

# A Pressure-Sensitive Stylus for Mobile Digital Sketching



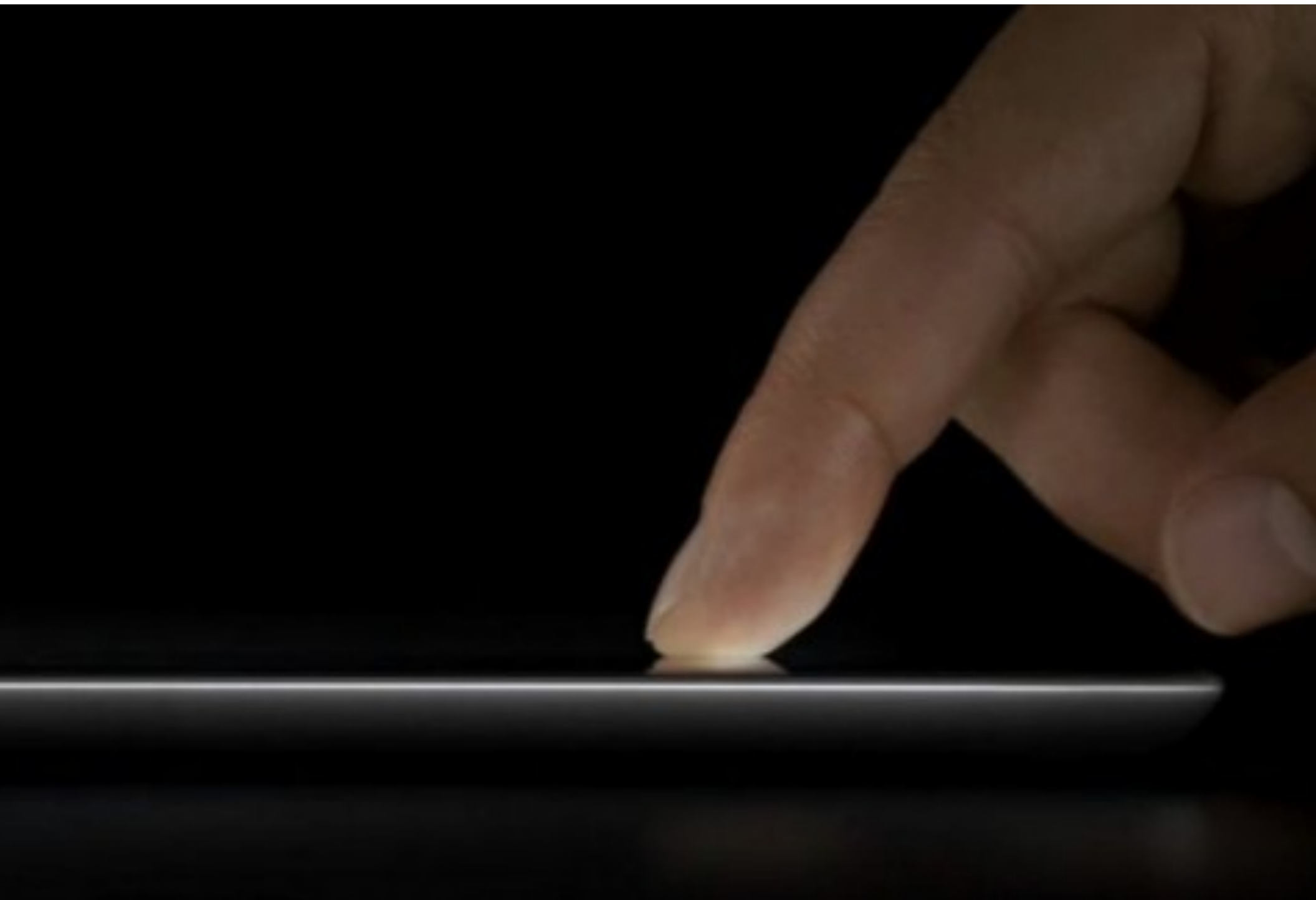
Photo:  
Patrick  
Osborne

Krispin Leydon

Disney Feature Animation

April, 2012





If you see a stylus,  
they blew it.

- Steve Jobs, 2010

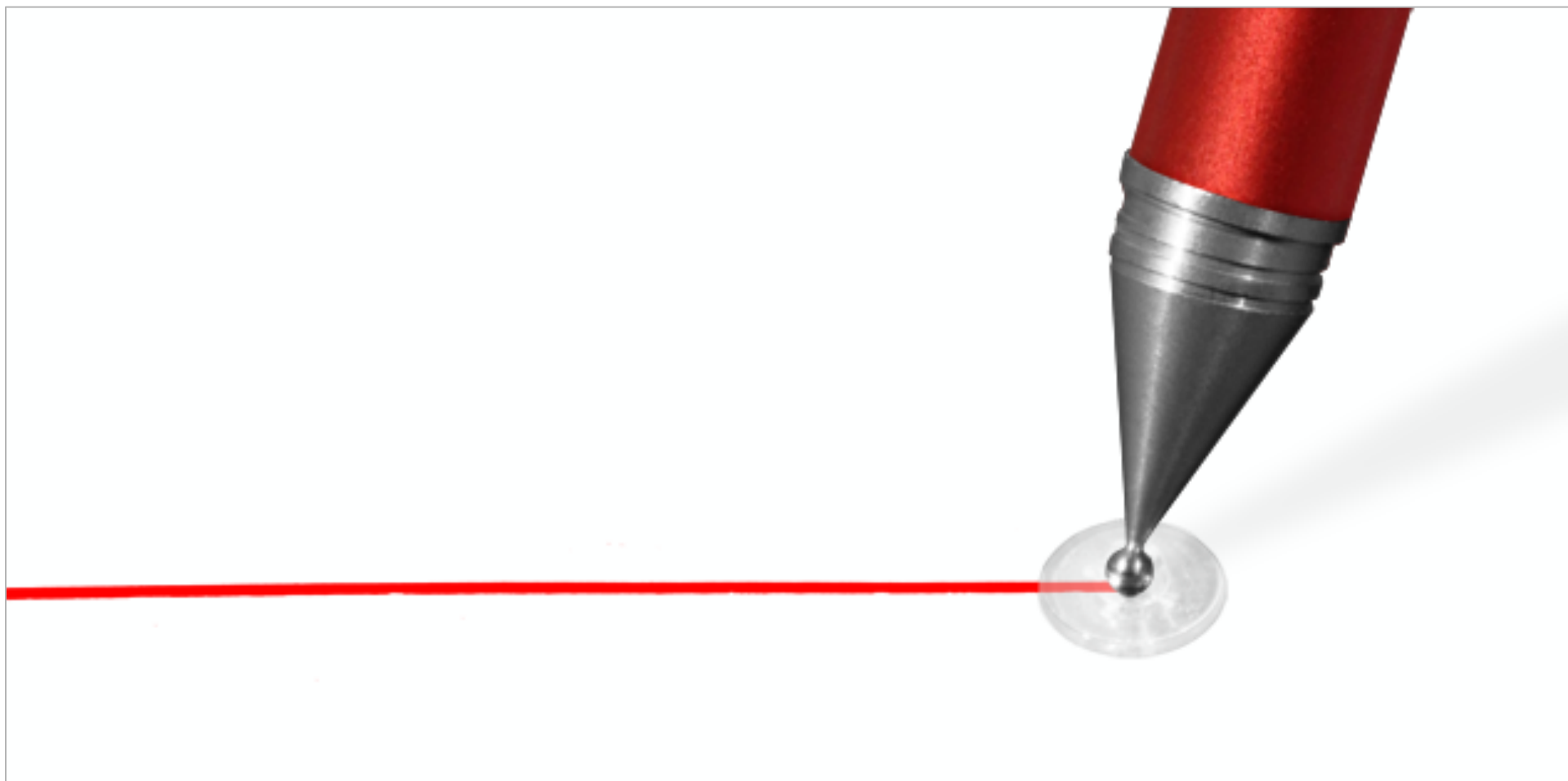




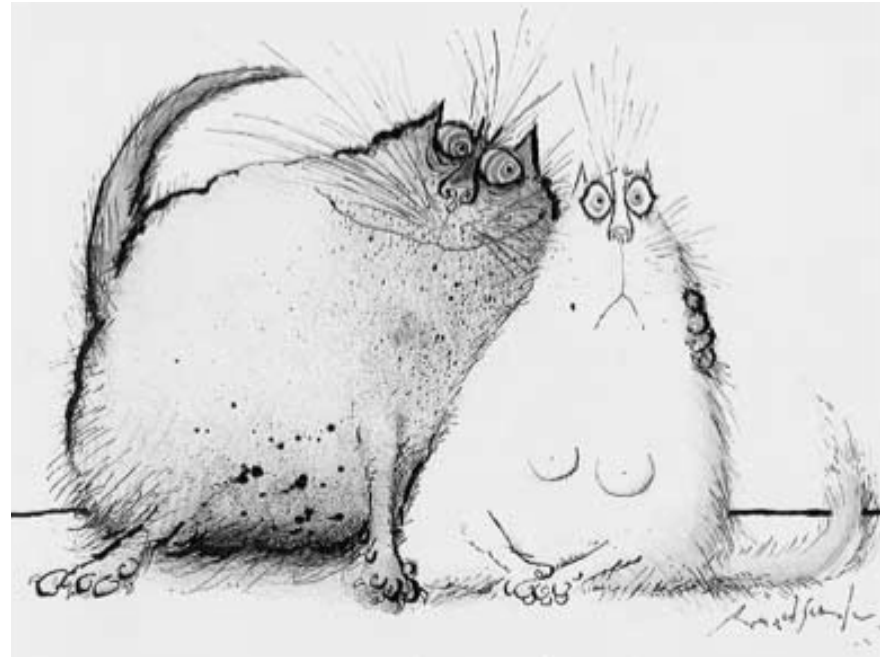
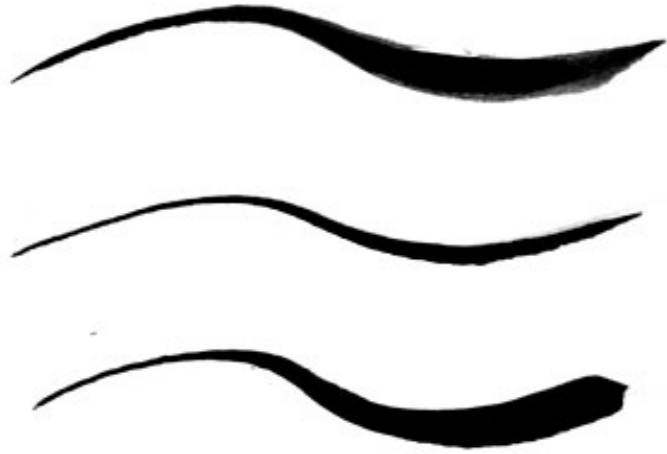
# DAGi Spring Tip



# Adonit Ball Tip





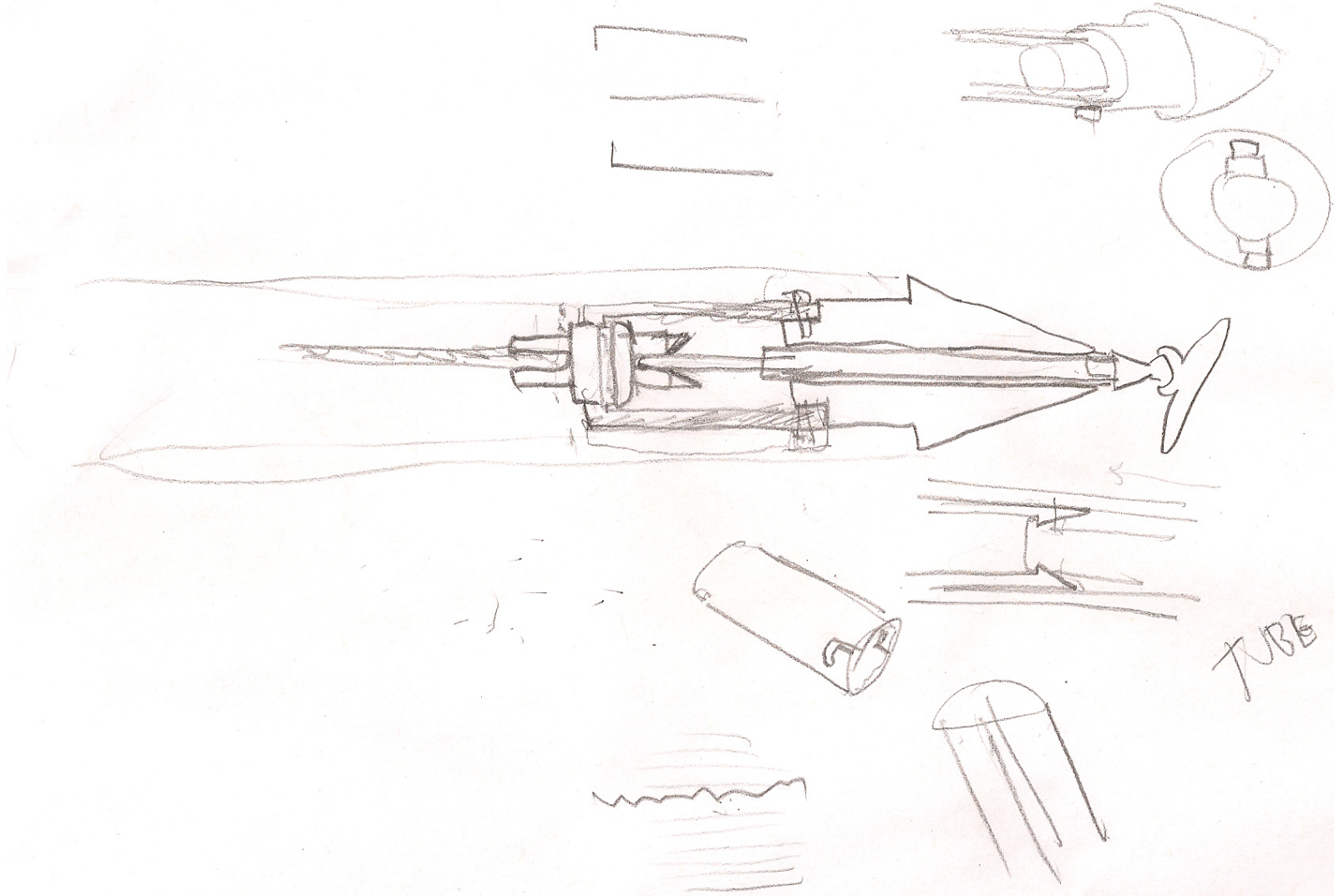


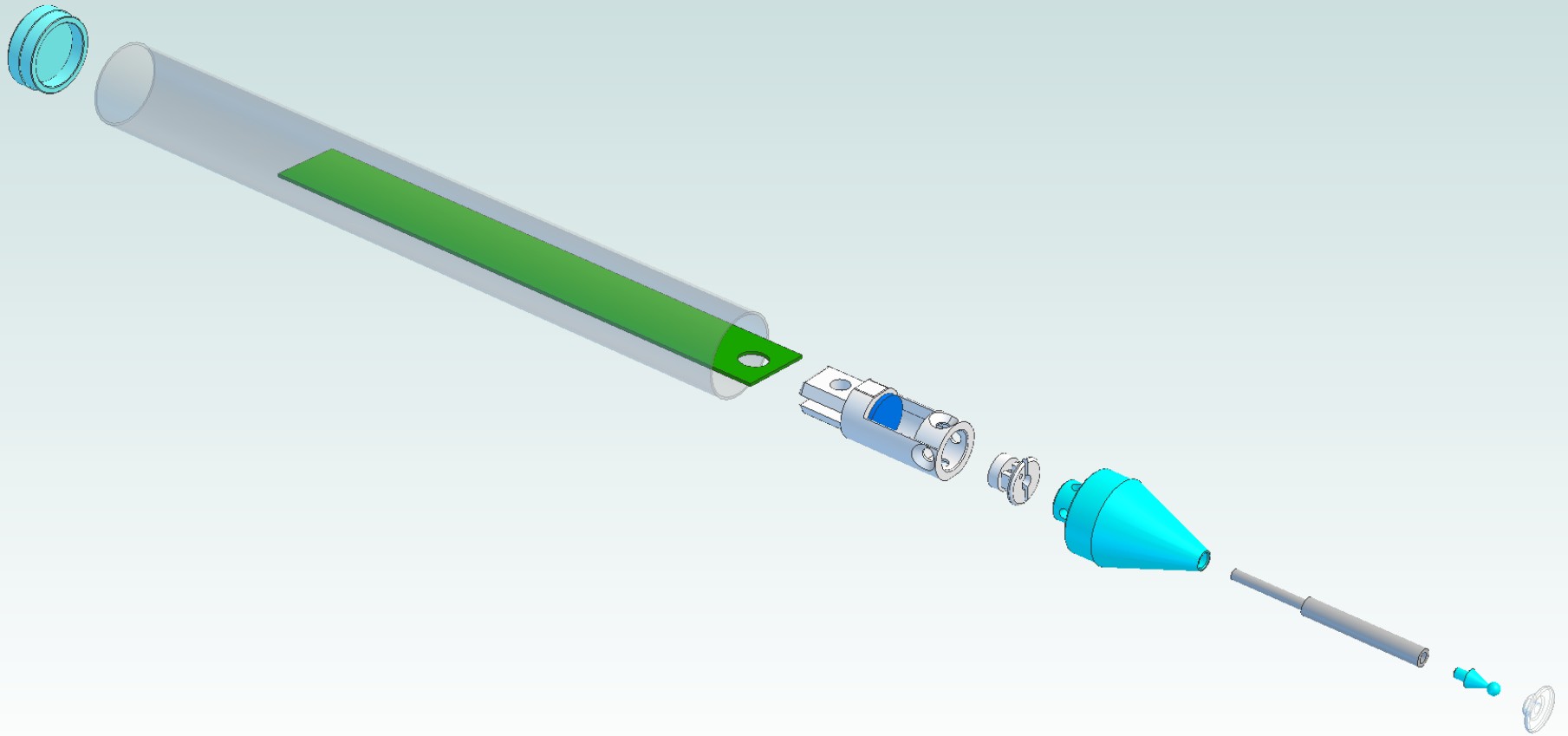
# A Pinpoint Accurate, Pressure-Sensitive Stylus

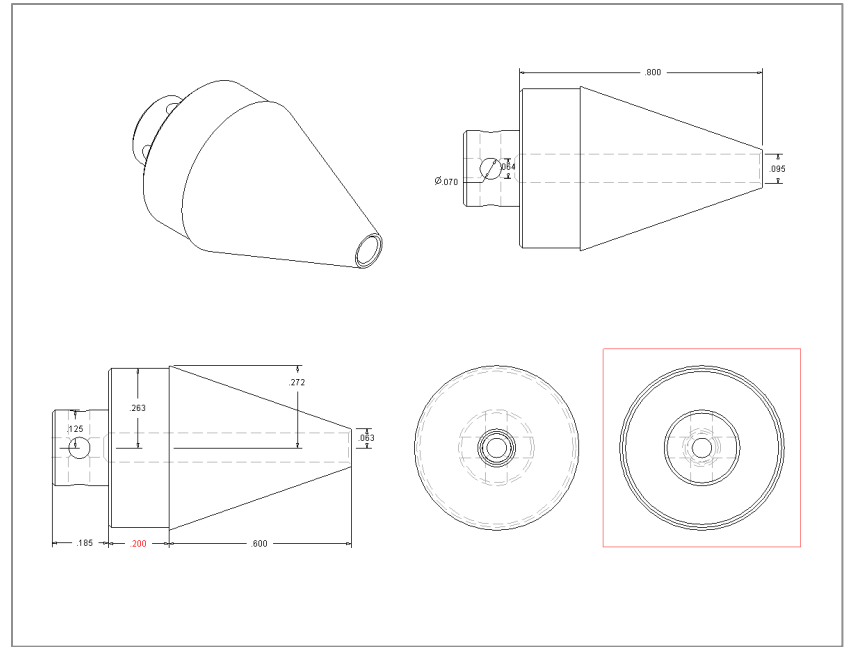
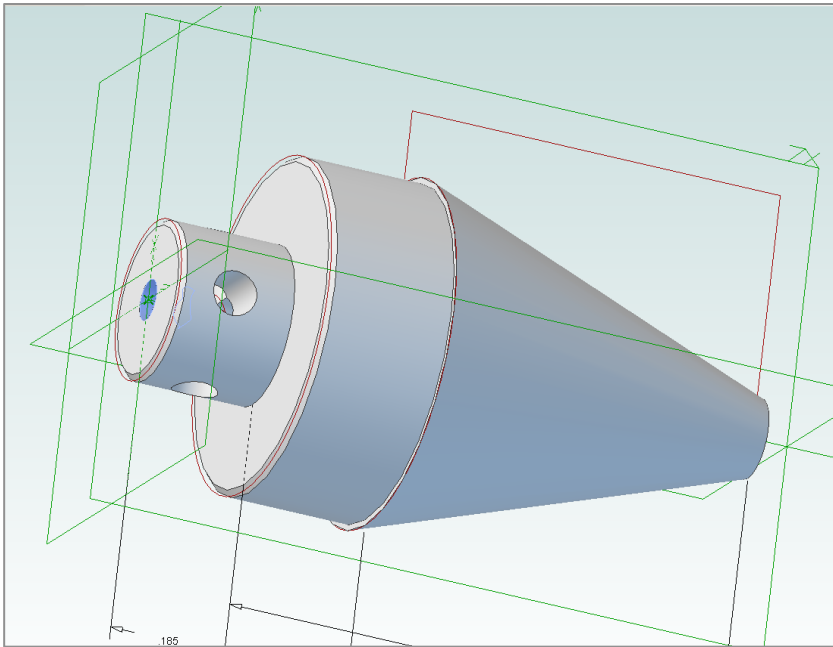
Nothing fancy, just a pen.

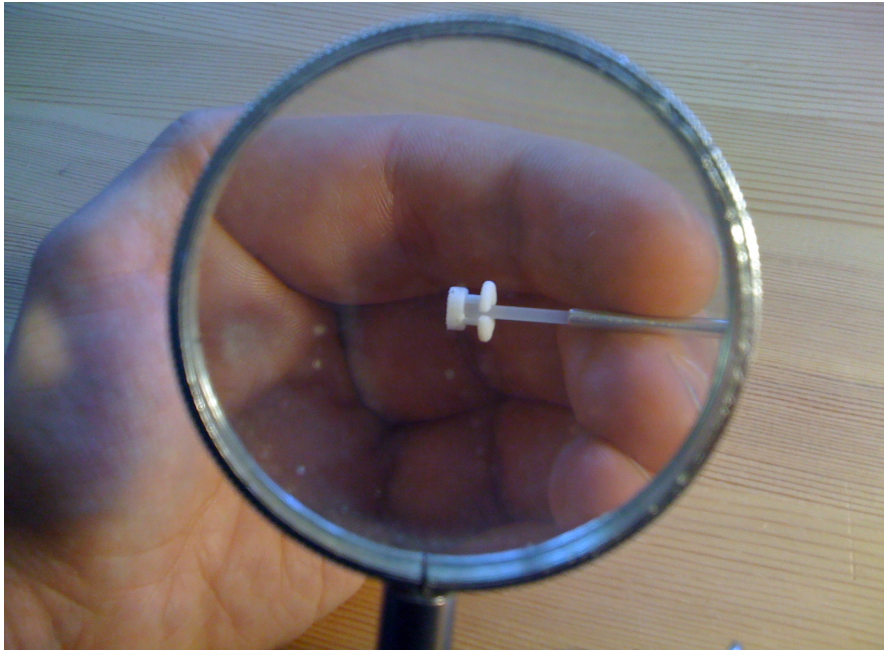
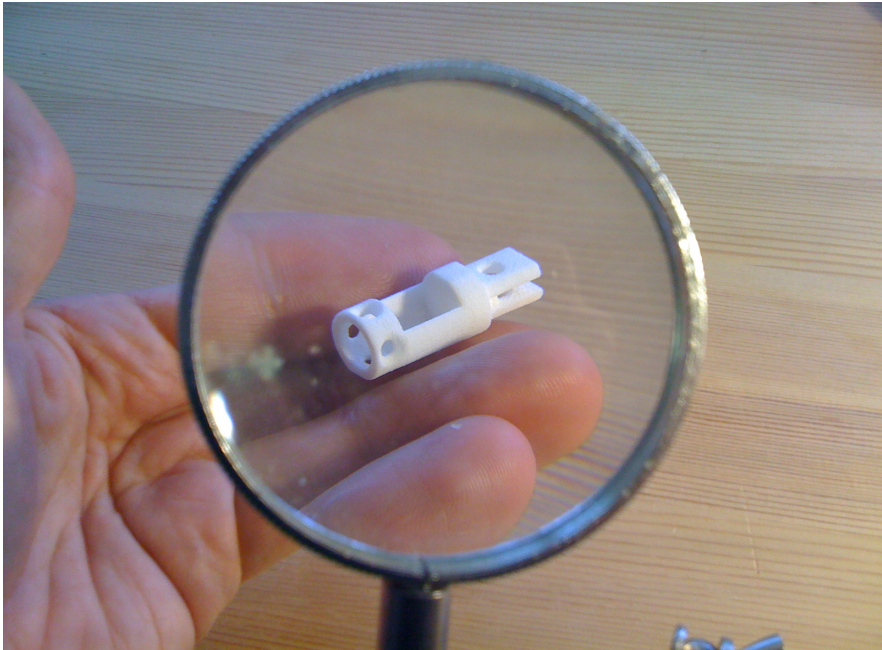
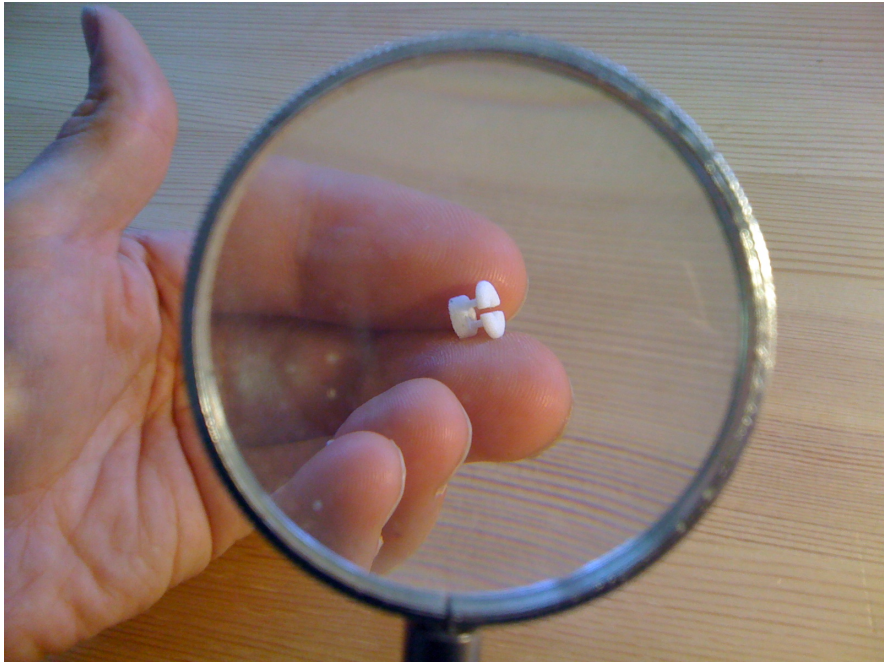
No modes,  
No buttons,  
No flashing lights.

# Form & Mechanism









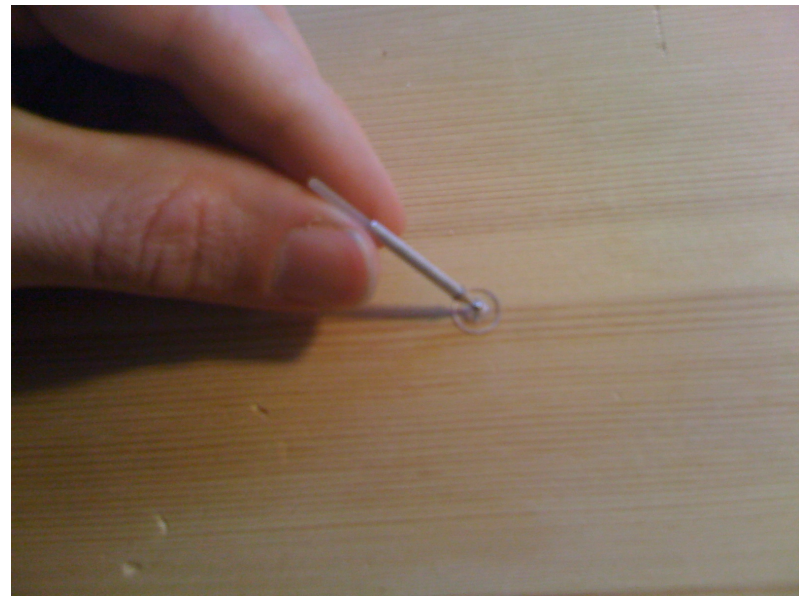




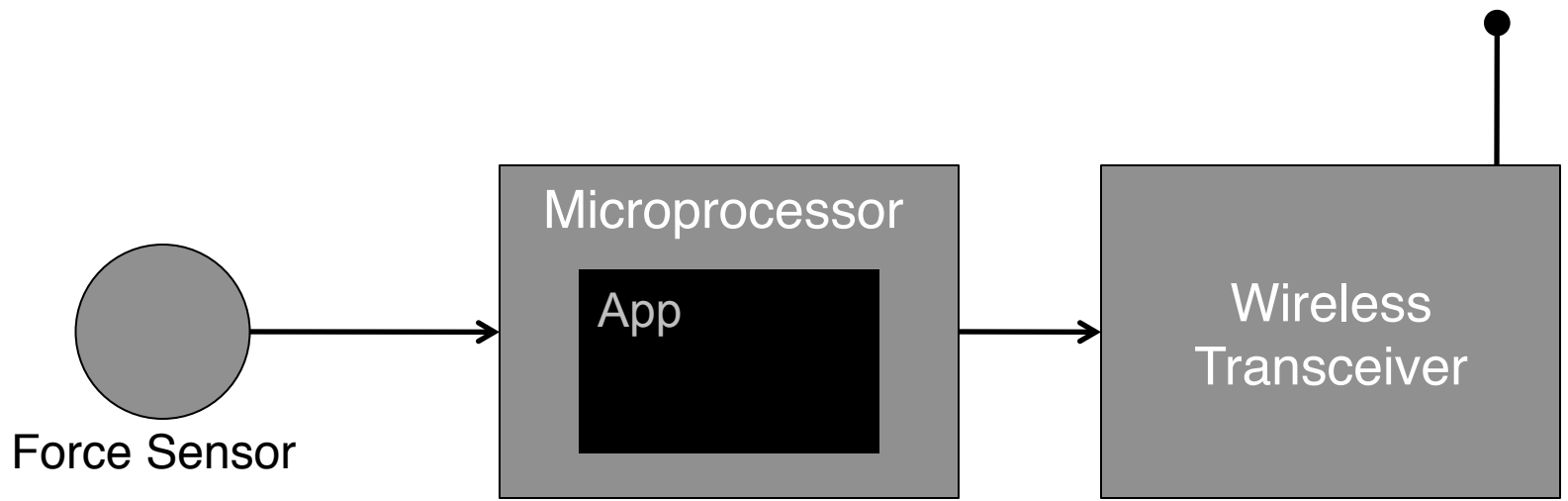
Spring Tip (DAGi)

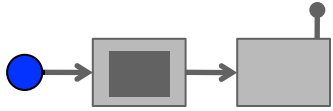


Ball Joint Tip (Adonit)



# Electronics & Behavior

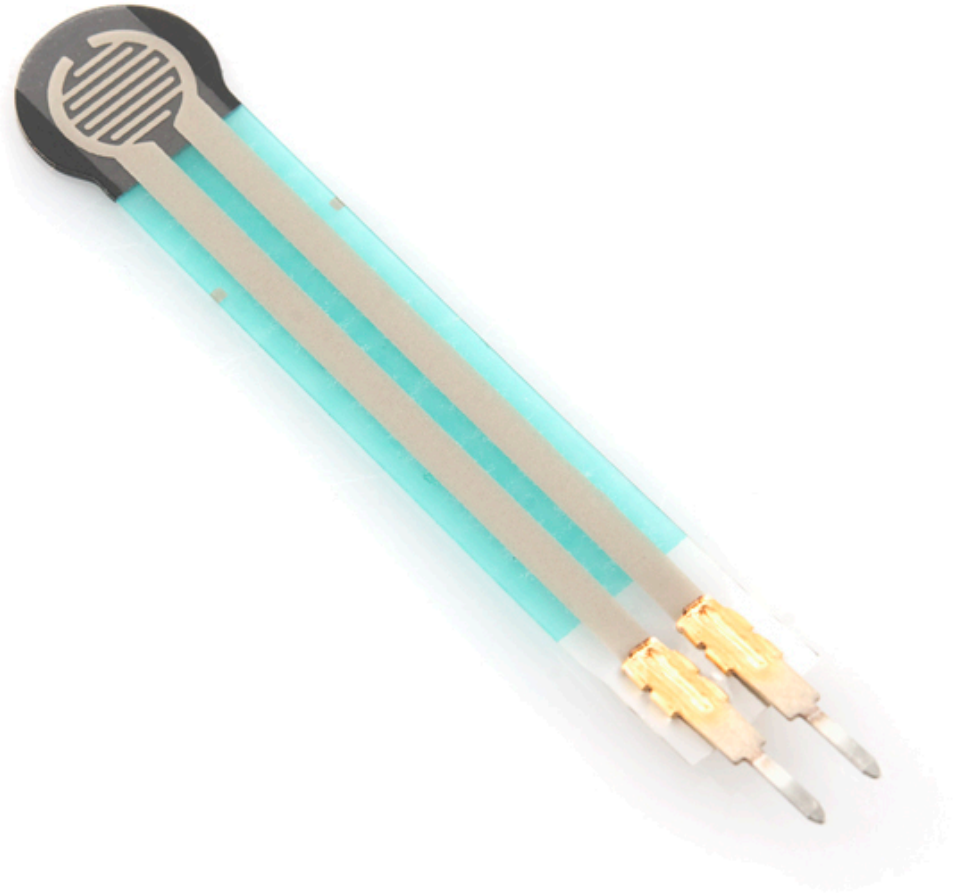


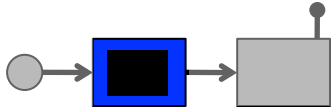


## Force Sensing Resistor (Interlink Electronics)

Activation Force: ~20g  
Lifetime: >10million presses

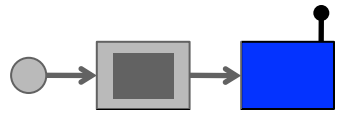
Wacom Tip Sensor (Generation 1):  
Activation Force: ~10g  
Lifetime: >10million presses





# Application

1. Wake up if there's anything interesting happening (e.g. force, angle, touch...)
2. While awake: Read force, relay wirelessly, take a quick nap. Repeat.
3. If nothing interesting has happened for a while, go to sleep.
4. While asleep, wake up periodically to see if anything interesting is happening.



# Wireless Protocol/Module



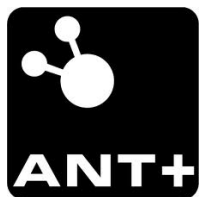
Bluetooth®

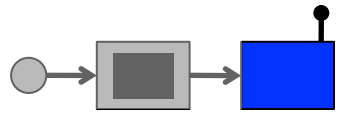


ZigBee®



Nordic Gazelle





# Wireless Protocol/Module



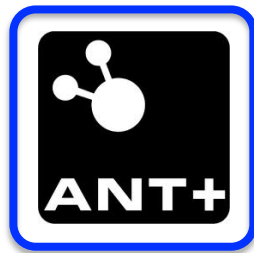
Bluetooth®

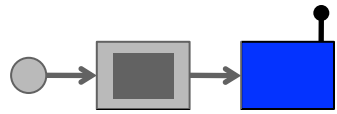


ZigBee®



Nordic Gazelle





# Wireless Protocol/Module



Bluetooth®



ZigBee®

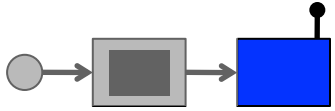


Nordic Gazelle



Nordic Semiconductor  
nRF24AP2-1CH chip  
+  
Wahoo Fitness Connector





# Wireless Protocol/Module



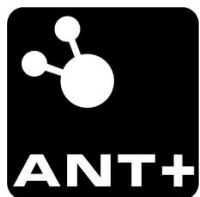
Nordic Semiconductor  
nRF24AP2-1CH chip

+

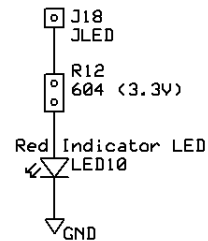
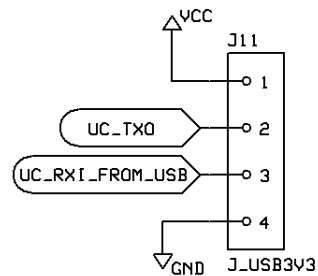
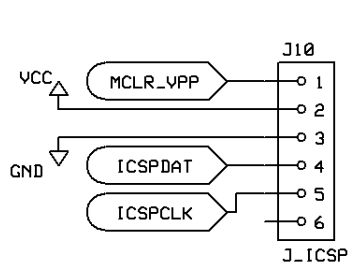
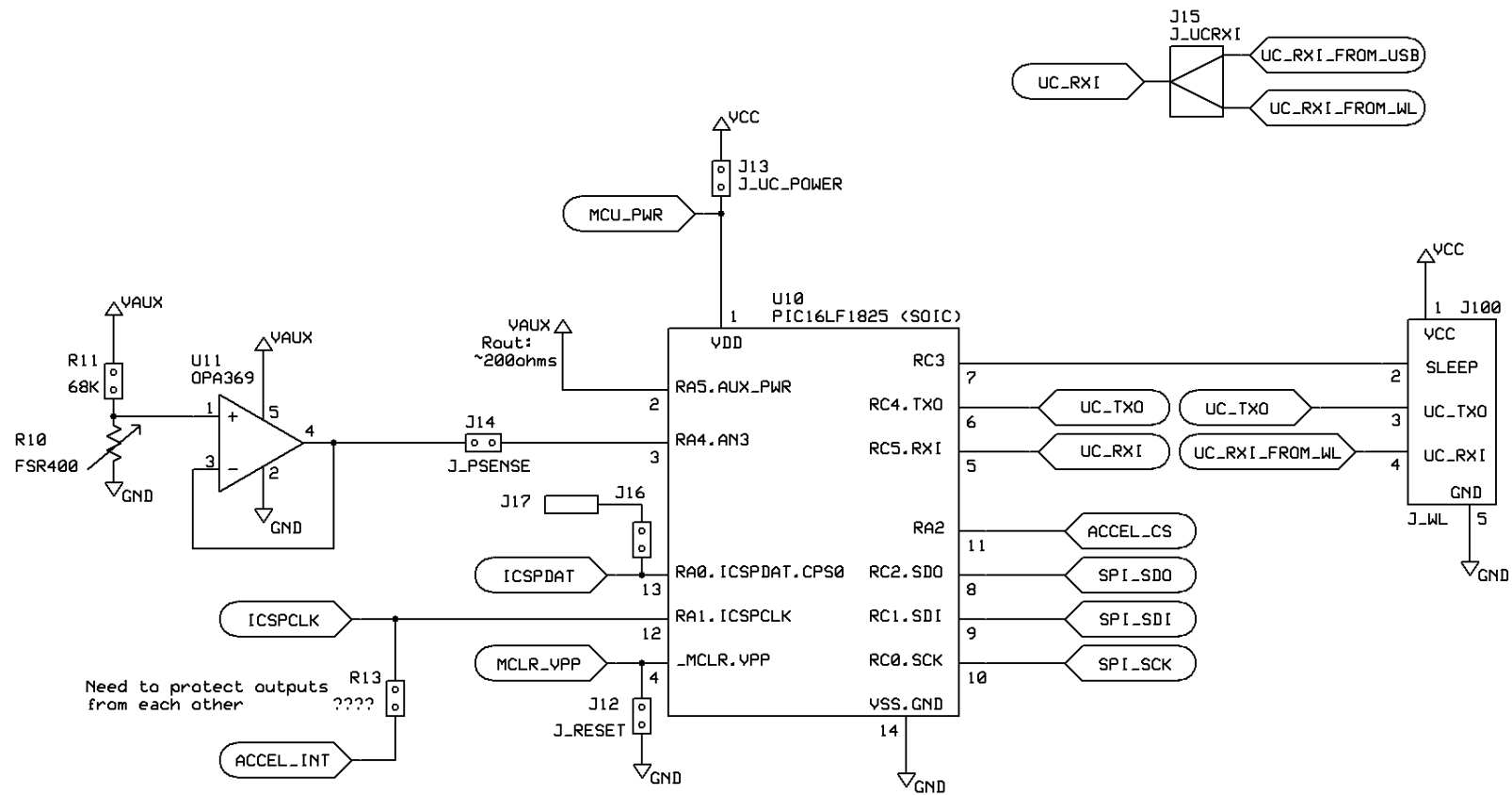
Wahoo Fitness Connector



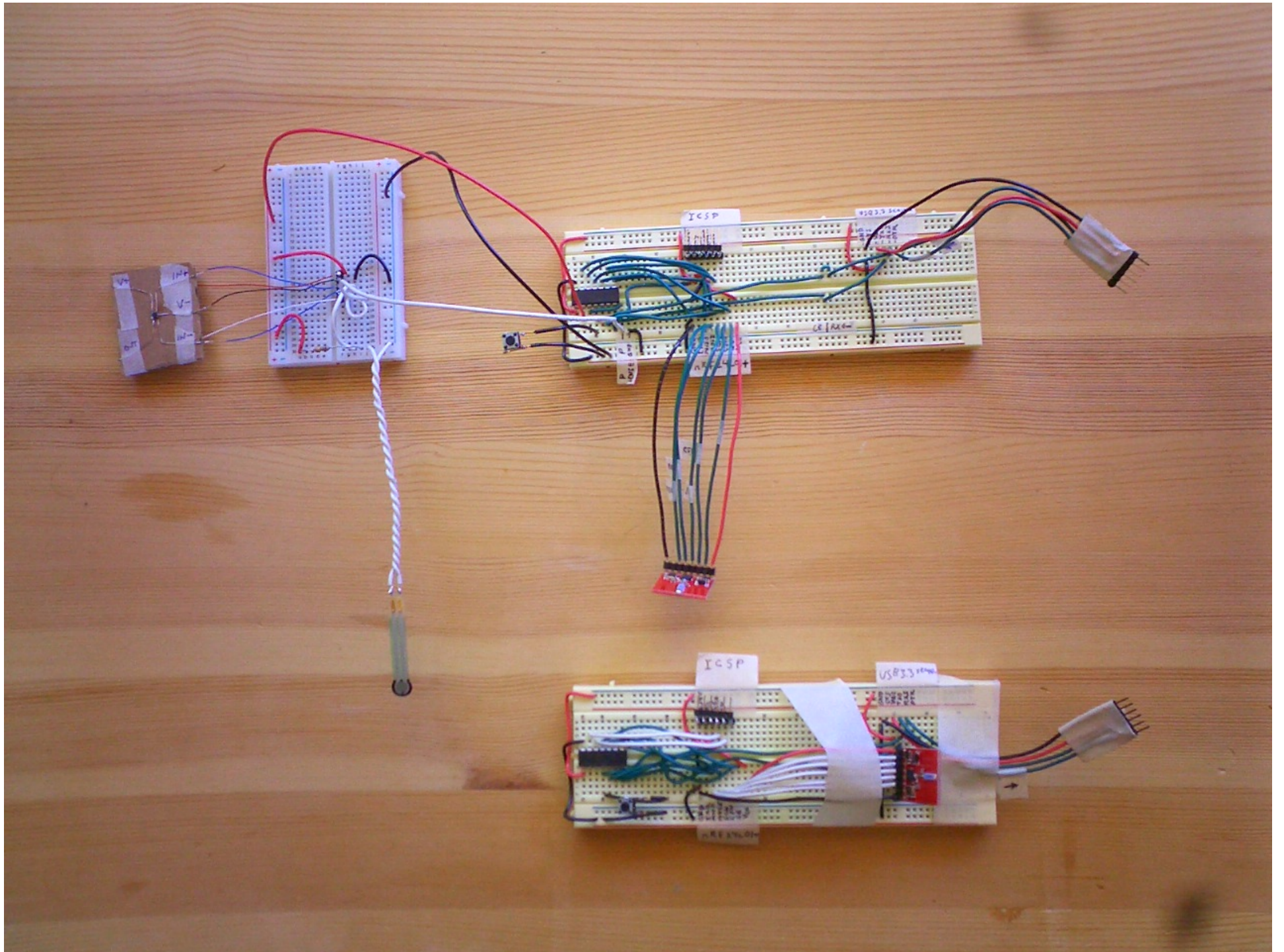
## Nordic Gazelle

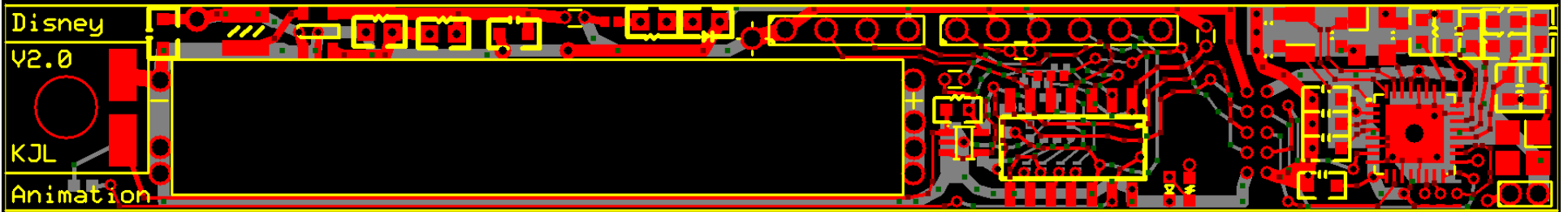


Bluegiga BLE112  
Module

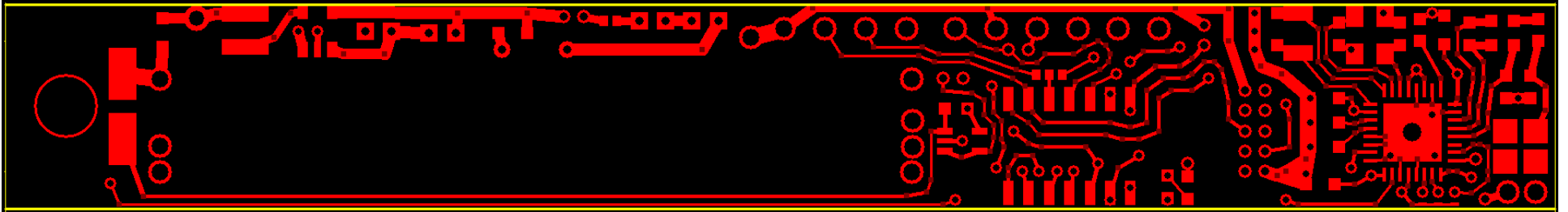


Walt Disney Animation Studios		
Pressure-Sensitive Capacitive Stylus		
Krispin Leydon	Rev 2.0 2/18/2012	Controller

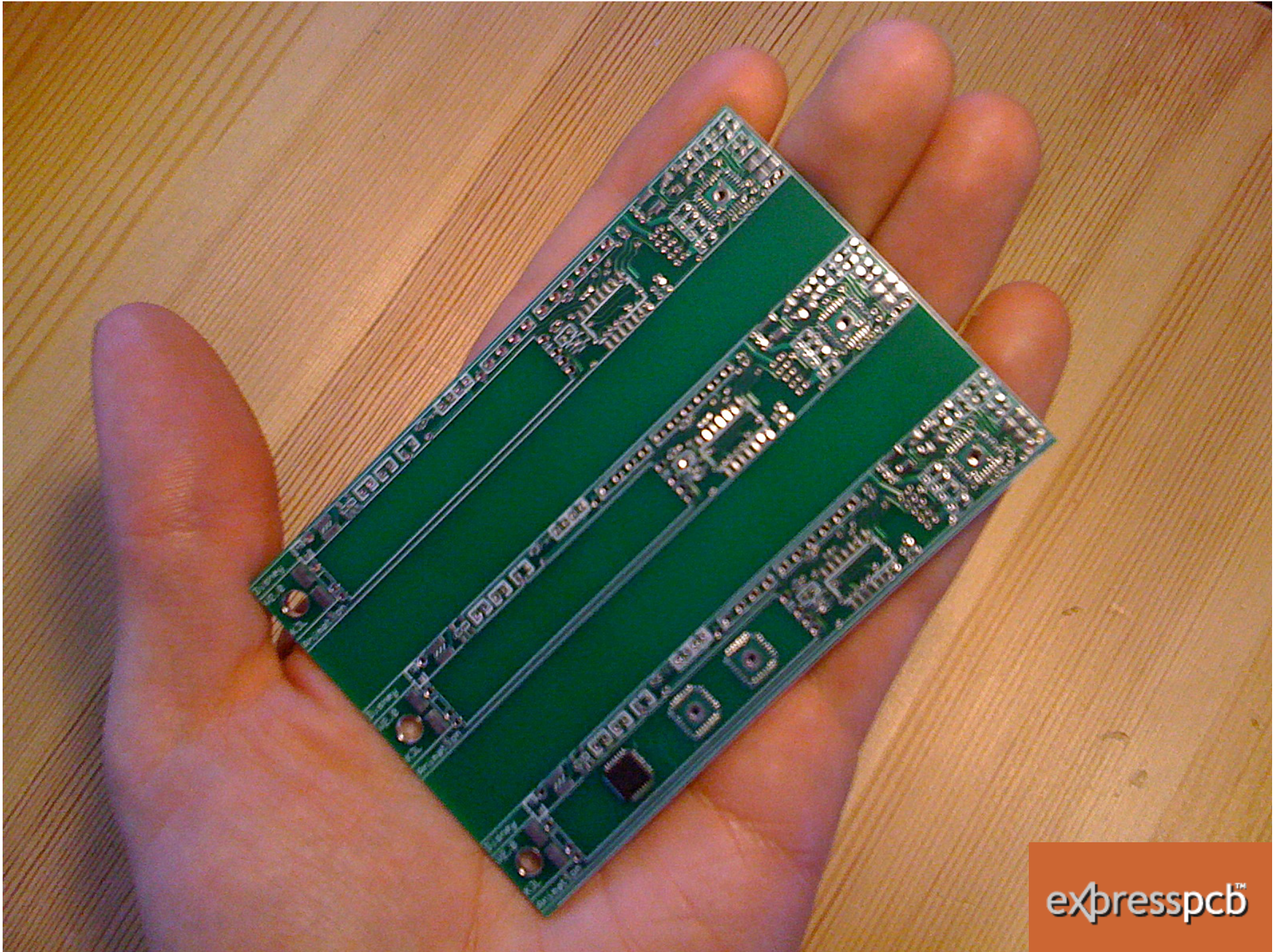




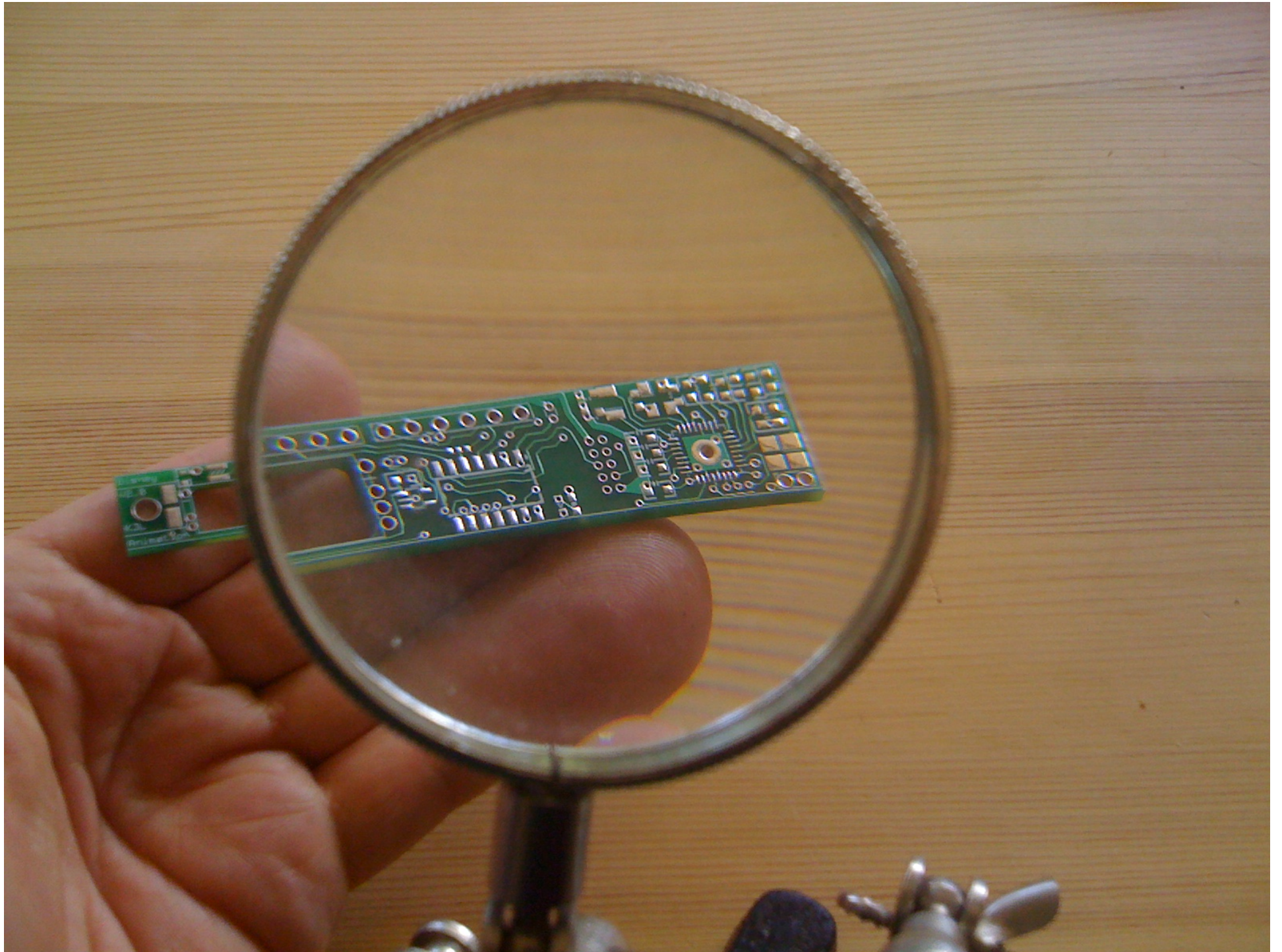
Board Layout  
All Layers

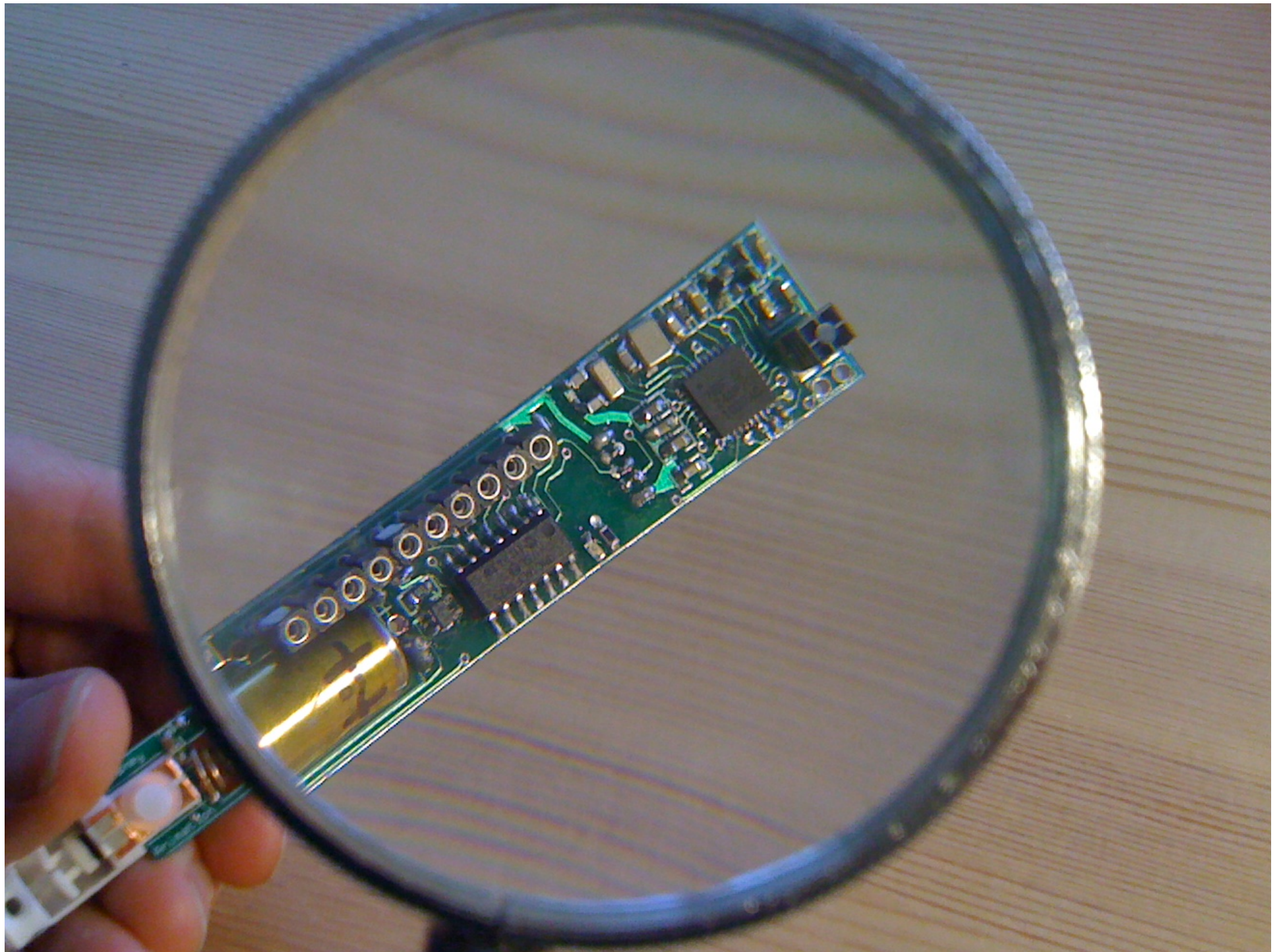


Board Layout  
Top Copper Layer

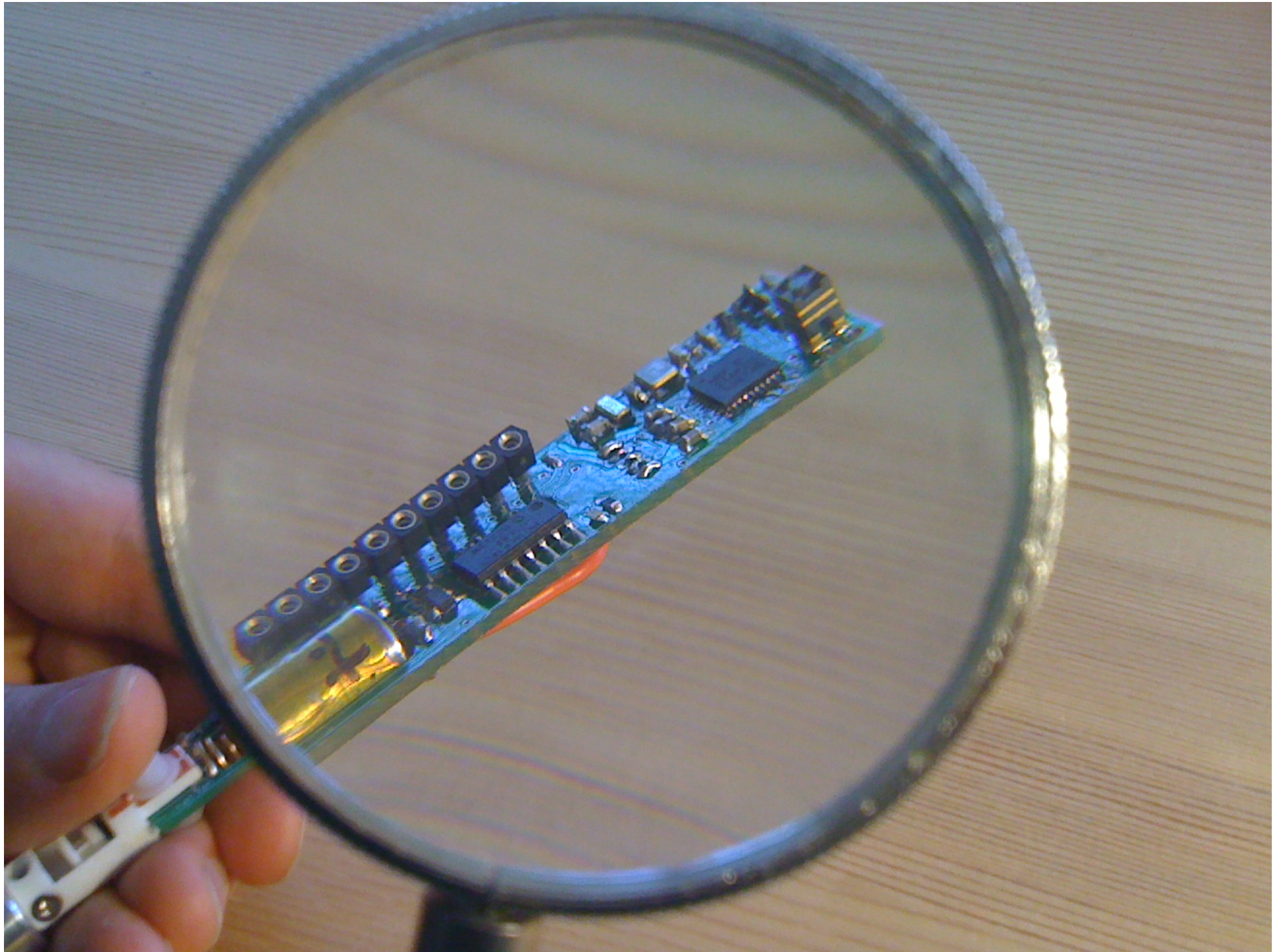


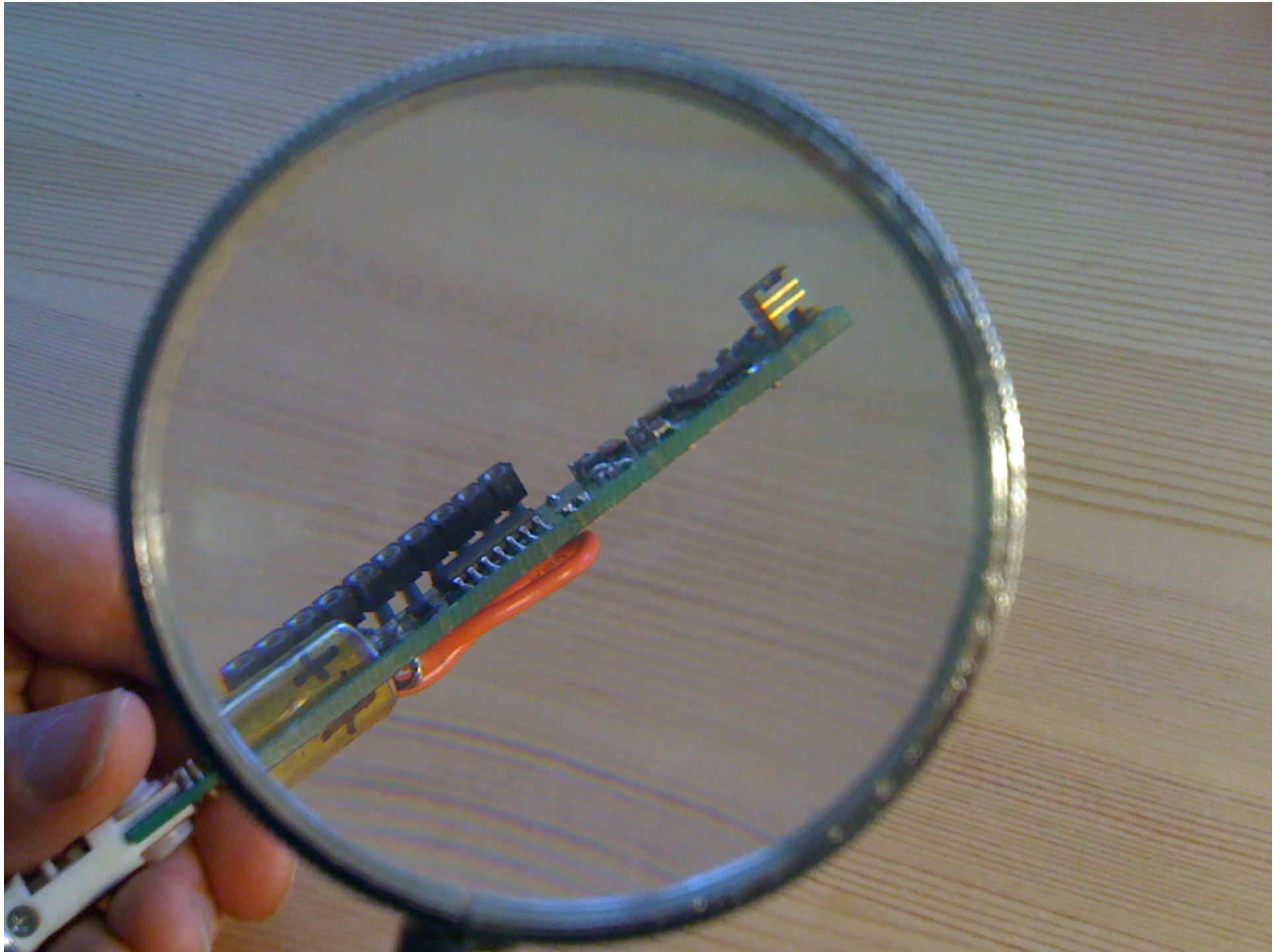
expresspcb™

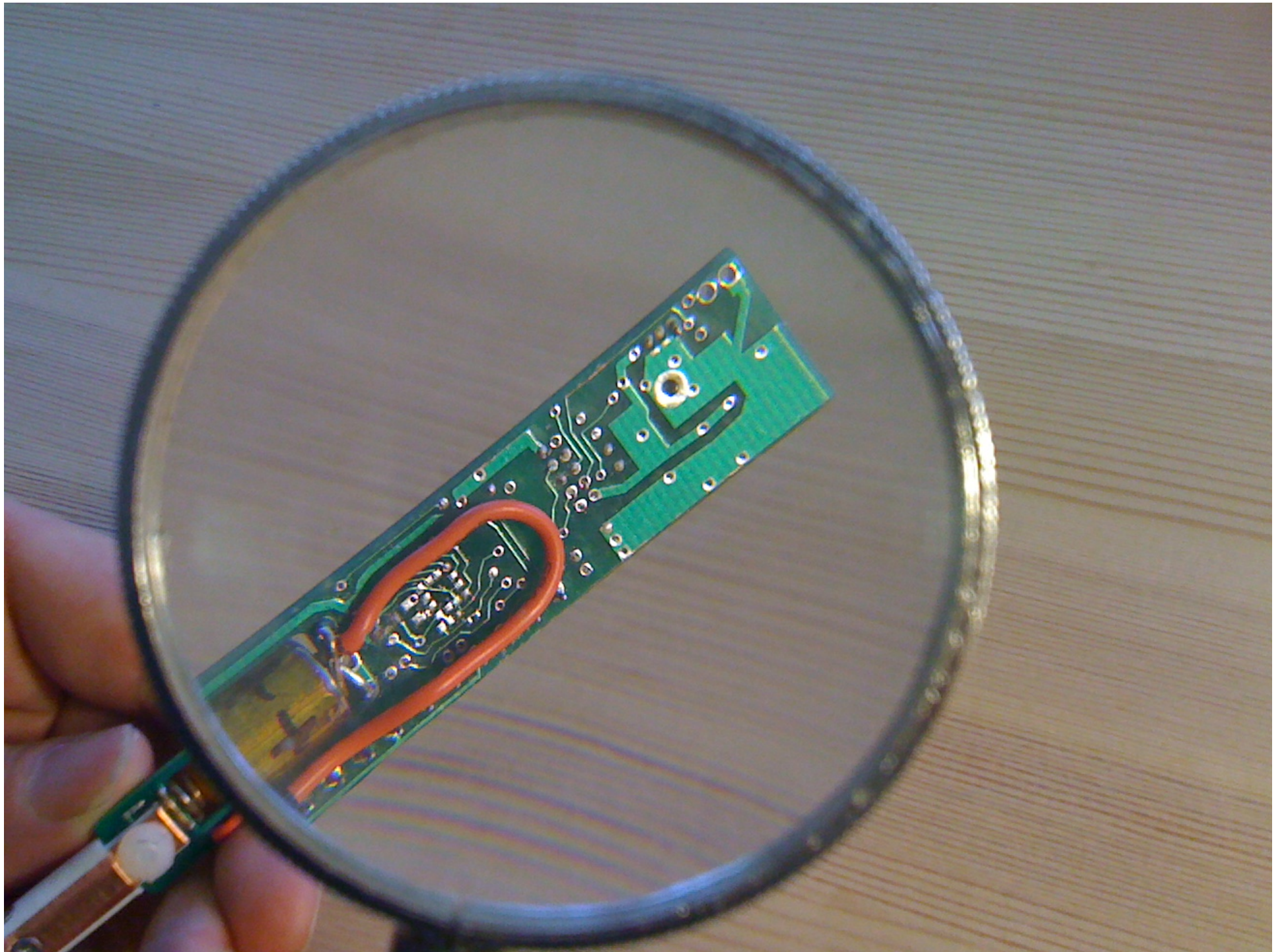






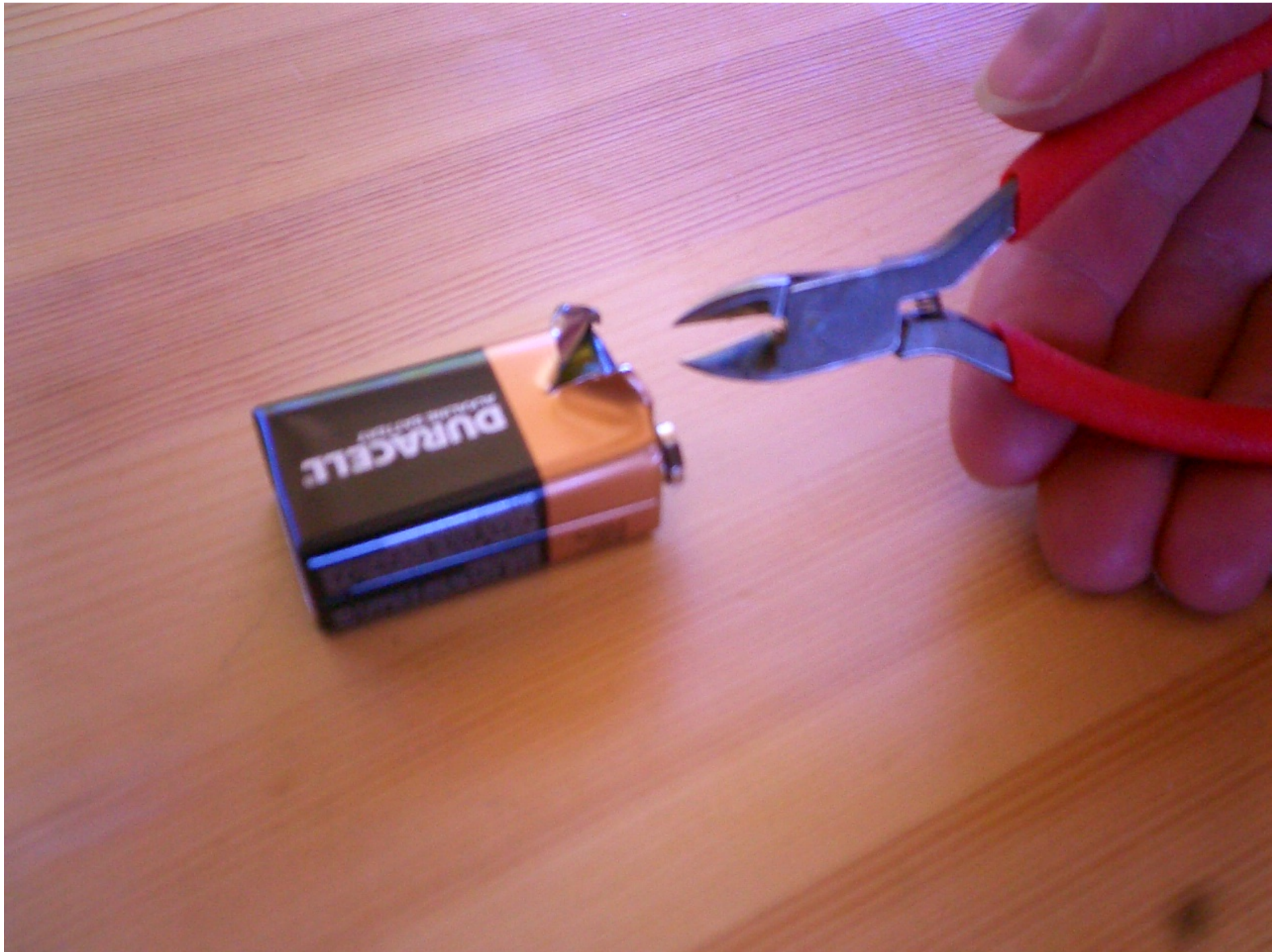






Power

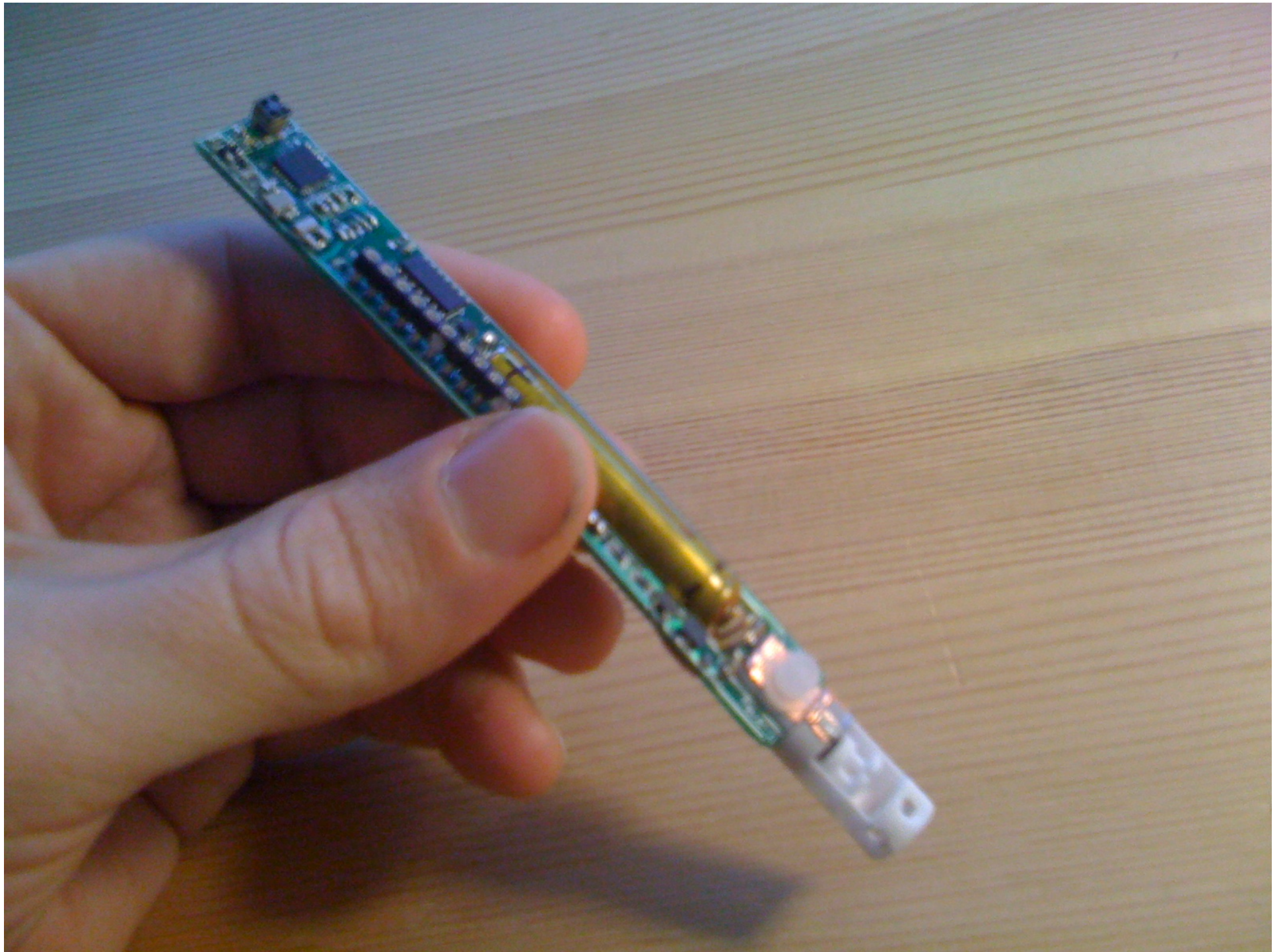


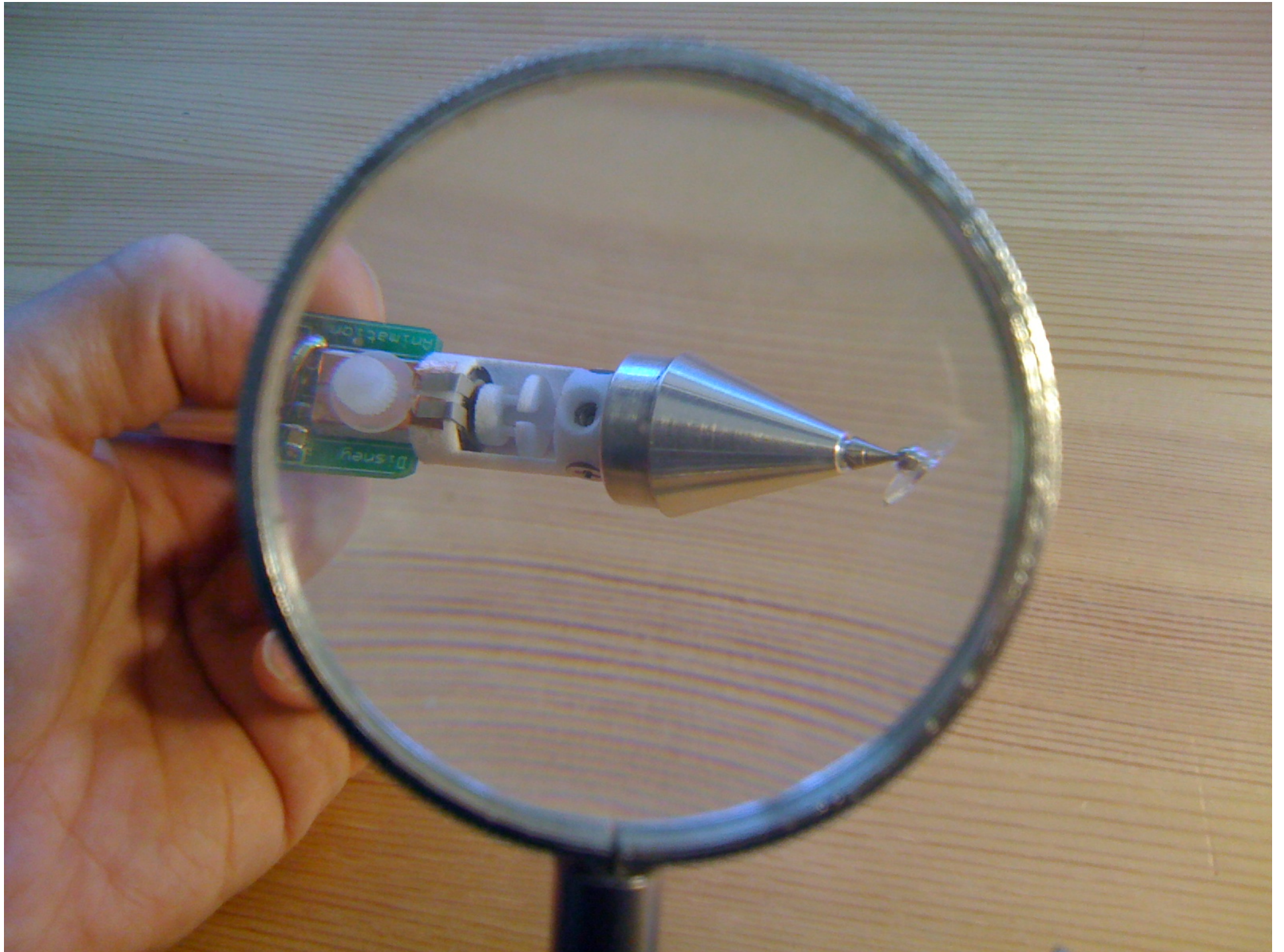




# Assembly







Stylus - MPLAB IDE v8.76

File Edit View Project Debugger Programmer Tools Configure Window Help

Checksum: 0x1e7e

Stylus.mcp

- Source Files
  - adc.c
  - ant.c
  - isr.c
  - main.c
  - sleep.c
  - sysclk.c
  - timer0.c
  - uart.c
  - wdt.c
- Header Files
  - adc.h
  - ant.h
  - isr.h
  - sleep.h
  - sysclk.h
  - timer0.h
  - uart.h
  - wdt.h
- Object Files
- Library Files
  - libpic16.lib
- Linker Script
- Other Files

```

main.c | sysclk.c
1 //main.c
2
3 #include <PIC16LF1825.h>
4 #include <system.h>
5
6 #include "..\source\drivers\sysclk.h"
7 #include "..\source\drivers\uart.h"
8 #include "..\source\drivers\timer0.h"
9 #include "..\source\drivers\adc.h"
10 #include "..\source\drivers\wdt.h"
11 #include "..\source\drivers\sleep.h"
12 #include "..\source\drivers\ant.h"
13 // #include "..\source\drivers\spi.h"
14 // #include "..\source\drivers\accel.h"
15 // #include "..\source\drivers\cap.h"
16
17 #pragma DATA _CONFIG1, _FOSC_INTOSC & _WDTE_SWDTEN &
18 #pragma DATA _CONFIG2, _WRT_OFF & _P_LLEN_OFF & _STVREN
19
20 extern unsigned char str_buff[MAX_STR_BUFF_LENGTH];
21
22 extern ant_msg_t ant_reset_system_msg;
23 extern ant_msg_t ant_assign_channel_msg;
24 extern ant_msg_t ant_set_channel_id_msg;
25 extern ant_msg_t ant_set_channel_period_fast_msg;
26 extern ant_msg_t ant_set_channel_period_slow_msg;
27 extern ant_msg_t ant_open_channel_msg;
28 extern ant_msg_t ant_close_channel_msg;
29 extern ant_msg_t ant_crystal_enable_msg;
30 extern ant_msg_t ant_sleep_msg;
31
32

```

Output

Build | Version Control | Find in Files | PICKIT 3

Programming/Verify complete

Target Removed

Target Detected

Device ID Revision = 00000000

CoolTerm\_1

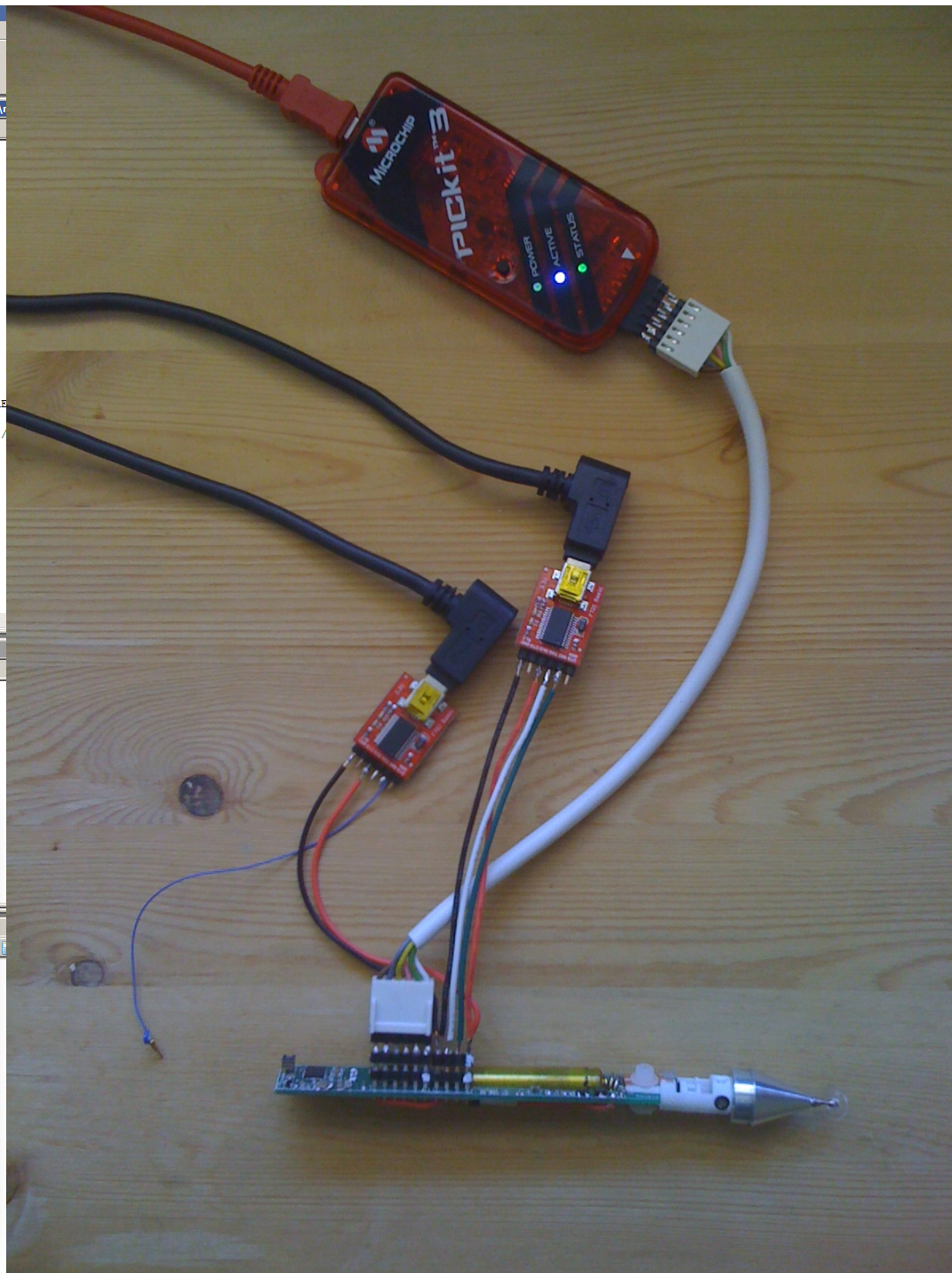
New Open Save Connect Disconnect Clear Data Options View ASCII Help

2610	00 00 00 00 E3 00 00 A4 09 4E 00 00 00 00 00	.....N.....
2620	00 00 00 E3 00 00 A4 09 4E 00 00 00 00 00 00	.....N.....
2630	00 00 E3 00 00 A4 09 4E 00 00 00 00 00 00 00	.....N.....
2640	00 E3 00 00 A4 09 4E 00 00 00 00 00 00 00 00	.....N.....
2650	E3 00 00 A4 09 4E 00 00 00 00 00 00 00 00 E3	.....N.....
2660	00 00 A4 09 4E 00 00 00 00 00 00 00 00 00 E3 00	.....N.....
2670	00 A4 09 4E 00 00 00 00 00 00 00 00 00 00 E3 00 00	.....N.....
2680	A4 09 4E 00 00 00 00 00 00 00 00 00 00 E3 00 00 A4	.....N.....
2690	09 4E 00 00 00 00 00 00 00 00 00 E3 00 00 A4 09	.....N.....
26A0	4E 00 00 00 00 00 00 00 00 00 E3 00 00 A4 09 4E	N.....N.....
26B0	00 00 00 00 00 00 00 00 00 E3 00 00 A4 09 4E 00	.....N.....
26C0	00 00 00 00 00 00 00 00 E3 00 00 A4 09 4E 00 00	.....N.....
26D0	00 00 00 00 00 00 00 E3 00 00 A4 09 4E 00 00 00	.....N.....
26E0	00 00 00 00 00 00 E3 00 00 A4 09 4E 00 00 00 00	.....N.....
26F0	00 00 00 00 00 E3 00 00 A4 09 4E 00 00 00 00 00	.....N.....
2700	00 00 00 00 E3 00 00 A4 03 43 00 00 00 E4 00 00	.....C.....

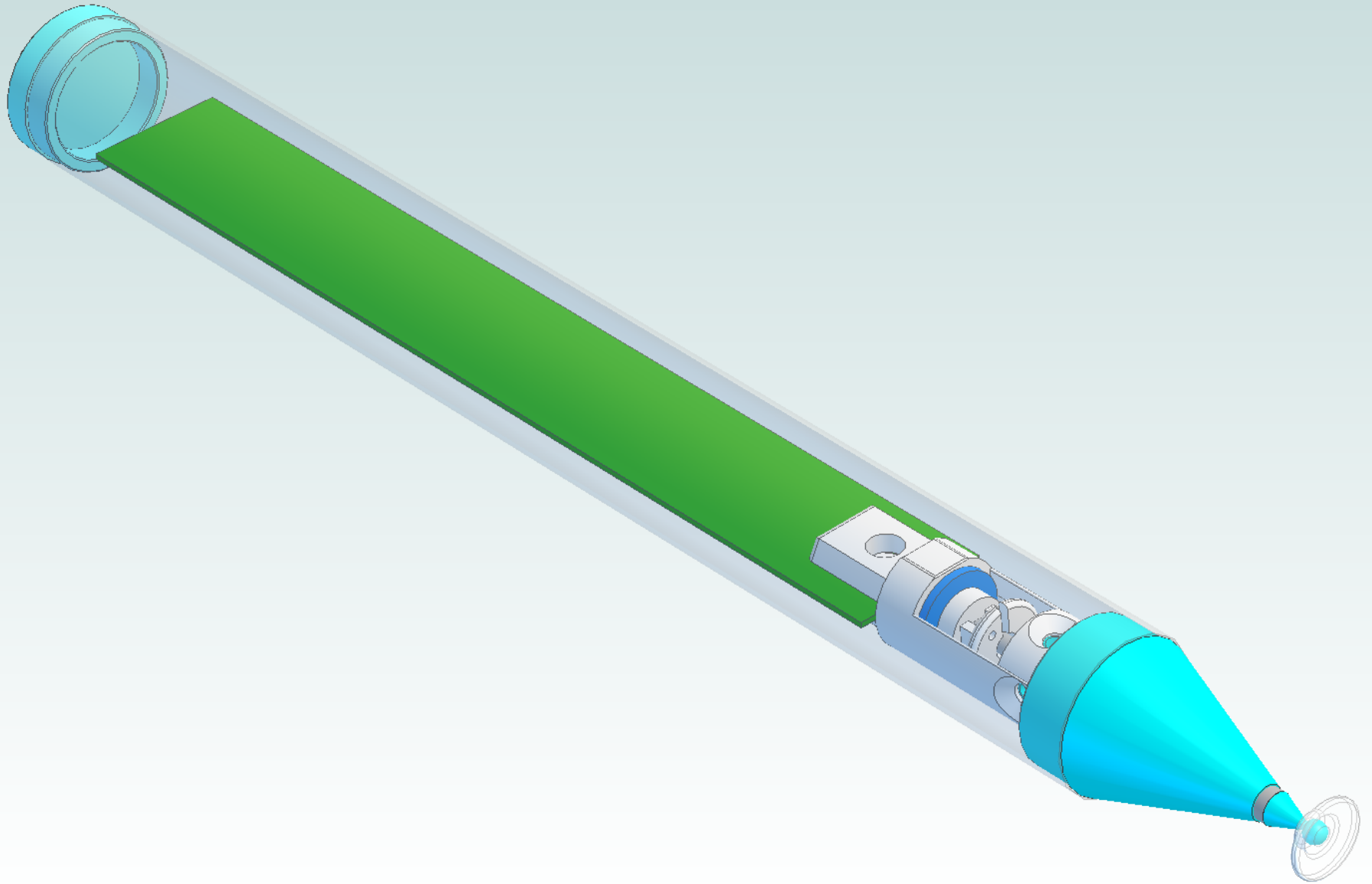
usbserial-A800K38M / 9600 8-N-1

Connected 00:28:48

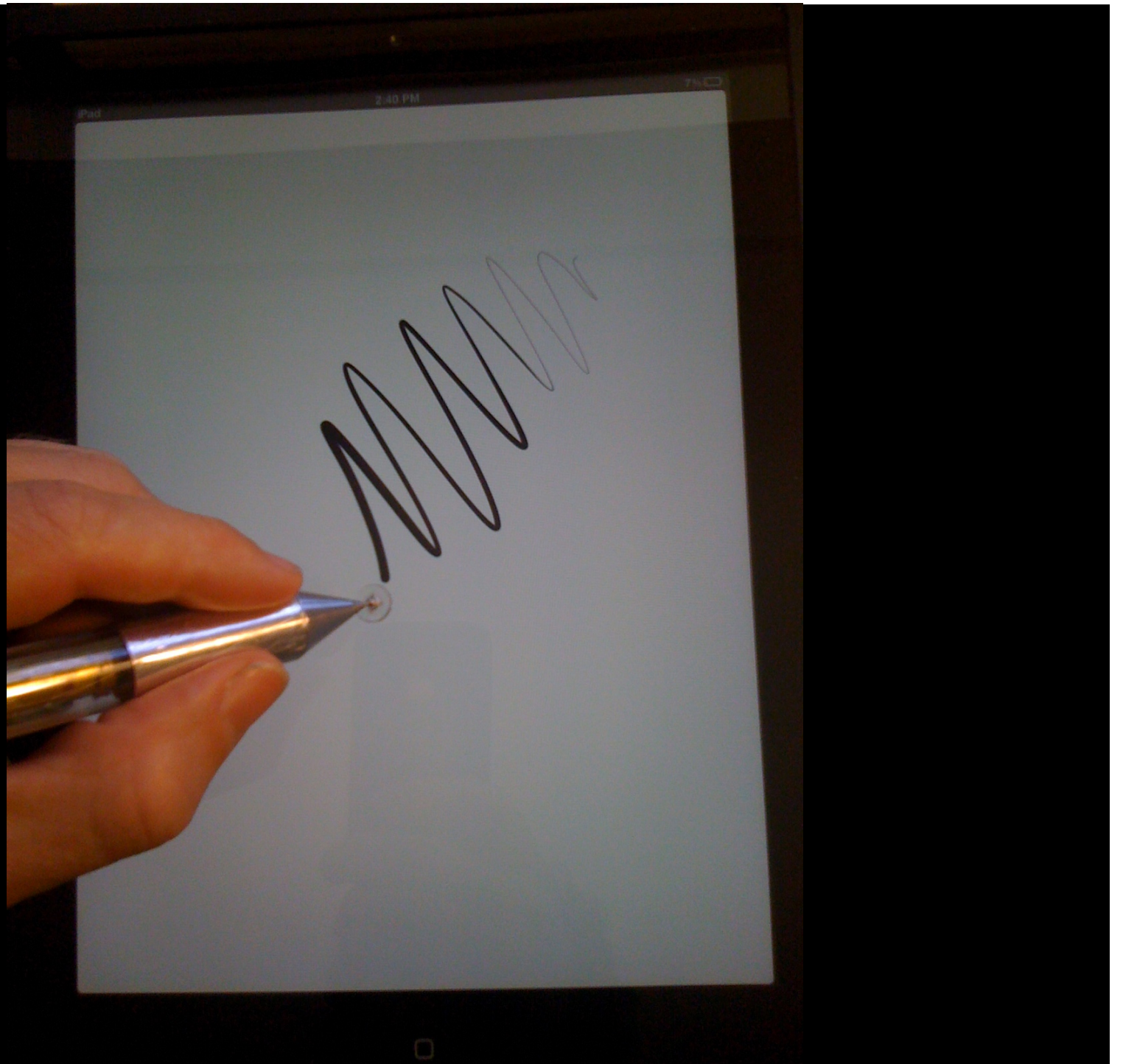
- TX
- RTS
- DTR
- DCD
- RX
- CTS
- DSR
- RI

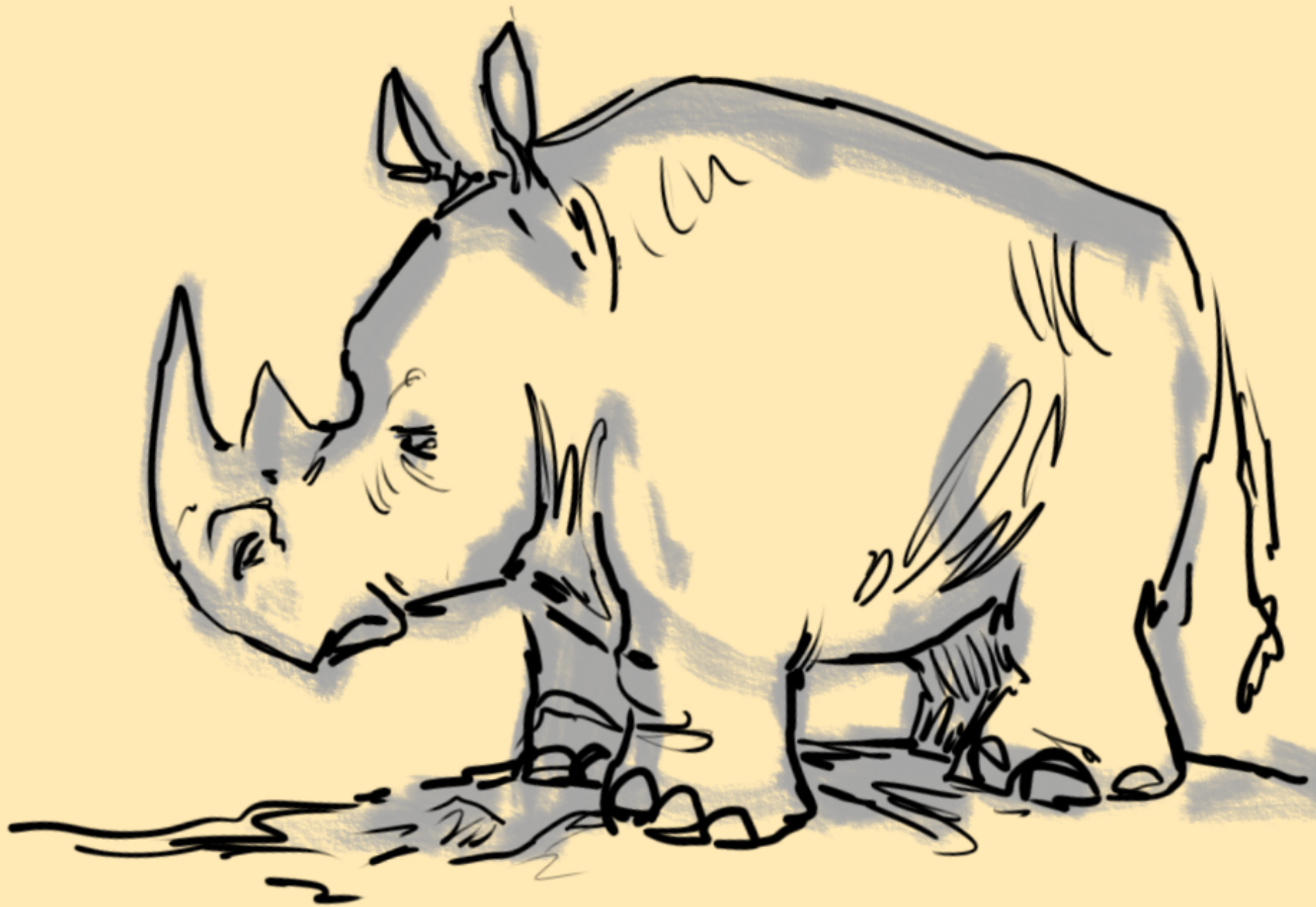












Brian Kessinger





Matt Roberts





Jeremy Spears

# Special Thanks

[ Jeremy Spears

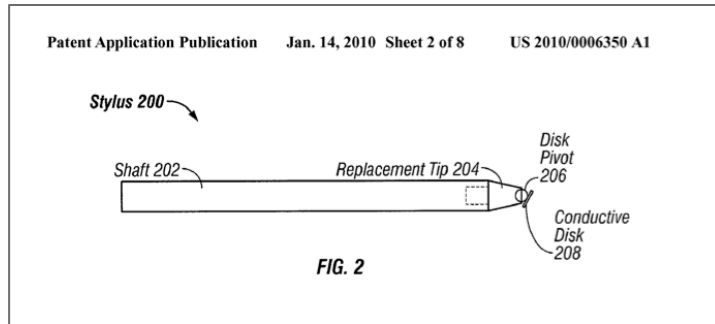
Rajesh Sharma

Brian Whited

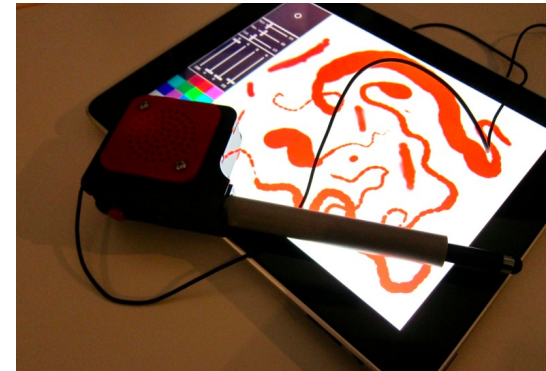
IxD Team ]

@ Disney Animation

# Recent Related Art



Apple Stylus Patent



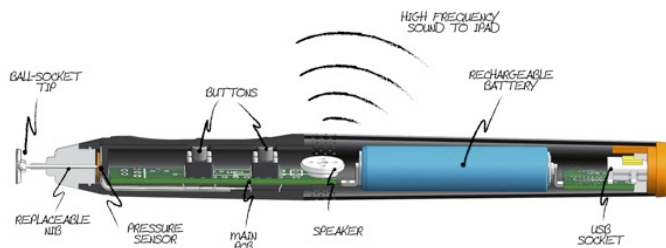
“Sound Stylus”  
Michael Knuepfel, NYU



Cregle iPen (Jan, 2012)



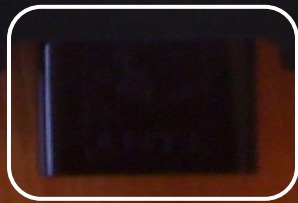
BlueTiger, Ten One Design  
(Forthcoming)



JaJa+ (Forthcoming)




Jot Touch (Forthcoming)



Ant+ Wireless Module

# Pipeline/Tool-chain


  
Physical Parts

  
3D Solid  
Modeling

  
Machine shop:  
Traditional machining

  
3D Plastic Prototyping

  
Electronic Parts

  
Circuit Design,  
Board Layout  
and Manufacturing

 MPLAB IDE   
BoostC Compiler

Firmware Development



Clay Kaytis