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Quick start guide KIT_DRIVER_1EDN7511B

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KIT_DRIVER_1EDN7550B



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Included in this kit



Heatsink for
TO-220 MOSFET

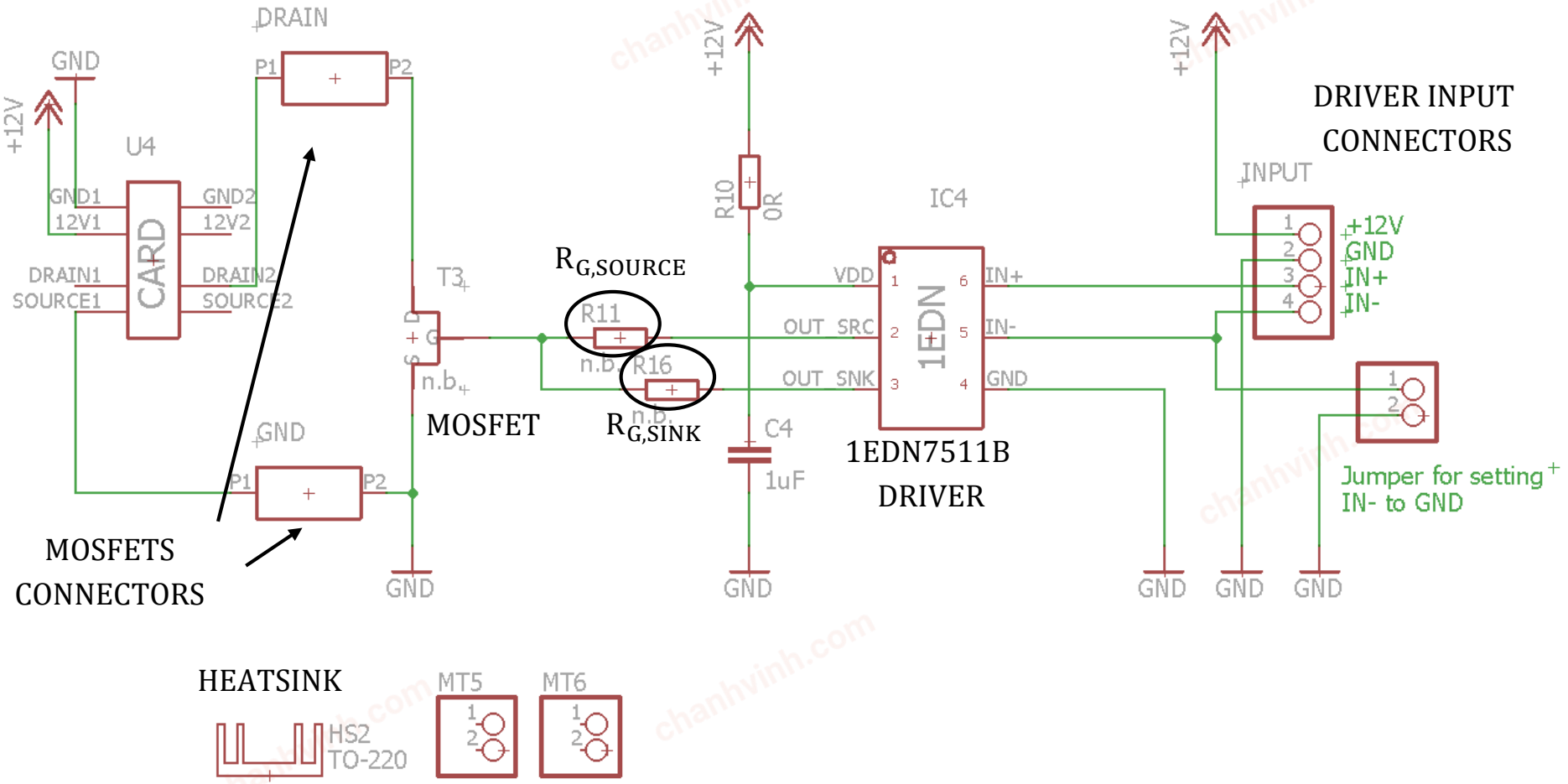
Evaluation kit
KIT_DRIVER_1EDN7511B



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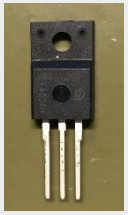
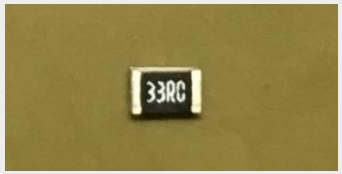
Board schematic



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Components to add – BOM suggestion

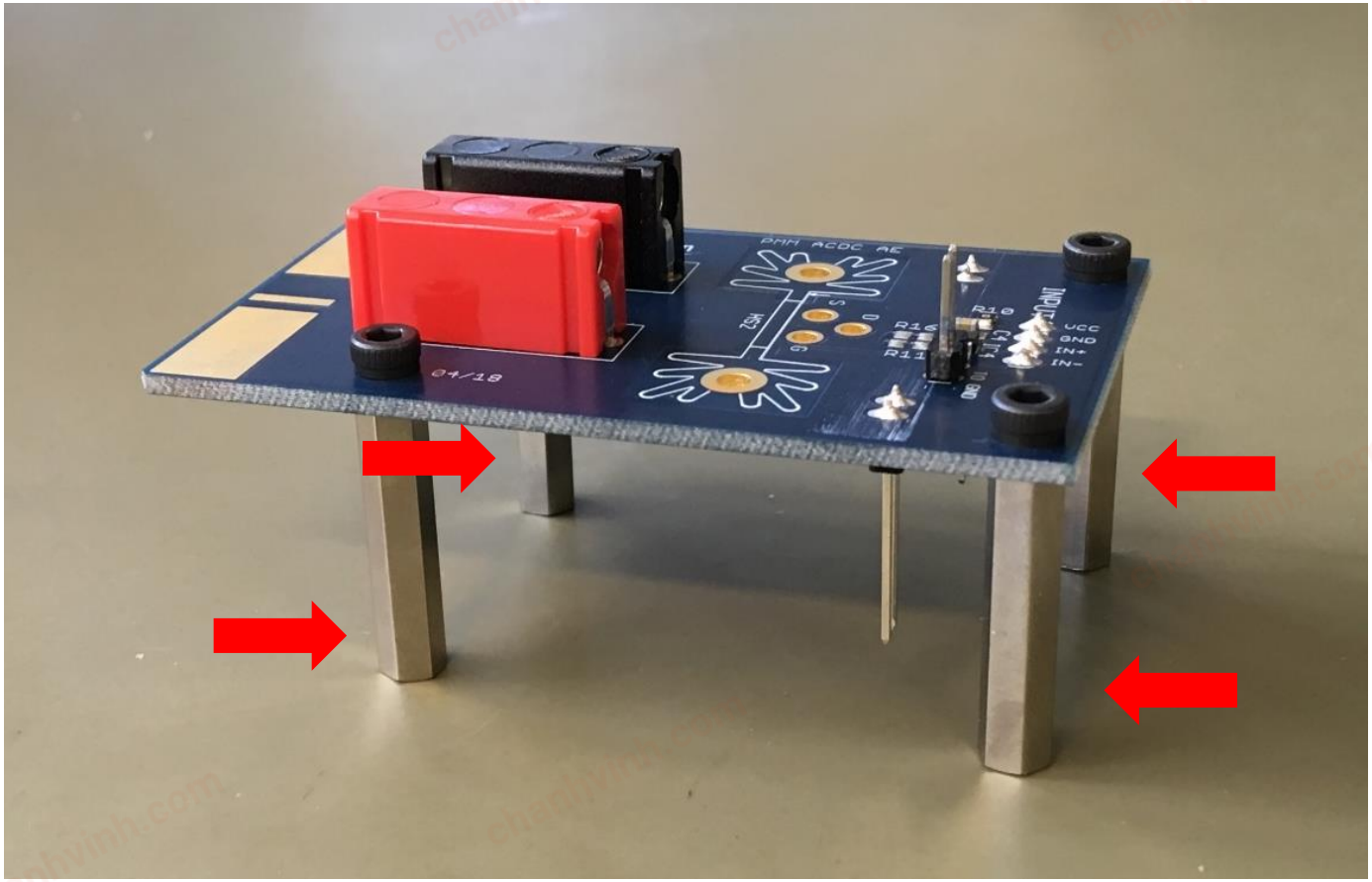
Distance bolts	Screws for distance bolts	Screw and washer for MOSFET mounting to heatsink	TO-220 sockets
			
TO-220 MOSFET	**Source resistor (R11)**	**Sink resistor (R16)**	
			

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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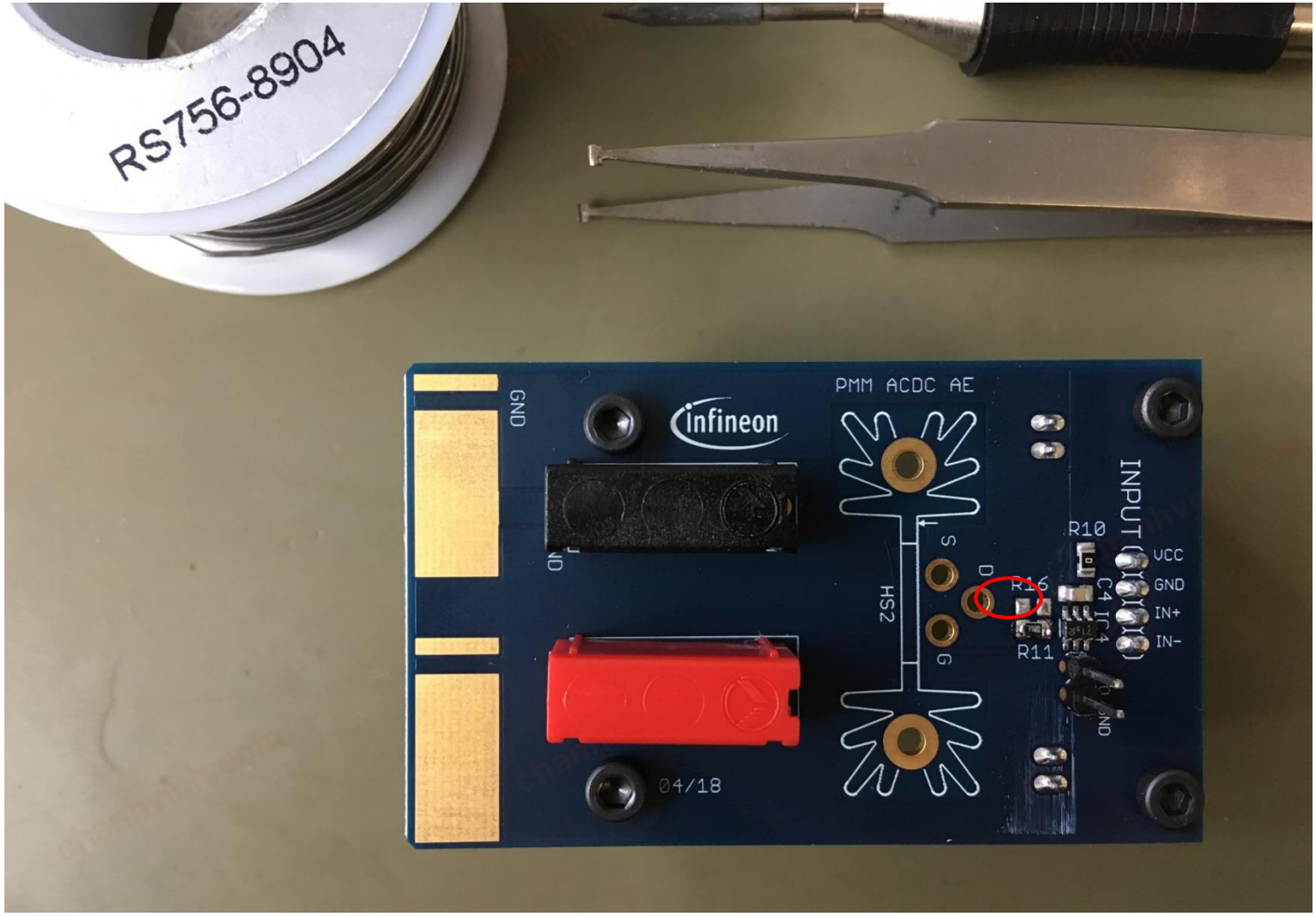
Step 1: Distance bolts mounting



