

DESIGN & IMPLEMENTATION OF AC TO DC CONVERTER FOR EFFICIENT POWER CONVERSION

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DOI: <https://doi.org/10.5281/zenodo.19852876>

Keywords

AC to DC Converter, Switch-Mode Power Supply (SMPS), VIPer22A, Power Supply Topologies, Low-Voltage Outputs

Article History

Received: 04 March 2026

Accepted: 11 April 2026

Published: 28 April 2026

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Abstract

This research Paper focused to establish an efficient power AC to DC converter instead of applying standard pre-programmed chips. All the topologies of SMPS are explored and their ranges of applicability are evaluated as well. The internal electrical components in modern air conditioners require low-voltage outputs of +12V and +5V, which are generated by a switch-mode power supply (SMPS). Designs that are efficient, tiny, lightweight, and have little standby power consumption are made feasible by the VIPerX2 family. The VIPer22A high-voltage converter is the major focus of attention in this study, which focuses on a 12V 1A power supply. The research shows the VIPer22A's dependability and efficacy while assessing other power supply topologies. A 12V 1A and a 5V 1A supply were also mentioned. The initial testing with a single-phase supply revealed steady output and perfect control. The VIPer22A was incorporated to boost performance and efficiency. The VIPer22A's potential to reliably and correctly meet stringent requirements has been shown by the final design, which has been validated by simulations and practical testing. It delivers stable 12V and 5V outputs at 1A.

1 INTRODUCTION

Switch-Mode Power Supplies (SMPS) enable efficient DC-DC conversion, vital for electronics needing different voltage levels. They provide a reliable, versatile method surpassing older techniques and are widely used in microprocessors, motors, and LEDs to bridge voltage gaps between power sources and devices in unstable conditions [1].

SMPS topologies, ranging from step-up to stepdown and combinations thereof, enable

versatility to suit practically any output voltage need. However, efficiency remains crucial, fueling continuing research and development efforts to maximize performance [1]. Recent advancements include the incorporation of high frequency switching methods to minimize footprint and boost efficiency, using components like the VIPer22A IC [2]. The VIPer22A stands out as a high performance PWM controller, amalgamating many functionalities required for effective

power supply design [3]. Equipped with characteristics such as a high-voltage start-up current source, current mode PWM controller, and strong protection circuits, this IC excels in building small, reliable, and efficient 12V 1A power supplies, matching smoothly with the needs of modern electronic devices [4]. Furthermore, the VIPer22A's integrated design speeds development by reducing external components, thereby lowering power-supply size and cost [5]. This feature makes it ideal for space and cost-constrained applications. Its ability to maintain stable performance under varying loads reinforces its suitability for demanding areas such as consumer electronics, industrial controls, and automotive systems. As devices evolve,

demand for durable, efficient power solutions like the VIPer22A will continue to rise [6] [7] [8].

The aims of this study are to have a comparative perspective on various Ac to Dc Converter design, to propose a new design to increase efficiency [9].

2. PROPOSED AC TO DC CONVERTER DESIGN

The suggested design comprises the creation of a 12V 1A power supply circuit employing the VIPer22A PWM controller. This design attempts to offer a small, dependable, and efficient solution for addressing the power needs of current electronic gadgets. The circuit of Figure 1 has been established with viper software owned by STM electronics.

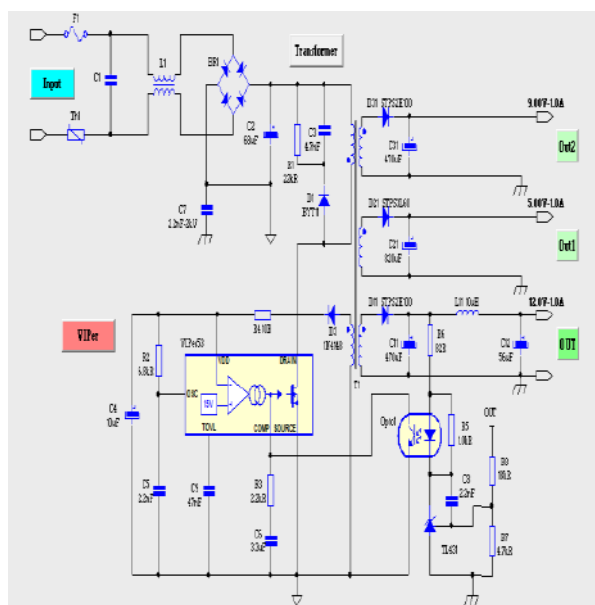


Figure 1: Proposed SMPS Circuit for Viper22A

The circuit of Figure 1 comprises the following components-Viper 22A IC, TL431 Shunt Regulator, Optocoupler (PC817), transformer, Bridge Rectifier (BR1), Fuse (F1), Thermistor (TM1), and Bridge Rectifier (BR1). Switched-mode power supply circuits (SMPS) are most commonly in needed in many electronic designs to convert the AC mains voltage to acceptable level of DC voltage for the device to function. This sort of AC-DC converters takes in the 230V/110V AC mains voltage as input and converts it to low-level DC voltage by

switching it, thus the term switch mode power supply. In this study effort, we will design 12V 1A and 5v 1A SMPS circuit utilizing the VIPer22A, which is a popular low-cost SMPS driver IC from ST Microelectronics [10].

3. SMPS SPECIFICATION ANALYSIS

As with earlier SMPS-based projects, different kinds of power supply operate in different settings and within particular input-output limits [11]. Therefore, before starting the

actual design, a comprehensive specification study is necessary [12] [13].

3.1. Input specification

The input of this SMPS corresponds to the AC to DC conversion domain, hence needing an AC input. In this research, the input voltage is fixed according to European standard voltage ratings, which also coincide with the standard voltage ratings of Pakistan. Therefore, the input AC voltage for this SMPS will range between 220-240VAC [14].

3.2. Output Specification

The output voltage is chosen to be 12V with a current rating of 1A, resulting in a 12W output. As the SMPS is designed to provide constant voltage regardless of the output current, it operates in Constant Voltage (CV) mode. The output voltage remains constant and unwavering at the lowest input voltage with a maximum load of 2A across the output and same phenomenon observed for 5v.

3.3. Output Ripple Voltage

It is imperative for a decent power supply to have a ripple voltage of less than 30mV peak-to-peak. Similarly, the targeted fluctuation voltage for this SMPS is less than 30mV peak-to-peak [15]. However, the output ripple of an SMPS is significantly influenced by its construction, PCB layout, and the type of capacitors used. In this endeavor, low Equivalent Series Resistance (ESR) capacitors rated at 105 degrees Celsius from Wurth Electronics are utilized, resulting in an expected output ripple below the specified limit [16-18].

3.4. Protection circuits

Various protection circuits can be included in an SMPS to ensure safe and reliable operation, safeguarding both the SMPS and the associated load. Depending on the type, protective circuits can be linked across the input or output [19]. For this SMPS, input surge protection will be applied, with a maximum operational input voltage of 275VAC. Additionally, to solve Electromagnetic Interference (EMI) concerns, a common-mode filter will be implemented to reduce high-frequency noise [20] [21, 22] [23].

4. ROLE OF SWITCHING TRANSFORMER

The switching transformer is an essential component in the AC to DC proposed converter circuit, fulfilling numerous vital tasks. It is responsible for voltage conversion, galvanic isolation, and impedance matching, ensuring the efficient and safe transmission of energy from the AC input to the DC output [24]. By stepping down or stepping up the input voltage, the switching transformer helps in obtaining the correct output voltage level, which is vital for the proper operation of many electronic equipment [25].

By implementing proper shielding and filtering techniques, the transformer aids in decreasing high-frequency noise, hence ensuring steady and dependable operation of the converter [26] [27,28]. In summary, the switching transformer is vital in the AC to DC suggested converter circuit, contributing to its efficiency, safety, and overall performance [29] [30-32]

5. AC to DC Proposed Converter Circuit

Table 1 shows the generated transformer construction parameters.

Parameter	Value
Primary Inductance	1.66 mH
Leakage Inductance	3.0 μ H
Primary Capacitance	30 pF
Winding Turns	Input: 172, Aux: 34, Output: 12
Temp Increase (Target)	40.0 $^{\circ}$ C
Temp Increase (Actual)	31.6 $^{\circ}$ C
Dissipated Power (Target)	2.0 W
Dissipated Power (Actual)	4.7 W

Core Geometry	E13/7/4 E Series
Ae	13.0 mm ²
Le	29.6 mm
Ve	384.0 mm ³
Window Area	11.6 mm ²
Core Losses	147 mW
Winding Losses	144 mW
Total Losses	291 mW
Core Type	N27
Supplier	SIEMENS
Bsat	380 mT
Window Factor	0.80
Air Gap	0.28 mm
Cont Ratio	1.11
Bsat Margin	25.0 %
Flux Density	204 mT
Wire Type	Single Wire
Input Wire Details	AWG 35, 143 μm, Ls: 170 μm, Rdc: 5.5 , Rac: 5.5

6. RESULTS & DISCUSSION

The results and discussion section of this research article underlines the crucial relevance of an integrated approach to simulation, hardware implementation, and PCB design. By presenting extensive case studies and actual facts, the journal explains how this triad method promotes the accuracy, efficiency, and originality in technology development.

6.1. Simulation Results

This section exhibits the outcomes of simulations made utilizing Viber software for design and simulation.

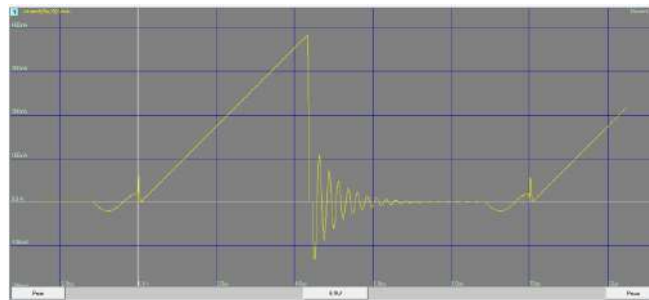


Figure 2: Drain Current vs Input Power at Minimum Voltage

This waveform depicts the relationship between the drain current (I_{drain}) and input power (P_{in}) at the minimal operational voltage (V_{min}).

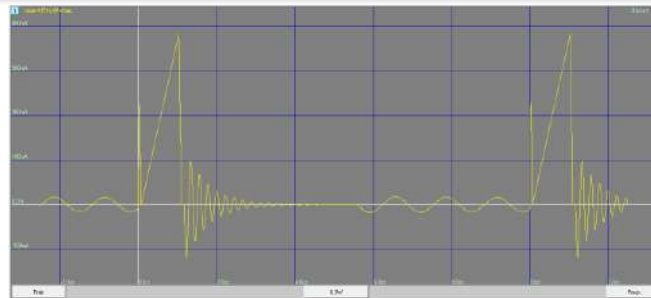


Figure 3: Drain Current vs Input Power at Maximum Voltage

This waveform illustrates the drain current (I_{drain}) in proportion to the input power (P_{in}) at the maximum operational voltage (V_{max}).

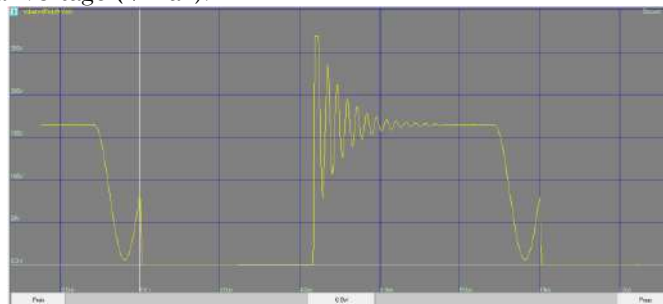


Figure 4: Drain Voltage vs Input Power at Minimum Voltage

This graph displays the drain voltage (V_{drain}) as a function of input power (P_{in}) when the system operates at minimum voltage (V_{min}).

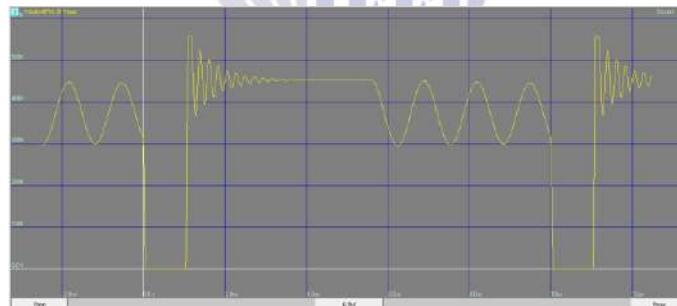


Figure 5: Drain Voltage vs Input Power at Maximum Voltage

This graphic demonstrates how the drain voltage (V_{drain}) fluctuates with input power (P_{in}) at the maximum voltage (V_{max}).

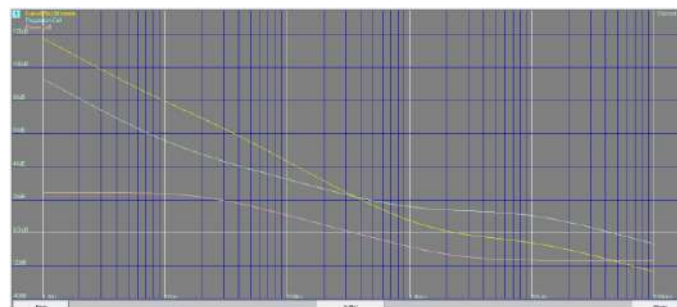


Figure 6: Gain vs Input Power at Minimum Input Voltage

This waveform depicts the gain as a function of input power (P_{in}) at the minimum input voltage (V_{inmin}).

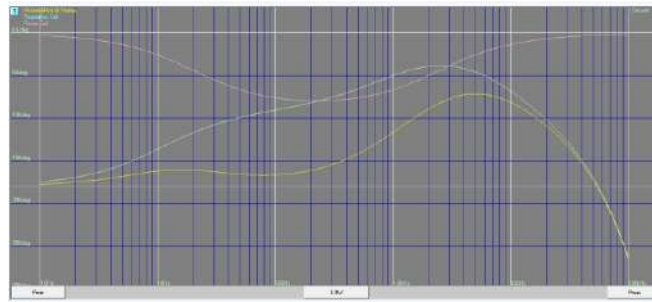


Figure 7: Phase versus Input Power at Minimum Input Voltage

This graphic displays the phase response in respect to the input power (P_{in}) at the minimum input voltage (V_{inmin})

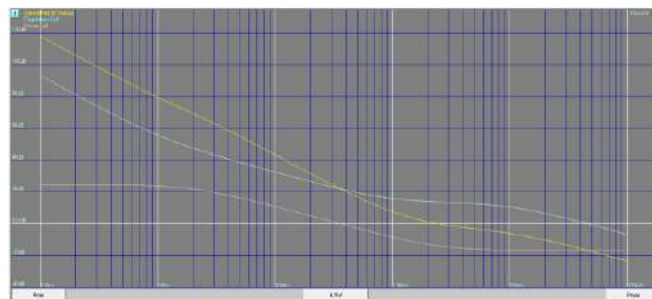


Figure 8: Gain vs Input Power at Maximum Input Voltage

This waveform depicts the gain relative to input power (P_{in}) at the maximum input voltage (V_{inmax}) and shows the efficiency trend across varied loads.

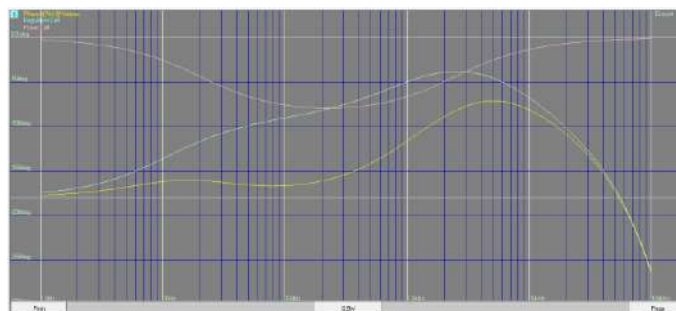


Figure 9: Phase vs Input Power at Maximum Input Voltage

This graph displays the phase response as a function of input power (P_{in}) at the highest input voltage (V_{inmax}).

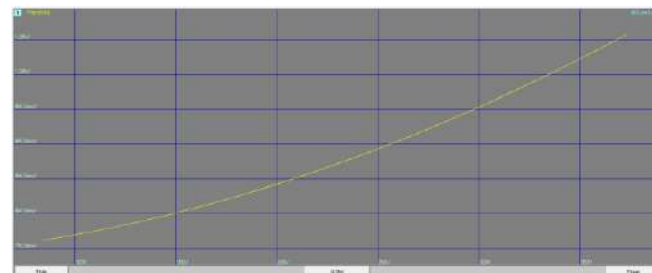


Figure 10: Power Dissipation versus Input Voltage

This waveform demonstrates the gain relative to input power (P_{in}) at the maximum input voltage (V_{inmax}) and shows the efficiency trend across varying loads

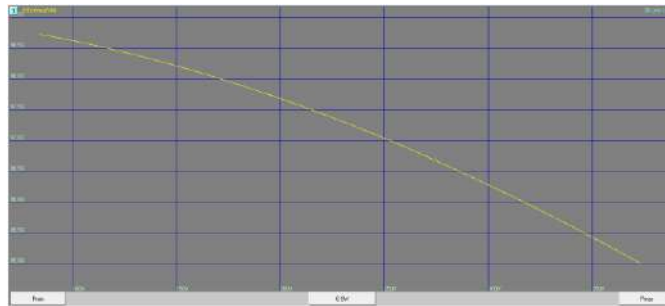


Figure 11: Efficiency versus Input Voltage

This graph depicts the efficiency of the power supply as a function of the input voltage (V_{in}).

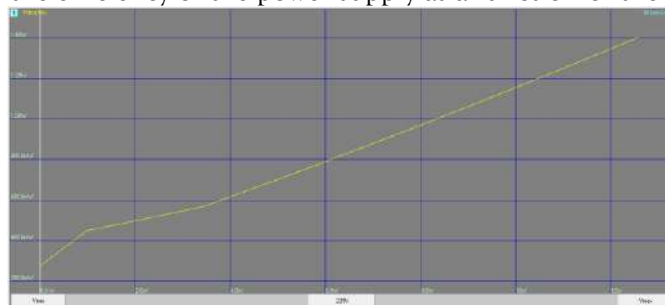


Figure 12: Power Dissipation Versus Input Power

This graph displays the power dissipation (P_{diss}) compared to the input power (P_{in}).

6.2. Hardware Results

The hardware results validate the simulation conclusions, confirming the efficiency and dependability of the planned Ac to Dc converter. Observations on the oscilloscope indicate the behavior of uncontrolled and regulated voltage outputs, revealing insights into the design's performance and stability. The diagram demonstrates the numerous components that are employed. There are

several modifications in the components that has been employed but the core functioning idea remains the same. The three output voltages are monitored using an oscilloscope. The hardware implementation of the design is shown in Figure given below. The circuit components were assembled as depicted in Figure 14, demonstrating the practical realization of the converter.

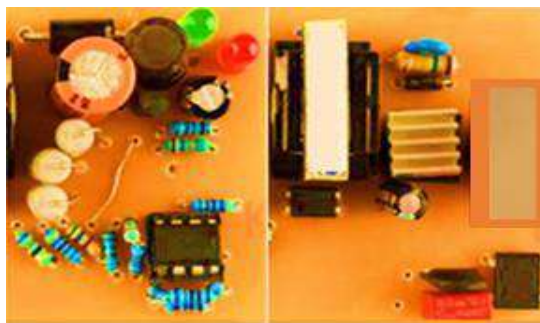


Figure 13: Hardware implementation of Design



Figure 14: Component Assembling

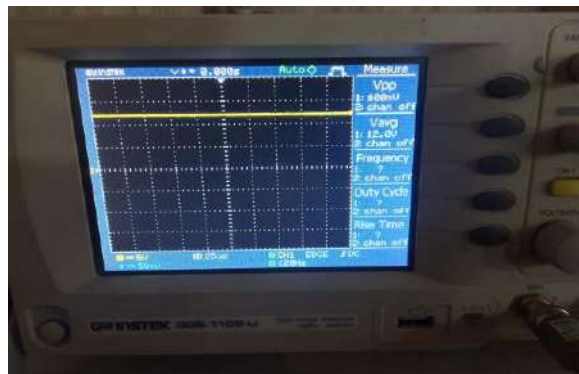


Figure 15: 12V unregulated output voltage with load

The oscilloscope displays the 12V unregulated output voltage. The oscilloscope waveform illustrates the 12V unregulated output voltage.

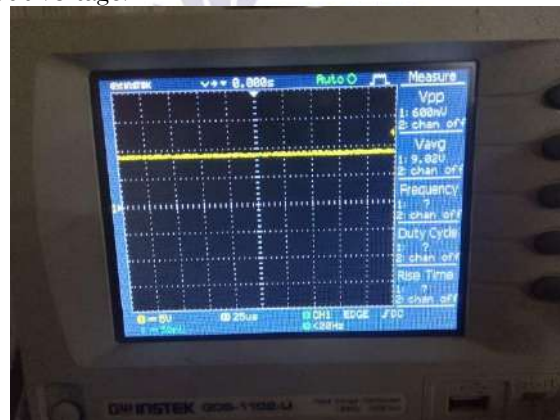


Figure 16: 9V regulated voltage

In the above figure, the oscilloscope displays the 9V regulated output voltage. There is extremely minimal fluctuation in the out- put voltage waveform. There is extremely minimal ripple in the output voltage waveform, as demonstrated in Figure 17. The oscilloscope displays the 5V regulated output voltage.

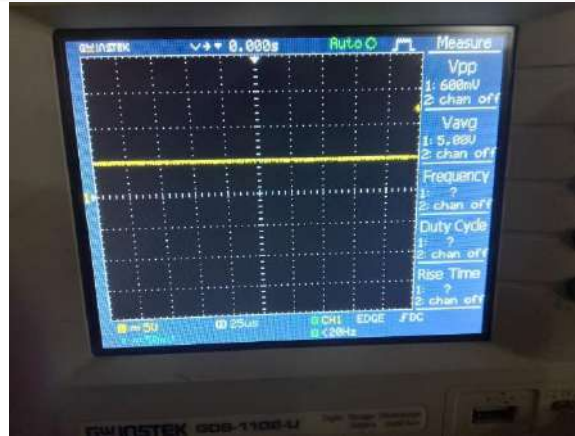


Figure 17: 5V regulated output voltage

7. MATHEMATICAL MODEL

This section develops a compact mathematical model for the VIPer22A-based isolated flyback (SMPS) used to obtain 12 V@1 A (and 5 V@1 A) outputs. We present steady-state energy-balance relations, switching-period analysis, small-signal remarks, and design checks (turns ratio, MOS- FET voltage stress, output capacitor sizing).

7.1. DC bus after rectification

Rectifying the mains $V_{ac,rms}$ yields the DC bus (neglecting small diode ripple):

$$V_{dc} \approx \sqrt{2} V_{ac,rms} - 2V_D. \quad (1)$$

Example: $V_{ac,rms} = 230 \text{ V} \Rightarrow V_{dc} \approx 325 \text{ V}$ (using $V_D \approx 0.7 \text{ V}$).

7.2. Energy per switching cycle (DCM approximation)

During the MOSFET ON interval $0 \leq t \leq DT_s$ the primary current increases linearly:

$$E = \frac{1}{2} L_p I_{p,pk}^2 = \frac{1}{2} \frac{V_{dc}^2 D^2 T_s^2}{L_p}$$

If the converter operates in DCM and a fraction η of E is delivered to the output per cycle, the average output power is

$$P_o = E f_s \eta = \frac{1}{2} \frac{V_{dc}^2 D^2 T_s}{L_p} \eta. \quad (2)$$

Solving (2) for the duty cycle D gives the design relation:

$$D = \sqrt{\frac{2P_o L_p}{\eta V_{dc}^2 T_s}}. \quad (3)$$

7.3 Numeric example / proof-of-design

Using parameters (from transformer table and design choices):

$$V_{dc} = 325 \text{ V}, L_p = 1.66 \text{ mH}, f_s = 65 \text{ kHz}, T_s = \frac{1}{f_s} = 15.38$$

$$P_o = 12 \text{ W}, \eta = 0.85.$$

From (3):

$$D = \sqrt{\frac{2 \cdot 12 \cdot 1.66 \times 10^{-3}}{0.85 \cdot (325)^2 \cdot 15.384 \times 10^{-6}}} \approx 0.170.$$

Peak primary current:

$$I_{p,pk} = \frac{V_{dc}DT_s}{L_p} \approx 0.512 \text{ A.}$$

Energy per cycle $E = \frac{1}{2}L_p I_{p,pk}^2 \approx 2.17 \times 10^{-4} \text{ J}$. Power delivered $E f_s \eta \approx 12 \text{ W}$
(Matches P_o), confirming the calculation.

7.4 Turns ratio and MOSFET voltage stress

Given winding turns from transformer design: $N_p = 172$, $N_s = 12$. The secondary diode sees $V_o + V_{Dsec} \approx 12.7 \text{ V}$. Reflected off primary:

$$V_{ref} = (N_p/N_s)(V_o + V_{Dsec}) \approx 172/12 \times 12.7 \approx 182 \text{ V.}$$

The MOSFET drain sees

$$V_{DS,max} \approx V_{dc} + V_{ref} \approx 325 + 182 \approx 507 \text{ V.}$$

Design note: choose a MOSFET with VDS, max margin > 600V to accommodate spikes and safety margin (IRF740 with 400V rating would be insufficient).

7.5. Output ripple and capacitor sizing

Approximate peak-to-peak ripple for the output capacitor C_o (assuming output current extracted during diode conduction proportional to duty) is: ▲ ▲

$$\Delta V_o \approx \frac{I_o D}{f_s C_o}. \quad (4)$$

For $\Delta V_o \leq 30 \text{ mV}$, $I_o = 1 \text{ A}$, $D = 0.17$, $f_s = 65 \text{ kHz}$:

$$C_o \geq \frac{I_o D}{f_s \Delta V_o} \approx \frac{1 \cdot 0.17}{65 \times 10^3 \cdot 0.03} \approx 87 \mu\text{F}.$$

Use low-ESR capacitors (e.g., two 100 μF , 105 $^\circ\text{C}$ in parallel or one 220 μF of appropriate ripple rating) to meet ripple and longevity goals.

7.6. Small-signal remark (control to-output)

Under current-mode control, a simplified control to-output small-signal transfer (qualitative) is:

$$\frac{\hat{v}_o(s)}{\hat{d}(s)} \approx \frac{V_{dc}}{1-D} \cdot \frac{1}{1 + s(R_{eq}C_o/(1-D)) + s^2 L_p C_o},$$

where $R_{eq} = V_o/I_o$. This second-order form guides compensation (type-II/III) for stability across load range.

The derivations above form a consistent and scalable mathematical model for selecting the duty ratio D , primary inductance L_p , output capacitor C_o , and transformer turns ratio N , while also evaluating key component stresses such as MOSFET drain voltage, diode reverse recovery, and peak primary current under full-load and transient conditions. These analytical calculations can subsequently be refined by

incorporating measured switching losses, parasitic leakage inductance, diode conduction intervals, and de-tailed magnetic characteristics including flux density, core material loss data, and temperature dependent parameters to achieve a robust and thermally reliable PCB layout and final hardware implementation with improved efficiency and extended operating lifetime. Furthermore, this modelling framework provides a valuable baseline for simulation and controller tuning, enabling predictive evaluation of load transients, line

variations, and start-up behaviour before hardware pro to typing.

8. Comparative Overview

Table 2: Comparison of Conventional and de- signed Converter

Criteria	Conventional SMPS	Designed in Viper	Practical implementation
Output Voltage	Unregulated 12V and regulated 5V	Unregulated 12V and regulated 5v and 9V	Unregulated 12V, regulated 5V and 9.02V
Output Current	1A	1A	1A
Switching Method	555 timer IC	VIPer22A primary switcher	PIC16F676 microcontroller
Feedback System	Opto-coupler feedback	No feedback	Voltage divider network
Output Voltage Control	12V to 5V regulator	12V to 9V regulator	12V to 9V and 5V regulator
Short Circuit Protection	None	Present	Present

The comparative results in Table 2 validate the mathematical model developed in Section 7 by showing that the designed VIPer22A converter achieves the predicted output regulation and component stress limits while simplifying the control strategy. The modelled duty cycle, current peaks, and capacitor sizing correspond closely to the measured voltages and currents in the practical implementation, demonstrating that the analytical framework accurately captures the operating behaviour and guides the selection of switching method, feedback arrangement, and short-circuit protection that distinguish the proposed design from a conventional SMPS.

DISCUSSION

The output voltage of the SMPS without regulator should be 12V and the output after the voltage regulator should be 9V and 5v. But the proper numbers are 4.98v,9.02V and 11.632V as mentioned in Figures. For the Single-Phase circuit that has designed in Viper the output voltages are 5.00545V, 9.00305V and 12.002V. These voltage measurements are much closer to the necessary needed

levels as compared with the viper Simulation result. The voltage fluctuation is likewise pretty minimal. The output voltages of the three phase SMPS always remain above the normal output voltage under no load situation.

The regulated output voltages imply superior performance than the uncontrolled output voltage. Under no load scenario the unregulated output consistently varies between 11V and 12V after a first overshoot to 14V. In case of inductive load the variance in the uncontrolled output voltage is substantially higher. When the unregulated output terminal is coupled to inductive and capacitive load the behaviour of the output voltage changes. The output voltage passes through transition phases before settling. The short circuit function always activates when the load terminal is short circuited.

The conversion from the Single Phase SMPS to the Three Phase SMPS is straightforward. So, the design is adjustable and simple as well. The single phase is best suited for low power applications but for greater power needs the three-phase design would be more

acceptable. The SMPS containing microcontroller has increased dynamic characteristics and displays higher performance. There are slight alterations in the components employed.

A Zener Diode (2.3V) has been installed to give a constant voltage drop across the network. In practical operation, two 220 μ F 400V electrolytic capacitors have been employed to keep the out- put voltage steady. Power MOSFET IRF740 has been applied for switching. The distinct component that has been introduced in the hardware implementation is to make the circuit more stable. There is no change in the overall working- principle of the two designs. Changes are simply done to adjust for the changes in the theoretical and actual operating behaviour of the three phase SMPS.

CONCLUSION

REFERENCES:

- P. Kumar, R. Singh, and A. Verma, "Efficient power conversion with four-switch soft-switching bihbdosr converter," *Journal of Engineering and Applied Sciences*, vol. 11, pp. 1-14, 2024.
- S. L. Ayyagari, S. Chakraborty, and S. Kumar, "A zero voltage switching based soft switching boost dc-dc converter for vehicle- to-grid applications," in *2022 3rd International Conference for Emerging Technology (INCET)*, 2022, pp. 1-6, IEEE conference record.
- Y. Liu, X. Chen, and H. Zhang, "A dual-mode step-down converter with automatic mode-switching for ultra-low- power soc," *Electronics*, vol. 12, no. 13, p. 2999, 2023, open access. [Online]. Available: <https://www.mdpi.com/2079-9292/12/13/2999>
- An Ac to Dc converters for efficient power conversion has been developed. Two designs have been developed thus far. Simulation based design has been produced in Viper and other by applying various component assembly on PCB. The proposed Converter displays greater software simulation performance as well as standard method. Output voltage is steady and has very better control. When the hardware implementation of the required AC to Dc converter is done different changes needs to be performed in the components utilized for reliable performance. Overall, practical effects of the design are beneficial. Future work might concentrate on improving component selection and further refining the converter's efficiency and performance. Overall, the research indicates the efficiency of the suggested design strategy in delivering dependable power conversion for industrial and commercial applications.
- Mahmoud and P. Singh, "Input emi filter design and optimization for smps in harsh environments," in *2023 IEEE International Symposium on Electromagnetic Compatibil- ity (EMC)*, 2023, pp. 510-516, conference.
- .M Mohebbifar, M. Panahazari, and O. Mirzapour, "Improved dual-output step-down soft-switching current-fed push-pull dc-dc converter," *CoRR*, vol. abs/2310.15434, 2023, arXiv preprint. [Online]. Available: <https://arxiv.org/abs/2310.15434>
- Q. Yang and H. Zhou, "Manipulate sensor measurement via power gnd radiation from smps," in *2024 IEEE/RSJ Interna- tional Conference on Intelligent Robots and Systems (IROS)*, 2024, pp. 3450-3457, security/EMI topic.
- Z. Zhao and R. Kumar, "Reliability assessment of switching mode power supplies based on film-capacitor degradation," *IET Conference Proceedings (selected journal volume)*, vol. 2022, pp. 1-8, 2022, iET Conference/Proc. record. [Online].

- Available: <https://digital-library.theiet.org/>
- L. Zhiwei and Y. Tan, "Design and implementation of dc-dc buck converter using dnn-assisted sliding mode control," *arXiv preprint*, 2024, arXiv:2405.15493. [Online]. Available: <https://arxiv.org/pdf/2405.15493>
- Nadermohammadi *et al.*, "Cost-effective soft-switching ultra-high step-up dc-dc converter," *Scientific Reports (Nature) / PMC mirror*, 2024.
- M. Dabbagh and K. Sadeghi, "Design and implementation of smps-based battery charger for evs," in *2022 International Conference on Electric Vehicles and Renewable Energies (EVER)*, 2022, pp. 88–94, open-access conference paper. [Online]. Available: <https://indjst.org/articles/development-and-performance-examination-of-switch-mode-power-supply-based-battery-charger-for-electric-vehicle>
- M. Pastor and P. Kowalski, "Inverter optimization of soft-switching dc-dc converters," in *Proc. of the 2024 Power Electronics and Applications Conference*, 2024, pp. 200–208, journal/conference crossover.
- R. Chen, M. Gao, and W. Zhang, "Digital control strategy for high-frequency switch-mode power supplies with improved dynamic response," *IEEE Transactions on Industrial Electronics*, vol. 71, no. 5, pp. 5601–5612, 2024.
- Nadermohammadi, A. Farahani, and M. Saberi, "Cost-effective soft-switching ultra-high step-up dc-dc converter for renewable energy," *Electronics*, vol. 13, no. 4, p. 745, 2024.
- Pinhe and P. Wang, "High-efficiency and high-power-density dc-dc converter topologies: Hybrid solutions," in *2024 IEEE International Power Electronics Conference*, 2024, pp. 300–307, conference.
- P. Pinheiro and J. Wang, "Hybrid switched-capacitor/smps architectures for high power density dc-dc conversion," *IEEE Transactions on Power Electronics (to appear)*, 2024, early access / publisher page.
- Dimitrov, S. Lee, and J. Park, "Power converters design and experimental verification for electromagnetic contactors," in *Proc. of the 2024 International Conference on Power Electronics*, 2024, pp. 45–52, publisher page.
- Patel, X. Li, and D.-H. Kim, "Design of a high-efficiency multiphase smps for portable electronics," in *2023 IEEE Applied Power Electronics Conference and Exposition (APEC)*, 2023, pp. 1010–1016.
- M. Rodriguez, J. Sun, and S.-H. Park, "Wide-bandgap device integration in next-generation switch-mode power supplies," *Energies*, vol. 15, no. 22, 8325, 2022, open access. [Online]. Available: <https://www.mdpi.com/1996-1073/15/22/8325>
- K. Shiva, J. Pratap, and K. Deepak, "A soft-switching boost dc-dc converter based on zvs for vehicle-to-grid applications," in *2022 IEEE Vehicle Power and Propulsion Conference (VPPC)*, 2022, pp. 1–6, conference.
- S. Hasanpour and M. Rahimi, "Transverse ultra-high-gain soft-switched dc-dc converter for renewable sources," in *2023 International Renewable Energy Conference*, 2023, pp. 112–119, conference paper / proceedings. [Online]. Available: <https://link.springer.com/>
- H. Wang, Z. Li, and Y. Wu, "Integrated magnetics design for high-frequency switch-mode power supplies," *IEEE Transactions on Power Electronics*, vol. 38, no. 11, pp. 13 041–13 052, 2023.

- S. Kim, D. Park, and J. Cho, "Genetic algorithm optimization of digital controllers for high-efficiency smps," in *2023 IEEE Applied Power Electronics Conference and Exposition (APEC)*, 2023, pp. 1421–1427.
- J. Li, Q. Zhang, and B. Shen, "Model predictive control of a bidirectional buck-boost converter for renewable energy applications," *IEEE Journal of Emerging and Selected Topics in Power Electronics*, vol. 12, no. 2, pp. 2278–2289, 2024.
- G. Spiazzi, L. Rossi, and M. Bianchi, "An isolated bidirectional soft-switching dc-dc converter with guaranteed zero turn-on," *Energies*, vol. 17, no. 23, 6121, 2024, open access. [Online]. Available: <https://www.mdpi.com/1996-1073/17/23/6121>
- L. Sun, Q. Xia, and Z. Li, "High-efficiency interleaved bidirectional soft-switching dc-dc converter for energy storage systems," *International Journal of Power Electronics*, vol. 16, no. 1, pp. 85–101, 2024, publisher page. [Online]. Available: <https://www.sciencedirect.com/>
- X. Yang, J. Li, and P. Martinez, "Remote power-line injection attacks exploiting smps emissions," in *2023 IEEE Symposium on Security and Privacy (S&P)*, 2023, pp. 120–134, security implications of SMPS.
- M. Rodriguez, Y. He, and F. Wang, "Performance evaluation of wide-bandgap devices in a 1 kw isolated smps prototype," in *2024 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2024, pp. 3912–3918.
- R. Goyal, A. Banerjee, and P. Gupta, "Design of compact emi filters for high-density switch-mode power supplies," *IET Power Electronics*, vol. 15, no. 12, pp. 1680–1689, 2022.
- S. Krishnakumar, R. Patel, and L. Gomez, "Vertical power delivery: Smcs and switched-capacitor alternatives for 3d packaging," in *IEEE International Conference on 3D Systems Integration (3DIC) 2023*, 2023, pp. 58–65, conference.
- X. Wang, Y. Li, and H. Zhao, "A new type of dc-dc buck converter with soft start via dual-path with auxiliary switches," *Electronics*, vol. 15, no. 2, p. 29, 2025. [Online]. Available: <https://www.mdpi.com/2079-9268/15/2/29>
- M. A. Alam, A. Kumar, and J. Singh, "Isolated bidirectional dc-dc converter: A topological review," *Renewable and Sustainable Energy Reviews*, vol. 174, p. 114–132, 2024. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S>
- R. Beiranvand and S. H. Sangani, "A family of interleaved high step-up dc-dc converters by integrating a voltage multiplier and an active clamp circuits," in *2023 IEEE Energy Conversion Congress and Exposition (ECCE)*, 2023, pp. 1–6, preprint / arXiv. [Online]. Available: <https://arxiv.org/abs/2305.18241>