



Dual Gate MOSFET 48 V switch board

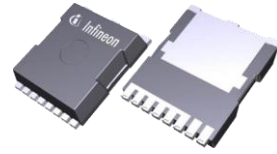
Quick introduction

IFAG ATV MOS
25.01.2024



SOA and RDSON comparison

Dualgate trench vs. Standard trench vs. Planar



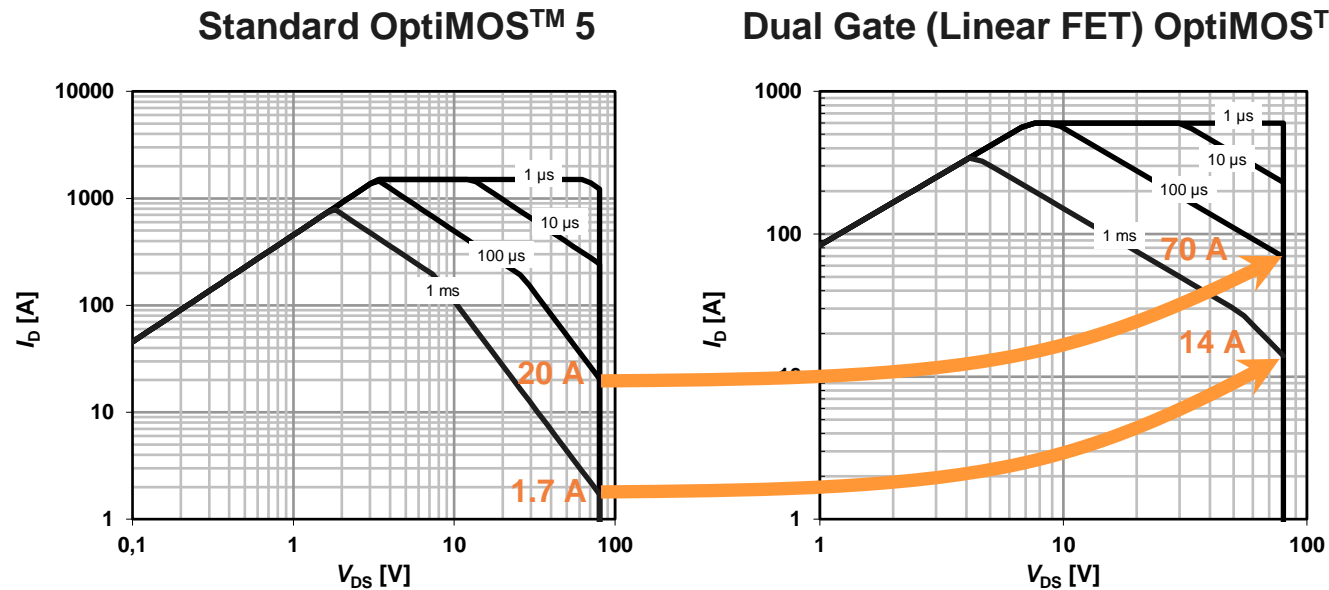
	IAUTN08S5N012L Dual Gate 80 V OptiMOS™ 5 Trench technology	IAUT300N08S5N011 Standard 80 V OptiMOS™ 5 Trench technology	IPB80N08S2-07 Standard 80 V OptiMOS™ Planar technology
SOA 1 ms at max V_{DS} , $T_C = 25^\circ\text{C}$	14 A (Linear MOSFET)	1.7 A	14 A
$R_{DS(on)}$ at $V_{GS} = 10\text{ V}$, $T_J = 25^\circ\text{C}$	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



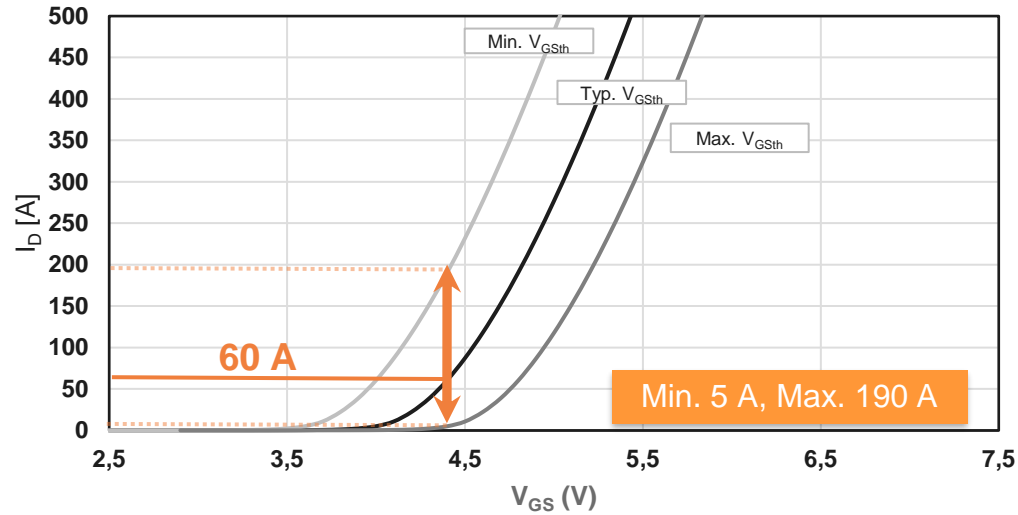
Dual Gate (Linear FET) SOA significantly larger at high V_{DS}

