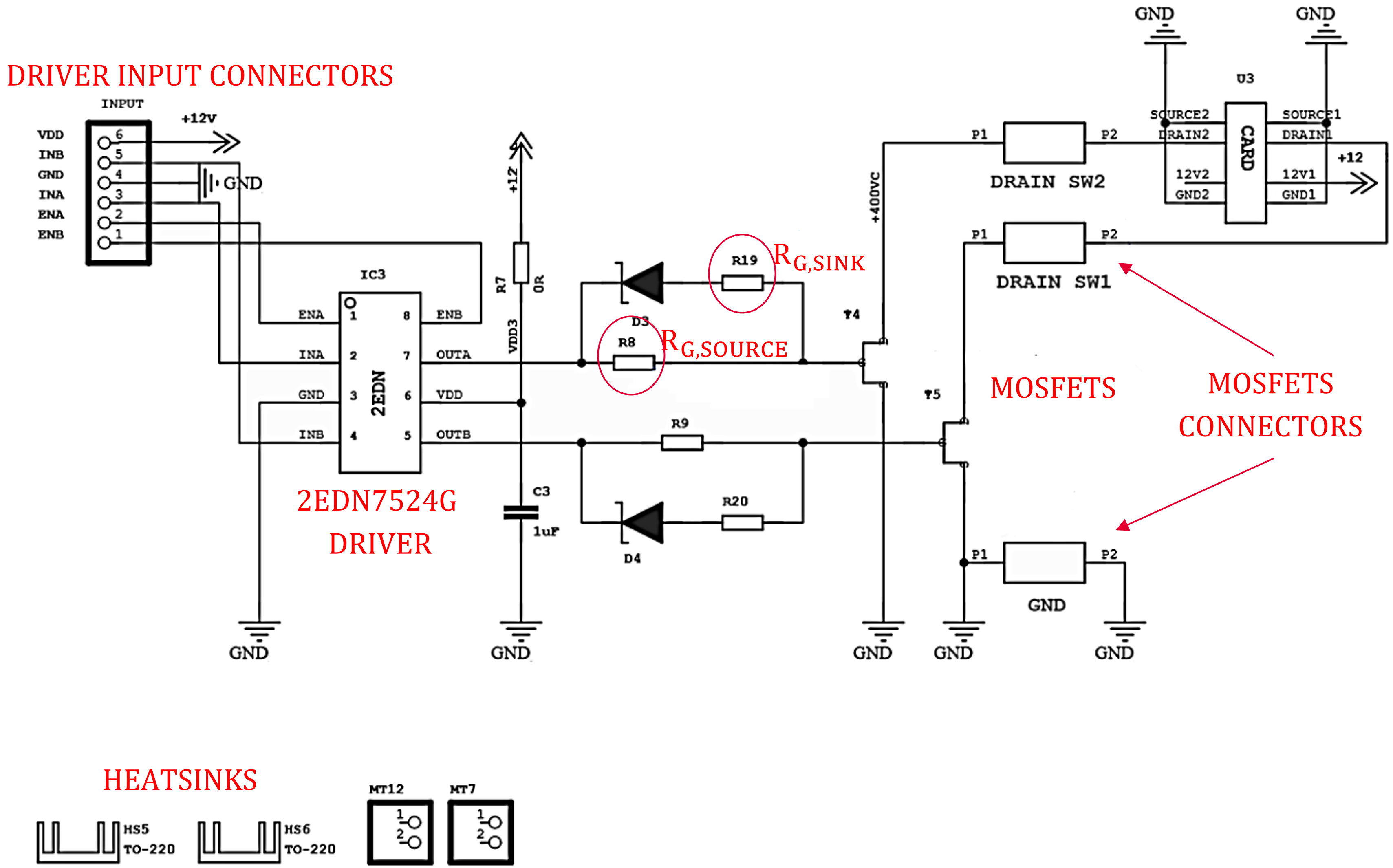
Quick start guide KIT_DRIVER_2EDN7524G

August 2018

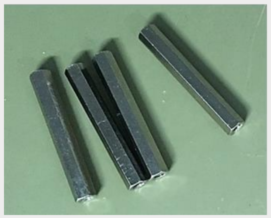
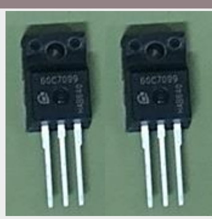
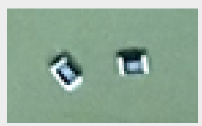
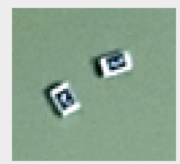
KIT_DRIVER_2EDN7524G

Included in this kit

Board schematic

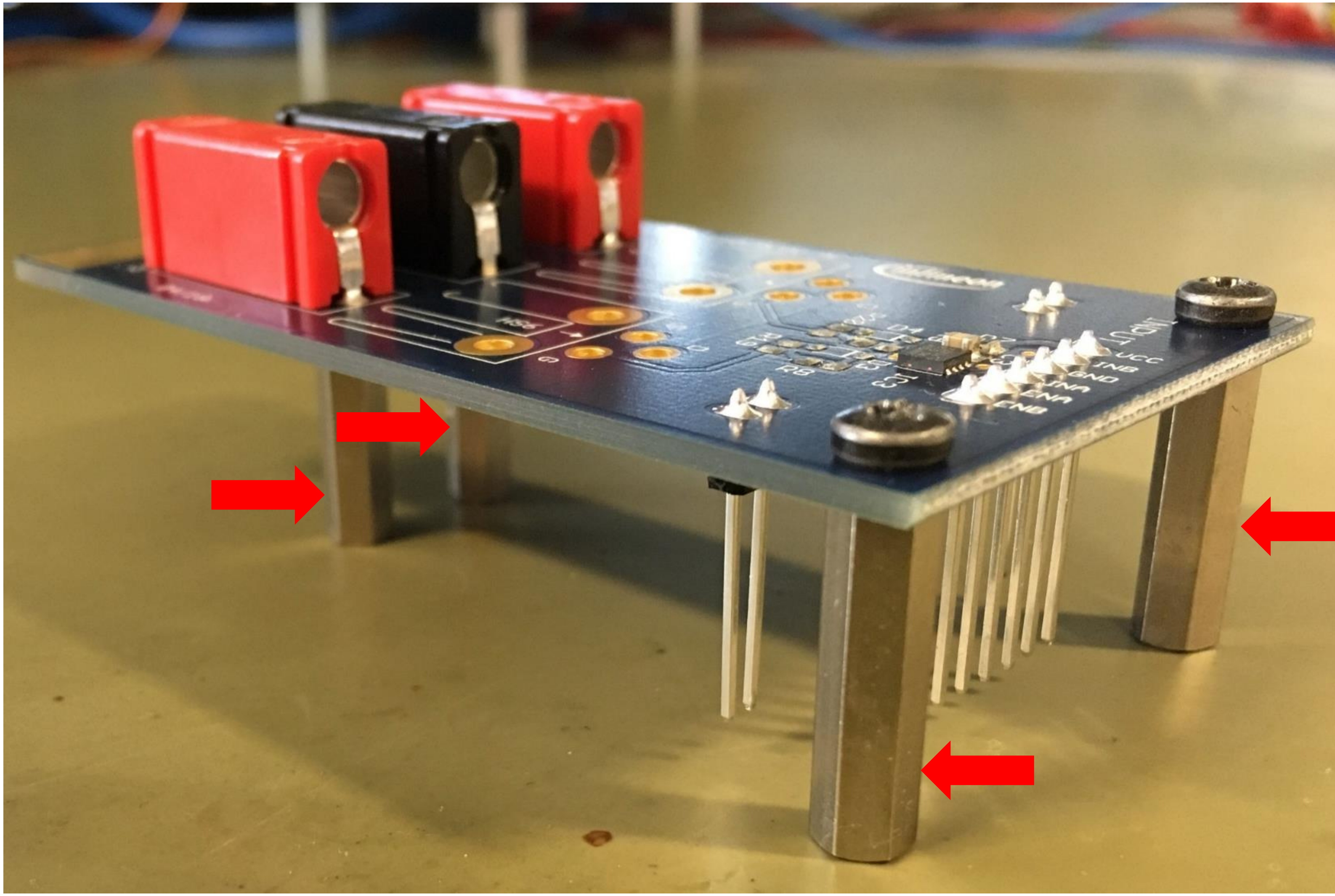


Components to add – BOM suggestion

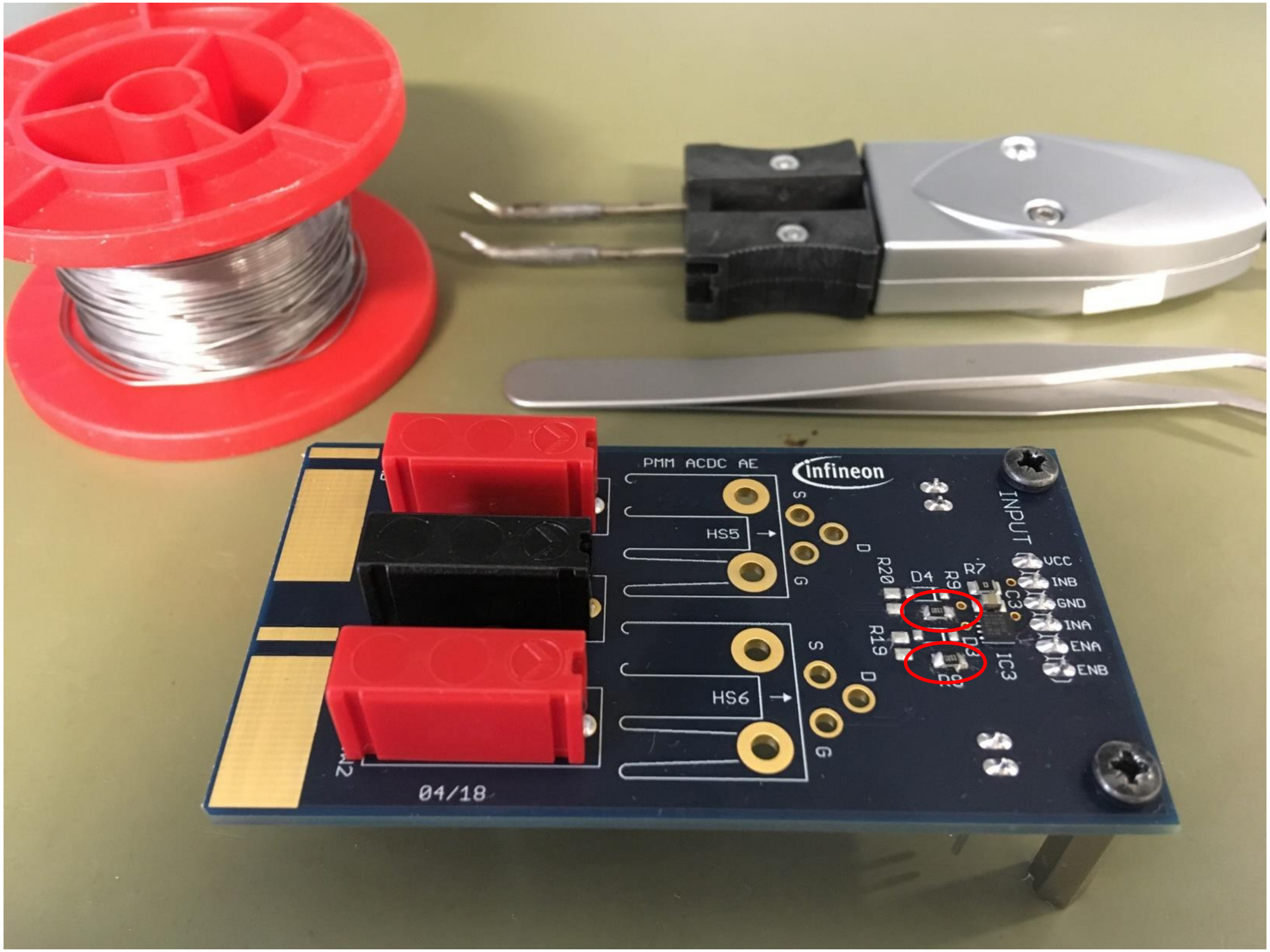
Distance bolts	Screws for distance bolts	Screws and washers for MOSFET mounting to heatsink	TO-220 sockets
			
TO-220 MOSFETs	**Source resistors (R8, R9)**	**Sink resistors (R19, R20)**	**Sink diodes**
			

