Let's hack cheap hardware 2016 edition

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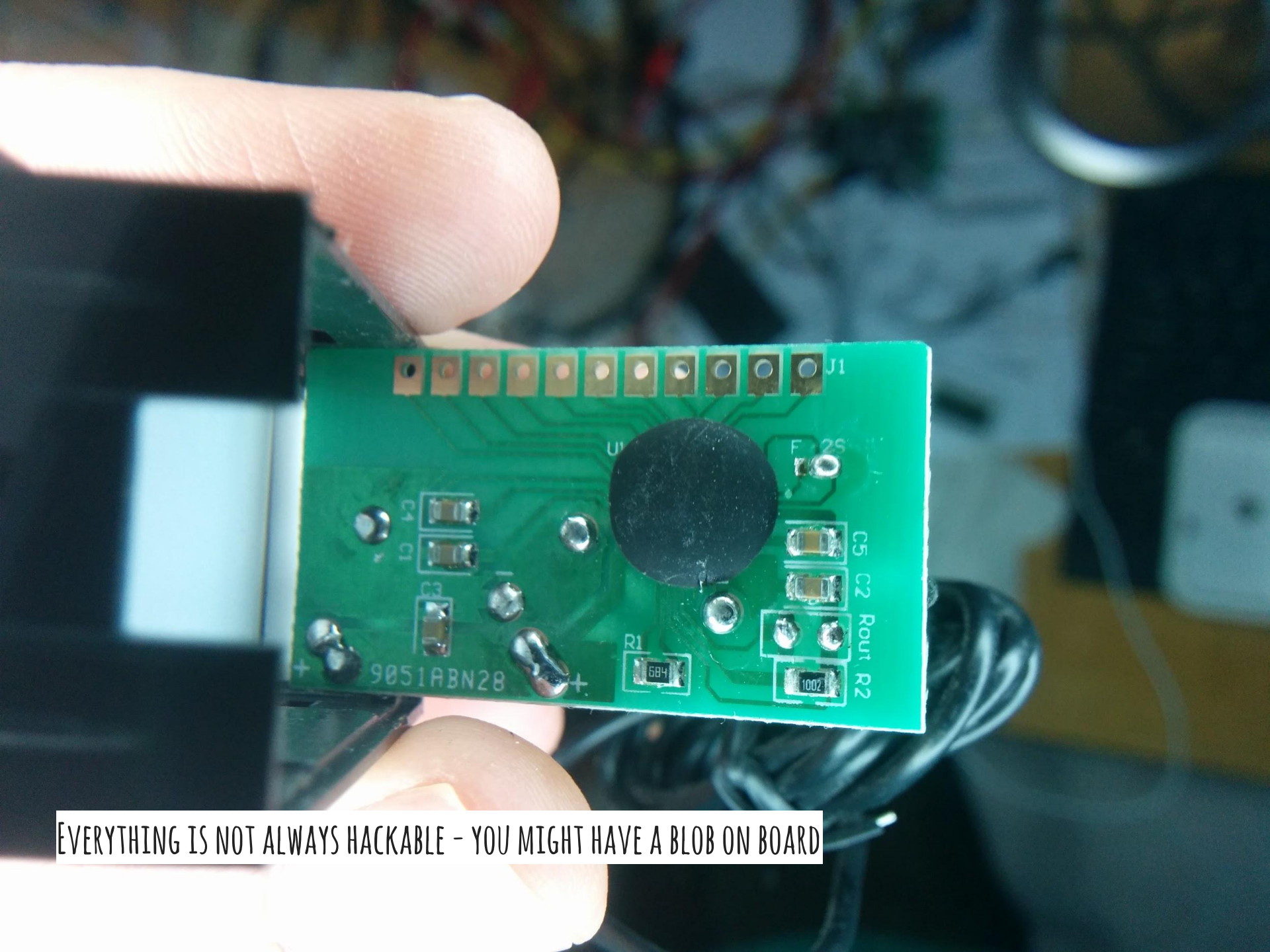
HULK, HrOpen

2016-05-12 #dorscluc
2016-05-14 Osijek Mini Maker Fare

Why are we here?

You bought something which is not quite useful as it should be...
...or it could be improved!
Let's hack it!



Everything is not always hackable - you might have a blob on board

Everything should be hackable!

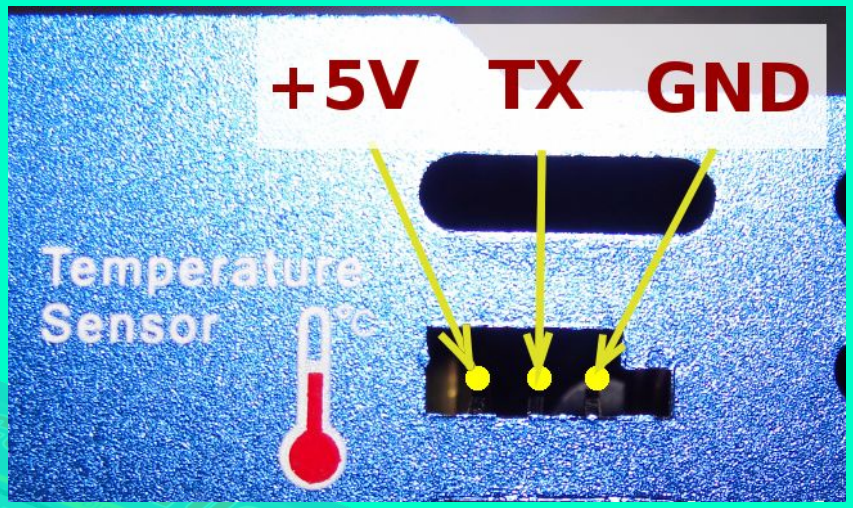
We will talk mostly about power today.

Let's see some interesting products with free/open firmware replacement!

IMAX B6 BATTERY CHARGER

Universal battery charger

Li-ion, LiPo, LiPo-4.30V, LiPo-4.35V, LiFe, NiCd and NiMH, NiZn, Pb



Why would you want to hack this device?

Serial port and temperature sensor share same pins!

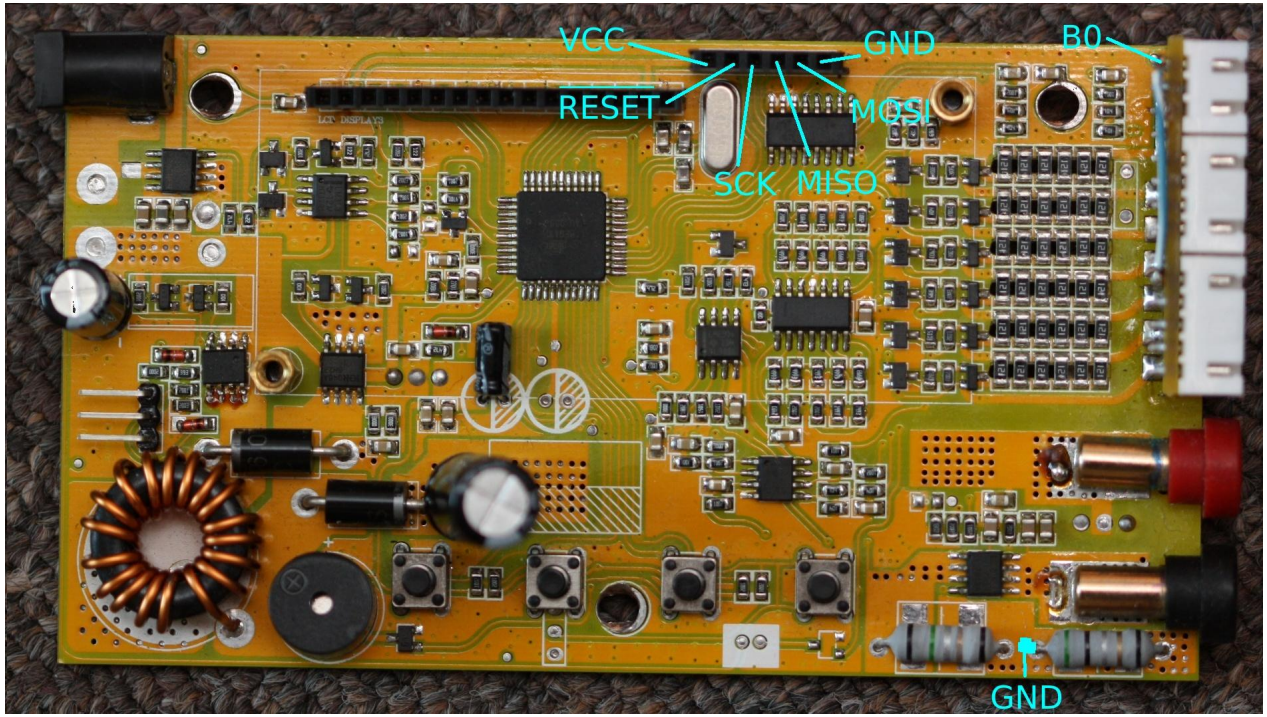
We want temperature sensor **and** serial logging!

