ISBN 979152630-3

9 799791 526301

PROCEEDINGS

Printed Version

ISBN: 979-15263-0-3

The 2nd Indonesia Japan Joint Scientific Symposium 2006

September 6 – 8, 2006

Center of Japanese Studies,
University of Indonesia, Indonesia

Organized by :

University of Indonesia, Indonesia

Chiba University, Japan

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BANDGAP ON SWITCHING POWER SUPPLY 75 V DC / 400 mA FROM 15 V DC WITH LOW RIPPLE VOLTAGE.

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ABSTRACT – **the fact, electric or electronic systems can't be operated directly with electric source. Because it's needed a converter to convert electric source from one voltage form and level to another voltage form and level, as the boost converter or step up converter. Boost converter or step-up converter has an output voltage that is always greater than the input voltage. Output voltage can be differentiated depend on the duty cycle. It's needed a pulse width modulation (PWM) generator. In design, the output voltage of boost converter has voltage about 5 times than the input voltage. Because of that, the duty cycle is 0.8. The output voltage of boost converter is about 74 V DC with error percentage 0.8 % and the output current of boost converter is 396 mA with error percentage 0.8 % with ripple 6.504 mVp-p obtained is efficiency 98 %.**

Keywords — **Bandgap, switching, Converter power supply, low ripple.**

I. INTRODUCTION

The power supply is a system which could feed the load with efficient and softy cited. The part off power supply is the simple boost converter circuit, the simple converter with filter from core of toroid with two bandgaps as filter CLC. It be calculate with approach magnetic circuit to circuit electric. Bandgap can change the system.

Switching boost converter [3], the out put voltage 75V/400mA DC. Vin 15 VDC with ripple maximum 0.2Vp-p ***Switching on Boost*** **converter**

Switching on Boost converter [is IGBT]. The IGBT have duty cycle which one to operate the power supply so the voltage output have low ripple. See fig. 1

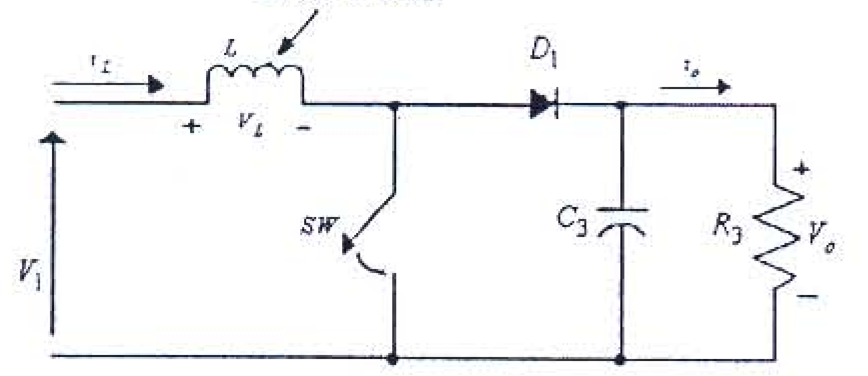

Fig.1 The simple boost converter circuit

Fig. 1. the simple boost converter circuit it takes the duty cycle, the duty cycle reduce the out put voltage. The duty cycle make the IGBT on and off as eq. 1.

$$V_d t_{on} + (V_d - V_o)\ t_{off} = 0 \tag{1}$$

The effect of on and off switching on converter like eq 2.

$$\frac{V_o}{V_d} = \frac{T_s}{t_{off}} = \frac{1}{1-D} \tag{2}$$

From eq. 2. The characteristic of duty cycle see fig. 2 :

