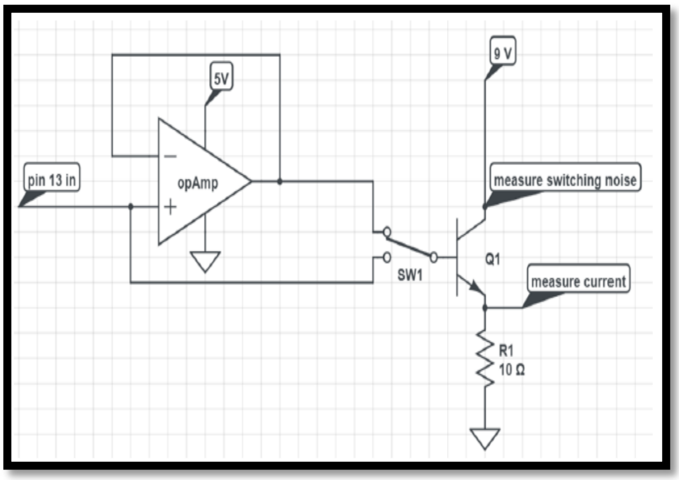
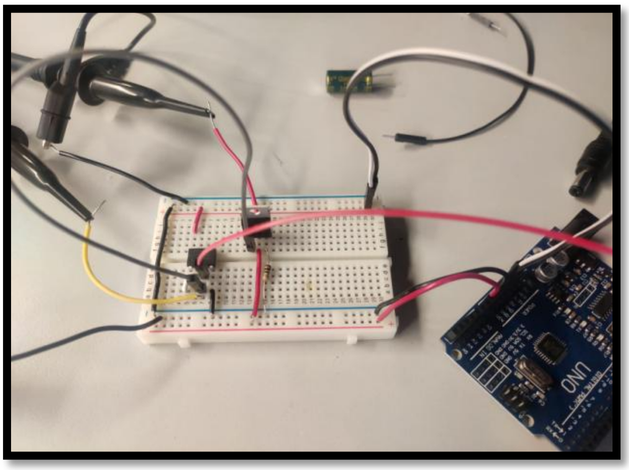
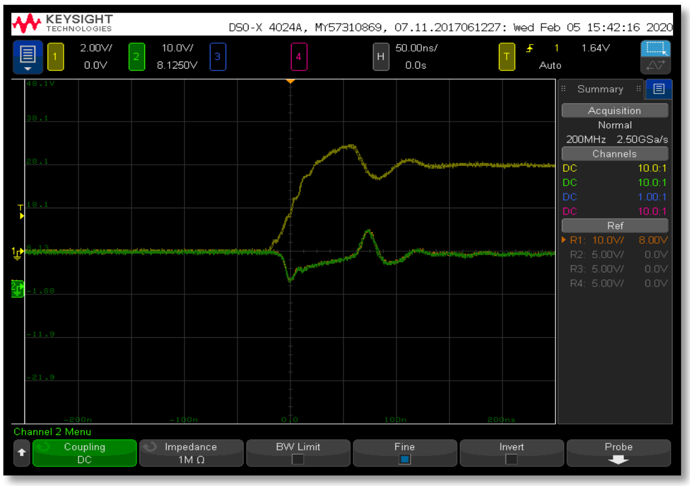
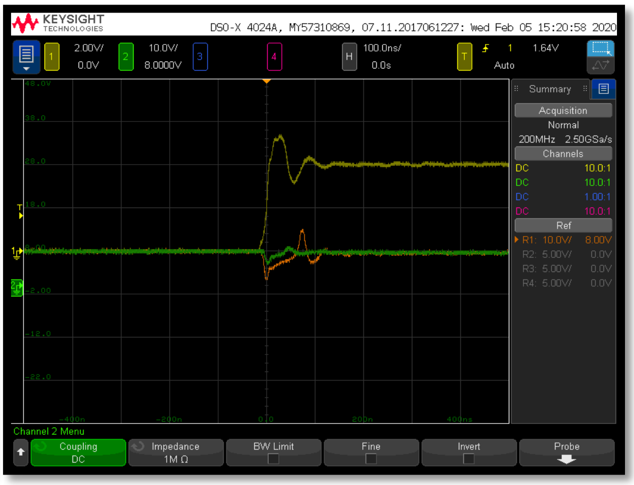
GOAL- Building a simple slammer circuit which will draw a fast transient current from the power rail and to explore the role of loop inductance between the IC and the decoupling capacitors.





