# Exploration And Applications Of Electronic Balance For High Power Discharge Lamps At High Frequency Through Power Factor Modification

**S.Vijayalakshmi, P.Sabarish, S.R.Paveethra, Dr.P.R.Sivaraman, Dr.V.Venkatesh**

**ABSTRACT :** In this paper, a high power factor electronic ballast for metal halide (MH) lamps based on Rectifier, Boost converter, High frequency inverter and a LC filter is proposed. The boost converter acts as a power factor corrector (PFC) and it is designed to operate in discontinuous conduction mode to attain a high power factor at the input line. A full bridge inverter with bi-directional switch, an inductor, and a capacitor with a high frequency voltage is used to prevent the lamp from resonance. The output power of the lamp is controlled only by adjusting the duty ratio and the circuit operation is designed and its performance shown in MATLAB/SIMULINK.

**Index Terms :** Acoustic reverberation, electronic counterweight, metal-halide (MH) light and power factor.

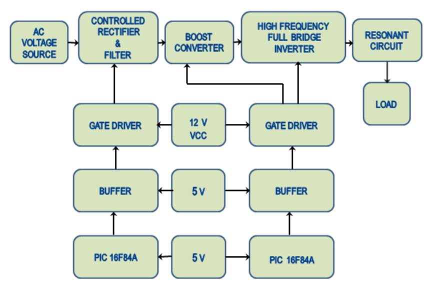
## 1 INTRODUCTION

AMONG different sorts of high-power release (HID) lights, metal-halide (MH) lights have the upsides of long light life, high iridescent adequacy, great shading interpretation, and have been generally utilized in many lighting applications. Since MH lights have the qualities of negative gradual impedance, stabilizer are required to the balance out the light current [1-2]. With the quick advancement of intensity gadgets, high-recurrence electronic counterweights have variously supplanted the customary electromagnetic ones to lessen the size and weight and improve the viability of the stabilizer circuit and light execution lately. A PWM rectifier-inverter frameworks with dc connect utilizing aberrant air conditioning dc-air conditioning transformation technique. In this strategy a major tank capacitor in the dc interface gives decoupling between the rectifier and the inverter, so the two converters can be driven freely as indicated by regular PWM systems, furnishing phenomenal information and yield exhibitions with high effectiveness of about 90.5% and great unwavering quality [3,4].

"High Intensity Discharge" (HID) is a wide term used to depict any lighting framework utilizing a vaporous release curve light in which the gas-filled circular segment tube works at a few times the typical environmental weight, contrasted with the close to vacuum conditions in lights. The different kinds of HID lights are arranged and named by the sort of gas contained inside the curve tube. The electrical curve created between the two primary terminals of a HID light is a lot of like a runaway short out, which can be supported uncertainly [5]. When adequate voltage is available, the gases inside the circular segment tube are "ionized" to where they will direct the bend current. Circular segment development isn't a quick procedure. It can take a few seconds for the bend to be built up and a few minutes until full light yield is come to.

Concealed lights are a negative-impedance gadget. This implies except if controlled, the current would keep on expanding, making the light flop quickly subsequent to beginning. Consequently, stabilizer, which is a current-constraining gadget, must be utilized with each HID light. The stabilizer serves three capacities. To start with, it gives the best possible beginning voltage to set up the curve. Second, it supplies the correct voltage to work the light. Third, as far as possible the light present to a recommended level [6-8].

A bit of leeway in any event of numerous electronic counterweights is that they work with any recurrence including DC. This can't be normal from attractive weight.




