# Quick start guide KIT_DRIVER_1EDN7511B

# KIT_DRIVER_1EDN7550B





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# Included in this kit



Heatsink for
TO-220 MOSFET

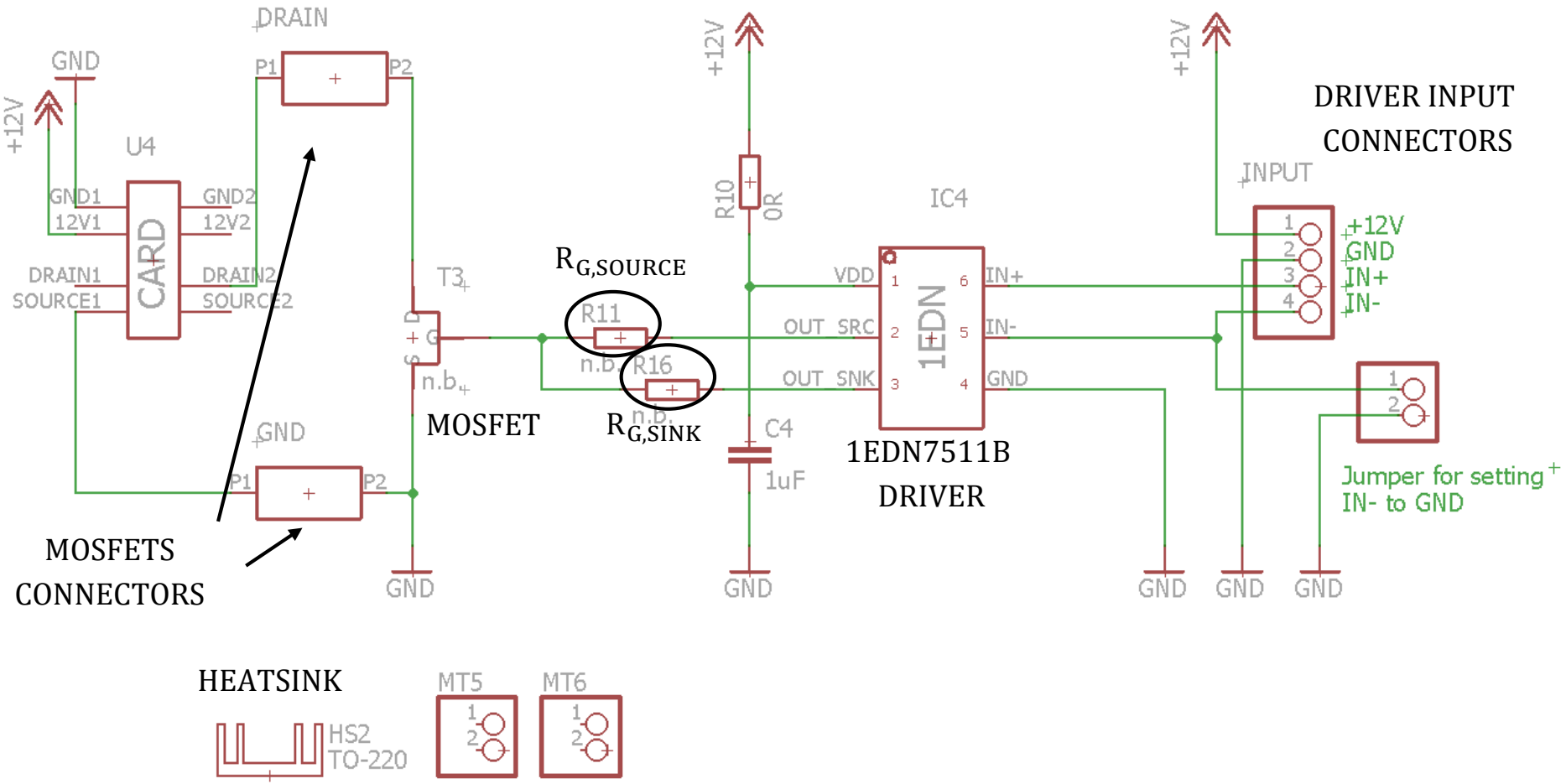
Evaluation kit
KIT_DRIVER_1EDN7511B





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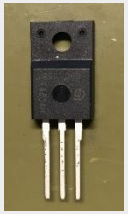
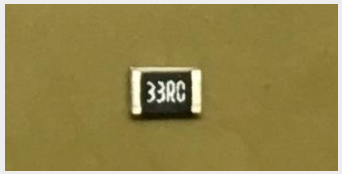
# Board schematic





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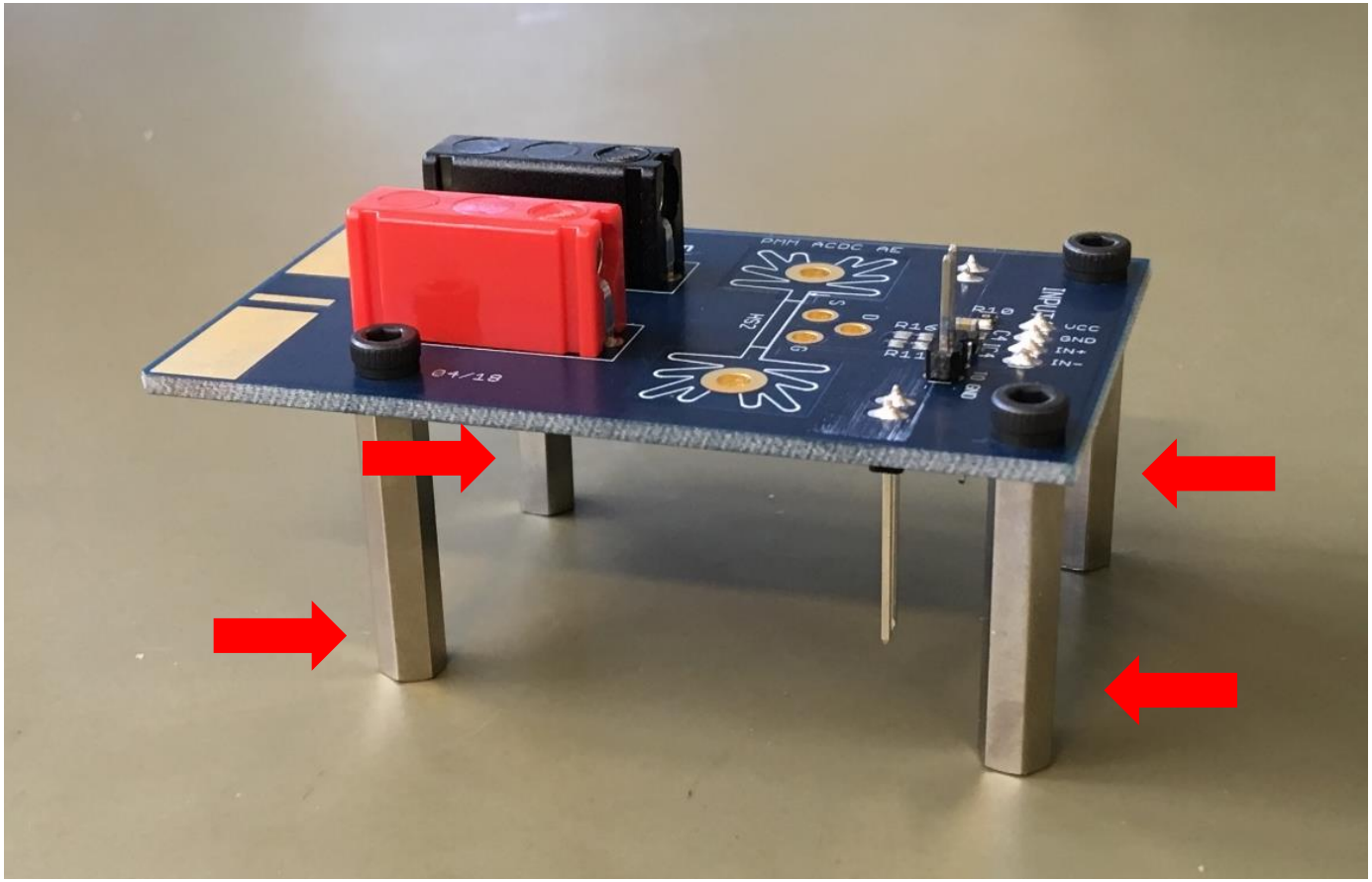
# Components to add – BOM suggestion

| 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 |


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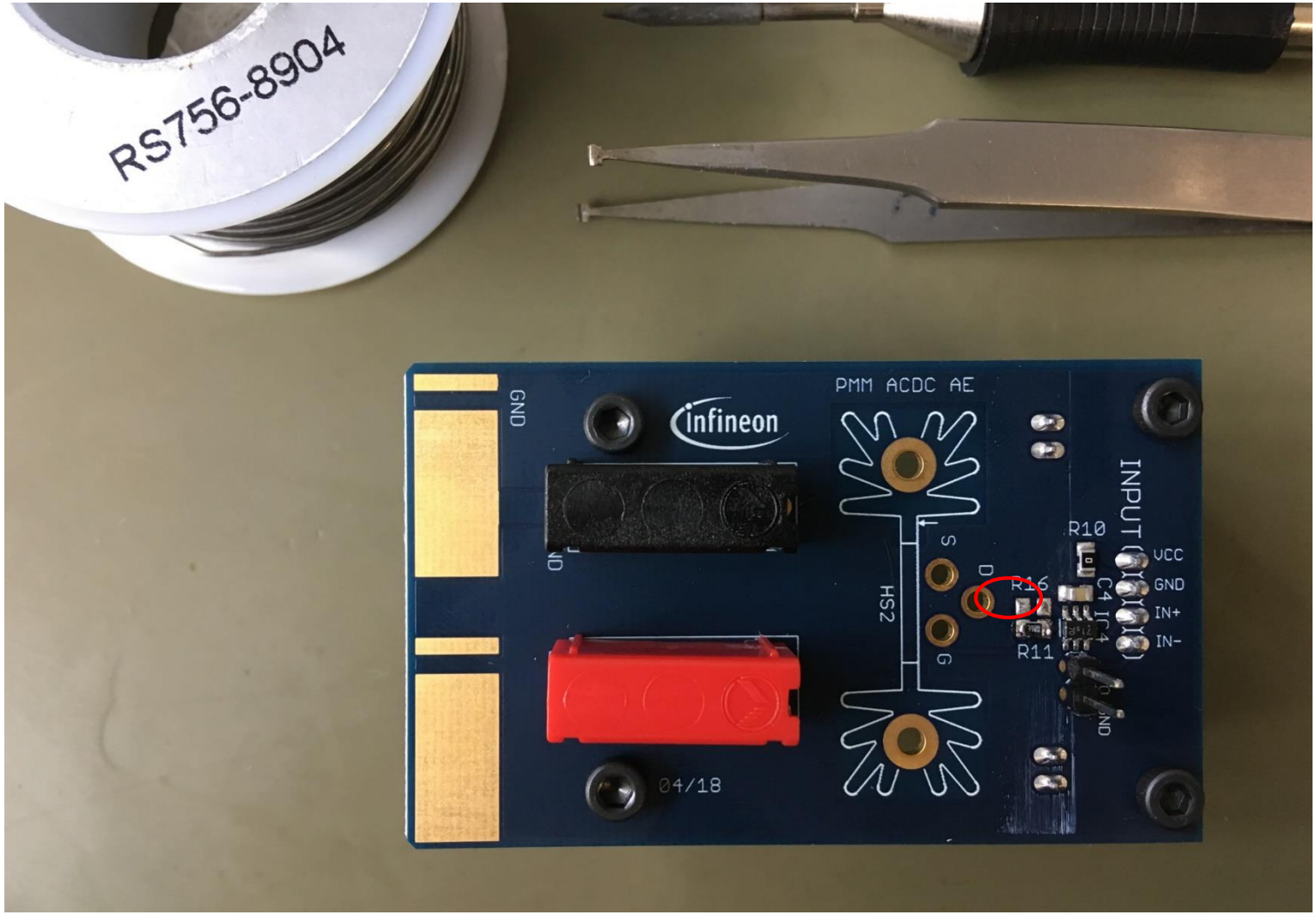
# Step 1: Distance bolts mounting





