

Today's plan:

- Multiple ADC inputs
- Current regulators
- Measuring capacitance
- Noise suppression

Announcements:

Materials return:

You will need to return all the materials borrowed from the lab: (breadboard, launchpad, motors, cars, etc).

The sets should be returned to Sing, the project parts directly to me.

This can be done after the presentations and not later than April 15th. You need your deposits back!

Announcements:

Time is going by quickly. You have only 2 weeks of labs before presentation!

Multiple ADCs

```
ADC12CTL0 = ADC12SHT02 + ADC12ON + ADC12MSC;  
// Sampling time, ADC12 on, automatic multiple conversions
```

```
ADC12CTL1 = ADC12SHP | ADC12CONSEQ_1 |  
ADC12CSTARTADD_0; // sampling timer, multichannel,  
starting memory address
```

```
ADC12MCTL0 = ADC12INCH_0;  
//selects A0 to be stored in memory ADC12MEM0
```

```
ADC12MCTL1 = ADC12INCH_1+ADC12EOS;  
//selects A1 to be stored in memory ADC12MEM1 and this memory  
to be the last of sequence
```

```
ADC12CTL0 |= ADC12ENC; // ADC enable  
conversions
```

```
P6SEL |= 0b00000011; // allow ADC on pin 6.0,6.1
```

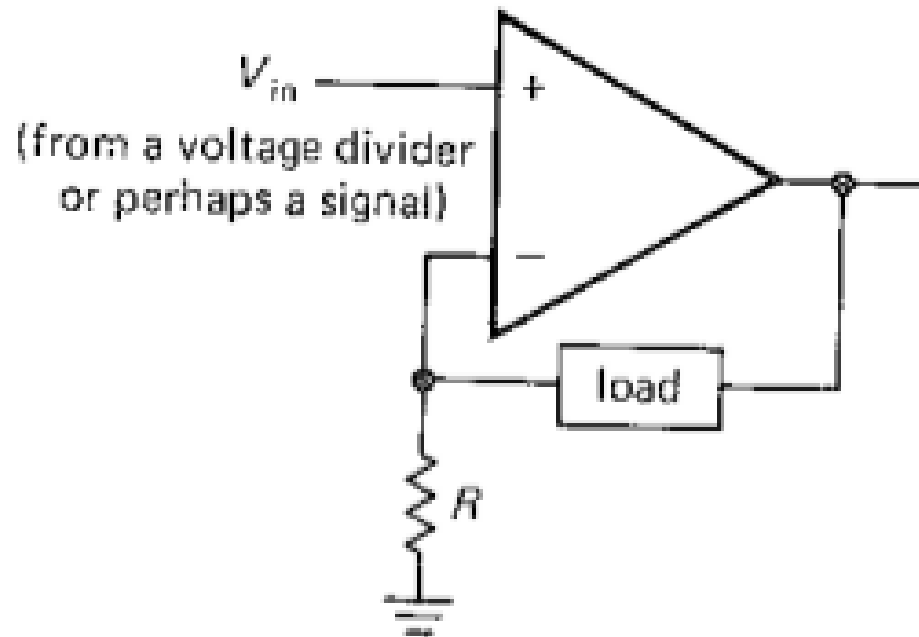
Family Manual ADC12

Page 740 program flow

Page 749 control registers

Page 754 memory control registers

Current Regulation



But load isn't grounded in this circuit.