***Block diagram of Electronic Ballast***

The block diagram shows the construction of Electronic ballast at High Frequency with Power Factor Correction (PFC). It consists of four main circuits. They are controlled rectifier, boost converter, full bridge inverter and resonant circuit [9]. The circuit diagram is shown below with the following circuits.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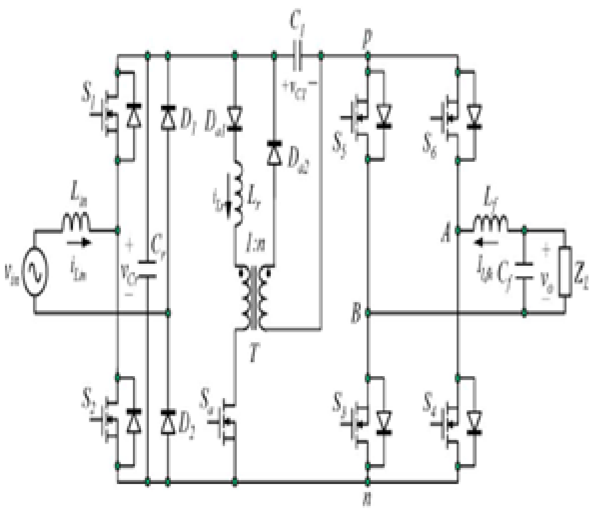


***Circuit Diagram of three stage Electronic Ballast***

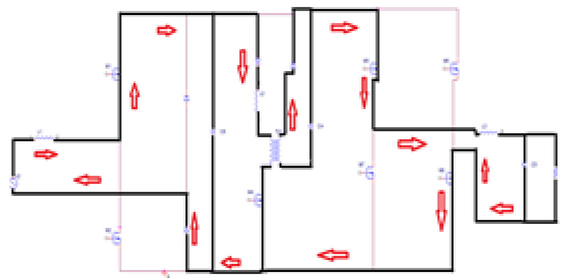
Here the controlled rectifier circuit consist of two power Mosfets S1 and S2. Parallel to Mosfet 1 and 2, diode D1 and D2 is connected. And a capacitor connected across the Mosfets. Supply is given from an ac voltage of 220volts. This ac supply is converted to dc source through controlled converter [10]. The controlled converter is a rectifier. The controlled converter is connected to the Boost converter which has Boost transformer. In this stage the power factor correction is achieved and the dc supply act as a ac source which is been controlled by Power mosfet Sa, then its allowed to transformer. The transformer will step up the voltage to the required level [11-15]. The output of the Boost converter is connected to the High frequency full bridge inverter circuit. In this stage the dc supply is converter to an ac supply. And this is connected to the load through the resonant filter circuit. A noteworthy decrease in the conduction misfortunes is accomplished, since the circling current for the delicate exchanging streams just through the assistant circuit and a base number of exchanging gadgets is engaged with the flowing current way, and the rectifier in the Proposed converter utilizes a solitary converter rather than the traditional arrangement made out of a four-diode front-end rectifier pursued by a lift converter [16-18]. A normal current-mode control is utilized in the rectifier side of proposed converter to recognize the progress time and integrate an appropriate low music sinusoidal waveform for the information current. The sinusoidal heartbeat width adjustment (SPWM) control technique is utilized in the inverter of proposed converter to accomplish great powerful guideline [19-20].

## II. OPERATION MODES

There are two modes of operation. They are

i. Positive mode and
ii. Negative mode

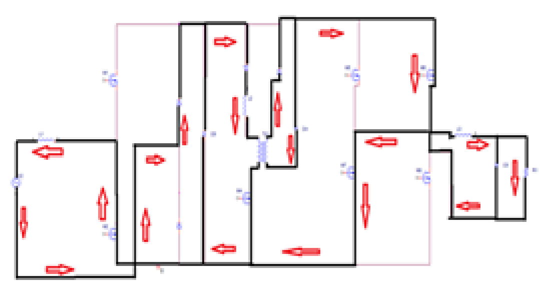
Positive mode:



In Positive Modes, during positive half cycle Primary side - L1, M1, D2, C6, Da1, L2, M4, are conducting and at same time the magnetizing current flow through the Secondary side -Da2, C4, M5, M8, L3, C5 are conducting and current flow through the load. In the primary circuit, the Mosfet M4 is switched ON and OFF periodically such that the dc waveform will turn to AC waveform. Then this ac supply is given to the transformer and the transformer will conduct. When the current passes through the inductance L2, the inductor get charged as a result the power factor correction is achieved [21-25]. In the secondary circuit, the high frequency is applied to the load through the inverter where the dc voltage is converter to ac supply by using the four power mosfets.

