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EUROPE

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NUREMBERG

D³GaN for EV Inverter

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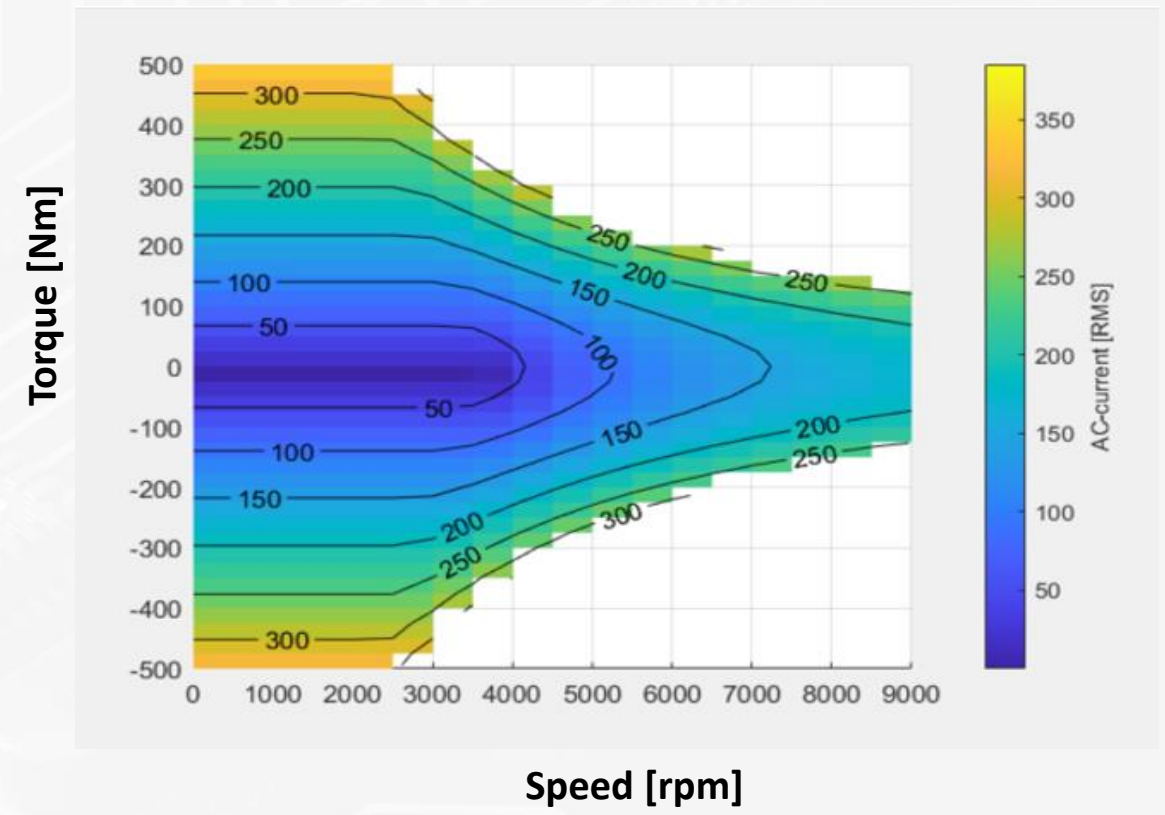
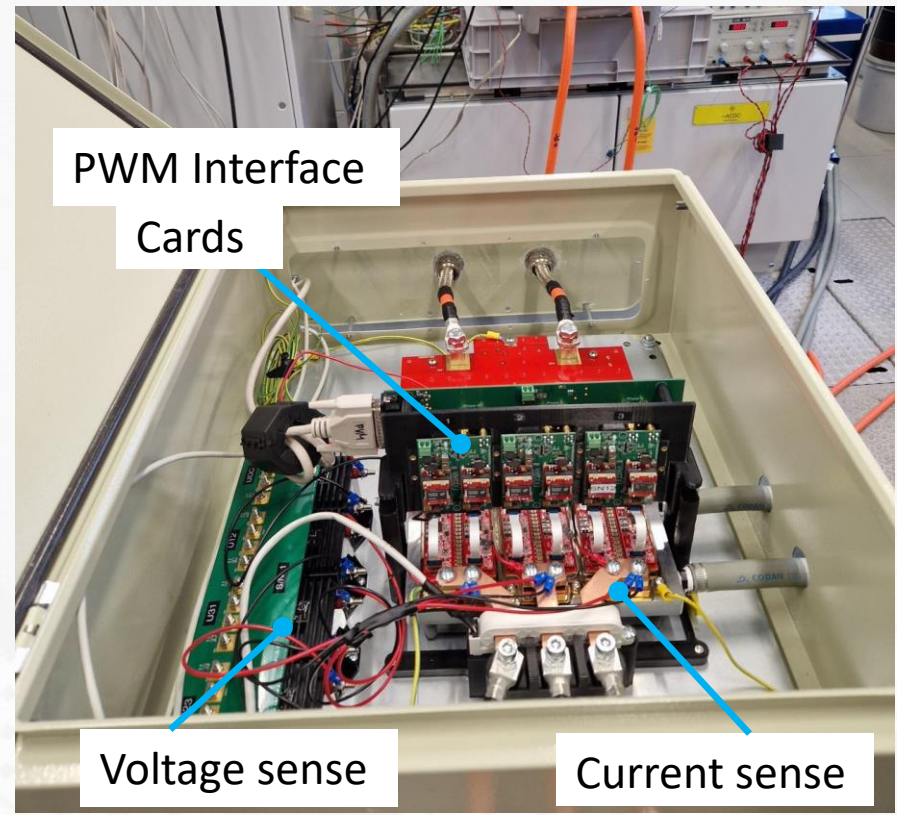
Q: D³GaN – How does VisIC Technologies utilize the benefits of a D-Mode GaN device for high-power application?

**A: D³GaN: Robust & Reliable high-power D-mode device with Direct Drive of the GaN die
= Fast switching, low switching losses
D-mode Direct Drive GaN**

Can a D³GaN device power an EV inverter?