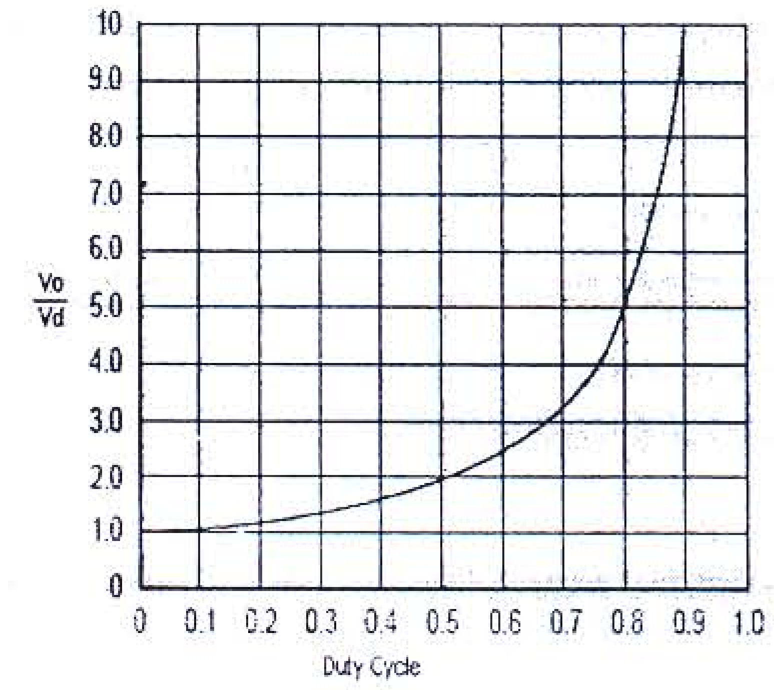

Fig 2. Characteristic curve

The figure 2. To show the ratio of voltage with duty cycle the maximize duty cycle is 1.

II. THE CURRENT DISCONTINUE WITH V_D CONSTANT

Switching on or off with discontinue to show the integrated voltage see figure 3.

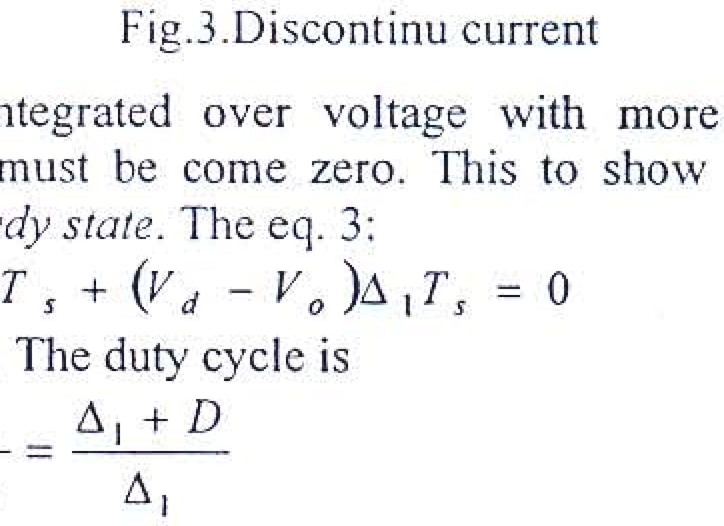

Fig.3.Discontinu current

The integrated over voltage with more than one controller must be come zero. This to show the steady state. *Steady state.* The eq. 3:

$$V_d DT_s + (V_d - V_o)\Delta_1 T_s = 0 \tag{3}$$

From fig 3. The duty cycle is

$$\therefore \frac{V_o}{V_d} = \frac{\Delta_1 + D}{\Delta_1} \tag{4}$$

With assumption there aren't power losses ($P_d = P_o$), so the ratio current discontinues is the eq. 5:

$$\frac{I_o}{I_d} = \frac{\Delta_1}{\Delta_1 + D} \qquad (5)$$

From the fig. 3. The current is physical defect so the average current is deferent with duty cycle. The eq. 4. So the peak current is eq. 6:

$$i_{Lpeak} = \frac{V_d D T_s}{L} \qquad (6)$$

And the average input current in eq. 7:

$$I_d = \frac{V_d D T_s}{2L}\left(D + \Delta_1\right) \qquad (7)$$

Use the equation 7 and 5 so the average current in eq 8.

$$I_o = \left(\frac{T_s V_d}{2L}\right) D \Delta_1 \qquad (8)$$

The component the simple boost converter. [6] circuit in the tabel 1.

TABLE 1
List of the simple boost Converter.

