

Quick start guide

KIT_DRIVER_1EDN7511B

KIT_DRIVER_1EDN7550B

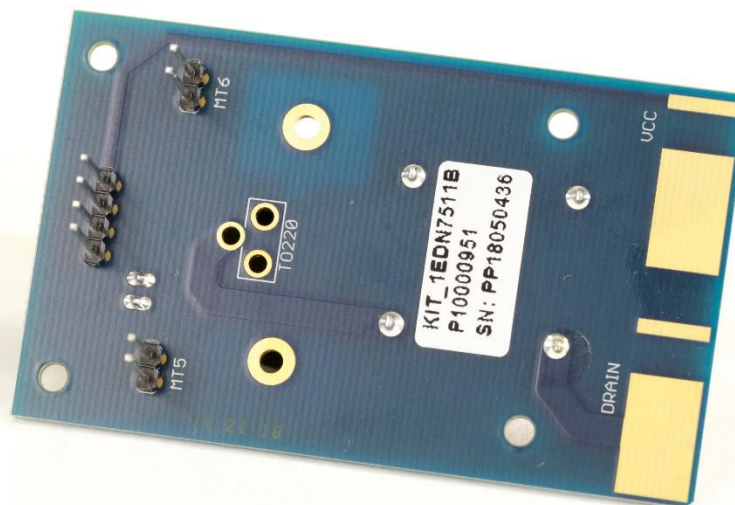


Included in this kit

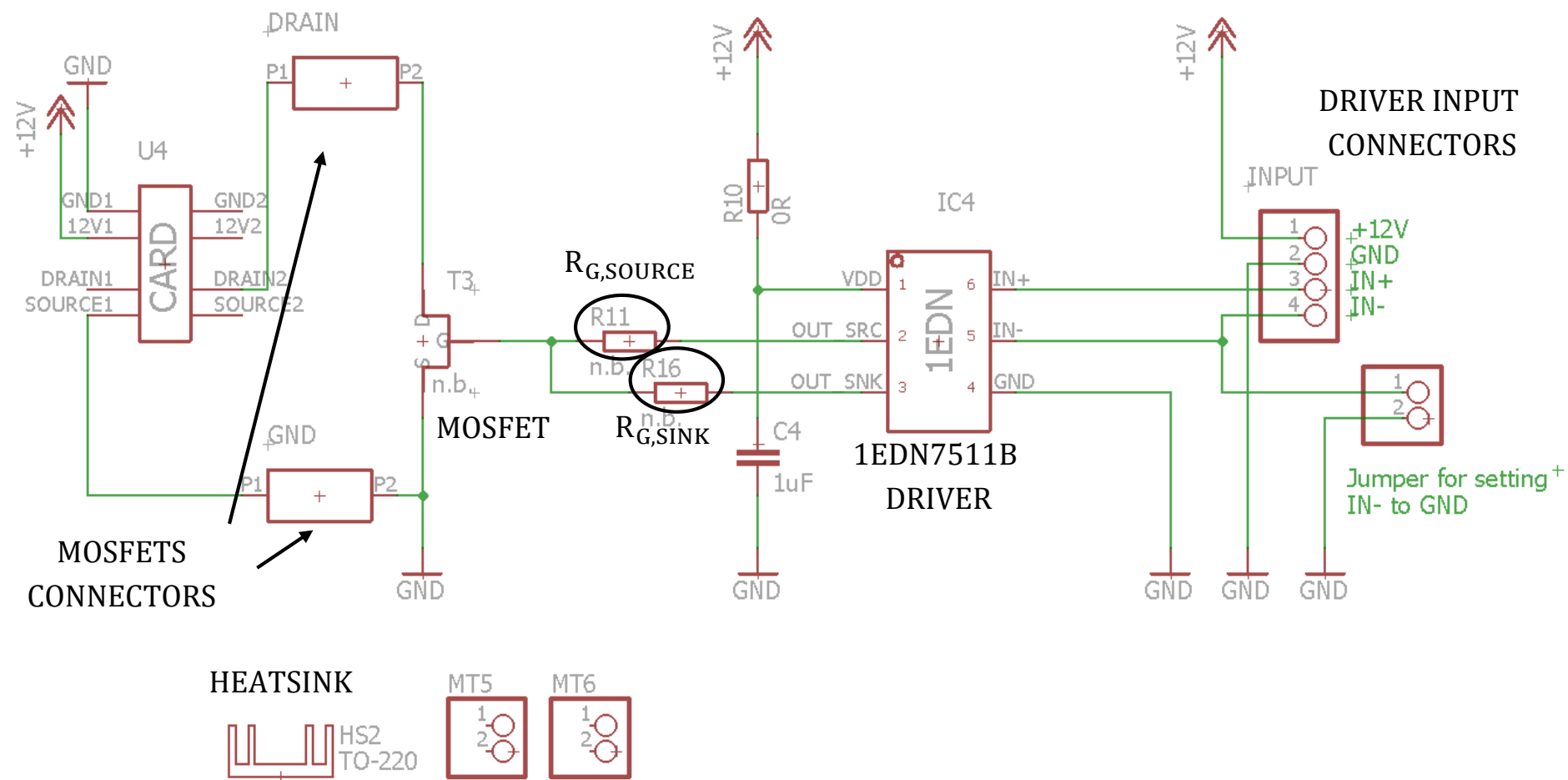


Heatsink for
TO-220 MOSFET








Evaluation kit
KIT_DRIVER_1EDN7511B



Board schematic

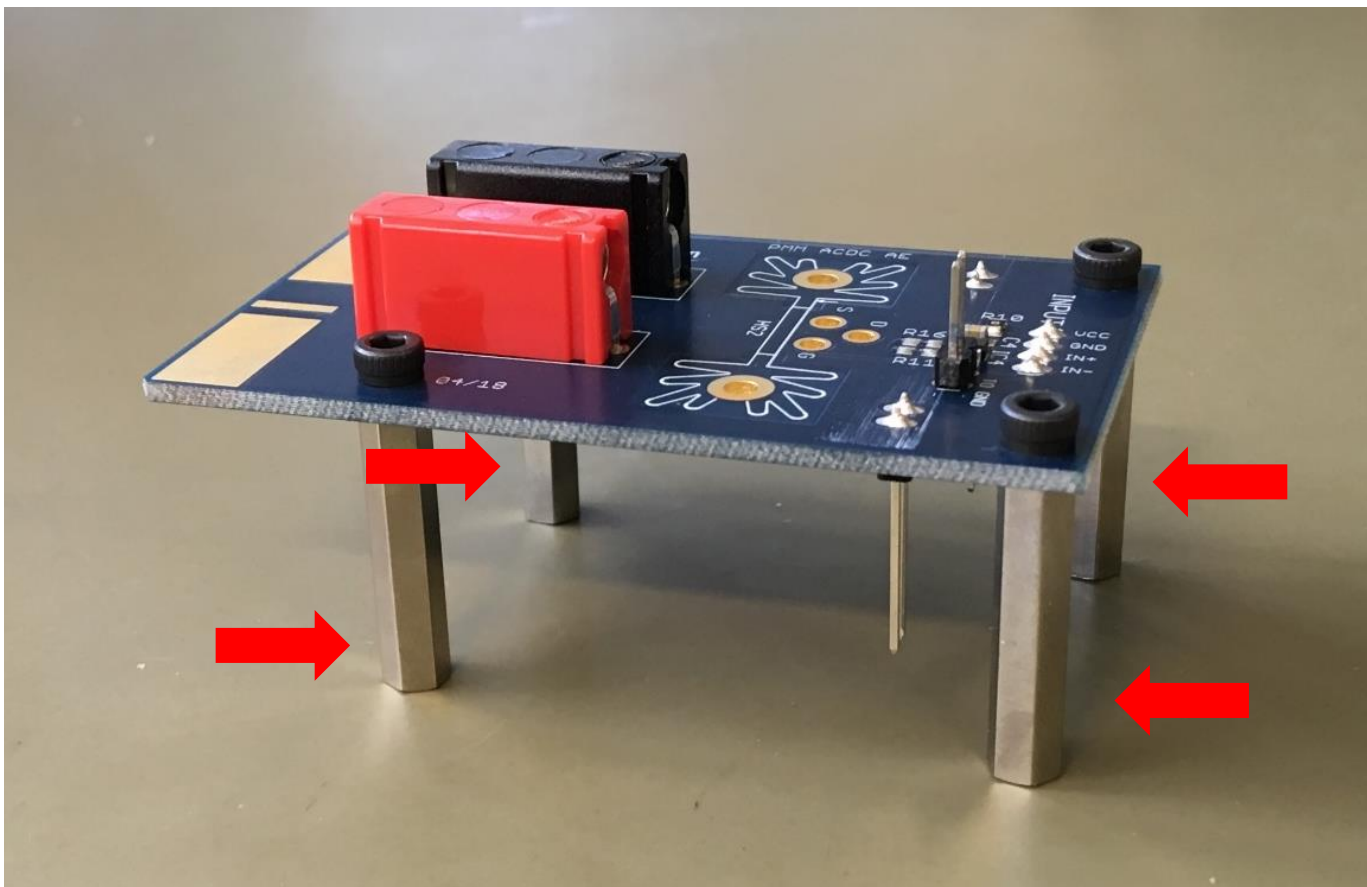


Components to add – BOM suggestion

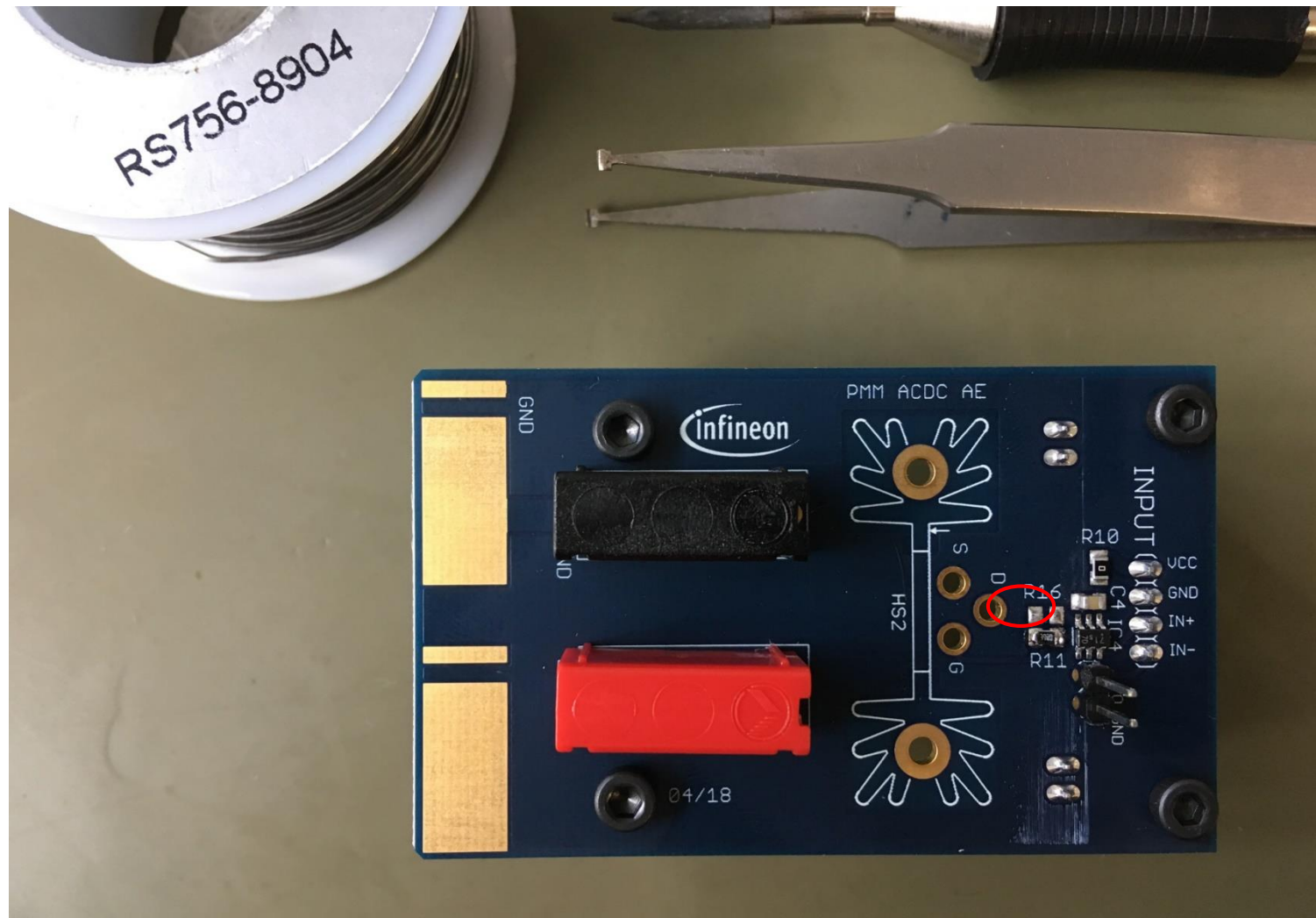
Distance bolts	Screws for distance bolts	Screw and washer for MOSFET mounting to heatsink	TO-220 sockets
			
TO-220 MOSFET	Source resistor (R11)	Sink resistor (R16)	
			

Component	Quantity	Designator	Comment	Voltage	Footprint	Type	Part number/ supplies
Resistors	2	R11,R16			RES805R	SMD ceramic resistor	
TO-220 sockets	1	T3	TO-220 socket		TO-220	Receptacle Connector 0.034" ~ 0.041" (0.86 mm ~ 1.04 mm)	5050865-5 Digi-key