3-Phase D³GaN Inverter, Closed loop DYNO testbench, tested up to 113 kW (El. Pwr)

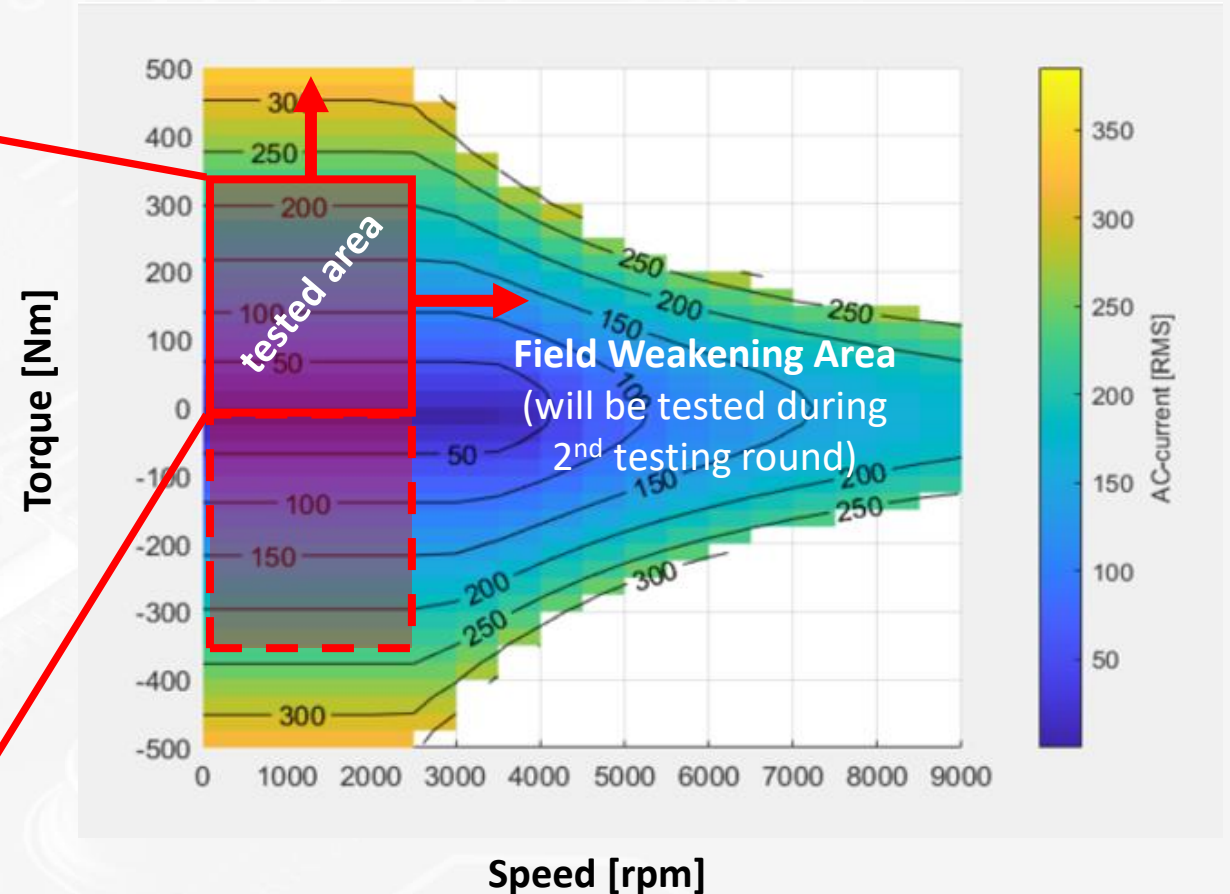
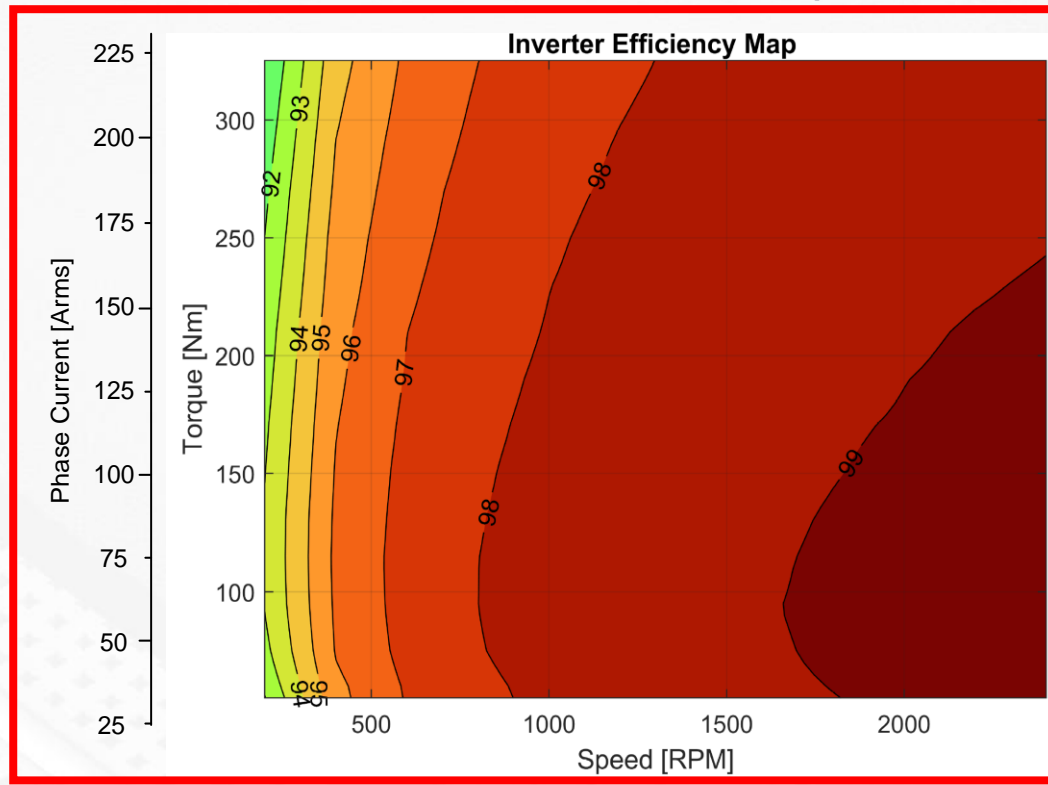
WLTC Standard (Worldwide harmonized Light-duty vehicles Test Cycle) is a 30 min test for passenger cars and light commercial vehicles mimicking driving cycle



Multiple operation points in the WLTP cycle

3-Phase D³GaN Inverter, Closed loop DYNO testbench:

