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Synaptics AudioSmart® 2-Mic Development Kit for Amazon AVS

511-000841-01 Rev C

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1. Introduction

This document provides step-by-step introductions on setting up the Synaptics AudioSmart® 2-Mic Development Kit for Amazon™ AVS. This document describes how to make the necessary hardware connections, install the driver, flash the firmware (only when needed), set up the Amazon Alexa™ Voice Service (AVS), and switch between the keyword detection (voice trigger) modes.

1.1. Target Audience

This document is intended for manufacturers and developers for creating Smart Home device prototypes that use the Synaptics AudioSmart 2-Mic Development Kit and the Raspberry Pi 3 (RPi3) (not provided with the kit) to offer an ideal Voice Control experience via Amazon's Alexa Voice Service.

1.2. References

Table 1. References

Name	Description	Location
I2C	I2C Specification	http://www.nxp.com/documents/user_manual/UM10204.pdf
ACPI	Advance Configuration and Power Interface	http://www.acpi.info/DOWNLOADS/ACPIspec50.pdf
RPi3	An open source code single-board computer	https://www.raspberrypi.org/products/raspberry-pi-3-model-b/
ALSA	The Advanced Linux Sound Architecture (ALSA) provides audio and MIDI functionality to the Linux operating system.	http://www.alsa-project.org/main/index.php/Main_Page
ASoC	ALSA system on Chip for I2S codecs	http://www.alsa-project.org/main/index.php/ASoC
Sensory	Wake word engine plug-in for Raspberry Pi	https://github.com/Sensory/Alexa-rpi

1.3. Definitions, Acronyms, and Abbreviations

Table 2. Definitions

Term	Definition
AVS	Alexa Voice Service
DSDT	Differentiated System Description Table
GPIO	General-Purpose Input/Output
I2C	Inter-Integrated Circuit
RPi3	Raspberry Pi 3

2. Overview

The Synaptics AudioSmart 2-Mic Development Kit for Amazon AVS contains the following:

- CX20921 evaluation board, pre-flashed with firmware for the CX20921 device.
- Microphone module with two omnidirectional mics
- Stereo 3.5 mm male-to-male audio cable
- Micro-USB cable
- Type A to Type B USB cable
- Cable assembly (colored wires)
- +5V power supply for CX20921 evaluation board

Note:

- Micro SD card of at least 8 GB is required
- Powered speakers, RPi3 board, and micro SD card are all mandatory for the set up but are NOT included in the Synaptics AudioSmart 2-mic Development Kit.
- Proper speaker protection will enhance overall performance. See *External Loudspeaker Guidelines and Recommendations for Smart Speaker Applications* (PN: 507-000837-01) document for additional information.

Figure 1. Development Kit Components
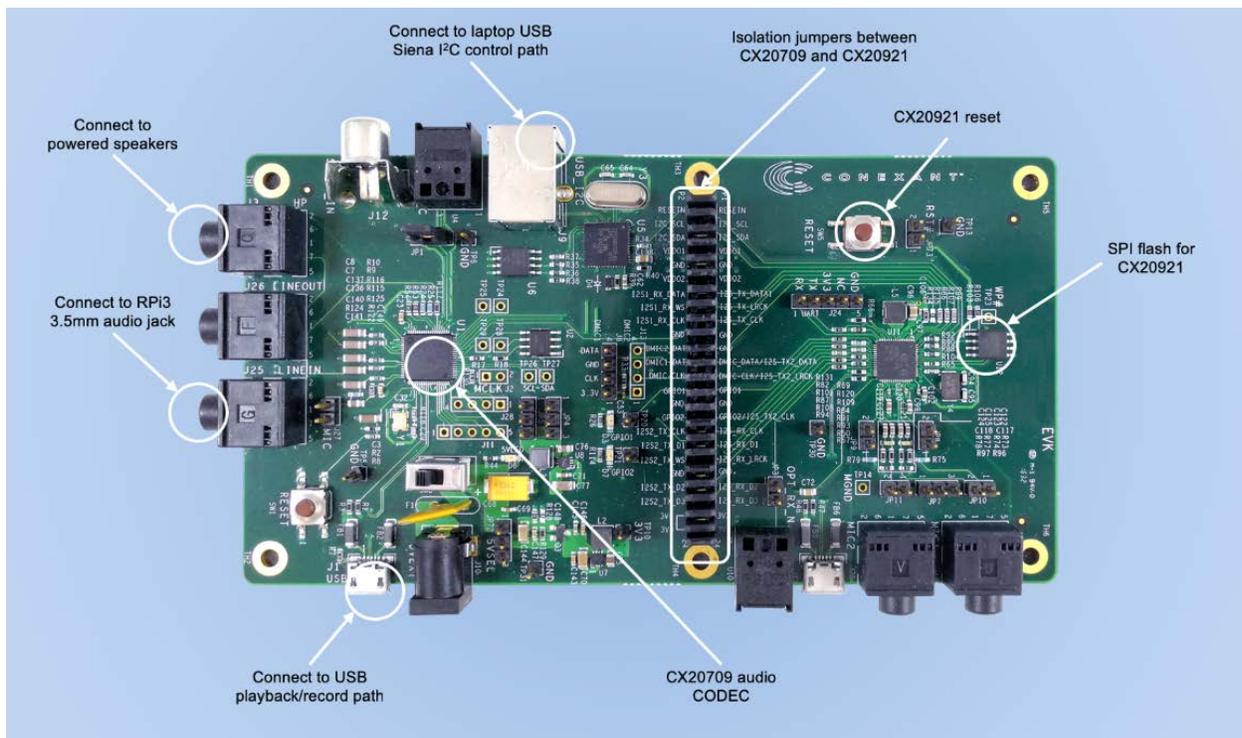
2.1. CX20921 Evaluation Board

Figure 2. CX20921 Evaluation Board: Connections, Interfaces and Devices

2.2. Pin Definition

Figure 3 shows the RPi3 pinout definition. Pins 13 and 14 are used and are emphasized in red.

