Application User Guide for Liquid Level Detection Demo Setup

Contents

1 INTRODUCTION

This guide will explain the process to setup and run the liquid level detection demo. Using a liquid level detection demo with Chirp sensor module, the amount of liquid in a cup can be distinguished. Using automatic parameter settings, the demo can demonstrate a cup in an empty or semi-filled state to be detected by a sensor and then filled to the parameter's set level percentage. The liquid level demo is standalone setup and can be used without an external GUI or computer software. For a more refined demonstration or to see output plots, refer to the reference documentation section for the reference design write up.

1.1 SCOPE

- Review the liquid detection Demo H/W setup

- To run the liquid detection demo

- Understand basics how sensor detects cup edge, table, and liquid level

- Introduction to integrating liquid detection application

- To debug H/W setup issues

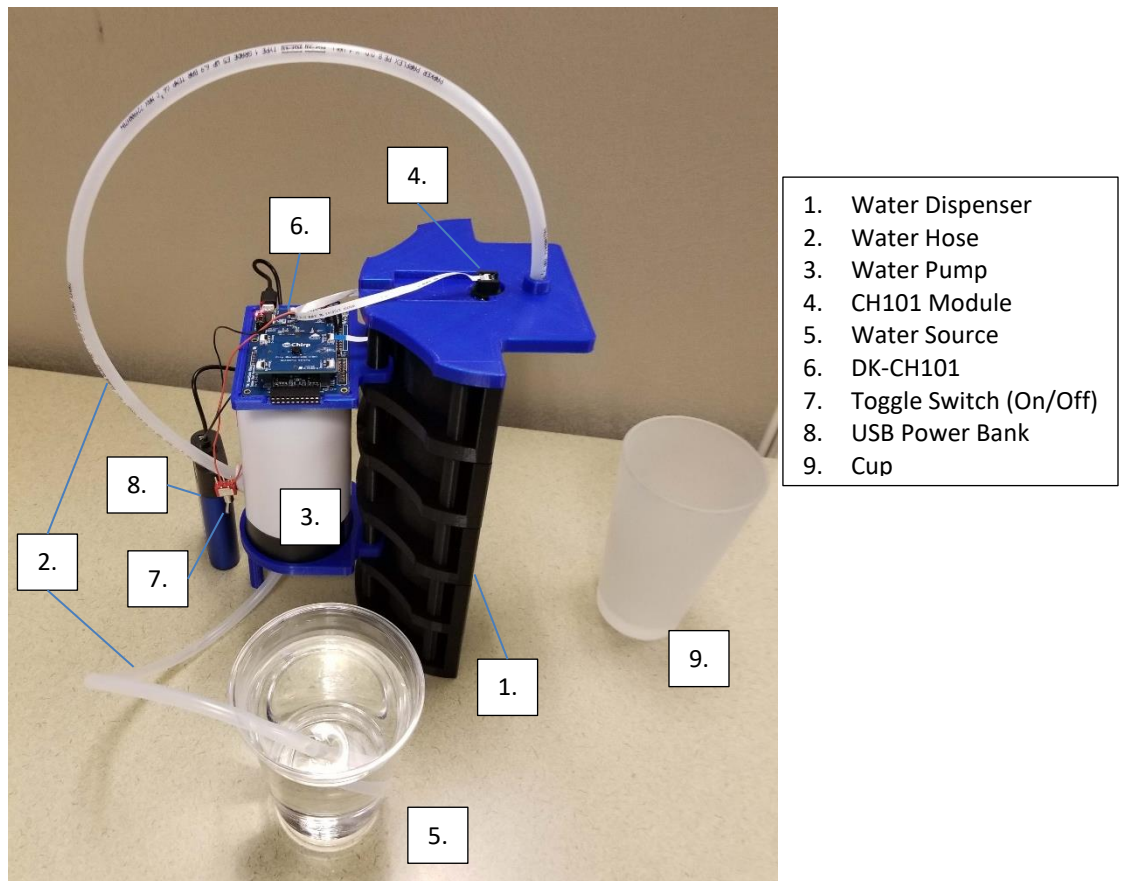## 1.2 REFERENCE DOCUMENTATION

Table 1-1. Reference Documentation

Type	TDK/ Chirp Reference Document	
	Document Number: Name	**Section**
CH101 Module	AN-000259: CH101 Design Guide AN-000231: EV_MOD_CH101 User Guide DS-000388: CH101 Datasheet DK-CH101: Product Brief	1
Hardware	AN:000333: Liquid Level Detection Reference Design Guide AN-000158: CH101 Mechanical Integration Guide	1
Software	AN-000180: CH101 & CH201 Smart Sonic Eval Kit AN-000154: SmartSonic Hello Chirp Application Hands-on Exercise AN-000175: SonicLib Programmers Guide AN-000301: SmartSonic Liquid Level Example User's Guide	2

1.3 REQUIRED HARDWARE AND SOFTWARE

The liquid level detection demo hardware and software bill of materials (BOM) is below:

1. Hardware:
   - Water/Liquid Dispenser
     - o Water Pump w/ tubing
   - DK-CH101 - Evaluation Kit
     - o Needs USB power source
     - o Demo needs two extra pins on DK-CH101 to control water pump
   - Micro-USB cable
   - Chirp sensor module: EV_MOD_CH101-03-01
   - Cable FFC 8POS
2. Software:
   - Proper f/w package - if f/w flash needed
     - o See Section 2.1
   - Atmel Studio 7 - if f/w flash needed

Figure 1-1. Liquid Level Detection Demo BOM

1. Water Dispenser
2. Water Hose
3. Water Pump
4. CH101 Module
5. Water Source
6. DK-CH101
7. Toggle Switch (On/Off)
8. USB Power Bank
9. Cup

1.4 THEORY

Please refer to AN-000259 CH101 Design Guide for detailed module and module integration information.

