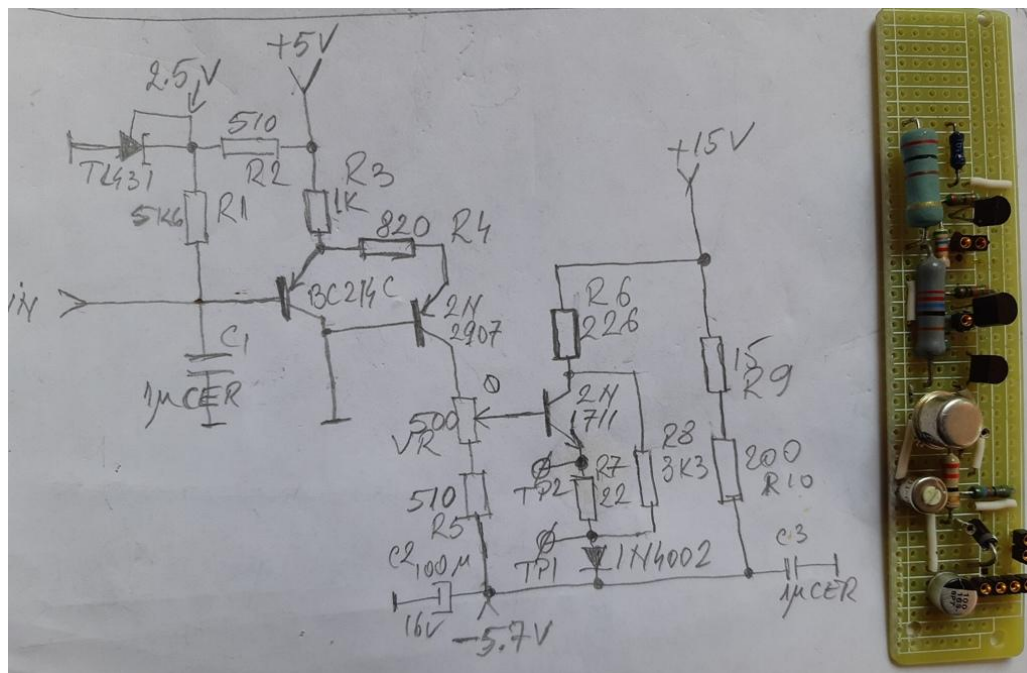


Considering different criteria I started to study TDS30xxX regarding an acceptable solution for LED driver to replace CCFL.

Original solution needs, going from Low, Medium and High intensity, between 430 mA to 900 mA; at 5 V that means 2.2 - 4.5 W.