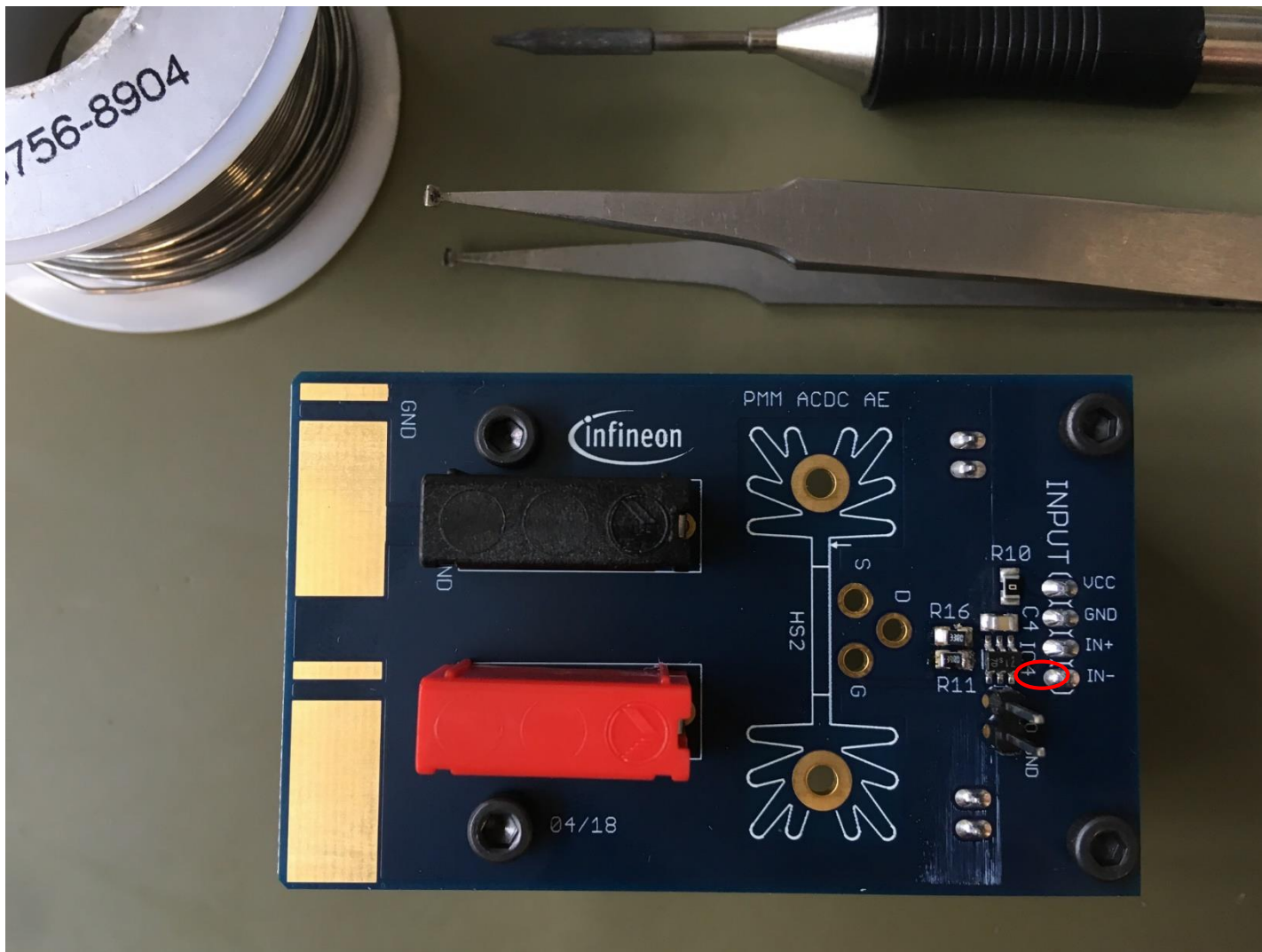
Step 1: Distance bolts mounting



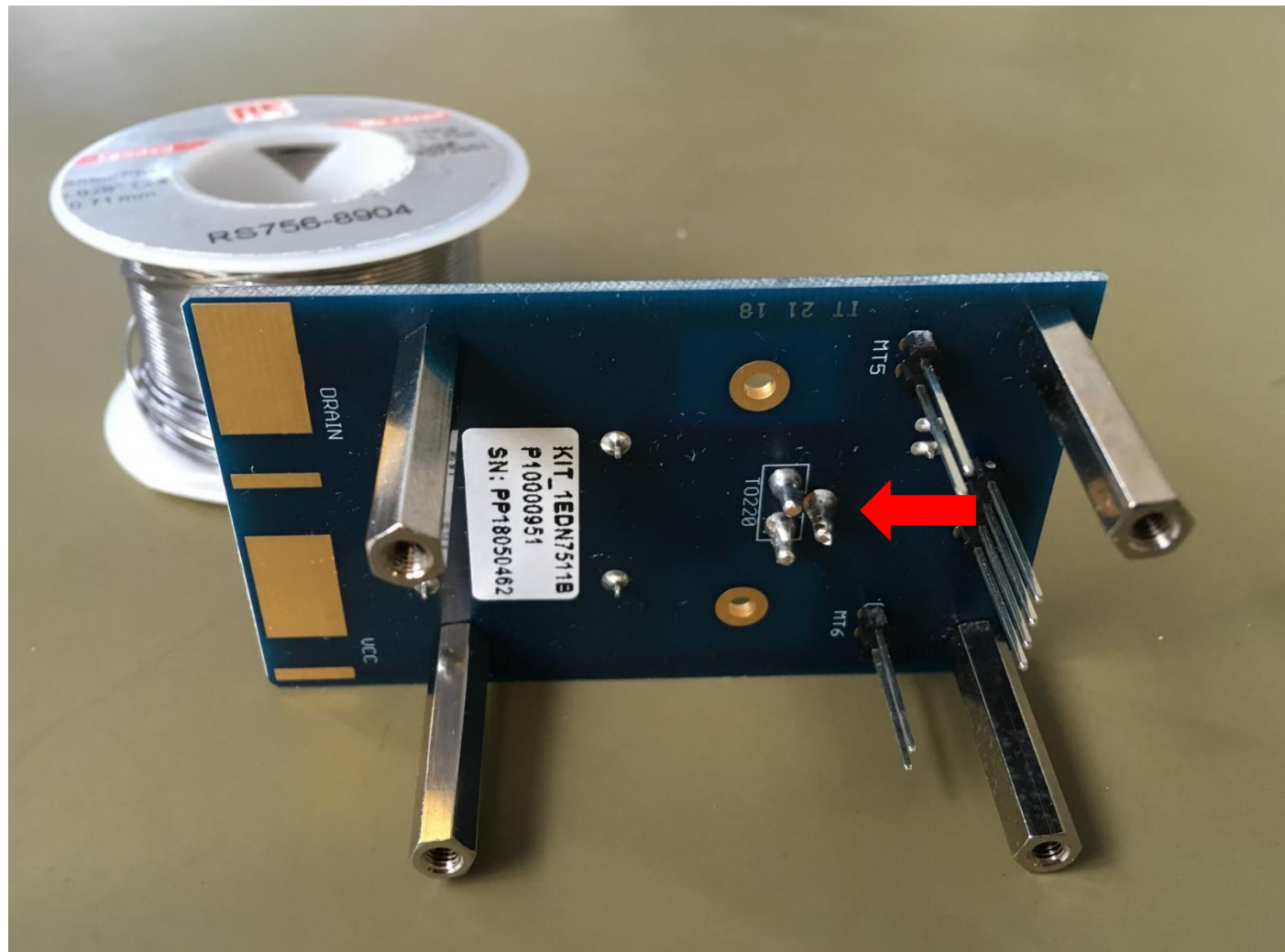
Step 2: Source resistor soldering



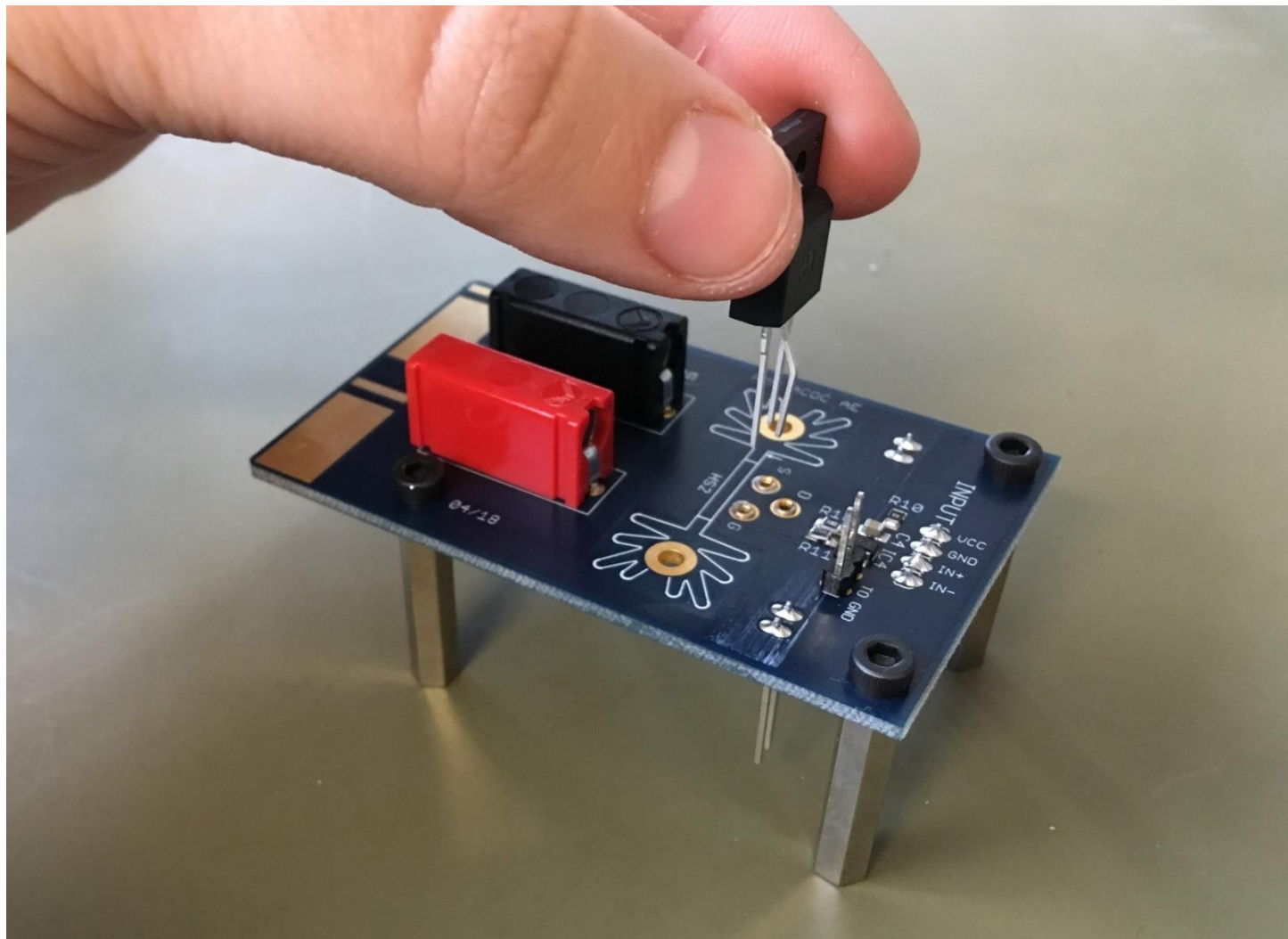
Step 3: Sink resistor soldering



Step 4: TO-220 sockets soldering

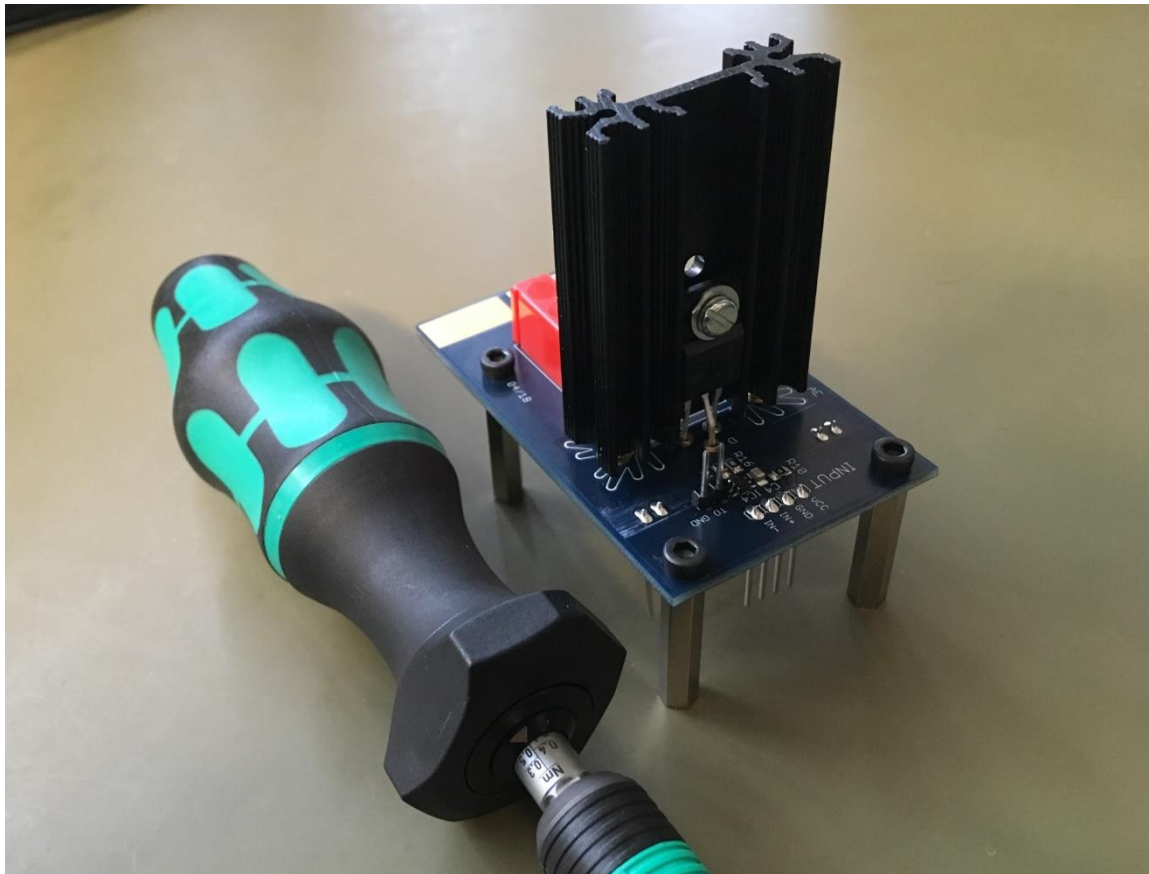


Step 5: MOSFETs placement into the sockets

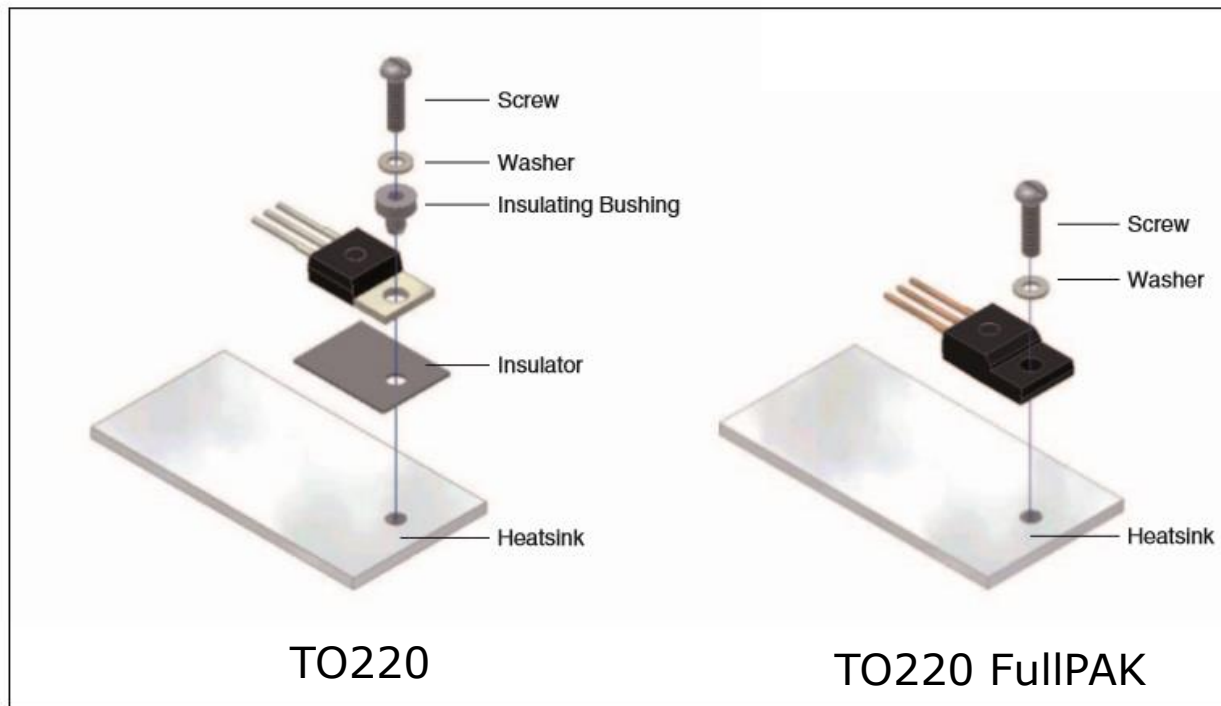


