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Simulation And Comparative Analysis of Linear DC Power Supply

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ABSTRACT
DC power source of a certain importance is required by electronic circuitry to work successfully. This proposed research work views the design as well as assessment regarding transformer-based and transformer less-based changing controlled DC power supply. It will also represent any marketplace analysis investigation involving them and their particular own aspects of uses. The product quality, expense, dimension, excess weight, efficiency as well as effective manufacturing regarding DC power supply, all these pose lots of matter and focus in the DC power manufacturing. The structure methodology found in this work will involve application layout with regard to aspect selection, increased equipment layout, computer simulation. This proposed research work will also presents an assessment regarding transformation, rectification, filtration and regulation stages for both equally transformer-based & transformer-less adjustable DC power supply along with graphic outputs. The final results obtained following the layout specification had been extremely adequate. The particular transformer-based has an effective output current as well as very well out of the way through the supply voltage, making it far better for higher current applications. The transformer less DC supply provides scaled-down dimension, excess weight as well as cheaper. It also generates less noise, warmth; inter harmonic distortion ranges and larger transient response. However lack of proper solitude as opposed to its counterpart hence cause decrease Mean Time to Failure (MTTF). Transformer less changing DC power supply should be considered any viable choice with regard to decrease power. Expense, dimension as well as excess weight limitations lessen the usage of traditional transformer-based DC power supply.

Keywords: DC (Direct Current), Rectification, Filtration, Regulation.

I. INTRODUCTION

Today power system needs more reliability & precision due to rapid growing need of electricity. In Electrical as well as Telecommunication Anatomist subject, methods as well as machines like amplifiers, satellites, microwave web page link methods rely on the particular accessibility to a stable as well as top quality nicely controlled Direct Current (DC) power materials with regards to appropriate operations. No technology laboratory or engineering is actually complete with not a nicely controlled (or variable) DC power supply. It is the 1st crucial element necessary in any technology device. The actual construction, layout as well as analysis of this bit of electronic digital products are useful now plus within foreseeable future.

The principle as well as simple prerequisites of your nicely controlled DC power supply product are Remoteness between supply as well as load, Small ripple, Small result impedance, Power aspect, Excessive transient reply, Small levels of input harmonic distortion, Reduced power losses, Very good polices, Tight result short-circuits protection, Practical dimensions as well as bodyweight. A simple yet effective, dependable Power supply can remain to possess a crucial function within rewarding the particular nation's rising being thirsty pertaining to energy.

DC Power supply includes a very long background regarding setting up brand new systems of which usually boost effectiveness within reply to the particular different requires regarding modern society. This approach regarding creativity becomes necessary right now. DC power supply which is each productive as well as dependable than today's system is actually planned to satisfy the nation's goal of your sustainable foreseeable future pertaining to electronic devices.

Electronics circuitry requires DC power supply of a unique worth to work correctly. This specific planned exploration perform can look at the layout as well as analysis regarding transformer-based as well as transformer less-based varied controlled DC power supply along with the purpose of showing any comparative examination between these individuals; as well as the respected areas of applications. The product quality, expense, dimensions, bodyweight, effectiveness as well as productive output regarding DC power supply hence cause significant amounts of matter as well as focus inside the DC power output regarding any kind of computer.

II. RELEVANT WORK

Mike Papadimitriou [1], in his work used LM317 for varying DC power supply. It's a 3−terminal positive voltage regulator which is changeable. It can give current of 1.5A. Its output voltage cans changer over interval of 1.2 V to 37 V. For fixing the output voltage in this regulator, an external capacitor and resistor is used. This makes this type of regulator easy to use.

National Microchip co-operation [2] also worked on Transformer-less Power Supplies. The transformation component used in this work was a resistor. In this work a reliable circuit diagram was presented that works very well in computer simulation. This circuit presented no protection in opposition to over-current and over voltage problem.

