Conexant AudioSmart[™] 2-Mic Development Kit for Amazon AVS

User Guide



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Administrative Information

Only the forms fields' variables should be changed. Note that some fields are used to fill other parts of the document e.g. the title page and the header fields.

Form Field Variable (double click to change)	Notes Bookmark <i>variable name</i>	Description
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1. Scope

This documentation provides step-by-step instructions on setting up the **Conexant AudioSmart 2-Mic Development Kit for Amazon AVS**. The document covers 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.

2. Target Audience

This document is intended for manufacturers and developers to create Smart Home device prototypes that utilizes **Conexant AudioSmart™ 2-Mic Development Kit and the Raspberry Pi3** (<u>not provided with the kit</u>) to offer an ideal Voice Control experience via Amazon's Alexa Voice Service

3. References

Table 3.1: References

Name of Document	Description	Location
I ² C	I ² C Specification	http://www.nxp.com/documents/u ser_manual/UM10204.pdf
ACPI	Advanced Configuration and Power Interface	http://www.acpi.info/DOWNLOAD S/ACPIspec50.pdf
Raspberry Pi 3	An open source code single-board computer.	https://www.raspberrypi.org/produ cts/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

4. Definitions, Acronyms, and Abbreviations

Table 4.1:	Definitions	of Abbreviation
------------	-------------	-----------------

Word, Acronym, or Abbreviation	Description
l ² C	Inter-Integrated Circuit
GPIO	General-purpose input/output
DSDT	Differentiated System Description Table
RPi3	Raspberry Pi 3
AVS	Alexa Voice Service



5. Overview

The Conexant AudioSmart[™] 2-Mic Development Kit for Amazon AVS contains the following:

- CX20921 evaluation board, pre-flashed with firmware
- Microphone module with 2 omnidirectional mics
- Microphone holder board
- Stereo 3.5mm 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 8GB is required.
- *Powered speakers, Raspberry Pi3 board, and micro SD card are all mandatory for the set up but are NOT included in the Conexant AudioSmart[™] 2-mic Development Kit.

*Proper speaker selection will enhance overall performance. Please download "External loudspeaker Guidelines and Recommendation for Smart Speaker Applications" for additional info



Figure 5.1 - components in the development kit



6. CX20921 evaluation board



Figure 6.1 - CX20921 evaluation board: Connections, Interfaces, and Devices



7. Pin Definition

Pin#	NAME		NAME	Pin#
01	3.3v DC Power		DC Power 5v	02
03	GPIO02 (SDA1 , I ² C)	$\bigcirc \bigcirc$	DC Power 5v	04
05	GPIO03 (SCL1, I ² C)	$\bigcirc \bigcirc$	Ground	06
07	GPIO04 (GPIO_GCLK)	$\bigcirc \bigcirc$	(TXD0) GPIO14	08
09	Ground	00	(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)	00	(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)	00	Ground	14
15	GPIO22 (GPIO_GEN3)	0	(GPIO_GEN4) GPIO23	16
17	3.3v DC Power	$\bigcirc \bigcirc$	(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)	$\bigcirc \bigcirc$	Ground	20
21	GPIO09 (SPI_MISO)	$\bigcirc \bigcirc$	(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)	\odot	(SPI_CE0_N) GPIO08	24
25	Ground	$\bigcirc \bigcirc$	(SPI_CE1_N) GPIO07	26
27	ID_SD (I ² C ID EEPROM)	\odot	(I ² C ID EEPROM) ID_SC	28
29	GPIO05	\mathbf{O}	Ground	30
31	GPIO06	00	GPIO12	32
33	GPIO13	00	Ground	34
35	GPIO19	00	GPIO16	36
37	GPIO26	00	GPIO20	38
39	Ground	00	GPIO21	40

The pinout definition on Raspberry Pi3 (not included in the kit). The pins that are used are emphasized.