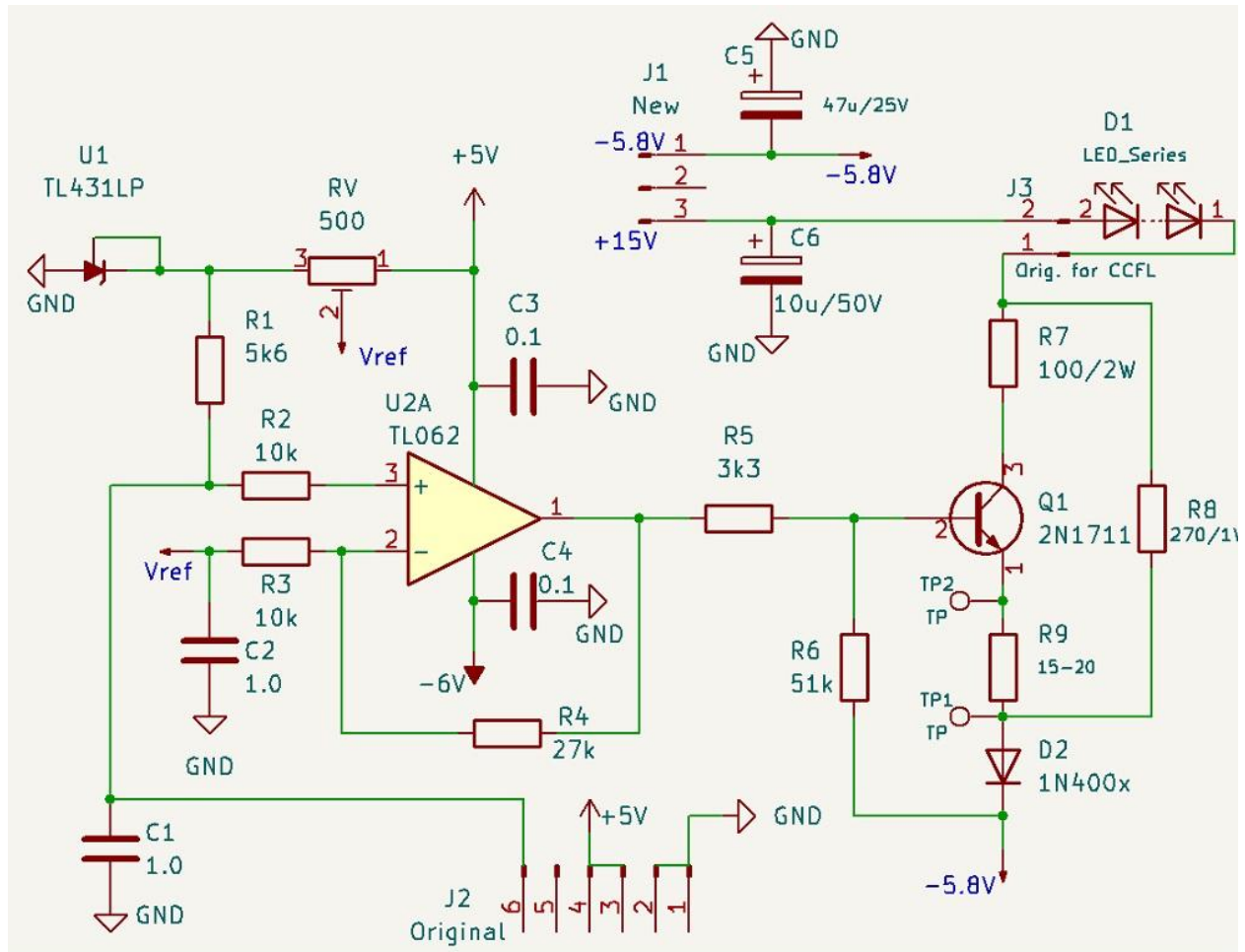
Banggood solution (and versions of it) adapted to this instrument is very inefficient (below 40% at High, possibly even lower at Medium and Low – I did not verify the last two). Also, poor filtering seems to increase the noise displayed by the scope (Sicco mentioned that – could be true). Advantage to buy one: you can build 6 strips of LEDs for 3 TDS30xx(X), discarding the control/driver module (which is not, physically, a great fit anyway).

I tried to find an analog (non switching) solution; first version was this:



Fairly simple schematic, implemented with through hole components. Input side is close to Tek implementation (5.6Kohms at 2.6 V and 1 micro capacitor for slow start). I did not like the adjustment process (lack of current gain in the first stage and narrow range of adjustment, only 0.4 V, provided by scope control signal). Output does not go directly to +15 V but to the two strings of LED replacing CCFL.

To improve behavior I replaced the first two transistors with an OA and some other small differences in the schematic, including the fact that I used the original connector for power and control, also the one for connecting the two LED strips; but added an additional connector for -5.8 V and 15 V (both voltages available from the scope). Here it is:



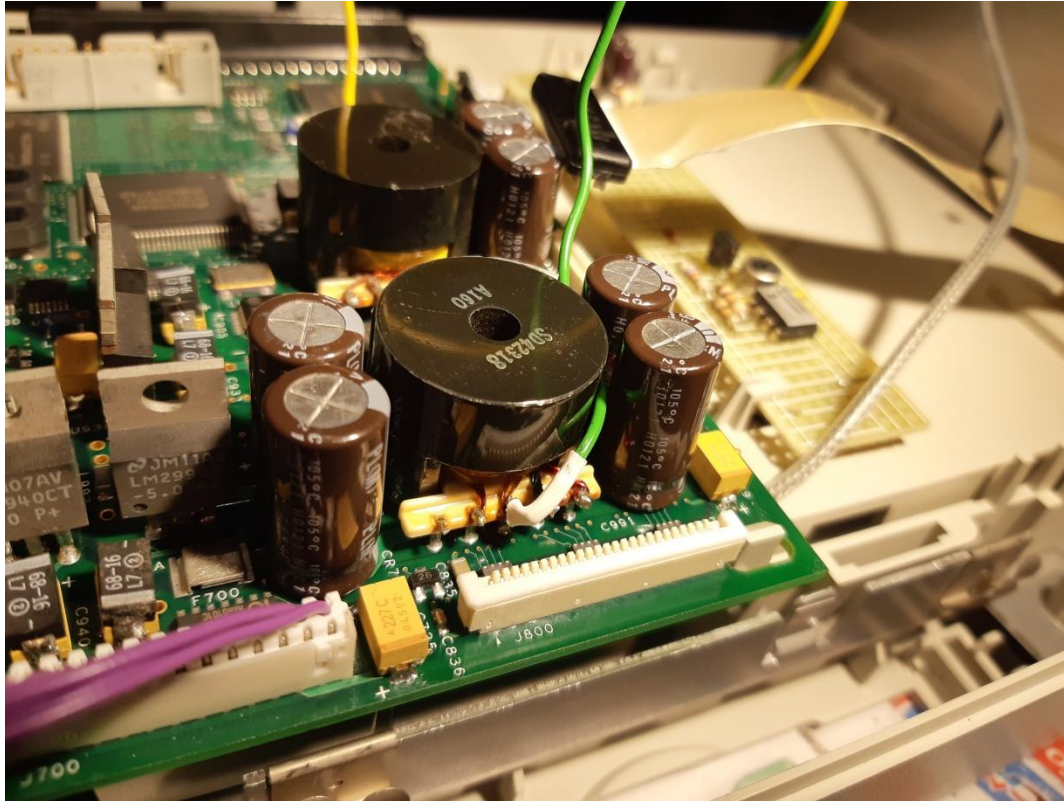
Implemented using the same method, but also using some SM components (R1, R4, C1 to C4).

As it seems the whole series of TDS3xxx was designed to be (very) reliable, I kept the same idea; schematic is overdesigned: Q1 does not need to be in a TO5, possibly a 2N2222 in metal case and a small heat sink would be more than enough – I did not test that. But I also used BSY88 instead of 2N1711. R7 does not need to be 2 W, nor R8 1 W; essentially I used what I had on hand, so R9 was tested between 15 and 20 ohms, R7 between 90 and 200 ohms, R8 between 200 and 270 ohms. Values in the schematic work fine for me, with two strings of 27 LEDs each (or, if you prefer, two strings of 9 groups of 3 LEDs each); as I discovered different versions of displays, two strings of 24 LEDs was enough in one case (I built 4 drivers in total).

U2(A or B, up to you) was also tested with LMC6062 and LMC6482 (through hole versions); there is a mistake in the schematic, pin 4 (number not shown) goes to the same -5.8 V as D2 (don't ask why D2) and R6 (first time using Kicad). This -5.8 V source comes from the Main Board, before the -5 V regulator and after LC filter. (Side note: in version with TL062 the value of R4 was 22kohms - no special reason; testing shows no difference in performance.)

Pin 8 goes to +5 V, available from original connector – to mention here that this +5 V source is not the same +5 V from the Main Board, comes from the Battery Board together with +15V.

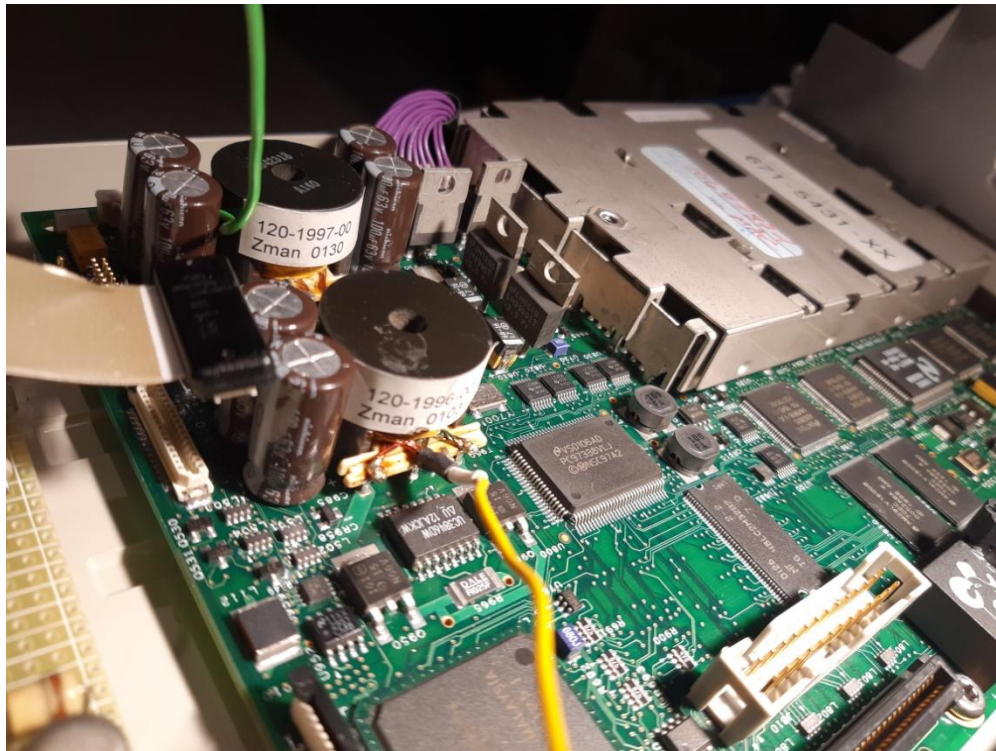
To emphasize that -5.8 V and +15 V (more or less, for both) could be taken from the main board, but there are difference between scopes - simple and B version; no idea about C version.