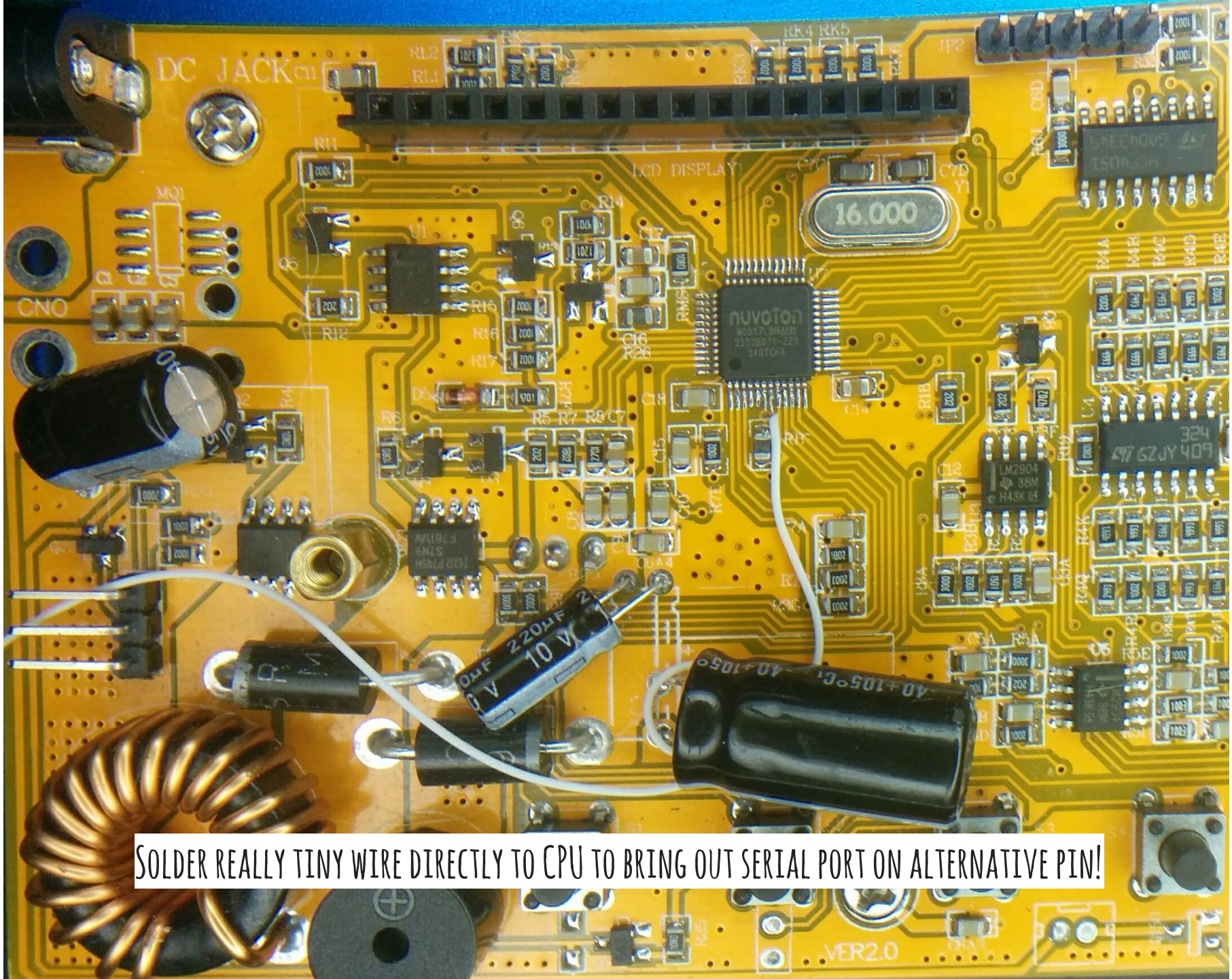
IMAX B6 BATTERY CHARGER

https://github.com/stawel/cheali-charge

Two supported variants: ATmega32 and Nuvoton NuMicro M0517LBN

There is also unsupported 8051-based variant!! YMMV

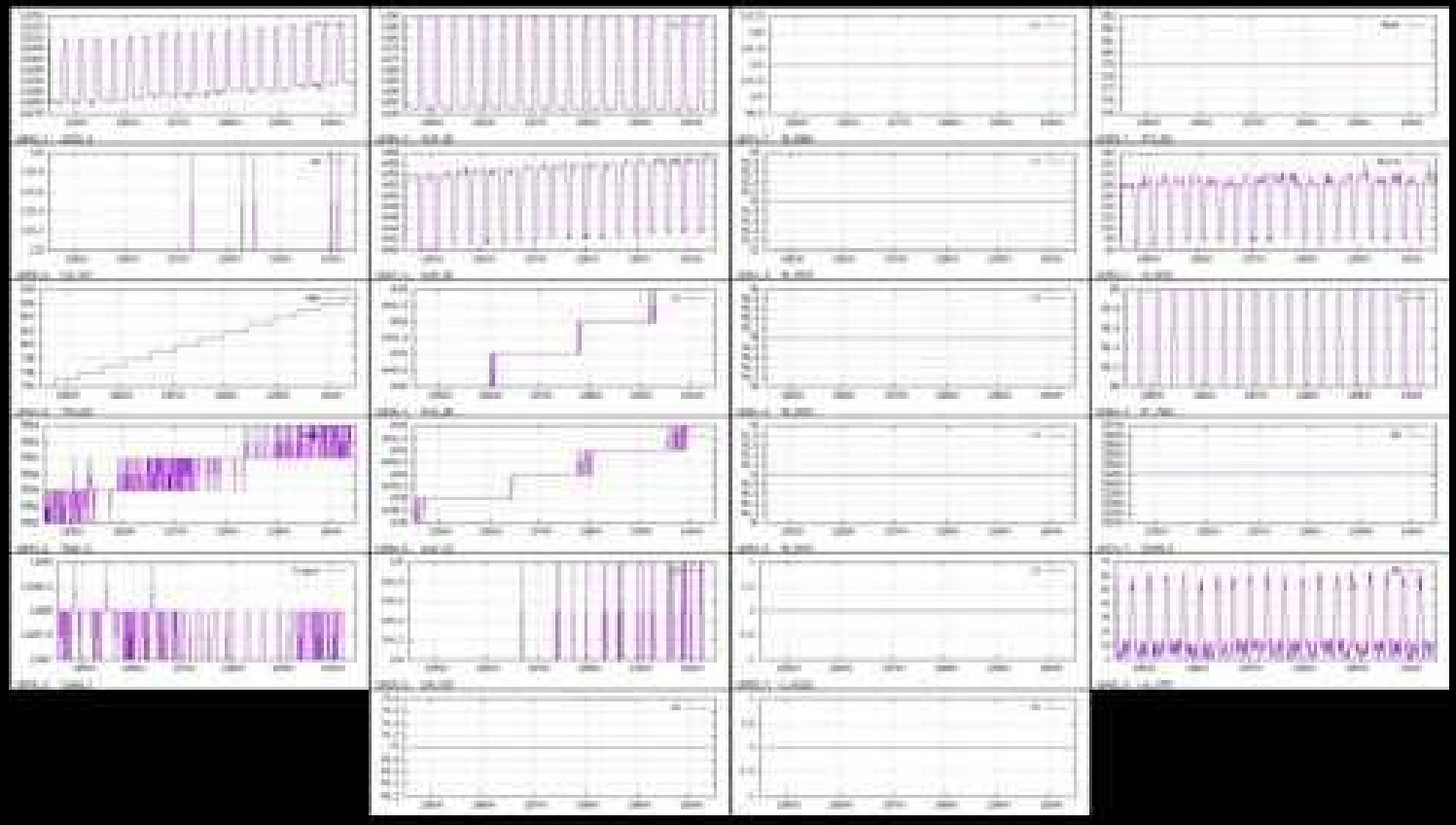




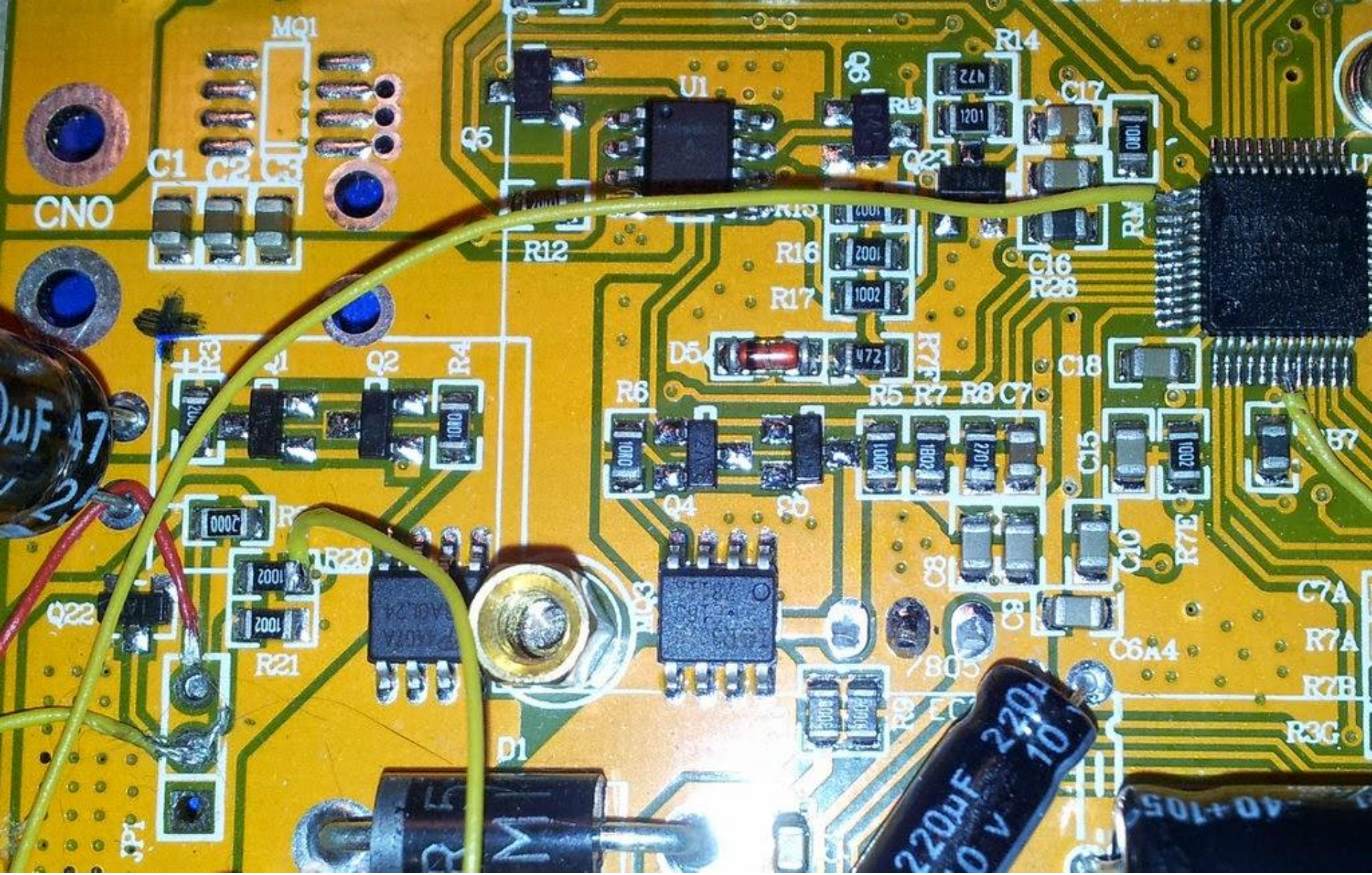
Solder really tiny wire directly to CPU to bring out serial port on alternative pin!


CGR18650CF
You might have a frew old batteries from laptops which just want to be reused...

Was it Worth it?



https://github.com/dpavlin/cheali-logview-gnuplot



There are two unused pins on CPU which can be used with alternative firmware!
And various possibilities for thermal sensor if you solder few more wires...

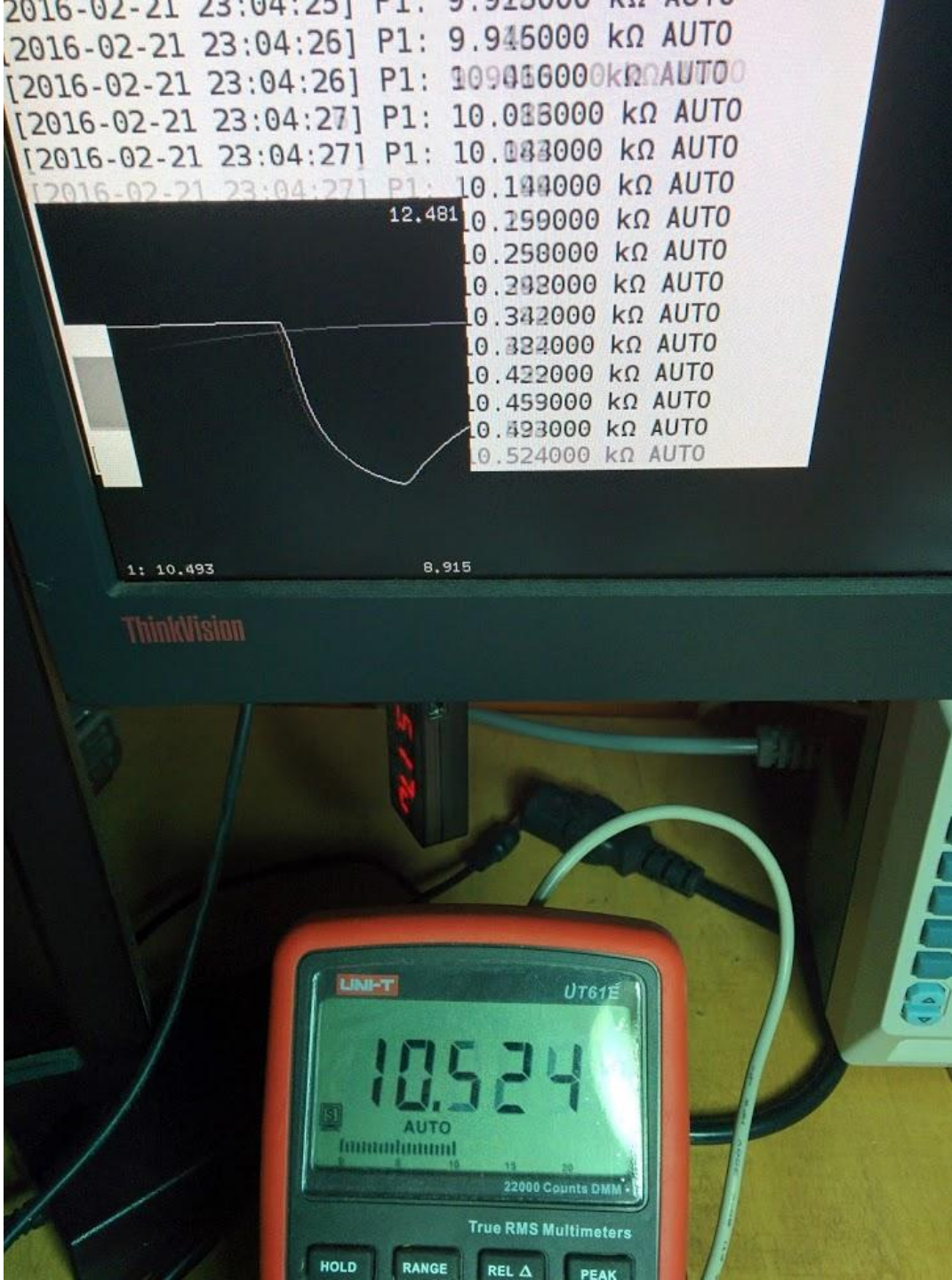
CALIBRATION REQUIRED!

