PODAS

Power Output Driver Automated System for Integrated Circuits over Time

ELECOMP Capstone Design Project 2019-2020

Sponsoring Company:

ON Semiconductor Corp
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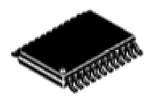

SSOP–24
CASE 565AL

ON Semiconductor is continuing their support of the Program for the 3rd Consecutive Year!

2018-2019

https://web.uri.edu/elecomp-capstone/project-details-by-team-2018-2019/on-semi-bench/

https://web.uri.edu/elecomp-capstone/project-details-by-team-2018-2019/on-semi-smps/

2017-2018

https://web.uri.edu/elecomp-capstone/project-details-by-team/2017-2018/on-semiconductor/

Company Overview:

ON Semiconductor, (formerly Motorola SCI [Semiconductor Components Industries] purchased the former Cherry Semiconductor in 2000. Cherry Semiconductors strong automotive focused portfolio fit into the long term growth plans of the company.

Since the acquisition, the ON Semiconductor, EG (East Greenwich) has developed integrated circuit solutions into the world automotive markets finding homes for its products in all the big players in the automotive world (GM, Ford, Chrysler, BMW, Mercedes Benz, Audi).

Presently, the East Greenwich facility is divided into 3 groups dedicated to 3 integrated circuit functionalities. These include switching regulators, drivers, and SmartFETs.

We are part of a large organization with of more than 30,000 employees.

Technical Directors:

Frank Kolanko
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Project Motivation:

When a driver integrated circuit with an inductive load is turned off, the system will try to maintain the current flow using the energy stored in the inductor. Since the driver is turned off, the voltage will start to rise (for a low-side driver) on the output pin. Low-side drivers include a clamp sensor, which turns the device on once a voltage threshold is exceeded. The current created through the inductor with the voltage will create power dissipation in the IC. That power times time is the Clamping Energy in the output driver.

Integrated circuit driver IC's often have an absolute maximum rating specified for Clamping Energy stated in mJ (milli Joules). Part of the integrated circuit prove out is taking data in the lab for this parameter. To do this test, a circuit is set up with a large inductor and pulse width controlled with a function generator. A pulse is set and the circuit is excited. The energy value is recorded. The pulse width is increased, and the subsequent value is recorded. This continues until the device fails (in a shorted condition). The abs max value measured on the previous setup is recorded as the data point. This is a tedious process.

An automated test system is needed to streamline this process. This will consist of a pulse width computer controlled (Arduino preferred) setup which monitors the output current until damage occurs to the IC. The data will be extracted from the setup and imported into an excel spreadsheet for graphing.

Anticipated Best Outcome:

Software Programming

- Computer code written to create and control a pulse width logic signal used in this project.
- Computer code written to extract data from the Lecroy Oscilliscope.

PCB Development

- PADS PCB layout tool used for main board to support the pulse width control and extraction of energy data into a spreadsheet and display the digital result on the board.

Complete Setup

Push-button automated system to control a logic-level input of an integrated circuit of a driver IC to measure the output energy capability of a device.

Project Details:

Below is a graphic which shows an inductor load to a low-side driver. The clamp voltage is equivalent to Vdrain. We will be measuring the current throught the inductor and the drain voltage.

NCV7750

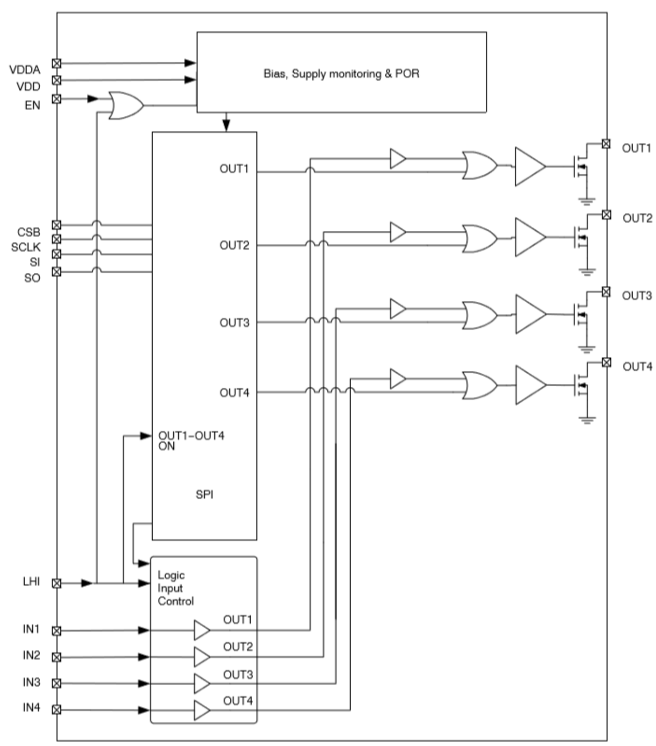
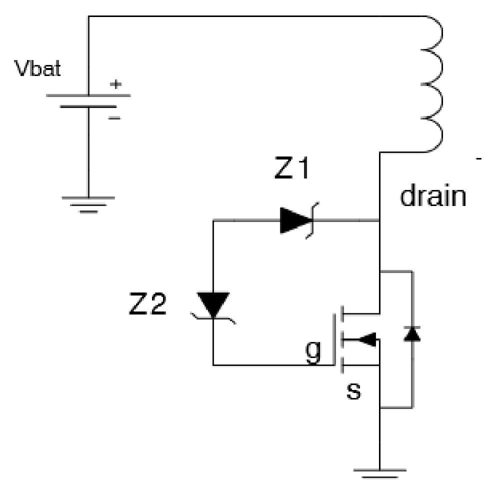


