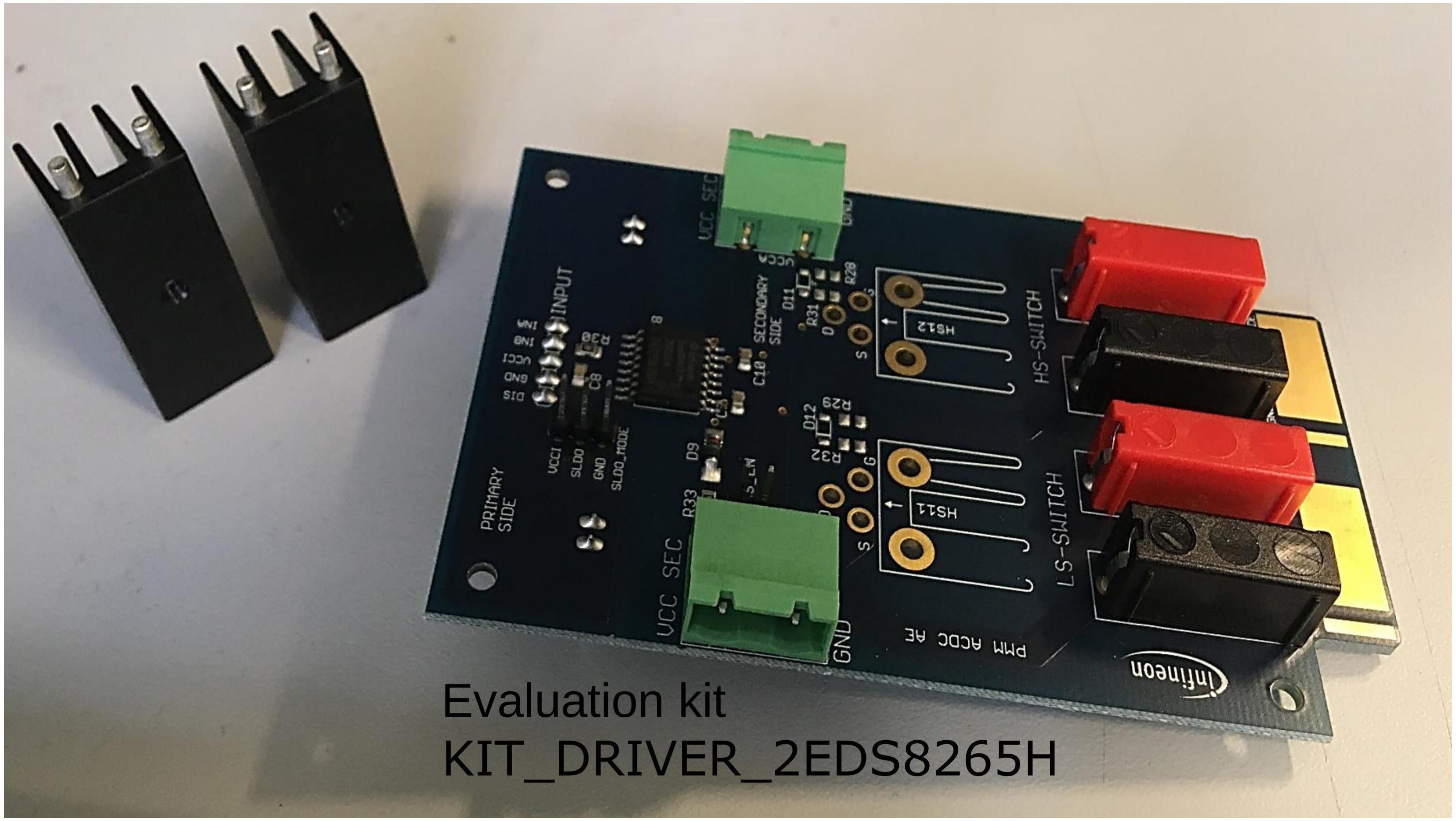
Quick start guide KIT_DRIVER_2EDS8265H

PMM Gate Driver AE

KIT_DRIVER_2EDS8265H

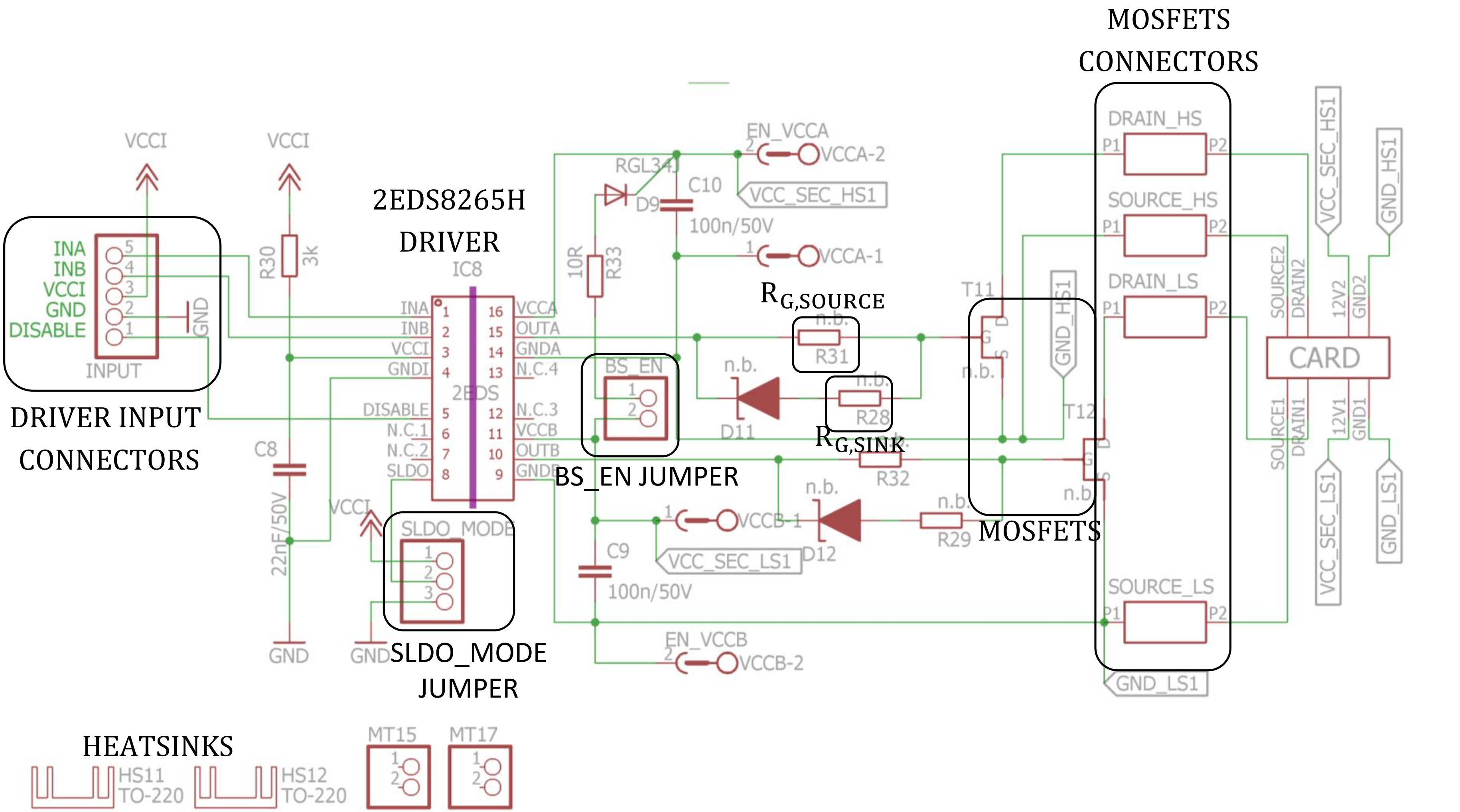
Included in this kit

Heatsinks for
TO-220 MOSFETs

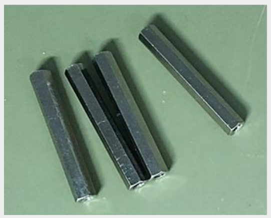
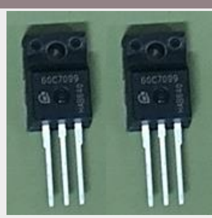
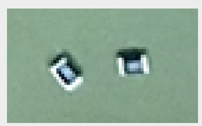
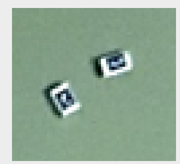