Step 6: Heatsink mounting (optional)

- > 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

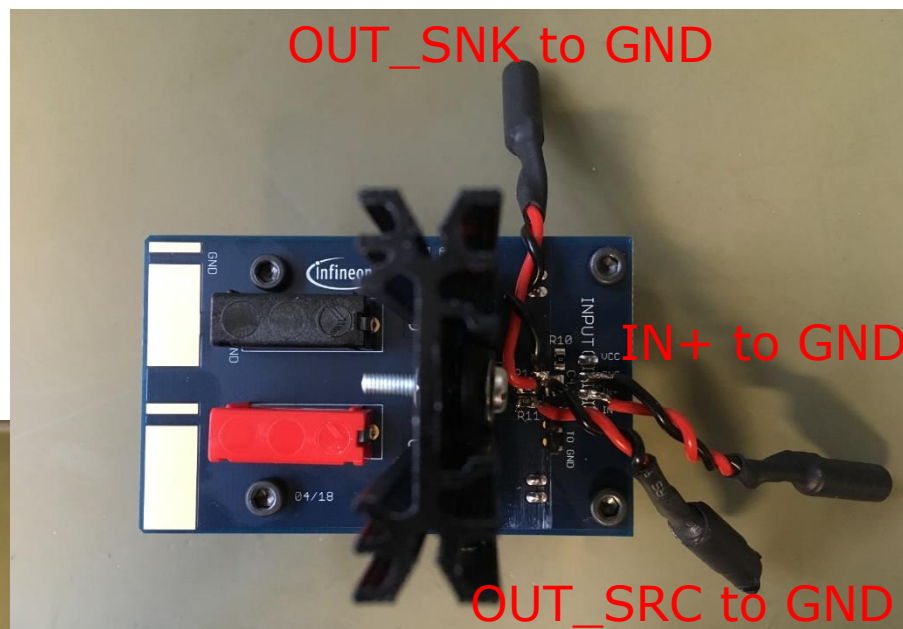
- > Recommendations for assembly of Infineon TO packages:
https://www.infineon.com/dgdl/Infineon-Package_recommendations_for_assembly_of_Infineon_TO_packages-AN-v01_00-EN.pdf?fileId=db3a30431936bc4b011938532f885a38