Component	Quantity	Designator	Comment	Voltage	Footprint	Type	Part number/ supplies
Sink diode	2	D3,D4	Schottky diode	30 V	SOD-123	PMEG3020 Schottky diode	816-6858 RS-Components
Resistors	4	R8,R9,R19,R20			RES805R	SMD ceramic resistor	
TO-220 sockets	2	T4,T5	TO-220 socket		TO-220	Receptacle Connector 0.034" ~ 0.041" (0.86 mm ~ 1.04 mm)	5050865-5 Digi-key

Step 1: Distance bolts mounting

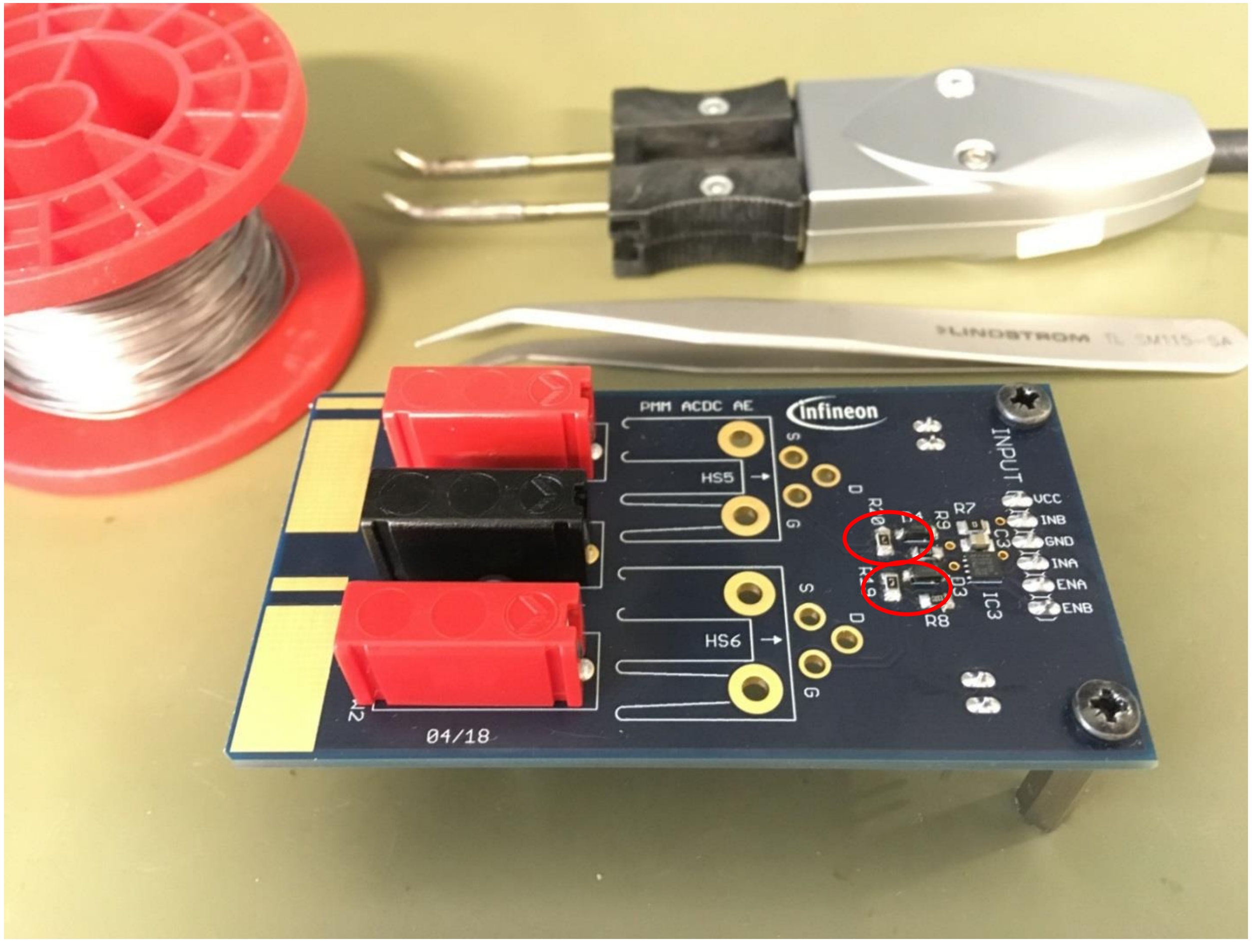


Step 2: Source resistors soldering

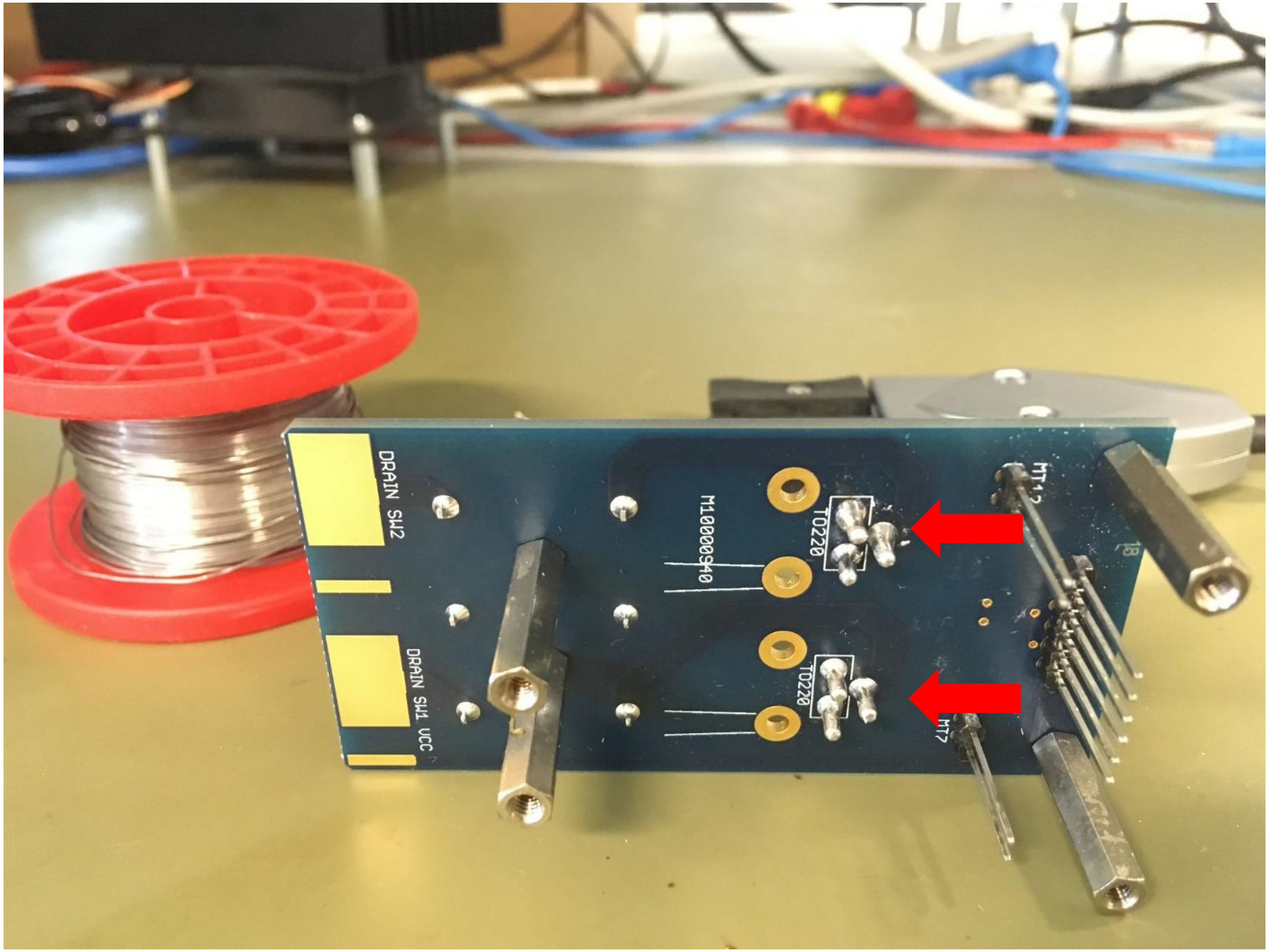


Step 3: Sink resistors and sink diodes soldering

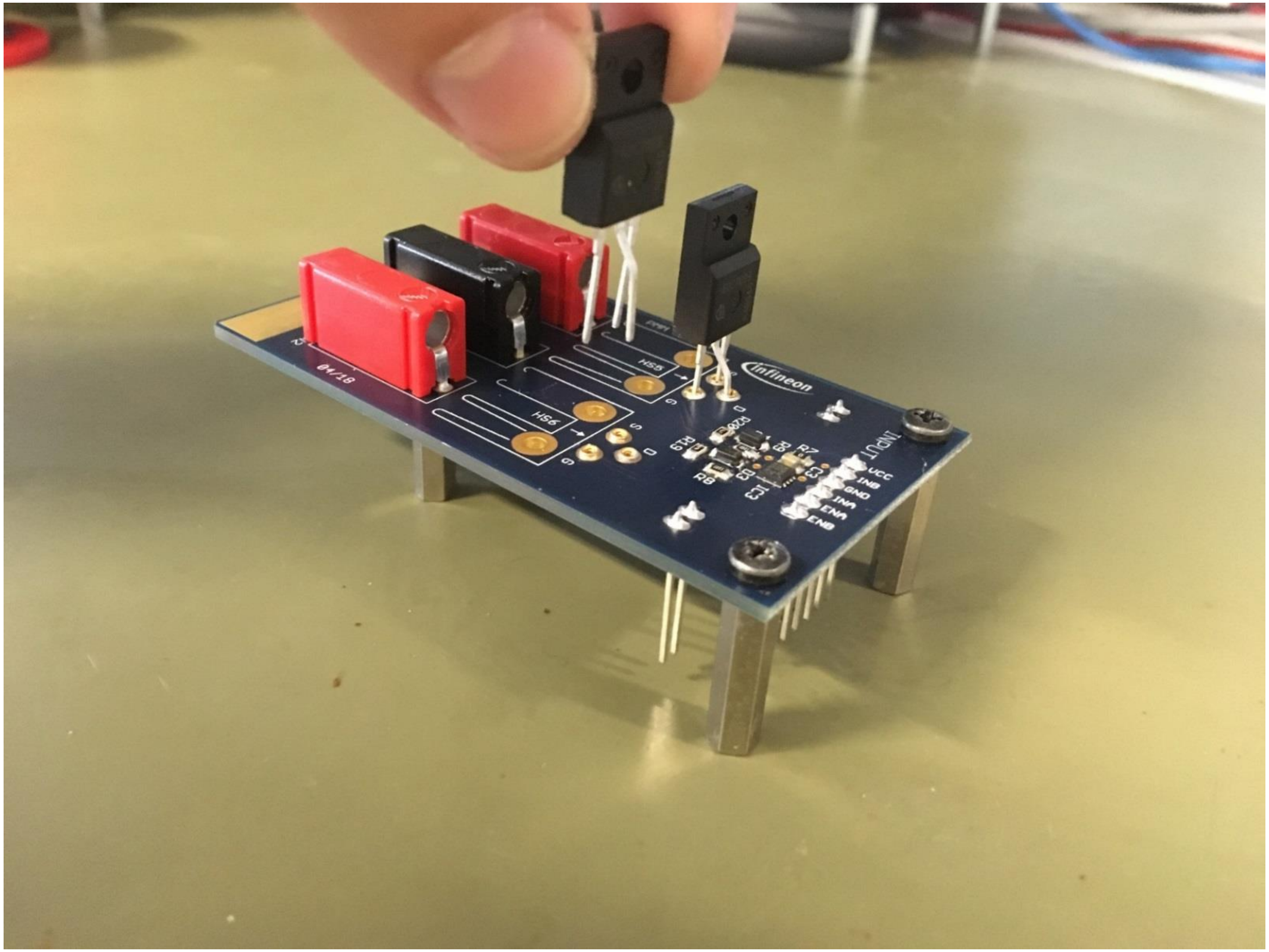
› Add the sink resistors and the sink diodes only if a differentiation between the turn-on and the turn-off behavior is required



