Lab 18: Measure the in rush current and operation current of a board

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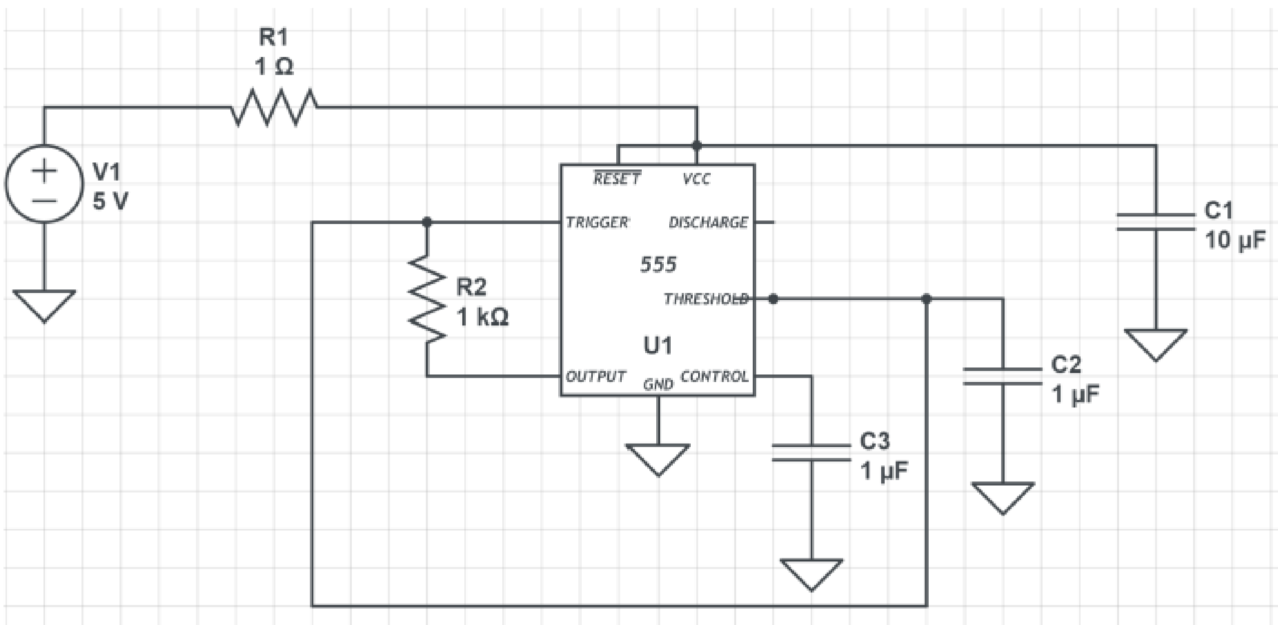
Purpose: To measure the in-rush current and steady state current draw that a board draws from the power supply.

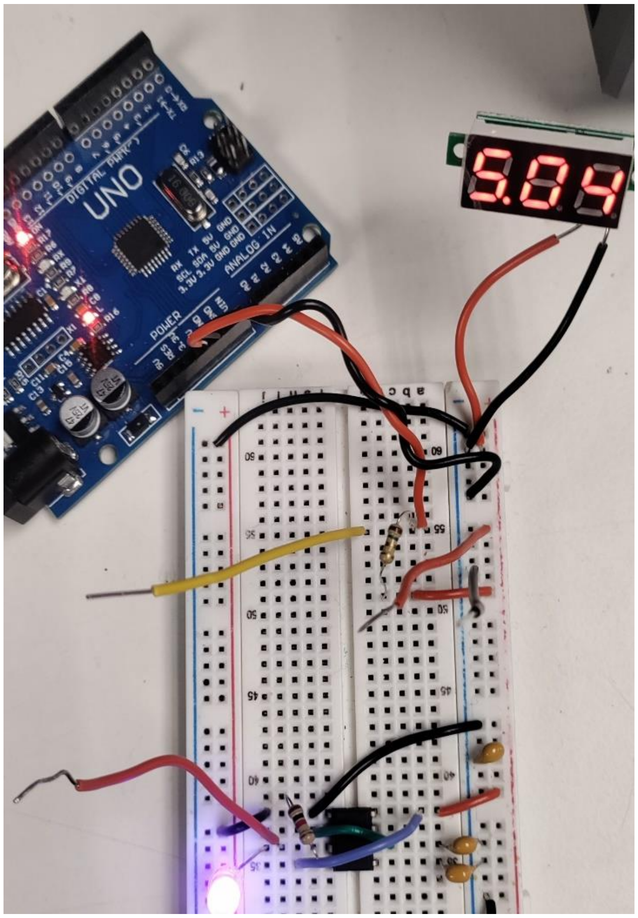
Experiment:

For this experiment, we try to measure the in-rush current that a board draws from the power supply. For measuring this, a 555 timer circuit is used at 50% duty cycle and the simplified circuit looks as follows,

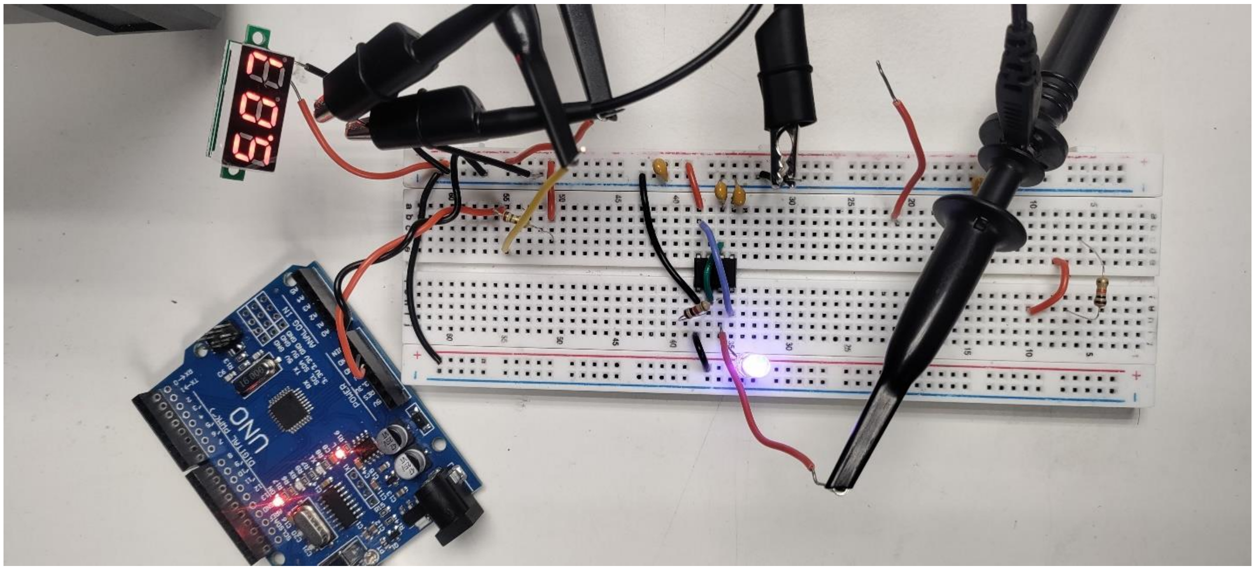


A series resistance is added to the high side of the power rail to measure the current draw when a device is plugged in. The voltage is measured across the resistor and the current is calculated at the initial state (inrush current) and the regular state (steady state current).