Raspberry Pi 3 GPIO Header

Pin#	NAME			NAME	Pin#
01	3.3v DC Power			DC Power 5v	02
03	GPIO02 (SDA1 , I²C)			DC Power 5v	04
05	GPIO03 (SCL1 , I²C)			Ground	06
07	GPIO04 (GPIO_GCLK)			(TXD0) GPIO14	08
09	Ground			(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)			(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)			Ground	14
15	GPIO22 (GPIO_GEN3)			(GPIO_GEN4) GPIO23	16
17	3.3v DC Power			(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)			Ground	20
21	GPIO09 (SPI_MISO)			(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)			(SPI_CE0_N) GPIO08	24
25	Ground			(SPI_CE1_N) GPIO07	26
27	ID_SD (I²C ID EEPROM)			(I²C ID EEPROM) ID_SC	28
29	GPIO05			Ground	30
31	GPIO06			GPIO12	32
33	GPIO13			Ground	34
35	GPIO19			GPIO16	36
37	GPIO26			GPIO20	38
39	Ground			GPIO21	40

Figure 3. RPi3 pinout

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3. Using the Development Kit

3.1. Hardware Setup

Connect the CX20921 evaluation board and the RPi3 (not provided with the kits).

3.1.1. Connecting the Evaluation Board to the RPi3

Make the following hardware connections between the CX20921 evaluation board and the RPi3 (not provided with the kit), as shown in Figure 4 and Figure 5.
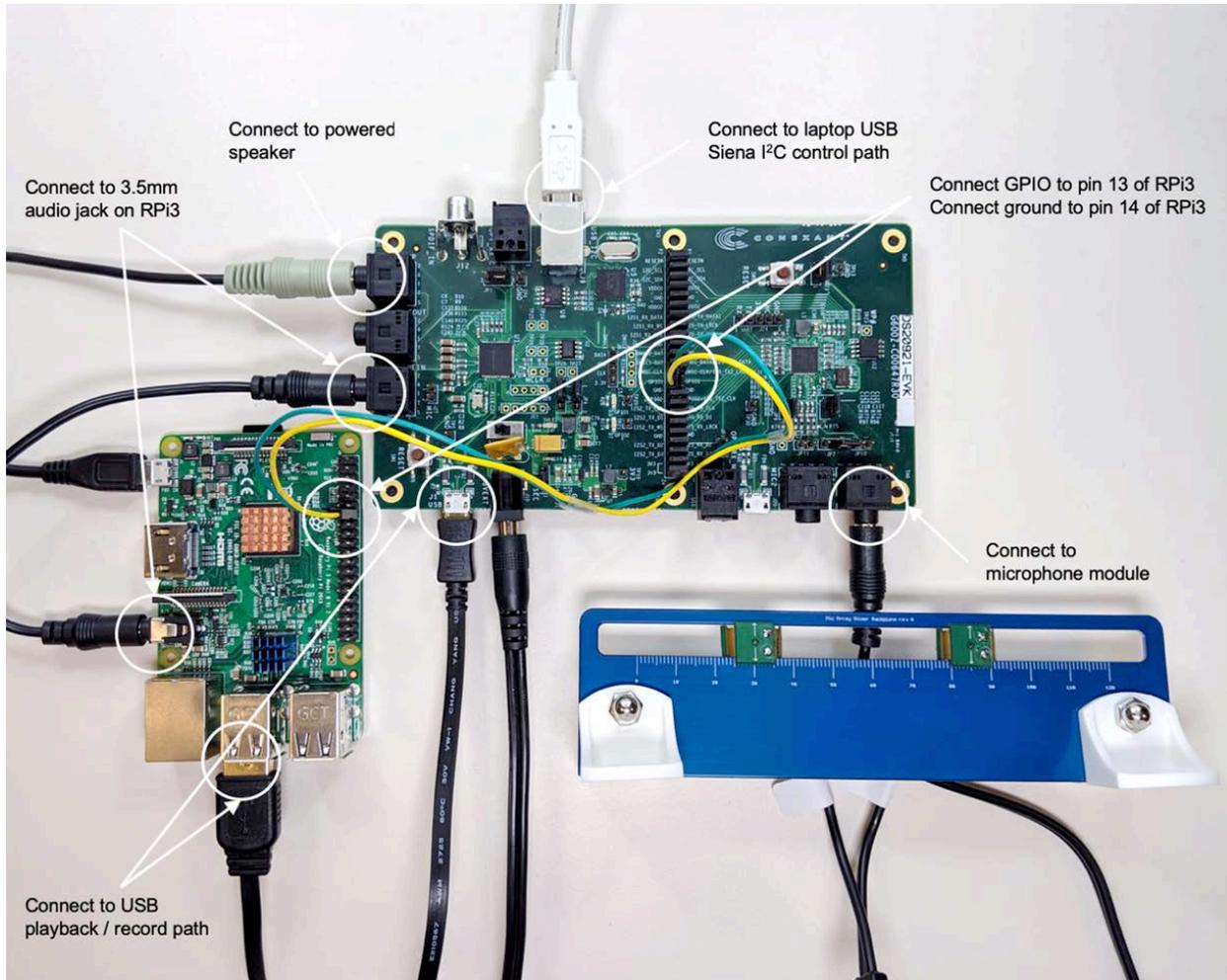

