TOF Detection Problem

Problem:

We cannot get consistent TOF indications from theTDC1011, STOP signal detected varies as much as 30uS, reading to reading, with a 300uS delay between readings.

Application:

We are using plastic bags with different levels of water (one 3.5" and one 7.5") housed in acrylic containers with ceramic plates below and the transducer is mounted at the top of a bag of water, we get spurious readings for Time-of-Flight from TDC1011.

Our design has a 12MHz oscillator and the TX_FREQ_DIV is set to divided by 4 for 3MHz on the TDC1011. Our TX amplitude is set to 6.8vdc anything greater or less than this will not allow us to get readings from the sensor.

We have tried two different 3MHz piezo and we are getting the same results using both:

1) Piezo Ceramic Disc 20x0.7mm R 3.0 MHz https://www.steminc.com/PZT/en/piezo-ceramic-disc-20x07mm-r-30-mhz
2) Piezo Ceramic Disc 28x0.7mm R 3.0 MHz https://www.steminc.com/PZT/en/piezo-ceramic-disc-28x07mm-r-3-mhz

We can calculate the expected TOF by using the following calculation:

TOF for water@19cm (7.5") = (2*38cm) / 1480m/s = 256uS
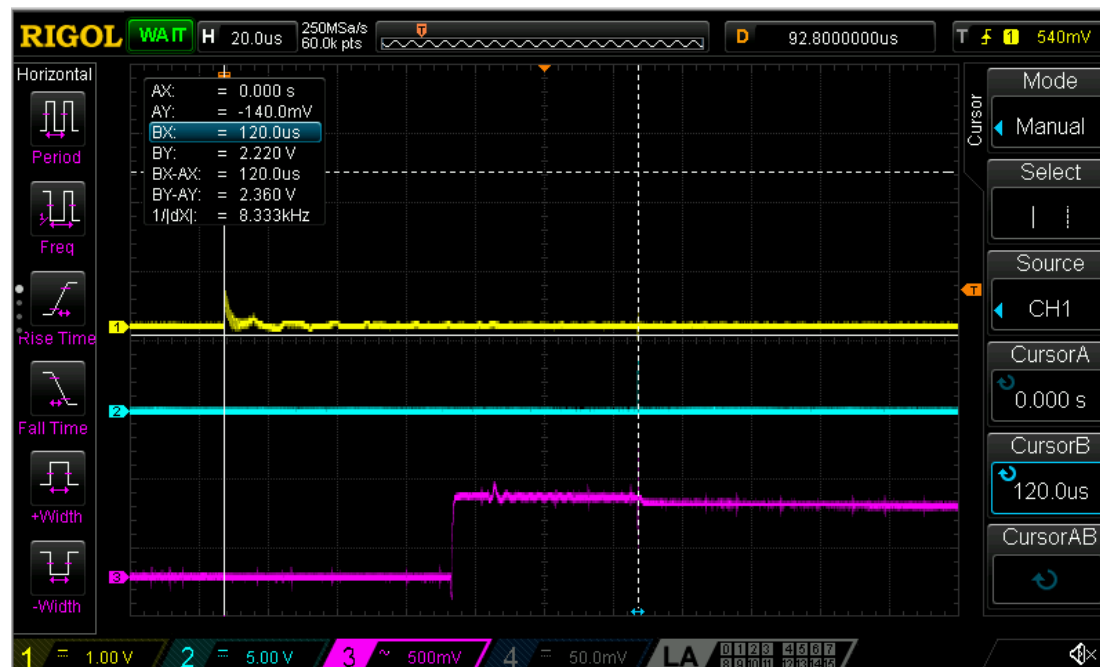
TOF for water@9cm (3.5")= (2*9cm) / 1480m/s = 122uS

To get readings out in the uS we are using "Power Blanking" that allows us to start detecting COMPIN 66uS after the TRIG signal, "TIMING_REG" = 0x0080, Echo_Threshold = -35mV, PGA_GAIN = 18dB.

3.5" container and 28mm piezo: CH1 = TRIG, CH2 = STOP, CH3 = COMPIN

TRIG to COMPIN = 66uS
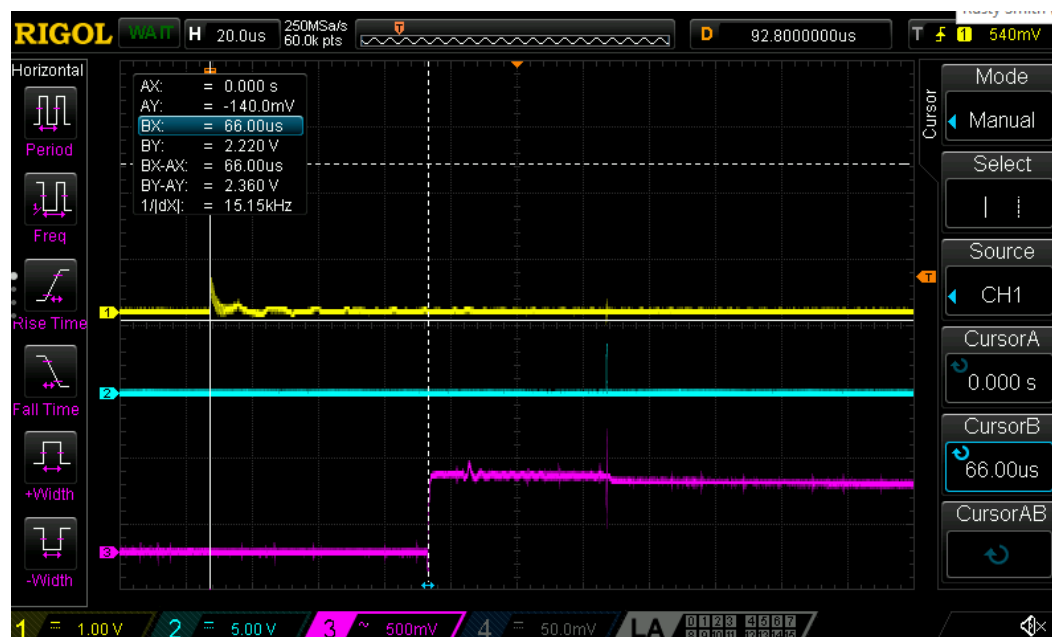
3.5" container and 28mm piezo: TRIG to STOP = 120uS

The following are an example of TOF reading from TDC7200 using the 3.5" container and 28mm piezo, we verified that the readings from the TDC7200 match the scope readings.

```
TOF        126 h
TOF        125 h
TOF        158 h
TOF        126 h
TOF        132 h
TOF        125 h
TOF        149 h
TOF        140 h
TOF        126 h
TOF        158 h
TOF        125 h
TOF        140 h
TOF        134 h
TOF        140 h
TOF        125 h
TOF        125 h
TOF        125 h
TOF        131 h
TOF        140 h
TOF        125 h
TOF        125 h
```

Using the dame setup on the 7.5" container we get the following readings, you can see that we are getting greater TOF readings, but they are still bouncing around and not consistent.

```
TOF        158 h
TOF        125 h
TOF        201 h
TOF        140 h
TOF        150 h
TOF        125 h
TOF        126 h
TOF        140 h
TOF        125 h
TOF        125 h
TOF        125 h
TOF        158 h
TOF        140 h
TOF        199 h
TOF        195 h
TOF        140 h
TOF        150 h
TOF        132 h
TOF        127 h
TOF        140 h
TOF        125 h
TOF        126 h
TOF        140 h
```

The following are how the TDC1011 register are setup:

```
// Write to AFE      Conf0 Conf1 Conf2 Conf3 Conf4 TOF-1 TOF-0 EOR_F TmOT Clk Rate
//                    (0)   (1)   (2)   (3)   (4)   (5)   (6)   (7)   (8)    (9)
uint16 TOF_REGs[10] = {0x21, 0x41, 0x00, 0x08, 0x00, 0xC0, 0x80, 0x03, 0x03, 0x03};
```

The following are how the TDC7200 register are setup:

```
// Write to TDC      Confg1 Confg2 IRQ_St Int_Mask  CCOH  CCOL  CLCOH  CLCOL  CLCMH  CLCML
//                    (0)    (1)    (2)     (3)     (4)   (5)   (6)    (7)    (8)    (9)
uint16 TDC_REGs[10] = {0x02, 0x00,  0x1F,   0x01,   0x04, 0x00, 0x00,  0x00,  0x00,  0xF0};
```