TOF Detection Problem Update 1

Gabriel:

One potential cause of this behavior is false positive spikes on the STOP line between TDC1000/TDC7200, but given the that the data with averaging is still pretty spread out, it may not be very likely. However, if you see any evidence of a false positives these can be dealt with by adding a series resistor on the STOP signal line near the TDC7200 to form a low pass filter with the input capacitance or you can try playing with autozero, blanking period, and LNA_CTRL. Also check your test hardware and environment for noise that could be coupled to the transducer leads or your PCB.

Answer:

Checked the STOP line from the TDC1011 to the TDC7200, there is no false spikes the START and STOP were run as a 50 ohm impedance pair to circumvent any possible timing issues.

Gabriel

If the received echo signal can be obviously identified in the scope plots, then I'd try altering the physical setup to see if any adjustments to transducer placement or mounting help identify a cause. I would continue to use multi-cycle averaging as well.

Answer:

We modified the test setup to mimic the TI Application Report SNAA266A dated April 2015, "*How to Select and Mount Transducers in Ultrasonic Sensing for Level Sensing and Fluid ID*" The following are the pictures of the test setup using 3" of water and the sensor is mounted on the bottom using hot-glue, this did not change the results.
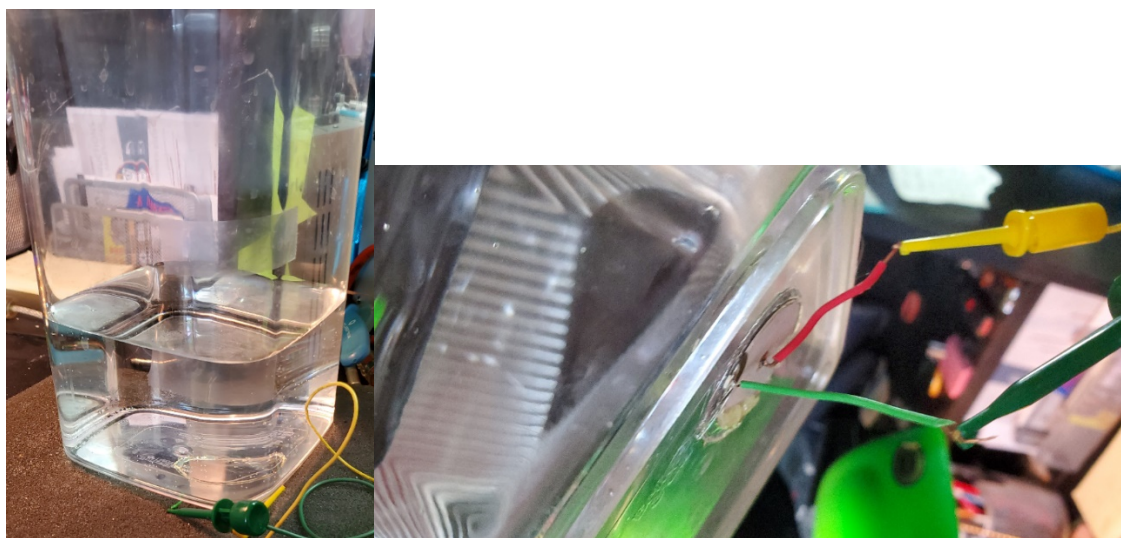

If we have the gain to high we get a reflection 54uS from the rising edge of the blanking signal (blanking @0x00 0x50 = 34us + 54uS = 88uS) using blanking set to 0x00 0x50 we blank out anything less than 34uS with the PGA_GAIN at -21dB we have a constant reading 54uS later.