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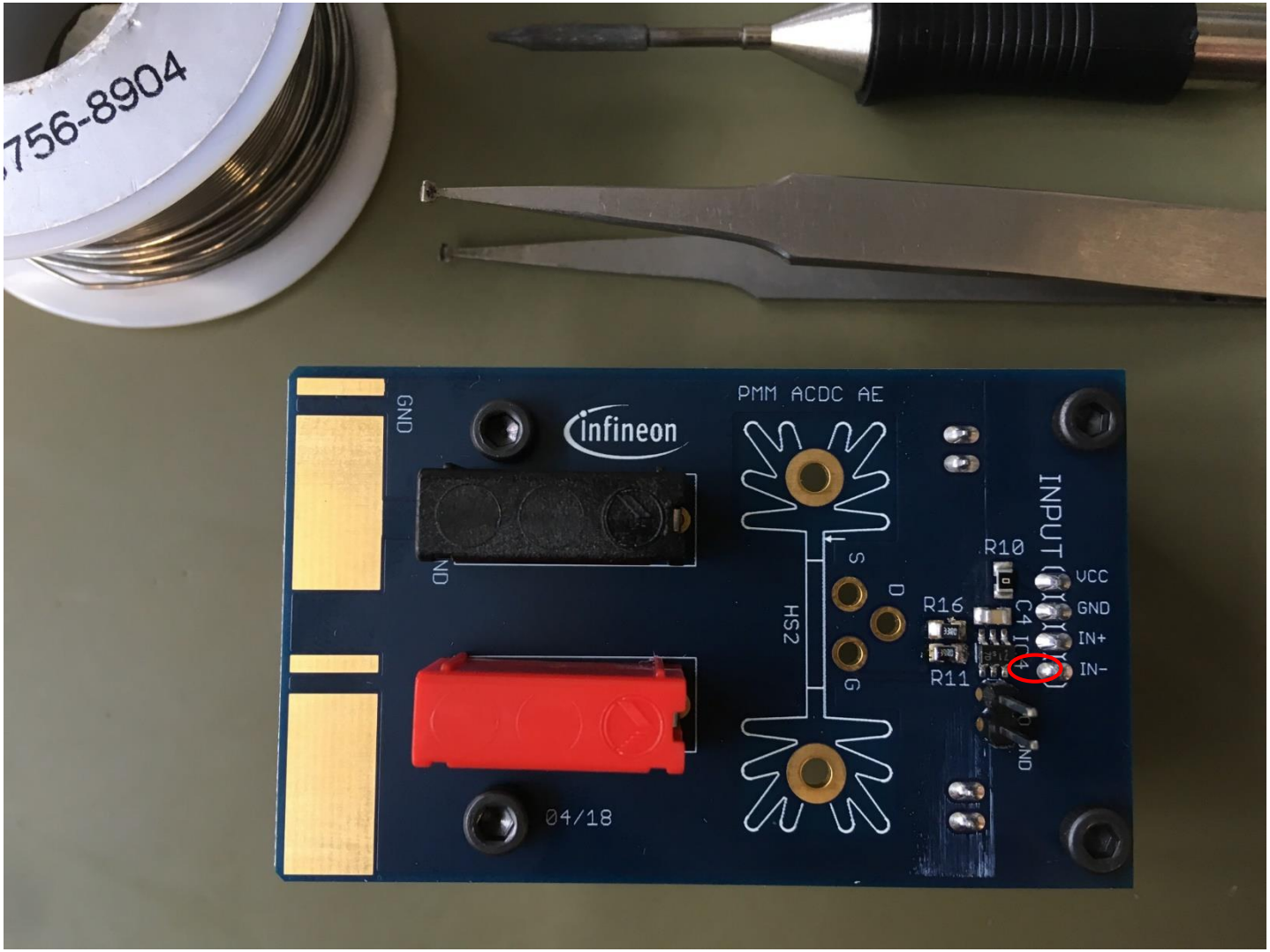
# Step 2: Source resistor soldering





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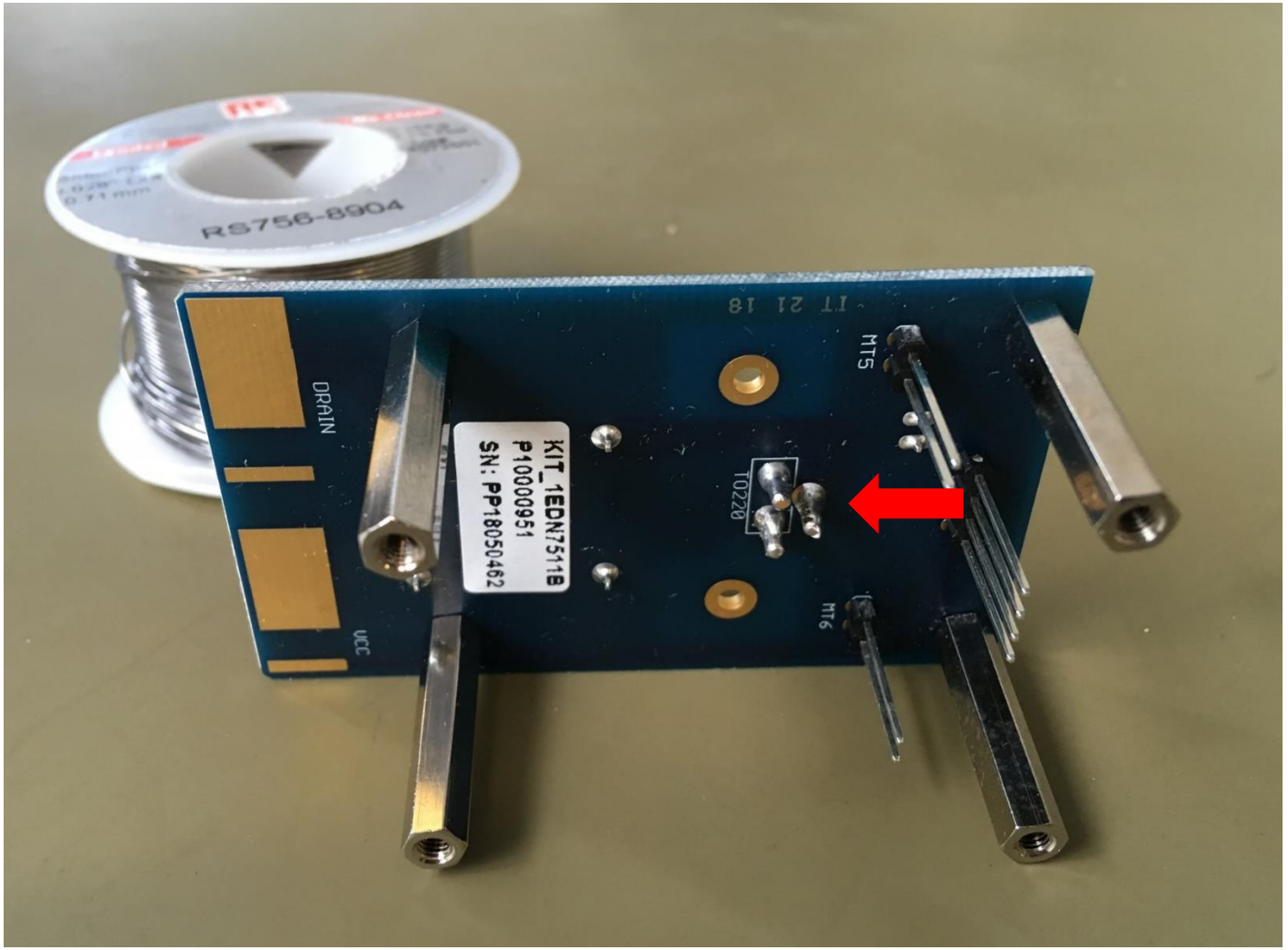
# Step 3: Sink resistor soldering





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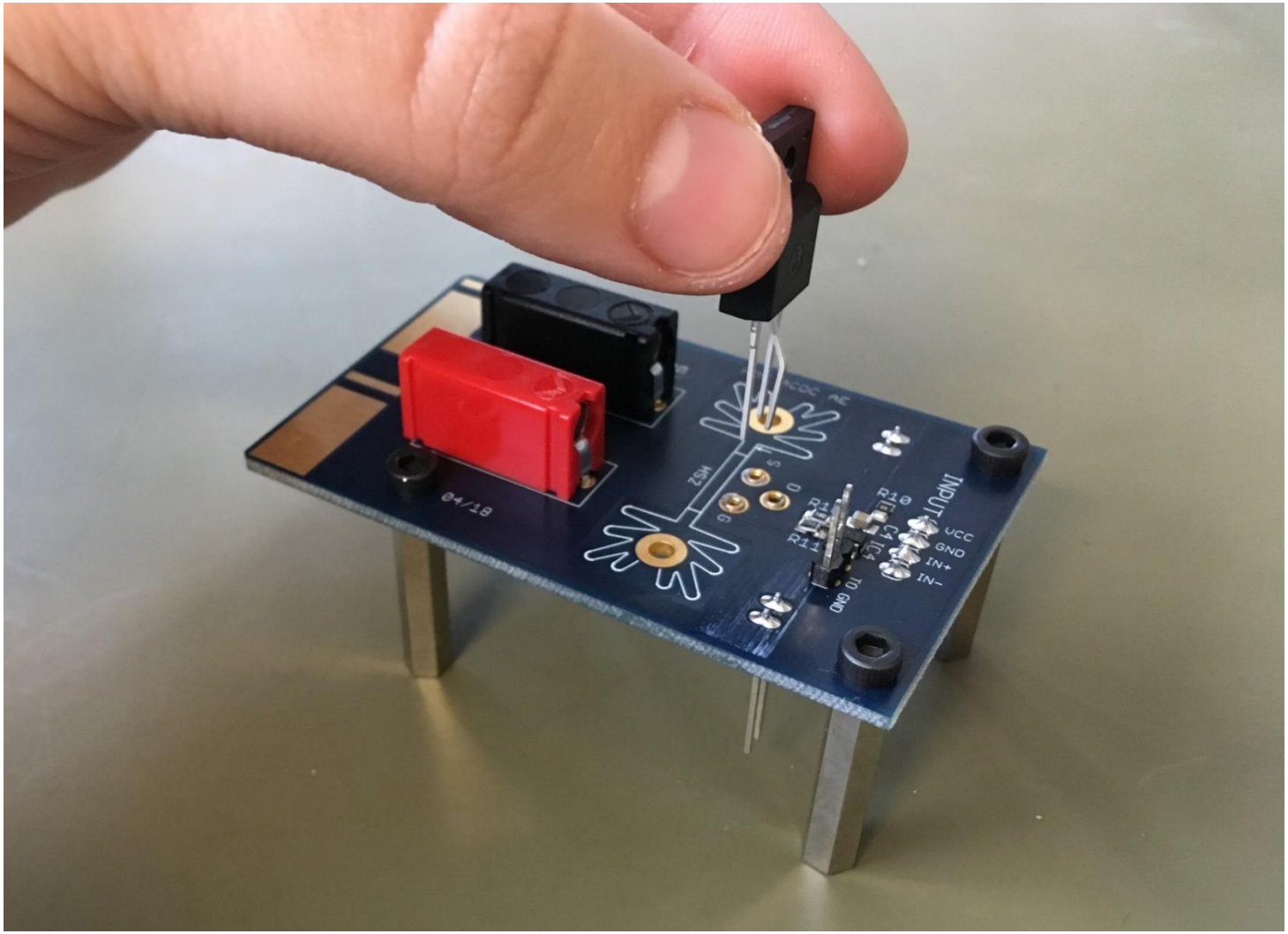
# Step 4: TO-220 sockets soldering





