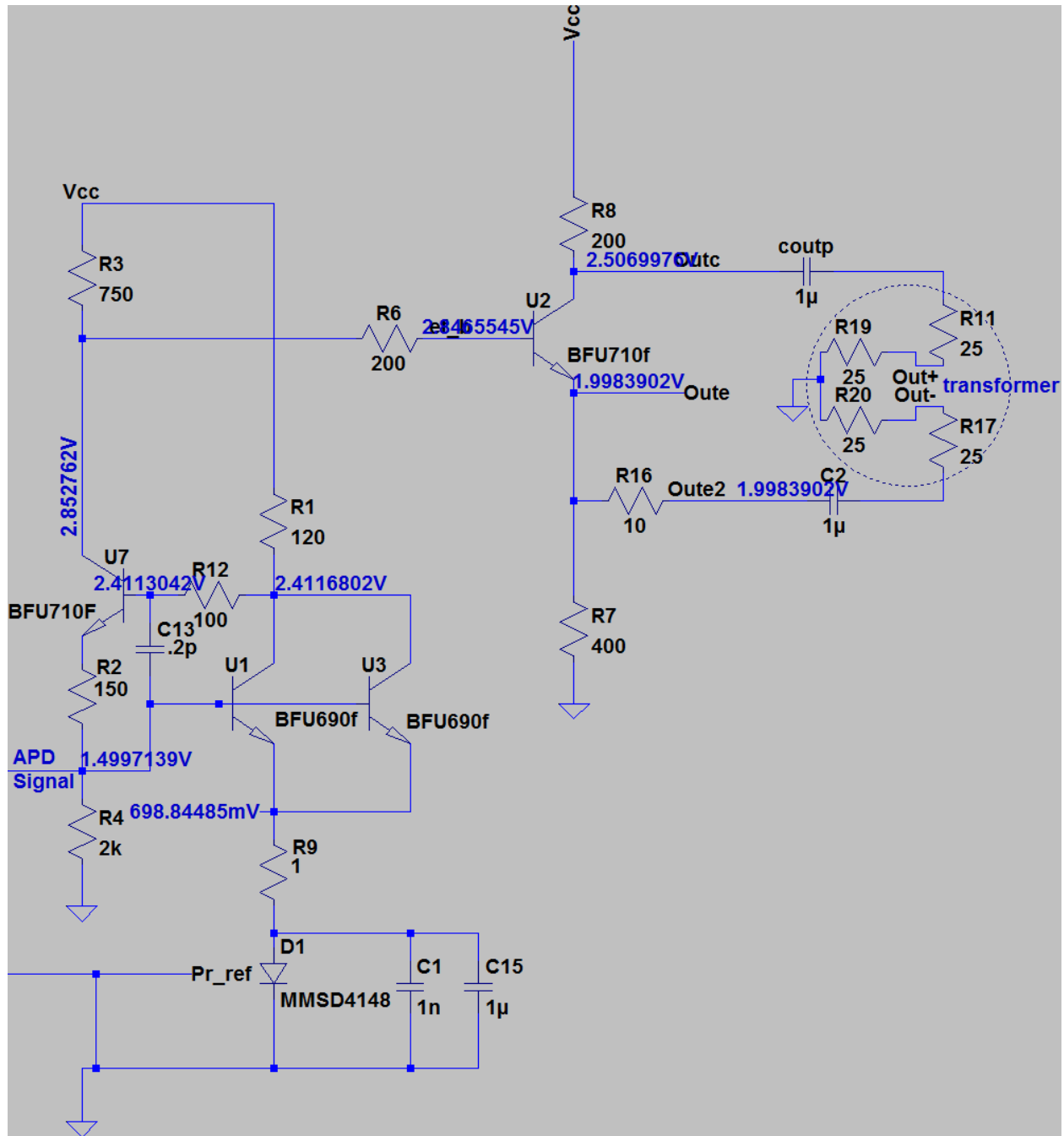# Penn Fast Amp for CMS Detector at CERN

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Schematic

LTSpice circuit of the board. R11 and R17 are located right before the transformer. R19 and R20 are used for simulation purposes.

Stuffing

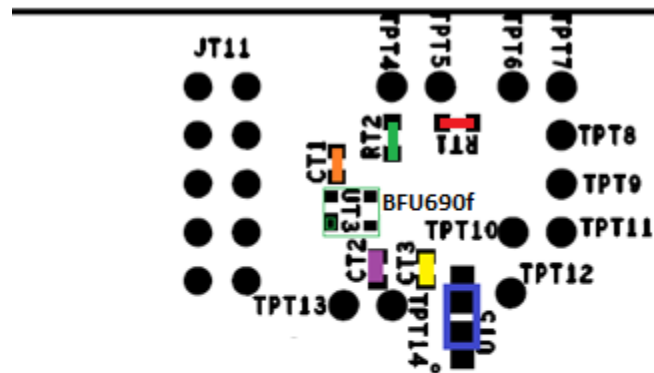The following images are used for stuffing the board:

C0402	R0402	R0603
1nF	150	0
NS	100	1
1uF	200	10
	750	400
	2k	

UB1 = BFU710f = UB2
UB3 = BFU690f

Board's top side above.

Board's bottom side below.

C0402	R0603	Diode
1nF	120	MMSD4148
0.2pF	200	
1uF		

Construction

Between the high voltage input of the APD and the box's supply there is two 1MΩ resistors in series, and a 1nF capacitor to ground, between the resistors, rated for 2kV. The APD is wrapped in three layers of kapton tape and a layer of copper tape. The Fast Amp's power supply line has a set of two capacitors at each end of the cable (a 100pF and a 0.1μF), and a ferrite core when it comes into the box.
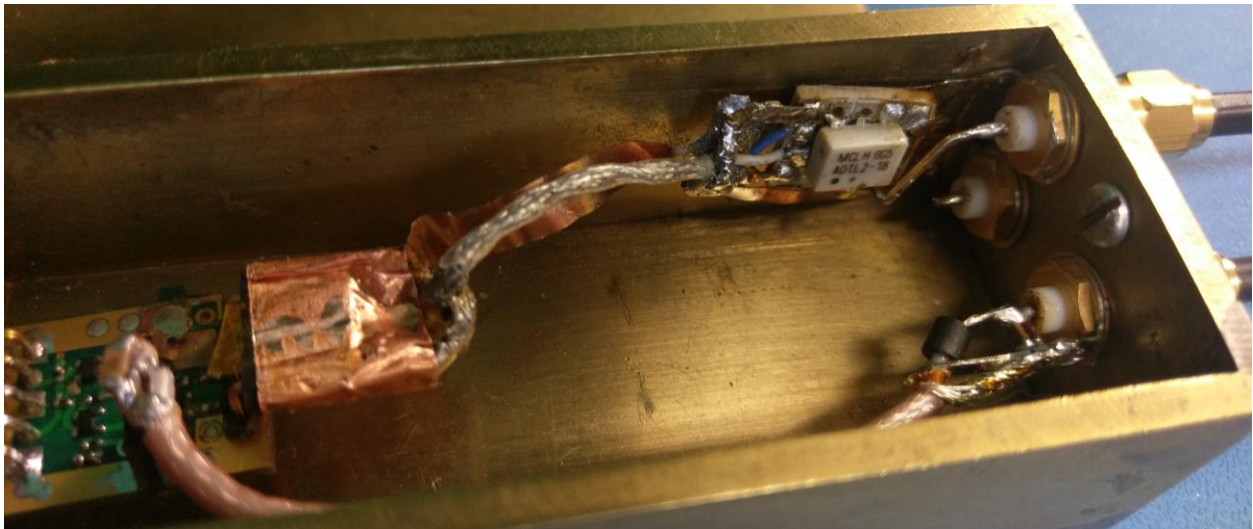
The output differential signal of the board goes through a transformer at the output end of the box. The cable that carries the differential signal to the transformer has a strip of copper for shielding and another for creating a more solid connection to ground since moving the cable a lot can cause the ground shielding of the wires to get damaged at the ends.
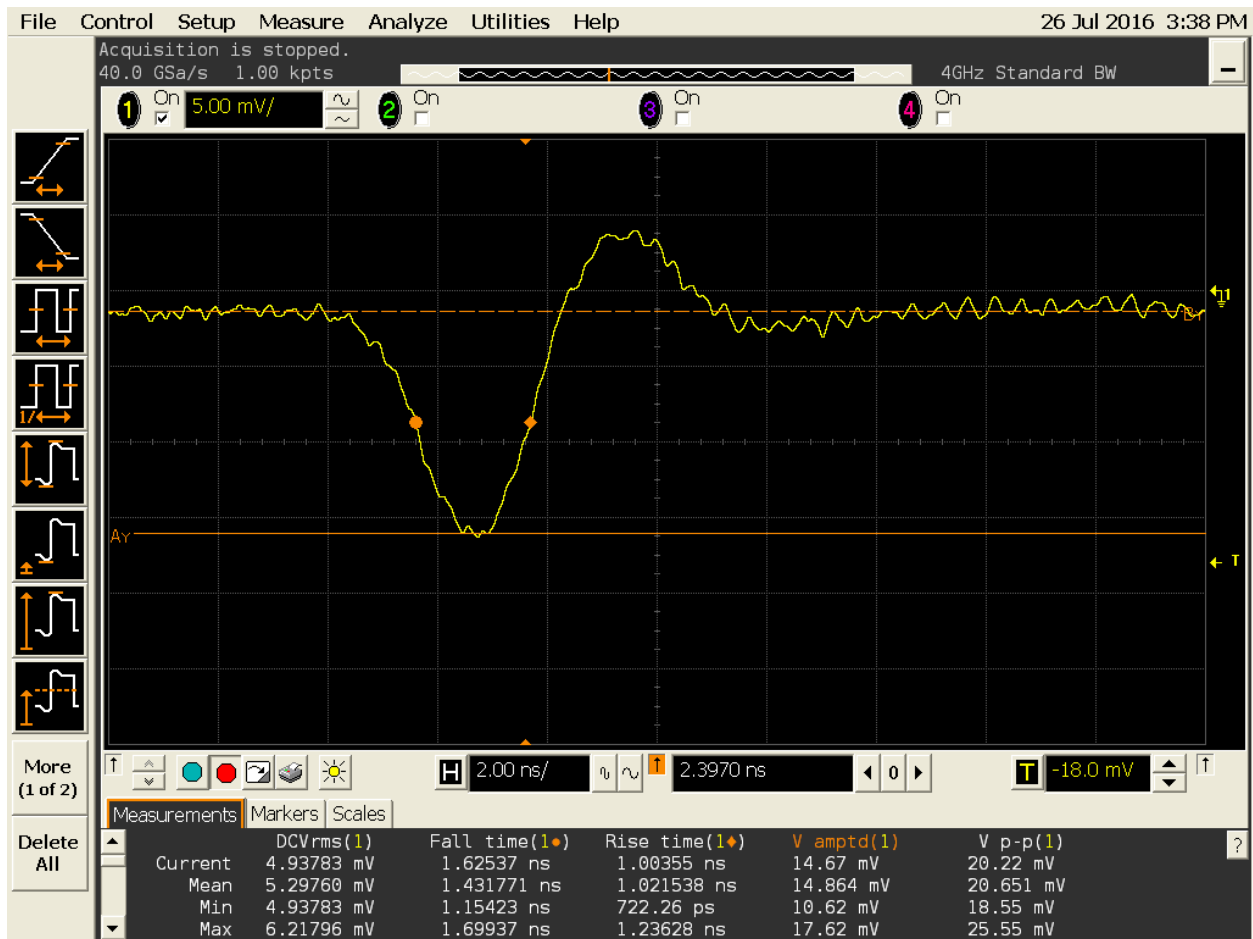
Setup
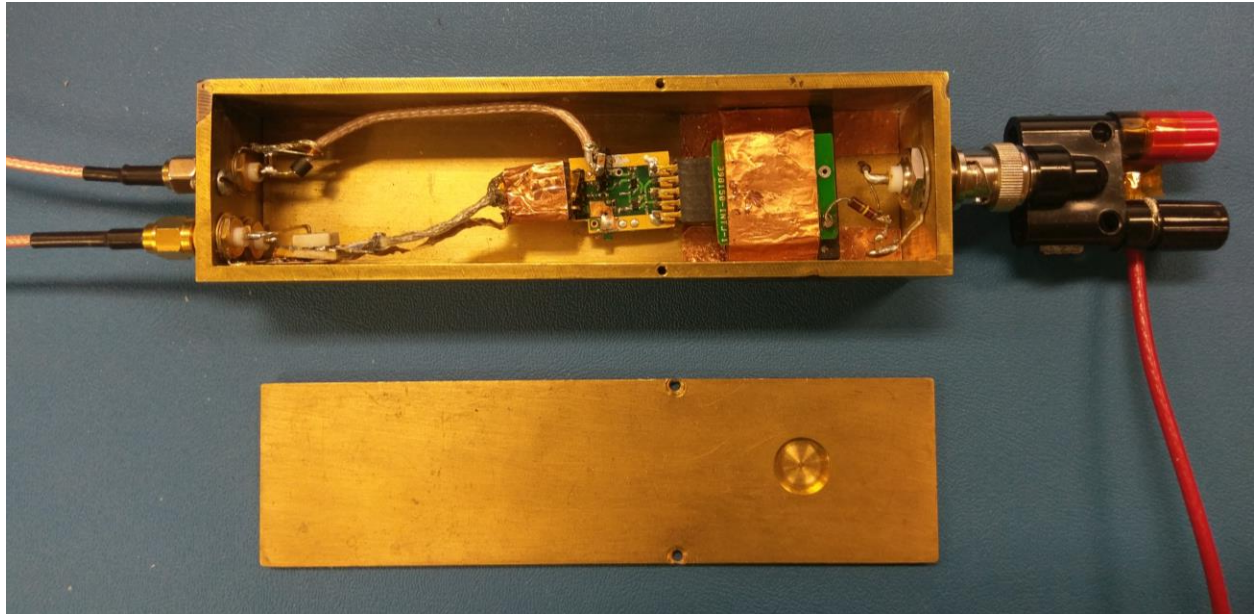
The board has been tested to run for:

- Input Voltage: 3.5V ± 0.2V
- Current draw: 17mA ± 1.5mA
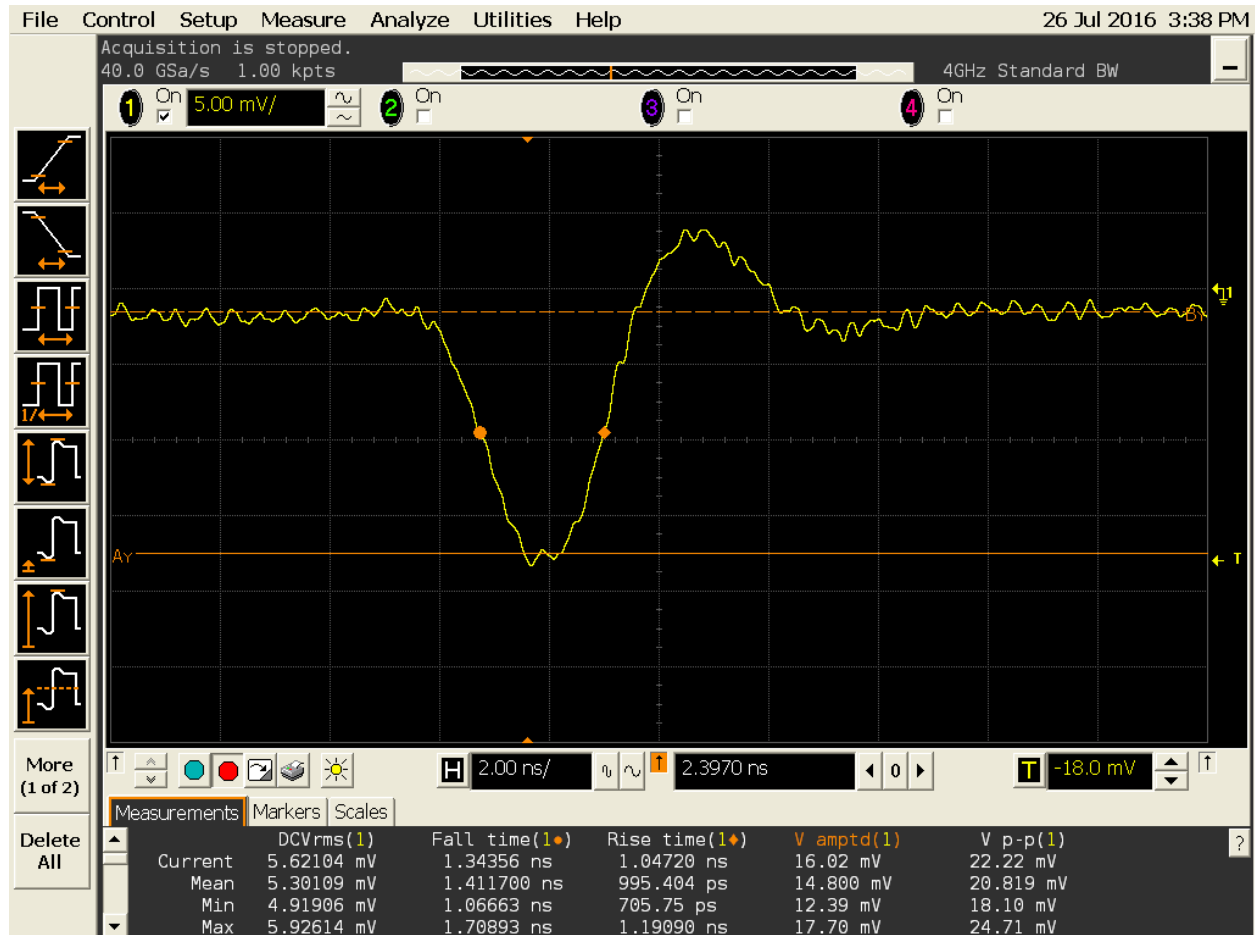- High Voltage input: 1800 V ± 10V
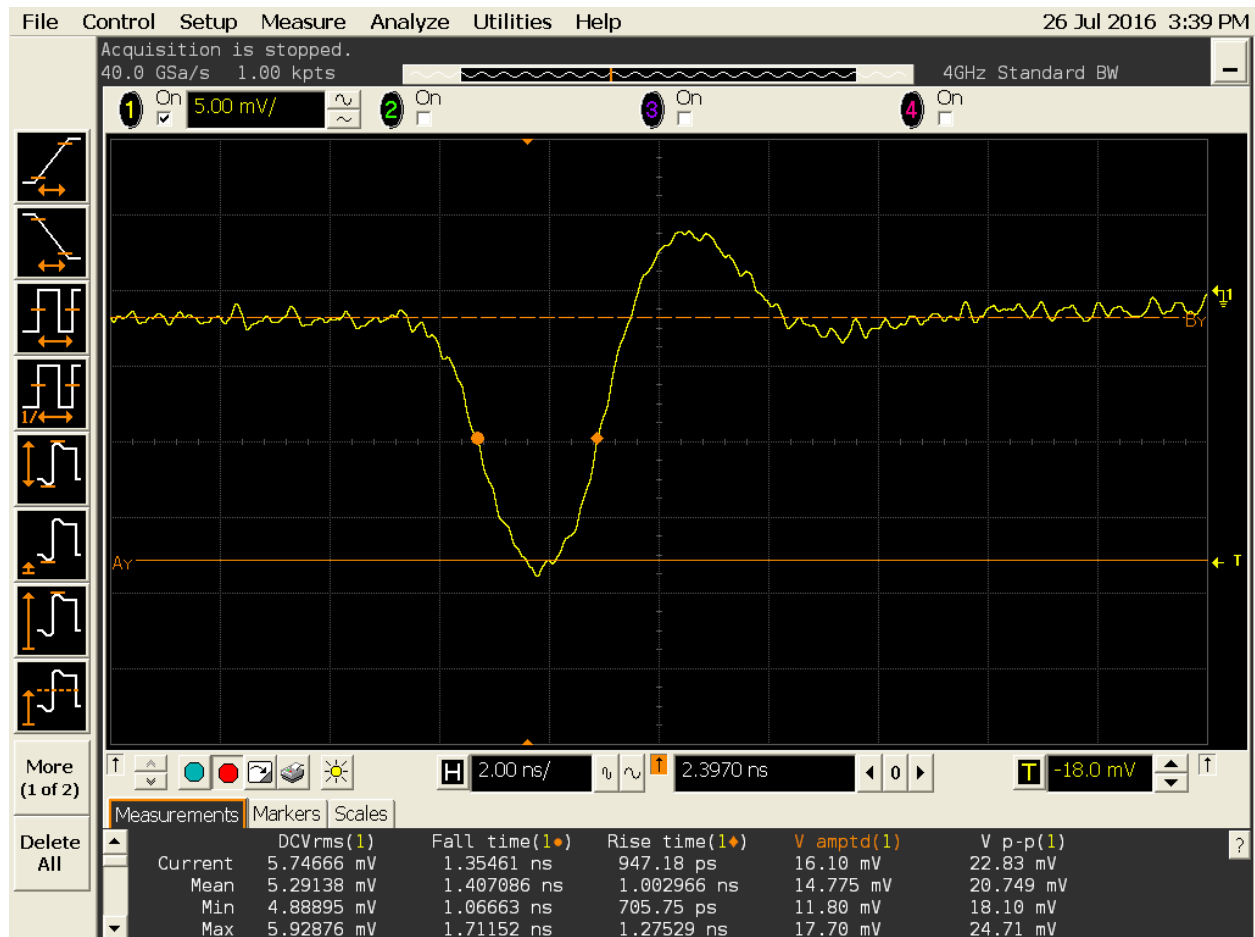
Output

Sample signal 1

- Fall time: 1.625ns
- Rise time: 1.004ns
- Signal amplitude: 14.67mV
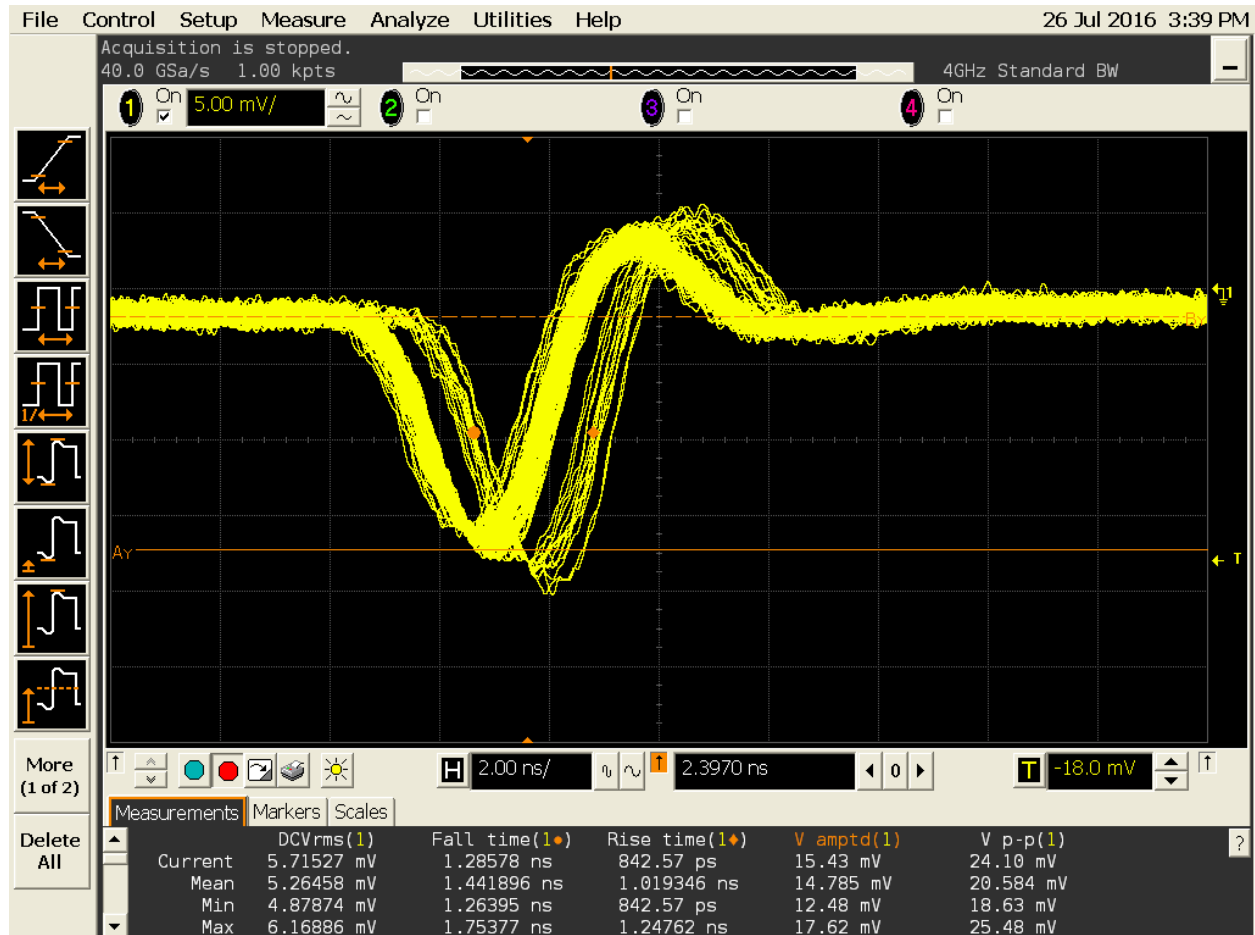- Overshoot amplitude: 5.55mV

Sample signal 2

- Fall time: 1.344ns
- Rise time: 1.047ns
- Signal amplitude: 16.02mV
- Overshoot amplitude: 6.20mV
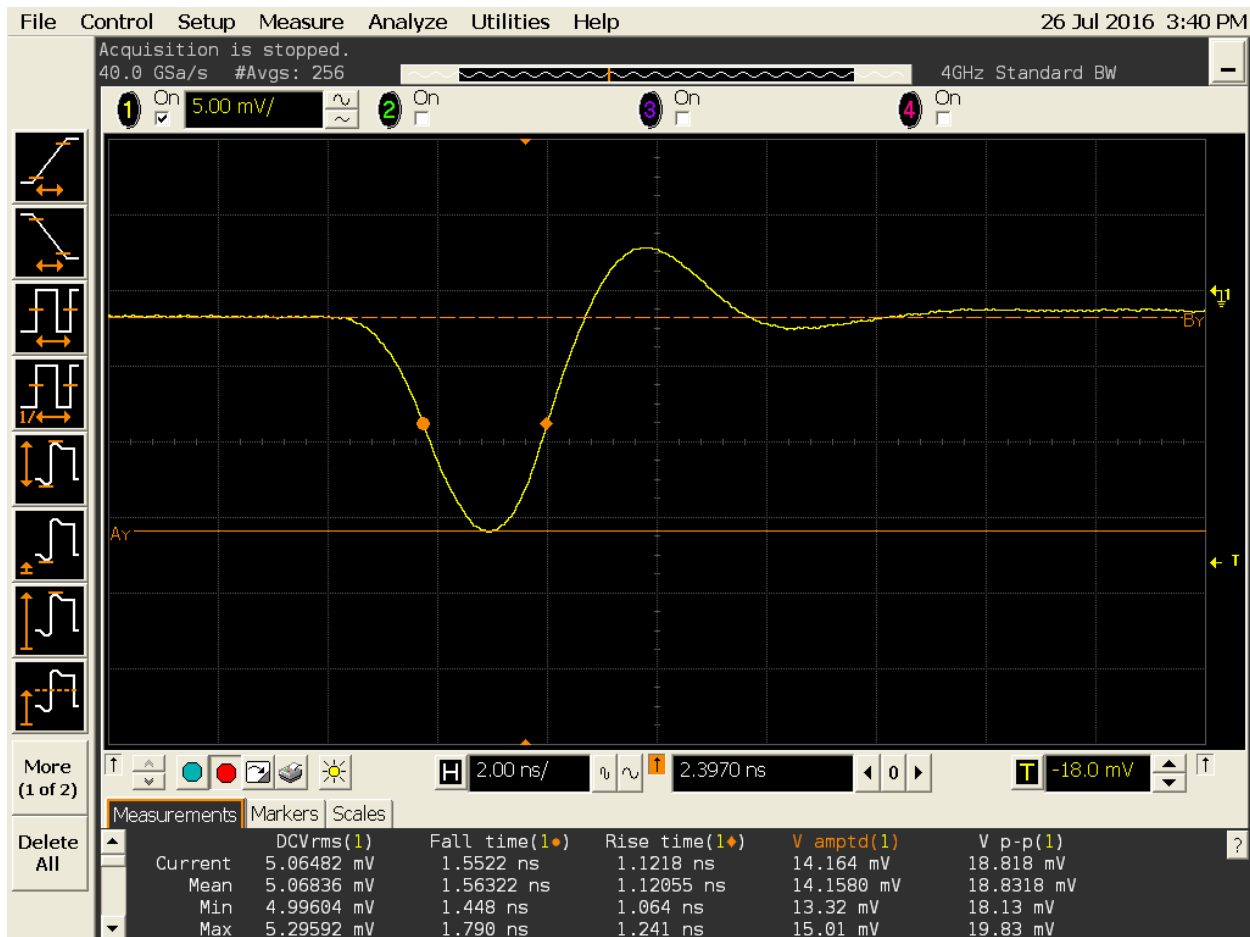
Sample signal 3

- Fall time: 1.355ns
- Rise time: 0.947ns
- Signal amplitude: 16.10mV
- Overshoot amplitude: 6.73mV

Signal persistence

- Mean fall time: 1.442ns
- Mean rise time: 1.019ns
- Mean signal amplitude: 14.78mV
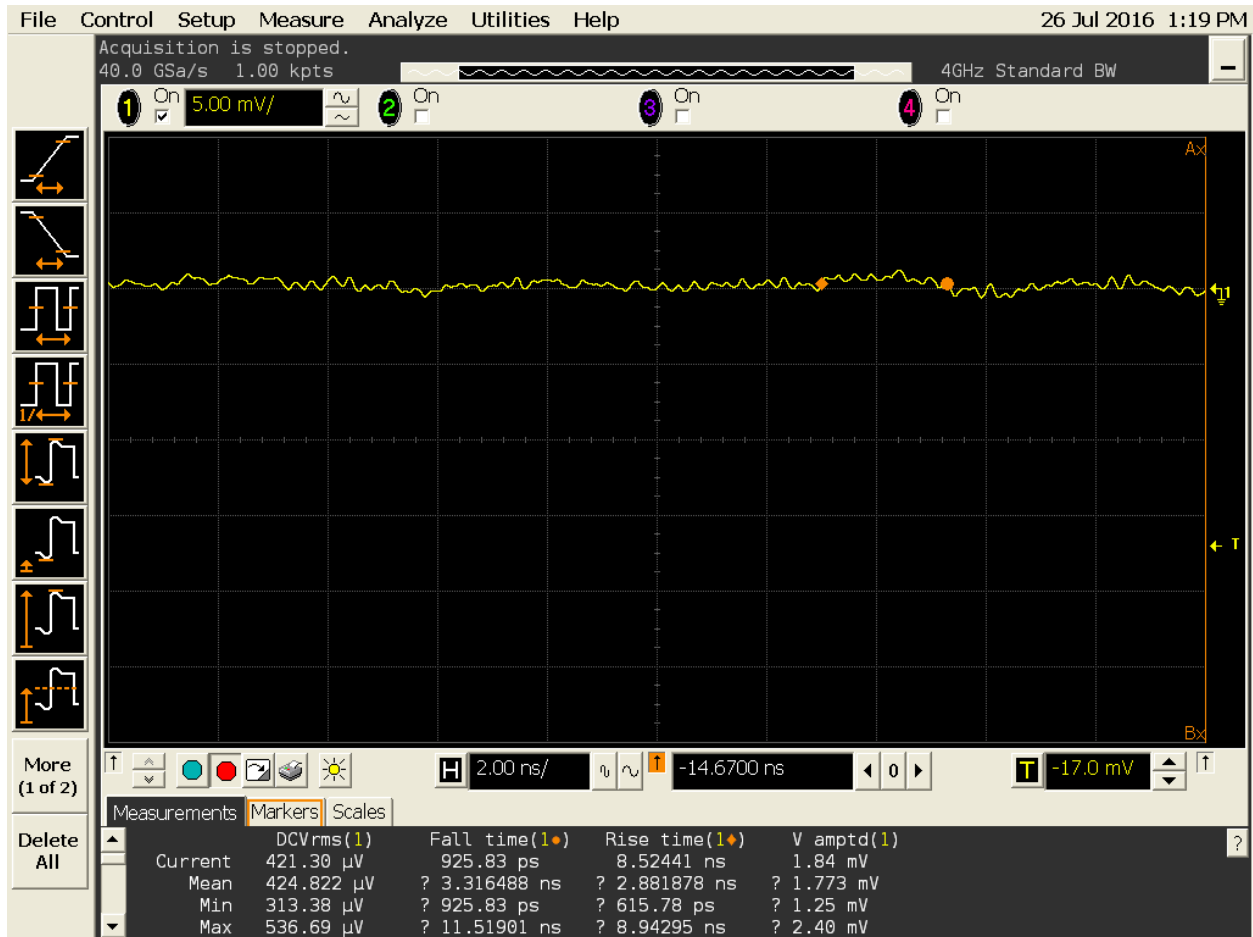- Mean overshoot amplitude: 5.80mV
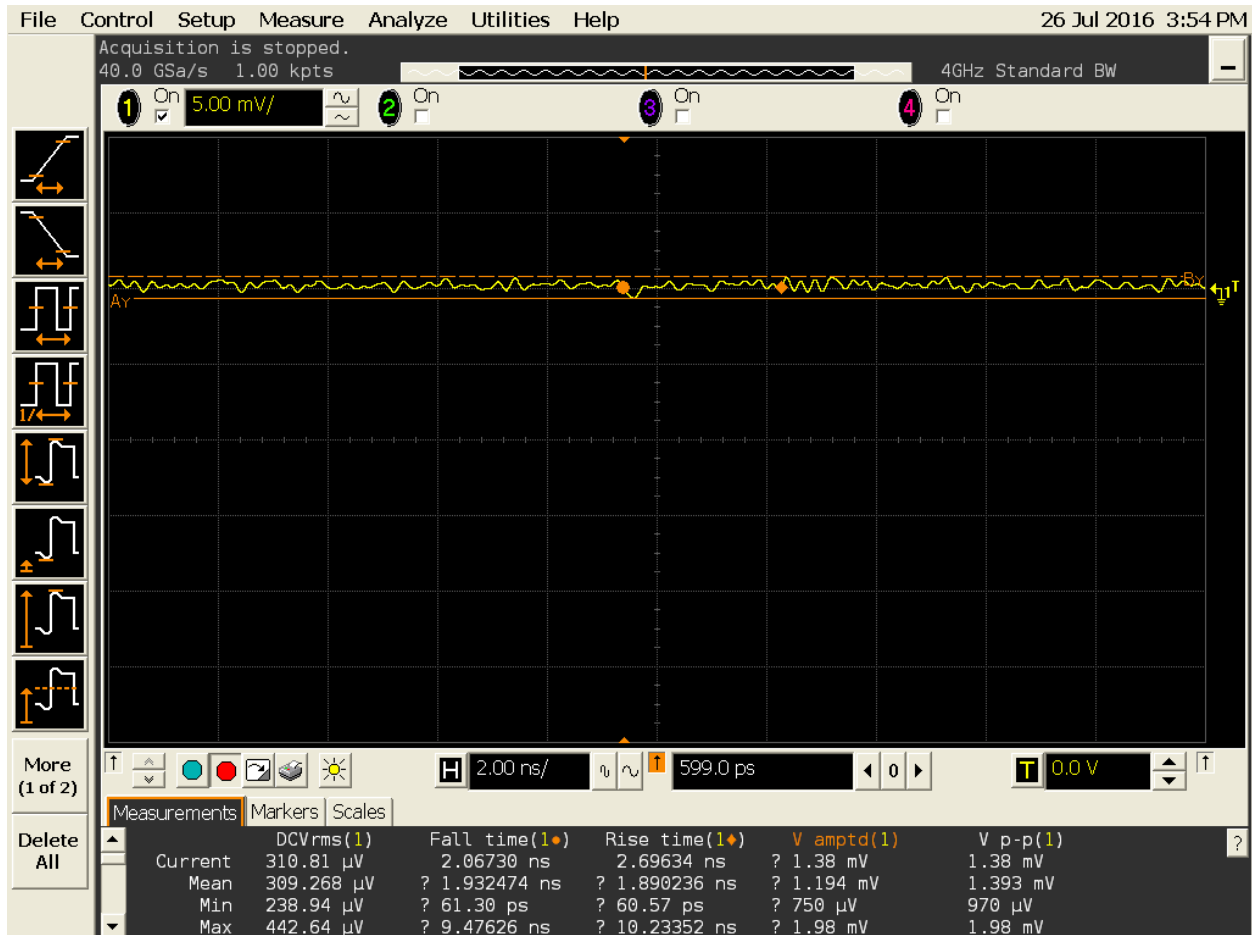
Signal average of 256 samples

- Fall time: 1.552ns
- Rise time: 1.121ns
- Signal amplitude: 14.16mV
- Overshoot amplitude: 4.654mV

Because of the scope triggering at two different times, the timing on this average is slower, and the overshoot is smaller, when compared to a single sample.
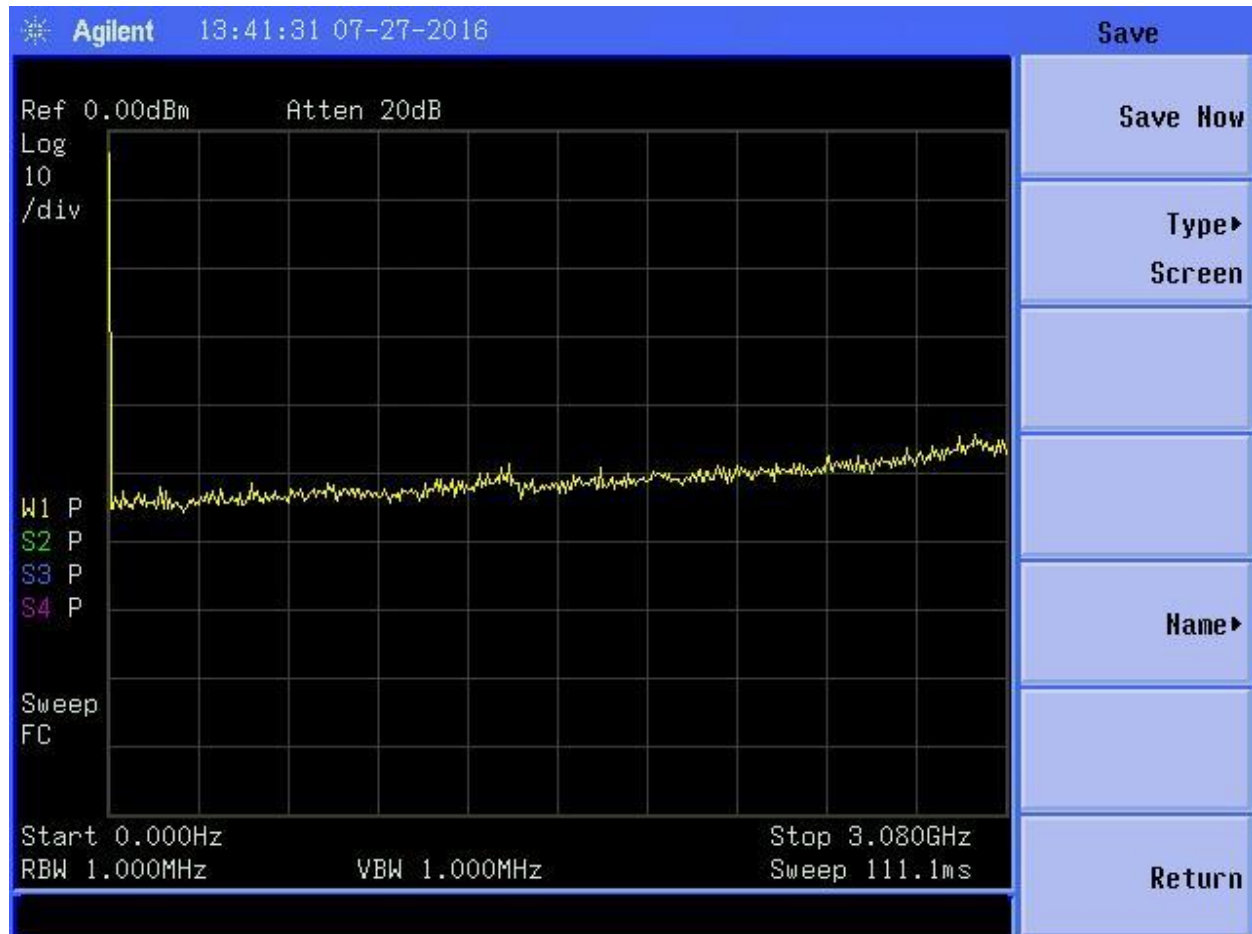
Noise while powered

Noise V_{rms}: 425µV

Noise unpowered

Noise V$_{rms}$: 310µV

Spectrum Analyzer

The noise level of the board while it is being powered is below -45dBm. This remains true when the board is not being powered.