Ch1 – TRIG, CH2 – STOP, CH3- COMPIN   using blanking set to 0x00 0x50 we blank out anything less than 34uS with the PGA_GAIN at -21dB we have a constant reading 54uS later
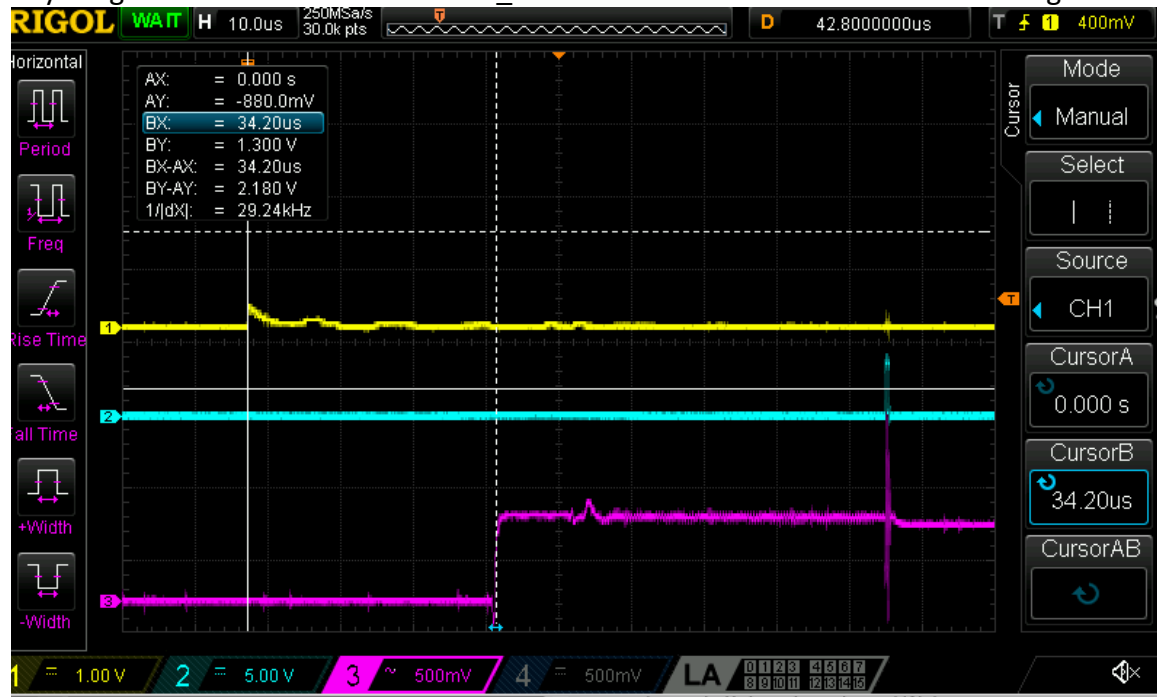
Ch1 – TRIG, CH2 – STOP, CH3- COMPIN   STOP at 88uS
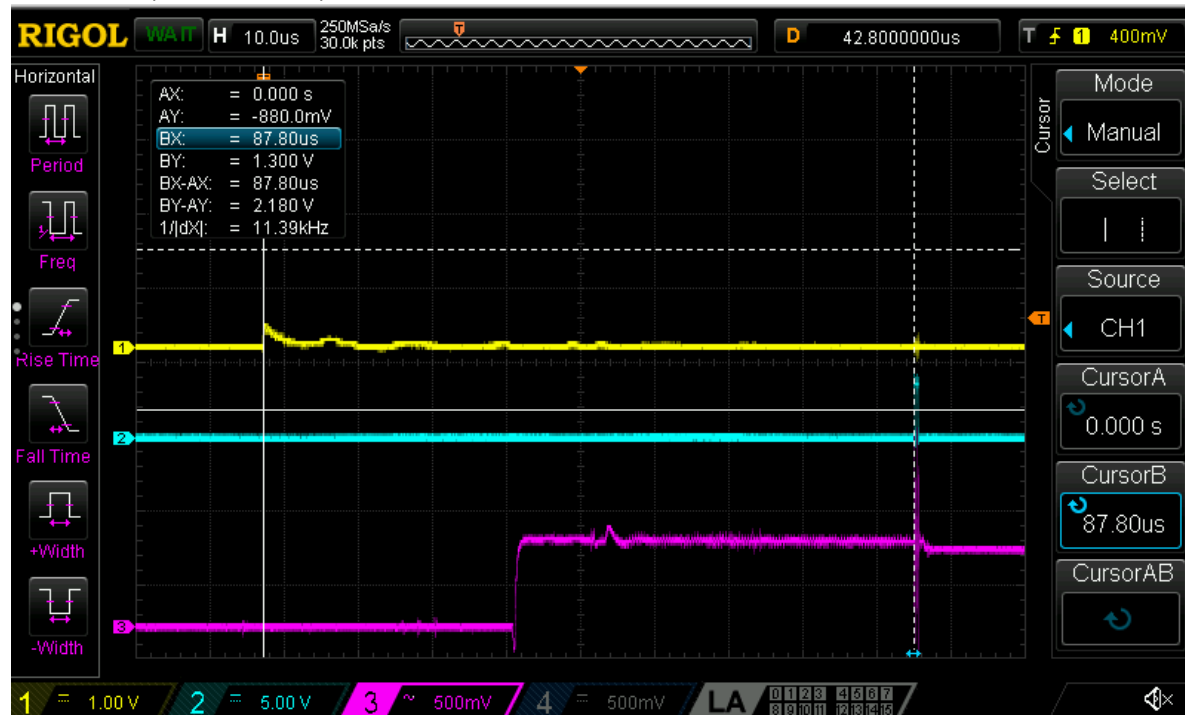
TOF in uS from TDC7200

```
COM3:115200baud - Tera T
File  Edit  Setup  Control  \
TOF          87
TOF          87
TOF          88
TOF          87
TOF          88
TOF          88
TOF          88
TOF          87
TOF          88
TOF          88
TOF          87
TOF          87
TOF          88
TOF          88
TOF          88
TOF          87
TOF          88
TOF          88
TOF          88
TOF          88
TOF          88
TOF          88
TOF          88
```