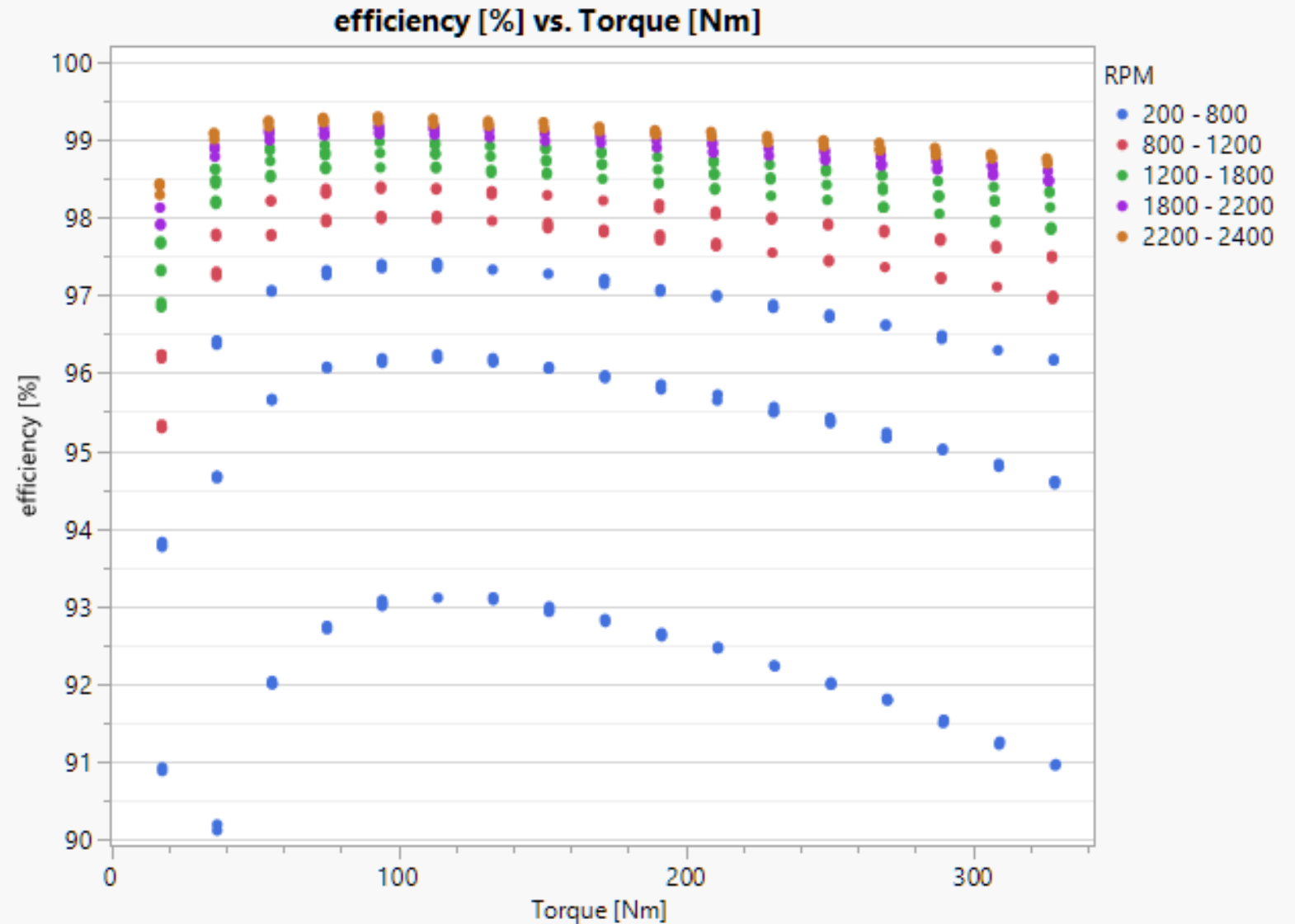
- **200** points were measured (measurements repeated 3 times) at:
 - Current up to 225A_{RMS}
 - Bus Voltage = 400V_{DC}
 - Motor's Rounds Per Minute: up to 2400RPM



Multiple operation points in the WLTP cycle

Max Efficiency point:

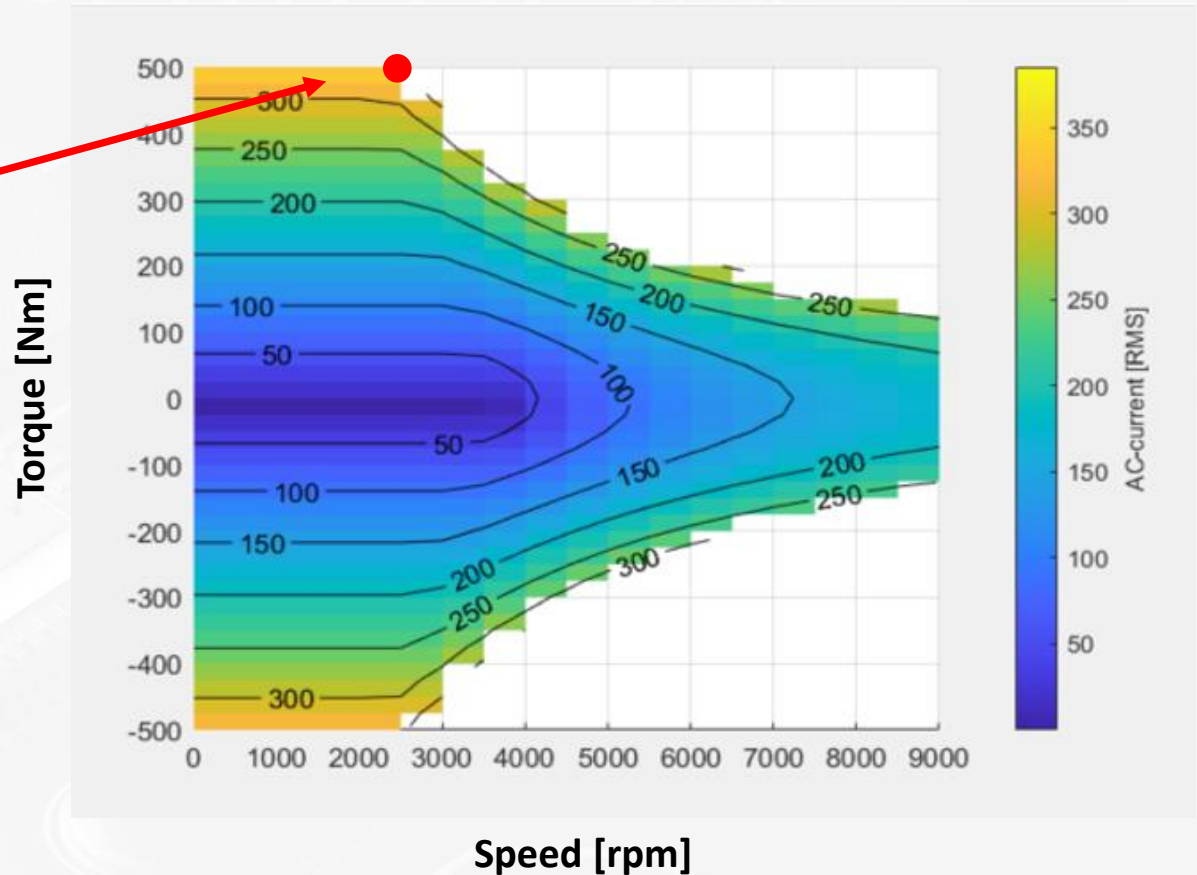
- 99.295%
- 2400RPM (120Hz)
- 92.8Nm
- 24.4kW output