Figure 7.1 – Pinout of Raspberry Pi3



8. Setup

1. Connect the CX20921 evaluation board and the Raspberry Pi3 (not provided with the kit). For more detailed information, refer to:

Section 9 - Connect EVK to Raspberry Pi3 (RPi3

 Upgrade the firmware for CX20921 device. Note that the CX20921 evaluation board is pre-flashed with the firmware required, so this step is only necessary if an updated CX20921 firmware is provided. For detailed information, please refer to:

Section 11 - Flashing New Firmware

3. Setup the AVS. For detailed information, please refer to:

Section 12 - AVS setup

9. Connect EVK to Raspberry Pi3 (RPi3)

Make the following hardware connections between the CX20921 evaluation board and the RPi3 (not provided with the kit), as shown in Figure 9.1 and Figure 9.2

- a. Connect the 3.5mm audio jack on the RPi3 (J7) to LINEIN on the CX20921 evaluation board (J25)
- b. Connect audio jack, J3, (Line Out labeled as HP) on the CX20921 evaluation board to a *powered speaker
- c. Connect the microphone module (Attach 2 microphones to the microphone board) to the CX20921 evaluation board (J19)
 - i. Spacing between the left MIC and right MIC should be set to **55mm** with the preloaded configuration. Refer to Figure 9.1.
 - ii. Software tool (FCP Essential) will be provided for mic distance adjustment between 30mm 120mm
- d. Connect the audio path from micro USB (J1) to USB port on RPi3.
- e. Using the Cable Assembly, connect GPIO1 at pin 2.14 from CX20921 evaluation board to J8.pin13 on RPI3, and the other wire from the Cable Assembly to Ground (GND) at pin 2.15 from CX20921 evaluation board to J8.pin14 on RPi3
- f. Connect the power supplies for both CX20921 evaluation board, (J10, +5V power supply included) and RPi3 (J1). Switch the power switch (SW3) to turn on the CX20921 evaluation board. LED D6 (5VLED) will turn on when there is power on the board.

*Proper speaker selection will enhance overall performance. Please download "External Loudspeaker Guidelines and Recommendation for Smart Speaker Applications" for additional info





Figure 9.1 CX20921 evaluation board setup with Raspberry PI3 board (not included in the kit) and microphone board (with 2-mic attached)



Figure 9.2 Connections for CX20921 evaluation board and microphone board (with 2-mic attached)





Figure 9.3 Connections for Raspberry Pi3 (not included in the kit)

Signal	RPi3	CX20921 evaluation board
GPIO (indicating trigger detected in CX20921)	J8.pin 13 (GPIO_GEN2)	GPIO1, P2.pin14
Ground	J8,Pin 14 (Ground)	GND, P2.pin15
Audio signal from RPi3	3.5mm audio jack (J7)	LINEIN (J25)
Processed microphone signal from CX20921 evaluation board	USB port	Micro USB (J1)

Table 9.1 CX20921 to RPi3 connections



10. Cypress Siena USB-to-I2C Device Driver Installation

A Driver must be installed to enable the onboard Cypress Siena USB-to-I2C device. Once enabled, this device will allow the user to communicate with the CX20921 evaluation board over I2C. This is necessary to flash firmware.

1. Connect Type A to Type B USB cable between your laptop and the CX20921 evaluation board as shown in **Error! Reference source not found.**.

- a. This cable will interface to a Cypress USB-to-I2C control device, allowing you to control parameters of the CX20921 evaluation board using a Conexant GUI (see separate section).
- b. This cable can also be used to flash new Firmware to the CX20921 evaluation board if needed (see **Section 11 Flashing New Firmware**)

2. The Cypress Siena driver to enable USB-I2C communication between your laptop and the CX20921 evaluation board can be downloaded from http://conexant.com/avs-support/Conexant_Siena.rar

- a. Filename = "Cypress Siena Drivers for EVK.zip"
- b. Copy the "Cypress Siena Drivers for EVK.zip" file onto your laptop and Unzip.

3. Run the "Setup exe" file included in the "Cypress Siena Drivers for EVK" folder as shown below:



4. You will get this message, Click the "Yes' button:





5. In Device Manager, you should shortly see "Conexant Siena USB Driver" appear under "Universal Serial Bus Controllers":

A Device Manager	
File Action View Help	
⊳ - 🛗 Smart card readers	*
Sound, video and game controllers	
Storage controllers	
⊳-1. System devices	
🖌 🏺 Universal Serial Bus controllers	
🚽 🚽 Conexant Siena USB Driver	
🔚 🚽 💭 Generic USB Hub	
🔚 🚽 🗍 Generic USB Hub	
🔚 🚽 🗍 Generic USB Hub	_
📕 🔤 🔤 Generic USB Hub	
📖 🏺 Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller - 1C26	
🟺 Intel(R) 6 Series/C200 Series Chipset Family USB Enhanced Host Controller - 1C2D	
USB Composite Device	E
USB Composite Device	
USB Composite Device	
USB Root Hub	
USB Root Hub	
	*

6. The Cypress Siena device is now ready to use.

11. Flashing New Firmware

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

- 1. Connect the standard USB cable to allow Cypress Siena USB-I2C control as shown in Error! Reference source not found. 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 CX20921 and SPI flash device.
 - a. FW update system flow:
 - i. 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 detailed in section 10.