To calibrate IMAX B6 you will need multimeter which is more precise than ADC in device

If you also want serial logging UNI-T UT61E might be good choice since it’s supported by sigrok:

http://sigrok.org/wiki/UNI-T_UT61E

You will also need ST-Link v2 to program ARM core using SWD or USBasp (or Arduino with ASP sketch) to program AVR



But, I don't care about battery chargers!

How about adjustable power supply?

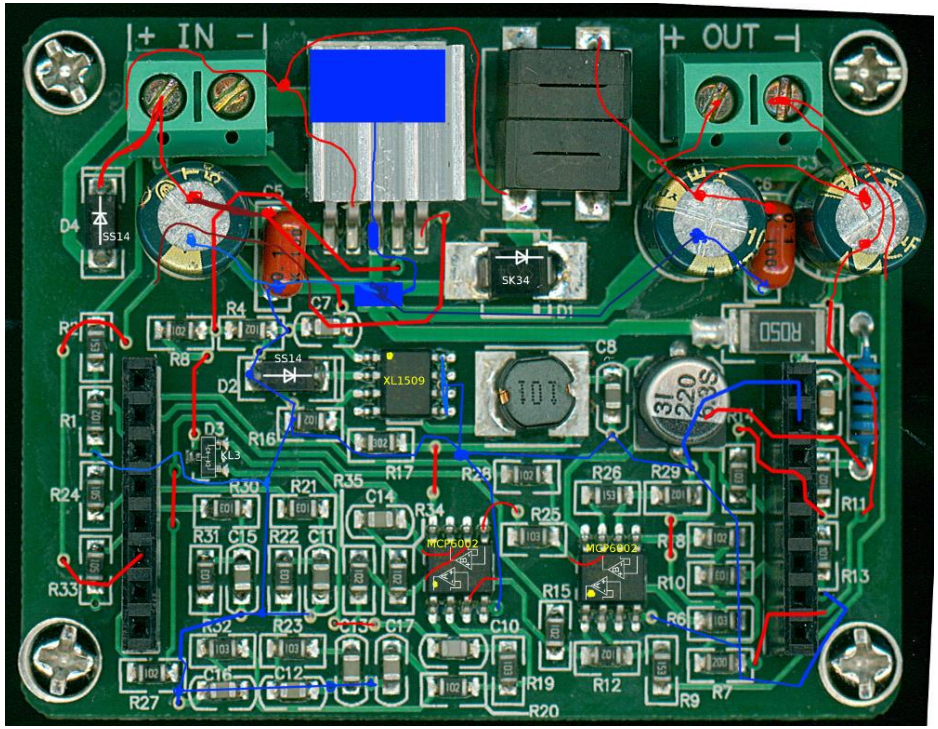
B3603 $10 step down buck

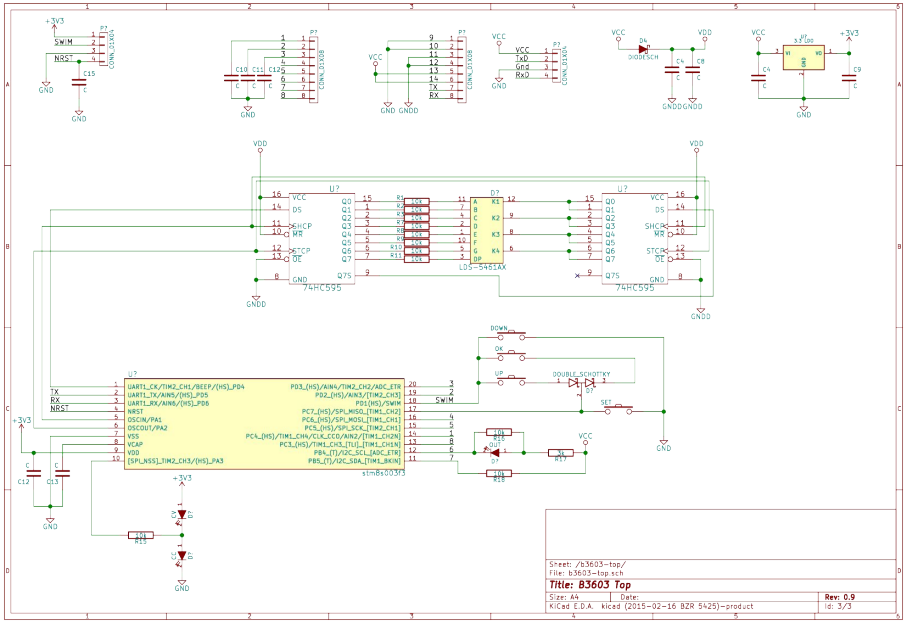
Input: 6-40V
(+1.5V more then output)

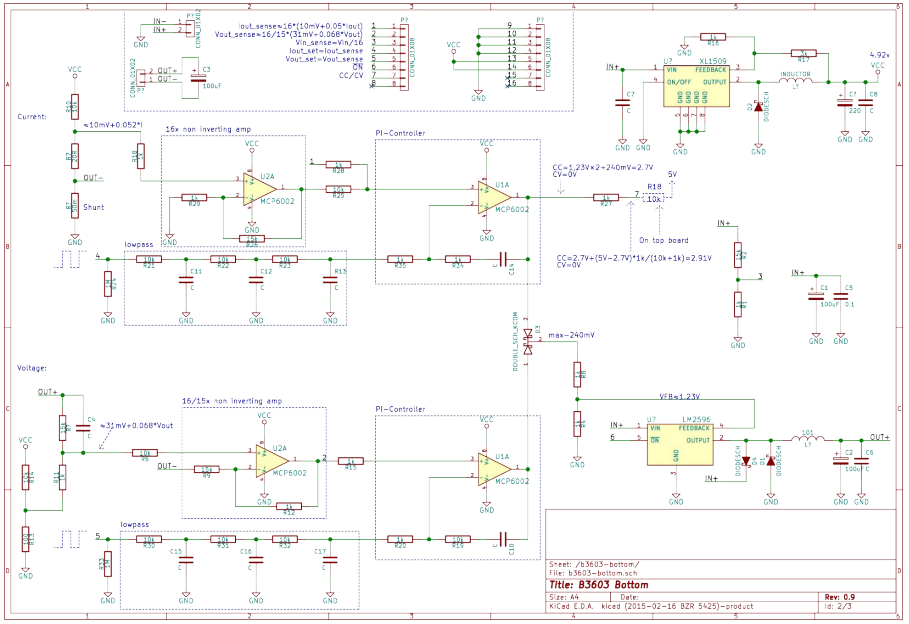
Output: 0-36V

Output current: 0-3A
(2A continuous!)

Constant current or
constant voltage







Quite nice and stable power supply

Not a open hardware project, but people put some effort into it and reverse engineered schematics of top and bottom boards

