Modified Electronic Ballasts to Prevent the Signal Interference

[1] Sang Jin Lee , [1] Dal Hwan Yoon*, [2] Seung Gi Min, [3] Kyung Man Kim

[1] Dept. of Electronics Engineering, Semyung University

[2] Human Meditek, Co., Ltd.

[3] Electronic Engineering, Chongju Polytechnic College

[1] San21-1, Shinwol-dong, Chechon, Korea

[1] Tel. +82-43-649-1790, Fax. +82-43-644-6165

[1] E-mail : yoondh@semyung.ac.kr*

Abstracts: The cancellation of the output signal occur between output tubs have occurred place an electromagnetic interference and deteriorated the light efficiency of the neon tub. In order to prevent this problems, we have developed the modified electronic ballast for neon(MEBN). The MEBN have used a shielded line to the output and designated partly the half-bridge in the middle of the circuit. In an experimental results, this will be lengthen the life of the neon tub and obtain the effect which shields an electromagnetic wave to injurious to the people's body.

Keyword: modified electronic ballast for neon(MEBN), electromagnetic interference, effect.

I. Introduction

Recently, we have researched and developed the electronic ballasts to reduce the power consumption[1]. The electronic ballasts have lower weight than the type of coiled ballasts.

The electronic ballasts for neon(EBN) was designed to control an electric current of neon tube using the capacitance of capacitor, and showed their color properties of depending any gas in tube. Especially, The EBN has very dangerous for applying to high voltage. Also when the output line of high voltage is exposed on heavy air with moisture[2, 3].

The efficiency of the EBN is reduced and the output signal of the neon tube is cancelled, by electro magnetic field phenomenon each other. Then both the EBN and the neon tube take a damage[4, 5].

P.H Ammond & J.K.Sykulski[6-9] have developed the ballast for modifying the power factor and electromagnetism. They have operated the oscillation parts using stable switching circuit and prevented on an electric shock from the overvoltage. The EBN use the frequency of 20 kHz have developed recently. But it has token place seriously an electromagnetic interference (EMI) phenomenon. Also, when the neon tube in output line is close to each other. The cancellation phenomenon of tube signal has occurred.

In this paper, we have developed the modified EBN(MEBN) to improve the EBN. The MEBN have the shielded line and filter is output side and added party the half-pride circuit by doing these, we can obtain stable output properties for minimizing the electronic interference.

II. Design of an Electronic ballasts.

In general, an electronic ballasts are composed of drive circuit, multivibrator, protection circuit and

output parts, so on. The ac input signal for driving the ballasts is transferred to that circuit, the oscillator and the switching circuit drives.

The variable resistor of an oscillator can control the pulse width of signal and the driving speed. By doing these operation, the electronic ballasts can control the output voltage and current of a transformer.

The period of pulse use 0.5μs, the output voltage and the current are design to have 15kV and 20mA respectively. The stabilized high voltage in the rectifier circuit drives the transformer. If we add output load(or neon tube) to an electronic ballasts, the overvoltage protection circuit isn't operate. But if an electronic ballasts have no load, it stop the high voltage by holding the output signal of oscillator.

The existed EBN uses the unshielded simple output line. There take place various electromagnetic field. Then we can find the inductance and capacitance per unit length as follows[10];

$$L = \frac{\mu}{\pi}\ln\left(\frac{d}{r}\right),\ C = \frac{\pi\varepsilon}{\ln(d/r)} \qquad (1)$$

Where d is the distance between two lines, r is half-radius, the μ and the ε are the permeability and the dielectric parameter, respectively.

Actually, the electronic ballasts having the frequency of 20khz and the driving voltage of 15kV in output transformer take place the electric field of approximate 80 ~130 V.

The magnetic field using 20 mA is no so much. The electromagnetic field occurred in the output part of the transformer take place the signal cancellation of neon tube, and sometimes this becomes the case of reducing the lifecycle of the tube. In the output signal of the transformer, the output signal power is presented by S= E x H, and then the drove voltage is as follows[9].

$$V = \frac{Q\ln(d/r)}{\pi\varepsilon} \qquad (2)$$

When the output signal of the transformer is reached at the neon tube. If the neon tube could not take in sufficiently the signal power, the EBN can be damaged by reflective wave of the output line[10].

