Preethi's ROIC analysis

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1 setup

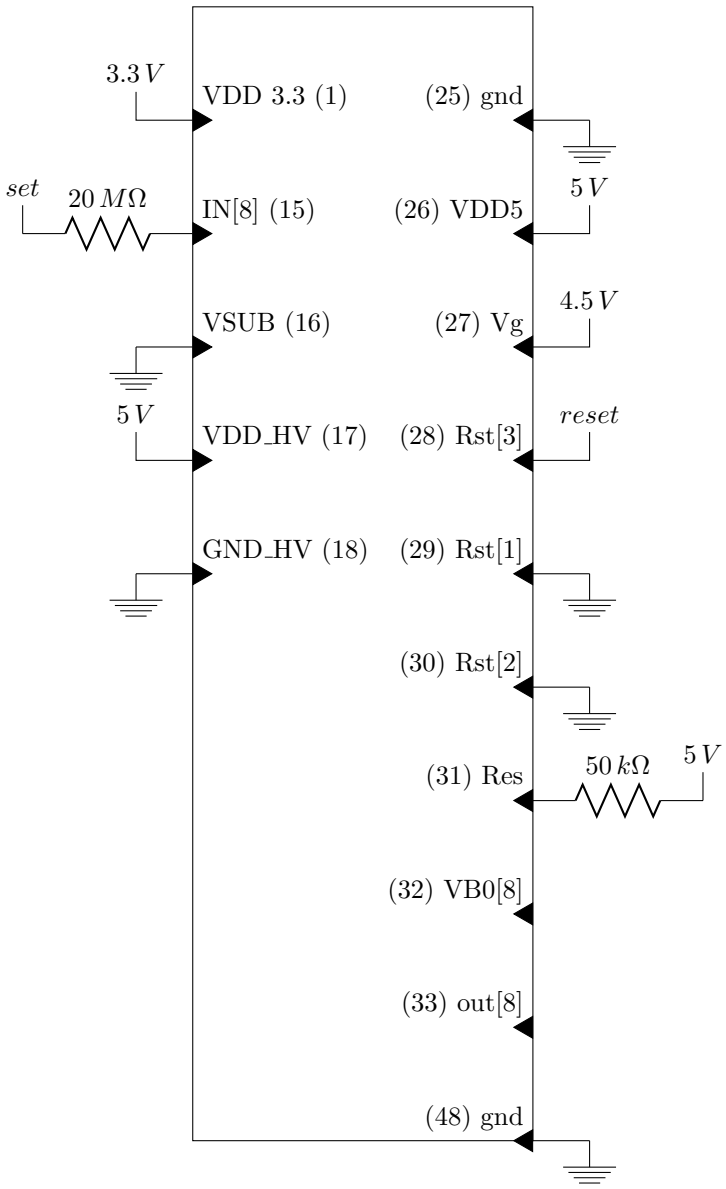


Figure 1: Schematic of breadbord

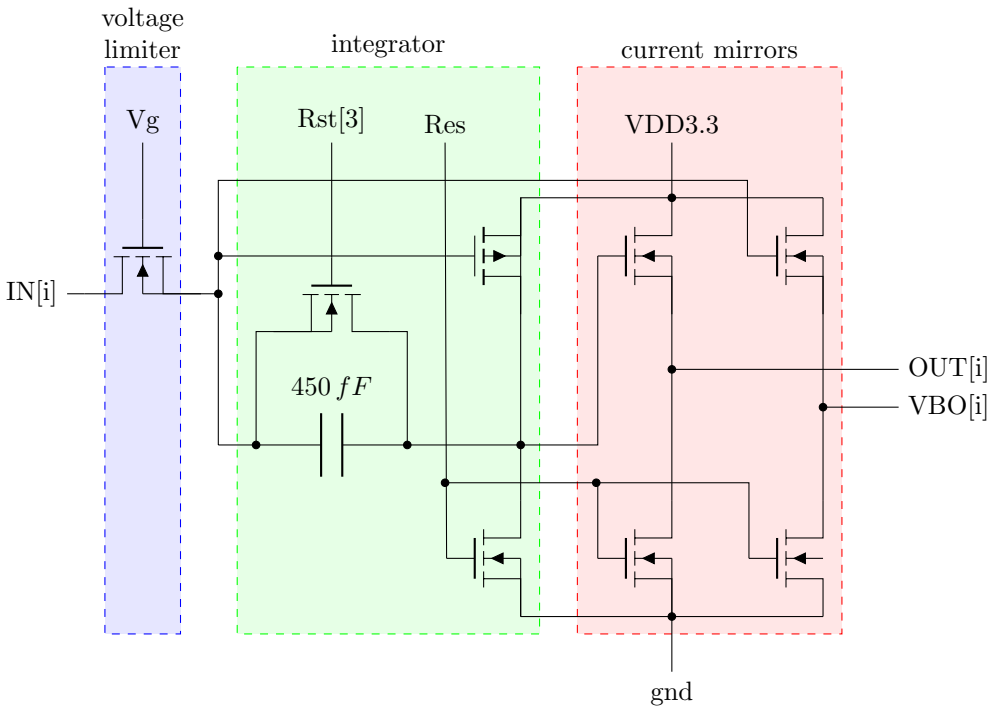


Figure 2: Schematic of ROIC channel

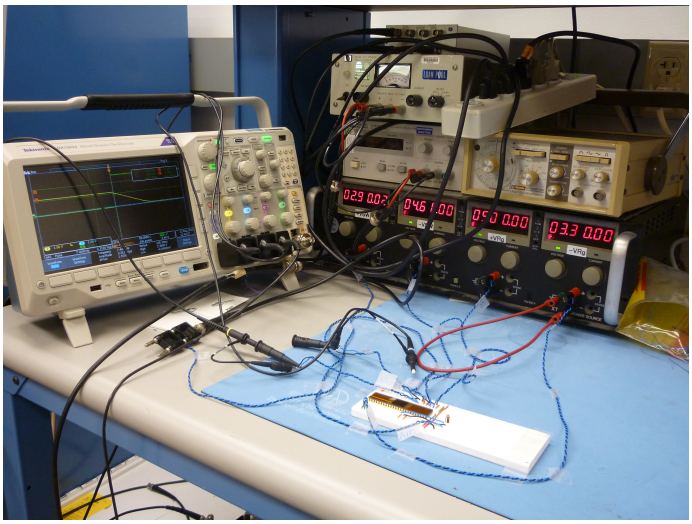


Figure 3: setup overview