**Negative mode:**

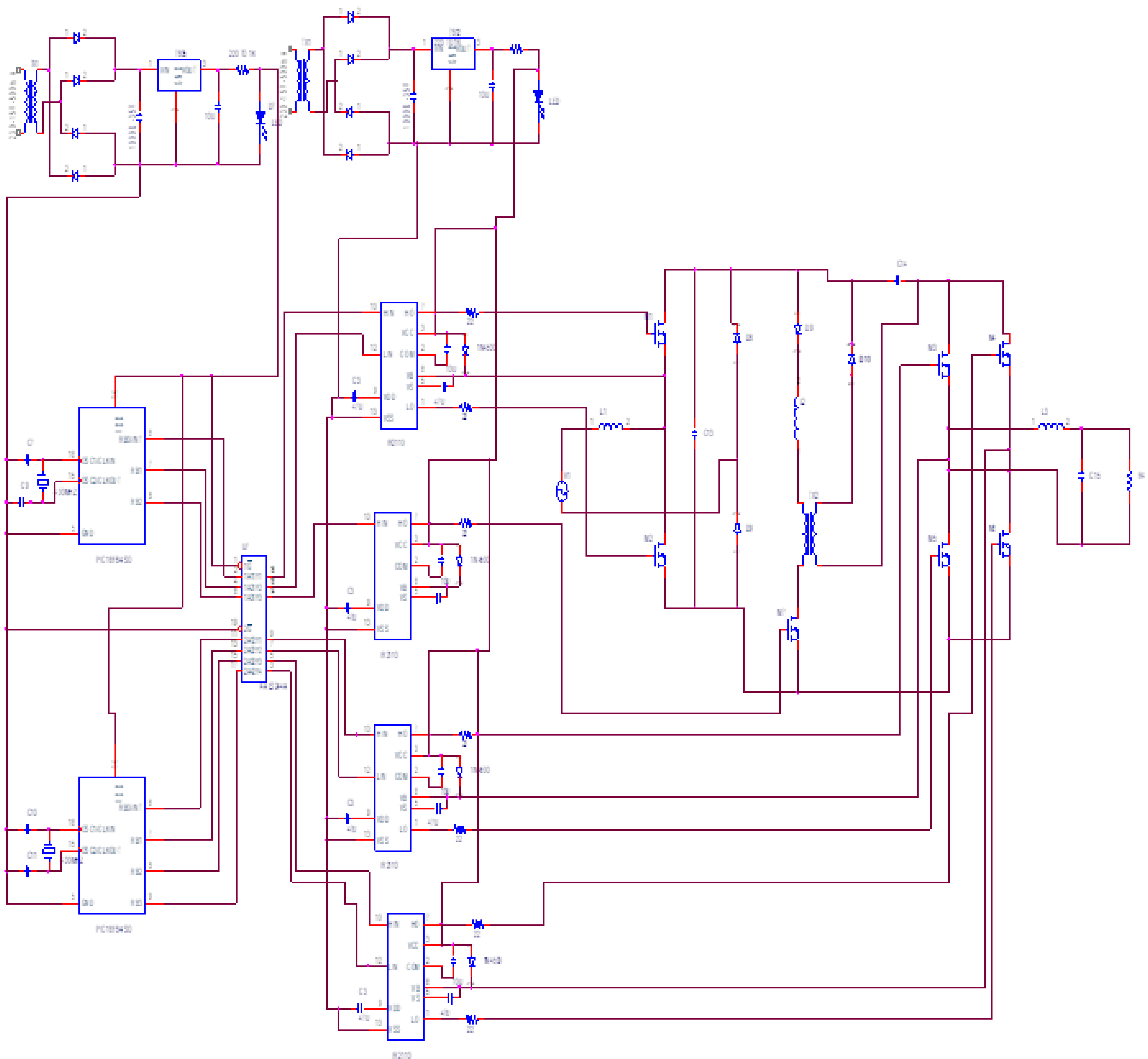
In Negative Mode, During negative half cycle Primary side - L1, M2, D1, C6, Da1, L2, M4 are conducting while at same time the magnetizing current flow through the Secondary side – Da2, C4, M6, M7, L3, C5 those all are conducting flow through the load.