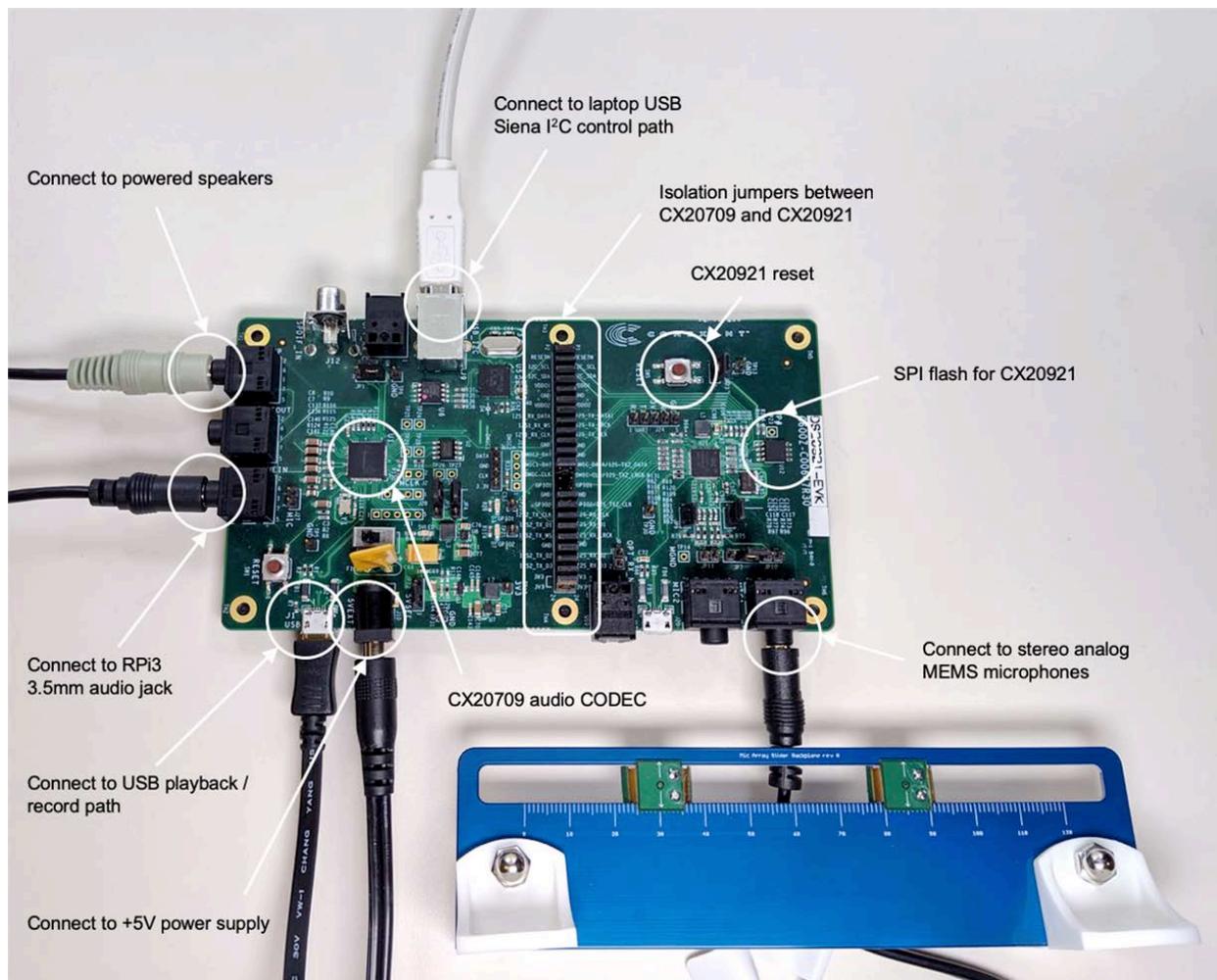*Figure 4. CX20921 evaluation board setup with RPi3 board and Mic board (with 2-mic attached)*

Figure 5. Connections for CX20921 evaluation board and Mic board (with 2-mic attached)

1. Connect the 3.5 mm audio jack on the RPi3 (J7) to LINEIN on the CX20921 evaluation board (J25).
2. Connect audio jack (J3) (Line Out labeled as HP) on the CX20921 evaluation board to a powered speaker.
3. Connect the microphone module to the CX20921 evaluation board (J19).
   a. Spacing between the left MIC and right MIC should be set to 55 mm with the preloaded configuration (see Figure 4).
   b. Software tool (FCP Essential) will be provided for mic distance adjustment between 30 mm – 120 mm.
4. Connect the audio path from micro USB (J1) to USB port on RPi3.

5. Using the Cable Assembly, connect GPIO1 at pin 2.14 from the CX20921 evaluation board to J8.pin13 on the RPi3, and the other wire from the Cable Assembly to Ground (GND) at pin 2.15 from the CX20921 evaluation board to J8.pin 14 on the RPi3.
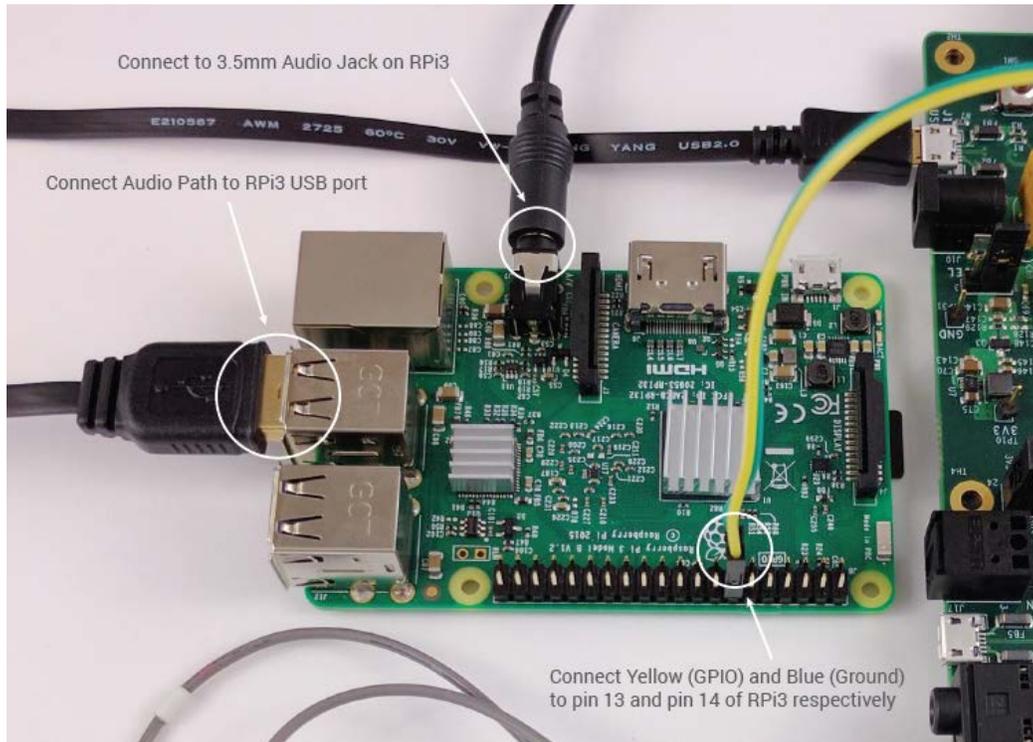
Figure 6. Connections for RPi3