Step 7: IN- jumper connection

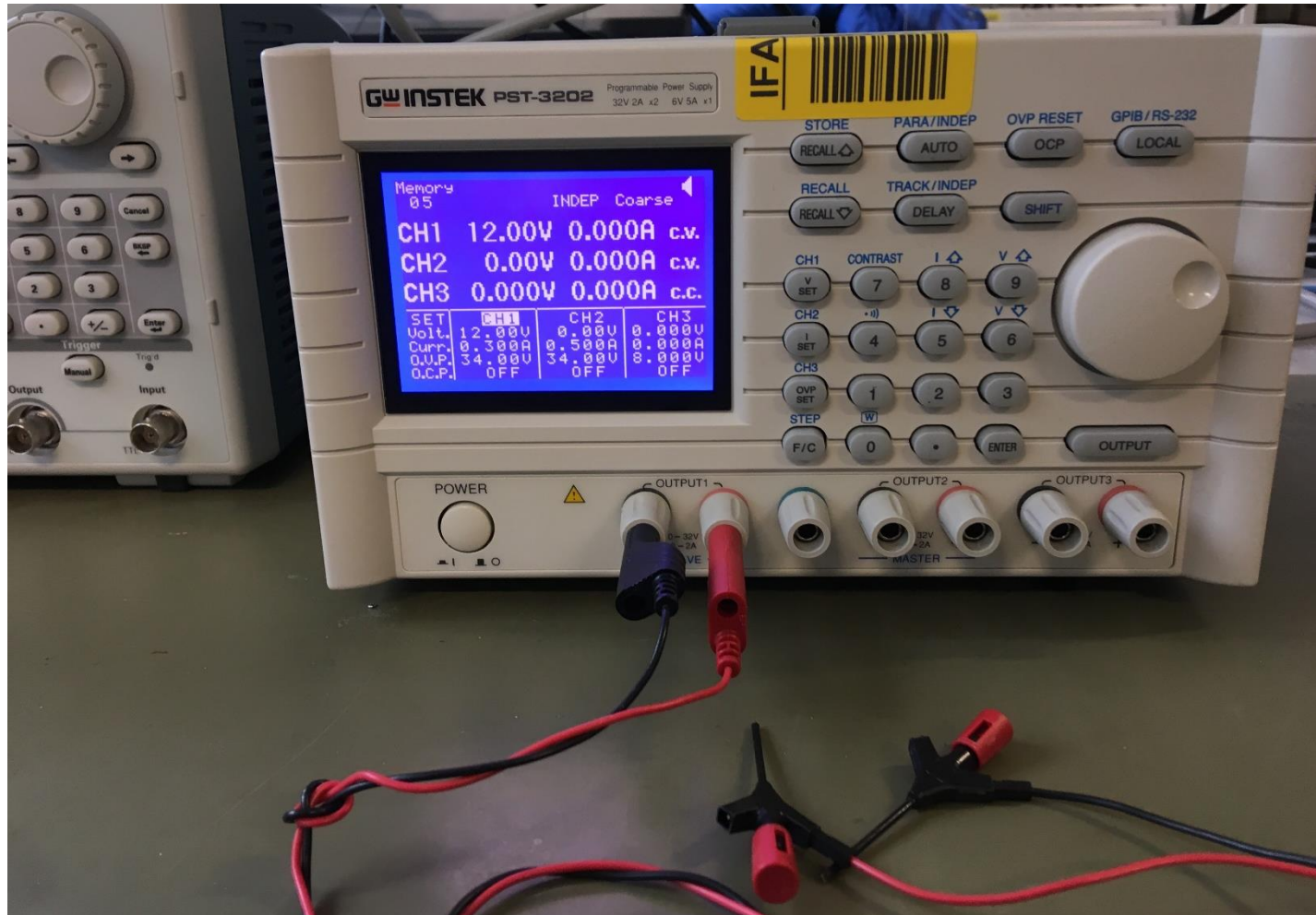


- > In non-inverting operating mode, short IN- to GND with a jumper

Step 8: BNC connectors soldering

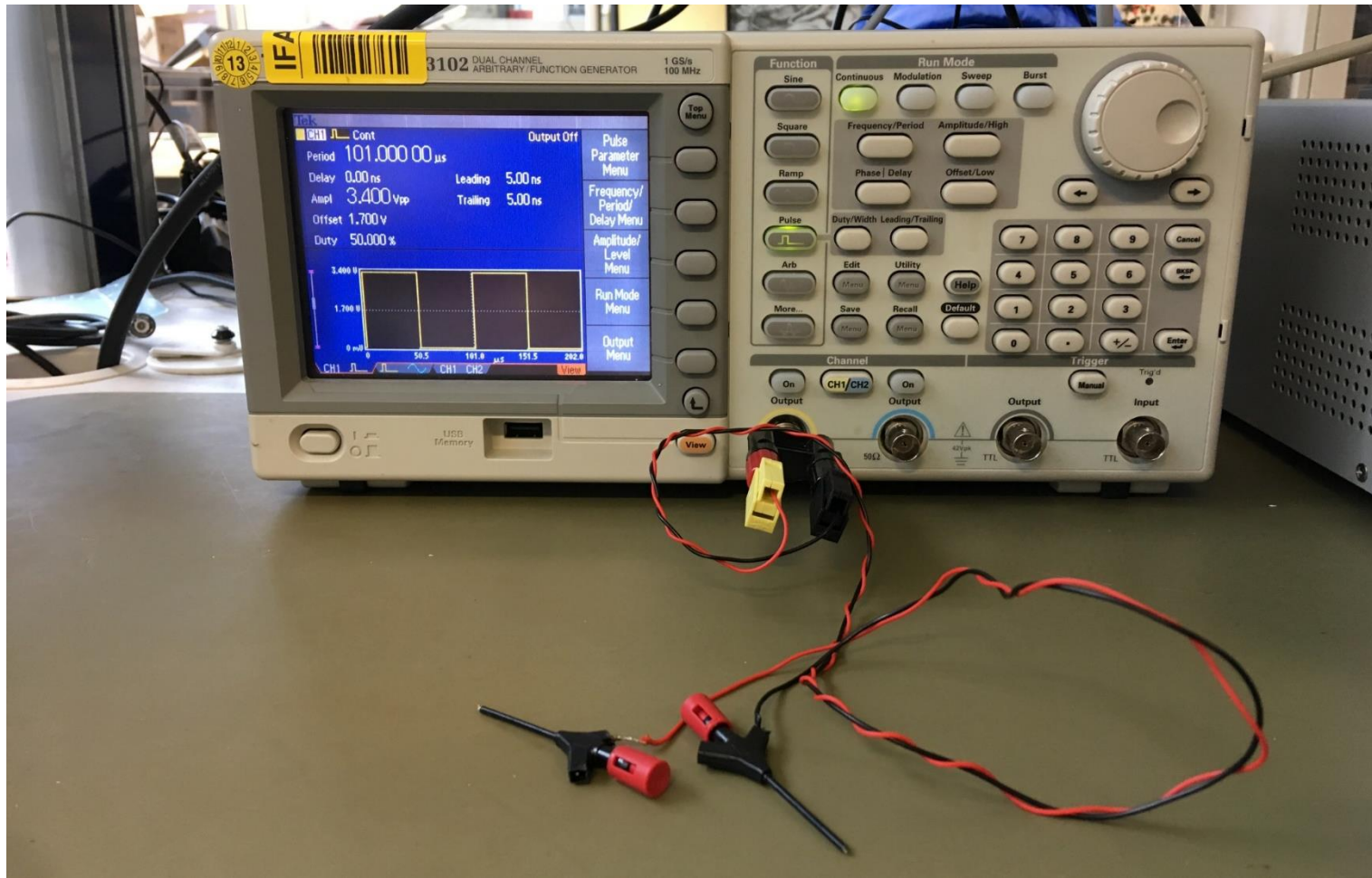


Instrumentation for driver supply generation



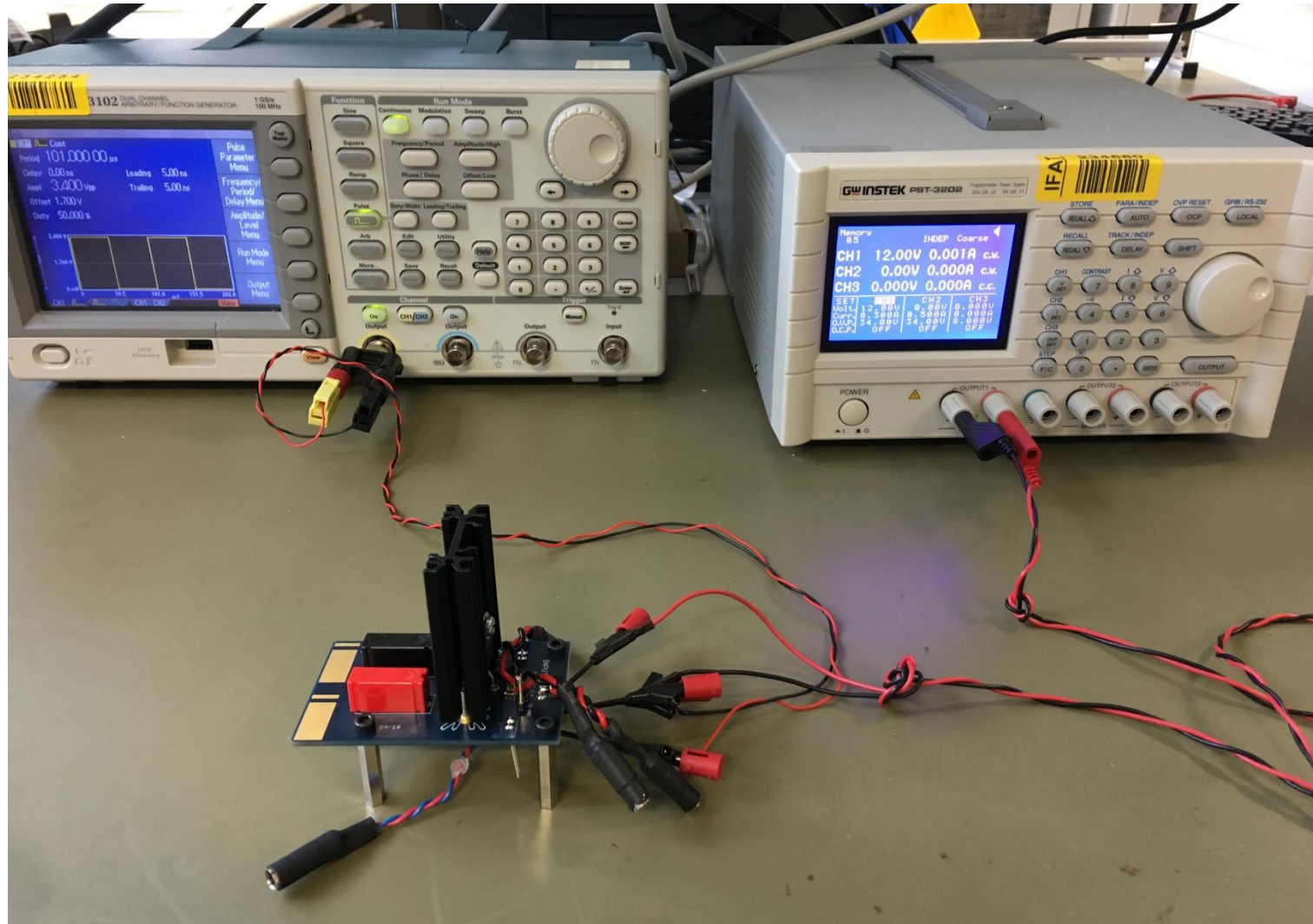
- > V_{cc} = 12V for CoolMOS™ and 8V for OptiMOS™
- > Set the current limit to 0.3A