MingHe B3603

https://github.com/baruch/b3603

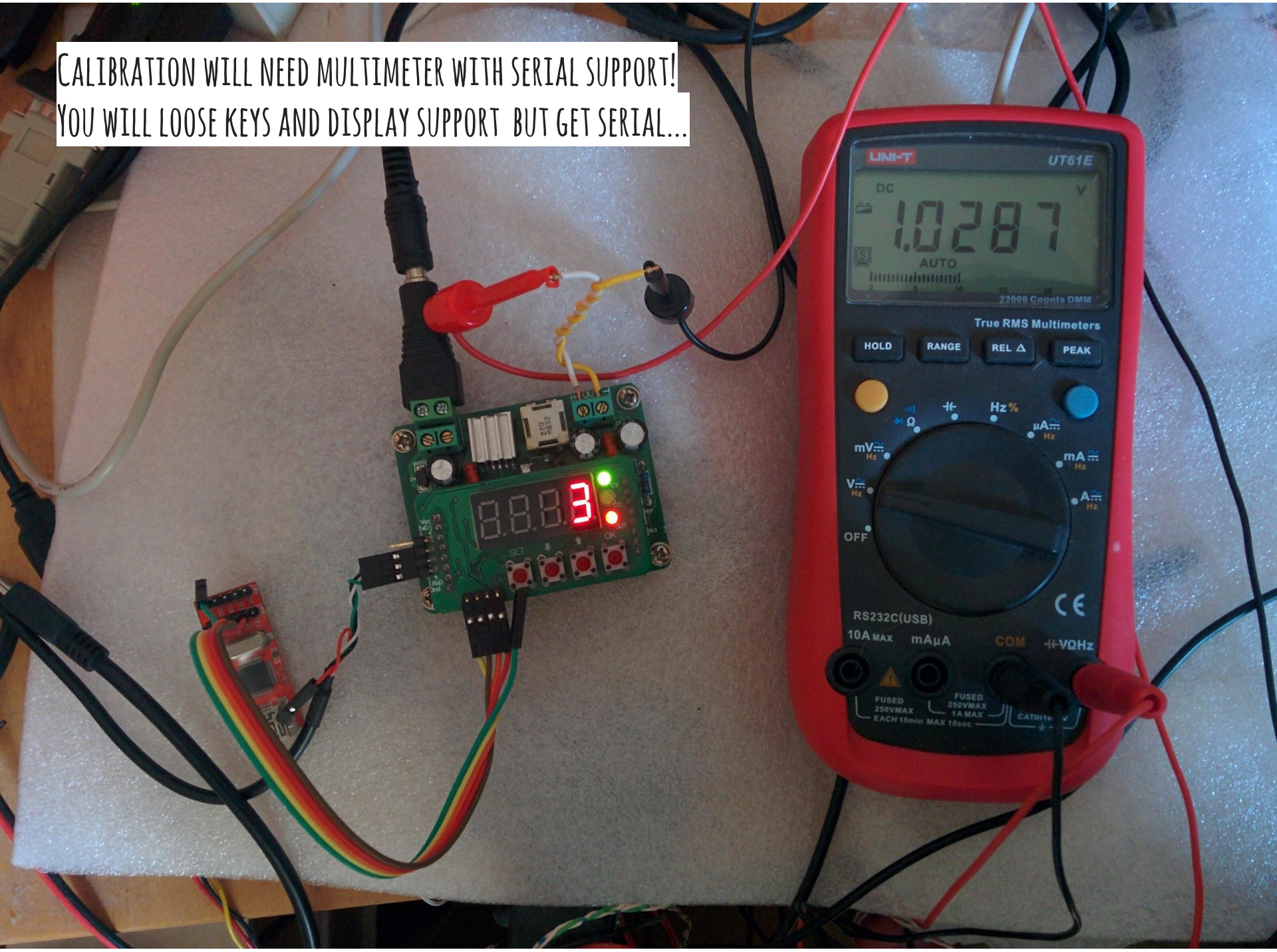
https://github.com/swegener/b3603

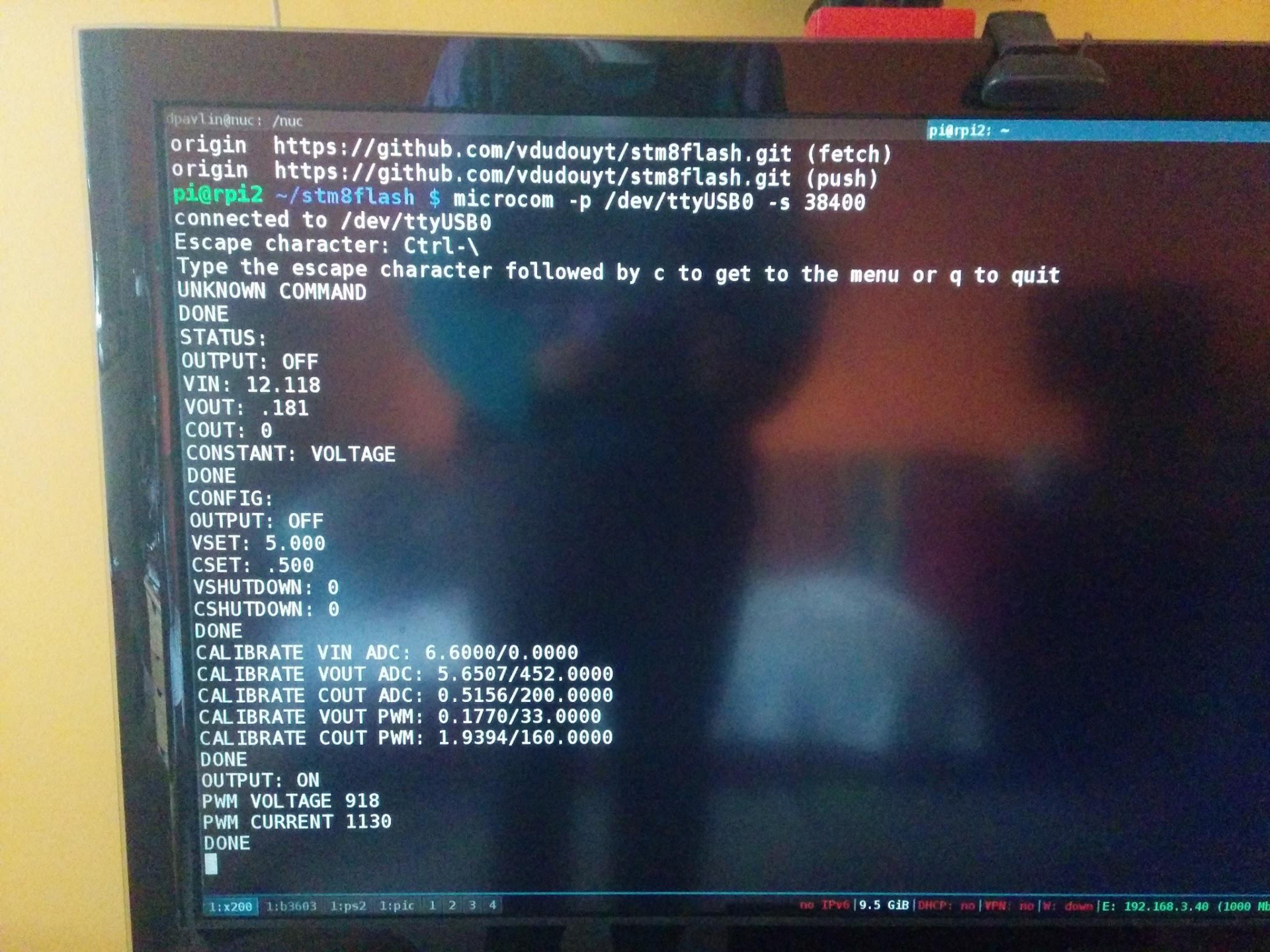
Convert this step-down into **USB controlled power supply** (display and keys no longer work so have that in mind)

Needs ST-Link v2 to flash it using SWIM and CP2102 USB serial

Uses sdcc to compile for 8051

https://hackaday.io/project/4362-power-supply-b3603-alternative-firmware


CALIBRATION WILL NEED MULTIMETER WITH SERIAL SUPPORT!
YOU WILL LOOSE KEYS AND DISPLAY SUPPORT BUT GET SERIAL...
UNI-T
UT61E
DC
1.0287
AUTO
22000 Counts DMM
True RMS Multimeters
HOLD
RANGE
REL Δ
PEAK
OFF
RS232C(USB)
10A MAX
mAμA
COM
VΩHz
FUSED 250VMAX EACH 15min MAX
FUSED 250VMAX 1A MAX
SET
OK


dpavlin@nuc: /nuc
pi@rpi2: ~
origin https://github.com/vdudouyt/stm8flash.git (fetch)
origin https://github.com/vdudouyt/stm8flash.git (push)
pi@rpi2 ~/stm8flash $ microcom -p /dev/ttyUSB0 -s 38400
connected to /dev/ttyUSB0
Escape character: Ctrl-\
Type the escape character followed by c to get to the menu or q to quit
UNKNOWN COMMAND
DONE
STATUS:
OUTPUT: OFF
VIN: 12.118
VOUT: .181
COUT: 0
CONSTANT: VOLTAGE
DONE
CONFIG:
OUTPUT: OFF
VSET: 5.000
CSET: .500
VSHUTDOWN: 0
CSHUTDOWN: 0
DONE
CALIBRATE VIN ADC: 6.6000/0.0000
CALIBRATE VOUT ADC: 5.6507/452.0000
CALIBRATE COUT ADC: 0.5156/200.0000
CALIBRATE VOUT PWM: 0.1770/33.0000
CALIBRATE COUT PWM: 1.9394/160.0000
DONE
OUTPUT: ON
PWM VOLTAGE 918
PWM CURRENT 1130
DONE
1:x200 1:b3603 1:ps2 1:pic 1 2 3 4
no IPv6 | 9.5 GiB | DHCP: no | VPN: no | W: down | E: 192.168.3.40 (1000 Mb

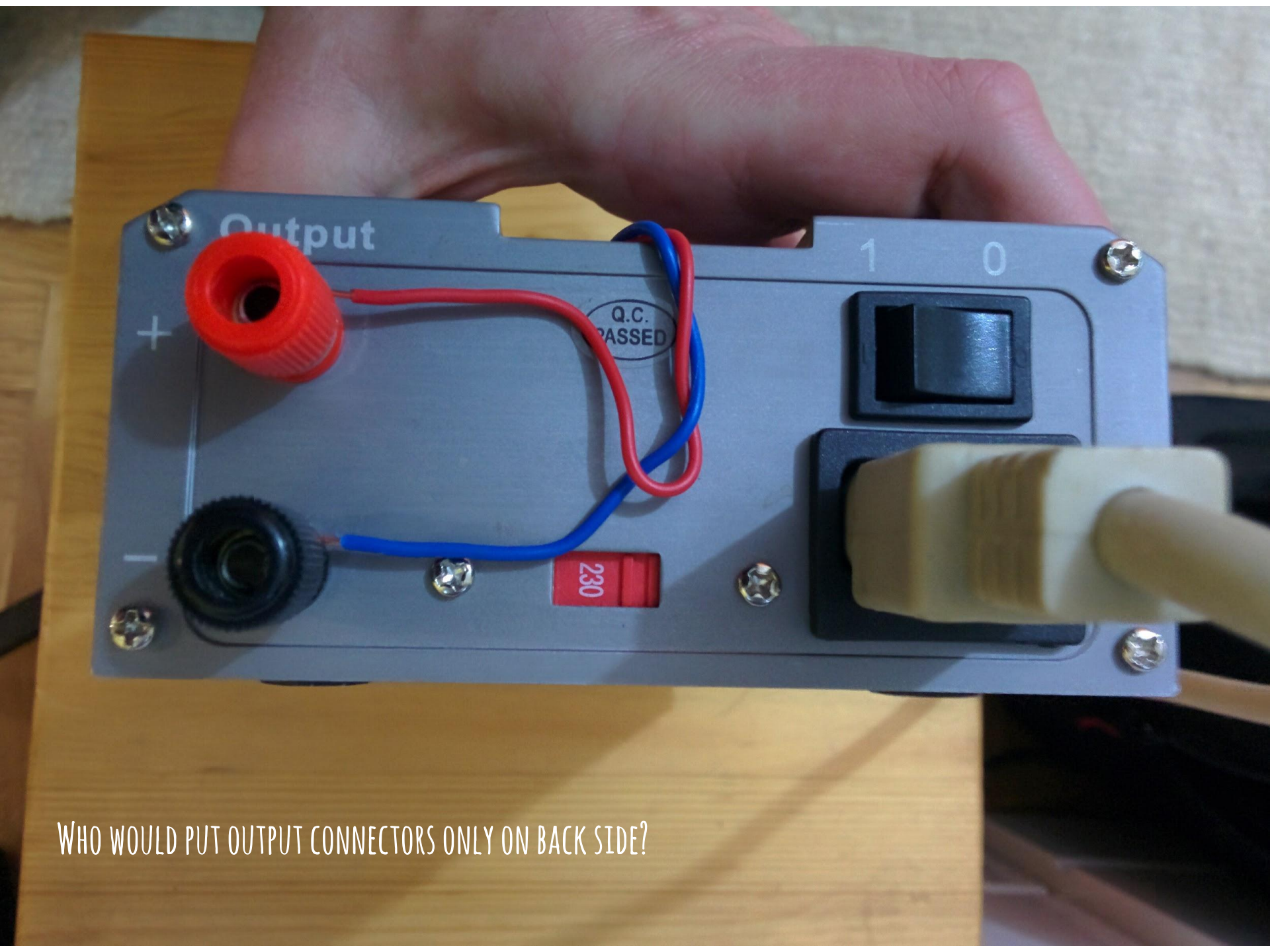
But I want real power supply...

CPS-3205

0-32V 0-5A
Adjustable power suppy

Nice $60 power supply

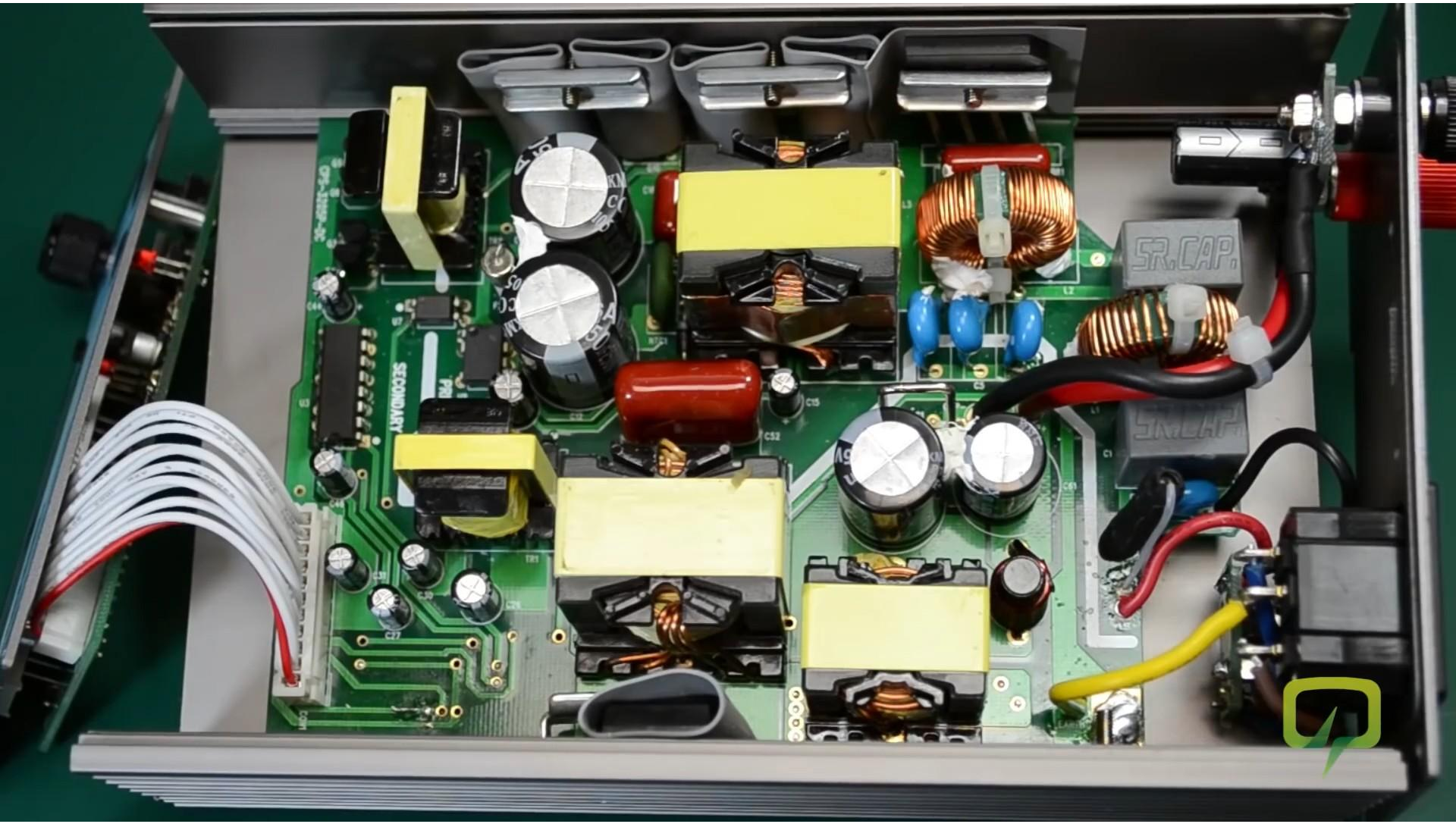
Not much to hack on it, expect output terminals



