PRO-Q2 Team 1 Special Speaker System

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# Introduction

The company BARK is a small and well-known loudspeaker manufacturer. BARK have been planning to develop a series of active speakers, using built-in power amplifiers but BARK however have limited knowledge on analogue and digital electronics systems. It is up to group one to conduct research and design an active loudspeaker with the conditions that BARK has given.

# Design

Insert figure 10 and 22 (final design report)

Figure 10 shows a block diagram of the speaker system and figure 22 shows the final design of the speaker system built by team one. The design consists of multiple modules. So that each of these modules could be tested individually and then if they all meet the specifications the active loudspeaker was assembled by connecting all the modules.

# Components

The speaker system consist of the following parts:

1. Digital control unit.

The following features and choices have been chosen/made for the implementation of the DCU:

* 1. For the microcontroller, an ATmega328 will be used since it bears a lot of 235 similarity with the ATmega32 which the team is most familiar with.
  2. The DCU will allow digital control of the balance, tone, bass, treble and volume controls through the use of digital potentiometers.
  3. MIDI messages will be used to pass commands to the DCU

1. Power amplifier

The amplifier used for the power amplifier is a monolithic component.

1. Power supply

The power supply takes 230V mains and converts it to lower voltages to power

the various modules in the speaker system.

1. The preamplifier
   1. Volume control

The volume control regulates the sound. It can be chosen for the speaker system to be very loud or to turn off the sound.

* 1. Tone control

The tone control regulates the bass and the treble frequencies of the sound.

* 1. Balance control

Regulates the gain difference between the right and left speakers in dB

# Research

1. Simulations

Insert figure 13 and 14

Figure 13 shows a simulation of the bode plot of the preamplifier with the bass and treble both at maximum boost. Figure 14 shows the simulation of the bode plot of the preamplifier with the bass and treble both at maximum attenuation.

1. Measurements

Insert figure 15 and 16

Figure 15 shows the measurement of a bode plot of the preamplifier with the bass and treble both at maximum boost Figure 16 shows the measurements of a bode plot of the preamplifier with the bass and treble both at maximum attenuation.

# Results

These are the result that came out of our test procedure that we conducted for the system as a whole. In this version of the system the Potentiometers where still analog, thus the DCU was not tested. The test setup concluded out of an Audio source connected to the system using an Audio cable and the output was connected to a ’TEKTRONIX DPO2004B’ oscilloscope and an 8Ohm speaker.

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| --- | --- | --- | --- |
| # | Procedure | Expected results | Pass / Fail / Not Tested |
| 1 | Play music from the audio source | Hear music coming from the speaker regardless the performance of the sound. | Pass |
| 2 | Test the volume of the preamplifier | No audible sound when the volume control adjust is turned down to the minimum.  The sound will get louder as the  volume control is turned up to the  maximum | Pass |
| 3 | Is the sound clear? | No distortion, no clipping, little mains hum | Pass |
| 4 | Test the bass of the preamplifier | Low frequencies will be heard when the bass is in maximum boost. | Pass |
| 5 | Test the treble of the preamplifier | High frequencies will be heard when the treble is in maximum boost | Pass |
| 6 | Turn up the volume.  Does the thermal shutdown feature of the amplifier work? | The amplifier should shut down when it reaches 170°C | Pass |
| 7 | Test the DCU system | Filters and volume control can be controlled using the MIDI interface without interference or distorted sound. | Pass |

# Conclusion

After approximately 2 months of working on PRO-Q2, the active loudspeaker was finally finished by connecting the power supply, the power amplifier and the preamplifier. After testing the active loudspeaker as a whole, the team concluded that the active loudspeaker works. The sound may not be perfect but at the very least the speaker is able to produce sound without excessive distortions. Unfortunately the DCU was not tested.