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

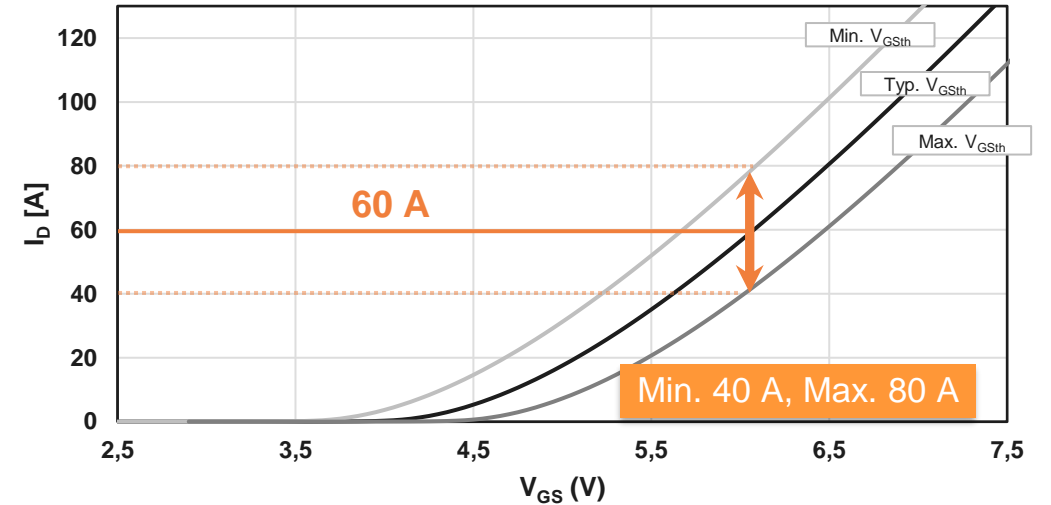
Transfer characteristics comparison

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

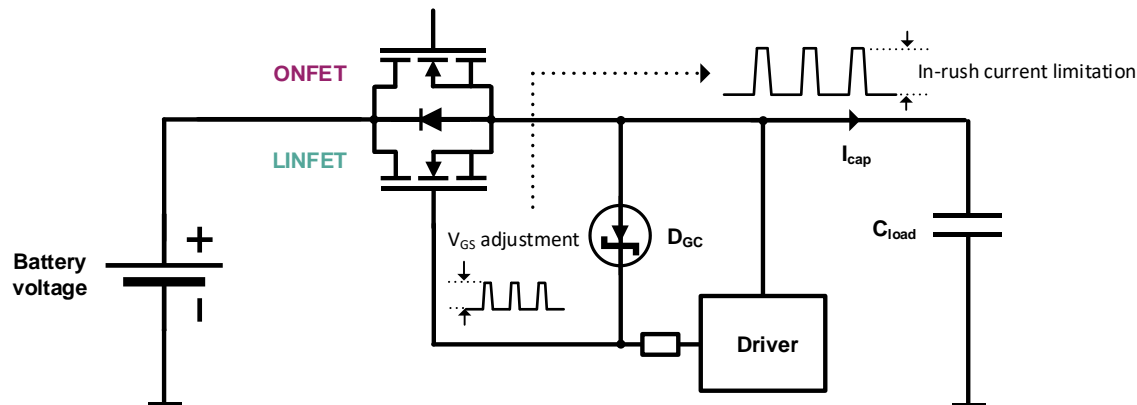
Enabling paralleling in linear mode operation

Dual Gate MOSFET 80 V

Application examples

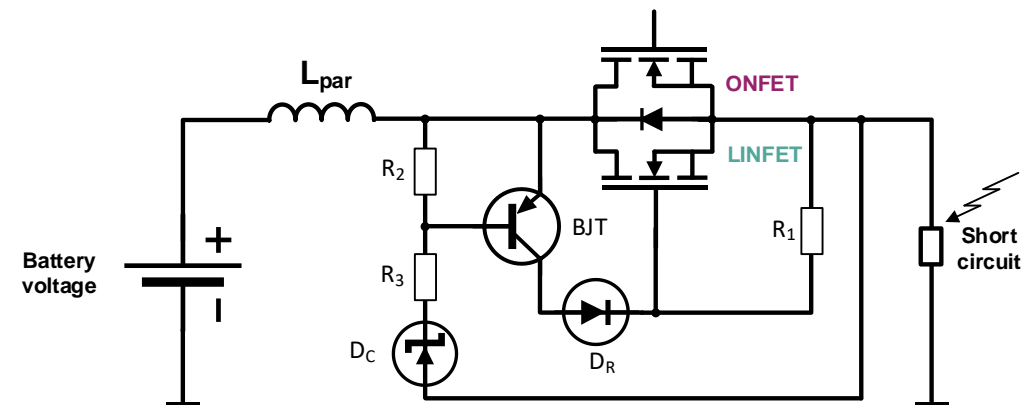
Capacitor charging

- 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.



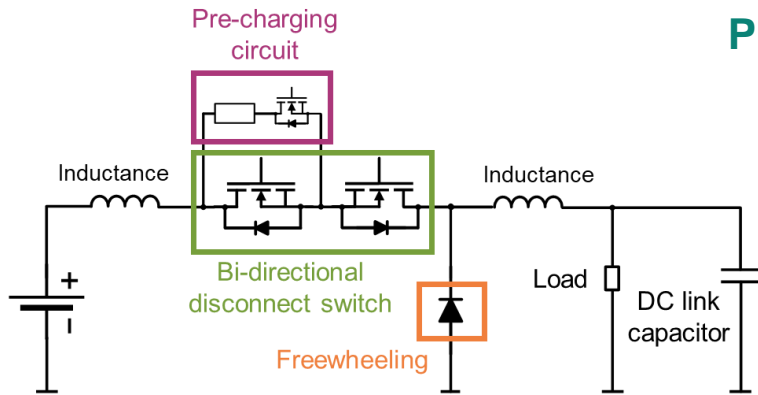
Short circuit clamping

- D_C limits the V_{DS} voltage to avoid avalanche (no hot carrier injection). Instead the MOSFET operates in linear mode to dissipate inductor energy.
- LINFET allows higher currents in linear mode and gives more flexibility for clamping circuit design.
- ONFET can be turned on to minimize steady state losses during normal operation.

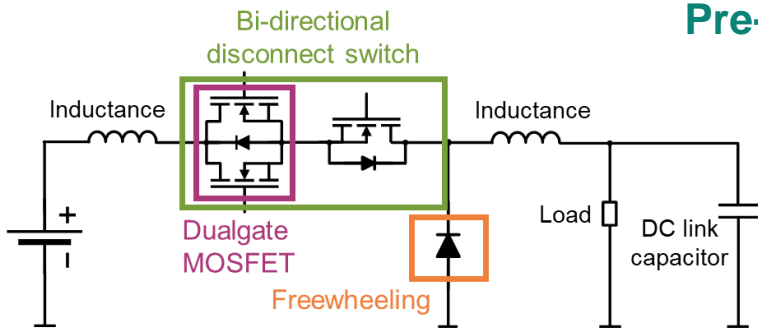
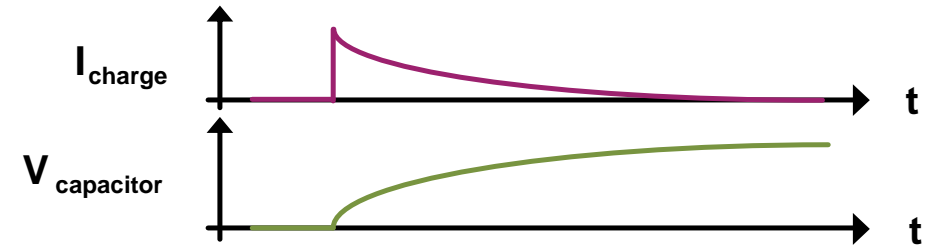


Capacitor pre-charging with power resistor vs. Dual Gate MOSFET

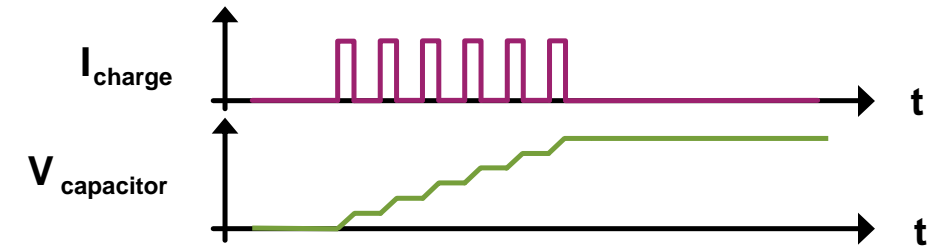
Reduction of system cost (no pre-charge circuit needed) and acceleration of capacitor charging



Pre-charging with power resistor



Pre-charging with Dual Gate MOSFET



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



Dual Gate 48 V switch board (uni-directional)

