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Device Modeling  
With Spice  
**Semiconduc  
tor Device  
Modeling  
With Spice**

***The general aim  
of this book is to  
present selected  
chapters of the  
following types:  
chapters with***

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***more focus on modeling with some necessary simulation details and chapters with less focus on modeling but with more simulation details. This book contains eleven chapters divided into two sections:***

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***Modeling in  
Continuum  
Mechanics and  
Modeling in  
Electronics and  
Engineering. We  
hope our book  
entitled  
"Modeling and  
Simulation in  
Engineering -  
Selected  
Problems" will***

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*serve as a useful  
reference to  
students,  
scientists, and  
engineers.*

*From power  
electronics to  
power integrated  
circuits (PICs),  
smart power  
technologies,  
devices, and  
beyond,*

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*Integrated Power  
Device Modeling  
With Spice  
TCAD Simulation  
provides a  
complete picture  
of the power  
management and  
semiconductor  
industry. An  
essential  
reference for  
power device  
engineering*

Where To  
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*students and  
professionals, the  
book not only  
describes the  
physics inside  
integrated power  
semiconductor  
devices such  
lateral double-  
diffused metal  
oxide  
semiconductor  
field-effect*

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*transistors*  
(LDMOSFETs),  
lateral insulated-  
gate bipolar  
*transistors*  
(LIGBTs), and  
super junction  
LDMOSFETs but  
also delivers a  
*simple*  
*introduction to*  
*power*  
*management*

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***systems. Instead  
of abstract  
theoretical  
treatments and  
daunting  
equations, the  
text uses  
technology  
computer-aided  
design (TCAD)  
simulation  
examples to  
explain the***



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***design of  
integrated power  
semiconductor  
devices. It also  
explores next  
generation power  
devices such as  
gallium nitride  
power high  
electron mobility  
transistors (GaN  
power HEMTs).  
Including a***

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*virtual process  
flow for smart PIC  
technology as  
well as a hard-to-  
find technology  
development  
organization  
chart, Integrated  
Power Devices  
and TCAD  
Simulation gives  
students and  
junior engineers*

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***semiconductor  
Device Modeling  
With Spice***  
**a head start in  
the field of power  
semiconductor  
devices while  
helping to fill the  
gap between  
power device  
engineering and  
power  
management  
systems.**

**The advent of the  
microelectronics**

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**technology has  
made ever-  
increasing**

**numbers of small  
devices on a  
same chip. The  
rapid emergence  
of ultra-large-  
scaled-integrated  
(ULSI) technology  
has moved device  
dimension into  
the sub-quarter-**

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***micron regime  
and put more  
than 10 million  
transistors on a  
single chip. While  
traditional closed-  
form analytical  
models furnish  
useful intuition  
into how  
semiconductor  
devices behave,  
they no longer***

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***provide consistently accurate results for all modes of operation of these very small devices. The reason is that, in such devices, various physical mechanisms affect the device performance in a***

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*complex manner,  
and the  
conventional  
assumptions (i. e.  
, one-dimensional  
treatment, low-  
level injection,  
quasi-static  
approximation,  
etc. ) employed  
in developing  
analytical models  
become*

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**questionable.**  
**Thus, the use of**  
**numerical device**  
**simulation**  
**becomes**  
**important in**  
**device modeling.**  
**Researchers and**  
**engineers will**  
**rely even more**  
**on device**  
**simulation for**  
**device design**



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Device Modeling  
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***and analysis in  
the future. This  
book provides  
comprehensive  
coverage of  
device simulation  
and analysis for  
various modern  
semiconductor  
devices. It will  
serve as a  
reference for  
researchers,***

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***engineers, and  
students who  
require in-depth,  
up-to-date  
information and  
understanding of  
semiconductor  
device physics  
and  
characteristics.  
The materials of  
the book are  
limited to***

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**conventional and  
mainstream  
semiconductor  
devices; photonic  
devices such as  
light emitting and  
laser diodes are  
not included, nor  
does the book  
cover device  
modeling, device  
fabrication, and  
circuit**

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**applications.**

***The editors and authors present a wealth of knowledge regarding the most relevant aspects in the field of MOS transistor modeling. The variety of subjects and the***

