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11 - MOSFET (III) MOSFET Equivalent  
Circuit Models October 18, 2005  
Contents: 1. Low-frequency small-signal  
equivalent circuit model 2. High-  
frequency small-signal equivalent circuit  
model Reading assignment: Howe and

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Sodini, Ch. 4, §4.5-4.6

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Lecture 11 - MOSFET (III) MOSFET  
Equivalent Circuit Models March 15, 2001  
Contents: 1. Low-frequency small-

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signalequivalentcircuitmodel 2.High-freq  
uencysmall-signalequivalentcircuitmodel  
Reading assignment: HoweandSodini,Ch.  
4,§4.5-4.6

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6.012 - Microelectronic Devices and  
Circuits - Spring 2003 Lecture 11-1  
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Equivalent Circuit Models March 13,  
2003 Contents: 1. Low-frequency small-  
signal equivalent circuit model 2. High-  
frequency small-signal equivalent circuit  
model Reading assignment: Howe and  
Sodini, Ch. 4, §4.5-4.6

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Complete MOSFET small-signal  
equivalent circuit model for low  
frequency:  $G$   $S$   $D$   $B$   $+v_{gs}$   $g_m$   $v_{gs}$   $g_{mb}$   
 $b_s$   $r_o$   $+v_{bs}$   $i_d$  metal interconnect to bulk  
metal interconnect to gate  $n+$   
polysilicon gate  $p$ -type  $n+$  drain  $V_{DS}$   $V_{GS}$   $X$   $d$   $(y)$   $0$   $y$   $Q$   $N(y)$   $x$   $V_{BS}$   $+$   $-$   $+$   $-$   $+$   
 $-$   $n+$  source

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## **Lecture 10 - MIT - Massachusetts Institute of Technology**

MOSFET (III) MOSFET Equivalent Circuit  
Models Outline • Low-frequency small-  
signal equivalent circuit model • High-  
frequency small-signal equivalent circuit  
model Reading Assignment: Howe and  
Sodini; Chapter 4, Sections 4.5-4.6 6.012  
Spring 2009 Lecture 10 1

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## **6.012 Microelectronic Devices and Circuits, Lecture 10**

MOSFET Small-Signal Model A. Small  
Signal Modelling Concepts • Find an  
equivalent circuit which relates the  
incremental changes in  $i_D$ ,  $v_{GS}$ ,  $v_{DS}$ ,  
etc. • Since the changes are small, the  
small-signal equivalent circuit has linear

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elements only (e.g., capacitors,  
resistors, controlled sources)

## **I. MOSFET Circuit Models A. Large Signal Model - NMOS**

6.012 - Microelectronic Devices and  
Circuits Lecture 11 - MOSFETs II; Large  
Signal Models - Outline •

Announcements On Stellar - 2 write-ups

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on MOSFET models • The Gradual  
Channel Approximation (review and  
more) MOSFET model:  $I_D = K (v_{GS} - V_T)^2$   
with  $K \equiv (W/L)\mu_n C_{ox}$  e gradual channel  
approximation (Example: n-MOS) for  $(v_{GS} - V_T)/\alpha \leq 0 \dots$

## **MOSFETs II; Large Signal Models - MIT OpenCourseWare**

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MOSFET Equivalent Circuit Models: R12: Examples of MOSFET Equivalent Circuit Models including SPICE Model: Digital Circuits: L12: Logic Concepts Inverter Characteristics ... MIT OpenCourseWare is a free & open publication of material from thousands of MIT courses, covering the entire MIT curriculum.

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## **Calendar | Microelectronic Devices and Circuits ...**

Problems on long MOSFET : L29: C-V characteristics; small-signal equivalent circuit models : L30: Short-channel MOSFET: short-channel effects : L31: MOSFET short-channel effects (cont.)  
Homework 7 due. Homework 8 out. R9:  
Problems on short MOSFET : L32:

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MOSFET scaling: Project 4 out. Project 3  
due. L33: Evolution of MOSFET design :  
L34

## **Integrated Microelectronic Devices - MIT OpenCourseWare**

The complete FET Equivalent Circuit  
Model is shown in Fig. 11-5 (a). It is seen  
that tilt source terminal is common to



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both input and out, so this is a common-source equivalent circuit. Resistor  $R_{GS}$  between the gate and source terminals is the resistance of the reverse-biased gate-source junction, and  $C_{gs}$  is the junction capacitance.