The CH101 sensor, a single pulse-echo sensor, is an ultrasonic transceiver that can transmit and receive ultrasound signals. These sensors measure the round-trip time that it takes for sound to be transmitted and returned to determine the distance. This also known as the Time of Flight (ToF). The image below shows an example of the how the sensor detects a signal, in this case a table surface. Using the data received, the floor type can be distinguished with various metrics. The table is determined by the strength of the return signal. For a more in-depth explanation of ultrasonic sensing and hardware.

Figure 1-2. Single-Sensor Pulse-Echo
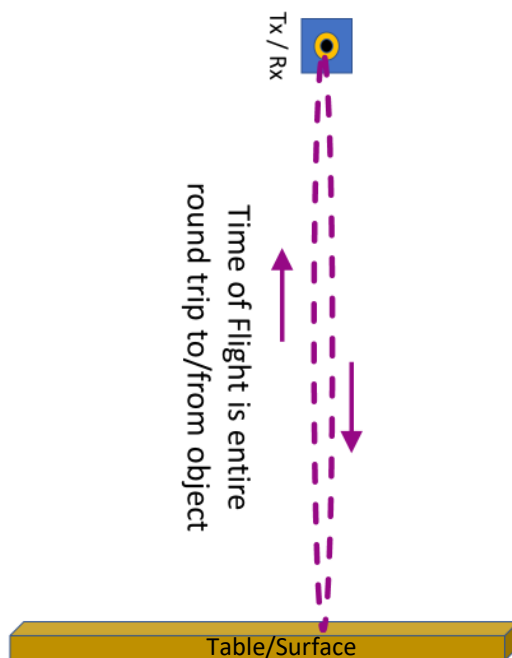
2 HARDWARE SETUP

2.1 SMARTSONIC (DK-CH101) PREPARATION

Before using the demo, the DK-CH101 SmartSonic needs to be flashed with the proper firmware (f/w). Download and unpack the latest or desired firmware release package. This step can be skipped if the DK-CH101 is known to have the correct f/w or if It was received from shipment. Below is the list of available f/w packages available for use with this standalone demo.

Table 2-1. Available f/w for Standalone Demo

Description	FW
Liquid Level Demo – Fill to threshold	invn.chirpmicro.smartsonic.liquidlevel-example.1.42.xx

2.1.1 DK-x01 SmartSonic and Daughterboard Hardware

The DK-x01 SmartSonic hardware out-of-box is shown below. Note that the horn on the daughter board may differ from the picture. Refer to the reference documentation for more information.

Figure 2-1. SmartSonic Hardware basics
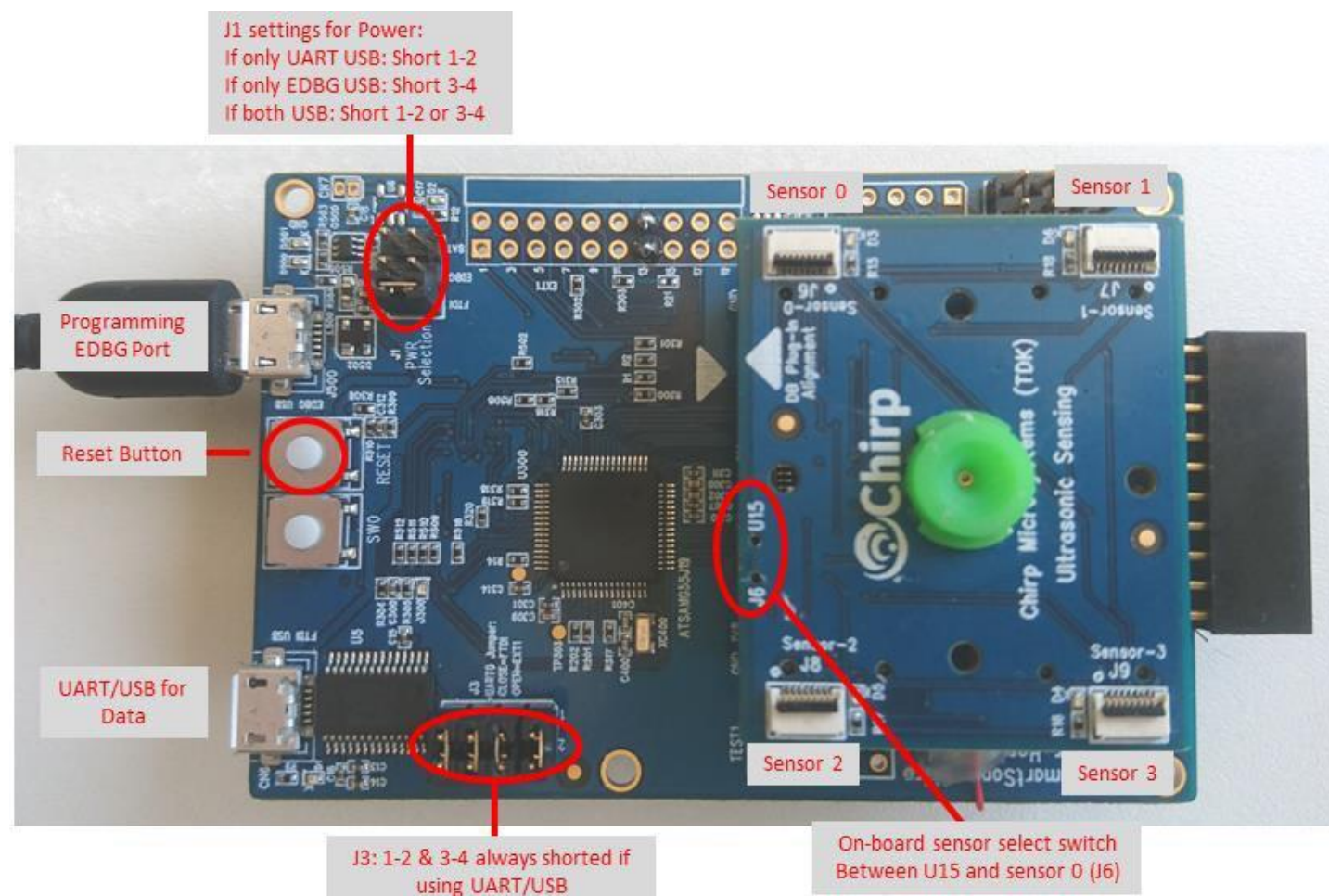
2.1.2   Using SmartSonic Module Sensor