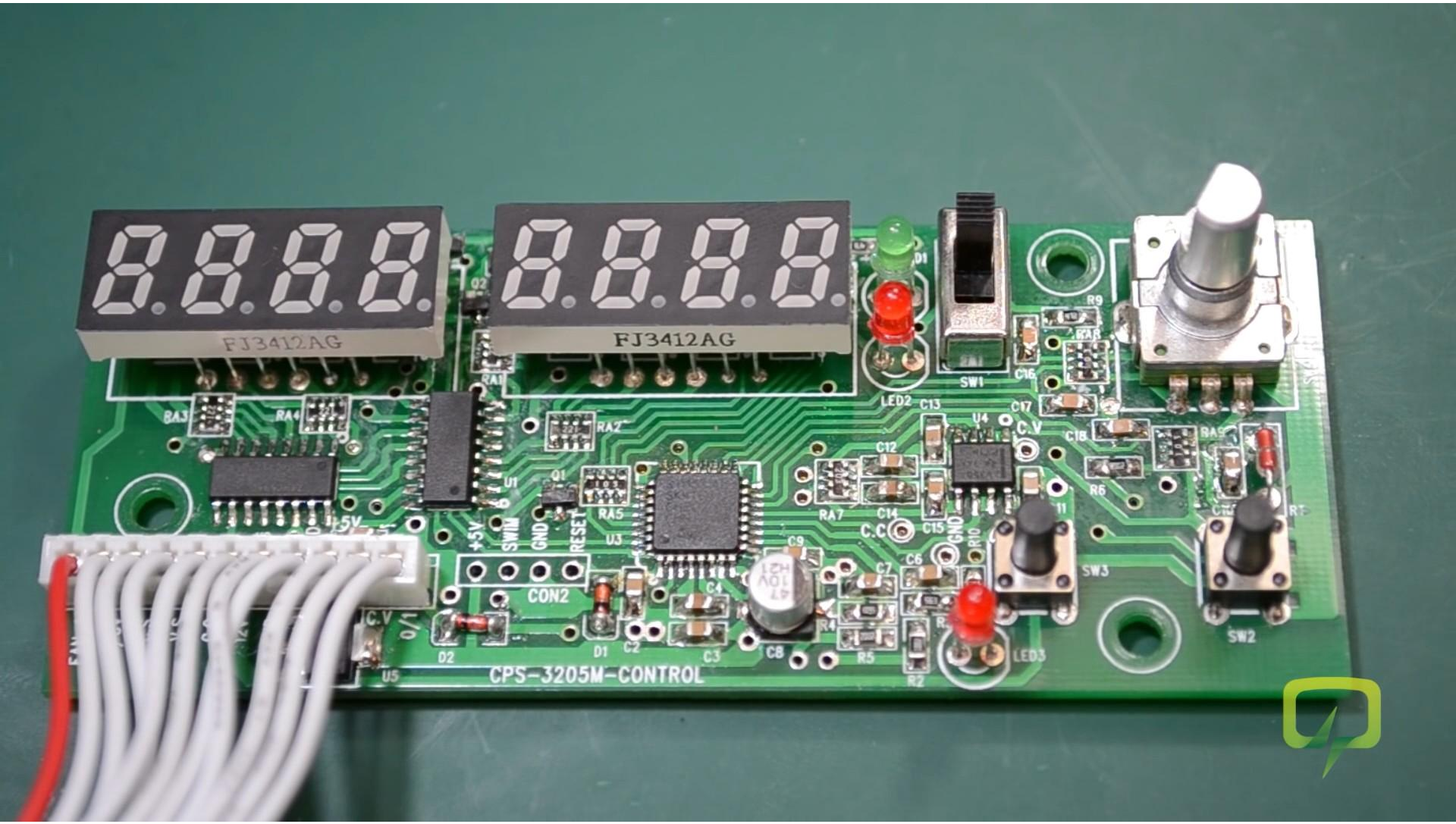
Who would put output connectors only on back side?

CALIBRATION IS DESCRIBED IN HTTPS://YOUTU.BE/5QBOGPKT2KM

No hardware hacking here!
It runs from mains (220V) voltage which might be lethal if you don't know what you are doing (like me :-)



Let's take a look inside.... Nice construction, cheap caps



It does have stm8 mcu and swim headers on board....

I have USB power supply which should work (with RPi2 ;-) but does not

ZHIYU ZPB30A1

60W dummy load

Nice $22 dummy load

Constant current

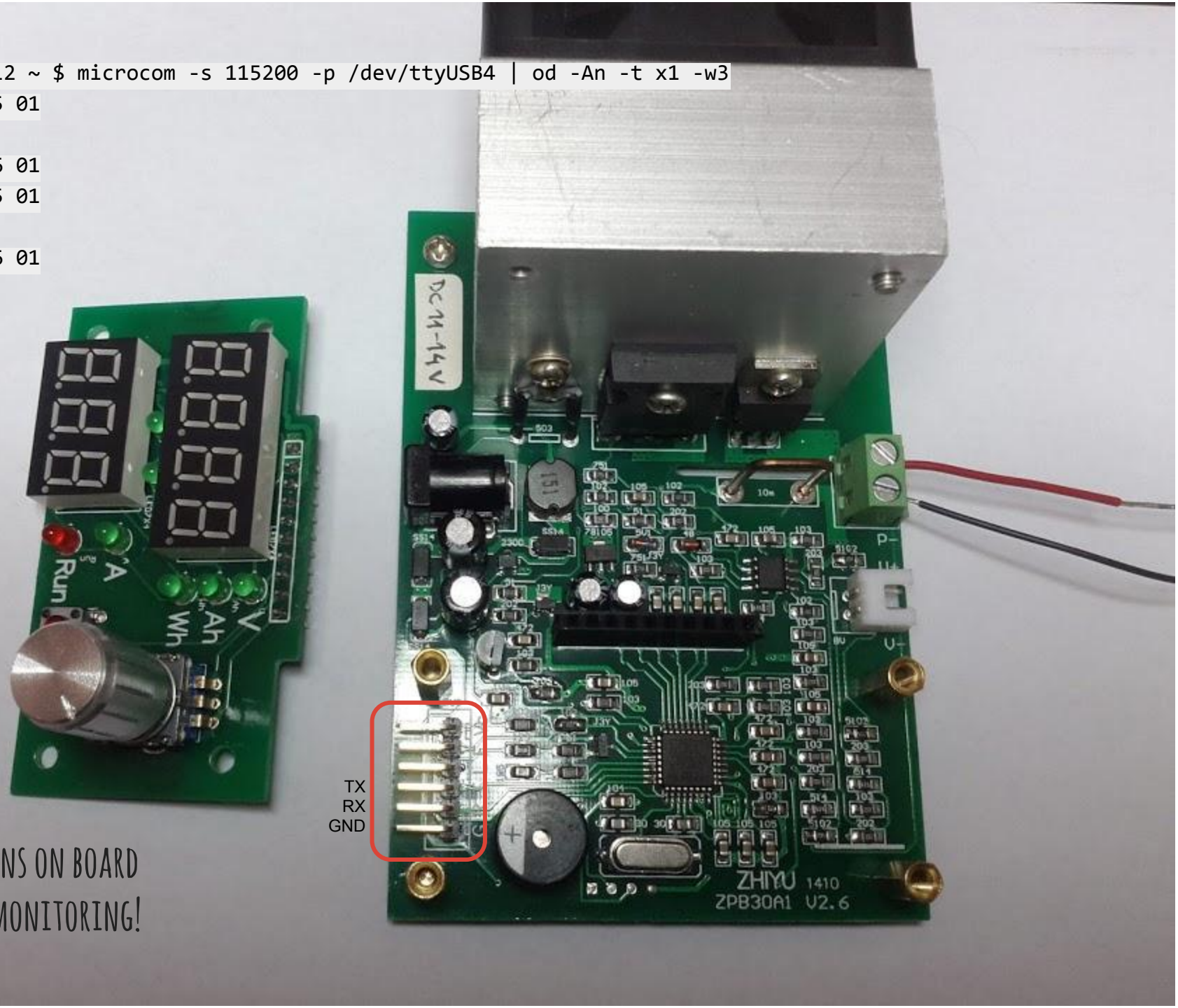
30V 0.20-9.99A

Setup voltage alarm

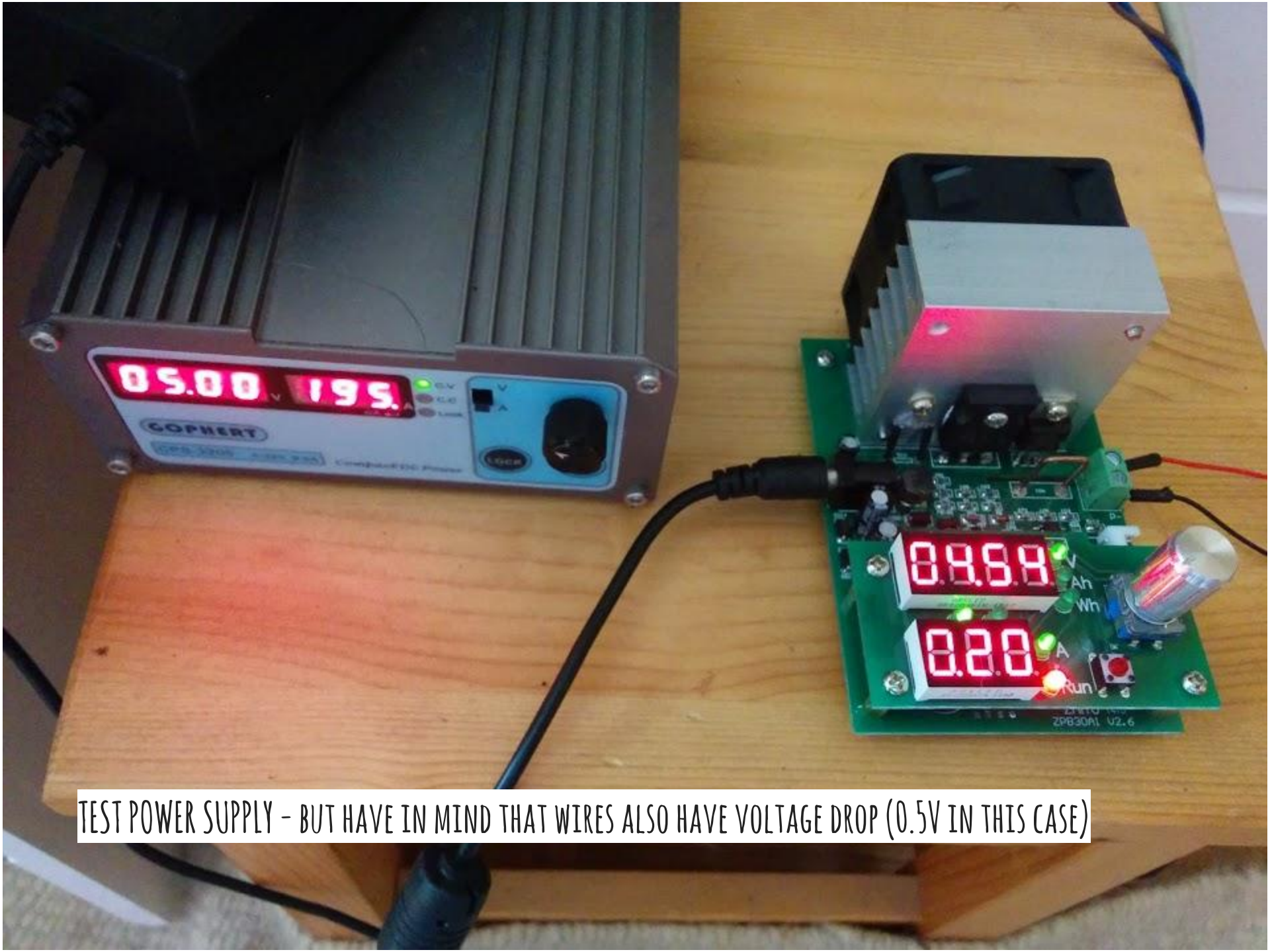
Fun1 - alert when voltage drops (for power supply)

Fun2 - stop discharge on voltage drop (for batteries)

