

Hard

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2026

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A DC-DC Boost converter has $V_{in} = 10\text{ V}$, $L = 100\text{ }\mu\text{H}$, $f = 50\text{ kHz}$. It delivers 25 W at $V_o = 25\text{ V}$. Verify 1. The duty cycle D is 0.6. 2. The peak-to-peak inductor current ripple

A

1 and 2 only

B

2 and 3 only

C

1, 2 and 3

Correct

D

1 and 3 only

Correct Answer: C

Full Detailed Explanation

Correct Answer: C - 1, 2 and 3 Quick Concept Explanation An ideal boost converter in continuous conduction has an output voltage greater than or equal to input for $0 < D < 1$.

$D = 1 - V_{in}/V_o = 1 - 10/25 = 0.6$. $I_L = V_{in}D/(Lf) = 10 \cdot 0.6/(100 \cdot 10^{-6} \cdot 50 \cdot 10^3) = 1.2\text{ A}$. Ideal average

input/inductor current $= P/V_{in} = 25/10 = 2.5\text{ A}$. Key relation: $V_o = V_{in}/(1 - D)$; $I_{L_avg} = V_{in}D/(Lf_s)$.

Exam focus: For an ideal boost, $D = 1 - V_{in}/V_o$. Common trap: A normal boost converter cannot produce $V_o < V_{in}$ merely because $D < 0.5$. Statement-wise Verification Statement 1 -

Correct. The duty cycle D is 0.6. $D = 1 - V_{in}/V_o = 1 - 10/25 = 0.6$. $I_L = V_{in}D/(Lf) = 10 \cdot 0.6/(100 \cdot 10^{-6} \cdot 50 \cdot 10^3) = 1.2\text{ A}$.

Statement 2 - Correct. The peak-to-peak inductor current ripple is 1.2 A. Ideal

average input/inductor current $= P/V_{in} = 25/10 = 2.5\text{ A}$. Statement 3 - Correct. The average inductor

current is 2.5 A. Ideal average input/inductor current $= P/V_{in} = 25/10 = 2.5\text{ A}$. Core Concept An ideal

boost converter in continuous conduction has an output voltage greater than or equal to input

for $0 < D < 1$. When the switch is off, it must block approximately the output voltage. The

output capacitor supplies load current between energy-transfer intervals and reduces output

ripple. Formula / Key Relationship $V_o = V_{in}/(1 - D)$; $I_{L_avg} = V_{in}D/(Lf_s)$. Step-by-Step Check

$D = 1 - V_{in}/V_o = 1 - 10/25 = 0.6$. $I_L = V_{in}D/(Lf) = 10 \cdot 0.6/(100 \cdot 10^{-6} \cdot 50 \cdot 10^3) = 1.2\text{ A}$. Ideal average