Automated Screening SOP

Super-user:

Kent Irwin

Nicholas Rapidis

Tom Liu

Qualified users:

Kent Irwin

Nicholas Rapidis

Jason Corbin

Tom Liu

Abdullah al Shirawi

Antonio Fortes

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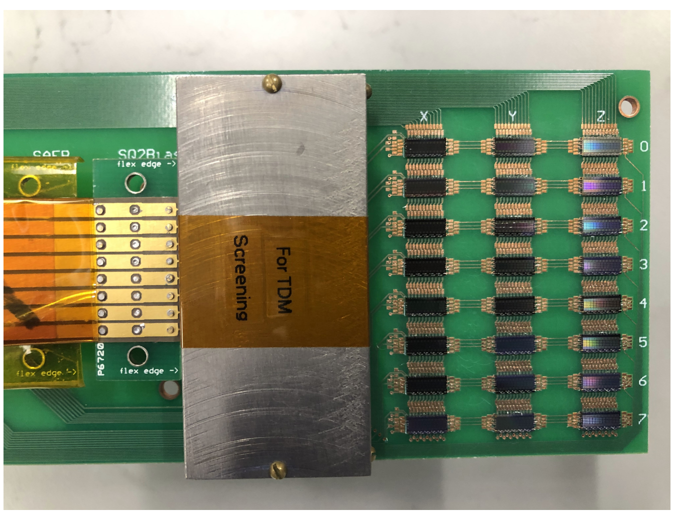
Chip Mounting



Gathering parts:

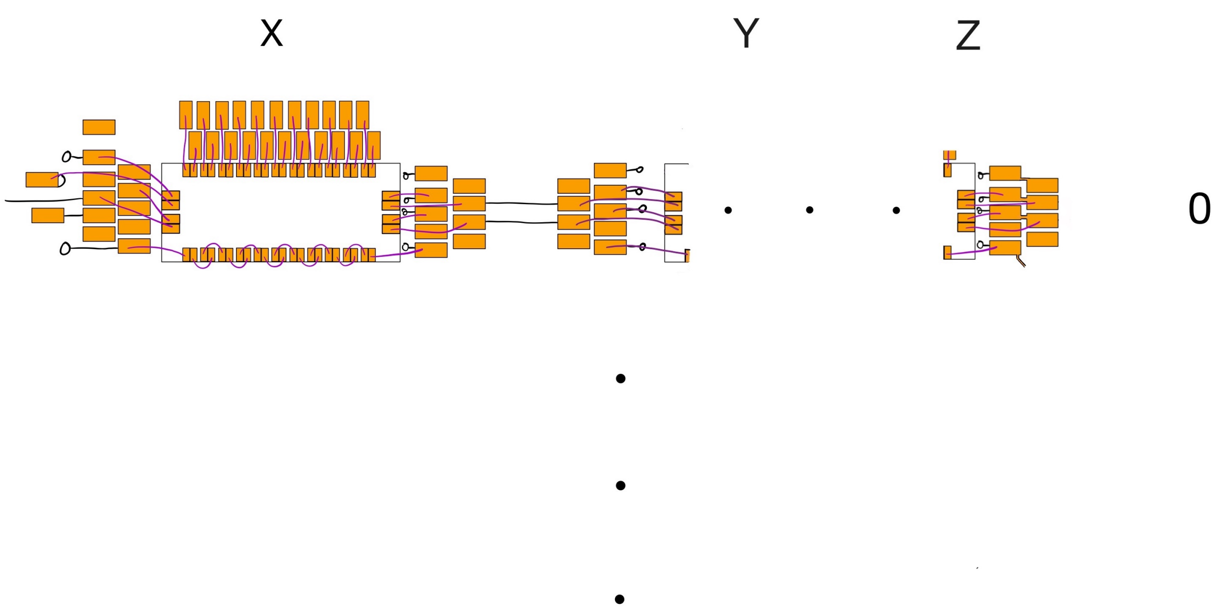
1. Gel pak releasing tool plug into CDA
2. Gel Paks with chips
3. Screening PCB
4. Peek flat tip tweezers (drawer marked as hand tool)
5. al dishes (consumable drawers)

6. Wipes (consumable drawers)
7. Cotton swab (consumable drawers)
8. Eraser (consumable drawers)
9. Fresh rubber cement
10. wooden sticks (for applying rubber cement and pressing chips to PCB; consumable drawers)
11. Safety glasses
12. Nitrile gloves

Steps:

1. Put on nitrile gloves
2. Thoroughly polish the copper bond pads with an eraser (the typewriter pencil style erasers tend to work the best to remove oxide); (SC tips: always finish the bon pad surfaces with the pink eraser to get a polished finished)
3. Use a cotton swab with IPA to wipe down bond pad region of PCB. Use CDA to dry off.
4. Mount the gel pak to the gel pak releasing tool and turn on the tool to release chips from gel pak.
5. Use plastic tip tweezers for chip handling!! (SC notes: The sharp tip tweezers would break the gel and cause damage on si chips.)
6. Put on safety glasses
7. Remove Photoresist with Acetone bath followed by IPA bath. (a-e are SC notes)
    a. The best practice is to set up three dishes – acetone 1, acetone 2 and IPA.
    b. soak the chip to acetone 1 al dish for ~ 30 sec or longer. When moving to the acetone 2 bath, keep the chip wet. After acetone 2 bath, move to IPA to remove acetone residue.
    c. Use CDA blow dry
    d. If the acetone 1 bath is too yellow, pour the acetone from acetone 1 to Solvent waste bottle (inside flammable cabinet). Put the wet al dish into a plastic bag (to be disposed to the dry waste bucket at B07).
    e. You can use your previous acetone 2 to become acetone 1 and create another acetone 2.
8. I like to do three at a time. X, Y, and Z and work my way down the PCB
9. Use a wooden stick to dab a small amount of rubber cement on the PCB
10. Place the chip on the rubber cement, and using two of the wooden sticks, press the chip down from opposite corners at ~45^{o} carefully moving the chip into alignment with the bond pads.

Chip Bonding

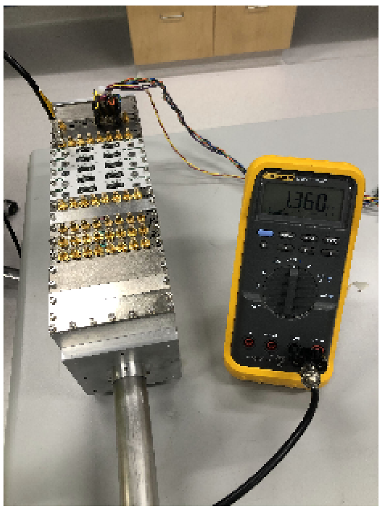
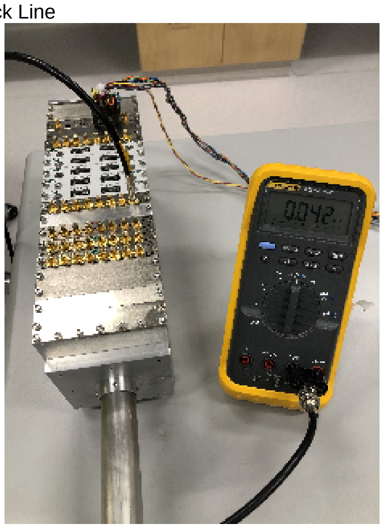


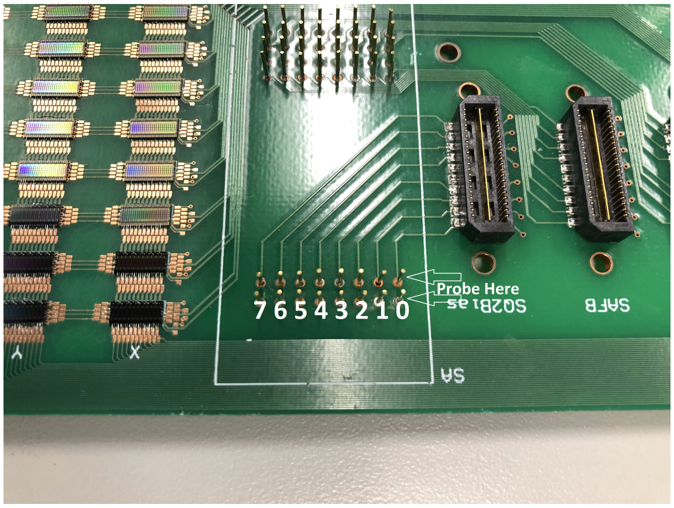
1. Bond the chips immediately after mounting to minimize the time that the Cu pads have to oxidize and try to do it in one sitting. It takes a few hours to bond a whole PCB, and you will notice less consistent bonds toward the end.
2. Do the FB, RS, and OUT bonds first, followed by the input bonds. The specific order doesn't really matter.
3. Currently, buffer #10 is set for CuNb bonds, and buffer #9 is set for NbNb bonds

Continuity Checks (Room Temperature)

All of these measurement have pretty generous tolerances (maybe 5-10%)

1. Row Selects

    a. 
    b. Use the HDMI breakout box and at least the **40kOhm range on the multimeter.** The 1-4 (top) HDMI covers channels 1-4, the other 5-8. Cycle through all 8 channels to measure values.
    c. Expected value: ~11kOhms
2. Inputs
    a. 
    b. **Use the MOhm range on the multimeter**
    c. Expected value: ~1.4MOhm
3. Feedback Line
    a. 
    b. **Use the MOhm range on the multimeter**
    c. Expected Value: ~42KOhm
4. Bias Line
    a. The SQ1 bias continuity cannot be probed on the Tower because of the 1Ohm shunt resistor. Instead, probe directly on the PCB (**Use the MOhm range on the multimeter**)

b. 

c. Expected Value: ~19KOhms

5. Because the chips are wired in series (3 in a column), you can't isolate which chip(s) is problematic if the any of the above measurements (Input, FB, or Bias) are anomalous, and all three chips will fail the testing. A somewhat sketchy hack that has saved me a ton of time is to probe the PCB directly to isolate which chip has an open Feedback, Input, or Bias line. To do this you have to use the wirebonder tip (powered off) as a probe tip. Connect one end of the multimeter to the wirebonder somewhere, and use the other multimeter lead to probe the corresponding connector on the PCB. Do this with the SSA module removed. By gently touching the tip to different points (usually the copper bond pads), you can isolate which chip is open. Like I said, this is a little sketchy, but I has saved me countless hours of dismounting, remounting, rebonding, and retesting chips to isolate the problem chip.
6. This same method can be used to find an open Row Select. An open row select would cause all 8 chips in the row to fail. This is almost always just a bad wirebond.

Each Wafer has it's own Wiki page, and each PCB has it's own Wiki page which is a child page of the Wafer page (see here). All of the room Chip IDs, room temp resistances, and notes go on this page.

Dip Procedure

Electronics and Wiring

1. Agilent E3631A Tower Power Supplies
    a. GPIB
2. RS232 Serial Dongle
    a. USB
3. Agilent 33220A Function Generator
    a. USB
4. Teledyne-Lecroy HDO6104-MS Oscilloscope
    a. USB
5. Keysight 34970A Data Acquisition / Switch Unit
    a. GPIB

6. Custom SAFB/FB1 Switch Box
    a. USB
7. BlueBoxes
    a. Optical Serial Dongle
    b. SQ1 Bias
    c. Row Select
8. Tower
    a. Optical Serial Dongle (It doesn't stay in very well, so I tape it to the power cables)
9. 12V BlueBox Power Supply
    a. I power the blueboxes with a lab power supply rather than batteries so that I don't have to worry about batteries dying. The added noise is negligible for these measurements,

Set power supply for tower (above scope) as shown in picture above, i.e. on the top power supply, set the +/- 25 V supply to +/- 6. On the bottom one set the +6 V supply to +6 V and the +25 V to +12 V.

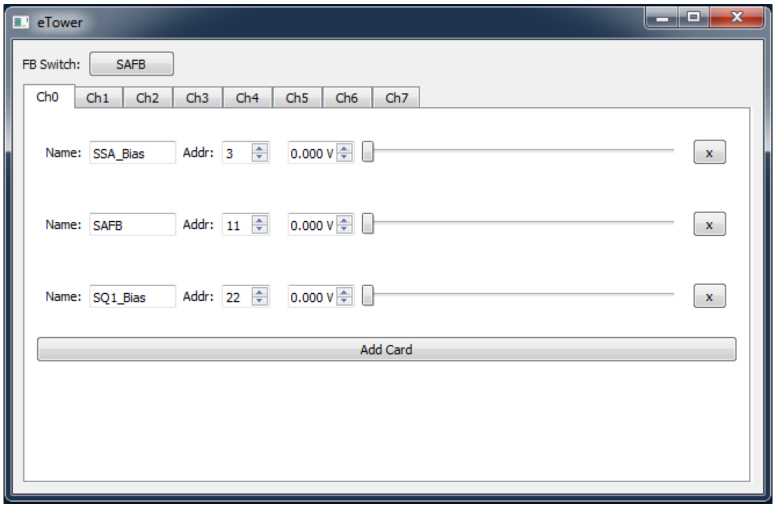
Set the function generator to a 8 kHz ramp function, 1 V_pp, 50% symmetry.

Set the power supply on the table to 12 V (shown in picture above)

Manual Control

Desktop Shortcut: **eTower**

```
> python C:\Users\squidscreener\Documents\eTower
```



The "FB Switch" button switches the custom BNC switch box between FB1 and SAFB.

The Channel tabs are populated with the cards corresponding to the current configuration of the TDM screening tower. Each row corresponds to a physical tower card, and these can be added or removed or changed if necessary

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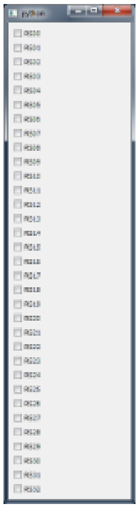
Desktop Shortcut: **MUX**

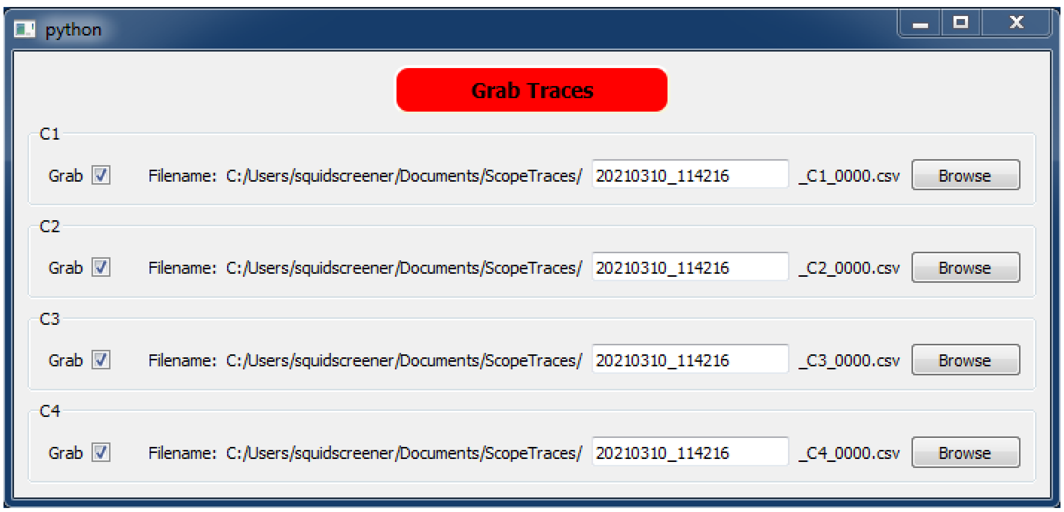
```
> python C:\Users\squidscreener\Documents\MUX
```



Controls the Keysight 34970A. With the HDMI cables plugged into the Tower, this turns on/off row selects.

Desktop Shortcut: **Lecroy Trace Grab**

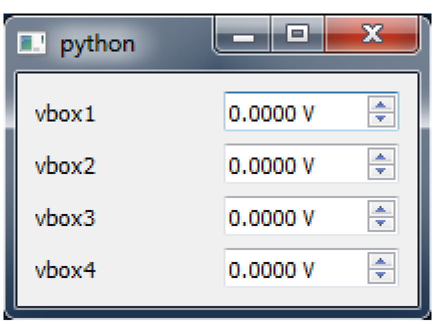
`> python C:\Users\squidscreener\Documents\LecroyTraceGrab` **(Must use the Anaconda Terminal)**



This is just a quick and dirty way to grab data from the Lecroy Oscilloscope. It saves whatever is currently displayed on the scope to disk. You can select which channels to save.

Desktop Shortcut: **BlueBoxes**

`> python C:\Users\squidscreener\Documents\BlueBoxes` **(Must use the Anaconda Terminal)**



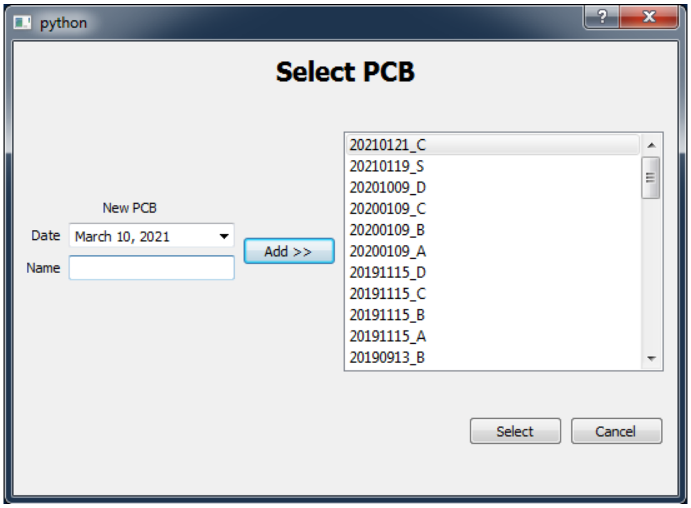
This controls the 4 Serial ports on the SerialGear dongle. Use this if you want to control a BlueBox from one of those ports.

Automation Software

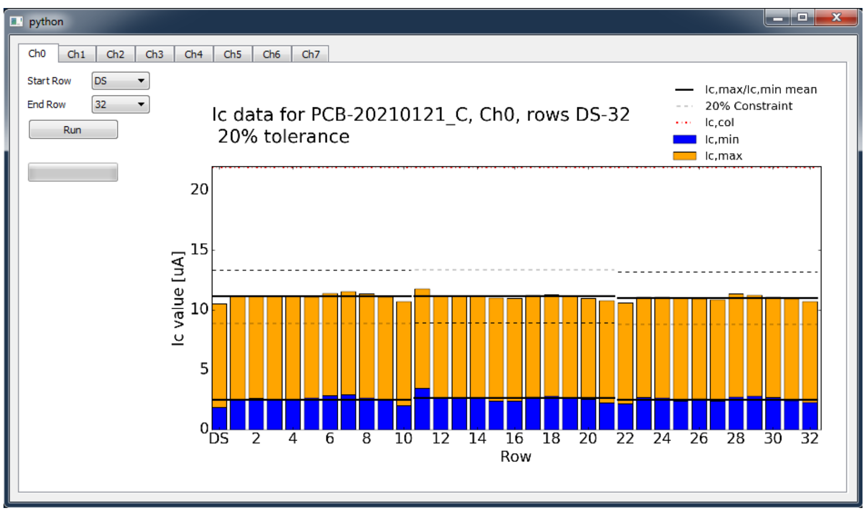
Desktop Shortcut: **Squid Screening Automation**

```
> python C:\squidscreeningautomation\qtGUI.py
```

Select (or create) a PCB. The name should usually correspond to the letter on the PCB (A, B, C, D).



This is the UI. The tabs correspond to channels. Select a "start row" and an "end row" over which to run the screening, then press "Run". This is helpful if you know that not all of the chips are populated, if a chip is bypassed, or if you need to go back and spot check anomalous rows. The plot on the right will update as the screening progresses.

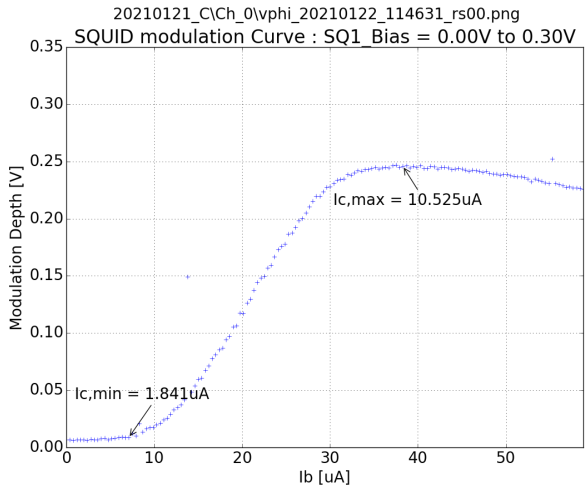


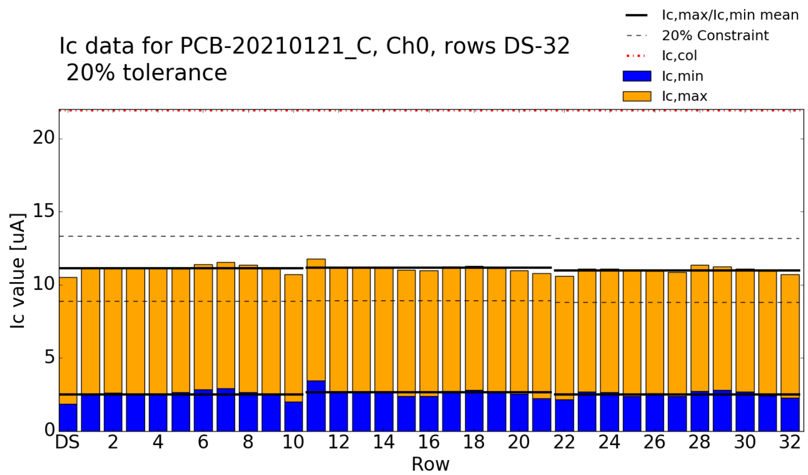
Data Output

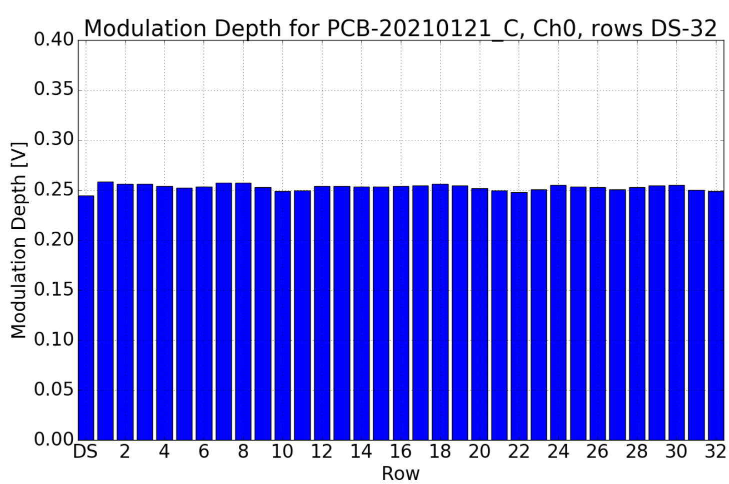
Raw data is saved in `C:\squidscreeningautomation\datafiles`

File Structure:

- PCB Name
  - Ch_0
    - iccol.txt
      - this just holds the iccol value for this row. If this exists, the automation skips the get_iccol step
    - Ic_**YYYYMMDD_HHMMSS**_rsDS-32.txt
      - This hold the summary Ic data for all 33 rows
      - SSA_BIAS [V]; SSA_FB to Center [V];SSA_FB_Ic,min [V]; SQ1_BIAS_Ic,min [V]; Ic,min Modulation [V]; Ic,min [uA]; SSA_FB_Ic,max [V]; SQ1_BIAS_Ic,max [V]; Ic,max Modulation [V]; DC_volt [V]; Ic,max [uA]
    - ib_mod_rs**X**.txt
      - This is the raw bias vs modulation depth data
      - SQ1_bias; Mod_depth; SSA_FB
    - ib_icmax_fluxlock_rs**X**.txt
      - this is the raw data from the "poor man's fluxlock" part of the algorithm (for determining accurate Ic,max)
      - SQ1_bias; SAFB; SSA_out_mean

- rs**X**_icmax_trace.txt
    - This is the raw V-Phi trace at Ic,max
    - SSA_OUT; FB1
- vphi_**YYYYMMDD_HHMMSS**_rs**X**.png
    - This is the SQ1 bias vs Modulation depth curve. The x-axis is total bias current, while the Ic values are the actual I_{SQ1} v alues.
    - 

- Ic_**YYYYMMDD_HHMMSS**_rsDS-32.png
    - 

- mod_**YYYYMMDD_HHMMSS**_rsDS-32.png
    - 

- Ch_1
- Ch_2
- ...

Notes on Postprocessing

This is all great, but at this point the data is mapped to a PCB rather than to individual chip ID's. At some point after the chips are mounted and bonded, use the microscope to read the chip ID's. Map these to their location on the PCB (X0, Y2, etc.). There is a place to put this on the PCB wiki pages.

There is some code in `C:\Users\squidscreener\Documents\BICEP_reports` to take this data and generate reports mapped by chip ID. It needs some work.

I have been keeping track of everything by hand in this spreadsheet: . There doesn't seem to be a better way to do this at the moment.

Development Notes

If any changes are made in: `C:\squidscreeningautomation\blue_box, C:\squidscreeningautomation\hardware_io, or C:\squidscreeningautomation\named_serial`

then you have to run `> python C:\squidscreeningautomation\setup.py install` (or Desktop shortcut: **Setup Squid Screening Automation**) for the changes to take effect.

These modules are installed python packages for historical reasons. It also means you can import from them from any other project or script as long as you are using the system python 2.7 distribution.

Just answer n to the installation queries or close the terminal. This is for setting up `squidscreeningautomation` on a new machine.