

Development of Low Cost Gate Drive for SiC JFET

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Motivation

- The current gate driver chip developed by SemiSouth is very costly compared to the SiC JFET itself.
- SiC transistors have vast potential in high voltage environment and can reduce the cost of using heatsink as well since it can operate in high temperature conditions.
- The concepts can be used in driving future SiC MOSFET.

Main Objectives

- To develop a low cost gate driver circuit to drive SiC JFET
- To develop a circuitry which has components which can be used on breadboard testing.
- If possible, to develop a smart circuitry which reacts to increase or decrease the gate voltage and gate current based on temperature conditions.

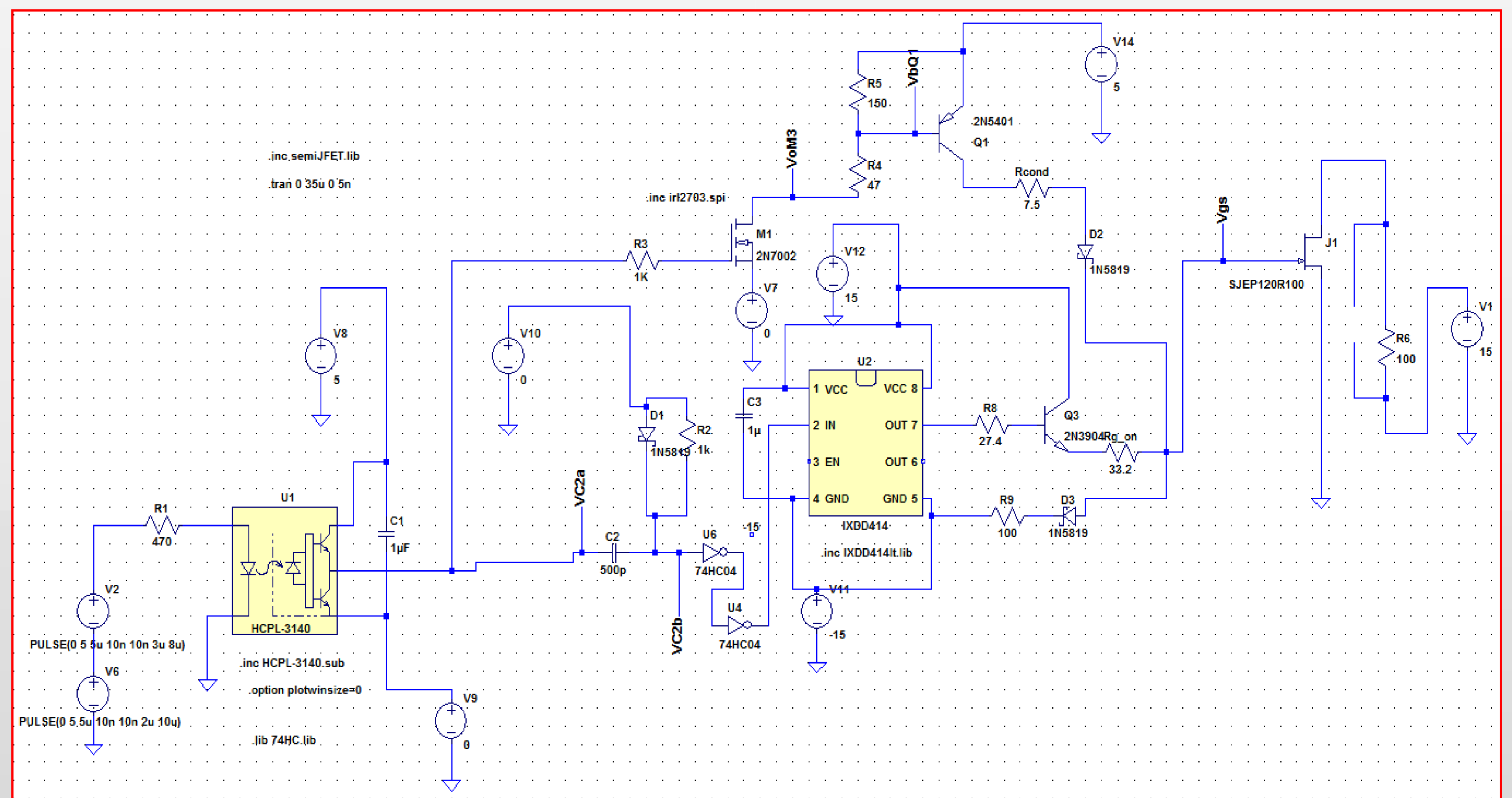
The Problem/ Project Background

- The current gate driver chip developed by SemiSouth is very costly compared to the SiC JFET itself.
- The circuitry is also not flexible
- Development is to be made for a low-cost and yet flexible drive circuit to cater various kinds of SiC JFET devices.
- The gate drive should also be able to enable faster switchings.