Table 3. CX20921 to RPi3 connections

Signal	RPi3	CX20921 evaluation board
GPIO (indicating trigger detected in CX20921	J8. Pin 13 (GPIO_GEN2)	GPIO1, P2. Pin 14
Ground	J8. Pin 14 (Ground)	GND, P2. Pin 15
Audio Signal from RPi3	3.5 mm audio jack (J7)	LINEIN (J25)
Processed microphone signal from CX20921 evaluation board	USB port	Micro USB (J1)

6. Connect the power supplies for both the CX20921 evaluation board, (J10, +5V power supply included) and the RPi3 (J1).

    a. Switch the power switch (SW3) to turn on the CX20921 evaluation board.

    b. LED D6 (5VLED) will turn on when there is power on the board.

• Proper speaker protection will enhance overall performance. See *External Loudspeaker Guidelines and Recommendations for Smart Speaker Applications* (PN: 507-000837-01) document for additional information.

3.2. Software Setup

3.2.1. Writing Raspbian OS to the MicroSD Card

1. Format the SD card. This can be done by going to the 'Computer' folder and right clicking on the SD card. Click **Format...** to display the format options. When reformatting, confirm that the File system is FAT32 or FAT, as shown below.
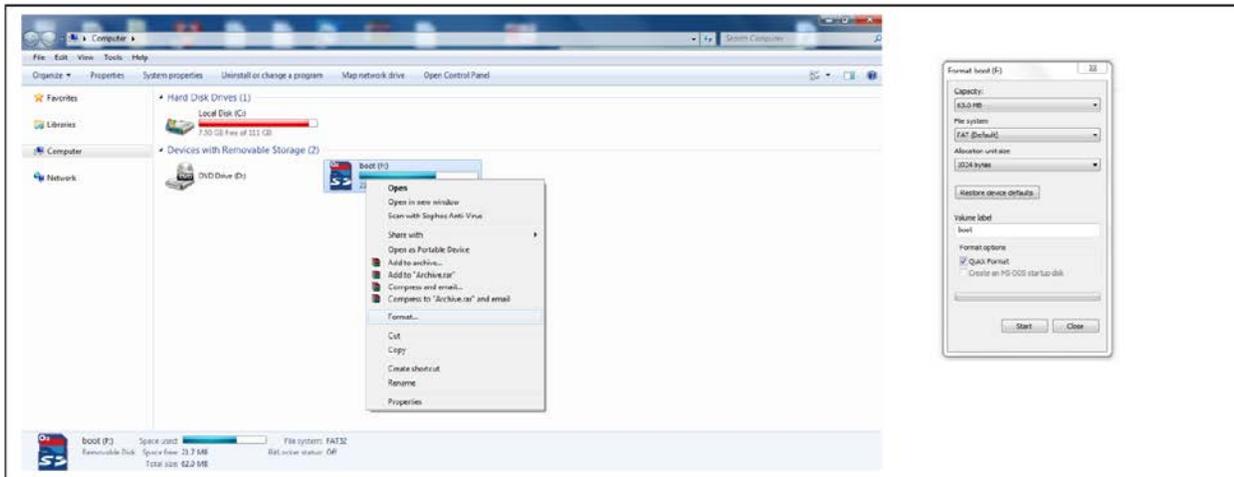
2. Download the Raspbian Stretch OS. The zip file is located at the following link:

   http://downloads.raspberrypi.org/raspbian/images/raspbian-2018-11-15/

3. Unzip and write the downloaded image to the SD card using Win32DiskImager. This tool can be found at the following link: https://sourceforge.net/projects/win32diskimager/

4. Run the Win32DiskImager to write the image to the SD card.
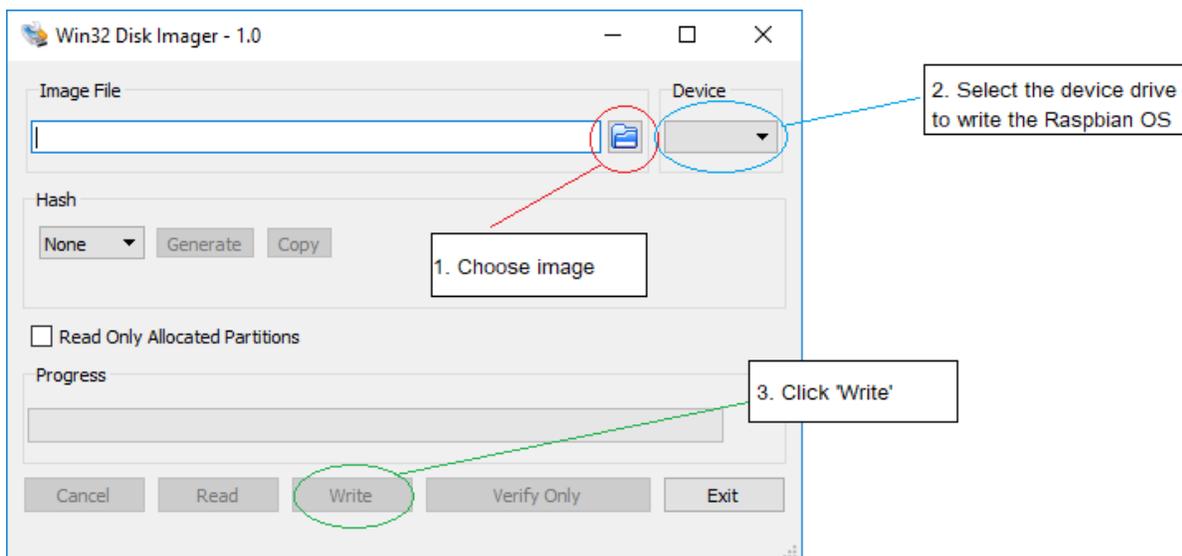
   o Browse to the subdirectory icon and select the image file.
   o Select the device drive in the **Device** drop down menu to write the Raspbian OS.
   o Click **Write** to write the image to the SD card.