Evaluation kit
KIT_DRIVER_2EDS8265H

Board schematic

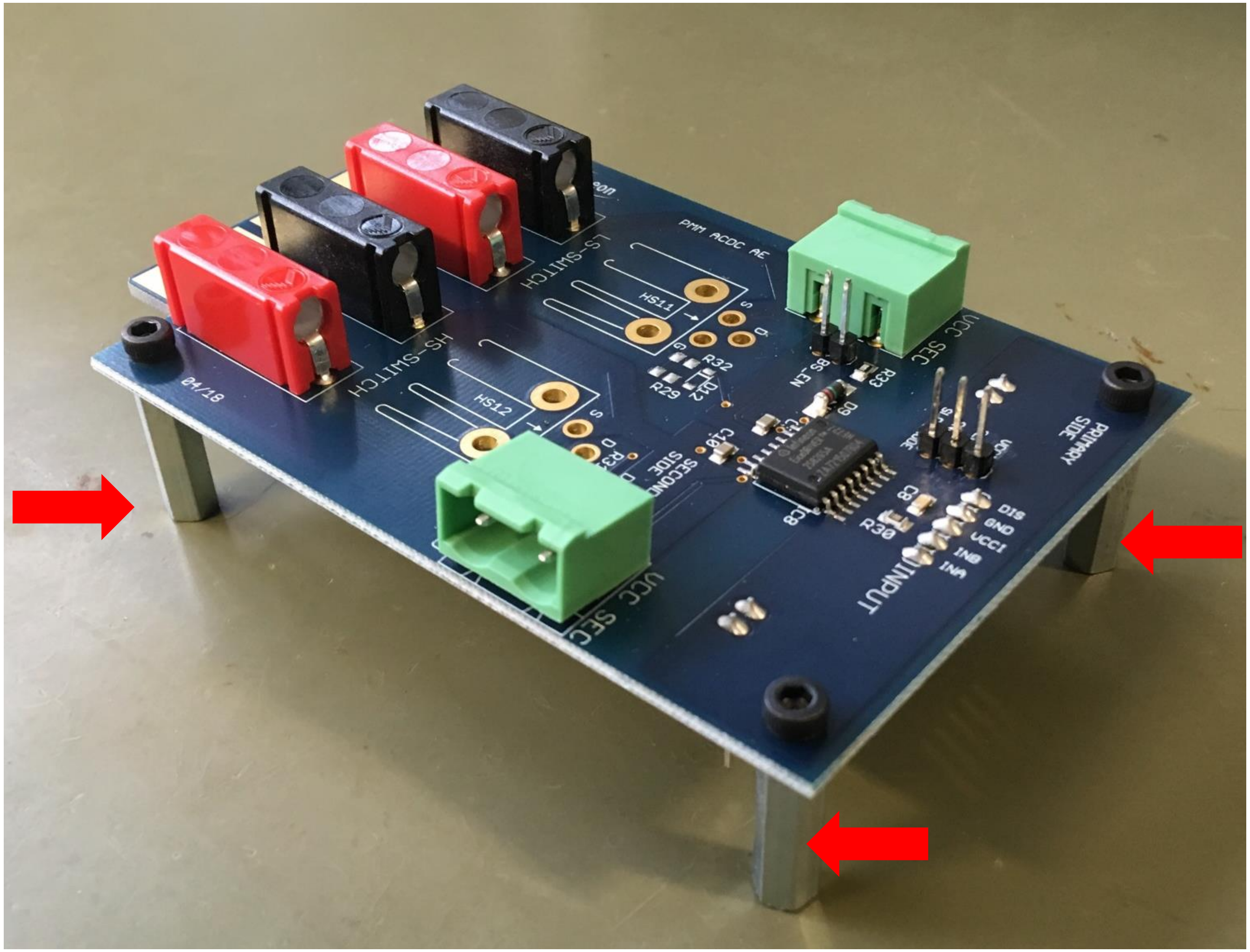


Components to add – BOM suggestion

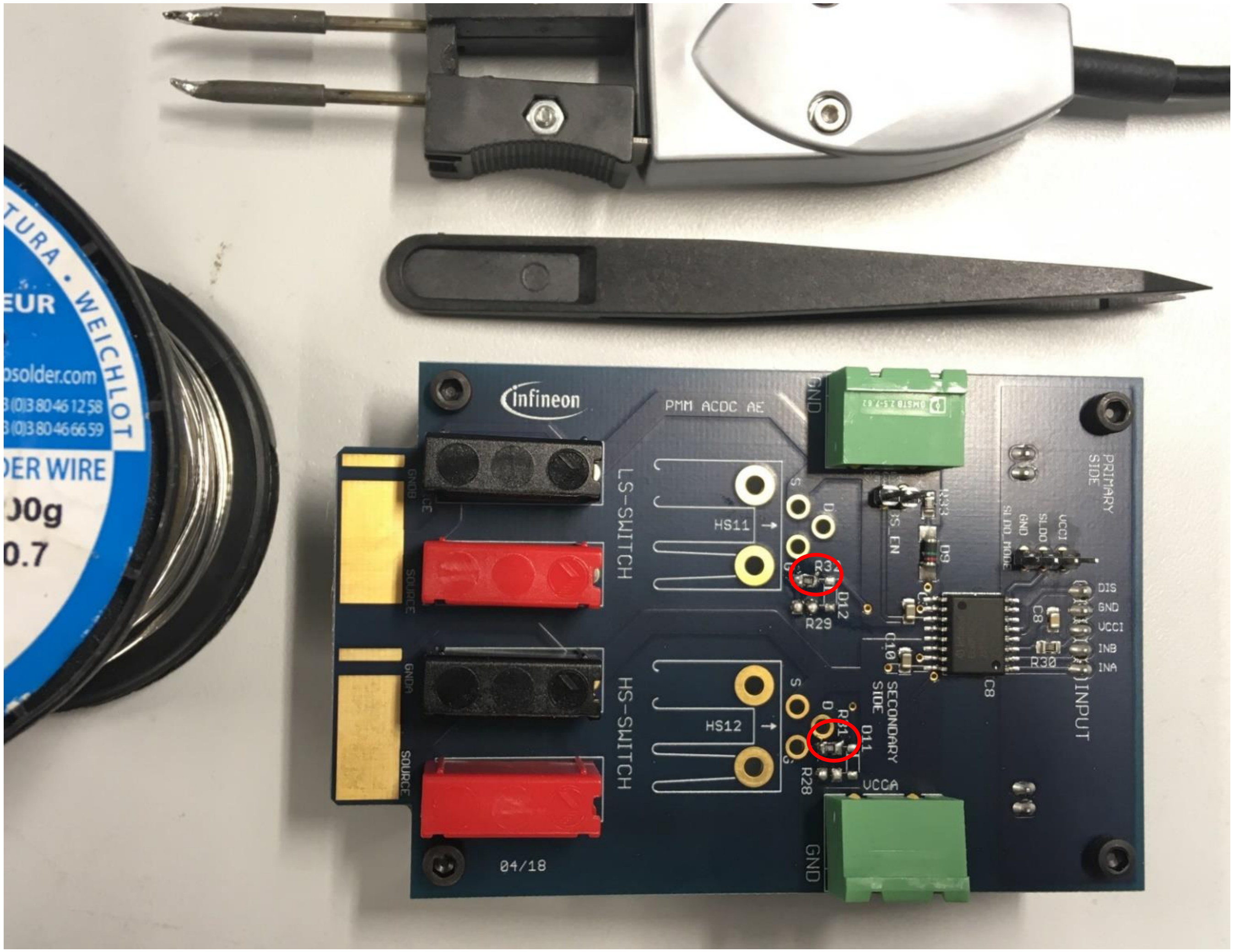
Distance bolts	Screws for distance bolts	Screws and washers for MOSFET mounting to heatsink	TO-220 sockets
			
TO-220 MOSFETs	**Source resistors (R31, R32)**	**Sink resistors (R28, R29)**	**Sink diodes**
			

Component	Quantity	Designator	Comment	Voltage	Footprint	Type	Part number/ supplies
Sink diode	2	D11,D12	Schottky diode	30 V	SOD-123	PMEG3020 Schottky diode	816-6858 RS-Components
Resistors	4	R28,R29,R31,R32			RES805R	SMD ceramic resistor	
TO-220 sockets	2	T11,T12	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

