

Date: 18.04.2019

Attendees: Mesut Uğur, Furkan Karakaya

Location: Electrical Machines Laboratory

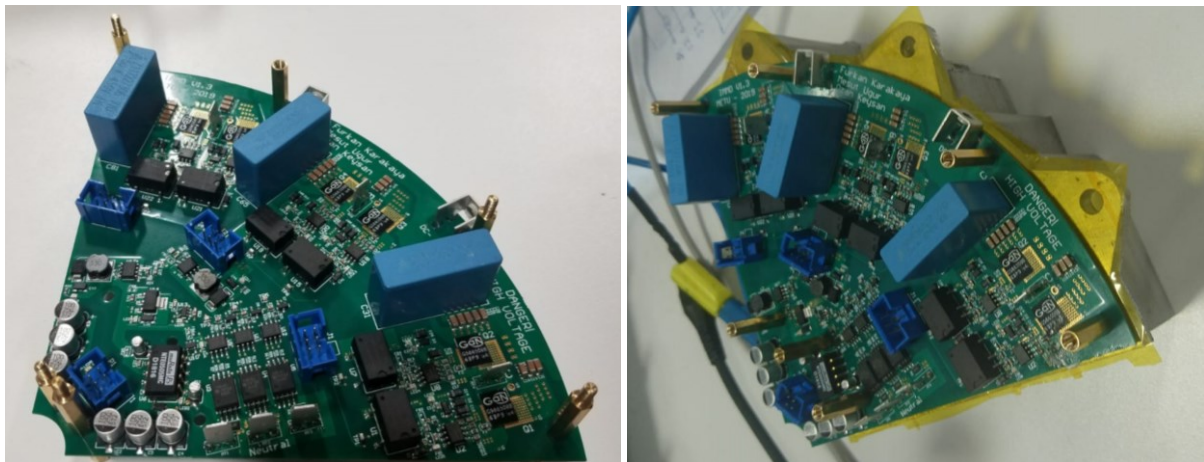
Target: V1.3 Gate Driver Board (#1)

Test type: Inverter test with RL load

Aims before the test:

1. To test the V1.3 GDB as an inverter
2. To verify that the inverter is working at 300Vdc voltage
3. To verify that the inverter is working at 8Arms current
4. To verify that the inverter can deliver 2kW power to the load (Thermal test)
5. To verify that the inverter is working at nominal values with 40kHz switching frequency

Conditions: 22 Ohm R_{on} , 2 Ohm R_{off} . 0-300V VDC. RL Load: Five different stages. 10kHz-40kHz fsw. 0.9 power factor. Sinusoidal PWM with 0.9 modulation index.



Steps:

