

Università degli Studi di Padova – Dipartimento di Ingegneria Industriale

Corso di Laurea in Ingegneria dell'Energia

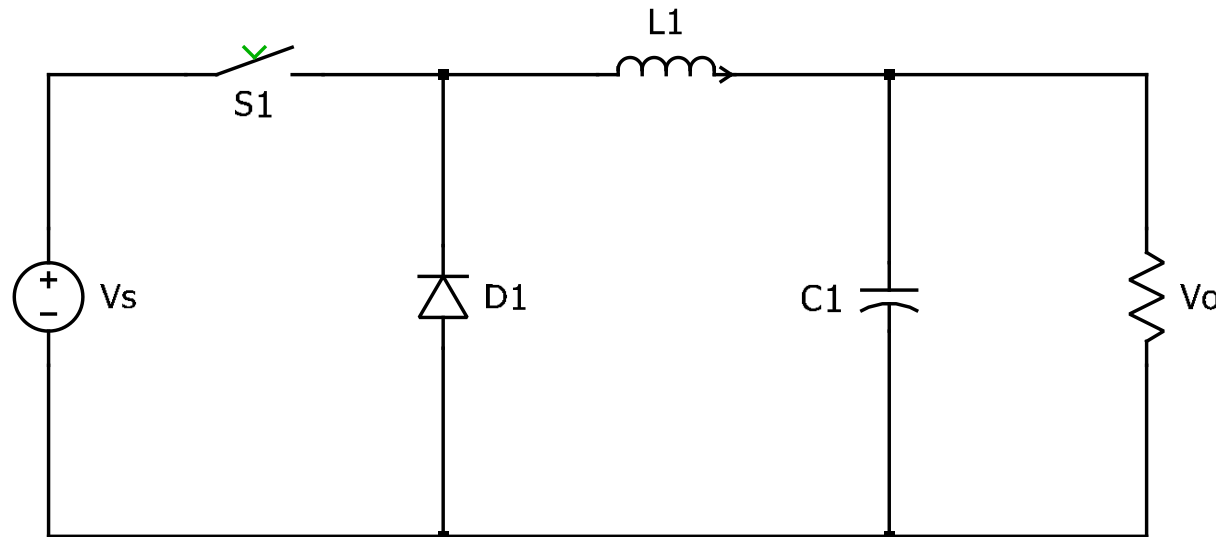
Relazione per la prova finale
**«CONVERTITORE BUCK: ANALISI
CIRCUITALE E TERMICA»**

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Convertitore Buck: leggi fondamentali



$$V_o = \delta \cdot V_s$$

$$\delta = \frac{t_{on}}{t_{on} + t_{off}} = \frac{t_{on}}{T}$$

Poniamo le seguenti ipotesi di studio per analizzare il convertitore:

- Circuito lavora in regime periodico
- È garantita la modalità di conduzione continua (CCM)
- Capacità del condensatore è infinita
- Componenti del convertitore sono ideali
- Il periodo di commutazione è $T = 1/f$, l'interruttore è chiuso per l'intervallo

$$t_{on} = \delta \cdot T \text{ ed è aperto per } t_{off} = (1 - \delta) \cdot T$$

Il caso di studio presenta i seguenti dati:

- Tensione alla sorgente V_s : 500 V
- Duty cycle δ : 0.5
- Frequenza di switching f_s : 10 kHz
- Resistenza del carico R : 5 Ω
- Induttanza L : 1.2 mH
- Capacità C : 100 μF
- Temperatura ambiente T : 25 °C

