Design and Implementation of Class B Power Amplifier for 5kW AC Power Source

Jeong-Chay Jeon[1], Hyoung-Keun Park[2] and Hyun Seob Cho[3]

[1]Korea Electrical Safety Corporation
#27 Sangcheon-ri, Cheongpyeoung-myeon, Gapyeong-gun, Gyeonggi-do, 477-814, Rep. of Korea
[2] Department of Electronic Engineering, Namseoul University
#91 Daehak-ro Seonghwan-eup Sebuk-gu Cheonan-si, Chungcheongnam-do, Rep. of Korea
[3] Department of Electronic Engineering, ChungWoon University
#San29, Namjang-ri, Hongseong-eup Hongseong-gun, Chungnam, Rep. of Korea
kescoin@naver.com*

Abstract. This paper presents the design and implementation of class B linear power amplifier for 5 kW three-phase AC Power Source. The power amplifier was designed using power transistor 2SA1494(PNP) and 2SC3858(NPN), and was implemented so that the enlargement of the capacity in the future is possible. The developed amplifier was applied to the AC power source system and output accuracy and capacity were tested was tested.

Keywords: Power Amplifier, AC power source,

1 Introduction

A single and three-phase AC power source using sliding mode control was proposed by Low and predictive control with pulse width modulated inverters was generalized [1][2]. The harmonic generator with pulse width modulated inverter has problem that switching losses increase with the elevation of the switching frequency [3][4]. And although its efficiency is poor and a large heat sink and an isolation transformer are required which increases the size and the weight of the systems, the ac power source with linear power amplifier allows the generation of any waveform and has merit that input-output characteristic is good. Linear amplifiers are classified into different classes such as A, B, C, and F according to their circuit configurations and methods of operation. These classes range from entirely linear with low efficiency to entirely non-linear with high efficiency [5]. This paper describes the design and implementation of 5kW class B power amplifier for AC power source.

2 Output stage of class B power amplifier

The class B amplifier is a two-transistor circuit that is designed to improve on the efficiency characteristics of class A amplifiers. A class B amplifier is shown in Fig. 1. The circuit shown is a complementary-symmetry amplifier, or a push-pull emitter follower. The circuit contains one npn transistor (Q_1) and one pnp transistor (Q_2).

The maximum power dissipation $P_{D(\max)}$ can be written as

$$P_{D(\max)} = \frac{4V^2{}_s}{\pi^2 RL} - \frac{2V^2{}_s}{\pi^2 RL} = \frac{2V^2{}_s}{\pi^2 RL} \cdot \quad (1)$$

In order to design an amplifier that has an output power of 200 W and drives a load of 25 Ω, the output voltage is calculated as

$$P_L \le 200 \rightarrow \frac{A^2}{2R_L} \le 200 \rightarrow A \le 35.36 \cdot \quad (2)$$

Considering the saturation voltage of transistors, the supply dc voltage V_s of the amplifier should be larger than the maximum output voltage $A_{\max}$. The designed amplifier of Fig. 2 has power transistor 2SA1494(PNP) and 2SC3858(NPN), while the supply dc voltage V_s was chosen as 39.5 V.

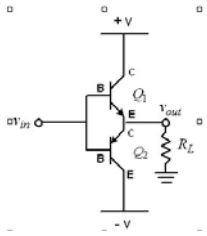

Fig. 1. A class B amplifier

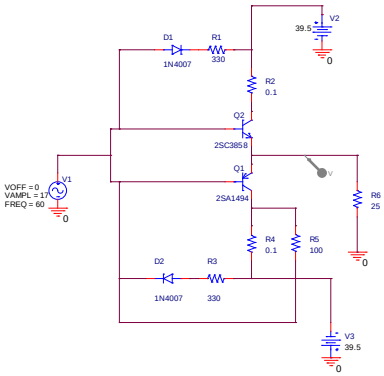

Fig. 2. The basic structure of the designed amplifier

3 H/W Implementation and test

The power amplifier module is consisted of power transistor 2SA1494 (PNP type) and 2SC3858 (NPN type). These linear AC power amplifiers are constructed as shown Fig. 3. It has the output capacity of 5 kW and is designed so that the enlargement of the capacity in the future is possible. The performance of the amplifier is tested by some measurements. Output Voltage test results indicated that the developed amplifier yielded less than 0.2 % error.

Fig. 3. The developed linear power amplifier PCB(500W*10=5kW)

4 Conclusion

This paper designed and implemented class B power amplifier for AC power source to test electric system and equipment. The developed amplifier was applied to the ac power system and output accuracy and capacity were tested. The test results have demonstrated that there is little error of output voltage due to the linear power amplifiers. Therefore, future work to develop power amplifier with high accuracy and large capacity will be need.

References

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