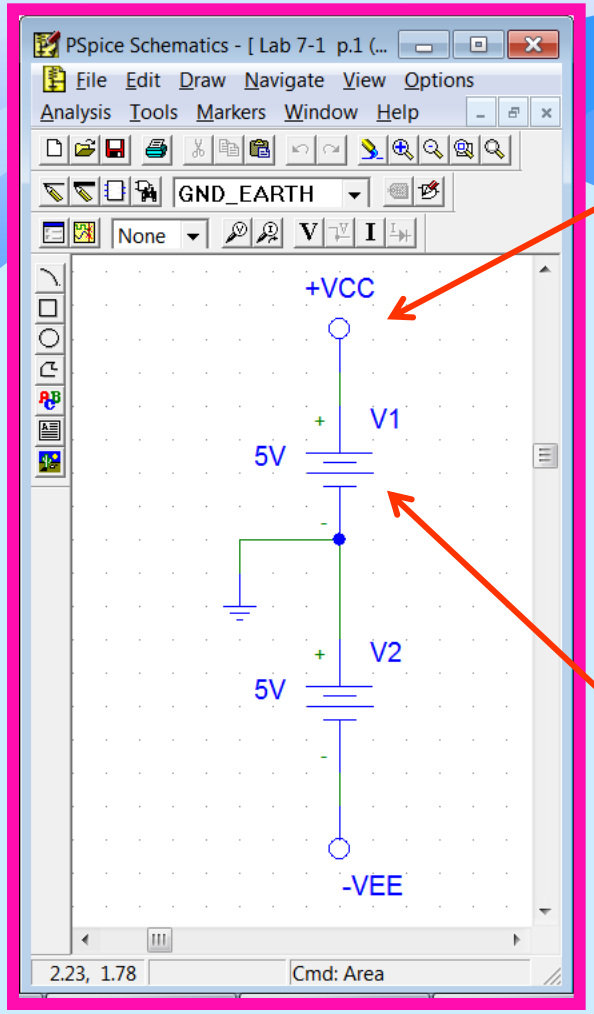
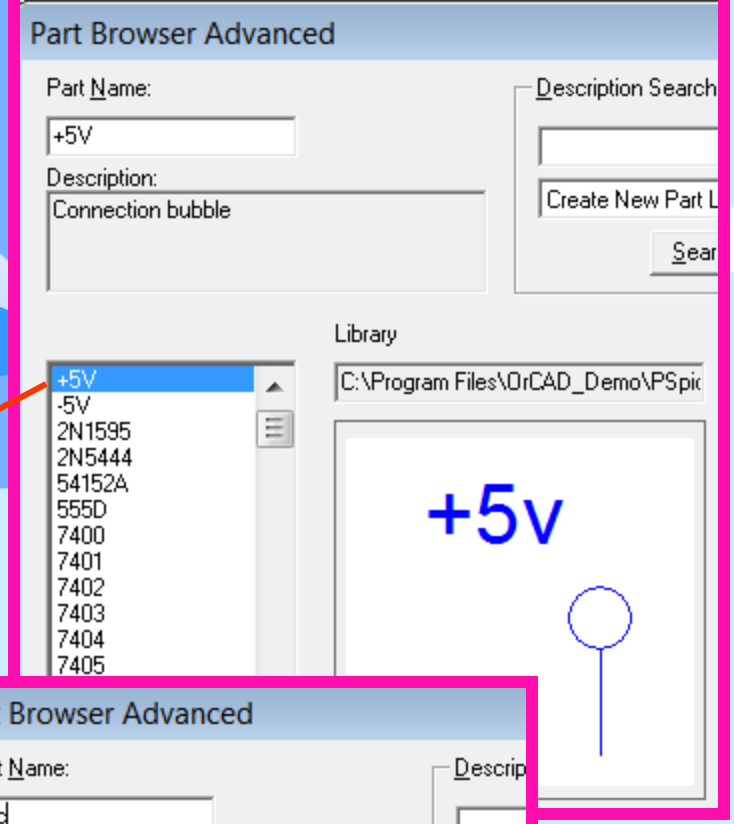
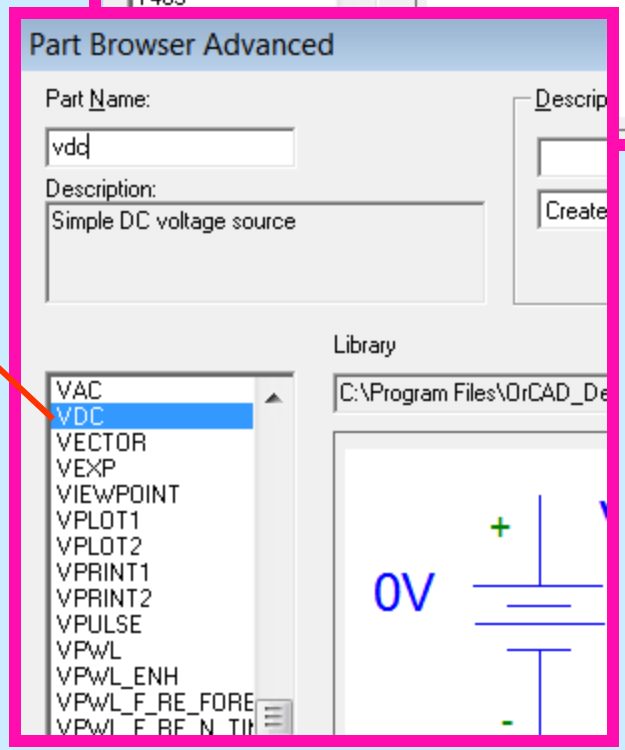
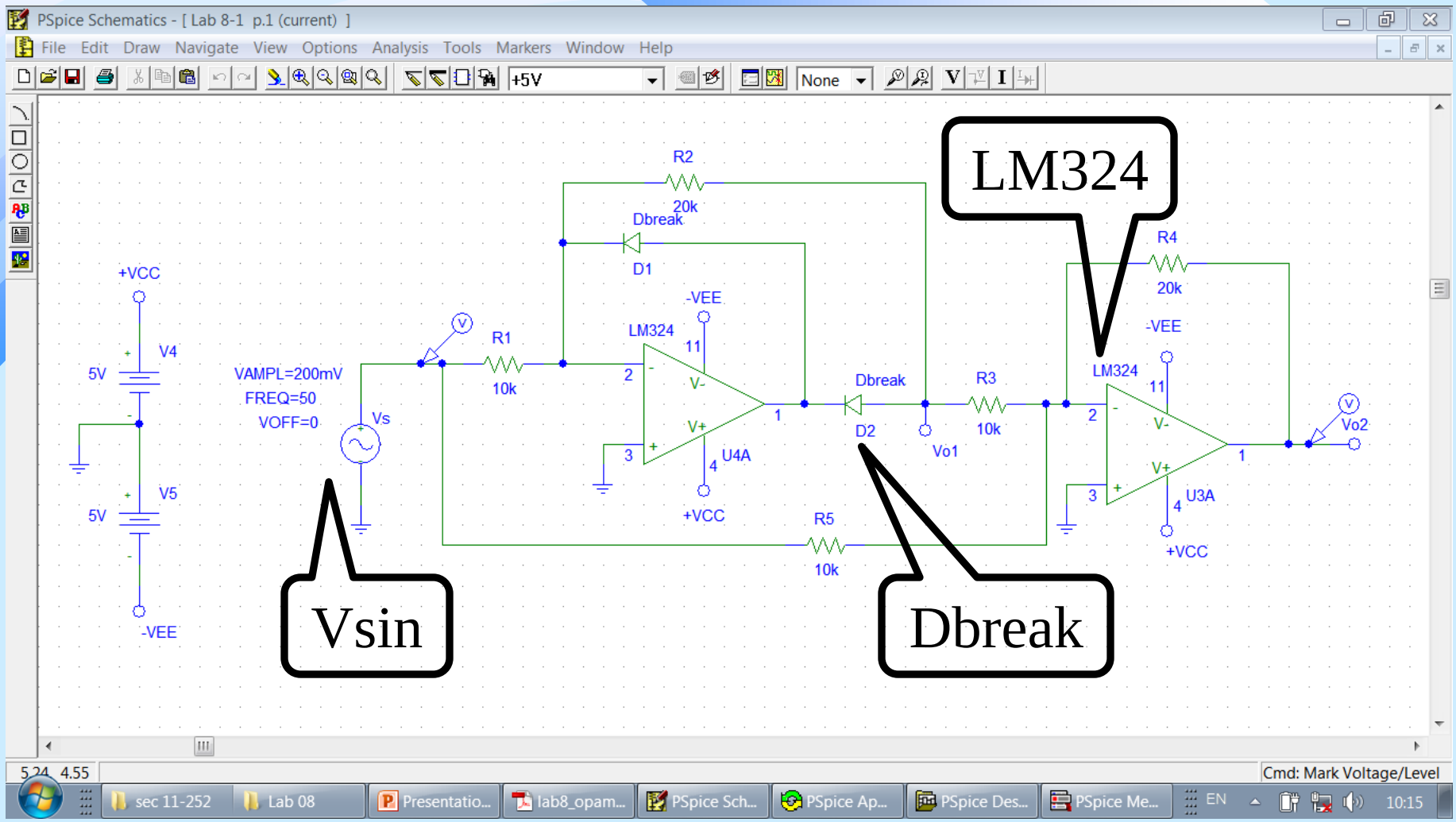
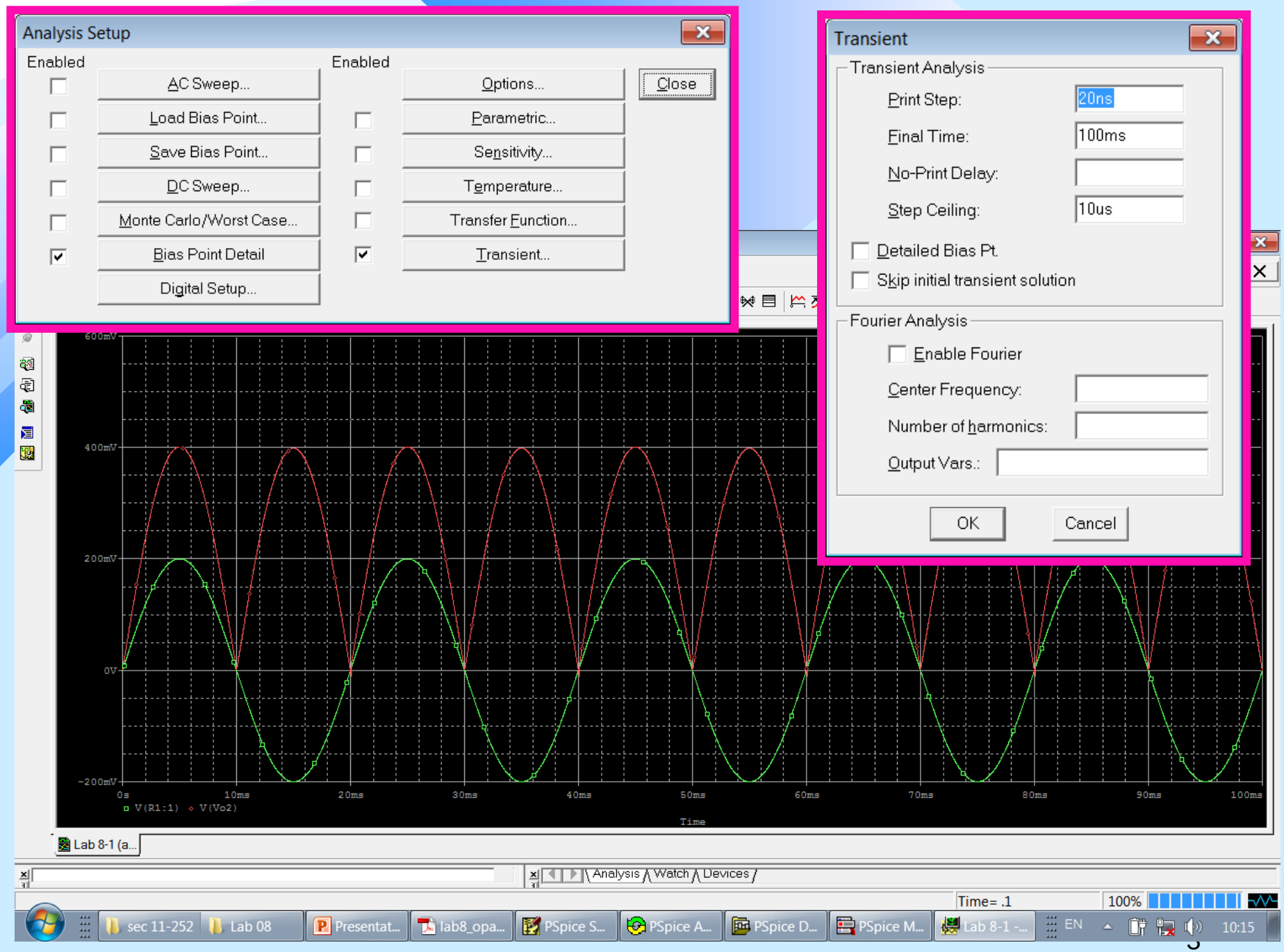
Positive / Negative Supply



