模拟电子学 基础实验

晶体管放大器的仿真 实验步骤

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1、 启动OrCAD/Capture

・选择"开始"→"程序"→"OrCAD
9.2"→"Capture", 以进入
Capture 的工作环境

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2、创建新项目

•执行File/New/Project命令

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- 在Name框中键入欲
 建立项目的名称
 (如: Amplifier)
- 在Location框中键入
 该项目的保存路径
 (如: E:\0221033)
- 在Create a New
 Project Using复选框
 中选择Analog or
 Mixed-Signal Circuit





- 出现"Create Pspice Project"对话窗口
- 在Create base upon an existing project复选框中选择simple.opj
- 单击"OK"

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	3、电路原理图编辑	
•	在项目管理器中, 依次双击"Design	1
	Resources", "Amplifier.dsn",	
	"Schematic1", "Page1"	

• 自动进入原理图编辑器界面

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放置晶体管符号

- 执行Place/Part命令
- 在 "Libraries"列表框 中选择"BIPOLAR"
- 在 "Part"列表框中选 择" Q2N2222"
- 单击"OK"
- 将晶体管移至合适 位置,按鼠标左键



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放置电阻符号

- 执行Place/Part命令
- 在 "Libraries"列表框中 选择"ANALOG"
- 在 "Part"列表框中选择 "R"
- 单击"OK"
- 将电阻R移至合适位 置,按鼠标左键
- 按ESC键以结束绘制 元素系统。 宏语和文字系统



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放置电容符号

- 执行Place/Part命令
- 在 "Libraries"列表框中 选择"ANALOG"
- 在 "Part"列表框中选择 "C"
- 单击"OK"
- 将电容C移至合适位 置,按鼠标左键
- 按ESC键以结束绘制 元器像状态 ^{专业电子} ^{坛业}"www.cepark.com</sub>



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放置直流电源符号

- 执行Place/Part命令
- 在 "Libraries"列表框 中选择"SOURCE"
- 在 "Part"列表框中选 择" VDC"
- 单击"OK"
- 将直流源VDC移至合 适位置,按鼠标左键





放置激励电源符号

- 执行Place/Part命令
- 在 "Libraries"列表框中 选择"SOURCE"
- 在 "Part"列表框中选择 "VSIN"
- 单击"OK"
- 将激励源VSIN移至合 适位置,按鼠标左键
- 按ESC键以结束绘制
 元器機械态
 ^{专业电子} 坛:http://bbs.c





放置地符号

- 执行Place/Ground命令
- 在 "Libraries"列表框中 选择"SOURCE"
- 在 "Symbol"列表框中 选择" 0"
- 单击"OK"
- 将地符号0移至合适位
 置,按鼠标左键
- 按ESC键以结束绘制元 器件表态^园 ^{专业电子} ^{法:<u>http://bbs</u></sub>}





元器件间的电连接

- 执行Place/Wire命令
- 将光标移至互连线的起始位置处,点
 击鼠标左键
- •移动鼠标,互连线出现
- 在互连线终点,单击鼠标左键
- •继续移动鼠标,以绘制下一段互连线
- 单击鼠标右键,选择End Wire子命令,

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将R1修改为Rb

将鼠标对准R1,双击鼠标左键,出
 现"Display Properties"窗口

•在"Value"栏填入"Rb"

• 単击"OK"

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将R1值由1k修改为560k

将鼠标对准R1值1k,双击鼠标左
 键,出现"Display Properties"窗口

• 在"Value"栏填入"560k"





修改其余元件属性参数

•将R2修改为Rc

地:www.cepark.com

- •将R3修改为RL, 100k
- •将C1、C2值修改为10u
- •将V1修改为Vcc, 6V
- •将V2修改为Vi, VOFF=0,

VAMP=20m, FREQ=1k

坛:http://bbs.cepark.com/



电路原理图保存

•执行File/Save命令

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•执行PSpice/Create Netlist命令

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2、仿真参数类型设置

• 执行PSpice/Edit Simulation Profile命令

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- 在Maximum step栏,填 写0.01ms
- 点击"确定"