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# Step 5: MOSFETs placement into the sockets

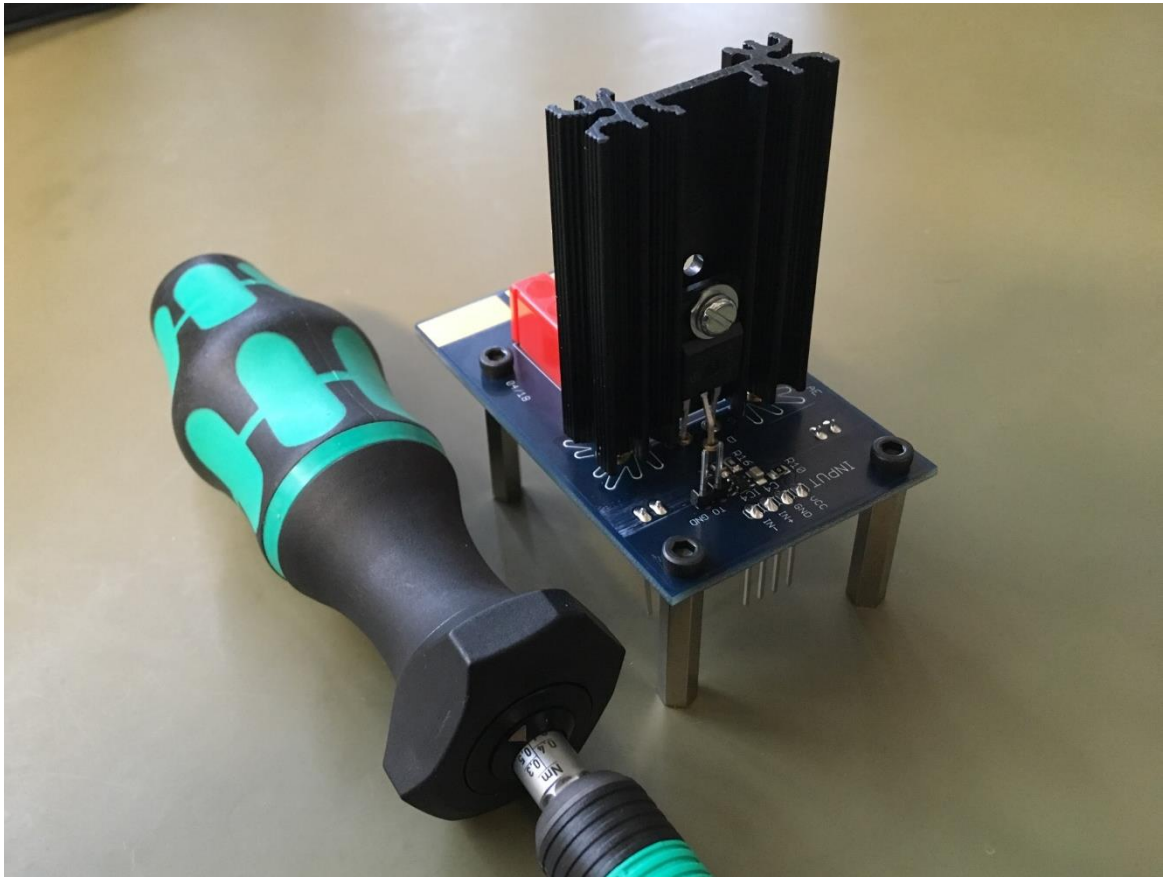




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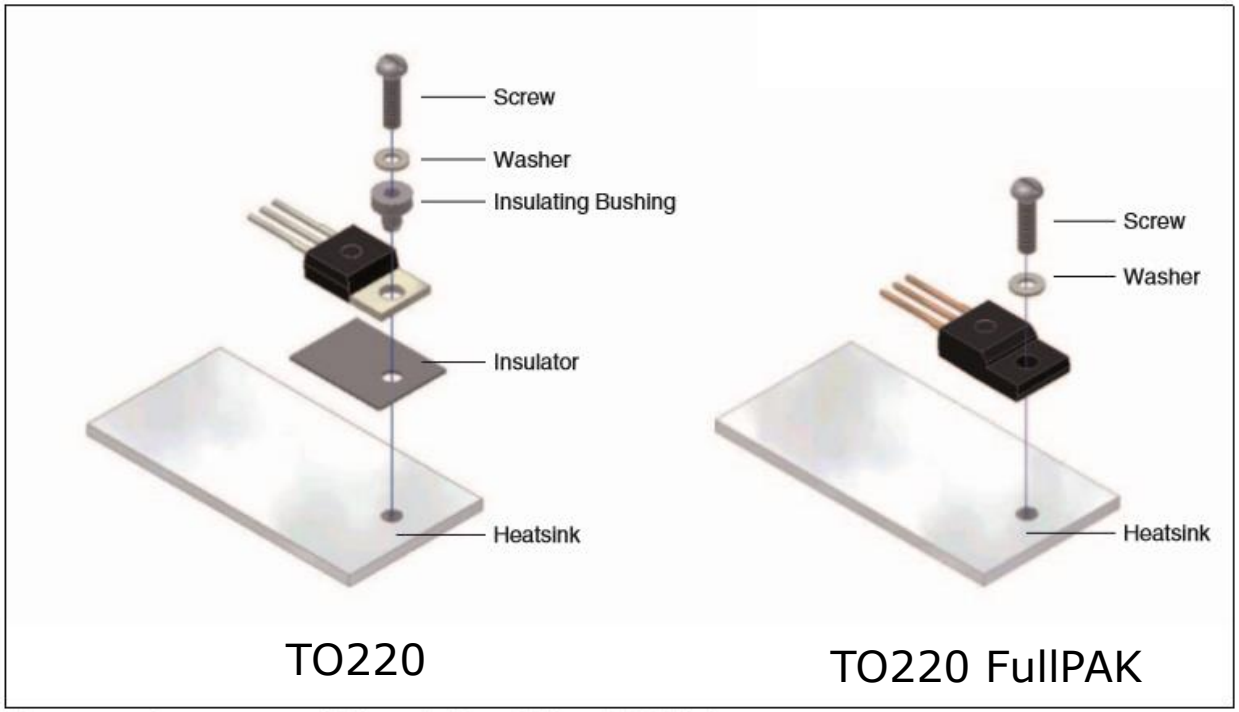
# Step 6: Heatsink mounting (optional)

- 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




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# TO-220 MOSFET mounting to the heatsink



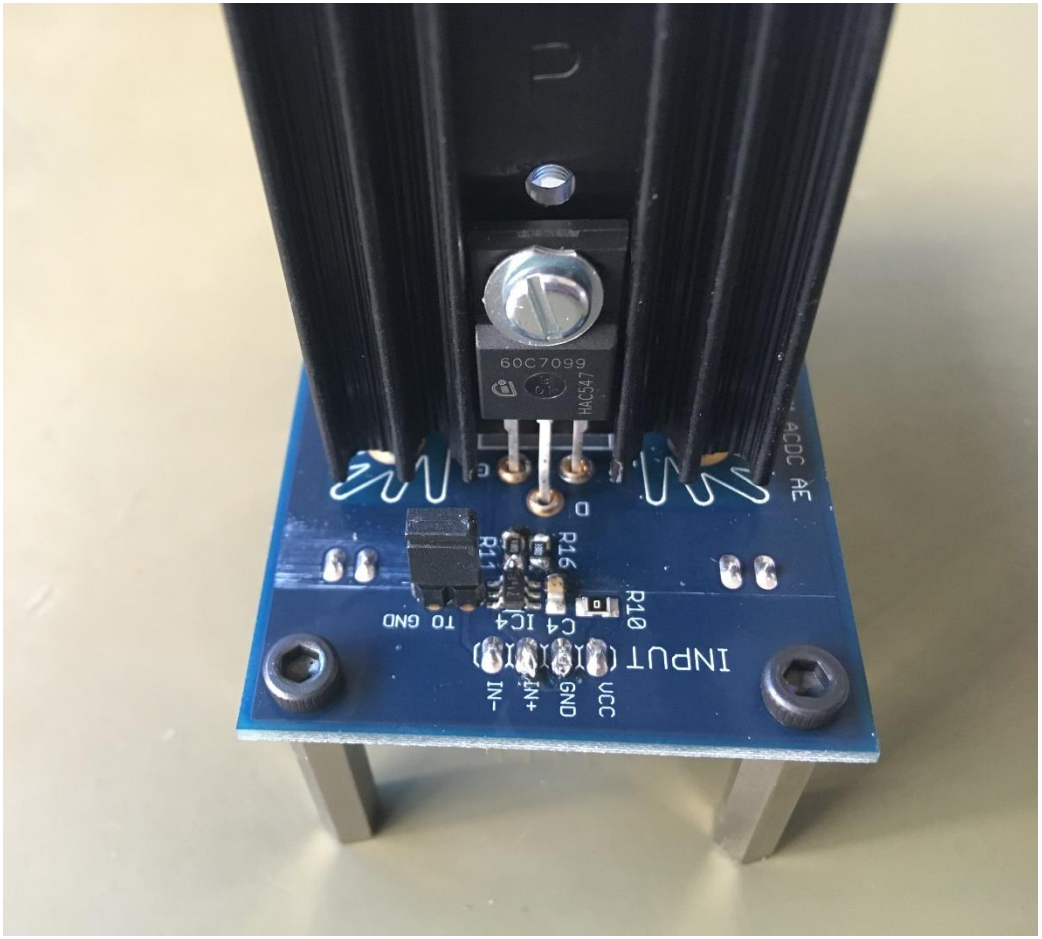

TO220 TO220 FullPAK

| 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


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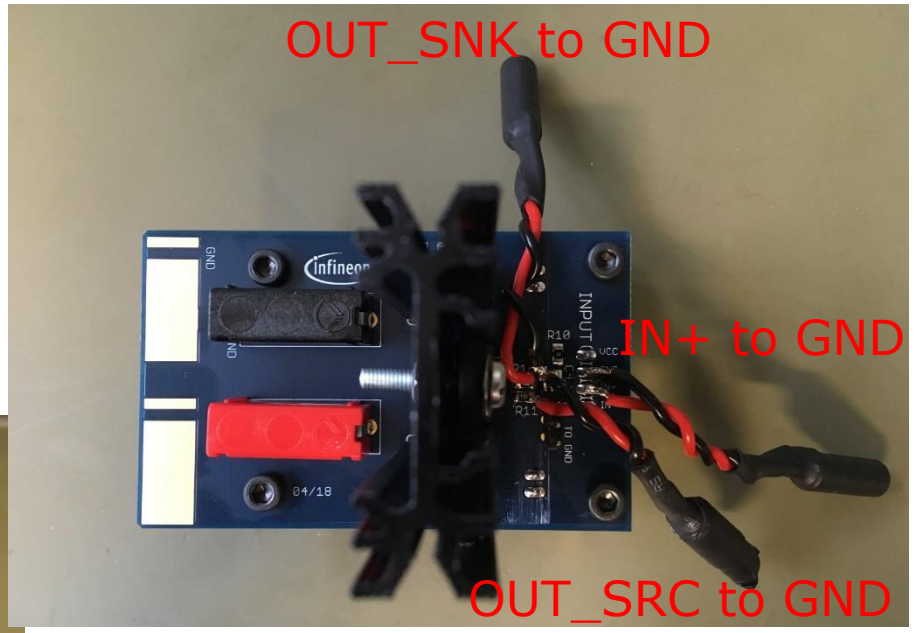
# Step 7: IN- jumper connection