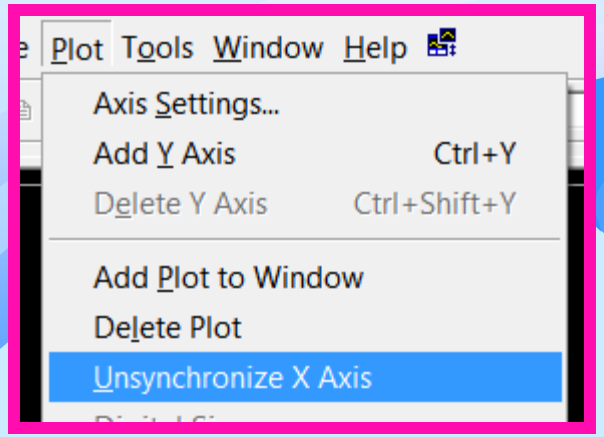




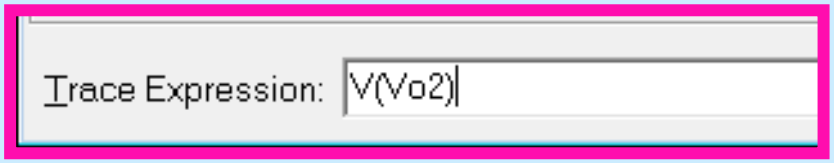

PSpice Schematics - [Lab 8-1 p.1 (current)]
File Edit Draw Navigate View Options Analysis Tools Markers Window Help
+5V
None
LM324
R2
20k
Dbreak
D1
R4
20k
+VCC
V4
5V
-VEE
R1
10k
LM324
11
VAMPL=200mV
FREQ=50
VOFF=0
Vs
2
V-
V+
3
1
U4A
4
+VCC
Dbreak
D2
Vo1
R3
10k
-VEE
LM324
11
2
V-
V+
3
1
U3A
4
+VCC
Vo2
V5
5V
-VEE
R5
10k
Vsin
Dbreak
5.24 4.55
Cmd: Mark Voltage/Level
sec 11-252
Lab 08
Presentatio...
lab8_opam...
PSpice Sch...
PSpice Ap...
PSpice Des...
PSpice Me...
EN
10:15