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*high quality of  
content of this  
volume make it a  
reference  
document for  
researchers and  
users of MOSFET  
devices and  
models. The book  
can be  
recommended to  
everyone who is  
involved in*

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**compact model  
developments,  
numerical TCAD  
modeling,  
parameter  
extraction, space-  
level simulation  
or model  
standardization.  
The book will  
appeal equally to  
PhD students  
who want to**

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*understand the  
ins and outs of  
MOSFETs as well  
as to modeling  
designers  
working in the  
analog and high-  
frequency areas.  
"This dynamic  
text applies  
physics concepts  
and equations to  
practical, real-*

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**world**  
Device Modeling  
With Spice

**applications of  
semiconductor  
device theory"--**

***This book is a  
useful reference  
for practicing  
electrical  
engineers as well  
as a textbook for  
a junior/senior or  
graduate level  
course in***



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**electrical  
engineering. The  
authors combine  
two subjects:  
device modeling  
and circuit  
simulation - by  
providing a large  
number of well-  
prepared  
examples of  
circuit  
simulations**

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Device Modeling  
With Spice  
***immediately  
following the  
description of  
many device  
models.***

***A practical,  
tutorial guide to  
the nonlinear  
methods and  
techniques  
needed to design  
real-world  
microwave***

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***circuits.  
Starting with the  
simplest  
semiclassical  
approaches and  
ending with the  
description of  
complex fully qua  
ntum-mechanical  
methods for  
quantum  
transport  
analysis of state-***

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*of-the-art*  
Device Modeling  
With Spice  
**Computational  
Electronics:  
Semiclassical and  
Quantum Device  
Modeling and  
Simulation  
provides a  
comprehensive  
overview of the  
essential  
techniques and**

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***methods for  
effectively  
analyzing  
transport in  
semiconductor  
devices. With the  
transistor  
reaching its limits  
and new device  
designs and  
paradigms of  
operation being  
explored, this***

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*timely resource  
delivers the  
simulation*

*methods needed  
to properly model  
state-of-the-art  
nanoscale  
devices. The first  
part examines  
semiclassical  
transport  
methods,  
including drift-*

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Device Modeling  
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***diffusion,  
hydrodynamic,  
and Monte Carlo  
methods for  
solving the  
Boltzmann  
transport  
equation. Details  
regarding  
numerical  
implementation  
and sample codes  
are provided as***

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Device Modeling  
With Spice  
**templates for  
sophisticated  
simulation**

**software. The  
second part  
introduces the  
density gradient  
method, quantum  
hydrodynamics,  
and the concept  
of effective  
potentials used  
to account for qu**



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**antum-**  
Device Modeling  
With Spice  
**mechanical space  
quantization  
effects in particle-  
based simulators.  
Highlighting the  
need for quantum  
transport  
approaches, it  
describes various  
quantum effects  
that appear in  
current and**

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***future devices  
being mass-  
produced or  
fabricated as a  
proof of concept.  
In this context, it  
introduces the  
concept of  
effective  
potential used to  
approximately  
include quantum-  
mechanical space-***

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With Spice

**quantization  
effects within the  
semiclassical  
particle-based  
device simulation  
scheme.**

**Addressing the  
practical aspects  
of computational  
electronics, this  
authoritative  
resource  
concludes by**

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*addressing some  
of the open  
questions related  
to quantum  
transport not  
covered in most  
books. Complete  
with self-study  
problems and  
numerous  
examples  
throughout, this  
book supplies*

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*readers with the  
practical  
understanding  
required to  
create their own  
simulators.*

[\*\*Transistor Level  
Modeling for  
Analog/RF IC  
Design\*\*](#)  
[\*\*MODELLING AND  
TECHNOLOGY\*\*](#)  
[\*\*Industry\*\*](#)

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Compact Model  
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Design  
Microwave and  
RF  
Semiconductor  
Control Device  
Modeling  
Open Source  
TCAD/EDA for  
Compact  
Modeling](#)

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Simulation in  
Engineering  
Reliability of High  
Temperature  
Electronics  
The SPICE Book**

**Integrated Power  
Devices and  
TCAD Simulation  
Silicon and III-V  
Compound**

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***Compact Models  
for Integrated  
Circuit Design:  
Conventional  
Transistors and  
Beyond provides  
a modern treatise  
on compact  
models for circuit  
computer-aided  
design (CAD).***