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


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# Step 8: BNC connectors soldering

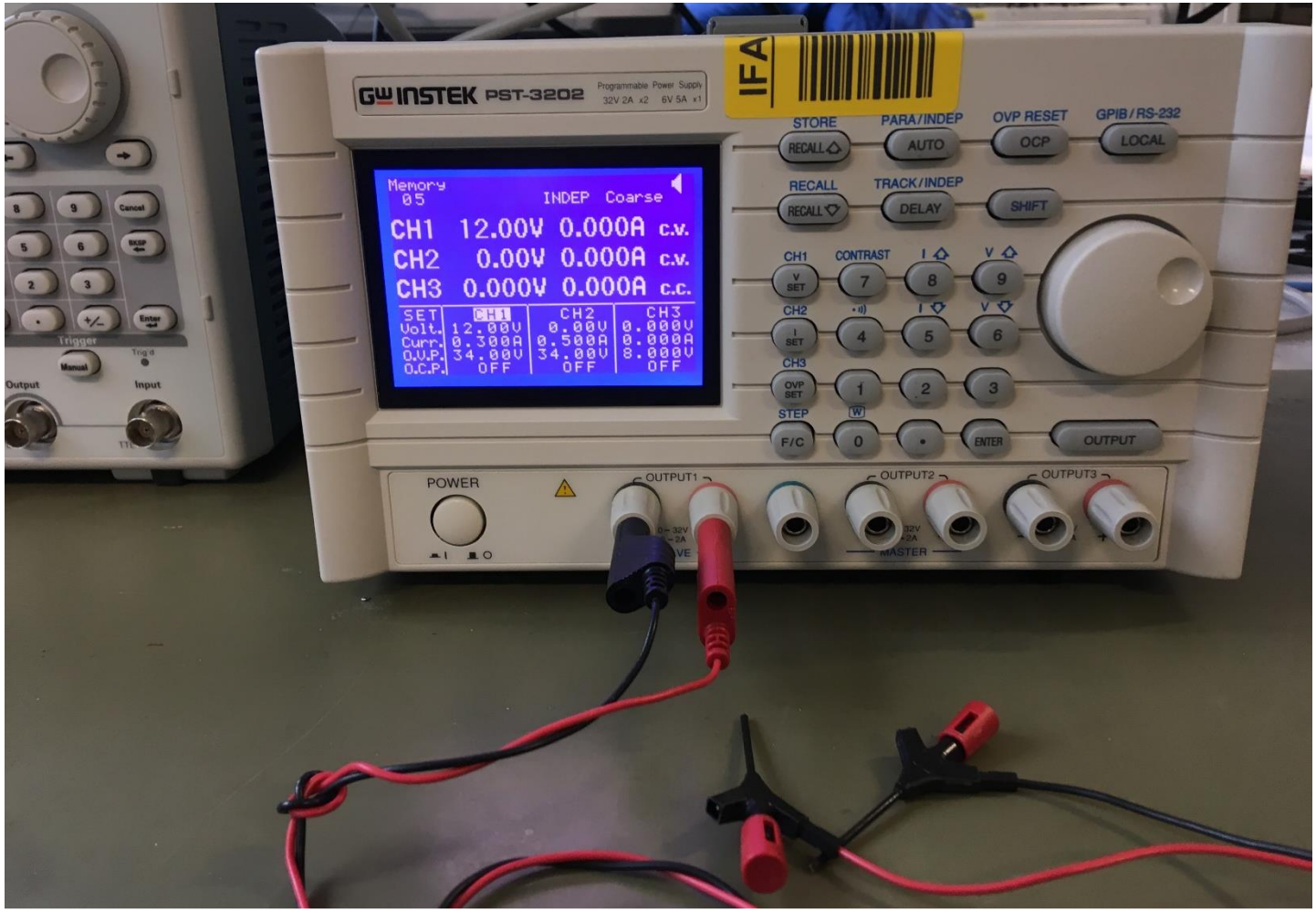







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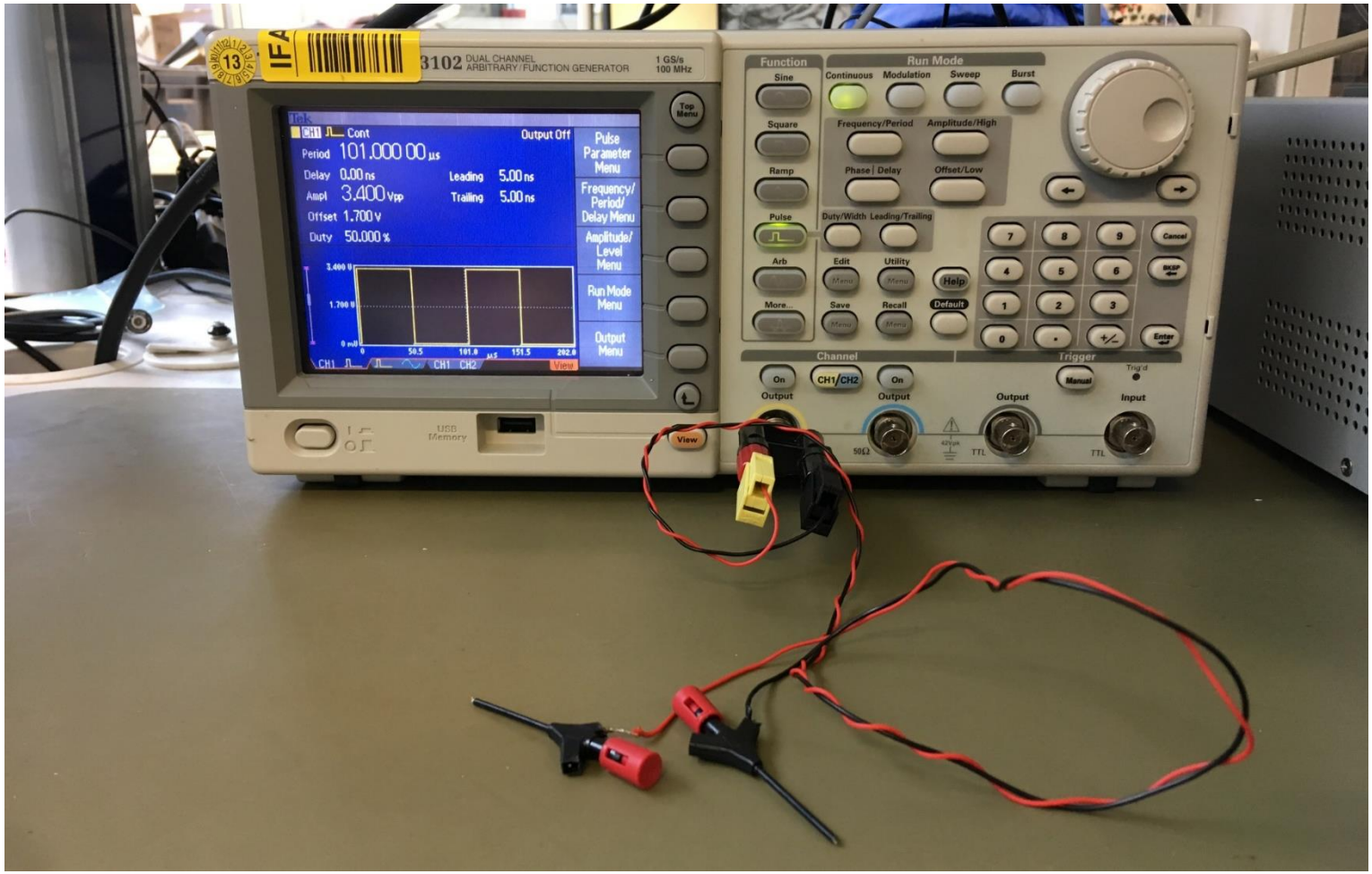
# Instrumentation for driver supply generation




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


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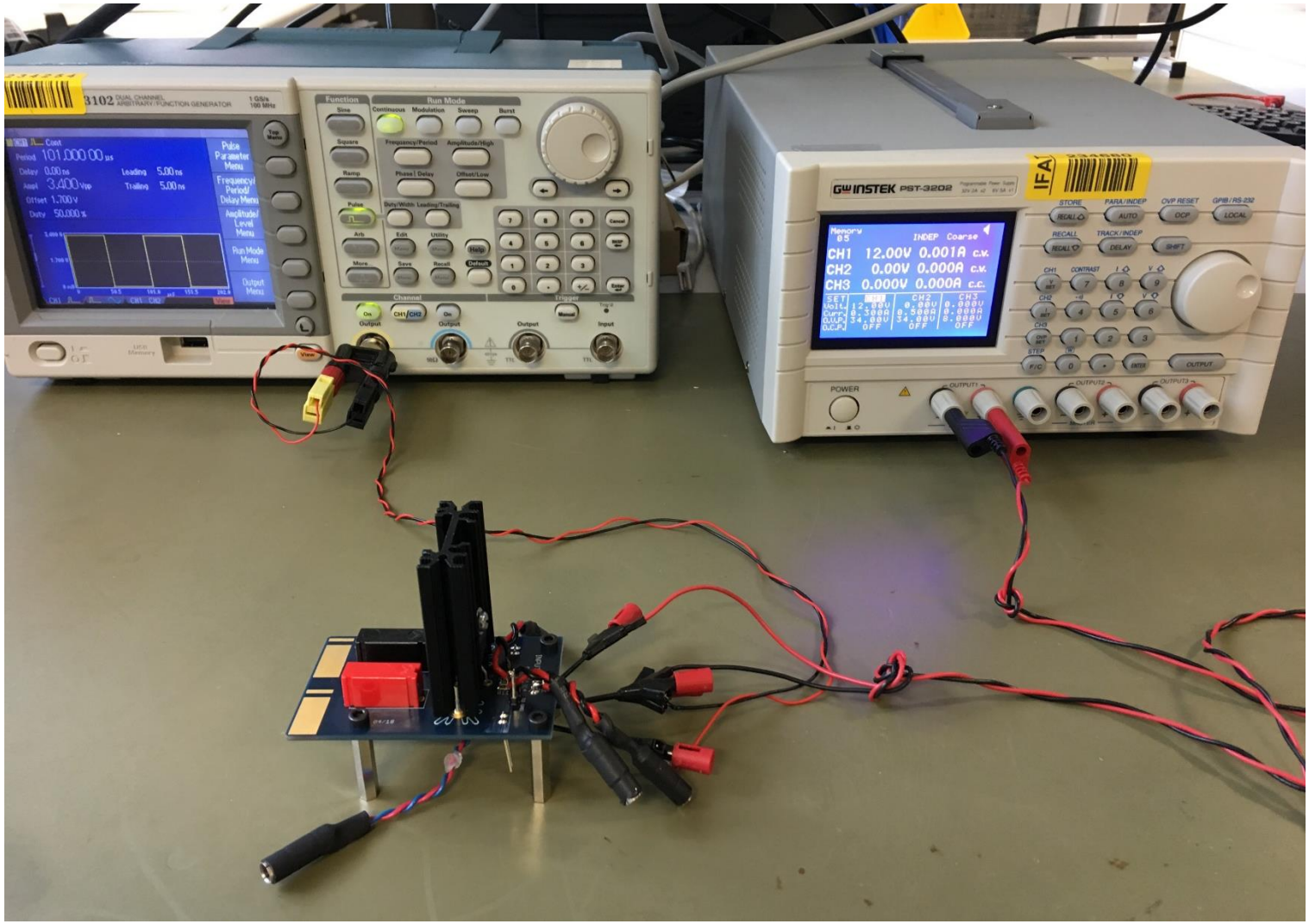
# Instrumentation for PWM signals generation




- Use a function generator or a microcontroller


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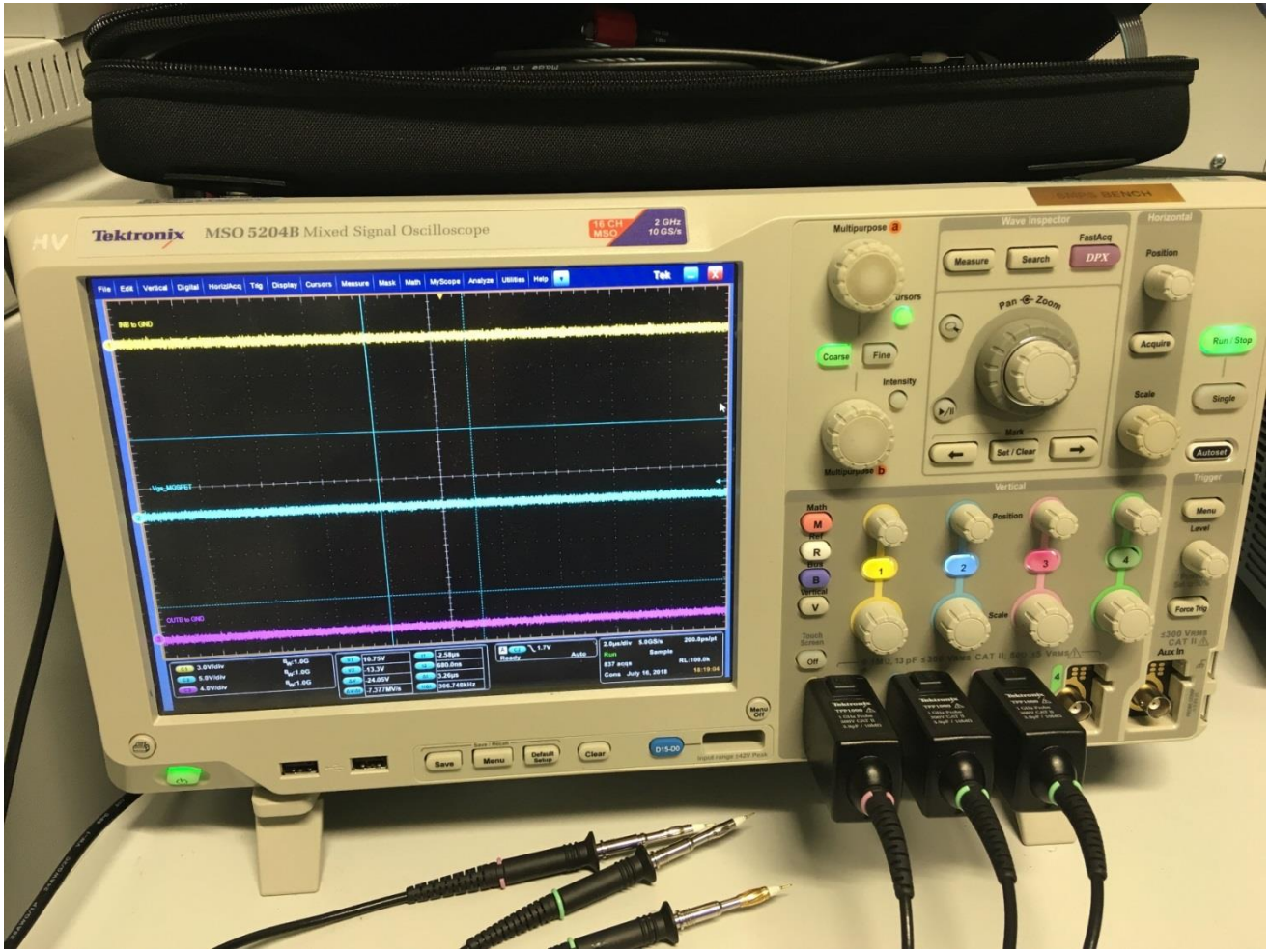
# Connections





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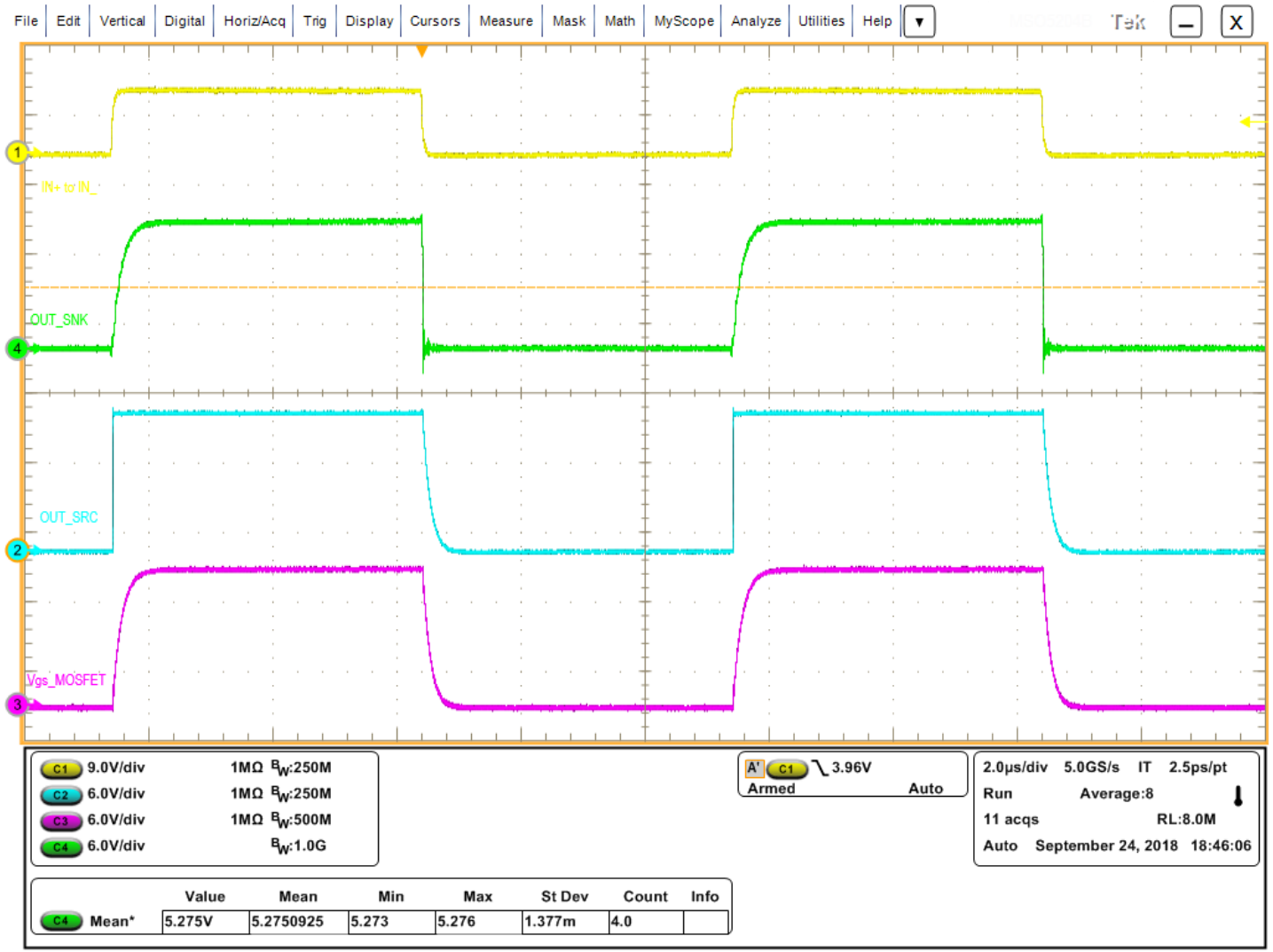
# Instrumentation for signals evaluation




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


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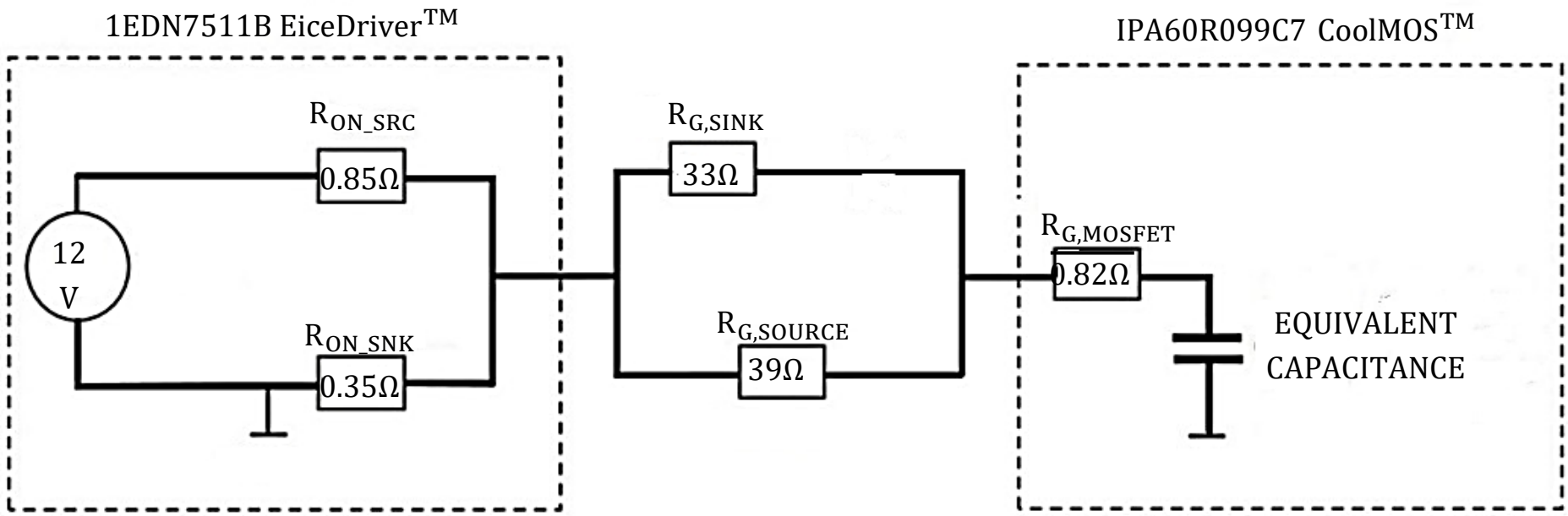
# Oscilloscope waveforms





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# Equivalent model of the driving circuit





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# $C_{LOAD}$ calculation for IPA60R099C7