– Perfect fit for 48 V disconnect switch applications

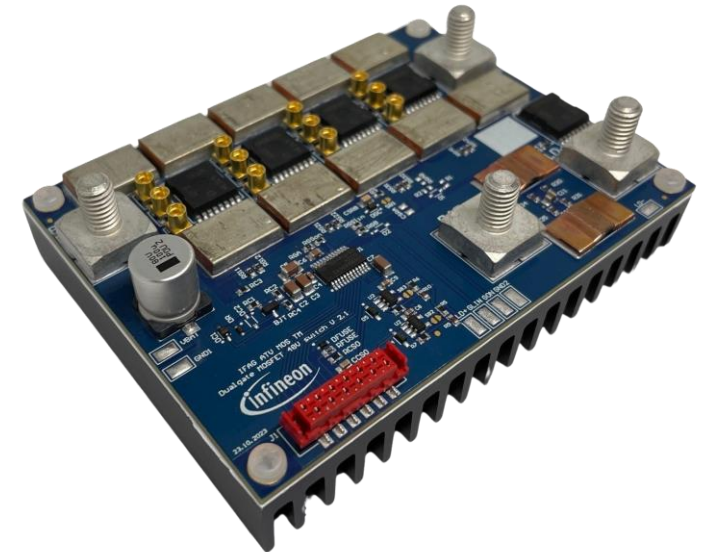
- Power distribution
- Battery management
- Electrically heated catalyst

– Used Infineon components

- Dual Gate MOSFETs IAUTN08S5N012L: 80 V, max. $R_{DS(on)}$ 1.15 m Ω
- Freewheeling MOSFET: IAUT300N08S5N012
- 48 V high-side driver: 2ED4820-EM

– System advantages

- Supports fast pulsed capacitor charging with Dual Gate MOSFET to minimize system costs (no separate pre-charging path needed).
- Active clamping capable to dissipate inductive energy from cable harness. Dual Gate MOSFET operates in linear mode instead of avalanche to increase short circuit robustness and increase drain-source voltage clamp accuracy.



Evaluation Board (available for purchase)

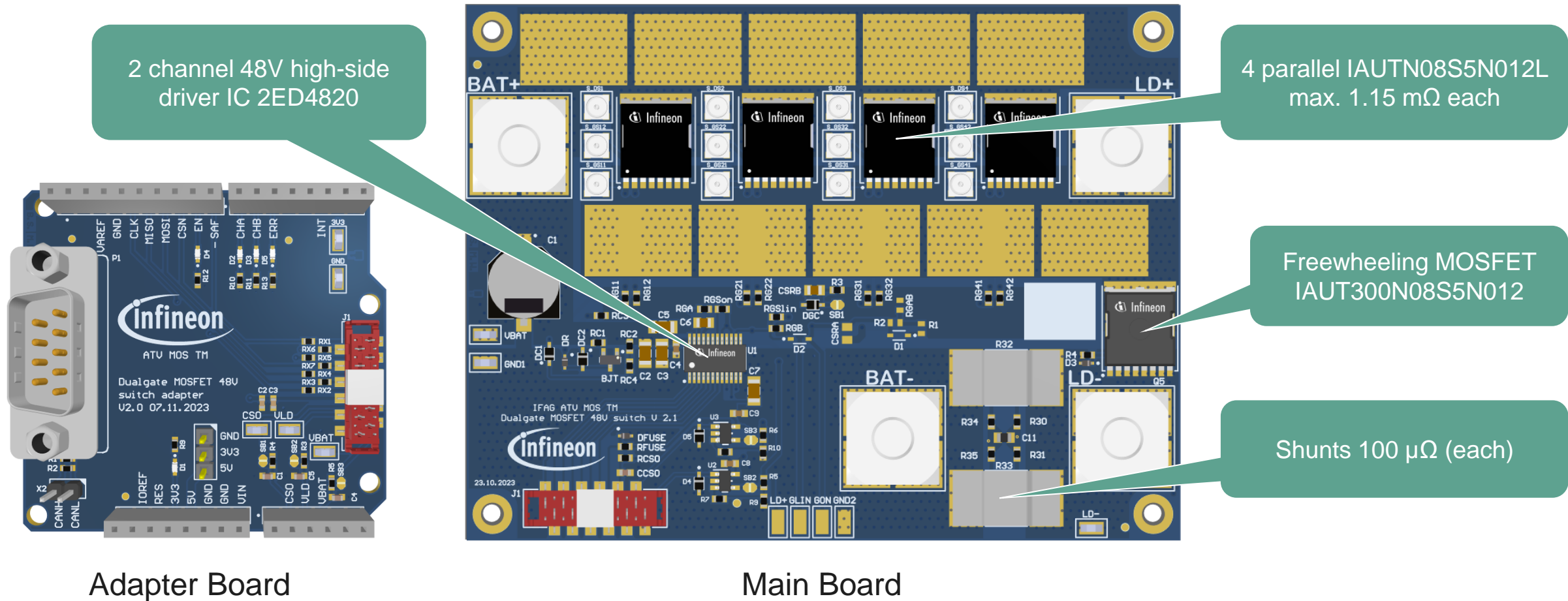
Part number: DG_48V_SWITCH_KIT

Contact your Infineon salesperson for support

Check out infineon.com for more information

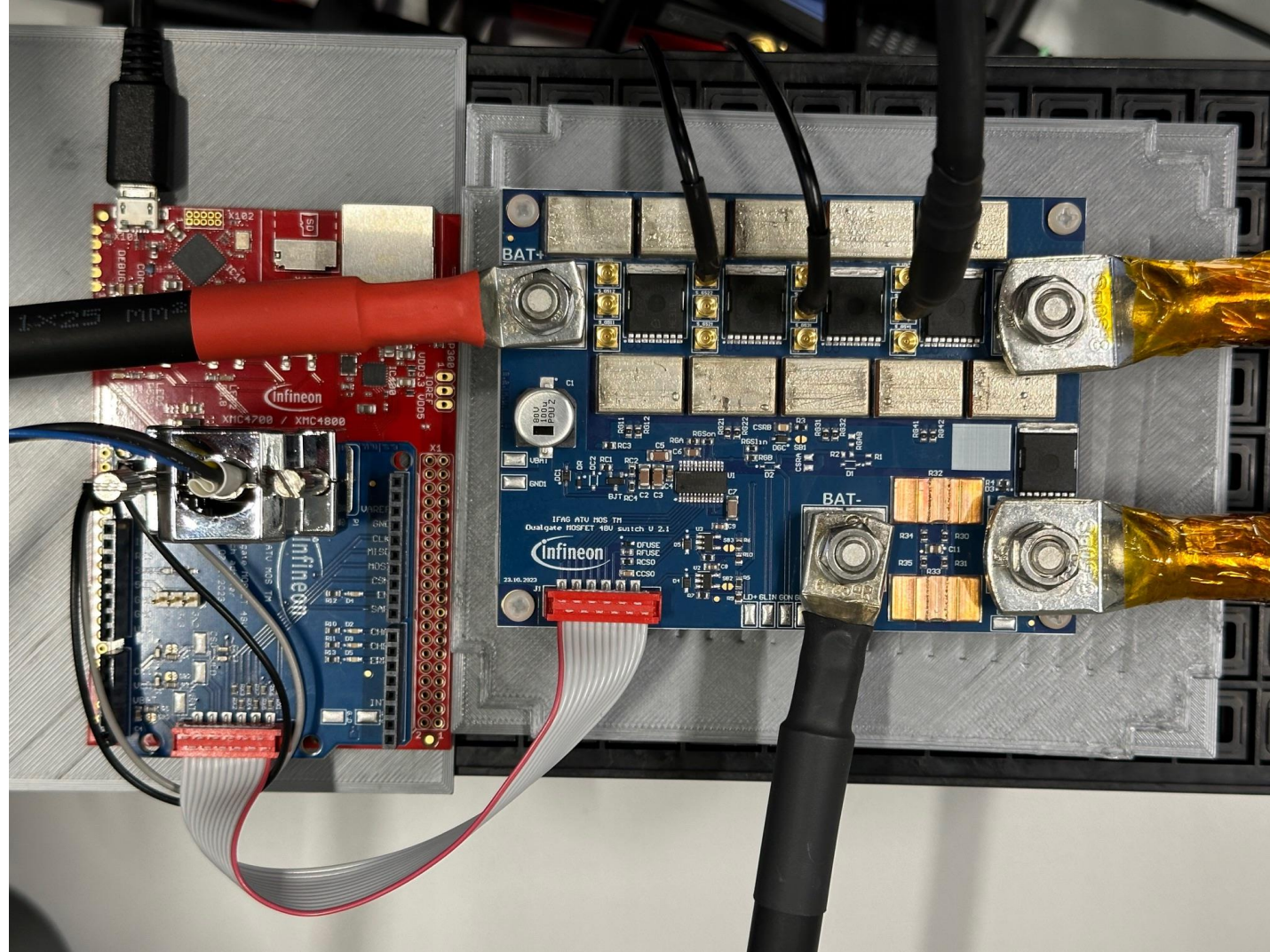
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Dual Gate MOSFET 80 V 48 V switch board (uni-directional) overview