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*Written by an  
author with more  
than 25 years of  
industry  
experience in  
semiconductor  
processes,  
devices, and  
circuit CAD, and  
more than 10  
years of  
academic*

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***experience in  
teaching compact  
modeling***

***courses, this first-  
of-its-kind book  
on compact  
SPICE models for  
very-large-scale-  
integrated (VLSI)  
chip design  
offers a balanced  
presentation of***

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***compact  
modeling crucial  
for addressing  
current modeling  
challenges and  
understanding  
new models for  
emerging  
devices. Starting  
from basic  
semiconductor  
physics and***

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*covering state-of-the-art device regimes from conventional micron to nanometer, this text: Presents industry standard models for bipolar-junction transistors (BJTs), metal-oxi*

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*de-*  
semiconductor  
(MOS) field-effect-  
transistors  
(FETs), FinFETs,  
and tunnel field-  
effect transistors  
(TFETs), along  
with statistical  
MOS models  
Discusses the  
major issue of

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**process**  
Device Modeling  
With Spice  
**variability, which**  
**severely impacts**  
**device and circuit**  
**performance in**  
**advanced**  
**technologies and**  
**requires**  
**statistical**  
**compact models**  
**Promotes further**  
**research of the**

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***evolution and  
development of  
compact models  
for VLSI circuit  
design and  
analysis Supplies  
fundamental and  
practical  
knowledge  
necessary for  
efficient  
integrated circuit***

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*(IC) design using  
Device Modeling  
nanoscale  
With Spice  
devices Includes  
exercise  
problems at the  
end of each  
chapter and  
extensive  
references at the  
end of the book  
Compact Models  
for Integrated*



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***Circuit Design:  
Conventional  
Transistors and  
Beyond is  
intended for  
senior  
undergraduate  
and graduate  
courses in  
electrical and  
electronics  
engineering as***

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*well as for  
researchers and  
practitioners  
working in the  
area of electron  
devices.*

*However, even  
those unfamiliar  
with  
semiconductor  
physics gain a  
solid grasp of*

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***compact  
modeling  
concepts from  
this book. The  
Open Access  
version of this  
book, available at  
<https://doi.org/10.1201/b19117>, has  
been made  
available under a  
Creative***

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***This  
comprehensive  
new resource  
presents a  
detailed look at  
the modeling and  
simulation of***

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*microwave*  
Device Modeling  
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*semiconductor*  
*control devices*

*and circuits.*

*Fundamental PIN,  
MOSFET, and  
MESFET*

*nonlinear device  
modeling are  
discussed,  
including the  
analysis of*

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*transient and  
harmonic  
behavior.*  
Device Modeling  
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*Considering  
various control  
circuit  
topologies, the  
book analyzes a  
wide range of  
models, from  
simple  
approximations,*

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Device Modeling  
With Spice  
***to sophisticated  
analytical  
approaches.***

***Readers find  
clear examples  
that provide  
guidance in how  
to use specific  
modeling  
techniques for  
their challenging  
projects in the***

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***field. Numerous  
illustrations help  
practitioners***

***better understand  
important device  
and circuit  
behavior,  
revealing the  
relationship  
between key  
parameters and  
results. This***



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*authoritative*  
Device Modeling  
*volume covers*  
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*basic and*  
*complex*  
*mathematical*  
*models for the*  
*most common*  
*semiconductor*  
*control elements*  
*used in today's*  
*microwave and*  
*RF circuits and*

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**systems.**  
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**Semiconductor  
power electronics  
plays a dominant  
role due its  
increased  
efficiency and  
high reliability in  
various domains  
including the  
medium and high  
electrical drives,**

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***automotive and  
aircraft  
applications,  
electrical power  
conversion, etc.  
Power/HVMOS  
Devices Compact  
Modeling will  
cover very  
extensive range  
of topics related  
to the***

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*development and  
characterization  
power/high  
voltage (HV)  
semiconductor  
technologies as  
well as modeling  
and simulations  
of the power/HV  
devices and  
smart power  
integrated*

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***circuits (ICs).  
Emphasis is  
placed on the  
practical  
applications of  
the advanced  
semiconductor  
technologies and  
the device level  
compact/spice  
modeling. This  
book is intended***