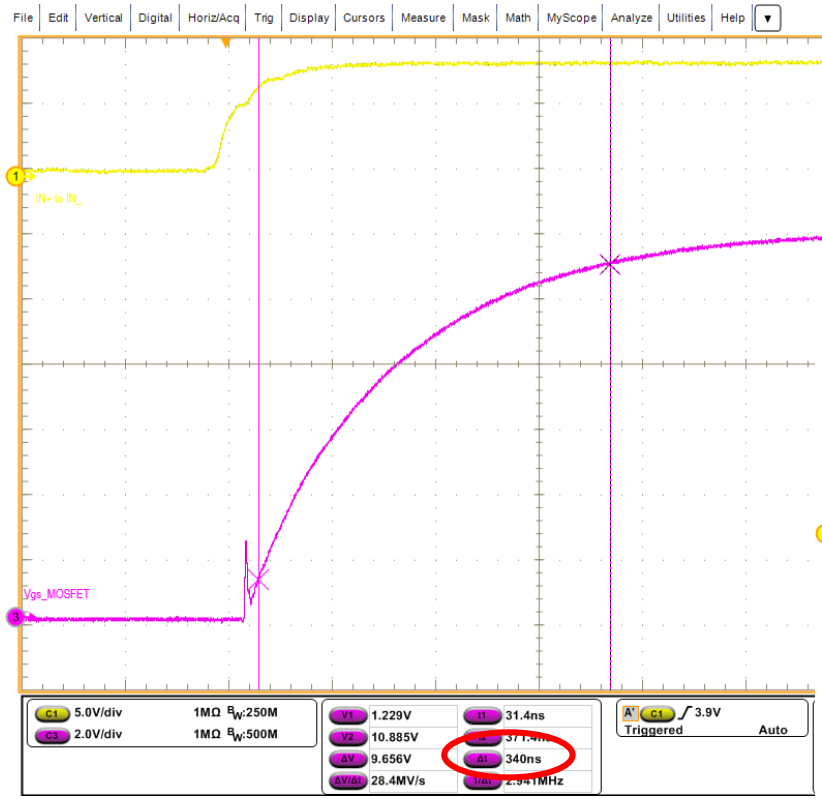

| | | | | | | |
|---|---|---|---|---|---|---|
| Gate to drain charge | $Q_{gd}$ | - | 14 | - | nC | $V_{DD}$=400V, $I_D$=9.7A, $V_{GS}$=0 to 10V |
| Gate charge total | $Q_g$ | - | 42 | - | nC | $V_{DD}$=400V, $I_D$=9.7A, $V_{GS}$=0 to 10V |

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

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


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# Rise/fall times



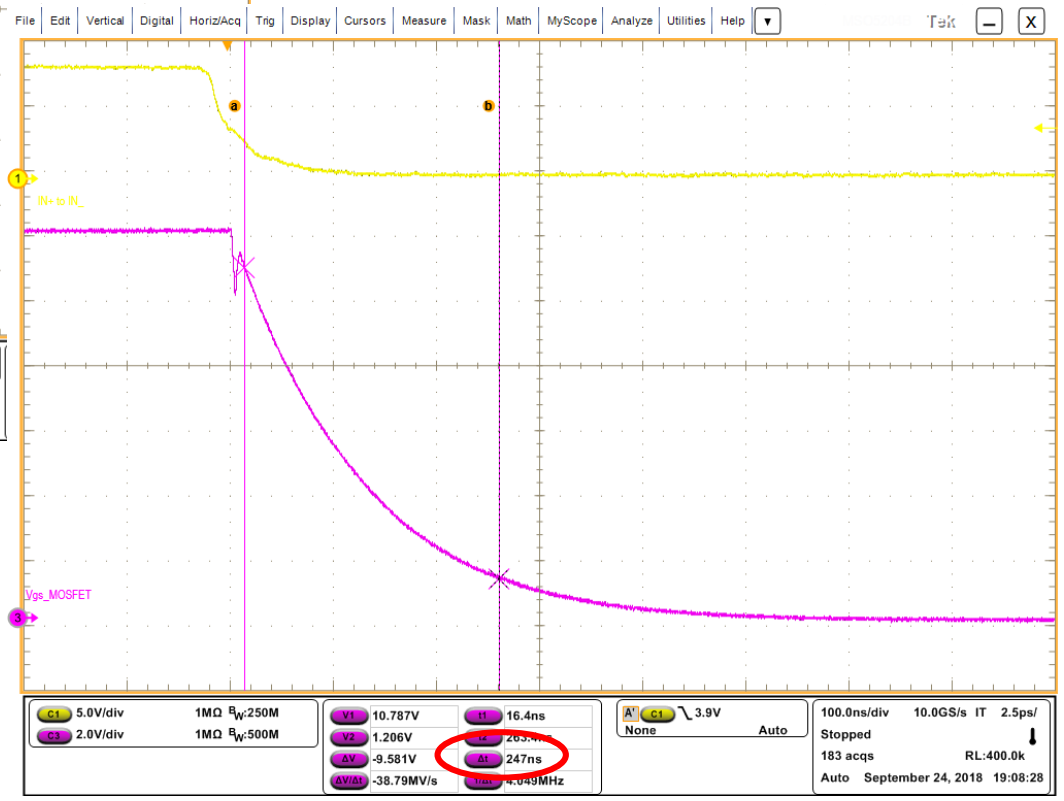

$R_{G,SOURCE} = 39\ \Omega$

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

$MOSFET = IPA60R099C7$

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

$C_{LOAD} \approx 2.8\ nF$





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# Gate resistors replacement

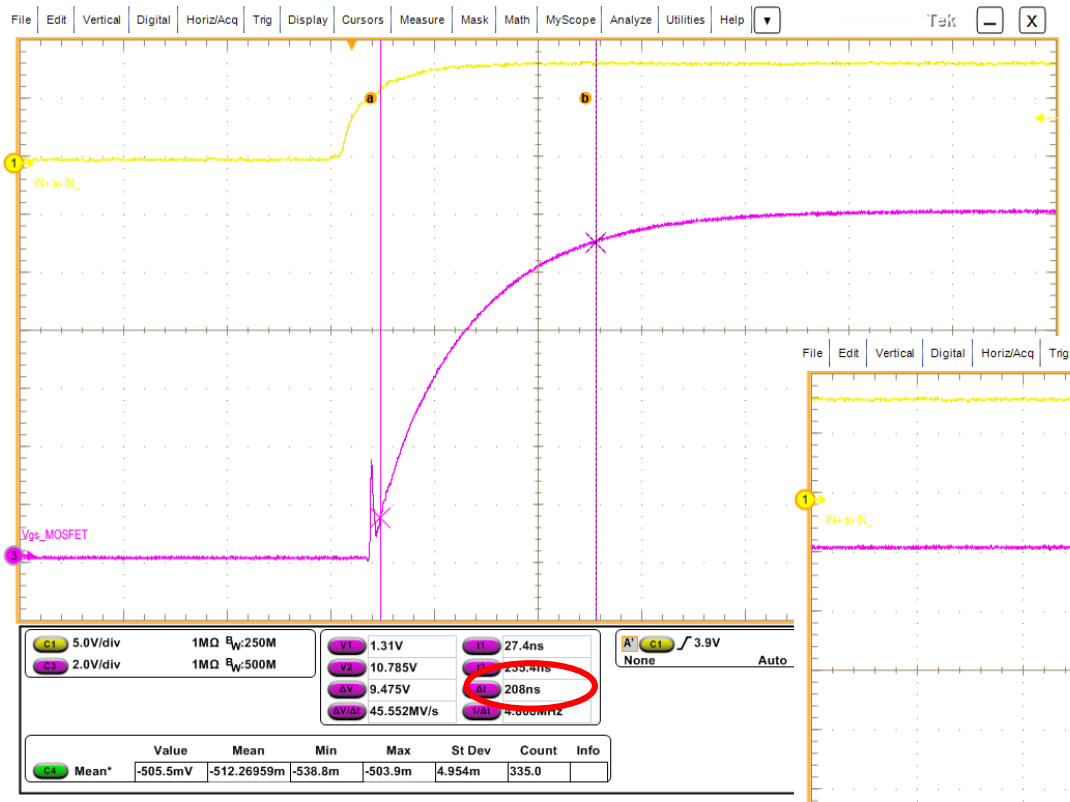
$$R_{G,SOURCE} = 39\ \Omega \quad \rightarrow \quad 24\ \Omega$$

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

MOSFET = IPA60R099C7


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# Rise/fall times: New set of gate resistances



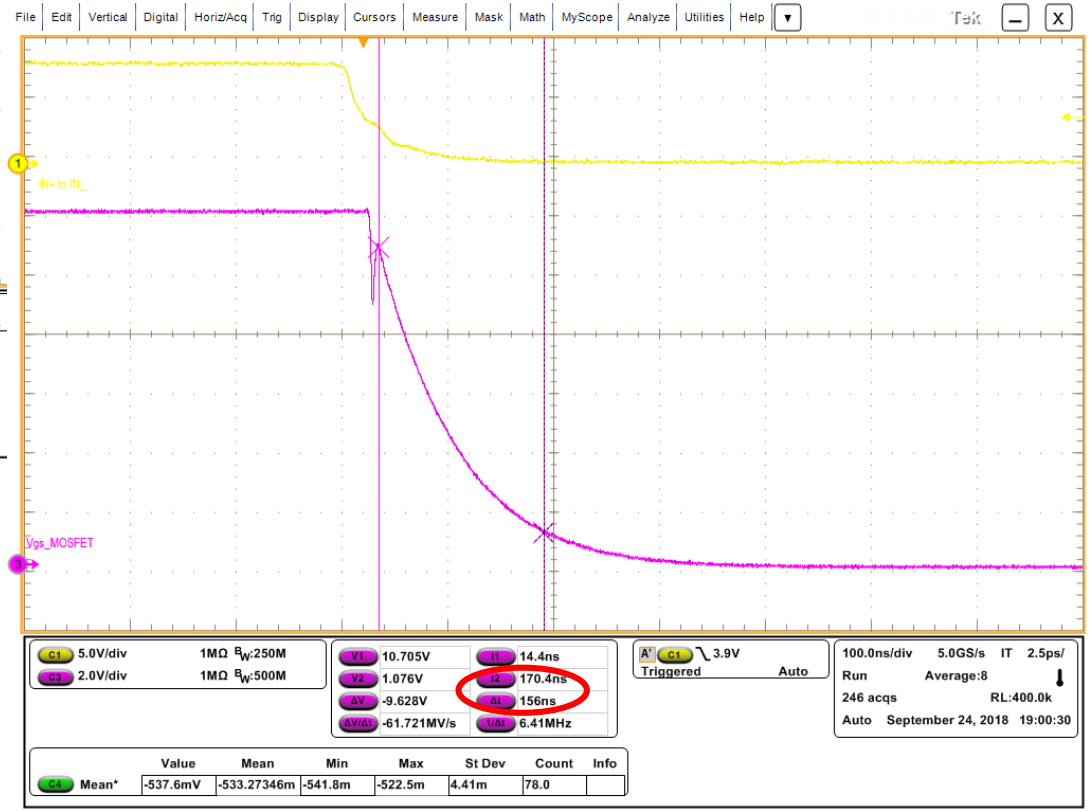

$R_{G,SOURCE} = 24\ \Omega$

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

$MOSFET = IPA60R099C7$

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

$C_{LOAD} \approx 2.8\ nF$





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# Gate resistors replacement