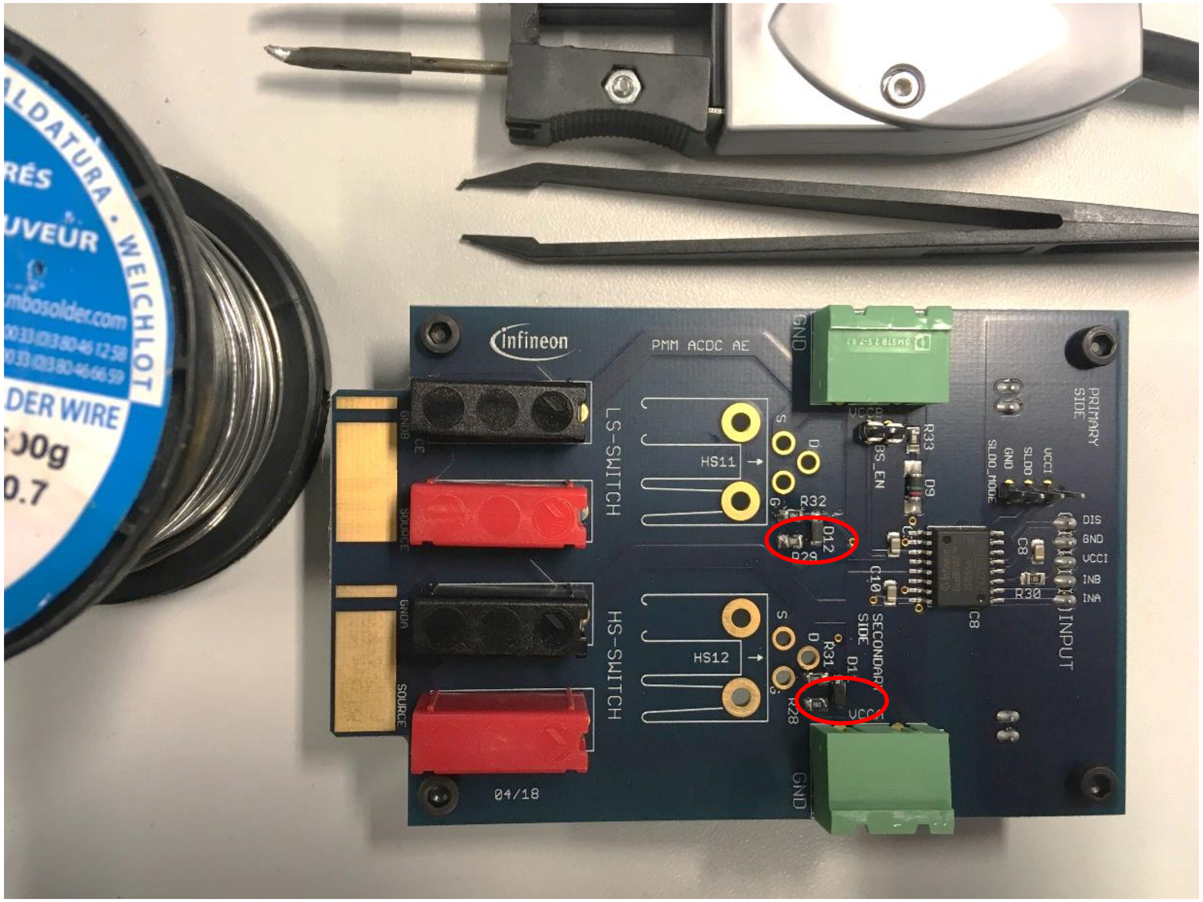


Step 2: Source resistors soldering

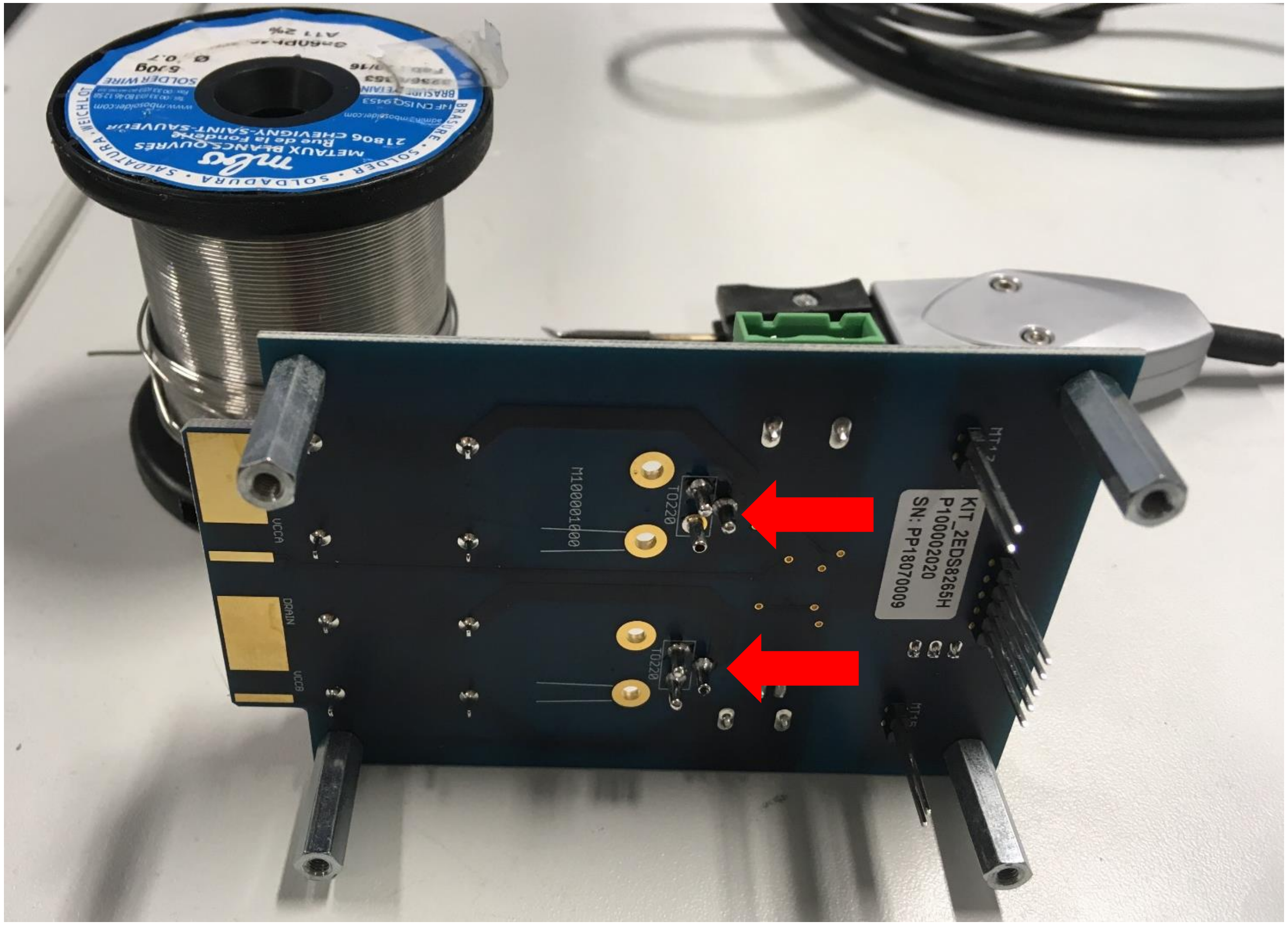


Step 3: Sink resistors and sink diodes soldering

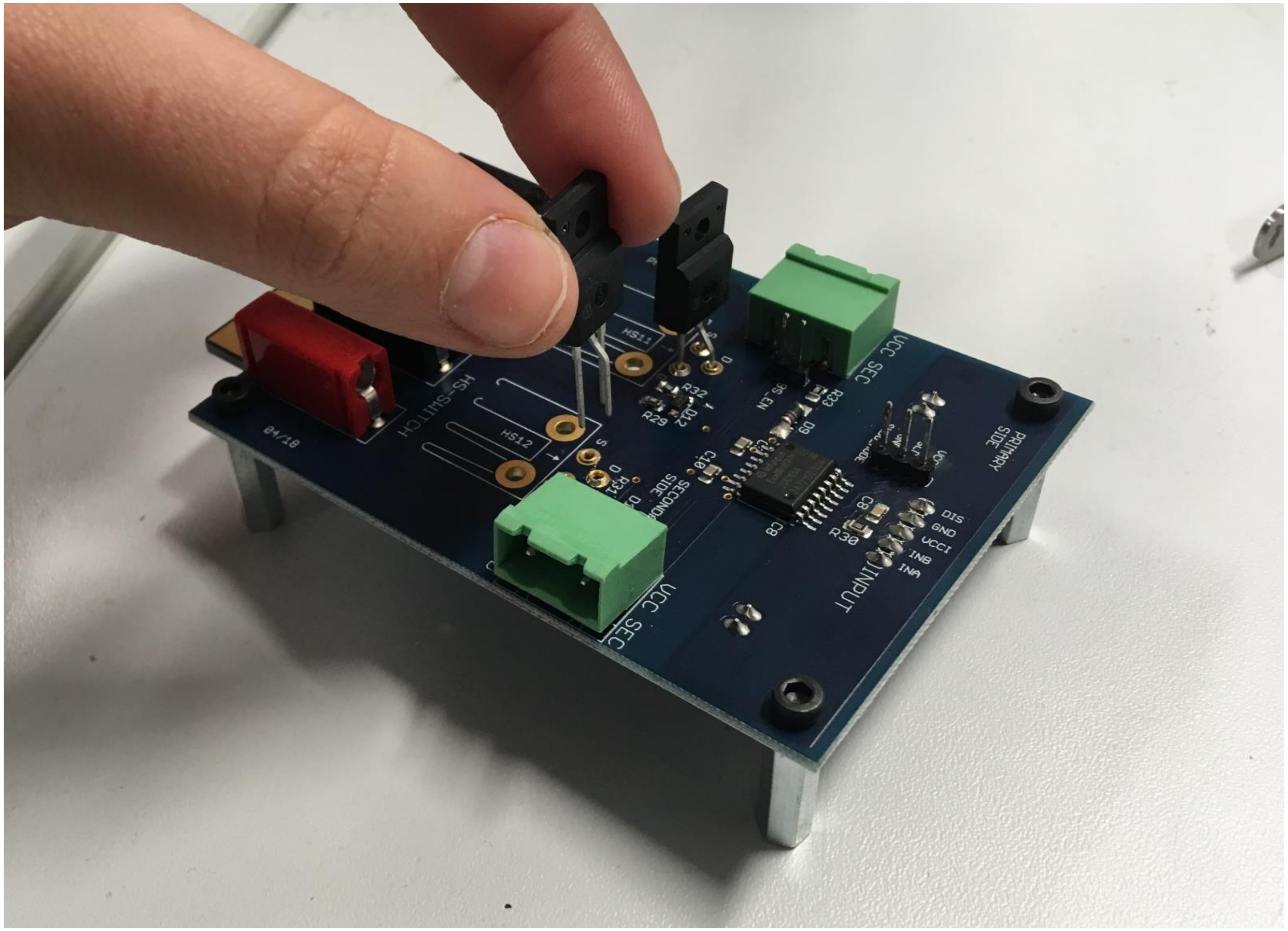
- Add the sink resistors and the sink diodes only if a differentiation between the turn-on and the turn-off behavior is required



Step 4: TO-220 sockets soldering

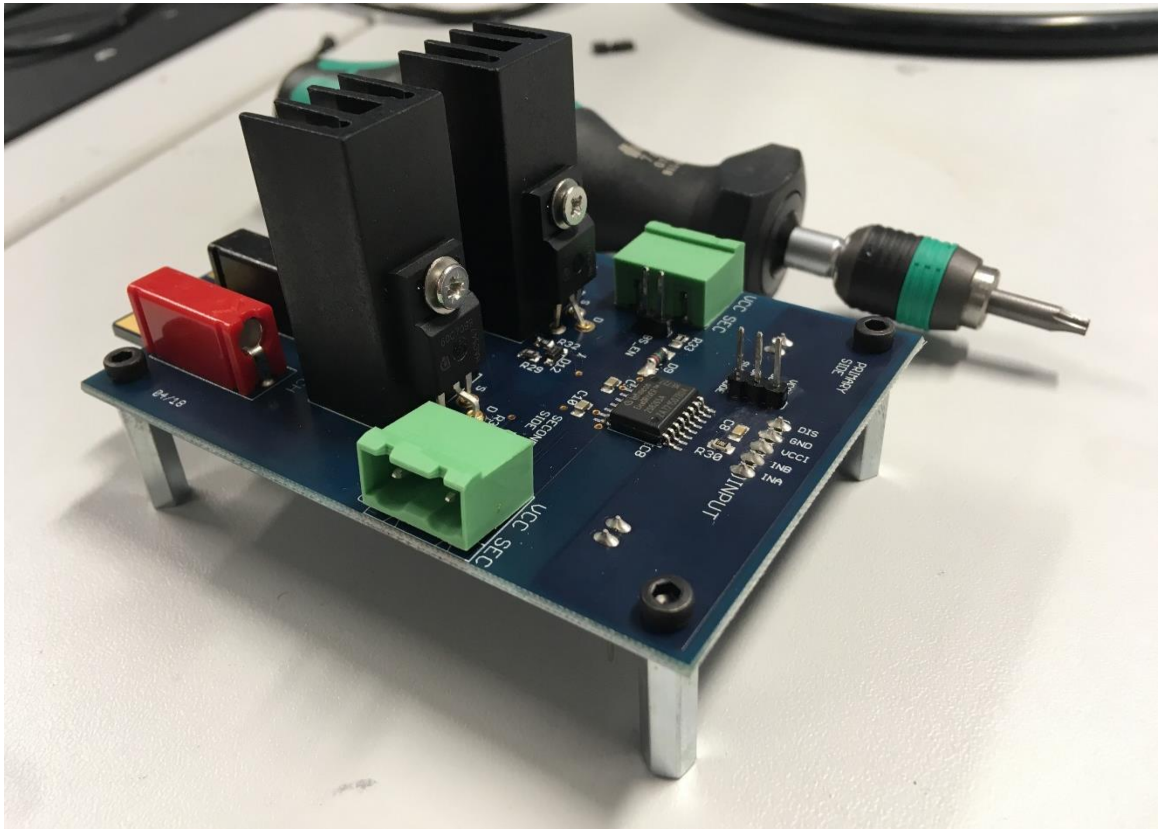


Step 5: MOSFETs placement into the sockets

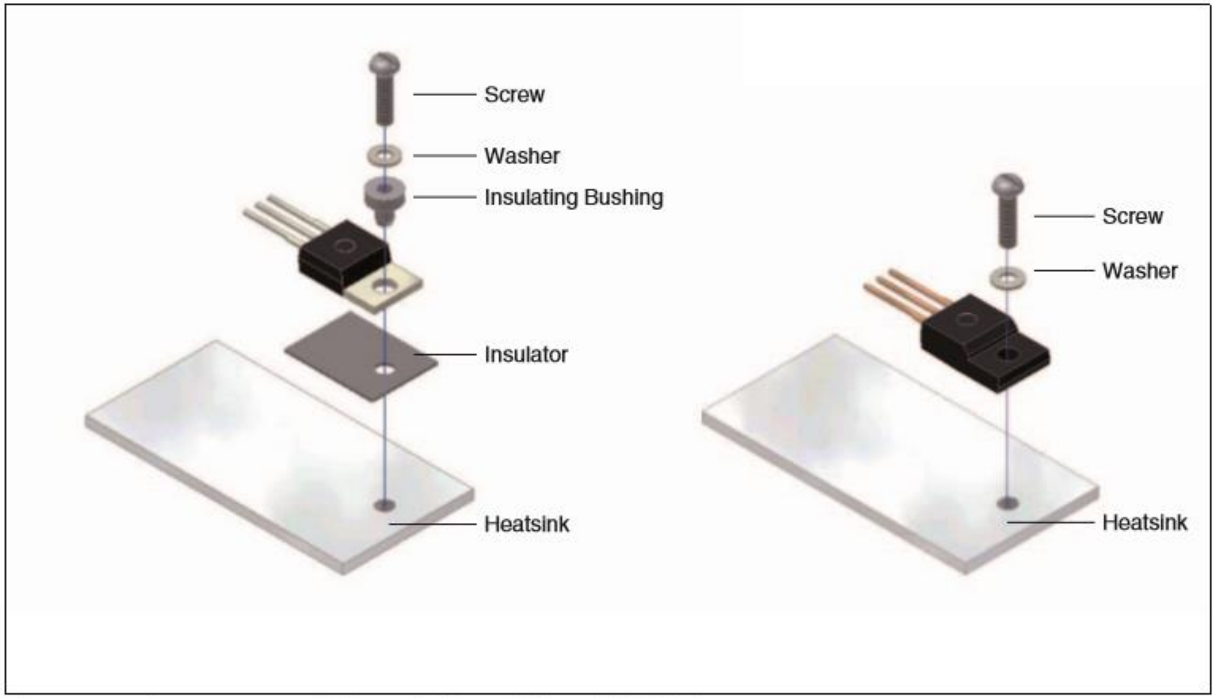


Step 6: Heatsink mounting (optional)

- 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



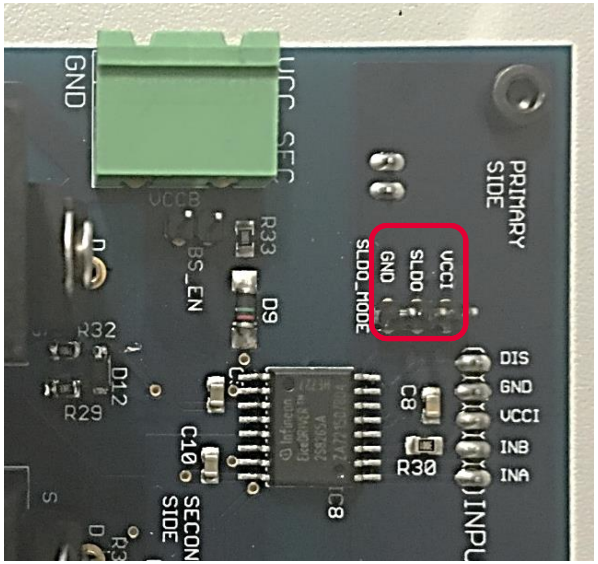
TO-220 MOSFET mounting to the heatsink



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: Select the SLDO_MODE jumper configuration



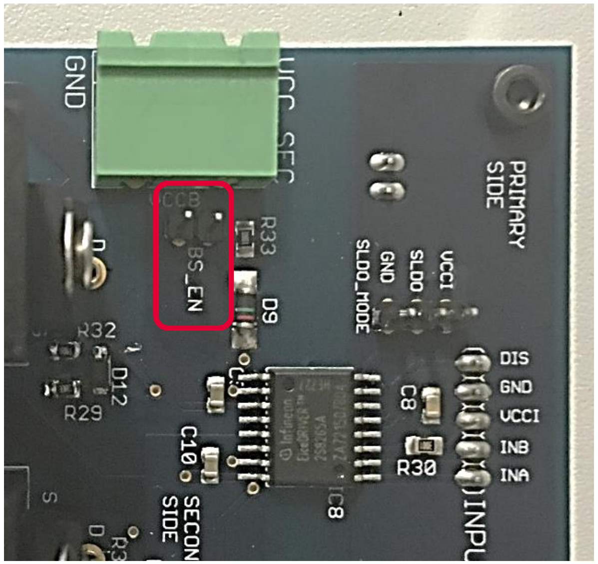
- If VCCI=3.3V:
  - connect the SLDO_MODE jumper across VCCI and SLDO (*normal mode operation*)
  - Replace the shunt resistor R30 with 0Ω resistance

- If VCCI ≥3.3V, connect the SLDO_MODE jumper across SLDO and GND (*shunt mode operation*)
  - if VCCI 3.3V≤ VCCI ≤ 12V, please decrease the shunt resistor R30 according to the table below

Available supply	Switching frequency		
	100 KHz	**1 MHz**	**3 MHz**
5 V	< 732 Ω	< 453 Ω	< 316 Ω
8 V	< 2.15 kΩ	< 1.37 kΩ	< 953 Ω
12 V	< 4.02 kΩ	< 2.61 kΩ	< 1.78 kΩ
15 V	< 5.49 kΩ	< 3.48 kΩ	< 2.43 kΩ

› In this quick start guide the shunt mode is used, as example; the SLDO_MODE jumper is connected across SLDO and GND pins and 12V VCCI is applied.

