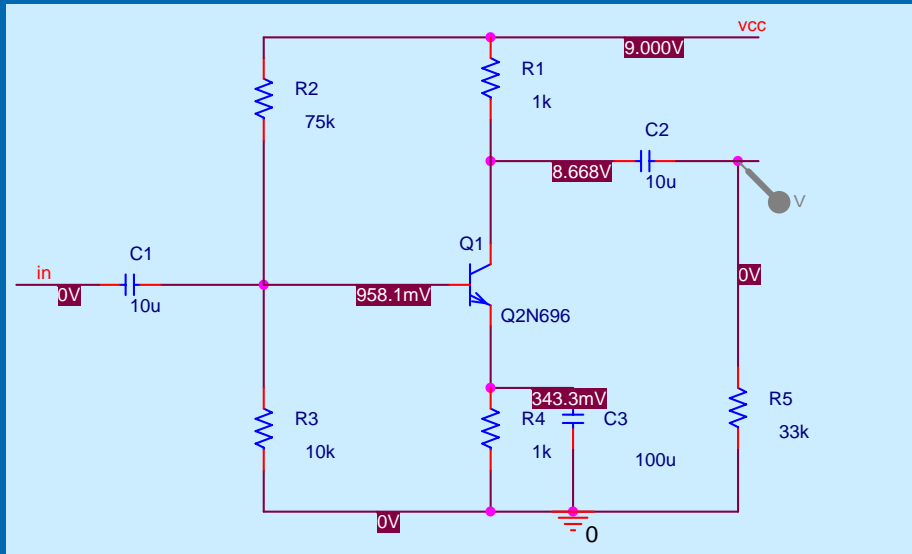


基于OrCAD的
电子线路计算机辅助设计

第3讲仿真分析

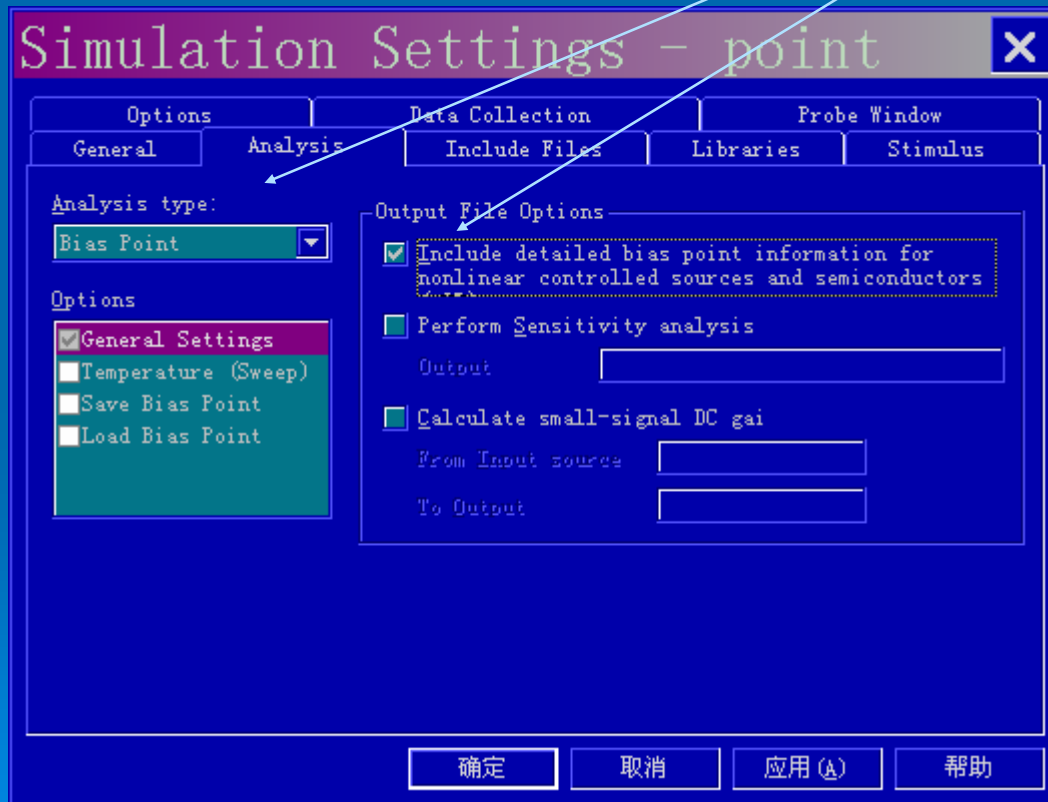
一.直流工作点分析



- 电容开路、电感短路、激励源取直流电平值
- 结果包含直流工作点、小信号线性化参数值。
- 结果保存在输出文件中。

进入直流工作点分析

- 选项
- 运行Pspice即可。
- 结果在输出文件。



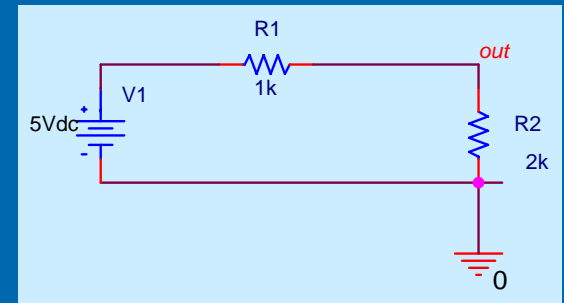
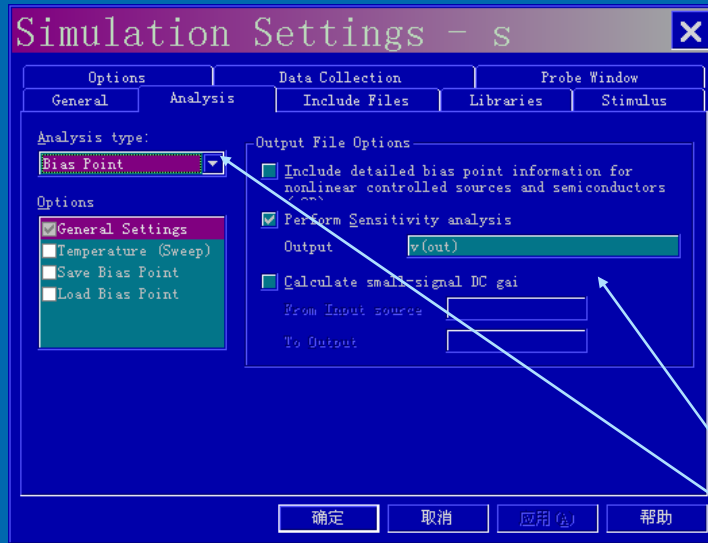
直流灵敏度分析

- 绝对灵敏度：电路的特性参数对元件值绝对变化的灵敏度
T:特性参数, X:元件值, S:灵敏度。 $S(T, S) = \partial T / \partial X$
- 相对灵敏度：特性参数对元件值相对变化的灵敏度 $S_n = X \cdot (T, X) / 100$
- 参数设置：在灵敏度分析栏设置节点特性参数值
- 结果保存在输出文件

DC SENSITIVITIES OF OUTPUT V(OUT)

ELEMENT NAME	ELEMENT VALUE	ELEMENT SENSITIVITY (VOLTS/UNIT)	NORMALIZED SENSITIVITY (VOLTS/PERCENT)
R_R1	3.000E+00	-6.250E-02	-1.875E-03
R_R2	1.000E+00	1.875E-01	1.875E-03
V_V1	1.000E+00	2.500E-01	2.500E-03

直流灵敏度分析的设置



DC SENSITIVITIES OF OUTPUT V(OUT)

ELEMENT NAME	ELEMENT VALUE	ELEMENT SENSITIVITY (VOLTS/UNIT)	NORMALIZED SENSITIVITY (VOLTS/PERCENT)
R_R1	1.000E+03	-1.111E-03	-1.111E-02
R_R2	2.000E+03	5.556E-04	1.111E-02
V_V1	5.000E+00	6.667E-01	3.333E-02

设置

分析输出电压V(out)对电阻及电压源的灵敏度。

结果在输出文件

三. 直流传输特性

- 计算工作点
- 在工作点处对电路的元件做线性化处理。
- 计算线性化电路的小信号增益、输入输出电阻，结果保存在输出文件。
- 参数设置：设置输入信号源及输出电压。