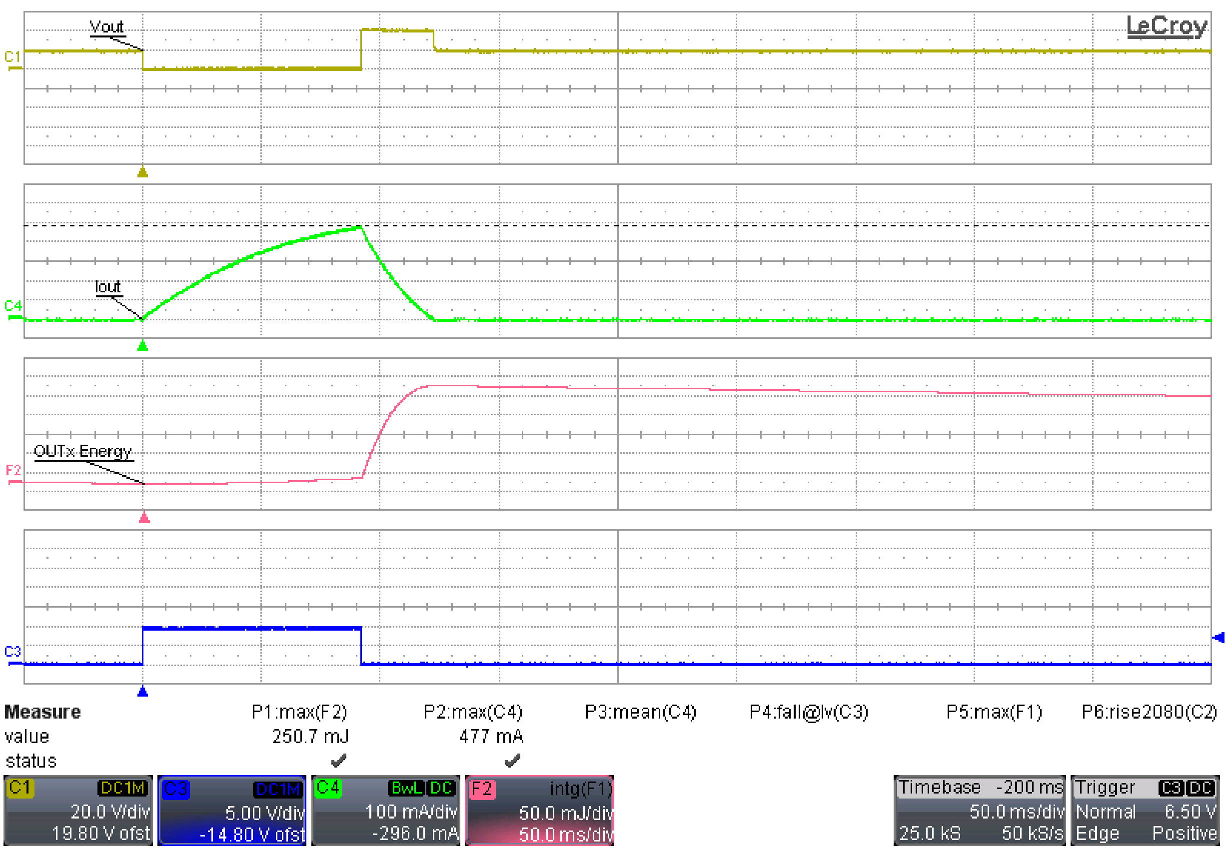
Figure 1. Basic Block Diagram



$$V_{drain} = V_{Z1} + V_{Z2} + V_{gs}$$

Below is a graphic for this project from an oscilliscope which highlights the data needed for extraction of output energy capability.

- C3 is the pulse width input control to the setup.
- C4 is the current through the inductor. You can see the current rising as long as the pulse width signal is high.
- C1 is the output voltage. Note as the device is turned on, the signal is low, then clamps to a higher voltage when the device is turned off.
- F2 is the energy calculation of V*I*time.



The same Lecroy oscilloscope setup is anticipated for this project.