Analysis Setup
Enabled
AC Sweep...
Load Bias Point...
Save Bias Point...
DC Sweep...
Monte Carlo/Worst Case...
Bias Point Detail
Digital Setup...
Enabled
Options...
Parametric...
Sensitivity...
Temperature...
Transfer Function...
Transient...
Close
Transient
Transient Analysis
Print Step:
20ns
Final Time:
100ms
No-Print Delay:
Step Ceiling:
10us
Detailed Bias Pt.
Skip initial transient solution
Fourier Analysis
Enable Fourier
Center Frequency:
Number of harmonics:
Output Vars.:
OK
Cancel
600mV
400mV
200mV
0V
-200mV
0s
10ms
20ms
30ms
40ms
50ms
60ms
70ms
80ms
90ms
100ms
V(R1:1)
V(Vo2)
Time
Lab 8-1 (a...
Analysis
Watch
Devices
Time= .1
100%
sec 11-252
Lab 08
Presentat...
lab8_opa...
PSpice S...
PSpice A...
PSpice D...
PSpice M...
Lab 8-1 -...
EN
10:15

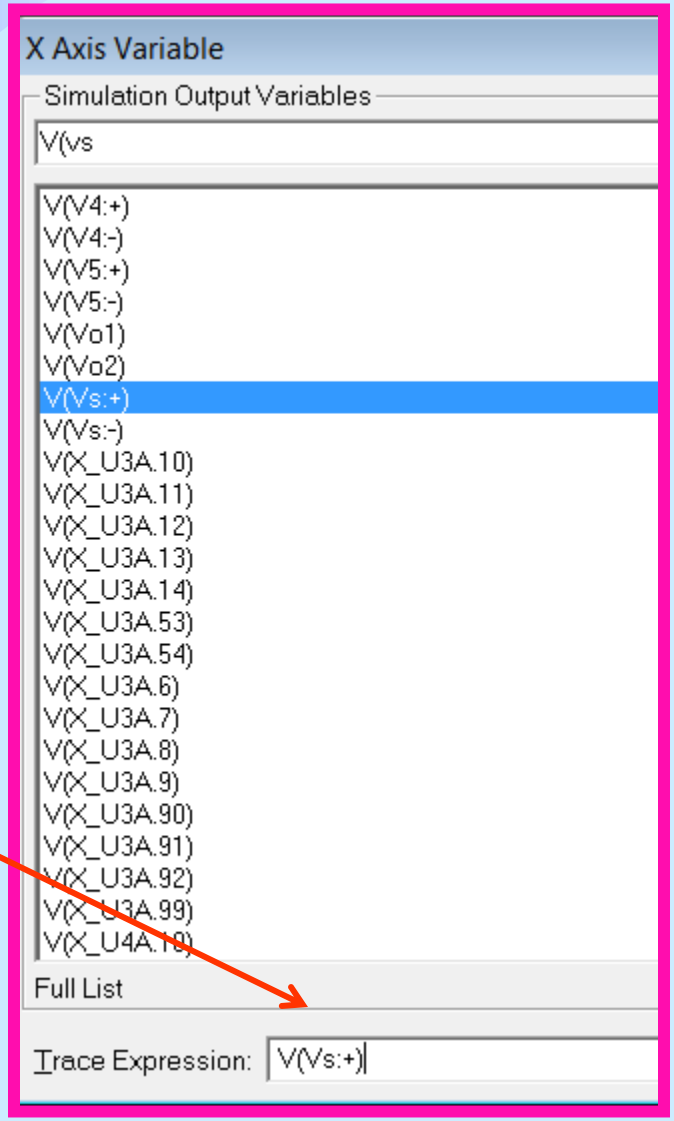
Plot → Add plot

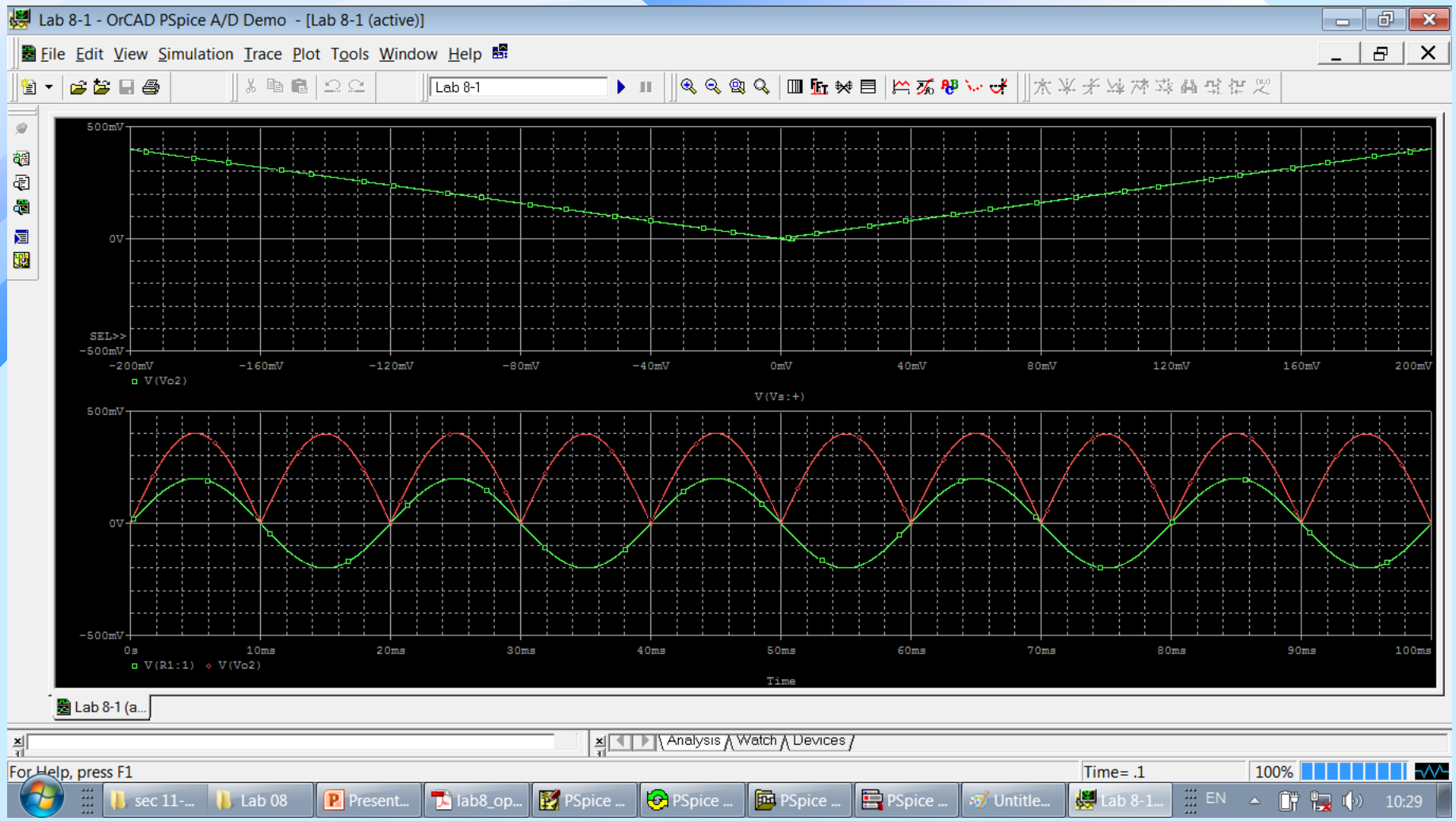


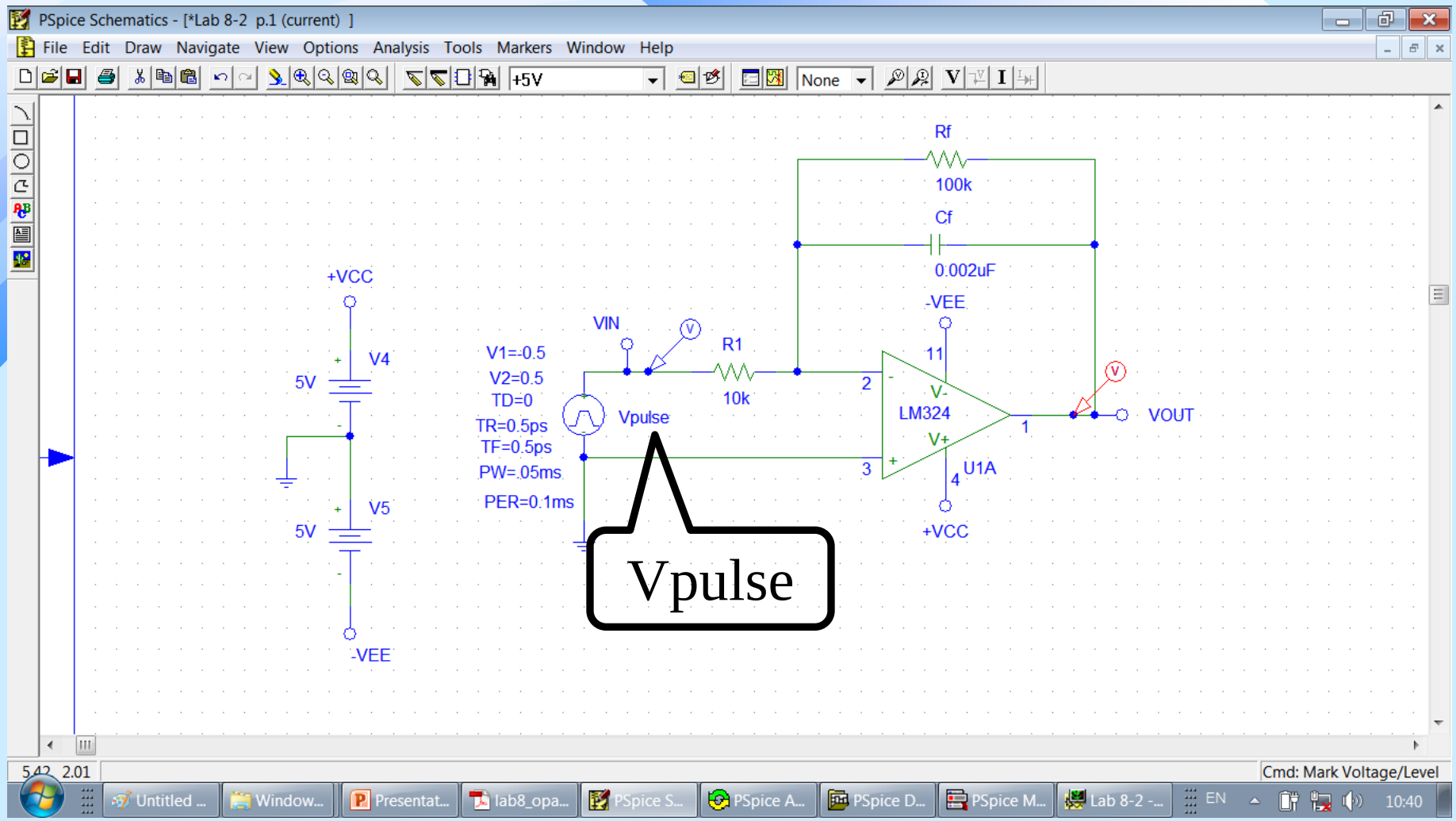
Trace → Add trace

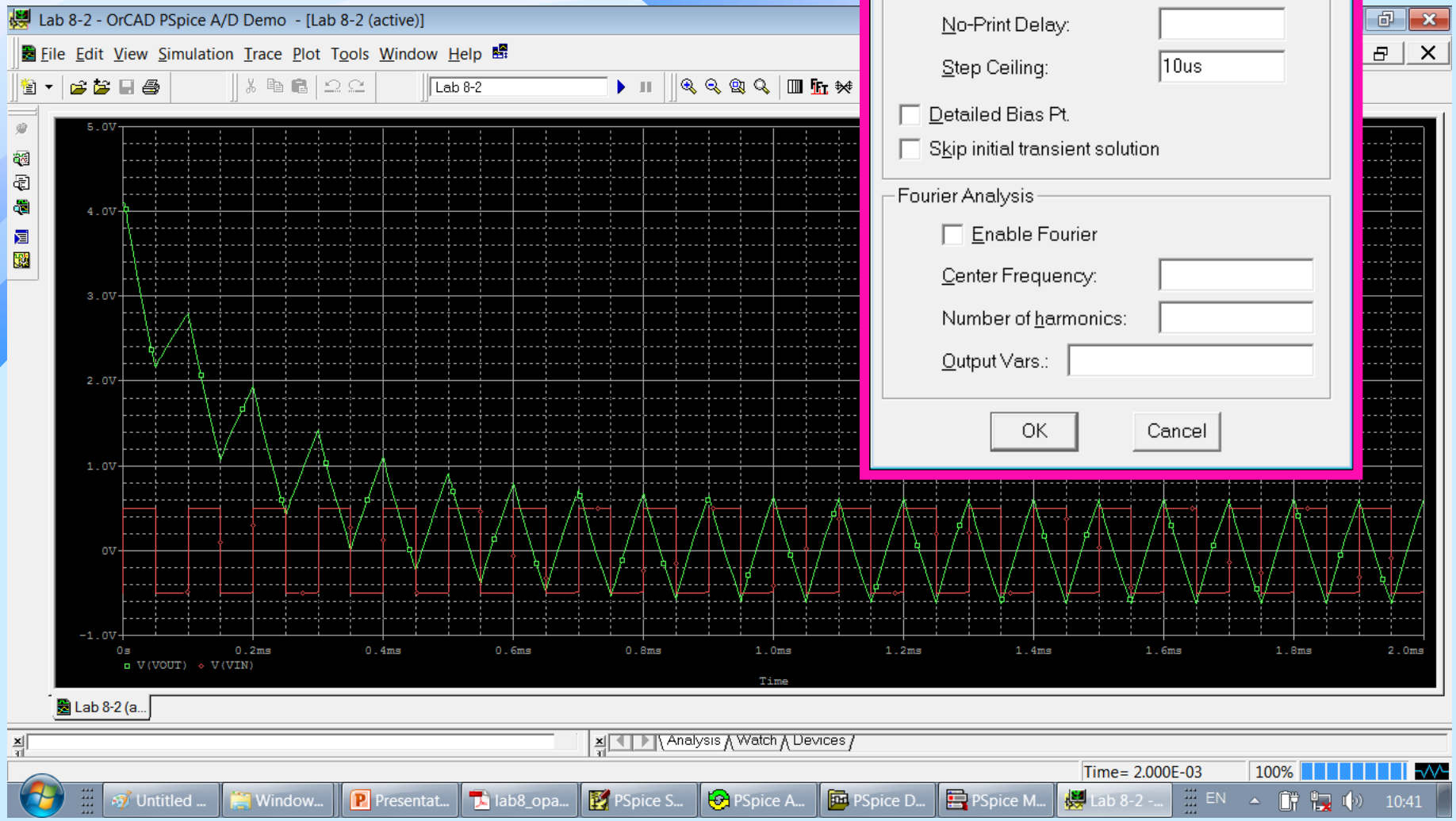


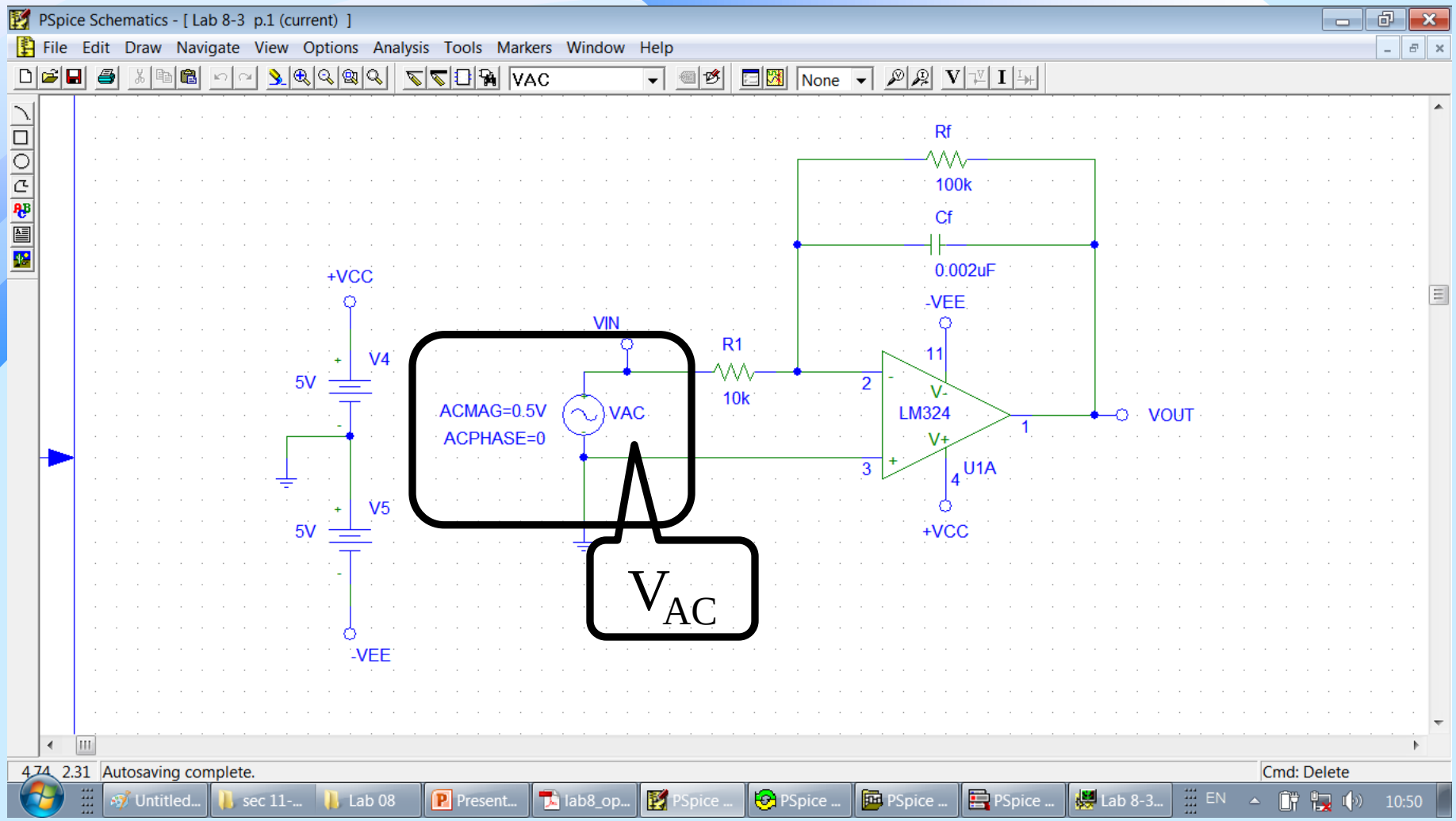
Axis setting

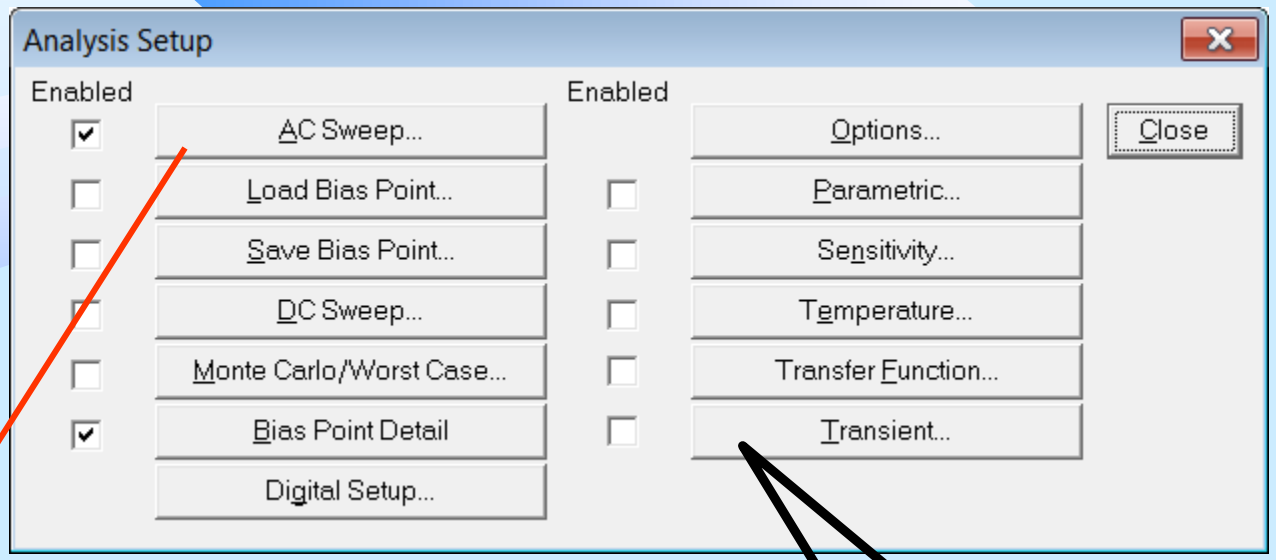