**** SMALL-SIGNAL CHARACTERISTICS

V(OUT)/V_V2 = 0.000E+00

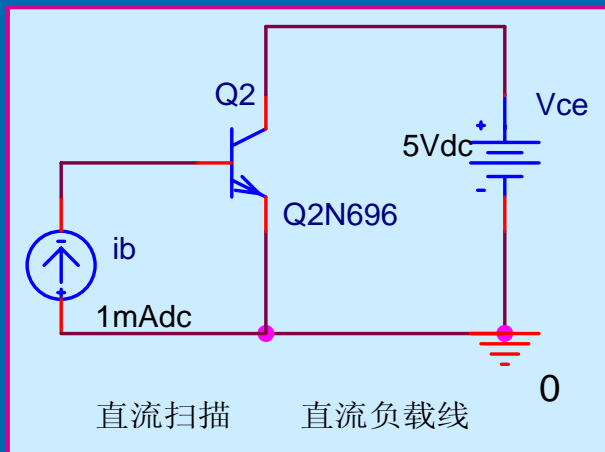
INPUT RESISTANCE AT V_V2 = 1.000E+20

OUTPUT RESISTANCE AT V(OUT) = 3.300E+04

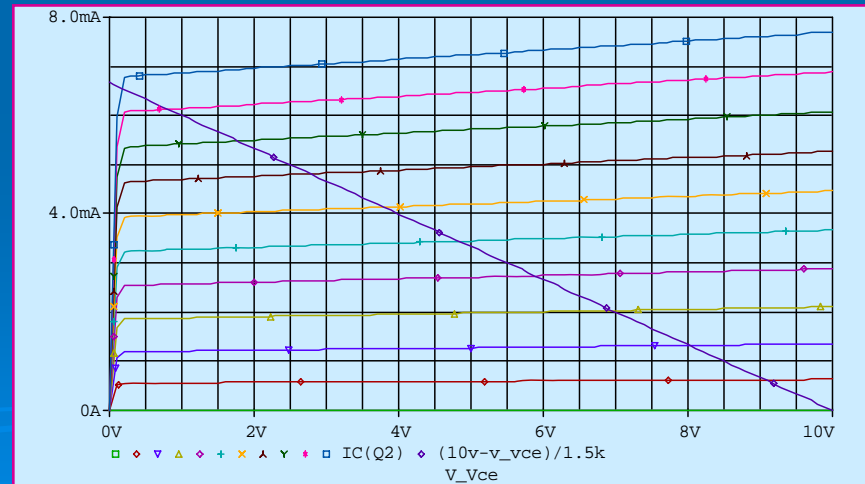
四. 直流特性扫描(DC分析)

- 以电路参数（电压、电流、全局变量、模型参数、温度）为自变量，计算自变量在一定范围内变化，电路直流偏置的特性。
- 增设电路参数为参变量，计算自变量和参变量都在一定范围内变化，电路的直流偏置特性。
- 分析时，电容开路、电感短路、各信号源取直流平均值。逻辑单元延时取0，逻辑激励源取0时刻值。

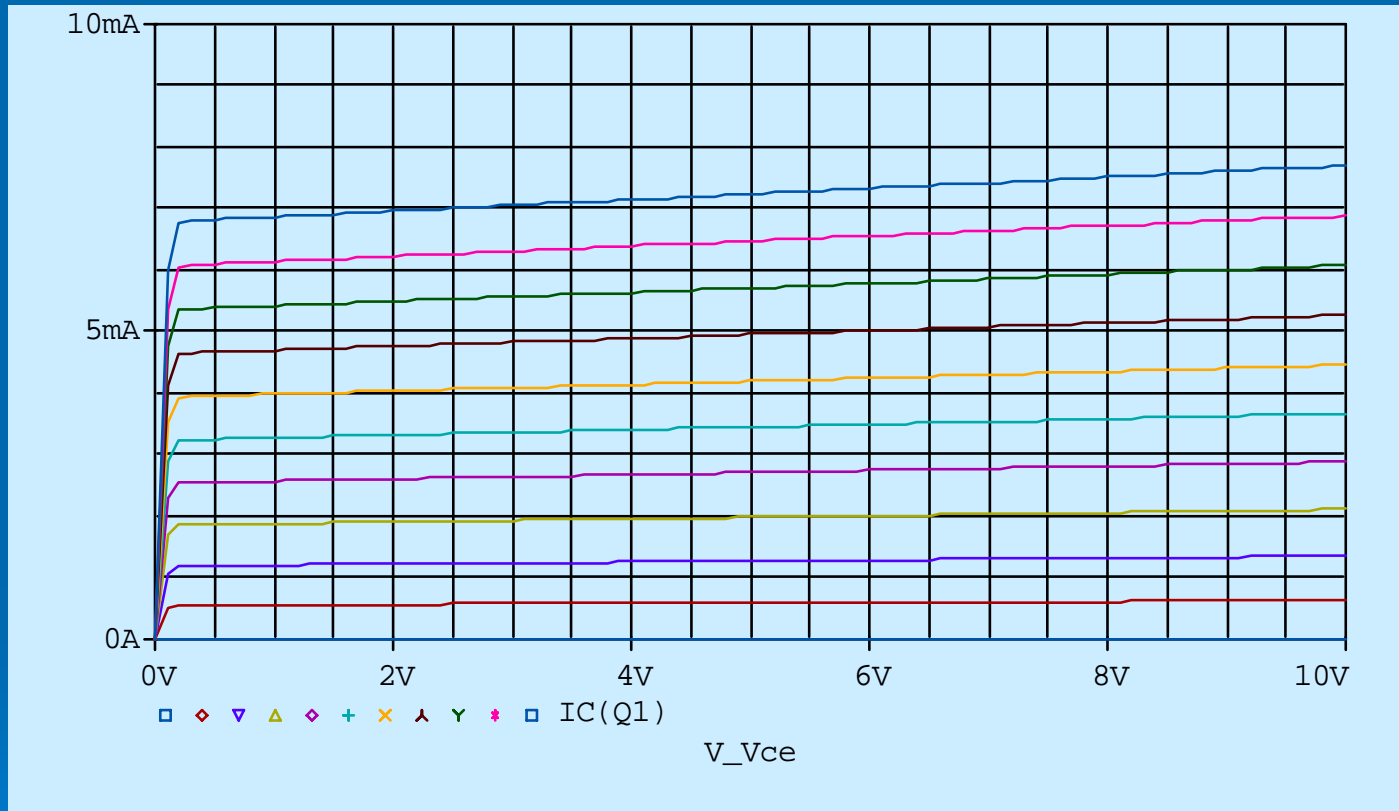
晶体管的输出特性曲线



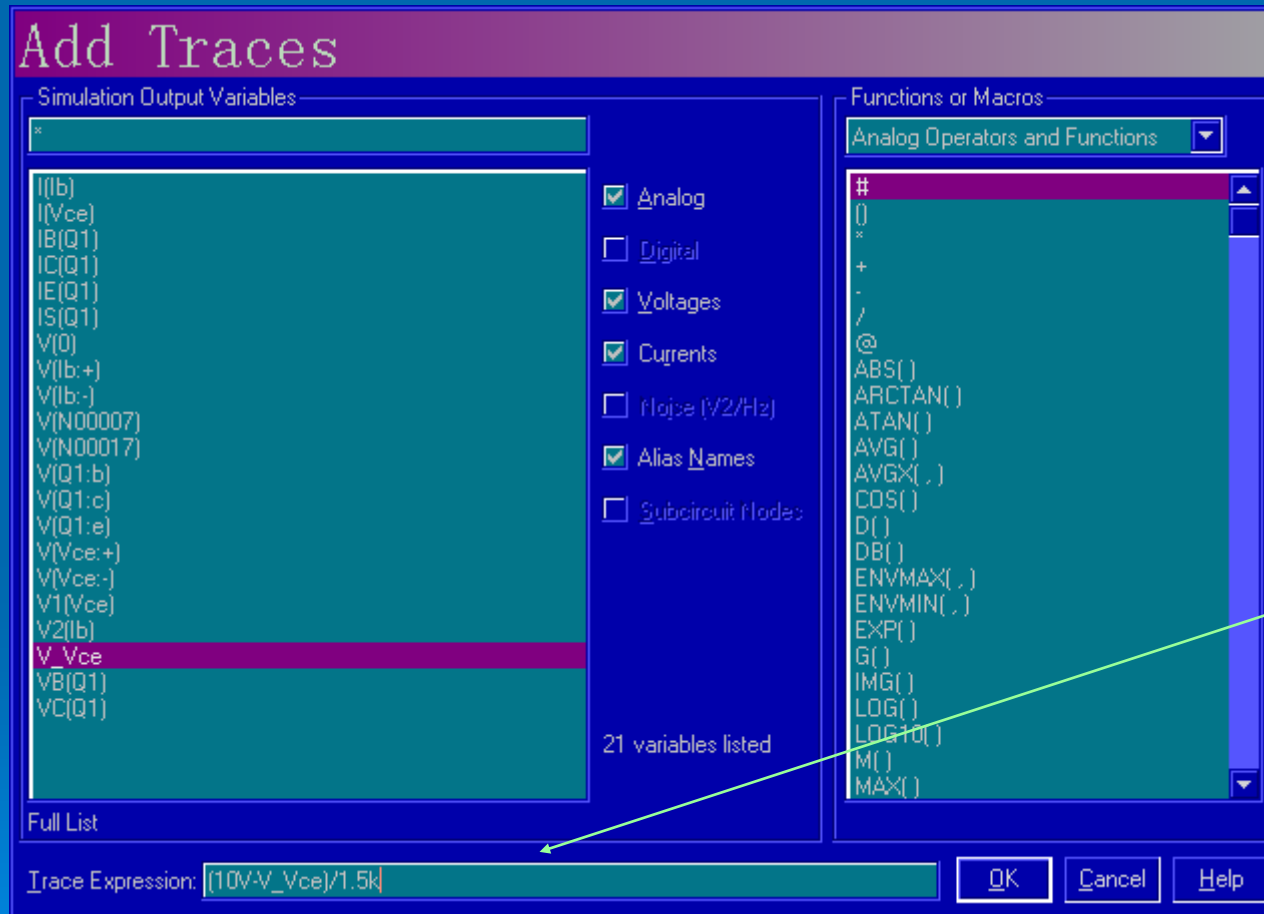
- 自变量: $v_{ce}, 0 \sim 10\text{V}, 0.1\text{V}$ 。
- 参变量: $I_b, 0 \sim 200\mu\text{A}, 20\mu\text{A}$ 。
- 负载: 1.5k