And the circuit when connected on a solder less breadboard looks like,

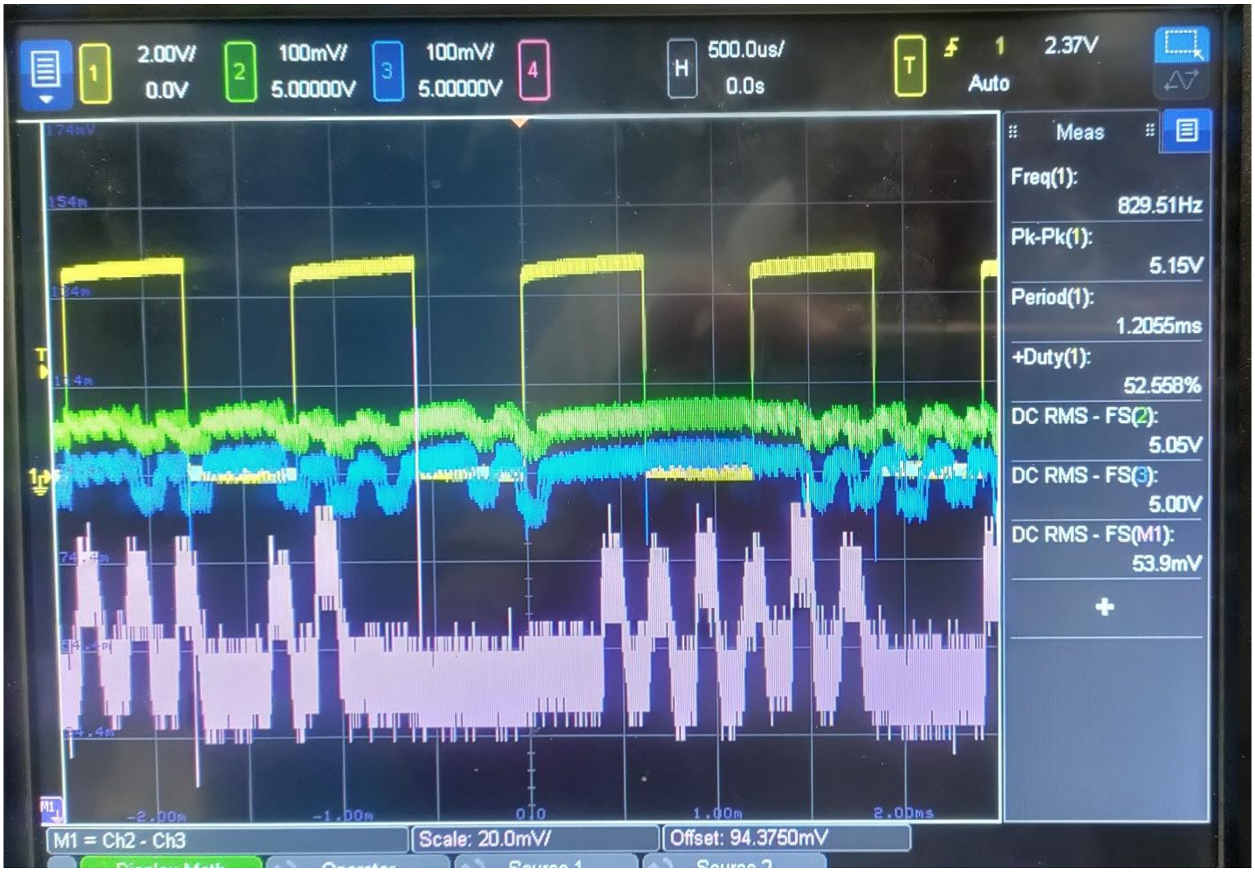


To measure the differential voltage between the high side and the low side of the 1.5 Ohm resistor, the probes are attached to the circuit as in the following circuit:



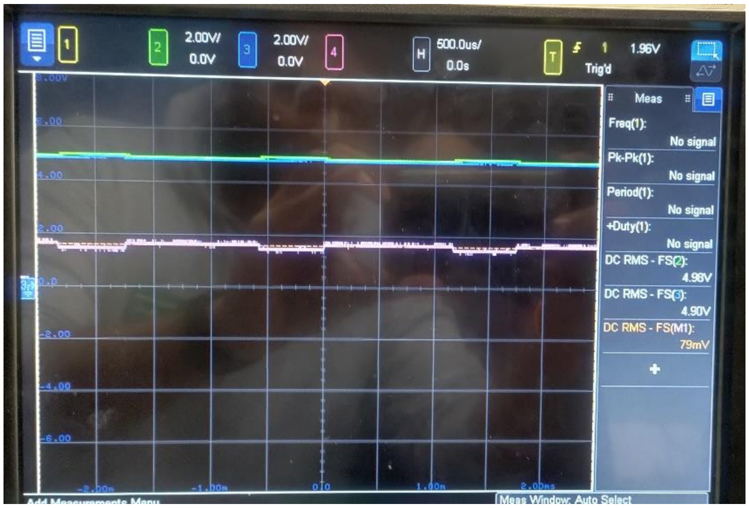
Steady State Current:

The voltage across the 1.5 ohm resistor can be shown as below:



The yellow is the 555 IC timer circuit output. The green curve is the high side of the sense resistor, the blue line is the low side of the sense resistor. The pink curve is the math function which gives the difference between the voltages of the high side and the low side.