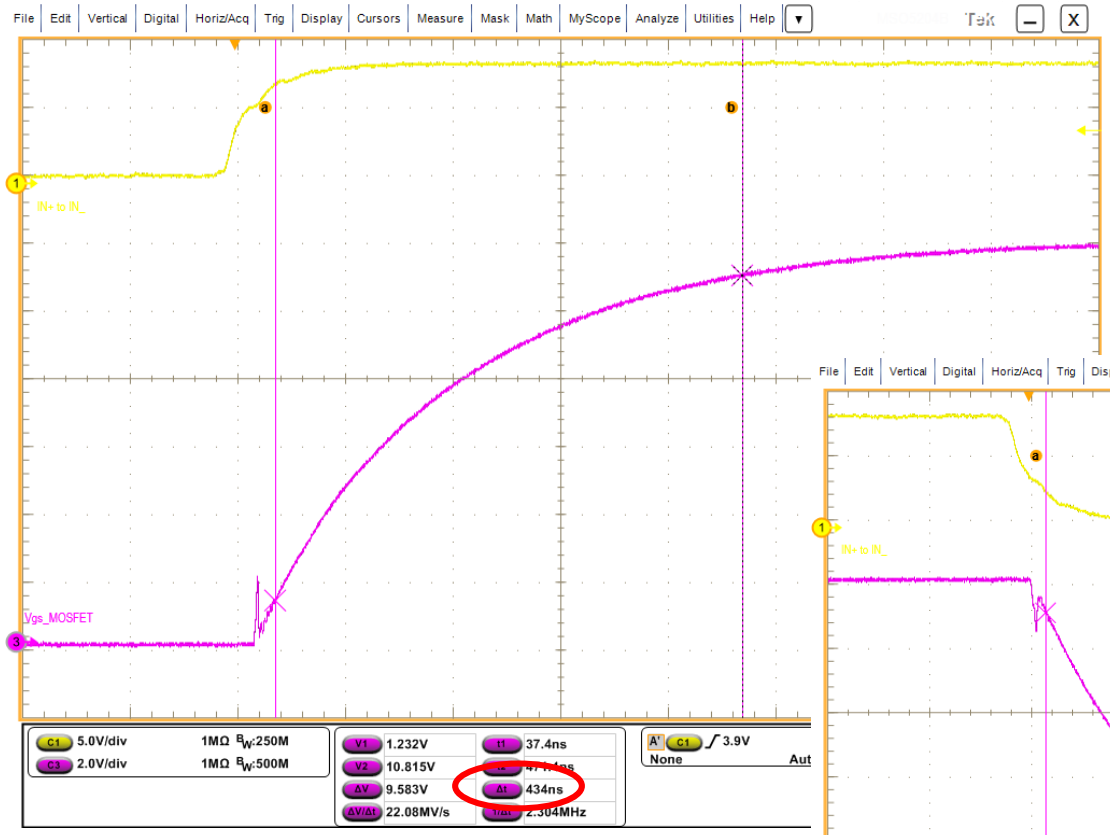
$$R_{G,SOURCE} = 24\ \Omega \quad \rightarrow \quad 51\ \Omega$$

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

MOSFET = IPA60R099C7


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# Rise/fall times: New set of gate resistances



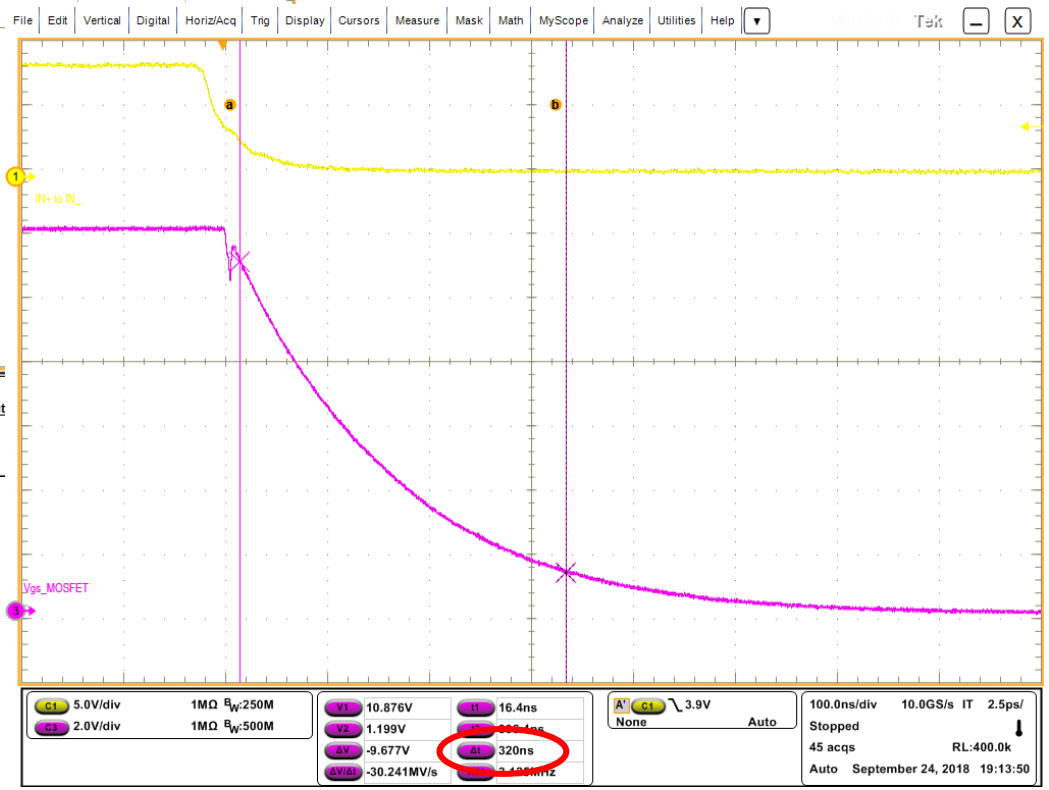

$R_{G,SOURCE} = 51\ \Omega$

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

$MOSFET = IPA60R099C7$

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

$C_{LOAD} \approx 2.8\ nF$

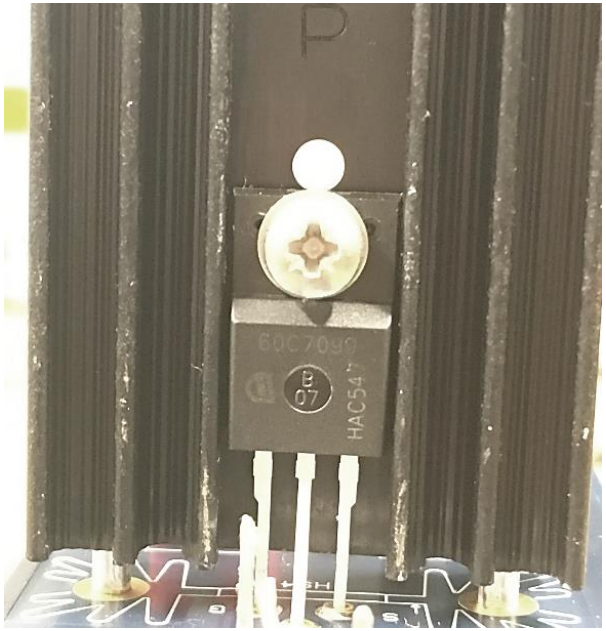


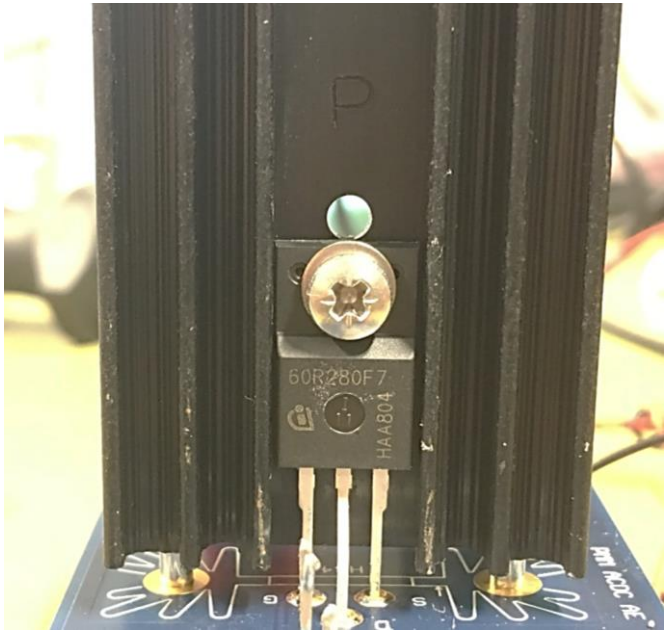


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# MOSFET Replacement

## IPA60R099C7 → IPA60R280CFD7



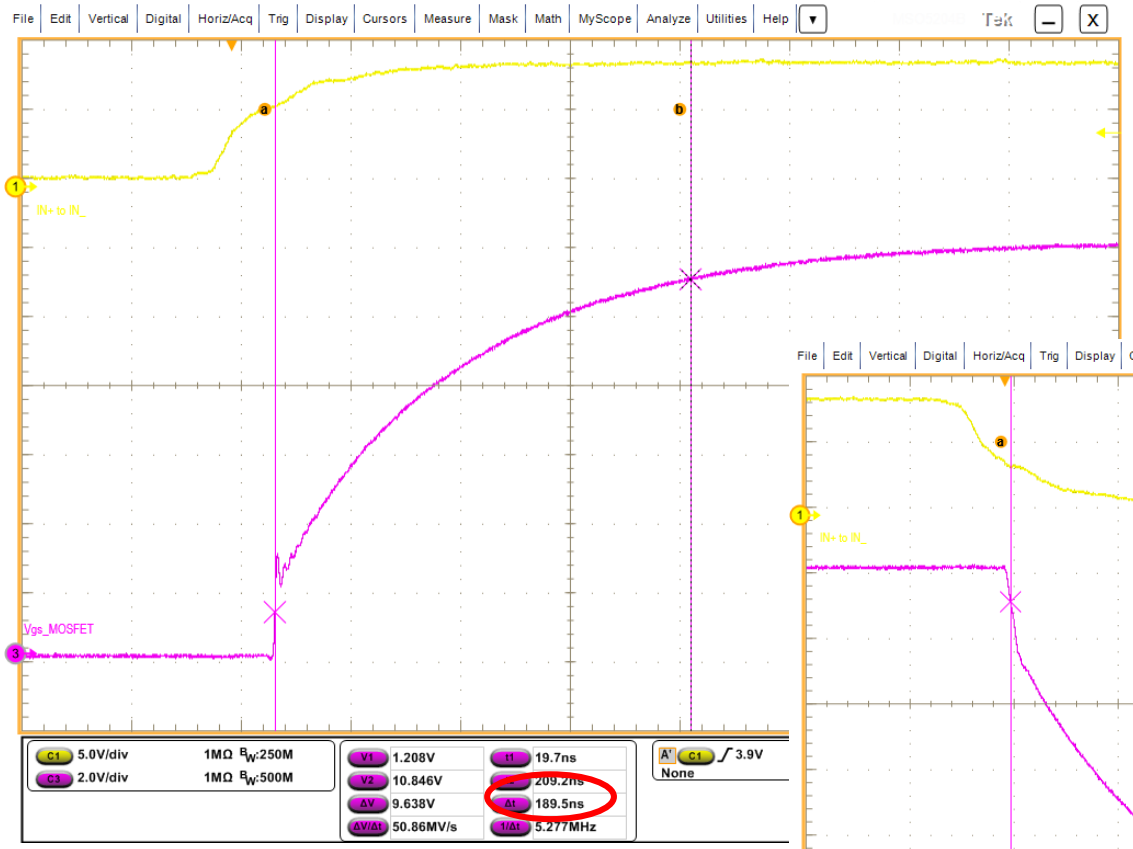




| | | | | | | |
|---|---|---|---|---|---|---|
| Gate to drain charge | $Q_{gd}$ | - | 5 | - | nC | $V_{DD}$=400V, $I_D$=5.0A, $V_{GS}$=0 to 10V |
| Gate charge total | $Q_g$ | - | 18 | - | nC | $V_{DD}$=400V, $I_D$=5.0A, $V_{GS}$=0 to 10V |

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


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# Rise/fall times: New MOSFET



