Noise Mitigation Through 2018

Agenda

- Review 2019 Goals
- Results of Last Dive
- Review Path of 2018 Noise Efforts
- Discuss System Architecture
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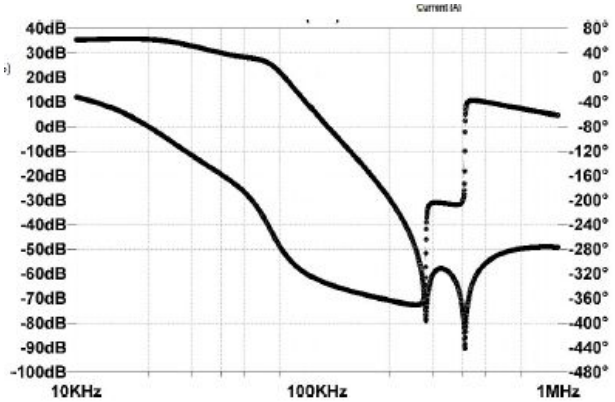
2019 Goals

- Remove noise components from all sources.
- Current worst source are the LED lights.
- 2 Development Days:
  - Feb 26
  - May 3
- Monthly use w/ Robison
- 6 other KBB/ROBI days

Light Modifications

Initial Response

There are two fixed frequency SMPS controllers in the LSL-2000. The internal low power DC-DC bias supply operates at 540kHz and the primary high power LED constant current driver operates at a center frequency of 400KHz. However, by default we ship these in a configuration that uses a spread spectrum oscillator on the primary LED controller to distribute the switching energy over a ±60kHz band (triangle distribution) with a peak at 400kHz and significantly reduce the peak energy in the higher harmonics. I believe there is also a ~400Hz peak in the power spectral density that corresponds to the spread spectrum slew rate. If they are seeing noise in either the 400Hz or 400kHz range it is likely due to the primary LED driver. There is no PWM control over the output power; the LEDs operate at constant current.