5. After the image has finished writing, insert the microSD card into the RPi3.

3.3. Install, Configure, and Build the SDK

1. Insert the microSD card with the Raspbian Stretch OS installed in the RPi3.

2. Power on the RPi3 using the included +5V supply.

3. When the desktop loads, establish a WLAN or LAN connection.

4. Open a terminal and send the following command to get the files necessary for installing the SDK.

   `$ git clone https://github.com/conexant/avs-device-sdk.git`

The following shows a screen with representative results:

5. After the files are downloaded, go into the avs-device-sdk directory and run the install.sh script.

   `$ cd avs-device-sdk`

   `$ bash install.sh`

6. Several screen prompts will follow. You will need to provide your account credentials and answer several prompts. Depending on your answers to the prompts, you may need to acknowledge the Sensory license agreement.

Note: If you haven't already registered your device, you can do so at https://developer.amazon.com/alexa/console/avs/home . To create a security profile, go to https://github.com/alexa/avs-device-sdk/wiki/Create-Security-Profile for step-by-step instructions.

   a. ClientId: Type in the ClientId and press **Enter**.

   b. ProductId: Type in the ProductId and press **Enter**.

7. After the ClientId and ProductId are entered, you will be asked if your kit has an LED ring. Select **1** for no LED ring.
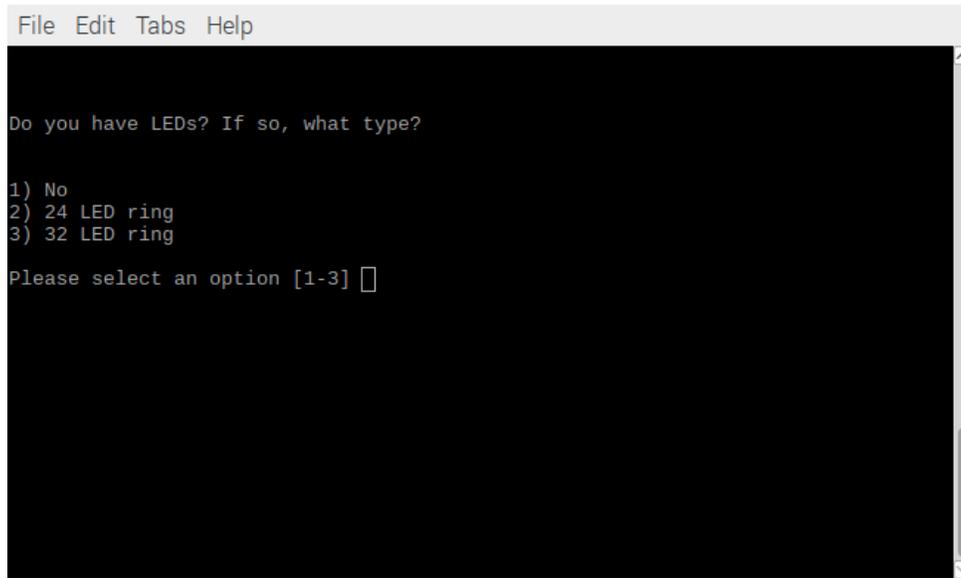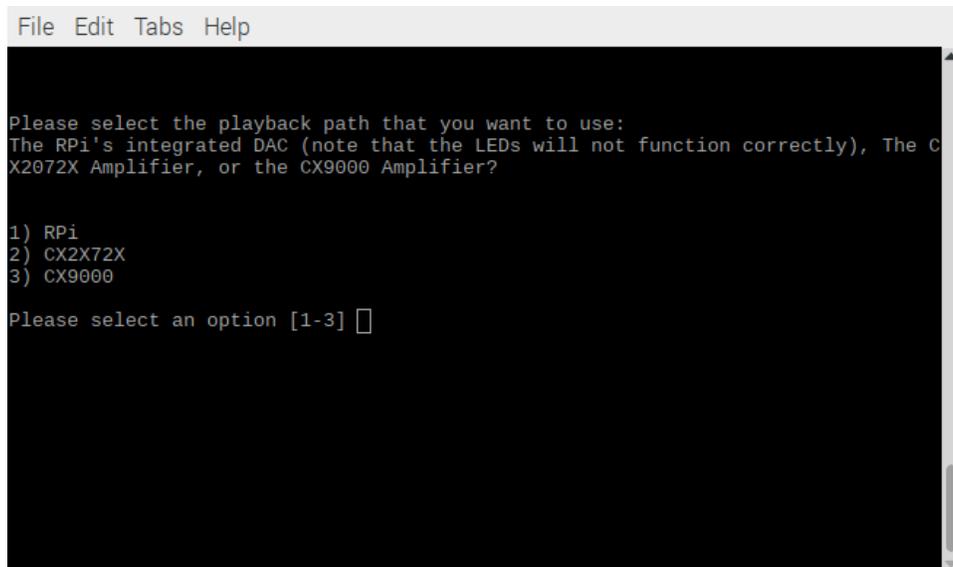

