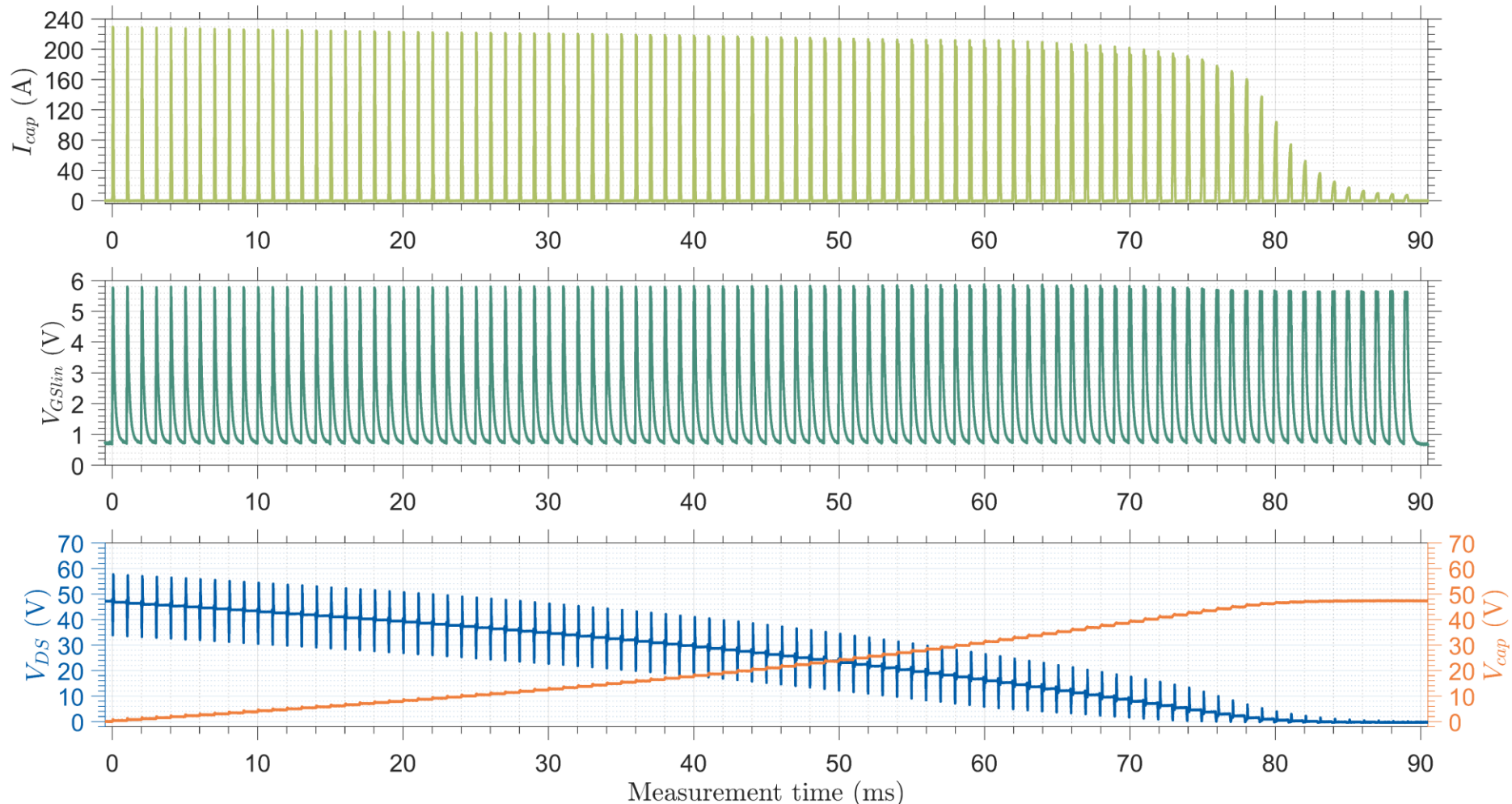
Capacitor charging 33 mF measurement setup