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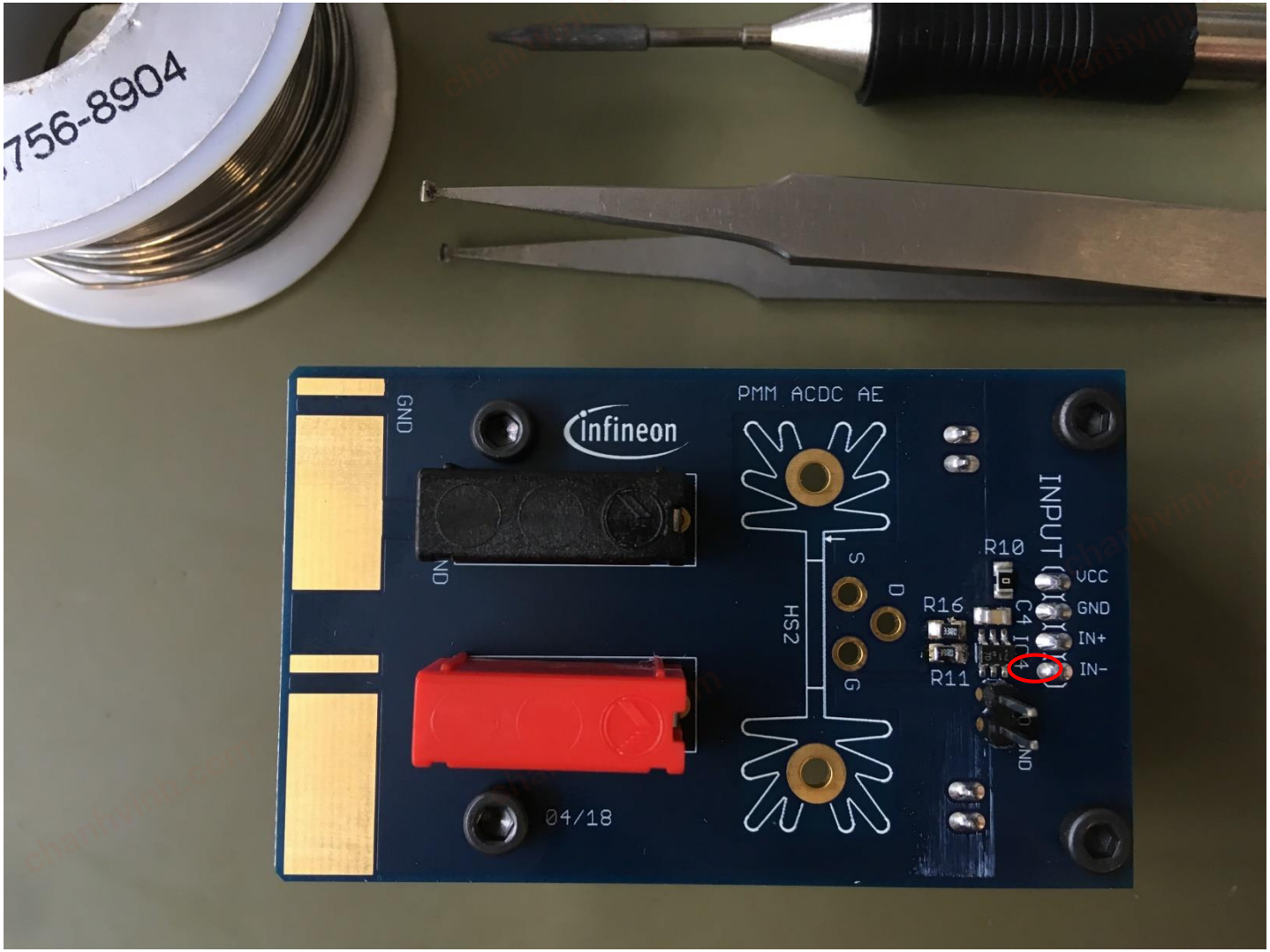
Step 2: Source resistor soldering



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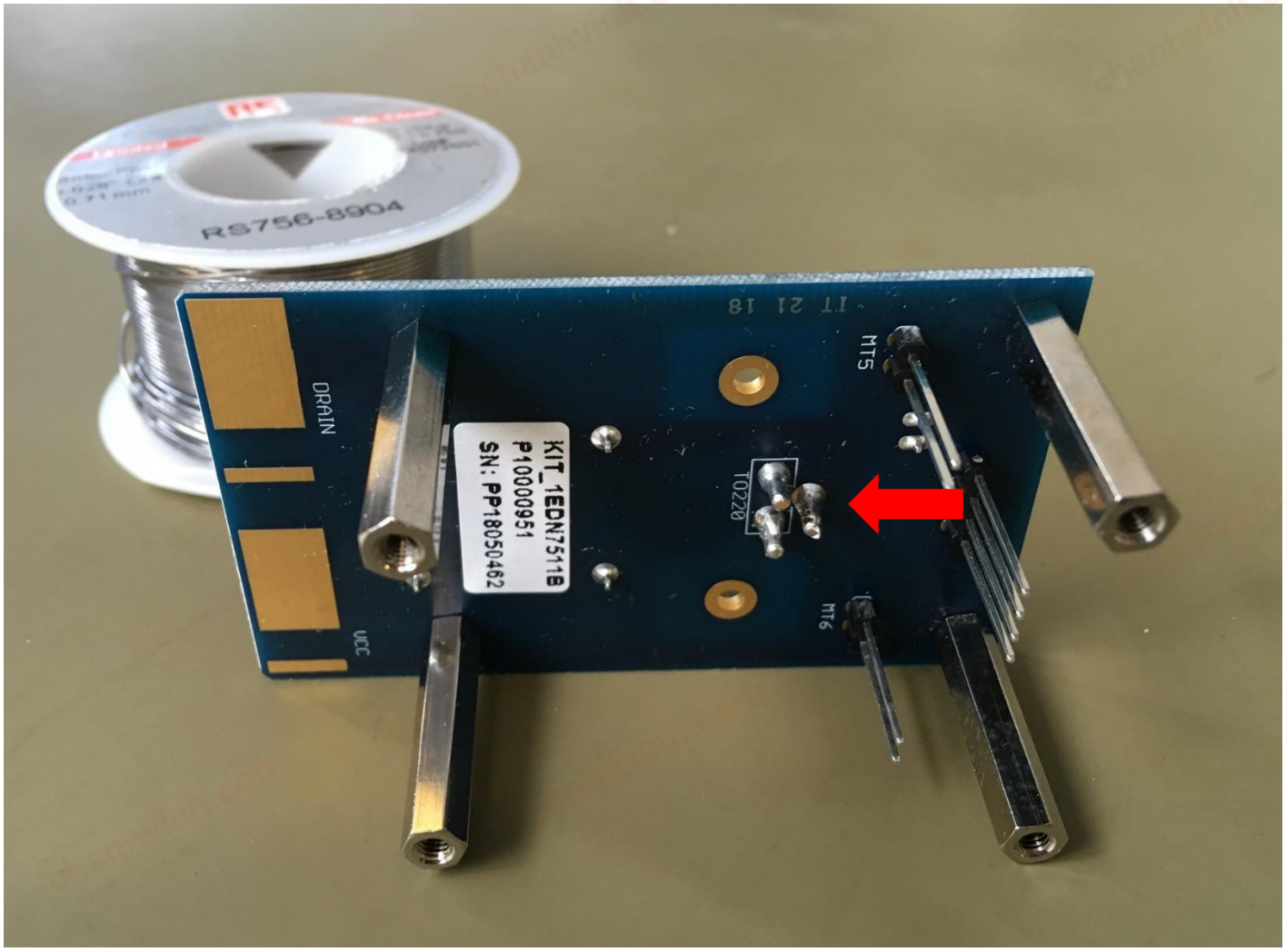
Step 3: Sink resistor soldering



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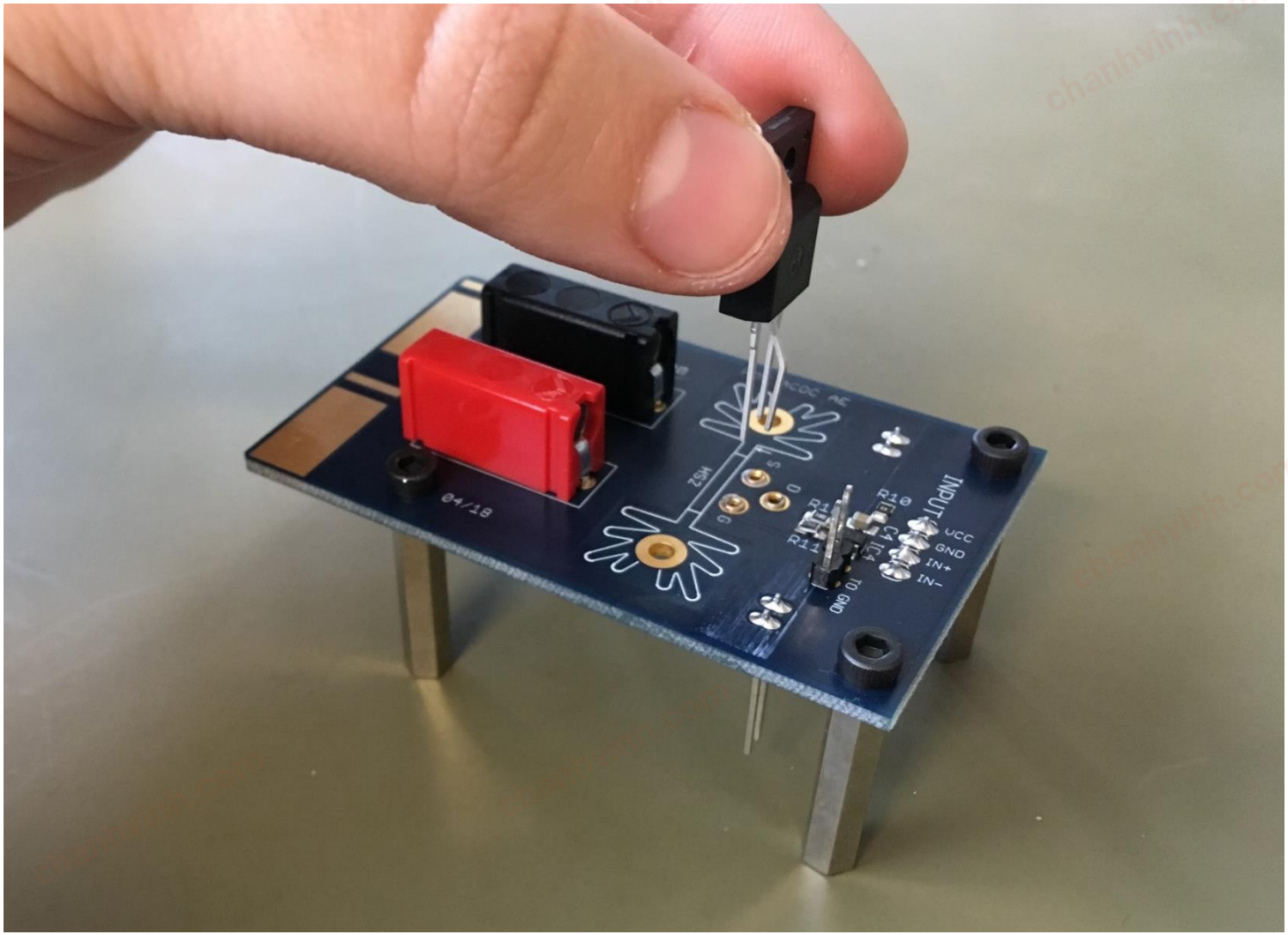
Step 4: TO-220 sockets soldering



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Step 5: MOSFETs placement into the sockets