The following the result of math function,



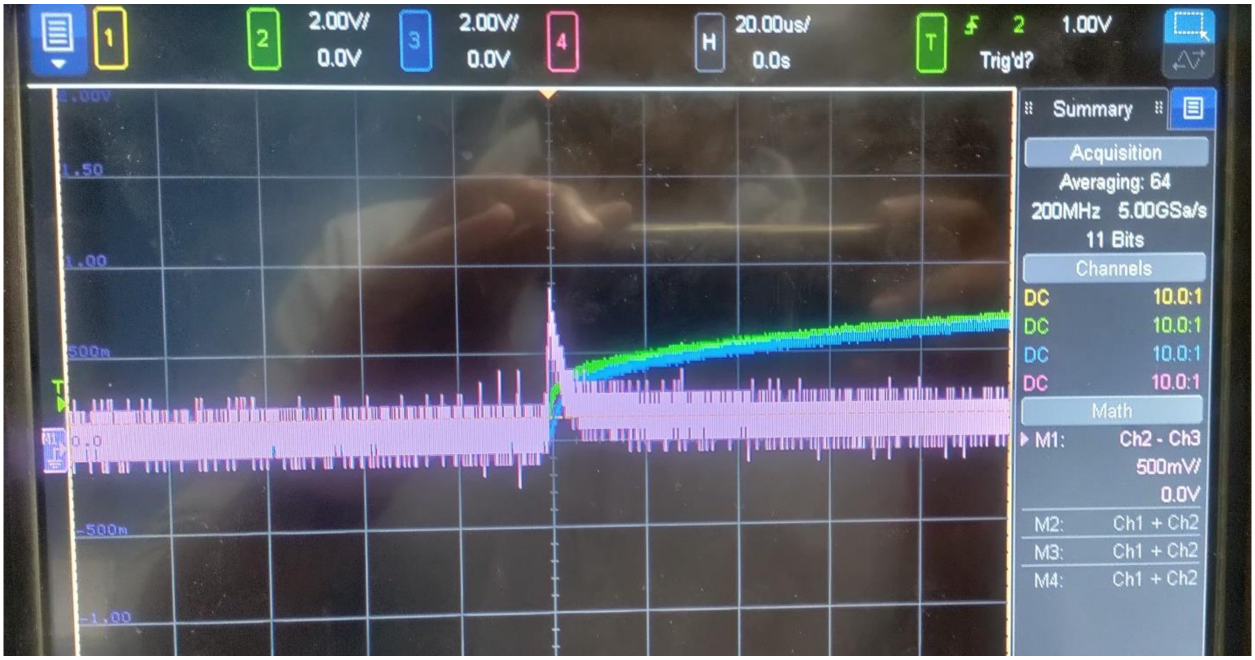
The voltage difference is around 200.433mV through the sense resistor. The resistance value being 1.5 Ohm, the current passing through is given by 79mV/ 1.5Ohm = 52.6mA.

The noise is far more than the expected value, hence there is a change in the steady state current.

In-Rush Current:

For measuring the inrush current, the trigger on the scope is set to the rising voltage of the resistor and the displayed voltage difference on the scope is the inrush current itself. This can be achieved using the normal mode of trigger operation since in auto mode, the scope triggers only on trigger event unless nothing comes in the first 50msec.

The circuit is connected and to measure the inrush current, the power is switched OFF and when it is switched on the on normal mode, the first trigger is displayed with the voltage difference which shows the in-rush current as follows:



The green curve is the high side of the sense resistance, the blue curve is the low side of the sense resistance. The pink curve is the math function which shows the inrush current. The math function has a scale of 500mV, hence the inrush voltage is approximately 900mV.

The inrush current can be calculated as 900mV/ 1.5Ohm = 600mA

This current lasts for around 4usec, which is a very low time.

Conclusion:

By this experiment, we can analyze the steady state current and the inrush current in a circuit. The changes with respect to the decoupling capacitance can be observed, that the inrush current is directly dependent on the decoupling capacitance used. When there is a higher capacitance, the inrush current is higher and vice versa.