3. The FW release package comes in a folder called 'fcp. This folder contains a number of other folders.

🕞 🗢 📕 🕨 fcp 🔸		_	- ⁻ € ₂	Search fcp		
ile Edit View Tools	Help					
Organize 🔻 🛛 😭 Open	Include in library Share with	New folder				?
🔆 Favorites	Name	Date modified	Туре	Size		
🧱 Desktop	퉬 build	12/2/2016 4:29 PM	File folder			
〕 Downloads	Idocumentation	12/2/2016 12:01 PM	File folder			
🐔 OneDrive - Conexan	鷆 fw	12/2/2016 1:46 PM	File folder			
📃 Recent Places	퉬 scripts	12/2/2016 2:43 PM	File folder			
	퉬 temp	12/2/2016 4:29 PM	File folder			
📜 Libraries	퉬 tools	12/2/2016 5:15 PM	File folder			
Documents						
J Music						
Pictures						
Subversion						
Videos						
Computer						
🏭 Local Disk (C:)						
Maturals						
- INCLWOIK						
build Date r	nodified: 12/2/2016 4:29 PM					
File folder						

Figure 11.1 Example FCP folder

- 5. Open the 'build' folder, which contains the *.sfs FW image file.
- 6. Double click on the "i2c_flash.exe" file.



J V V III + TCp + Bu		-	▼ + j	Search build	_
File Edit View Lools Organize 🕶 💼 Open	Help Share with 🔻 New folder				
🛠 Favorites	Name	Date modified	Туре	Size	
🧮 Desktop	amazon-ss_sensory3176.1.sfs	12/2/2016 4:29 PM	SFS File	336 KB	
鷆 Downloads	amazon-ss_sensory3176.1-padded.sfs	12/2/2016 4:29 PM	SFS File	4,096 KB	
🐔 OneDrive - Conexan	amazon-ss_sensory31761M.sfs.orig	12/2/2016 2:32 PM	ORIG File	336 KB	
📃 Recent Places	amazon-ss_sensory31761M-padded.sfs	12/2/2016 2:32 PM	ORIG File	4,096 KB	
	i2c_flash.exe	12/2/2016 2:31 PM	Application	97 KB	
🥽 Libraries	🔳 iflash.bin	12/2/2016 2:31 PM	BIN File	20 KB	
Documents	🔳 uflash.bin	12/2/2016 2:31 PM	BIN File	16 KB	
🁌 Music					
Pictures					
Subversion					
📑 Videos					
Computer					
Local Disk (C:)					
• • • • •					
Vetwork					

Figure 11.2 'build' folder contents

7. FW updating will begin, and the following window will appear:





- 8. Wait for the green "PASS" message to appear, indicating your FW was updated successfully. FW upgrade should take less than 30msec to complete.
- 9. Once the successful "PASS" message is seen, close the window and cycle power on the board by unplugging and plugging back the power on the CX20921 evaluation board.
- 10. The CX20921 device is ready to be used with the new updated FW.

12. AVS setup

Note: Micro SD card with at least 8GB is MANDATORY.

