**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 0.504 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 softly 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 output 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

\[ V_d t_{on} + (V_d - V_o) t_{off} = 0 \]  (1)

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

\[ \frac{V_o}{V_d} = \frac{T_s}{T_s - t_{off}} = \frac{1}{1 - D} \]  (2)

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

![Fig. 2. Characteristic curve](image)

**II. THE CURRENT DISCONTINUE WITH VD CONSTANT**

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

\[ \frac{V_o + \Delta V_d}{V_d} = D + \Delta \]  (4)

From fig 3. The duty cycle is

\[ \frac{V_o}{V_d} = \frac{\Delta_1 + D}{\Delta_1} \]  (4)

The duty cycle is

\[ V_o = \frac{\Delta_1}{\Delta_1 + D} \]  (4)

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

\[ V_d DT_s + (V_d - V_o) \Delta_1 T_s = 0 \]  (3)

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

\[ V_o = \frac{\Delta_1 + D}{\Delta_1} \]  (4)

The duty cycle is

\[ \frac{V_o}{V_d} = \frac{\Delta_1 + D}{\Delta_1} \]  (4)
With assumption there aren’t power losses \( (P_d = P_o) \), so the ratio current discontinues is the eq. 5:

\[
\frac{I_o}{I_d} = \frac{\Delta_1}{\Delta_1 + \Delta}
\]  

(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:

\[
i_{L,\text{peak}} = \frac{V_d DT}{L}
\]  

(6)

And the average input current in eq. 7:

\[
I_d = \frac{V_d DT}{2L}(D + \Delta_1)
\]  

(7)

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

\[
I_o = \left(\frac{\Delta_1 - \Delta}{2}\right)D \Delta_1
\]  

(8)


### TABLE 1

<table>
<thead>
<tr>
<th>Components</th>
<th>Component parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>2,307 mH</td>
</tr>
<tr>
<td>R_3</td>
<td>187.5 Ω</td>
</tr>
<tr>
<td>C_3</td>
<td>4 uF</td>
</tr>
<tr>
<td>MOSFET</td>
<td>IRF150</td>
</tr>
<tr>
<td>D_1</td>
<td>D1N4002</td>
</tr>
</tbody>
</table>

The complete converter is shown in fig. 4.

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

**III. BANDGAP AS FILTER CLC**

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

The voltage average is:

\[
\bar{V} = \frac{V_{dc}}{2} \left(1 - \frac{r}{2} - \frac{r'}{100}\right)
\]  

(9)

The voltage average is:

\[
V_{r,\text{rms}} = \frac{V_{dc}}{2G} \sqrt{3}
\]  

(10)

So the ripple is:

\[
r = \frac{V_{r,\text{rms}}}{V_{dc}} \times 100\%
\]  

(11)

Chose \( L_1 = 250 \text{ mH} \) and \( C_3 = 4 \mu\text{F} \), 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.

The coupling electromagnetic is

\[
k_1 = a\sqrt{\frac{\mu_0 \pi}{2\rho}}
\]  

(12)

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

\[
R_{Di} = \rho \frac{L_1}{\pi a^2}
\]  

(13)

Self inductance \( L_1 \) is

\[
L_1 = L_i + \frac{\mu_0}{2\pi} \log \left[ \frac{1}{[\log (2/\mu a] - 1} \right]
\]  

(14)

The mutual inductance is eq. 15

\[
M = \frac{\mu_0}{2\pi} \log \left( \frac{21}{a + b} \right)
\]  

(15)

Calculate the reluctance from the material and band gap as eq. 16:
\[ R_g = \frac{g}{\mu_0 A_g} \] (16)

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

\[ N^2 = \frac{2\pi \rho_{ox} L}{\mu_0 A_c} \] (17)

Current and magnetic fluxes was generate from fig. 5 has difference so it makes more strongly or weakness so the parameter \( \Delta B \) like eq. 18.

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

So fluxes density maximum \( B_B \) from eq. 19.

\[ B_B = B_R + \frac{\mu_0 \mu N P_o}{V_o} + \frac{\Delta B}{2} \] (19)

Fluxes density residual is eq. 20

\[ B_R = B_B - \frac{\mu_0 \mu N P_0}{V_o} - \frac{\Delta B}{2} \] (20)

Fluxes density minimum eq. 21

\[ B_A = B_R + \frac{\mu_0 \mu N P_0}{V_o} - \frac{\Delta B}{2} \] (21)

The reactant current) rms is eq. 22

\[ I_{x, \text{rms}} = \frac{P_o}{V_0} \sqrt{\frac{1 + \frac{1}{12} \left( \frac{V_o(V_1 - V_Q - V_o)(V_o + V_D)Ts}{\mu_0 \mu N^2 P_0(V_1 - V_Q + V_D)} \right)^2} \] (22)

The peak reactance current in eq. 23.

\[ I_{x_B} = \frac{l(B_B - B_R)}{\mu_0 \mu N} \] (23)

The reactance current minimum in eq. 24

\[ I_{x_A} = \frac{l(B_A - B_R)}{\mu_0 \mu N} \] (24)

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

### Table II

<table>
<thead>
<tr>
<th>( g ) (mm)</th>
<th>( k ) (cm)</th>
<th>( A_e ) (cm²)</th>
<th>( A_g ) (cm²)</th>
<th>( \mu_0 A = \mu_0 A_e ) (AT/Wb)</th>
<th>( 10^3 )</th>
<th>( \mu_0 A_g = \mu_0 A_g ) (AT/Wb)</th>
<th>( 10^3 )</th>
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</table>

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 output voltage about 73 Volt with a time stabled about 25 ns have, with Vin/Vout have the duty cycle about 0.8 in.

![Fig 6. Voltage output power supply in initial condition.](image)

The output power supply with bandgap as fig. 7.

![Fig 7. Output voltage power supply with bandgap.](image)

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 %.

REFERENCES