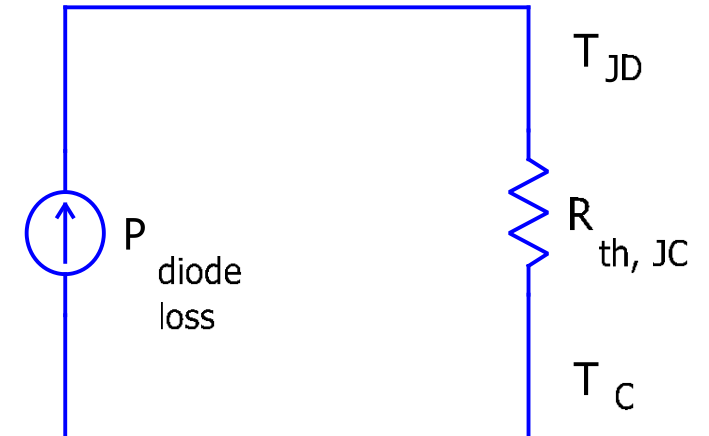
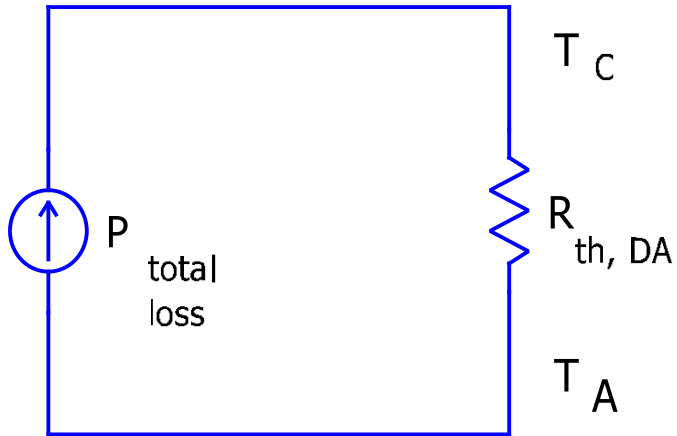
$$L_{min} = \frac{(1 - \delta)}{2} \cdot \frac{R}{f} = 1.25 \cdot 10^{-4} \text{ H} \quad (\text{CCM garantita})$$

$$I_o = \frac{V_o}{R} = 50 \text{ A}$$

$$\Delta i_L = \frac{(V_s - V_o) \cdot \delta}{L \cdot f} = 10.42 \text{ A}$$

$$\Delta V = \frac{T \cdot \Delta i_c}{8 \cdot C} = \frac{V_o \cdot (1 - \delta)}{8 \cdot L \cdot C \cdot f^2} = 1.30 \text{ V}$$

$$I_{LRMS} = \sqrt{I_{0L}^2 + \left(\frac{\Delta i}{2\sqrt{3}}\right)^2} = 50.09 \text{ A}$$