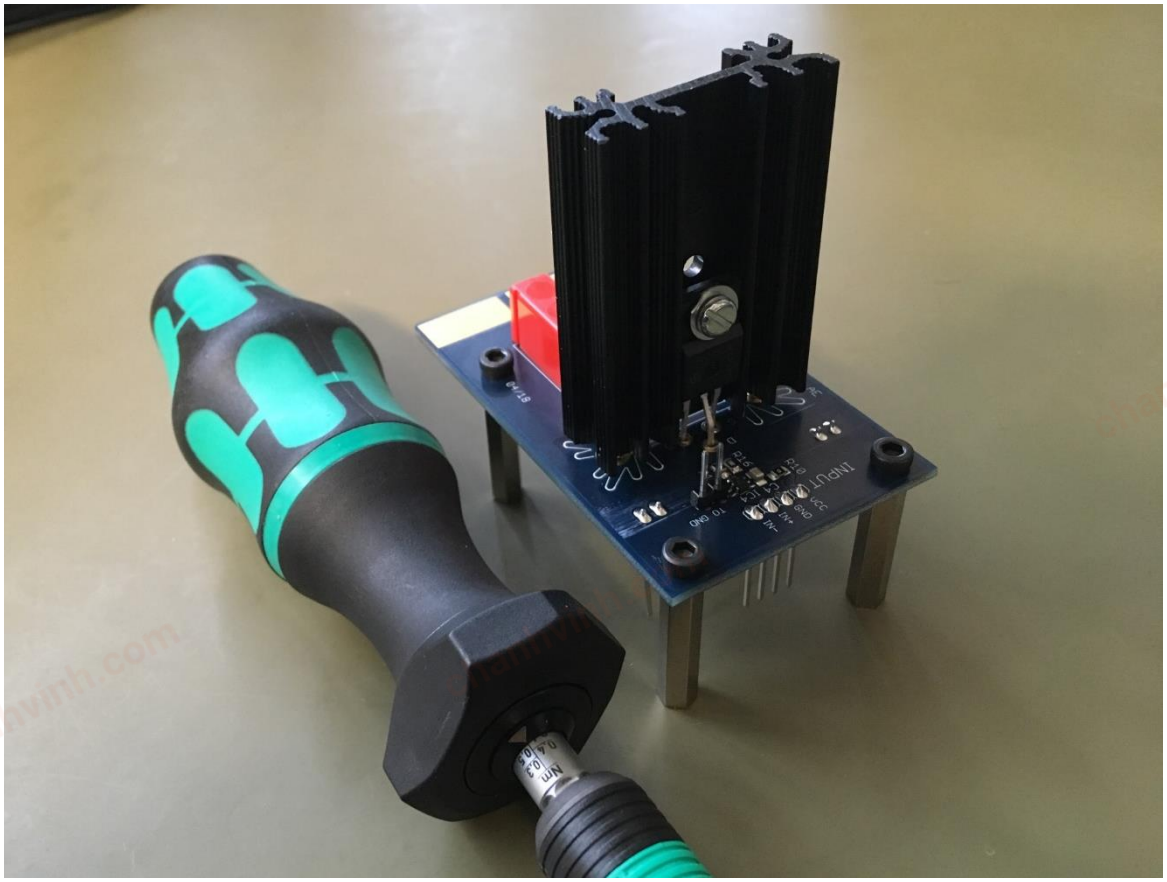


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Step 6: Heatsink mounting (optional)

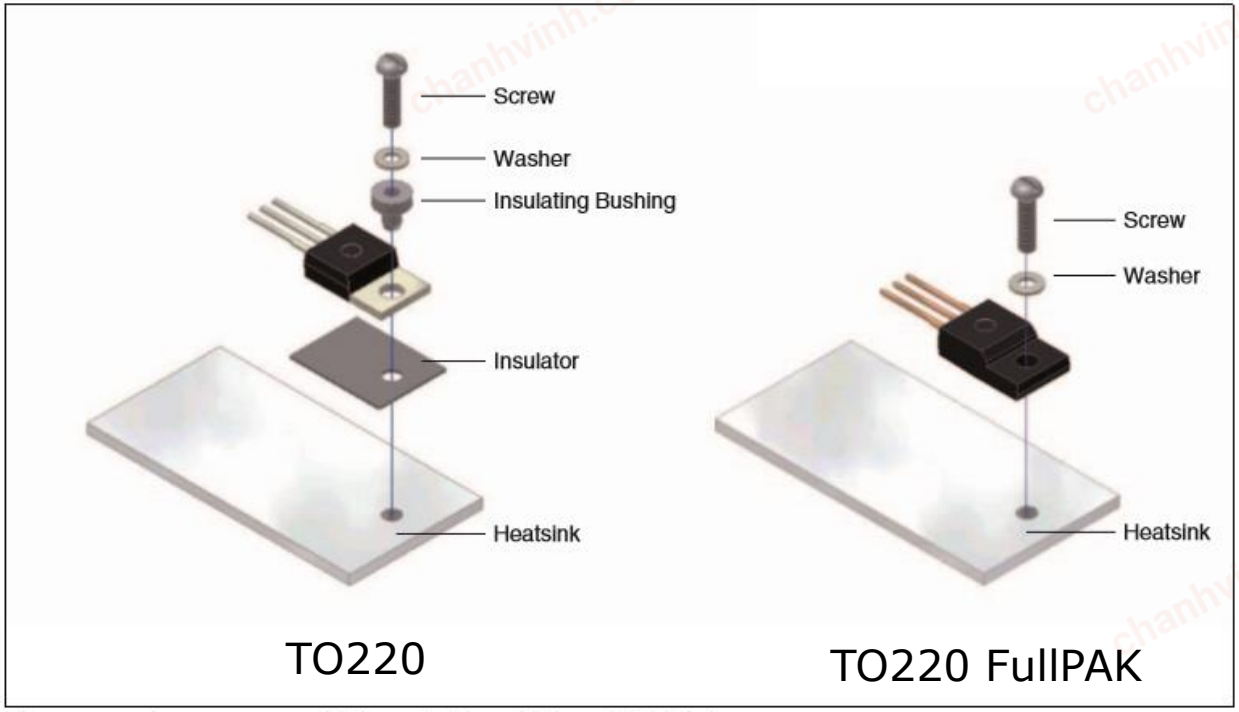
- Solder the heatsink if the board is used in high voltage scenarios
- In basic measurements it is not necessary
- See next slide for further information on how to properly mount the MOSFETs to the heatsink



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TO-220 MOSFET mounting to the heatsink



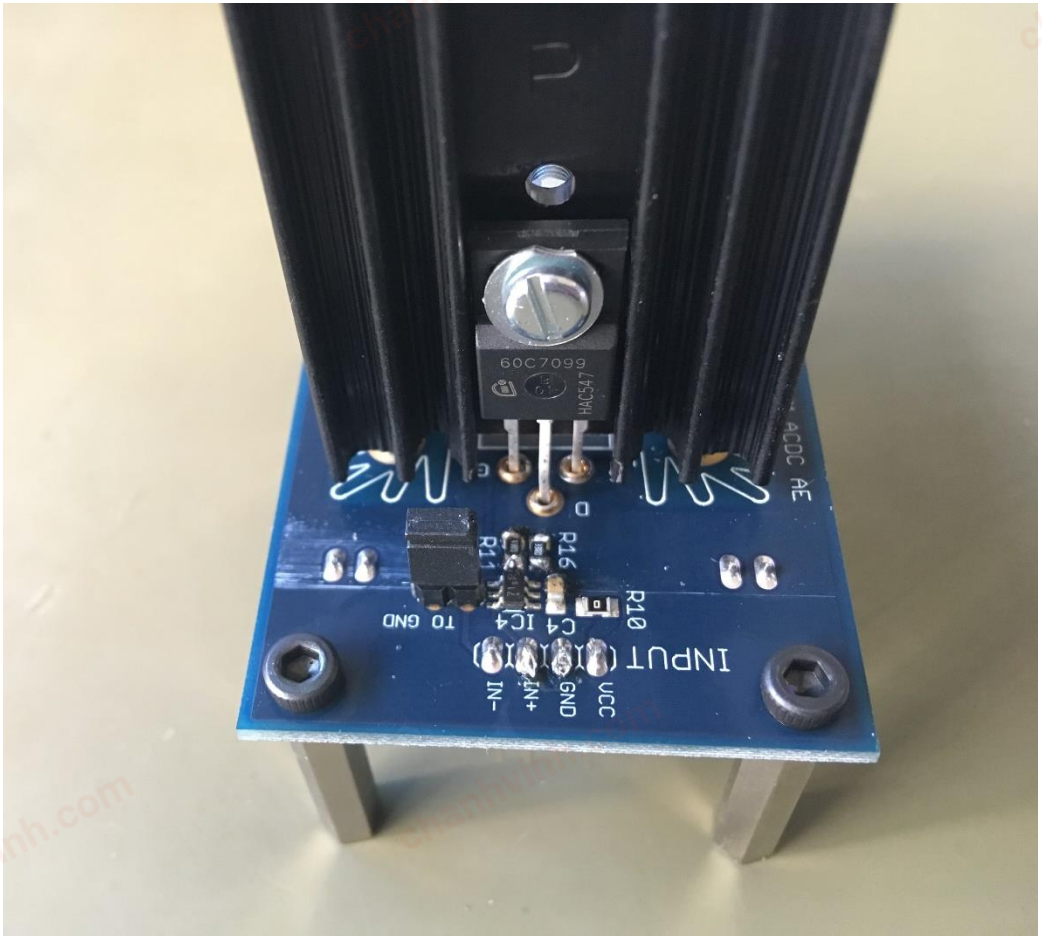
Package	Typ. Torque [Nm]	Max. Torque [Nm]	Comment
PG-TO220	0.6	0.7	Screw M3
PG-TO220 FullPAK	0.5	0.7	Screw M2.5

- 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

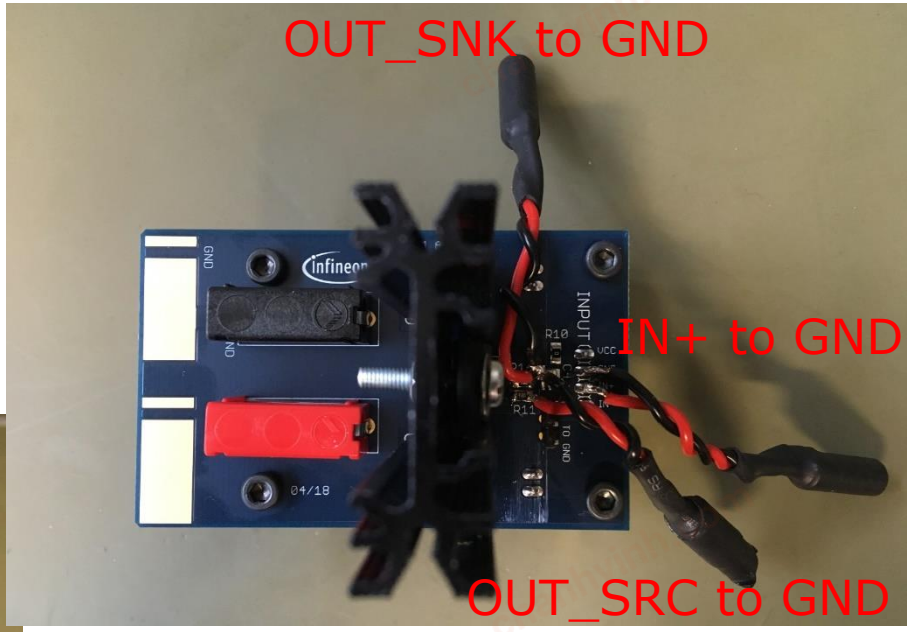


- In non-inverting operating mode, short IN- to GND with a jumper

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Step 8: BNC connectors soldering