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***to provide  
reference  
information by  
selected, leading  
authorities in  
their domain of  
expertise. They  
are representing  
both academia  
and industry. All  
of them have  
been chosen***

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*because of their  
intimate  
knowledge of  
their subjects as  
well as their  
ability to present  
them in an easily  
understandable  
manner.*

*Explains basic  
semiconductor  
physics, and*

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*looks at bipolar  
junction, metal  
oxide*

*semiconductor  
field effect, and  
compound  
semiconductor  
field effect  
transistors, thin  
film transistors,  
and circuit  
simulation*



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***SiC and GaN devices have been around for some time. The first dedicated international conference on SiC and related devices, "ICSCRM," was held in Washington, DC,***

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*in 1987. But only recently, the commercialization of SiC and GaN devices has happened. Due to its material properties, Si as a semiconductor has limitations in high-temperature, high-voltage, and*

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***high-frequency regimes. With the help of SiC and GaN devices, it is possible to realize more efficient power systems. Devices manufactured from SiC and GaN have already been impacting***

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*different areas  
with their ability  
to outperform Si  
devices. Some of  
the examples are  
the telecommunic  
ations, automotiv  
e/locomotive,  
power, and  
renewable energy  
industries. To  
achieve the*

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***carbon emission  
targets set by  
different***

***countries, it is  
inevitable to use  
these new  
technologies.***

***This book  
attempts to cover  
all the important  
facets related to  
wide bandgap***

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***semiconductor  
technology,  
including new  
challenges posed  
by it. This book is  
intended for  
graduate  
students,  
researchers,  
engineers, and  
technology  
experts who have***

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*been working in  
the exciting fields  
of SiC and GaN  
power devices.  
Semiconductor  
device modelling  
has developed in  
recent years from  
being solely the  
domain of device  
physicists to  
span broader*

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***technological  
disciplines  
involved in  
device and  
electronic circuit  
design and  
develop ment.  
The rapid  
emergence of  
very high speed,  
high density  
integrated circuit***



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*technology and  
the drive towards  
high speed  
communications  
has meant that  
extremely small-  
scale device  
structures are  
used in  
contemporary  
designs. The  
characterisation*

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***and analysis of  
these devices  
can no longer be  
satisfied by  
electrical  
measurements  
alone. Traditional  
equivalent circuit  
models and  
closed-form  
analytical models  
cannot always***

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***provide consistently accurate results for all modes of operation of these very small devices.***

***Furthermore, the highly competitive nature of the semiconductor***

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***industry has led  
to the need to  
minimise***

***development  
costs and lead-  
time associated  
with introducing  
new designs.***

***This has meant  
that there has  
been a greater  
demand for***

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*models capable  
of increasing our  
understanding of  
how these  
devices operate  
and capable of  
predicting  
accurate  
quantitative  
results. The  
desire to move  
towards*

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**computer aided  
design and  
expert systems**

**has reinforced  
the need for  
models capable  
of representing  
device operation  
under DC, small-  
signal, large-  
signal and high  
frequency**

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***operation. It is  
also desirable to  
relate the  
physical  
structure of the  
device to the  
electrical  
performance.  
This demand for  
better models  
has led to the  
introduction of***

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*improved  
equivalent circuit  
models and a  
upsurge in  
interest in using  
physical models.  
This book is the  
first to explain  
FinFET modeling  
for IC simulation  
and the industry  
standard – BSIM-*



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*CMG - describing  
the rush in  
demand for  
advancing the  
technology from  
planar to 3D  
architecture, as  
now enabled by  
the approved  
industry  
standard. The  
book gives a*

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**strong**  
Device Modeling  
With Spice  
**foundation on the  
physics and  
operation of  
FinFET, details  
aspects of the  
BSIM-CMG model  
such as surface  
potential, charge  
and current  
calculations, and  
includes a**

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***dedicated  
chapter on  
parameter  
extraction  
procedures,  
providing a step-  
by-step approach  
for the efficient  
extraction of  
model  
parameters. With  
this book you will***

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***learn: Why you  
should use  
FinFET The  
physics and  
operation of  
FinFET Details of  
the FinFET  
standard model  
(BSIM-CMG)  
Parameter  
extraction in  
BSIM-CMG***

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***FinFET circuit  
design and  
simulation***