输出特性曲线

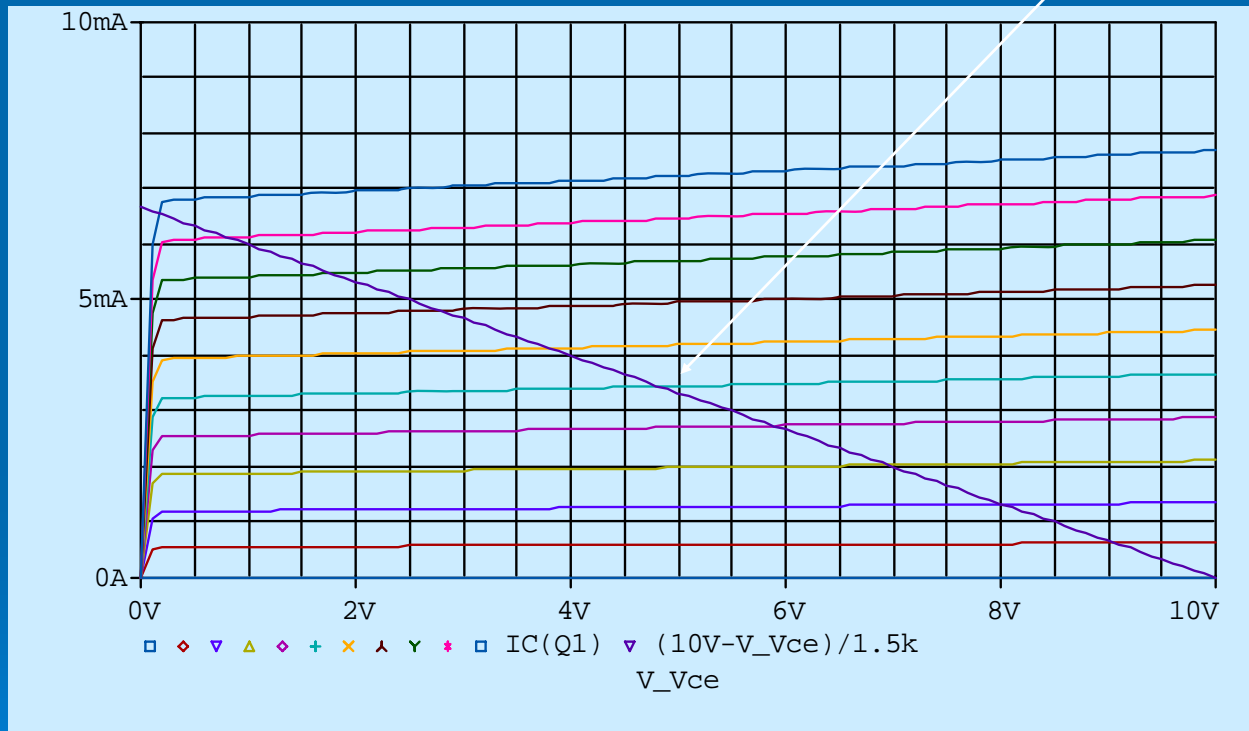


加入负载线

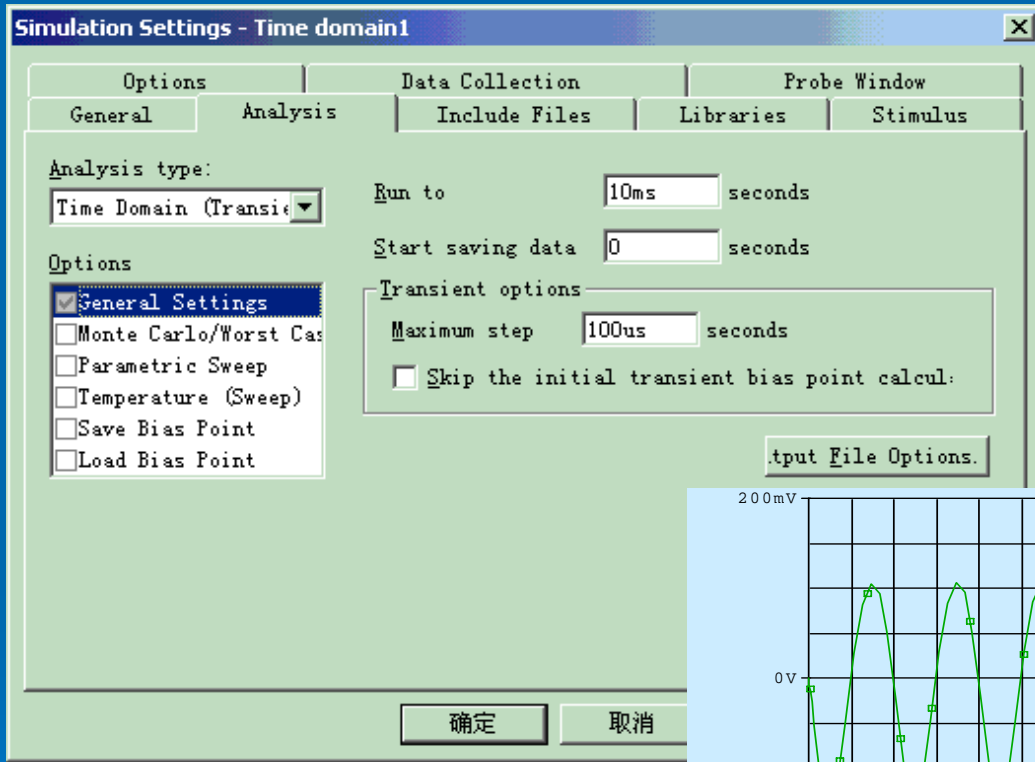


计算负载线
表达式。

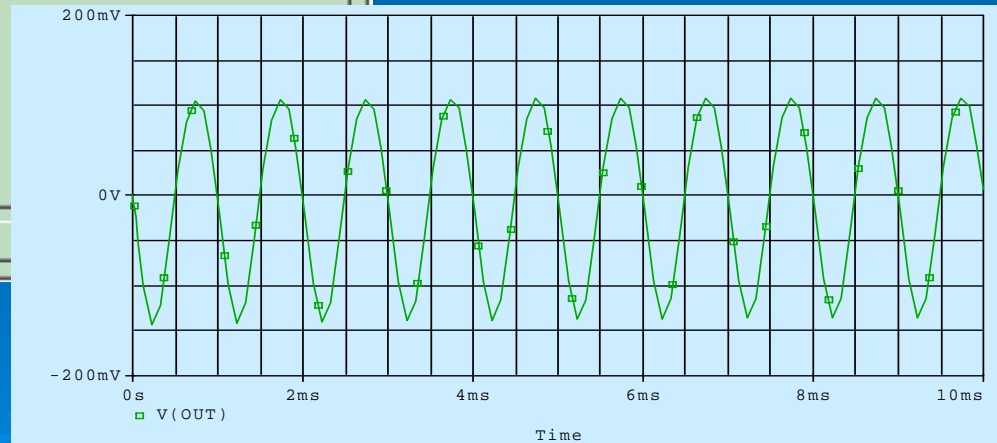
负载线



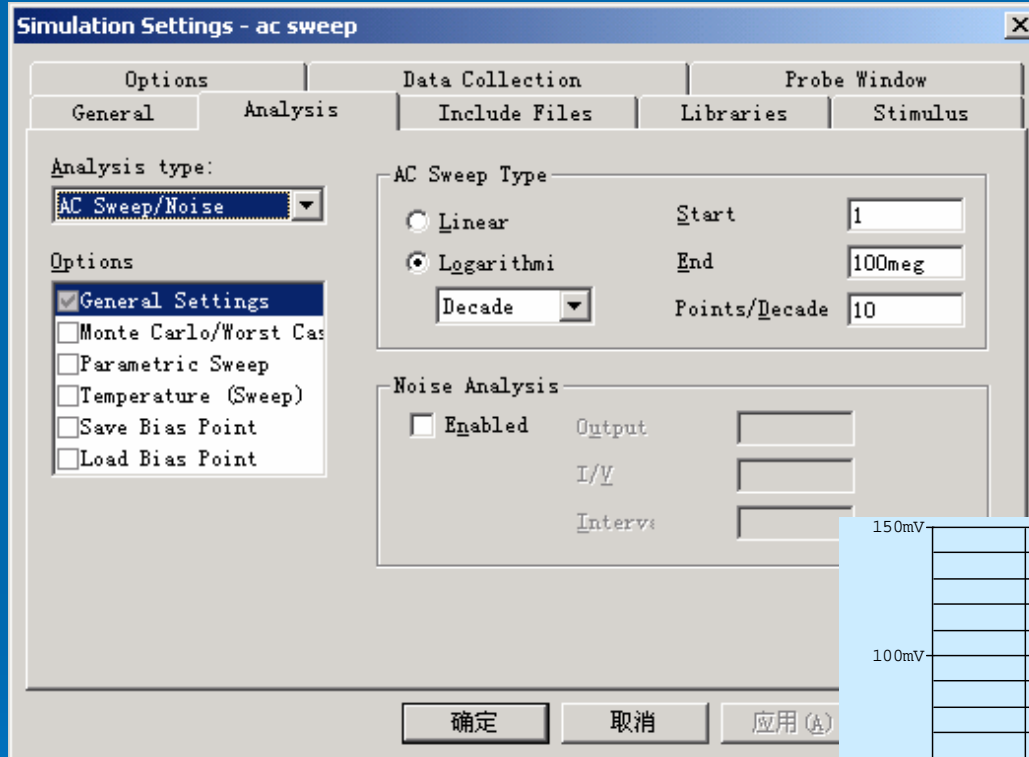
时域分析



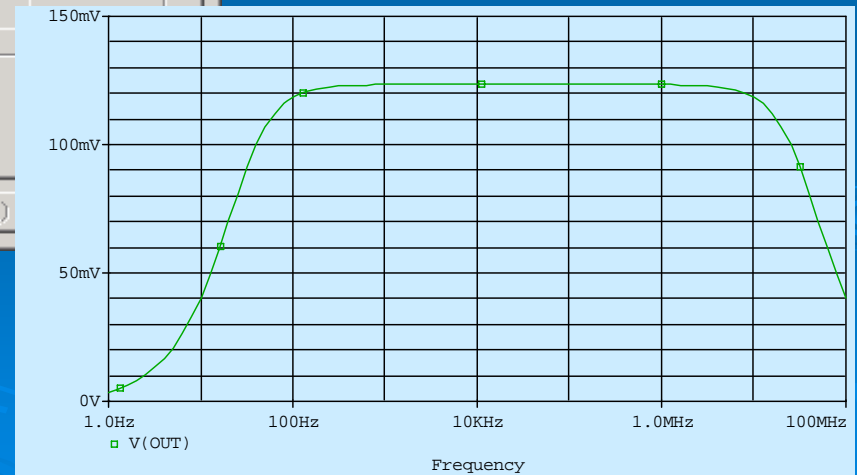
➤ 时域分析后可进行FFT变换



频域分析



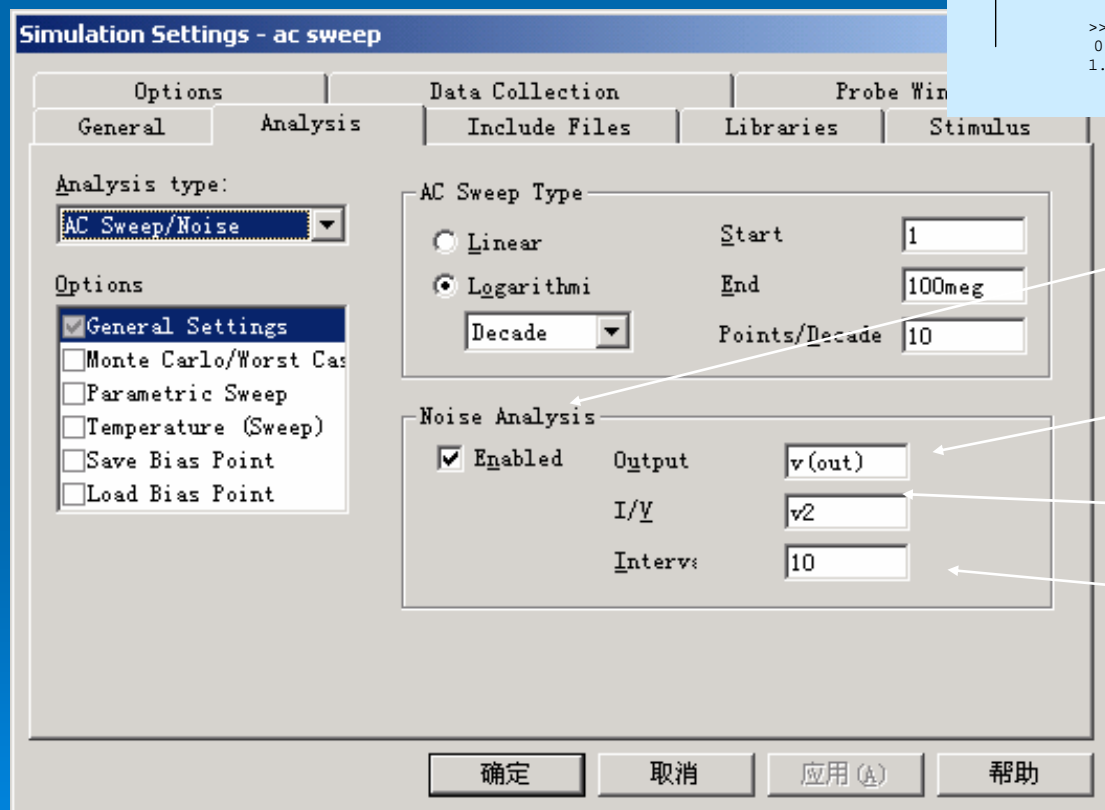
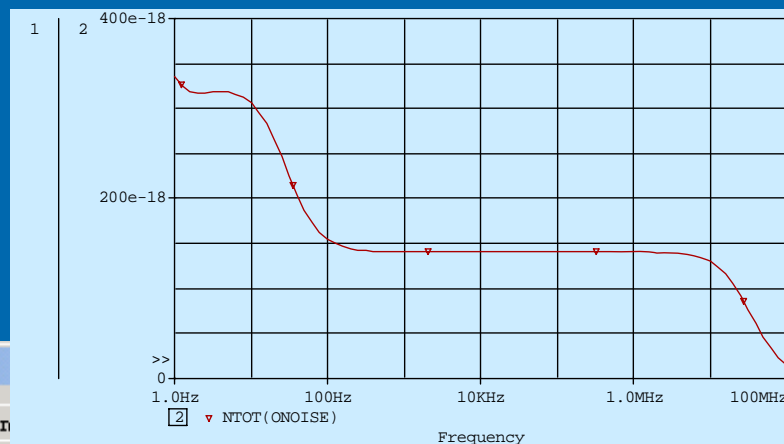
- 每数量级 (Octave)
- 每十倍频 (Decade)



噪声分析原理

- 在电路中选定一个节点，计算电路各器件噪声在该点的均方根值并将期叠加。
- 确定电路中一个独立源，计算该点到输出噪声节点处的增益。
- 用增益除输出噪声，结果为该独立源处的噪声源值。

噪声分析的参数设置



• 设置