Methodology

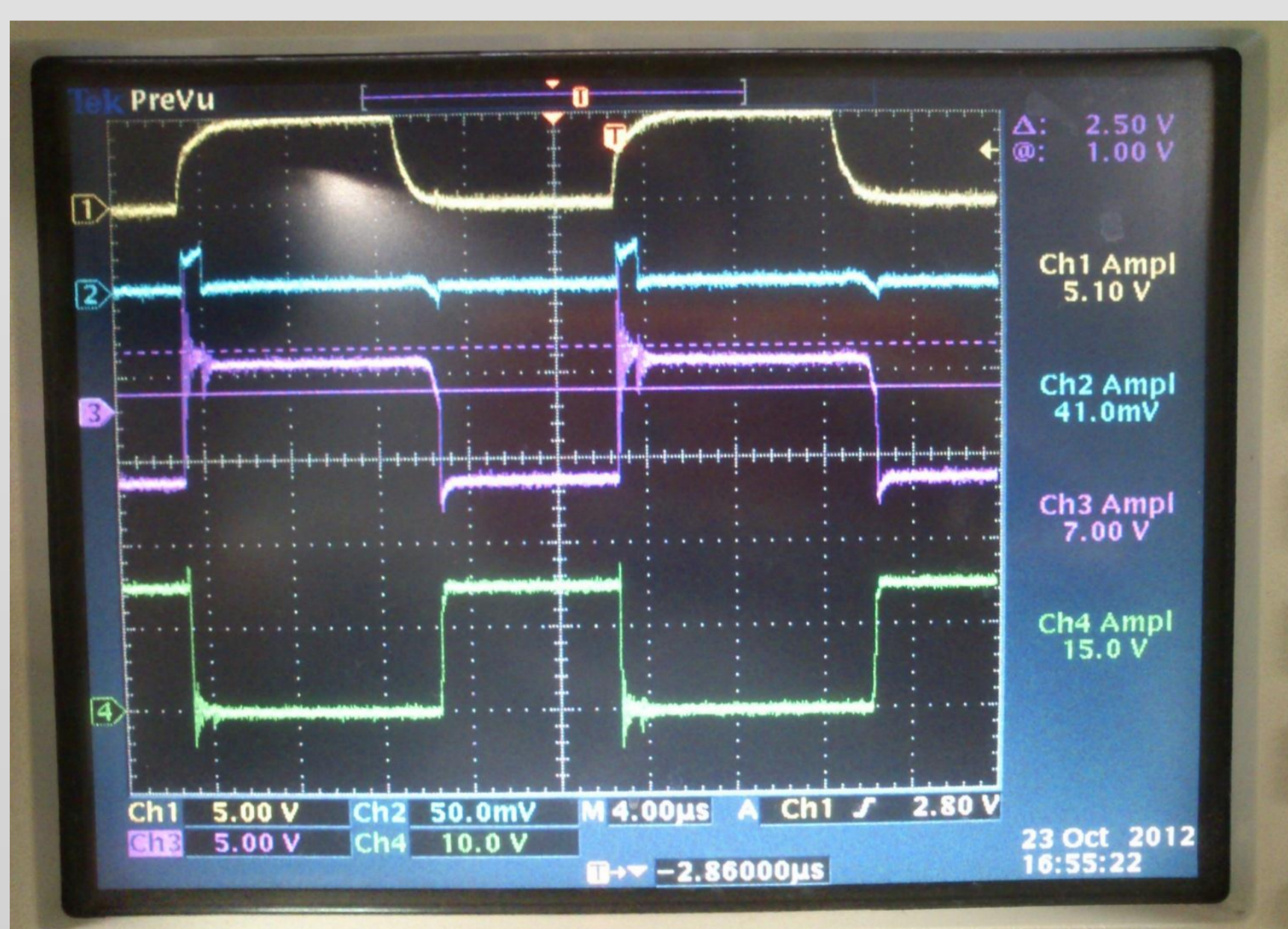
- To use discrete, cheap and easily available components so that one can build a gate drive circuit in the lab.
- Try to reduce the number of components needed.
- To enhance the current in gate drive for faster switching
- To provide proper isolation between the CMOS control circuits and the high-voltage power circuit

Circuit Configuration



Channel 2: Gate current
Channel 3: Gate voltage
Channel 4: Drain Voltage

Experimental Waveforms



Discussion

- The turn-off stage may need modification. The turn-off stage has been slower than expected.
- Current results show that the SiC JFET is able to turn on and off at 50kHz. A higher frequency will be used to enhance the inverter circuit performance, which will be built shortly.

Impact / expected result

- Expect the circuit to be able to turn on and off the SiC JFET accordingly.
- Expect the low cost circuit to be able to operate at high frequency at more than 1MHz and with good efficiency.
- Circuitry to be able to operate accordingly at various temperature level.
- A full bridge inverter circuit will be built based on the developed gate drive for high efficiency energy conversion.

Future Goals

- Able to achieve low cost circuitry for fast driving of SiC MOSFET.
- To enhance the operating frequency to MHz range for power electronic system volume reduction.