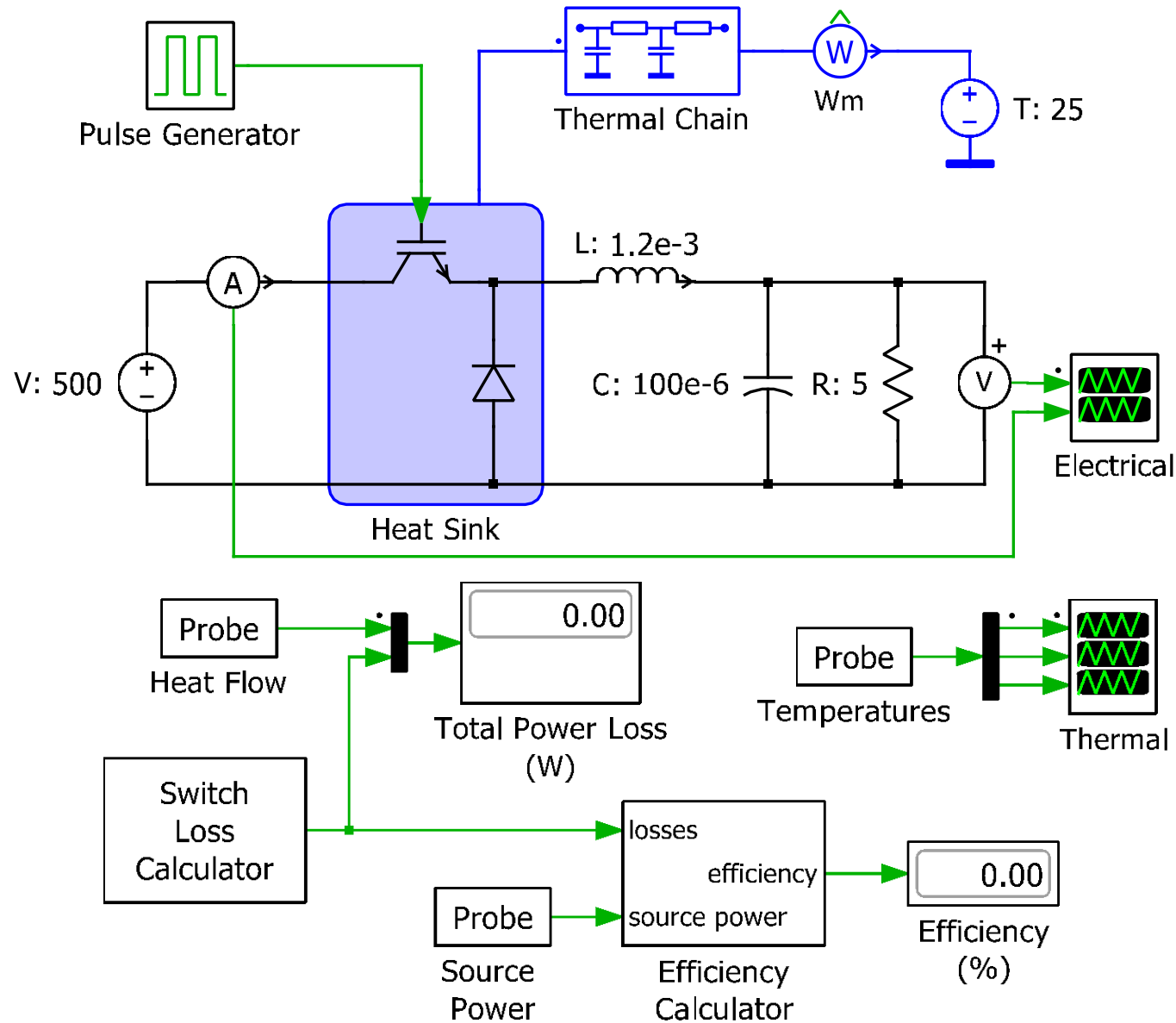


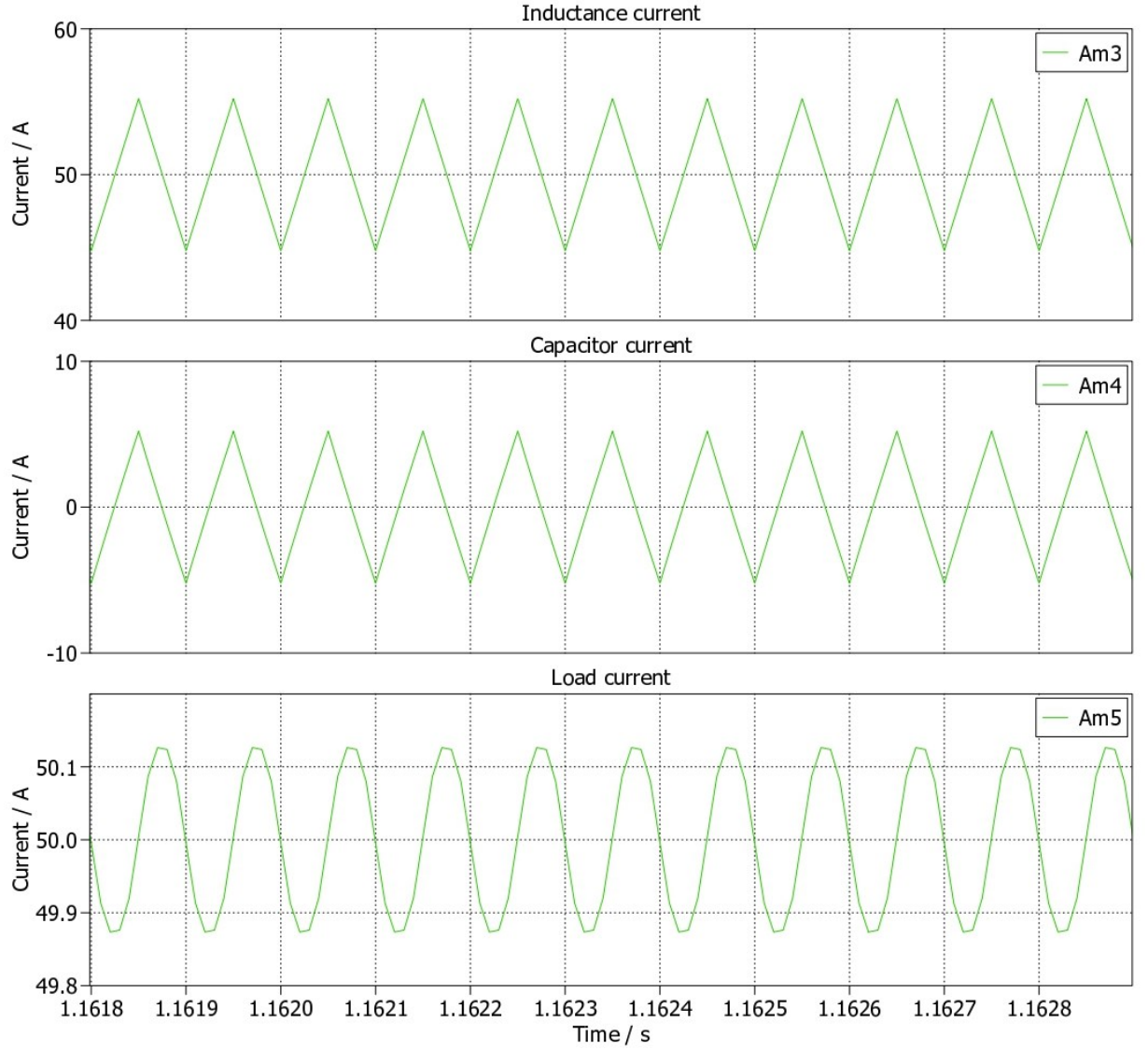
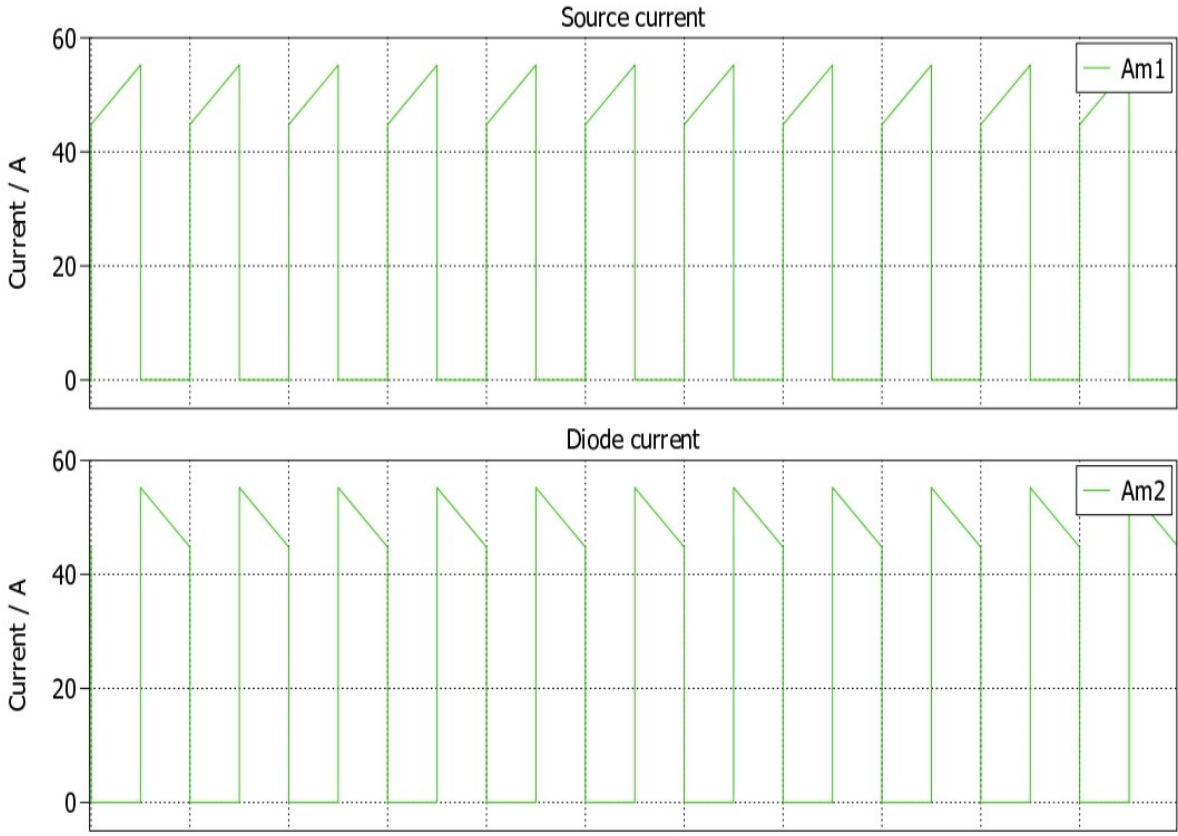
$$T_C = T_A + P_{total\ losses} \cdot R_{th\ heat\ sink} = 58.63 \text{ } ^\circ\text{C}$$