Components	Component parameter
L	2,307 mH
R_3	187,5 Ω
C_3	4 uF
MOSFET	IRF150
D_1	D1N4002

The complete converter is shown in fig. 4

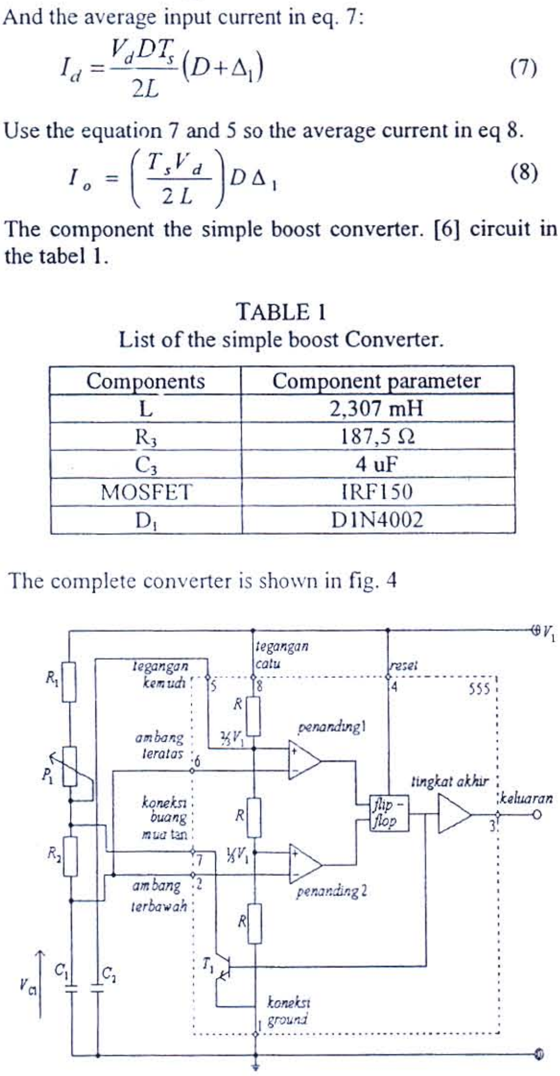

Fig. 4. the boost converter. [4]

III. BANDGAP AS FILTER CLC

The Filter CLC like fig. 5. From the core type with two bandgaps material.

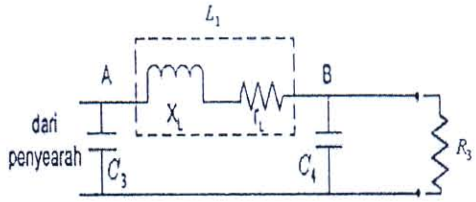

Fig.5. circuit filter CLC

If the voltage is:

$$V'_{dc} = \frac{R_3}{R_3 + r_L} \cdot Vdc \qquad (9)$$

The voltage average is:

$$V'_{r,rms} = 0,2 / 2\sqrt{3} \qquad (10)$$

So the ripple is:

$$r' = \frac{V'_{r,rms}}{V'_{dc}} \times 100\% \qquad (11)$$

$$r' = \frac{0,0577}{15} \times 100\%$$

$$r' = 0,38\%$$

Chose $L_1 = 250$ mH and $C_3 = 4\ \mu F$, this parameter it takes from core type band gap as fig. 6. :

IV. BANDGAP IN THE TOROID CORE

Bandgap in fig 5. As capacitor and the inductor it takes from winding, material and also two bandgap fig. 4.

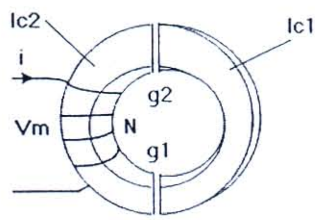

Fig. 6. Two band gap in the toroid core

The coupling electromagnetic is

$$k_1 = a\sqrt{\omega \mu o \pi / 2\rho} \qquad (12)$$

The coupling equation 12, used in equation 14 to find self inductance eq. 14 or mutual inductance equation 15 the resistant material magnet permanent, in primer

$$R_{D1} = \rho\, l_1 / (\pi a^2) \qquad (13)$$

Self inductance L_1 is

$$L_1 = Li_1 + (\mu o/2\pi)/1(\log[2/1/a] - 1) \qquad (14)$$

The mutual inductance is eq. 15

$$M = (\mu o/2\pi)\, l_{2e}\,\{\log[2l_{1e}/(a+b)] - 1\} \qquad (15)$$

Calculate the reluctance from the material and band gap as eq. 16 :

$$\Re g = \frac{g}{\mu Ag} \tag{16}$$

Count self inductance like esq. 14, mutual inductance eq 15, reluktans, from the band gap and the material so it found the accumulation magnetomotans as winding eq 17.

$$N^2 = \frac{2\pi\rho oxL}{\mu oAc} \tag{17}$$

Current and magnetic Fluks was generate from fig. 5 has difference so it makes more strongly or weakness so the parameter ΔB like eq. 18.

