Comparative analysis between the switch mode power supply (SMPS) using IC Tl494cn transformer based on power supply linear

A Azis H*, Cholish, Rimbawati and N Evalina

Department of Electrical Engineering University of Muhammadiyah Sumatera Utara
Jl. Kapt Muchtar Basri No. 3, postcode 20238, Medan, Indonesia

* Email: abdulazis@umsu.ac.id

Abstract. In general Audio Amplifier using linear transformer-based power supply as energy conversion. Such use may cause interference with electrical installation sourced from the substation circuit. The non-linear load would cause problems in the electrical installation system. This research shows that Switch Mode Power Supply (SMPS) has a minimum voltage Vdrop output load of about 100 to 33.33 ohms. On the burden of 25-20 ohms as the voltage Vdrop output, which is different from Linear Power Supply Transformer-based parameters, that its voltage Vdrop output was changed significantly.

Keyword: Power Supply Linear, Audio Amplifier Efficiency, SMPS

1. Preliminary
At present, the use of electrical energy is one of the most basic needs of people. It can be seen from the power consumer demand for electrical energy needs [1]. This condition is not far from people's dependence on electrical energy requirements as a staple. These needs include the need for electrical energy for household such as a motor on the machine water, washing machines, fans, blender, Lamp as lighting, cooling in the refrigerator, air conditioner, heater (Heater) at an iron, rice cooker, and goods - other electronic goods that also serves as an entertainer entertainers such as televisions, audio players, radios, audio amplifiers, and others.

Texas Instruments Incorporated designing Switch Mode Power Supply (SMPS) [2]-[8] using MOSFET TL598. A control circuit that uses MOSFET TL598 is designed with the ability to avoid the need for additional output circuits. In addition, MOSFET TL598 here used as a control circuit pulse-width-modulation.

2. Literature Review
Subsequent research of Switch Mode Power Supply Using Boost For PFC Converter. This is done to eliminate the problems that occur in Switch Mode Power Supply (SMPS), which is not using power factor correction and, thus, requiring the addition of great value as a filter capacitor DC [2]-[5]. To solve this problem is the addition of power factor correction (PFC) in switch-mode power supply (SMPS)[6]-[9]. In this SMPS, power factor correction is placed at the output of the rectifier by using Boost converter. Boost converter working in discontinuous conditions, because the conditions are not continuous did not appear backflow (IRR) on the components of the boost converter diode, the diode so that less can be used. In addition to the continuous condition resulting in lower I2R losses and low
ripple current in the inductor resulting in lower core loss. The boost converter is connected in series with the load buck converter to supply 24V/60W [9]-[10]. Boost converter as a power factor correction (PFC) in the design of an output voltage of 50 V and a current of 3 A. While the buck converter design produces a voltage of 24 V with a current output 2.5 A.

3. Method
Before modifying an audio amplifier, it needs to know construction and part of it to simplify the design modifications. A series of Switch Mode Power Supply (SMPS) functions the same as a linear transformer-based power supply, supplying voltage and current on the audio amplifier, the only difference being its mechanism of action. For more details, can be seen one-line diagram in Switch Mode Power Supply (SMPS) (Figure 1) and Power Supply transformer-based linear (Figure 2).

Figure 1. Schematic SMPS Power Control at +/- 35 VDC - 350W using IC TL494CN

Figure 2. One-Line Diagram In Audio Amplifier using Linear Transformer-Based Power Supply
One-line diagram (Figure 2) is a condition when the audio amplifier using transformer-based Linear Power Supply. AC voltage is converted into AC voltage other smaller ones with the help of transformer. This voltage is then rectified by using a series rectifier voltage (Rectifier), and at the end added condenser as smoothing voltage (Filter) so that the DC voltage generated is not too bumpy. Then the DC voltage refines again regulator so that the voltage generated is better (no ripple on the waves). Linear transformer-based power supply produces a DC voltage that varies between 0-60Volt with a current between 0-10 amperes.

After a linear transformer-based power supply switched using the Switch Mode Power Supply, a different mechanism of action, which is directly rectified (Rectify) and filter (Filter) 220 V AC input voltage to obtain a DC voltage. The DC voltage is then Switch ON and OFF at a high frequency to high-frequency circuit that generates an AC that can pass through a high-frequency transformer. How to rectify the voltage is to use a high frequency between 10KHz to 1MHz, which is much higher frequency than the frequency of around 50Hz AC. Additionally In SMPS gave feedback circuit so that voltage and current are out of this circuit can be controlled either automatically using PWM Control.

4. Results and Discussion

From the tests performed on Switch Mode Power Supply (SMPS) and Power Supply Transformer Based Linear, then obtained the desired parameter data and analysis have a comparison (Figure 3 to Figure 5).

**Figure 3.** Expense ratio graph of the Output Power On Second Device
Figure 4. Comparison of Charges Against Graph $V_{drop}$ On both devices

Figure 5. Comparison of Charges Against Efficiency Graph On both devices
5. Conclusion
From experiments conducted on Switch Mode Power Supply (SMPS) and Linear Transformer shows that the Switch Mode Power Supply (SMPS) experienced minimal $V_{drop}$ output voltage to the load 100 to 33.33 ohms. On the burden of 25-20 ohms, the output voltage $V_{drop}$ very much. Different from Linear Power Supply Transformer-based parameters - parameters such as output voltage $V_{drop}$ changed significantly, as well as its efficiency. From these facts, it can not be said SMPS is perfect because it is not as expected at first. This is because the modified Switching Transformer not meet the quality standards, and there are several other factors so that the resulting efficiency is low. The results of this experiment can be made about improving the performance of the SMPS itself in order to obtain future results that perfect as expected.

References
[1] Fundamentals of Power Electronics “Chapter 15: Transformer Design”.
[2] EE IIT, “Design of Transformer for Switched Mode Power Supply (SMPS) Circuits”, Version 2 EE IIT, Kharagpur.
[3] IEEE Canadian Review, 2009, “Switching Mode Power Supplies”, Fall / Automne 2009, No.61, Canada.
[4] Kwon Su-Han, Yoo Doo-Hee, Jeong Gang-Youl, 2014, 2014, “High-Efficiency AC-DC Switch-Mode Power Supply Using Full-Bridge Converter Circuits”, International Jurnal Of Control and Automation Vol.7. No.6.
[5] L. Wuidart, 1999, “Topologies For Switched Mode Power Supplies”, Application Note, STMicroelectronics, Italy.
[6] Manasa, 2014, “Variable Switched Mode Power Supply Using TL494”, Project Report Submitted In Partial Fulfilment Of The Requirements For The Award Of The Degree Of Bachelor Of Technology In Electrical And Electronics Engineering, Gokaraju Rangaraju Institute Of Engineering And Technology Hyderabad, Andra Pradesh.
[7] Ngah Demon Siti Zulaikha, Tamuri Abdul Rahman, Bidin Noriah, 2008, “High Voltage Switch Mode Power Supply For Laser System”, Department of Physics Centre of Foundation Studies, National Defense University Malaysia, 57000 Kuala Lumpur.
[8] SCILLC, 2014, “Switch-Mode Power Supply Reference Manual”, On Semiconductor, USA.
[9] Texas Instruments Incorporated, 2001, “Section 4 - Power Transformer Design”, Dallas, Texas.
[10] Zhang. J Henry, 2013, “Basic Concepts Of Linear Regulator And Switching Mode Power Supplies”, Linear Technology, USA.