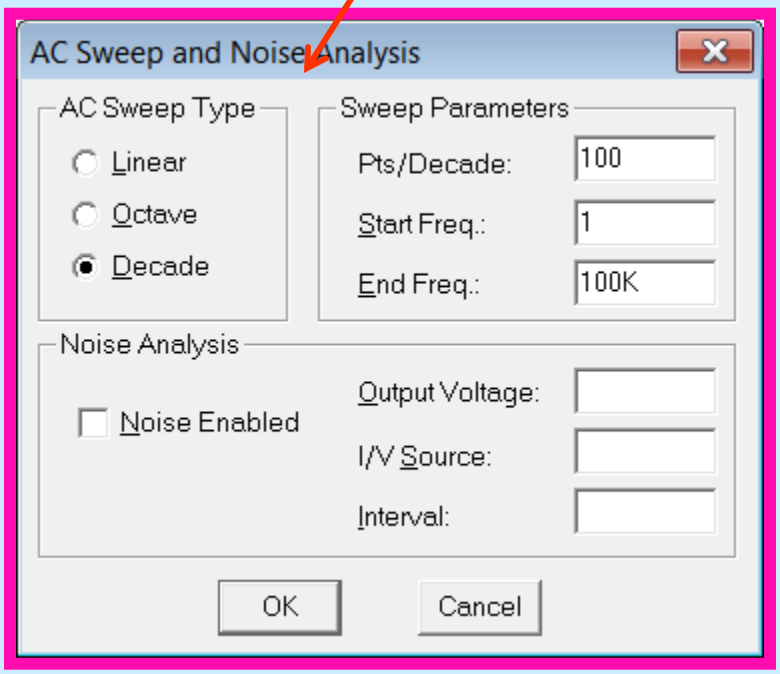

Lab 8-1 - OrCAD PSpice A/D Demo - [Lab 8-1 (active)]
File Edit View Simulation Trace Plot Tools Window Help
Lab 8-1
500mV
0V
SEL>>
-500mV
-200mV -160mV -120mV -80mV -40mV 0mV 40mV 80mV 120mV 160mV 200mV
V(Vo2)
V(Vs:+)
500mV
0V
-500mV
0s 10ms 20ms 30ms 40ms 50ms 60ms 70ms 80ms 90ms 100ms
V(R1:1) V(Vo2)
Time
Lab 8-1 (a...
Analysis Watch Devices
For Help, press F1
Time= .1
100%
sec 11-... Lab 08 Present... lab8_op... PSpice ... PSpice ... PSpice ... PSpice ... Untitle... Lab 8-1... EN 10:29