Step 8: Select the BS_EN jumper configuration

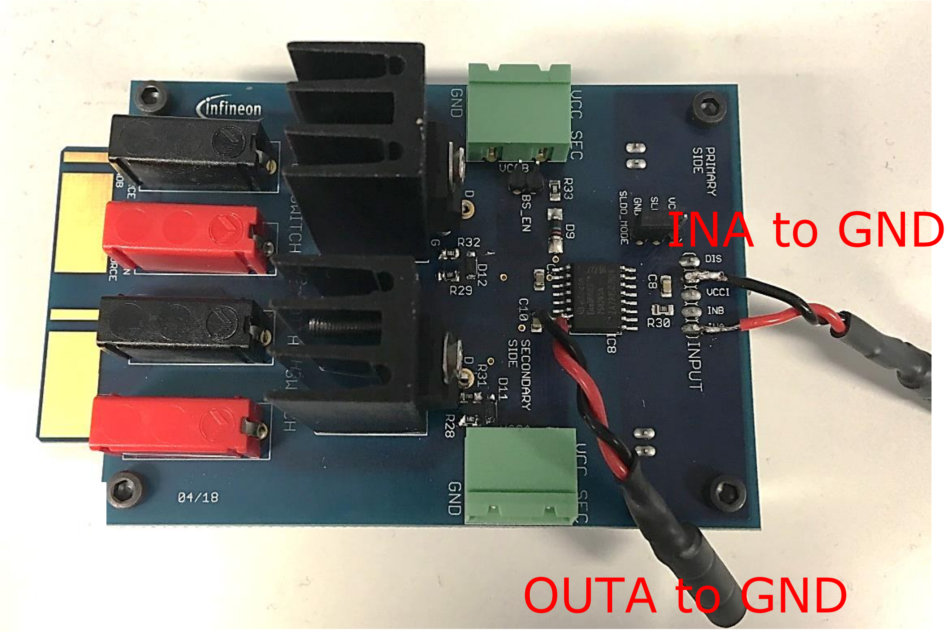


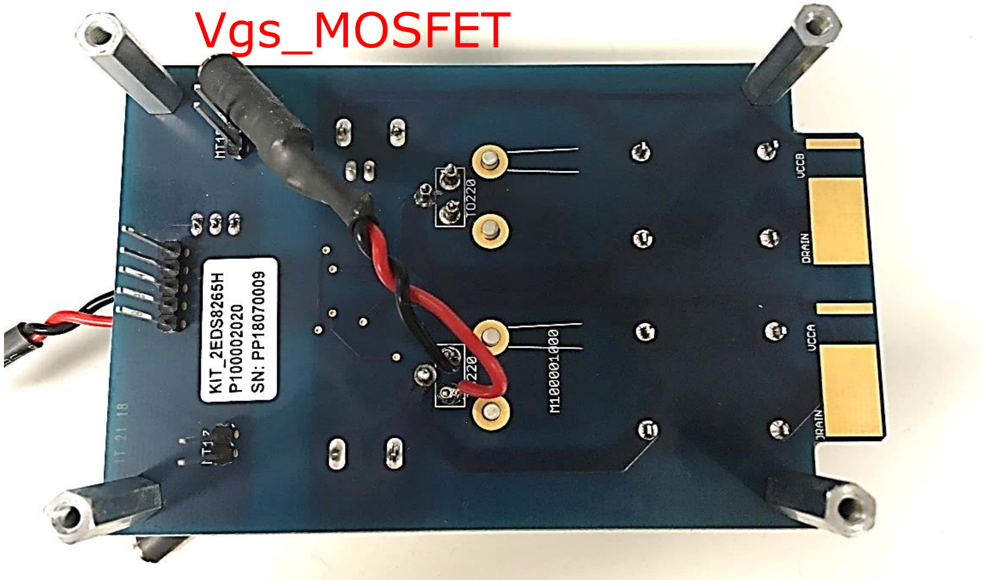
BS_EN jumper:

- Opened, if the MOSFETs are driven independently; in this case, if both channels are used, both VCCA and VCCB must be supplied
- Closed, in half-bridge configurations; in this case the bootstrap circuit is enabled and only VCCB must be supplied

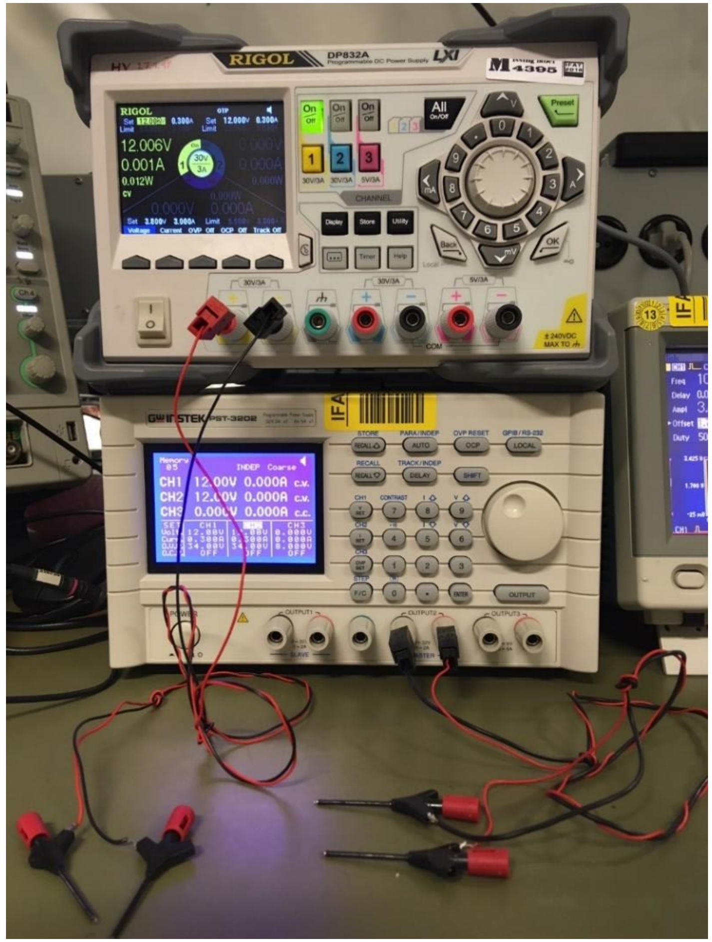
› In this quick start guide only one MOSFET is driven and BS_EN is left opened

