TIDA00322 TEST DATA

I. General Description

This document describes the setup and results for testing the TIDA00322EVM with an 88cm tank. The TIDA00322EVM contains a TDC1000 ultrasonic analog-front-end, C2000 MCU to process data, and a 5V-to-30V boost converter for the transmit (Tx) pulses. In test setup the EVM interfaces with a 1MHz transducer to measure the surface level of the water inside the tank. The application for this TI Design includes automotive fluid level, identification, and concentration.

II. Equipment

List of equipment

- TIDA00322 evaluation board with USB-to-TTL serial cable
- Test cylinder with 1MHz transducer mounted on the bottom. This test uses STEMiNC's transducer (p/n: SMD10T2R111)
- RTD1000 or another accurate temperature sensor
- Tektronix Voltage Probe
- 20V DC Power Supply

A. Test cylinder:

34.64" (88 cm) tank with water and 1MHz transducer mounted at the bottom of tank

Cylinder specifications	
Diameter	6.9 mm
Base Height	4 mm
Cylinder Height	880 mm
Cylinder Material	Acrylic (Perspex)

Table 1- Cylinder Specification

Figure 1 - Cylinder tube

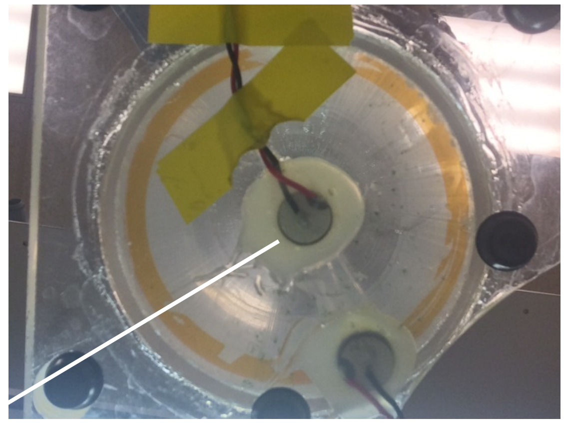

Figure 2 - Transducer glued to the bottom of tube

B. **Tektronix Voltage Probe**

Tektronix P6243 1 GHz, TEKPROBE BNC Single-Ended Low Voltage Probe was used to corroborate the STOP pulses with the echo signal at the COMPIN node at C32.
An active FET prove is needed to avoid offsetting the signal at the COMPIN node