Setup instructions are below:

1. Connect one end of the 8POS FFC cable to the Sensor-0 connector and the other into the CH101 module sensor. Check flex orientation to prevent flex cable hitting other components.

    a) Sensor-0 – J6

    b) CH101 - Note: Horn may differ from picture

2. Move jumper to FTDI slot after board has been programmed

3. Connect all J3 jumpers

4. Move USB connection to PC to FTDI-USB connector

5. Toggle the switch from U15 to J6 (Sensor-0) - Note: U15 will use horn on SmartSonic

6. Reset when changing connections, if necessary

Figure 2-2. SmartSonic Connections
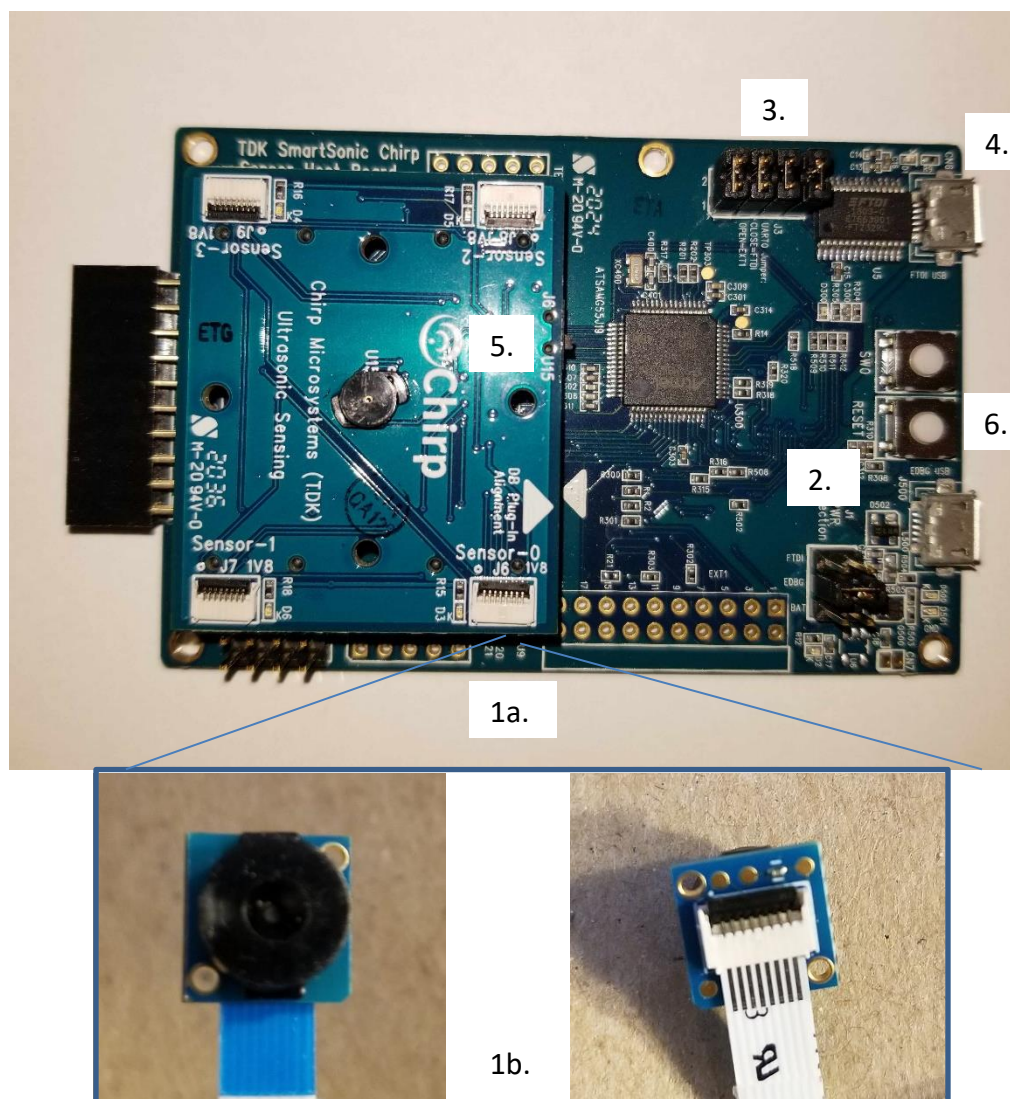
2.1.3 Flash SmartSonic FW

If the SmartSonic has the correct FW, this section can be skipped.

Flash setup instructions are below:

1. Connect the SmartSonic Board to your PC:

   - Plug Micro-USB into the EDBG-USB

   - Move jumper to EDBG (middle)

2. Open Atmel Studio 7 application or use command prompt:

   - Search and download Atmel Studio from their website, if needed.