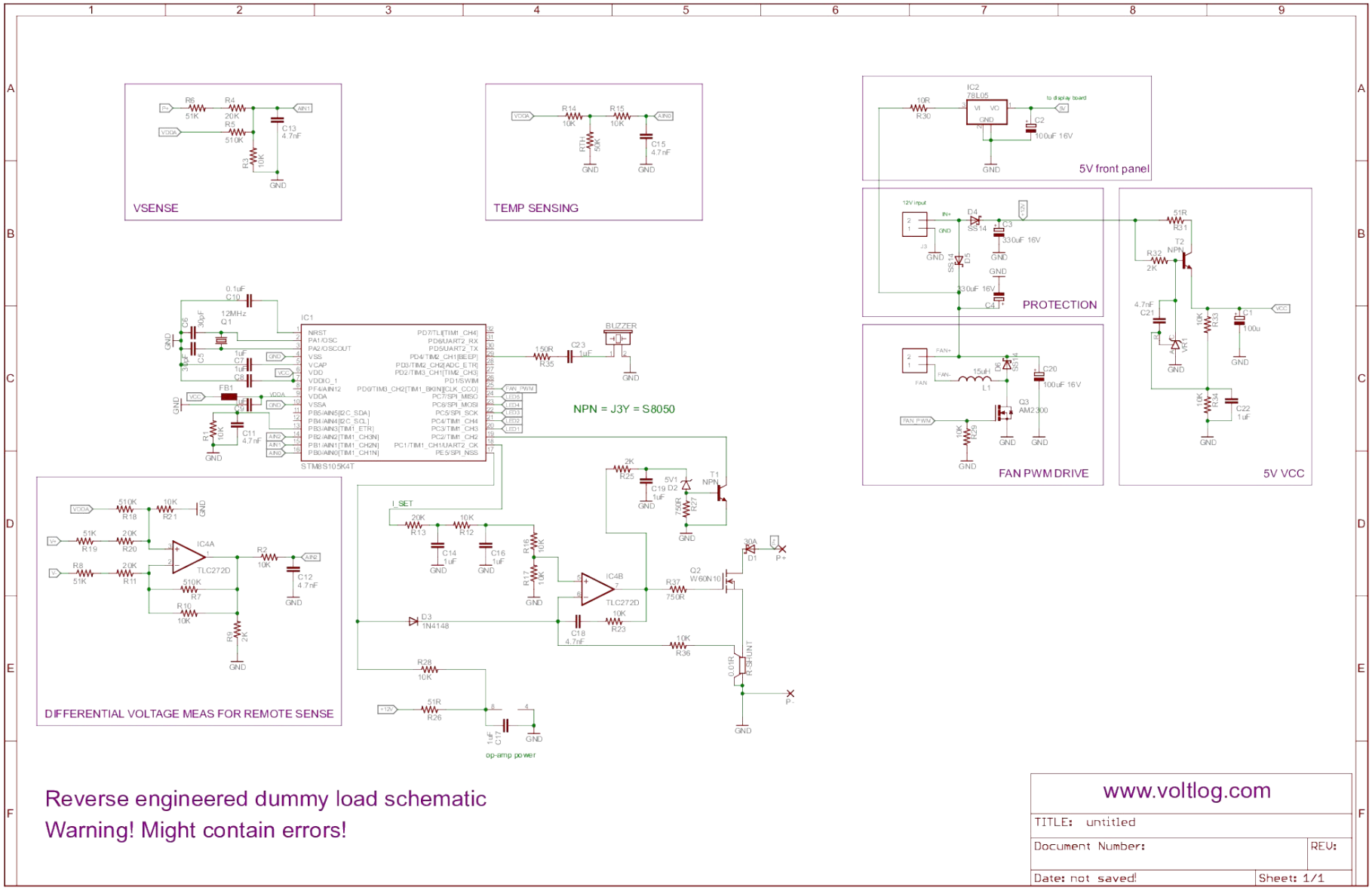
```
pi@rpi2 ~ $ microcom -s 115200 -p /dev/ttyUSB4 | od -An -t x1 -w3
 04 35 01
*
 04 36 01
 04 35 01
*
 04 36 01
```



SOLDER PINS ON BOARD
AND GET MONITORING!



TEST POWER SUPPLY - BUT HAVE IN MIND THAT WIRES ALSO HAVE VOLTAGE DROP (0.5V IN THIS CASE)



Reverse engineered dummy load schematic

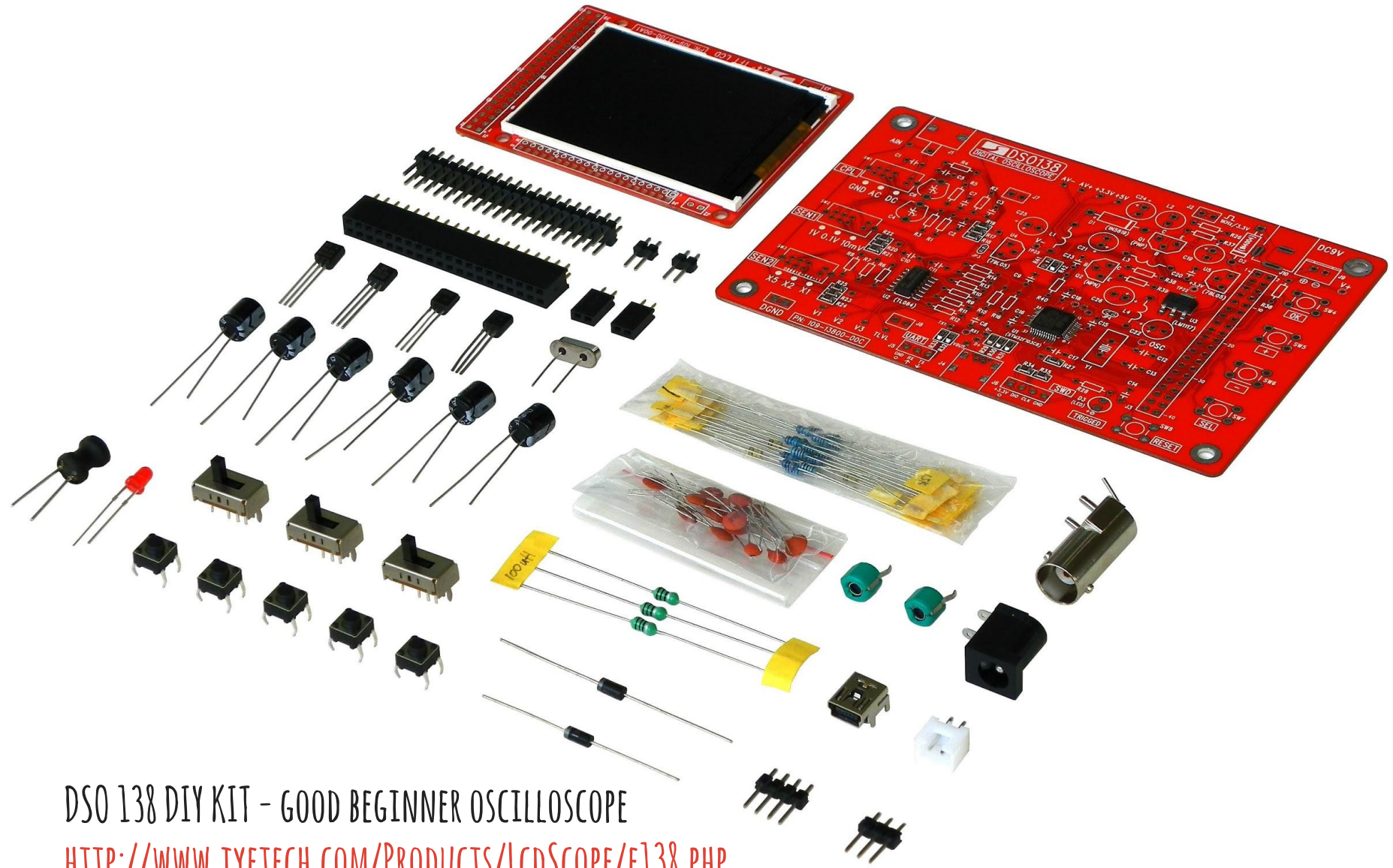
Warning! Might contain errors!

VoltBlog reversed schematics -- waiting for open firmware? ;-) Also STM8

Questions?
@dpavlin

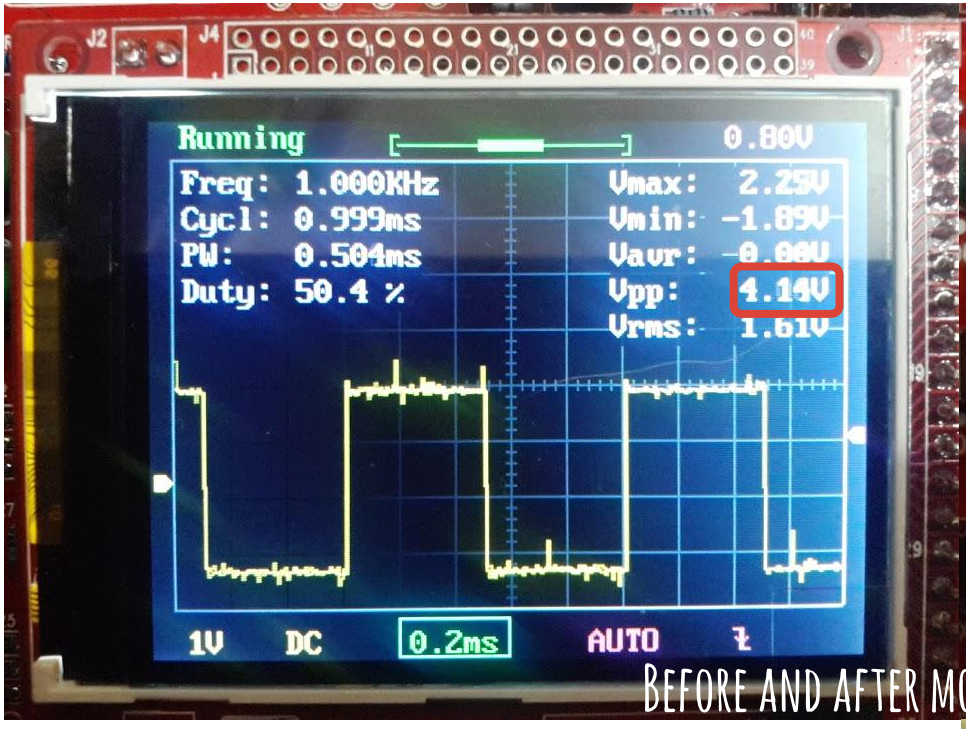
Find something and improve it yourself!
http://bit.ly/dc2016-cheap

