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

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALSA</td>
<td>The Advanced Linux Sound Architecture (ALSA) provides audio and MIDI functionality to the Linux operating system.</td>
<td><a href="http://www.alsa-project.org/main/index.php/Main_Page">http://www.alsa-project.org/main/index.php/Main_Page</a></td>
</tr>
<tr>
<td>Sensory</td>
<td>Wake word engine plug-in for Raspberry Pi</td>
<td><a href="https://github.com/Sensory/Alexa-rpi">https://github.com/Sensory/Alexa-rpi</a></td>
</tr>
</tbody>
</table>

1.3. Definitions, Acronyms, and Abbreviations

Table 2. Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVS</td>
<td>Alexa Voice Service</td>
</tr>
<tr>
<td>DSDT</td>
<td>Differentiated System Description Table</td>
</tr>
<tr>
<td>GPIO</td>
<td>General-Purpose Input/Output</td>
</tr>
<tr>
<td>I²C</td>
<td>Inter-Integrated Circuit</td>
</tr>
<tr>
<td>RPi3</td>
<td>Raspberry Pi 3</td>
</tr>
</tbody>
</table>
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

![CX20921 Evaluation Board: Connections, Interfaces and Devices](image)

*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](image)

**Figure 3, RPi3 pinout**
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.

![Image showing connections](Figure 6 Connections for RPi3)

### Table 3. CX20921 to RPi3 connections

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

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.

   - Browse to the subdirectory icon and select the image file.
   - Select the device drive in the Device drop down menu to write the Raspbian OS.
   - 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.


   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.

![Image of command prompt showing options between GPIO and None]

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

![Image of command prompt showing options between On and Off]

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):

![Image of terminal output](image)

6. Open a browser and go to [https://amazon.com/us/code](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.

![Image of Amazon login](image)

Once you see the message ‘Success! Your registration is now complete’. You should also see “Authorized!” in the terminal message.

![Image of successful registration](image)

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.
  - 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.
  - 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:

   ![Setup GUI](image)

4. When the following message appears. Click Yes.

   ![User Account Control](image)

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 Sienna USB-i2C control if not done already.

2. Firmware flashing on the CX20921 device is done from the laptop/PC through the onboard Cypress Sienna 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 Sienna CY7C68013A device, so make sure you have previously installed the Cypress Sienna CX7C68013A driver as described in Installing the Cypress Sienna 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](image)

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

![Figure 8. Build folder contents](image)
4. Double click on the `i2c_flash.exe` file. FW updating will begin, and the following window will appear.

![Image of i2c_flash.exe window with PASS message]

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

<table>
<thead>
<tr>
<th>Revision</th>
<th>Description</th>
</tr>
</thead>
</table>
| C        | Updated: Software Setup
           |             |
|          |             |
|          |             |
|          | Updated:   |
|          | Changed recommended Raspian OS on p. 8. |
|          | Changed Cypress Siena driver link on p. 14. |
| A        | Initial release |
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