Step 4: TO-220 sockets soldering

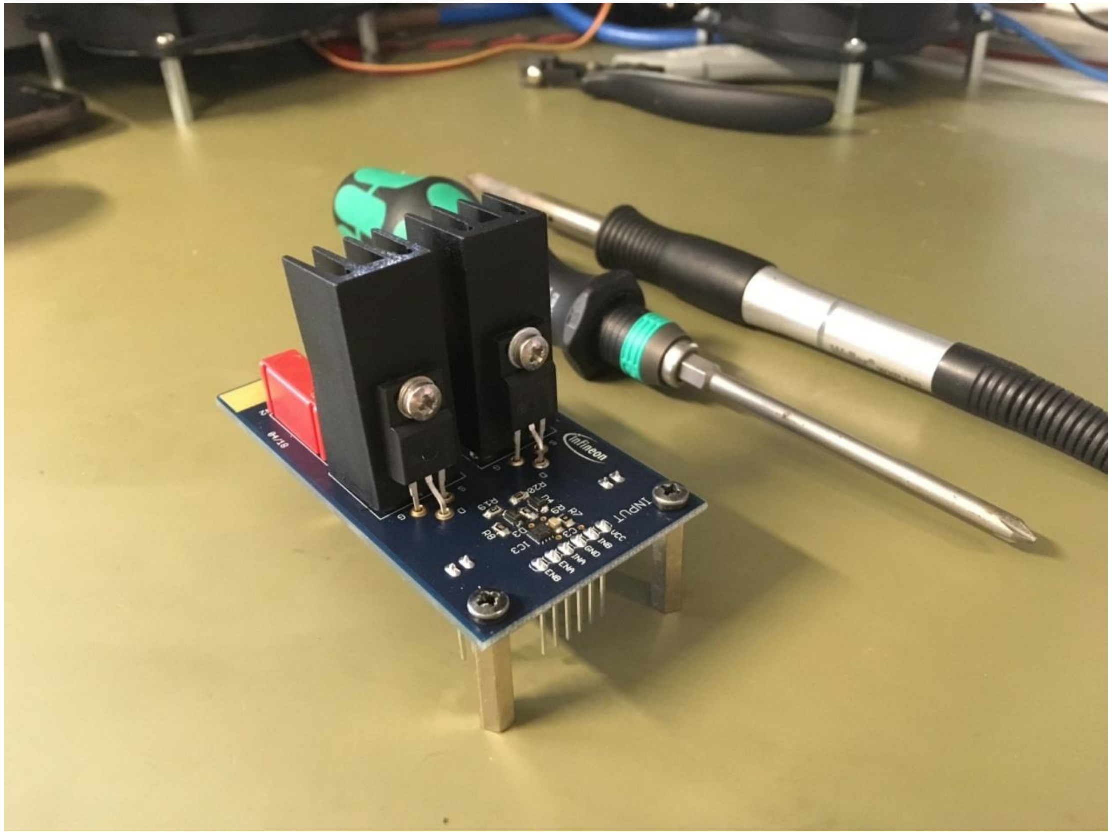


Step 5: MOSFETs placement into the sockets

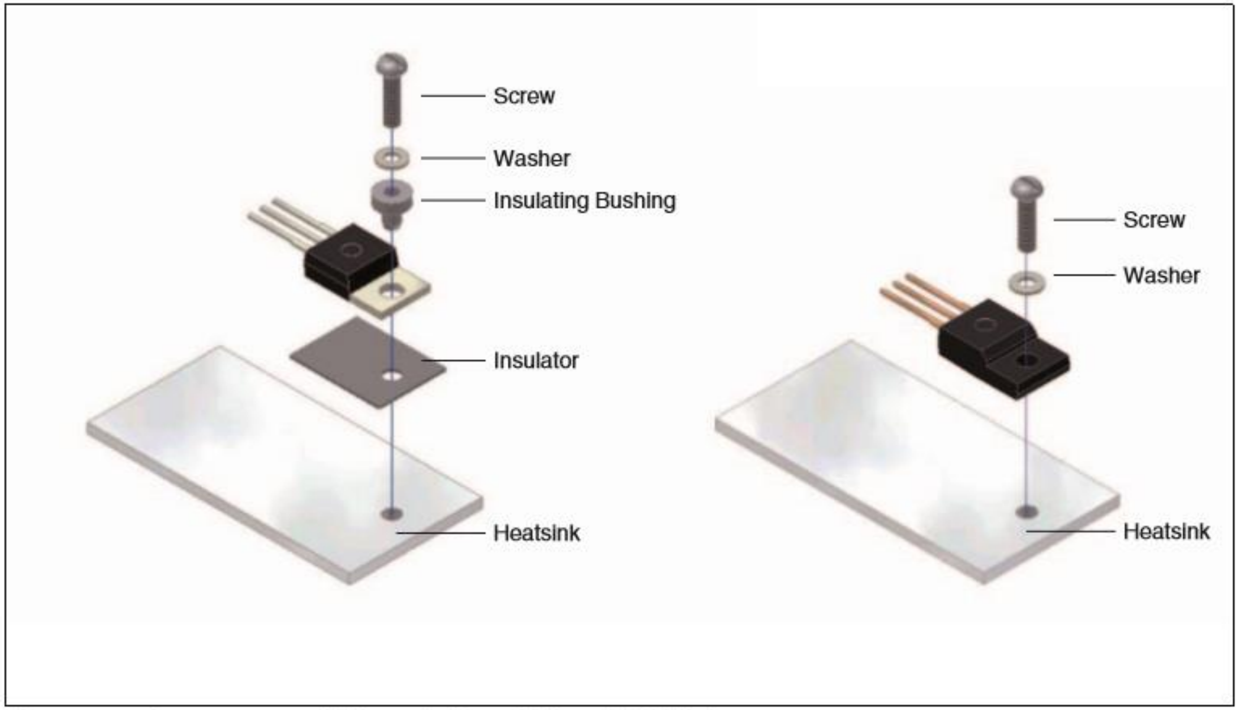


Step 6: Heatsink mounting (optional)

- Solder the heatsink if the board is used in high voltage scenarios
- In basic measurements it is not necessary
- See next slide for further information on how to properly mount the MOSFETs to the heatsink



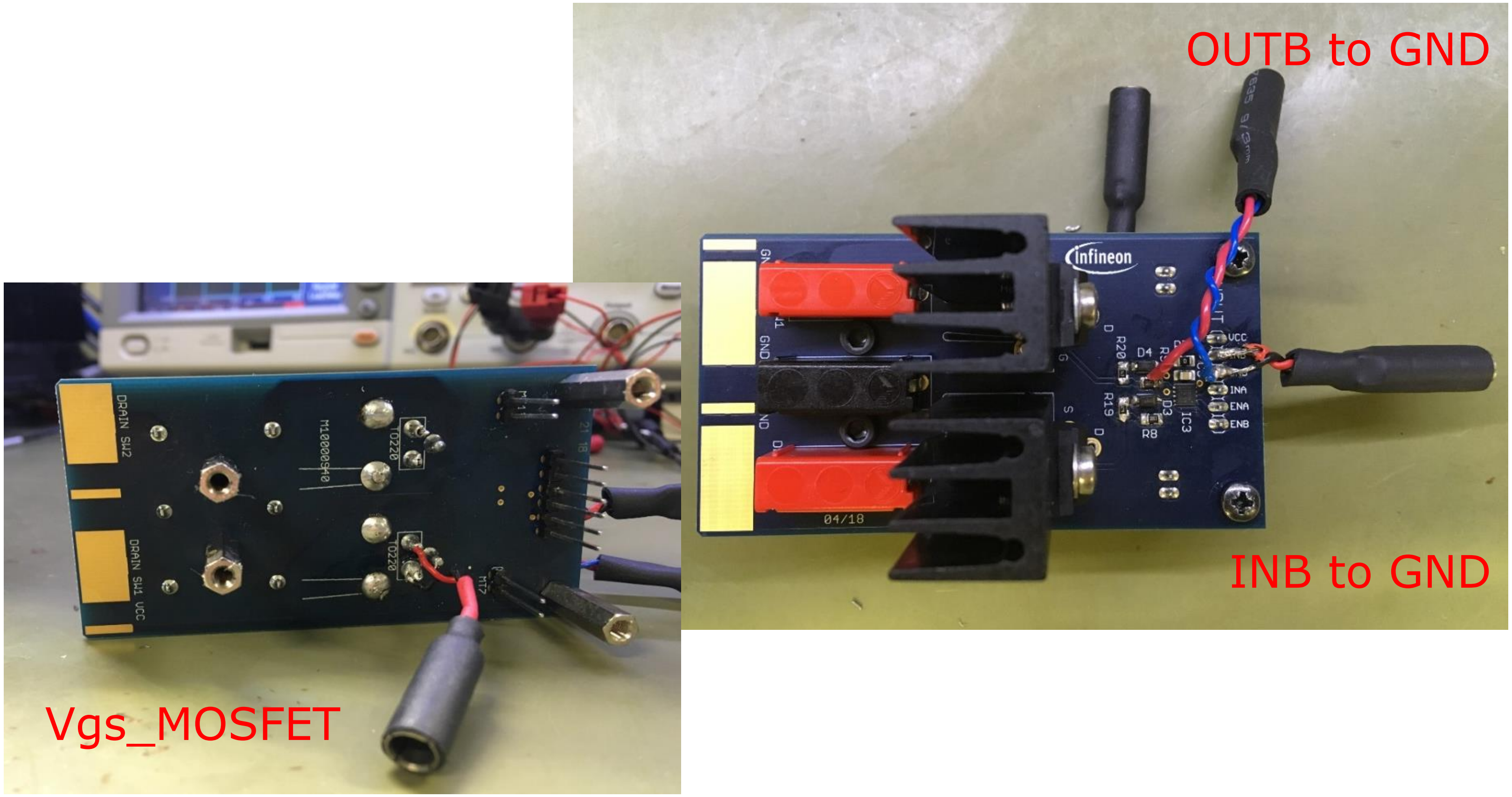
TO-220 MOSFET mounting to the heatsink



Package	Typ. Torque [Nm]	Max. Torque [Nm]	Comment
PG-TO220	0.6	0.7	Screw M3
PG-TO220 FullPAK	0.5	0.7	Screw M2.5

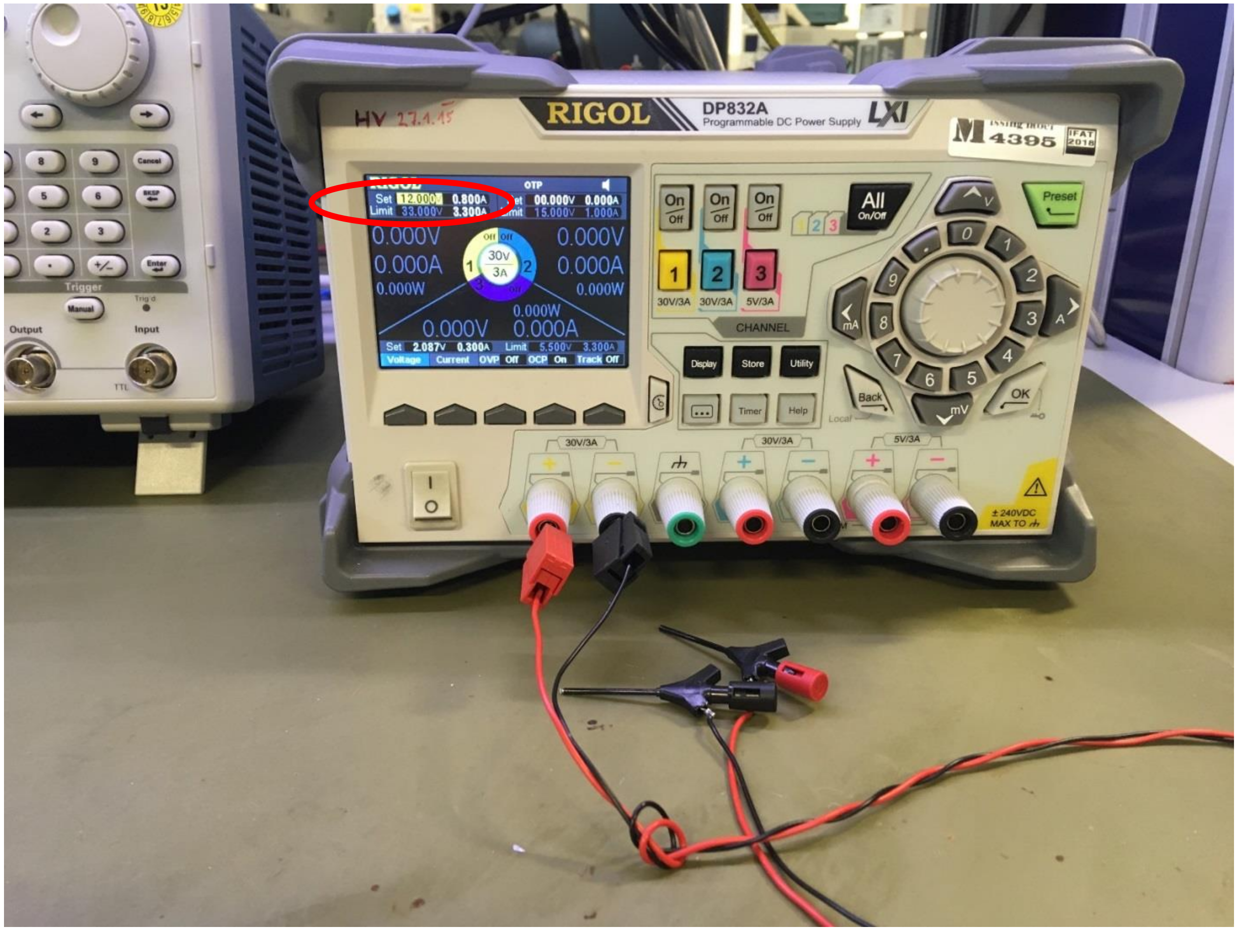
- Recommendations for assembly of Infineon TO packages: https://www.infineon.com/dgdl/Infineon-Package_recommendations_for_assembly_of_Infineon_TO_packages-AN-v01_00-EN.pdf?fileId=db3a30431936bc4b011938532f885a38