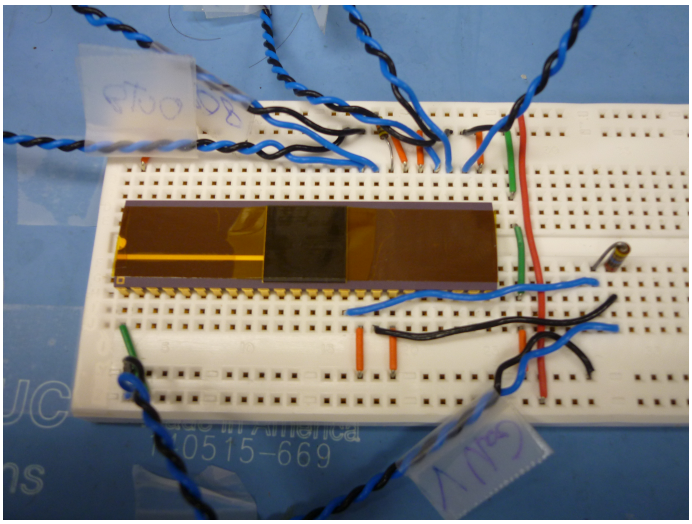


Figure 4: close-up

2 Reset mode

This test addresses the behavior of the circuit in reset mode. Figure 5 shows the measured values during reset mode. Note that the input voltage is $2.4\,V$, which is important when calculating the input current.