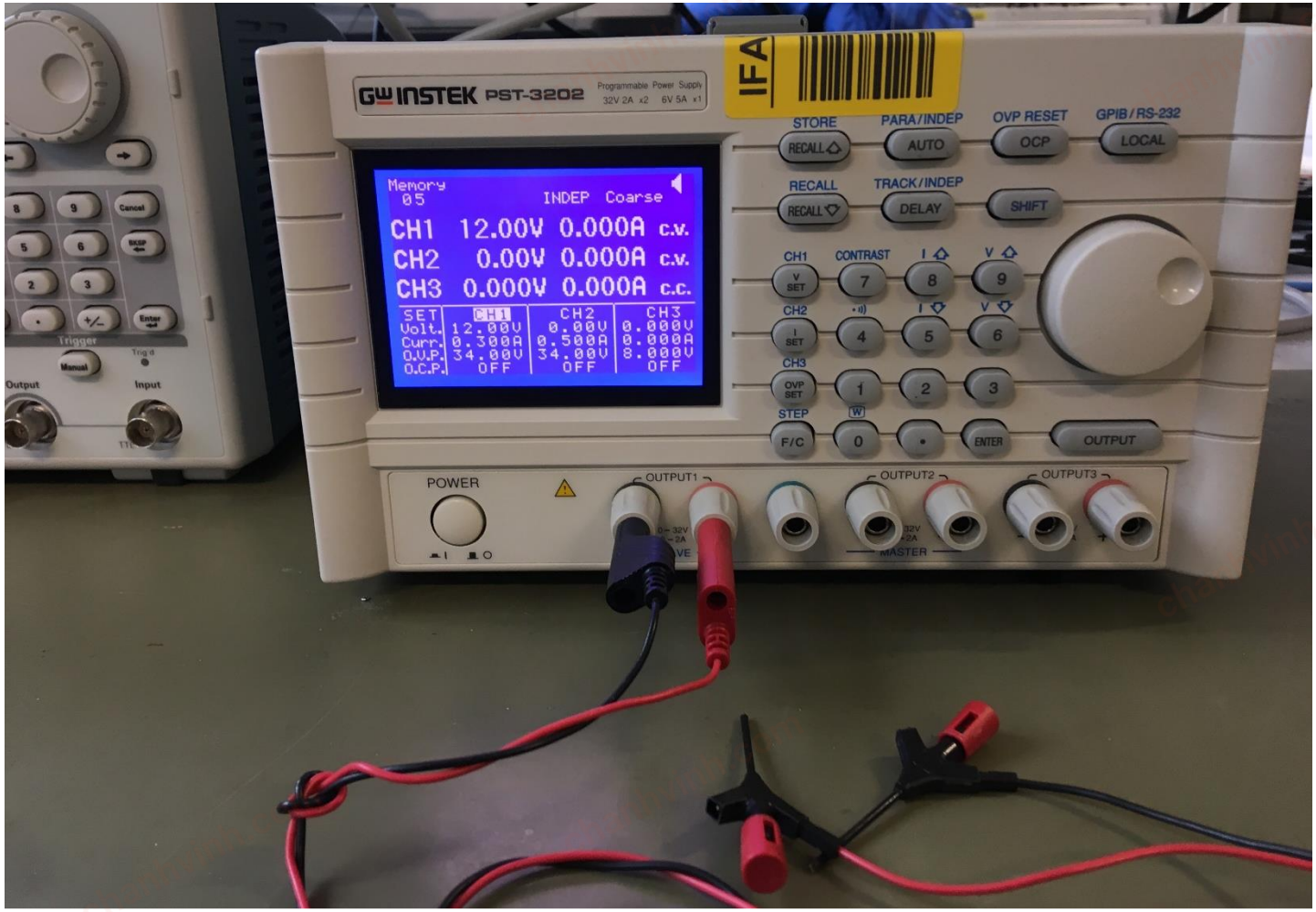




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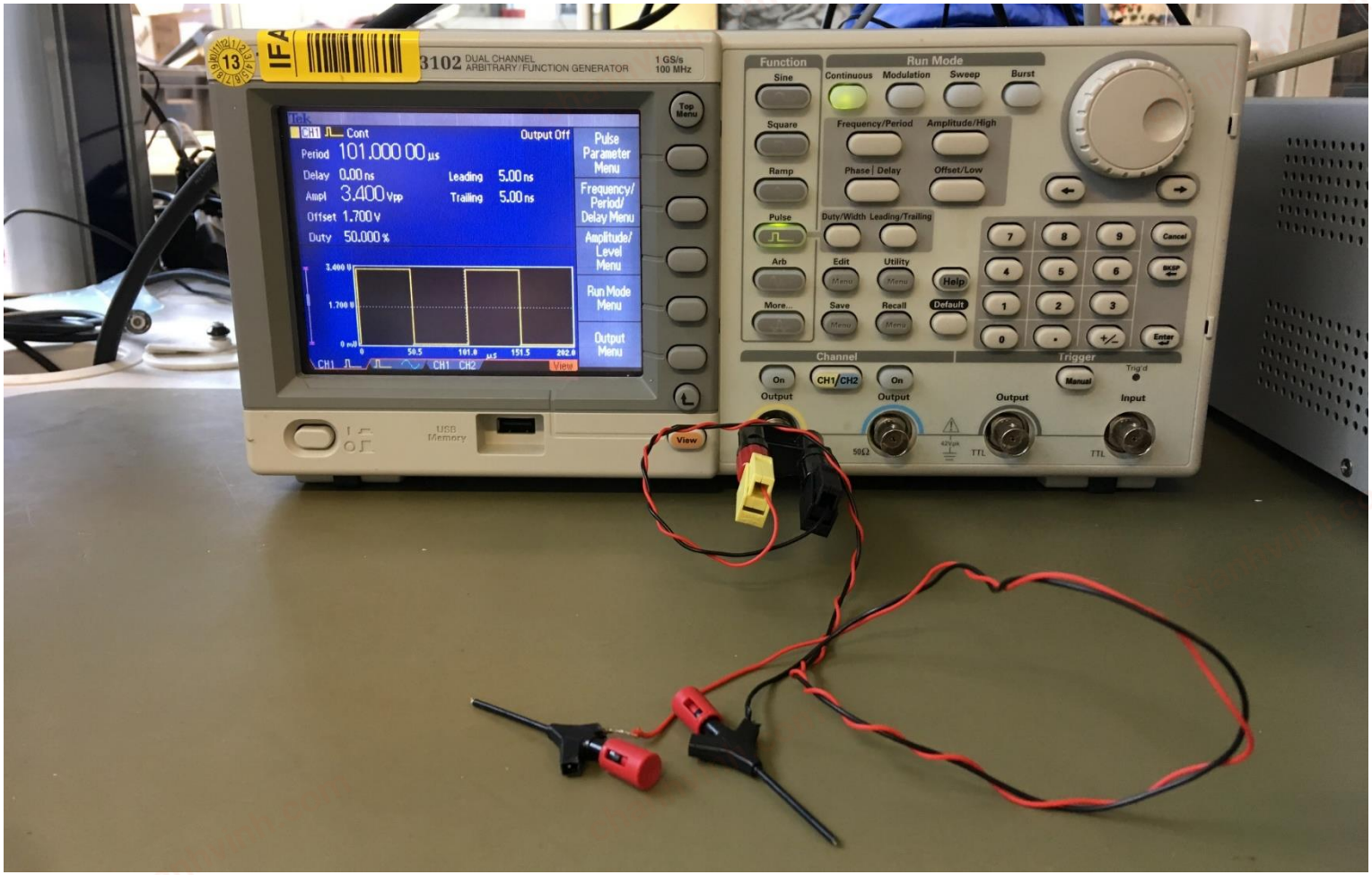
Instrumentation for driver supply generation