1. Format the SD card. When reformatting, confirm that the File system is FAT32 or FAT, as shown below.

Format boot (E:)
Capacity:
60.0 MB 🗸
File system
FAT (Default)
Allocation unit size
8192 bytes 💌
Volume label
Formet and the
Ouick Format
Create an MS-DOS startup disk
Start Close

2. Use the September 23, 2016 release of the Raspbian OS (Raspbian Jessie with PIXEL). This can be found at the following:

http://downloads.raspberrypi.org/raspbian/images/raspbian-2016-09-28/



3. Unzip and write the downloaded image to the SD card using Win32DiskImager. This tool can be found at:

https://sourceforge.net/projects/win32diskimager/

4. Run the Win32DiskImager. The following window should display:

👒 Win32 Disk Image	r				23
Image File					Device
	a.				F:\] ▼
Copy MD5 Hash:					b.
Progress			C.		
Version: 0.9.5	Cancel	Read	Write)	Exit

- a. Select the path to the downloaded image
- b. Select the SD card device
- c. Select 'Write' to write the image to the SD card. This process will take approximately 10 minutes.
- 5. Once the SD card has the OS loaded, next set up AVS on the RPi3. Connect the RPi3 to a monitor, keyboard, and mouse. Instructions can be found at the following link:
- 6. https://github.com/alexa/alexa-avs-sample-app/wiki/Conexant2Mic-Raspberry-Pi

7. Note: The 3.5mm jack will be used for audio output

8. Before step 7, make the hardware connection between the RPi3 and the CX20921 evaluation board and reboot the board. Information on the hardware setup is located at:

Section 9 - Connect EVK to Raspberry Pi3 (RPi3

As shown in the instructions from <u>https://github.com/alexa/alexa-avs-sample-app/wiki/Conexant2Mic-Raspberry-Pi</u>, the commands to run the Alexa wake word are run in three terminals:

a. In terminal one, send the commands:

```
cd ~/Desktop/alexa-avs-sample-app/samples
cd companionService && npm start
```

b. In terminal two, send the commands:

```
cd ~/Desktop/alexa-avs-sample-app/samples
cd javaclient && mvn exec:exec
```



After this step, a window as shown below should pop-up. Press "Yes" to continue

	Login to Register/Authenticate your Device 🗕 🗖 🗙
?	Please register your device by visiting the following URL in a web browser and follow the instructions: https://localhost:3000/provision/97d07a610fac64bca8f67ce4 Would you like to open the URL automatically in your default browser?
	Yes No

Ignore the warning and click to display advanced settings. Click 'Proceed to localhost'. The following window should display:



Login using an Amazon account. After the login, the following window will display:





Once the login is complete, the window will display the message 'device tokens ready'



When AVS is set up, the following window should display with a value in the Bearer Token parameter:





- 9. For the 3rd terminal, there are options to select high performance trigger or low power embedded trigger.
 - a. For high performance trigger mode, send the following commands

```
cd ~/Desktop/alexa-avs-sample-app/samples
cd wakeWordAgent/src && ./wakeWordAgent -e sensory
```

b. For low power embedded trigger mode, send the following commands

```
cd ~/Desktop/alexa-avs-sample-app/samples
cd wakeWordAgent/src && sudo ./wakeWordAgent -e gpio
```

10. To switch trigger modes, first kill the currently running process. For more detailed information, see **Section 13 - Changing trigger modes**

13. Changing trigger modes

To test and verify different trigger modes, please follow the instruction below.

Before switching the trigger mode, kill the process running the current trigger mode by using 'Ctrl + C' in the terminal running the "wakeWordAgent"

a. To confirm the process is successfully ended, open a terminal and send

top

b. If a process called 'wakeWordAgent' is not displayed, then the process is killed.

Note: Each time the trigger mode is changed, the previous processes must be killed. If the terminal windows are closed before the process is killed, it is necessary to find the PID of the process and kill the process.

Find the PID of the process with the following command:

top

The process to kill is called 'wakeWordAgent'. This process can be killed by the following command, using the PID number found above.

sudo kill [PID#]