8. Next you will be asked to select which playback path to use. Select **1** for RPi.

9. Next you will be asked to select which recording path to use. Select **1** for USB from DSP.

10. Next you will be asked to select the keyword detector to run on the RPi. If you are planning to use the Embedded Synaptics Smart Trigger (recommended) select **3** for None. Otherwise select **1** for Sensory.
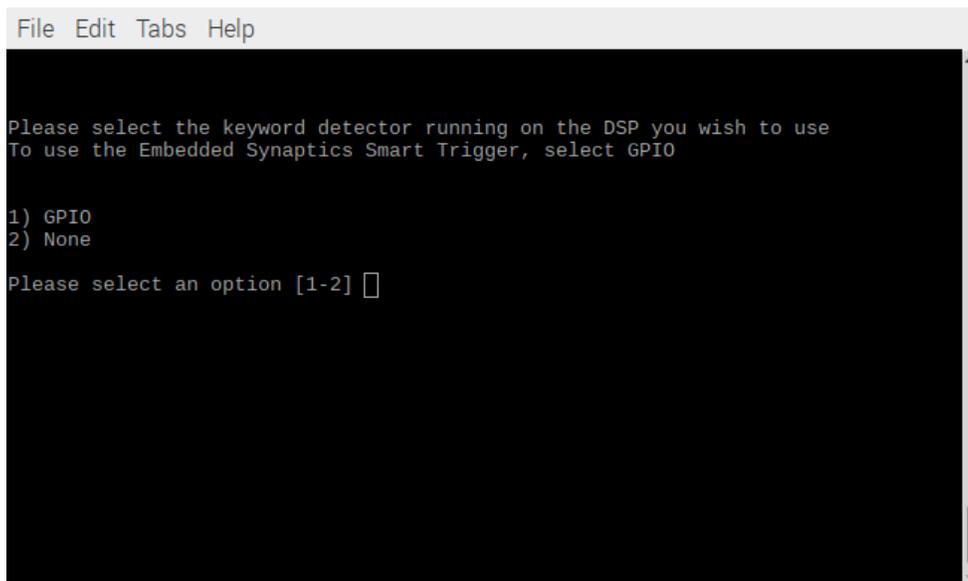
11. If Option 1 was selected in Step 10, then select **2** for None. If Option 3 was selected in Step 10, then select **1** for GPIO.

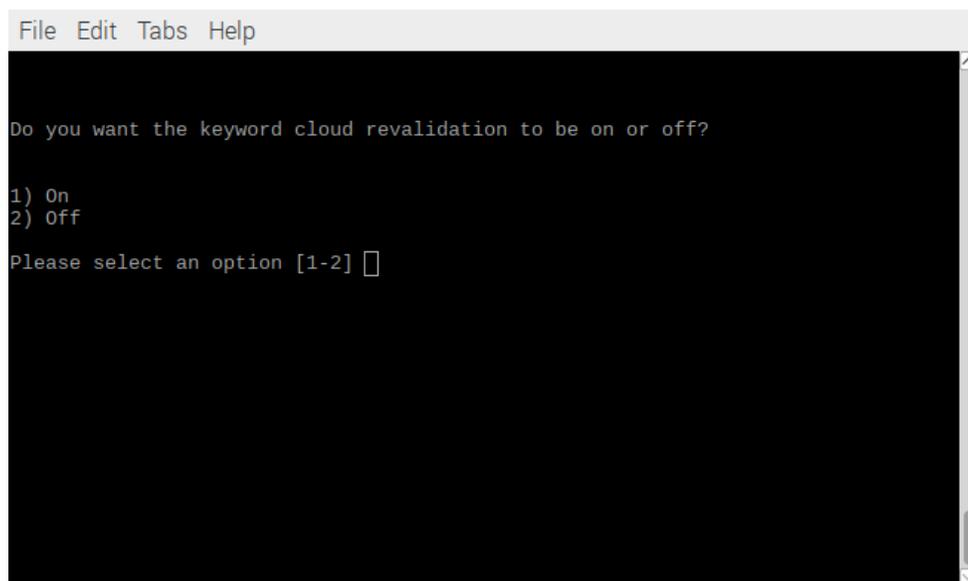12. Next you will be asked if you want keyword cloud revalidation on or off. Select **1** for On.


This starts the installation, which will take less than an hour to finish.

13. Once the hardware and software setup is complete, refer to Running the Setup to run the 2-mic setup.

3.4. Running the Setup

1. Configure volume settings before running the sample app. Open a terminal and send the following command:

   `$ alsamixer`

2. Configure the volume setting for the bcm2835 ALSA sound card as well as the I2S RX 16K TX 48K sound card. The following screens show the RPi3 user interface for these settings.
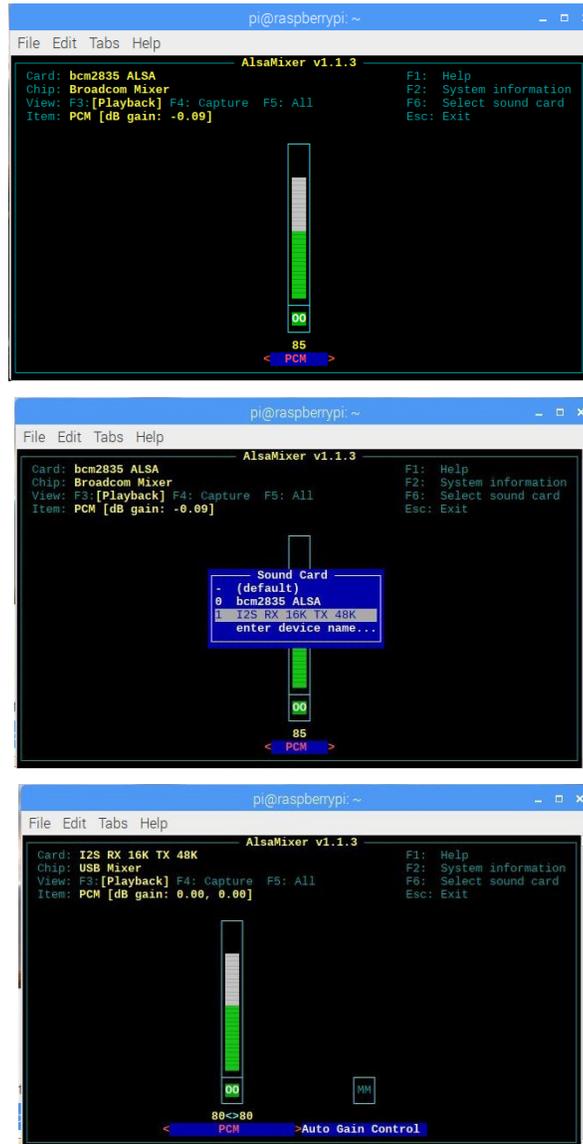

3. After configuring both cards, exit the alsamixer and send the command:

   `$ sudo alsactl store`

4. Open a terminal and send the following command to run the sample app:

   `$ bash run.sh`

5. When the sample app is running for the first time, you will be asked to authorize. Find the following message (you may have to scroll up a bit):

6. Open a browser and go to https://amazon.com/us/code (this can be done on your RPi3 or PC) and log into the Amazon account you wish to use.