Step 8: BNC connectors soldering



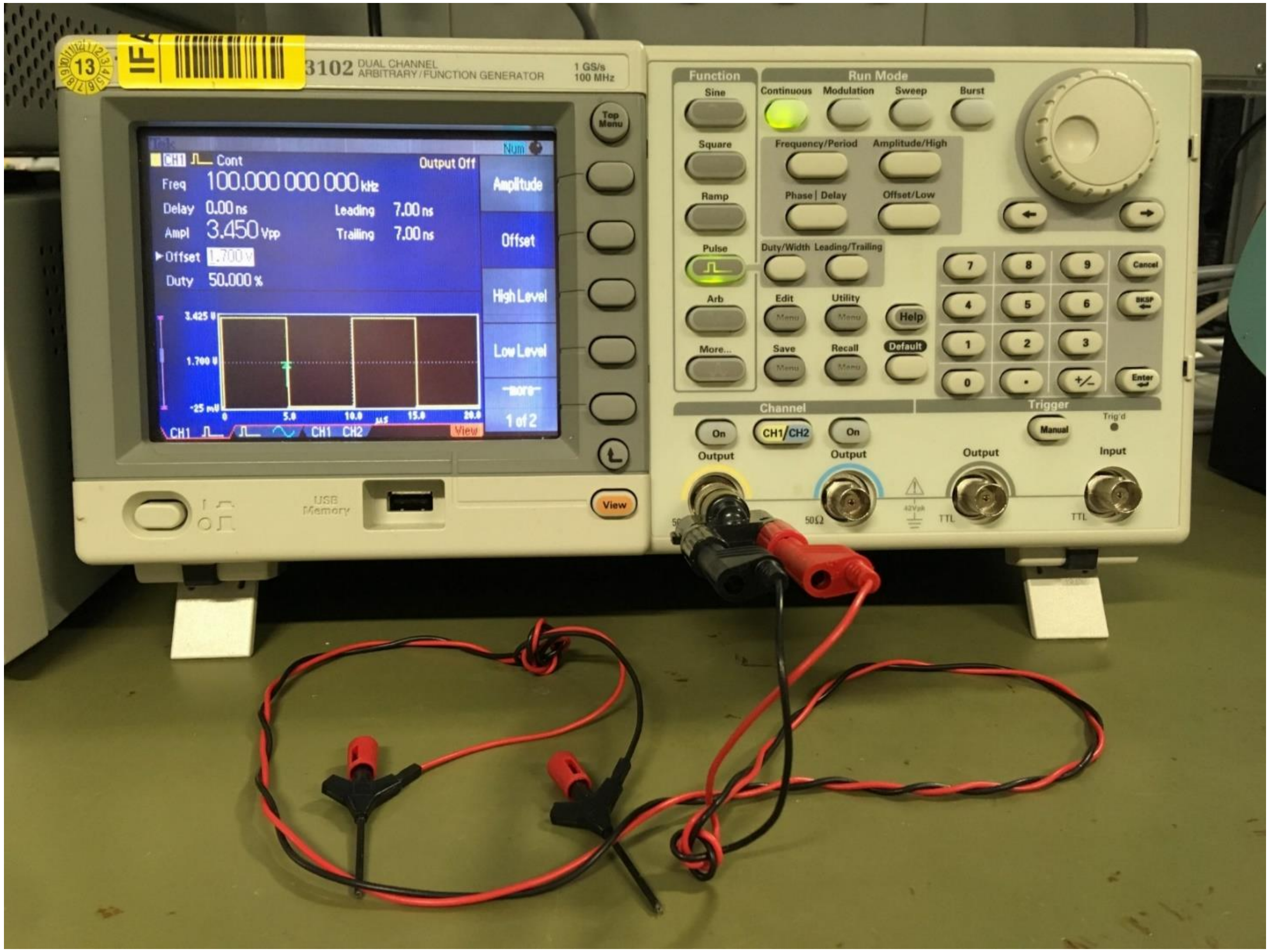


Instrumentation for driver supply generation



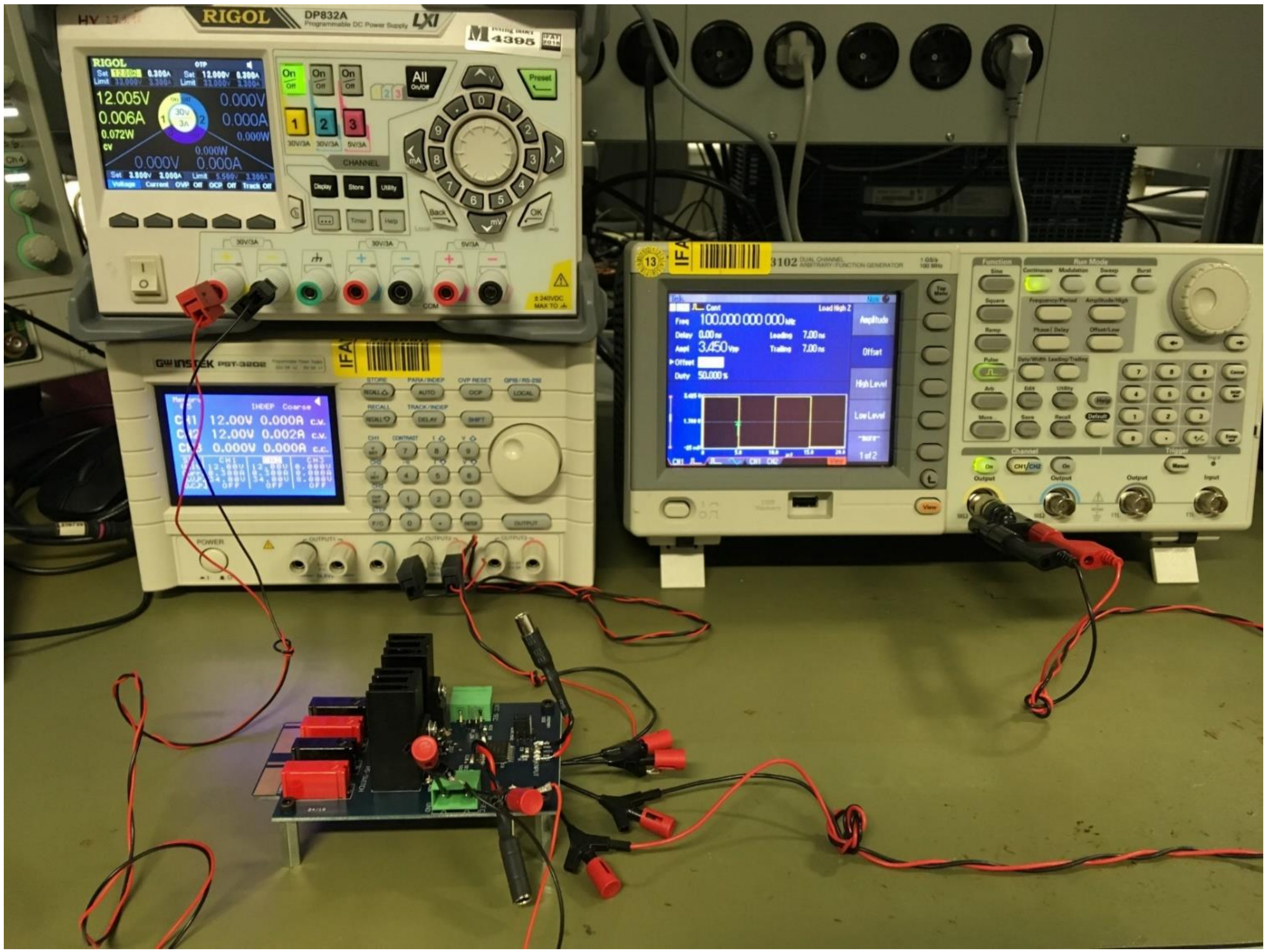
- V_{cc}=12 V for CoolMOS™ and 8 V for OptiMOS™
- Set the current limit to 0.3mA

