

Inside an audio signal generator: the inner beauty of an electronic device Team 98989A

Team of Hangzhou Xuejun High School Robotics Lab

Abstract

As we all know, interesting gadgets always exist in a robotics lab. During a recent cleanup, we Accidentally found a device called audio signal generator (model SP121B). After a quick research, we found out that this device is owned by a retired teacher who is also an audio device enthusiast. It was used to generate audio signal, however, due to the lack of maintenance it could not be utilized any more. After getting consent from lab teacher, we tore it down to learn how it works.



Components

Summary of the chips and components you found inside. Were any TI components?

Tearing the whole signal generator down, we found numerous components including micro controller (MCU), variable-frequency drive (VFD) driver, hex inverter, digital-to-analog converter (DAC), DDS waveform generator, analog multiplexer, comparator and lots of operational amplifier.

We searched for information of all components we found by finding critical information on them, for example, part ID, which is used to identify component. We found that all multiplexer, comparator and some operational amplifier were Texas Instruments' products.

Part Number	Category	Manufacture	Title
CD4052BM	Switch / Multiplexer	Texas Instruments	CMOS Single 8- Channel Analog Multiplexer/ Demultiplexer With Logic-Level Conversion
LM393	Logic	Texas Instruments	Dual Differential Comparators
NE5532	Amplifier	Texas Instruments	Dual Low-Noise Operational Amplifiers
LM318N	Amplifier	Texas Instruments	Operational Amplifiers
TL072C	Amplifier	STMicroelectronics	Low noise JFET dual operational amplifiers
CS16311EN	VFD Driver	Semico Research	VFD Display Driving Circuit
74HC04D	Logic	NXP	Hex inverter
SP202EEN	Interface	Exar	High Performance RS-232 Line Drivers/ Receivers
ATmega64A	Microcontroller	Atmel	8-bit AVR Microcontroller, 64KB Flash, 64-pin

For more information about components we found, please see the table below.

AD9833	Data Converter	Analog Devices	Low Power Programmable Waveform Generator
AD7533	Data Converter	Analog Devices	CMOS Low Cost, 10- Bit Multiplying DAC

Discoveries

Research findings of what these components do and the role they play in the system.

With existing information and the internal structure that we discovered, we assume once user sets target output frequency using specific button sequence, these button signals will be detected by VFD driver first. Then VFD driver will pass instructions to MCU. Since this controller is the "heart" of the whole device, it will set pixels' status on the LCD display to present essential information to the user (for example, target frequency).



Figure 1 Assumed Structure

Device microcontroller (MCU) is responsible for selecting the best signal generator to achieve the best performance at the target output frequency. When the user presses button to turn the device on, it will determine whether to use the DAC or DDS waveform generator.

After generator selection, the microcontroller tells the multiplexer to switch the signal line according to user's selection. Then, it sends signals to selected signal generator, which immediately starts generating the unamplified output signal. The signal will flow through the multiplexer, the Operational amplifiers and a transistor-based amplifying system.

Finally, the powerful output signal is ready to use. Meanwhile, the microcontroller generates some additional signals, which routes through the hex inverter or the Operational amplifier and finally goes into the TTL Output port or the Sync Output port.

Conclusion

Conclusion. What were the lessons you learned from this experiment?

Our team solved lots of problems of taking pictures, finding chips' function and composing this essay. All team members participated in this activity using our collaboration skills to get things done. That reminds me one proverb called "One finger could not lift a stone". We found out that every chip on the logic board is essential - just like our team. We might now be able to feel the beauty outside, but after tearing it down and learning how it works, we discovered the ultimate inner beauty of an electronic device.





And this integrated inner beauty exists everywhere in the world - and every engineer are working hard to achieve the future vision. This world is made up by everyone - so we need to get inspired by the motivation to achieve more.