7. Enter the code found in the AVS app (shown in previous picture) and hit continue.
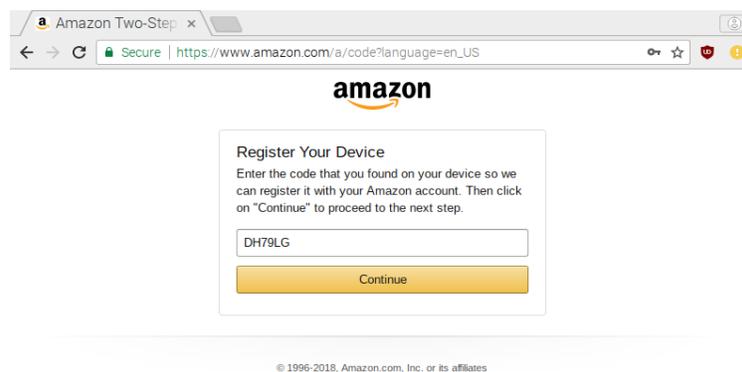
Once you see the message 'Success! Your registration is now complete'. You should also see "Authorized!" in the terminal message.

The sample app is now ready to be used, try asking Alexa a question!

3.5. Verifying the Setup

To verify whether the setup is done properly, please say Alexa followed by a question or command.

- A green LED will light up if Alexa wake word is heard. This confirms that the DS20921 evaluation board is working properly.
  - o If the green LED does not light up when speaking less than 1m away, check the power connection.
- A voice feedback can be heard if the development kit is successfully connected to the AVS network.
  - o If there is no voice feedback, check whether the speaker is powered on and all cables are connected properly between the evaluation board and RPi3.

To learn more about Amazon Alexa Voice Service and access the AVS API reference guide, see the following link: https://developer.amazon.com/alexa-voice-service/sdk.

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4. Installing the Cypress Siena USB-to-I²C Device Driver

A driver must be installed to enable the onboard Cypress® Siena USB-to-I²C device. Once enabled, this device allows you to communicate with the CX20921 evaluation board over I²C. This is necessary to flash firmware.

1. Connect the Type A to Type B USB cable between your laptop and the CX20921 evaluation board to connector J2.

   a. This cable interfaces to a Cypress USB-to-I²C control device, allowing you to control parameters of the CX20921 evaluation board using a Conexant GUI.

   b. This cable can also be used to flash new Firmware to the CX20921 evaluation board if needed (see "Flashing New Firmware" on page 16).

2. The Cypress Siena driver that enables USB-I²C communication between your laptop and the CX20921 evaluation board can be downloaded from:

   https://raw.githubusercontent.com/wiki/conexant/avs-device-sdk/assets/Conexant_Siena_Driver.rar
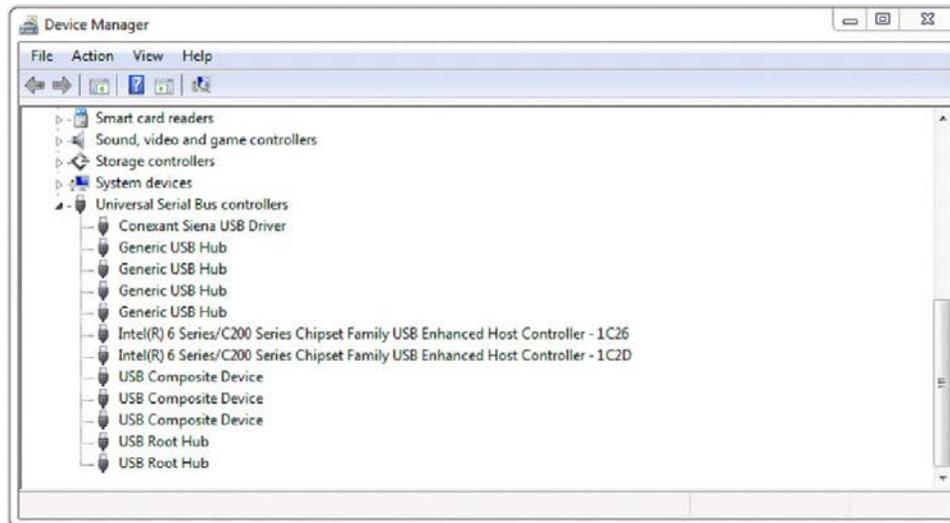
   a. Filename: **Conexant_Siena_Driver.rar**

   b. Extract the **Conexant_Siena_Driver.rar** file onto your laptop.

