

Calculation Report: Monolithic Power Amplifier PRO-Q2

Daan Conijn, 13023217
Andrew Lau, 13058339
Kevin Oei, 13090062
Koen van Vliet, 13093053
Group 1

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⁵ 1 Introduction

In this calculation report the monolithic power amplifier is determined and calculated.

2 Monolithic Power Amplifier

2.1 Requirements

10 The power amplifier has the following specifications:

- Input impedance of at least $50\text{k}\Omega$
- Output power: 15W sine in $R_{\text{load}} = 8\Omega$ at 1kHz
- Frequency range: 10Hz to 100kHz (-3 dB) at $P_{\text{load}} = 0.5\text{W}$ in 8Ω

2.2 Chosen Power Amplifier

15 For the power amplifier, the LM1875 (Farnell code: 1468913) was chosen. This specific power amplifier has been chosen because the LM1875 meets the specified requirements. The amplifier is also designed to suppress low-frequency noise such as the 50Hz hum originating from the mains, as seen in figure 7 of the datasheet. This is an important property when it comes to the performance of
20 audio amplifiers.

2.3 Calculations

Since the LM1875 is used as an inverting amplifier, the impedance Z_{in} will be equal to R_1 as depicted in the following diagram.

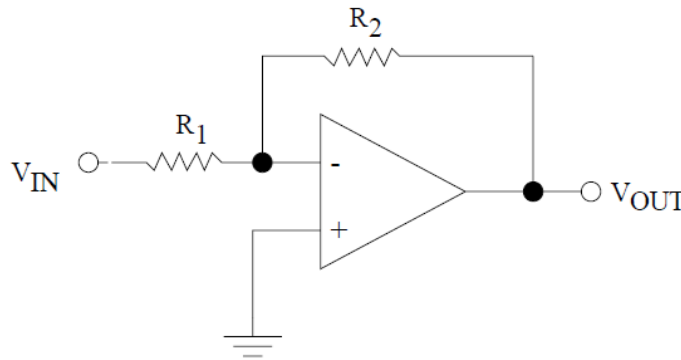


Figure 1: Inverting amplifier diagram

Z_{in} is required to be at least $50k\Omega$. Thus, the chosen value of R_1 will have to be
 25 at least $50k\Omega$ in order to meet the specified requirement.

For determining the maximum output voltage and current, it is assumed the amplifier drives an 8Ω load at $15W$.

The formula for the power equals to:

$$P = U \cdot I \quad (1)$$

Therefore the following formulas can be derived:

$$U_{OUT,max} = \sqrt{P \cdot R} = \sqrt{15 \cdot 8} = 11V \quad (2)$$

$$I_{OUT,max} = \sqrt{\frac{P}{R}} = \sqrt{\frac{15}{8}} = 1.37A \quad (3)$$

30 The amplifier has a bandwidth of $70kHz$ at $20W$ output power. However, the desired dynamic range of $10Hz$ to $100kHz$ can be easily achieved at lower power outputs. No additional calculations need to be done for the power amplifier in order to realize a frequency range of $10Hz$ to $10kHz$. The dynamic range can be controlled through software since the filters on the preamplifier are controlled
 35 by the digital control unit. According to the datasheet from LM1875 [1] the supply voltage needs to be approximately $\pm 18V$ to accomodate to the $15W$ output power.

With this information, the voltage gain can be determined by using the following formula:

$$A = \frac{U_{out}}{U_{in}} \quad (4)$$

40 Since $U_{out} = U_{out,max} = 11V$ and $U_{in} = 18V$ (the voltage delivered by the supply), the gain will be $\frac{11}{18} \approx 0.61$. Expressed in decibels, this is equal to $20 \cdot \log(\frac{11}{18}) \approx -4.28dB$.

It is now also possible to deduce the output impedance Z_{out} using the following equation:

$$\frac{U_{out}}{U_{in}} = \frac{Z_{out}}{Z_{in}} \quad (5)$$

⁴⁵ Filling in the known values, Z_{out} can be determined as follows:

$$\frac{11}{18} = \frac{Z_{out}}{50 \cdot 10^3} \implies Z_{out} = 50 \cdot 10^3 \cdot \frac{11}{18} \approx 30.6\Omega \quad (6)$$

References

- [1] Texas Instruments. (2004, May). “*LM1875 20W Audio Power Amplifier*” [online]. Available: <http://www.farnell.com/datasheets/1703151.pdf> [April 3, 2015].