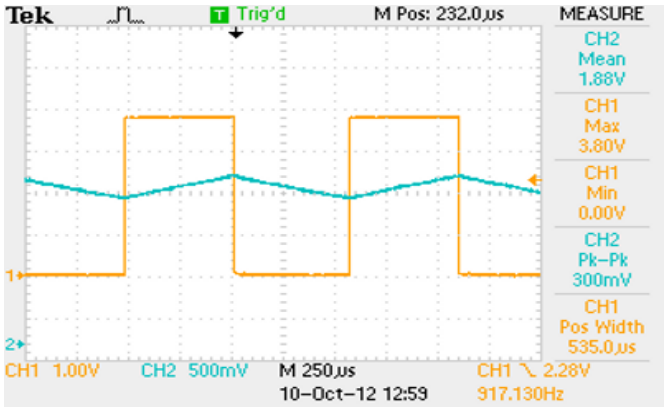
MEASURING CAPACITORS

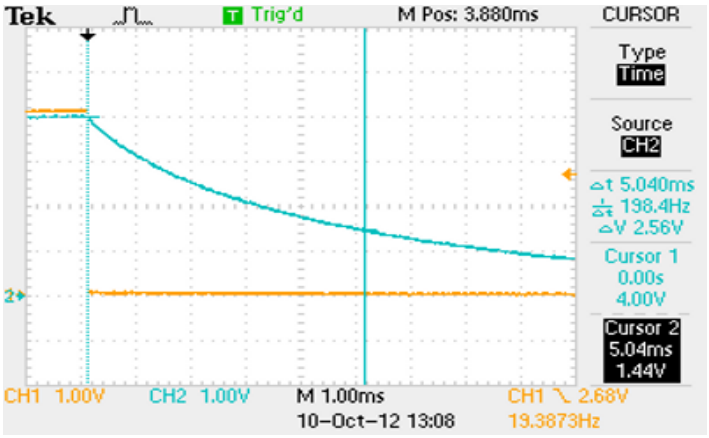
Sometimes little, trivial things keep bothering me. For instance that mystery regarding the switching power supply for the OLED display. Tests have shown the unexpected drop in supply voltage doesn't affect the quality of the displayed image, so it's a non-issue as far as I can see. But I guess it's the matter of engineering pride to find out what exactly has been going on. Recall that I've blamed a 4.7 µF chip ceramic capacitor from Murata to have less capacitance than it should. Well, I've been wrong.

For the production run of the Arduino OLED shield I've ordered another roll of capacitors, this time from Multicomp. The power supply circuit using them however behaves exactly like my prototype. Getting two bad shipments is just impossible I guess, so my brilliant deductions in that previous blog post must have gone seriously wrong somewhere.

To answer the capacitance question I rigged together a simple 555 timer circuit and measured capacitors from both batches using two methods: first by using a current-source and calculating the capacitance from the voltage time derivative, and second by measuring the time constant in a RC relaxation circuit.



Murata capacitors yielded 3.5 µF using the dU/dt method, Multicomp capacitors yielded 3.3 µF.



Murata capacitors yielded 5.1 µF using the RC method, Multicomp capacitors yielded 3.9 µF.

Now these home-grown measurements are nowhere near exact of course, but some back of the envelope estimates show that the declared value (4.7 µF with up to -20% tolerance) can most certainly lie within the error margins and my initial estimate of 1.4 µF doesn't.

So, if capacitors can't be blamed for the inconsistency, what can be? One of the wrong assumptions I made was that the switching power supply can provide at most 60 mA. That's certainly wrong as a simple experiment showed that in short-circuit it can source close to half an ampere. Investigating further it turned out that I didn't properly account for current regulation delays in the control IC and core saturation when the switcher is operating in such extreme circumstances.

In conclusion, now my opinion is that the initial measurements were correct and that in the pre-charge cycle the display indeed does sink a considerable amount of current. The fact that the results of that add-a-known-capacitance trick fit so well with the theory at the time must have been just a coincidence.

Source:

https://www.tablix.org/~avian/blog/archives/2012/10/measuring_capacitors/