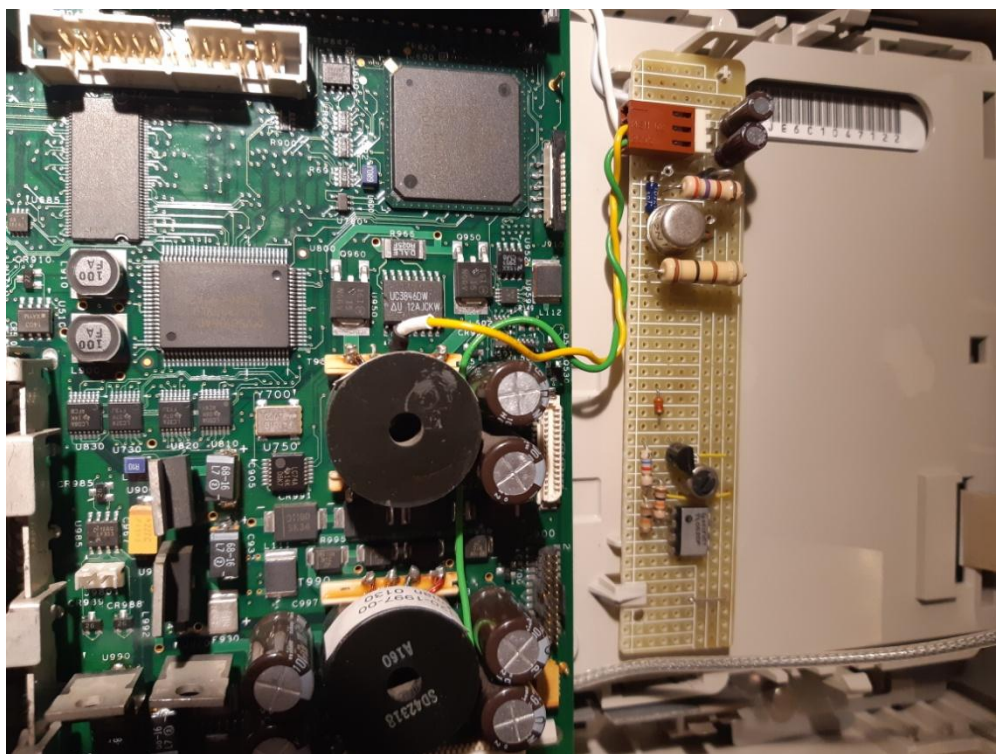
In this picture the green wire is -5.8 V; same voltage is available on the other side of the board (solder side), see next picture.

The yellow wire (better visibility in the next picture) is +15 V, also available on the other side of the board (I used both versions of connections; I prefer the other side, not the one shown in pictures, but it's easy to find the corresponding points; it's more about choice).





And altogether (this board is B version):



Connector for LED strips (J3) is mounted on the solder side, under the red-white connector; it is convenient for any version but in this case it's a B version where both CCFL (and, then, LED strips) were at the top of the display, side by side.

Also underside is J2, original connector, at the bottom of the board; in case of a B version the cable from that connector goes to Battery Board, not Main Board.