   - Link: https://www.microchip.com/mplab/avr-support/atmel-studio-7

3. Pull down the Tools menu: "Tools> Device Programming" for programmer SW.
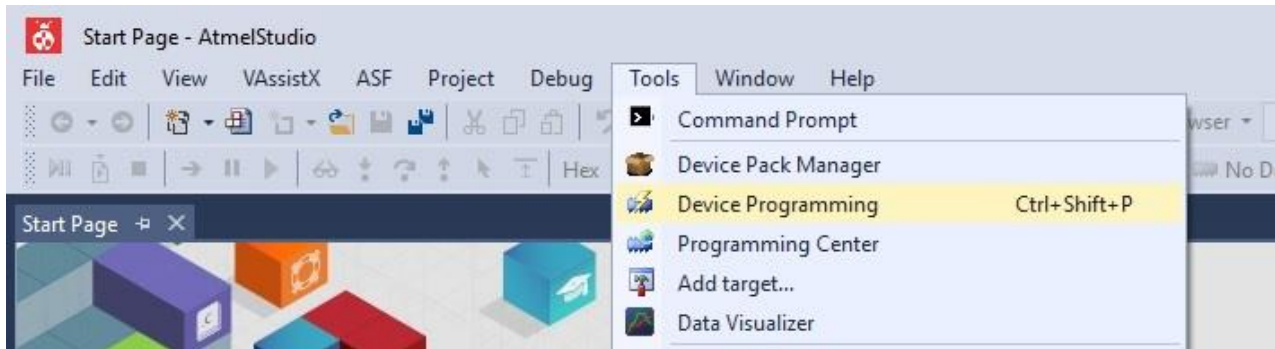
4. Select the settings below and hit 'Apply'.
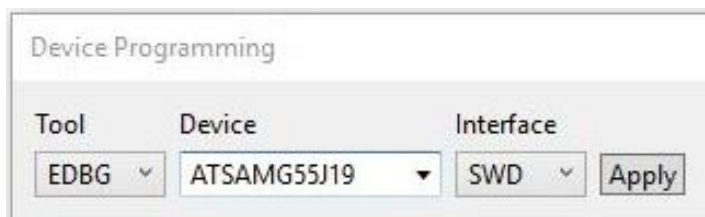
5. Upgrade firmware, if necessary. Older devices will need firmware upgrade.
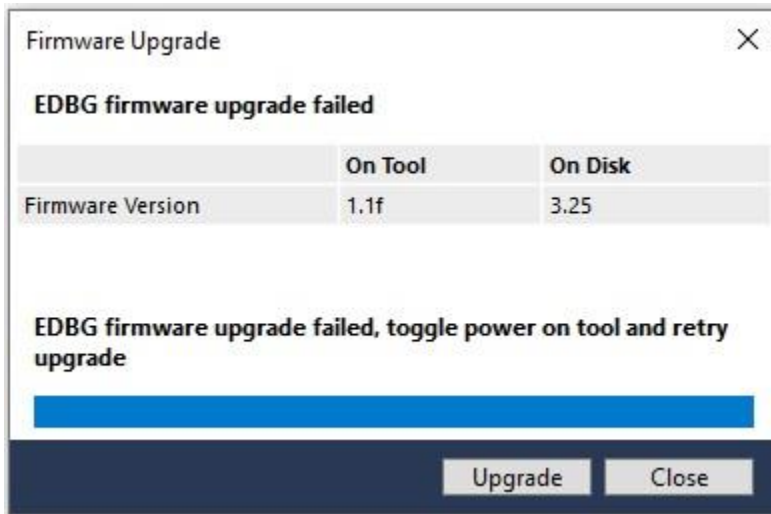
6. In the Memories section, browse for the hex/elf file from the desktop. The file will be in the packaged folder or search for desired file.
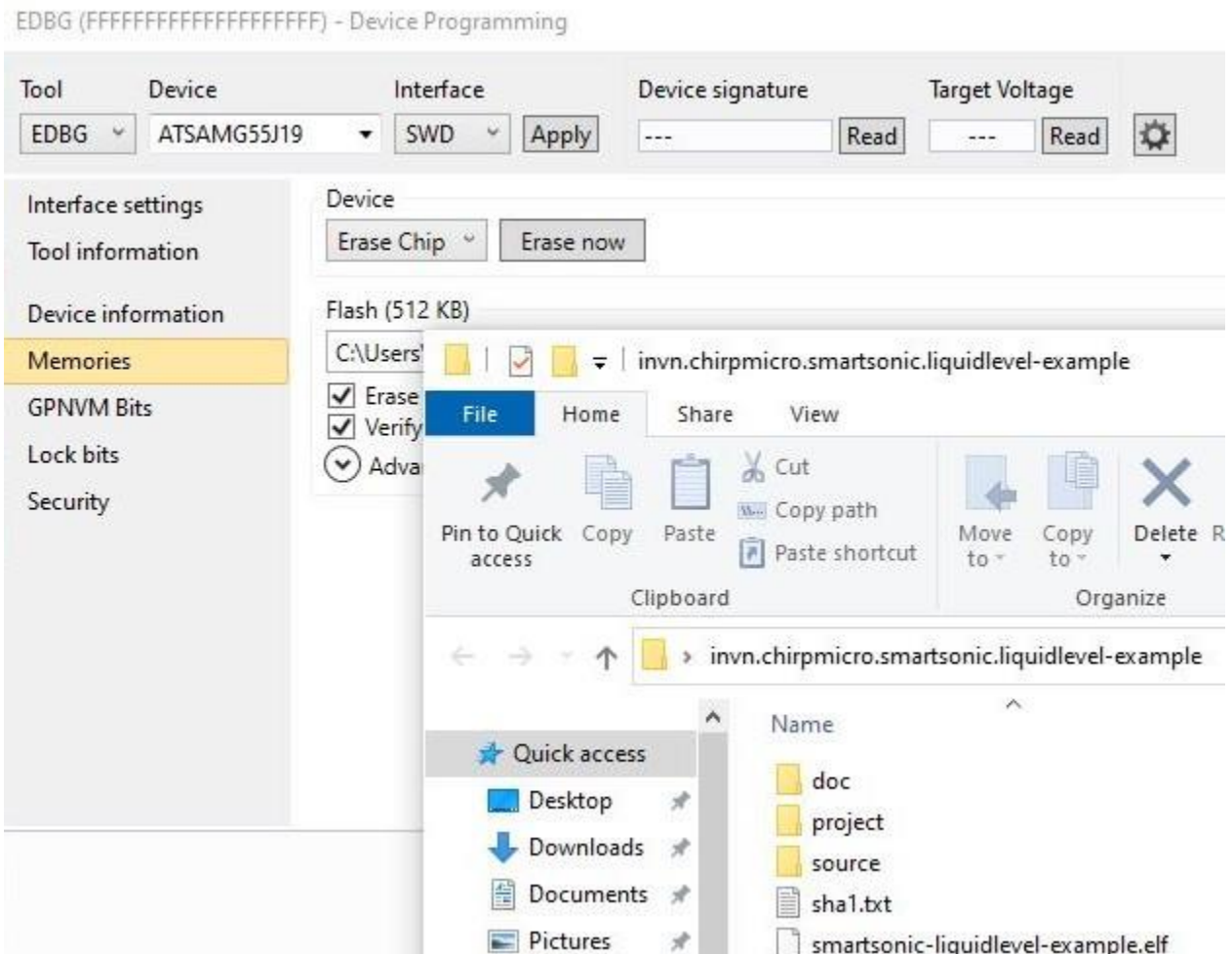
7. Hit 'Program' button. Note that the chip can be erased first than programed after.