Max power tested during 1st trials

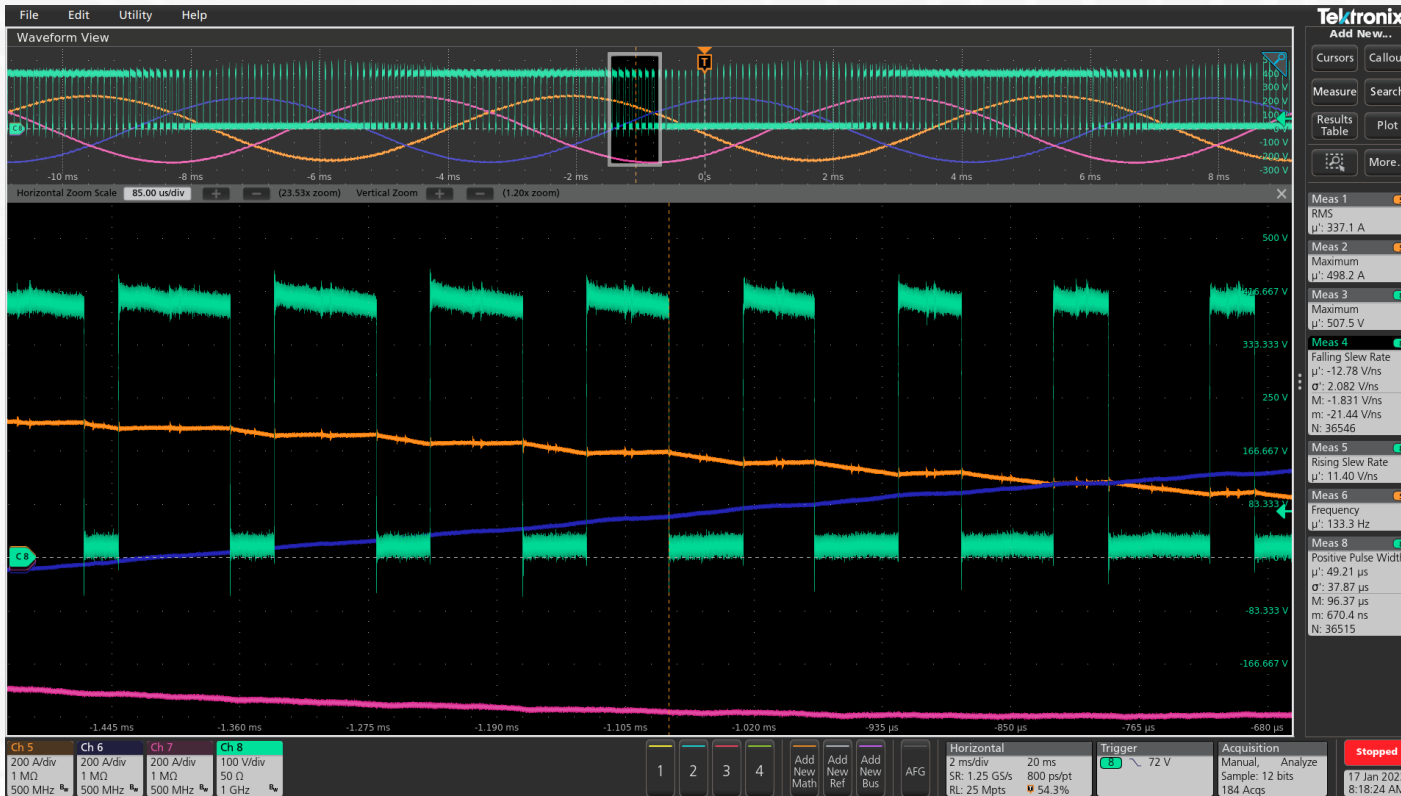
Objective: Testing the system at max parameters defined for this testing stage:

- 400Vbus
- 500Apk/350Arms.ph
- 133Hz (2660rpm)
- 30Sec



Max power tested during 1st trials

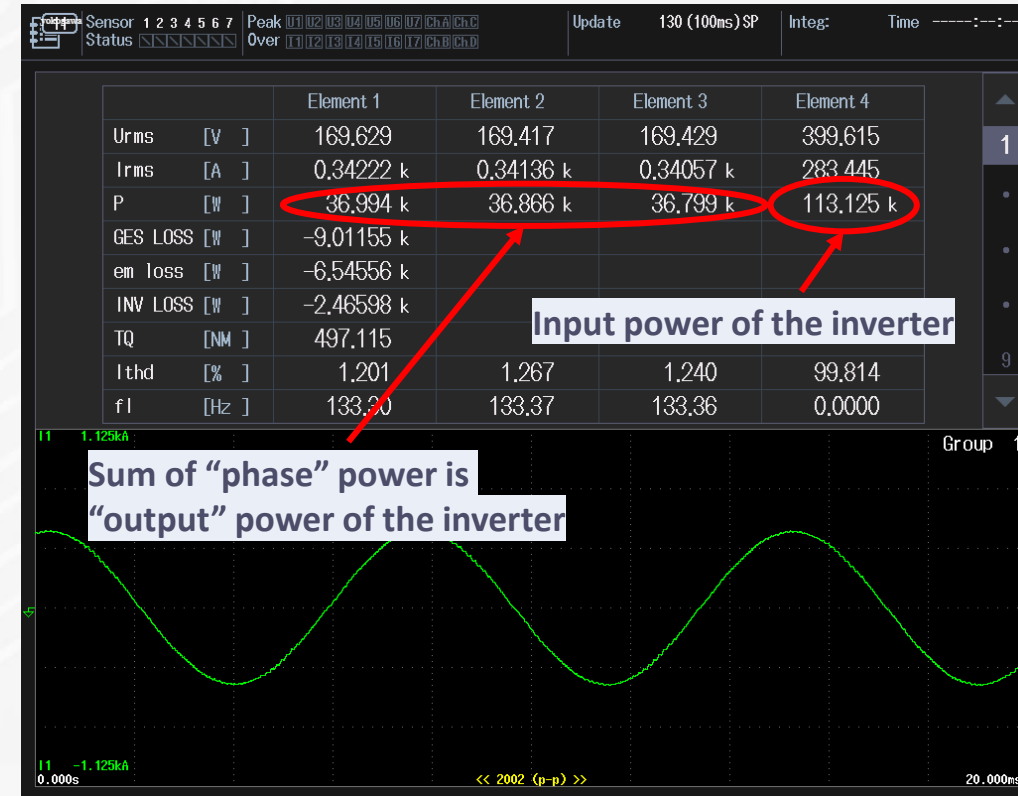
400VDC ; Phase current 350Arms/500Apeak; 2660 rpm/133Hz



Phase voltage and currents waveforms of inverter output

navy – phase 2 voltage; orange – phase 1 current

blue – phase 2 current; magenta – phase 3 current



Power meter measurements:

- Element 1/2/3 are measurements of phases 1, 2, 3 correspondingly.
- Element 4 is a measurement of the inverter input

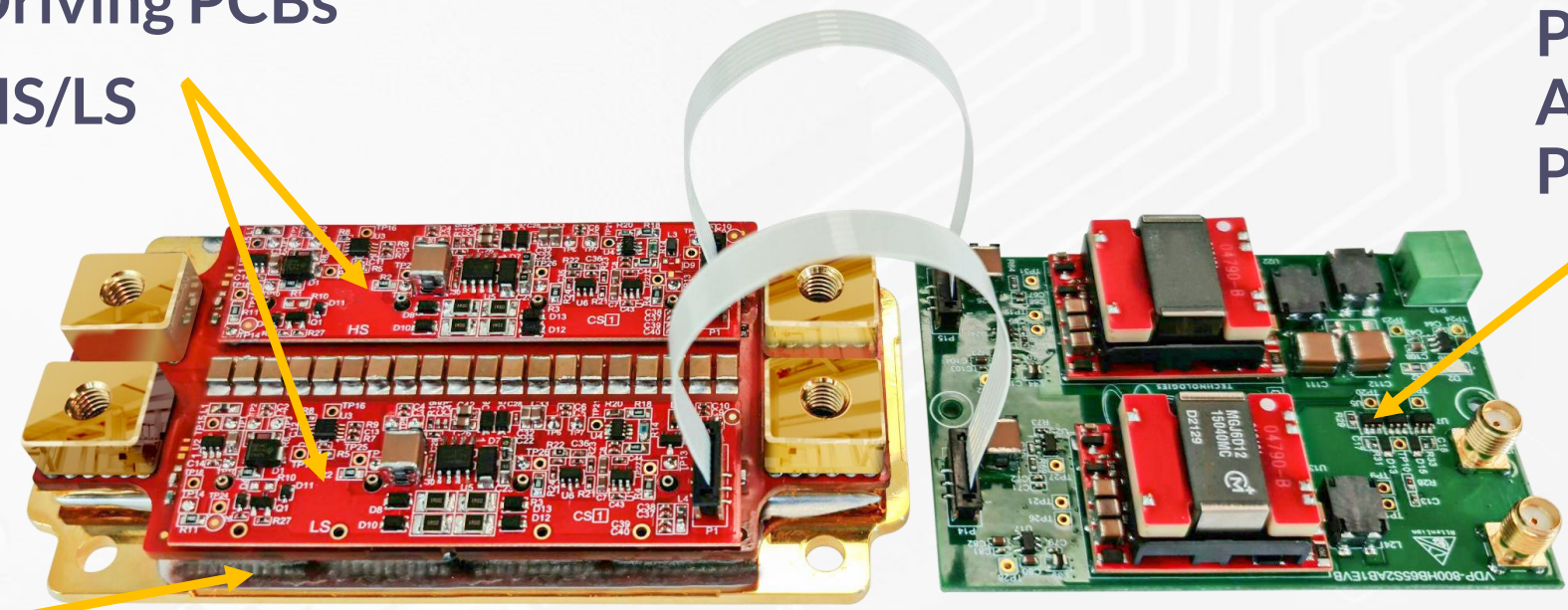
D³GaN Power Module prototype

- 4 parallel 8mOhm discrete devices in a HB configuration – 2.2mOhm 650V
- Straightforward paralleling of devices
- Off-the-shelf auxiliary components (Gate driver, Aux. power DC/DC, etc.)