Example - Killing a process

1. Opening a terminal and send the following command



top

2. Note the PID of the process called 'wakeWordAgent'. This is needed for the next step

						pi@rasp	berrypi	~		-	• ×	
File	Edit	Tabs H	elp									
top	14:07	:15 up 3	3 min	, 2 use	rs, lo	adaverag	ge: 2.5	9, 1	.59, 0.67			
Tasks	: 166	total,	2 r	unning,	164 sle	eping,	0 stop	ped,	0 zombie			
%Cpu(s	5): 2 /	.8 US,	0.4 toto	SY, U.U.	690 USO	./ 10, (0.0 Wa,	0.0	25512 buffors			
KIB M	wan:	102396	tota	1, /10		d 1023	206 fre	е, е	369012 cached Mem			
NID DI	incip i	102330		- /	0 000	.,			Soson2 cached mem			
PID	USER	PR	NI	VIRT	RES	SHR S	%CPU	%MEM	TIME+ COMMAND			
738	root	20	0	36544	3436	3212 S	100.8	0.4	3:33.98 wakeWordAgent			
1042	pi	20		390996	78460	26356 S	8.6	8.3	0:17.63 java			
639	root	20		220316	70412	38328 S	1.0		0:03.73 Xorg			
562	root	20					0.3	0.0	0:00.18 kworker/u8:3			
844	pi	20		320584	45588	10592 S	0.3	4.8	0:11.45 java			
892	pi	20		21348	12316	9640 S	0.3	1.3	0:01.02 openbox			
897	pi	20		94620	24876	20772 S	0.3	2.6	0:02.05 lxpanel			
1306	pi	20		46532	18600	15852 S	0.3	2.0	0:00.54 lxterminal			
1324	pi	20	0	5112	2488	2100 R	0.3	0.3	0:00.20 top			
	root	20		23844	3924	2680 S	0.0	0.4	0:03.17 systemd			
2	root	20				0 S	0.0	0.0	0:00.00 kthreadd			
	root	20					0.0	0.0	0:00.01 ksoftirqd/0			
	root	20				0 S	0.0	0.0	0:00.00 kworker/0:0			
	root		-20				0.0	0.0	0:00.00 kworker/0:0H			
	root	20				0 S	0.0	0.0	0:00.05 kworker/u8:0			
7	root	20	0	0	0	0 R	0.0	0.0	0:00.17 rcu_sched			
8	root	20	0	0	0	0 S	0.0	0.0	0:00.00 rcu_bh			

3. Send the command:

sudo kill [PID#]

For this example, send the following command:

		pi@raspberrypi:~	-	×				
File	Edit	Tabs	Help					
pi@ra	spber	гурі:~	\$ sudo	kill	738			

4. After the command is sent, the 'wakeWordAgent' process is gone from the 'top' window.



	pi@raspberrypi:~									-	×		
File Edit Ta	bs He	lp											
top - 14:11:4 Fasks: 157 to &Cpu(s): 1.4 (iB Mem: 9 (iB Swap: 1	6 up 8 tal, us, 47740 02396	min, 1 run 0.3 sy total, total,	2 use ning, 7, 0.0 632	rs, loa 156 slee ni, 98 164 usee 0 usee	ad averag eping, .3 id, 0 d, 3155 d, 1023	e: 1.1 O stop .O wa, 76 fre 96 fre	8, 1. ped, 0.0 e, e.	40, 0.84 0 zombie hi, 0.0 26720 buf 397672 cac	e si, 0.0 st ffers ched Mem	:			
PID USER	PR	NI	VIRT	RES	SHR S	%CPU	%MEM	TIME+	COMMAND				
639 root 1306 pi 1324 pi 45 root	20 20 20 20	0 2 0 0	19244 46708 5112 0	69040 18740 2492 0	38344 S 15852 S 2100 R 0 S	1.7 0.7 0.7 0.3	7.3 2.0 0.3 0.0	0:09.73 0:01.64 0:01.47 0:00.03	Xorg lxterminal top kworker/1:1		I		
81 root 892 ni	20 20	0				0.3	<u> </u>	ni@rasnbe					×
897 pi	20	0						pillingshpei	nypi. ~			-	^
1111 pi	20	0 5	File I	Edit Tab	os Help								
2 root 3 root 5 root 6 root 7 root 8 root 9 root 10 root	20 20 0 20 20 20 rt rt	0 0 -20 0 0 0 0 0	pi@ras pi@ras	pberryp pberryp:	i:~ \$ ⊆	o kill	738						

14. Verifying the setup

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

- 1. A green LED will light up if Alexa wake word is heard. This confirms that CX29021 evaluation board is working properly.
 - a. If LED does not light up when speaking less than 1m away, please check power connection.
- 2. A voice feedback can be heard if the development kit is successfully connected to AVS network.
 - a. If there is no voice feedback, please check
 - i. Whether speaker is on
 - ii. All cables are connected properly between the evaluation board and Raspberry Pi3

To learn more about Amazon Alexa Voice Service and access the AVS API reference guide, visit: <u>https://developer.amazon.com/alexa-voice-service/</u>

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