In the primary circuit, the Mosfet M4 is switched ON and OFF periodically such that the dc waveform will turn to AC waveform. Then this ac supply is given to the transformer and the transformer will conduct. When the current passes through the inductance L2, the inductor get charged as a result the power factor correction is achieved.

## III HARDWARE DESCRIPTION

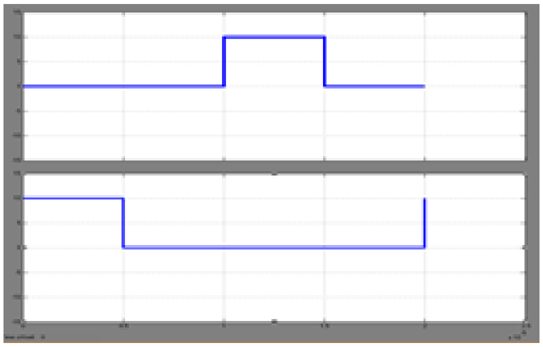
In the secondary circuit, the high frequency is applied to the load through the inverter where dc is converted to AC supply.



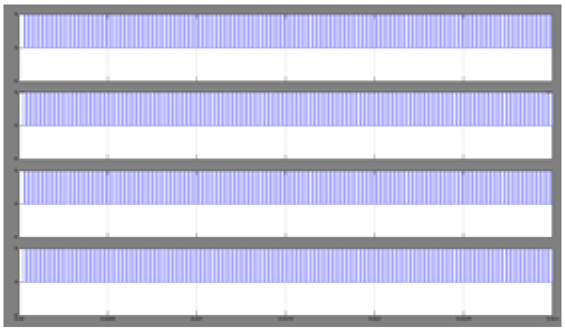
The hardware consist of two PIC Microcontroller PIC16F84/SO. Two PIC microcontroller are used because there is two frequency level is found. Each microcontroller isFeed with 5V supply from voltage regulator 7805. And we use four IR2110 gate driver for high voltage, high speed power MOSFET, drivers has independent high and low side referenced output channels. Gate drive supply is given 12V from the voltage regulator 7812. Each IR2110 is used to operate each pair of Mosfet. First IR2110 is used to trigger the controlled converter power devices. The second for Boost converter power devices. The third and IR2110 for the triggering the power devices of full bridge inverter.

## IV SIMULATION RESULT

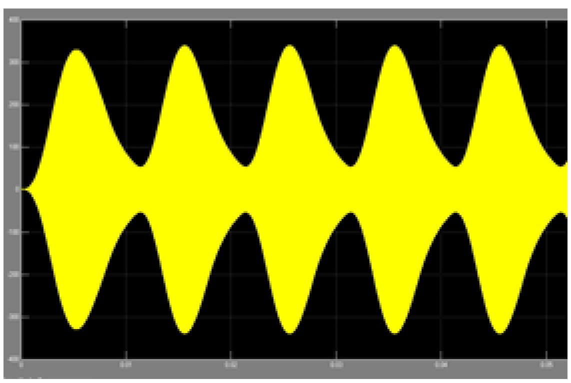
Input voltage waveform of voltage 220V



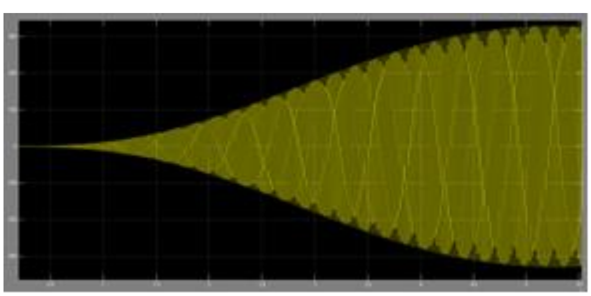
***Triggering pulse of Mosfet M1, M2:***