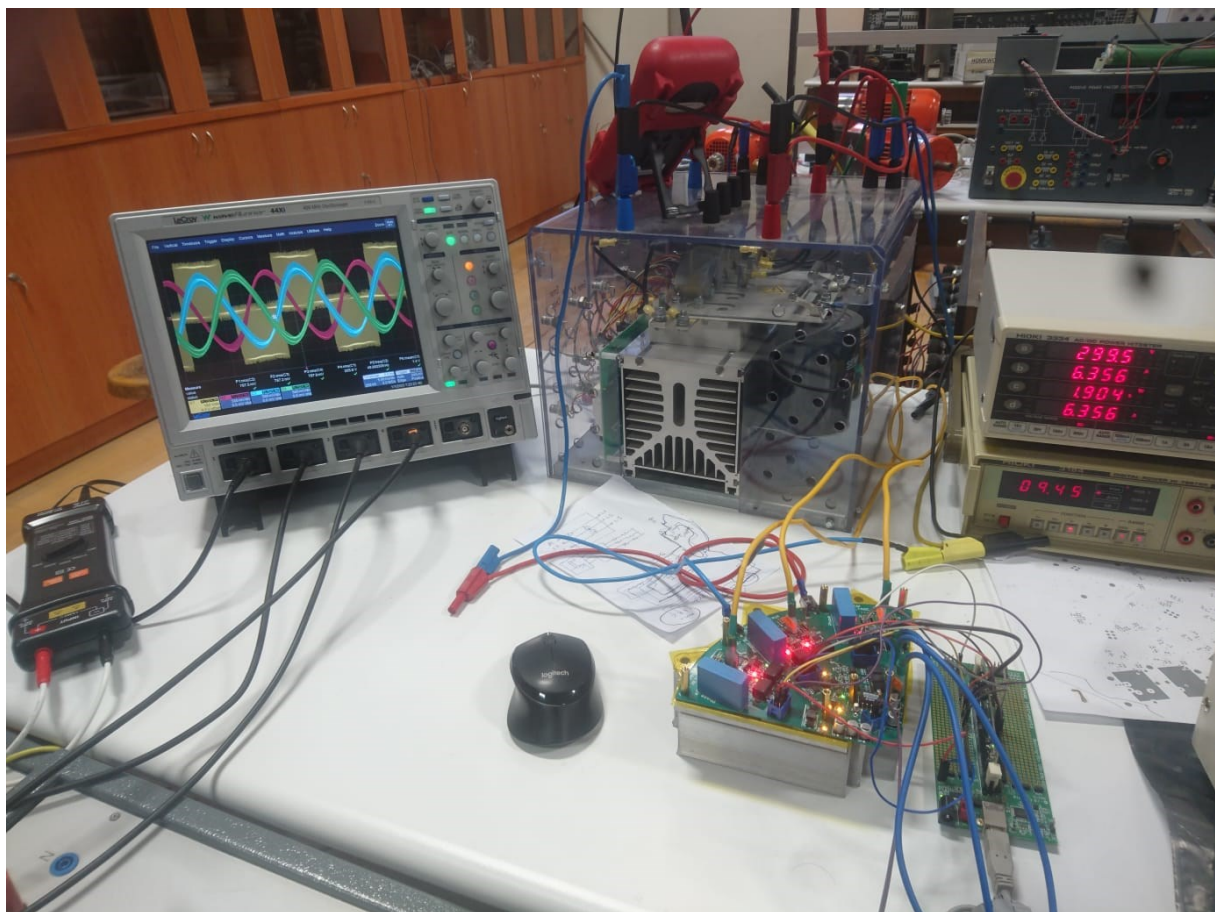
1. The test steps and conditions are as below. In all steps, the DC link voltage is increased gradually.
 - i. Load stage-1 (Light load). 0-300V DC. 10kHz fsw. 400W output power.
 - ii. Load stage-2. 0-300V DC. 10kHz fsw. 800W output power.
 - iii. Load stage-3 (Medium load). 0-300V DC. 10kHz fsw. 1200W output power.
 - iv. Load stage-4. 0-300V DC. 10kHz fsw. 1600W output power.
 - v. Load stage-5 (Full load). 0-300V DC. 10kHz fsw. 2000W output power.
 - vi. Load stage-5 (Full load). 0-300V DC. 40kHz fsw. 2000W output power.
2. All the steps are covered and the inverter is working successfully at 300V DC bus voltage, 8A line current, 2kW output power and 40kHz switching frequency.
3. The thermal performance of the system is better than expected. The highest temperature which has occurred around phase-B GaNs is 55 °C at full load.

What to do next:

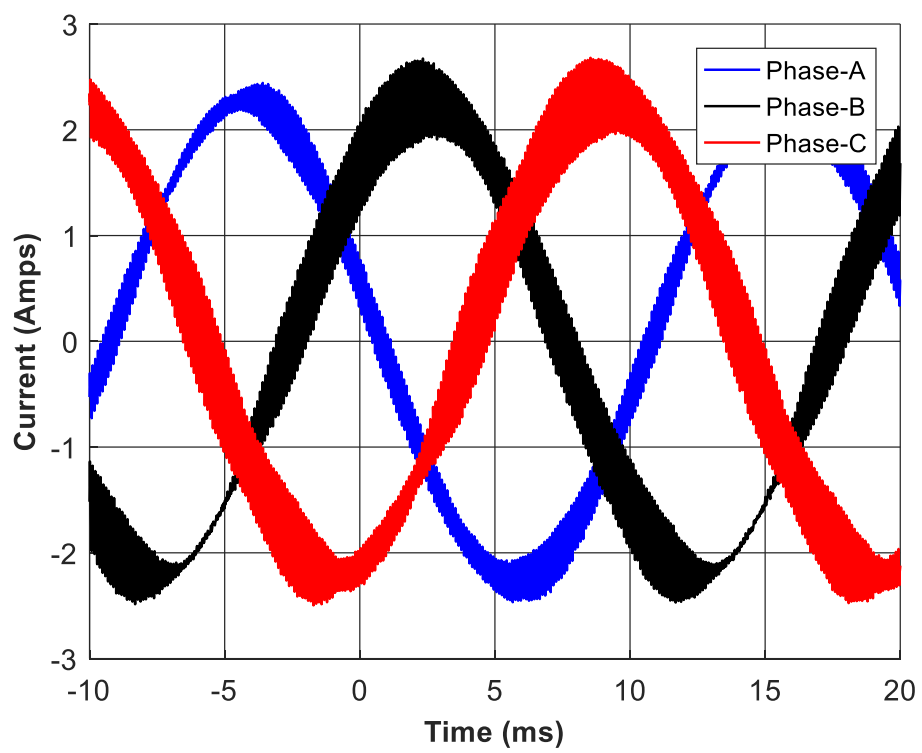
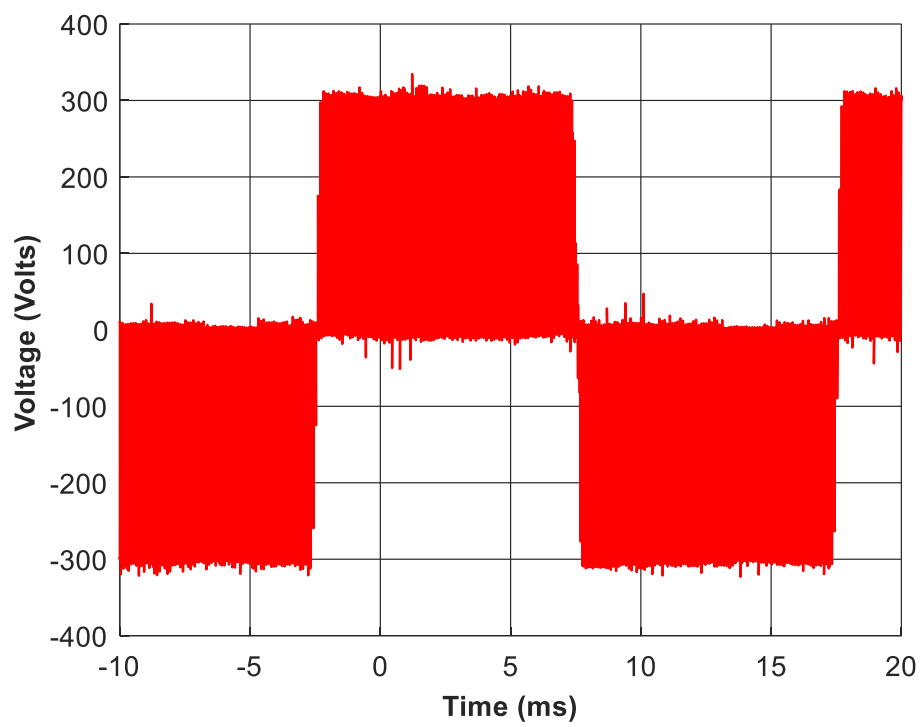
1. Efficiency could not be measured. A test setup will be proposed to measure it.
2. The thermal model will be revisited with new power loss inputs (4-5W). The previous simulation showed 90 °C temperature around GaN case with 10W loss. Actual losses are predicted as 4-5W.
3. DC bus capacitor voltage ripple will be observed and compared with calculations and simulations.

Results:

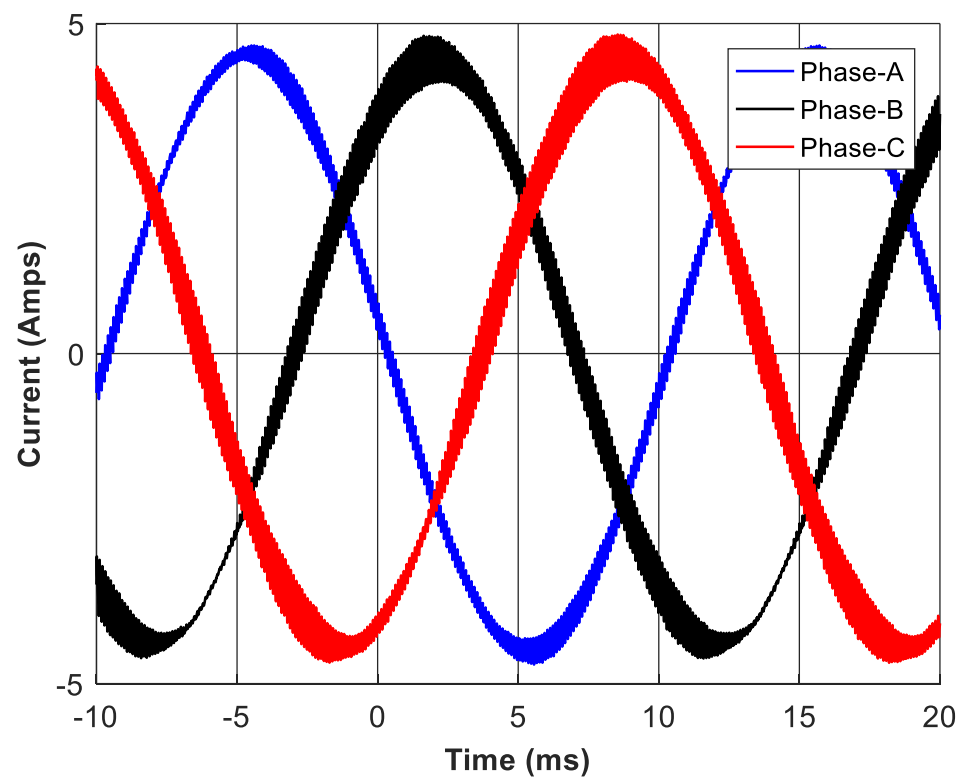
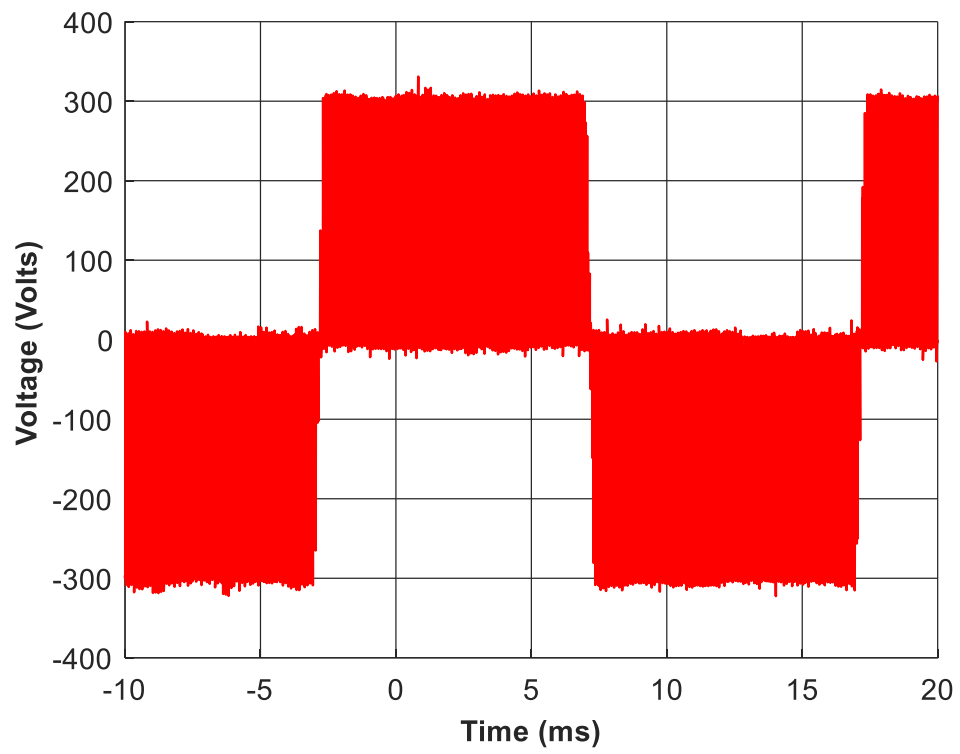
Caps or it didn't happen !