Driving PCBs
HS/LS

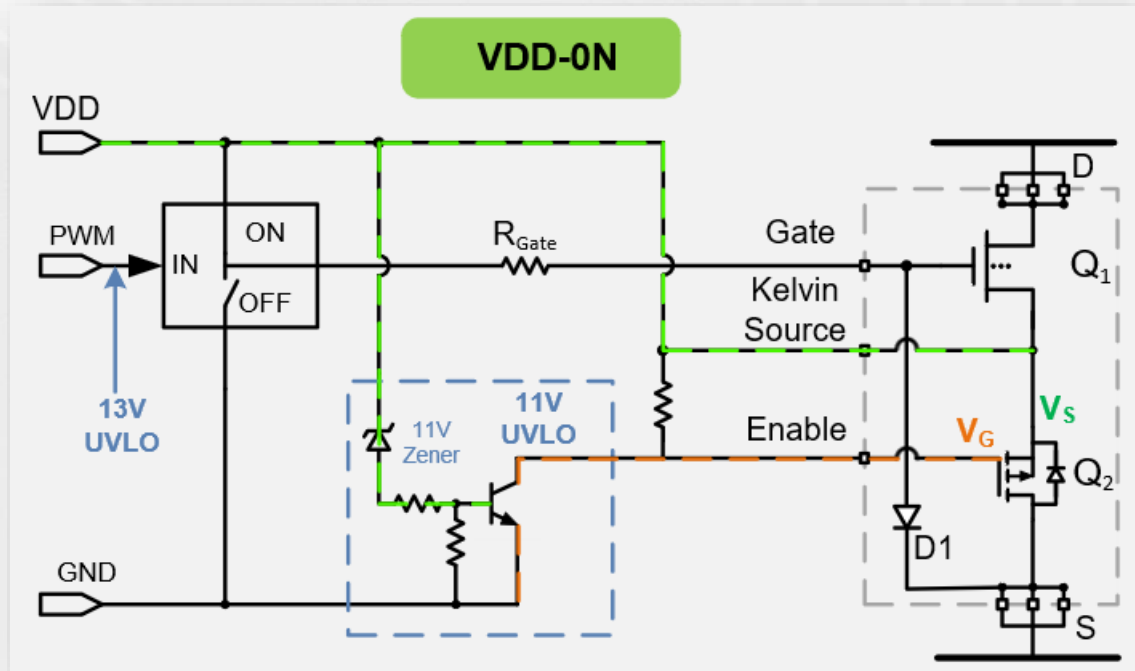
PWN input &
Aux. Power
PCB

Power PCB

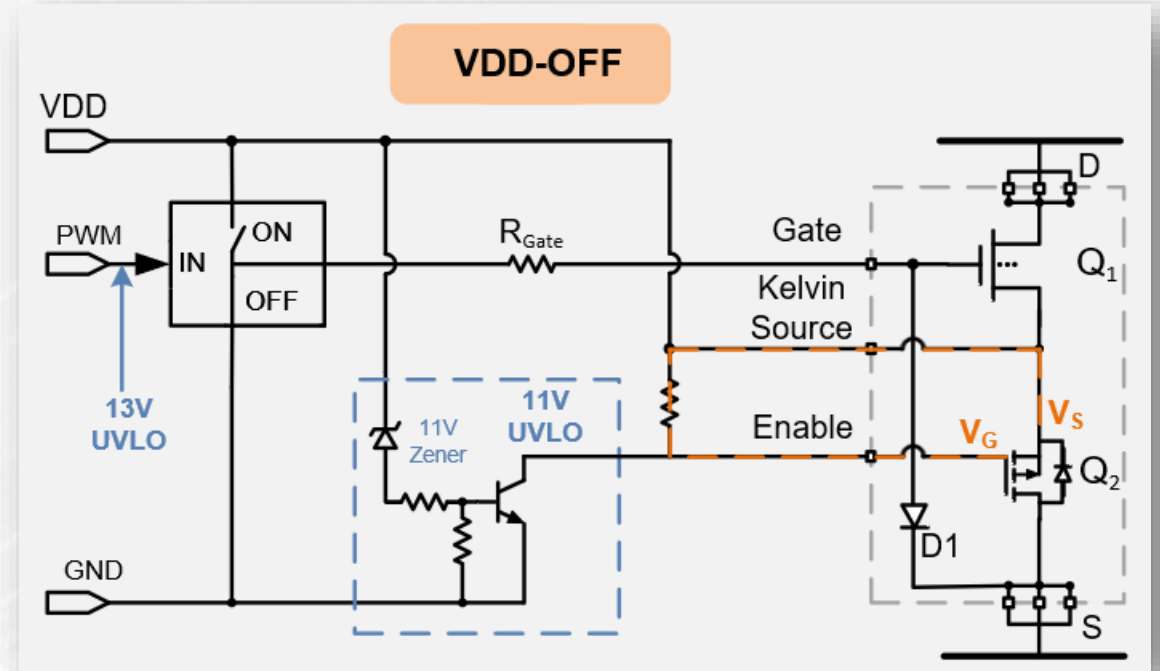


D³GaN – Direct Drive D-Mode GaN

pMOS Q2 Operation

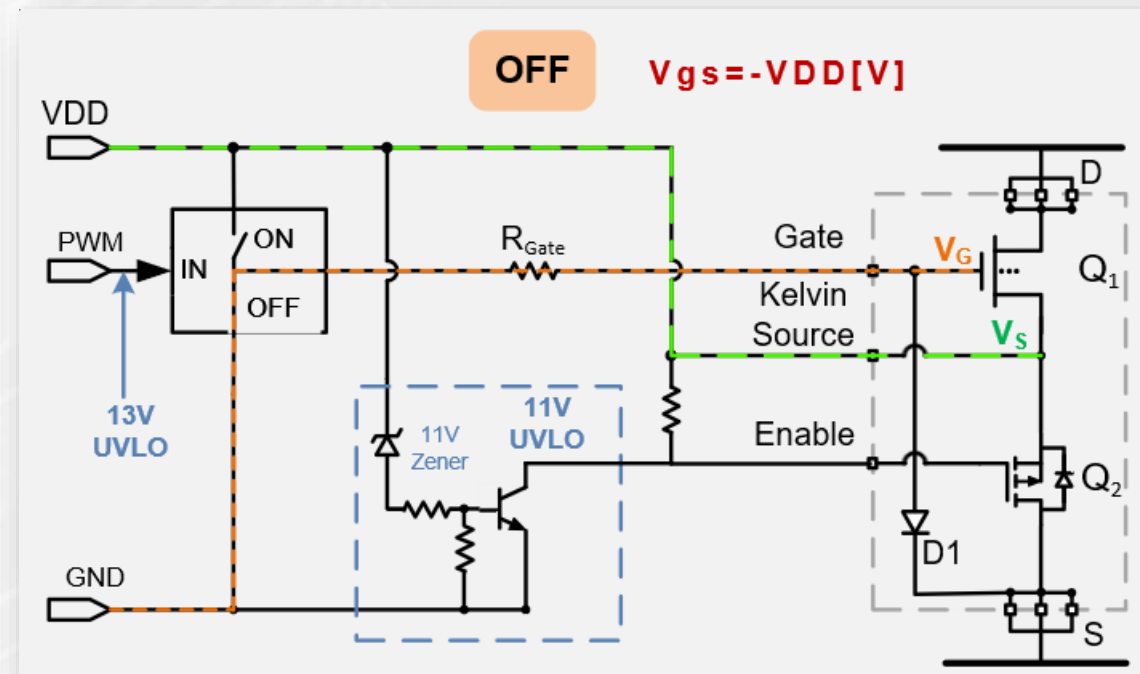
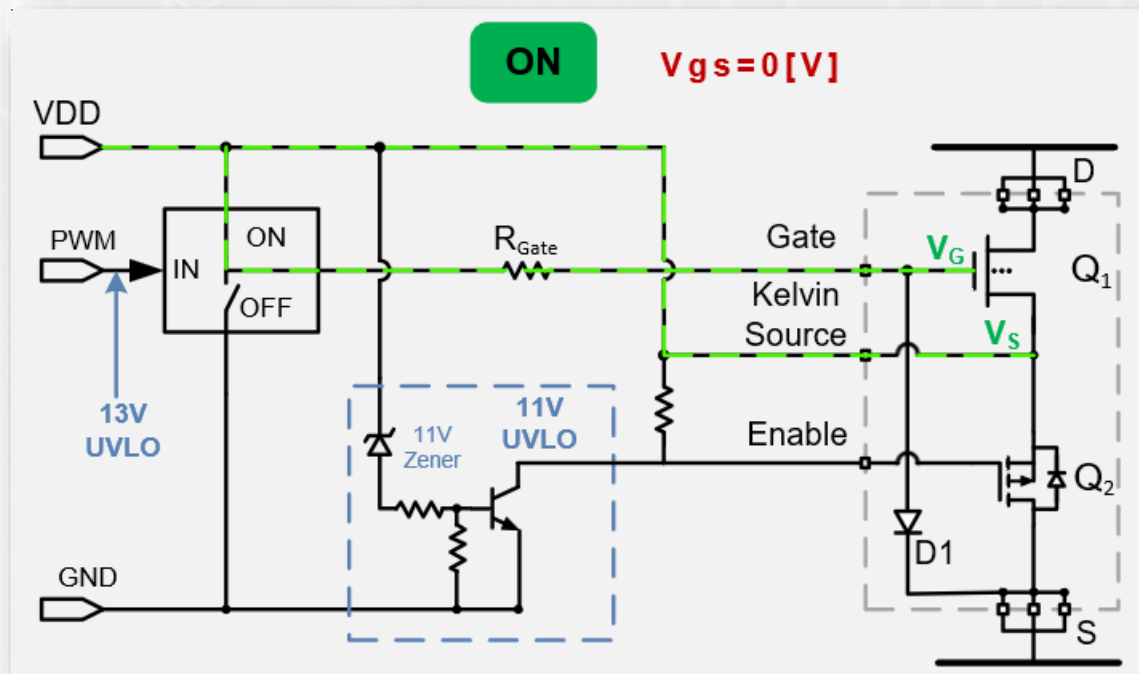


1. $V_{GS} [-VDD] \ll V_{TH} [-3V] \rightarrow Q2$ is ON



1. $V_G = V_S \rightarrow V_{GS} = 0 \rightarrow Q2$ is OFF

D³GaN - Direct Drive D-Mode GaN

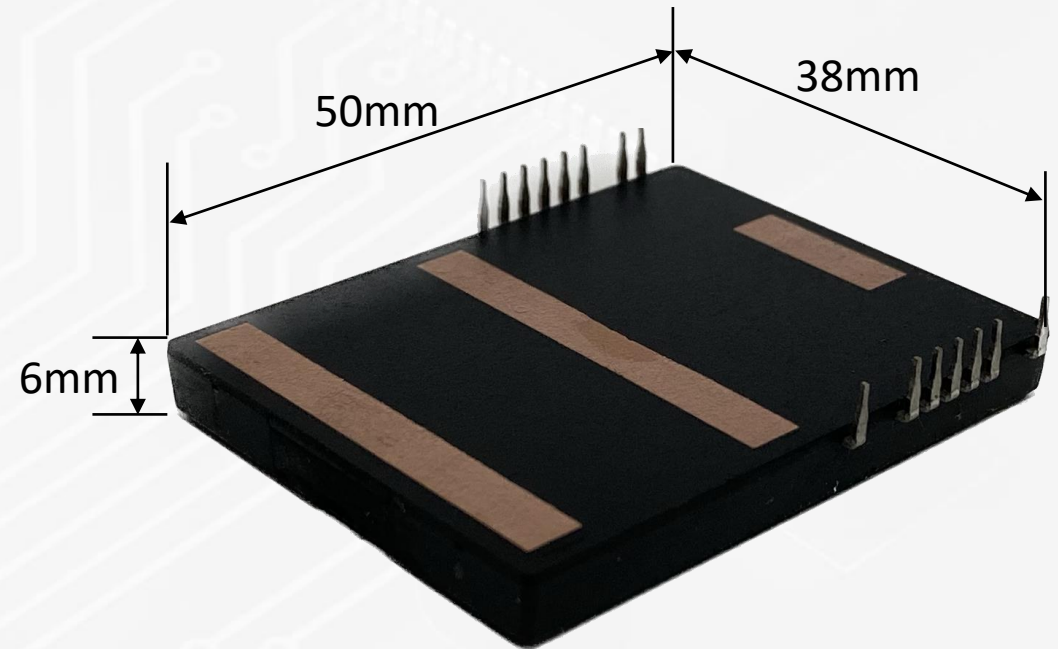


- Gate driver is directly driving the GaN Gate
- High Threshold Voltage margin: recommended $V_{DD} = 15V..20V$, $V_{TH} \approx 8V$
- Robust gate (compared to E-mode GaN technology)
- **Designing a device that will reduce the constraints on the application designers.**

D³GaN – Power Module VM044

Next iteration of D³GaN Power Module prototyping

- 2x8mΩ, 650V parallel die
- Half Bridge configuration
- Transfer molded package
- Weldable power terminals = Low inductance terminal connection to busbars
- Thermal case designed for sintering to the heatsink = Lower thermal resistance
- High-performance Si₃N₄ ceramic substrate
- NTC sensor