***High frequency resonant - triggering pulse.***



***Output waveform of Load, where the voltage is 330V.***



## V CONCLUSION

Clean air conditioning yield voltage is given straightforward and reduced arrangement. Subsequently, the proposed air conditioning dc–air conditioning converter is relevant in UPS structure. In the proposed circuit is worked at steady recurrence, and all semiconductor gadgets is worked at delicate exchanging without extra voltage stress and current pressure. A critical decrease in the conduction misfortunes is accomplished, since the coursing current for the delicate exchanging streams just through the assistant circuit and a base number of exchanging gadgets are associated with the flowing current way. Likewise, the rectifier in the A tale delicate exchanging single-stage air conditioning dc–air conditioning converter with high information control factor and proposed converter utilizes a solitary converter rather than the ordinary setup made out of a four-diode front-end rectifier pursued by a lift converter. A normal current-mode control is utilized in the rectifier side of proposed converter to distinguish the progress time and orchestrate an appropriate low music sinusoidal waveform for the information current. The sinusoidal heartbeat width balance (SPWM) control procedure is utilized in the inverter of proposed converter to accomplish great unique guideline.

## REFERENCES

[1] C.M.Huang, T. J. Liang, R. L. Lin, and J. F.Chen, “A novel constant power control circuit for HID electronic ballast,” IEEE Trans. Power Electron., vol. 22, no. 3, pp. 854–862, May 2007.

[2] K. F. Kwok, K.W. Eric Cheng, and D. Ping, “General study for design the HID ballasts,” in Proc. IEEE Int. Conf. Power Electron. Syst. Appl., Nov., 2006, pp. 182–185.

[3] A Nazar Ali, N Gowri [2016], “Power factor correction based bridgeless single switch SEPIC converter fed BLDC motor,” Advances in Natural and Applied Sciences, vol. 10, no. 3, pp. 196.

[4]A Nazar Ali, D Sivamani, R Jaiganesh M Pradeep [2019], “Solar powered air conditioner using BLDC motor,” IOP Conference Series: Materials Science and Engineering, vol. 23.

[5]V.Venkatesh, Kamalakannan, “Real time analysis of positive output super lift converter using ANN controller, “SIC Journal, Year: 2016, Volume: 25, No: 3, pp. 323-334, September 2016.

[6] V Venkatesh, A Nazar Ali,, R Jaiganesh. V indiragandhi [2019], “Extraction and conversion of exhaust heat from automobile engine in to electrical energy Energy”, IOP Conference Series: Materials Science and Engineering, vol. 23.

[7] Premkumar, Kamaraj et al. (2018), Antlion Algorithm Optimized Fuzzy PID Supervised On-line Recurrent Fuzzy Neural Network Based Controller for Brushless DC Motor, Electric Power Components and Systems, 45, 20, pages.2304-2317.

[8] A Ali Nazar, R Jayabharath, MD Udayakumar [2014] “An ANFIS Based Advanced MPPT Control of a Wind-Solar Hybrid Power Generation System,” international review of modelling and simulations. vol..7, no. 4, pp. 638–643.

[9] Sabarish, P., et al. "Performance Analysis of PV-Based Boost Converter using PI Controller with PSO Algorithm." Journal of Science and Technology (JST) 2.10 (2017): 17-24.

[10] Subramanian, AT Sankara, P. Sabarish, and R. Jai Ganesh.[2017] "An Improved Voltage follower Canonical Switching Cell Converter with PFC for VSI Fed BLDC Motor." Journal of Science and Technology (JST) 2.10 01-11.