Instrumentation for PWM signals generation

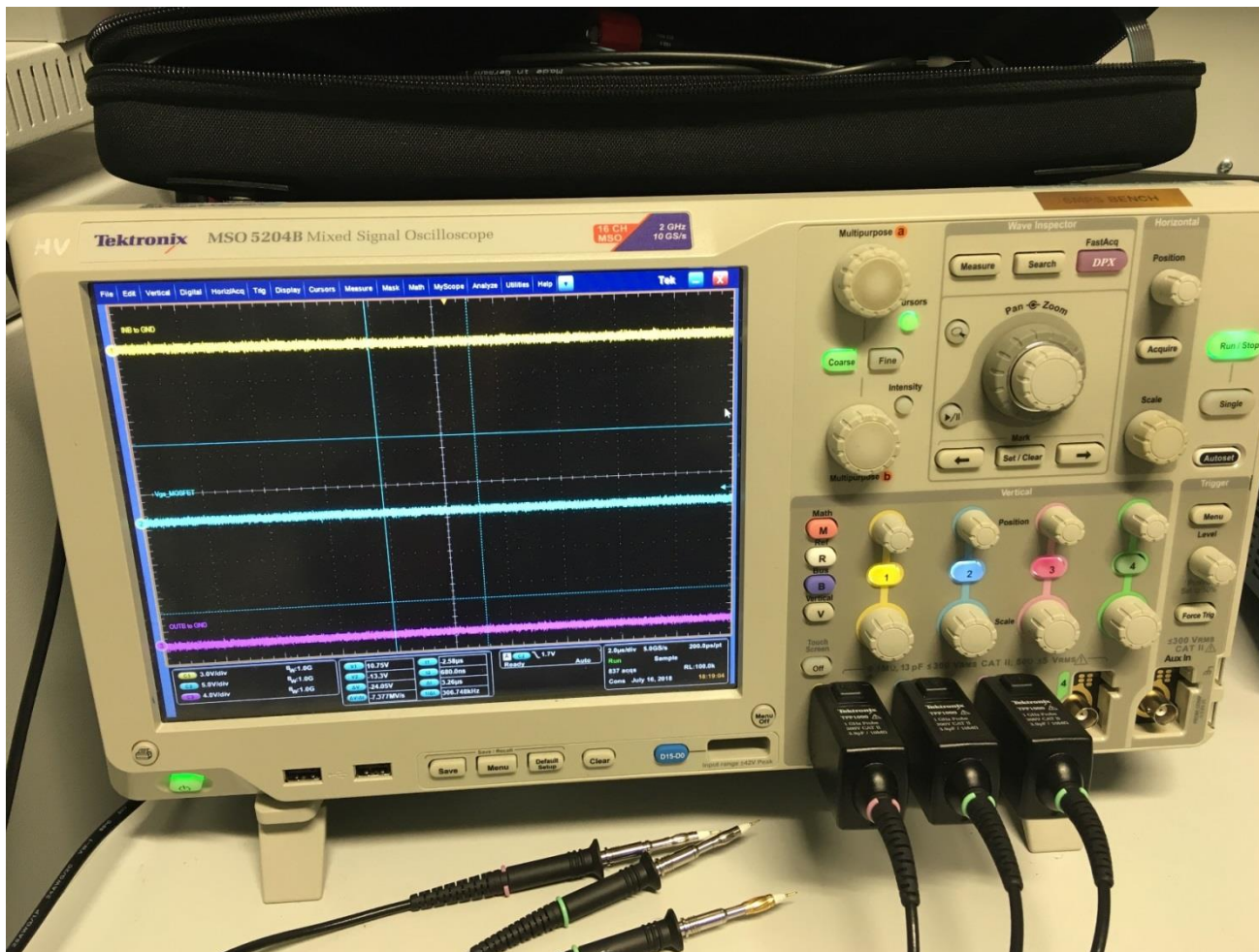


- Use a function generator or a microcontroller

Connections

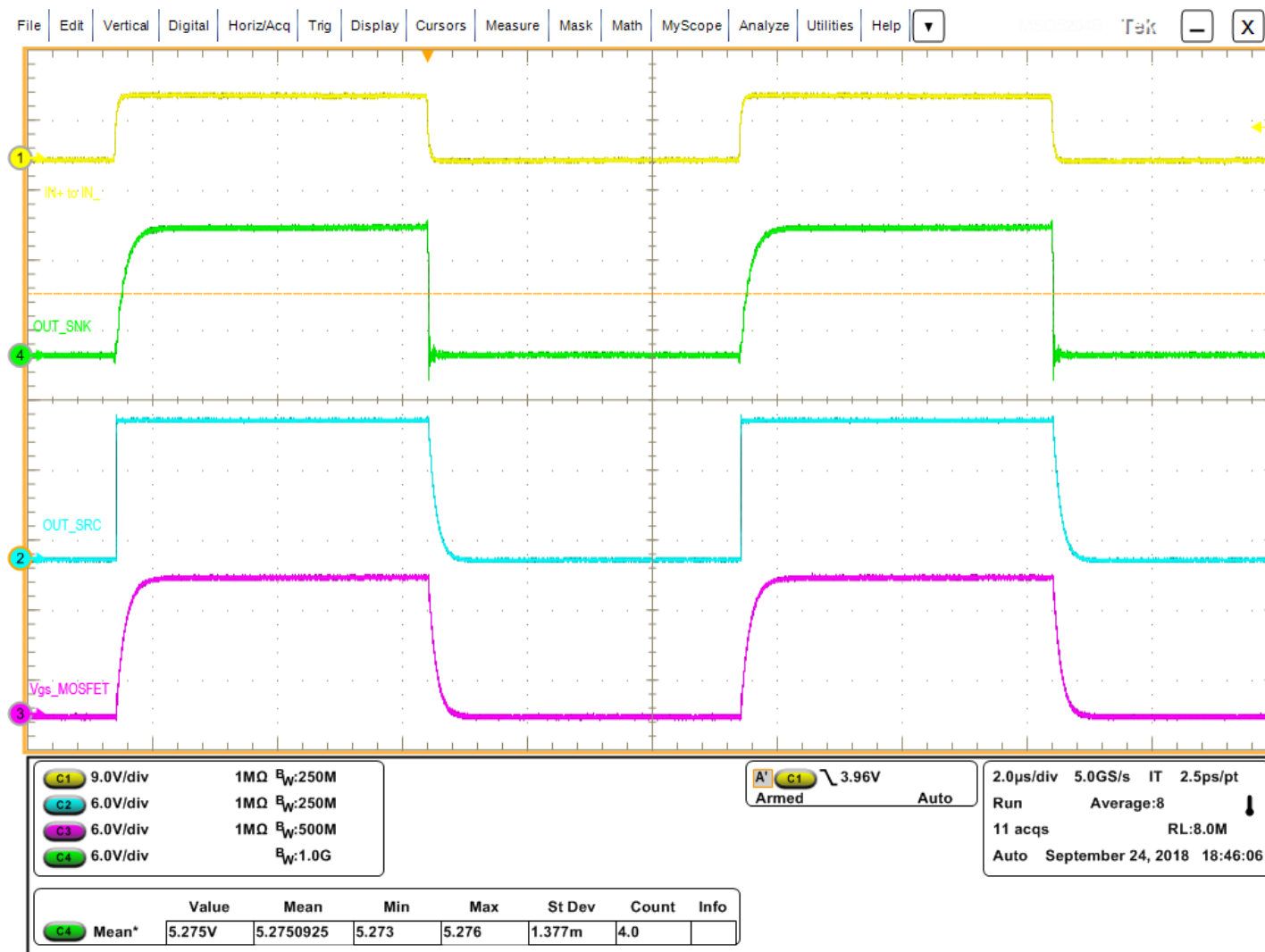


Instrumentation for signals evaluation

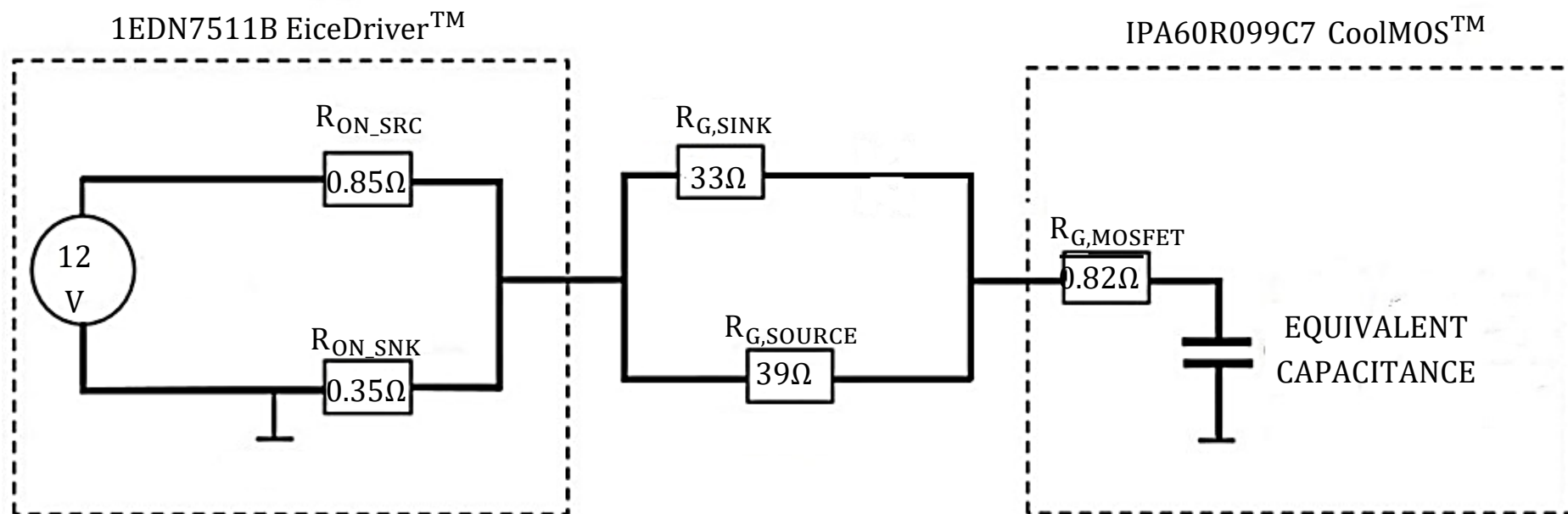


- Voltage probes used: Tetronix TPP1000 1GHz, 3.9pF

Oscilloscope waveforms



Equivalent model of the driving circuit



C_{LOAD} calculation for IPA60R099C7

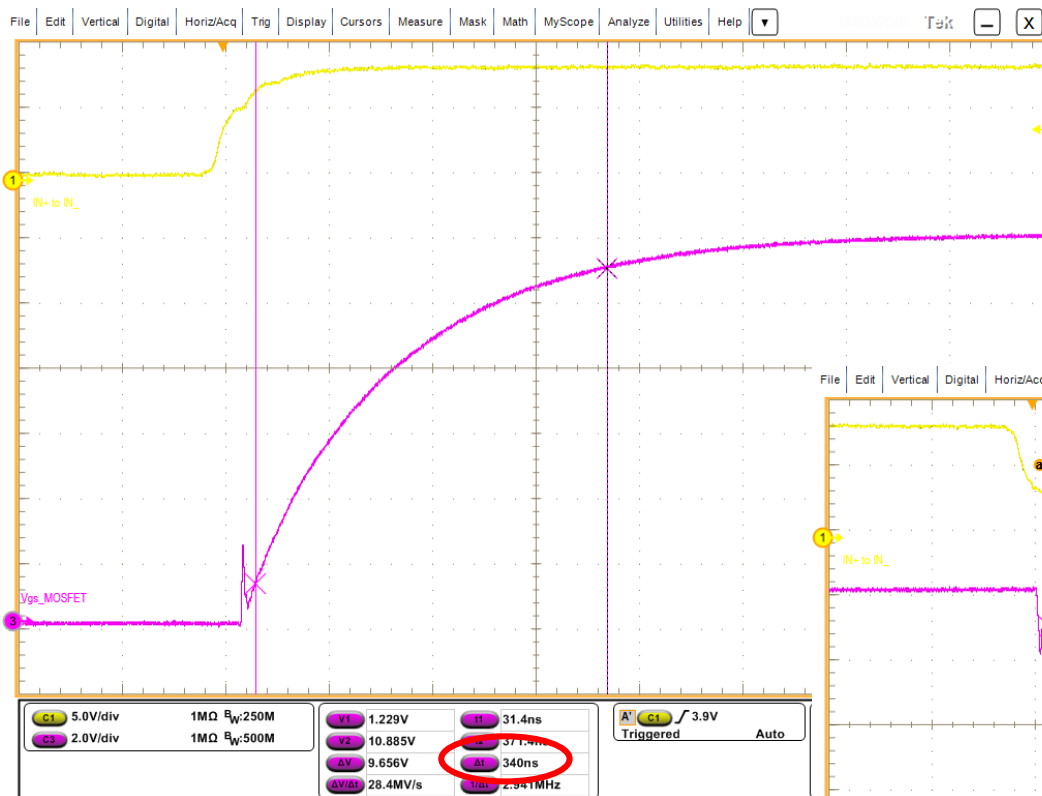


Gate to drain charge	Q_{gd}	-	14	-	nC	$V_{DD}=400V, I_D=9.7A, V_{GS}=0 \text{ to } 10V$