8. There will be a Verify Flash completion. If flash procedure has an error: reset the SmartSonic board, check the setup again from the start of this section
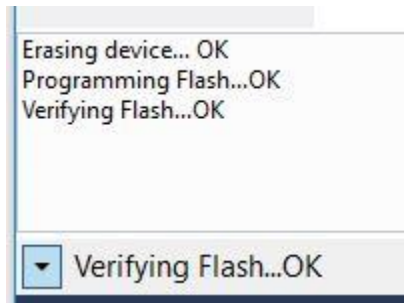
2.2 MODIFIED DK-CH101 FOR DEMO

To control the DK-CH101 to the water pump, two additional header terminals are needed from the SmartSonic board. For ease of assembly, terminals are used over direct wiring. The picture below shows the two connections that need to be plugged into the water pump.

Figure 2-3. Modified DK-CH101 Connections
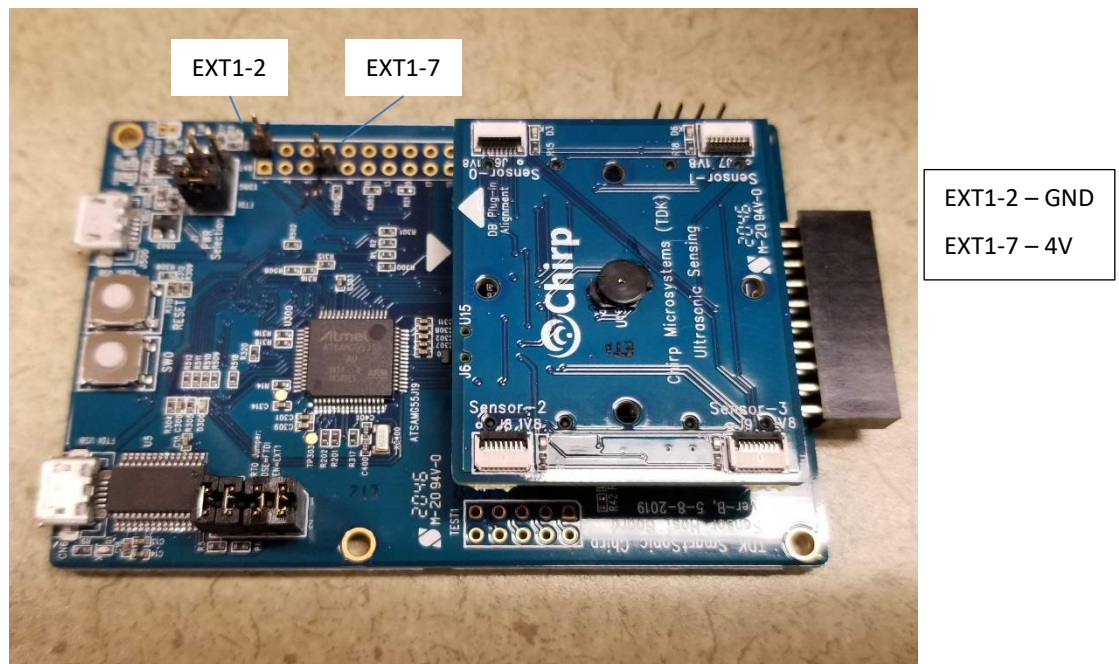
2.3   SETTING UP WATER PUMP

If setup is all plugged in, this section can be skipped.

Setup Instructions:

1. Plug Water Pump Hose to the bottom of the Water Pump

    • Plug tube side of hose to water pump

    • Opposite end of the tube will go into the water source

2. Plug water hose into the top lid of the Water Dispenser

    • Make that hose is flush to the bottom the top lid and the hose is pushed all the way into the water pump

    • Follow bend (see picture)

    • Make sure to push in hose all the way. There is a blue marker mark to know that you have pushed it in all the way