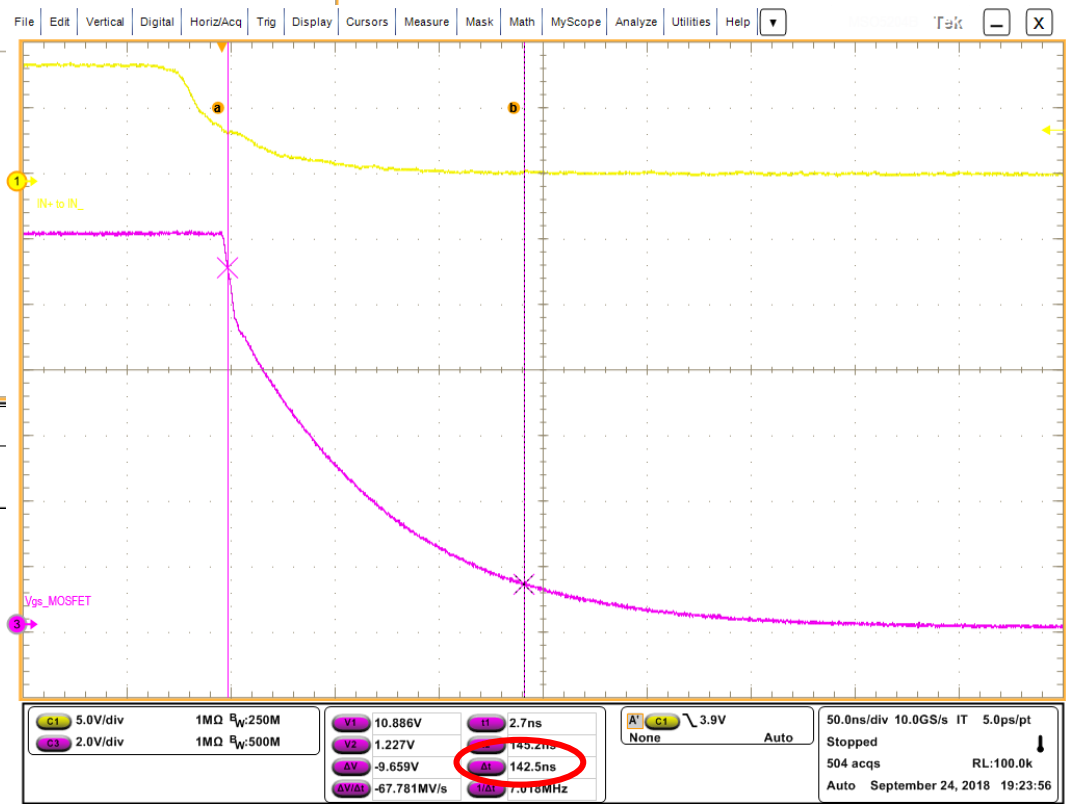

$R_{G,SOURCE} = 51\ \Omega$

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

MOSFET = IPA60R280CFD7

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

$C_{LOAD} \approx 1.3\ nF$

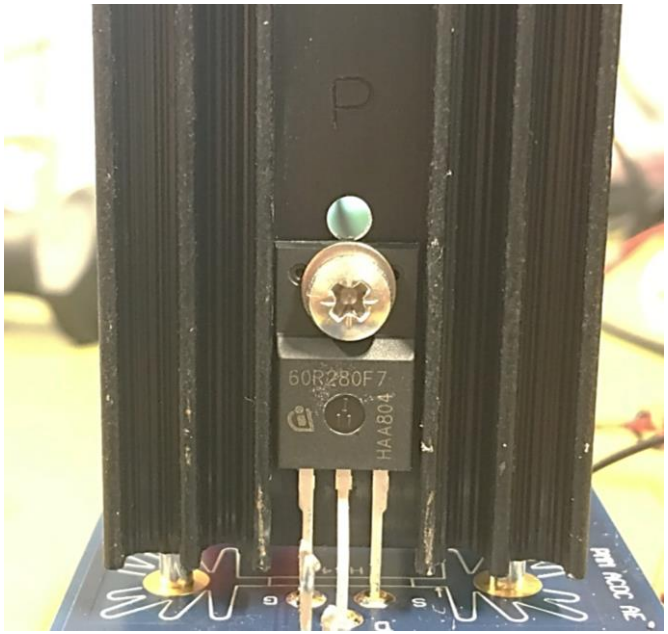


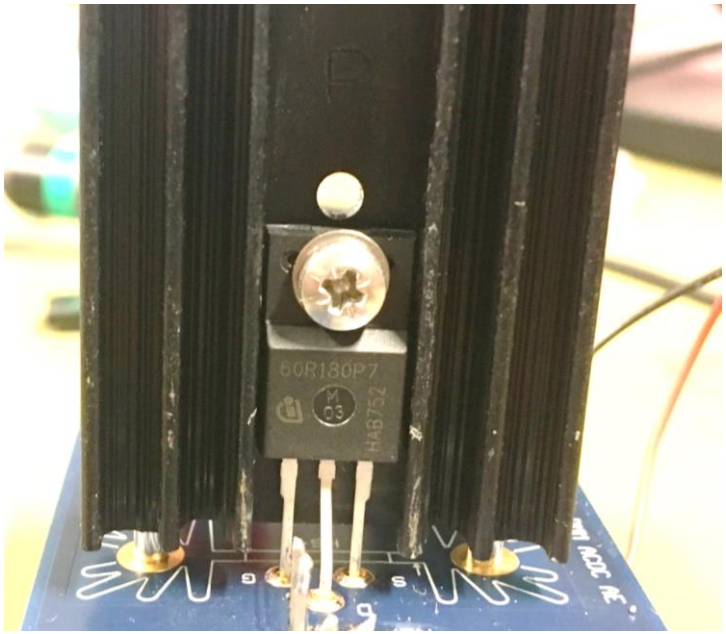


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# MOSFET replacement

## IPA60R280CFD7 → IPA60R180P7



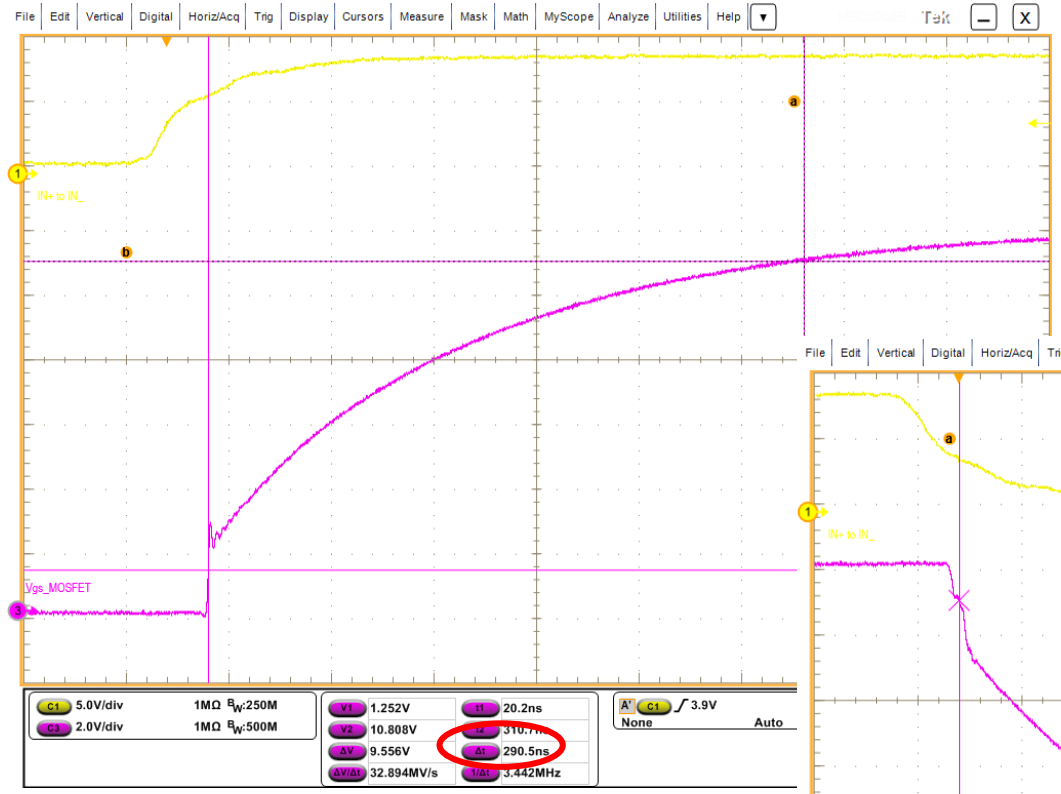




| | | | | | | |
|---|---|---|---|---|---|---|
| Gate to drain charge | $Q_{gd}$ | - | 8 | - | nC | $V_{DD}$=400V, $I_D$=5.6A, $V_{GS}$=0 to 10V |
| Gate charge total | $Q_g$ | - | 25 | - | nC | $V_{DD}$=400V, $I_D$=5.6A, $V_{GS}$=0 to 10V |

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


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# Rise/fall times: New MOSFET



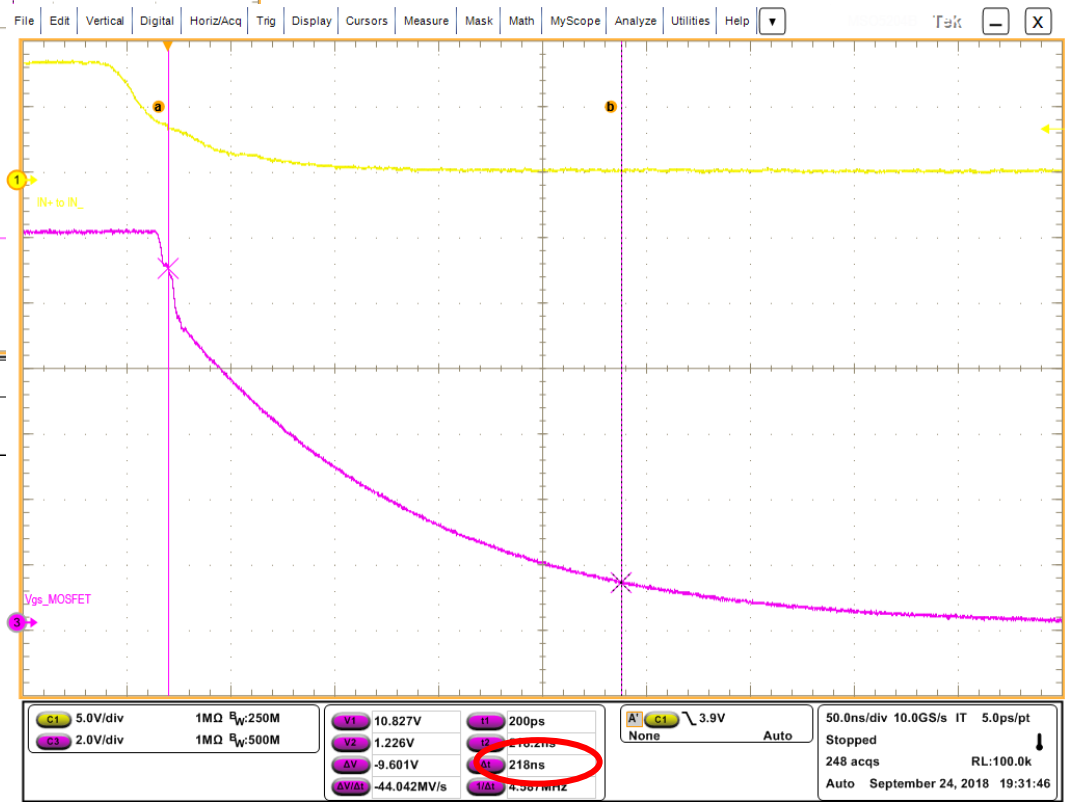

$R_{G,SOURCE} = 51\ \Omega$

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

$MOSFET = IPA60R180P7$

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

$C_{LOAD} \approx 1.9\ nF$





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# 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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