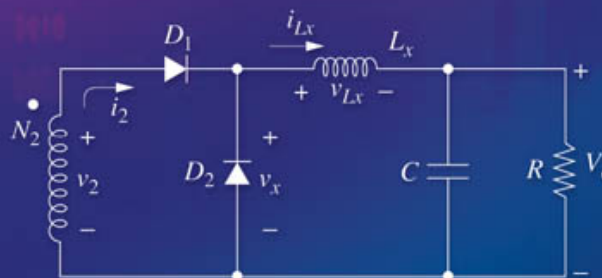
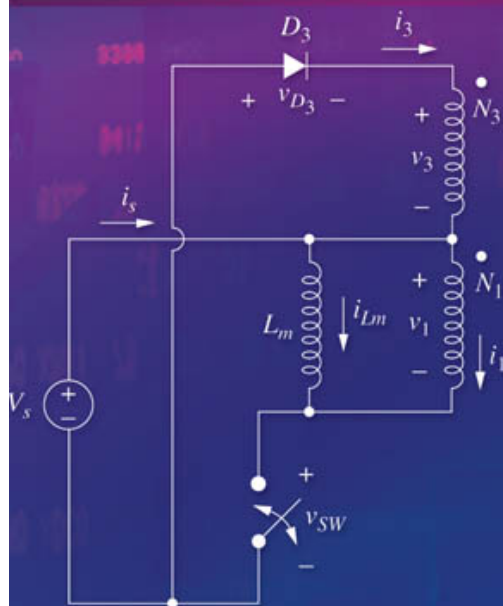


Power Electronics



Daniel W. Hart



Commonly used Power and Converter Equations

Instantaneous power: $p(t) = v(t)i(t)$

$$\text{Energy: } W = \int_{t_1}^{t_2} p(t) dt$$

$$\text{Average power: } P = \frac{W}{T} = \frac{1}{T} \int_{t_0}^{t_0+T} p(t) dt = \frac{1}{T} \int_{t_0}^{t_0+T} v(t)i(t) dt$$

Average power for a dc voltage source: $P_{dc} = V_{dc} I_{avg}$

$$\text{rms voltage: } V_{rms} = \sqrt{\frac{1}{T} \int_0^T v^2(t) dt}$$

rms for $v = v_1 + v_2 + v_3 + \dots$: $V_{rms} = \sqrt{V_{1,rms}^2 + V_{2,rms}^2 + V_{3,rms}^2 + \dots}$

rms current for a triangular wave: $I_{rms} = \frac{I_m}{\sqrt{3}}$

rms current for an offset triangular wave: $I_{rms} = \sqrt{\left(\frac{I_m}{\sqrt{3}}\right)^2 + I_{dc}^2}$

rms voltage for a sine wave or a full-wave rectified sine wave: $V_{rms} = \frac{V_m}{\sqrt{2}}$

rms voltage for a half-wave rectified sine wave: $V_{\text{rms}} = \frac{V_m}{2}$

Power factor: $\text{pf} = \frac{P}{S} = \frac{P}{V_{\text{rms}} I_{\text{rms}}}$

Total harmonic distortion: $\text{THD} = \frac{\sqrt{\sum_{n=2}^{\infty} I_n^2}}{I_1}$

Distortion factor: $\text{DF} = \sqrt{\frac{1}{1 + (\text{THD})^2}}$

Form factor = $\frac{I_{\text{rms}}}{I_{\text{avg}}}$

Crest factor = $\frac{I_{\text{peak}}}{I_{\text{rms}}}$

Buck converter: $V_o = V_s D$

Boost converter: $V_o = \frac{V_s}{1 - D}$

Buck-boost and Ćuk converters: $V_o = -V_s \left(\frac{D}{1 - D} \right)$

SEPIC: $V_o = V_s \left(\frac{D}{1 - D} \right)$

Flyback converter: $V_o = V_s \left(\frac{D}{1 - D} \right) \left(\frac{N_2}{N_1} \right)$

Forward converter: $V_o = V_s D \left(\frac{N_2}{N_1} \right)$

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POWER ELECTRONICS

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1 2 3 4 5 6 7 8 9 0 DOC/DOC 1 0 9 8 7 6 5 4 3 2 1 0

ISBN 978-0-07-338067-4

MHID 0-07-338067-9

Vice President & Editor-in-Chief: *Marty Lange*
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Design Coordinator: *Brenda A. Rolwes*
Cover Designer: *Studio Montage, St. Louis, Missouri*
(USE) Cover Image: *Figure 7.5a from interior*
Compositor: *Glyph International*
Typeface: *10.5/12 Times Roman*
Printer: *R. R. Donnelley*

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This book was previously published by: Pearson Education, Inc.

Library of Congress Cataloging-in-Publication Data

Hart, Daniel W.
Power electronics / Daniel W. Hart.
p. cm.
Includes bibliographical references and index.
ISBN 978-0-07-338067-4 (alk. paper)
1. Power electronics. I. Title.
TK7881.15.H373 2010
621.31'7—dc22

2009047266

www.mhhe.com

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