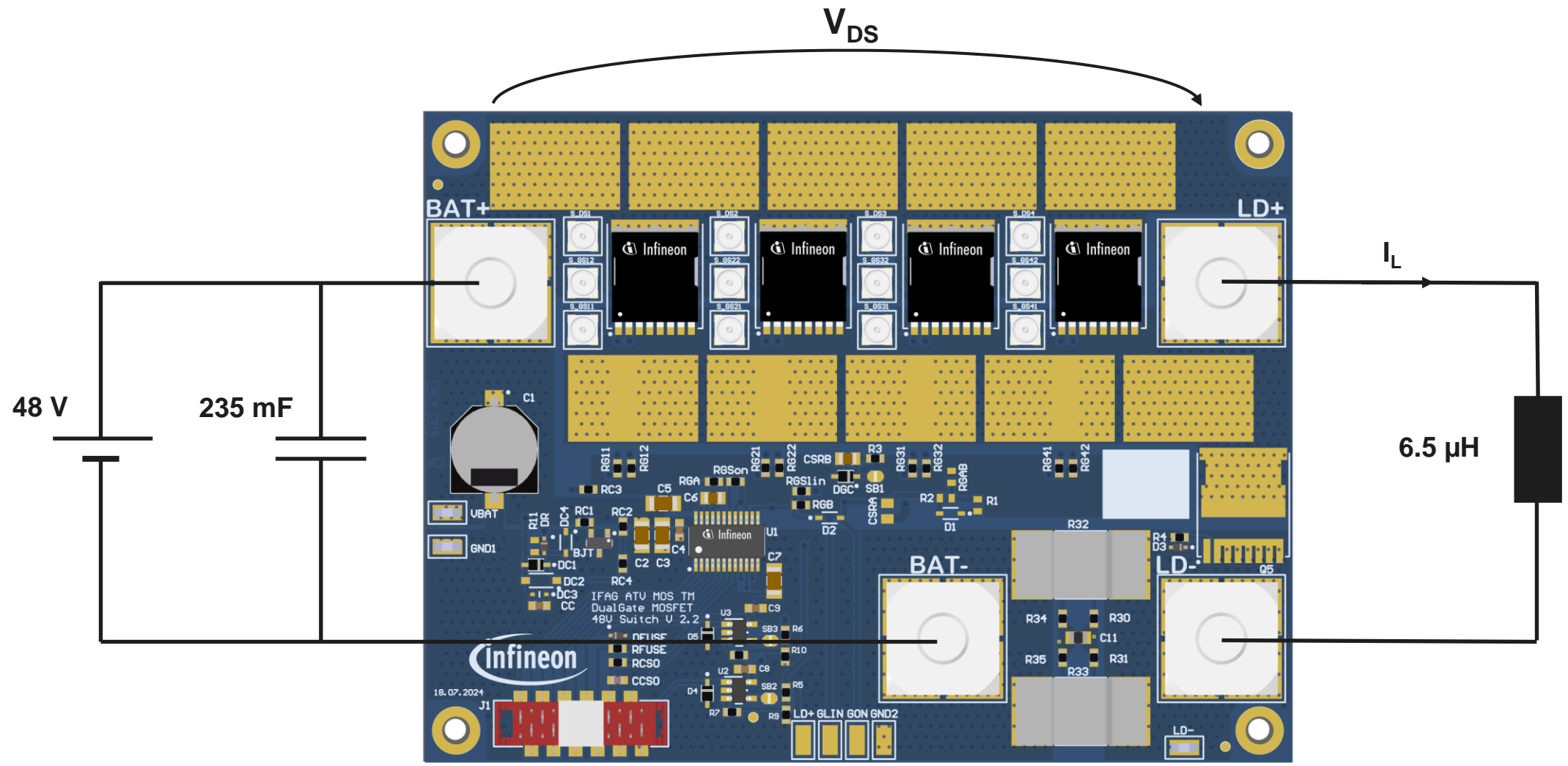
Capacitor charging 33 mF (first three pulses)