ELECOMP CAPSTONE

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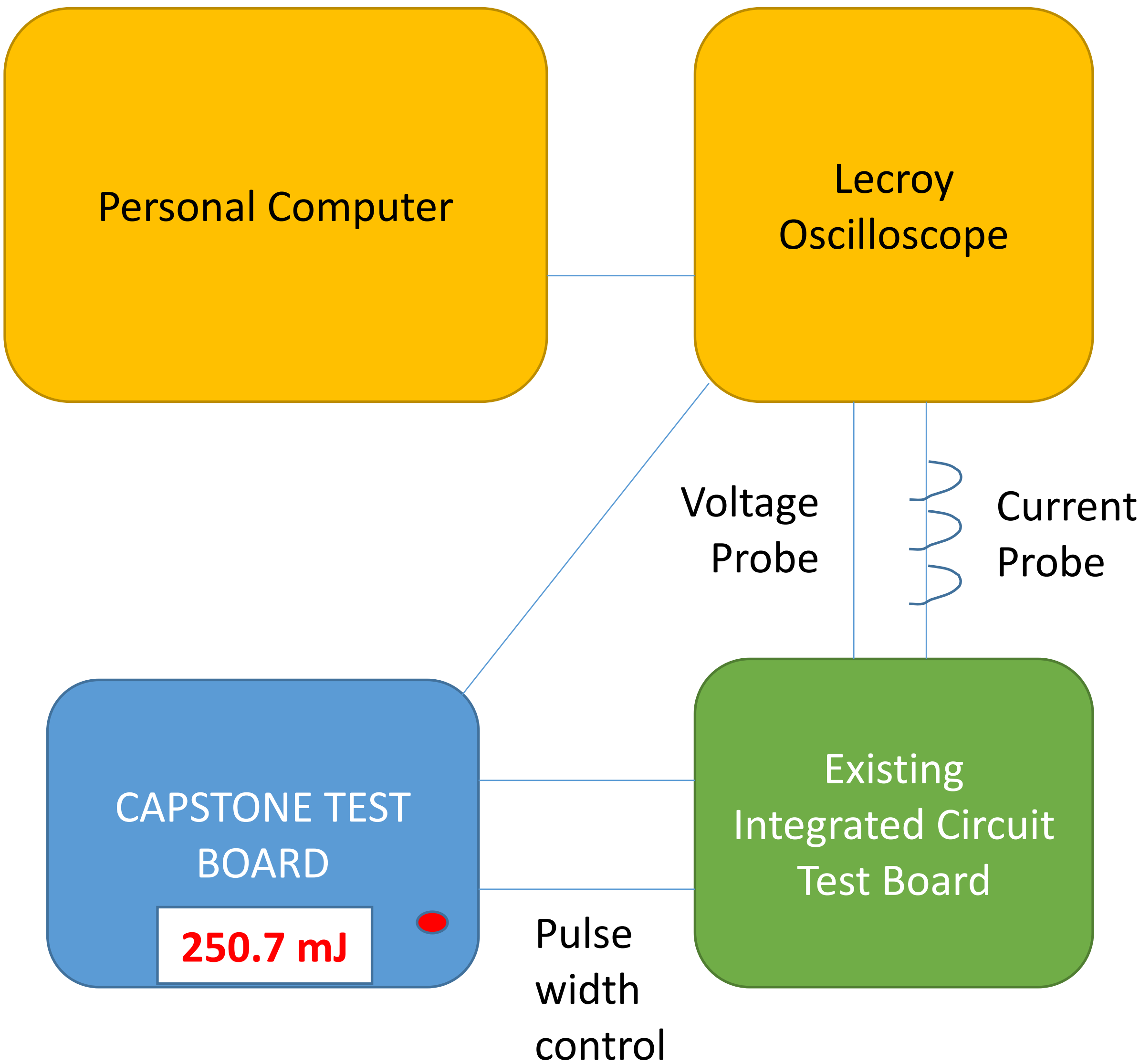
Block Diagram System Setup

Capstone test board will need programming for initial pulse time and pulse step increase as well as reading the results.



Composition of Team:

Two engineering students:

- One (1) Electrical Engineer (ELE)
- One (1) double-major Computer Engineer / Electrical Engineer (CPE/ELE)

Skills Required:

Electrical Engineering:

- Strong understanding of circuit fundamentals and power electronics especially inductors.
- Interest and experience with PCB Designs and Builds
- Electronics Lab Experience

Computer Engineering:

- Needs to be able to program an Arduino microcontroller.
- Interest and experience with PCB Designs and Builds
- Electronics Lab Experience

Anticipated Best Outcome's Impact on Company's Business:

Providing additional data for a highly sought customer parameter will satisfy the needs for more data than is presently available.

Broader Implications of the Best Outcome on the Company's Industry:

Providing additional technical information on our integrated circuits will help the customer design in the right part for the application and increase our sales.