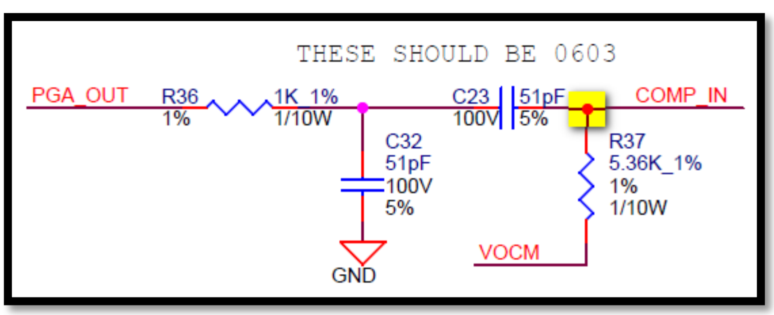

Figure 3 - Schematic COMPIN section

Figure 4 - FET probe

III. Block Diagram of Test Setup

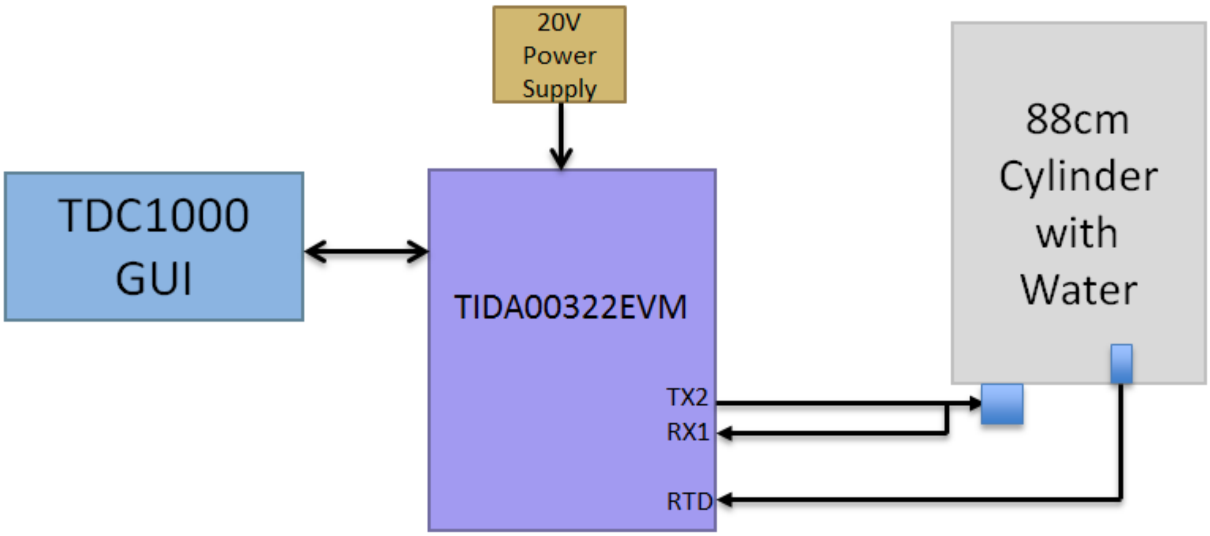

Figure 3 – Test Setup Block Diagram

IV. Test Setup

A. **Getting Started with Software –** refer to the "*TIDA00322EVM – Quick Start Guide.pdf*" to install the TDC1000 GUI for this TIDA00322EVM.

B. Getting Started with Hardware

1. Connect a USB-to-TTL serial cable to the TIDA00322EVM's J5 connector (for instructions on how to install the driver for this cable, see *TIDA00322EVM – Quick Start Guide.pdf*)