- 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

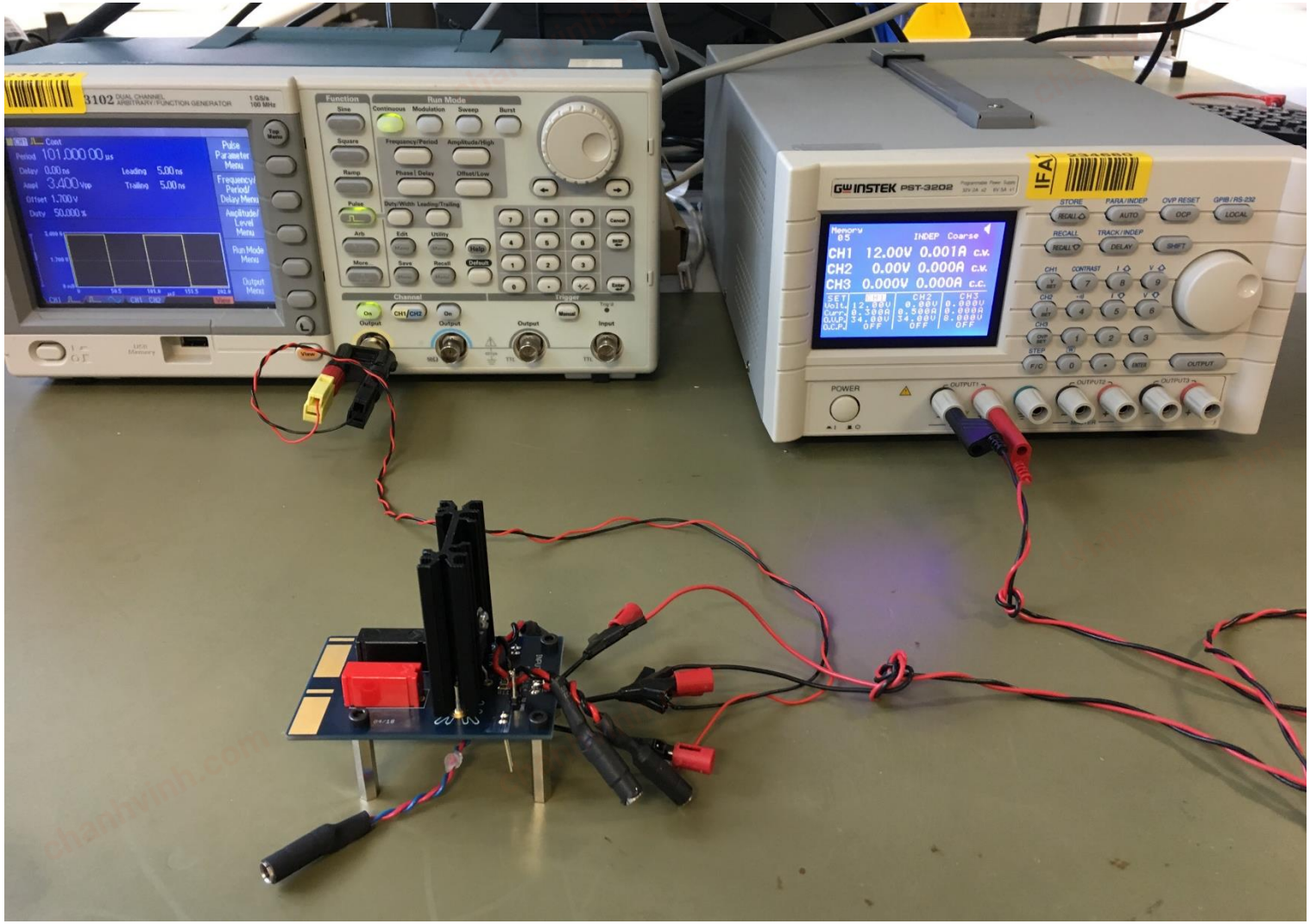


- Use a function generator or a microcontroller

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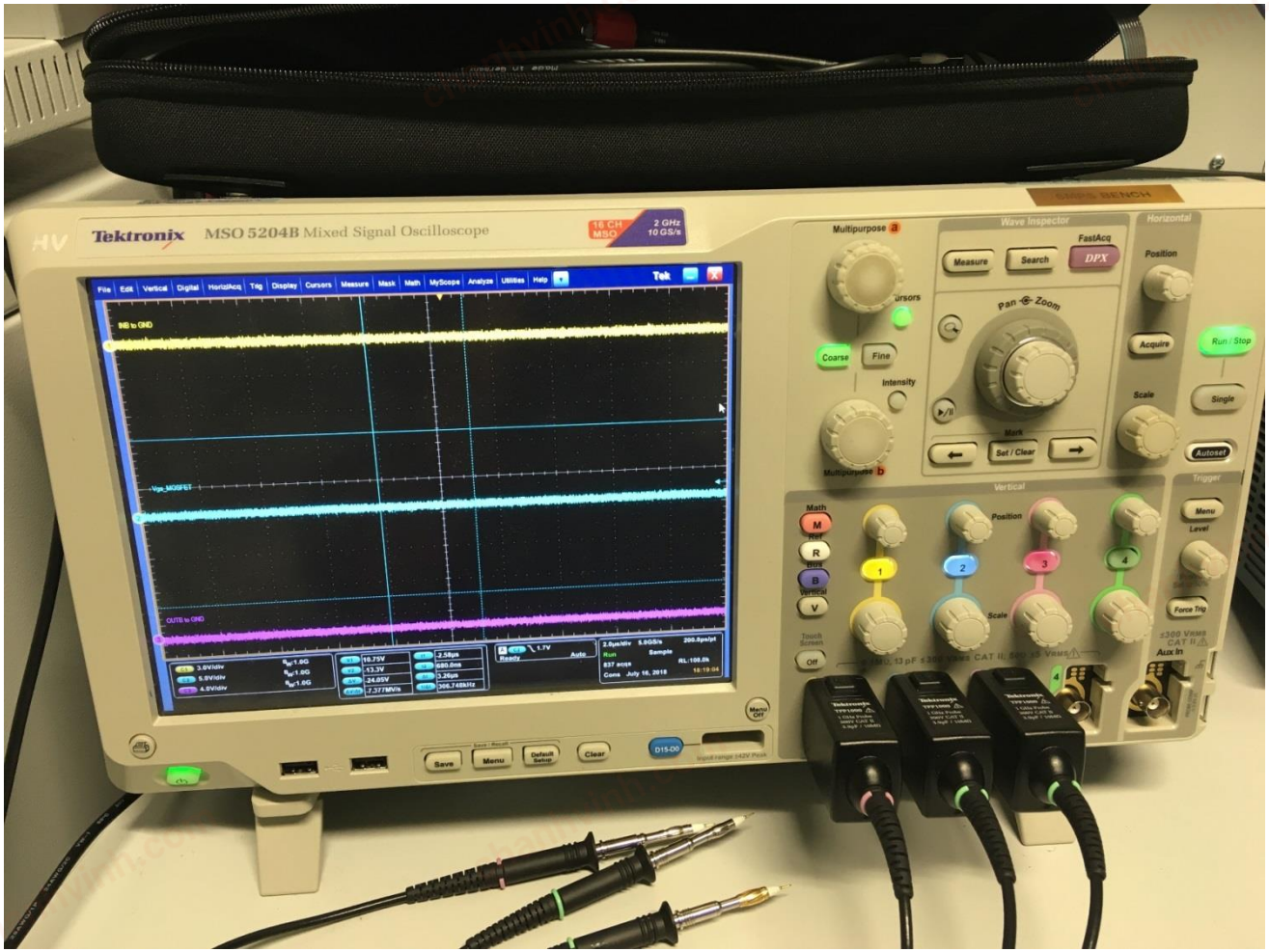
Connections



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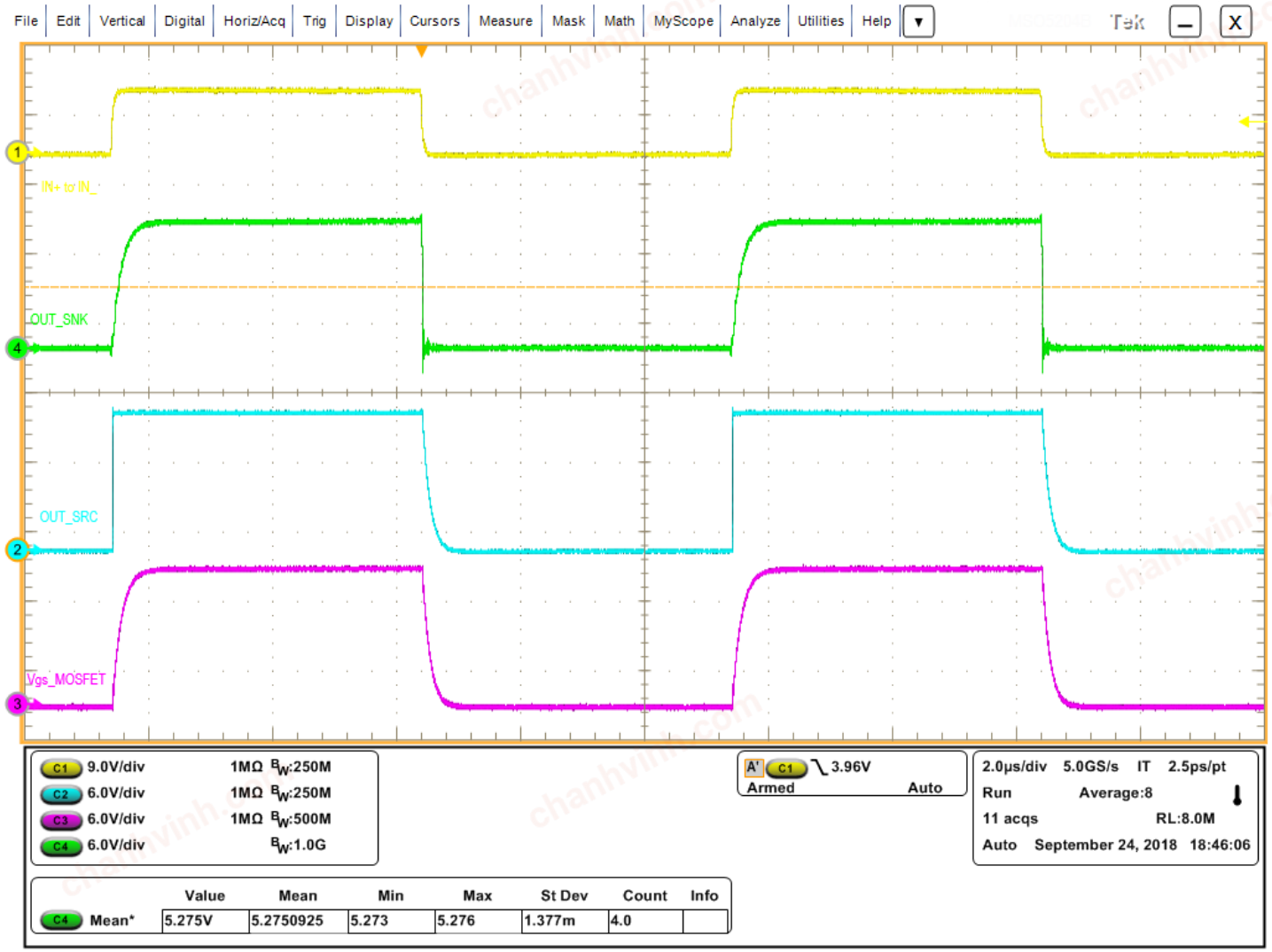
Instrumentation for signals evaluation



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

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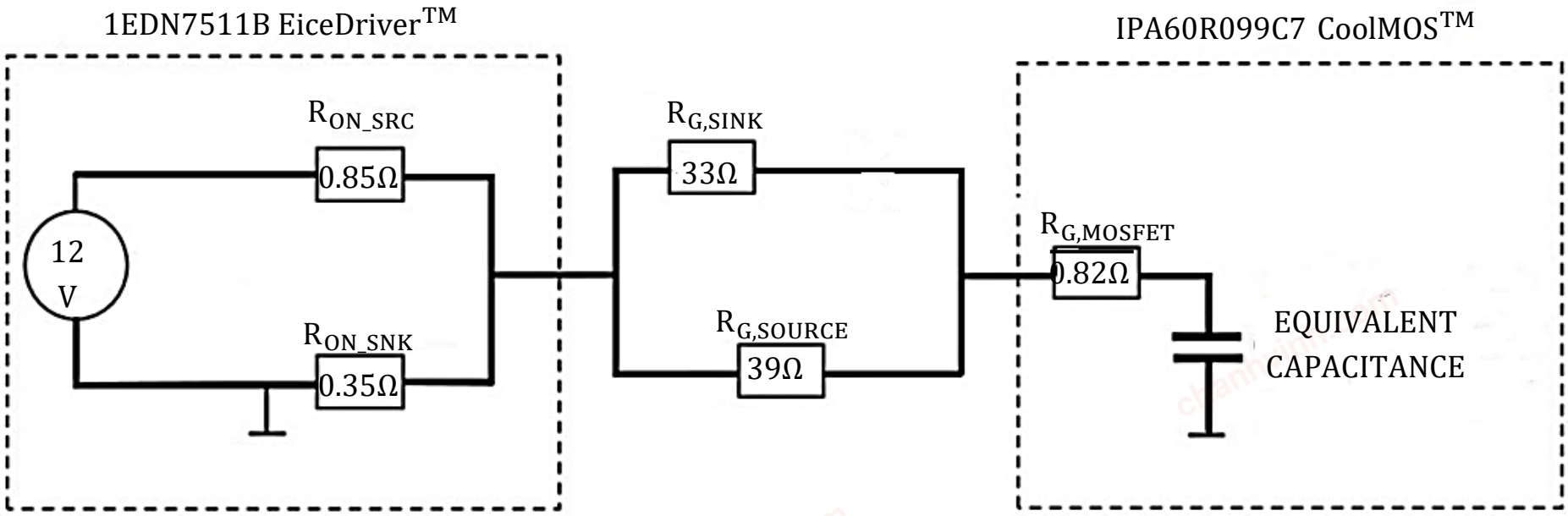
Oscilloscope waveforms



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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

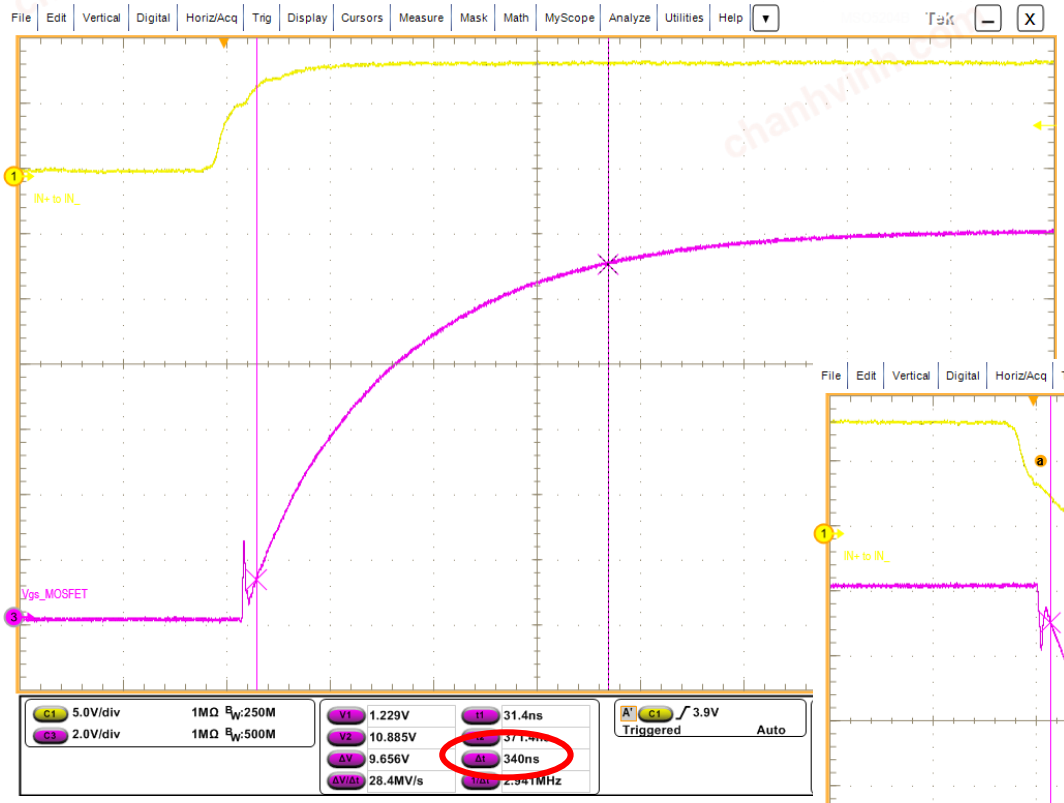
$$Q_{LOAD} = Q_g - Q_{gd} = 28\,nC \rightarrow C_{LOAD} = \frac{Q_{LOAD}}{V_{GS}} = 2.8\,nF \quad for\ V_{GS} = 10\,V \longrightarrow$$