Step 7: BNC connectors soldering



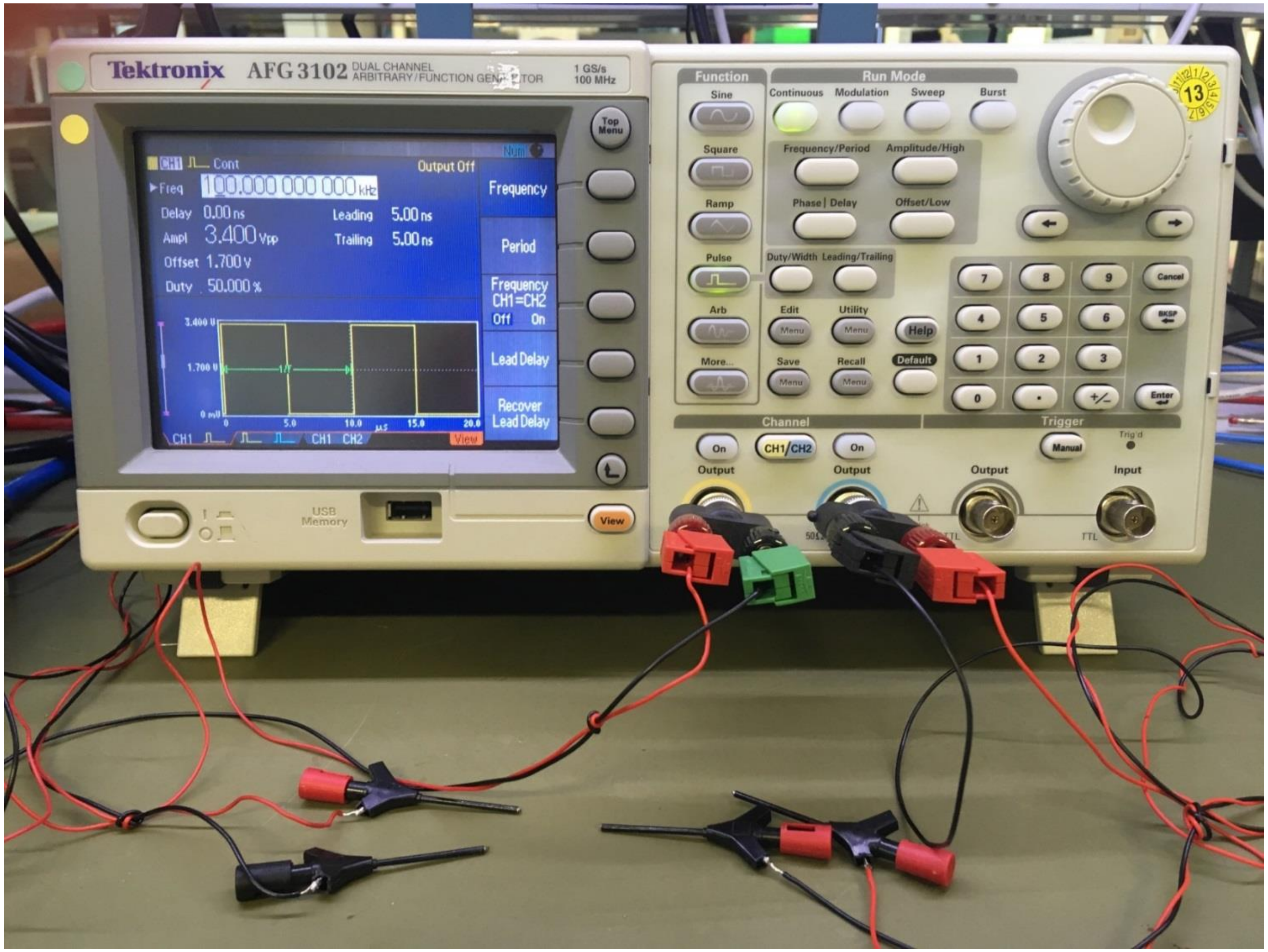
› N.B. For soldering simplicity the connector **OUTB to GND** can be soldered on the OUTB pad of the source resistors as in photo. Anyway soldering the connector directly on the outpin pin OUTB of the driver reduces the parasitic influence on the measurement.

Instrumentation for driver supply generation



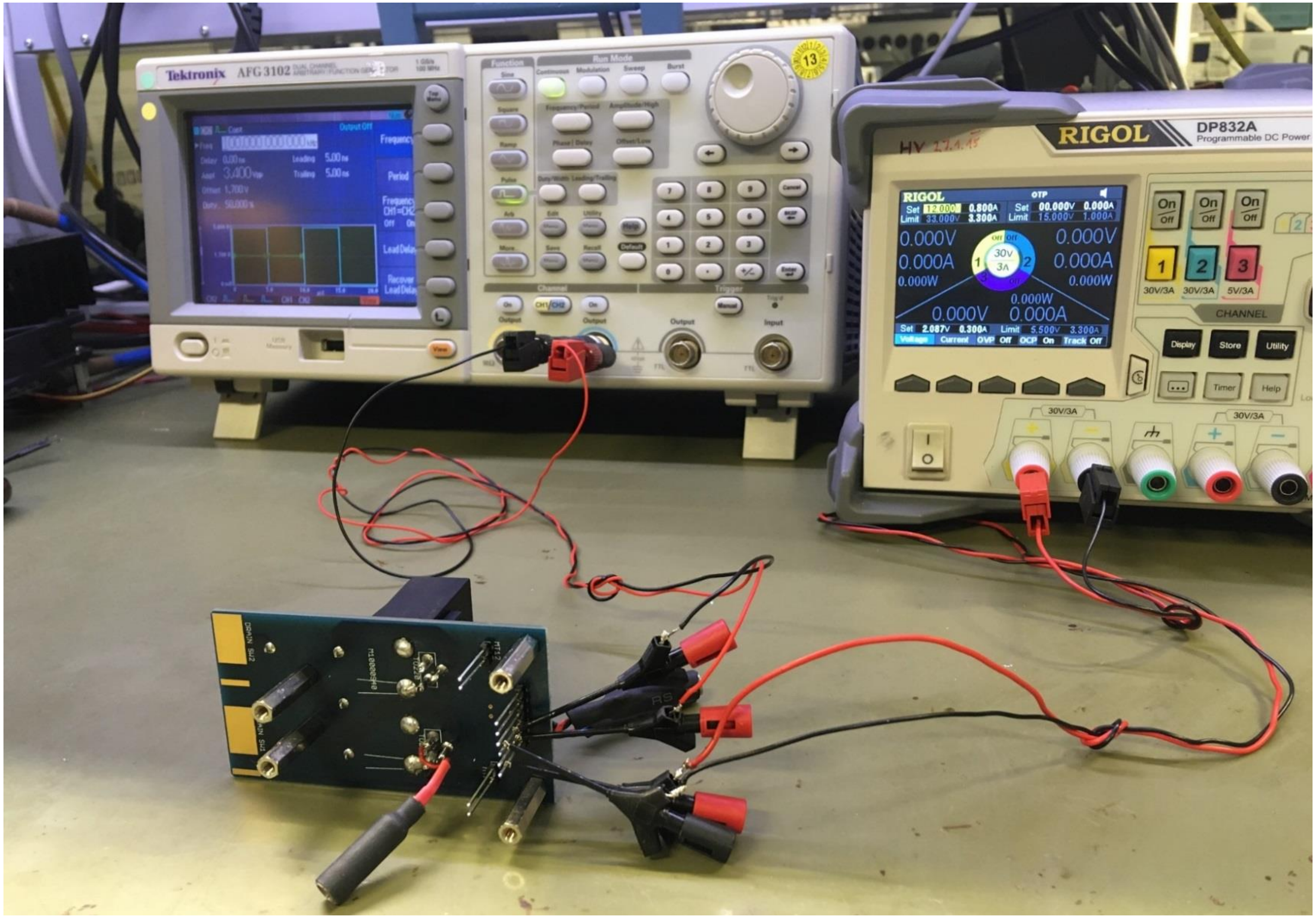
- V_{cc}=12 V for CoolMOS™ and 8 V for OptiMOS™
- Set the current limit below 1 A (0.8 A e.g.)