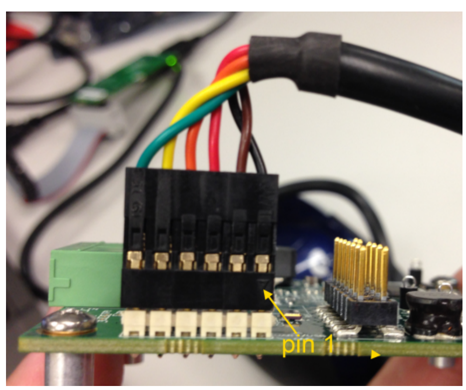

Figure 4 - FTDI connector

2. Connect the transducer TX/RX wire to J3.P8, and the sensor's ground to J3.P10

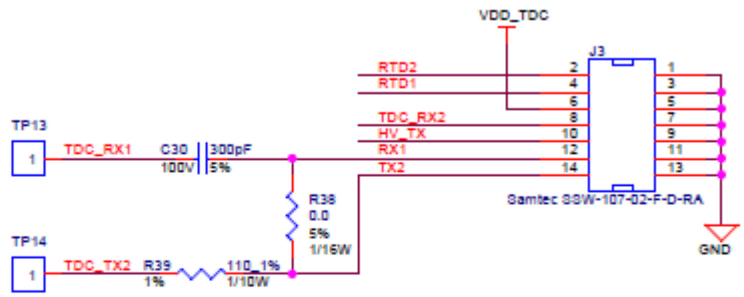

Figure 6 – Transducer Connector

C. TIDA00322EVM Power

1. Connect 20V to pin 1 of J4 (J4.P1), and the supply's ground to J4.P4. Limit the power supply current to 0.10mA

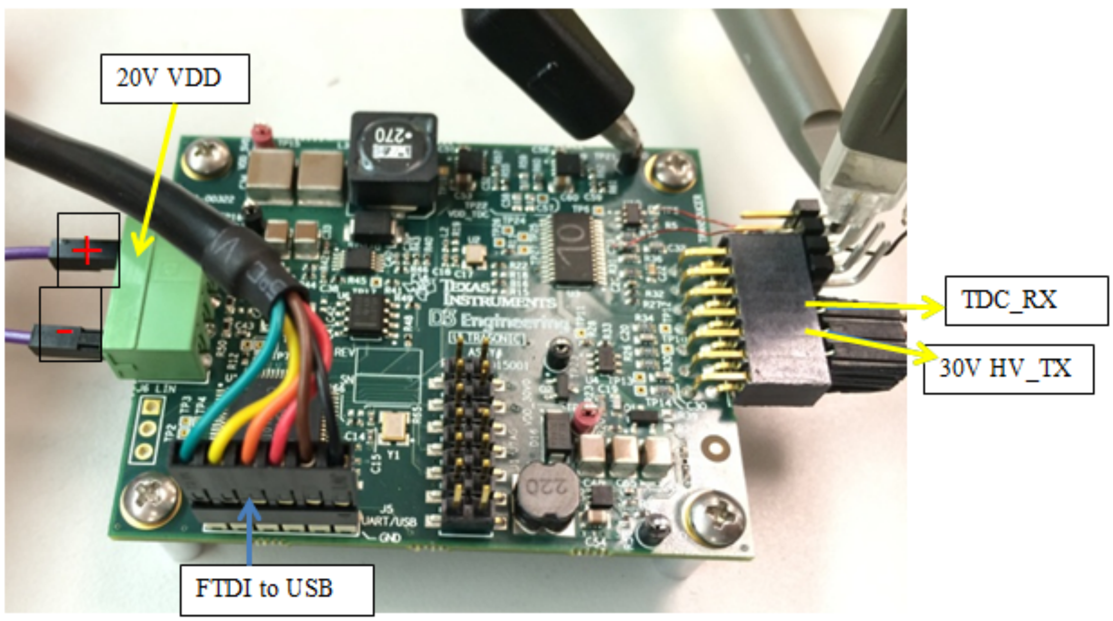

Figure 5 - EVM connections

D. Opening the GUI

1. Open the TDC1000_C2000EVM GUI software. By default it can be found by clicking on Start >> All Programs >> Texas Instruments >> TDC1000_C2000.
2. In order to enable the high voltage TX on channel 1, follow the steps below:
   a. In the **"Setup"** tab, select **TDC 1000 –HV Driver EN1**