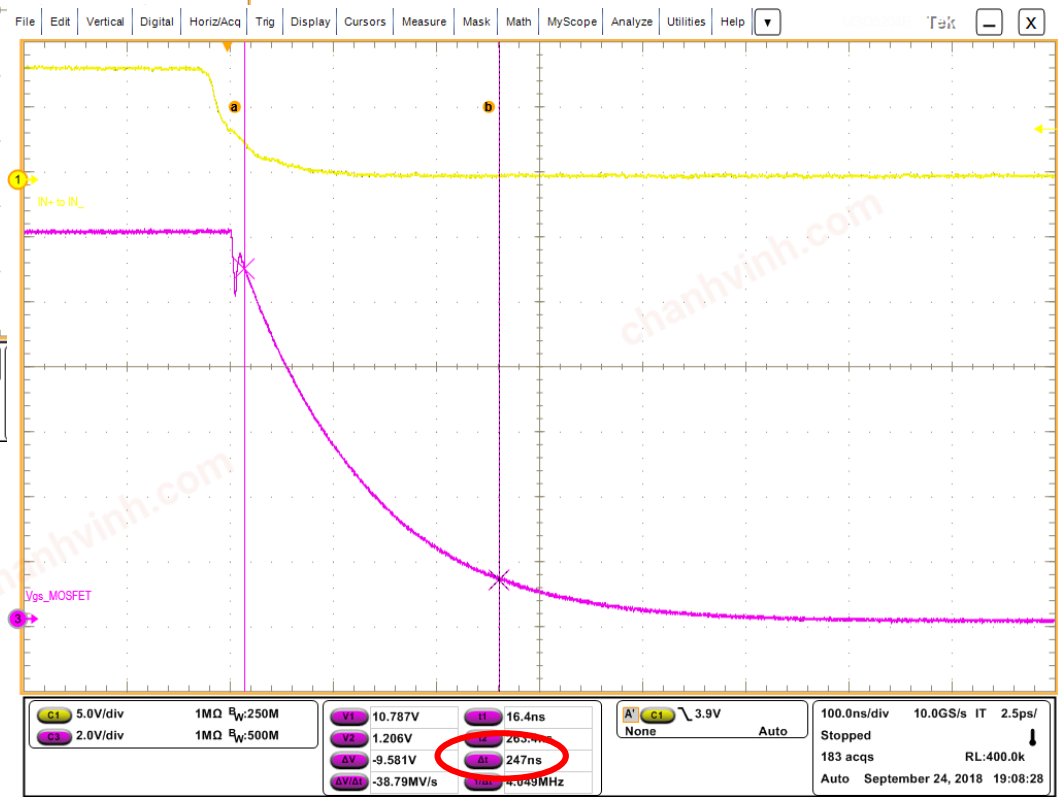
$$C_{LOAD} \approx 2.8\,nF \quad for\ V_{GS} = 12\,V$$

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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

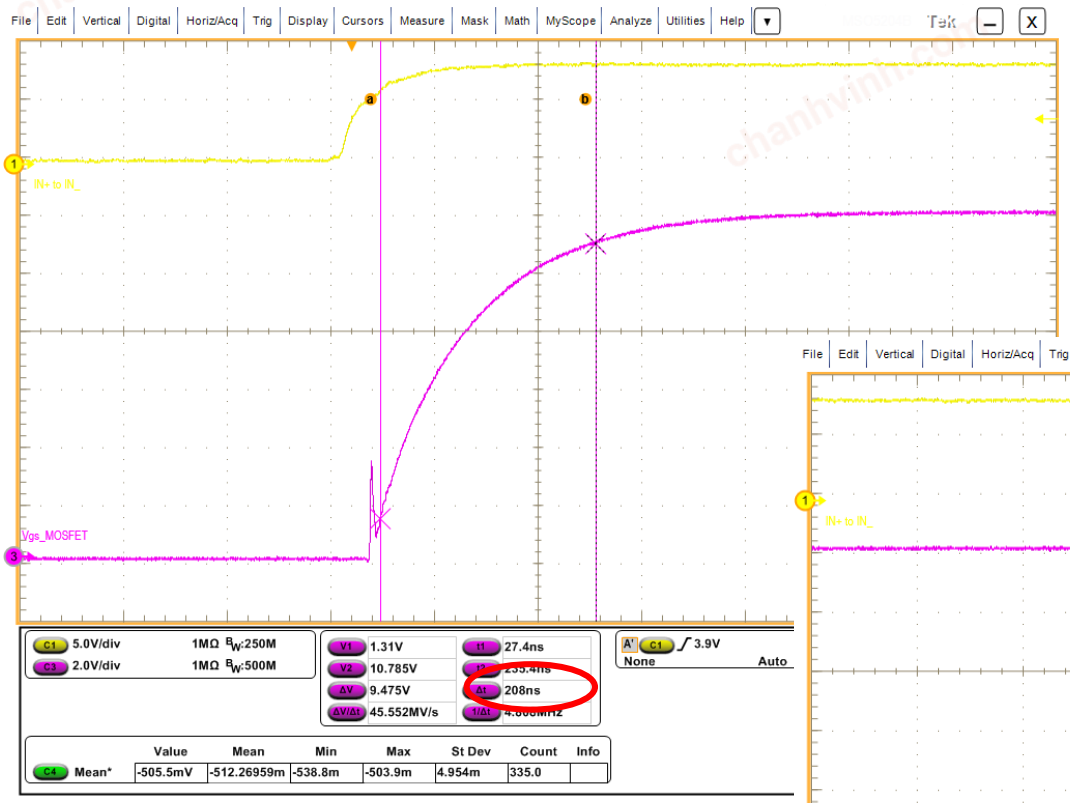
$R_{G,SOURCE} = 24\ \Omega$

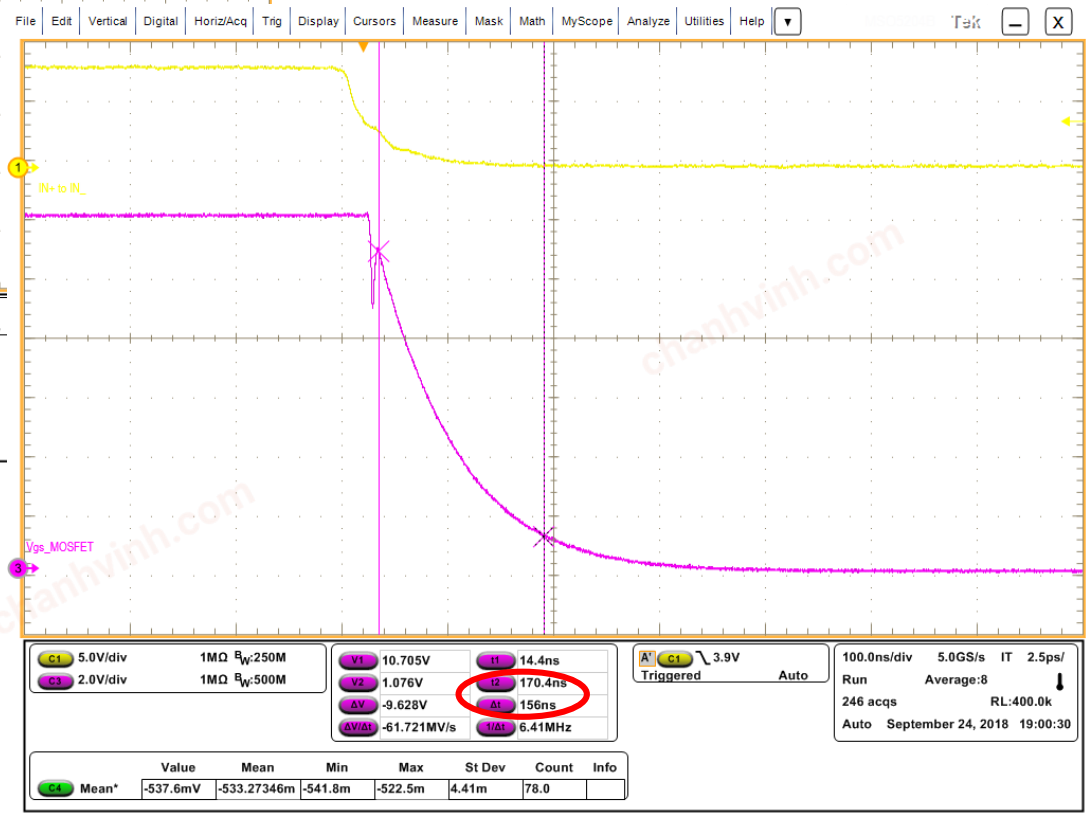
$R_{G,SINK} = 20\ \Omega$

$MOSFET = IPA60R099C7$

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

$C_{LOAD} \approx 2.8\ nF$





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Gate resistors replacement

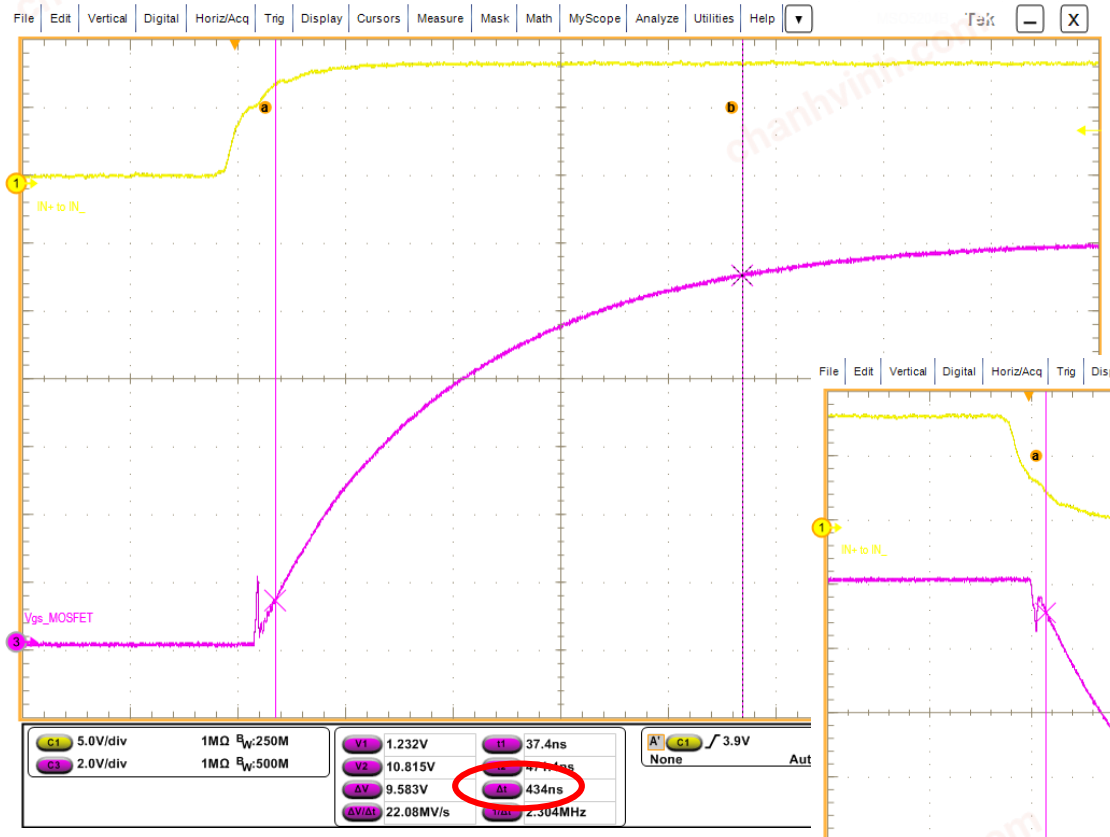
$$R_{G,SOURCE} = 24\ \Omega \quad \rightarrow \quad 51\ \Omega$$