Instrumentation for PWM signals generation

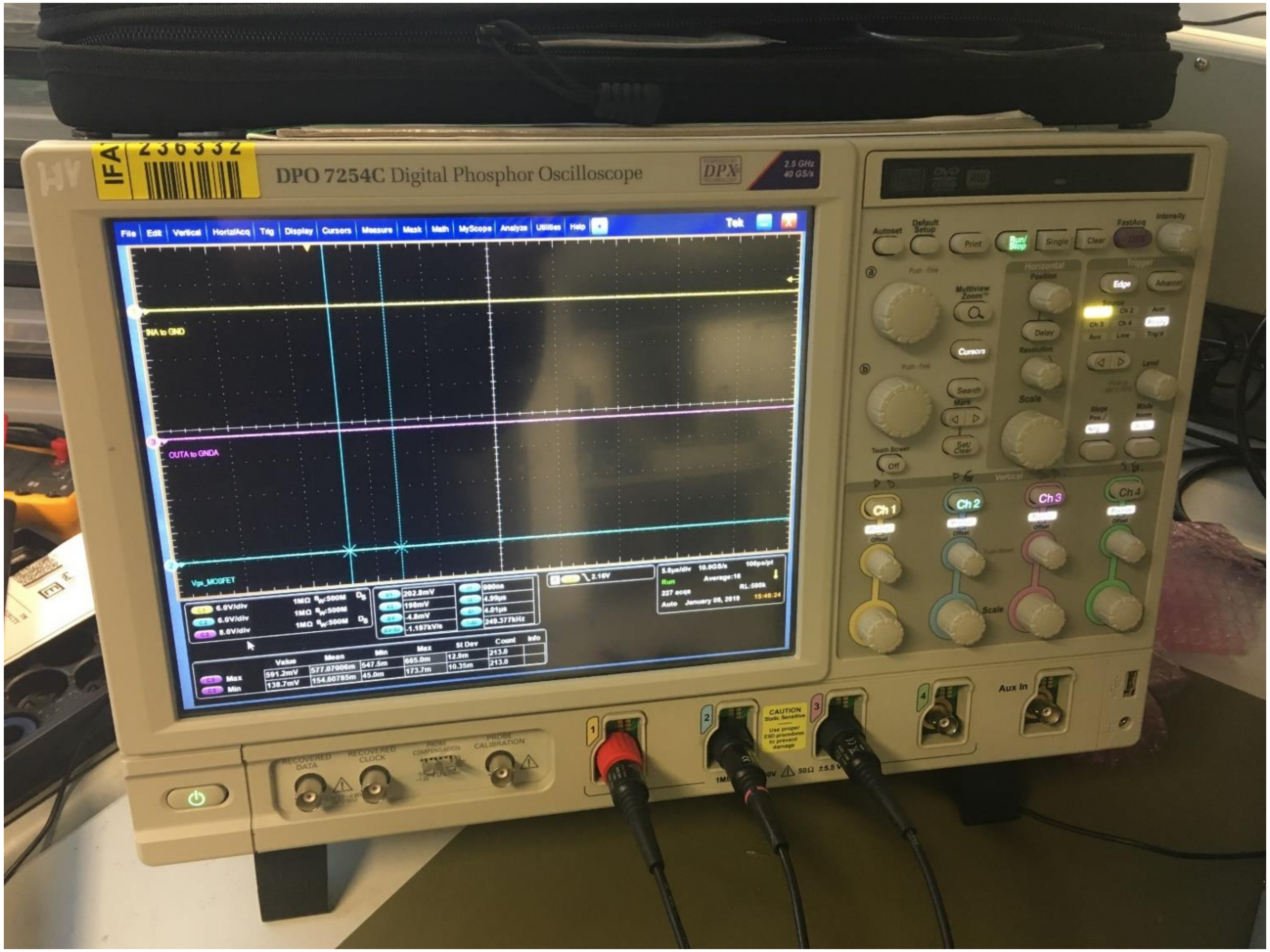


- Use a function generator or a microcontroller

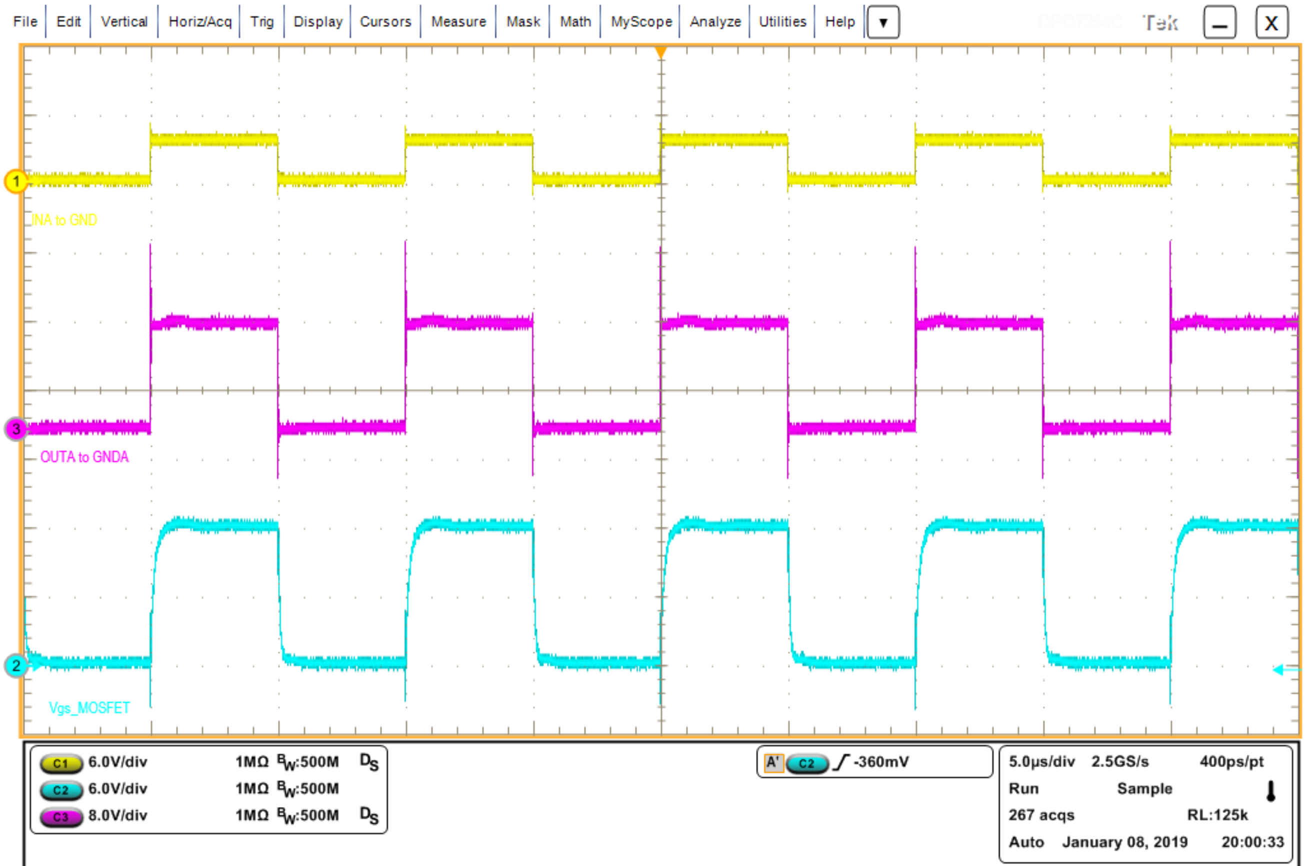
Connections



Instrumentation for signals evaluation



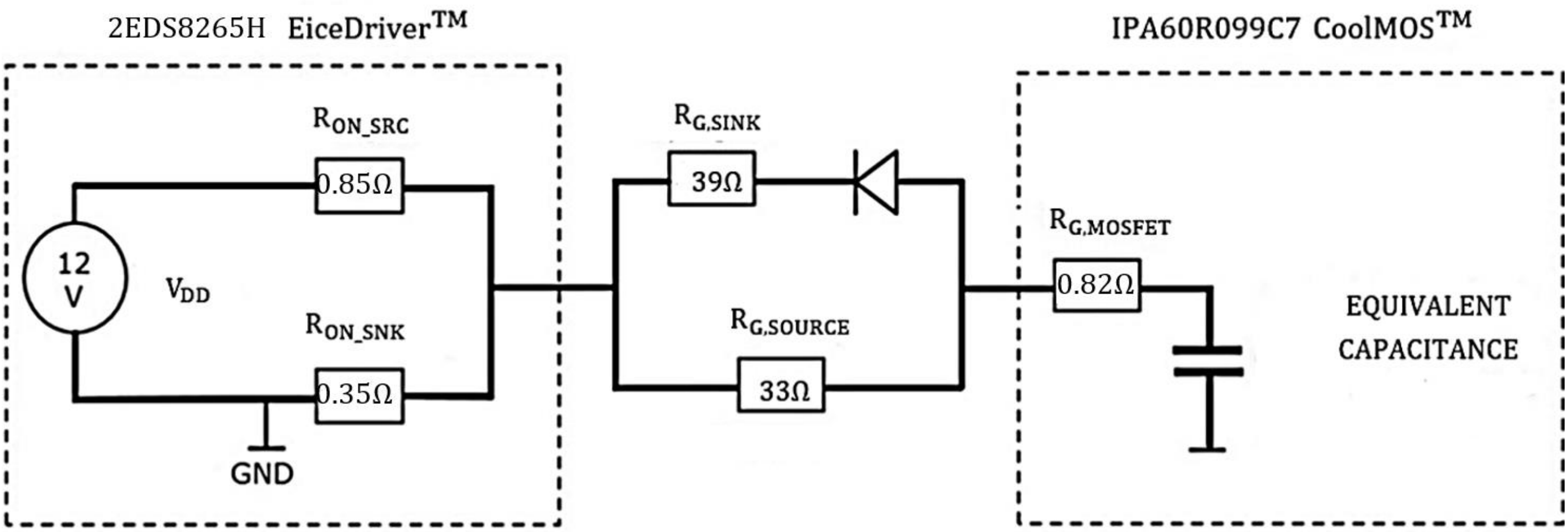
Oscilloscope waveforms



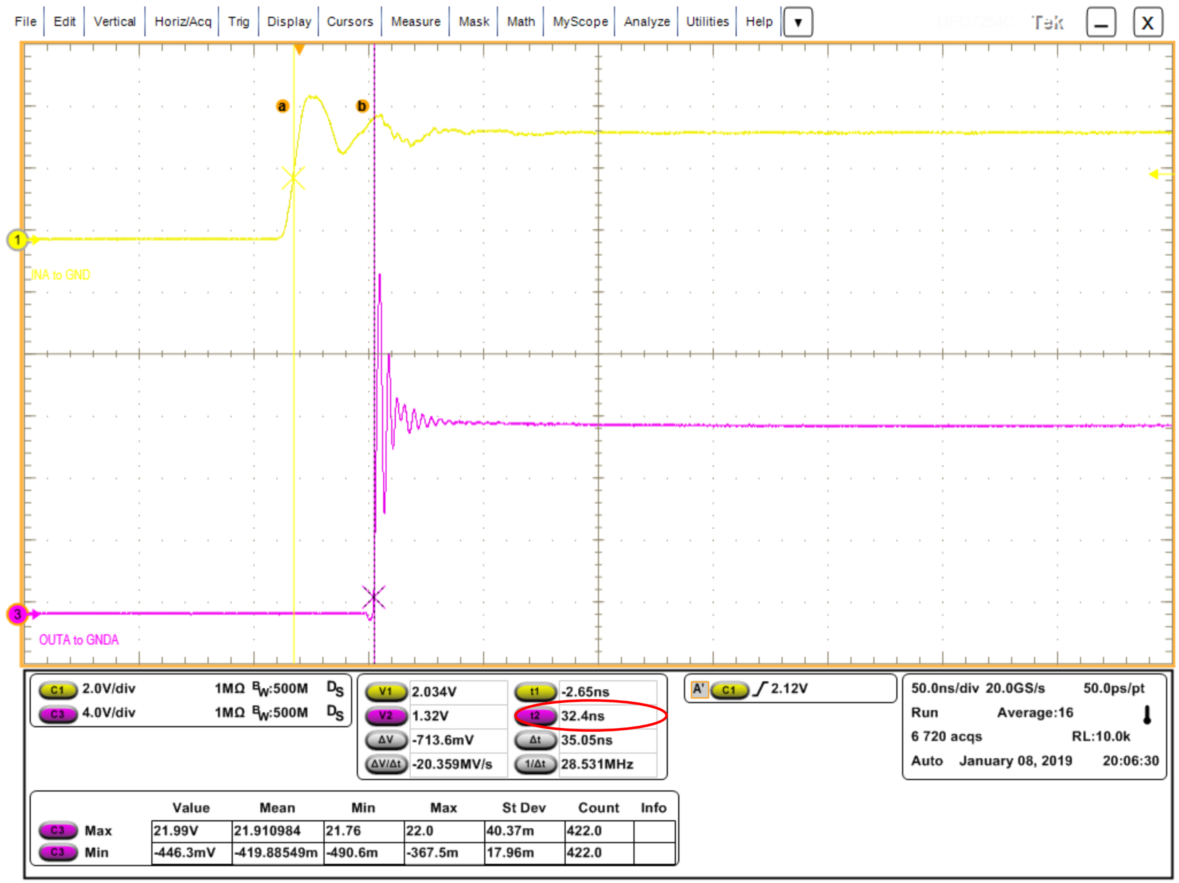
	Value	Mean	Min	Max	St Dev	Count	Info
C3 Max	21.76V	21.765362	21.44	22.4	193.3m	264.0	
C3 Min	-5.76V	-5.8776835	-6.4	-5.76	175.4m	264.0	

- 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



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

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

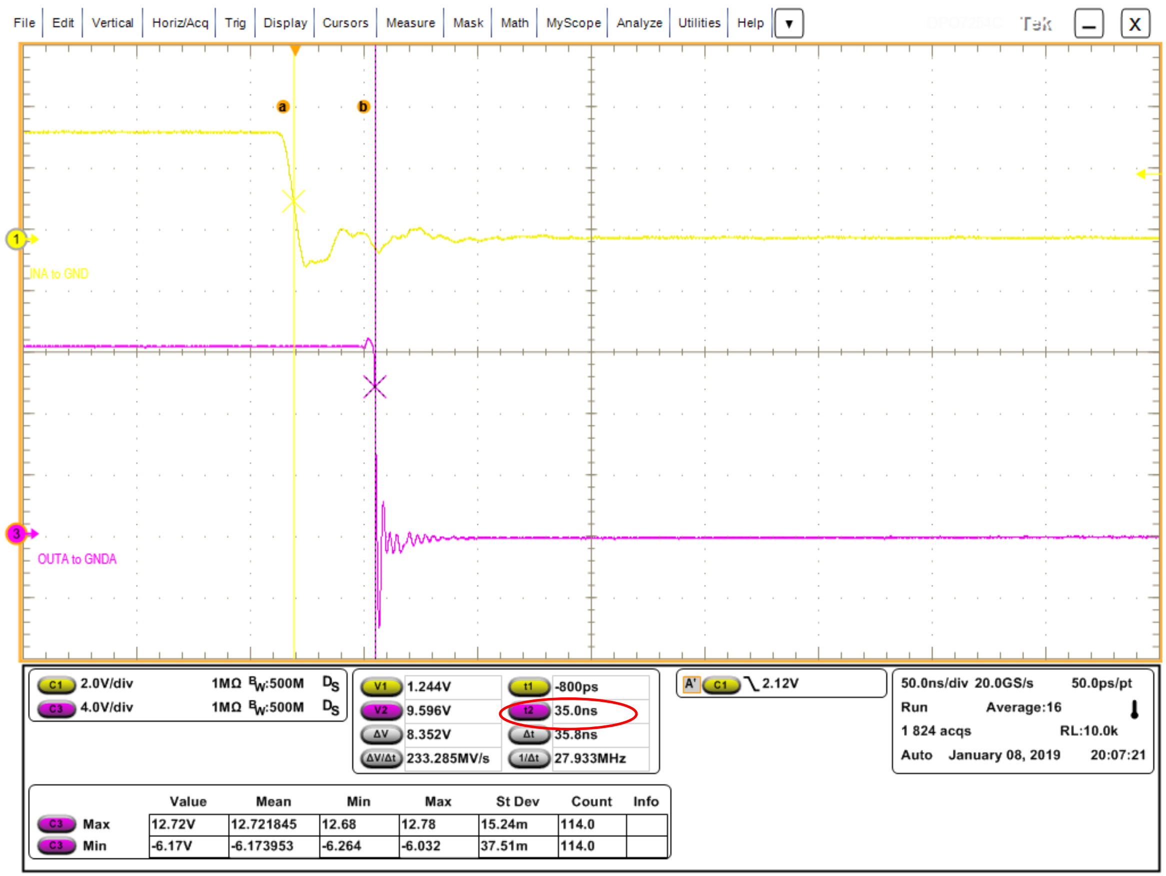
MOSFET = IPA60R099C7

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

$C_{LOAD} \approx 2.8\ nF$

- t_{PDlh} defined in the datasheed as time interval t($OUTB = 10\%\ VDD$) - t($INB = V_{INH} = 2\ V$) 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 24 for C_{LOAD} calculation)

High-Low propagation delay



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

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

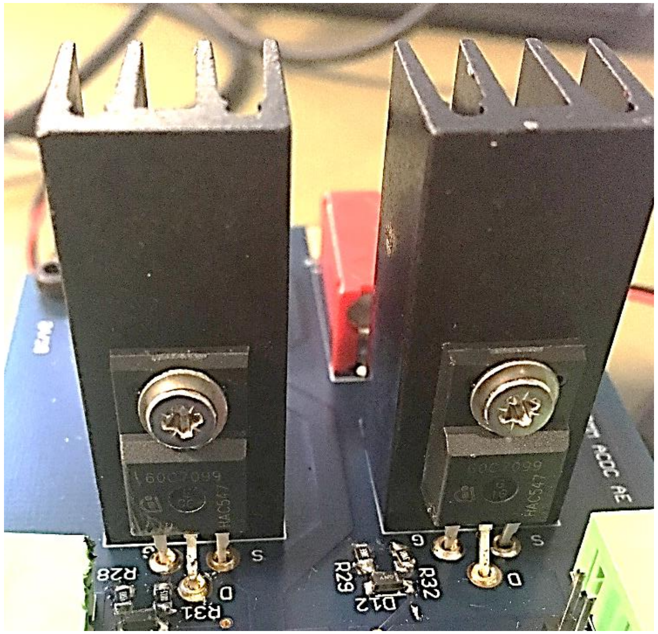
MOSFET = IPA60R099C7

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

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

- t_{PDhl} defined in the datasheed as time interval t($\text{INB} = V_{INL} = 1.2\ \text{V}$)- t($\text{OUTB} = 90\%\ \text{VDD}$) 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

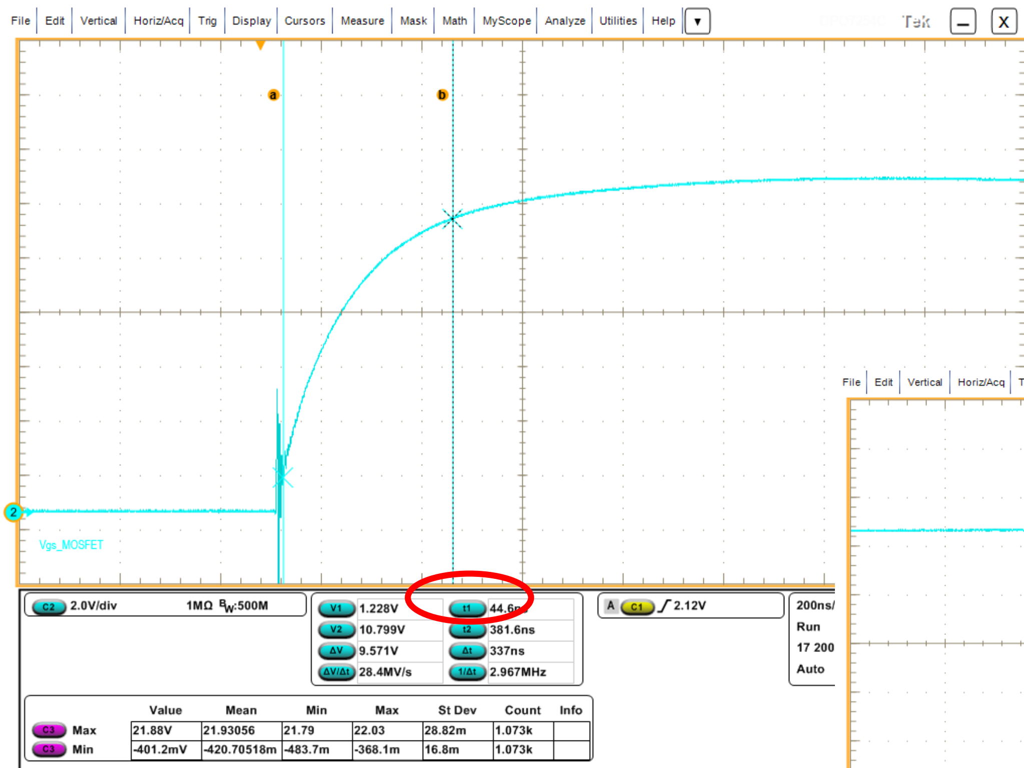


Gate to drain charge	Q_{gd}	-	14	-	nC	V_{DD}=400V, I_D=9.7A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	42	-	nC	V_{DD}=400V, I_D=9.7A, V_{GS}=0 to 10V