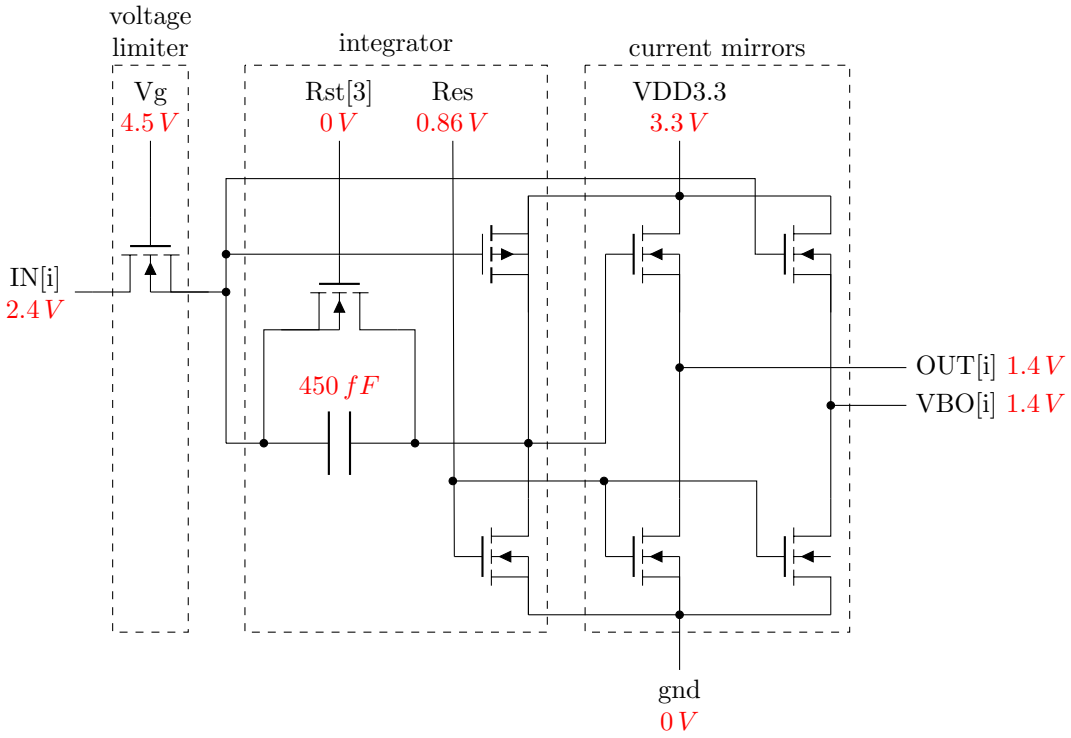


Figure 5: Schematic of ROIC channel template

3 Integrator

This section aims to address the performance of the integrator. Figure 6 shows the setup used for this test. Channel 8 was used, so the end of the $20\,M\Omega$ resistor is connected to IN[8], and the probe is connected to OUT[8].