Gabriel:

After this, if you are still seeing this issue, please send a scope shot zoomed in on the received echo on COMPIN and the STOP pulse, and also a few shots where you can identify the ToF variation on the scope plot, with time axis cursors (label expected ToF). Also include a picture or more details on the transducer mounting and the surface target (bottom of container/bag setup).

Answer:

Expected TOF: 3" water TOF for water@7.62cm (3.0")= (2*7.62cm) / 1480m/s = 102uS

If we look at the Acoustic Impedance for the Acrylic-to-Water barrier and the Water-to-Air barrier we get the following:

Example Polycarbonate and Water
Zwater = 1.5 , Zpolycarbonate = 2.69   R = $((2.69 - 1.5) / (2.69 + 1.5))^2$ = $(1.19/ 3.76)^2$ = 10.01%
10% of the signal is reflected back and 90% goes through the polycarbonate.

Example Water and Air
Zwater = 1.50 , Zair = .00429 R = $((1.5 - .00429) / (1.5+.00429))^2$ = $(1.49571/ 1.50429)^2$ = 98.56%
99% of the 86% (85%) is reflected back an 1% goes through the air

With this test setup we should be getting a decent, reliable echo return from the Water-to-Air barrier.

==If my calculations are correct, we should see it around 102uS, is this right?==