Board description

48 V Dual Gate MOSFET disconnect switch board with μ C control



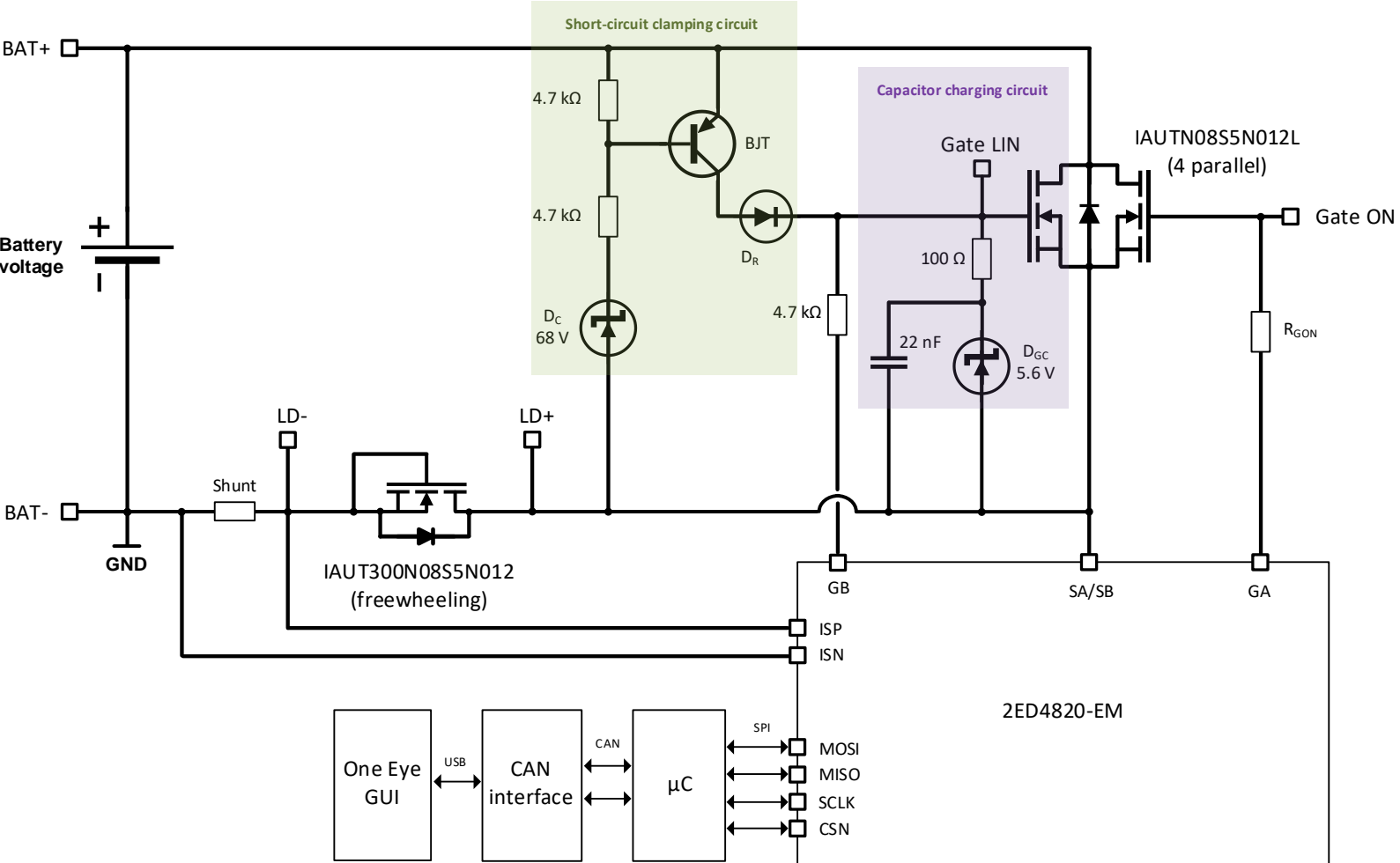
Simplified schematic Dual Gate 48V switch board

Clamping circuit

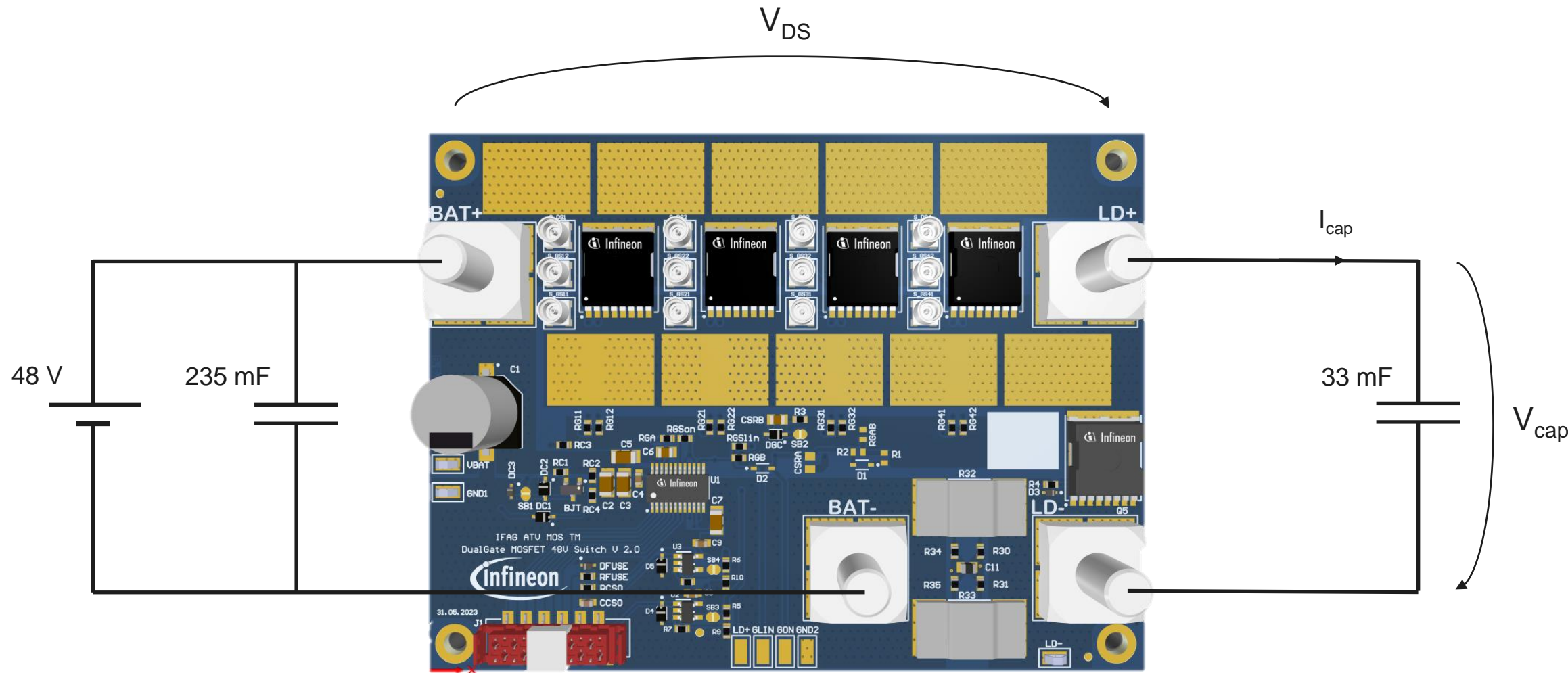
- Zener diode D_C to limit V_{DS} to 68 V
- BJT circuit for optimized clamping speed and high V_{DS} clamp accuracy: $V_{DS,clamp} \approx V_{DC}$
- Reverse diode D_R to avoid reverse currents