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3、放置仪器探头

- 执行PSpice/Markers/Voltage Level命令
- •将电压探头拖至输入端Vi、输出端RL处
- 按ESC键,以结束仪器探头放置

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4、运行仿真分析程序

- •执行PSpice/Run命令
- •屏幕上出现PSpice仿真分析窗口

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5、波形测量

•执行Trace/Cursor/Display命令

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- 点击分析窗口左下角"V(C2:2)",选择 输出端C2与RL连接处的输出电压波形
 执行Trace/Cursor/Peak命令,测量标尺
 - 定位于输出波形顶峰

👯 S	CHEMA	ATIC1-Bias	s - PSpice	A/D =	[Amplifier-sch	ematic1-bias	: (active	01								
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•执行Plot/Label/Mark命令,显示输出







•执行Trace/Cursor/Trough命令,测量标 尺定位于输出波形谷底



执行Plot/Label/Mark命令,显示输出 波形谷底标尺坐标

👹 SCHEMATIC1-Bias - PSpice A/D - [Amp]	lifier-schematic1-bias (active)]	
😸 File Edit View Simulation Trace	Plot Tools Mindow Help	
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		Ellipse
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输出峰峰值以及系统增益

- 将顶峰处电压数值与谷底处电压数 值相减,得到输出波形峰峰值
 Vopp=0.813576-(-1.6407)=2.4543V
- 输出波形峰峰值Vopp与输入波形峰 峰值Vipp相除,得到系统放大增益 Av=Vopp/Vipp=2.4543V/40mV=61

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(三)电路的仿真(交流分析) 1、更换激励信号源 • 删除电压仪探头、信号源VSIN • 执行Place/Part命令,放置信号源VAC

🚰 Orcad Capture - [/	- (SCHEMATIC1 : PAGE1)]		
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•将V1修改为Vi、20mVac、0Vdc



2、建立电路网表

•执行PSpice/Create Netlist命令

🚰 Orcad Capture - [/ - (SCHEMATIC1 -	: PAGE1)]	
🛐 File Edit View Place Macro 🗌	P <u>S</u> pice <u>A</u> ccessories <u>O</u> ptions <u>W</u> indow	Help
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3、仿真参数类型设置

• 执行PSpice/Edit Simulation Profile命令

🌃 Orcad Capture - [/ - (SCHEMATIC1	: PAGE1)]	
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8		

- Analysis Type栏选择 AC Sweep/Noise
- AC Sweep Type栏选择 Logarithmic及Decade
- Start 栏填写0.1Hz

• 点击"确定"按钮

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- End栏填写100MegHz
- Points/Decade填写100

	Simulation Settings - Bias			×
o al la	Options General Analysis	Data Collection Include Files	Probe Window Libraries Stimul	us
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专业电子技术证		Output File Options Include detailed bi nonlinear controlle	as point information for ed sources and	r
坛: <u>http://bbs.cepark.</u>		确定 取消	应用 (4) 【 希	5助

4、运行仿真分析程序

- •执行PSpice/Run命令
- •屏幕上出现PSpice仿真分析窗口

👫 Orcad Capture - [/ - (SCHEMATIC)	: PAGE1)]							
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🧱 SCHEMATIC1-Bias - PSpice A/D - [Amplifier-schematic1-bias (active)]	_ 8 ×
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100mHz 1.0Hz 10Hz 100Hz 1.0KHz 100KHz 1.0MHz 10MHz 10MHz Frequency	100MHz
Amplifie	
X Bias point calculated AC (and Noise) Analysis AC Analysis finished Simulation complete Image: Analysis (Watch Devices / De	•
For Help, press F1 Freq = 100.0E+06 100% 100%	En 21:19

系统增益频率特性分析 5

• 执行Trace/Add Trace命令

🞇 SCHEMATIC1-Bias - PSpice A/D - [Amplifier-schematic1-bias (active)]	
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J. Fourier	
<u>r</u> erformance Analysis	
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在Add Traces对话窗口