We must consider the loss and the reflection of output signal on the EBN design. And then impedance matching is established between circuit and output load.

The existed electronic ballasts have occurred the signal interference in the neon tube. In order to improve this phenomenon, we employ the filter in the output and half-bridge in the middle of circuit..

In order to make up for falling in efficiency and power factor, we add the smoothing circuit to the electronic ballasts as the Figures 1.

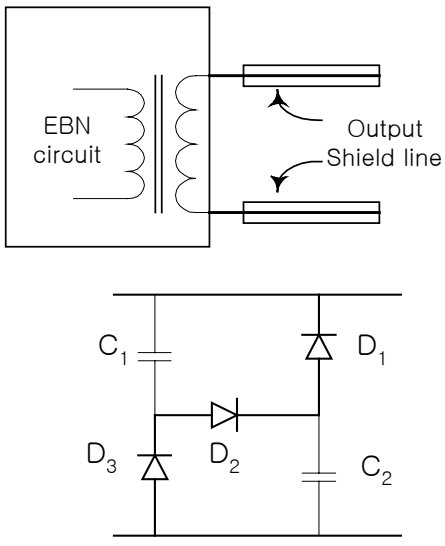


Fig. 1 The smoothing circuit.

In Figure 1, the diode and capacitor role of smoothing the spike voltage, and driving the stabilized

output signal due to increased DC component. Actually, the spike voltage give rise to the electromagnetic interference phenomenon.

III. Experimental results

In the experimental results, we use an input voltage 220 V, an input current 0.65 A and an input power 135 W, and the driven output voltage sustain 15 kV. If we change the length of the tube, then the various characteristics is obtained.

Table1 compares the experimental results at various condition. Where T.1 show an experimental condition that have no the filter and rectifier circuits, T.2 is an experimental condition that have a rectifier circuits and no the filter, and T.3 is an experimental condition that have both a rectifier circuits and the filter.

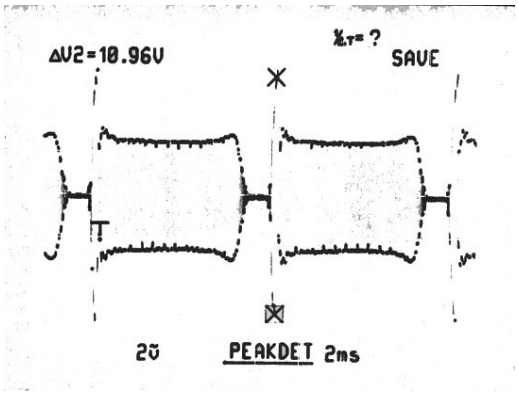
In table 1, P.F is the power factor, C.F is the crest factor and explain the rate of the maximum tube current to the effective current. The C.F is the measure parameter of estimating the lifecycle of the tube. And the illu. show an illuminance.

Table1. Comparison of an experimental result.

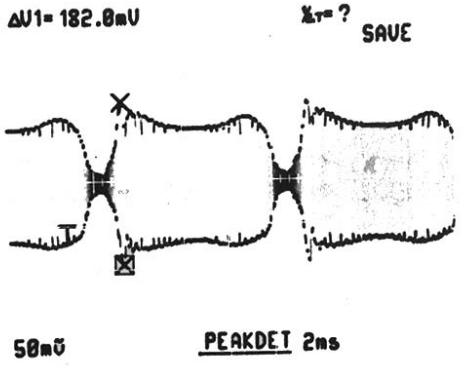
	Tube (mA)	Power (W)	P.F (%)	C.F (%)	Illu.
T.1	21	16.8	83	2.36	30
	46	64.7	97.6	1.97	26.2
T.2	21	18.8	83.5	2.36	34.4
	50	75.6	92.1	1.54	28.7
T.3	20	19.2	83.5	2.1	33.6
	19	83.7	91.4	1.93	27.5

The more an amplitude of the C.F is fallen, the more the lifecycle of the tube is large. In table1, we test the MBEN without having the filter and the smoothing circuit. Then the length of the tube are 0.6m and 4m, respectively.

If we use partly smoothing circuit and the filter, the current of the tube become smaller and the power consumption become enlarge about 19mW. While the crest factor, the power factor and an intensity of illumination are improved.