3. Run the **Setup.exe** file included in the **Conexant_Siena_Driver** folder as shown below:
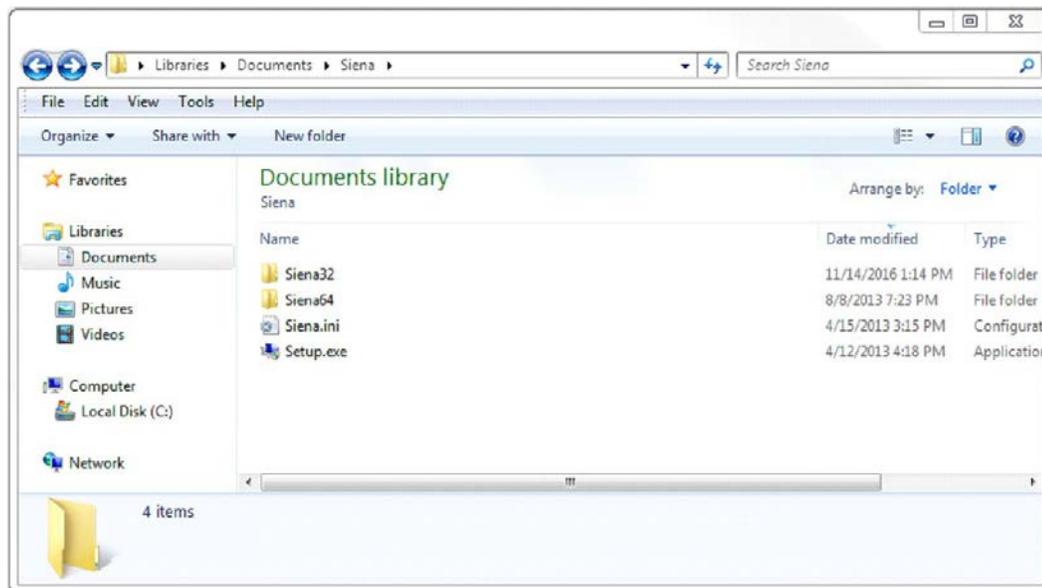
4. When the following message appears. Click **Yes**.
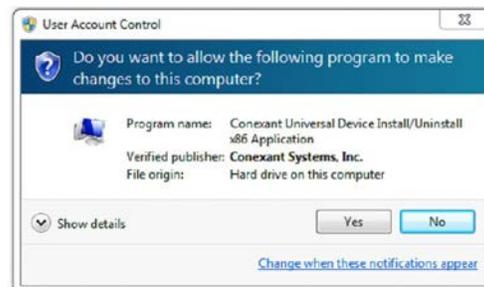
In the Device Manager, you should see the **Conexant Siena USB Driver** appear under the Universal Serial Bus controllers hierarchy.

The Cypress Siena device is now ready to use.

4.1. Flashing New Firmware

The CX20921 evaluation board comes pre-flashed with firmware (FW). The following instructions are only needed if a new firmware version needs to be loaded.

1. Connect the standard USB cable to allow Cypress Siena USB-I2C control if not done already.

2. Firmware flashing on the CX20921 device is done from the laptop/PC through the onboard Cypress Siena CY7C68013A I2C-to-USB converter device going to the CX20921 and the SPI flash device.

   a. FW update system flow: **Laptop/PC>Cypress CY7C68013A>CX20921>SPI Flash**.

   b. A driver is required to use the Cypress Siena CY7C68013A device, so make sure you have previously installed the Cypress Siena CX7C68013A driver as described in Installing the Cypress Siena USB-to-I2C Device Driver.

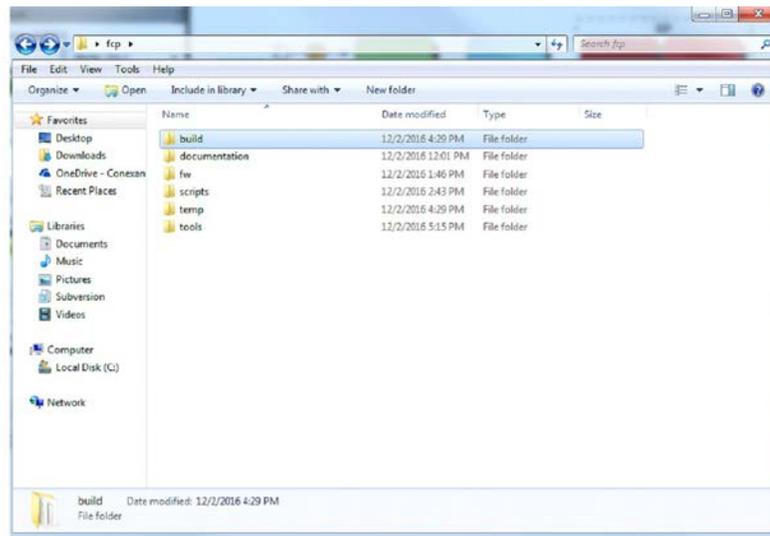The FW release package is stored in a folder named fcp. This folder contains subfolders as shown below.

Figure 7. Example fcp folder

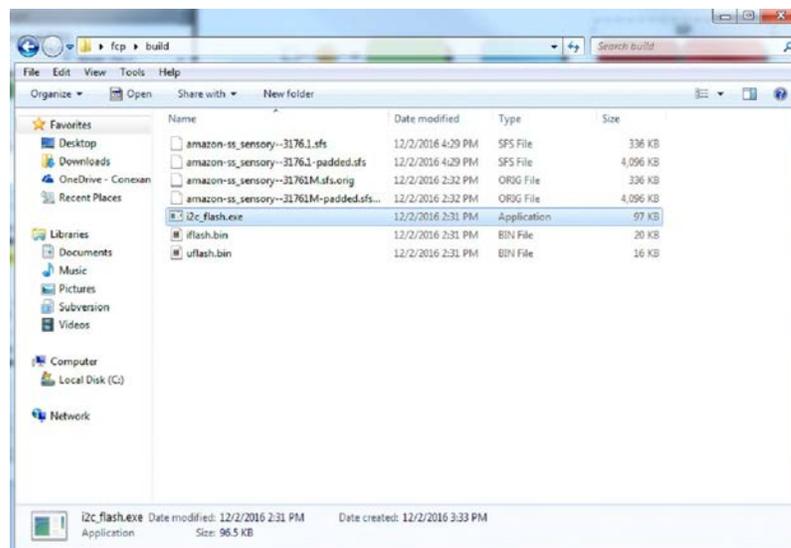3. Open the **build** folder which contains the ***.sfs** FW image file.

Figure 8. Build folder contents

4. Double click on the **i2c_flash.exe** file. FW updating will begin, and the following window will appear.

Wait for the green PASS message to appear, indicating that the FW was updated successfully. The FW upgrade should take less than 30 ms to complete.

5. Once the successful PASS message appears, close the window and cycle power on the board by unplugging and plugging back the power on the CX20921 evaluation board. The CX20921 device is ready to be used with the new updated FW.

5. Troubleshooting

If you encounter any issues with the AVS Sample App, see the following link to the list of solutions to some common problems reported by AVS developers.

https://github.com/conexant/avs-device-sdk/wiki/Troubleshooting

6. Revision History

Revision	Description
C	Updated: Software Setup Troubleshooting
B	Updated: Changed recommended Raspian OS on p. 8. Changed Cypress Siena driver link on p. 14.
A	Initial release

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