Capacitor charging circuit

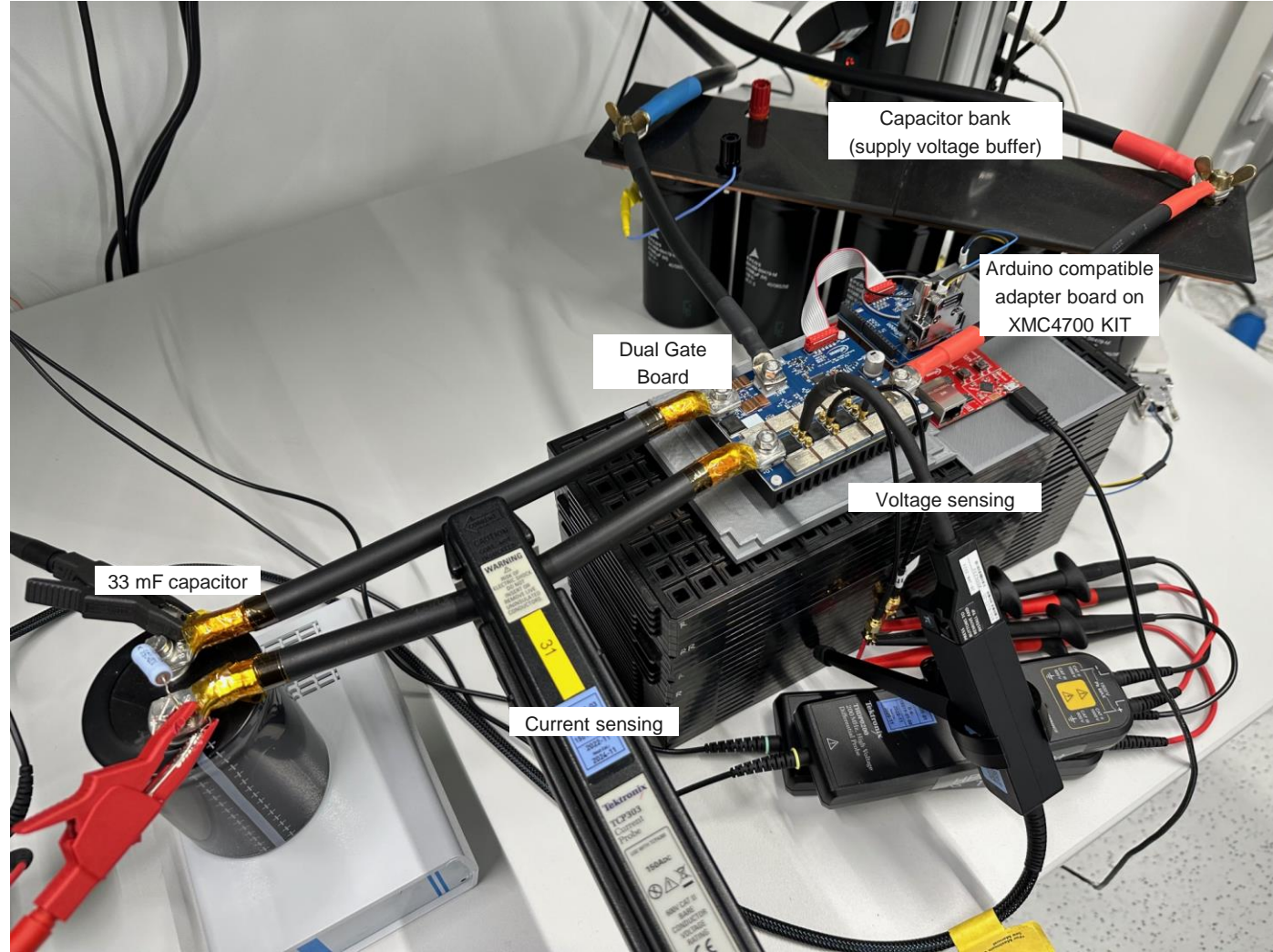
- Gate voltage limited by Zener diode D_{GC} 5.6 V to limit in-rush current
- 22 nF for slow switching
- 100 Ω resistance to decouple the capacitor charging circuit from the clamping circuit