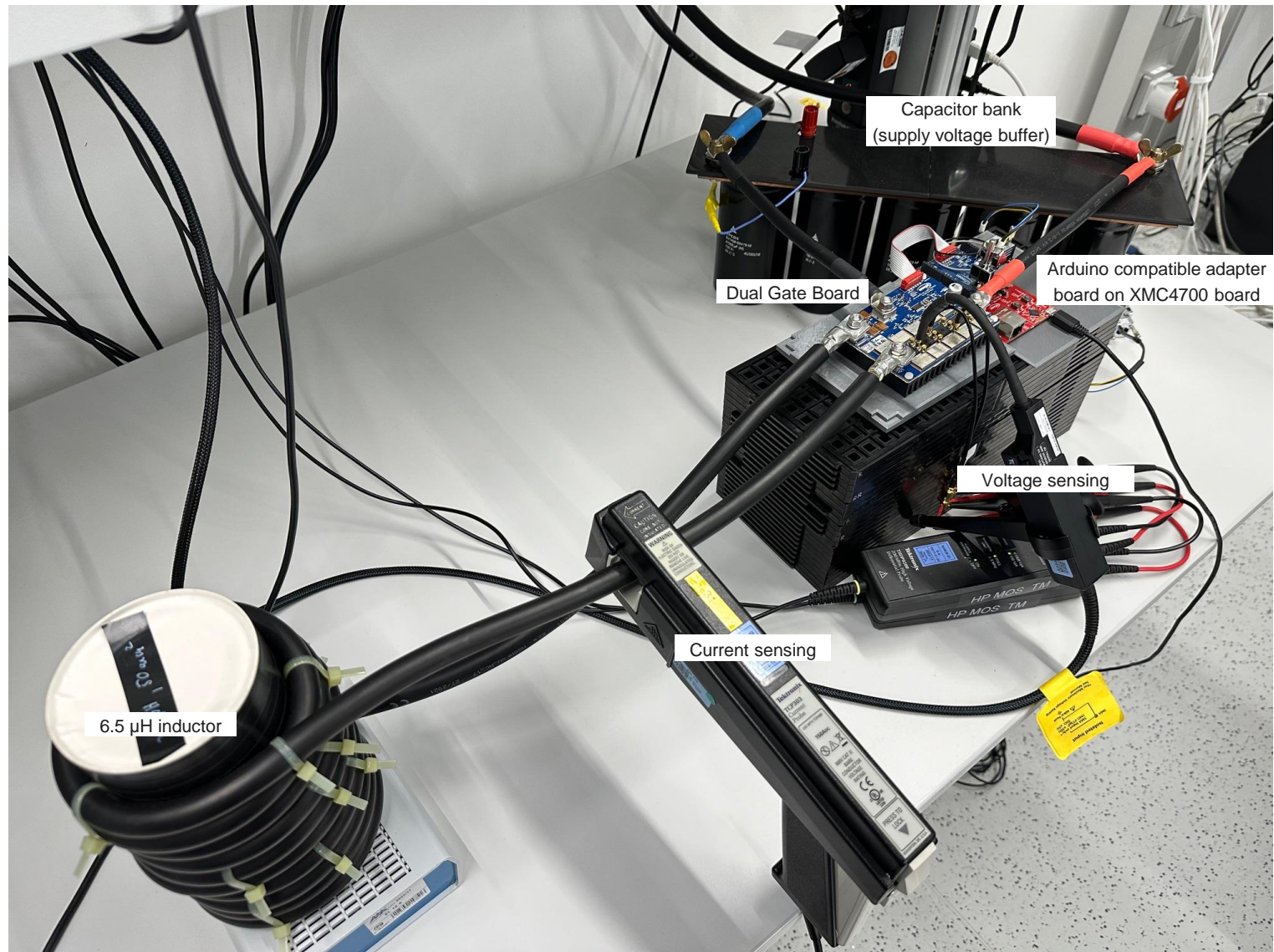
Capacitor charging 33 mF (whole charging wave-form)



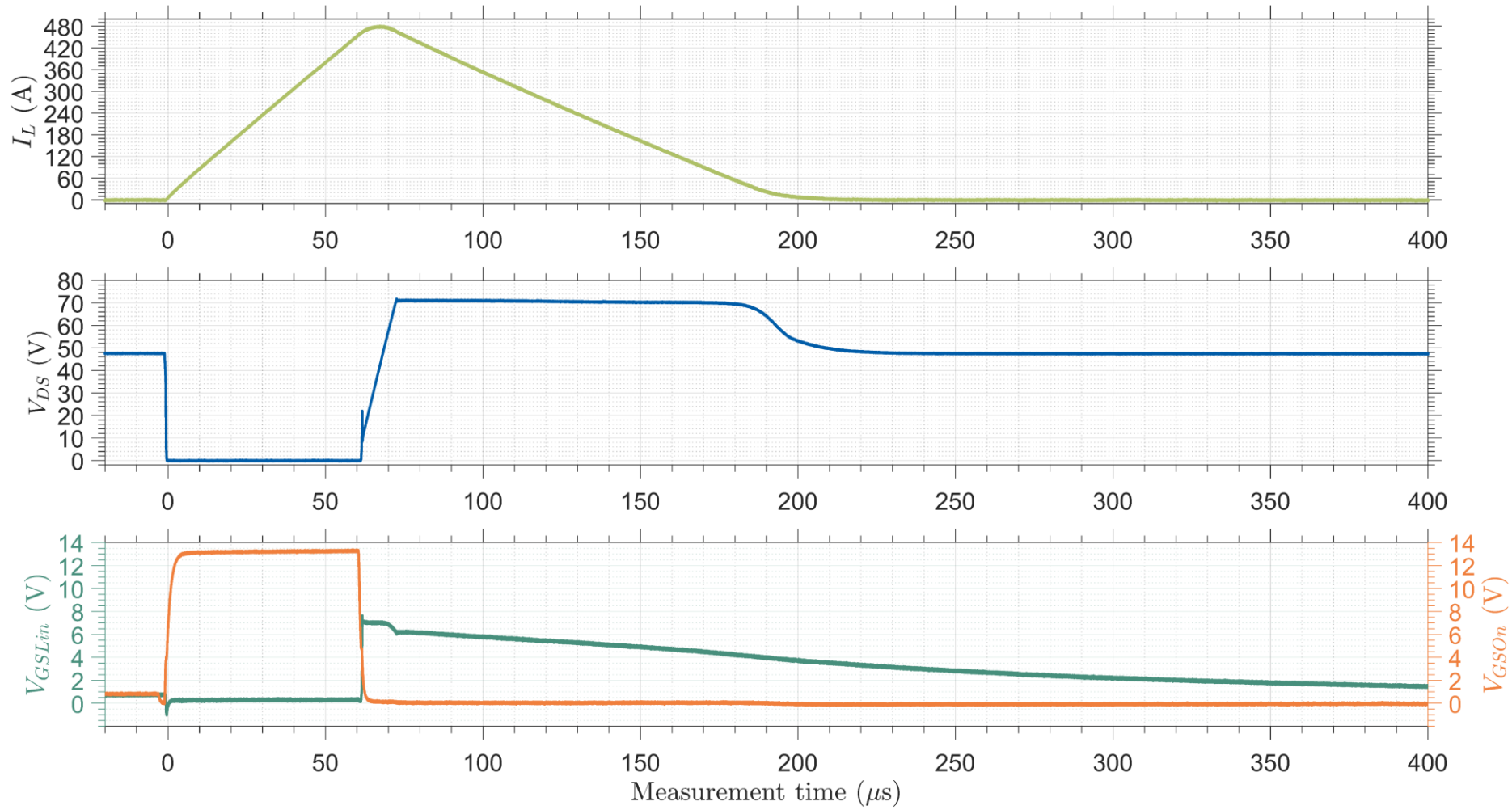
Short circuit clamping setup – simplified schematic