Gate charge total	Q_g	-	42	-	nC	$V_{DD}=400V, I_D=9.7A, V_{GS}=0 \text{ to } 10V$

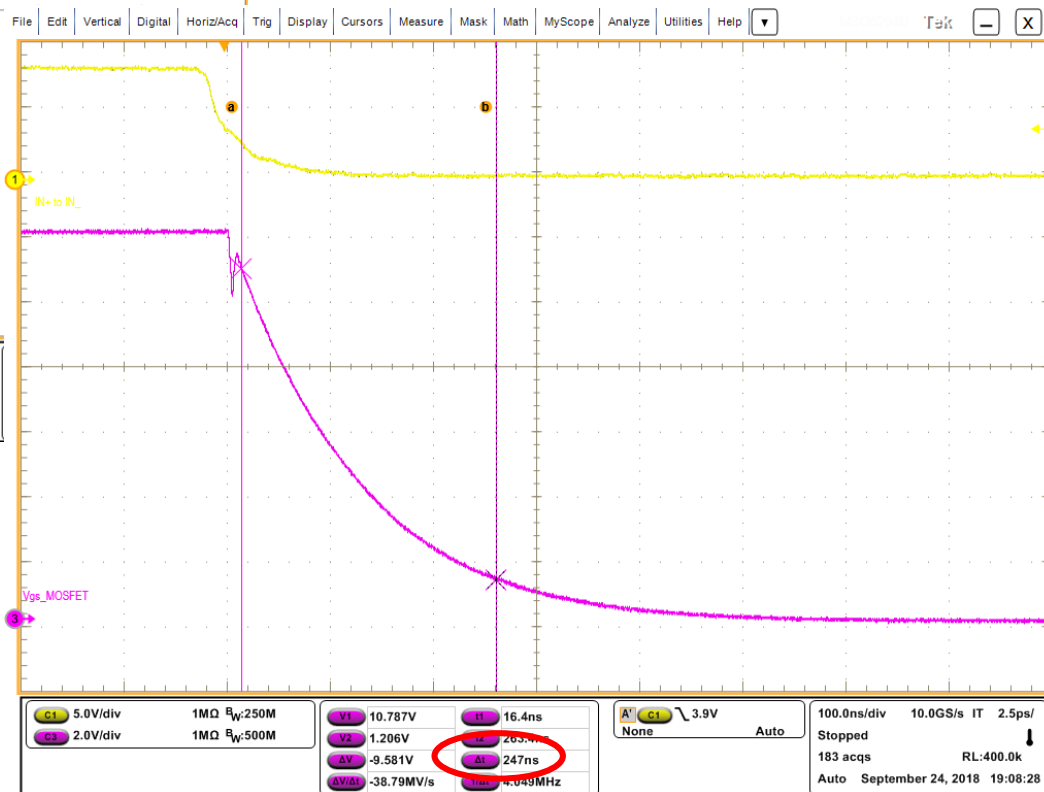
$$Q_{LOAD} = Q_g - Q_{gd} = 28 \text{ nC} \rightarrow C_{LOAD} = \frac{Q_{LOAD}}{V_{GS}} = 2.8 \text{ nF} \text{ for } V_{GS} = 10 \text{ V} \rightarrow$$

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

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

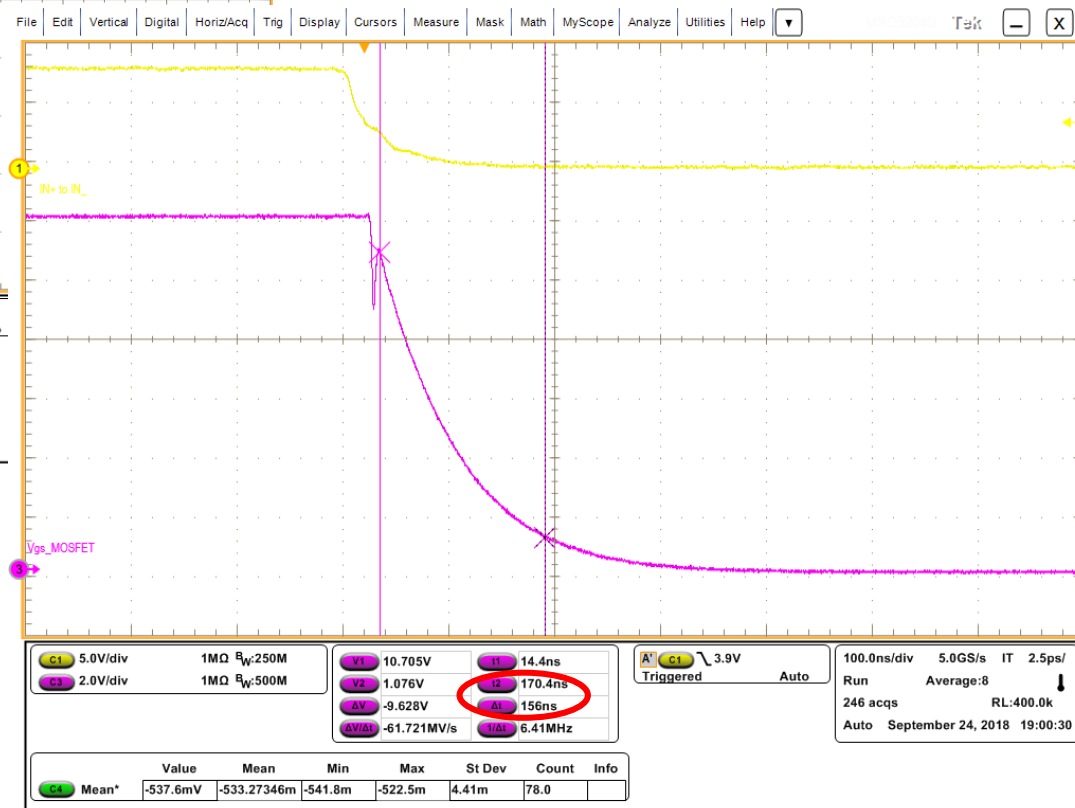
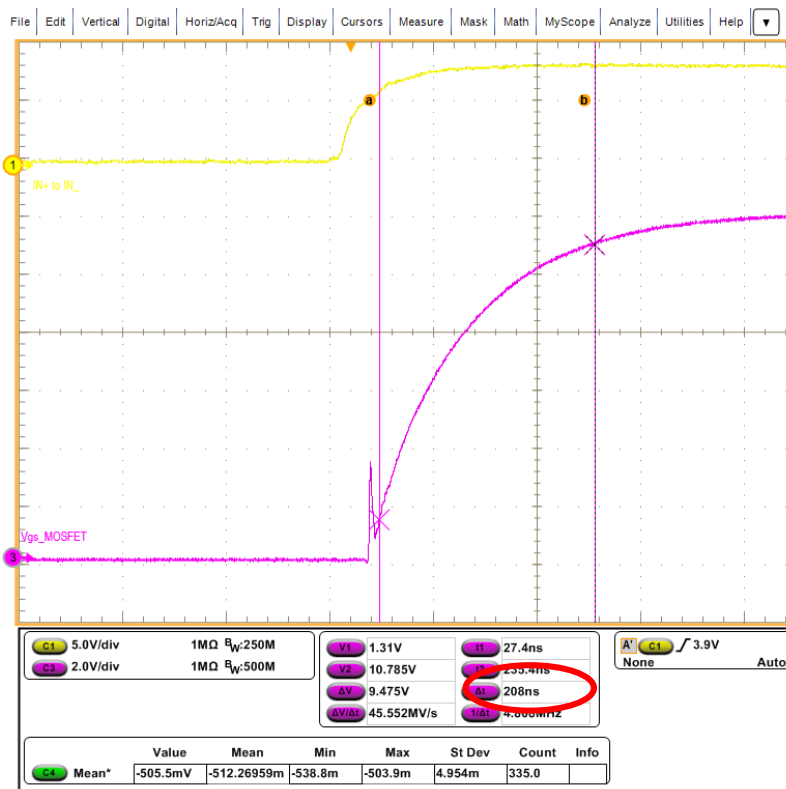
$$R_{G,SOURCE} = 24 \Omega$$