***Authored by the  
lead inventor and  
developer of  
FinFET, and  
developers of the  
BSIM-CM  
standard model,  
providing an  
experts' insight***

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*into the*  
Device Modeling  
With Spice  
*specifications of*  
*the standard The*  
*first book on the*  
*industry-standard*  
*FinFET model -*  
*BSIM-CMG*  
*This book*  
*presents the art*  
*of advanced*  
*MOSFET*  
*modeling for*

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***integrated circuit  
simulation and  
design. It  
provides the  
essential  
mathematical and  
physical  
analyses of all  
the electrical,  
mechanical and  
thermal effects in  
MOS transistors***

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***relevant to the  
operation of  
integrated***

***circuits.***

***Particular  
emphasis is  
placed on how  
the BSIM model  
evolved into the  
first ever industry  
standard SPICE  
MOSFET model***



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*for circuit  
Device Modeling  
With Spice*  
**CMOS**

*technology  
development. The  
discussion  
covers the theory  
and methodology  
of how a MOSFET  
model, or  
semiconductor  
device models in*

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parameter  
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interested or  
already engaged  
in work in the  
areas of  
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Carbide (SiC)  
power  
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of SiC power  
devices can be  
extremely  
challenging due  
to the wide  
bandgap of the  
semiconductor  
material. The  
material  
presented in  
this book aims*

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*to shorten the  
learning curve  
required to  
start successful  
SiC device  
simulation by  
providing a  
detailed  
explanation of  
simulation code  
and the impact  
of various  
modeling and*

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parameters on  
the simulation  
results. Non-  
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simulation to  
predict heat  
dissipation and  
lattice  
temperature  
rise in a SiC  
device  
structure under*

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condition has  
been explained  
in detail. Key  
pointers  
including  
runtime error  
messages, code  
debugging,  
implications of  
using certain  
models and  
parameter**

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**values, and  
other factors  
beneficial to  
device  
simulation are  
provided based  
on the authors'  
experience  
while  
simulating SiC  
device  
structures. This  
book is useful**

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researchers,  
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working in the  
area of SiC  
semiconductor  
technology.  
Readers will be  
provided with  
the source code  
of several fully**

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***functional  
simulation  
programs that  
illustrate the  
use of Silvaco®  
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simulate SiC  
power device  
structure, as  
well as  
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material for  
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book is to  
highlight the  
benefits of a  
higher  
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***focusing on  
specifically  
selected open  
source tools for  
compact  
modeling. Due  
to the  
tremendous  
developments  
in  
semiconductor  
technology in  
recent years,***

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***device level  
modelling and  
integrated  
circuit design  
have become  
intimately  
related.***

***However, they  
have been  
traditionally  
disconnected  
up to the circuit  
level. This book***

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set of extended  
user manuals  
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usual software,  
from multidime  
nsional  
numerical  
process and  
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and its Verilog-  
A**

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selected IC  
designs for  
analog, radio  
frequency and  
digital  
applications.  
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**and industrial**  
**researchers and**  
**engineers, the**  
**book forms a**  
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major state-of-  
the-art stress-  
and strain-  
engineered  
advanced***

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how to set up  
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simulation  
tools, from  
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process and  
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simulation,  
including  
design for  
manufacturing  
(DFM), and*

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modeling to  
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extraction. The  
book also offers  
an innovative  
and new  
approach to  
teaching the  
fundamentals  
of  
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device design  
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simulations of  
various  
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structures. The  
simulation  
examples  
chosen are  
from the most  
popular devices***

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*and provide*  
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*technology and*  
*device physics*  
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*extend the role*  
*of TCAD in*  
*today's*  
*advanced*  
*technology era,*  
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DFM issues  
have been*

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ign-technology  
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book provides  
an integrated  
view of silicon  
technology and*

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emphasis on  
TCAD  
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is the first book  
to provide a  
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laboratory for  
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device  
characterization and SPICE***

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extraction. It  
describes not  
only the  
manufacturing  
practice  
associated with  
the  
technologies  
used but also  
the underlying  
scientific basis  
for those***

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standpoint, this  
book provides  
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process  
modeling, and  
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book also  
advances the  
understanding  
and knowledge  
of modern IC  
design via  
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micro- and  
nanoelectronics  
R&D, and  
supports the  
training of  
semiconductor  
specialists. It is  
intended as a  
textbook or  
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for engineers  
involved in VLSI  
technology  
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who have to  
solve device  
and process  
problems. CAD  
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book useful  
since it*