PSpice Schematics - [*Lab 8-2 p.1 (current)]
File Edit Draw Navigate View Options Analysis Tools Markers Window Help
+5V
None
Rf
100k
Cf
0.002uF
-VEE
+VCC
VIN
R1
10k
V1=-0.5
V2=0.5
TD=0
TR=0.5ps
TF=0.5ps
PW=.05ms
PER=0.1ms
Vpulse
LM324
V-
V+
U1A
VOUT
V4
5V
V5
5V
-VEE
Vpulse
5.42 2.01
Cmd: Mark Voltage/Level
Untitled ...
Window...
Presentat...
lab8_opa...
PSpice S...
PSpice A...
PSpice D...
PSpice M...
Lab 8-2 -...
EN
10:40

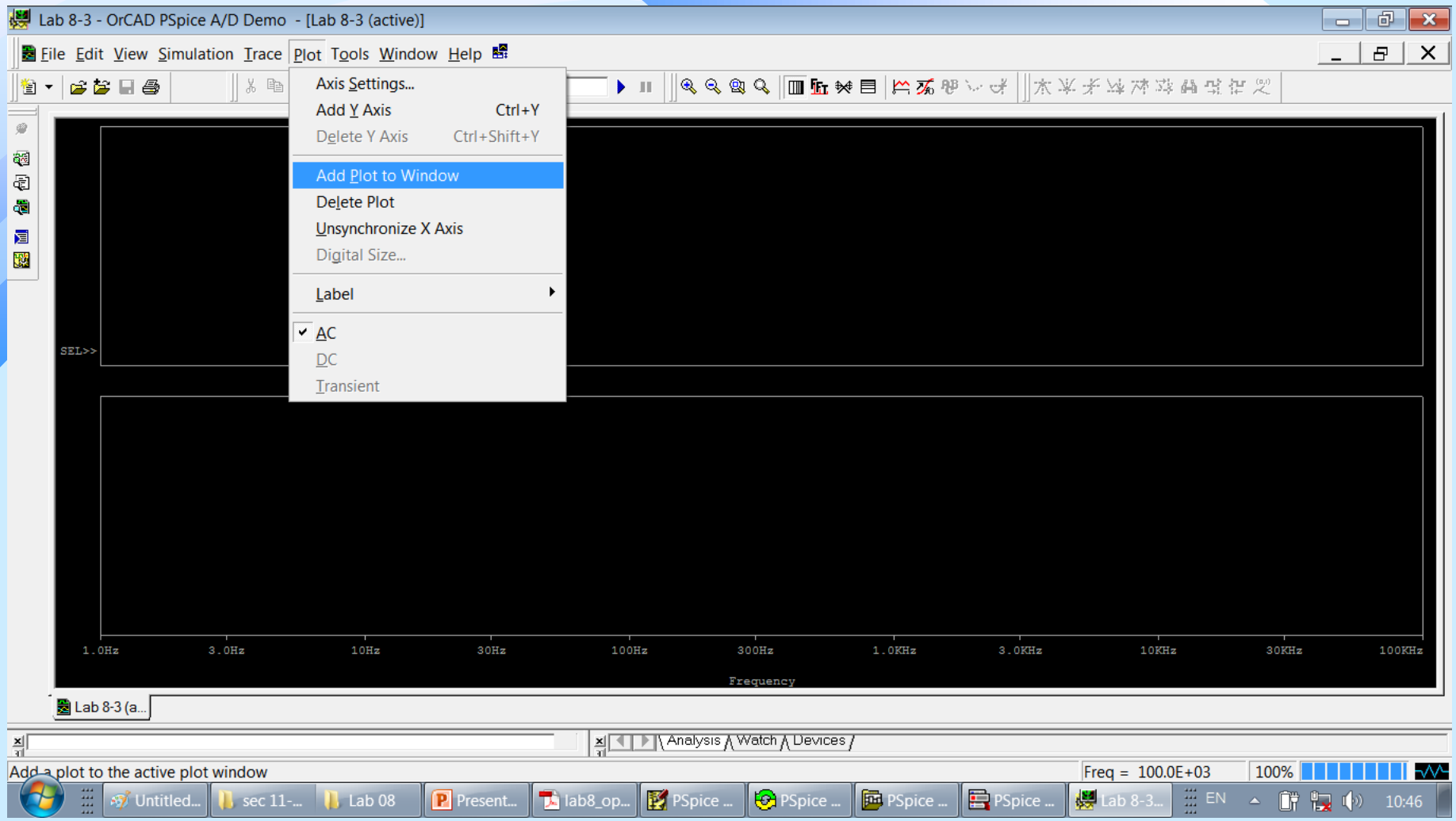

Lab 8-2 - OrCAD PSpice A/D Demo - [Lab 8-2 (active)]
File Edit View Simulation Trace Plot Tools Window Help
Lab 8-2
5.0V
4.0V
3.0V
2.0V
1.0V
0V
-1.0V
0s
0.2ms
0.4ms
0.6ms
0.8ms
1.0ms
1.2ms
1.4ms
1.6ms
1.8ms
2.0ms
V(VOUT) V(VIN)
Time
Lab 8-2 (a...
Analysis Watch Devices
Time= 2.000E-03
100%
Transient
Transient Analysis
Print Step: 20ns
Final Time: 2ms
No-Print Delay:
Step Ceiling: 10us
Detailed Bias Pt.
Skip initial transient solution
Fourier Analysis
Enable Fourier
Center Frequency:
Number of harmonics:
Output Vars.:
OK
Cancel