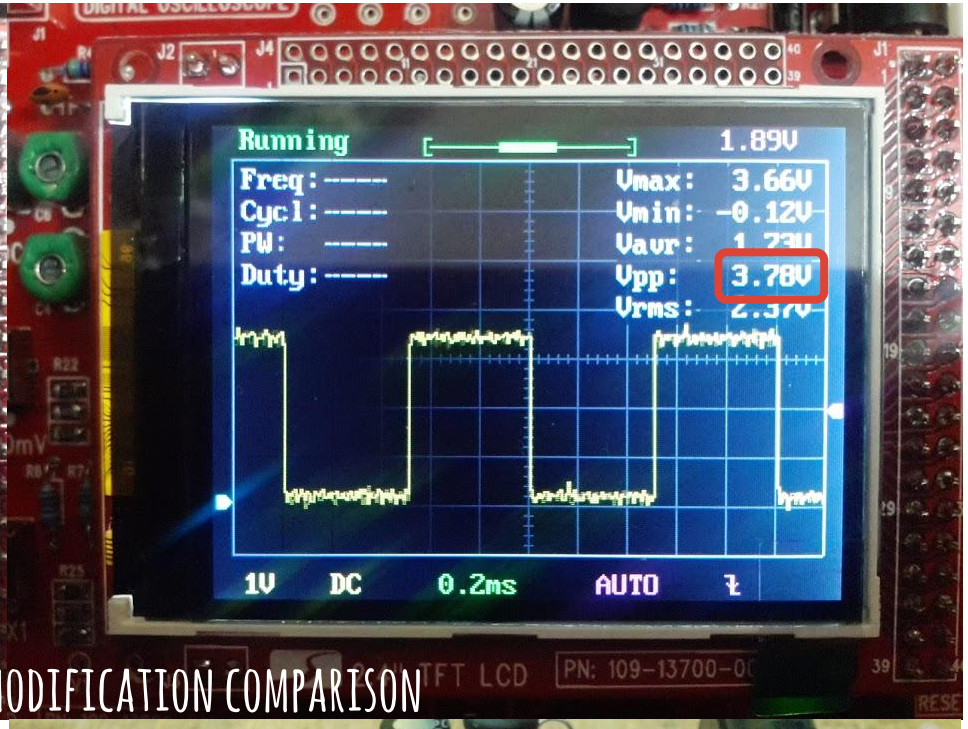
Improve existing tools



DSO 138 DIY KIT - GOOD BEGINNER OSCILLOSCOPE

http://www.jyetech.com/Products/LcdScope/e138.php



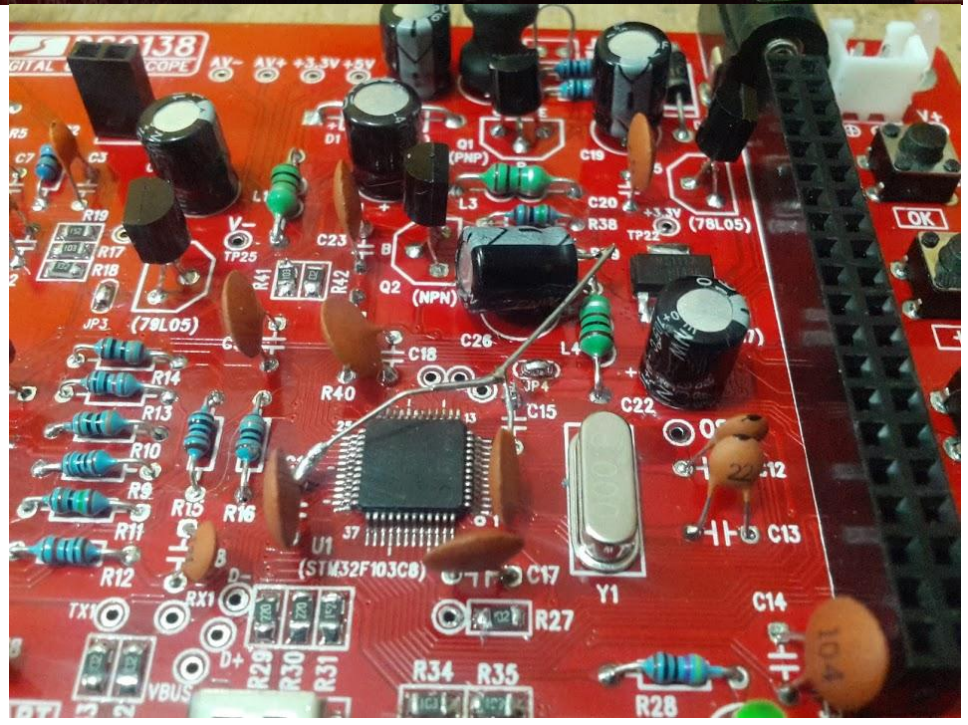


Before and after modification comparison

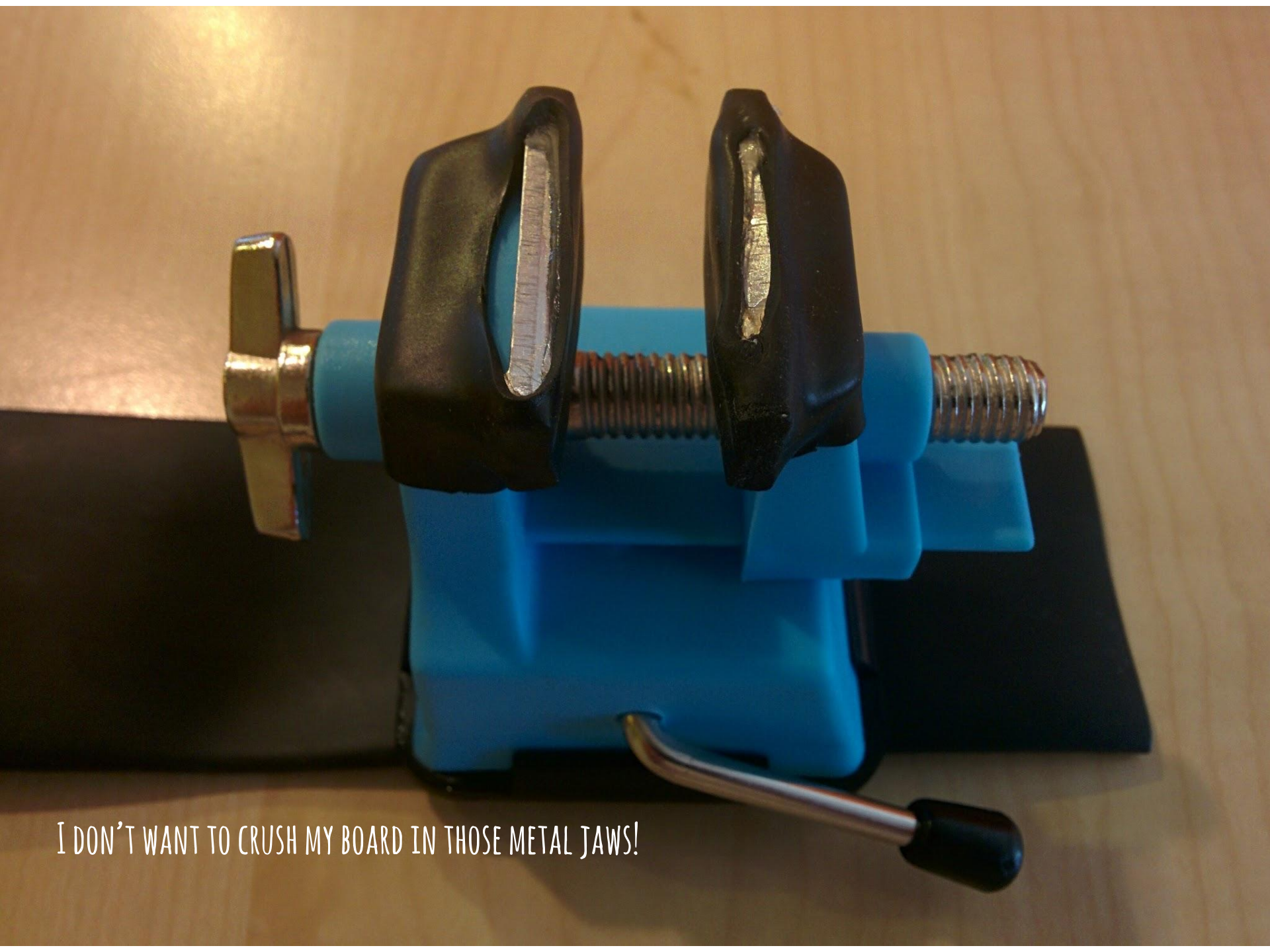
Dso138 - KIT oscilloscope

With quite a bit of analog noise... it's a KIT anyway, so modifications are expected :-)

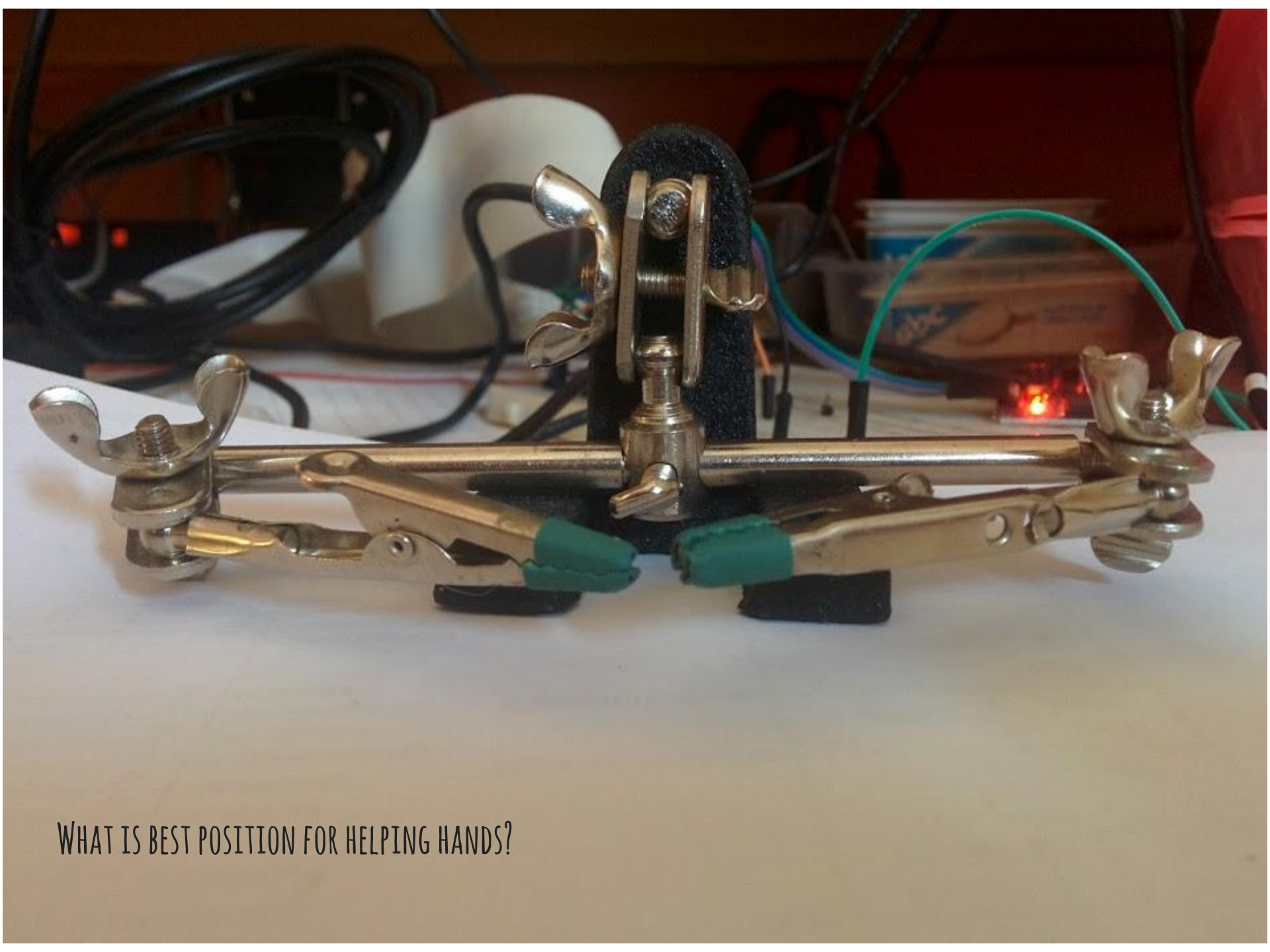
http://www.jyetech.com/forum/viewtopic.php?f=18&t=542



Simple heatshrink hacks


I don't want to crush my board in those metal jaws!


Or damage it in my helping hands!



What is best position for helping hands?

But what to do with leftover parts?