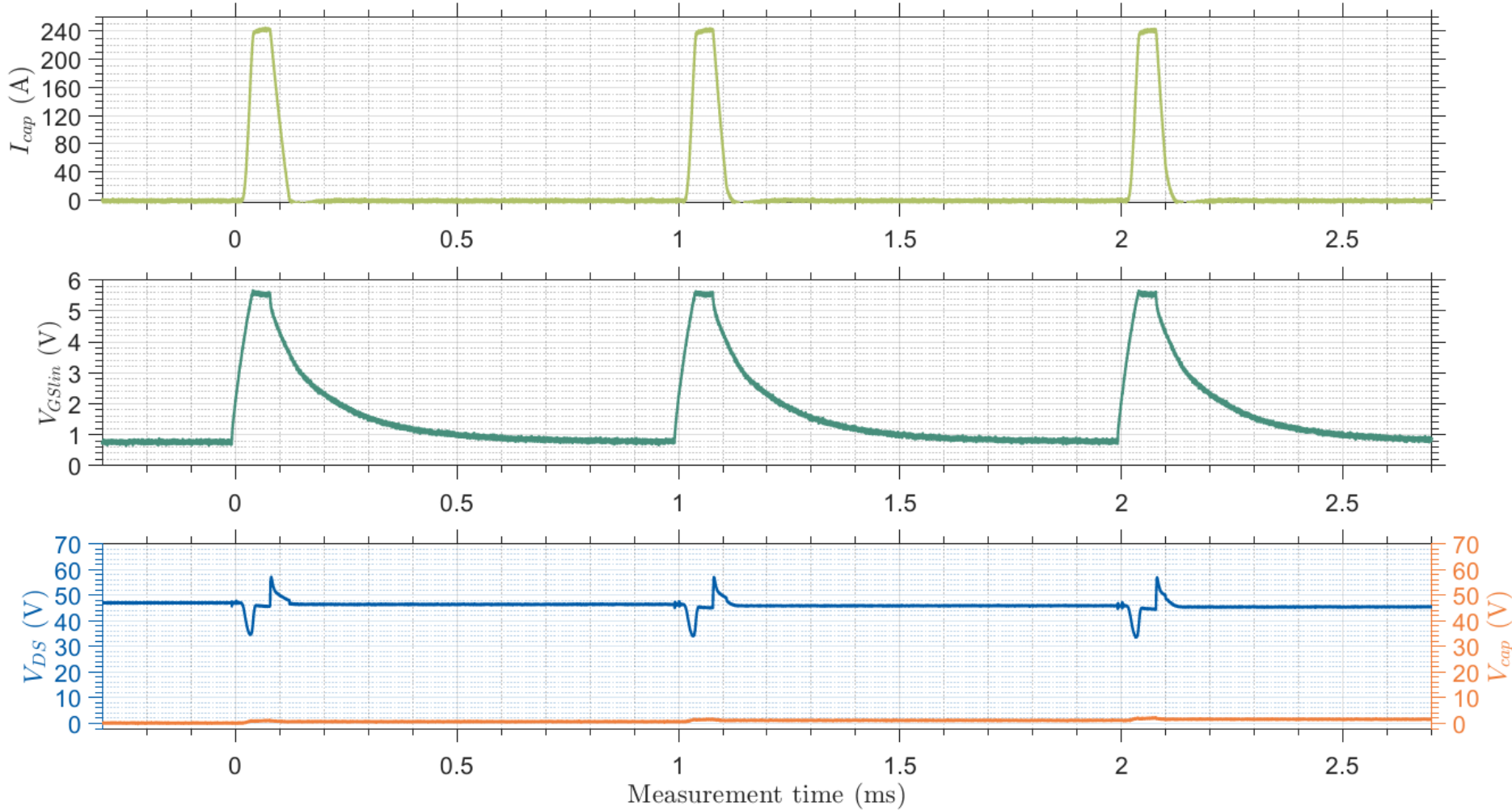
Capacitor charging setup – simplified schematic