Be careful where you place variable resistor, as some positions are not desired from adjustment point of view (e.g. middle of the board is a no-no). In any case, be aware that there are some 'ribs' on the plastic holder of the board; those may interfere with some SM components or soldering of some TH components.

This version of driver has an average efficiency of around 75%. With components in the schematic no significant heat is developed in the accessible components; I don't know how warm (hot) are LEDs.

How you install LED strips in place of CCFL is up to you; I found 3 different versions of displays. I used some silicone to fill the bottom of the metallic holder (maybe 1 mm, not more); after it cured (one day) I put an additional thin layer of silicone and pressed the strip inside. You may need to spread the 'walls' of the holder initially, to make room for strips, but don't forget to bring them back, it's a narrow space inside. Also, LEDs must be 0.5-1 mm below the edge of the 'walls'; and you need some patience...

Strips of LED come in different flavors, some at 3.8 mm width, others 3 mm; last one was the only option in the case of a more recent scope (B02xxxx), with CCFL of lower diameter.

About adjustment:

After verifying and re-verifying the board, install it and do not connect J1 and J2.

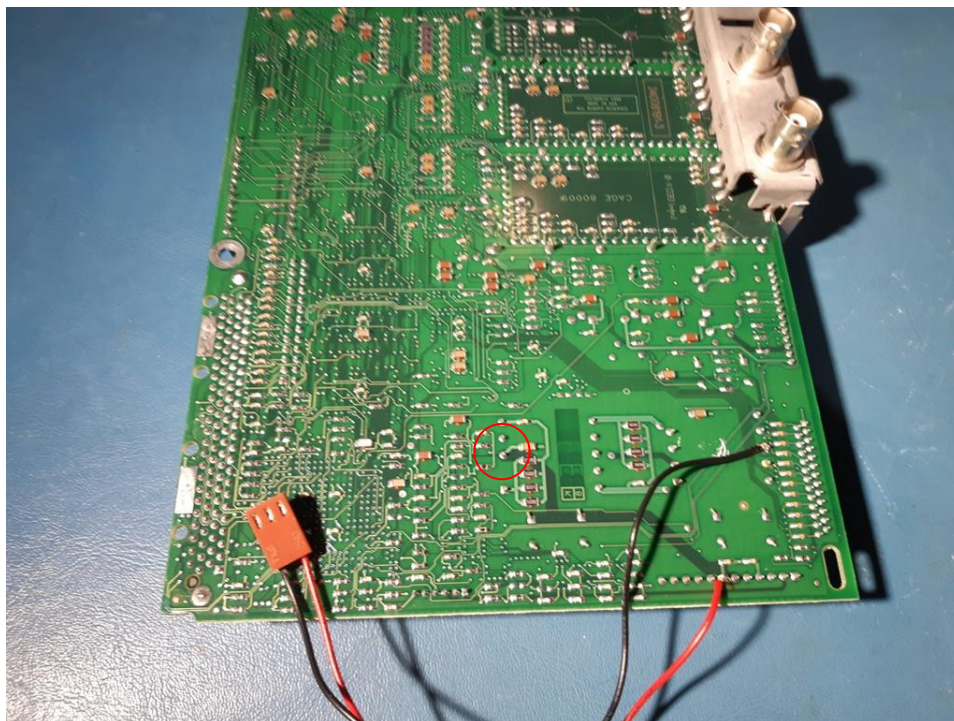
Start the scope and verify the voltages coming to the board, -5.8 V, +5 V and +15V. Shut down the scope and connect J1 and J2.

Start the scope, press Display and chose High; changing RV position should bring different intensities (be careful, dangerous voltages in the scope); with a meter read the voltage difference between TP1 and TP2; for R9=15 ohms should be (or adjust to) around 420 mV (28 mA). Press Medium and adjust voltage across R9 for 45% of the previous reading (around 190 mV for 15 ohms or 12-13 mA); you could also check that, at Low, current through R9 is around 2 mA .

Note: Vref, in my case, is ~3.8 V.

Below another version of connection to -5.8 V and +15 V and assembly for a TDS30xx:





Black wire goes to -5.8 V, red wire to +15 V (this is a non-B version).

In the B version check red circle for +15 V pin.



P.S. Please let me know if you notice mistakes; also, excuse my poor English.