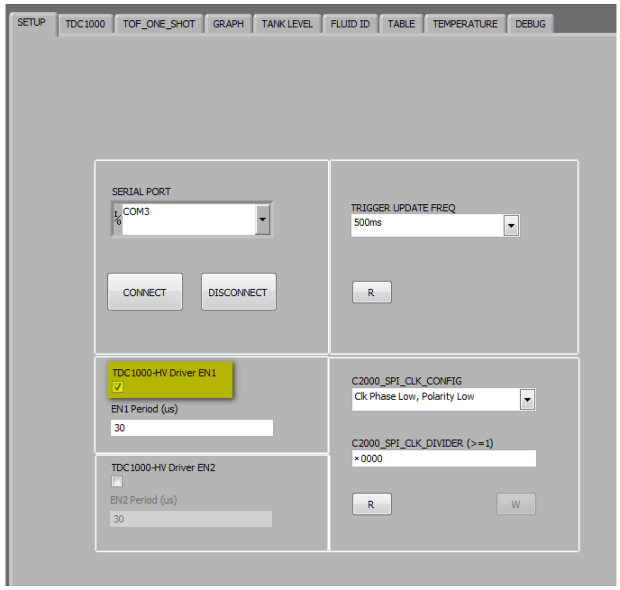

Figure 6 - EVM GUI SETUP tap

b. Click on the **"TDC1000"** tab

c. In the "**CH_SEL"** register, select "**CH1 (TX1)"**

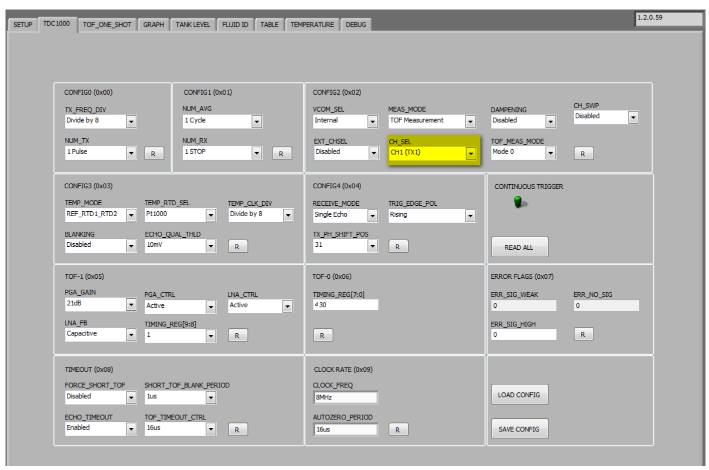

Figure 7 - EVM GUI TDC1000 tap

3. Slowly pour the tap water into the tube. On this test, we used random water levels (millimeters): 39, 70, 98, 133, 164, 212.5, 271, 402, 457.5, 550, 630, 760, 781 and 876

4. Before increasing the water levels, go to the "**Graph**" tab on the TDC1000-C2000EVM GUI and click "**Start Graph**". The time of flight (TOF) will be displayed in the window. Record the value that appears on the TDC AVG VALUE window.

5. Measure the level of the water in the tank using the measuring tape on the side of the tank, and record this value.

6. Use the equation on the next section to calculate the level using the TOF from the GUI

V. Test Results

A. Test conditions

Test conditions	Units
Average water temperature	23 C^0
Substance in tube	Tap Water
Speed of sound in tap water at 23 C^0	1,491.50 m/s
Transducer excitation pulse	30V
EVM C2000 D3 VDD	20V

Table 2 – Test Conditions

Note: The average temperature should be taken with a RTD1000 or another accurate temperature sensor. Speed of sound was obtain from *Journal of Rese arch of the National Bureau of Standards* http://nvlpubs.nist.gov/nistpubs/jres/59/jresv59n4p249_A1b.pdf

B. Measurements and test results- use the equations below to calculate for Calculated Height and Percentage Error:

1. Calculated Height using the GUI TOF = (Time-of-Flight from GUI)*1491.50 / 2
2. Percentage error (%) = |Measured ht. – calculated height| / (Measured height) * 100

n	Measured height with tape ruler [mm]	Time Of Flight From GUI [us]	Calculated Height from GUI's TOF [mm]	Measured height - experimental height [mm]	Percent Error [%]
1	39	51.42	38.35	0.65	1.7%
2	70	93.05	69.39	0.61	0.9%
3	98	129.57	96.63	1.37	1.4%
4	133	175.85	131.14	1.86	1.4%
5	164	220.77	164.64	0.64	0.4%
6	212.5	285.57	212.97	0.47	0.2%
7	271	365.10	272.27	1.27	0.5%
8	402	539.41	402.27	0.27	0.1%
9	457.5	613.59	457.58	0.08	0.0%
10	550	738.05	550.40	0.40	0.1%
11	630	845.89	630.82	0.82	0.1%
12	760	1018.77	759.75	0.25	0.0%
13	781	1047.61	781.26	0.26	0.0%
14	876	1174.43	875.83	0.17	0.0%
AVERAGE				**0.38875038 [mm]**	**0.48%**