$$\Delta B = \frac{(V1 - VQ - Vo)(Vo + VD)Ts}{AN(V1 - VQ + VD)} \tag{18}$$

So fluxs density maximum B_B from eq. 19.

$$B_B = B_R + \frac{\mu r \mu oNPo}{lVo} + \frac{\Delta B}{2} \tag{19}$$

Fluxes density residual is eq.20

$$B_R = B_B - \frac{\mu r \mu oNPo}{lVo} - \frac{\Delta B}{2} \tag{20}$$

Fluxes density minimum eq. 21

$$B_A = B_R + \frac{\mu r \mu oNPo}{lVo} - \frac{\Delta B}{2} \tag{21}$$

The reactants current) rms is eq .22

$$Ix,rms = \frac{Po}{Vo}\sqrt{1 + \frac{1}{12}\left[\frac{lVo(V_1 - V_Q - Vo)(Vo + V_D)Ts}{\mu r \mu oAN^2 Po(V_1 - V_Q + V_D)}\right]^2} \tag{22}$$

The peak reactance current in eq. 23.

$$I_{XB} = \frac{l(B_B - B_R)}{\mu r \mu oN} \tag{23}$$

The reactance current minimum in eq. 24

$$I_{XA} = \frac{l(B_A - B_R)}{\mu r \mu oN} \tag{24}$$

The integration toroid core was converting in boost converter in table II.

TABLE II

Assess permeans of nucleus toroid of 1 by 2 bandgaps

g (mm)	l_c (cm)	$A_c = A_g$ (cm^2)	$\Re_{c1} = \Re_{c2}$ (AT/Wb) 10^6	$\wp_{c1} = \wp_{c2}$ (H) 10^6	$\Re_{g1} = \Re_{g2}$ (AT/Wb)10^6	$\wp_{g1} = \wp_{g2}$ (H) 10^{-9}
0.2	4.68	0.07	5.325	188	22	45.5
0.4	4.66	0.07	5.3	188.6	45	22
0.6	4.64	0.07	5.28	189.4	68	14.7
0.8	4.62	0.07	5.25	190.6	91	11
1	4.6	0.07	5.23	191.2	113	8.8
1.2	4.58	0.07	5.2	192.3	136	7.3
1.4	4.56	0.07	5.19	192.6	159	6.3
1.6	4.54	0.07	5.16.	193.7	181	5.5

IV. ANALYSIS THE PROTOTYPE

The output power supply with initial condition like fig 6. we find the average voltage on switching power supply 74 V DC. We can see the ripple more than 3% . after using 6 core with bandgap see figure 7. the ripple out put voltage about 73 Volt with a time stabled about 25 ns have, with Vin/Vout have the duty cycle a bout 0.8 in.