- 输出噪声电压节点名
- 独立源名
- 输出信息间隔点数
- 结果为均方根值

输出文件中1kHz处的噪声数据

FREQUENCY = 1.000E+03 HZ

**** TRANSISTOR SQUARED NOISE VOLTAGES (SQ V/HZ)

Q_Q1

RB 7.733E-18

RC 7.315E-26

RE 0.000E+00

IBSN 7.171E-20

IC 2.839E-17

IBFN 0.000E+00

TOTAL 3.620E-17

**** RESISTOR SQUARED NOISE VOLTAGES (SQ V/HZ)

R_R1 R_R2 R_R3 R_R4 R_R5

TOTAL 4.126E-18 1.960E-21 1.959E-21 1.959E-20 4.127E-18

**** TOTAL OUTPUT NOISE VOLTAGE = 4.448E-17 SQ V/HZ

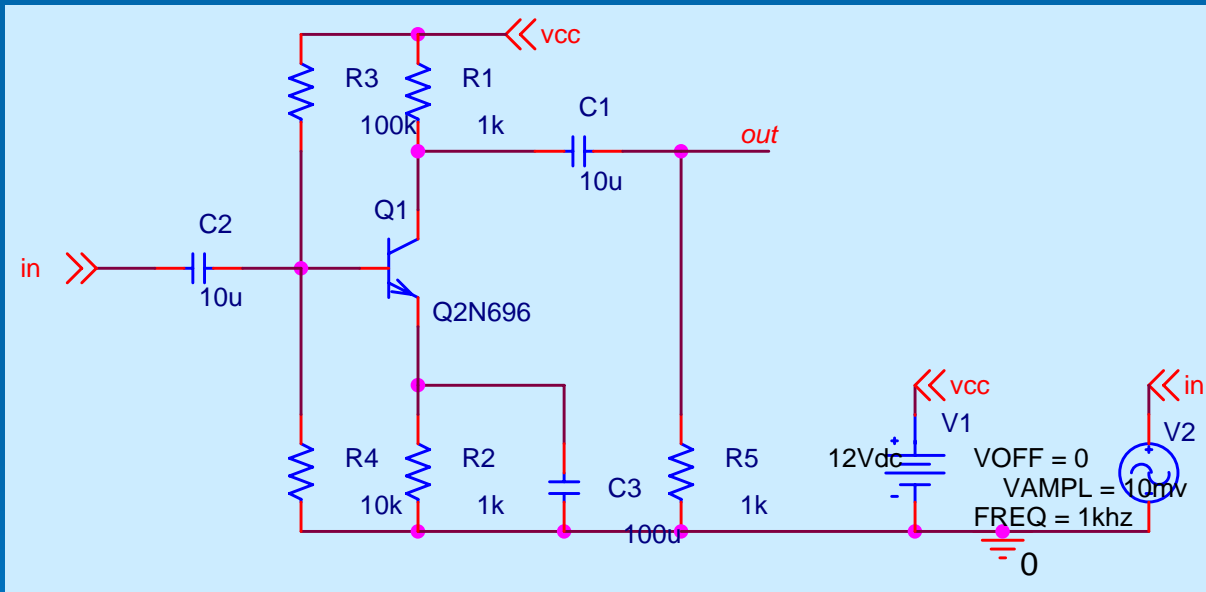
= 6.669E-09 V/RT HZ

TRANSFER FUNCTION VALUE:

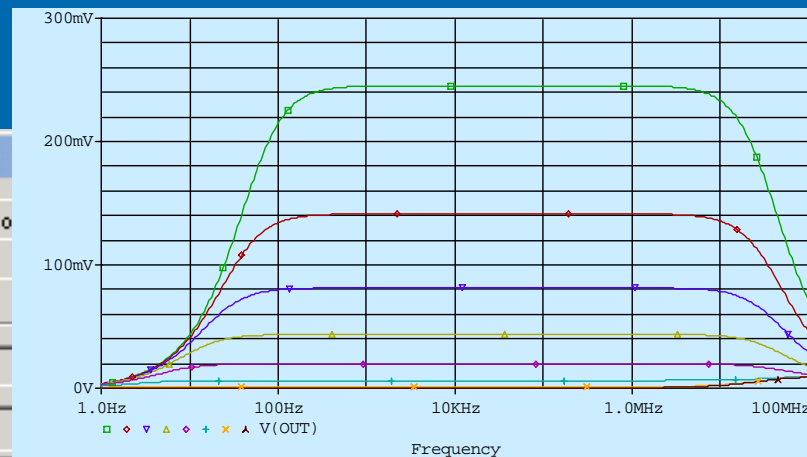
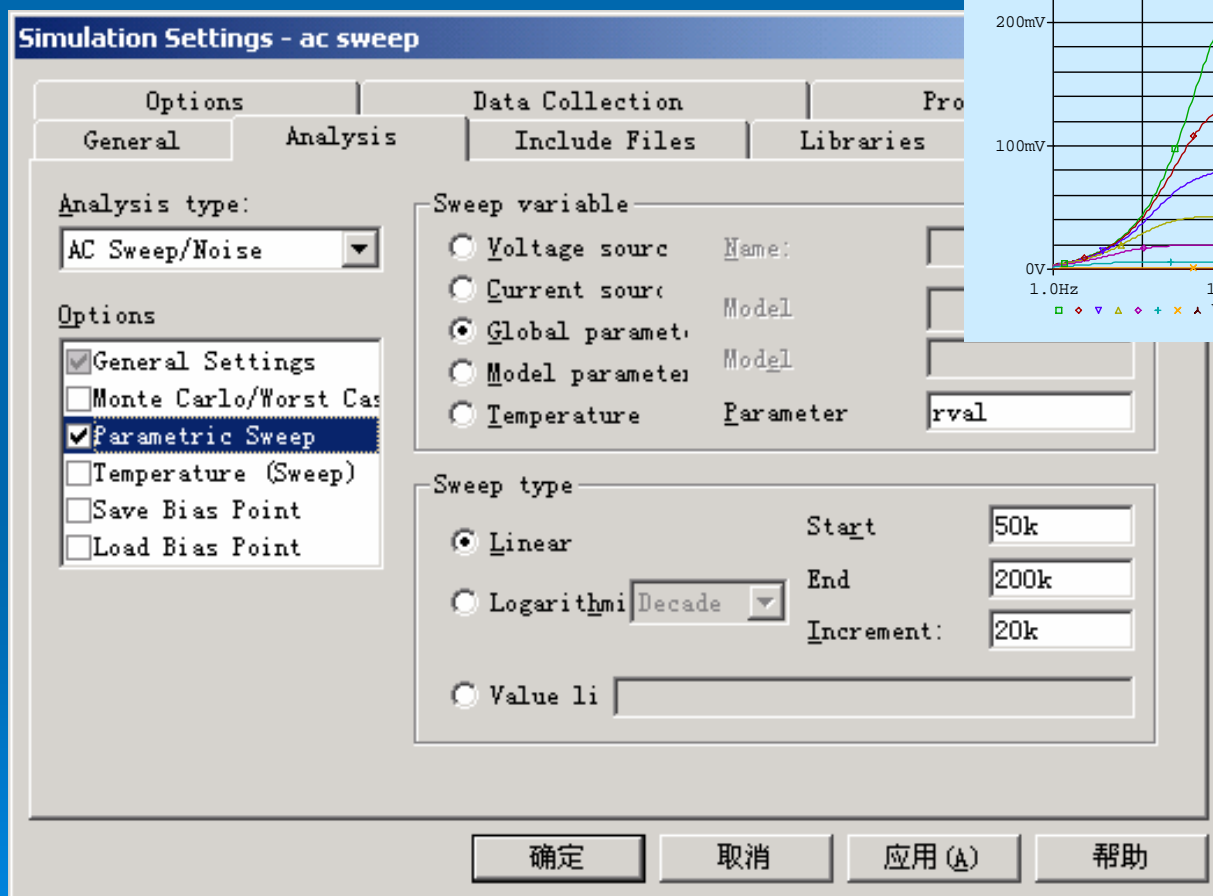
V(OUT)/V_V2 = 6.830E+00

EQUIVALENT INPUT NOISE AT V_V2 = 9.764E-10 V/RT HZ

示例电路



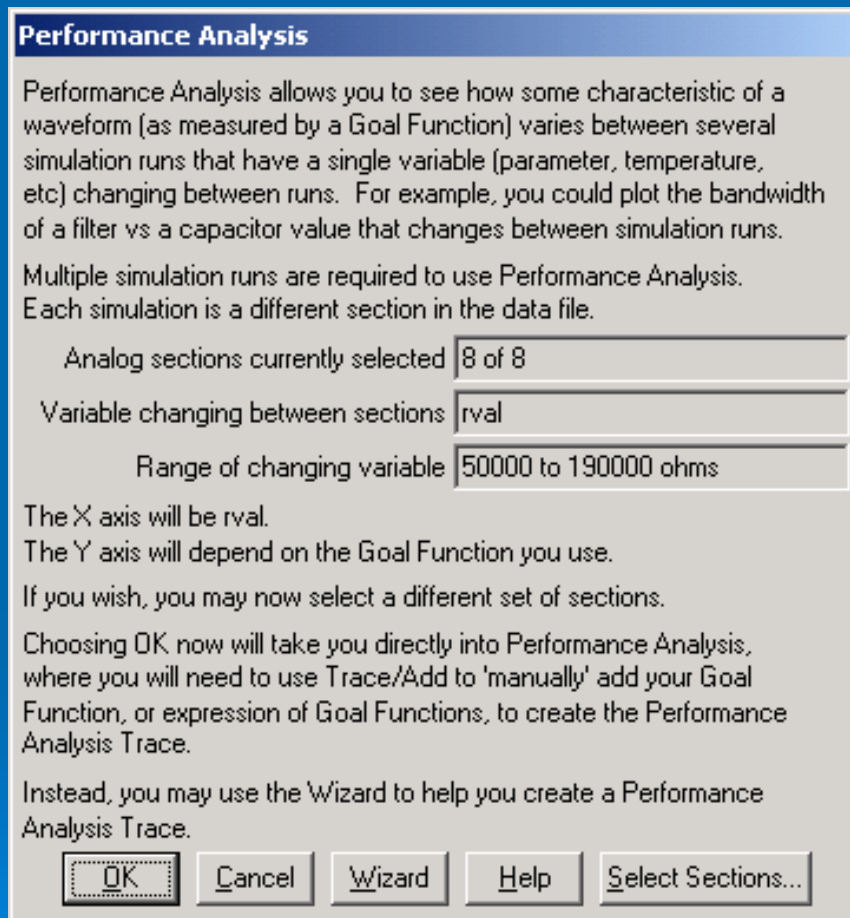
参数扫描



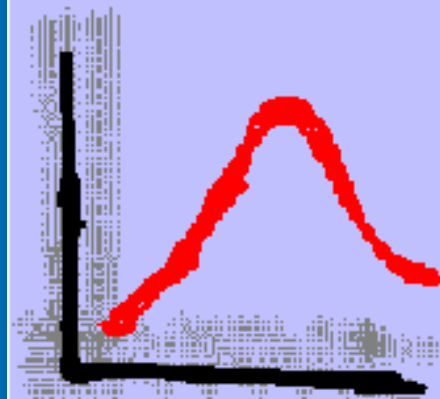
- 线性
- 对数
- 列表

性能分析

- 已在扫描时选中的当前要显示的数据批次。
- 变化参数名选择框，其中为变化的参变量名。
- 参变量的变化范围。
- 进入特征值选择。
- 进入引导方式。
- 选泽数据批次。



Performance Analysis Wizard - Step 1 of 4



Welcome to the Performance Analysis Wizard. It will help you create a Performance Analysis trace, by helping you choose a Goal Function, and test that Goal Function on one of the traces you want to characterize.

Choosing Finish now will take you directly into Performance Analysis, where you will need to use Trace/Add to 'manually' add your Goal Function, or expression of Goal Functions, to create the Performance Analysis Trace.