Figure 2-4. Water Hose Setup

Flush
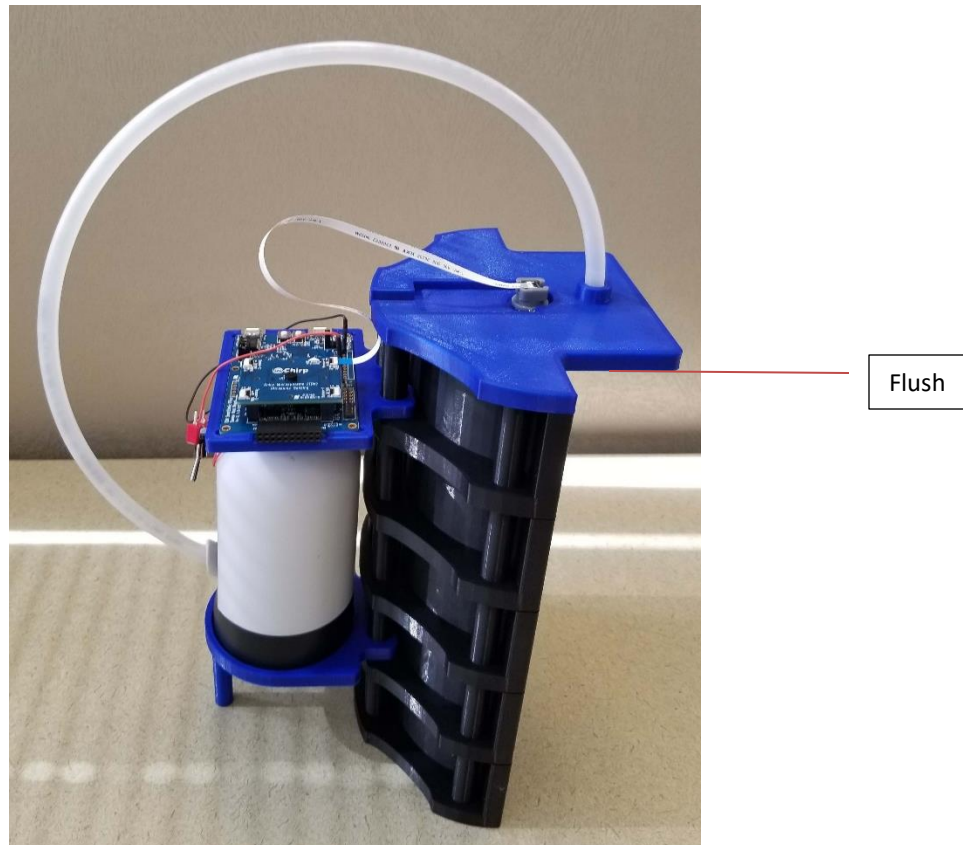
3. Place water pump on stand

    -   Make sure to slide the water pump hose through the opening

Figure 2-5. Water pump on platform

Platform
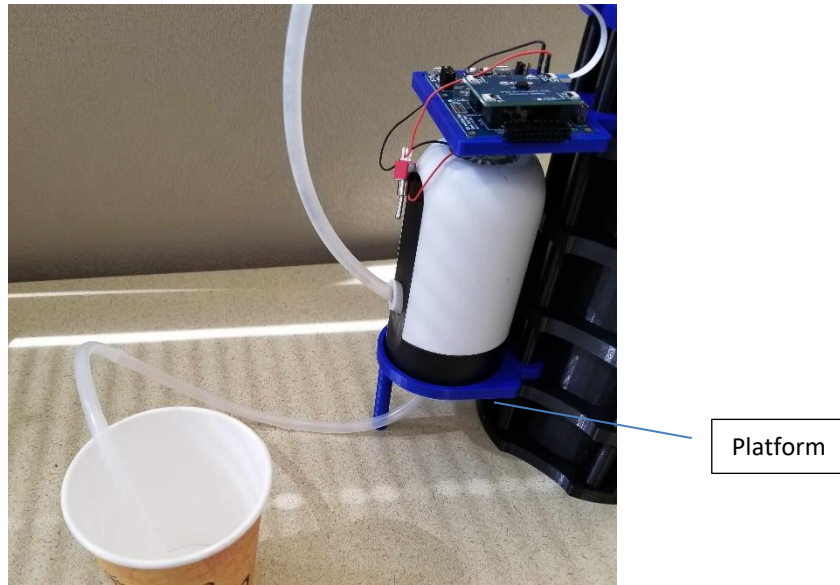
4. Plug in FFC to module and SmartSonic

    -   Notice orientation
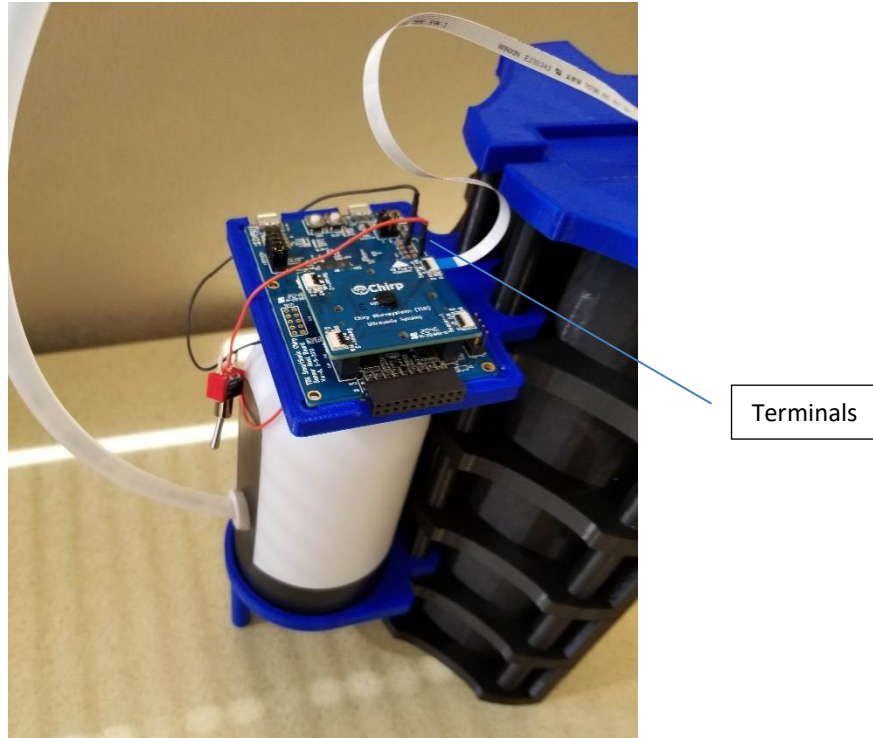   -   Refer to Section 2.1