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

$$\text{MOSFET} = \text{IPA60R099C7}$$

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

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



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

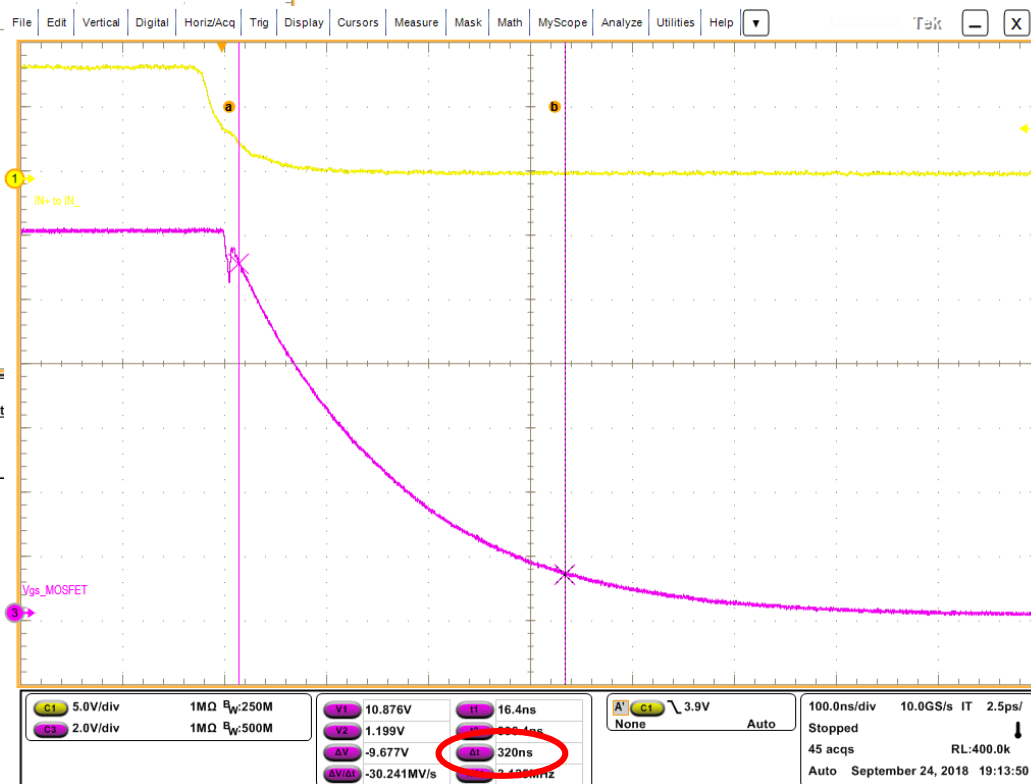
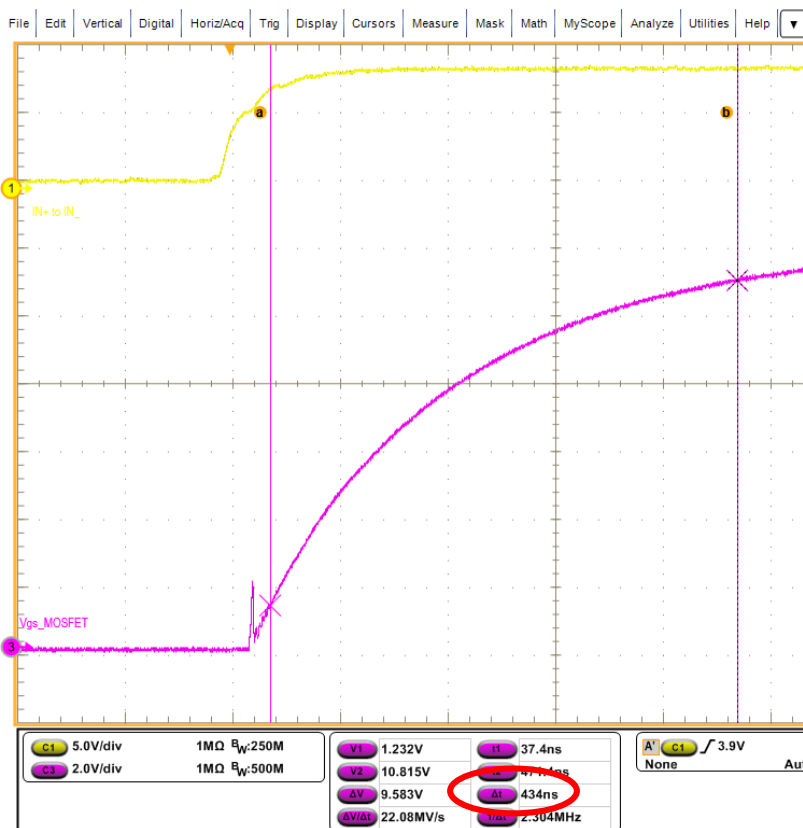
$$R_{G,SOURCE} = 51 \Omega$$

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

$$\text{MOSFET} = \text{IPA60R099C7}$$

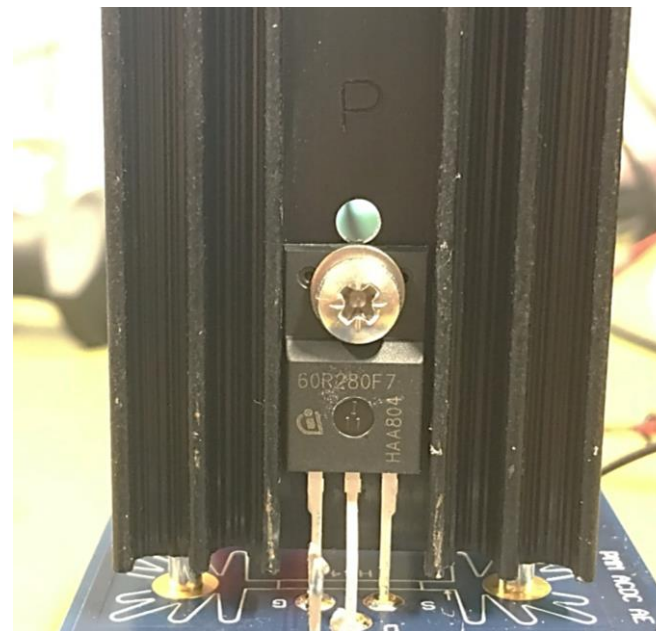
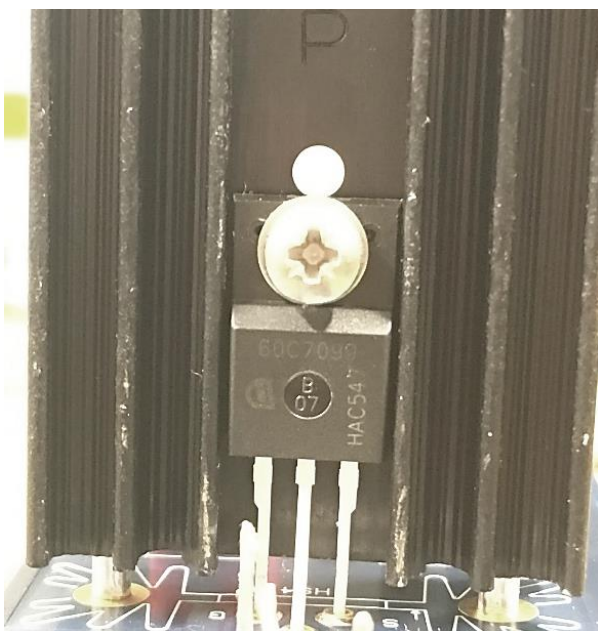
$$R_{G,MOSFET} = 0.82 \Omega$$

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



MOSFET Replacement

IPA60R099C7 → IPA60R280CFD7



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

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

Rise/fall times: New MOSFET

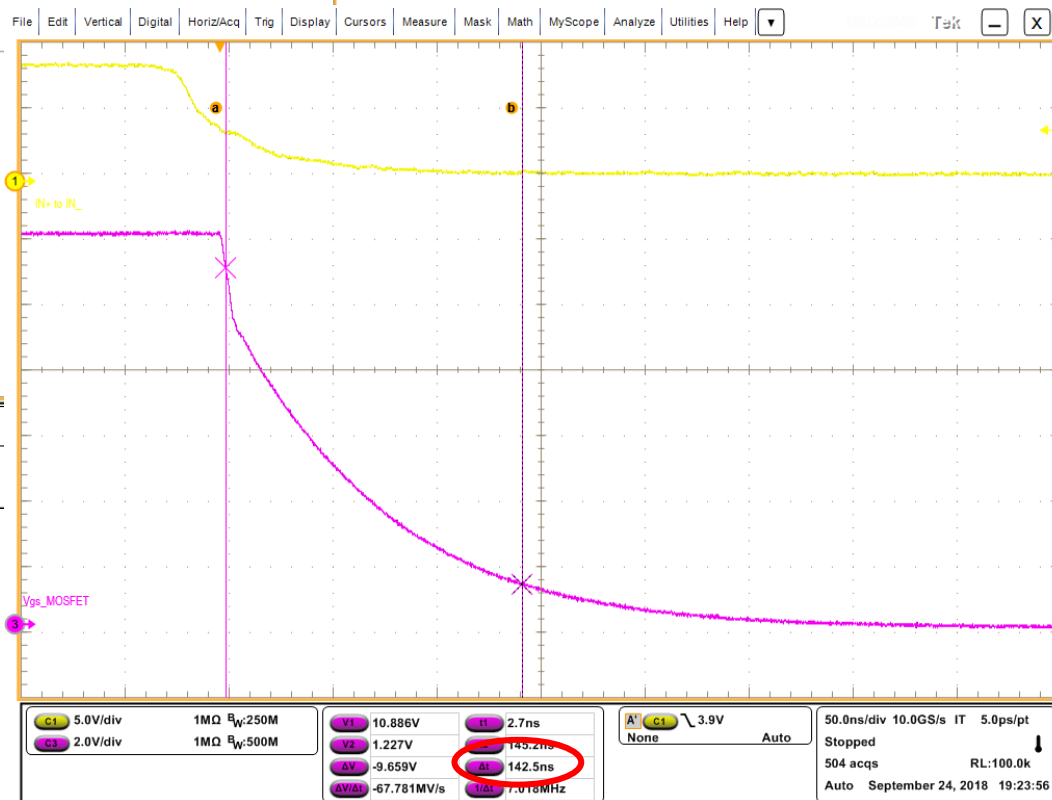
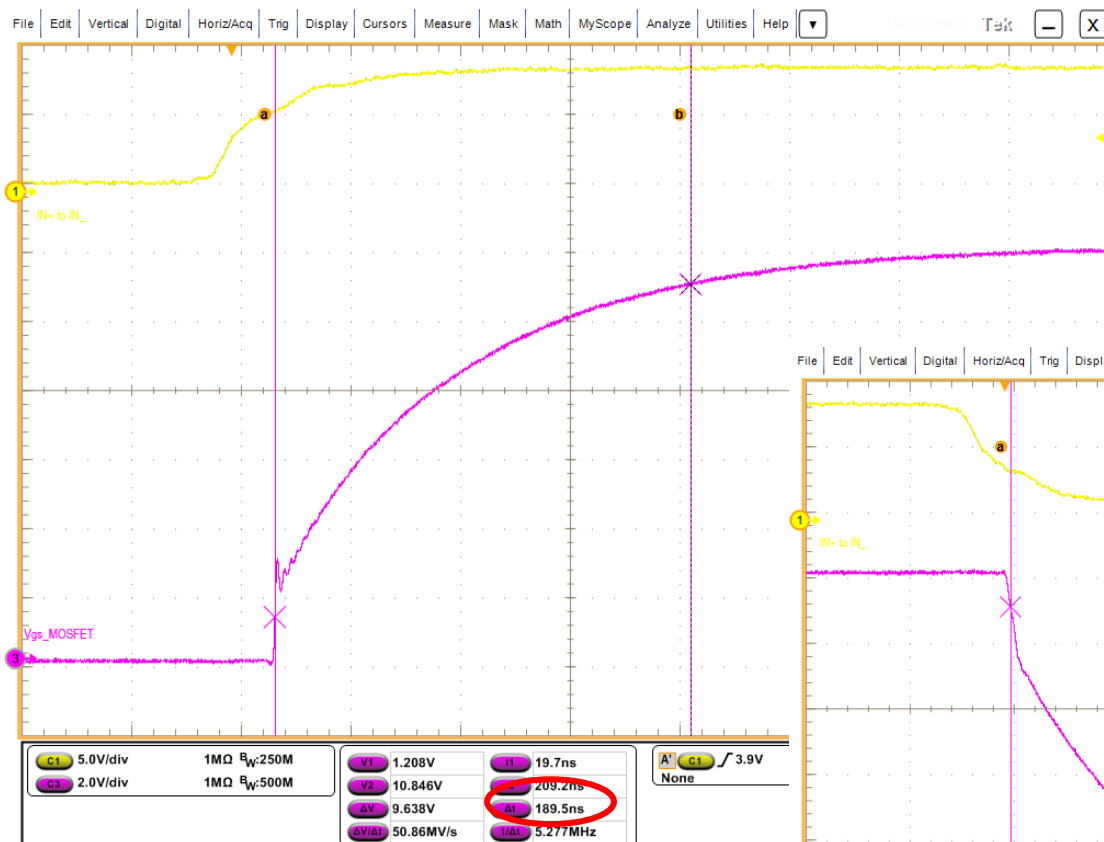
$$R_{G,SOURCE} = 51 \Omega$$