Like the work discuss before, Williams, O.A. [3] used LM 78 XX for making power supply. Its plus point is easy to use. It has internal current limiter. It is proficient of providing 1.0A over an output voltage range of 1.2 V to 21 V. its demerits includes the lack of internal thermal shutdown mechanism.

Ron J [4] in his work, designs a transformer-less power supply. He used X-rated capacitor for small current applications. Its current ranges up to 100mA current and a voltage of 12V. The major weakness was, it has no separation from the supply voltage hence creates additional safety concern.

Kiran Shrestha [5] has published his work on Transformer less 12V Dual Power Supply. By using zener diode in his design, he got two outputs of +12V and -12V. The drawback of his design was the lacking of protection not in favor of over-current and over voltage.

Garage [6] used LM 78XX to make a variable DC power supply. All the phases were in point of fact excluding the protection phase.

Mohamkumar [7] made a Transformer less power supply. In his research he placed an x-rated capacitor as transformation component as a replacement for the transformer. The x-rated capacitor has shown the usefulness and competence. He gave a glowing thorough circuit diagram of a fixed DC power supply by means of zener diode.

Shamsul and Bin [8] worked on improvement of DC Power supply by means of power electronics deployment. He made a fixed DC power supply by simulation. It performs successfully but there was no protection circuit.

Emerson Network Power [9] compared transformer based and transformer less uninterruptible power supplies. In this report prominence were given to the matchlessness, unlikeness and correspondence between transformer and transformer-less based gadgets.

III. OBJECTIVES

The primary aim of this proposed research thesis is to think about the design in addition to assessment of transformer-based and the transformer-less structured adjustable linear DC power supply. The objectives also includes of presenting a comparison analysis between these individuals; in addition to their particular respective areas of applications.

- For a higher value of MTTF (Mean Time to Failure), designing and simulation of a sound separated DC power supply.
- To carry out the simulation and comparative analysis of different phases for both transformers based and transformer less DC power supply using graphical outputs like transformation phase, rectification phase, filtration phase and regulation phase.

For making a good choice according to our needs between the transformer based and transformer less DC power supply, an analytical comparison will be done on the basis of simulation results.

IV. PROPOSED METHODOLOGY

The planning method employed in this proposed research work consists of selection of hardware components, robust components design and software implementation. In addition to these an assessment will be done involving equally transformer-based and transformer-less adjustable DC power supply with visual components.

Following methodology will be adopted to accomplish the above objectives:

I. To study in depth about the literature of DC Power Supply.
II. To do the simulation and evaluation of transformation & Rectification stages for proposed design.
III. To do the simulation and evaluation of filtration & regulation stages for proposed design.
IV. To do the cost analysis for both transformer-based and transformer-less based adjustable DC power supply.

To discuss and analyze overall results of simulations in terms of robustness, power loss, noise production, input harmonic distortion, weight, size and cost for both transformer-based and transformer-less DC power supply.

V. SIMULATIONS

In the given figure 7.1, an unregulated DC Power supply is simulated using Pspice Software. By unregulated we mean to say that when we start refrigerator in home and the voltage suddenly drops down. To avoid such fluctuations we should have design a regulated DC Power Supply is given in figure 7.2.

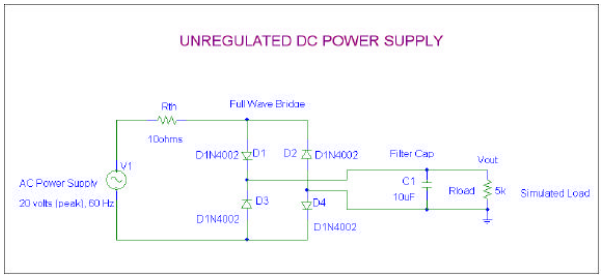


Figure 7.1 Unregulated DC power supply

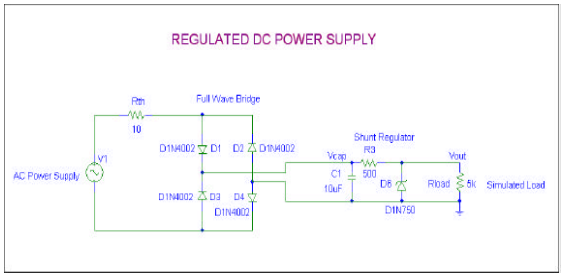


Figure 7.2 Regulated DC power supply

In this propose research work, the design and analysis is divided into several stages. Let's discuss and analyze these stages step by step. Following are the steps taken to accomplish this propose project.

