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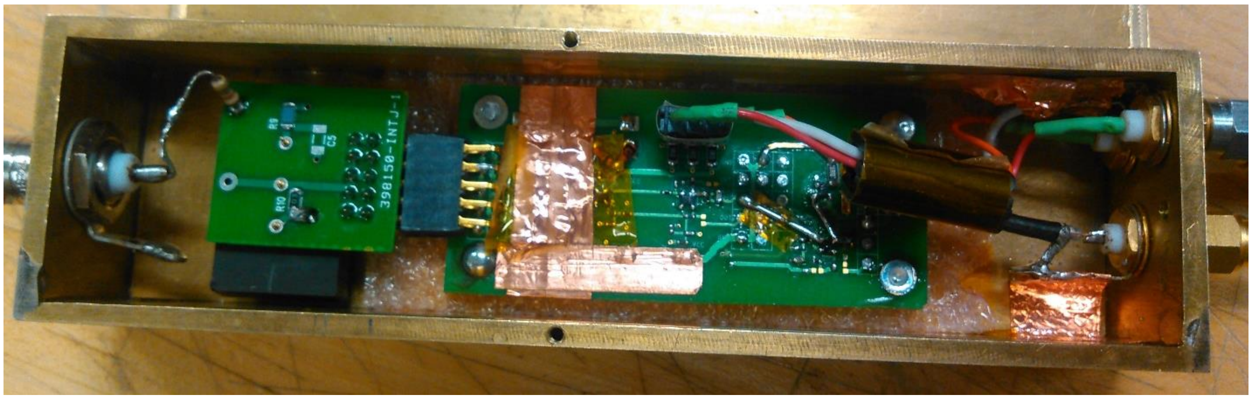
Documentation on Fast Amplifier Board v1.3

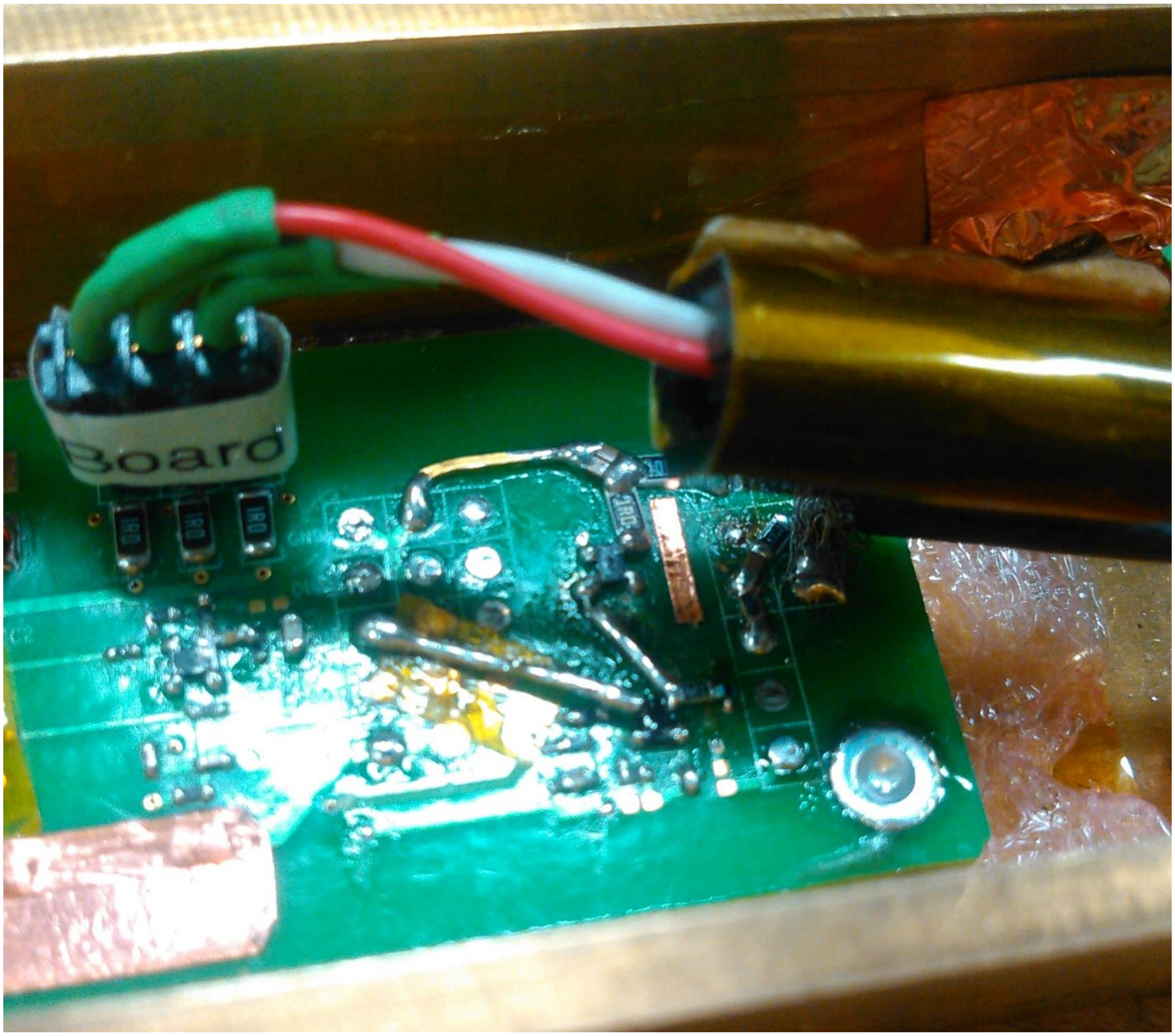
Mitch Newcomer, Michael Reilly, Emmanuel Morales

University of Pennsylvania, HEP

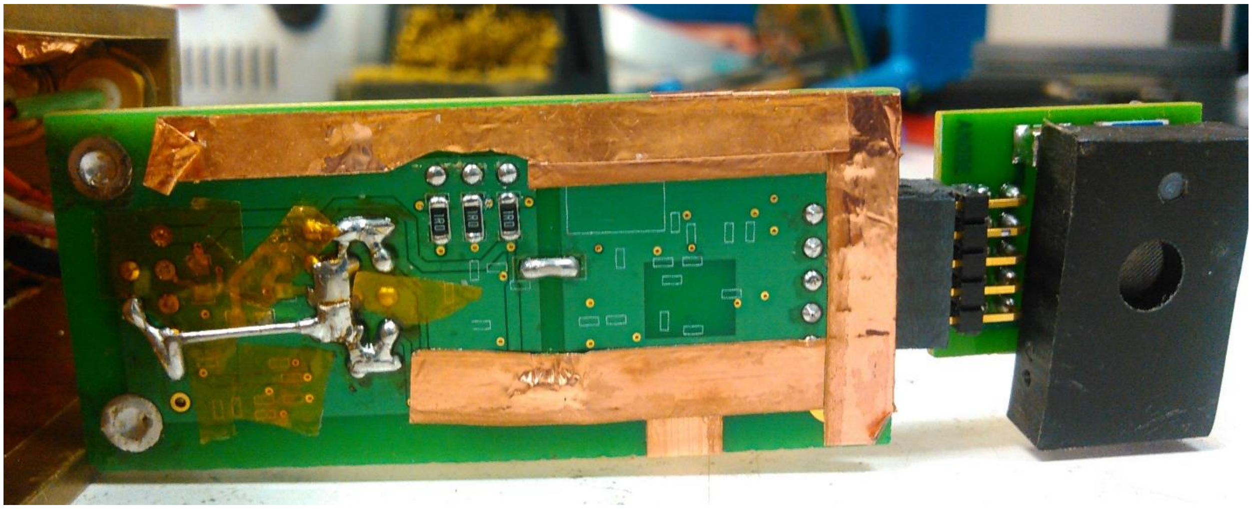


Visible modifications on the top layer of the board include:

- A connector was placed at the input so that the sensor can be removed with more ease and also be closer to the hole on the box.
- Kapton tape was placed over the first three transistors on the board, and copper strips were placed over, to shield the first two transistors and create a stronger connection between the ground planes.
- Traces that connected the first and second stage of the circuit were removed.
- Connections at the second stage were created with connector pins.
- A thin strip of copper was placed near the output, covering two vias that conduct the power for the 5th transistor. After covering these two vias acting as antennas, the noise at the output greatly decreased.
- The sides and the bottom of the box around the board are covered in kapton because noise can occur when the copper strips on the board make contact with the box. The piece of foam under the board also helps keep the board from getting too close to the box.
- A ferrite core around the power cable supports a low noise environment inside the box.

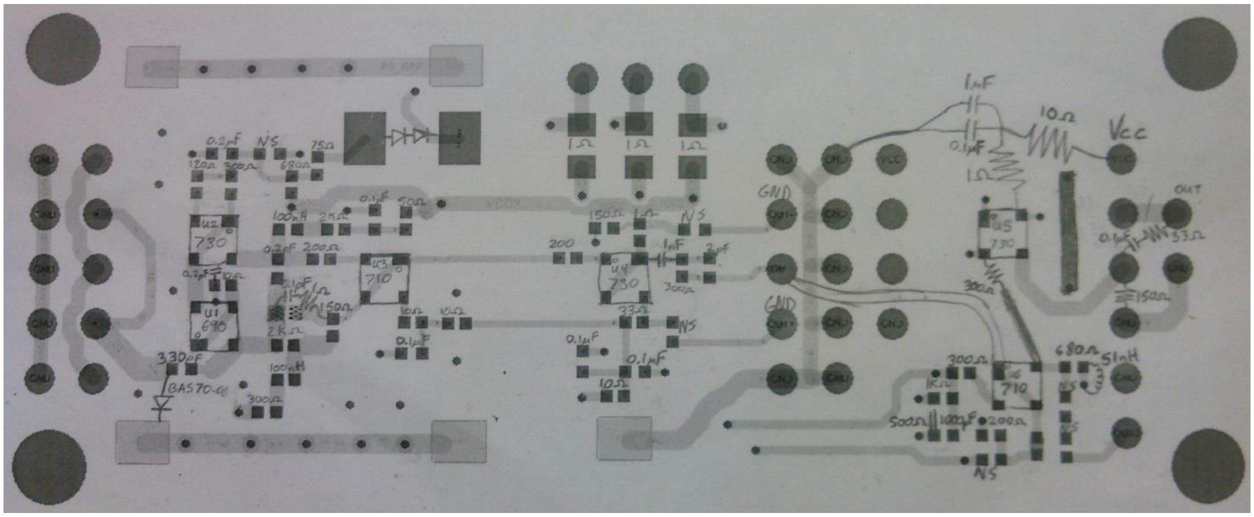


This image shows the connections at the output side of the board. The thin copper strip is part of the 4V supply and not ground.



Visible modifications on the bottom layer of the board include:

- Copper strips were used to improve ground connections.
- All the ground holes and vias on the output side of the board were connected by soldered connector pins to create a strong ground connection.
- All the unused traces on this layer were cut, including all the pads that were previously being used for the components of the 6^{th} transistor.



Stuffing for the board’s top layer.

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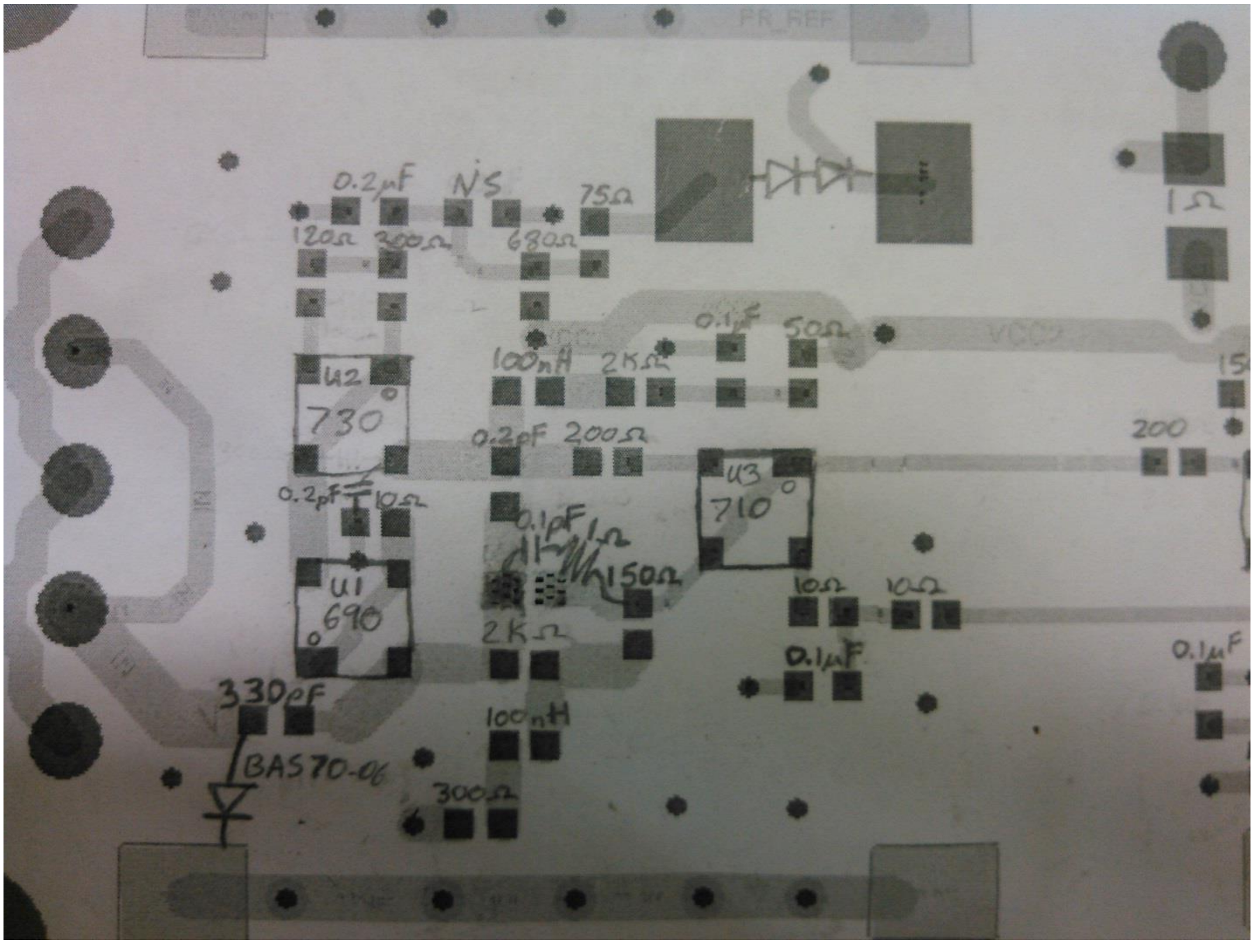
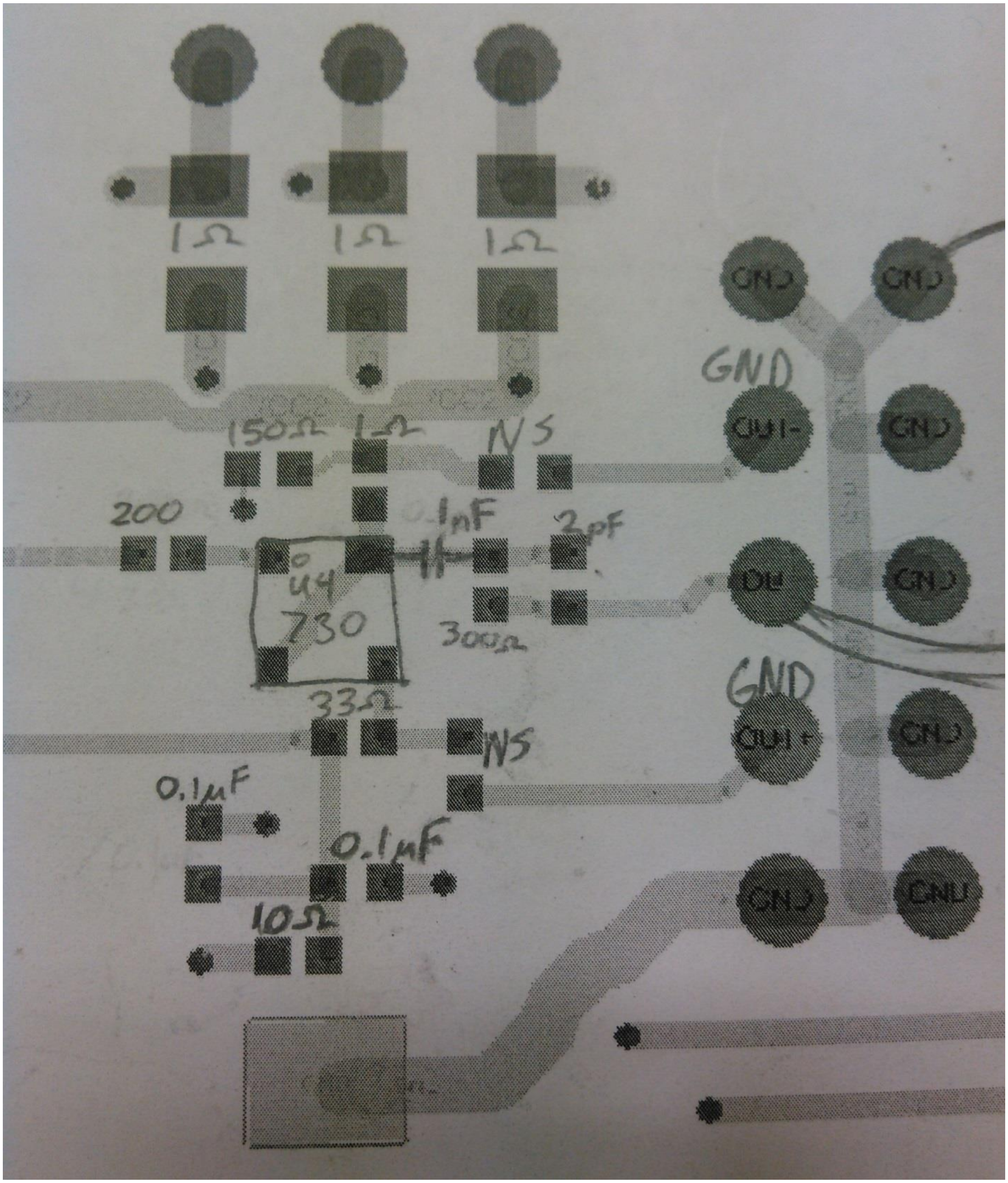
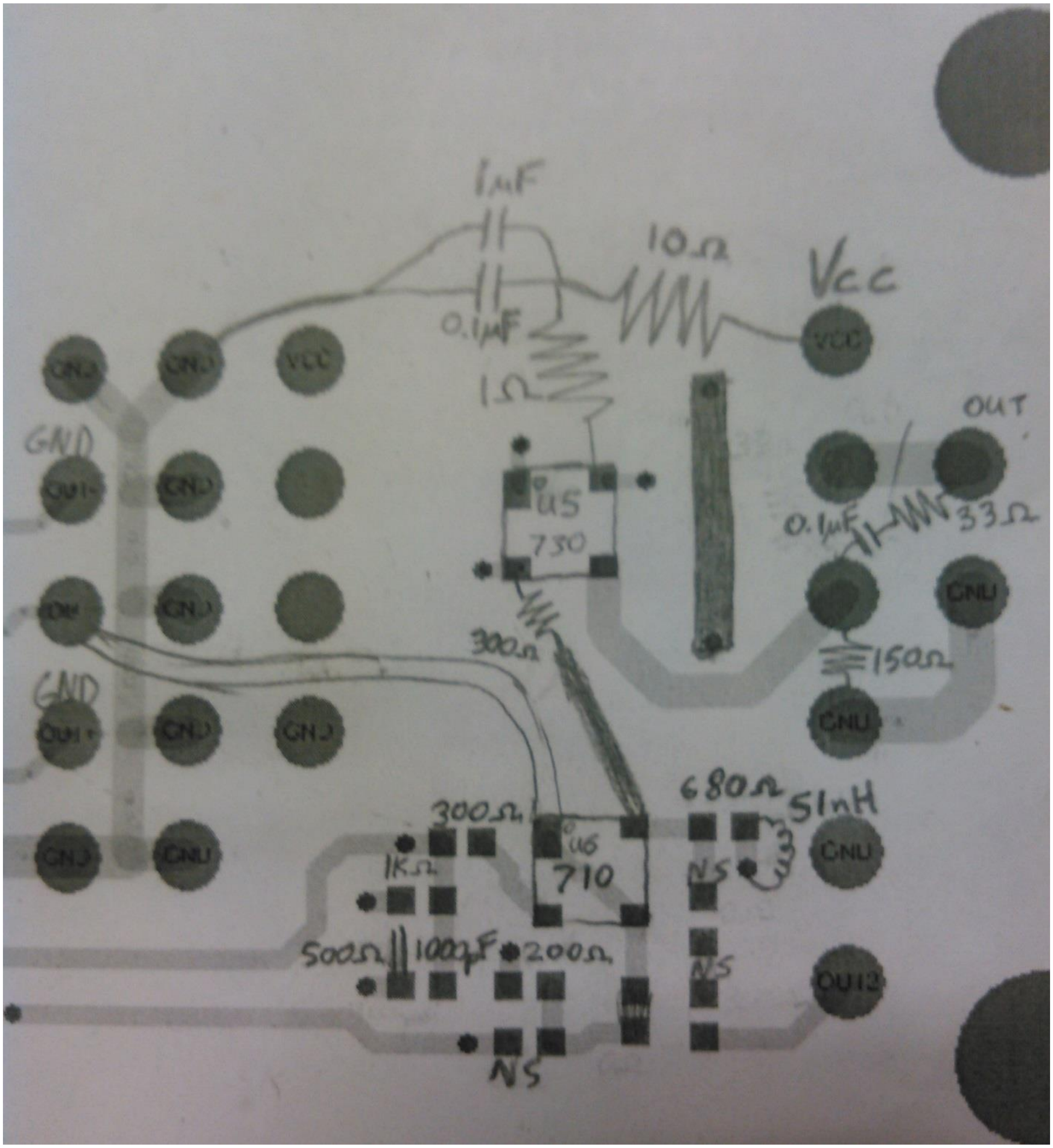


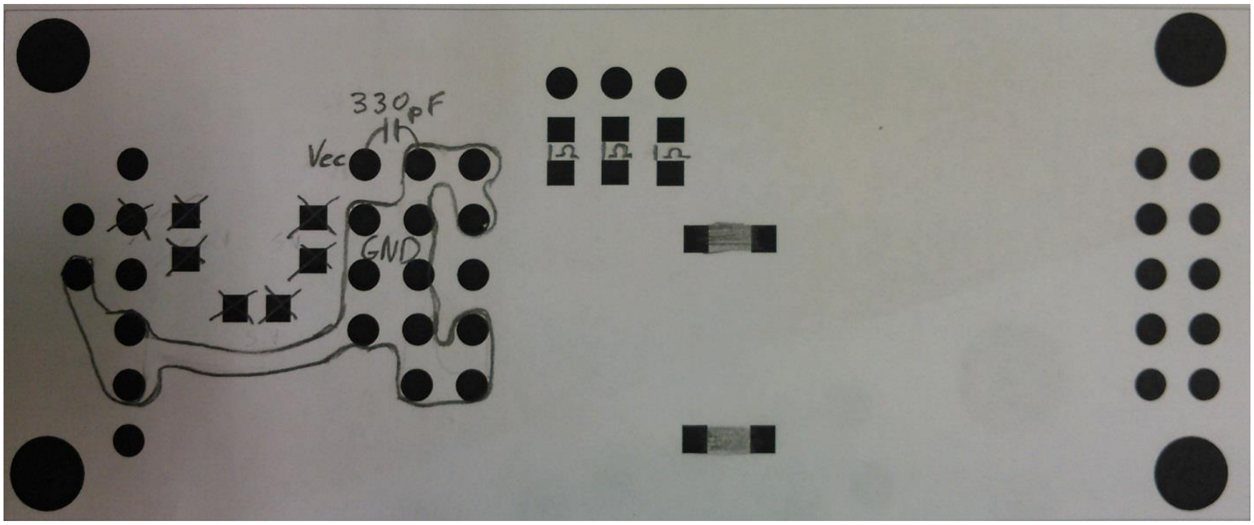
Values used on the first section of the board’s top layer.



Values used on the mid-section of the board’s top layer.



Values used on the output-section of the board’s top layer.



Stuffing for the board's bottom layer. The holes and pads that are crossed out had their traces removed in order to minimize antennas. The encircled area was all soldered together to create a large ground connection, which helped reduce the noise.

For the following sample signals Fe-55 was used as a source. The inputs to the board include a 4.0V supply (VCC), an 8.0V supply(VCC2), and a -1.80kV supply. Current drawn from the supplies was 0.02A for VCC and 0.01A for VCC2. The sample signals were taken while the output was only connected to the oscilloscope with a 50Ω termination. It was observed that if the ouput was connected to both the oscilloscope (terminated at 1MΩ) and the spectrum analyzer(terminated at 50Ω), the signals were slower.

Sample 1

Base to peak voltage: 35.35mV

Sample 1

Time from 10% to 90%: 1.30ns

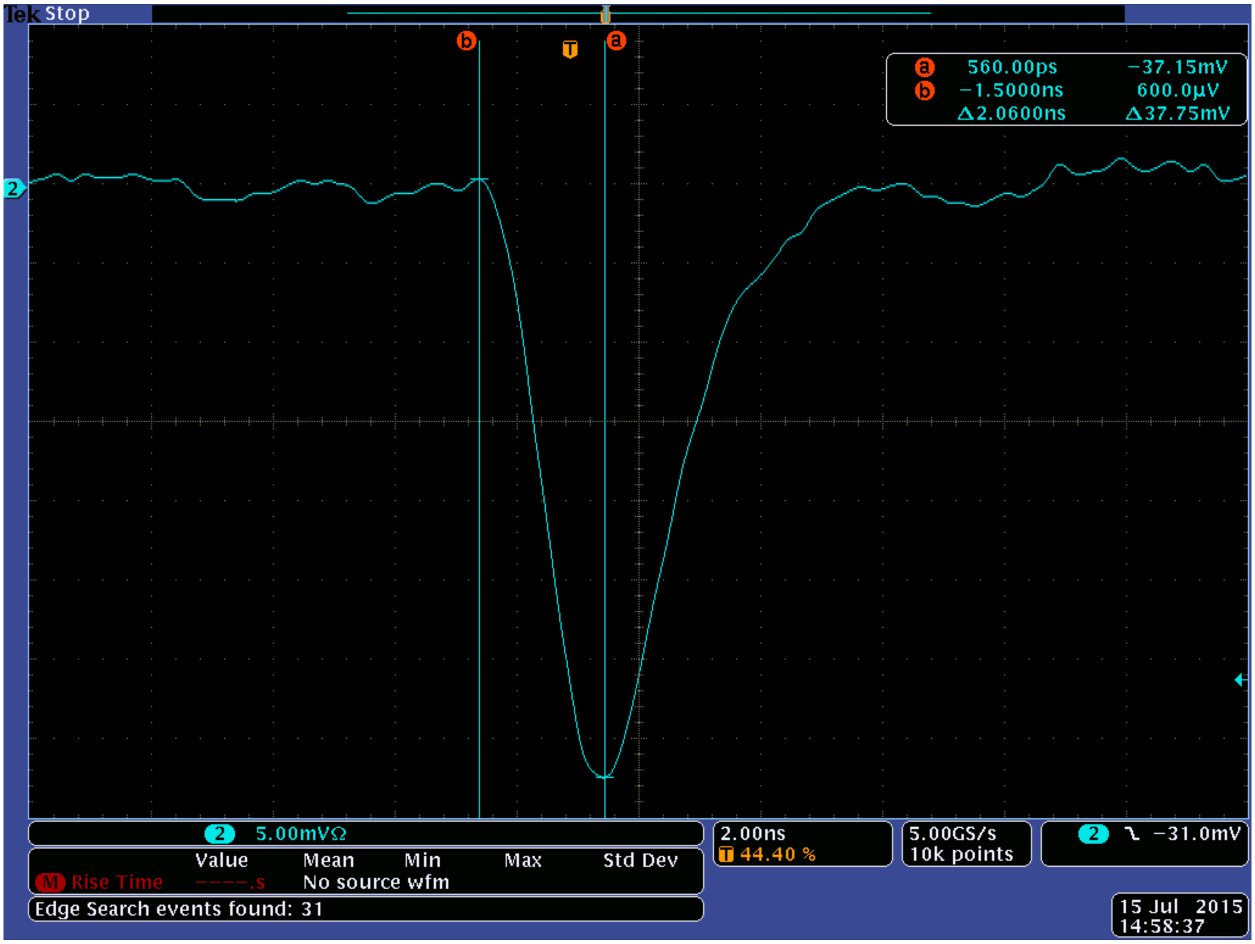
Sample 2

Base to peak voltage: 36.90mV

Sample 2

Time from 10% to 90%: 1.22ns

Sample 3

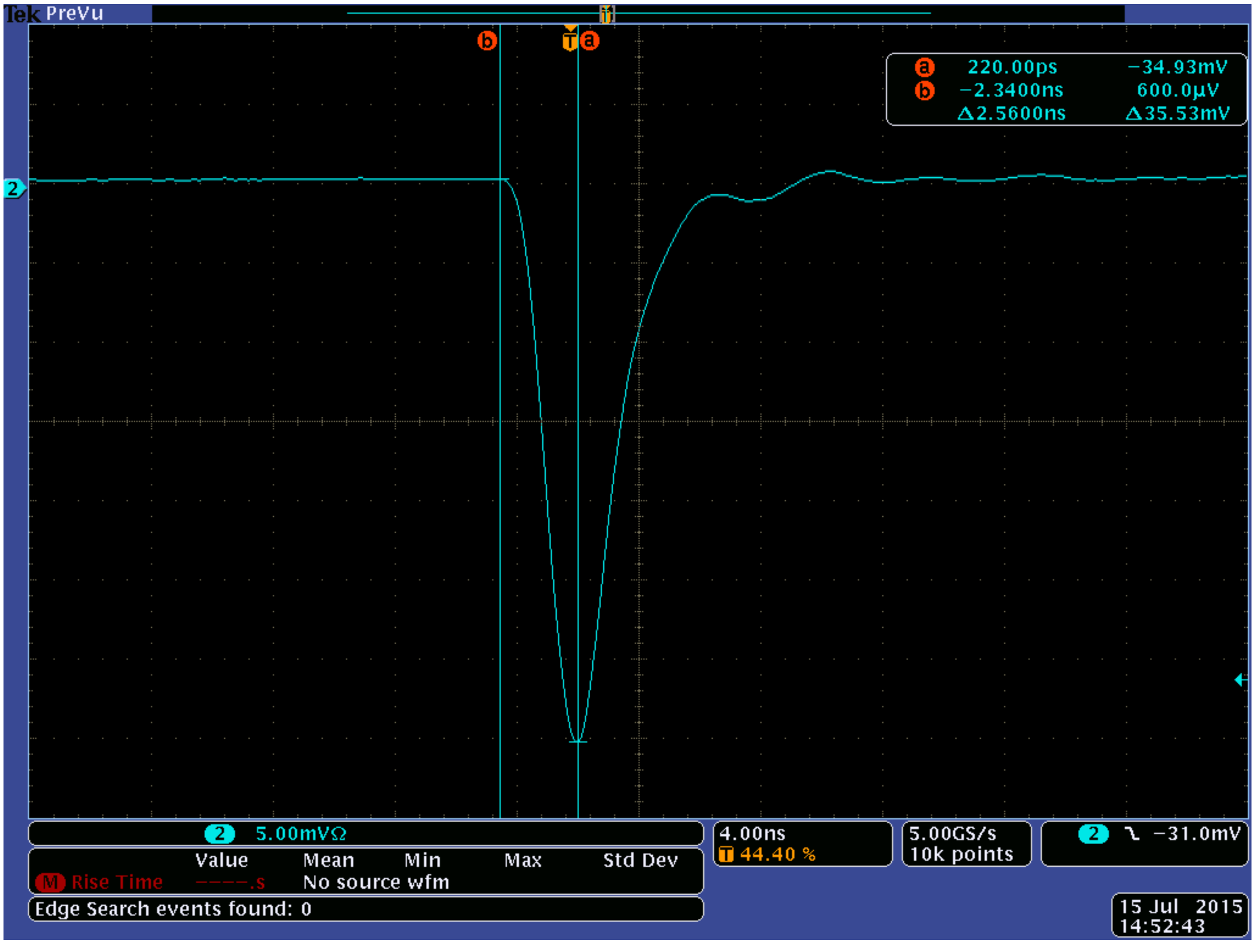


Base to peak voltage: 37.75mV

Sample 3

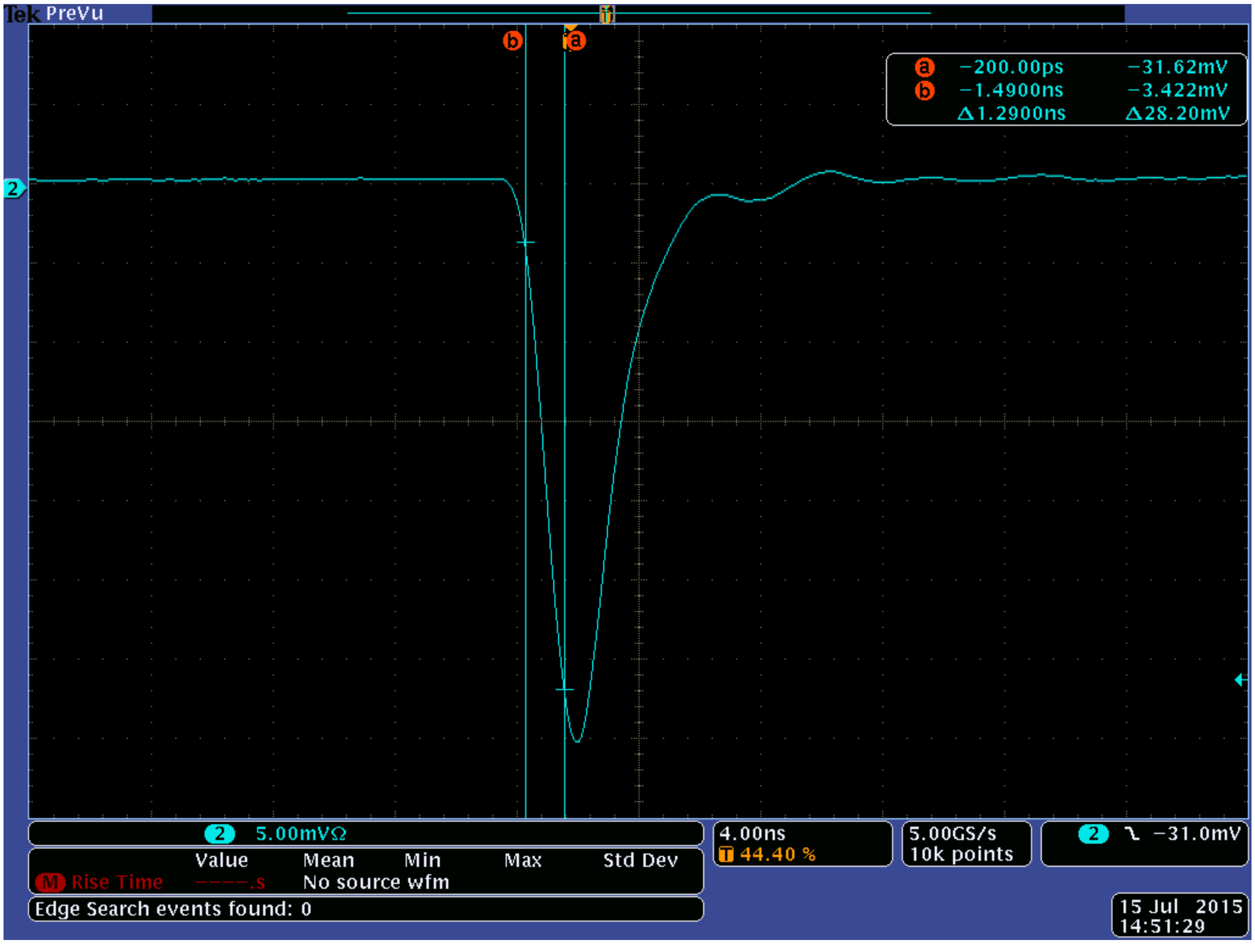
Time from 10% to 90%: 1.18ns

Signal Average of 512 Samples



Base to peak voltage: 35.53mV

Signal Average of 512 Samples



Time from 10% to 90%: 1.29ns

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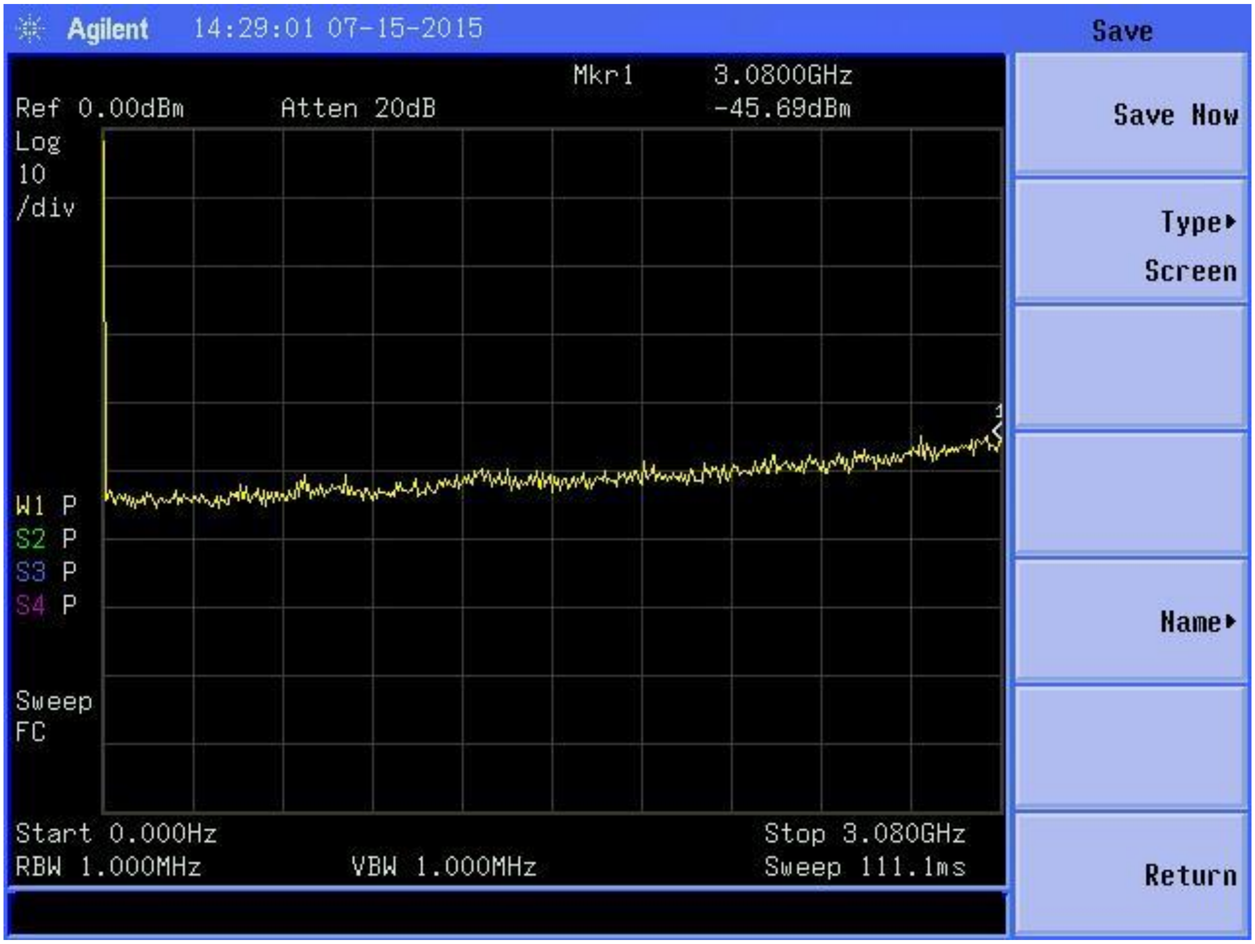
Spectrum Analyzer



This screenshot shows that there is barely noise in the system while it is being used. The start frequency was set to 0Hz and the stop frequency was set to 3.08GHz(highest frequency on this spectrum analayzer).

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The following LTspice schematic shows all the connections and values on the board.