UE Wonderboom Electronics Analysis

Texas Instruments Electronics Online Challenge

YNOT Robotics
Change Up: 2020-2021
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Introduction

For this year's Texas Instrument Electronics Online Challenge, our team chose to dismantle and analyse a UE Wonderboom speaker (**Figure 1**) which has been intensively used by our team for several years. This speaker was of particular interest because it no longer retains charge. Through this project, we hoped to deduce the cause of the speaker's electronic issues (i.e. battery, blown or bent USB port, or water damage) and make the necessary fixes if possible.

Figure 1: Team YNOT's UE Wonderboom speaker before being dismantled for this challenge.

What's Inside?

Inside the speaker, we found a total of five different boards including two main control boards stacked in a mezzanine configuration (**Figure 2 and 3**), a volume button board (**Figure 4**), a battery module board (**Figure 5**), and a USB port board (**Figure 6**). Additionally, there were two speaker drivers with a resistance value of 4 Ohms (as measured by a multimeter), two passive bass radiators, and a 7.98 Wh single cell battery. Upon first glance, one main board seems as if it is primarily used for Bluetooth connectivity and use interaction (such as the power button), and the other seems like it is primarily used to drive the speaker with a section that could be a battery management system (BMS). All the major chips are Texas Instruments products. The three smaller boards are very simple and only have resistors, capacitors, transitions and connectors.

Bluetooth and UI Board (**Figure 2**)	Audio and BMS Board (**Figure 3**)
1x AIOHA AB1520	1x Texas Instruments TPA3130
1x Fudan Micro FM25Q08A	1x Texas Instruments BQ24250
1x Six Pin Female Mezzanine Connector	1x Texas Instruments TPS61088
1x Fourteen Pin Mezzanine Connector	6x Inductors
3x LEDs	6x Electrolytic Capacitors
3x Push Buttons	1x Six Pin Female Crimp Connector
	1x Five Pin Female Crimp Connector
	1x Four PIn Female Crimp Connector
	1x Three Pin Female Crimp Connector
	1x Fourteen Pin Male Mezzanine Connector
	1x Six Pin Male Mezzanine Connector

Table 1: List of the major components on each board, not including smaller boards (due to their simplicity).

What's Inside? (continued)

Figure 2: The Bluetooth and UI Board

Figure 3: The Audio and BMS Board

What's Inside? (continued)

Figure 3: The Volume Button Board

Figure 4: The Battery Module Board

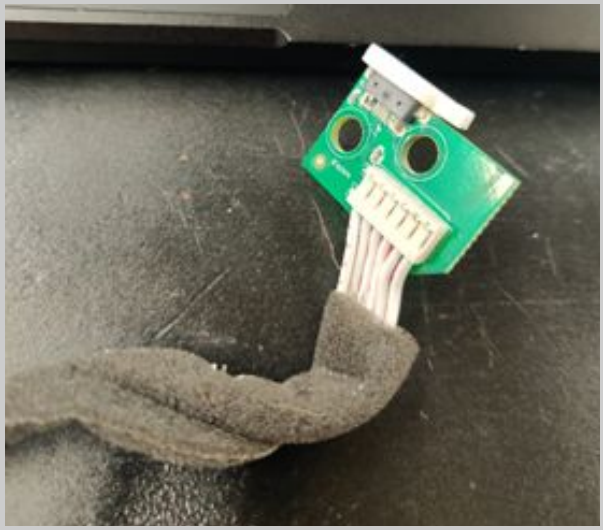

Figure 5: The USB Board

Part Analysis

On the Bluetooth and UI Board, we found that the Airoha AB1520 is a Bluetooth 4.2 receiver and decoder which is used to transfer audio from your personal device, such as a phone or laptop, and turn it into an amplifier-ready format. The Bluetooth and UI Board also contains the Fudan Micro FM25Q08A, which is a memory chip used to store Bluetooth pairing information. On the Audio and BMS Board, we found a TI BQ24250, which is a single cell battery charging chip for battery management, and the TI TPS61088, which is a boost converter chip that provides a higher voltage for the audio amplifier input. The most important component on the array is the TI TPA3130, which is the primary audio amplification chip and provides 50Wx2 at 4 Ohms.

Conclusion

As we already had basic knowledge about audio amplification circuits, the components involved in this process were familiar. However, the BMS and charging circuits were new to us and researching them was very useful as we are trying to integrate a battery management system in the custom electronics for our robots. Prior to this project, the task seemed quite daunting, but the board turned out to be relatively simple.

In terms of diagnosing the issues with the UE Wonderboom speaker, we found that many of the components on each board were corroded, most likely due to water damage. This corrosion likely caused poor contact on the charging chip and its auxiliary components, which can be easily fixed by cleaning the corroded parts.