Figure 2-6. FFC Connection

FFC
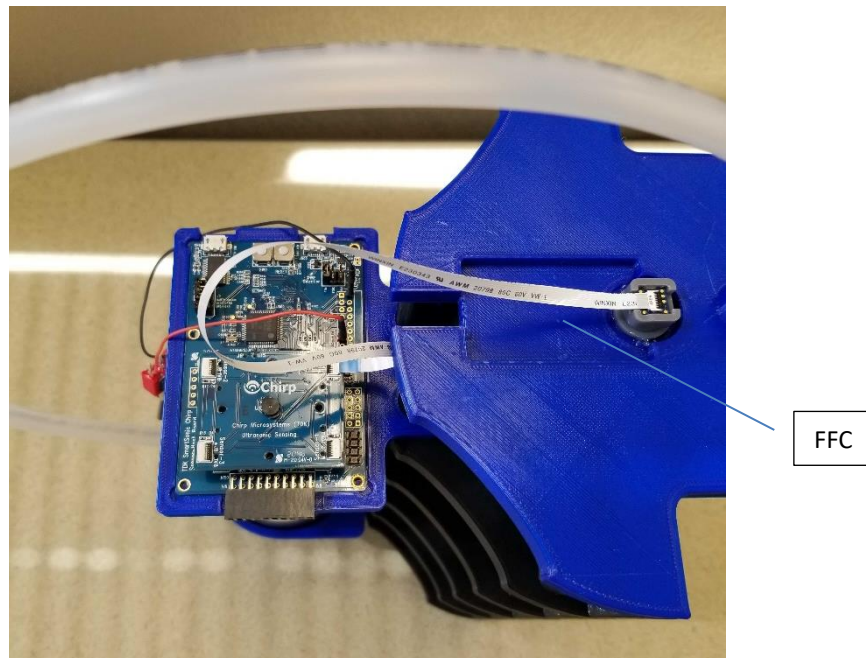
5. Plug in the ground and power pins into the SmartSonic

   - It is best to keep switch off when plugging in terminals

   - Refer to Section 2.2

   - Switch allows power signal to pass through. If you are having issues turning motor off, short the two lines.

Figure 2-7. Plugging Toggle Switch to SmartSonic

3 USING STANDALONE DEMO

The liquid level detection demo is an example mockup demonstrating a working water dispenser. A cup, at any liquid level state, is placed under the sensing area and it will fill liquid to the algo's set liquid percentage threshold. If the liquid is below the threshold value, the water pump will activate and fill to the threshold level. It will automatically turn off the water pump once the threshold is met. The sections below explain how to use the demo.

3.1 QUICK CHECKS BEFORE RUNNING DEMO

- Ensure water source reservoir is more than cup size
- Ensure that hose is securely attached to the water pump
- Clear and room temperature liquid (water) is being used with this demo setup
- Ensure that SmartSonic is flashed to desired FW (see Section 2 for Hardware Setup)
- Confirm cable connections and switch is set to the 'ON' position
- Plug Micro-USB cable from SmartSonic to power source (if other connections have been changed, reset SmartSonic)

3.2 RUNNING DEMO

To run the demo, follow the instructions below:

1. Ensure all checklist items in Section 3.1 are met.
2. Turn Switch to the 'ON' position when ready
   - Refer to Section 0

Figure 3-1. Toggle Switch On/Off
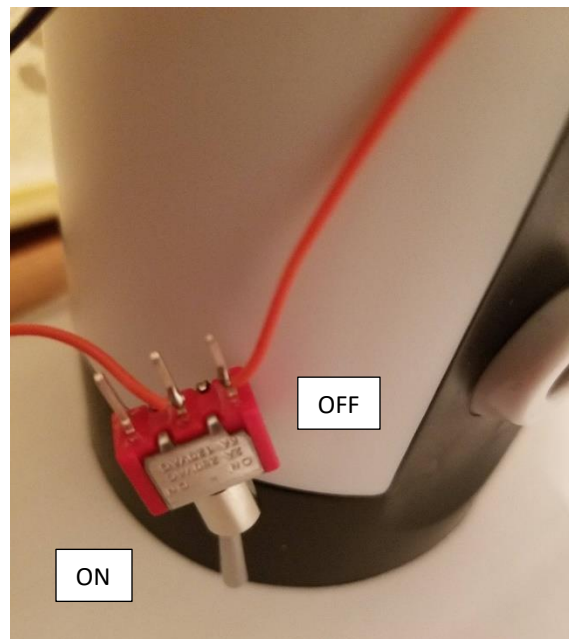
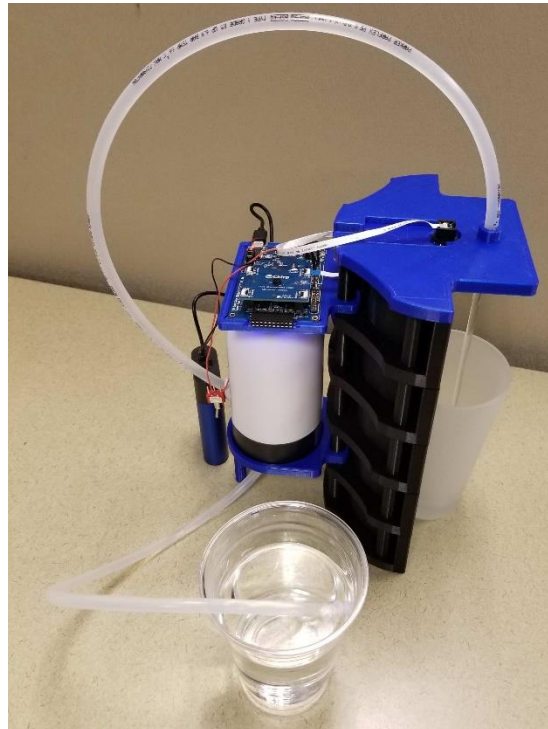3. Reset SmartSonic if connections have been disconnected or modified