### **FET Equivalent Circuit Model | Equivalent Circuit Parameters**

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6.012 Spring 2007 Lecture 18 12 2.

Large-signal equivalent circuit model  
Equivalent-circuit model representation  
(non-linear hybrid- $\pi$ model) [particular  
rendition of Ebers-Moll model in text]:  
System of equations that describes BJT  
operation:

## **The Bipolar Junction Transistor (II) -**

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Small-Signal Analysis - ac Equivalent  
Circuit • ac equivalent circuit is  
constructed by assuming that all  
capacitances have zero impedance at  
signal frequency and dc voltage sources  
are ac ground. Lecture13-Small Signal  
Model-MOSFET 6 Common-Source  
Amplifiers Small-Signal Equivalent

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Circuit • Input voltage is applied to the gate terminal

## **EE105 - Fall 2014 Microelectronic Devices and Circuits**

6.012 Electronic Devices and Circuits

-Fall 2000 Lecture 25 5 Synthesizing

Voltage Sources (contd.)  $v_{OUT}$  is a

function of  $I_{REF}$  and  $W/L$  of MOSFET: •

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$I_{REF} \uparrow \Rightarrow v_{OUT} \uparrow$  •  $W/L \uparrow \Rightarrow v_{OUT} \downarrow$

Small Signal Equivalent Circuit Model:  $m_o m_{out} g_r g R_1 || 1 = \approx R_{out}$  is small  
(good!)

## Lecture 25 - MIT

This free circuits course taught by edX CEO and MIT Professor Anant Agarwal and colleagues is for you. This is the first

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of three online Circuits & Electronics courses offered by Professor Anant Agarwal and colleagues at MIT, and is taken by all MIT Electrical Engineering and Computer Science (EECS) majors.

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4-1 Subcircuit model of MVS-G-RF model

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showing implicit-gate access regions and Schottky-gate diodes along with the intrinsic transistor. . 42 4-2 Band pro le of Intrinsic transistor in saturation under drain bias. . . 43

## **A Compact Transport and Charge Model for GaN ... - mit.edu**

Putting the mathematical model into a

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small signal equivalent circuit Compare this to the BJT small signal equivalent circuit. Georgia Tech ECE 3040 - Dr. Alan Doolittle ... SPICE MOSFET Model SPICE models the drain current ( $I_{DS}$ ) of an n-channel MOSFET using the

**MOSFET Small Signal Model and Analysis •Just as we did ...**



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MOSFET EQUIVALENT CIRCUITS Lesson  
#4 Section 5.4-6. BME 373 Electronics II  
- J.Schesser 21 Small-Signal Equivalent  
Circuits • As done for BJTs, we will  
investigate an equivalent circuit when  
the signal variations are small compared  
to the bias points • Some nomenclature:

## **MOSFET EQUIVALENT CIRCUITS**

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Lecture 18: Other Regimes of Operation of BJT; Equivalent Circuit Models  
Lecture 19: Single-Stage Amplifiers; Common-Source Amplifier Stage  
Lecture 20: Other MOSFET Amplifier Stages  
Lecture 21: Multistage Amplifiers  
Lecture 22: Current Sources and Sinks

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## **Engineering and Computer ...**

Also as the morphing of the hybrid- $\pi$  equivalent-circuit model to the T equivalent-circuit model is undertaken by connecting a resistor between D and S, an  $r_o$  can be thus connected to account for the Early effect or the channel-modulation effect as shown in Figure 8(a). Figure 8(b) is an alternative way of

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representing the T equivalent-circuit ...

## **ECE 255, MOSFET Small Signal Analysis**

equivalent circuit model, as usual Buck  
Converter Example • Ideal MOSFET, p-n  
diode with reverse recovery • Neglect  
semiconductor device capacitances,  
MOSFET switching times, etc. • Neglect

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conduction losses • Neglect ripple in  
inductor current and capacitor voltage

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d41d8cd98f00b204e9800998ecf8427e.

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