Table 3- Measurement Results

C. **Data Plot –** the plot below shows the Measured Height (in blue) and Calculated Height (in red)

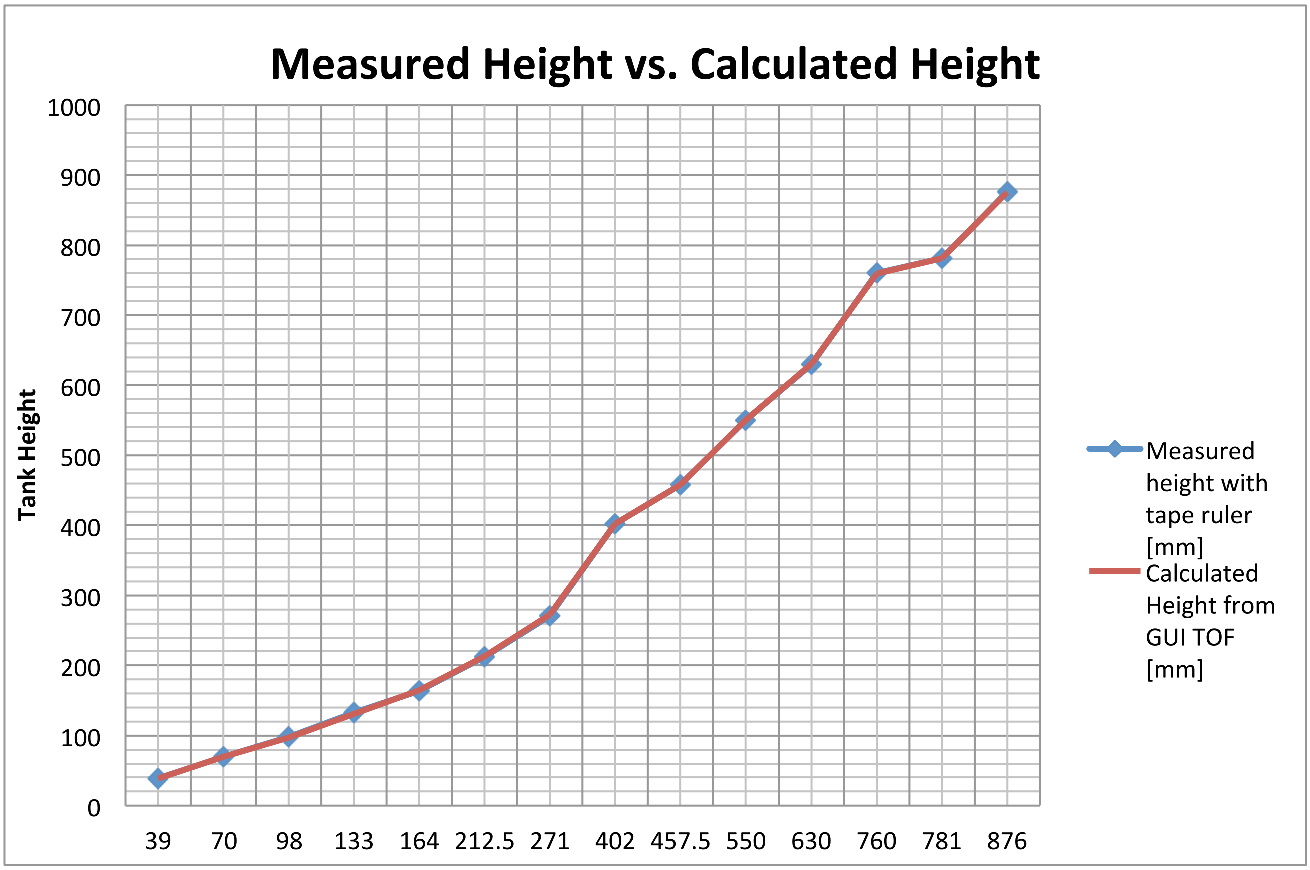

Figure 8 – Measured Height vs. Calculated Height

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