4. Place cup under the lid of the water dispenser

Figure 3-2. Cup under dispenser lid

5. Sensor will detect cup edge and activate the water pump

Figure 3-3. Sensor detecting cup to activate water pump

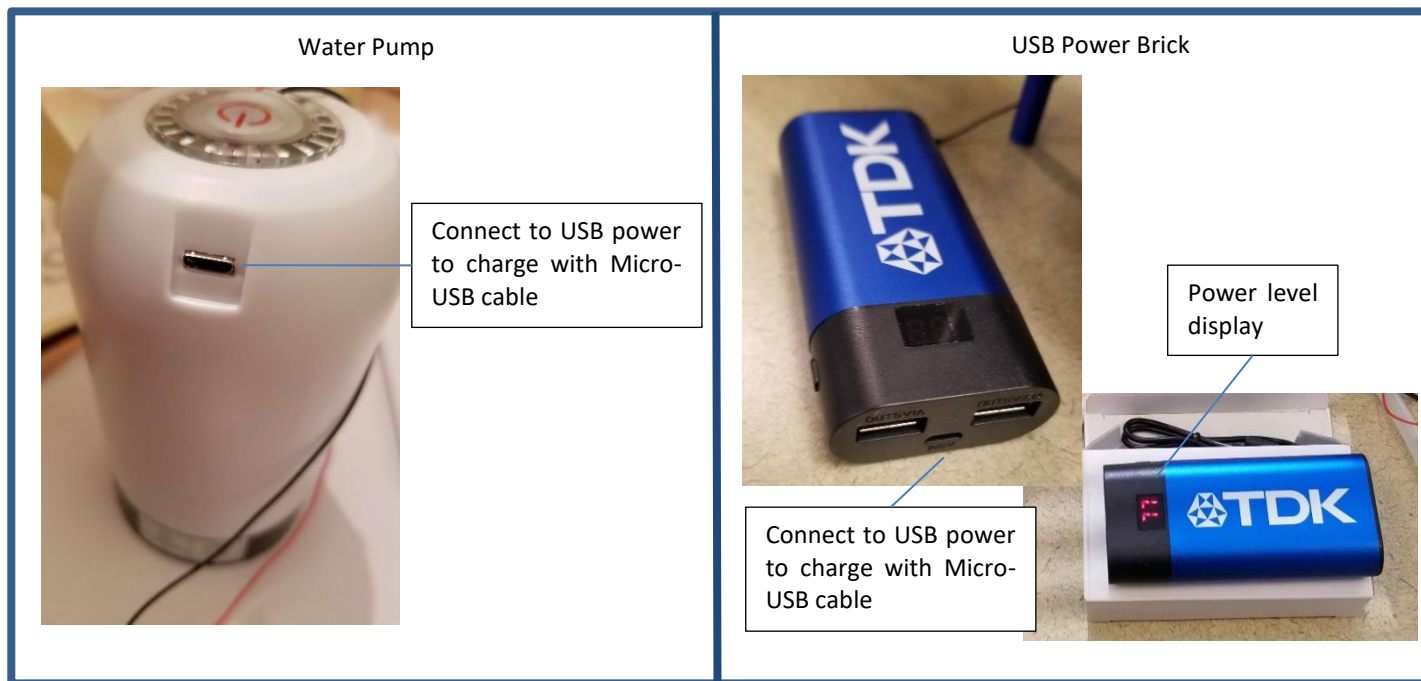6. Water pump will stop once water threshold is met

Figure 3-4. Water threshold met

4 APPENDIX

4.1 CHARGING WATER PUMP AND USB POWER BRICK

The water pump has a battery inside and needs to be charged periodically. The LED will illuminate red when it is charging and will turn green when it is fully charged. For the USB power brick, the power percentage will increase until it is fully charged. See picture below.

Water Pump	USB Power Brick
Connect to USB power to charge with Micro-USB cable	Power level display Connect to USB power to charge with Micro-USB cable

4.2 DEBUG: COMMON SETUP ISSUES

1. **Issue:** Water pump not turning on

   Resolution:

   - Recharge water pump – See Section 4.1
   - Check connections – See Section 2: Hardware Setup Section
   - Recharge/new USB power source – See Section 4.1

2. **Issue:** Demo not working

   Resolution:

   - SmartSonic is not flashed with proper FW – See Section 2.1
   - Check SmartSonic jumpers – See Section 2: Hardware Setup Section
   - Check Toggle Switch is in the 'ON' position
   - Check power Source to SmartSonic
   - Check water Pump is fully charged – See Section 4.1

3. **Issue:** Water is flowing slowly (or no water flowing)

    Resolution:

    - Check for kinks in the water hose from the water source

    - Recharge water pump – See Section 4.1

    - Ensure water source has more liquid than the cup can hold

4. **Issue:** Water pump motor won't stop; Accidental trigger out of box

    Resolution:

    - Short (touching terminals together) the red and black connections while toggle is 'ON' position

Short connection
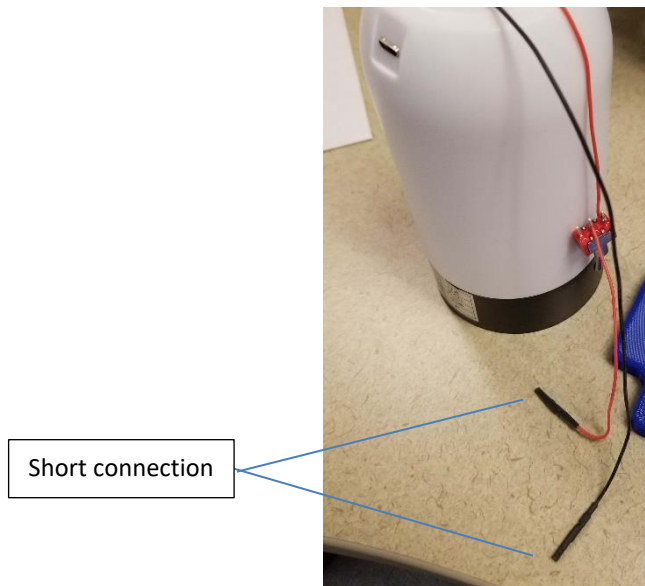
5 REVISION HISTORY

Revision Date	Revision	Description
01/05/2022	1.0	Initial Release