

1. Record Nr.	UNINA9910830878003321
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Titolo	Charge-based MOS transistor modeling [[electronic resource] ] : the EKV model for low-power and RF IC design // Christian C. Enz, Eric A. Vittoz
Pubbl/distr/stampa	Chichester, England ; ; Hoboken, NJ, : John Wiley, c2006
ISBN	1-280-64993-3 9786610649938 0-470-85546-0 0-470-85545-2
Descrizione fisica	1 online resource (329 p.)
Altri autori (Persone)	VittozEric A. <1938->
Disciplina	621.3815284
Soggetti	Metal oxide semiconductors - Mathematical models Metal oxide semiconductor field-effect transistors - Mathematical models
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references (p. [291]-298) and index.
Nota di contenuto	Charge-based MOS Transistor Modeling; Contents; Foreword; Preface; List of Symbols; 1 Introduction; 1.1 The Importance of Device Modeling for IC Design; 1.2 A Short History of the EKV MOS Transistor Model; 1.3 The Book Structure; Part I The Basic Long-Channel Intrinsic Charge-Based Model; 2 Definitions; 2.1 The N-channel Transistor Structure; 2.2 Definition of Charges, Current, Potential, and Electric Fields; 2.3 Transistor Symbol and P-Channel Transistor; 3 The Basic Charge Model; 3.1 Poisson's Equation and Gradual Channel Approximation; 3.2 Surface Potential as a Function of Gate Voltage 3.3 Gate Capacitance3.4 Charge Sheet Approximation; 3.5 Density of Mobile Inverted Charge; 3.5.1 Mobile Charge as a Function of Gate Voltage and Surface Potential; 3.5.2 Mobile Charge as a Function of Channel Voltage and Surface Potential; 3.6 Charge-Potential Linearization; 3.6.1 Linearization of $Q_i$ (s); 3.6.2 Linearized Bulk Depletion Charge $Q_b$ ; 3.6.3 Strong Inversion Approximation; 3.6.4 Evaluation of the Slope Factor; 3.6.5 Compact Model Parameters; 4 Static Drain Current; 4.1 Drain Current Expression; 4.2 Forward and Reverse Current Components; 4.3 Modes of Operation

4.4 Model of Drain Current Based on Charge Linearization  
4.4.1 Expression Valid for All Levels of Inversion; 4.4.2 Compact Model Parameters; 4.4.3 Inversion Coefficient; 4.4.4 Approximation of the Drain Current in Strong Inversion; 4.4.5 Approximation of the Drain Current in Weak Inversion; 4.4.6 Alternative Continuous Models; 4.5 Fundamental Property: Validity and Application; 4.5.1 Generalization of Drain Current Expression; 4.5.2 Domain of Validity; 4.5.3 Causes of Degradation; 4.5.4 Concept of Pseudo-Resistor; 4.6 Channel Length Modulation; 4.6.1 Effective Channel Length  
4.6.2 Weak Inversion; 4.6.3 Strong Inversion; 4.6.4 Geometrical Effects;  
5 The Small-Signal Model; 5.1 The Static Small-Signal Model; 5.1.1 Transconductances; 5.1.2 Residual Output Conductance in Saturation; 5.1.3 Equivalent Circuit; 5.1.4 The Normalized Transconductance to Drain Current Ratio; 5.2 A General NQS Small-Signal Model; 5.3 The QS Dynamic Small-Signal Model; 5.3.1 Intrinsic Capacitances; 5.3.2 Transcapacitances; 5.3.3 Complete QS Circuit; 5.3.4 Domains of Validity of the Different Models; 6 The Noise Model; 6.1 Noise Calculation Methods; 6.1.1 General Expression  
6.1.2 Long-Channel Simplification; 6.2 Low-Frequency Channel Thermal Noise; 6.2.1 Drain Current Thermal Noise PSD; 6.2.2 Thermal Noise Excess Factor Definitions; 6.2.3 Circuit Examples; 6.3 Flicker Noise; 6.3.1 Carrier Number Fluctuations (Mc Wörther Model); 6.3.2 Mobility Fluctuations (Hooge Model); 6.3.3 Additional Contributions Due to the Source and Drain Access Resistances; 6.3.4 Total  $1/f$  Noise at the Drain; 6.3.5 Scaling Properties; 6.4 Appendices; Appendix: The Nyquist and Bode Theorems; Appendix: General Noise Expression; 7 Temperature Effects and Matching; 7.1 Introduction  
7.2 Temperature Effects

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## Sommario/riassunto

Modern, large-scale analog integrated circuits (ICs) are essentially composed of metal-oxide semiconductor (MOS) transistors and their interconnections. As technology scales down to deep sub-micron dimensions and supply voltage decreases to reduce power consumption, these complex analog circuits are even more dependent on the exact behavior of each transistor. High-performance analog circuit design requires a very detailed model of the transistor, describing accurately its static and dynamic behaviors, its noise and matching limitations and its temperature variations. The charge-based EKV (Enz

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