The flow diagram for transformer based and transformer less DC power supply is exposed in Figure 7.3 and Figure 7.4 respectively.

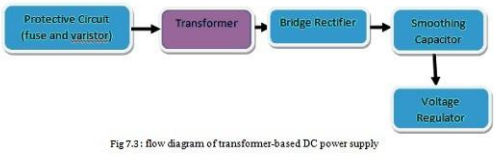


Fig 7.3 : flow diagram of transformer-based DC power supply

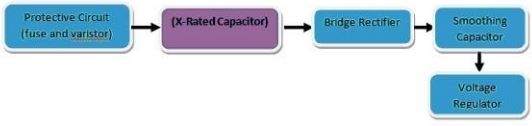
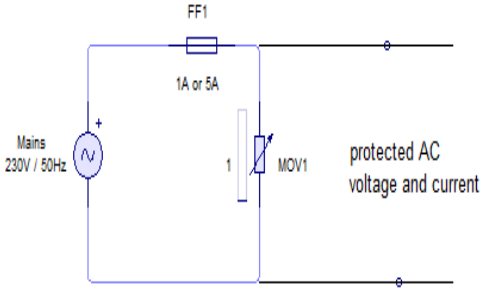


Fig 7.4 : flow diagram of transformer less DC power supply

1 Protection Stage:

The Protection Stage provides protection against over voltage and over current which makes the system reliable and economical one.

In this stage we use Fuse and Varistor for protection purpose.



2 Transformation Stage:

This stage is used to transform the AC voltage of 230V incoming from the protection circuit to the value acceptable for the circuit. In transformation stage we have transformer in transformer based DC power supply while we have an X-rated capacitor in transformer less DC power supply.

2. A) Using Step-Down Transformer:

The circuit with protection stage and transformation stage is shown in Figure 7.6. The circuit is analyzed and waveforms are shown after simulation of these two stages for transformer based DC power Supply.

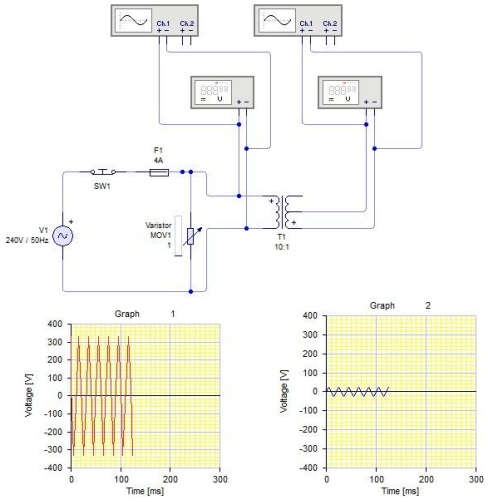


Figure 7.5 transformation phase of transformer based power supply

2. B) Using X-rated AC capacitor:

The X-rated AC capacitor is used in transformer less DC power supply. The simulations results in the form of waveforms are given below. The given Figure 7.6 shows the protective circuit and the transformation stage of the circuit.