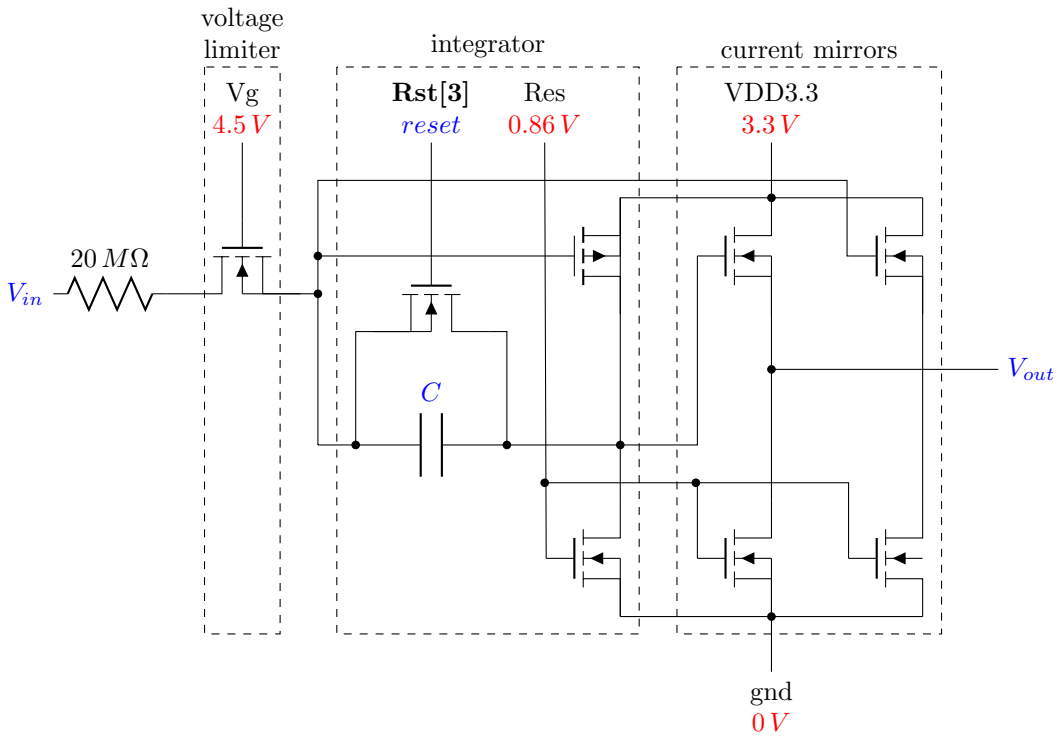


Figure 6: Schematic of ROIC channel template

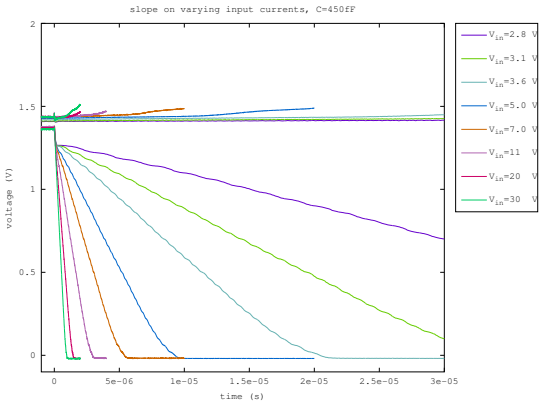
One can calculate the expected performance of the integrator using eq. (4). The expected time to discharge the capacitance versus the measured time is plotted in fig. 10. The slope of the 450 fF and 350 fF appear to be reasonably similar to the expected slope, but the 150 fF and especially 50 fF ones are way off. During some testing I found that adding approximately 90 fF to both of those would make the measured and expected values match. It is also interesting to see the current limiting properties of the device in action. All four configurations limit at a $\delta V/\delta t = 1.2 \cdot 10^6$, and with a resistanceof 20 $M\Omega$, this gives a current limitation of 50 mA.