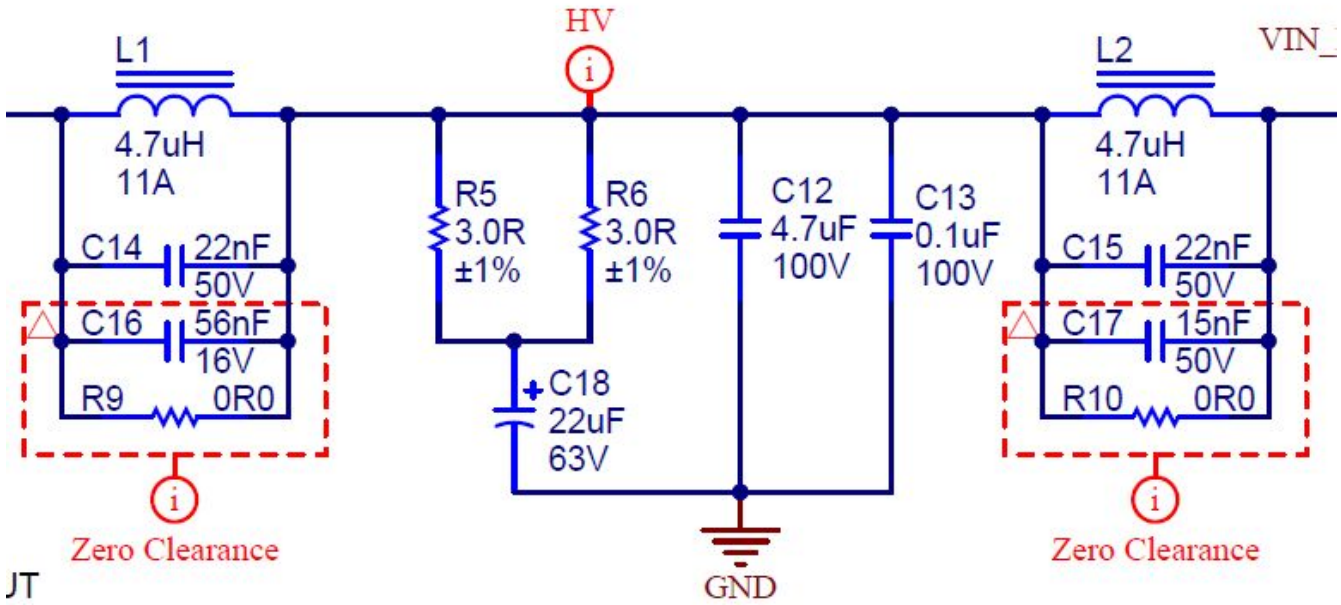


Both are downstream of a power line filter that provides >50dB of attenuation at these frequencies:

We can turn off the spread spectrum switching if the lower frequency peak is giving them trouble. This will increase the amplitude of the primary switch frequency peak and the higher harmonics but will eliminate the low frequency component all together. The modification requires rework of the PCB but the change is fairly simple.