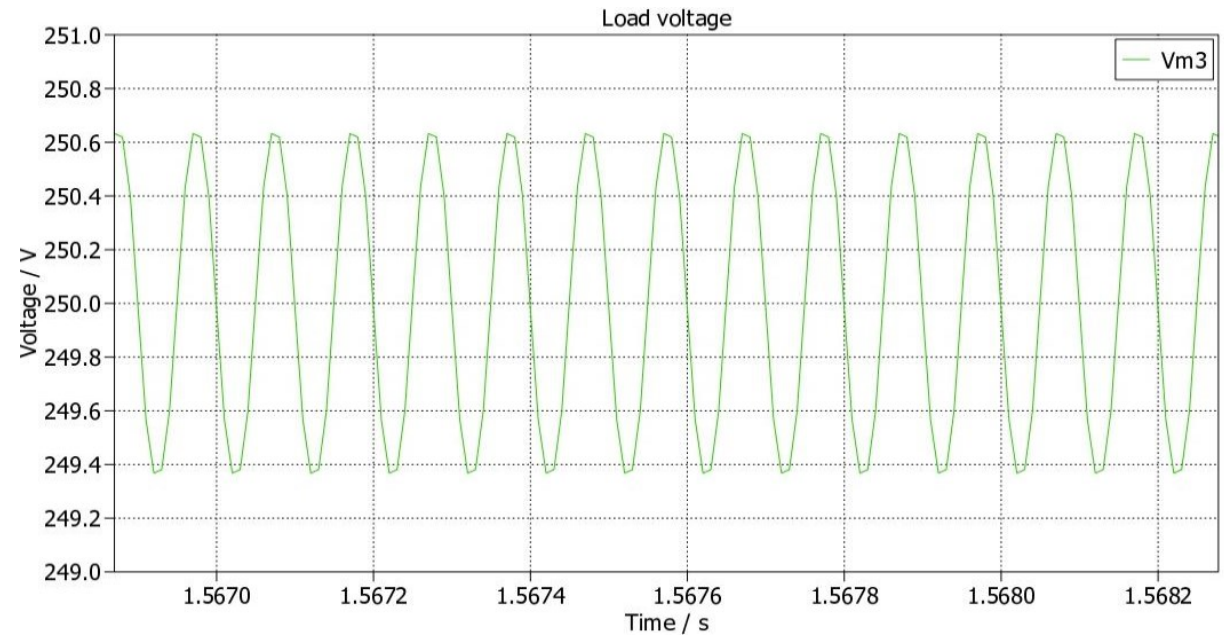
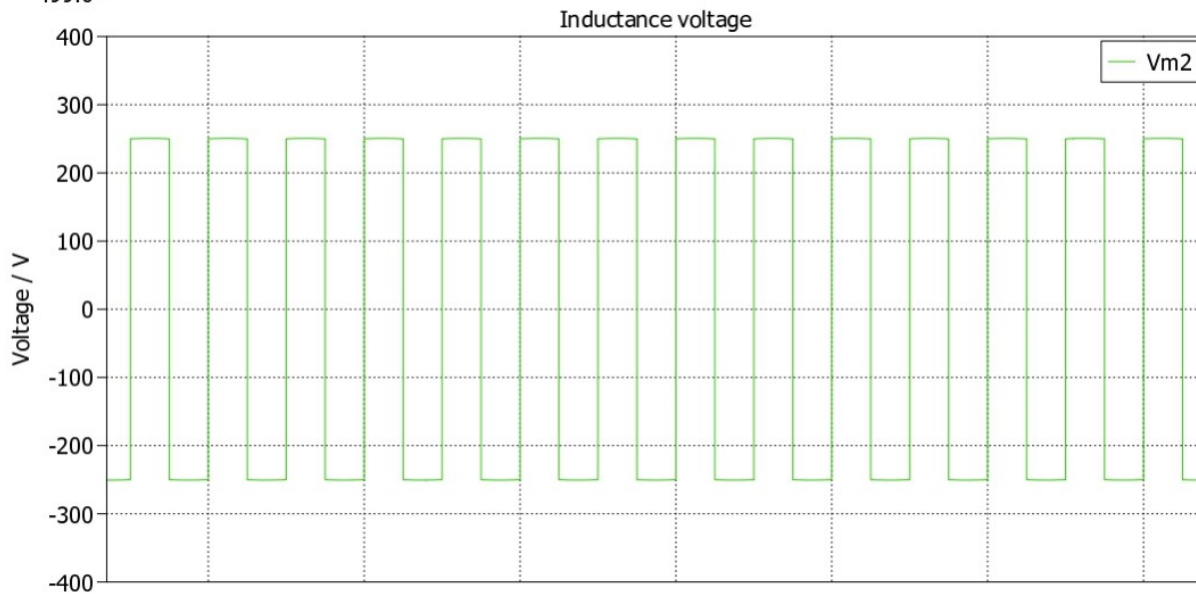
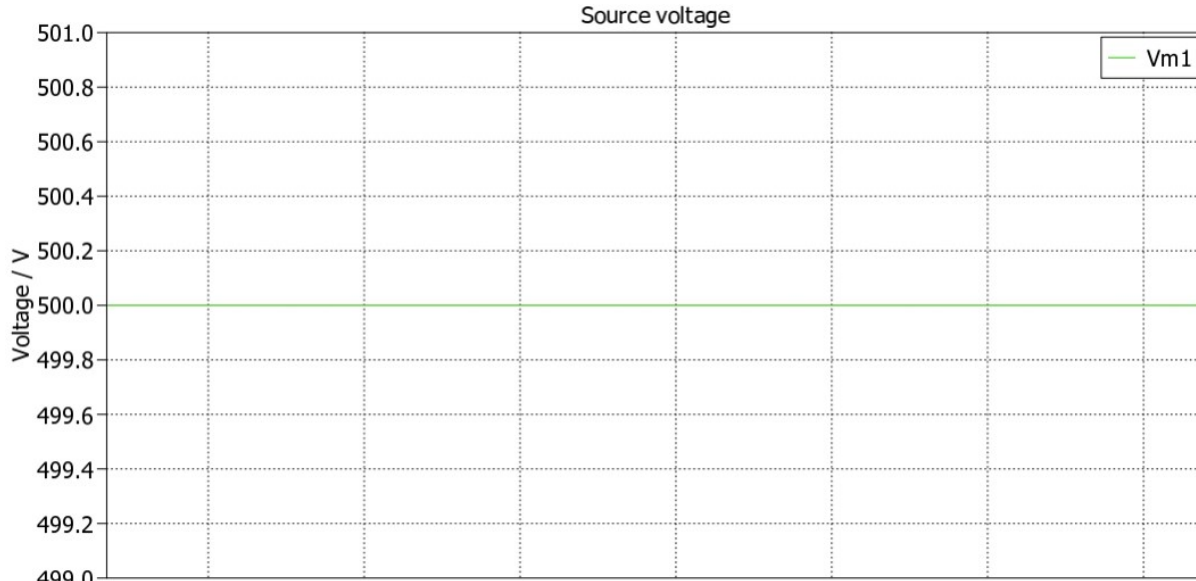
$$T_{JD} = T_C + P_{losses\ diode} \cdot R_{th\ diode} = 88.42 \text{ } ^\circ\text{C}$$