Ch1 – TRIG, CH2 – STOP, CH3- COMPIN   STOP at 149uS
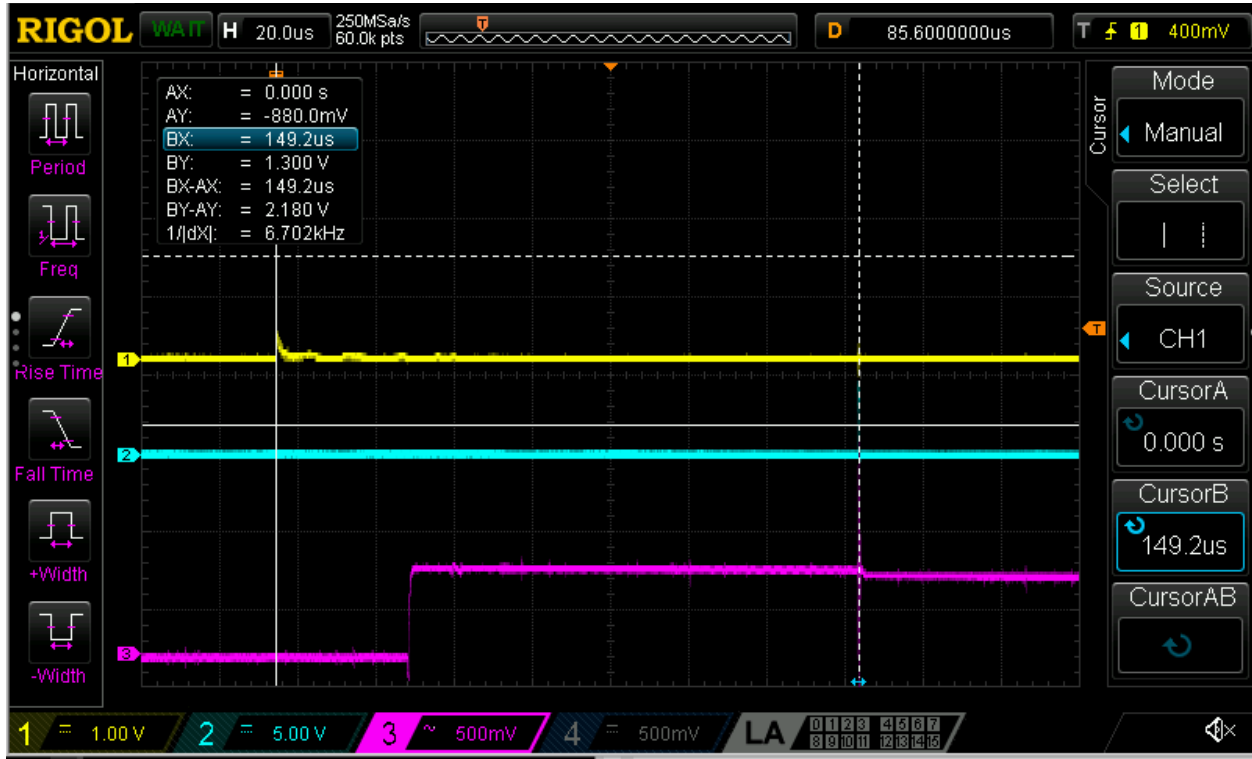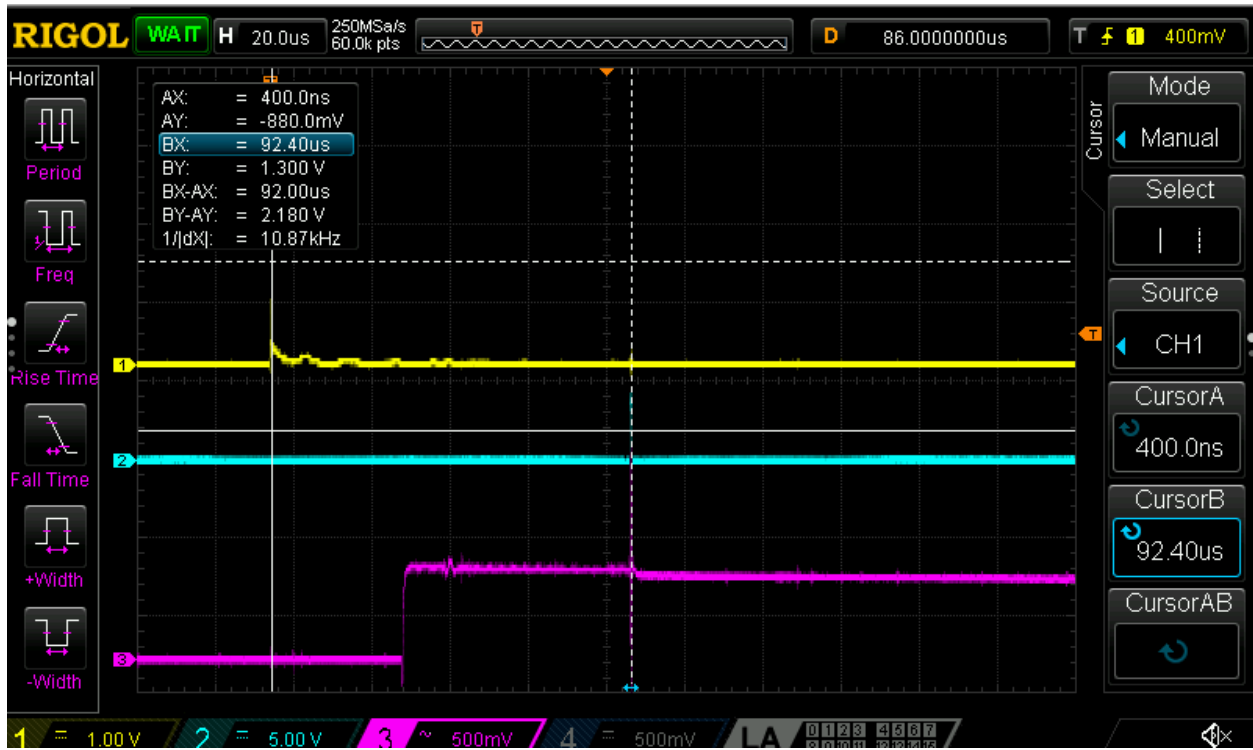
PGA_GAIN = 6dB, 2-STOP Events