Help

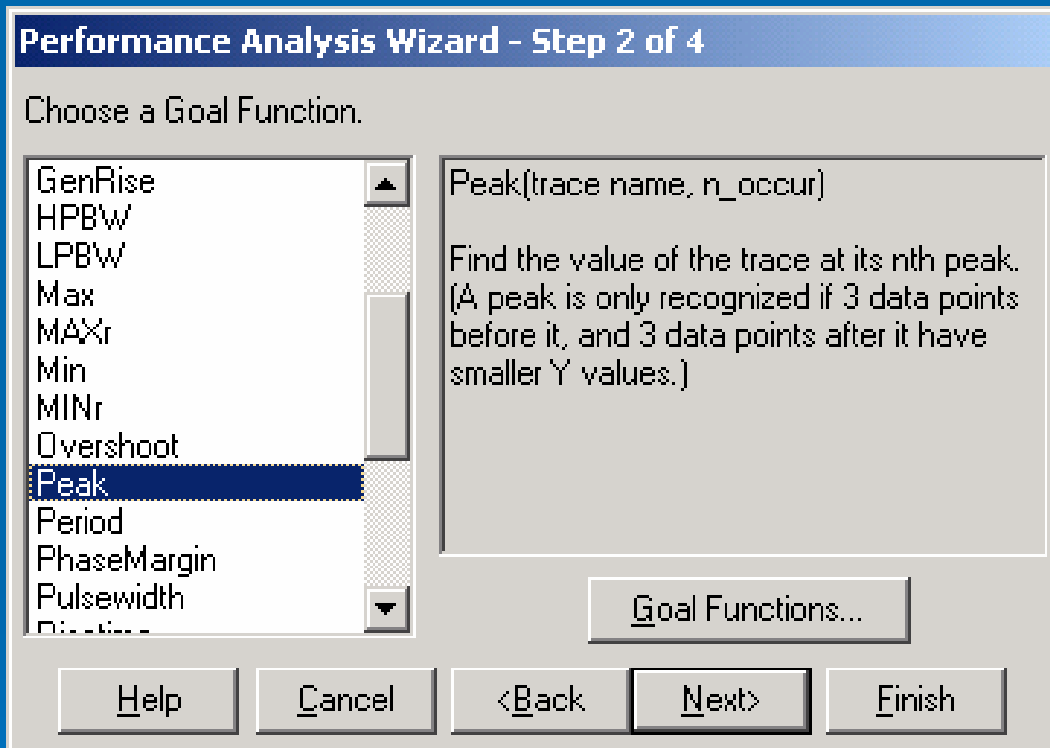
Cancel

<Back

Next>

Finish

- 继续
- 进入特征值选择。



- Goal管理界面
- 选择函数后继续
- 进入特征值选择。
- 选择峰值Peak。


Performance Analysis Wizard - Step 3 of 4

Goal Function Expression

Peak(V(out),)

Now you need to fill in the Goal Function arguments. That is, you need to tell the Goal Function which trace(s) to look at, and if necessary, the other numbers the Goal Function needs to work.

The Goal Function 'Peak' has 2 arguments. Please fill them in now.

Name of trace to search  V(out)

Number of peak to find

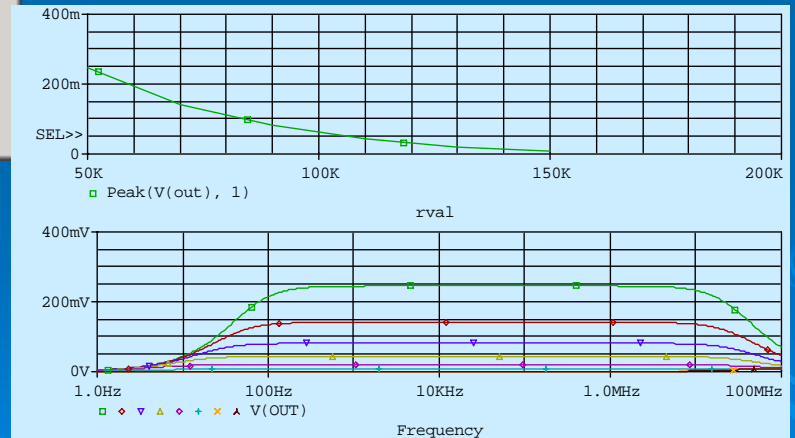
Help

Cancel

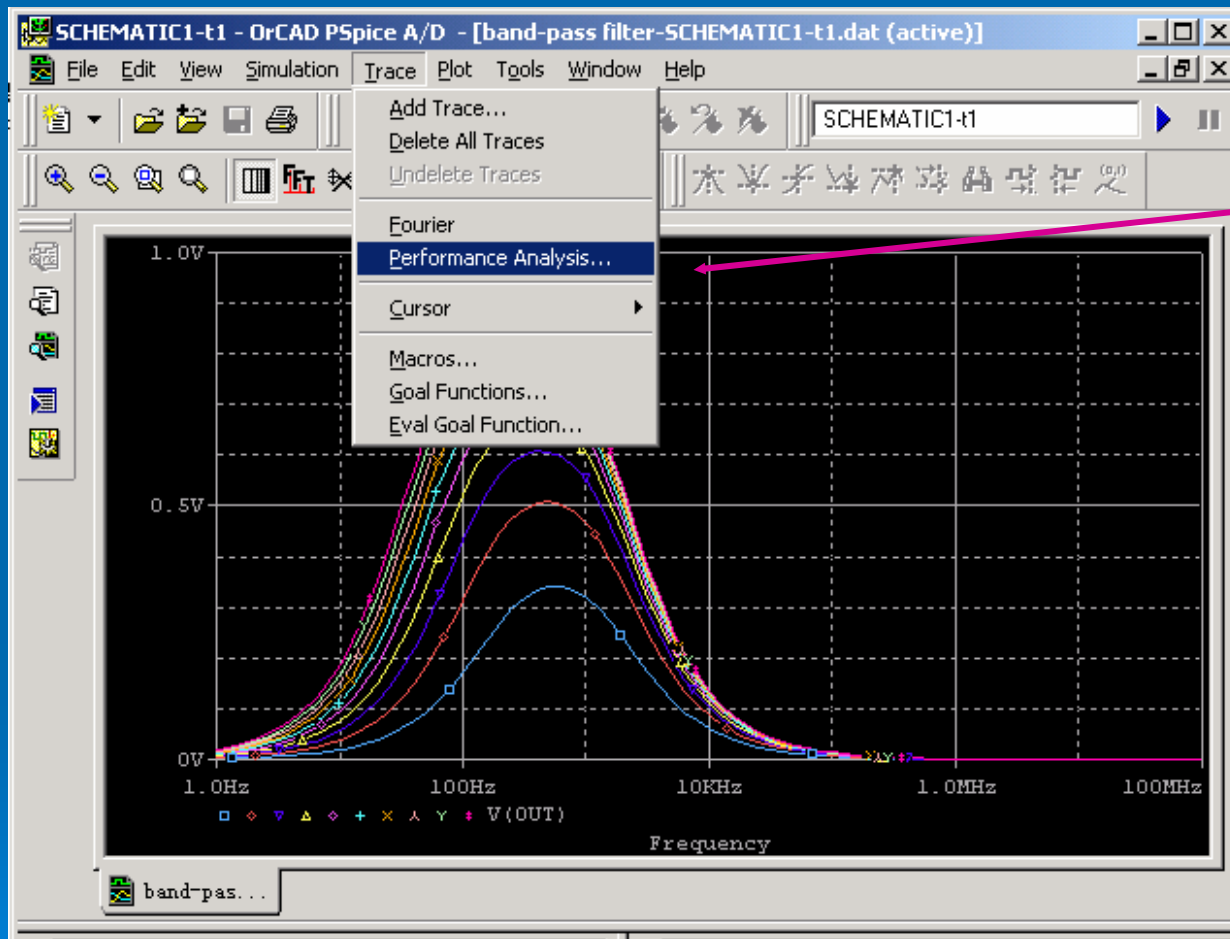
<Back

Next>

Finish



直接选择特征值函数



参数扫描后执行此命令。

Performance Analysis

Performance Analysis allows you to see how some characteristic of a waveform (as measured by a Goal Function) varies between several simulation runs that have a single variable (parameter, temperature, etc) changing between runs. For example, you could plot the bandwidth of a filter vs a capacitor value that changes between simulation runs.

Multiple simulation runs are required to use Performance Analysis. Each simulation is a different section in the data file.

Analog sections currently selected

Variable changing between sections

Range of changing variable

The X axis will be cval.