Current Regulation

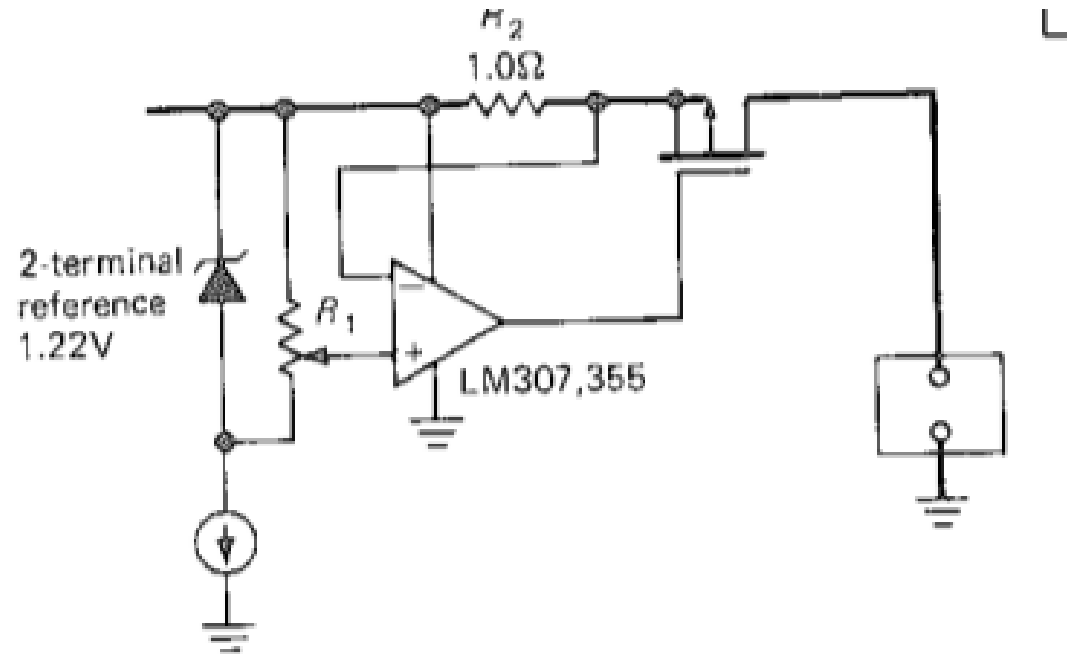
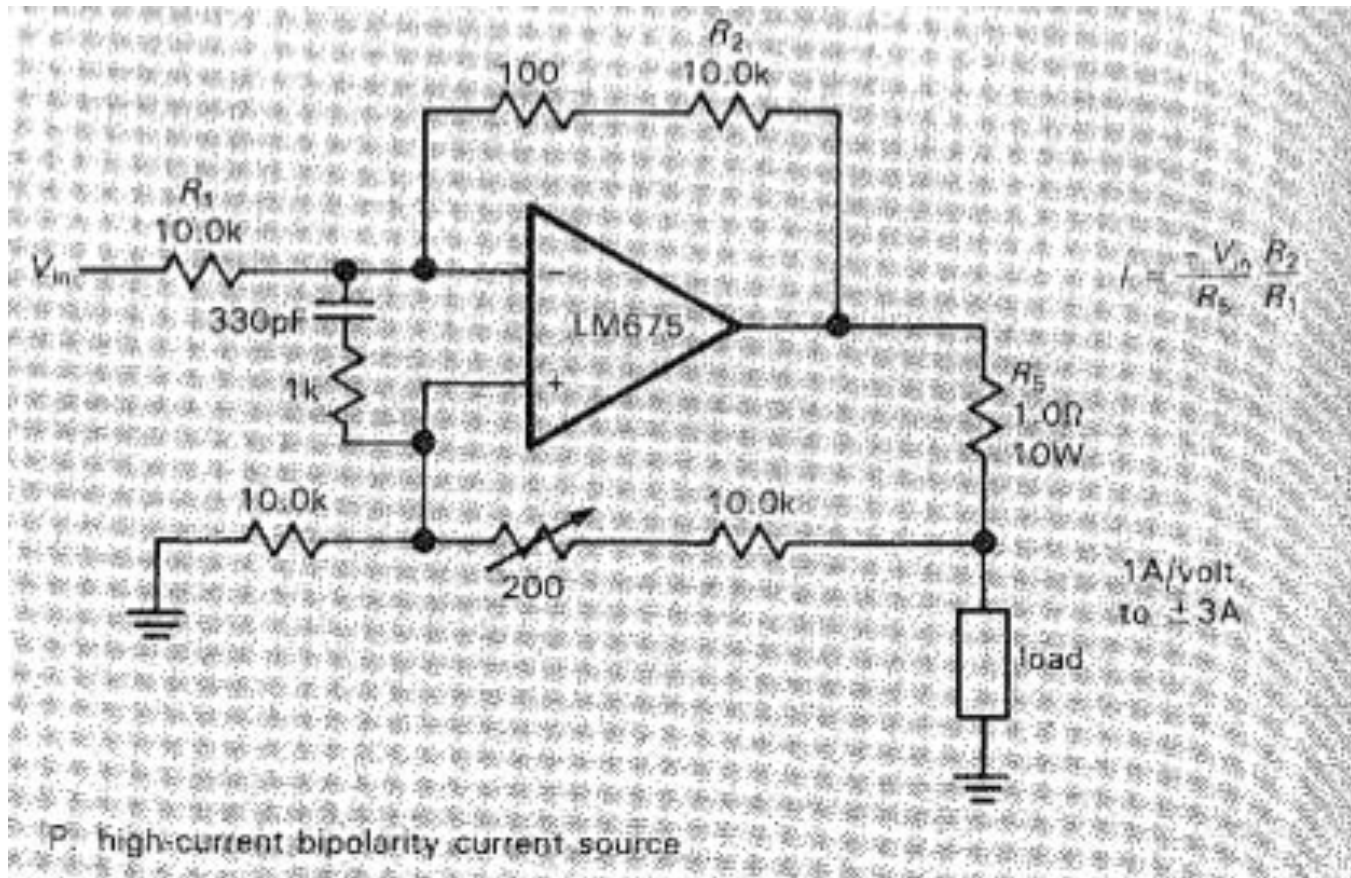


