HALF-BRIDGE INVERTER

1) Lab Introduction

In this lab, students compare Si versus SiC MOSFETs as switches in a half-bridge inverter. This lab begins with constructing a half-bridge inverter with Si switches. Students measure the output voltage across an *RLC* load and the current going through the load at a duty cycle of 50% and a switching frequency of 10 kHz, followed by changing to a switching frequency of 100 kHz. The AC fundamental frequency is equal to that of the switching frequency. A similar process repeats with SiC switches.

2) Materials and Supplies

The following are suggested:

1. PowerBox
2. Oscilloscope
3. dc power supply
4. Two differential voltage probes
5. Two current probes
6. Breadboard with passive capacitors and inductors
7. Variable-load power resistor
8. Six banana cables
9. Flathead screwdriver

3) Detailed Instructions

Step 1: Make the following connections: the drain of FET1 to the positive end of the dc power supply and also the top pin of the upper capacitor, the source of FET1 to one terminal of the resistive load and also to the drain of FET2, the source of FET2 to the negative power supply and also to the bottom pin of the lower capacitor. Connect the other terminal of the resistive load to the input pin of the *LC* filter.
Step 2: Turn on PowerBox. Measure the two gate signals with the oscilloscope. Make sure they are set to the initial 10 kHz. Set the output of the dc supply to 20 V.
Step 3: Have a lab TA check off the circuit before turning on the dc power supply output.
Step 4: Connect one differential voltage probe across the top switch and one across the load. Attach one current probe to the wire between the source of FET1 and the drain of FET2. Attach the second current probe through the resistive load. Turn on the dc supply output. Take a screenshot of each waveform and note any overshoot or ringing.
Step 5: Set the switching frequency to 100 kHz. Repeat Step 4.
Step 6: Disconnect power and switch from the Si side to the SiC side. Then reconnect the converter system in the same orientation as before with the SiC switches. Set switching frequency back to 10 kHz. Again, have a lab TA check off the circuit before turning on power.
Step 7: Turn on PowerBox and the dc power supply. Measure the voltage across SiC MOSFET 1. Repeat the remainder of Step 4 and Step 5.
Step 8: Turn off PowerBox and the dc power supply.

4) Post Lab Questions

Question 1: Attach the oscilloscope captures of the voltage across the switch (V_{ds}) taken with the Si and SiC switches. How do they compare? Is there any difference between the Si and the SiC waveforms at 10 kHz? What about 100 kHz?
Question 2: Calculate the system's efficiency at 10 kHz and the efficiency at 100 kHz for both switching technologies. How do the efficiency numbers compare between Si and SiC switches at both frequencies?