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

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

Rise/fall times



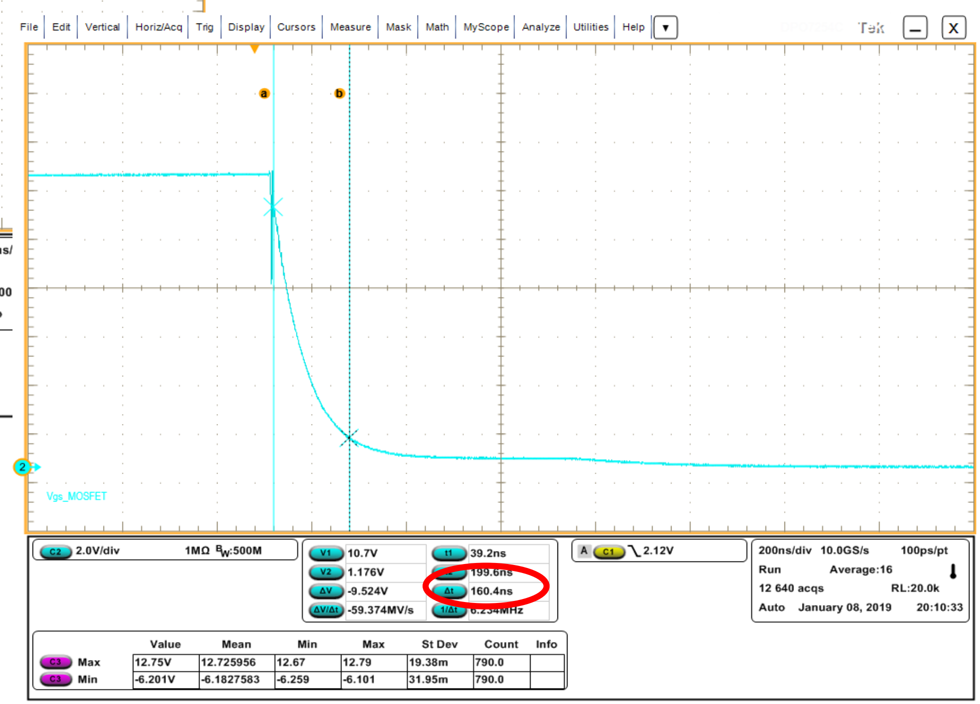
$R_{G,SOURCE} = 39\ \Omega$

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

MOSFET = IPA60R099C7

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

$C_{LOAD} \approx 2.8\ nF$



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

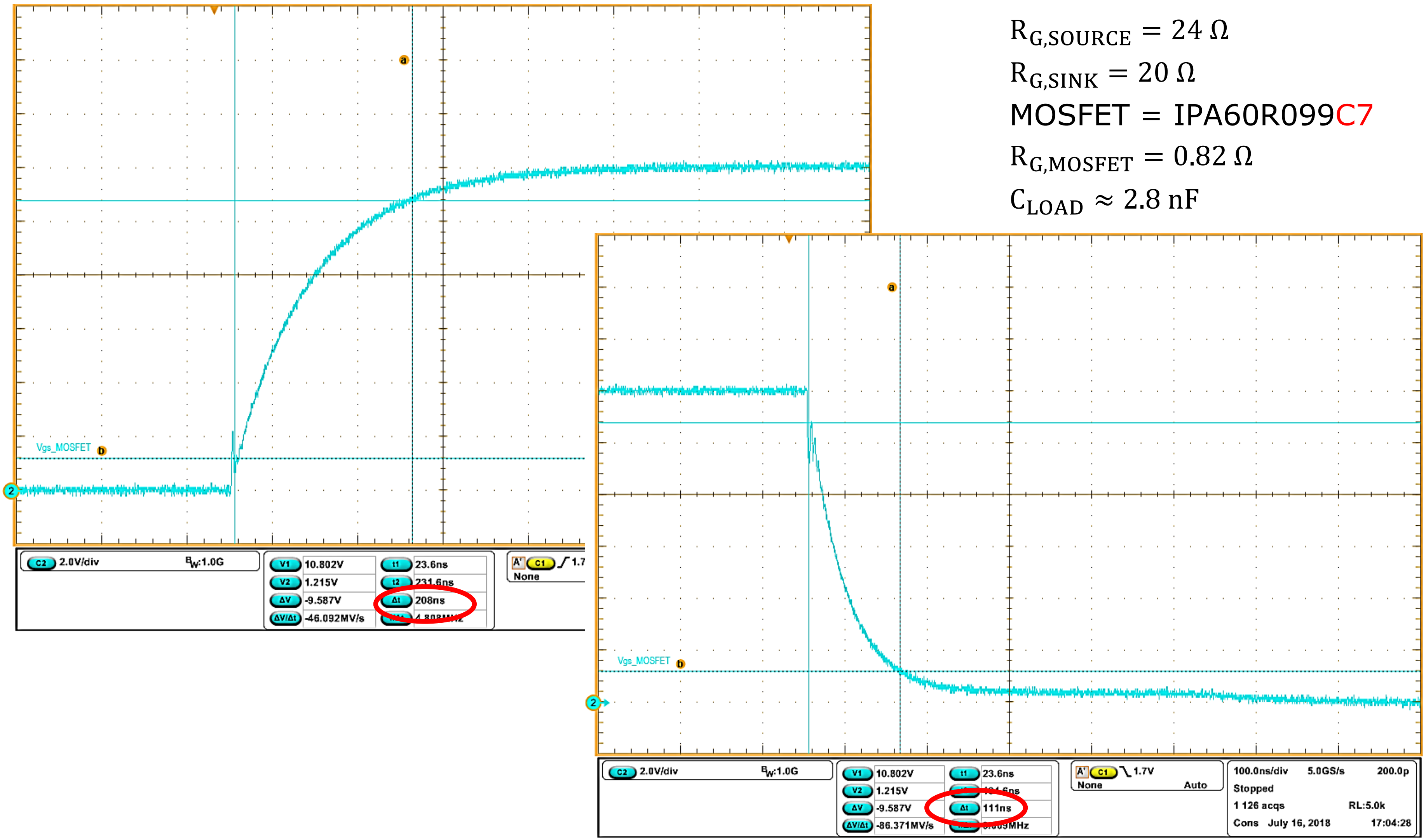
$R_{G,SOURCE} = 24\ \Omega$

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

MOSFET = IPA60R099C7

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

$C_{LOAD} \approx 2.8\ nF$



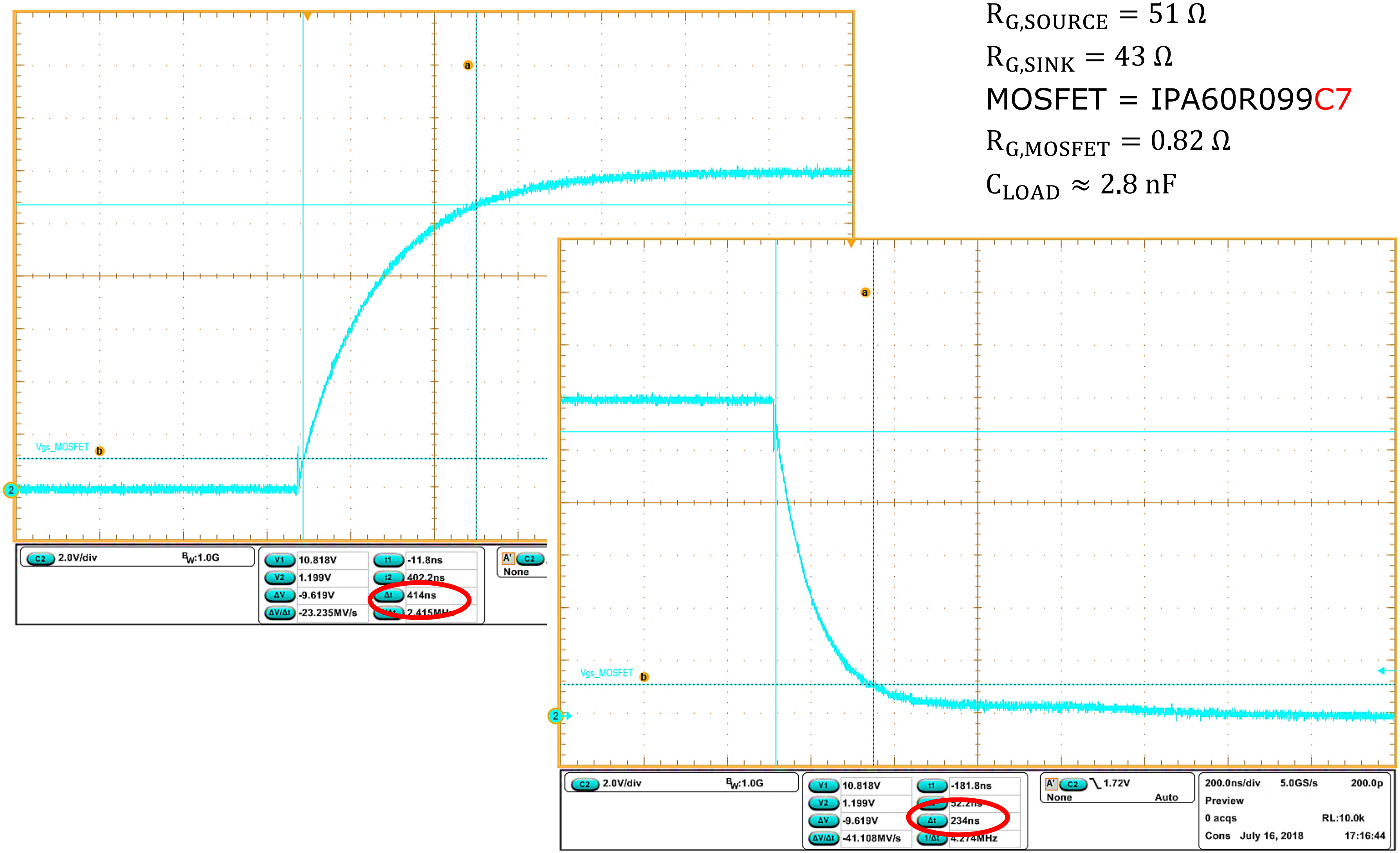
Gate resistors replacement

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

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

MOSFET = IPA60R099C7

Rise/fall times: New set of gate resistances



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