Figure 6.61. Input-rail current sensing.

Current Regulation



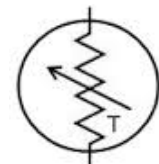
Overcurrent Protection

If one is using a DC power supply, generally it should be chosen so that it can supply the needed amount of current, and not too much more.

For battery powered projects though, it may make sense to include overcurrent protection to avoid: damaging the batteries or starting a fire.

Options include: fuses (kind of a pain as they need to be replaced), circuit breakers (expensive), thermal cut-outs (cheap, basically a fuse), PTC thermistors, or for a low power project, just a resistor in series with the supply may be ok (must be capable of dissipating the power developed in it when the load is short circuited).

The PTC thermistor is a semiconductor device where the resistance increases rapidly with temperature. If you try to draw “too much” current, the resistance rises and reduces the current.



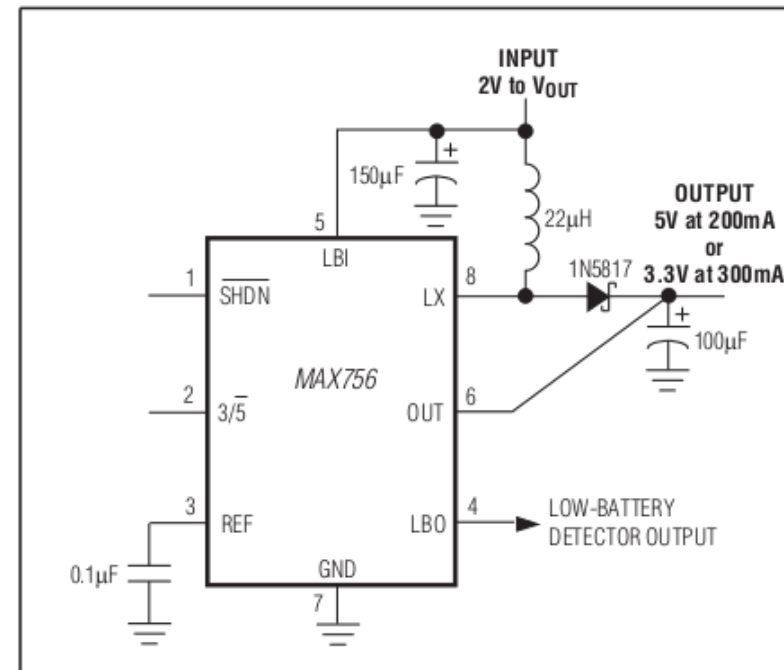
DC-DC convertors

Step-up or step-down DC-DC converters are available.