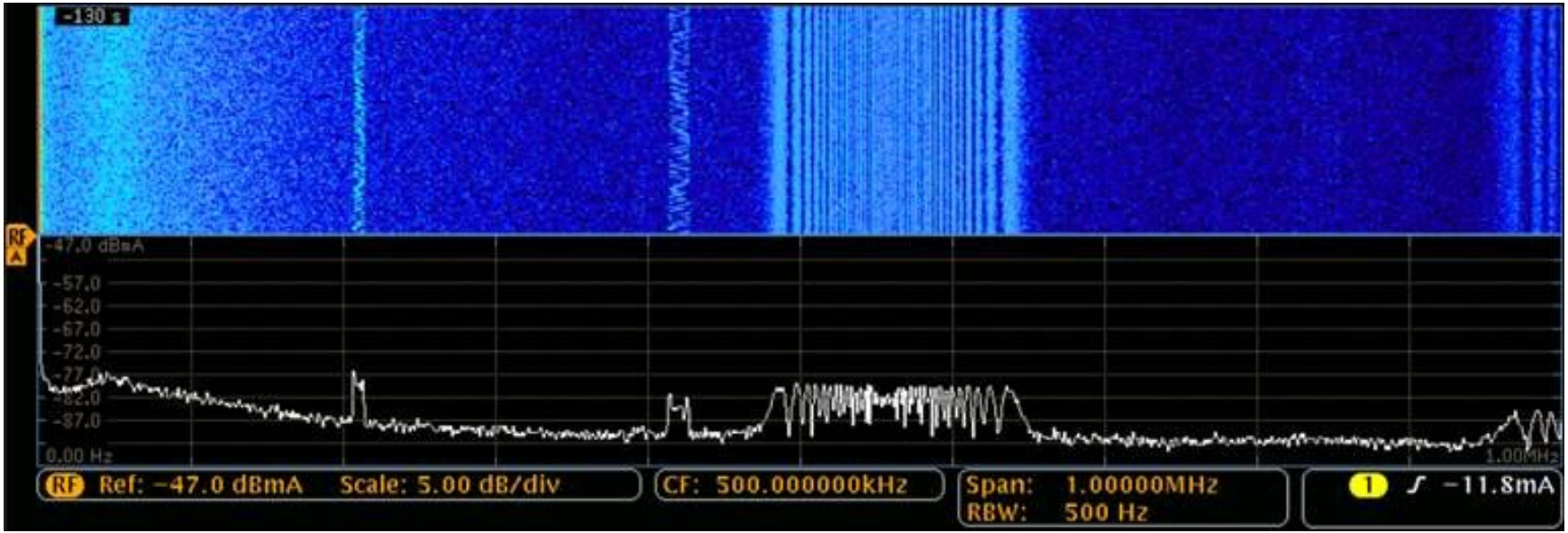
Switcher is LT8391

Filter Schematic (DSPL



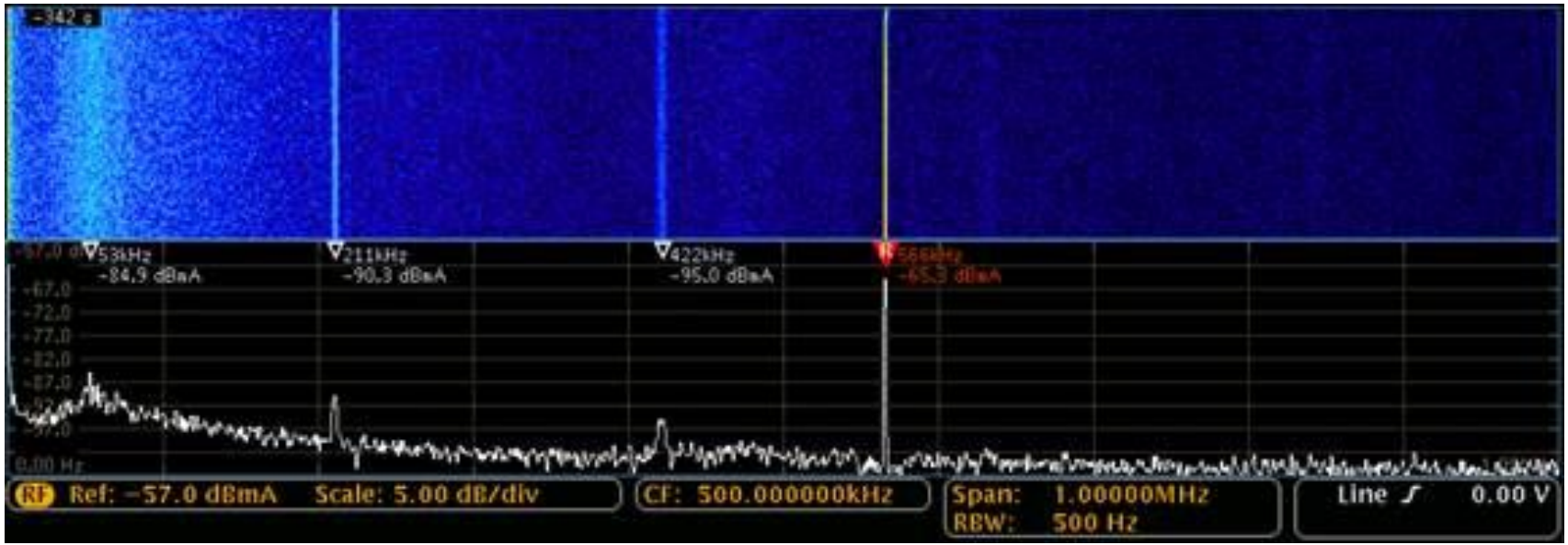
- Note that R9 and R10 are not populated
- No caps are placed from GND to CHASSIS (phone confirmation)

DSPL Initial Tests on Demo Unit (Spread Spectrum)



V_{IN}=36VDC, NOTE: lower frequency peaks are instrument related per baseline image below

DSPL Initial Mods to Monotonic



Monotonic switching mode, -65.3dBmA at 566kHz. Note the lower peaks are present without the light on in the “dark” spectrum below. These are an artifact of the current probe we are using here.

End Result

- These were tested a number of ways (independent PS, through camera, ducers mounted/unmounted)
- Light clearly have both electrical and acoustic coupling mechanisms:
  - Electronic: noise present when a light was dangled in by a ground wire to the tank.
  - Acoustics: The transducer had a directional noise response to the light when only the two items were in the tank.
- When tested at MBARI in the tank, we found the spread spectrum version still corrupted most of the upper band.
- The monotonic switching had peaks and subharmonic peaks, but this was deemed the best of poor options. All four were modified.
- Unfortunately, as expected, not all four lights switch exactly at the same frequencies, so each light has different subharmonics as well.
- This is true in both the test tank and at sea.