$$\delta q = C \cdot \delta V \tag{1}$$

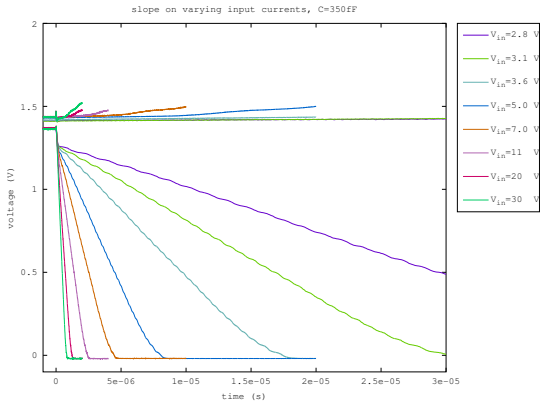
$$I = \frac{V_{in} - V_0}{R} \tag{2}$$

$$\delta t = \frac{\delta q}{I} \tag{3}$$

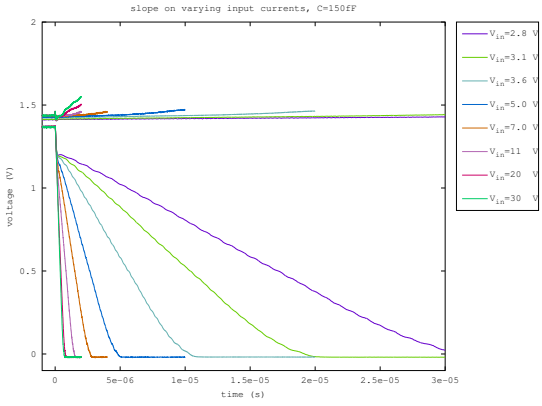
$$\frac{\delta V}{\delta t} = \frac{I}{C} = \frac{V_{in} - V_0}{RC} \tag{4}$$



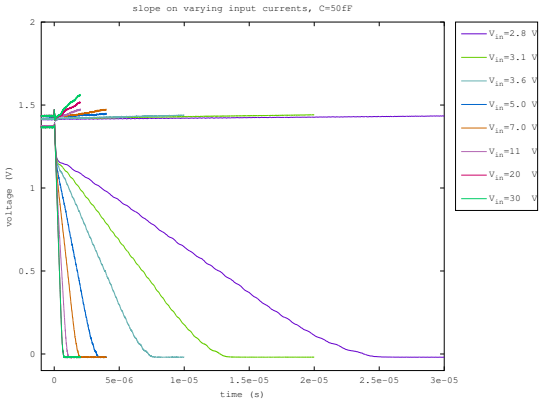
(a) $C = 450\,fF$



(b) $C = 350\,fF$

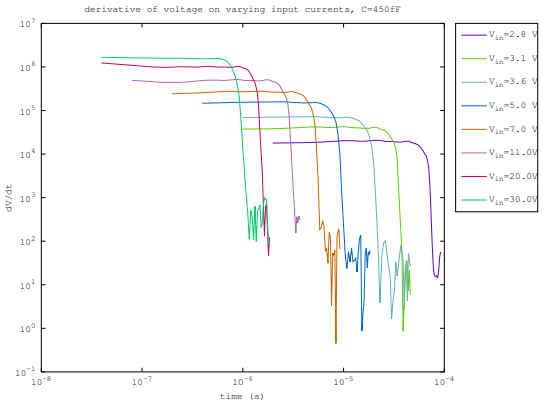


(c) $C = 150\,fF$

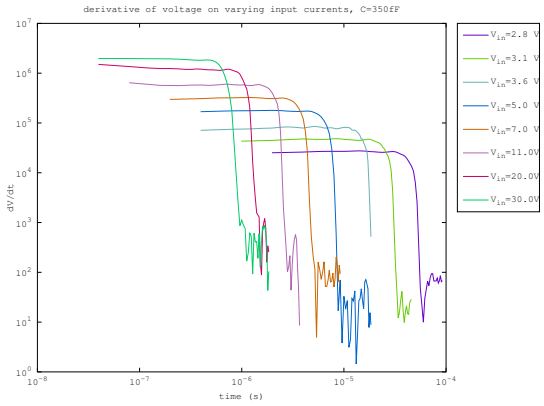


(d) $C = 50\,fF$

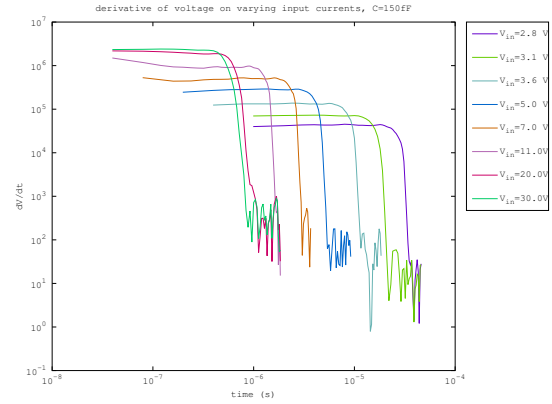
Figure 7: Expected versus measured charge up times for different input voltages. The input voltage is connected to the input through a resistor of $20\,M\Omega$