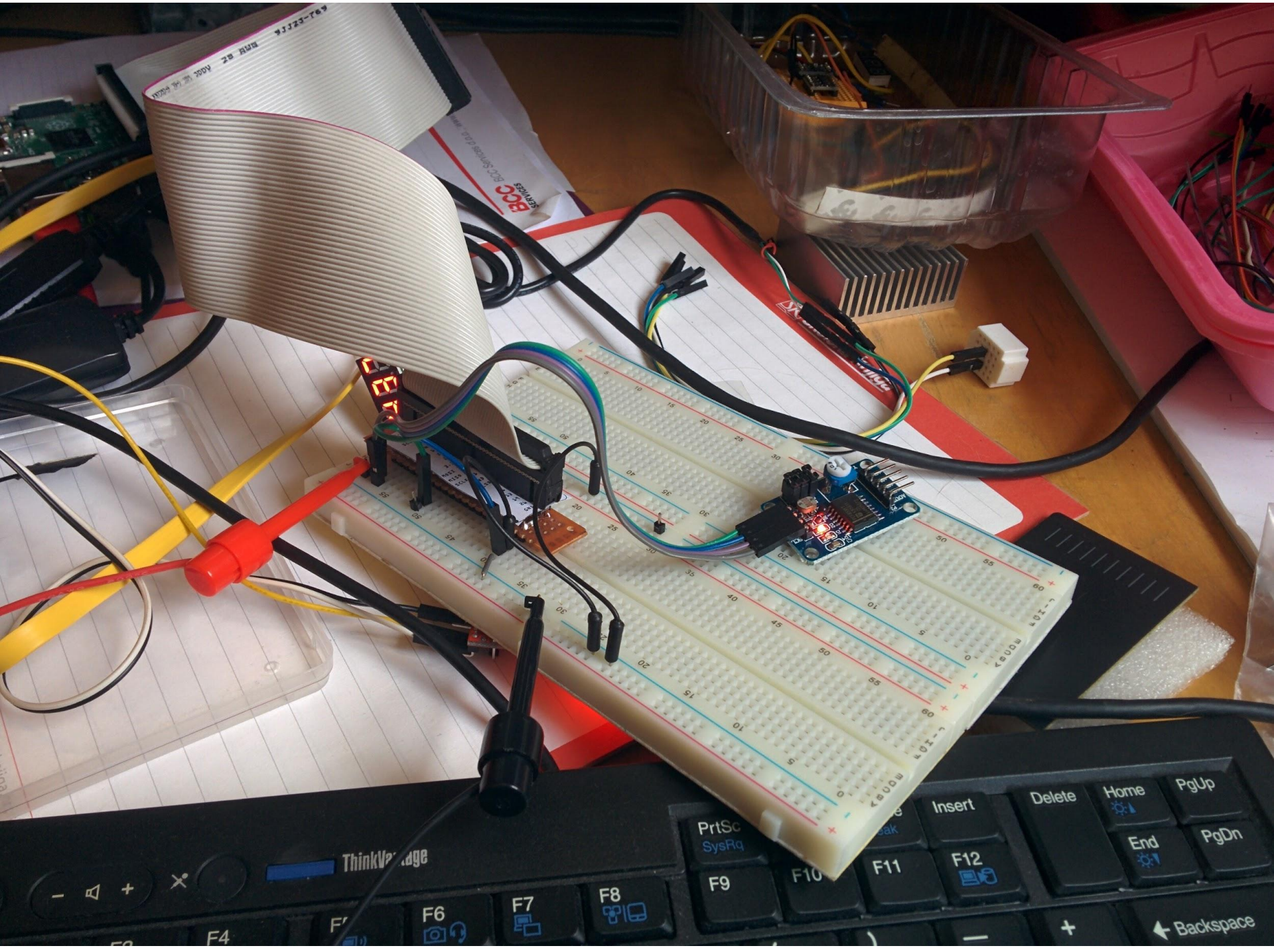
Attach it somewhere else where it can be useful

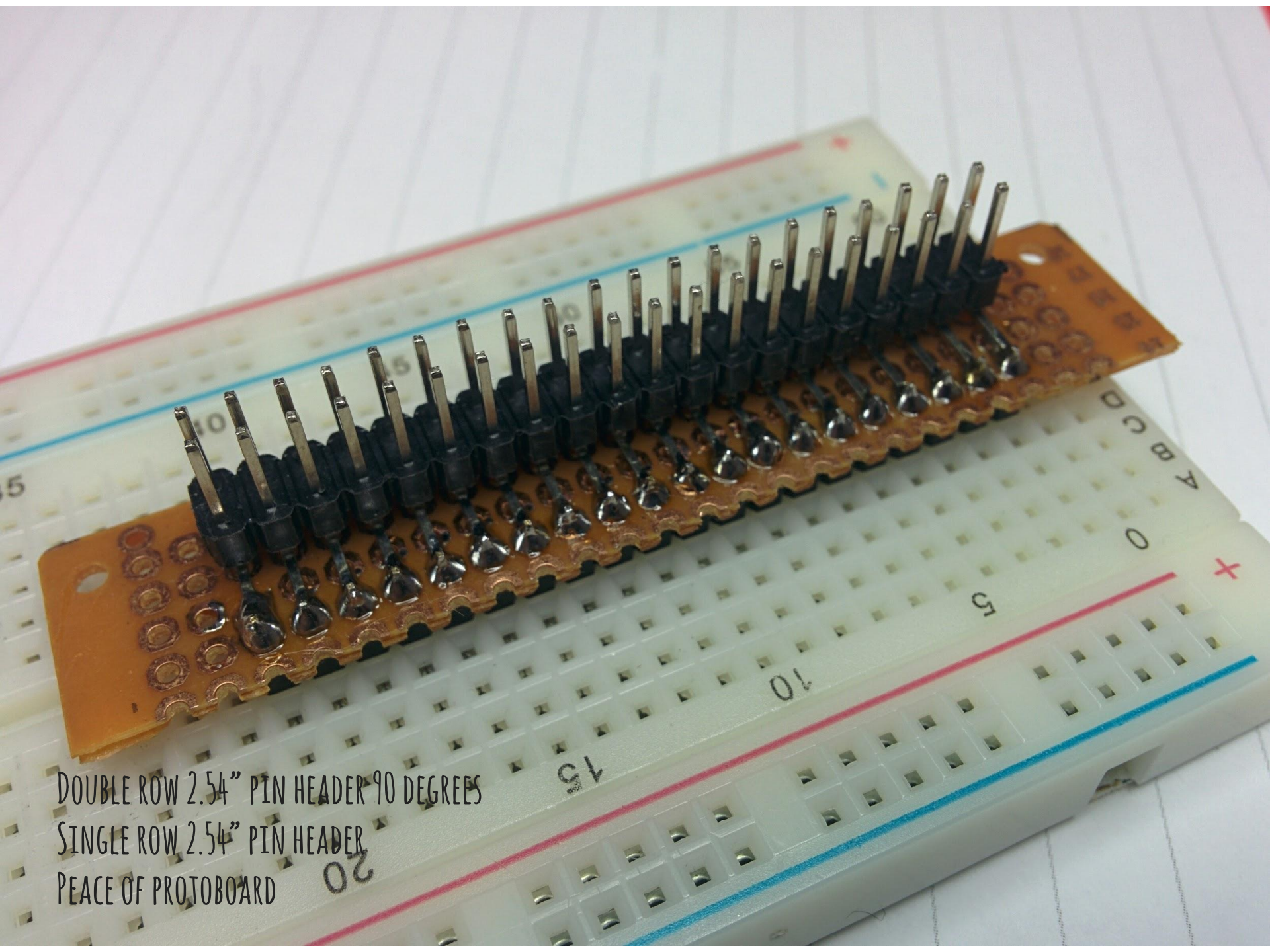
Modify insufficient light on magnifier

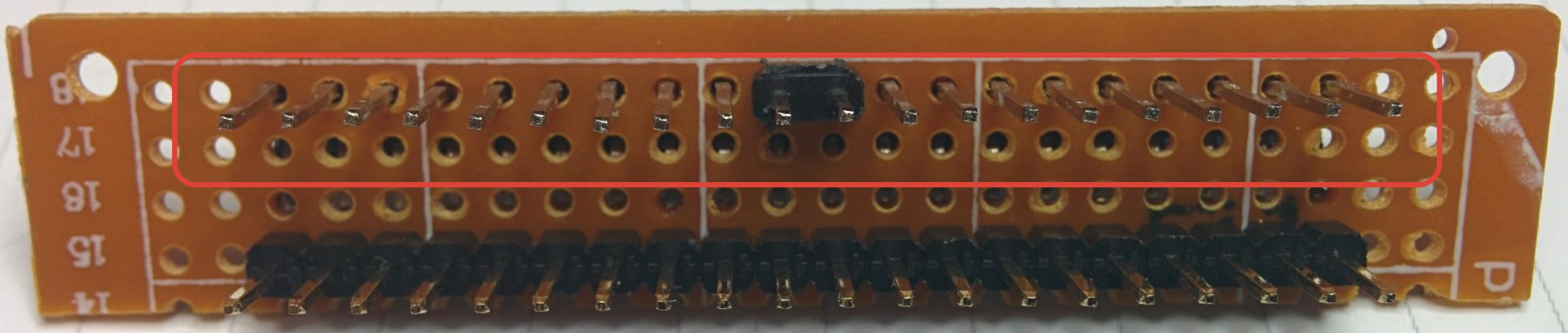
Simple hack which improves usability of this flexible magnifier by order of magnitude!

(needs 12V for led ring)

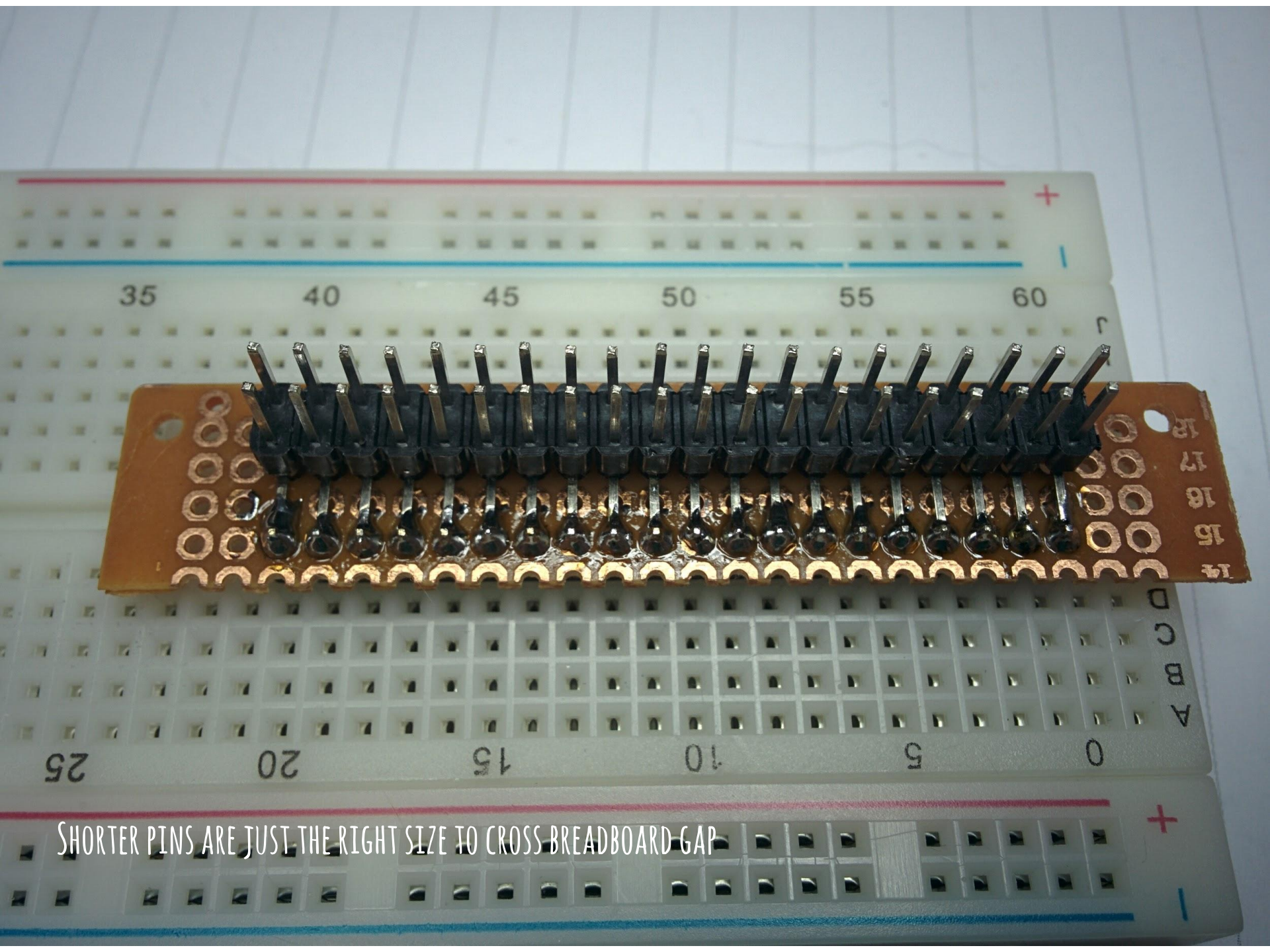
I need raspberry pi 2
40 pin connector
for breadboard!


ThinkVantage
PrtSc
SysRq
Insert
Delete
Home
PgUp
End
PgDn
F4
F6
F7
F8
F9
F10
F11
F12
Backspace


Double row 2.54” pin header 90 degrees
Single row 2.54” pin header
Peace of protoboard



1. Turn longer row of 90 degree pins straight (and add plastic spacer)
2. Add one more single row header separated by two rows (to cross breadboard gap)


Shorter pins are just the right size to cross breadboard gap

INTERESTING TOOLS WORTH LOOKING AT

Youyue 858D hot air gun

https://github.com/madworm/Youyue-858D-plus

http://www.eevblog.com/forum/reviews/youyue-858d-some-reverse-engineering-custom-firmware/


Welcome to my dungeon!