(a) The current waveform



(b) The voltage waveform

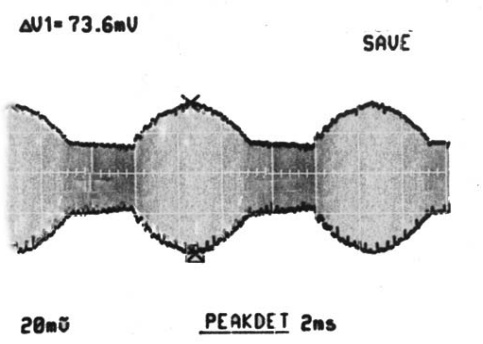
Fig 2. Waveform of the current and voltage signal.

Figure 2 shows (a) current wave, (b) voltage wave, where the length of the tube is 0.6m, and don't use the filter and partly smoothing circuit.

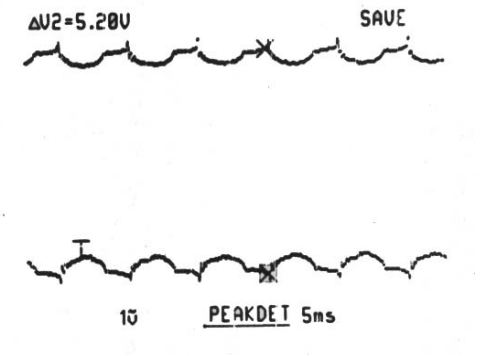
In Figure 2, the cause of generating the signal interference of the tube occurs in the spike displayed. In order to remove the spike signal, we experiment the

circuit with the filter and partly smoothing circuit.

Figure 3 shows (a) current waveform and (b) voltage waveform in case of using the filter and partly smoothing circuit.



(a) The current waveform



(b) The voltage waveform

Fig 3. Waveforms of the current and voltage

Then the length of the tube is 0.6m. In figure 5, the improved signal waveform of adding the dc component is to be obtained from the results of reducing the spike signal. Then it doesn't take place the phenomenon which we have care for the signal interference between two lines and then we have obtained a good results by using the filter and partly smoothing circuit. Also, we could prevent the damage from the high voltage of generating in an output of the MEBN.

V. Conclusion

We have developed the modified electronic ballast for the neon and evaluated the experimental performance to improve the driven light cancellation due to an electromagnetic interference between output tubs. When the driven frequency is 20 kHz, we have designated partly the half-bridge to the circuits and used the shielded line to the output tubs. By doing these operation, when the tube is close to each other, an electromagnetic interference couldn't have occurred.

Conference

[1] P.K. Sood, T.A. Lipo, "Power Consideration Distribution System using a Resonant High frequency AC Link", IEEE-IAS Annual Meeting Conference Records, pp. 533 - 556(1986)

[2] D.M. Divan, "Design Considerations for Very High Frequency Resonant Mode DC/ DC Converters", IEEE-IAS Annual Meeting Conference Records, pp. 640 - 647(1986)

[3] W.R. Alling, "Important Design Parameters for Solidstate Ballasts", IEEE Trans. on Industry Applications, Vol. 25, No.2, p. 203-207, 1989

[4] J. Spangler, B. Hussain, A.K. Berhera, "Electronic Fluorescent Ballast using a Power Factor Correction Techniques for Loads Greater Than 300 Watts", APEC-91, pp. 393-399, March, 1991

[5] Sam Ben-Yaakov & Michael Gulko, "Design and Performance of an Electronic Ballast for High pressure Sodium(HPS) Lamps", IEEE Trans. on Industry Application, pp.665 – 669, 1995

[6] E. Hammer, "High Frequency Characteristics of

Florescent Lamp up to 500 kHz", Journal of the IES, pp.70-76, Winter(1991)

[7] T.H. Yu, H.M. Haung, T.F. Wu, "Self Excited Half-bridge Series Resonant Parallel Loaded Fluoresent Lamp Electron Ballasts , IEEE Trans. on Industry Applications, pp. 657-664, 1995

[8] *Power Factor Corrector Application Mannul*, SGS-THOMSON Micro-electronics 1995

[9] P. H. Ammond, J. K. Sykulski, *Engineering Electromagnetism Physical Processes and Computation*, Oxford Science Pub. 1993

[10] Dal Hwan Yoon, *An Electronic Ballasts for the Neon Tubes*, No, of Licence : 0161777