Short-circuit clamping measurement setup



Short-circuit clamping measurement



OneEye control suite – Dual Gate MOSFET part 1

Dualgate_MOSFET_config.OneEye - Dualgate MOSFET 48V switch GUI

File Options View Help

Main DriverSettings

Microcontroller receive status

VBAT+ [V] 47.95
VLD+ [V] 0.07
Current [I] -0.04

Faults

Fails: Vbat UV, Vbat OV, Vdd UV, Chip Temp, VDS OVA, VGS UVA, VDS OV B, VGS UV B, OV CURR, Cpump UV, SAF EN

Warnings: INT DET, LOSS GND CP, LOSS GND D, LOSS GND A, OVERTEMP, MEMFAIL

Monitoring: SPI ADD NAVA, SOURCE OVA, SOURCE OV B, Cpump RDY

Channel A (ONFET) CHA ON/OFF

Channel B (LINFET) CHB ON/OFF

Current offset correction Clear faults

OneEye config version 01.00 MCU software version: 01.01

Pulse pattern

Channel B
Mode Fixed duty cycle

Period [us] 1000
Start duty cycle [%] 5
End duty cycle [%] 0
Cycles 1

Start pulse pattern
Stop pulse pattern

Setup CAN Interface

Log box

Plugin loaded: C:\Infineon\Tools\OneEye\2.58.2.202308041657\bin\bin\plugins\PCom_Core.dll
Plugin loaded: C:\Infineon\Tools\OneEye\2.58.2.202308041657\bin\bin\plugins\PCom_DAS.dll
Plugin loaded: C:\Infineon\Tools\OneEye\2.58.2.202308041657\bin\bin\plugins\PCom_PeakCan.dll

OneEye Version 2.58.2

OneEye control suite – Dual Gate MOSFET part 2

Dualgate_MOSFET_config.OneEye - Dualgate MOSFET 48V switch GUI

File Options View Help

Main DriverSettings

General

Channel cross control OFF

VBAT undervoltage auto-restart time 1 ms

VBAT overvoltage auto-restart time 10 μ s

Current sense highside or lowside Low-Side

Current sense amplifier gain G_DIFF 35 V/V

Overcurrent detection thresholds $\pm 0.2 \cdot V_{DD}$

Current sense amplifier output capacitor Output load > 100 pF

Channel

Channel A

Drain-source overvoltage threshold 250 mV

VDS safe state Disabled

MOS voltage blank time 10 μ s

MOS voltage filter time 2 μ s

Channel B

Drain-source overvoltage threshold 250 mV

VDS safe state Disabled

MOS voltage blank time 10 μ s

MOS voltage filter time 2 μ s

Read driver register

Set driver register

Microcontroller receive status

Setup CAN Interface

Log box

Plugin loaded: C:/Infineon/Tools/OneEye/2.58.2.202308041657/bin/bin/plugins/PCom_Core.dll
Plugin loaded: C:/Infineon/Tools/OneEye/2.58.2.202308041657/bin/bin/plugins/PCom_DAS.dll
Plugin loaded: C:/Infineon/Tools/OneEye/2.58.2.202308041657/bin/bin/plugins/PCom_PeakCan.dll

OneEye Version 2.58.2

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