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

$$\text{MOSFET} = \text{IPA60R280CFD7}$$

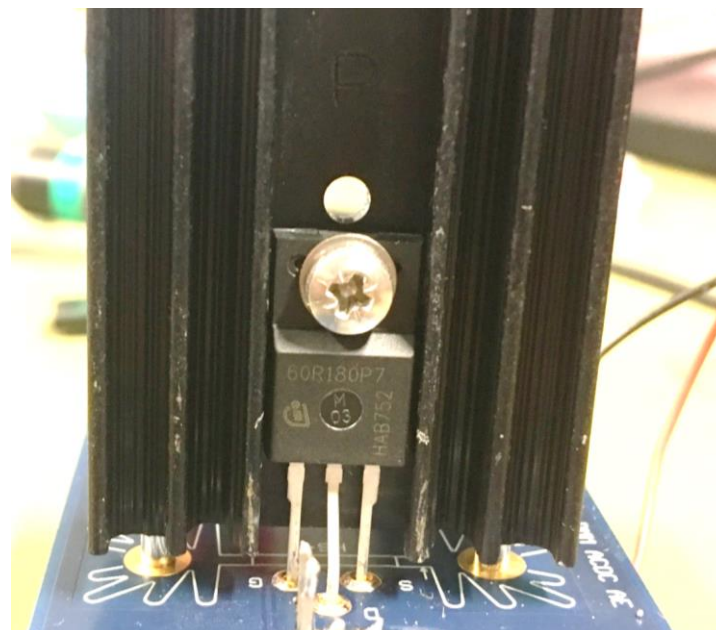
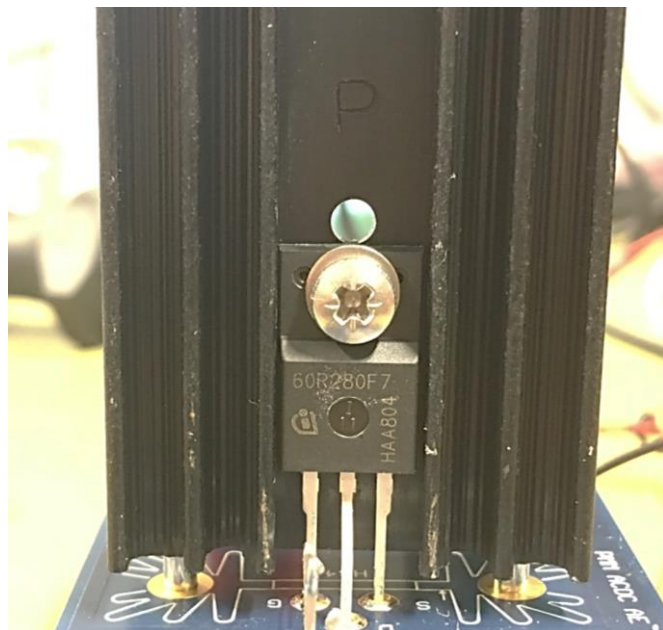
$$R_{G,MOSFET} = 11 \Omega$$

$$C_{LOAD} \approx 1.3 \text{ nF}$$



MOSFET replacement

IPA60R280CFD7 → IPA60R180P7

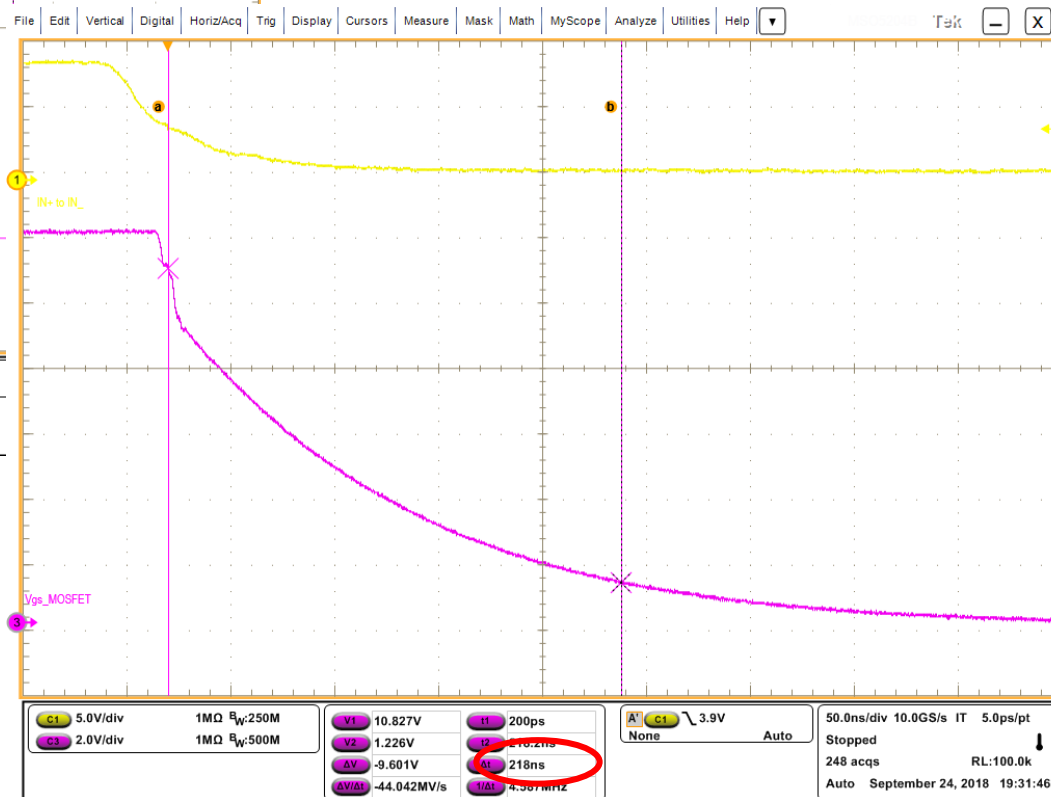
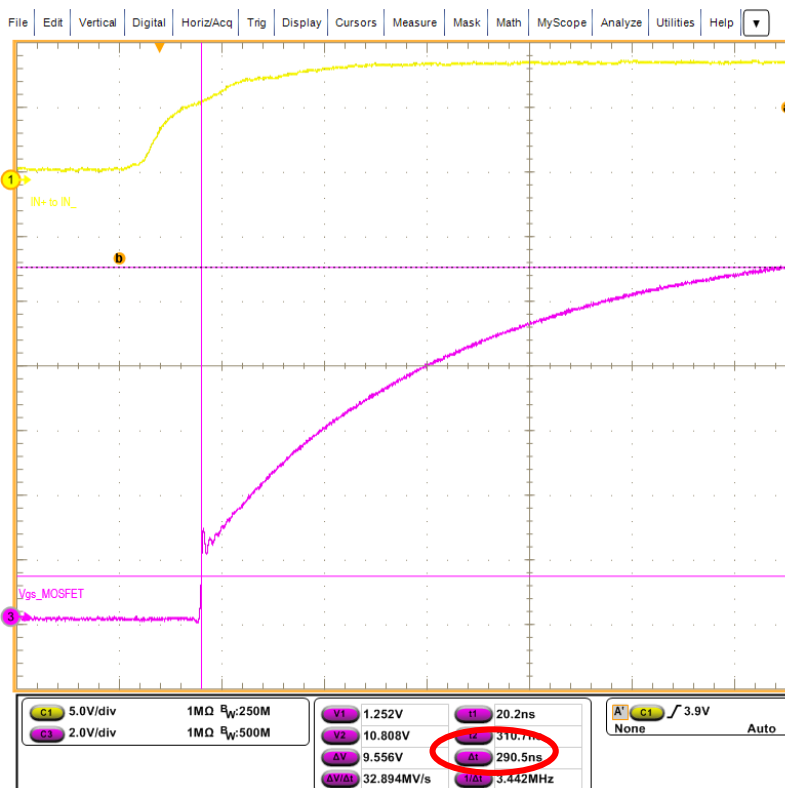


Gate to drain charge	Q_{gd}	-	8	-	nC	$V_{DD}=400V, I_D=5.6A, V_{GS}=0 \text{ to } 10V$
Gate charge total	Q_g	-	25	-	nC	$V_{DD}=400V, I_D=5.6A, V_{GS}=0 \text{ to } 10V$

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

Rise/fall times: New MOSFET

$R_{G,SOURCE} = 51 \Omega$
 $R_{G,SINK} = 43 \Omega$
MOSFET = IPA60R180P7
 $R_{G,MOSFET} = 11 \Omega$
 $C_{LOAD} \approx 1.9 \text{ nF}$



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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