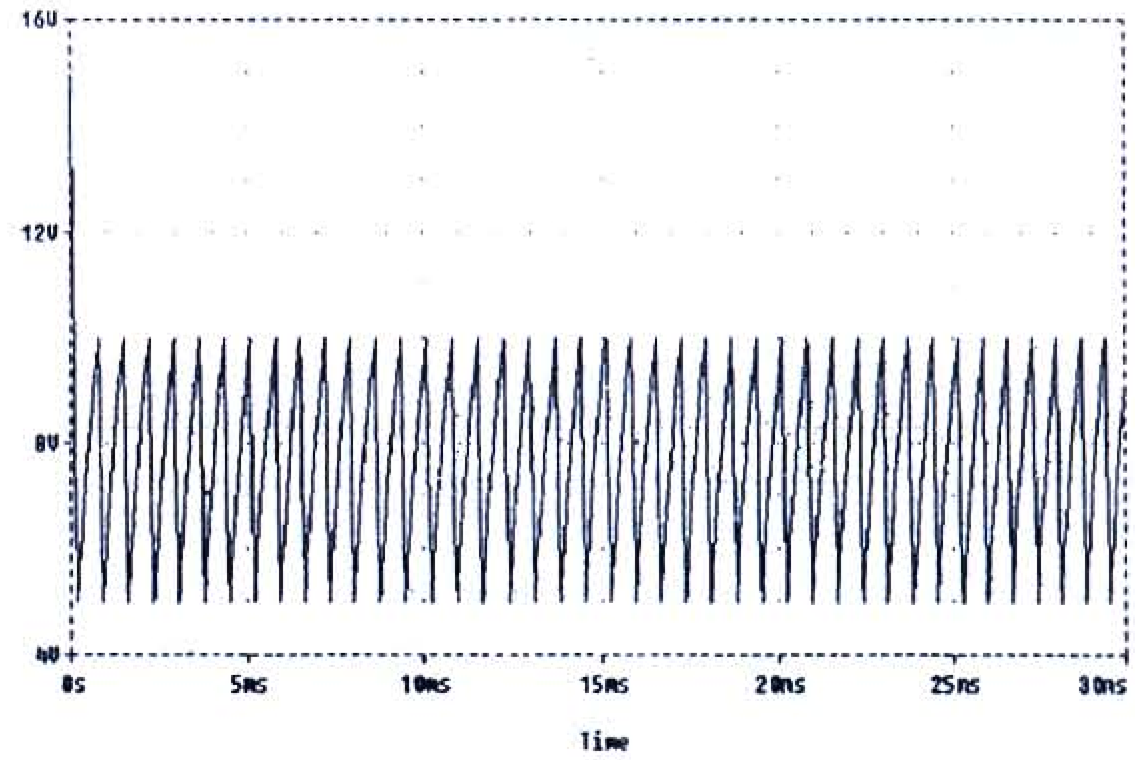

Fig 6. Voltage output power supply in initial condition.

The output power supply with bandgap as fig .7.

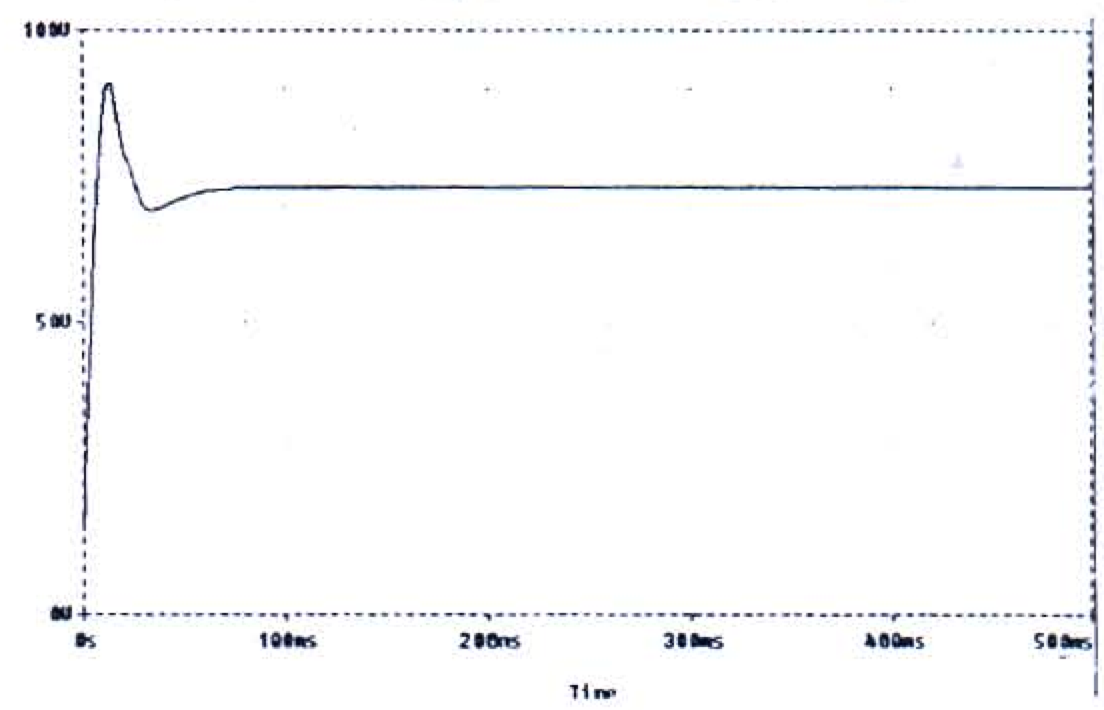

Fig. 7. Output voltage power supply with bandgap

V. CONCLUSION

- *Boost* converter is an important system its makes the power supply more efficient. With *Duty Cycle* D = 0. 8.
- The ripple voltage 0.2 % with modifies core type from converter so the output voltage is 73 V DC with ripple 7mVp-p.
- The ripple 0.2 % and output current is 389 mA and efficiency 94 %.

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