

# Calculation Report: Monolithic Power Amplifier PRO-Q2

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EQ2.a  
EQ2.c

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## <sup>5</sup> 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:  $15\text{W}$  sine in  $R_{\text{load}} = 8\Omega$  at  $1\text{kHz}$
- Frequency range:  $10\text{Hz}$  to  $100\text{kHz}$  ( $-3\text{ dB}$ ) at  $P_{\text{load}} = 0.5\text{W}$  in  $8\Omega$

### 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  $50\text{Hz}$  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  $Z_{\text{in}}$  will be equal to  $R_1$  as depicted in the following diagram.

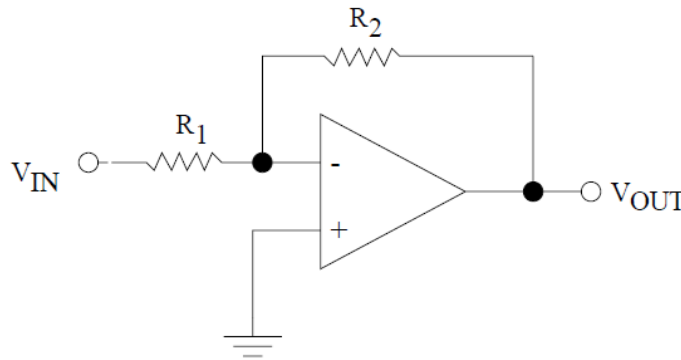


Figure 1: Inverting amplifier diagram

$Z_{in}$  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  $8\Omega$  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  $100kHz$ . 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:

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

<sup>45</sup> 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].