Instrumentation for PWM signals generation

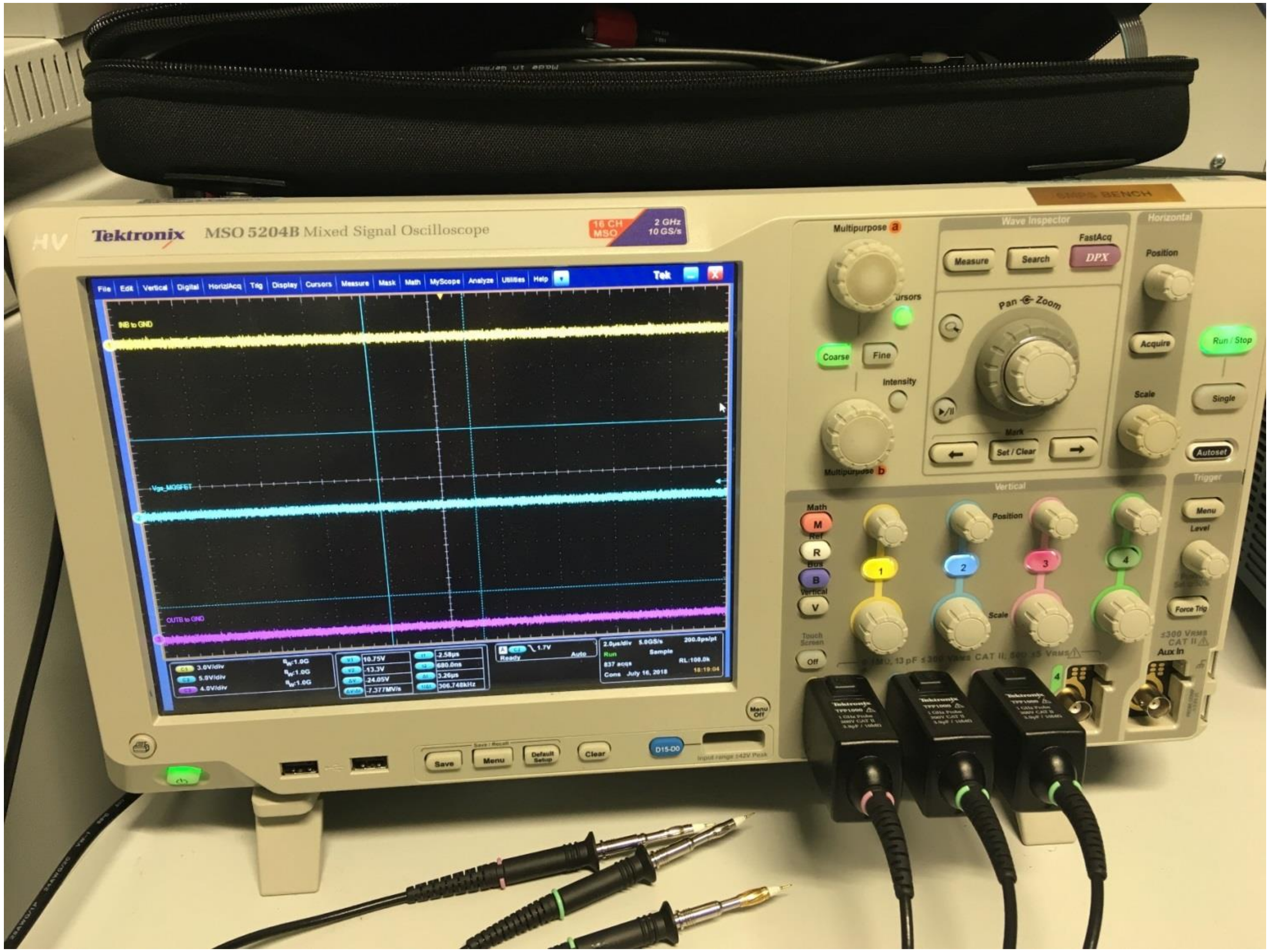


› Use a function generator or a microcontroller

Connections

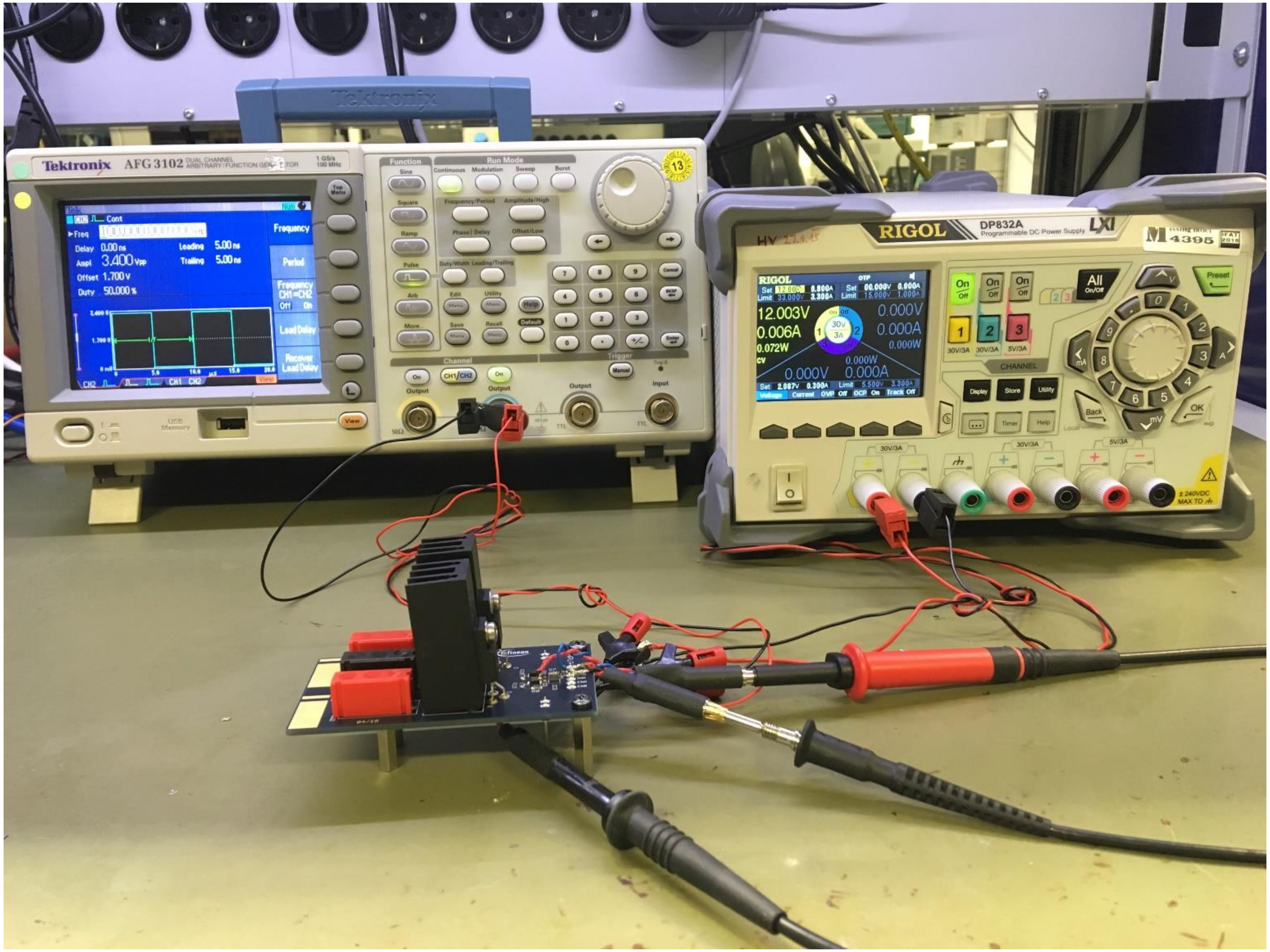


Instrumentation for signals evaluation

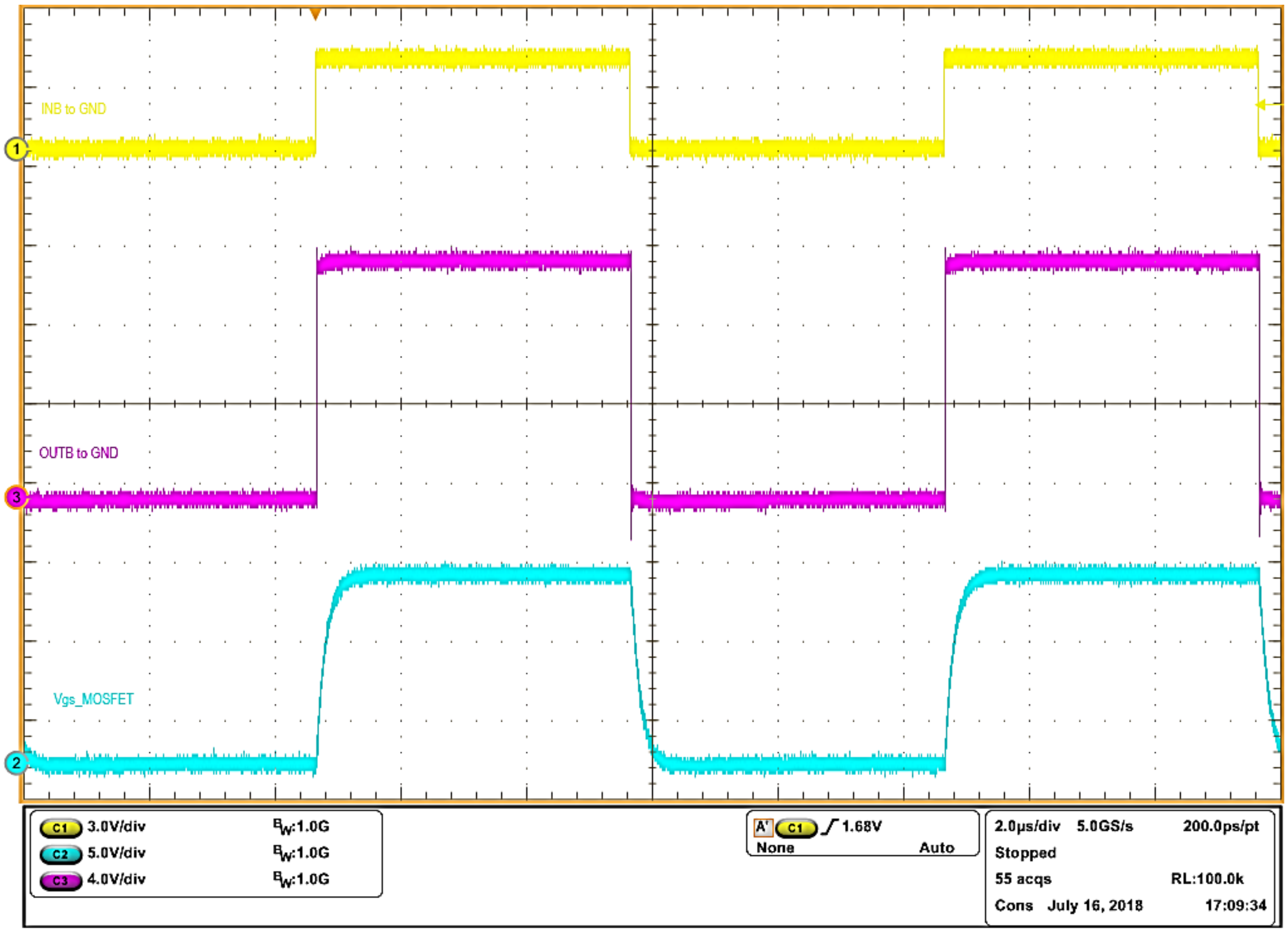


› Voltage probes used: Tetronix TPP1000 1 GHz, 3.9 pF

Complete measurement setup

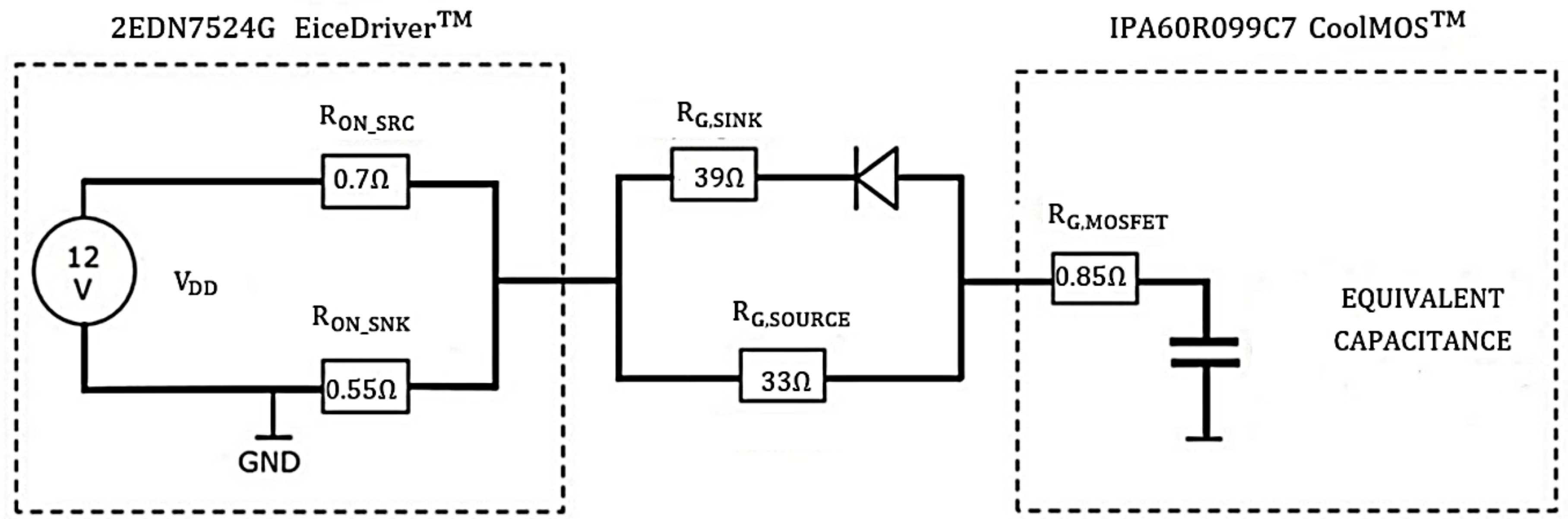


Oscilloscope waveforms

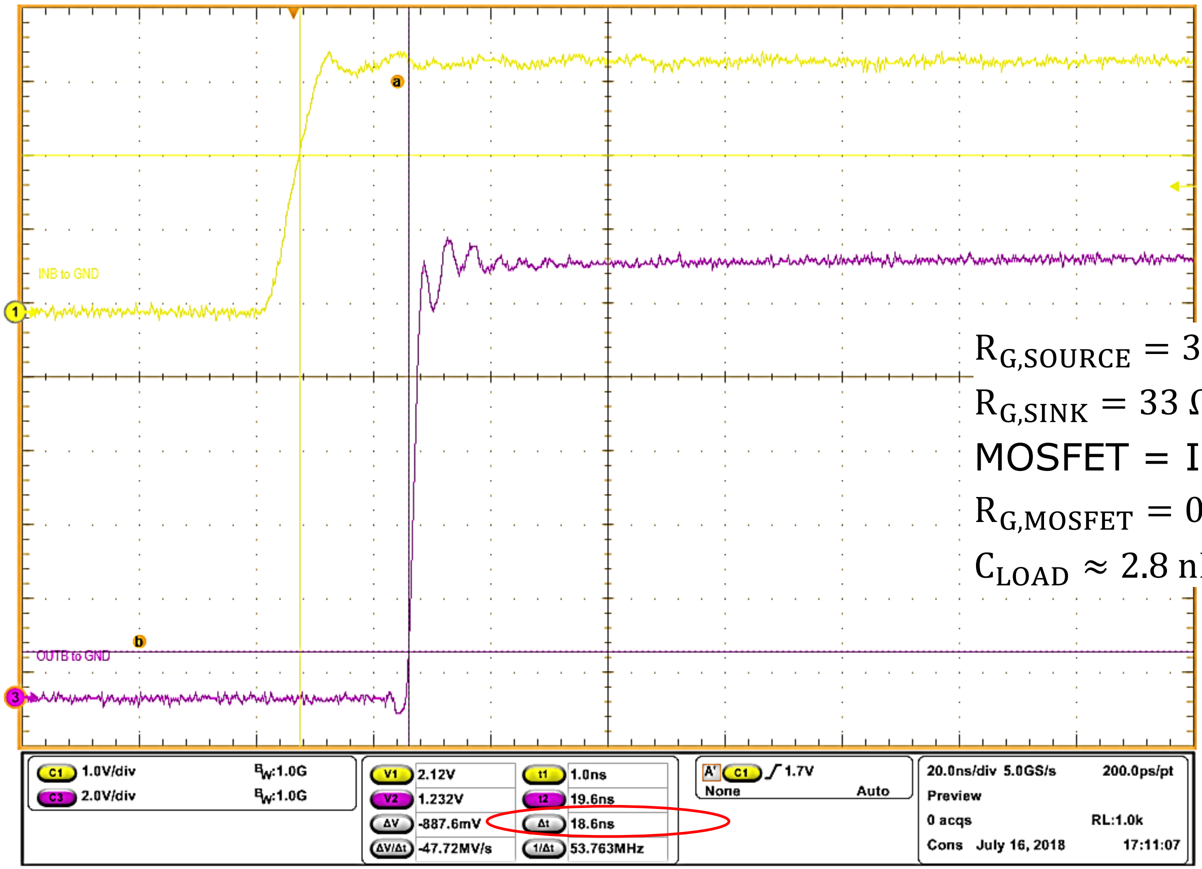


› Measurements done on a single MOSFET with $V_{DS} = 0\ V$ (drain and source shorted)