*discusses the  
organization of  
the simulation  
system, in  
addition to  
presenting  
many case  
studies where  
the user applies  
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***different situations. Aimed primarily at the undergraduate students pursuing courses in semiconductor physics and semiconductor devices, this text***

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*emphasizes the  
physical  
understanding  
of the  
underlying  
principles of  
the subject.  
Since engineers  
use  
semiconductor  
devices as  
circuit  
elements,*

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*device models  
commonly used  
in the circuit  
simulators, e.g.  
SPICE, have  
been discussed  
in detail.*

*Advanced  
topics such as  
lasers,  
heterojunction  
bipolar  
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*second order  
effects in BJTs,  
and MOSFETs  
are also  
covered. With  
such in-depth  
coverage and a  
practical  
approach,  
practising  
engineers and  
PG students  
can also use*



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***this book as a  
ready  
reference.***

***Bridges the gap  
between device  
modelling and  
analog circuit  
design.***

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dedicated  
software  
enabling actual  
circuit design.***

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three  
significant  
models: BSIM3,  
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guidance on  
device  
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and circuit  
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popularized  
compact  
modeling of  
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classrooms, and  
manufacturing  
engineering,  
over a decade  
ago. The first  
comprehensive  
book on MOS**

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**transistor**  
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**was the most**  
**cited among**  
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**the area and**  
**remains the**  
**most frequently**  
**cited today.**  
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**device-physics**  
**based and**

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*continues to be  
relevant to the  
latest advances  
in MOS  
transistor  
modeling. This  
is also the only  
book that  
discusses in  
detail how to  
measure device  
model  
parameters*

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Device Modeling  
*circuit*  
With Spice  
*simulations.*

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with the MOS  
Field Effect  
Transistor  
(MOSFET)  
models that are  
derived from  
basic  
semiconductor  
theory. Various*

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***models are developed, ranging from simple to more sophisticated models that take into account new physical effects observed in submicron transistors used in today's***



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**(1993) MOS  
VLSI  
technology. The  
assumptions  
used to arrive  
at the models  
are emphasized  
so that the  
accuracy of the  
models in  
describing the  
device  
characteristics**

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**are clearly  
understood.**

**Due to the  
importance of  
designing  
reliable circuits,  
device  
reliability  
models are also  
covered.**

**Understanding  
these models is  
essential when**

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circuits for  
state-of-the-art  
MOS ICs.*

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has proved to  
be a highly  
important  
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Semiconductor,  
providing the  
basis for  
adjustable*

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drives (used in  
air conditioning  
and  
refrigeration  
and railway  
locomotives),  
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ignition  
systems for gas  
olinepowered  
motor vehicles  
and energy-***

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include plasma  
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screen TVs) and  
electric power  
transmission  
systems,  
alternative  
energy systems***

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**and energy  
storage. This  
book is the first  
available to  
cover the  
applications of  
the IGBT, and  
provide the  
essential  
information  
needed by  
applications  
engineers to**

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***design new  
products using  
the device, in  
sectors  
including  
consumer,  
industrial,  
lighting,  
transportation,  
medical and  
renewable  
energy. The  
author, B.***

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**Jayant Baliga,  
invented the  
IGBT in 1980**

**while working  
for GE. His book  
will unlock IGBT  
for a new  
generation of  
engineering  
applications,  
making it  
essential  
reading for a**



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of electrical  
engineers and  
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engineers, as  
well as an  
important  
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specialists.  
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design  
information for***

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sensors. The  
first book to  
cover  
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***the IGBT, a  
device  
manufactured  
around the  
world by more  
than a dozen  
companies with  
sales exceeding  
\$5 Billion;  
written by the  
inventor of the  
device.***

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readers with a*

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address the  
challenges posed*

*by hot carrier  
degradation, one of  
today's most  
complicated  
reliability issues in  
semiconductor  
devices. Coverage  
includes an  
explanation of  
carrier transport  
within devices and*