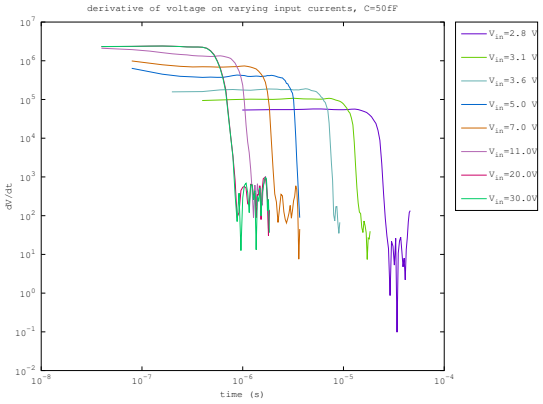
(a) $C = 450\,fF$



(b) $C = 350\,fF$

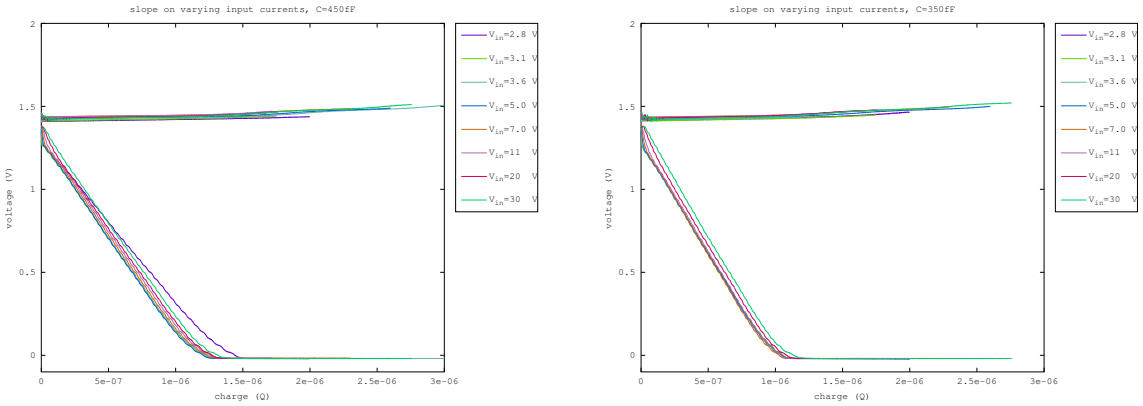


(c) $C = 150\,fF$



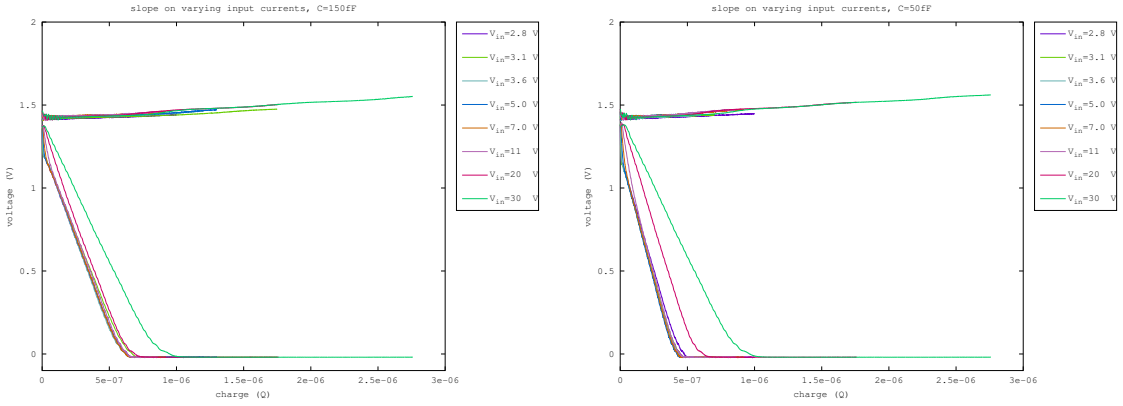
(d) $C = 50\,fF$

Figure 8: Expected versus measured charge up times for different input voltages. The input voltage is connected to the input through a resistor of $20\,M\Omega$