- Trace Expression栏填写
 V[Q1:c]/V[Vi:+],输出幅度与输入幅度
 之比即为增益Av随信号频率变化的关系
- 单击"OK"按钮



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标尺工具

•执行Trace/Cursor/Display命令

🗱 SCHEMATIC1-Bias - PSpice A/D	- [Amplifier-schematic1-bias (active)]				
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0 100mHz 1 □ V(Q1:c)/ V(I.OHZ 10HZ 100HZ (Vi:+)	1.0KHz 10H	KHZ 100KHZ	1.0MHz 10MHz	1



标尺对准Av曲线中频点

• 执行Trace/Cursor/Peak命令

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在中频点处标记位置坐标

• 执行Plot/Label/Mark命令

SCHEMATIC1-Bias - PSpice A/D -	[Amplifier=schematic1=bias (activ	ve)]				
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40			Circle Ellipse Mark			
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				P A A d	robe Cursor 1 = 3.9811K, 2 = 100.000m, if= 3.9810K,	57.151 1.0790 56.072
0 100mHz 1.0 □ V(Q1:c)/ V(Vi	Hz 10Hz :+)	100Hz 1.	0KHz 10KHz	100KHz	1.0MHz	10MHz





标记低半功率点处坐标

• 执行Plot/Label/Mark命令

le <u>E</u> dit <u>V</u> iew <u>S</u> imu	lation <u>T</u> race <u>P</u>	lot T <u>o</u> ols <u>W</u> indow <u>H</u> elp	· 📲					
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标记高半功率点处坐标

• 执行Plot/Label/Mark命令

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0 100mHz 1.0Hz i⊡!V(Q1:c)/V(Vi:+)		.0KHz 10KHz 100KHz	1.0MHz 10MHz 100MHz



• 执行Simulation/Edit Profile命令


•将Start栏由0.1Hz改为1Hz

•单击"确定"按钮

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<u>O</u> ptions	🖸 L <u>og</u> arithmi	<u>E</u> nd	100MegHz
General Settings	Decade 💌	Points/ <u>D</u> ecade	100
☐Parametric Sweep	Noise Analysis		
□Temperature (Sweep) □Save Bias Point	Ensbled Outpu	t	
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	└── └──Output File Options──		
	☐ Include detailed	bias point infor	mation for
		on)	

运行仿真程序

•执行Simulation/Run命令



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• 执行Trace/Add Trace命令

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AC Analysis finished Simulation complete		= 11						
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Add trace[s] to the selected plo	t	[11]	, ·, /			Freq = 100.0E+06	100%	
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在Add Traces对话窗口

- Trace Expression栏填写V[Vi:+]/I[Vi], 激励源输出电压与电流之比即为放大 器系统输入阻抗Ri
- 单击"OK"按钮



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标尺工具

• 执行Trace/Cursor/Dislay命令

🧱 SCHEMATIC1-Bias - PSpice A/D	- [Amplifier-schematic1-bias (ac	tive)]					_82
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	测量低半功率点f _L 处Ri
•	向右拖动十字标尺,对准低半功率点f _L
	处(约5.3280Hz)



标记低半功率点处坐标

• 执行Plot/Label/Mark命令

EMATIC1-Bias - PSpice A/D - [Amp	lifier-schematic1-bias (active)	1					
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8					A1 = 5.3280, A2 = 1.0000, dif= 4.3280,	4.2228K 16.193K -11.970K	
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	测量中频	点f _o 处Ri
•	向右拖动十字标尺,	对准测量中频点fo
	处(约3.9954kHz)	



标记中频点处坐标

• 执行Plot/Label/Mark命令

🚆 SCHEMATIC1-Bias - PSpice A/D - [Ampl	ifier-schematic1-bias (active)]					_ 8 ×
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1 вк			Lilipse Mark				
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6)- 1 -	0Hz 10Hz ⊡U(Vi:+)/ I(Vi)	100Hz	1.0KHz	10KHz	100KHz 1.	9MHz 1 0MH:	z 100MHz

标记高半功率点处坐标

• 执行Plot/Label/Mark命令

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5K (5.3280,4	.2228K)	(3 9954K, 2 9836	зк.)	Probe Eurson A1 = 25.029M, A2 = 1.0000, dif= 25.029M,	30.745 16.193K -16.162K
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(四)数据记录与处理

- •制定数据记录表格
- •记录与处理放大器瞬态分析数据
- •记录与处理放大器交流分析数据



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