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*describes the models*

*themselves, it*

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*them how to run*

*the program. This*

*guide is also*

*distinctive in*

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diodes; bipolar  
junction transistor  
(BJT); junction field  
effect transistor  
(JFET); metal oxide  
semiconductor  
transistor (MOST);  
metal  
semiconductor field  
effect transistor  
(MESFET); ion  
sensitive field  
effect transistor

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(ISFET);  
Device Modeling  
semiconductor  
controlled rectifier  
(SCR-thyristor).  
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International  
Conference on  
Simulation of  
Semiconductor  
Devices and  
Processes" (SISDEP  
93) continues a  
series of  
conferences which

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and Bologna in 1988,  
and W. Fichtner  
and D. Aemmer at  
the Federal  
Institute of  
Technology in  
Zurich in 1991.  
This year the  
conference is held  
at the Technical  
University of  
Vienna, Austria,  
September 7 - 9,  
1993. This



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provide an  
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process and de  
vice simulation.  
The miniaturization  
of today's  
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of new materials  
and advanced  
process steps in  
the development of  
new semiconduc  
tor technologies  
suggests the  
design of new  
computer  
programs. This  
trend towards  
more complex  
structures and*

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understanding of  
With Spice physical effects,  
the Conference on  
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Processes brings  
together the  
simulation  
community and the  
process- and  
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for the  
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state-of-the-art  
research and  
development  
results in the area*

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*of numerical  
process and device  
simulation.*

*Continuously  
shrinking device  
dimensions, the  
use of new  
materials, and  
advanced  
processing steps in  
the manufacturing  
of semiconductor  
devices require  
new and improved*

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*software. The trend towards increasing complexity in structures and process technology demands advanced models describing all basic effects and sophisticated two and three dimensional tools for almost arbitrarily designed geometries. The*

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latest results  
obtained by  
scientists from  
more than 20  
countries on  
process simulation  
and modeling,  
simulation of  
process equipment,  
device modeling  
and simulation of  
novel devices,  
power*



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and sensors, on  
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and parameter  
extraction for  
circuit models,  
practical  
application of  
simulation,  
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methods, and  
software.*

*Metal Oxide  
Semiconductor*

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*past decade, the complexity of MOS IC's has increased at an astonishing rate. This is realized mainly through the reduction of MOS transistor dimensions in addition to the improvements in processing. Today VLSI circuits with*

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*over 3 million transistors on a chip, with effective or electrical channel lengths of 0.5 microns, are in volume production. Designing such complex chips is virtually impossible without simulation tools which help to predict circuit behavior before*

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*actual circuits are fabricated.*

*However, the utility of simulators as a tool for the design and analysis of circuits depends on the adequacy of the device models used in the simulator. This problem is further aggravated by the technology trend*

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towards smaller and smaller device dimensions which increases the complexity of the models. There is extensive literature available on modeling these short channel devices. However, there is a lot of confusion too. Often it is not clear

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and which model  
parameter values  
are important and  
how to determine  
them. After  
working over 15  
years in the field of  
semiconductor  
device modeling, I  
have felt the need  
for a book which  
can fill the gap  
between the theory*

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*and the practice of  
MOS transistor  
modeling. This  
book is an attempt  
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made in silicon and  
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bipolar transistors,*



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MOS capacitors,  
and MOS field-  
effect transistors  
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concepts from  
quantum and  
statistical  
mechanics are  
used to describe  
electrons and holes  
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parameters are  
used to illustrate  
important*

*concepts. The book  
uses spice tools to  
analyze complex  
devices. Design  
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or modeling  
complicated  
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fluid dynamics as  
design tools. This  
book intends to  
provide the reader  
with an overview of  
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*this text is addressed to all users of electrical simulation. The approach to learning circuit simulation is to interpret simulation results in relation to electrical engineering fundamentals; the book asks the student to solve*

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examples by hand  
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results with SPICE.  
Addressed to both  
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chapters provide  
the relevant  
information on  
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*linear as well as  
nonlinear circuits.*

*Each of these  
chapters starts out  
with a linear  
example accessible  
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proceeds with  
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solution. The  
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*circuit operation but a complement.*

*The SPICE Book is different from*

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circuits it is not  
feasible to find the  
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but the approach  
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results. Readers*

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*gain a better  
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SPICE thanks to the  
importance placed  
on the relation  
between EE  
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interpretation. This  
book teaches the  
approach to  
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simulation rather  
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program. Examples  
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