[11]A Ali Nazar, R Jayabharath, MD Udayakumar “An ANFIS Based Advanced MPPT Control of a Wind-Solar Hybrid Power Generation System,” international review of modelling and simulations. vol..7, no. 4, pp. 638–643, Jul. 2014.

[12]Shyam D, Premkumar K, Thamizhselvan T, Nazar Ali A, Vishnu Priya M “Symmetrically Modified Laddered H-Bridge Multilevel Inverter with Reduced Configurationally Parameters “International journal of engineering and advanced technology”Vol 9, issue 1, Oct 2019

[13] K Premkumar et al. (2015), Online Fuzzy Supervised Learning of Radial Basis Function Neural Network Based Speed Controller for Brushless DC motor, Lecture Notes in Electrical Engineering, 326, pp.1397-1405.

[14] A.Nazar ali, Dr.R.Jayabharath, R.Shanthi Priyadharshini. “A Single phase high efficient transformer less inverter for PV Grid connected power system using ISPWM technique." International Journal of Applied Engineering Research (IJAER) Volume 10, No.9 (2015), pp.7489-7496

[15] A.Nazar Ali and R. Jayabharath. "Performance Enhancement of Hybrid Wind/Photo Voltaic System Using Z Source Inverter with Cuk-sepic Fused Converter." Research Journal of Applied Sciences, Engineering and Technology7.19 (2014): 3964-3970.

[16] K. Premkumar and B.V. Manikandan, “Stability and Performance Analysis of ANFIS Tuned PID Based Speed Controller for Brushless DC Motor,” in CURR SIGNAL TRANSD T, vol.13, no.1, 2018, pp. 19-30.

[17] Premkumar et al. (2015), GA-PSO optimized online ANFIS based speed controller for Brushless DC motor, Journal of Intelligent & Fuzzy Systems, 28, 6, pages.2839-2850.

[18] K Premkumar et al. (2018), Novel bacterial foraging-based ANFIS for speed control of matrix converter-fed industrial BLDC motors operated under low speed and high torque, Neural Computing and Applications, 29, 12, pages.1411–1434.

[19] Premkumar, Kamaraj et al. (2018), Antlion Algorithm Optimized Fuzzy PID Supervised On-line Recurrent Fuzzy Neural Network Based Controller for Brushless DC Motor, Electric Power Components and Systems, 45, 20, pages.2304-2317.

[20] Sabarish, P., Sankara Subramanian, A.T., Gayathri, A., Anton Amala Praveen, A. C.[2019] “A Novel wearable therapeutic aid with intelligent information processing systems” IOP conference series: Materials science and engineering .

[21] A. Nazar Ali, R. Sagayaraj and R.Jaiganesh. "Analysis the performance of Embedded ZSI fed Induction motor Under semiconductor failure condition”.TAGA JOURNAL VOL 14(2018): 1634-1644.

[22] AT Sankara Subramanian, P Sabarish, A Nazar Ali. “A power factor correction based canonical switching cell converter for VSI fed BLDC motor by using voltage follower technique”IEEE International Conference on Electrical, Instrumentation and Communication Engineering (ICEICE), pp.1-8, 2017.

[23] L Nagarajan, A Nazar Ali, S Arunkumar (2017)” Islanding Detection Technique for Grid Connected AC Distribution System” i-Manager's Journal on Future Engineering and Technology,Vol 13,pp.45-50

[24] J Jegatheesan, A Nazar Ali(2011)’ Improvement of Transient Stability Performance Using Adaptive Neuro-Fuzzy for FACTS Controllers” African Journal of Scientific Research Vol 6.

[25] A Nazar Ali, R Jeyabharath, MD Udayakumar” Cascaded Multilevel Inverters for Reduce Harmonic Distortions in Solar PV Applications” Asian Journal of Research in Social Sciences and Humanities, Vol 6,pp.703-715.