2 Monolithic Power Amplifier

2.1 Requirements

10 The power amplifier has the following specifications:

• Input impedance of at least 50 $k\Omega$



• Output power: 15 W sine in $R_{load} = 8 \Omega$ at 1 kHz

• Frequency range: 10 Hz to 100 kHz (–3 dB) at $P_{\rm load}=0.5~{\rm W}$ in 8 Ω

2.2 Chosen Power Amplifier

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.

2.3 Calculations

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

The formula for the power equals to:

$$P = U * I \tag{1}$$

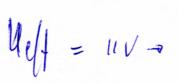
Therefore the following formulas can be derived:

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

$$I_{OUT,max} = \sqrt{\frac{P}{R}} = \sqrt{\frac{15}{8}} = 1,37A$$
 / (3)

The amplifier has a bandwidth of 70 kHz at 20 W output power, however the desired dynamic range of 10 Hz to 100 kHz can be easily achieved at lower power \wp output.

According to the datasheet from LM1875 [1] the supply voltage need to be approximately \pm 18 V to accommodate to the 15 W output power.



Calculation Report: Heat Sink Power Amplifier PRO-Q2

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EQ2.a EQ2.c

April 4th, 2015

Calculation: Heat Sink Power Amplifier $\mathbf{2}$

Imagine that the maximum temperature that the power amplifier can be 150 °C and that the surrounding temperature goes up to 70 °C. The maximum output power equals to 15 W. Then the total junction-to-ambient thermal resistance must be less than[1]:

 $\theta_{ja} = \frac{150-70}{10} = 8,0C/W$ The thermal resistance of a metal-metal interface equals: (1)

$$\theta_{jc} = 1, 2C/W \tag{2}$$

The therminal resistance of the heatsink equals:

$$\theta_{ca} = \theta_{ja} - \theta_{jc} = 8,0C/W - 1,2C/W = 6,8C/W$$
 (3)

To check whether the calculations are correct, we determine the temperature of the junction as a result of the thermal resistance.

The maximum average power that the IC will be required to dissipate is approximately [1]:

$$P_d MAX = \frac{V_S^2}{2\pi^2 R_L} + P_Q = \frac{18^2}{2\pi^2 * 8} + 10 = 12,05W$$
 (4)

- $\bullet~V_{\rm S}$ is the total power supply voltage across the power amplifier.
- R_L is the load resistance.
 - \bullet $\,{\rm P}_{\rm Q}$ is the quiescent power dissipation of the amplifier. The maximum power of the power amplifier is 15 W and the maximum required power is 15 W. Therefore

$$P_O = 25W - 15W = 10W \tag{5}$$

The maximum temperature is:

$$T = P_d MAX * \theta_{ja} = 12,05 * 8 = 96.4 \text{ r} C$$
 (6)

96,4 °C is higher than 70,0 °C and therefore the new

$$\theta_{ja} = \frac{150 - 96, 4}{10} = 5,36 \text{ Fe}/W \tag{7}$$

The new $\widehat{\mathbb{Q}}_a$ (5,360 °C / W) is lower than 8,0C / W, which means it meets the required specifications.