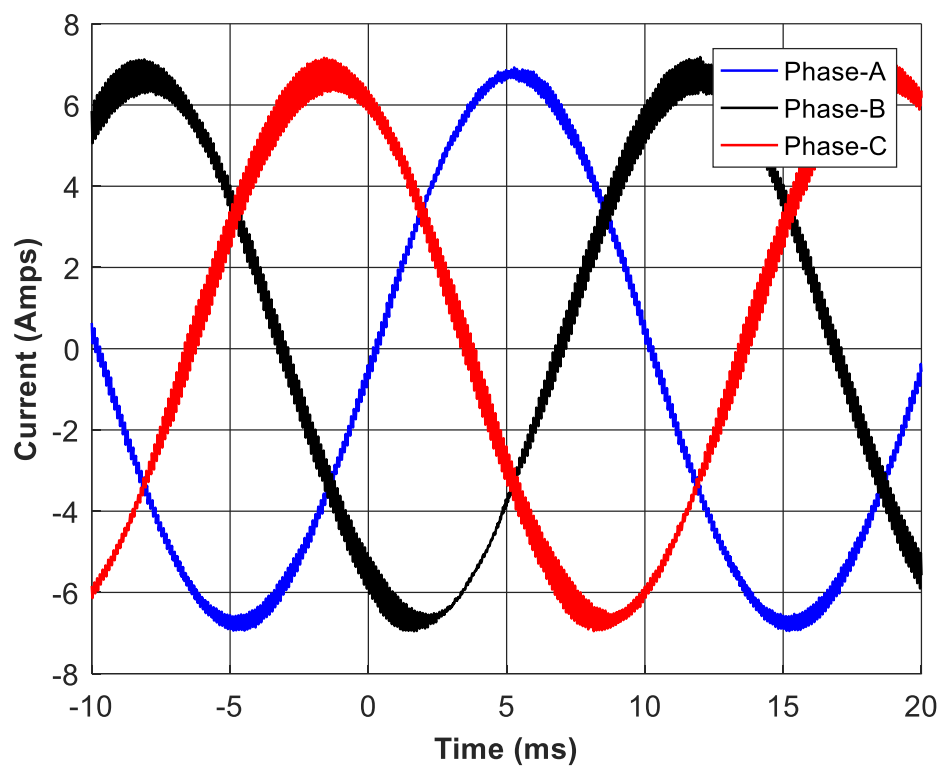
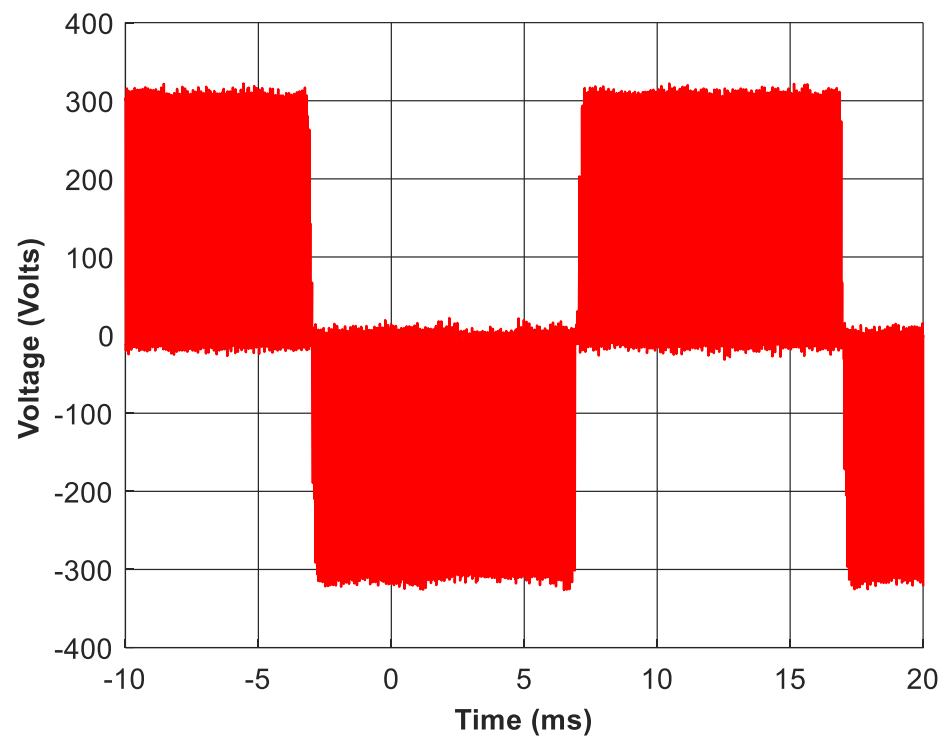
1. Load stage-1, 10kHz:



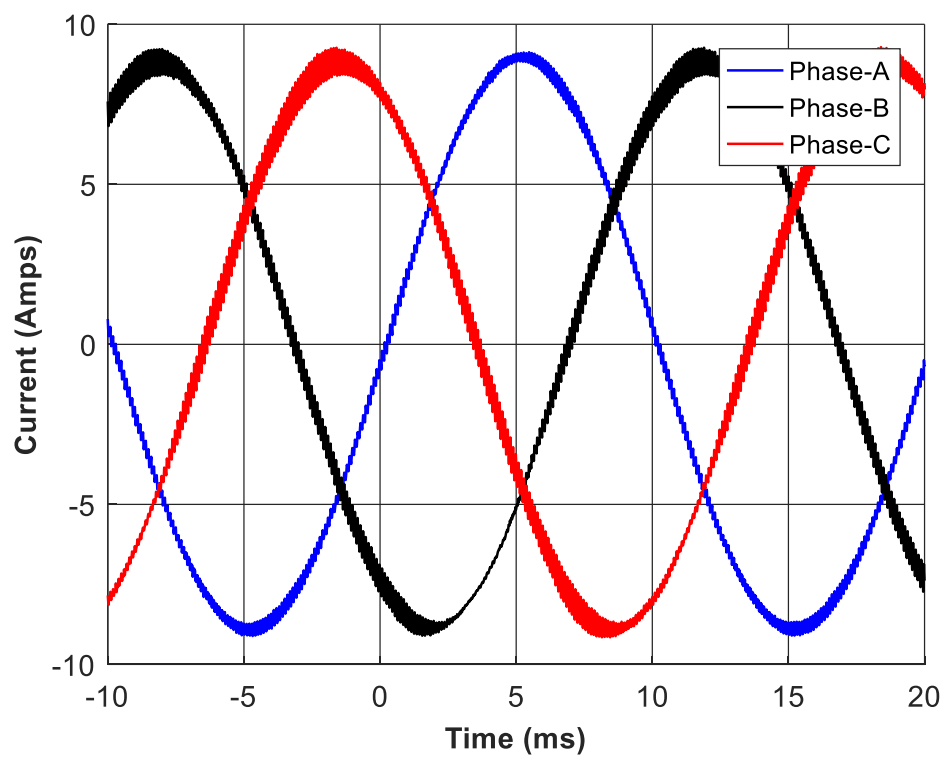
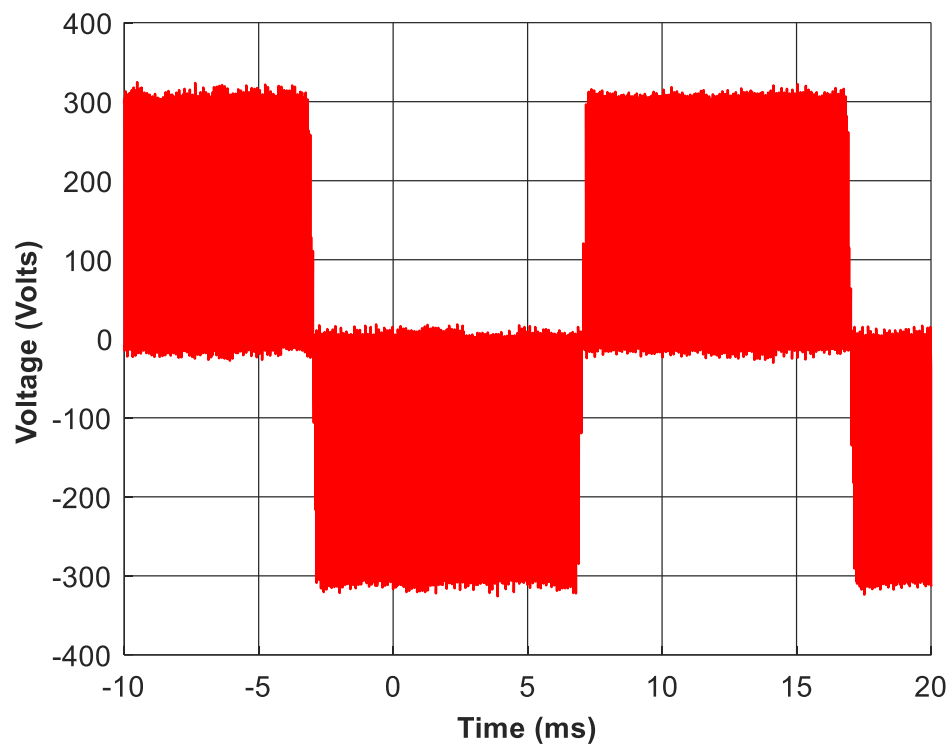
2. Load stage-2, 10kHz:



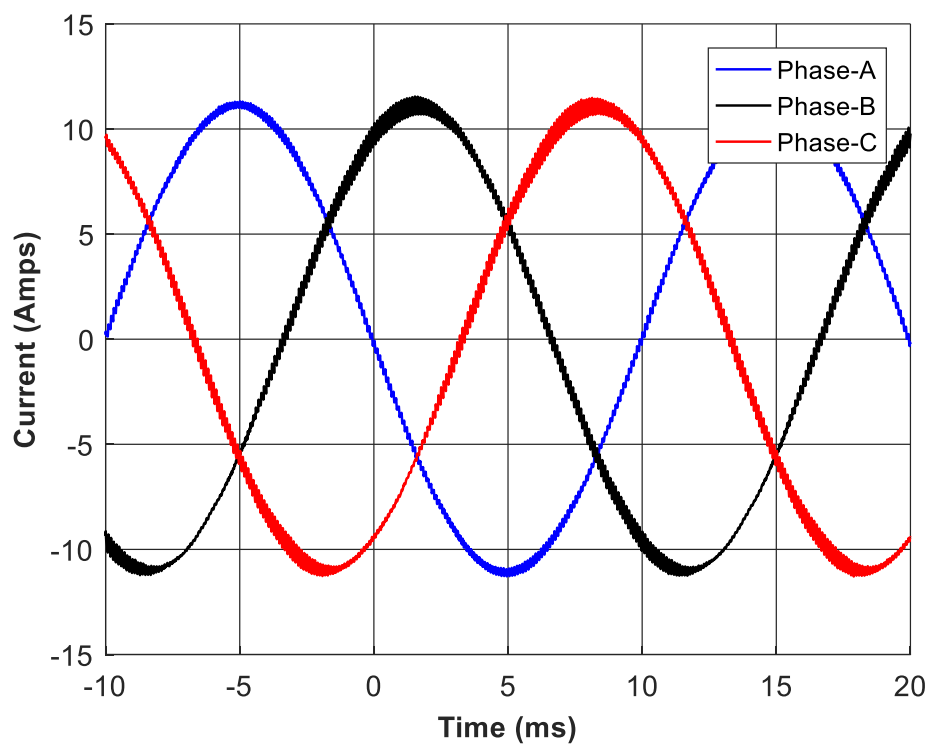
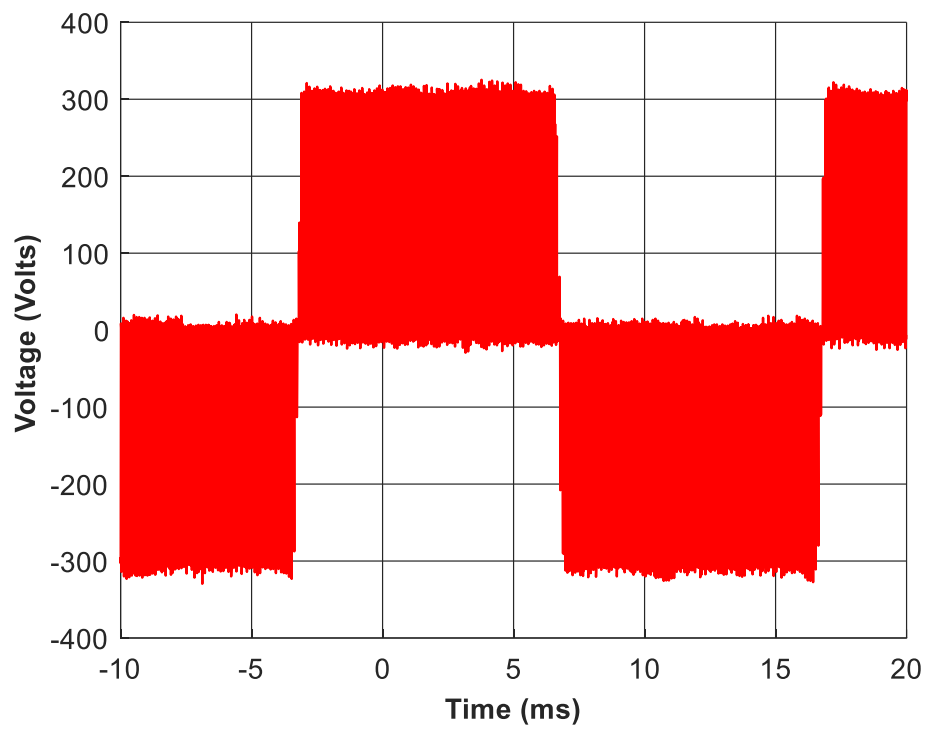
3. Load stage-3, 10kHz:



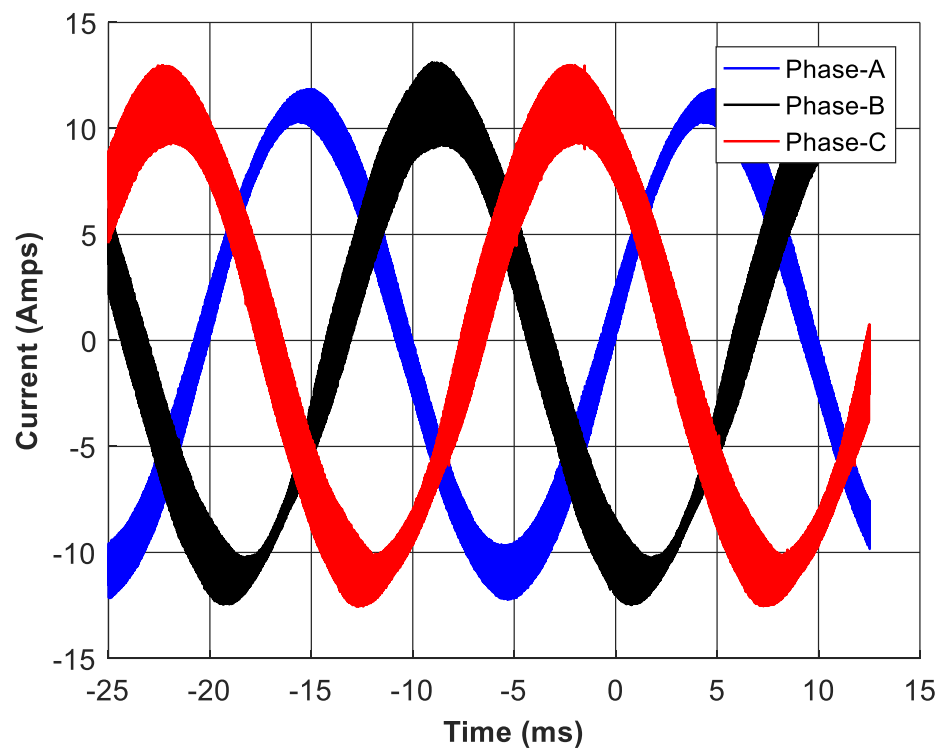
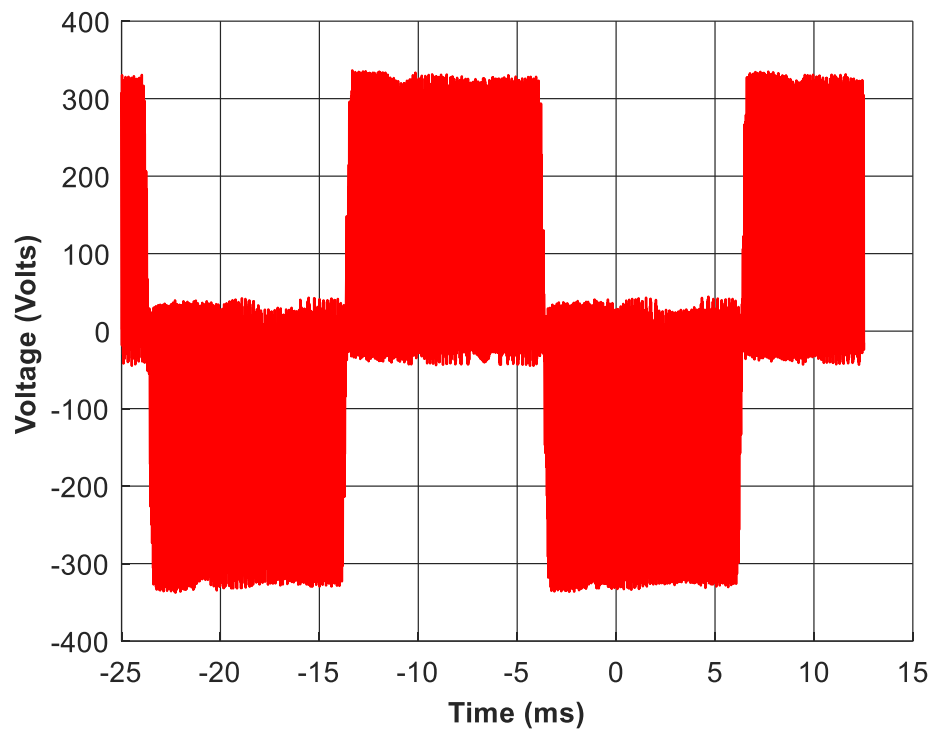
4. Load stage-4, 10kHz:



5. Load stage-5, 10kHz:



6. Load stage-5, 40kHz:



7. Thermal results: