

Powerboard Ground Noise

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(the Power Strippers)

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Instrumentation Meeting

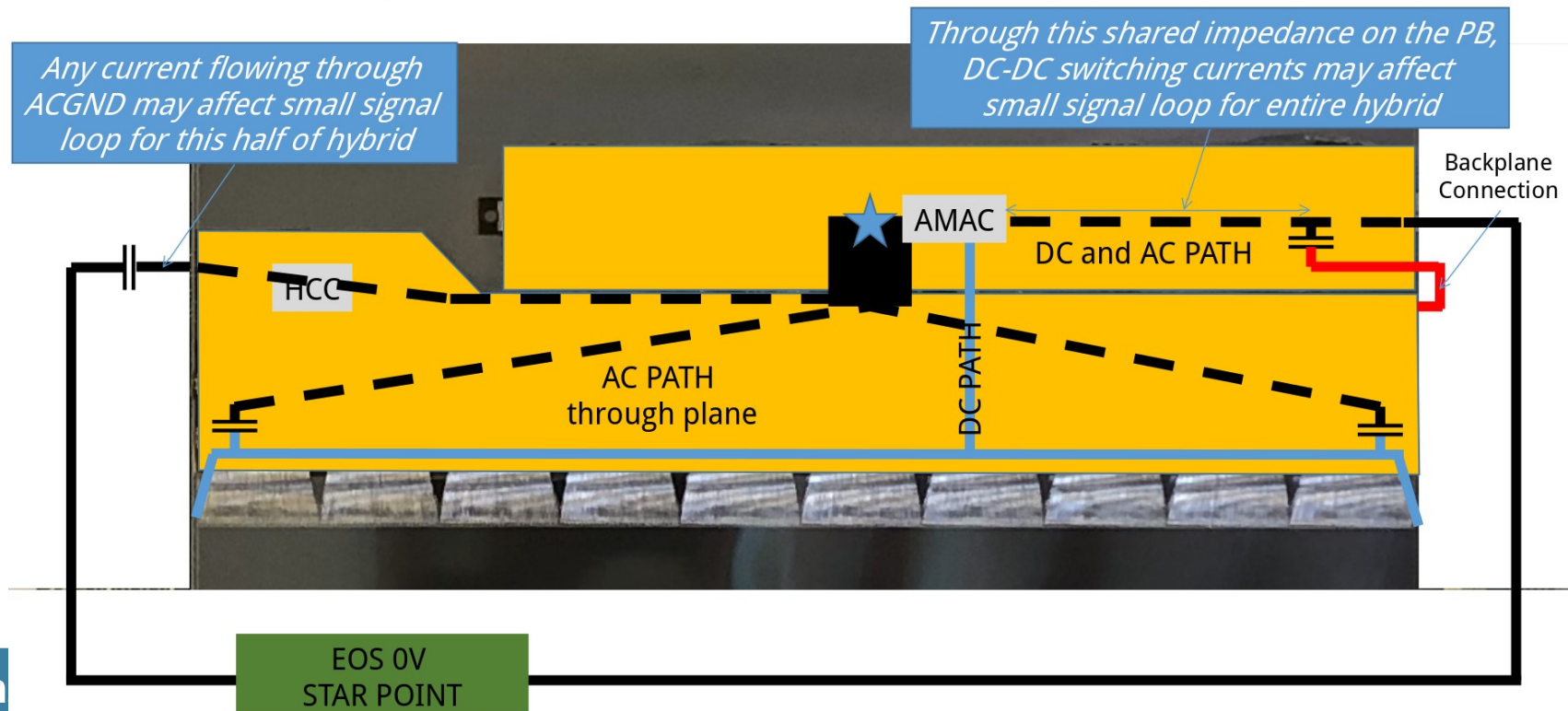
Noise Measurement

* as I understand it

- Peter's theory* is that the noise on a module is due to noise between VOUTrtn (hybrid ground) and VINrnt (stave ground)
- Sensor is tied to ground somewhere between the two
- Different copper thickness on v3.0a and v3.0b gives version dependance

Status Quo: Sensor Bias Loop

Dashed line: current on plane
Solid line: current in trace



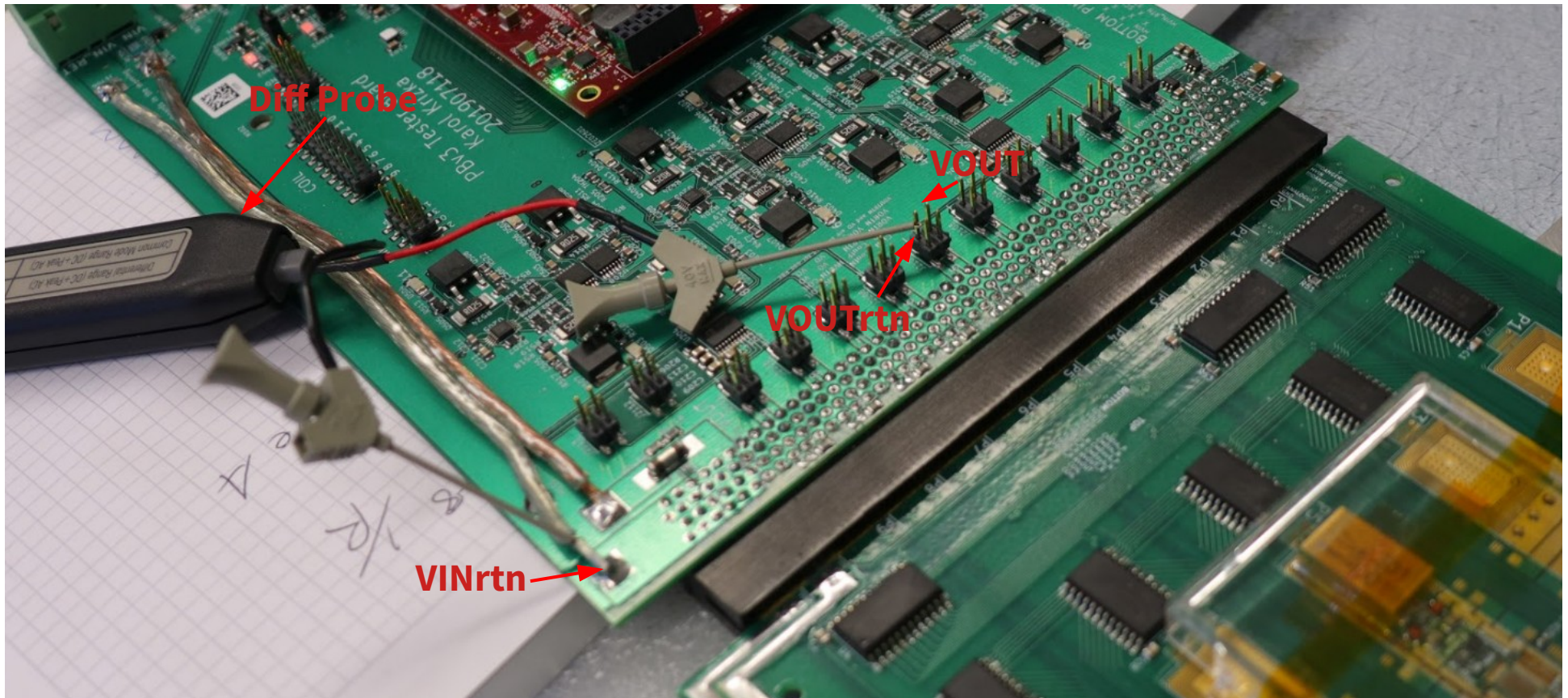
Measurement #1

Goal: Measure DC/DC noise on a standalone Powerboard

Procedure:

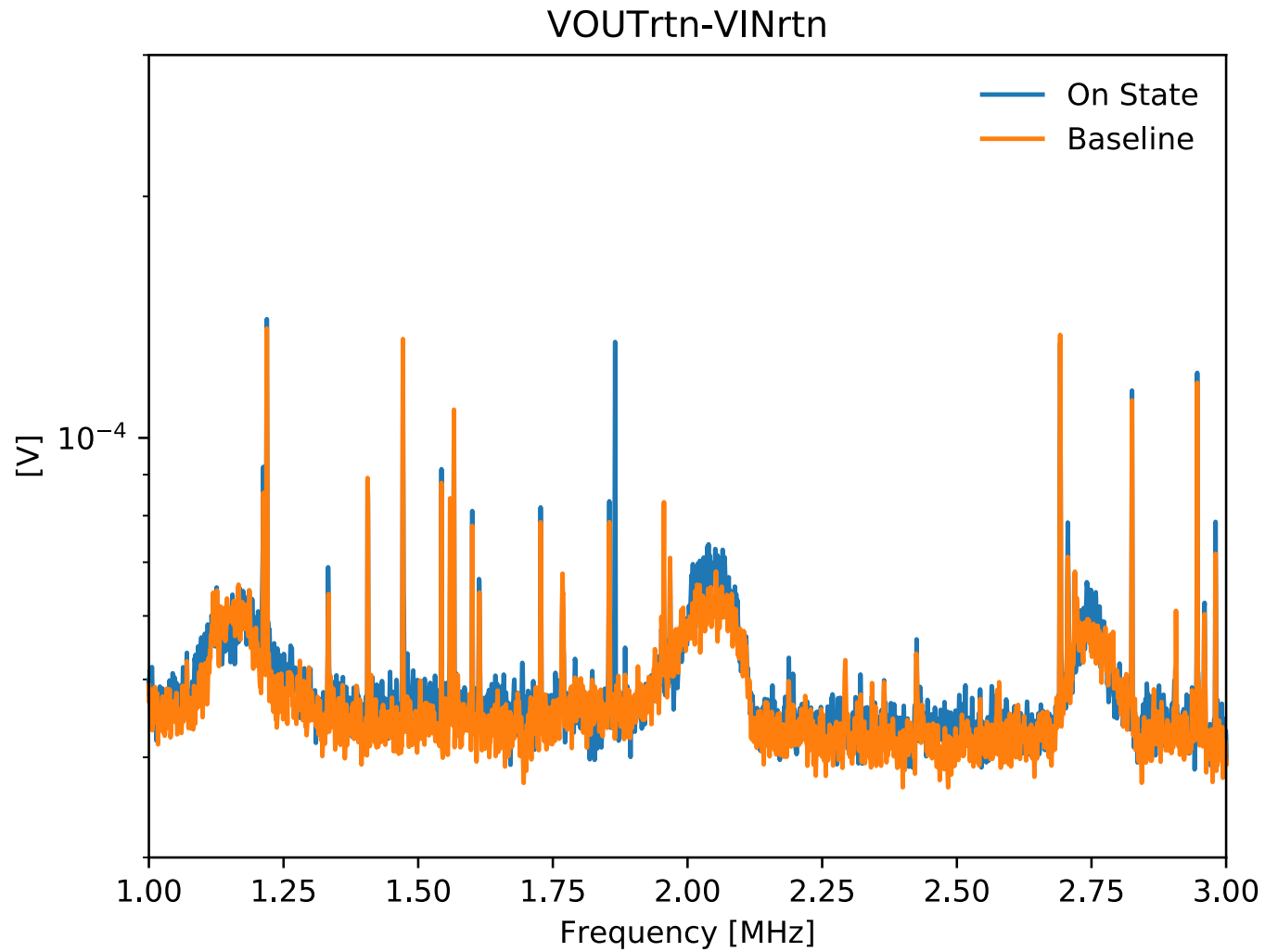
- Use Powerboard on a mass tester
- Measure V on power points using differential probe
 - VOUT vs VOUTrtn ← DC/DC output noise
 - VOUT vs VINrtn
 - VOUTrnt vs VINrtn ← noise on Powerboard ground
- Use Picoscope to take Fourier transform of the signal
 - average of 200 samples used for the final plots
- Two Fourier transforms taken:
 - Baseline: DC/DC disabled, should be background noise
 - On state: DC/DC enabled and loaded with 2 Amps (background + DC/DC noise)

Setup #1

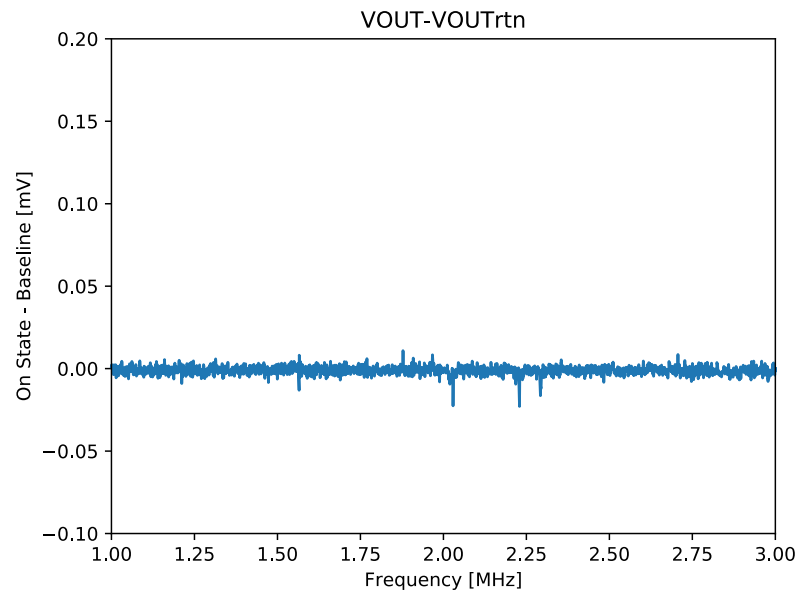
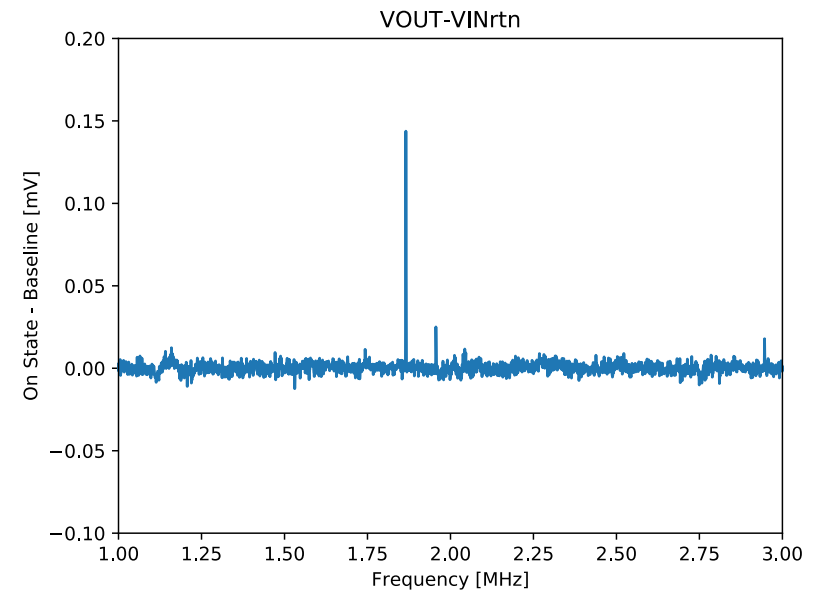
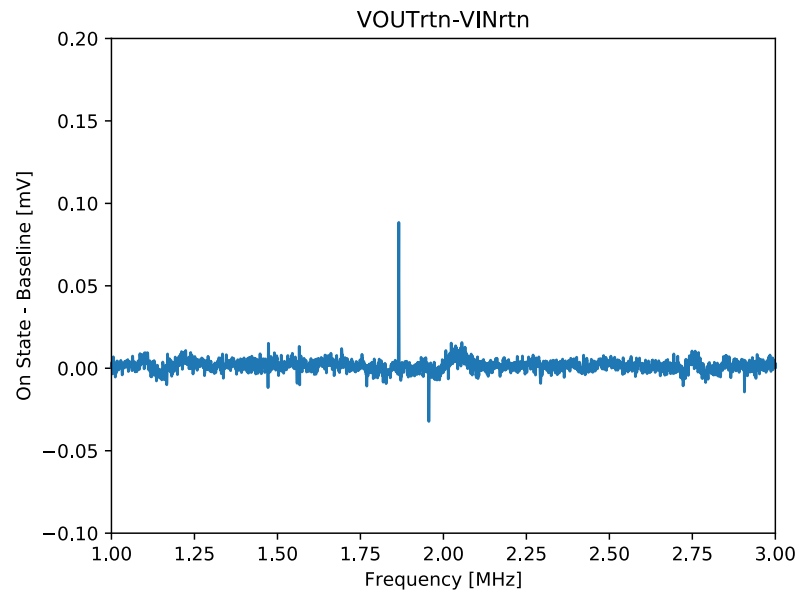


Note: There are long traces between probe connection and the Powerboard pads.

Example Spectrum



Results



- **PB ground is noisy!**
 - Consistent with Peter's theory
- **This is a 0.1 mV ripple....**
 - Big enough? Seems tiny...
- **Does this get worse at cold temp?**

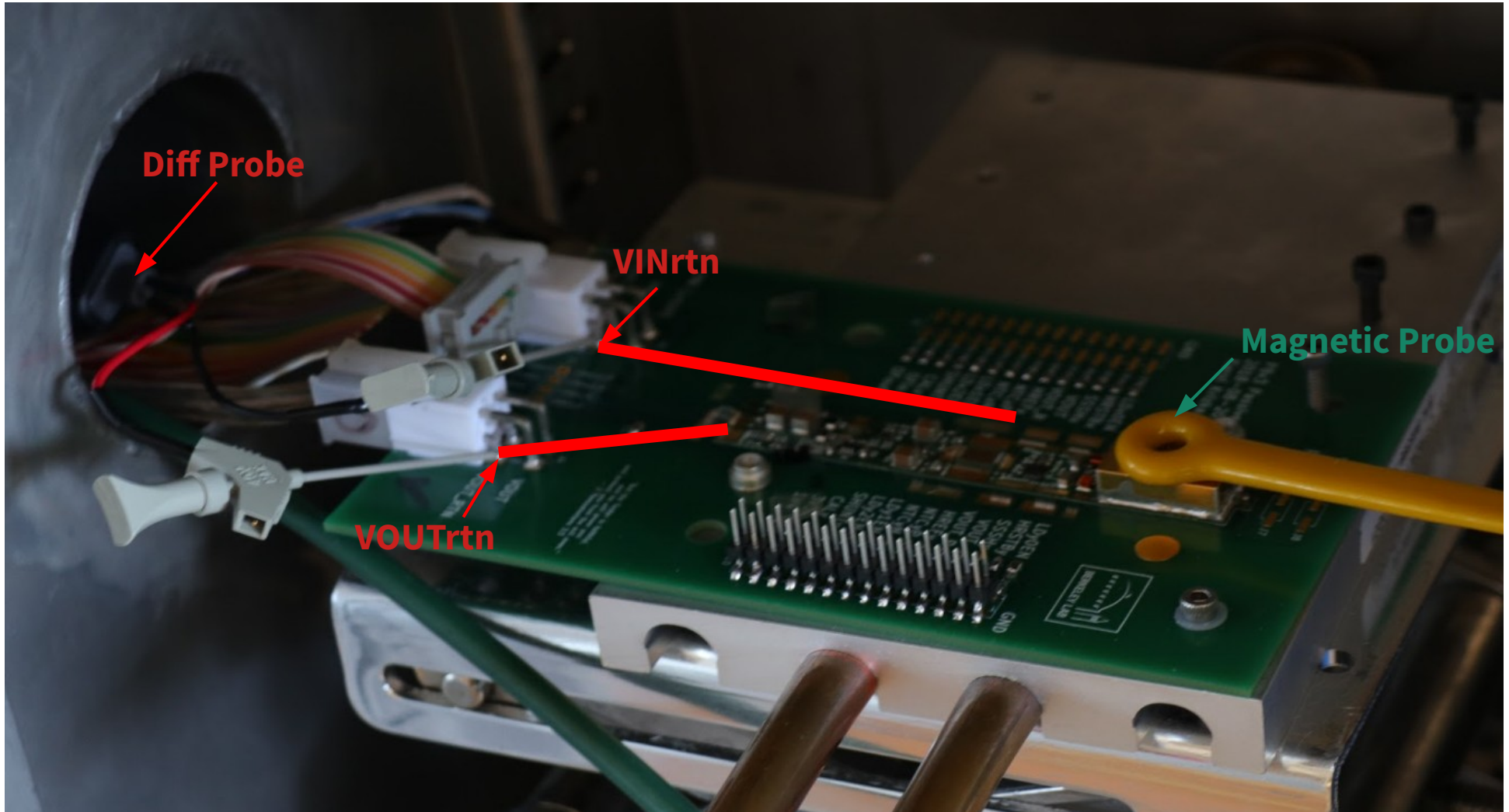
Measurement #2

Goal: Measure PB ground noise on a standalone Powerboard vs temperature

Procedure:

- Place Powerboard on a single tester into climate chamber
- Connect differential probe between VOUTrtn and VINrtn on the test PCB
- Use Picoscope to take Fourier transform of the signal
 - average of 200 samples used for the final plots
- Two Fourier transforms taken:
 - Baseline: DC/DC disabled, should be background noise
 - On state: DC/DC enabled and loaded with 2 Amps (background + DC/DC noise)

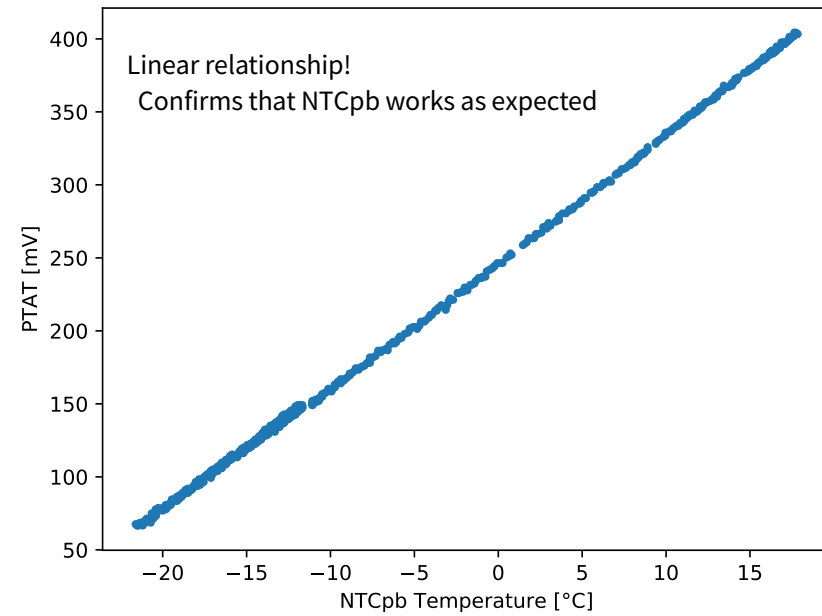
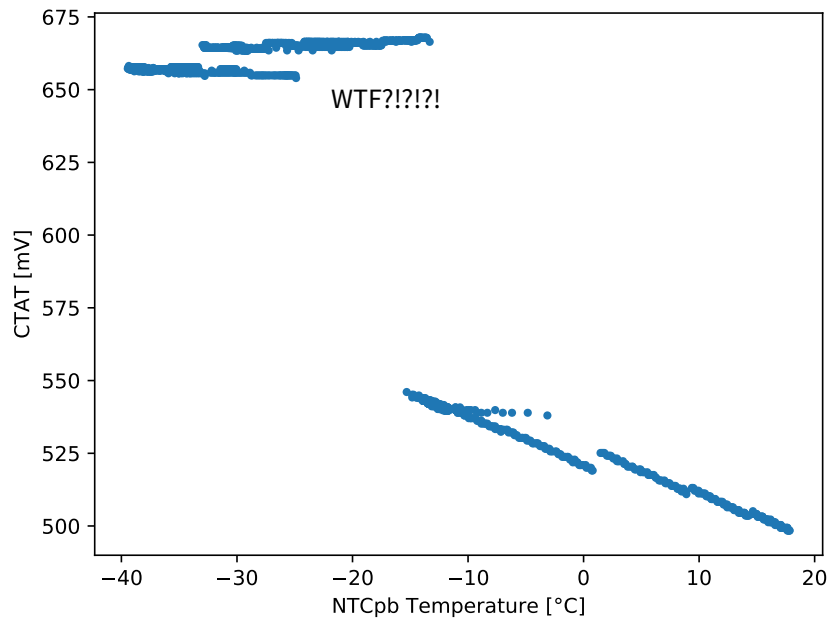
Setup #2



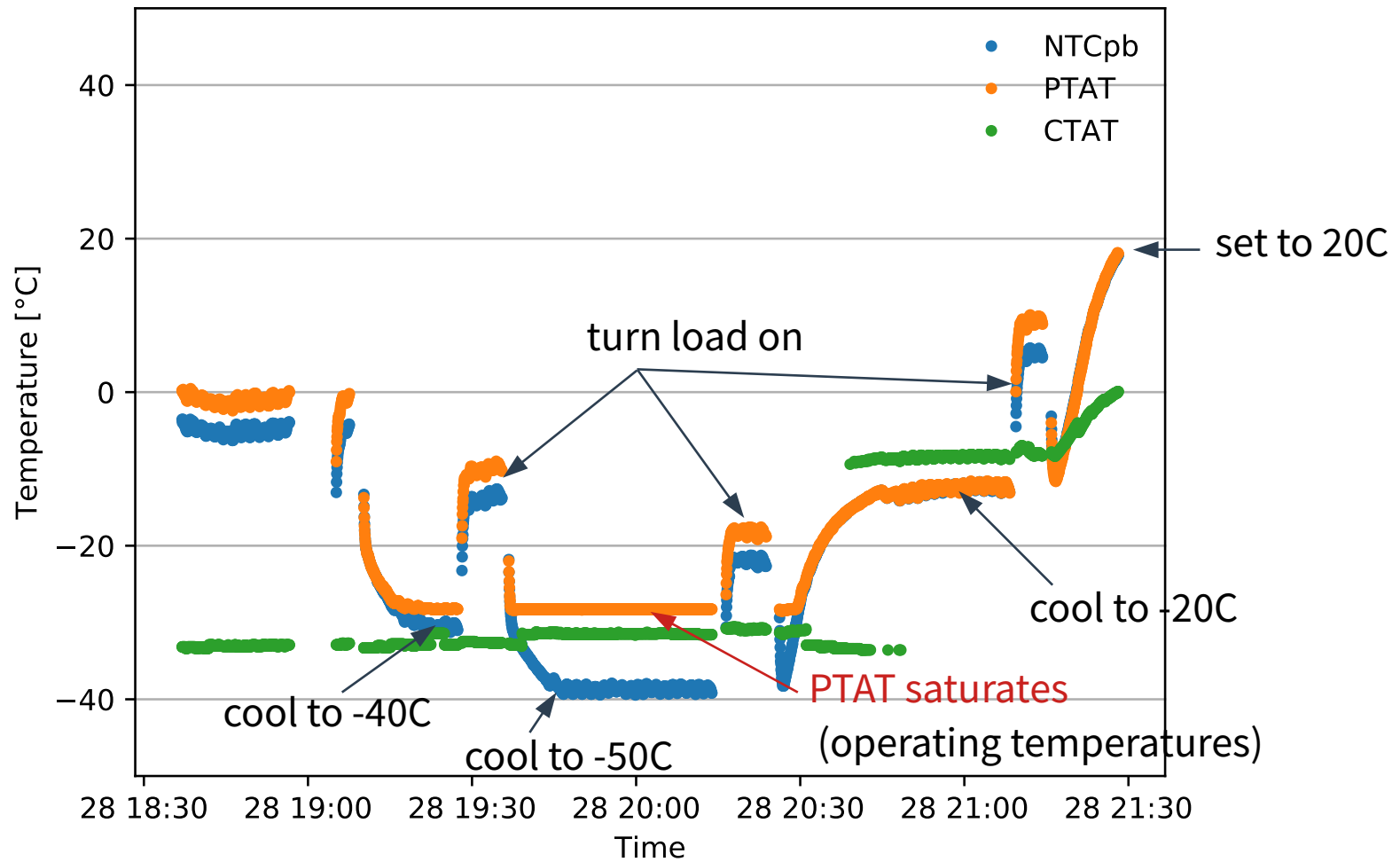
What is Temperature

- **Temperature set/monitored by climate chamber**
 - Not very precise, cable hole not isolated well...
 - Will be used in following labels
- **Temperature measured by NTCpb close to DC/DC**
 - Using all calibration procedures of AMAC for this
 - Conversion to Celsius using math and understanding of circuit
- **Temperature measured by DC/DC (PTAT)**
 - Should be same as NTCpb when off
 - Should be hotter than NTCpb when on
- **Temperature measured by AMAC (CTAT)**
 - First time using this, see some issues

CTAT and PTAT Calibrations

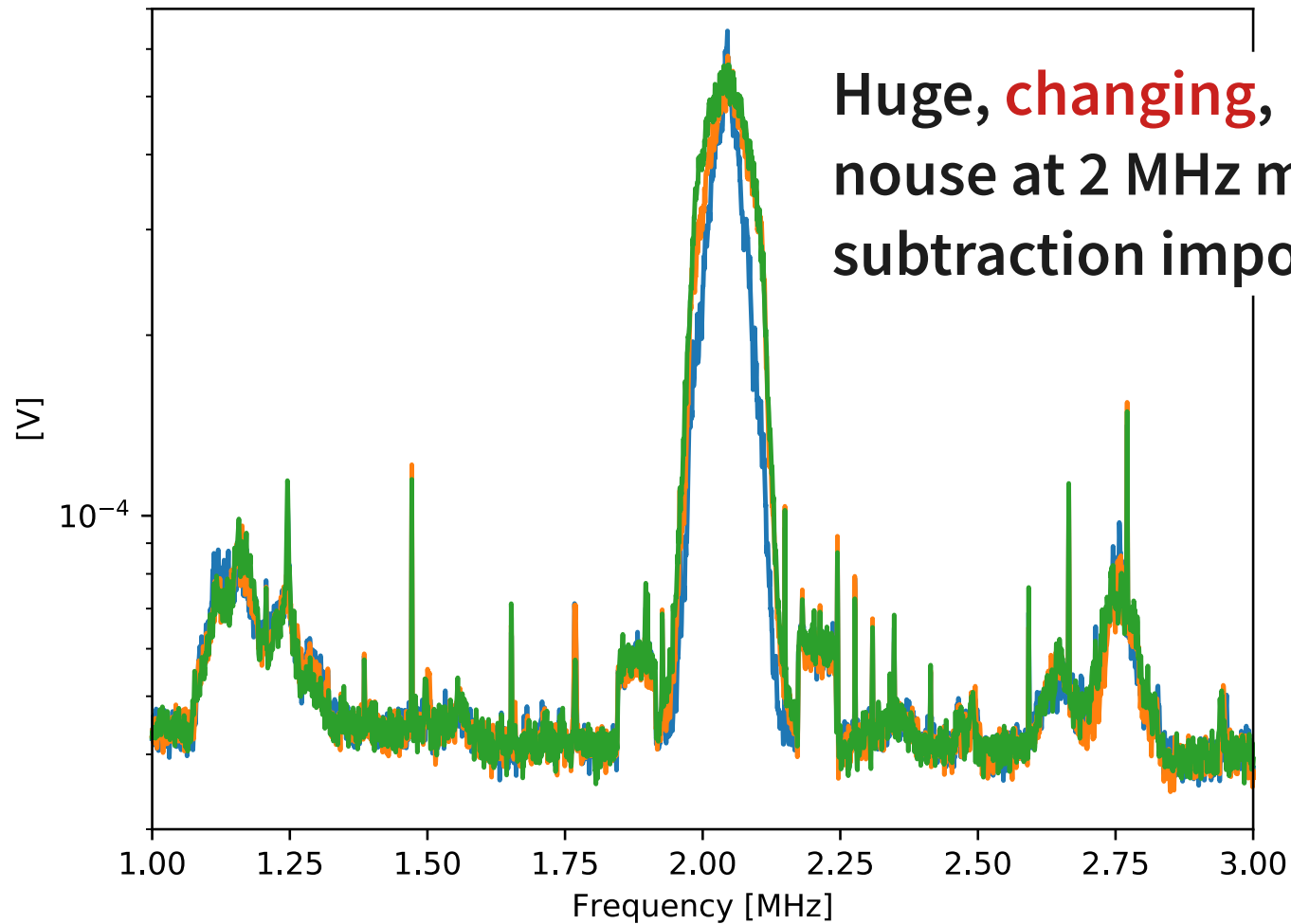


Temperature Monitoring

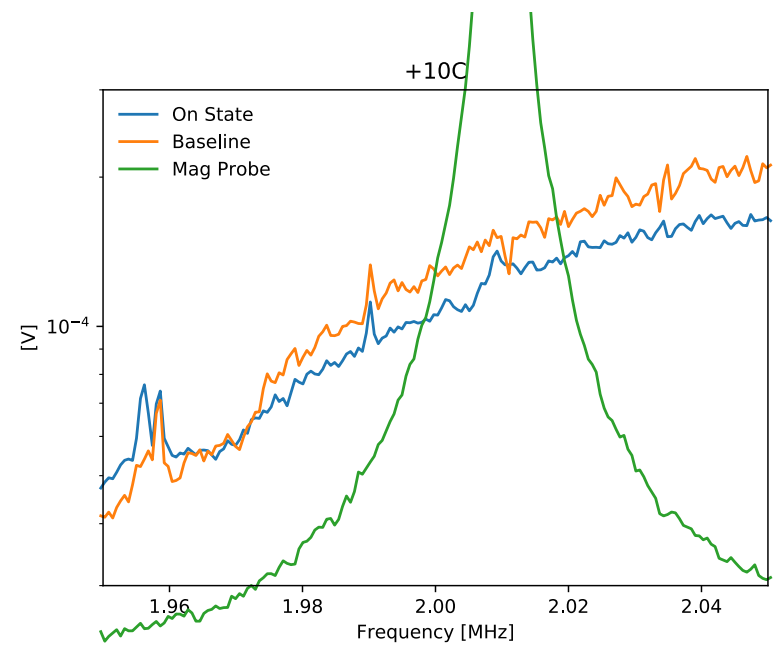
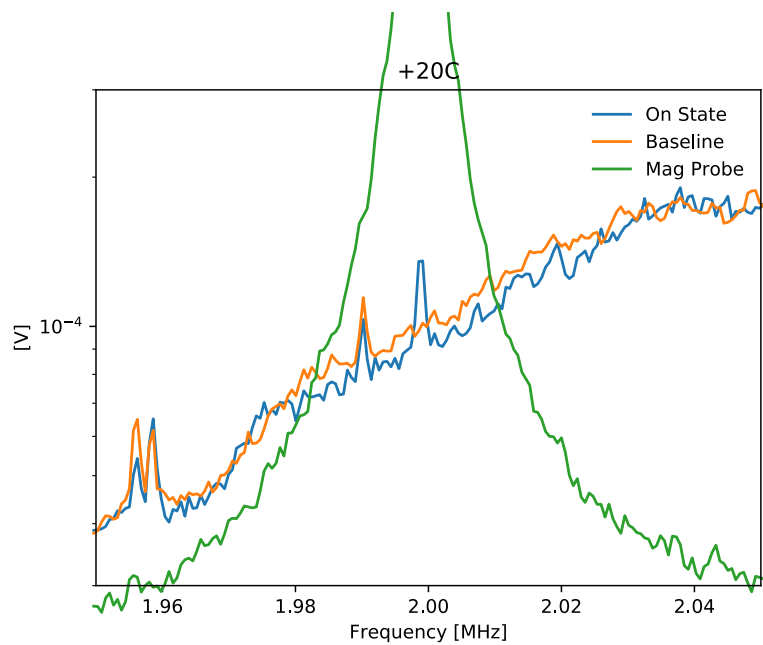
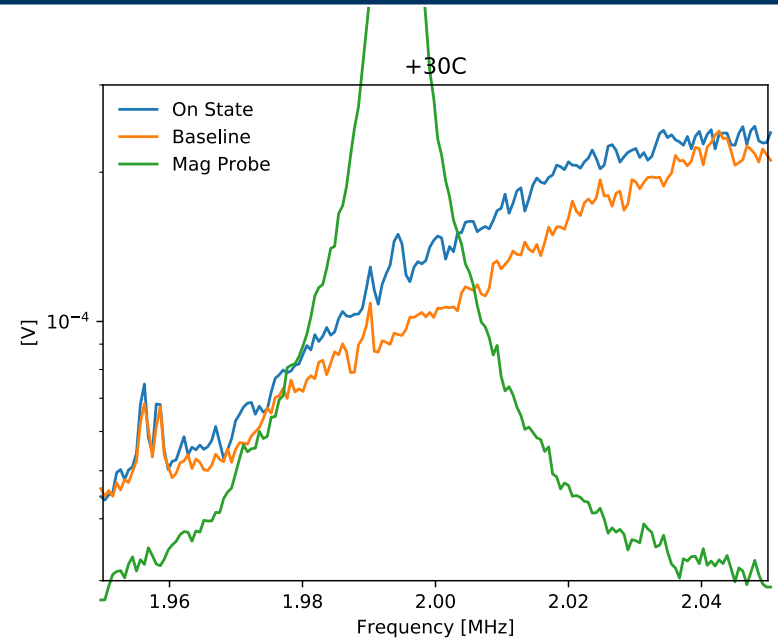
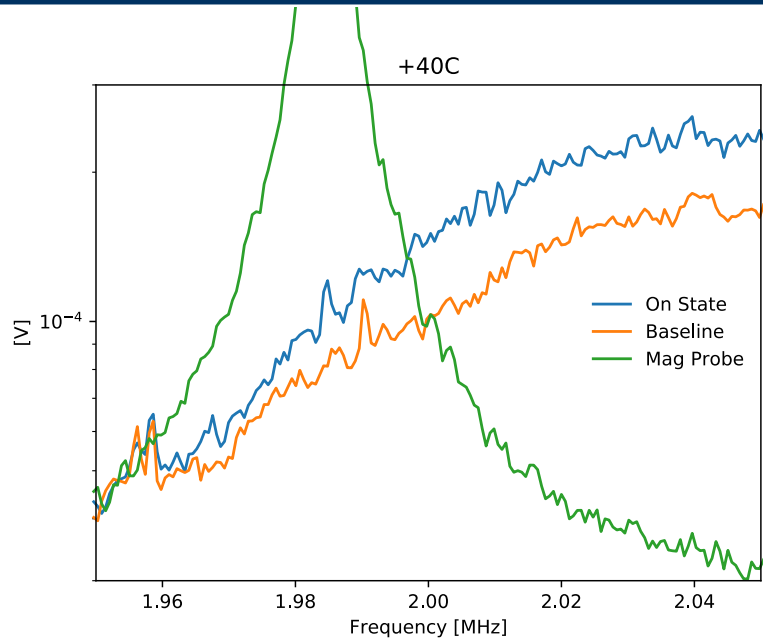


Baseline

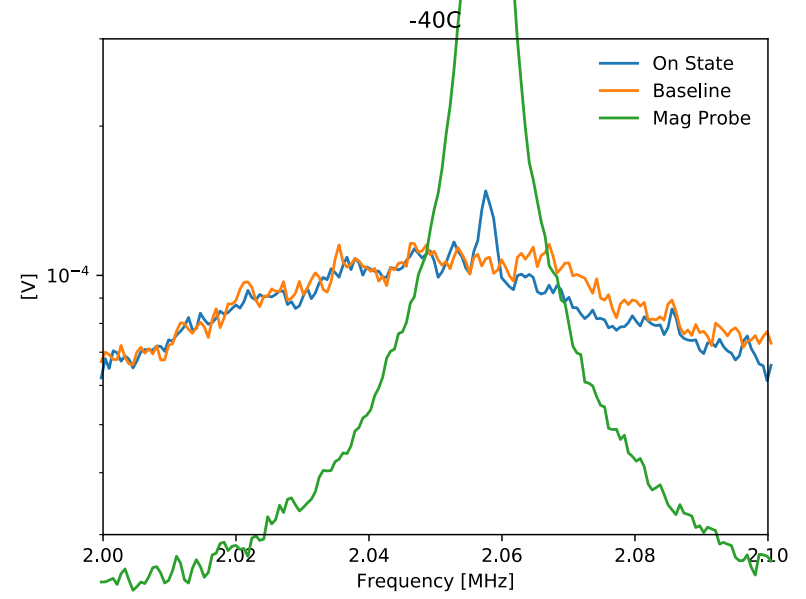
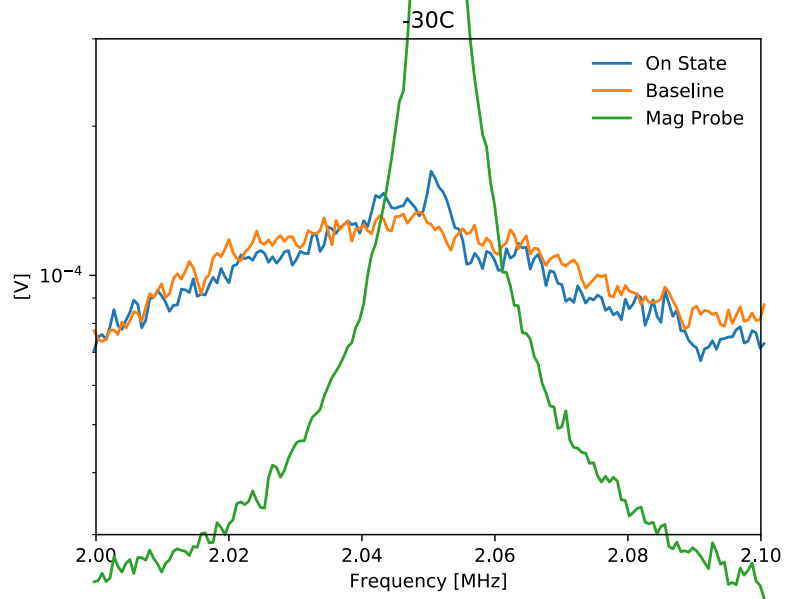
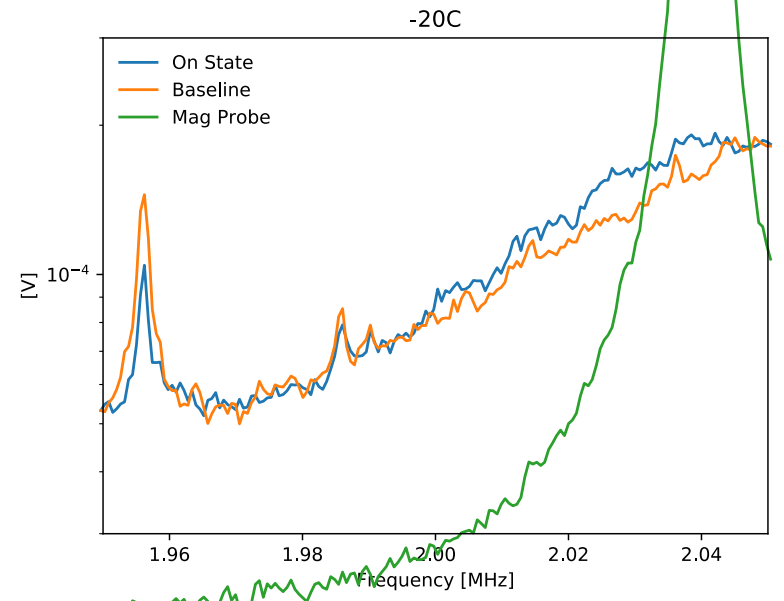
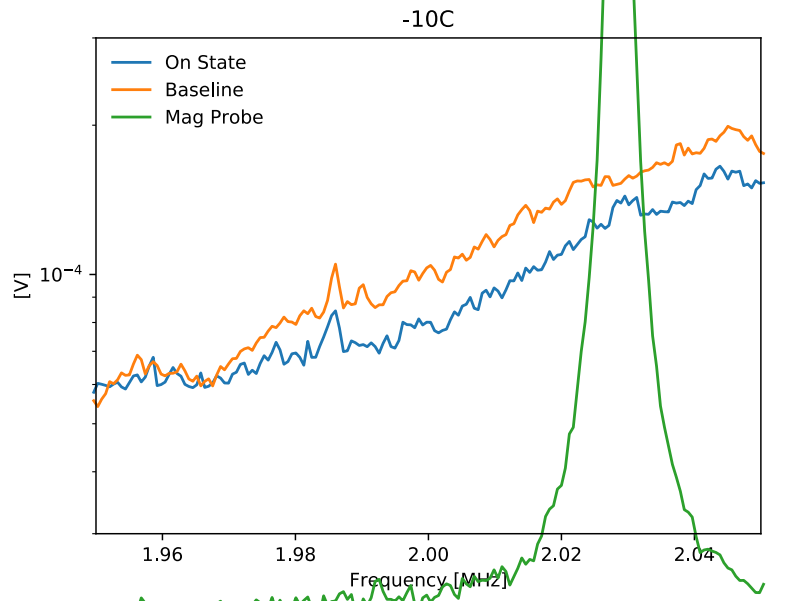
Baseline, Same Conditions



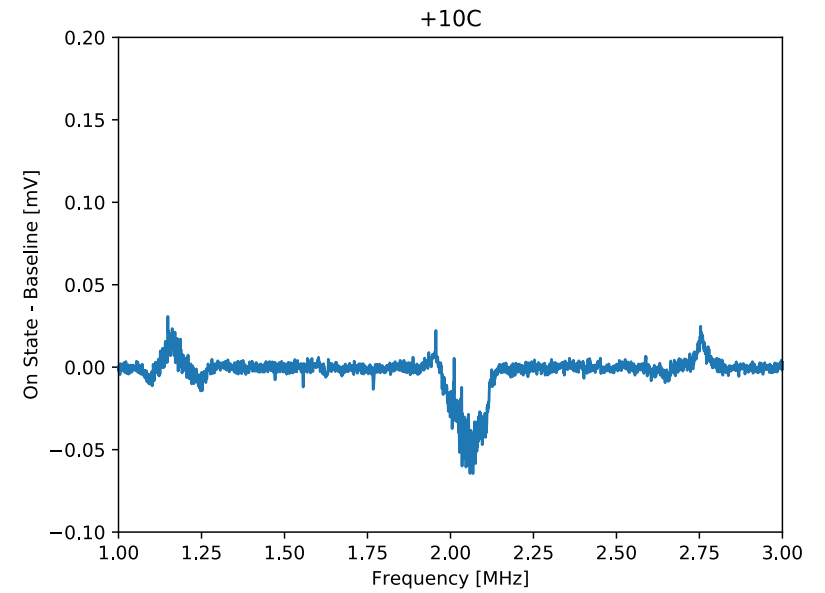
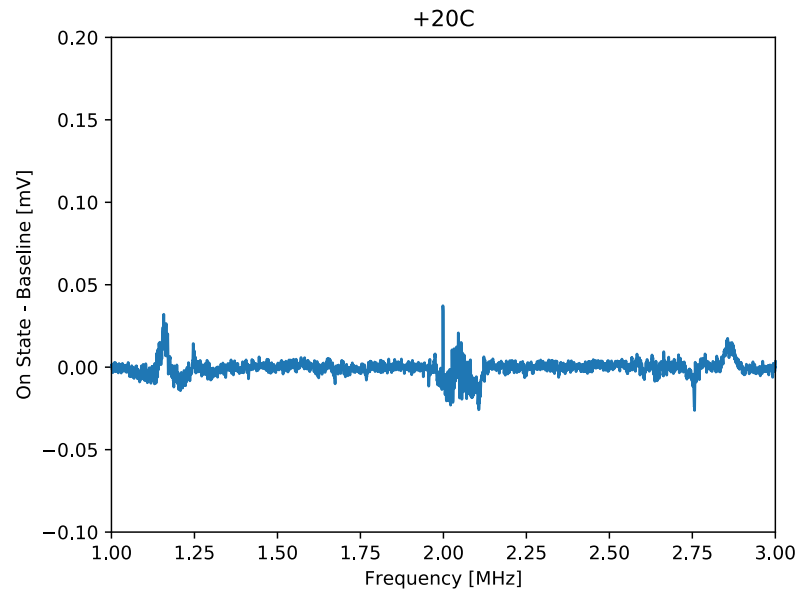
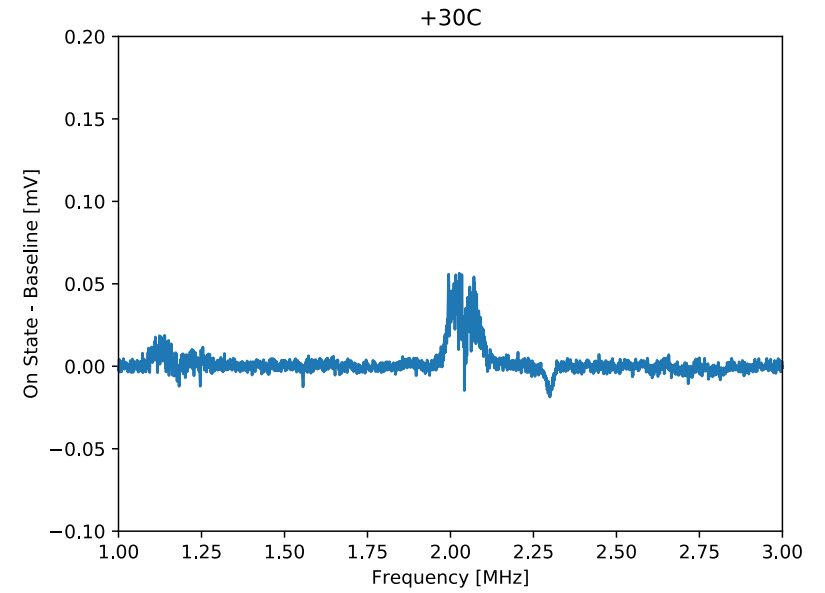
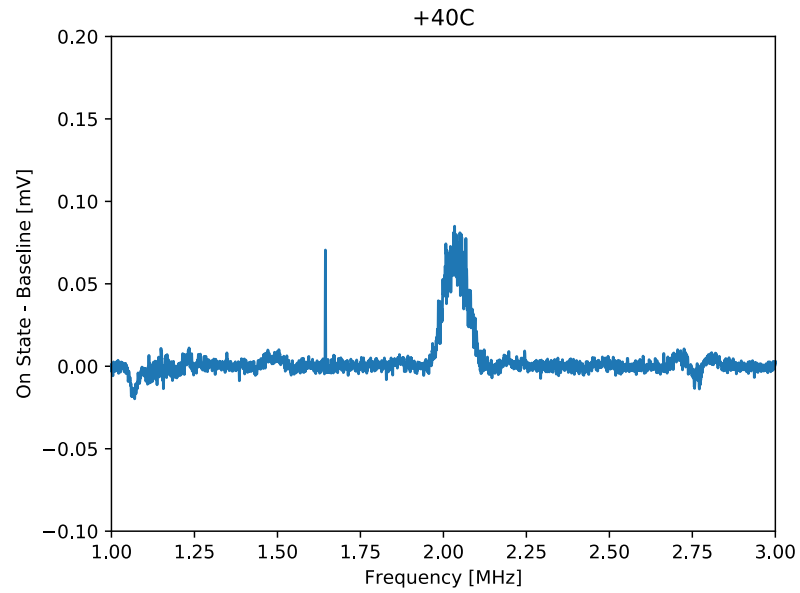
Spectra (warm)



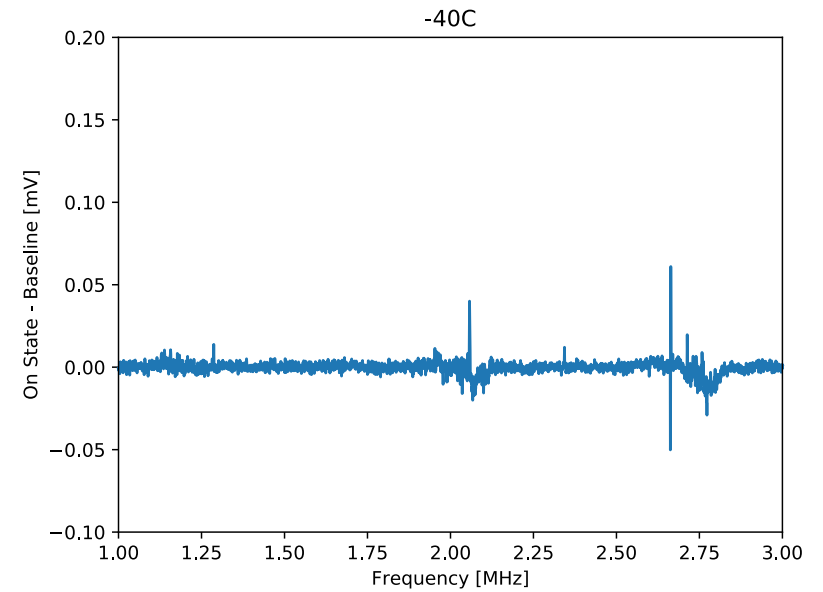
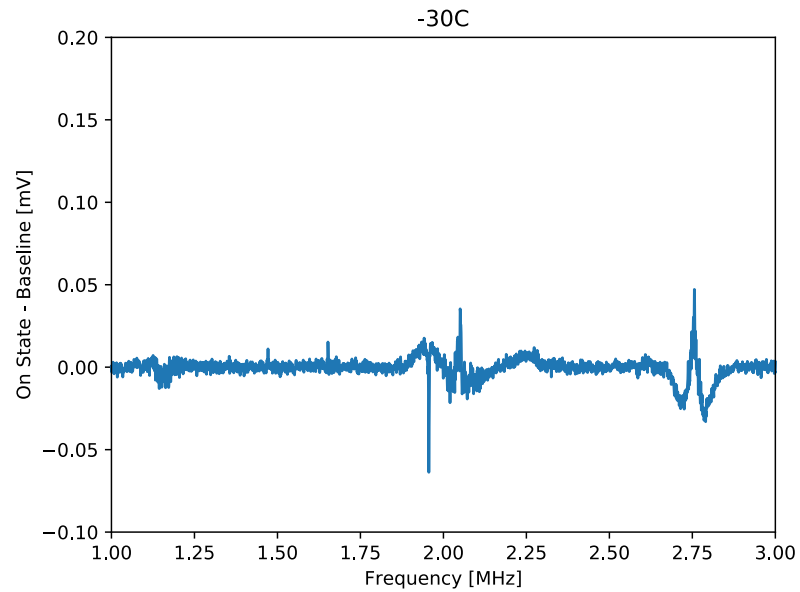
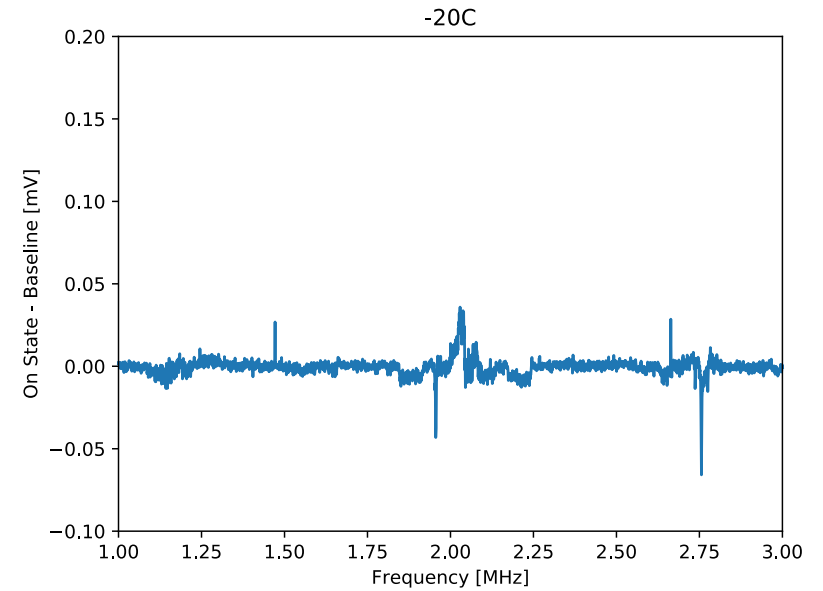
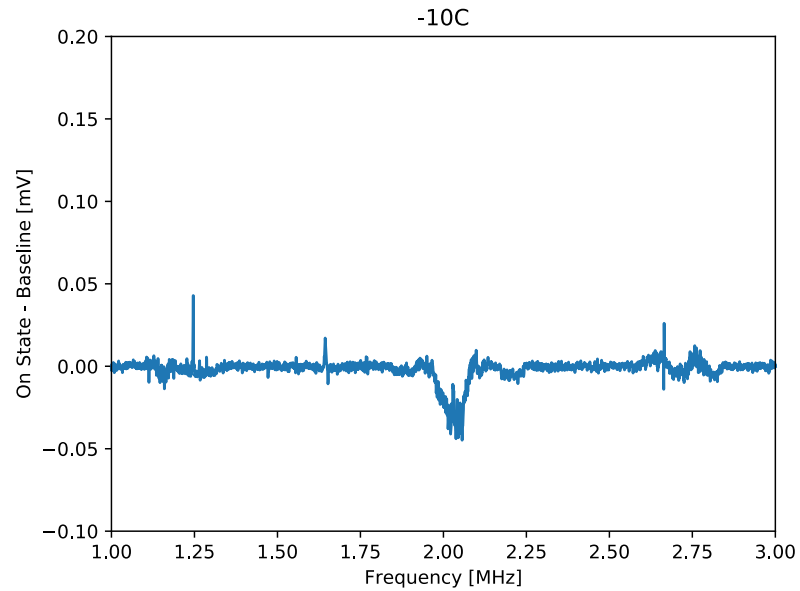
Spectra (cold)



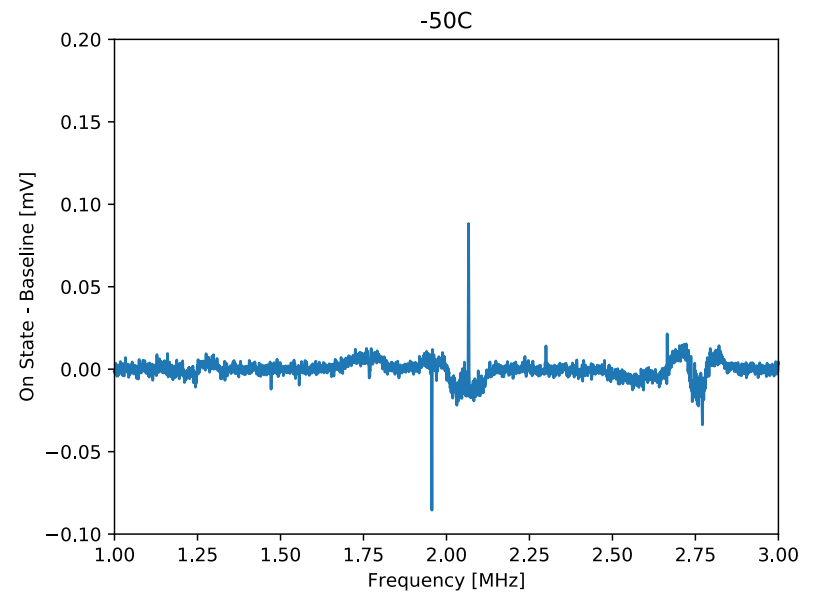
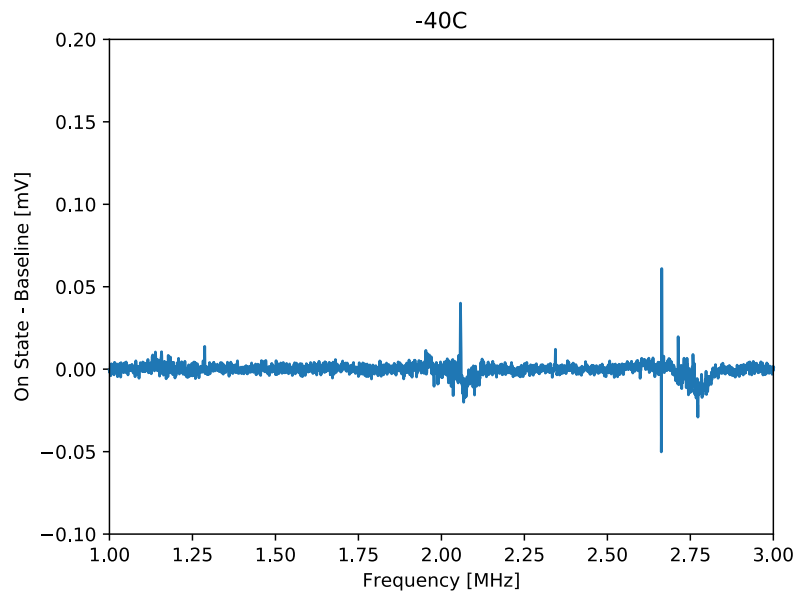
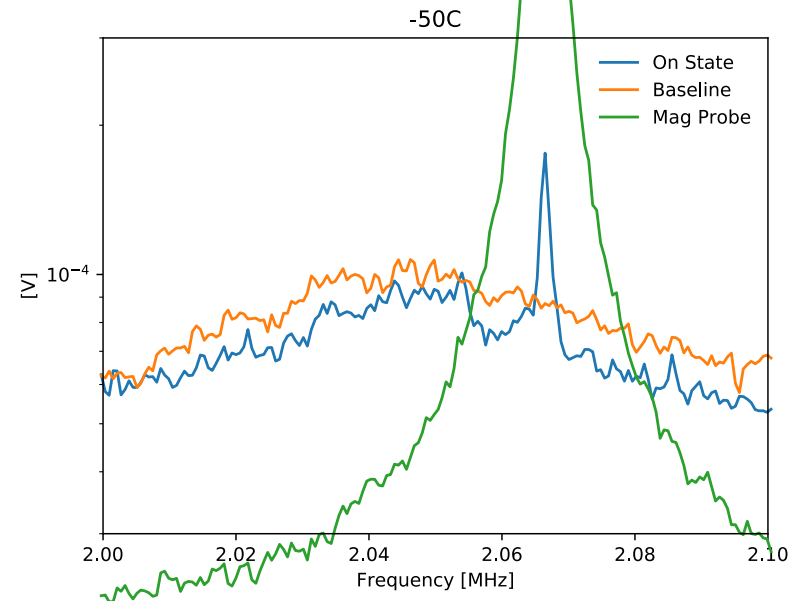
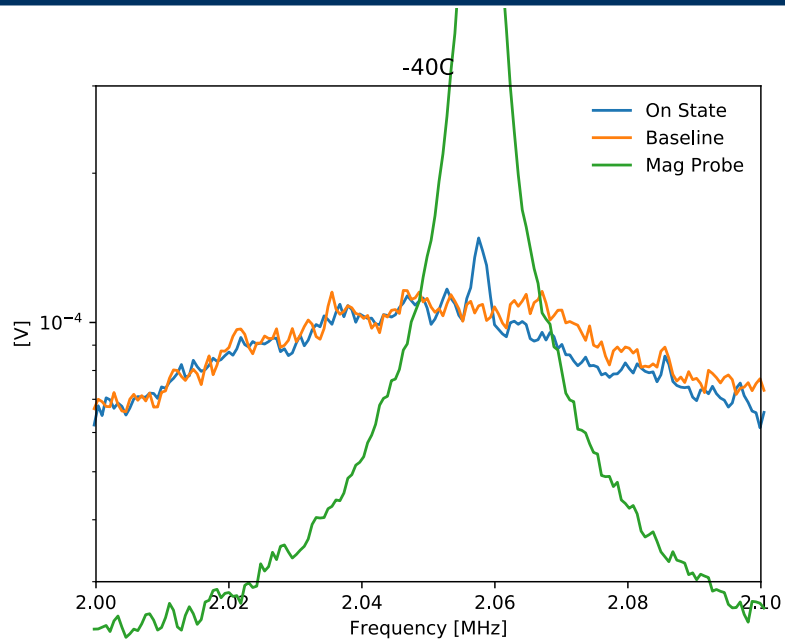
Results



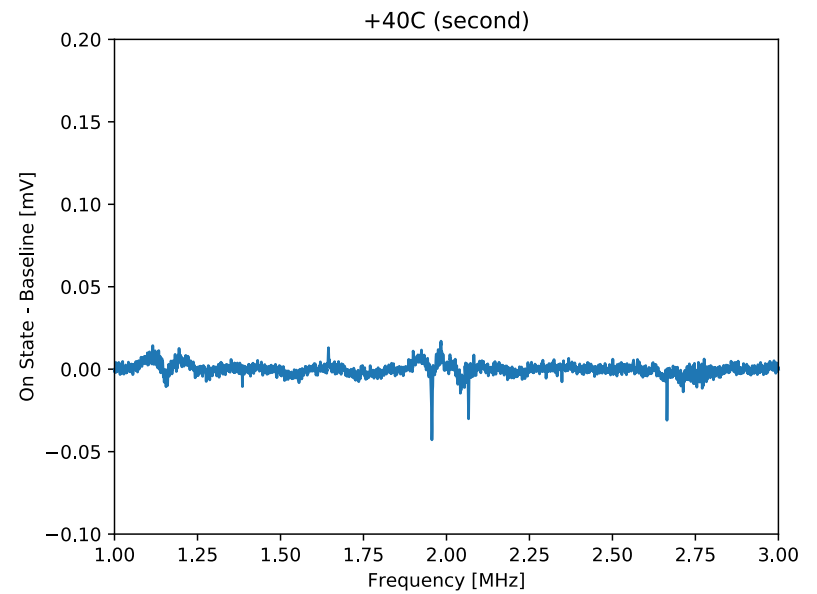
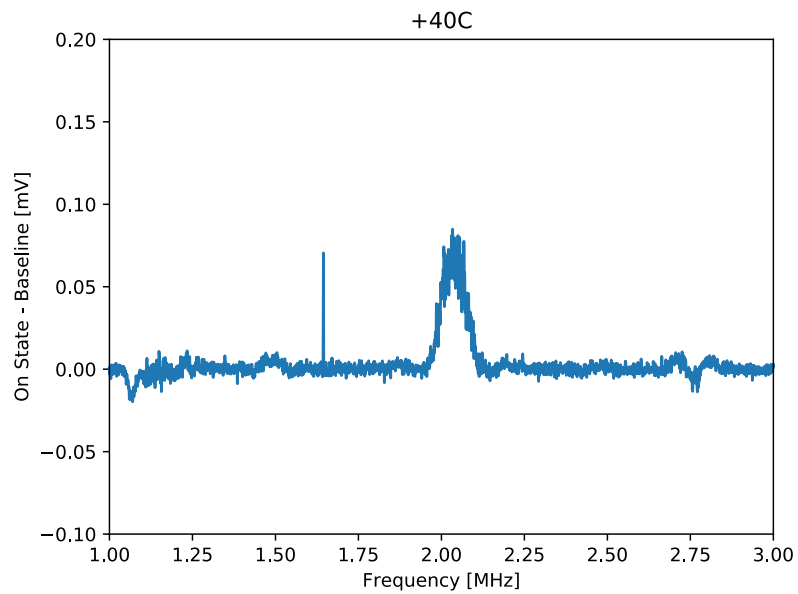
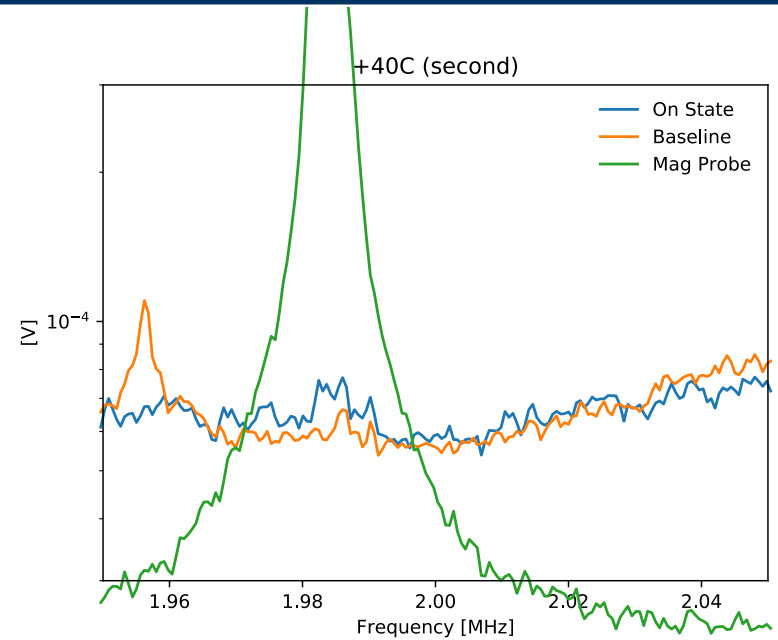
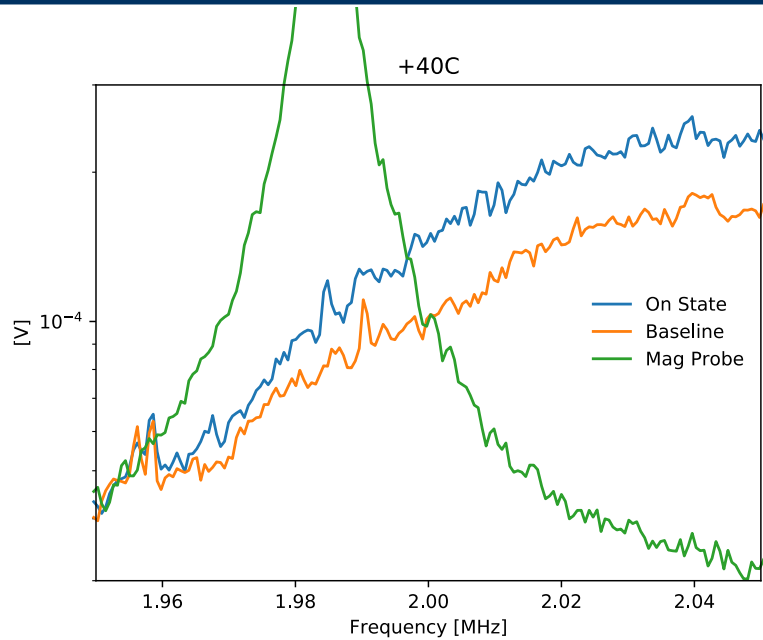
Spectra (cold)



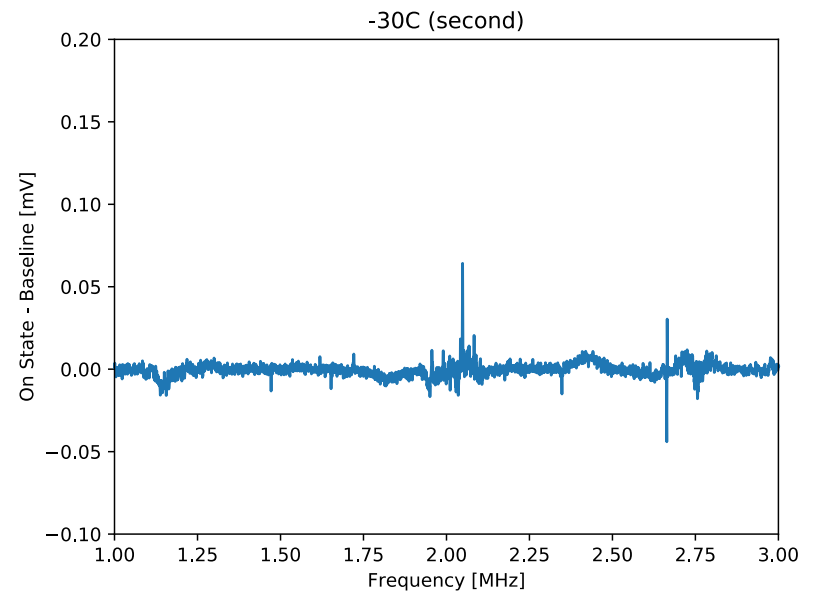
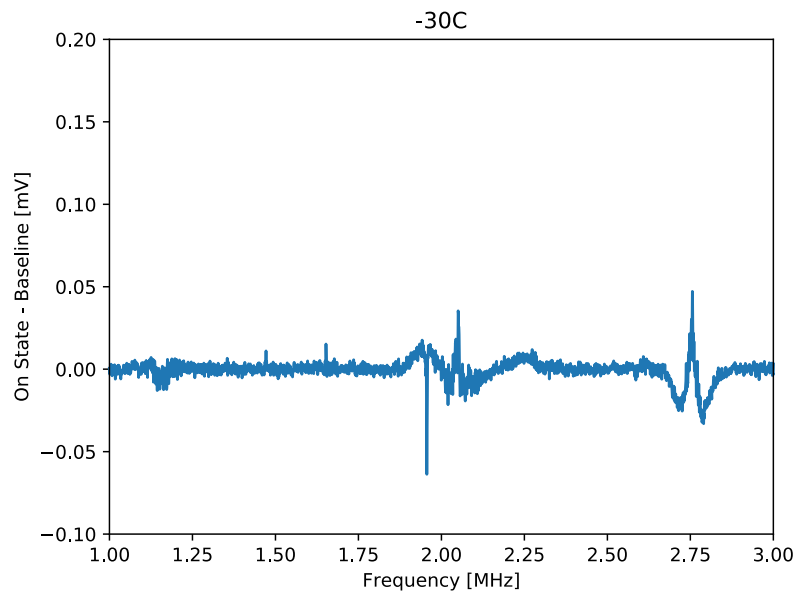
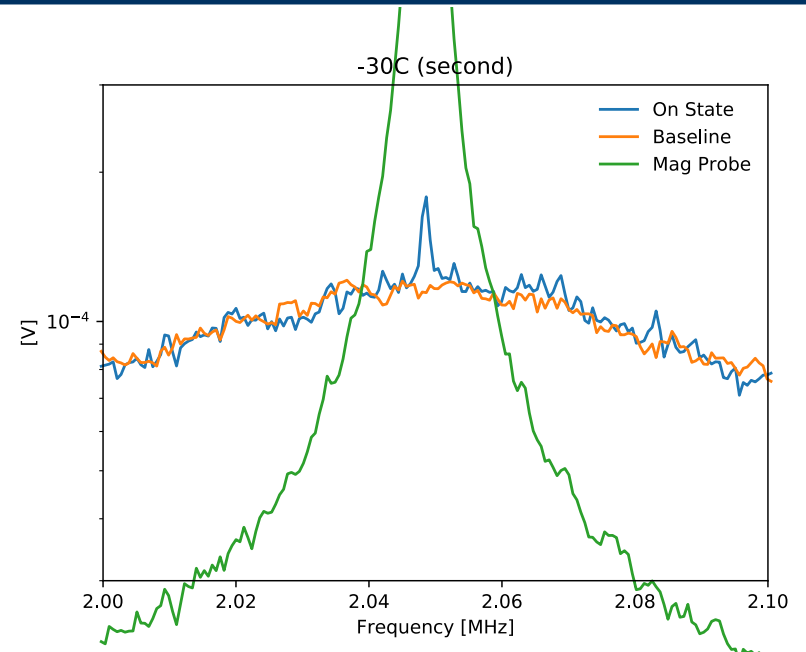
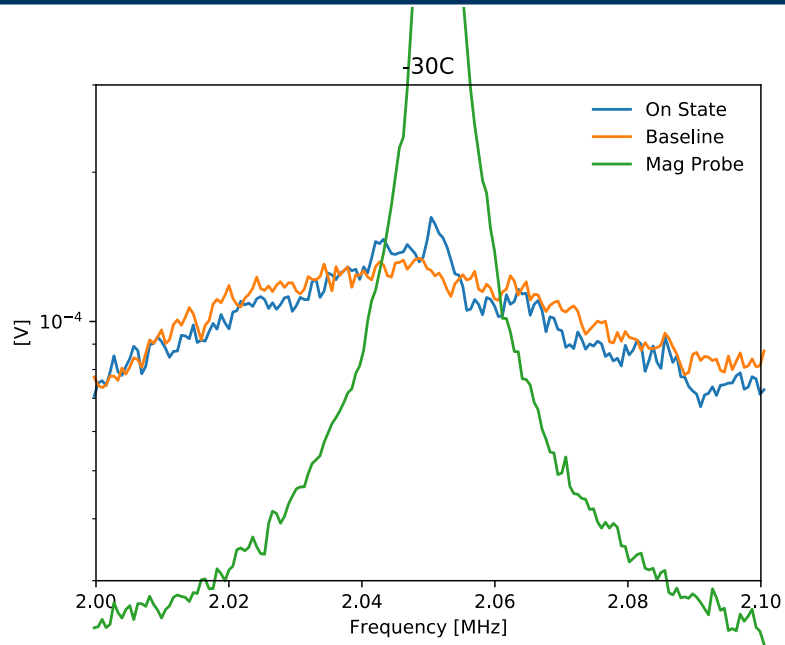
Coldest Temperatures



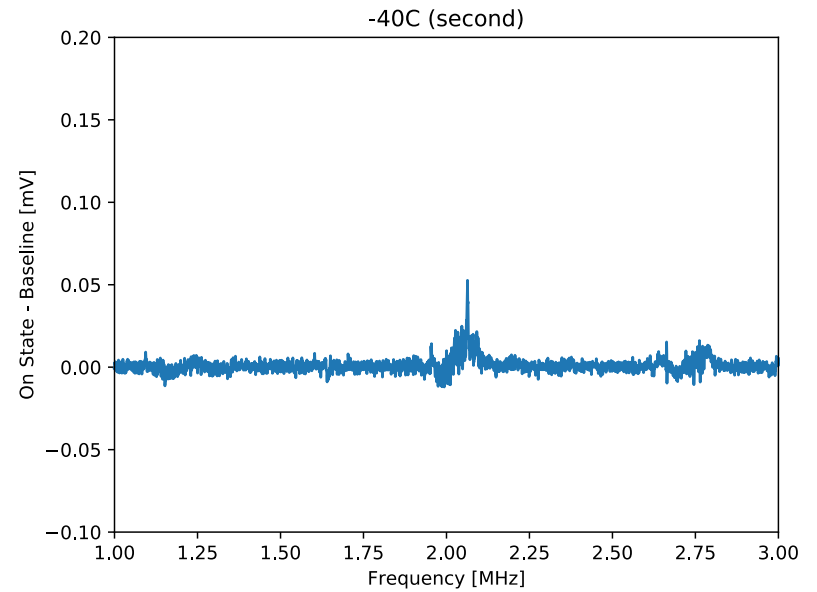
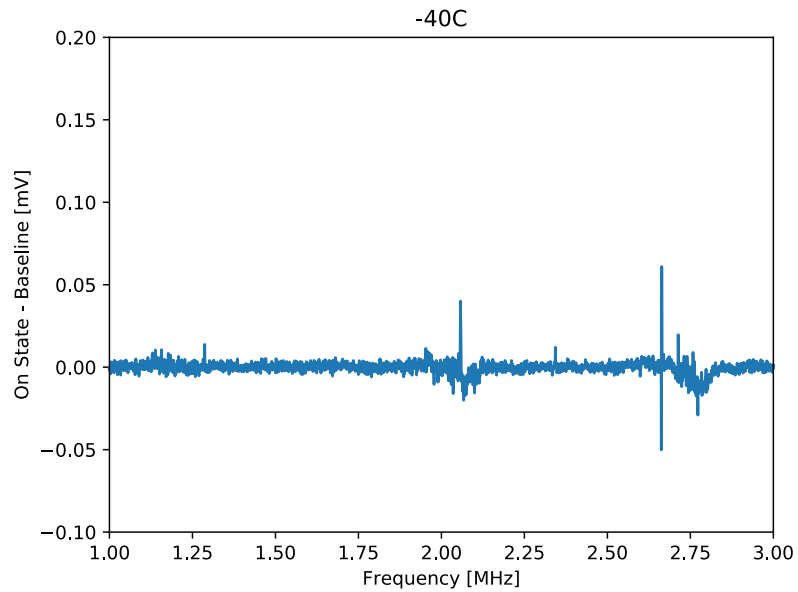
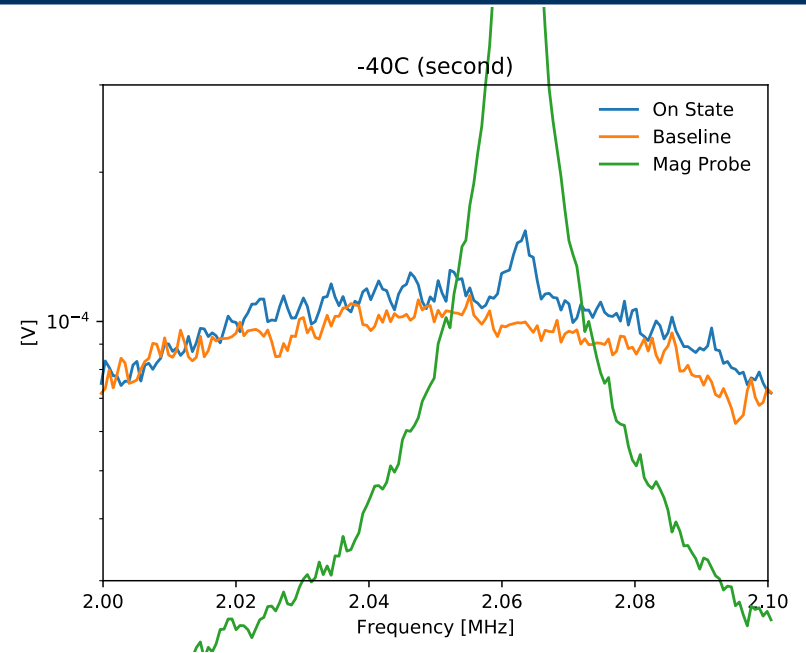
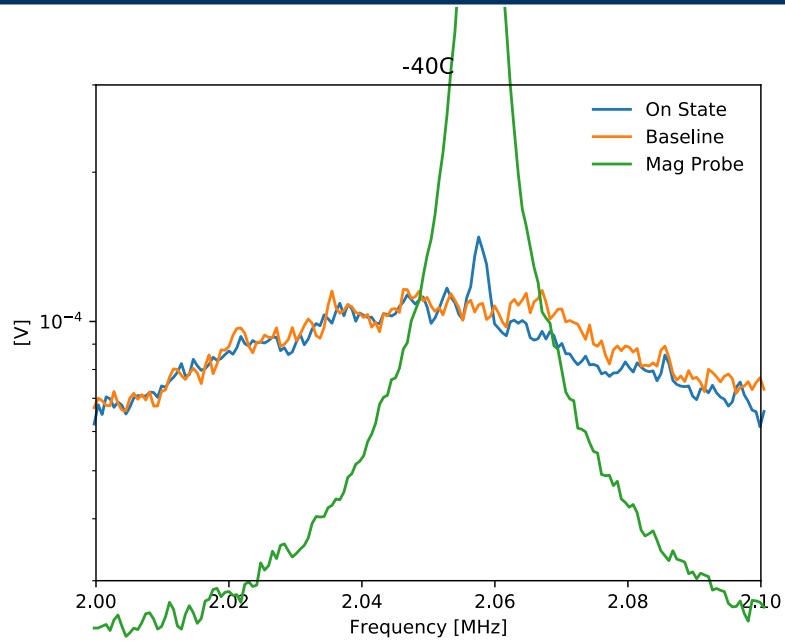
Repeated Measurement At +40C



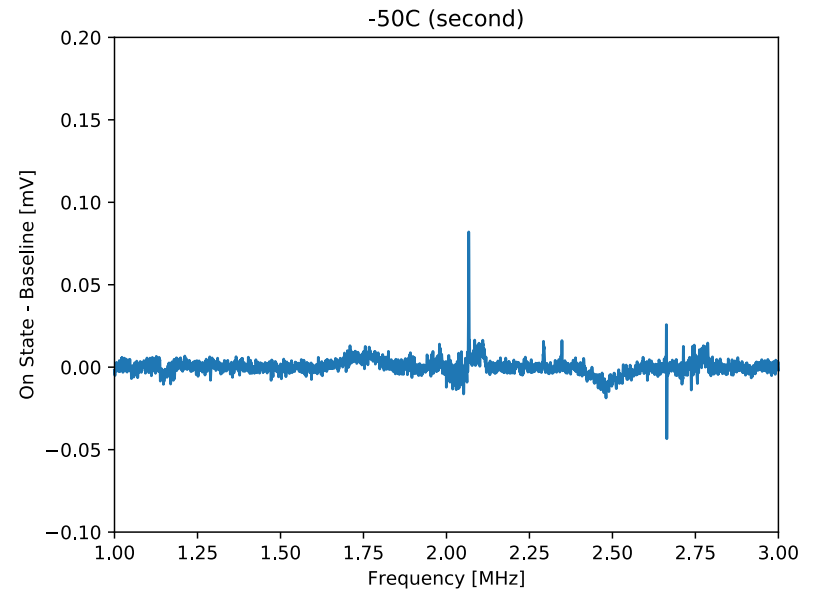
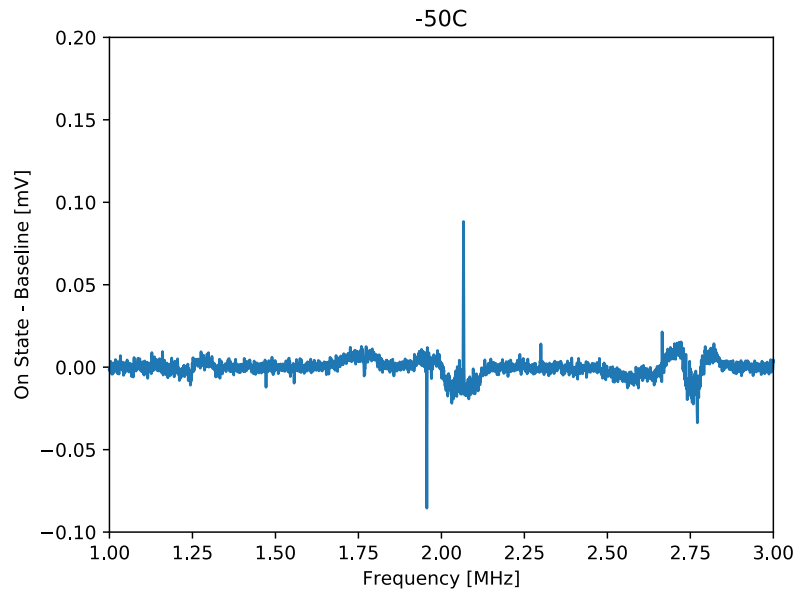
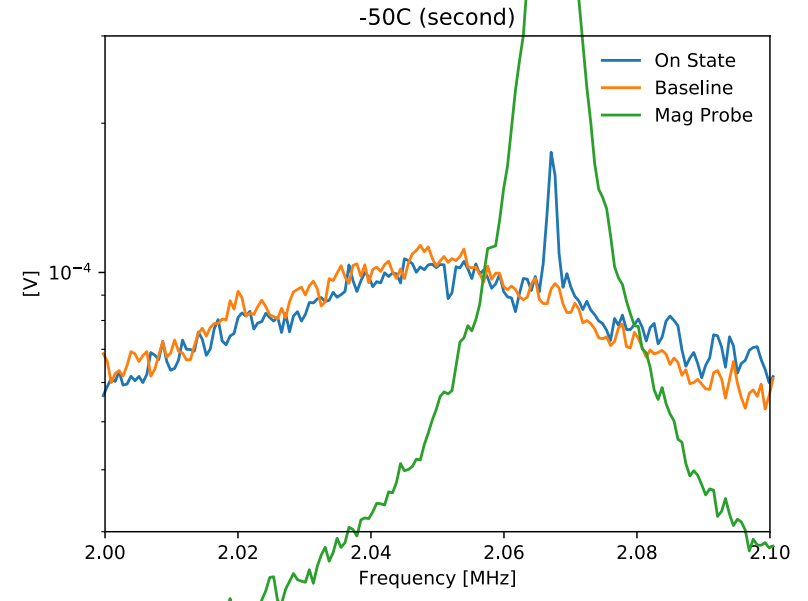
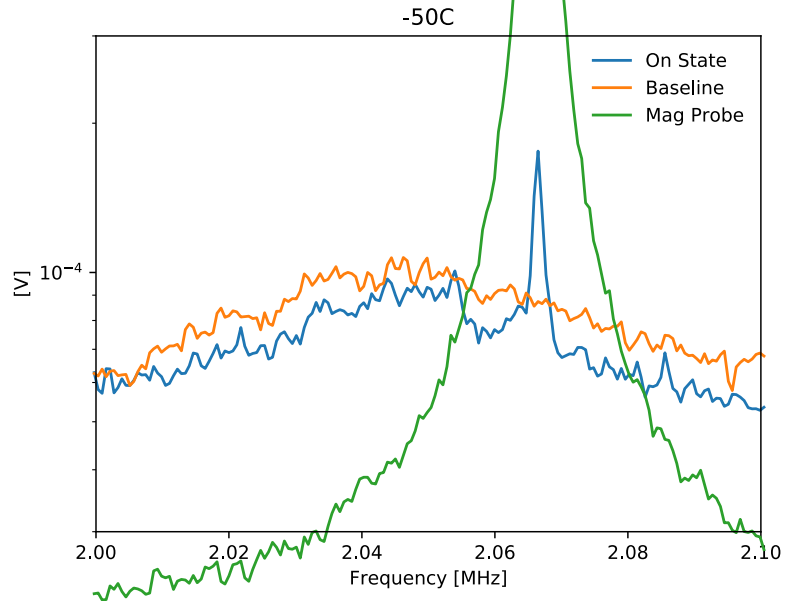
Repeated Measurement At -30C



Repeated Measurement At -40C



Repeated Measurement At -50C



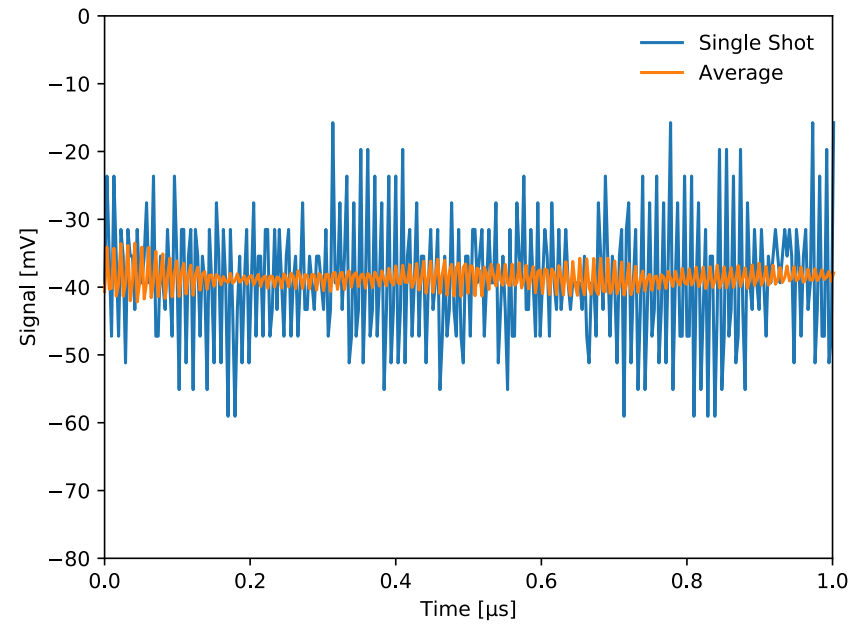
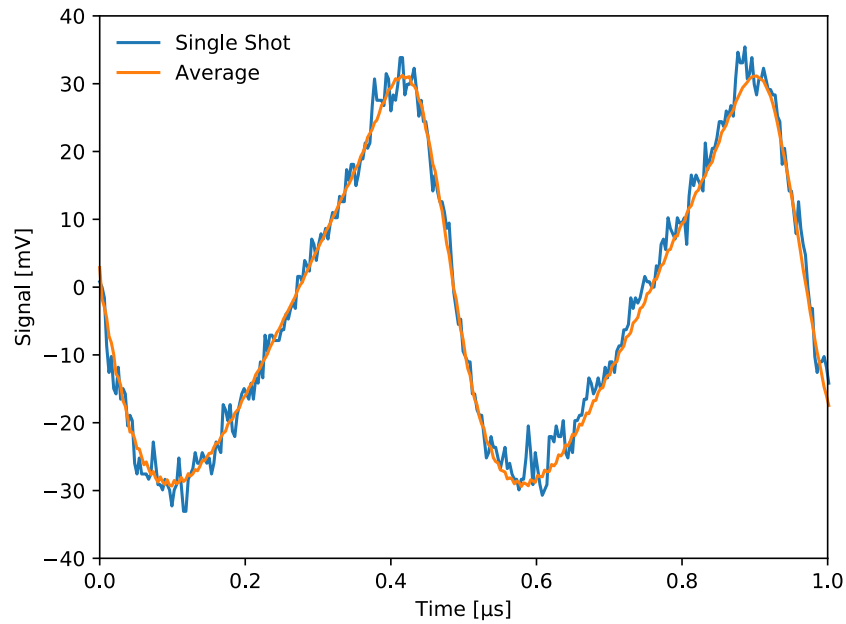
Measurement #3

Goal: Measure PB ground noise and profile on a standalone Powerboard vs temperature

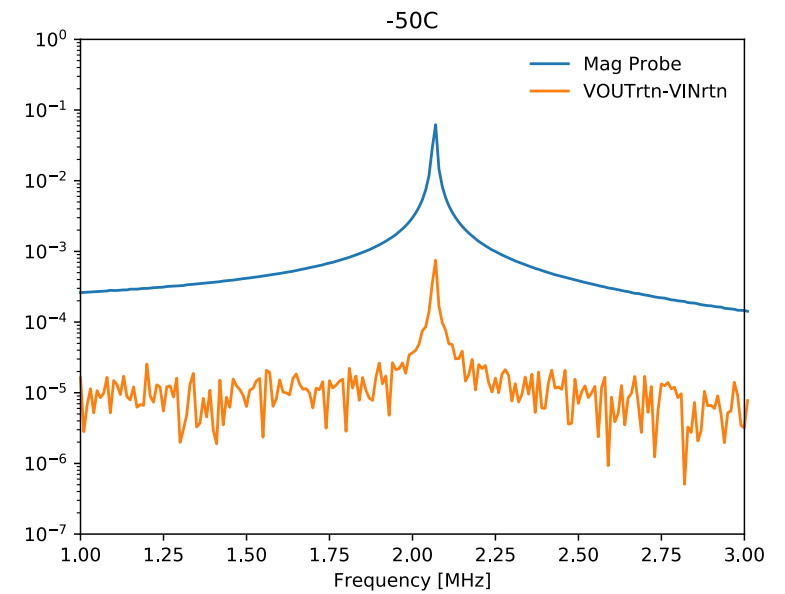
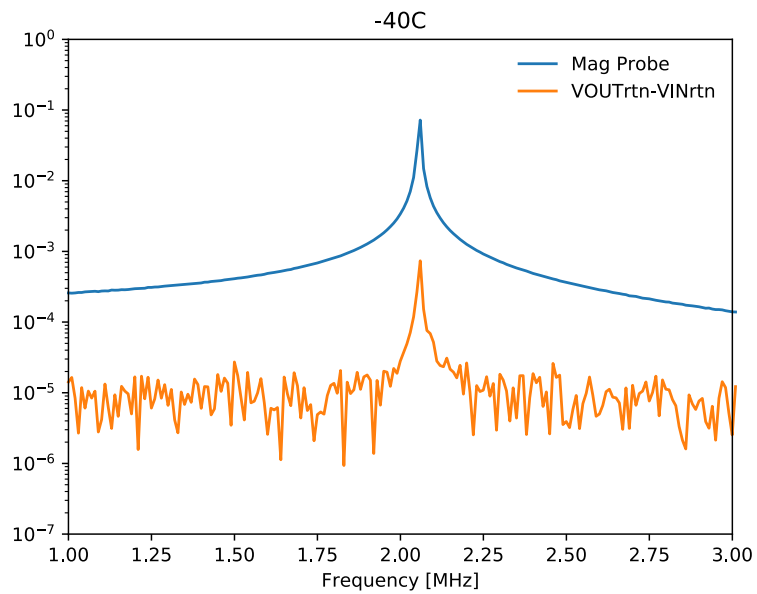
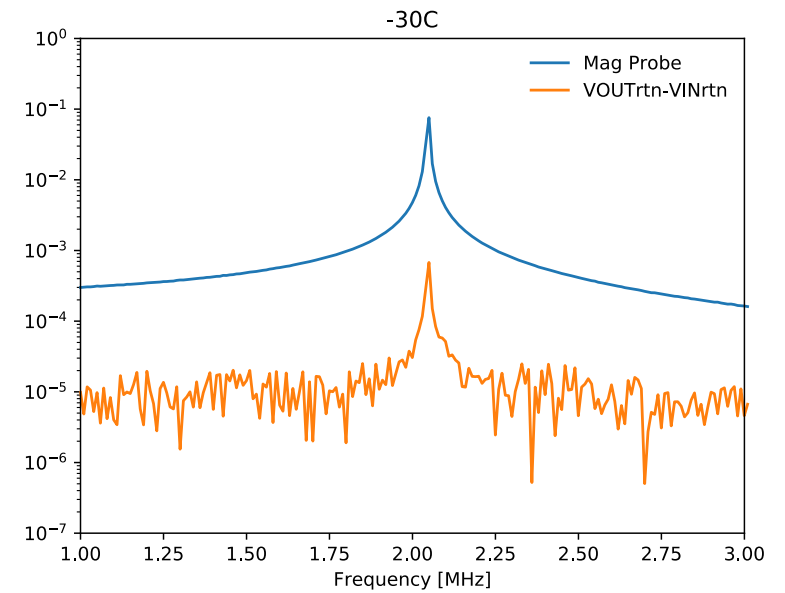
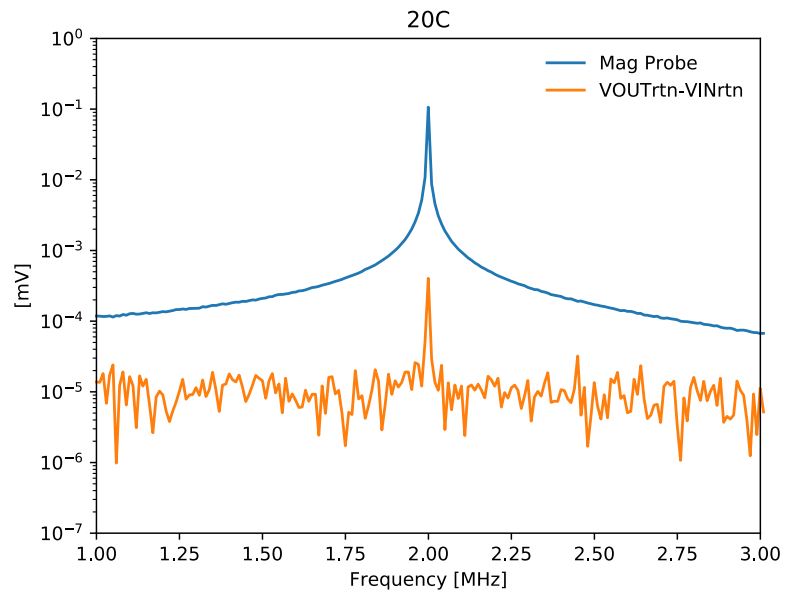
Procedure:

- Place Powerboard on a single tester into climate chamber
- Connect differential probe between VOTrtn and VINrtn on the test PCB
- Place magnetic probe above shieldbox
- Use Picoscope to trigger on falling edge of magnetic probe signal
- Take 800 scope shots, aligned by the trigger
- Average all 800 scope shots (both channels) to get a single smooth waveform
 - Since they are aligned by the trigger, DC/DC noise should be magnified and random noise cancelled

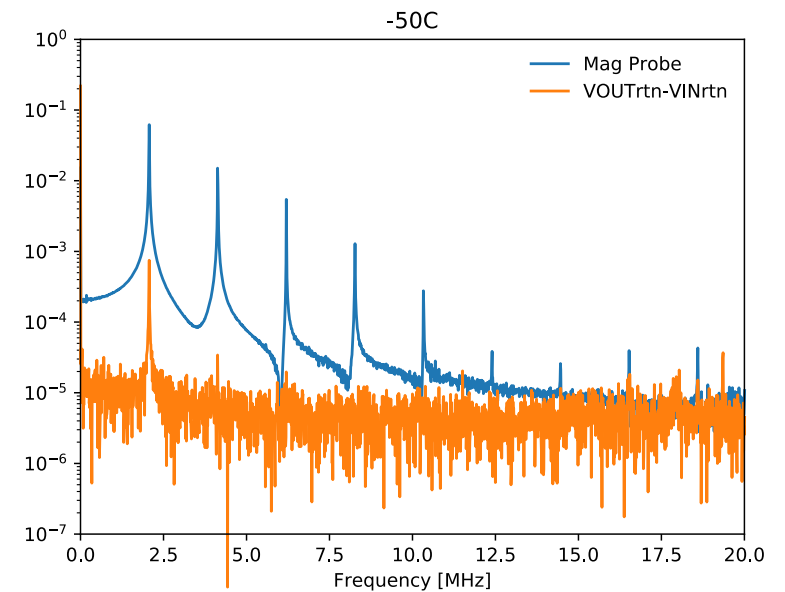
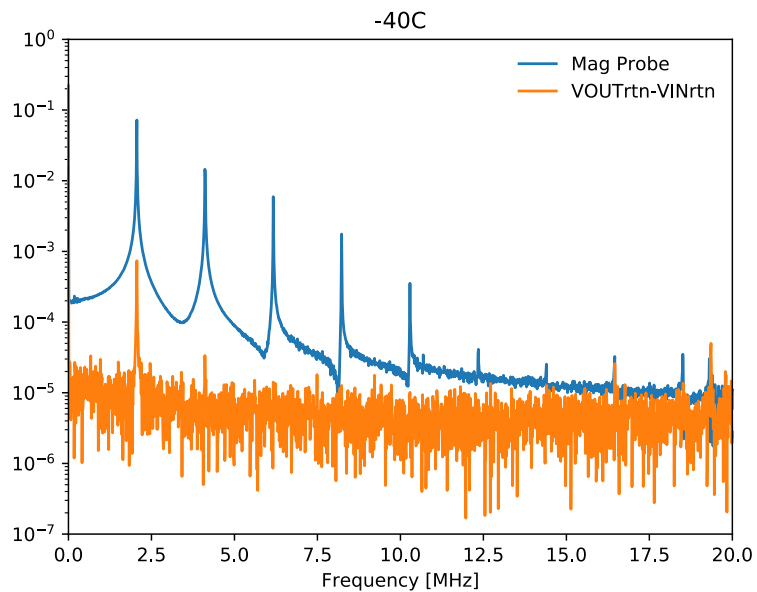
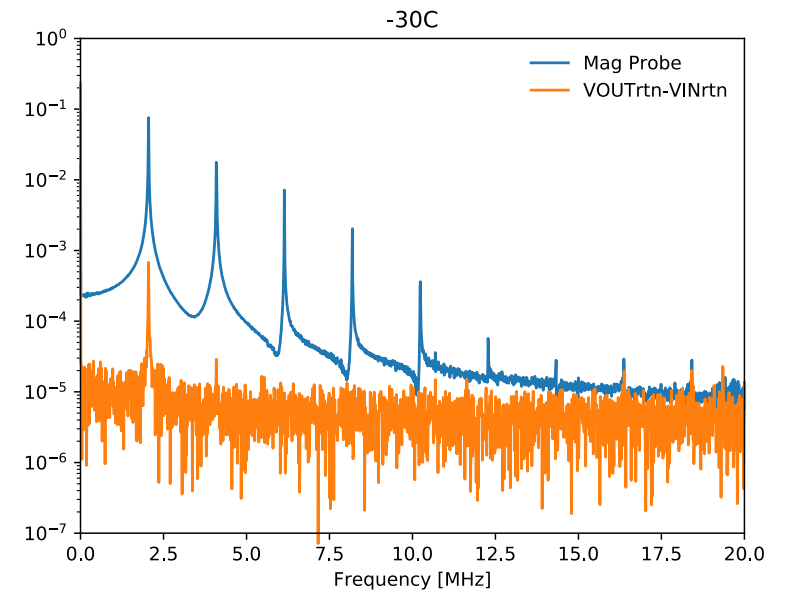
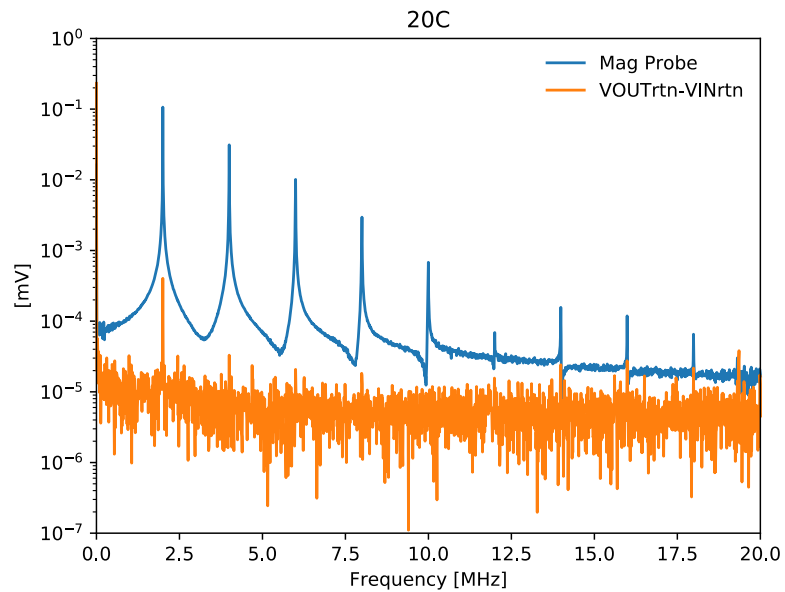
Example of Averaging



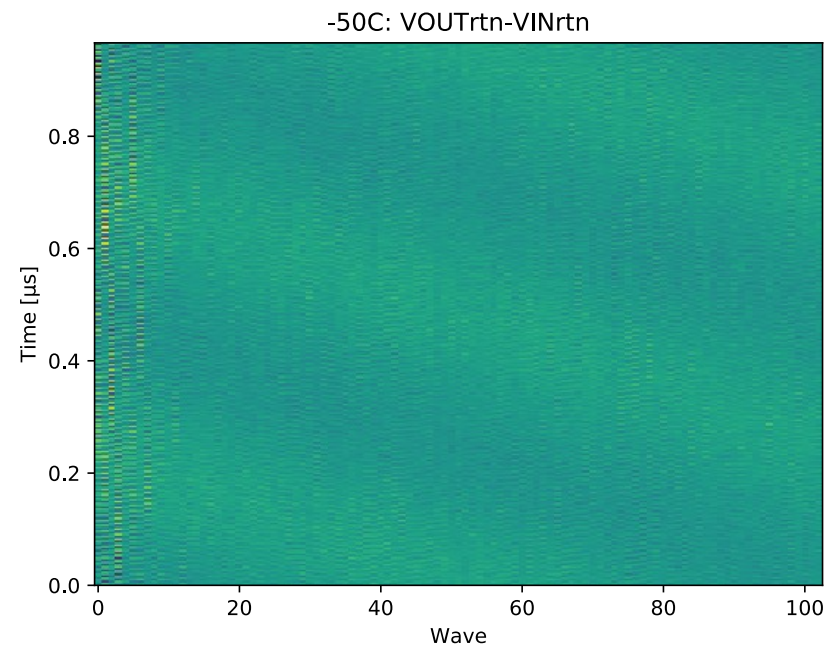
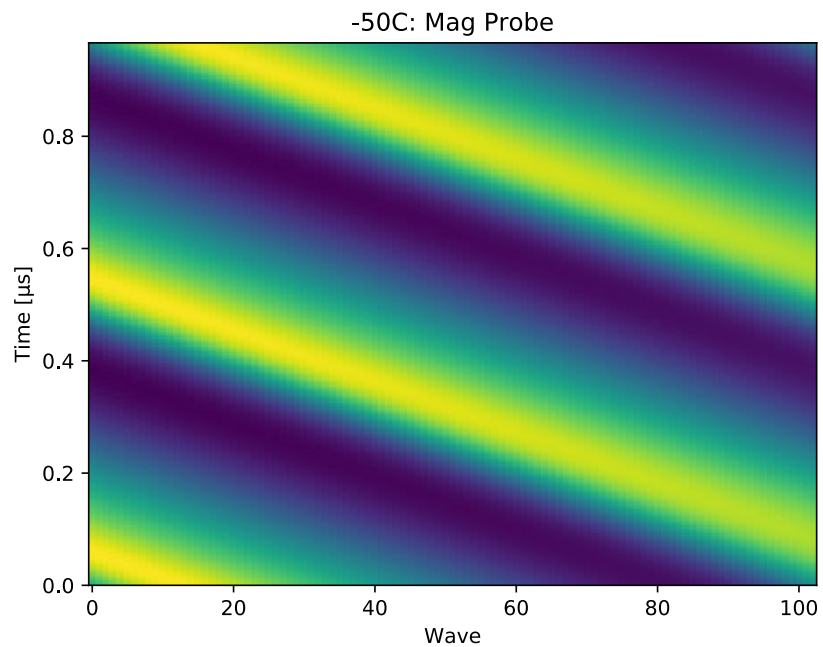
Fourier Transform



Fourier Transform



Profile (WIP)



Need to double check how I determine period.