System Architecture

- The acoustics sphere chassis is isolated from seawater, coupled by a capacitor on P. McGill's Filter board to seawater though a bulkhead on the sphere.
- The battery ground of the pack on the sphere is connected to chassis in the sphere at present.
- All signals are either optically or galvanically isolated from the auv.
- Noise also couples in through the cables on the transducer.
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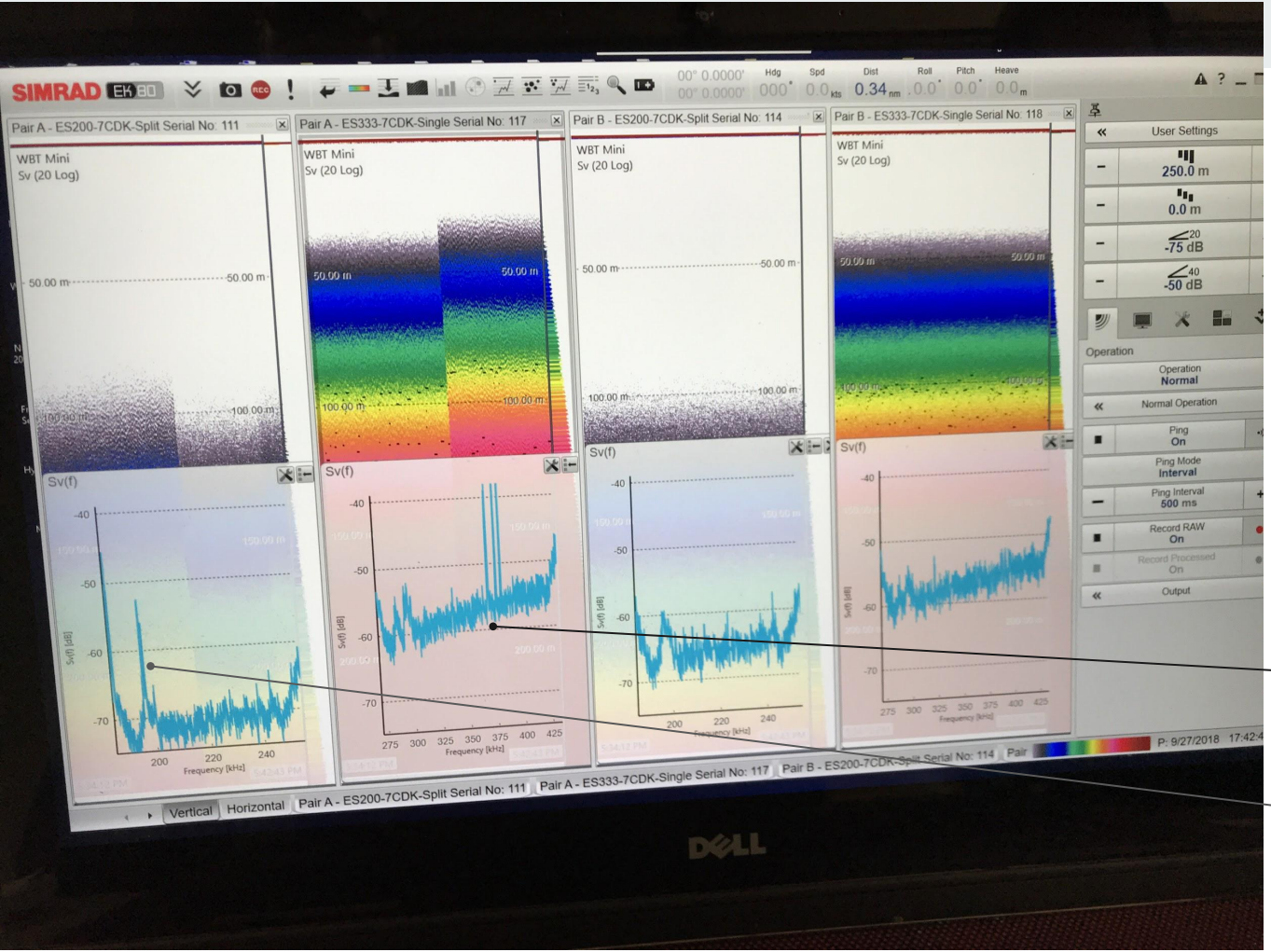

Noise measured on the echosounder in the test tank with 4 modified lights

370, 377, 381 kHz

~196 kHz