Equivalent model of the driving circuit



Low-high propagation delay



$R_{G,SOURCE} = 39\ \Omega$

$R_{G,SINK} = 33\ \Omega$

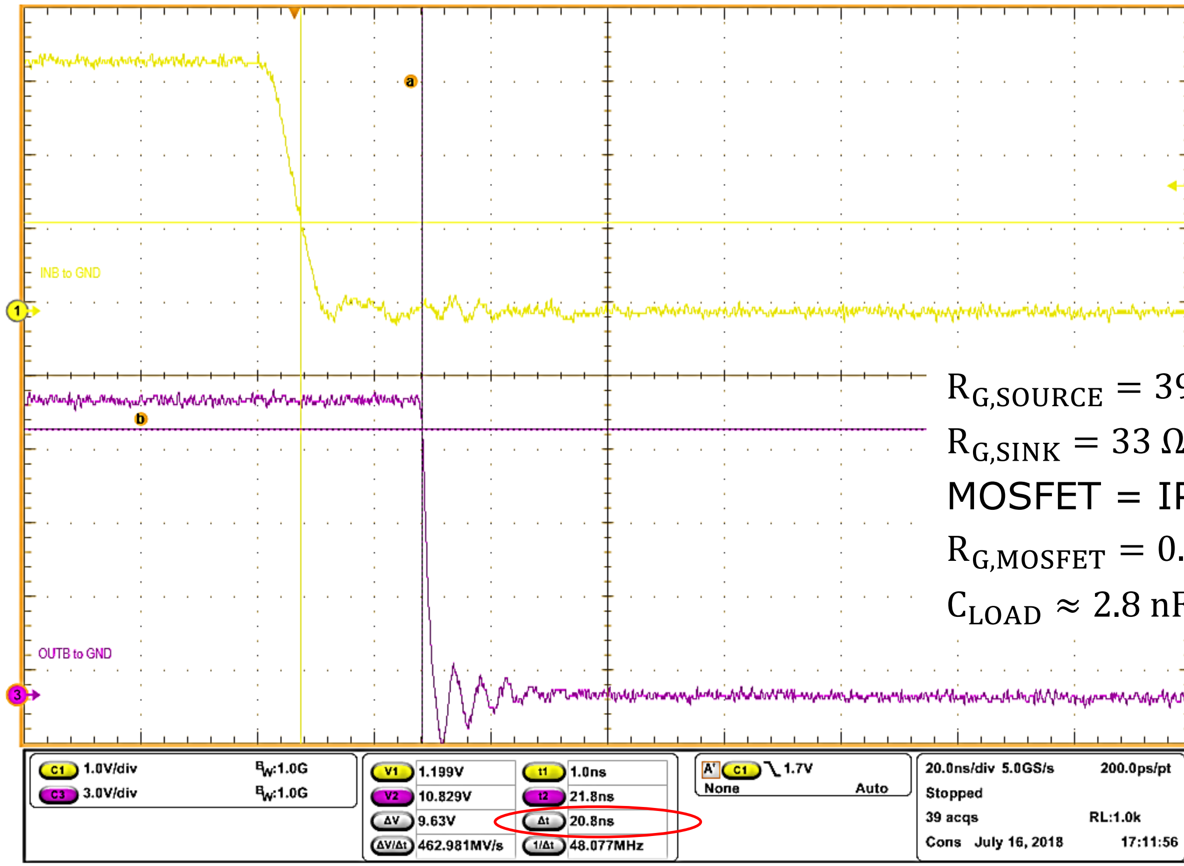
MOSFET = IPA60R099C7

$R_{G,MOSFET} = 0.82\ \Omega$

$C_{LOAD} \approx 2.8\ nF$

- t_{PDlh} defined in the datasheed as time interval t($OUTB = 10\%\ VDD$) - t($INB = V_{INH} = 2.1\ V$) for a pure capacitive load $C_{LOAD} = 1.8\ nF$ with $R_{G,SOURCE} = 0\ \Omega$
- N.B. In the considered measurements the load is the transistor with $R_{G,MOSFET} = 0.82\ \Omega$, $R_{G,SOURCE} = 39\ \Omega$, $C_{LOAD} \approx 2.8\ nF$ (see slide 23 for C_{LOAD} calculation)

High-Low propagation delay



$R_{G,SOURCE} = 39\ \Omega$

$R_{G,SINK} = 33\ \Omega$

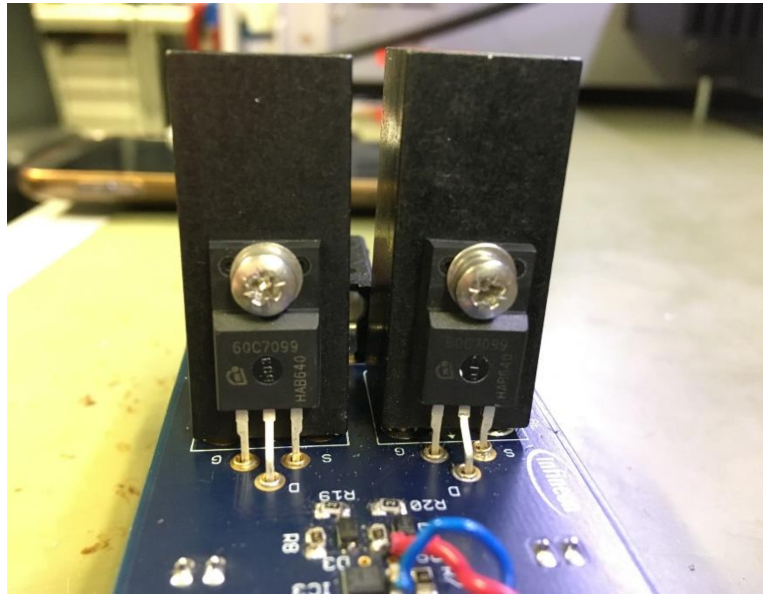
MOSFET = IPA60R099C7

$R_{G,MOSFET} = 0.82\ \Omega$

$C_{LOAD} \approx 2.8\ \text{nF}$

- t_{PDhl} defined in the datasheed as time interval t($\text{OUTB} = 90\%\ \text{VDD}$) - t($\text{INB} = V_{INL} = 1.02\ \text{V}$) for a pure capacitive load $C_{LOAD} = 1.8\ \text{nF}$ with $R_{G,SINK} = 0\ \Omega$
- N.B. In the considered measurements the load is the transistor with $R_{G,MOSFET} = 0.82\ \Omega$, $R_{G,SINK} = 33\ \Omega$, $C_{LOAD} \approx 2.8\ \text{nF}$

C_{LOAD} calculation for IPA60R099C7

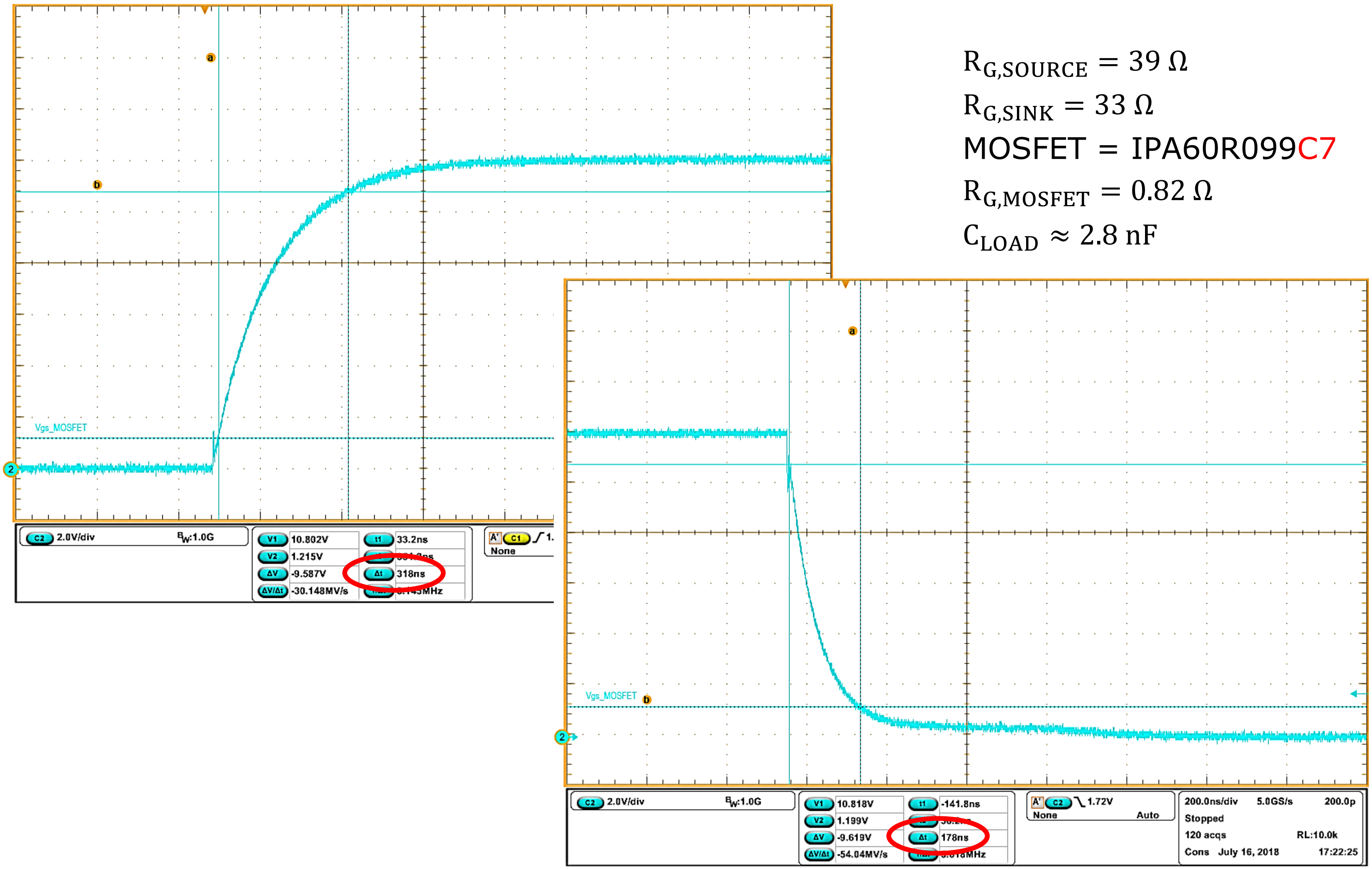


Gate to drain charge	Q_{gd}	-	14	-	nC	V_{DD}=400V, I_D=9.7A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	42	-	nC	V_{DD}=400V, I_D=9.7A, V_{GS}=0 to 10V

$$Q_{LOAD} = Q_g - Q_{gd} = 28\,nC \rightarrow C_{LOAD} = \frac{Q_{LOAD}}{V_{GS}} = 2.8\,nF \quad for\ V_{GS} = 10\,V \longrightarrow$$

$$C_{LOAD} \approx 2.8\,nF \quad for\ V_{GS} = 12\,V$$

Rise/fall times



$R_{G,SOURCE} = 39\ \Omega$

$R_{G,SINK} = 33\ \Omega$

MOSFET = IPA60R099C7

$R_{G,MOSFET} = 0.82\ \Omega$

$C_{LOAD} \approx 2.8\ \text{nF}$

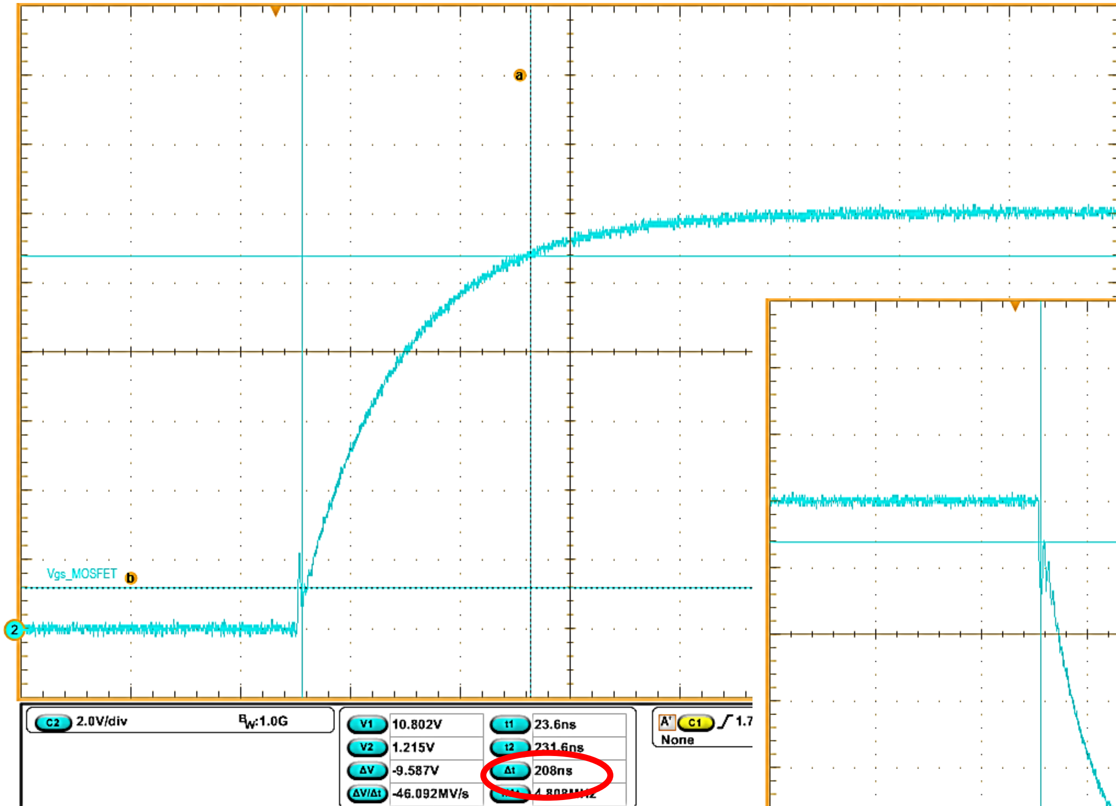
Gate resistors replacement

$$R_{G,SOURCE} = 39\ \Omega \quad \rightarrow \quad 24\ \Omega$$

$$R_{G,SINK} = 33\ \Omega \quad \rightarrow \quad 20\ \Omega$$

MOSFET = IPA60R099C7

Rise/fall times: New set of gate resistances



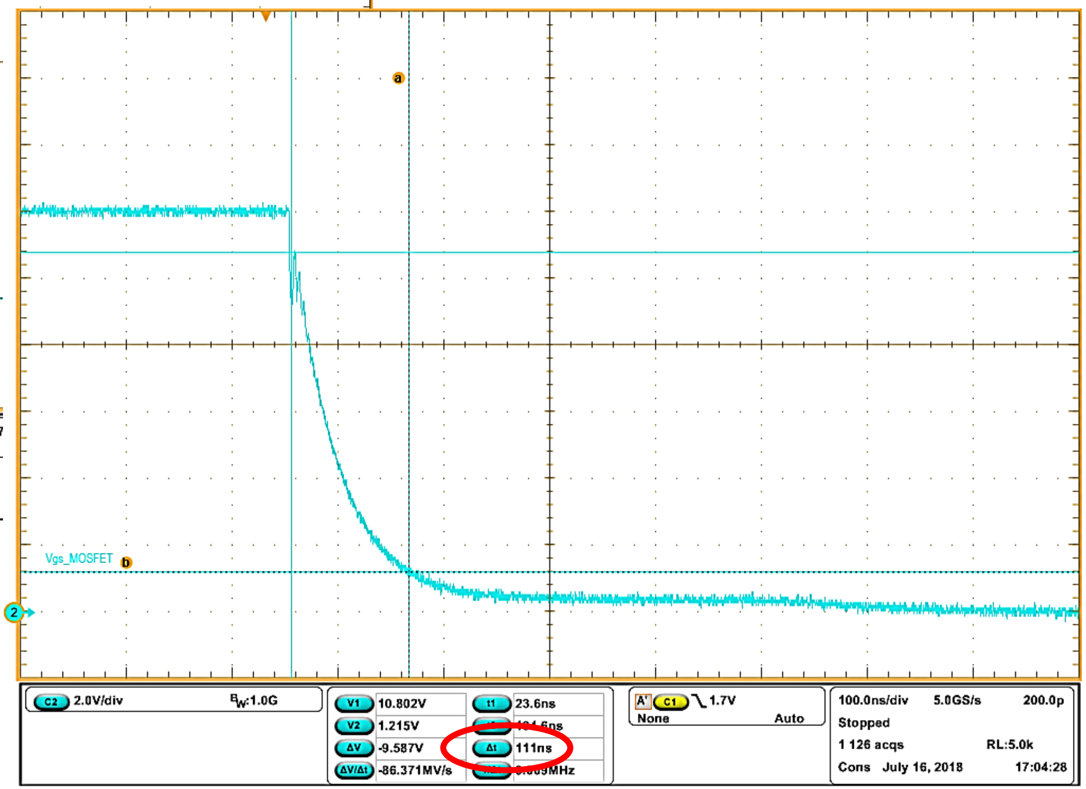
$R_{G,SOURCE} = 24\ \Omega$

$R_{G,SINK} = 20\ \Omega$

MOSFET = IPA60R099C7

$R_{G,MOSFET} = 0.82\ \Omega$

$C_{LOAD} \approx 2.8\ nF$



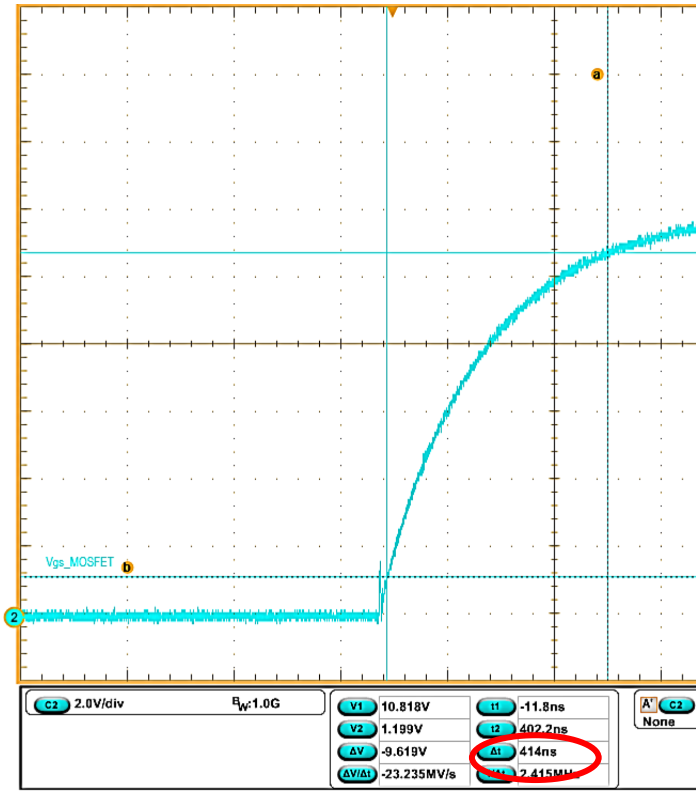
Gate resistors replacement

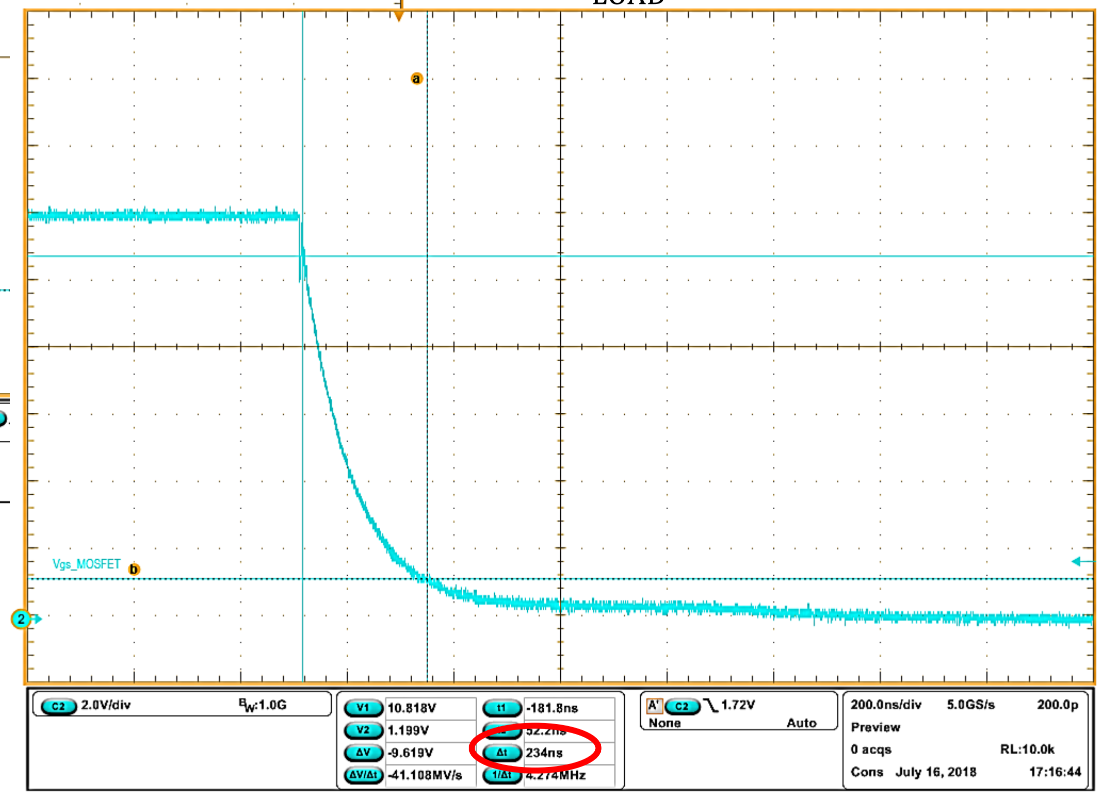
$$R_{G,SOURCE} = 24\ \Omega \quad \rightarrow \quad 51\ \Omega$$