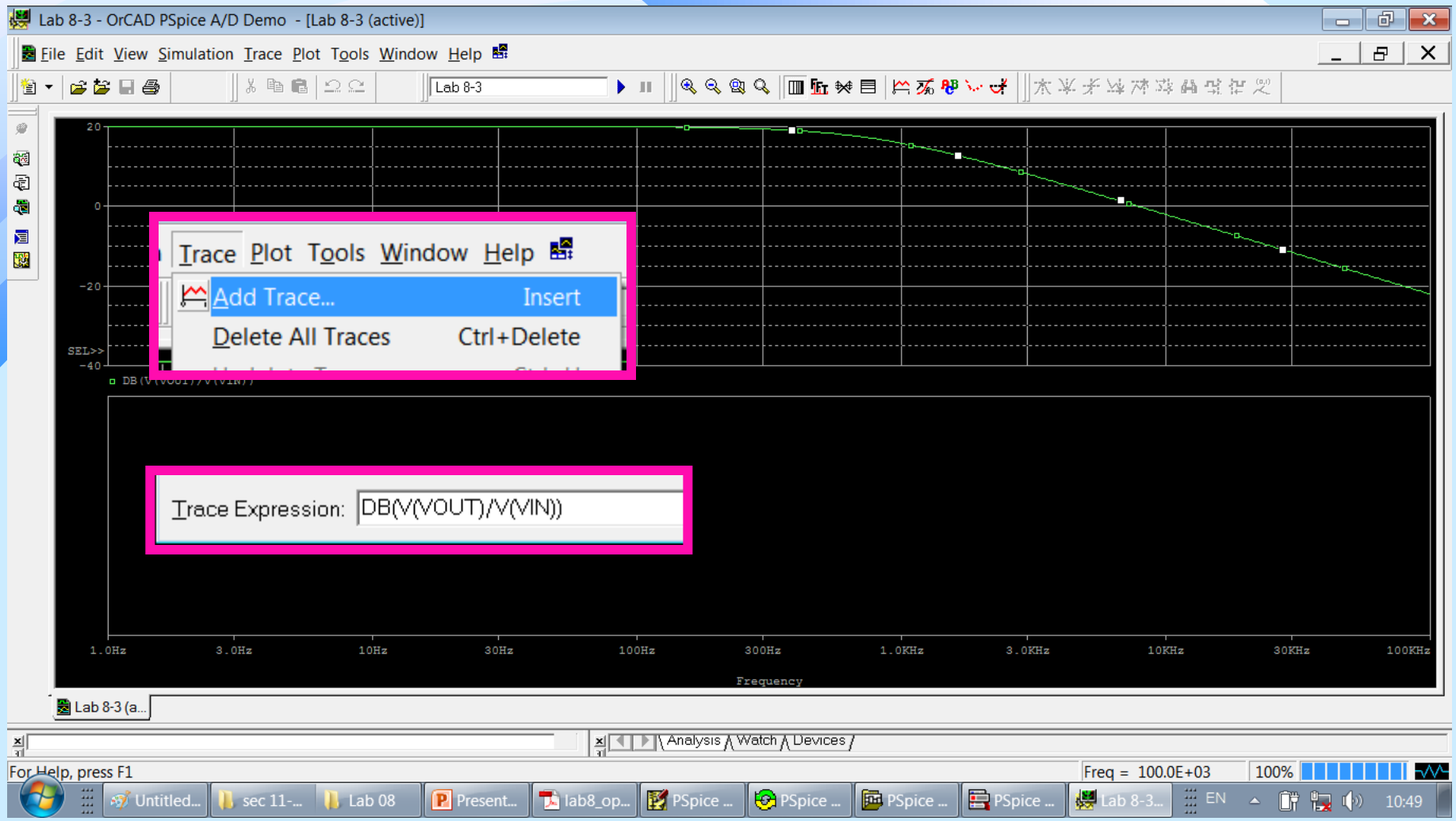

PSpice Schematics - [Lab 8-3 p.1 (current)]
File Edit Draw Navigate View Options Analysis Tools Markers Window Help
VAC
None
Rf
100k
Cf
0.002uF
+VCC
V4
5V
V5
5V
-VEE
VIN
ACMAG=0.5V
ACPHASE=0
VAC
R1
10k
-VEE
11
2
V-
LM324
V+
3
4
U1A
1
VOUT
+VCC
V_{AC}
4.74 2.31
Autosaving complete.
Cmd: Delete
Untitled...
sec 11-...
Lab 08
Present...
lab8_op...
PSpice ...
PSpice ...
PSpice ...
PSpice ...
Lab 8-3...
EN
10:50