(a) $C = 450\,fF$

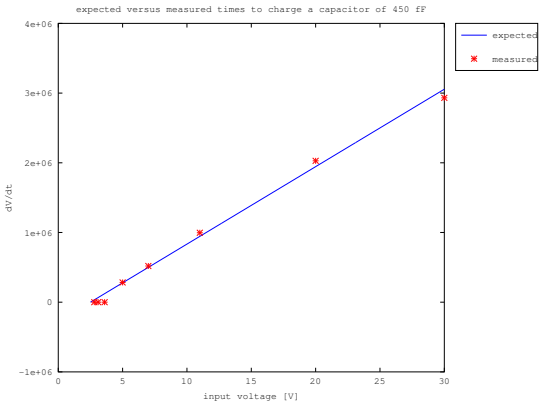
(b) $C = 350\,fF$



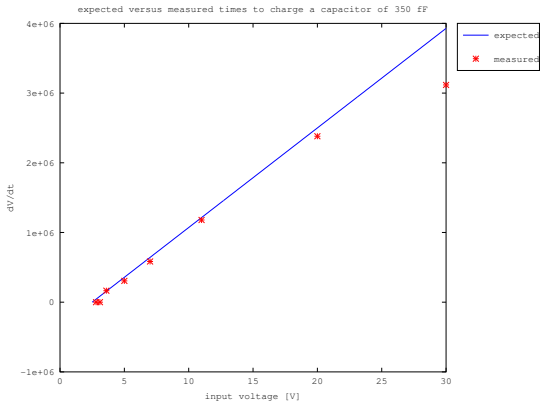
(c) $C = 150\,fF$

(d) $C = 50\,fF$

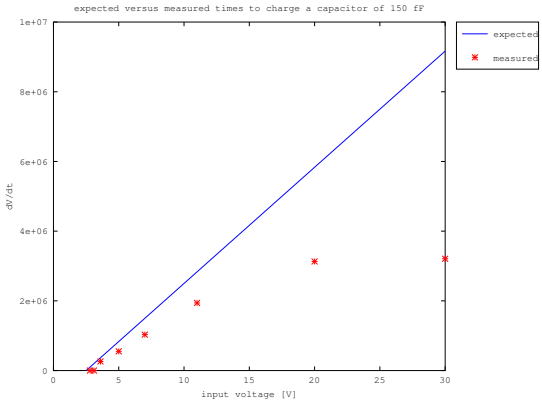
Figure 9: Expected versus measured charge up times for different input voltages. The input voltage is connected to the input through a resistor of $20\,M\Omega$



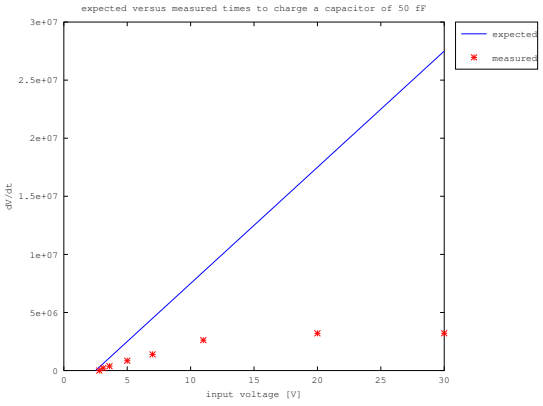
(a) $C = 450\,fF$



(b) $C = 350\,fF$



(c) $C = 150\,fF$



(d) $C = 50\,fF$

Figure 10: Expected versus measured charge up times for different input voltages. The input voltage is connected to the input through a resistor of $20\,M\Omega$.