$$T_{JI} = T_C + P_{losses\ IGBT} \cdot R_{th\ IGBT} = 96.76 \text{ } ^\circ\text{C}$$

$$\eta = \frac{P_{input} - P_{losses}}{P_{input}} = 97.68 \%$$





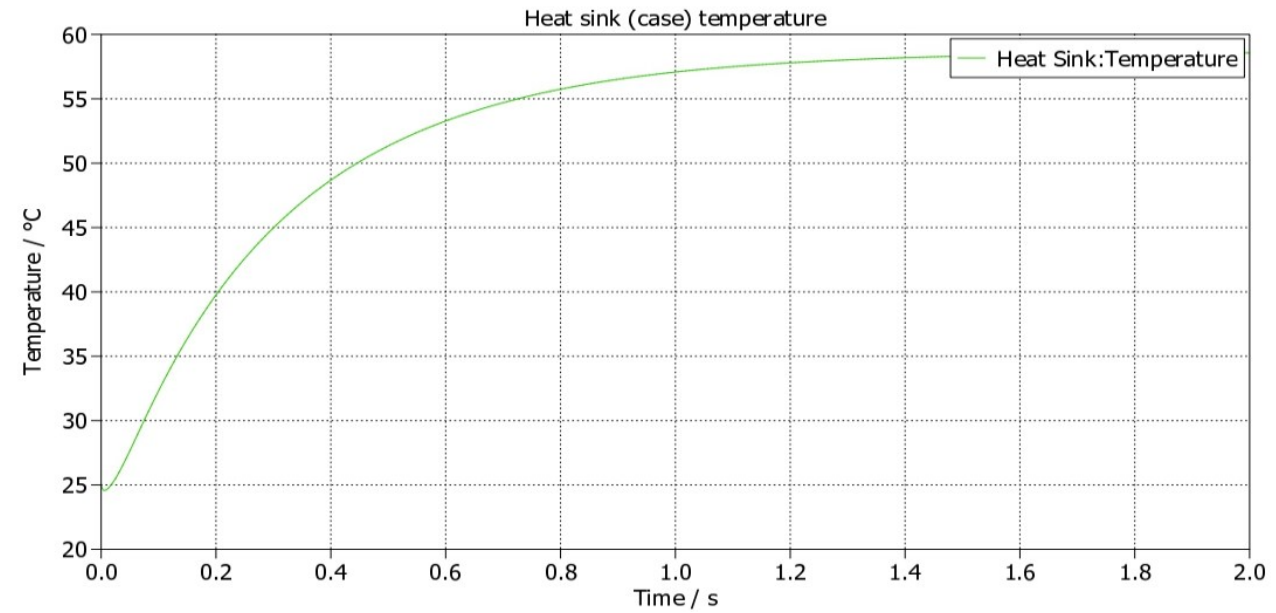
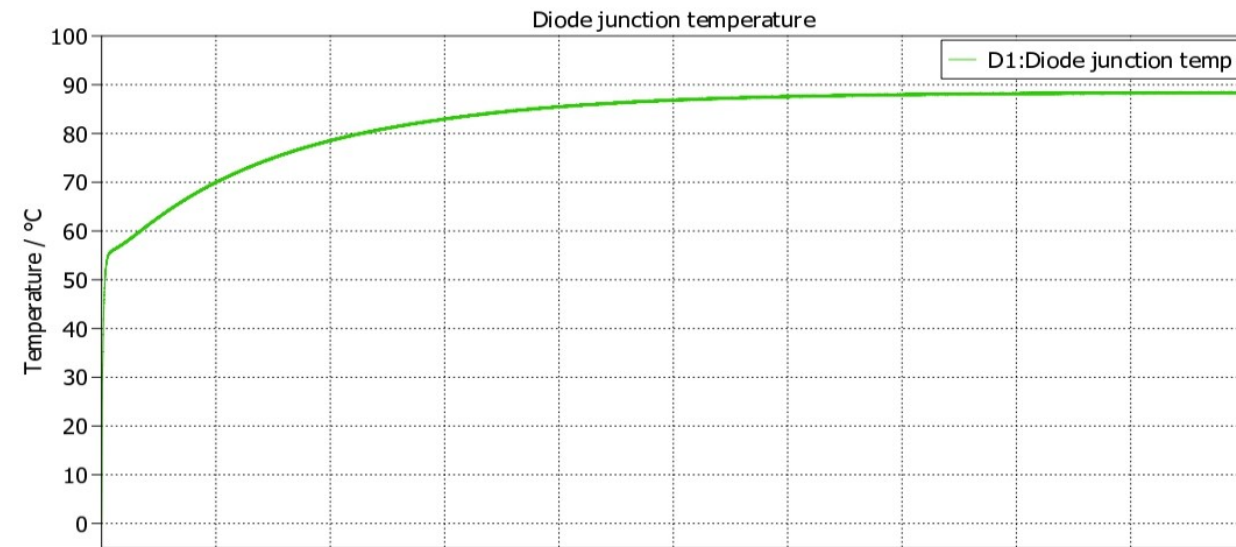
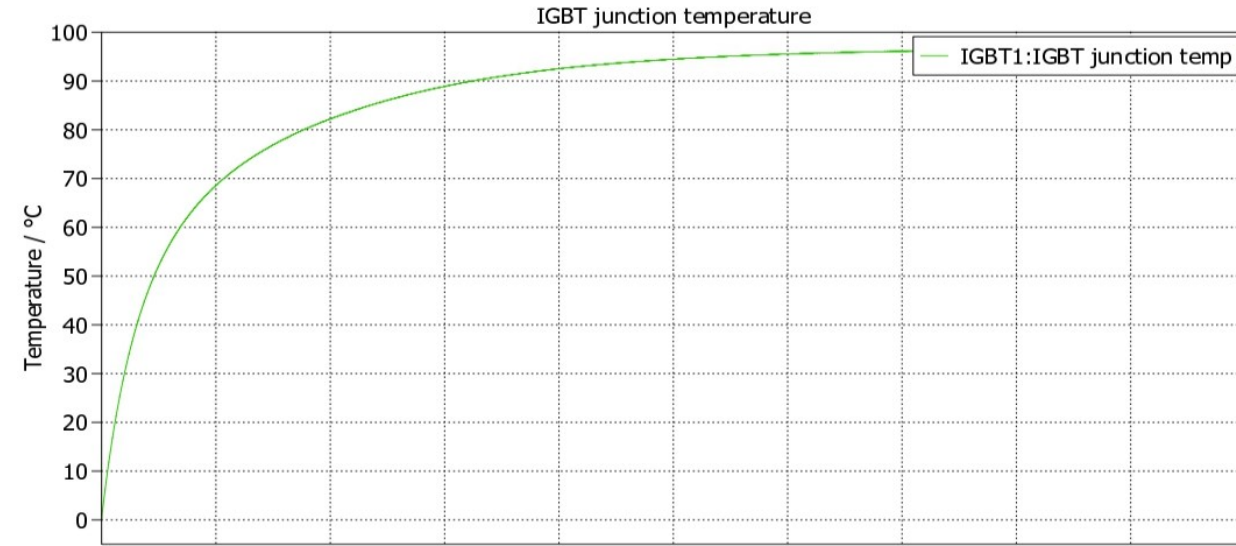