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

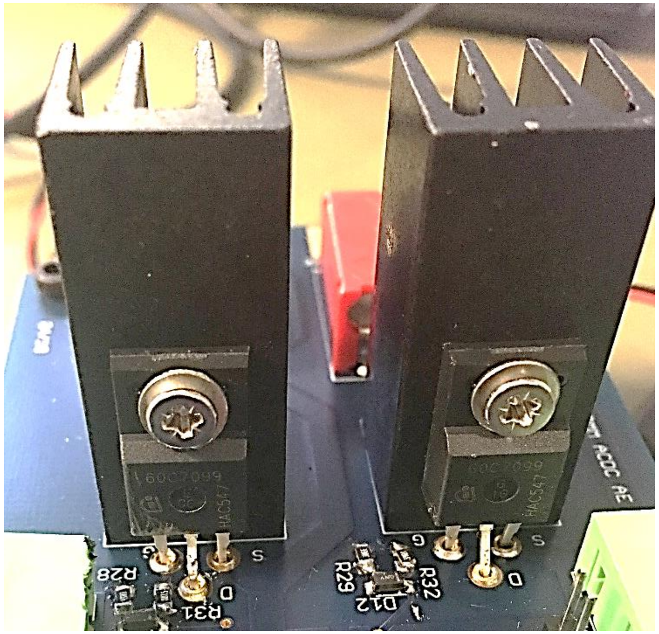
MOSFET = IPA60R099C7

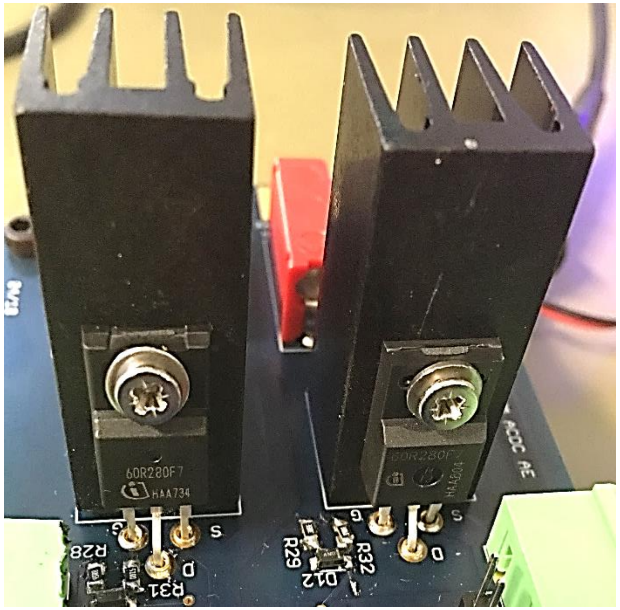
$R_{G,MOSFET} = 0.82\ \Omega$

$C_{LOAD} \approx 2.8\ nF$

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

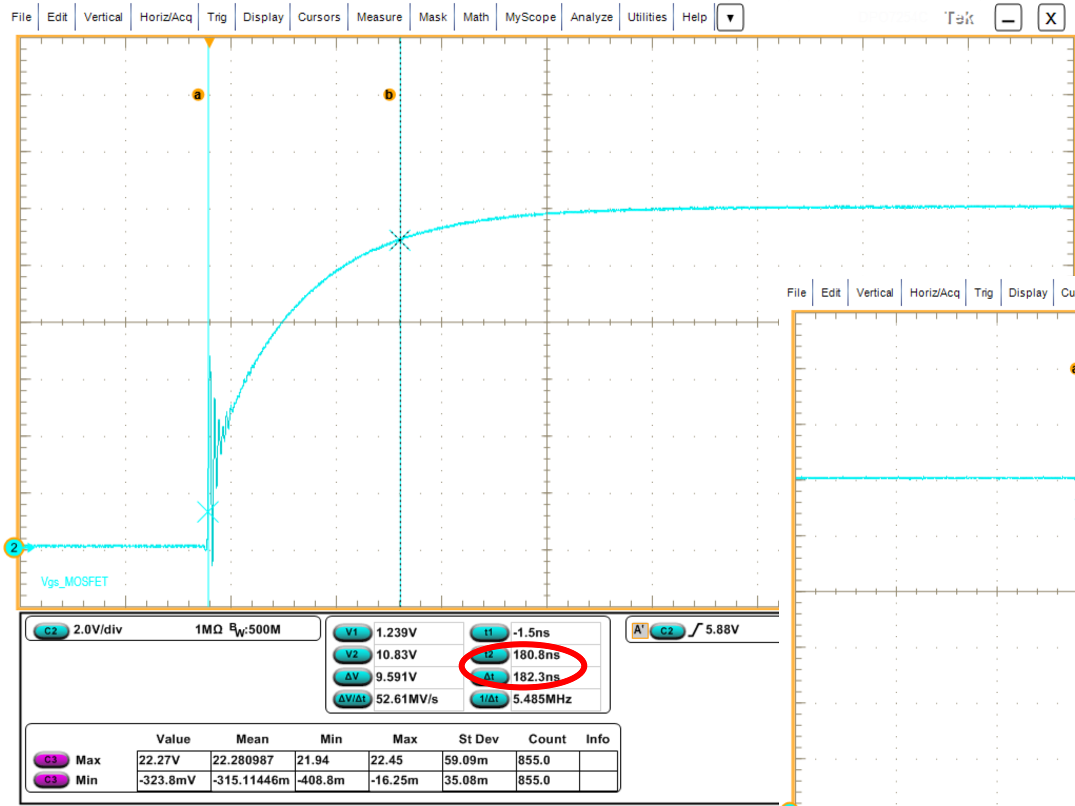
$R_{G,SOURCE} = 51\ \Omega$

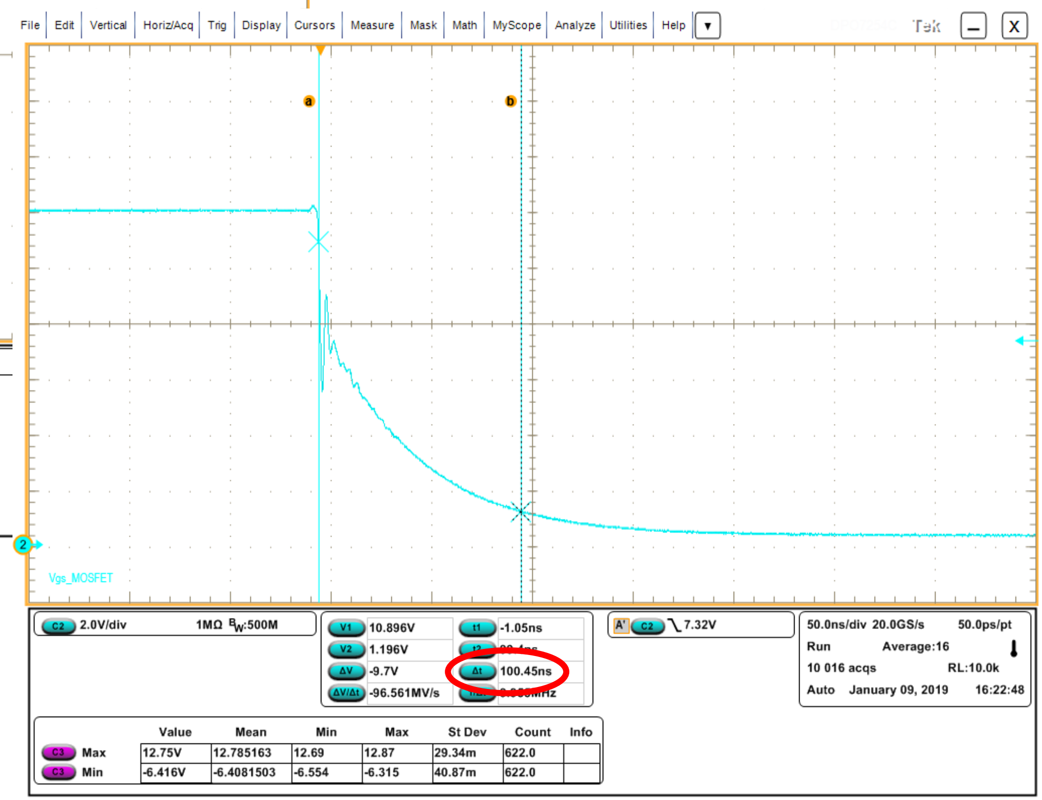
$R_{G,SINK} = 43\ \Omega$

MOSFET = IPA60R280CFD7

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

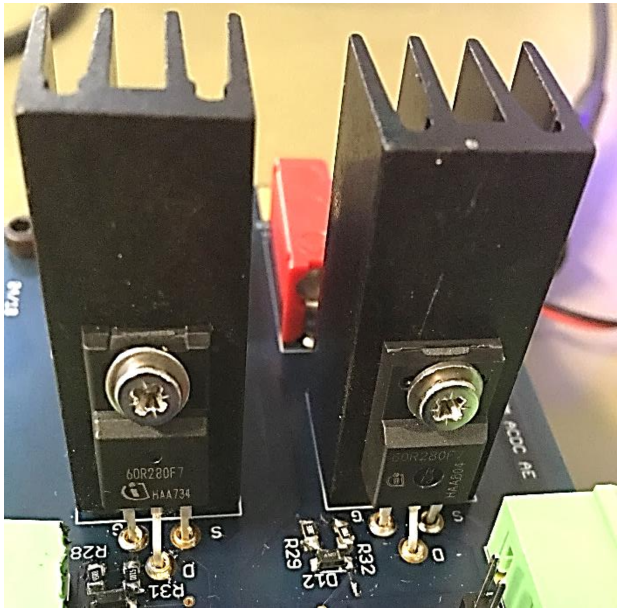
$C_{LOAD} \approx 1.3\ nF$

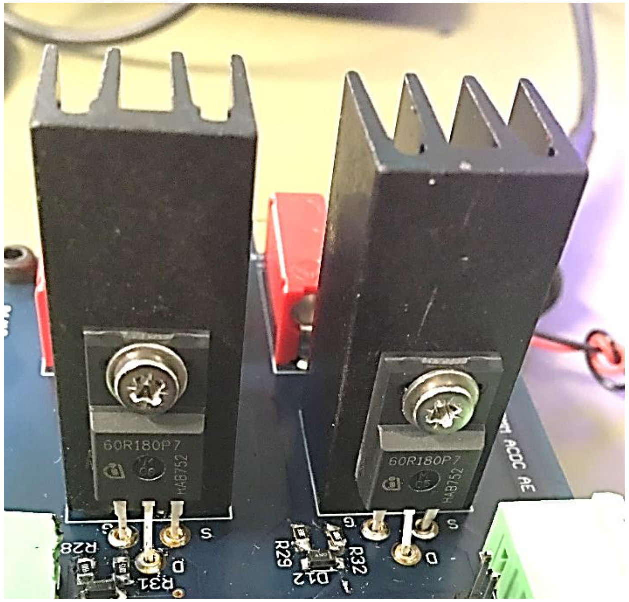




MOSFET replacement

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

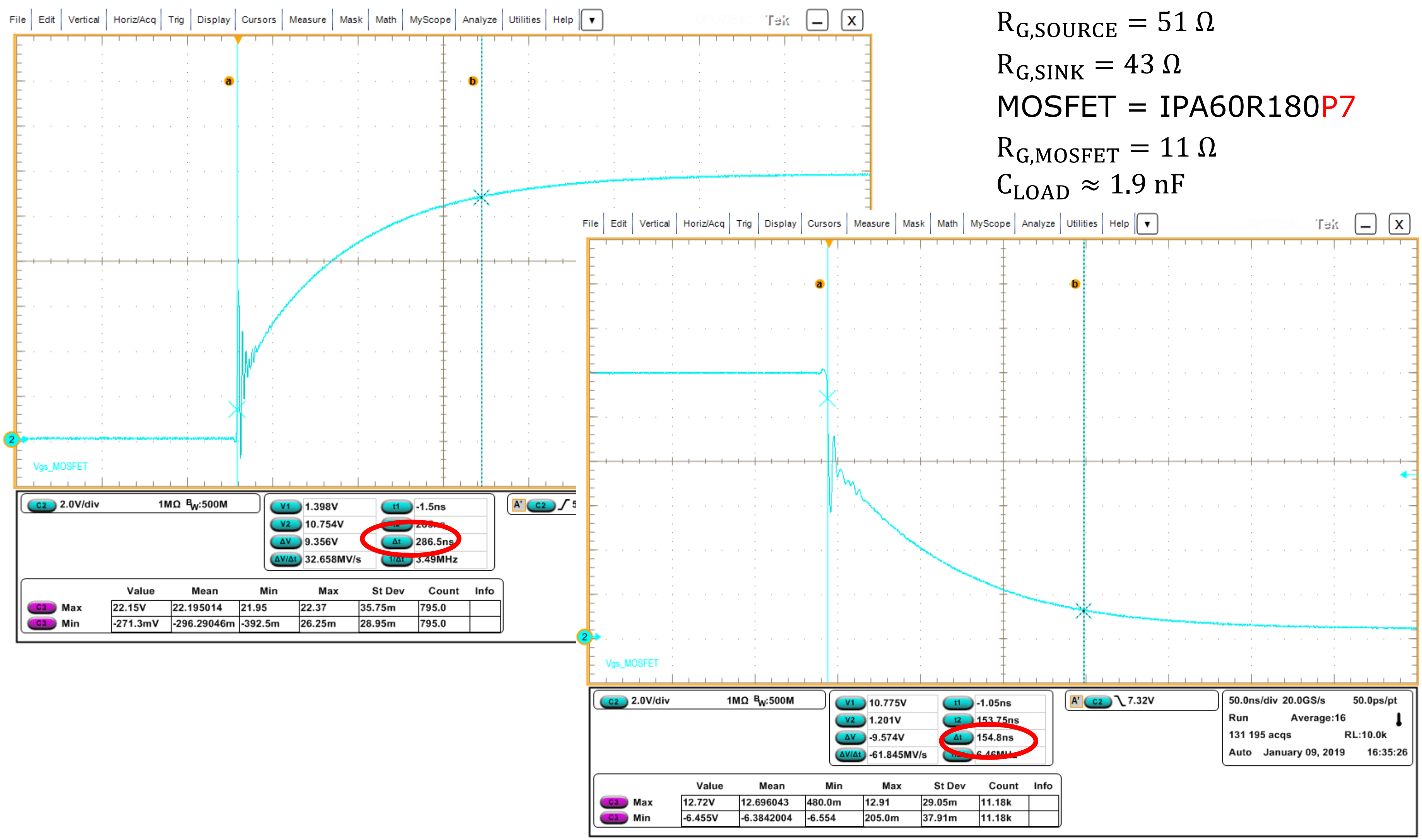
$R_{G,SOURCE} = 51\ \Omega$

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

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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