Much more energy efficient than linear regulators

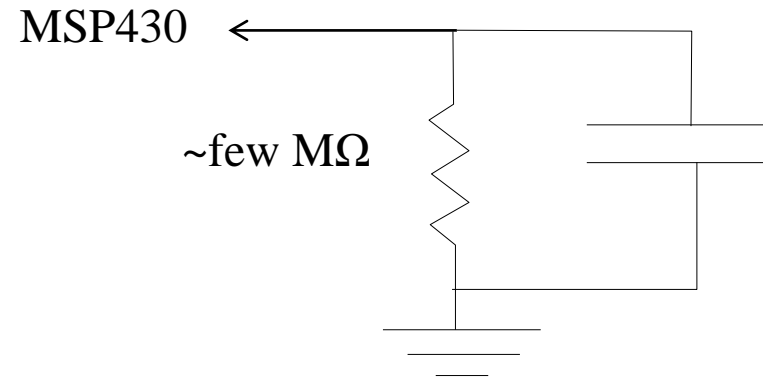
Noisier output

Allows, for example to generate 5V from 2 AA batteries.



Capacitance Measurements

Simplest:



- set the pin as an output, and set it H
- then set as input, and time how long it takes to discharge to read as low.

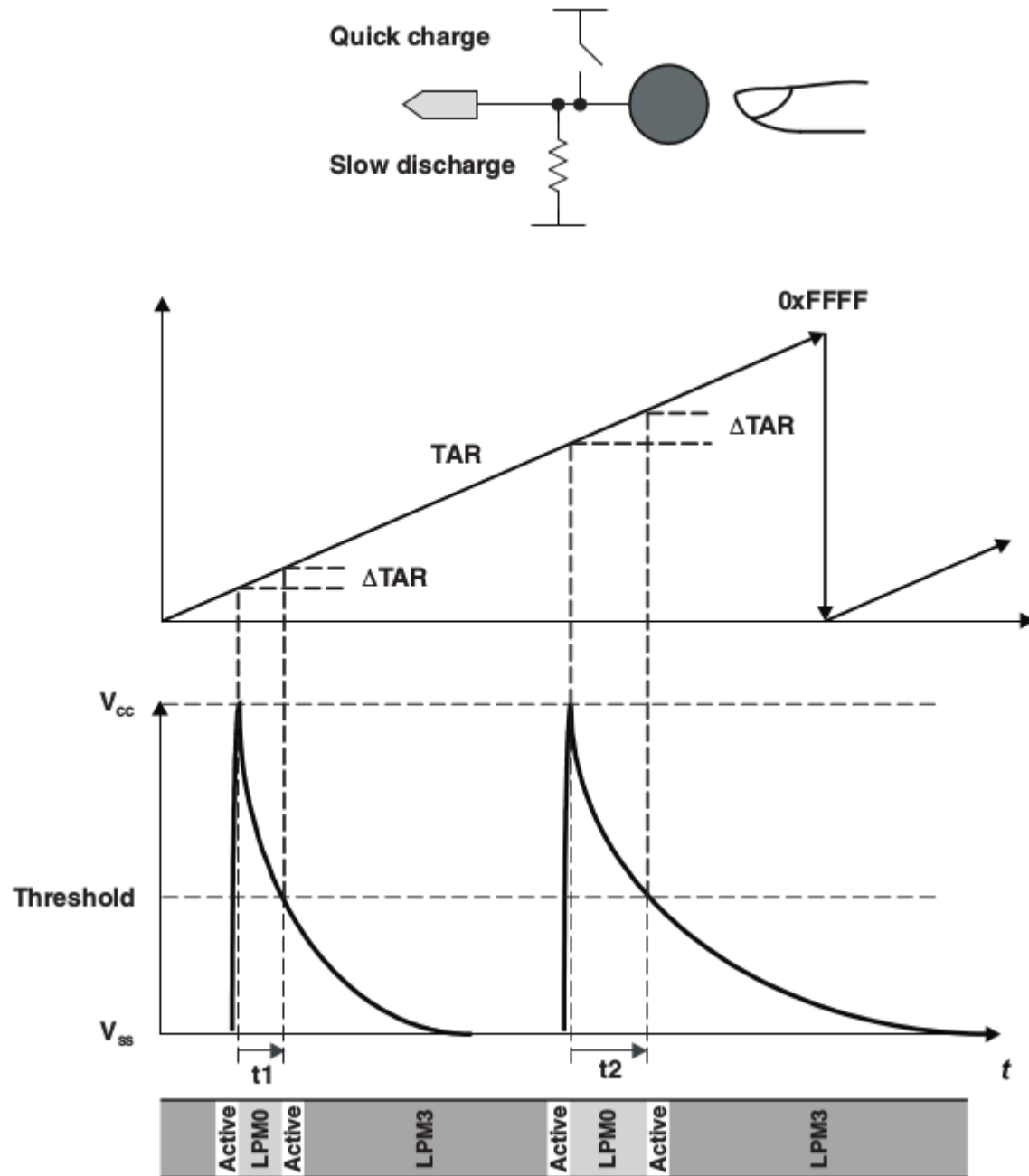
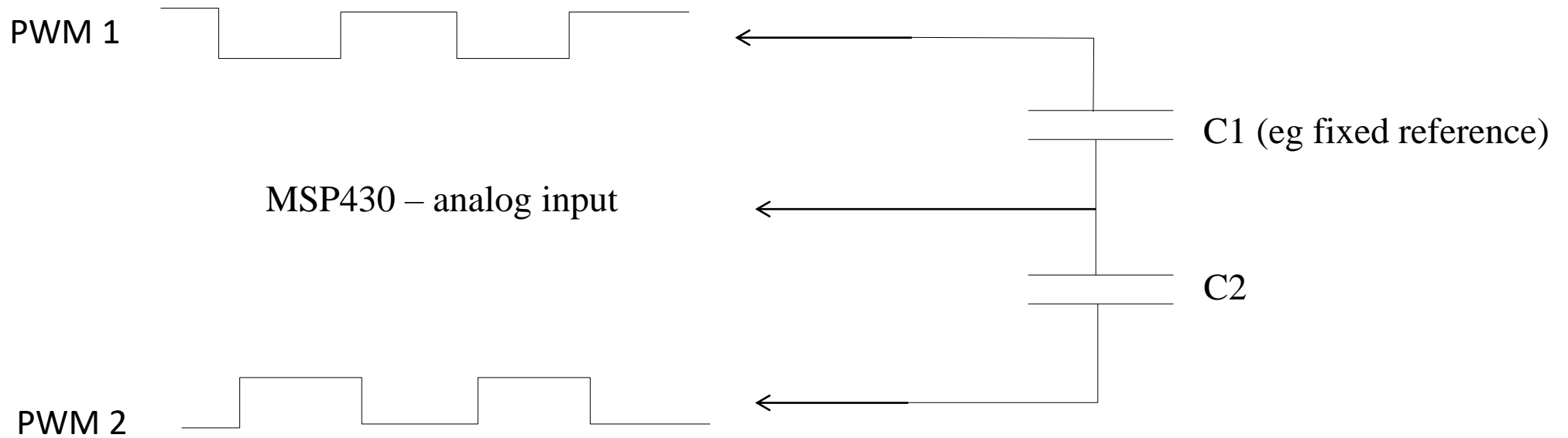


Figure 2. Charge-Discharge Sequence

Differential capacitance measurement:



Noise suppression

Software low-pass filter:

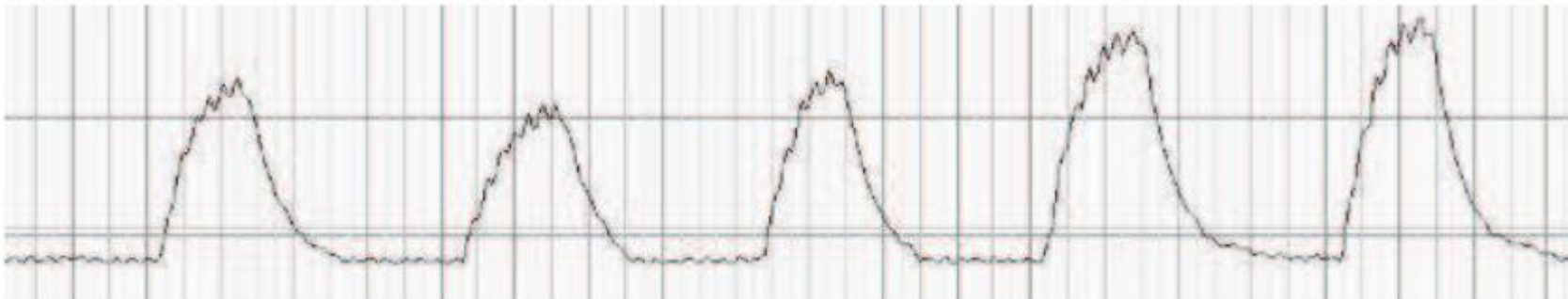
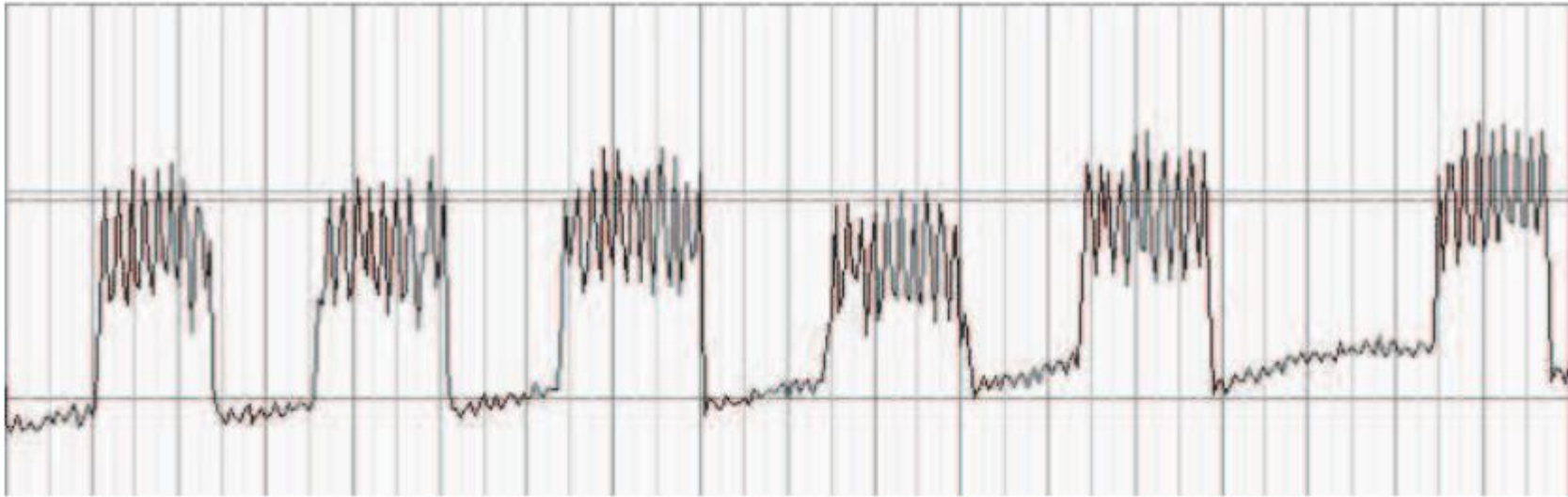


Figure 7. Oscilloscope With IIR Filter

Noise suppression

Software low-pass filter:

```
int current,filter;
```

```
// make measurement in here:
```

```
current = most recent measurement
```

```
filter = (1-K) * current + K*filter; // filter response same as simple RC low pass filter
```

```
// better implemented as, eg:
```

```
filter = (15*filter +current)/16;
```

```
// then output filter value.
```

This was our last
Lecture!

I will be in the lab
answering questions during
the lecture hours during the
last 2 weeks of labs.