	Min [A]	Max [A]	Mean [A]	RMS [A]
I(source)	0	55,2174	25,0001	35,4196
I(diode)	0	55,2174	24,9999	35,4196
I(inductance)	44,7826	55,2174	50	50,0907
I(capacitor)	-5,21303	5,21303	0	3,01159
I(load)	49,1264	50,1264	50	50,0001

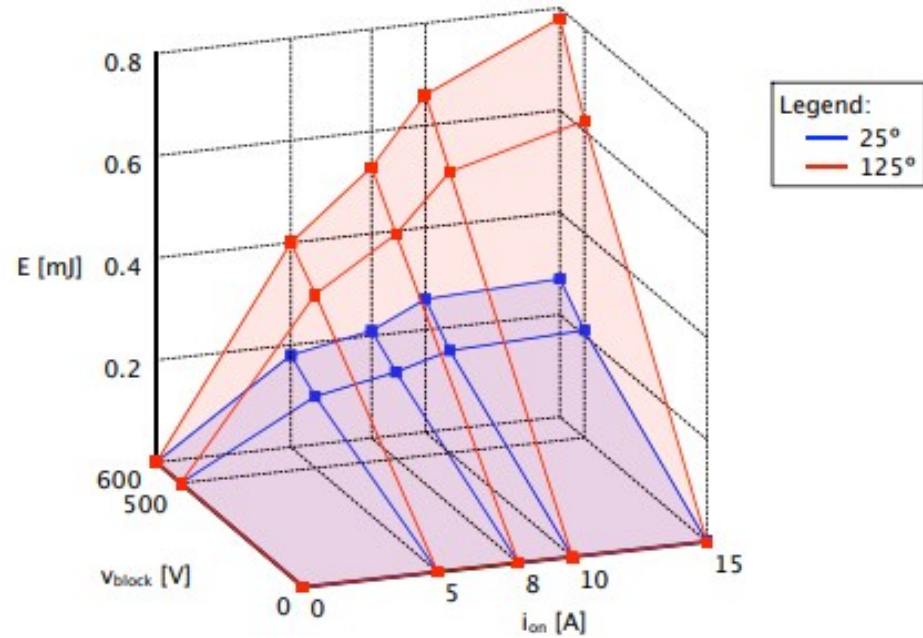
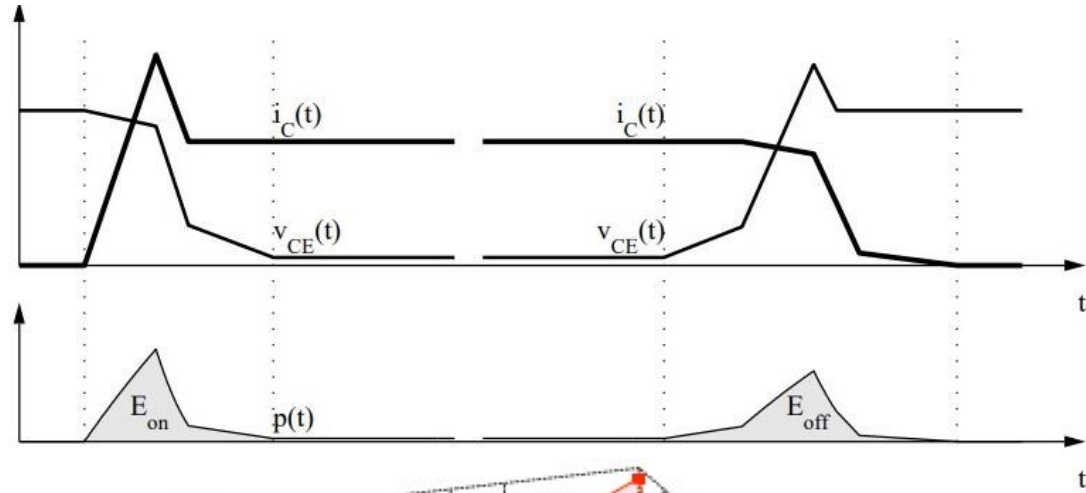
	Min [V]	Max [V]	Mean [V]	RMS [V]
V(source)	500	500	500	500
V(inductance)	-250,632	250,632	0	250,417
V(load)	249,368	250,632	250	250

$$\Delta V = V_{O_{MAX}} - V_{O_{min}}$$

$$= 1.264 \text{ V}$$



Perdite per commutazione:



Perdite per conduzione:

