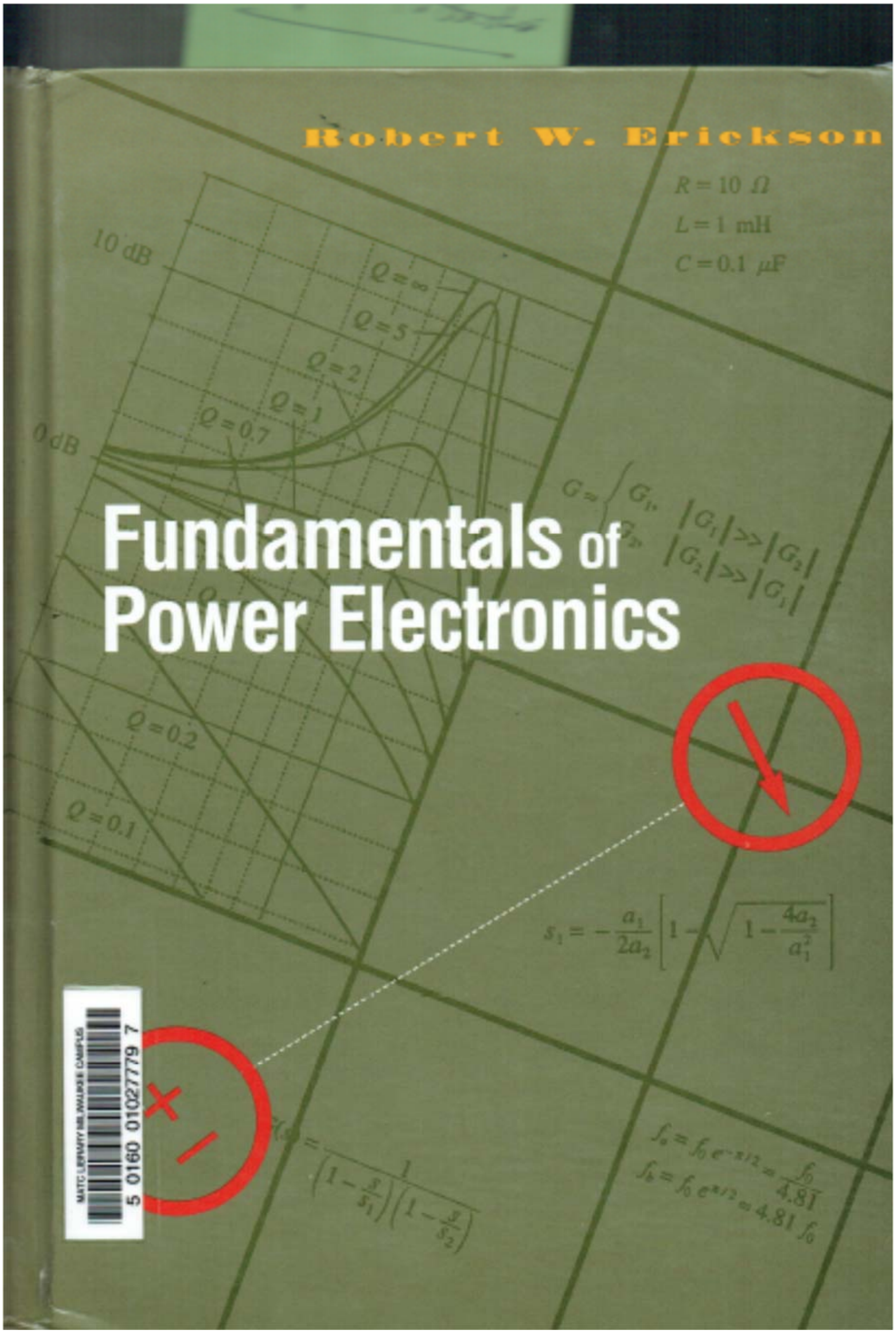
Robert W. Erickson
Fundamentals of Power Electronics
R = 10 Ω
L = 1 mH
C = 0.1 μF
10 dB
0 dB
Q = ∞
Q = 5
Q = 2
Q = 1
Q = 0.7
Q = 0.2
Q = 0.1

Fundamentals of Power Electronics

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Thus, we have two unknowns, V and D_2, and we have two equations. The first equation, Eq. (5.19), was obtained by inductor volt-second balance, while the second equation, Eq. (5.27), was obtained using capacitor charge balance. Elimination of D_2 from the two equations, and solution for the voltage conversion ratio $M(D_1, K) = V/V_g$, yields

$$\frac{V}{V_g} = \frac{2}{1 + \sqrt{1 + \frac{4K}{D_1^2}}} \tag{5.28}$$

where $K = 2L/RT_s$

valid for $K < K_{crit}$

This is the solution of the buck converter operating in discontinuous conduction mode.

The complete buck converter characteristics, including both continuous and discontinuous conduction modes, are therefore

$$M = \begin{cases} D & \text{for } K > K_{crit} \\ \dfrac{2}{1 + \sqrt{1 + \frac{4K}{D^2}}} & \text{for } K < K_{crit} \end{cases} \tag{5.29}$$

where the transistor duty cycle D is identical to the subinterval 1 duty cycle D_1 of the above derivation. These characteristics are plotted in Fig. 5.11, for several values of K. It can be seen that the effect

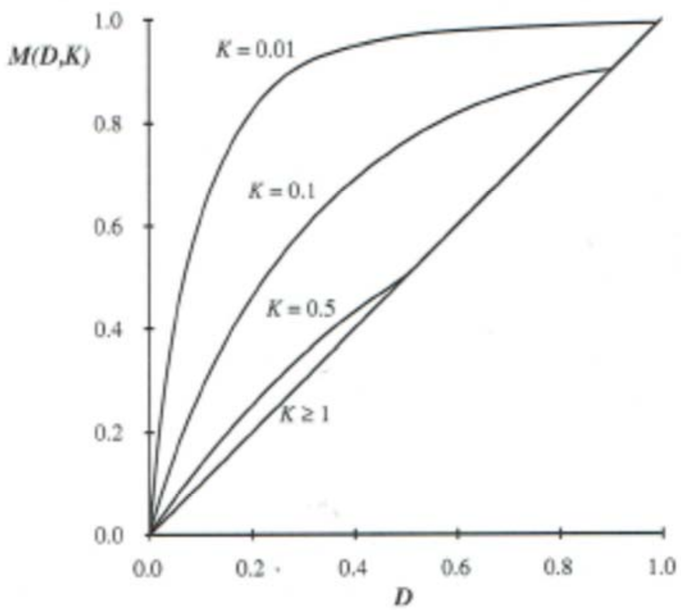

Fig. 5.11 Voltage conversion ratio $M(D, K)$, buck converter.