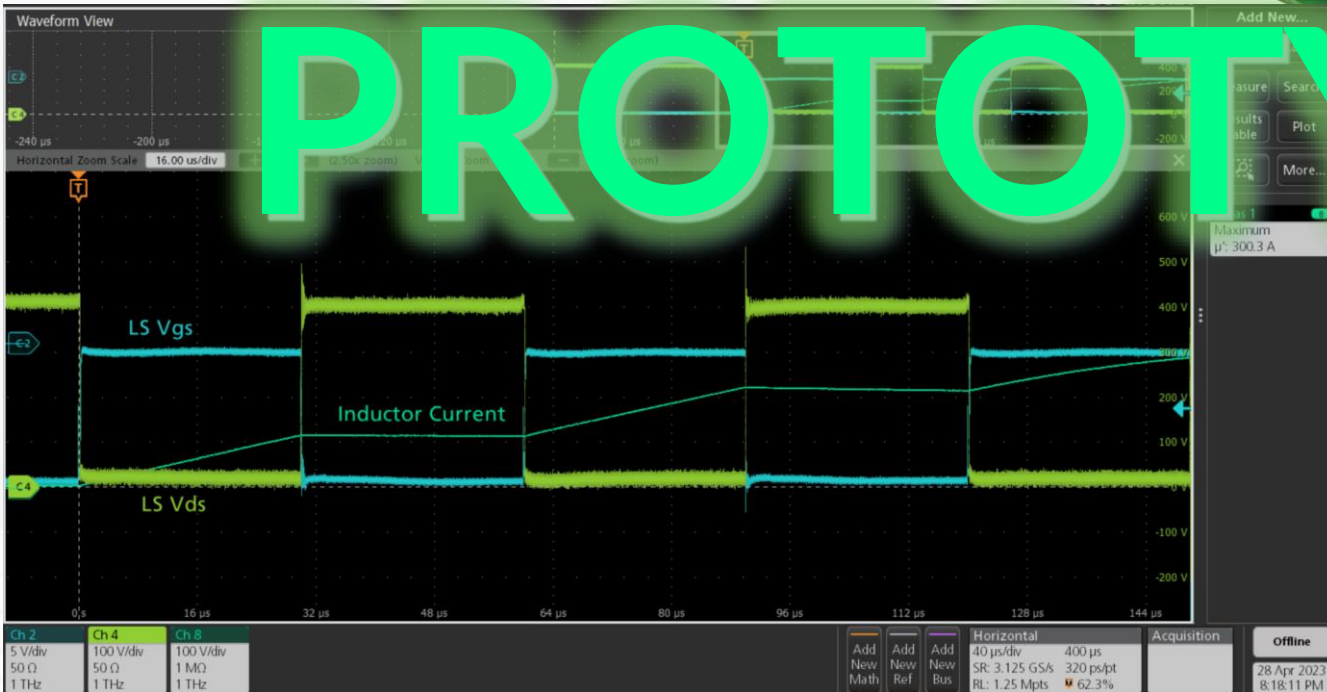
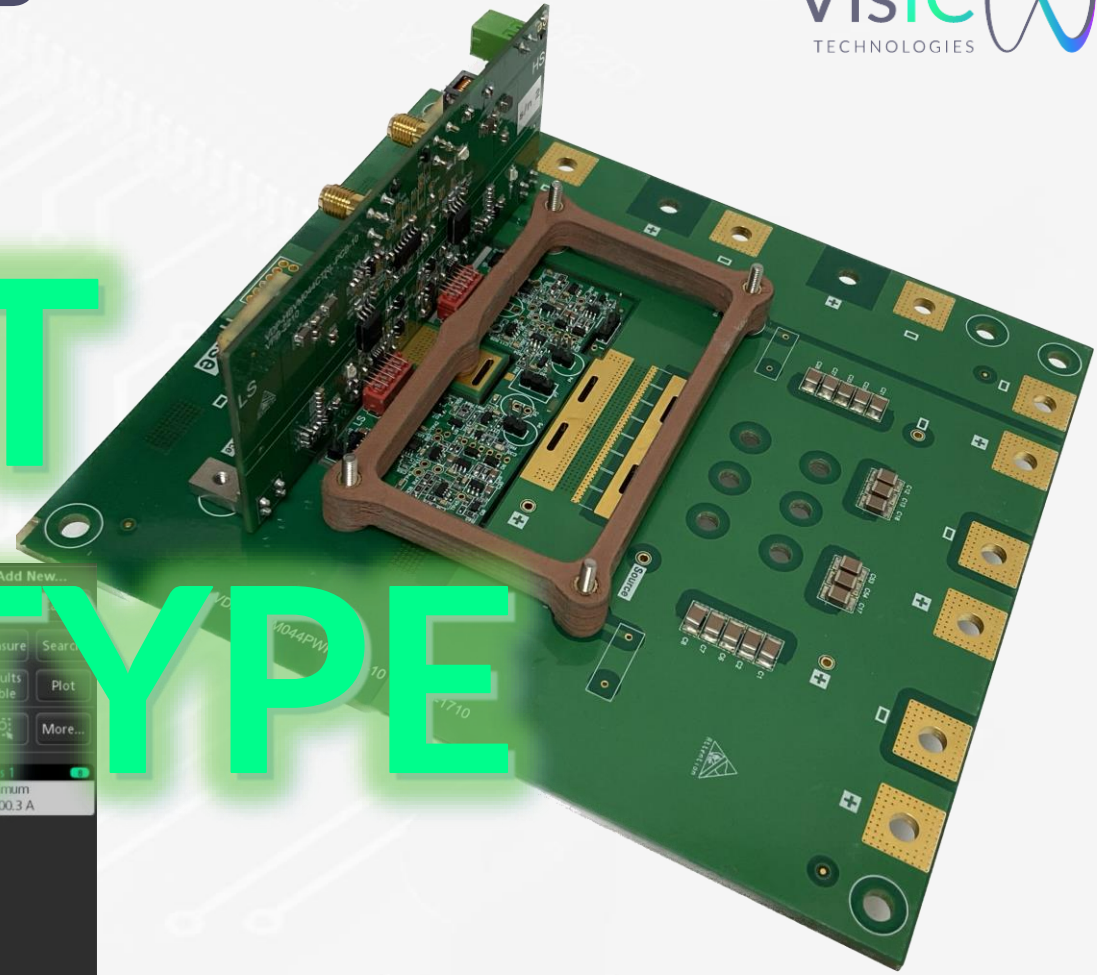
D³GaN – Power Module VM044 EVB

Next iteration

- VM044 Evaluation Board enables dynamic characterization and switching performance measurements of the power module

FIRST

1st prototype testing: Multi-Pulse 400V, 300A



PROTOTYPE

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in-depth technical discussion,
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Come to meet our team of experts
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at Booth 9-212

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the attention!**

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questions in booth 9-212

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THANK YOU

