

REVERSE ENGINEERING: AN AMAZON ALEXA SPEAKER (GEN 1, 2014)

WHY I CHOSE ALEXA *how I made my decision*

Alexa was my childhood music speaker. After we stopped using it and I grew up, I nurtured a fascination for robotics and electronics. Once I saw this challenge, our old Alexa instantly came to mind. I also considered that it had a microphone in addition to a speaker, which is quite unusual in terms of a single device.

CONTENTS *every component of the Alexa device*

■ *support components*



a deeper dive into the electrical components

//the microphone system

microphone board: contains LEDs for the rotatable top part, as well as seven microphones, and an ADC (analogue-to-digital converter). This means it converts our microphone signals to 0s and 1s. The seven microphones are for identifying the direction of the sound. The LEDs light up when the microphone detects words like 'Alexa' and when performing other functions such as notifications.

the gear: moves upwards/downwards depending on the rotation of the top part of the Alexa device. The gear is connected to an encoder, which tracks whether the ring is turning clockwise or anticlockwise, adjusting the volume accordingly. (circled in white in the image)

//main power system

mini motherboard: contains Flash and RAM (random access memory). These are both types of temporary memory. It also contains WiFi and Bluetooth modules and power management systems. This is similar to that of a PC.

power + audio board: takes in power from the plug and distributes it around the Alexa device. It boosts the audio signal using an amplifier, turning the volume up.

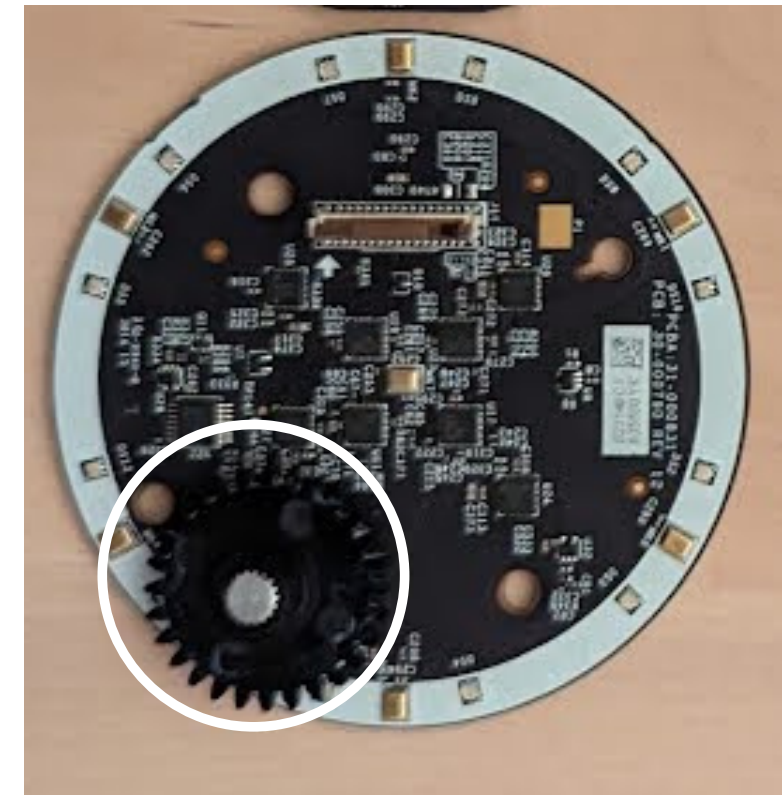
//the sound system

the woofer and the tweeter: the main components of the speaker system. The woofer provides bass and the tweeter provides higher tones.

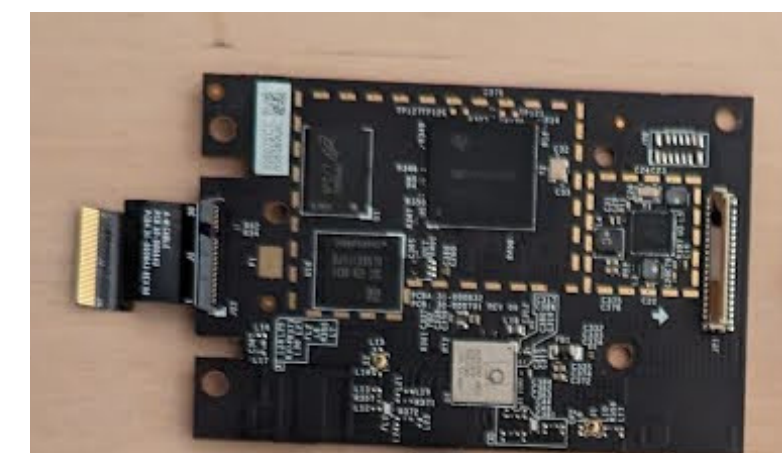
reflex port: a lengthened bass reflex system which boosts the sound of the bass. It is shaped like a saxophone to minimise the turns inside the port whilst utilising the limited space inside the Alexa



the lit-up microphone board



the microphone board with the gear attached



the mini motherboard



the power + audio board



left to right: the woofer and the tweeter



the reflex port

MY FINDINGS

the links between the project and VEX

//component similarities

- *the mini motherboard functions in a similar way to the VEX IQ brain, in that they both contain components such as memory and a processor. The VEX IQ brain also includes a radio, which is similar to the Bluetooth module on the mini motherboard of the Alexa.*
- *the gear is a component that both VEX and Alexa share. However, instead of having a motor to spin it (as in VEX IQ), our hands act as a motor for the Alexa, turning the gear as we turn the ring at the top.*

//transferrable skills

- *This project was useful for the building component of VEX in that we were able to take apart a working model of a successful machine, a process useful for understanding the interconnections between different parts, and eventually for putting together a robot for our competitions.*
- *The designer can also benefit from this project. In the future, the knowledge gained can be useful in determining how to put a number of advanced systems (in this case, stripped-down circuits) into a small, compact area.*

CONCLUSION

rounding off the whole project

Finally, this project gave me a sense of achievement. It was fascinating that the Alexa did not, in fact, need its casing. Also, after connecting up the whole circuit again (minus the external / protection parts), seeing the entire circuit working was satisfying.