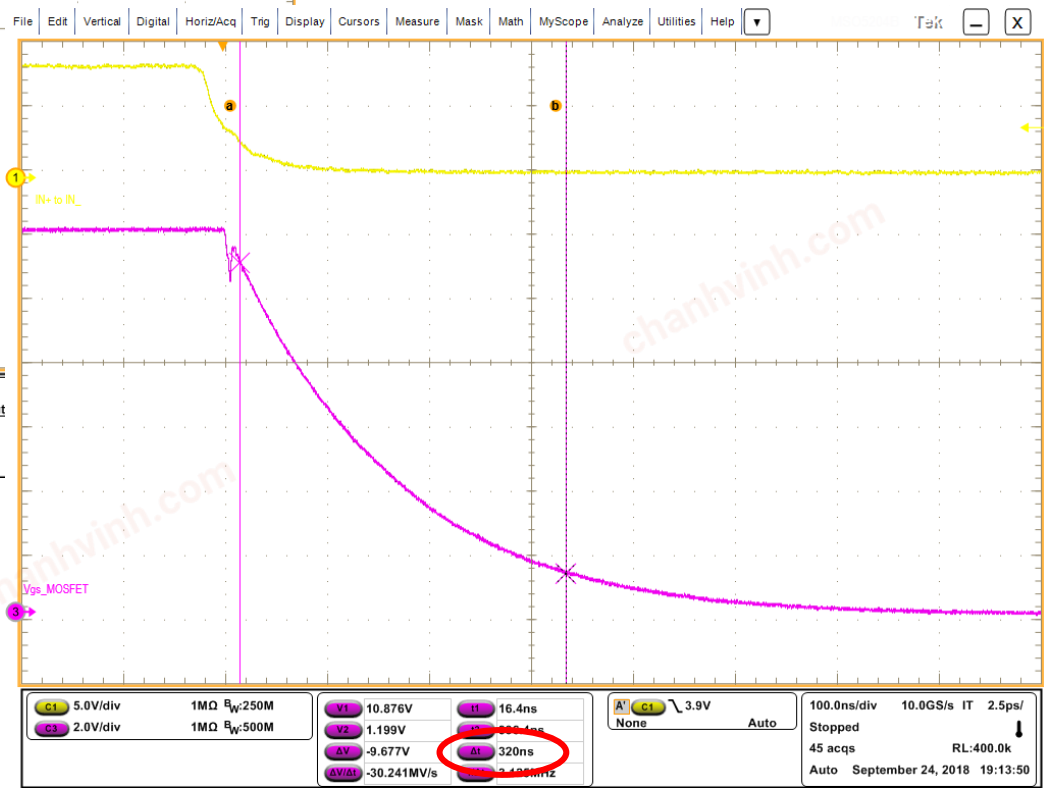
$$R_{G,SINK} = 20\ \Omega \quad \rightarrow \quad 43\ \Omega$$

MOSFET = IPA60R099C7

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Rise/fall times: New set of gate resistances





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

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

$MOSFET = IPA60R099C7$

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

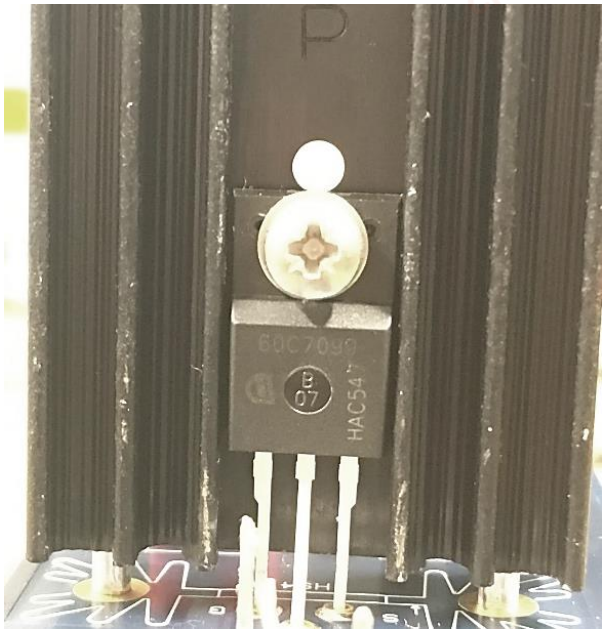
$C_{LOAD} \approx 2.8\ nF$

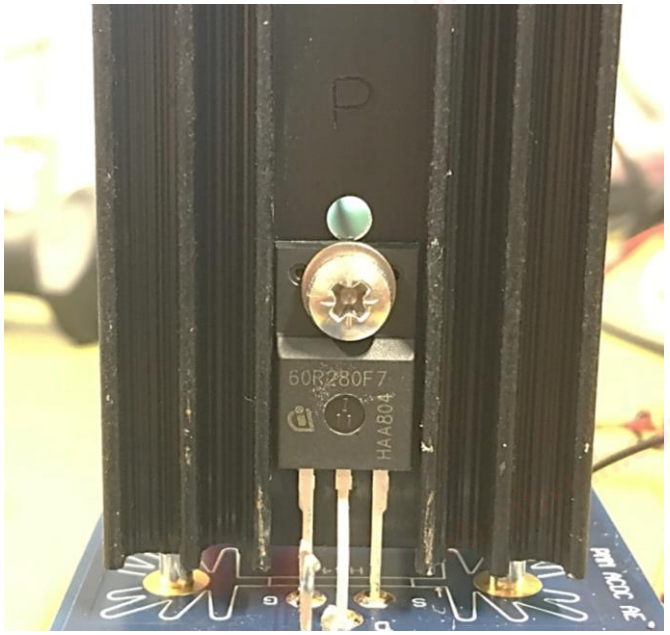
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MOSFET Replacement

IPA60R099C7 → IPA60R280CFD7



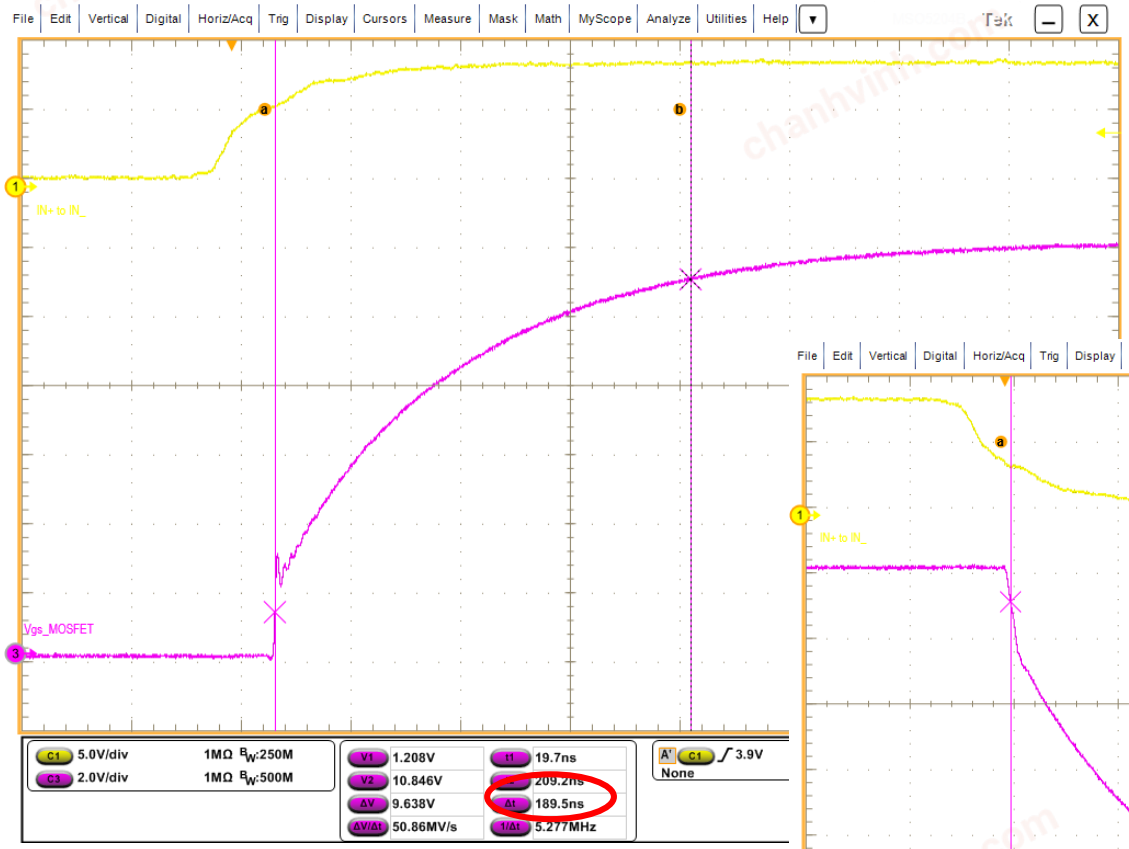


Gate to drain charge	Q_{gd}	-	5	-	nC	V_{DD}=400V, I_D=5.0A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	18	-	nC	V_{DD}=400V, I_D=5.0A, V_{GS}=0 to 10V

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

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Rise/fall times: New MOSFET



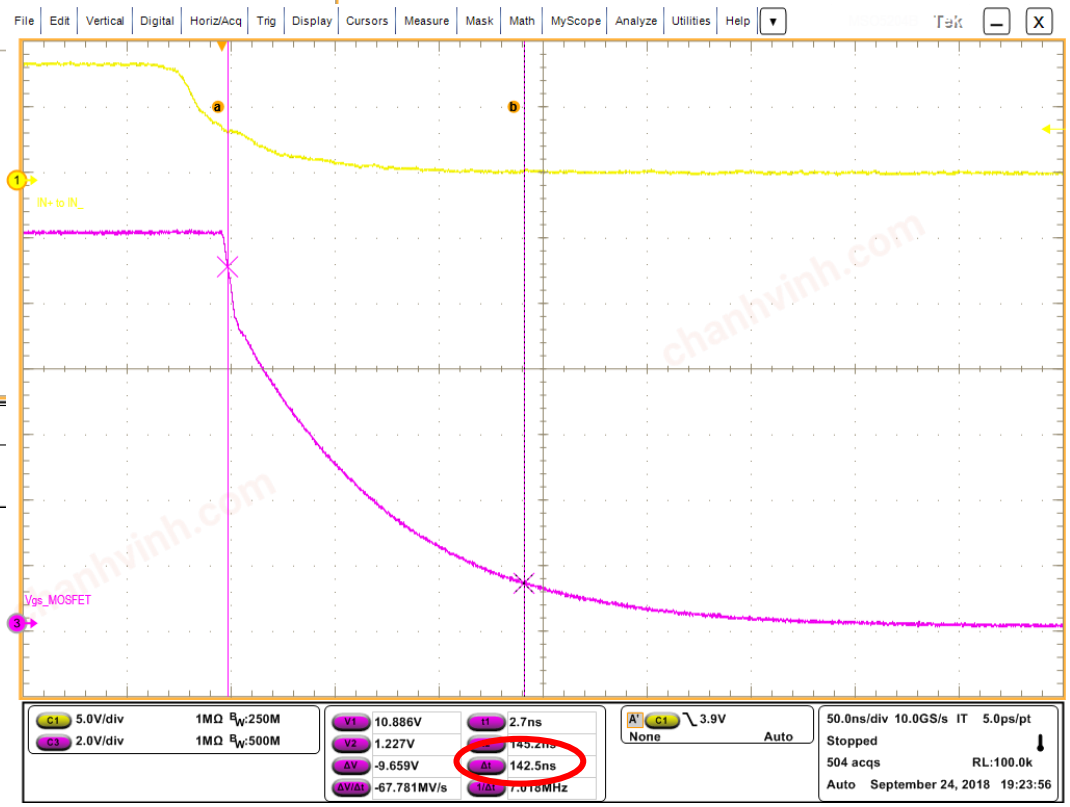
$R_{G,SOURCE} = 51\ \Omega$

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

$MOSFET = IPA60R280CFD7$

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

$C_{LOAD} \approx 1.3\ nF$

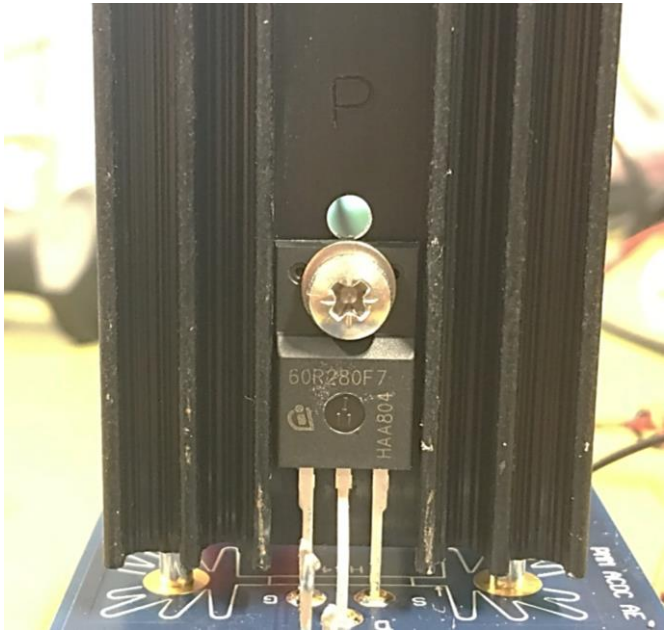


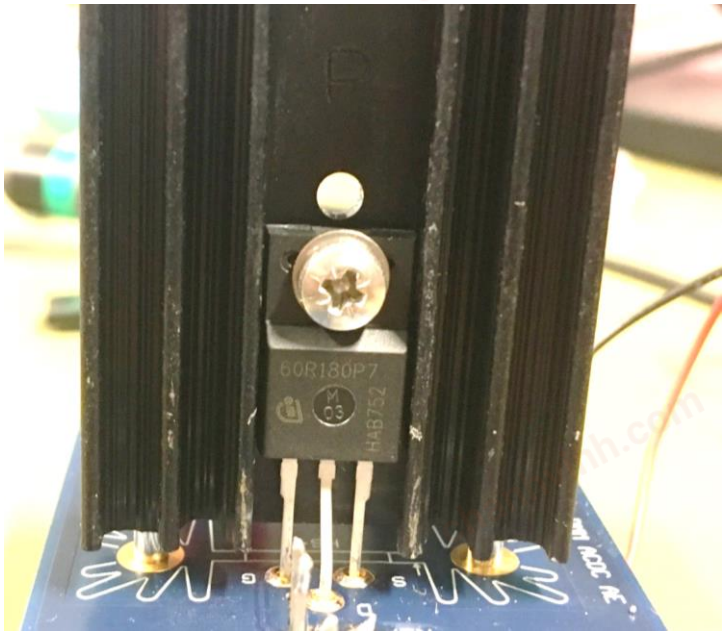
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MOSFET replacement

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

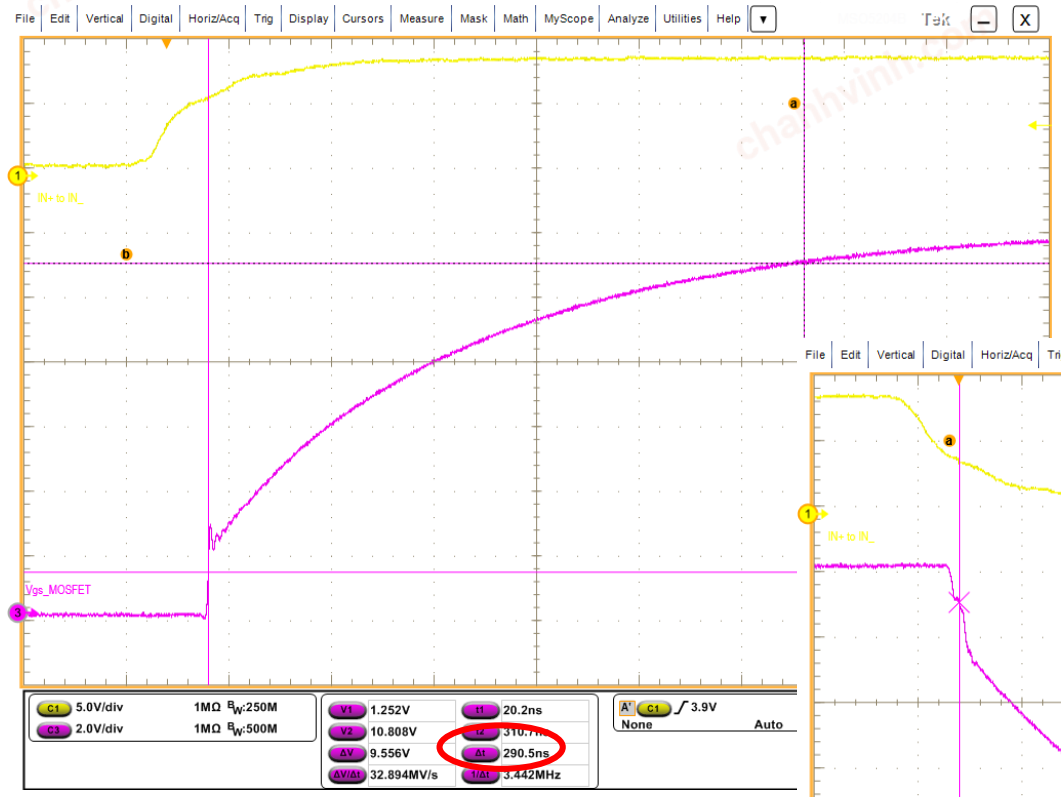
$R_{G,SOURCE} = 51\ \Omega$

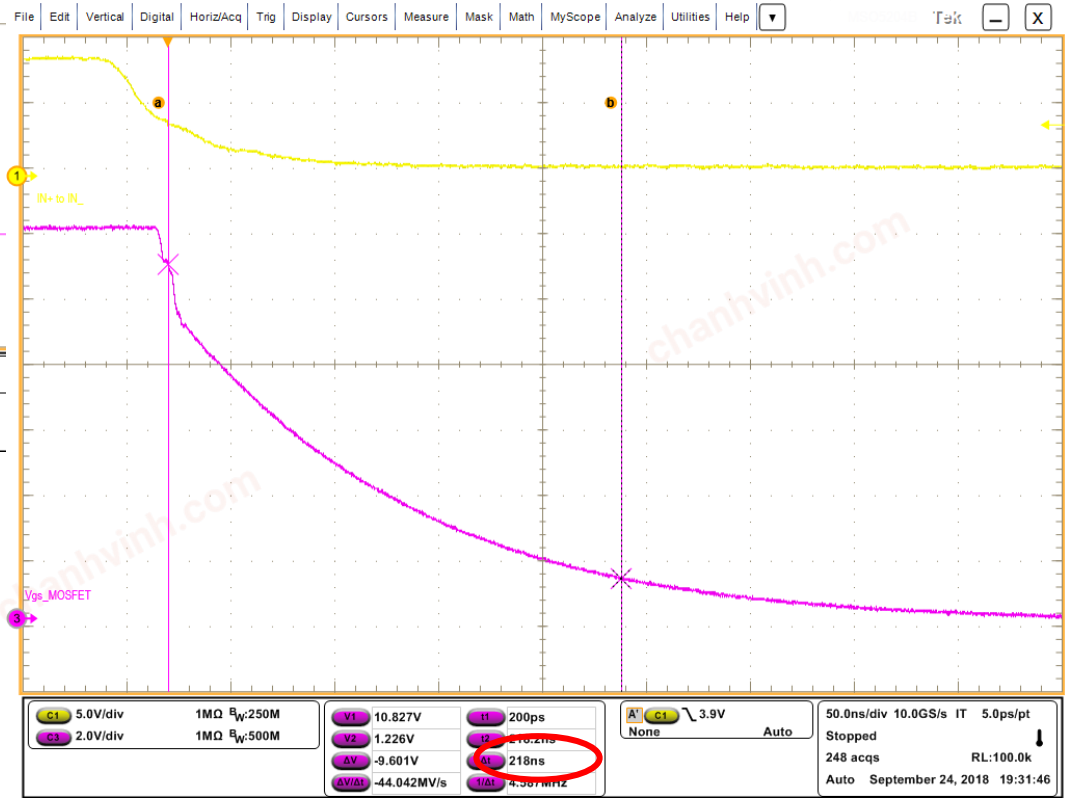
$R_{G,SINK} = 43\ \Omega$

$MOSFET = IPA60R180P7$

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

$C_{LOAD} \approx 1.9\ nF$





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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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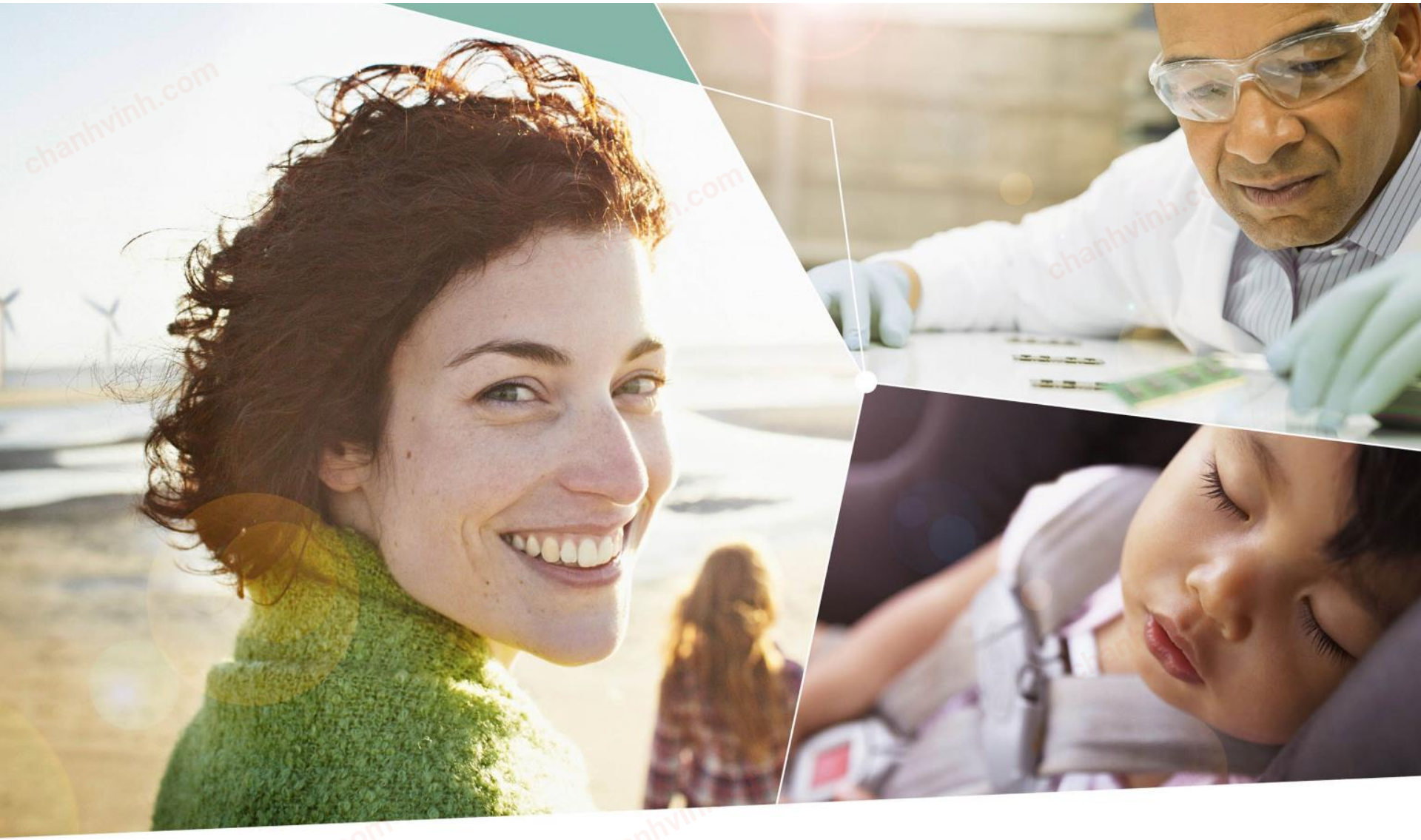
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