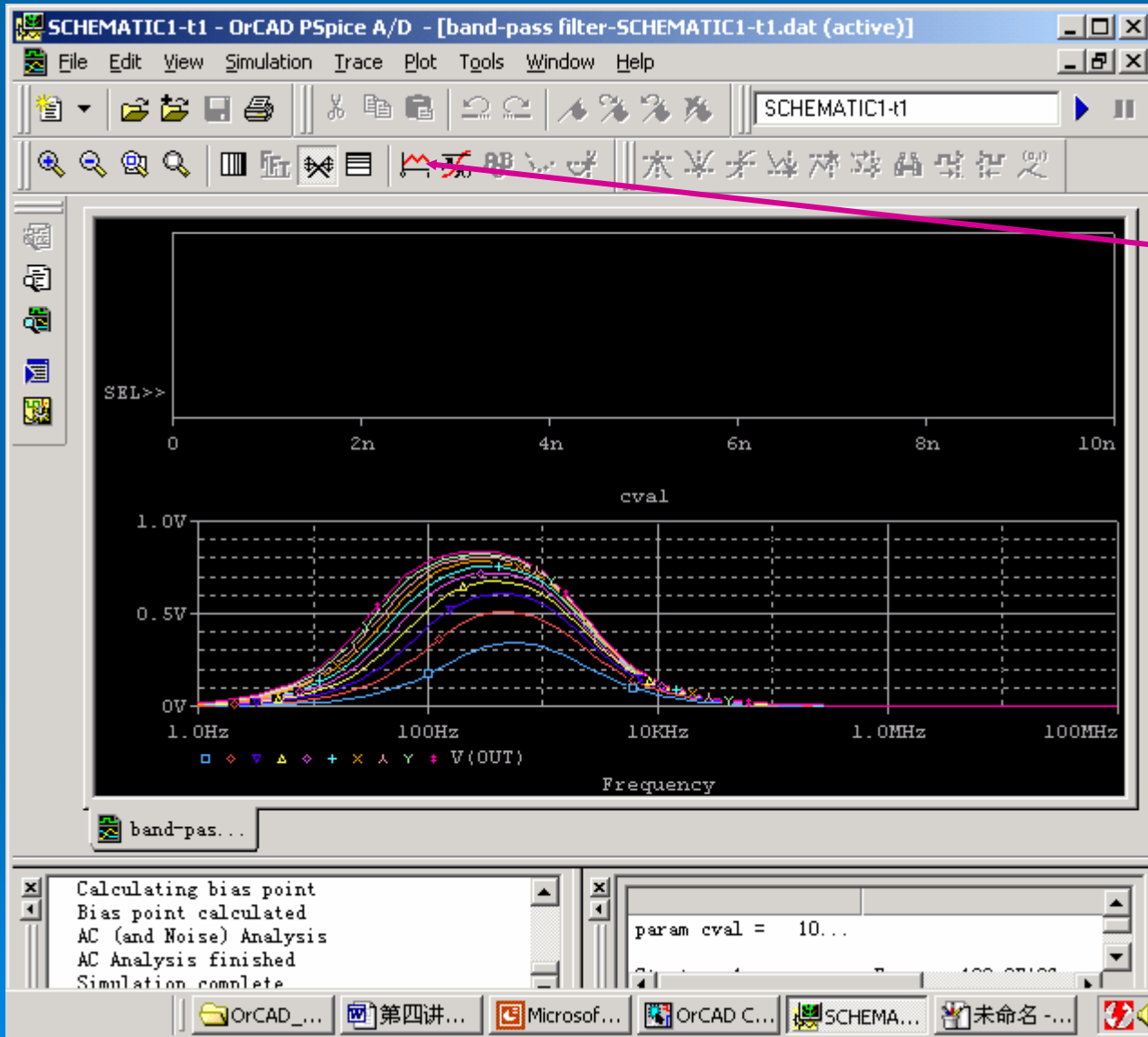
The Y axis will depend on the Goal Function you use.

If you wish, you may now select a different set of sections.

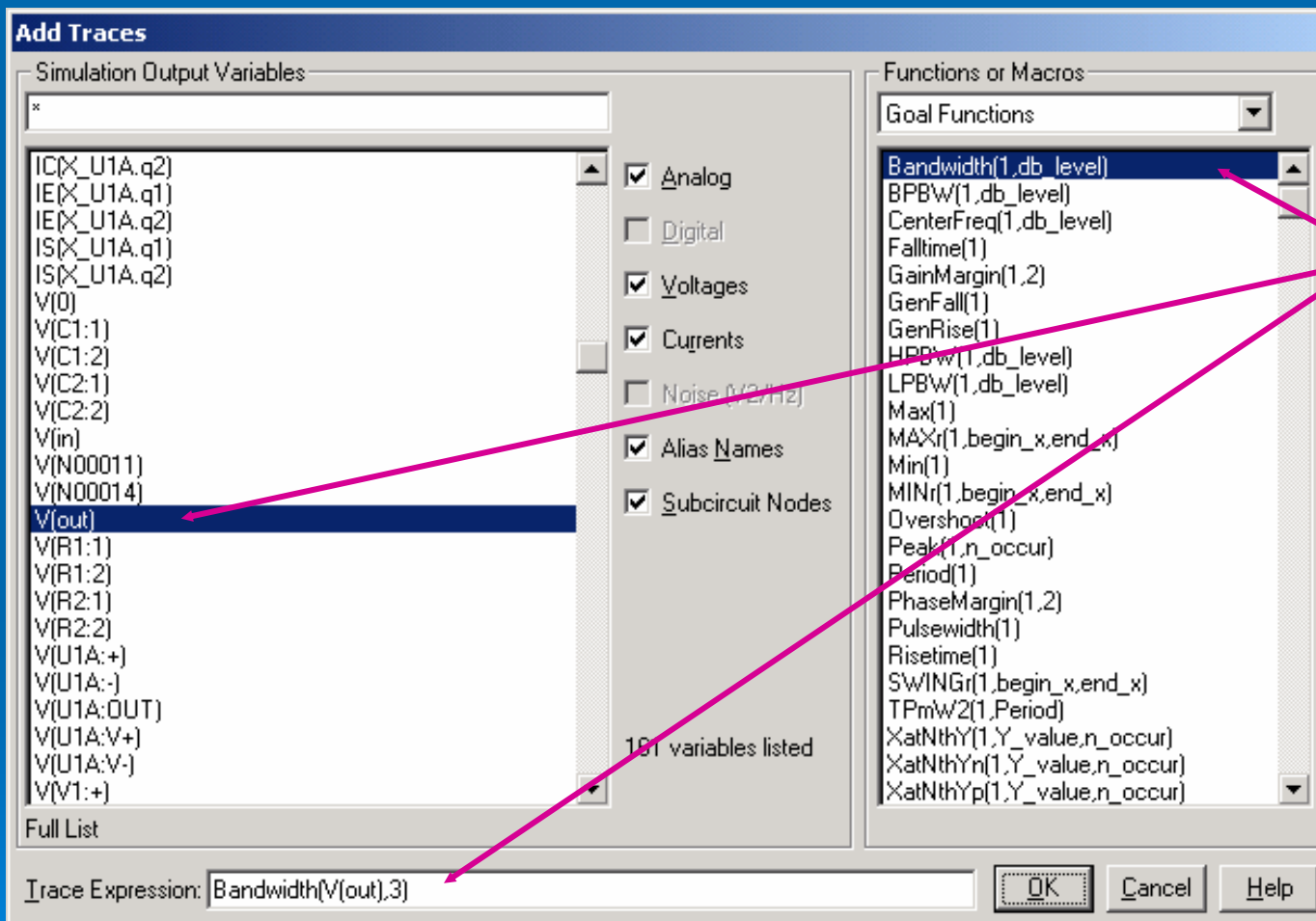
Choosing OK now will take you directly into Performance Analysis, where you will need to use Trace/Add to 'manually' add your Goal Function, or expression of Goal Functions, to create the Performance Analysis Trace.

Instead, you may use the Wizard to help you create a Performance Analysis Trace.

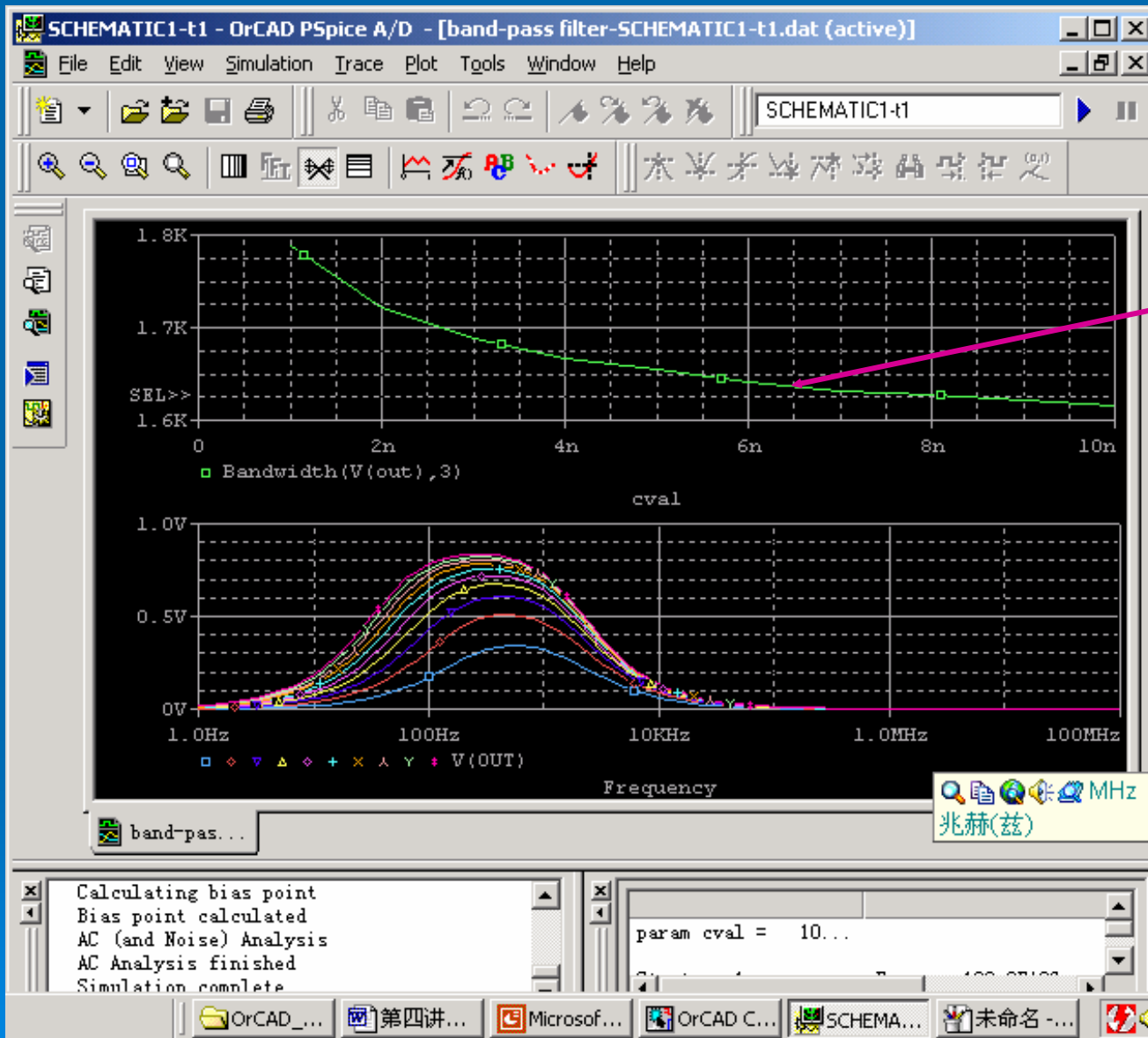
➤ 执行此命令。



执行此命令

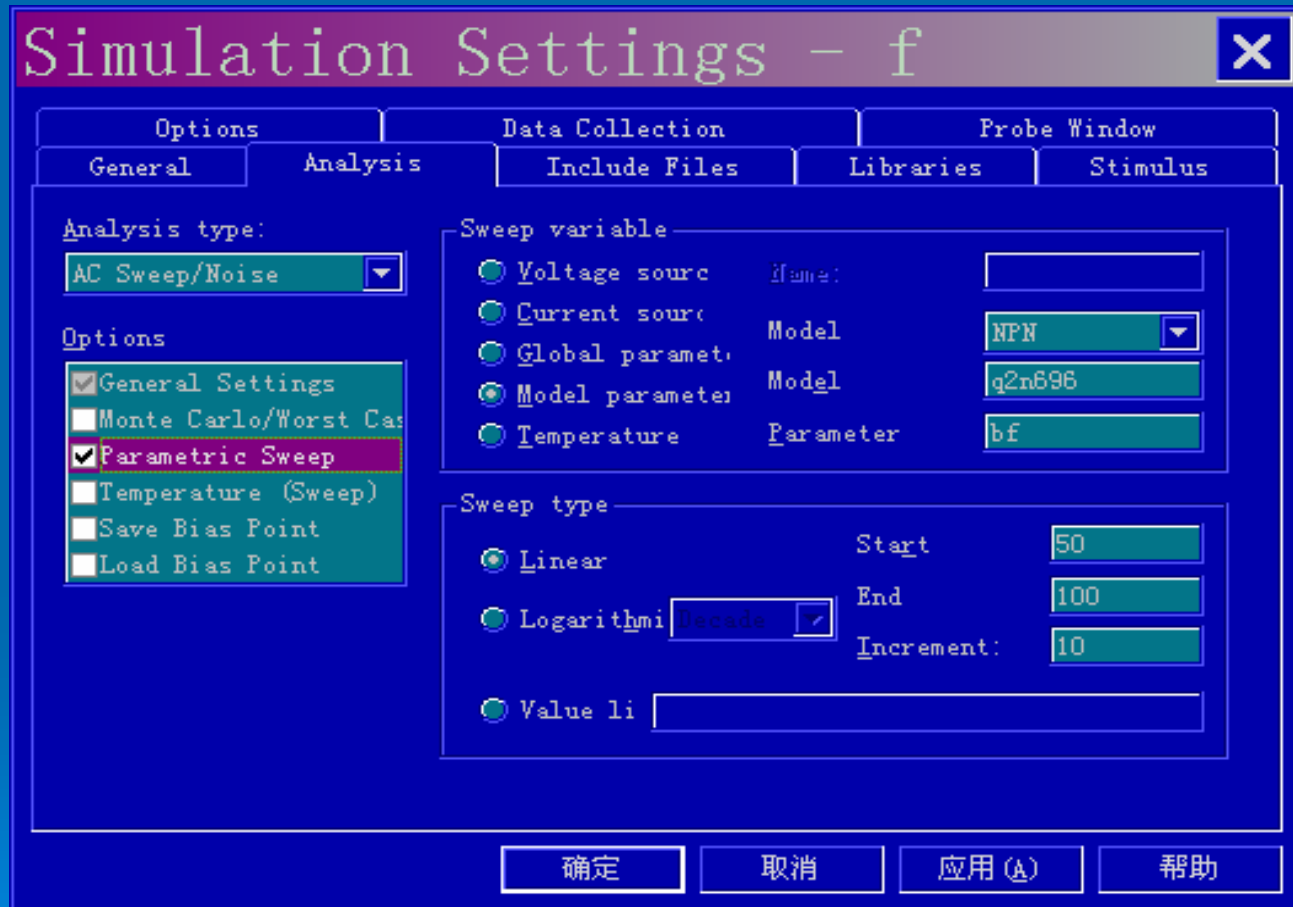


执行此命令

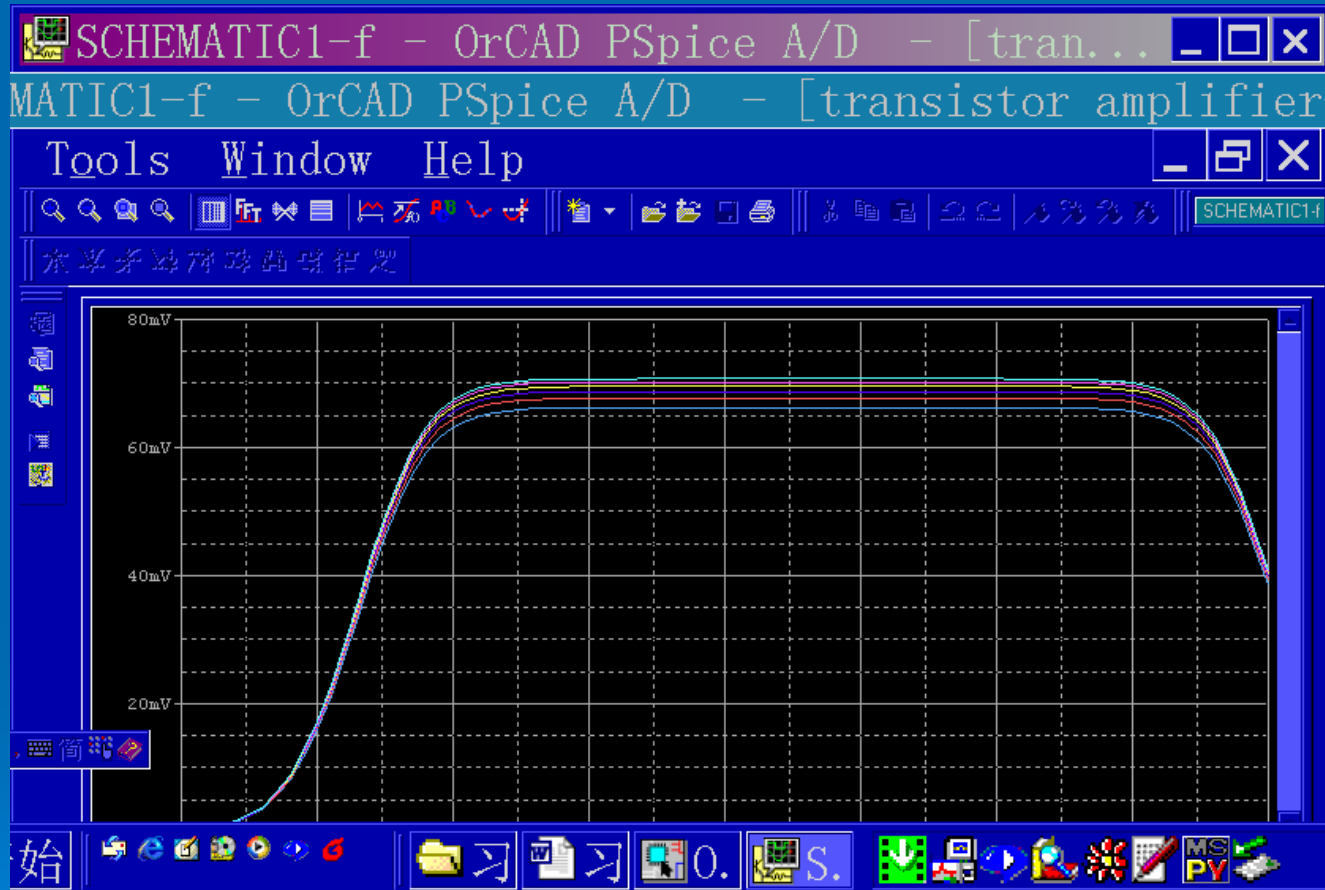


结果

BF值为扫描参数



结果



End