SCOPE TRACES - >



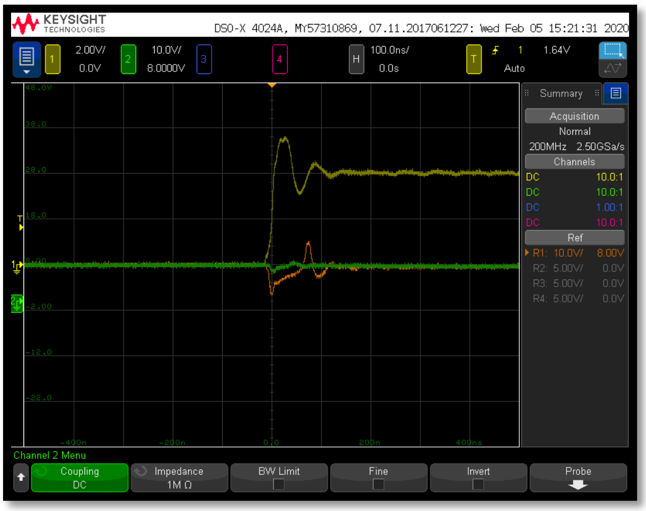


Noise without decoupling capacitor

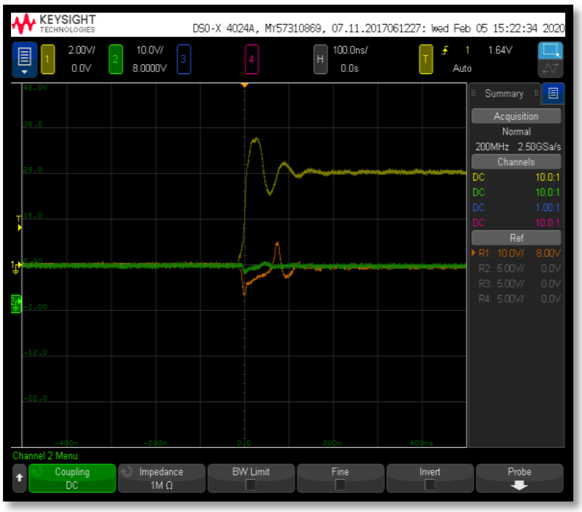
Decoupling using 1 microfarad

Switching noise of the power rail is due to the loop inductance in the power distribution path from the VRM to each IC. It is basically the changing current through the inductance of the power rail that causes the switching noise. If the di/dt is small enough the switching noise will also be very small hence there will be no problem to the circuit. Moreover, in our case there was about 5 nsec rise time during fast output compared to 2microsec rise time at slow output. More the rise time less the noise hence the fast output state had a much larger noise compared to the slow output state of the opamp.

Without the decoupling capacitor the noise was more as expected. Hence, the role of the decoupling capacitor was to add a kind of local source of charge or local VRM which would decouples the inductance of the rest of the power distribution network from the IC, hence named decoupled capacitor. The decoupling capacitor also provides current to the local devices which allows the transient current to get the high inductance by-passed hence also named as bypass capacitor.



1 microfarad close to the collector pin



2200 microfarad close to the collector pin

Hence with adding of the decoupling capacitors of 1 microfarad and 2200 microfarad, the amount of change is not different based on the noise as long as the capacitor value is taken after a minimum range. Since the inductance did not change, the switching noise remains the same even if whatever the capacitor value will be increased. The only factor to reduce the switching noise is based on the proximity of the decoupling capacitor to the power pins of the IC and using shorter leads of the capacitor in order to reduce the inductances.

- ➔ **Calculating the loop inductance-**

The voltage drop across an inductor is: Del V = L (dI/dt); Where voltage drop was around 8.125 volts and di was 315mA and dt= 50nsec, the loop inductance is 8.125/0.315A * 50nsec which is ~1289nH.

- ➔ The Thevenin's resistance across the VRM of 9V of RL = 10ohms is-:

Rth = RL *{(Vth-VL)/VL} where voltage drop was around 3 volts, so the thevenin's resistance as per the calculation is around 20 ohms.