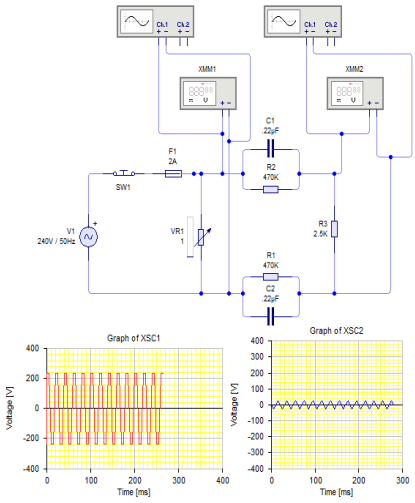


Figure 7.6 transformation phase of transformers less DC power supply

3 Rectification Stage:

The rectification stage is that stage in which the AC from the main supply and through the protective and transformation stage is change into DC by means of rectifiers. In this proposed work we applied a full wave rectifier. It is better than the half wave rectifier. In this proposed work we are using full wave bridge rectifier as for full wave center tap transformer we will need a center tap transformer.

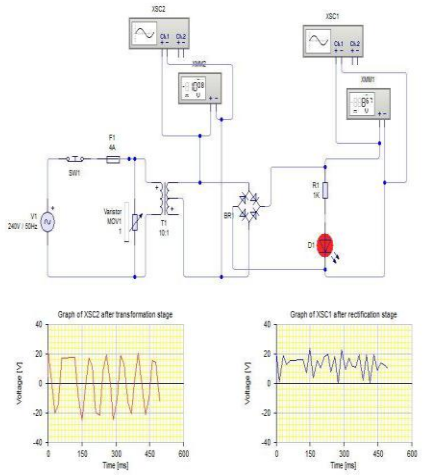


Figure 7.7 rectification stage for transformer based power supply

4 Filtration stage:

Smoothing capacitor is used for the filtration in this stage. This device change the fluctuating output of the half wave or full wave rectifier into the desire smooth DC output. It smooth down the ripples in the output of the rectifier circuit.

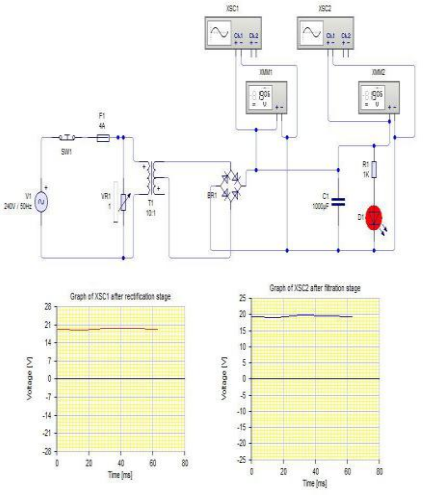


Figure 7.8 Filtration stage for transformer based power supply

5 Regulation stage:

In this stage the voltage is kept at the desire level. It remove the ripples or glitches which left after the filtration stage so make the output a pure DC ready to run any device with in its rating limits. In this proposed work two devices are used for regulation purpose in this stage. One is LM317 and other is zener diode.

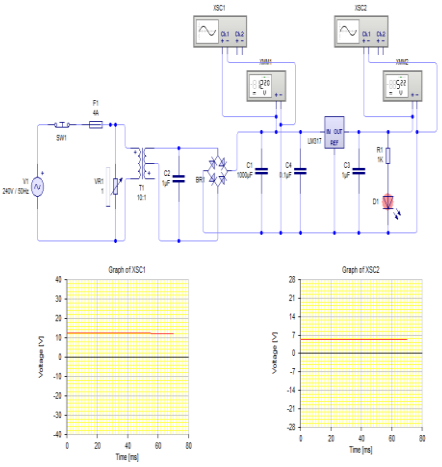


Figure 7.9 Regulation stage for transformer based power supply

6 Observations & Discussion:

Results in the form of cost analysis is given in the below table. This gives the exact price of all the components needed for making the transformer based and transformer less dc power supply.

Table 7.1 Transformer less DC power supply

Name	**Numbers**	**Amount (Rs)**
Switch (SW1 and SW2)	2	168
Fuse (2A)	1	34
Varistor (250 Vac)	1	252
X-rated Capacitor (C1 and C2-225K/400V)	2	505
Bleeder Resistor (R1 and R2- 470K,1W))	2	85
Bridge Diode (4-diodes-IN4007)	1	336
Filter Capacitor (470uF/50V)	1	85
Resistor (R3,R5,R6-100 ohms, 1W)	3	252
Zener Diode (12V/1W)	1	33
LED Resistor (R4-1K, 1/4W)	1	33
LED (red)	1	50
Zener Diode (5V/1W)	1	33
Zener Diode (3.7V/1W)	1	33
USB Female port	1	84
Package (box, lead and Vero Board)	3	844
Total	**21**	**2827**

Table 7.2 Transformer based DC power supply

Name	**Numbers**	**Amount (Rs)**
Switch (SW1)	1	84
Fuse (4A)	1	50
Varistor (250 Vac)	1	252
Transformer (24V/1.5A)	1	1011
Noise Suppressor Capacitor (C2 and C4)	2	168
Filter Capacitor (C1-1000uF/50V)	1	118
Ripple Rejection Capacitor (C5-1uF/16V)	1	84
Transients Capacitor (C3-1uF/25V)	1	84
LM 317 Resistor (R1-240 ohms,1W)	1	84
LM 317 Variable Resistor (VR1-5K)	1	252
LM317 Protective Diodes (IN4007)	2	67
VR1 knob	1	168
Packaging	1	1990
Total	**15**	**4412**

Table: 7.3 Results

Factors	**Transformer less DC power supply**	**Transformer base DC power supply**
1: Protection	Protection is provided against the over current and over voltage but still care should be taken when it is dealt without a package.	It has the plus point as it provide separation from input supply through transformer.
2: Transformation	It was good as to change the supply voltage of 240Vac w to 24 Vac. which is also given in the datasheet of 225K x-rated capacitor. Figure 7.5	It was better option as it provides good results due to transformation ratio as calculated. Figure 7.6
3: Rectification	A bridge rectifier was used in this work and it gives good results. Figure 7.7	Similar performance of the bridge rectifiers as in transformer less dc supply. Figure 7.7
4: Filtration	which gives a good l filtered DC signals with a smoothing capacitor of 470µf Figure 7.8.	The waveform shows nicely filtered DC signals with a smoothing capacitor of 1000µF. Figure 7.8.
5: Regulation	The resulting waveform had a lot of ripples by using LM 317 regulator. Figure 6.9	Same results as in transformer less dc supply. Figure 6.9
6: Robust	Any voltage value can be achieved using X-rated capacitor but with the low value of output current.	The current and voltage rating of transformer are robust.
7: Power Loss	It has low power losses due to low current values.	Due to huge input and output voltage difference, the power losses may be more. But for cooling there is a heat sink.
8: Noise Production	It is a Noise less device.	Minimize the noise created in this circuit by using capacitor.
10: Cost, Size and Weight	It has low cost, minimal dimensions and less weight. As shown in Table.7.1	It has more cost and dimensions depend upon the current rating. It is heavy. As shown in Table.7.2

VI. CONCLUSIONS

A relative evaluation connected with Transformer-based as well as Transformer-less changing DC Power supply is attained with their layout evaluation. The software program layout as well as layout simulation for the two transformers-less as well as transformer based changing DC power supply are done in this paper. By applying Pspice simulation software program their performance evaluation seemed to be acceptable. The transformer-based carries a powerful end resultant current as well

as very well isolation from the source voltage. This makes it more suitable to use for large values of current, highly reputable for input of gadgets units. While transformer-less DC supplier provides more compact size as well as less expensive so that you can miniaturize gadgets units but limited by minimal current units. In addition, it yields much less noises, heat, insight harmonic distortion quantities, as well as increased transient response. The drawback of the transformer less DC supply is the lack of separation contrary to the counterpart therefore results in reduces Mean Time to Failure (MTTF). Transformer-less changing DC power supply is highly recommended a workable solution for reduce strength, smaller as well as minimal current programs. The price tag, size as well as weight restrictions hinder the use of standard transformer-based DC power supply.

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