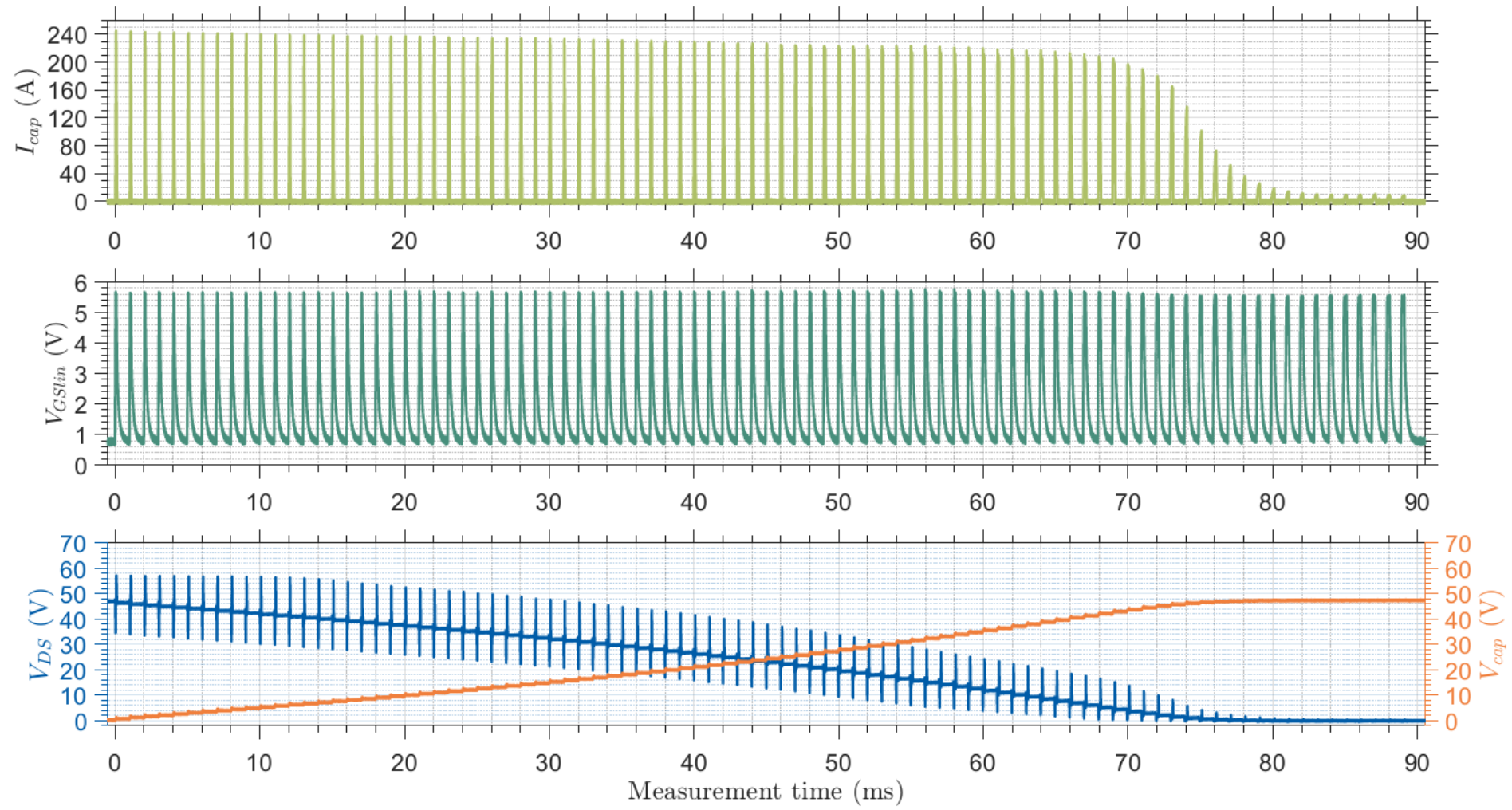
Capacitor charging setup



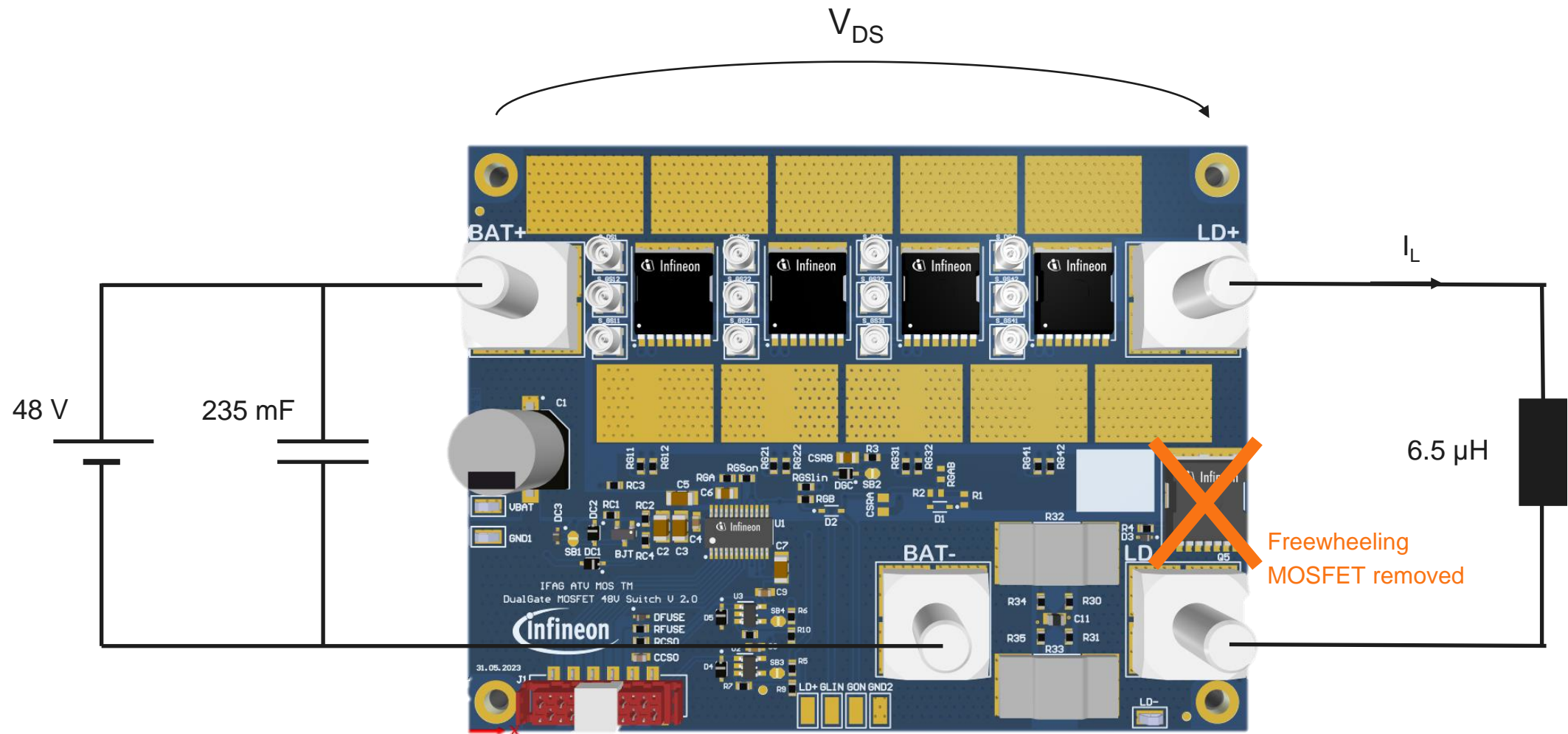
Capacitor charging – waveforms, first three pulses



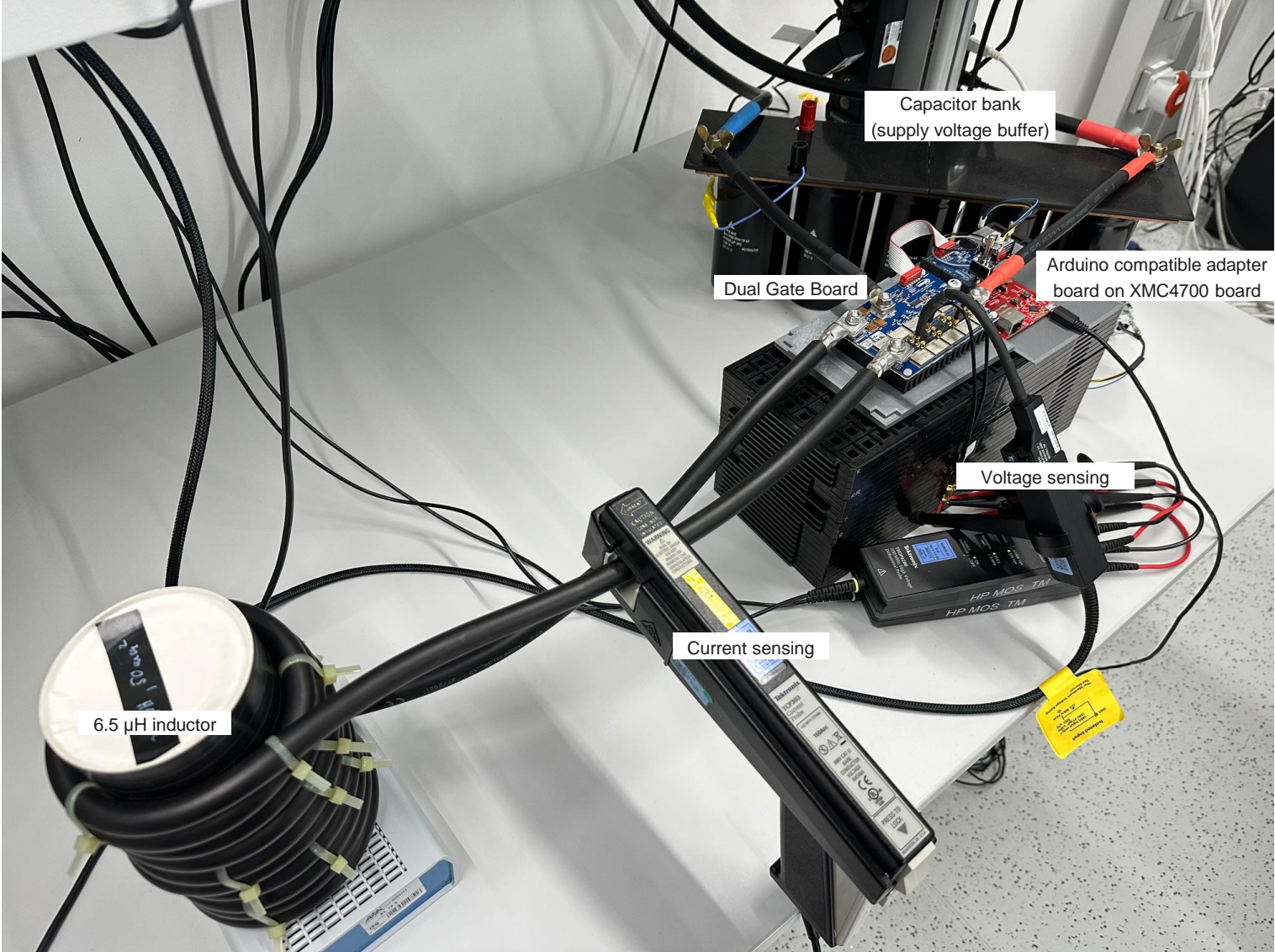
Capacitor charging – waveforms, all pulses