Ch1 – TRIG, CH2 – STOP, CH3- COMPIN   STOP at 149uS, zoomed into STOP
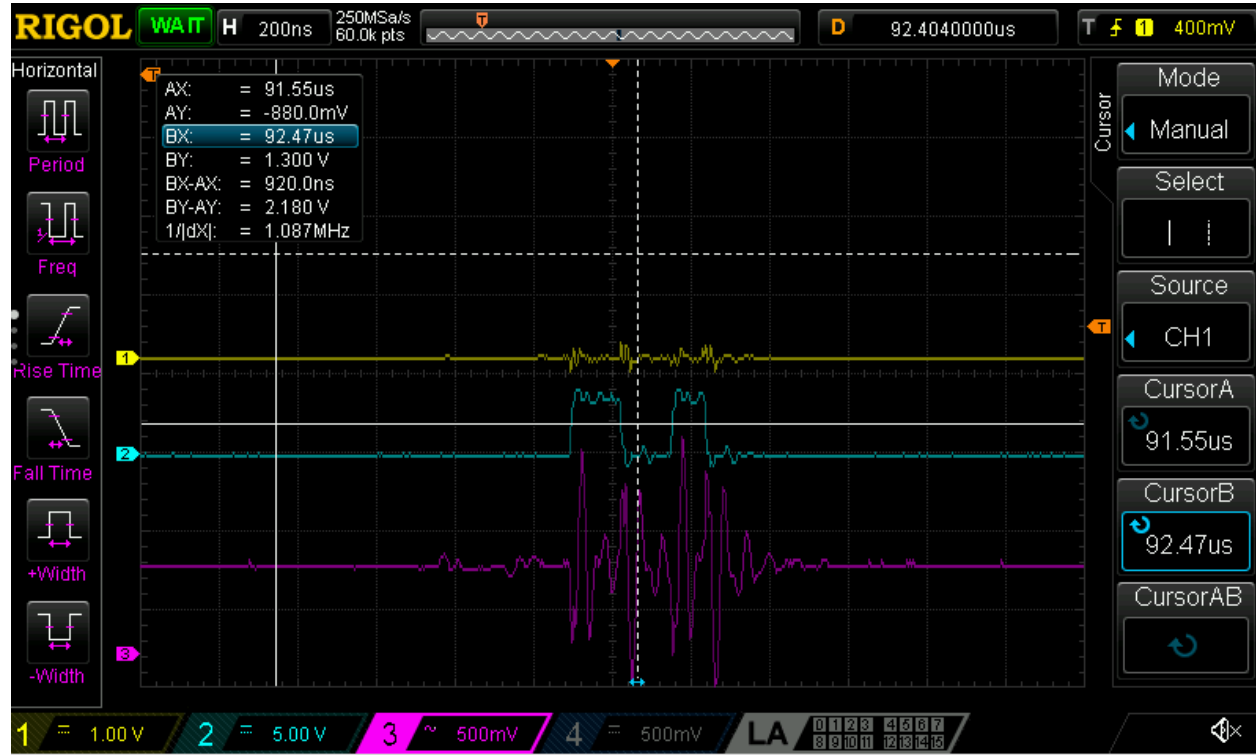

Same conditions and same test as above stopped at 92uS

Ch1 – TRIG, CH2 – STOP, CH3- COMPIN   STOP at 92uS,

Ch1 – TRIG, CH2 – STOP, CH3- COMPIN   STOP at 92uS, zoomed into STOP

TOF from TDC7200 in uS