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:

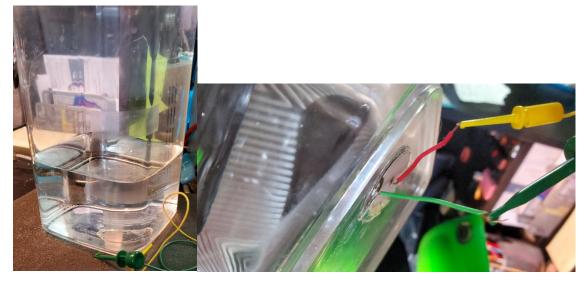
Checked the STOP line from the TDC1011 to the TDC7200, there is no false spikes the START and STOP were run as a 50 ohm impedance pair to circumvent any possible timing issues. Gabriel

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:

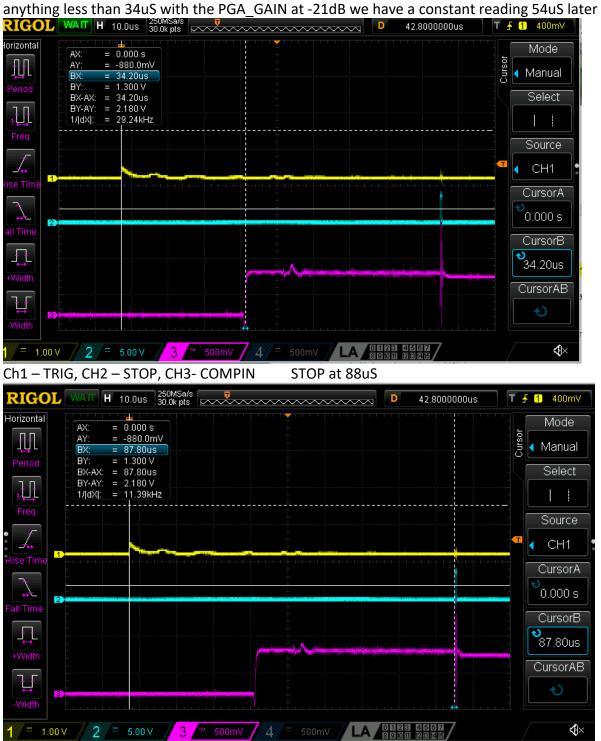
We modified the test setup to mimic the TI Application Report SNAA266A dated April 2015, "How to Select and Mount Transducers in Ultrasonic Sensing for Level Sensing and Fluid ID" The following are the pictures of the test setup using 3" of water and the sensor is mounted on

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.

I suspect we are driving the COMPIN stage too hard because I can increase the ECHO\_THERSHOLD and it goes away, can you explain what is happening?



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

TOF in uS from TDC7200

🜉 COM3:115200baud - Tera T				
File	Edit	Setup	Control	١
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TOF TOF TOF		88 88 88	3	
TOF 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

RIGOL	WAIT	H 20.0us 250MSa/ 60.0k pts	s	D 85.600000us	T <b>∱ 1</b> 400mV
Horizontal	AX:	= 0.000 s			Mode
ŢŢŢ	AY: BX:	= -880.0mV = 149.2us			Manual
Period	BY: BX-AX: BY-AY:				Select
ţŢ	1/ dX :	= 6.702kHz			
Freq					Source
<u>_</u> ,					🕶 📢 CH1
Rise Time					CursorA
÷. 2					<b>0.000</b> s
Fall Time					CursorB
╧╪╧					<b>≥</b> 149.2us
+VVidth					CursorAB
l L I I I I I I I I I I I I I I I I I I					€
-Width					
<b>1</b> = 1.00 V	/ 2	<sup></sup> 5.00 ∨ 3	~ 500mV 4 = 500mV LA		<b>4</b> ×

File Edit Setup Control Window Help

Help Menu	ı, to quit	press q			
Increase Decrease Increase	OF reading ECHO_THLD ECHO_THLD PGA_GAIN	press e press f press g	hit any	key to	stop
Decrease	PGA_GAIN	press i			
TOF	122				
TOF	155				
TOF	131				
TOF	115				
TOF	136				
TOF	108				
ŤŎF	148				
TOF	121				
TOF	149				

## PGA GAIN = 6dB, 2-STOP Events Ch1 – TRIG, CH2 – STOP, CH3- COMPIN STOP at 149uS, zoomed into STOP H 200ns 250MSa/s 60.0k pts RIGOL WAIT T 🛧 1 400mV D 149.500000us ~~~~~ Horizontal Т Mode = 148.6us Cursor ſĮſ AY: BX: = -880.0mV 📢 Manual = 150.1us BY: = 1.300 V Select BX-AX: = 1.492us BY-AY: = 2.180 V 1/[dX]: = 670.2kHz <u>,</u>]][ Source 4. CH1 • 1 CursorA wn ዮላድ 44 148.6us 2 CursorB J. Ð 150.1us CursorAB ł 0123 4567 < 1.00 V / 2 = 5.00 V 3

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	
RIGOL WATT H 200ns 250MSa/s 7 92.4040000us	T Ғ 1 400mV
Horizontal AX: = 91.55us AY: = -880.0mV BX: = 92.47us	Mode
Period BY: = 1.300 V BX-AX: = 920.0ns BY-AY: = 2.180 V	Select
BY-AY: = 2.180 V 1/JdX : = 1.087MHz Freq	
	Source
	CursorA
Fall Time	91.55us CursorB
	92.47us
	CursorAB
Width	
1 = 1.00 V / 2 = 5.00 V / 3 ~ 500 mV / 4 = 500 mV / LA 0120 400 m	<b>∕</b> ₽×
TOF from TDC7200 in uS lelp Menu, to quit press q	
Display TOF readings press d, hit any key to stop Increase ECHO_THLD press e	
Decrease ECHO_THLD press f Increase PGA_GAIN press g Decrease PGA_GAIN press i	
TOF 140 TOF 98	
TOF   149     TOF   140     TOF   140     TOF   113	
TOF 98 TOF 92 TOF 116	
TOF 158 TOF 89 TOF 132	
TOF 133 TOF 109 TOF 119	
IOF   105     TOF   87     TOF   117	
TOF 98   TOF 92   TOF 116   TOF 158   TOF 89   TOF 133   TOF 109   TOF 109   TOF 109   TOF 105   TOF 105   TOF 105   TOF 117   TOF 117   TOF 167   TOF 167   TOF 140   TOF 111   TOF 90   TOF 108	
TOF 140 TOF 111 TOF 90	
TOF 108 TOF 92	