$$R_{G,SINK} = 20\ \Omega \quad \rightarrow \quad 43\ \Omega$$

MOSFET = IPA60R099C7

Rise/fall times: New set of gate resistances





$R_{G,SOURCE} = 51\ \Omega$

$R_{G,SINK} = 43\ \Omega$

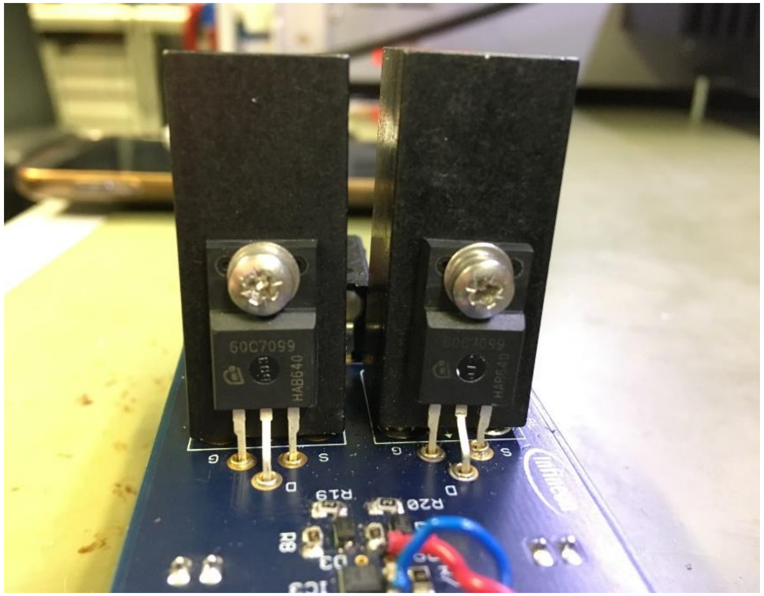
MOSFET = IPA60R099C7

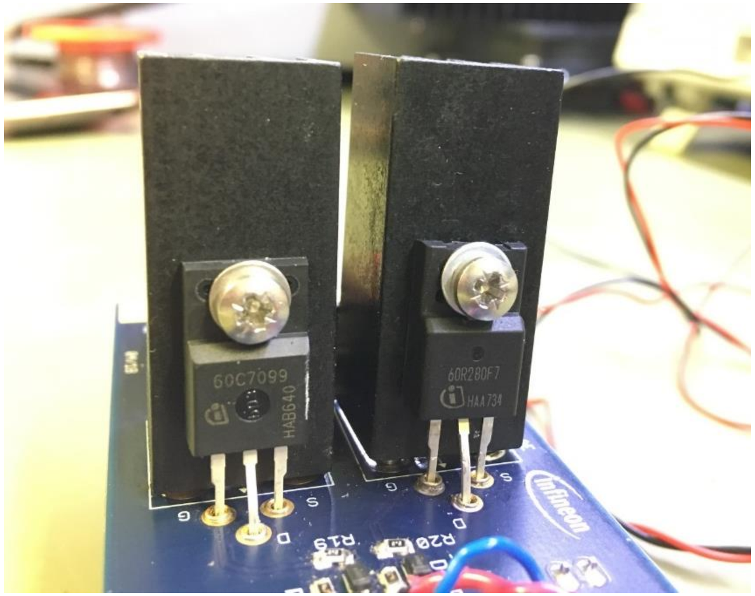
$R_{G,MOSFET} = 0.82\ \Omega$

$C_{LOAD} \approx 2.8\ nF$

MOSFET Replacement

IPA60R099C7 → IPA60R280CFD7





Gate to drain charge	Q_{gd}	-	5	-	nC	V_{DD}=400V, I_D=5.0A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	18	-	nC	V_{DD}=400V, I_D=5.0A, V_{GS}=0 to 10V

$$C_{LOAD} \approx \frac{13\ nC}{10\ V} = 1.3\ nF \quad for\ V_{GS} = 12\ V$$

Rise/fall times: New MOSFET

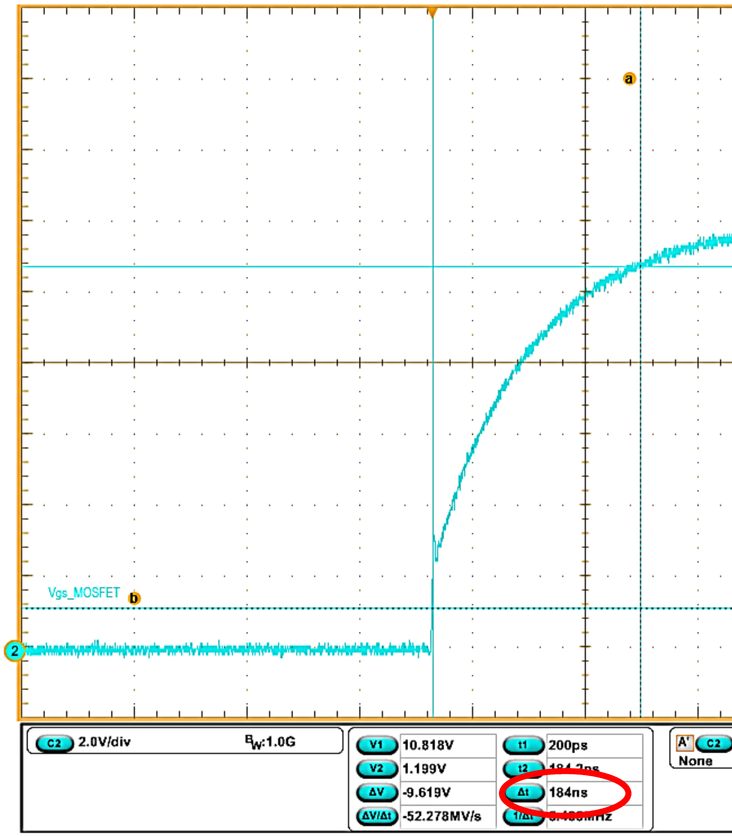
$R_{G,SOURCE} = 51\ \Omega$

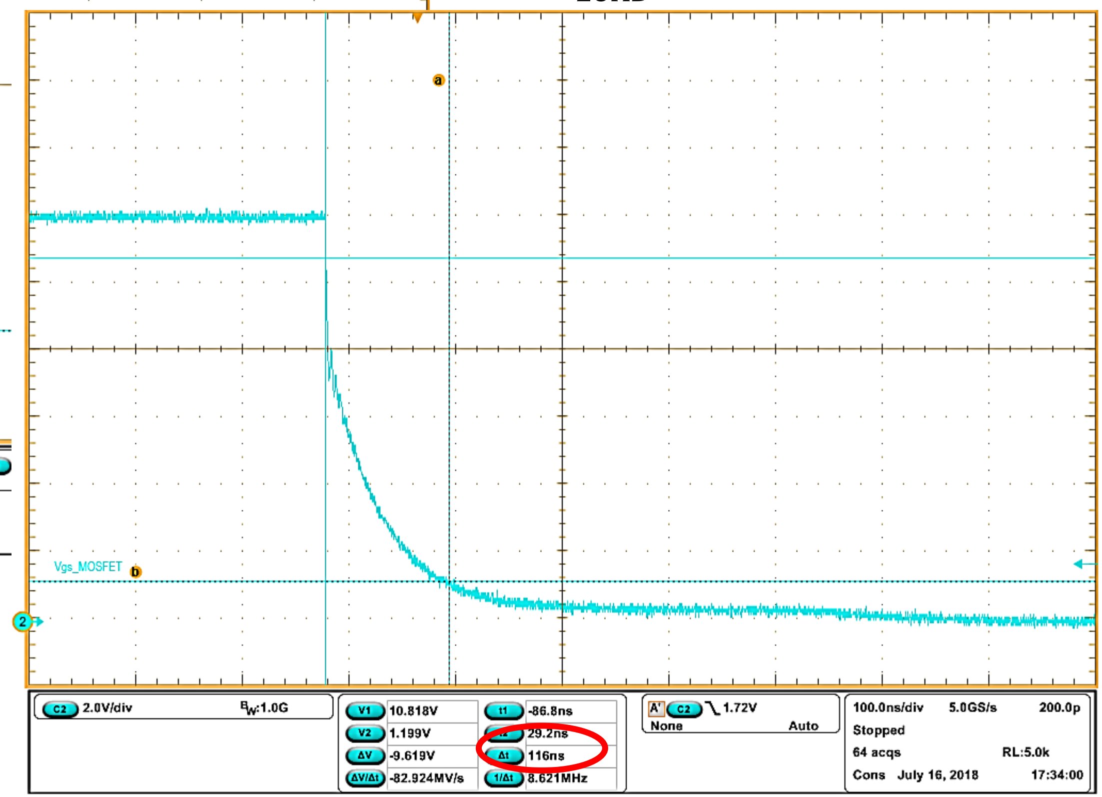
$R_{G,SINK} = 43\ \Omega$

MOSFET = IPA60R280CFD7

$R_{G,MOSFET} = 11\ \Omega$

$C_{LOAD} \approx 1.3\ nF$





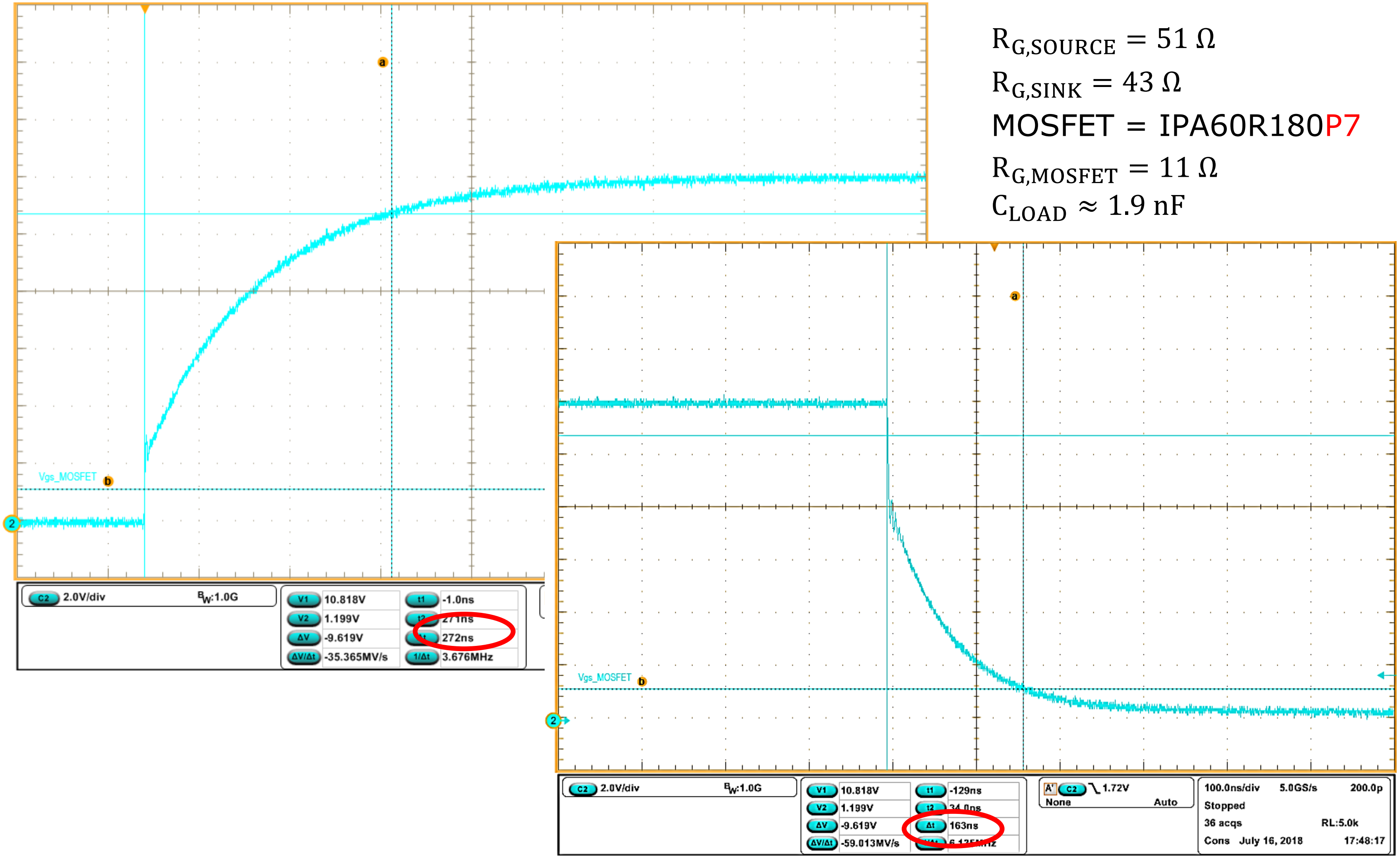
MOSFET replacement

IPA60R280CFD7 → IPA60R180P7

Gate to drain charge	Q_{gd}	-	8	-	nC	V_{DD}=400V, I_D=5.6A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	25	-	nC	V_{DD}=400V, I_D=5.6A, V_{GS}=0 to 10V

$$C_{LOAD} \approx \frac{19\ nC}{10\ V} = 1.9\ nF \quad for\ V_{GS} = 12\ V$$

Rise/fall times: New MOSFET



$R_{G,SOURCE} = 51\ \Omega$

$R_{G,SINK} = 43\ \Omega$

MOSFET = IPA60R180P7

$R_{G,MOSFET} = 11\ \Omega$

$C_{LOAD} \approx 1.9\ nF$

Additional notes

- Note that the MOSFET is not turned-on or -off, you are only charging/discharging the gate-to-source capacitance
- Changing the gate resistors and the MOSFETs, you are changing the load for the driver
- If you want to turn-on or turn-off the MOSFET, you must integrate the board in a proper circuit
- You can not apply directly the voltage (e.g 400 V) across the MOSFET through the banana connectors on the board
- You must limit the input current from the DC source generator → add an inductance
- You must create a freewheeling path for the current when MOSFET is off

Example: boost converter, simple MOSFET in clamped inductive mode

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IMPORTANT NOTICE

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