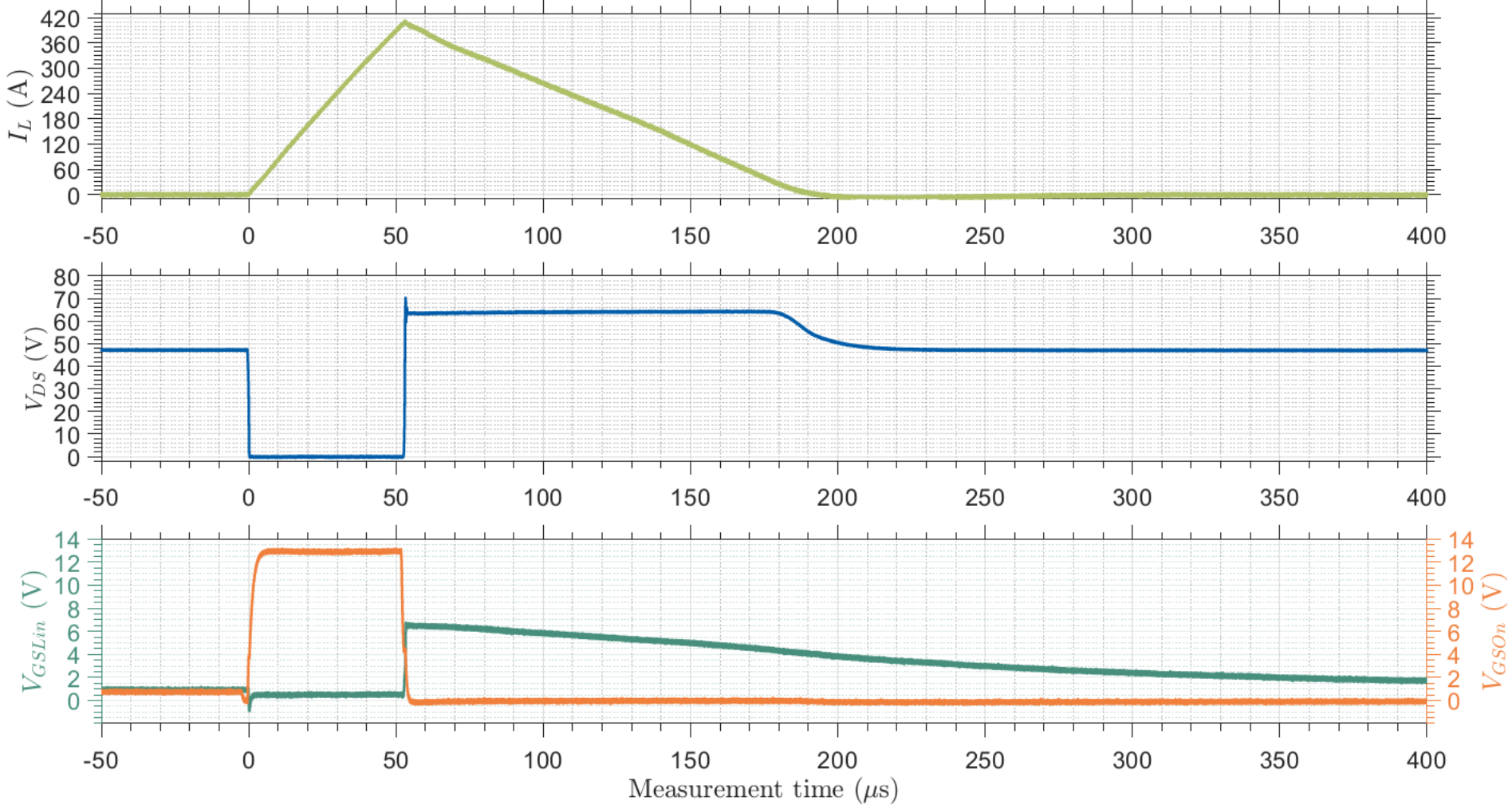
Short-circuit clamping setup – simplified schematic



Short-circuit clamping setup



Short-circuit clamping setup – waveforms



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 UV Vbat OV Vdd UV Chip Temp VDS OVA VGS UVA VDS OVB VGS UVB OV CURR Cpump UV SAF EN

INT DET LOSS GND CP LOSS GND D LOSS GND A OVERTEMP MEMFAIL SPI ADD NAVA SOURCE OVA SOURCE OVB Cpump RDY

Channel A (ONFET) Channel B (LINFET)

CHA ON/OFF 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

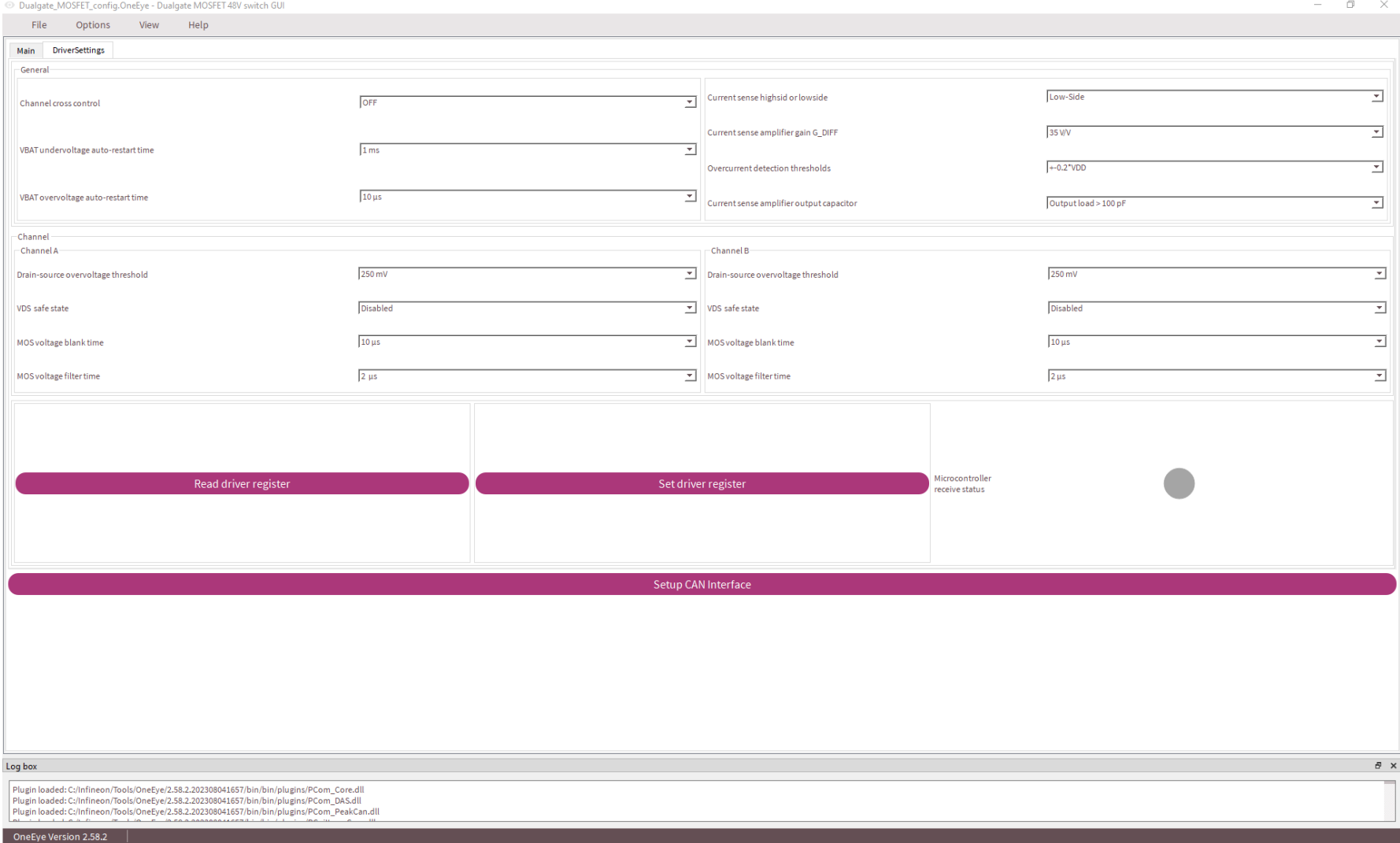
Setup CAN Interface

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 μs
 Current sense highside or lowside: Low-Side
 Current sense amplifier gain G_DIFF: 35 V/V
 Overcurrent detection thresholds: +-0.2*VDD
 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 μs
 MOS voltage filter time: 2 μs

Channel B
 Drain-source overvoltage threshold: 250 mV
 VDS safe state: Disabled
 MOS voltage blank time: 10 μs
 MOS voltage filter time: 2 μs

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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