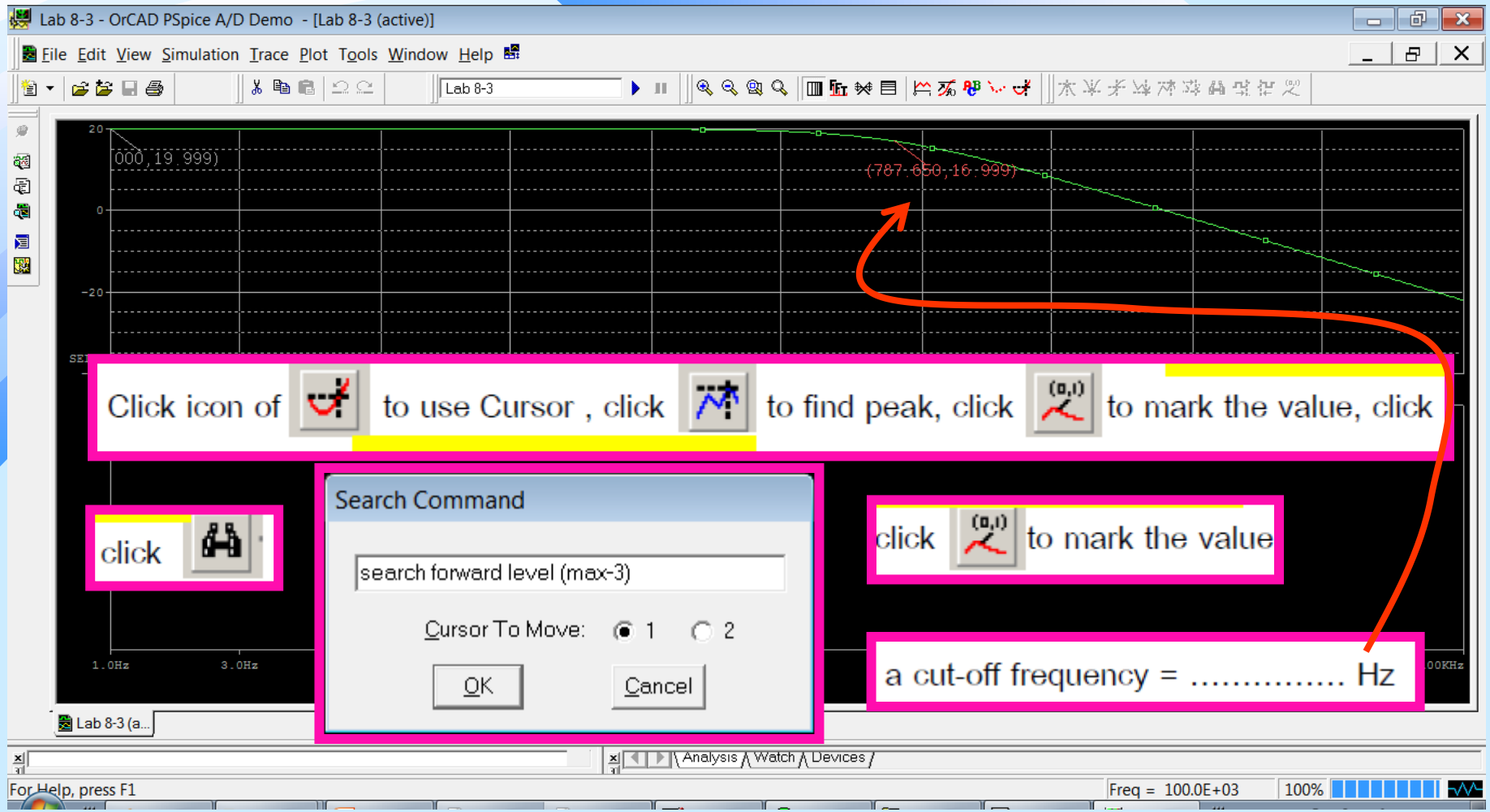


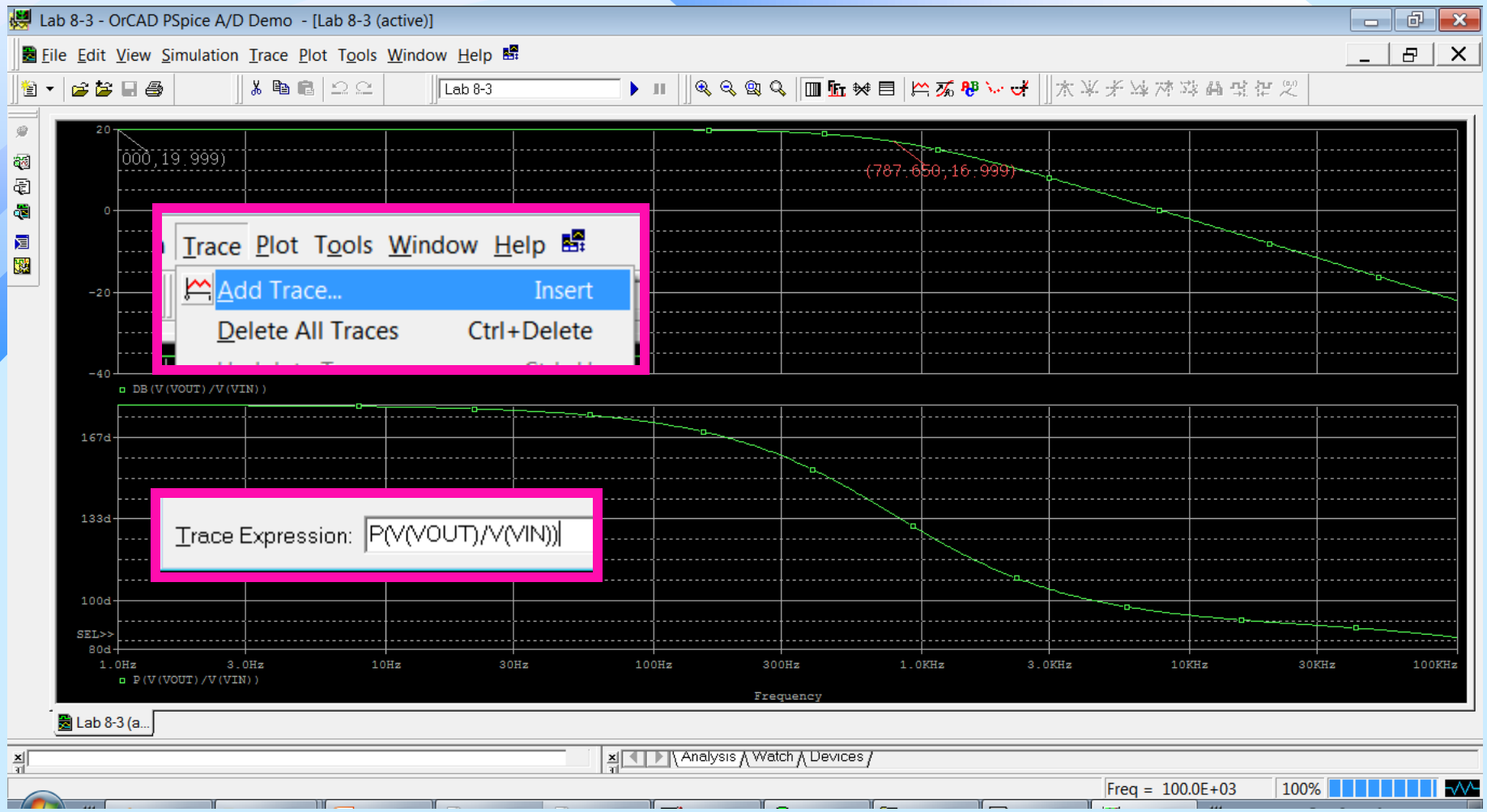


Un-tick transient

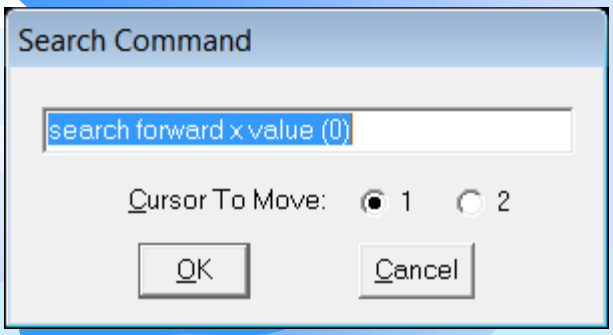

Lab 8-3 - OrCAD PSpice A/D Demo - [Lab 8-3 (active)]
File Edit View Simulation Trace Plot Tools Window Help
Axis Settings...
Add Y Axis Ctrl+Y
Delete Y Axis Ctrl+Shift+Y
Add Plot to Window
Delete Plot
Unsynchronize X Axis
Digital Size...
Label
AC
DC
Transient
SEL>>
1.0Hz
3.0Hz
10Hz
30Hz
100Hz
300Hz
1.0KHz
3.0KHz
10KHz
30KHz
100KHz
Frequency
Lab 8-3 (a...
Analysis Watch Devices
Add a plot to the active plot window
Freq = 100.0E+03
100%
Untitled...
sec 11-...
Lab 08
Present...
lab8_op...
PSpice ...
PSpice ...
PSpice ...
PSpice ...
Lab 8-3...
EN
10:46


Lab 8-3 - OrCAD PSpice A/D Demo - [Lab 8-3 (active)]
File Edit View Simulation Trace Plot Tools Window Help
Lab 8-3
Trace Plot Tools Window Help
Add Trace... Insert
Delete All Traces Ctrl+Delete
Trace Expression: DB(V(VOUT)/V(VIN))
20
0
-20
-40
SEL>>
1.0Hz
3.0Hz
10Hz
30Hz
100Hz
300Hz
1.0KHz
3.0KHz
10KHz
30KHz
100KHz
Frequency
Lab 8-3 (a...
Analysis Watch Devices
For Help, press F1
Freq = 100.0E+03
100%
Untitled...
sec 11-...
Lab 08
Present...
lab8_op...
PSpice ...
PSpice ...
PSpice ...
PSpice ...
Lab 8-3...
EN
10:49


Lab 8-3 - OrCAD PSpice A/D Demo - [Lab 8-3 (active)]
File Edit View Simulation Trace Plot Tools Window Help
Lab 8-3
(787.650,16.999)
Click icon of to use Cursor , click to find peak, click to mark the value, click
click
Search Command
search forward level (max-3)
Cursor To Move: 1 2
OK
Cancel
click to mark the value
a cut-off frequency = ... Hz
1.0Hz
3.0Hz
Analysis Watch Devices
For Help, press F1
Freq = 100.0E+03
100%

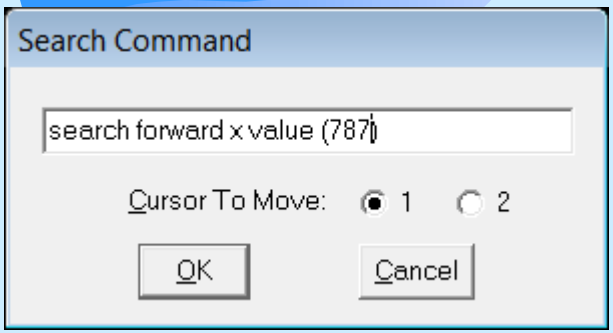

Lab 8-3 - OrCAD PSpice A/D Demo - [Lab 8-3 (active)]
File Edit View Simulation Trace Plot Tools Window Help
Lab 8-3
(787.650,16.999)
Trace Plot Tools Window Help
Add Trace... Insert
Delete All Traces Ctrl+Delete
DB(V(VOUT)/V(VIN))
Trace Expression: P(V(VOUT)/V(VIN))
1.0Hz 3.0Hz 10Hz 30Hz 100Hz 300Hz 1.0KHz 3.0KHz 10KHz 30KHz 100KHz
P(V(VOUT)/V(VIN))
Frequency
Lab 8-3 (a...
Analysis Watch Devices
Freq = 100.0E+03
100%

cursor search 



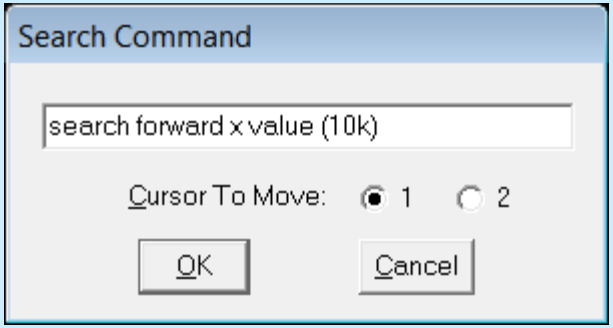
 to mark the value

cursor search 



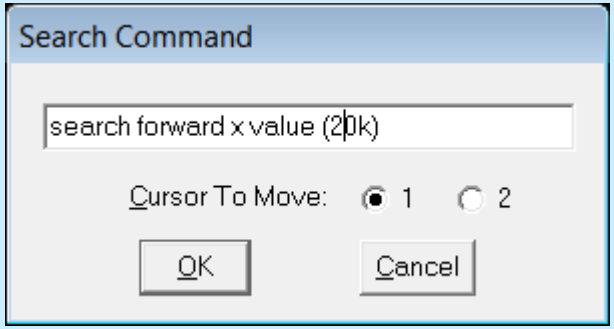
 to mark the value

cursor search 

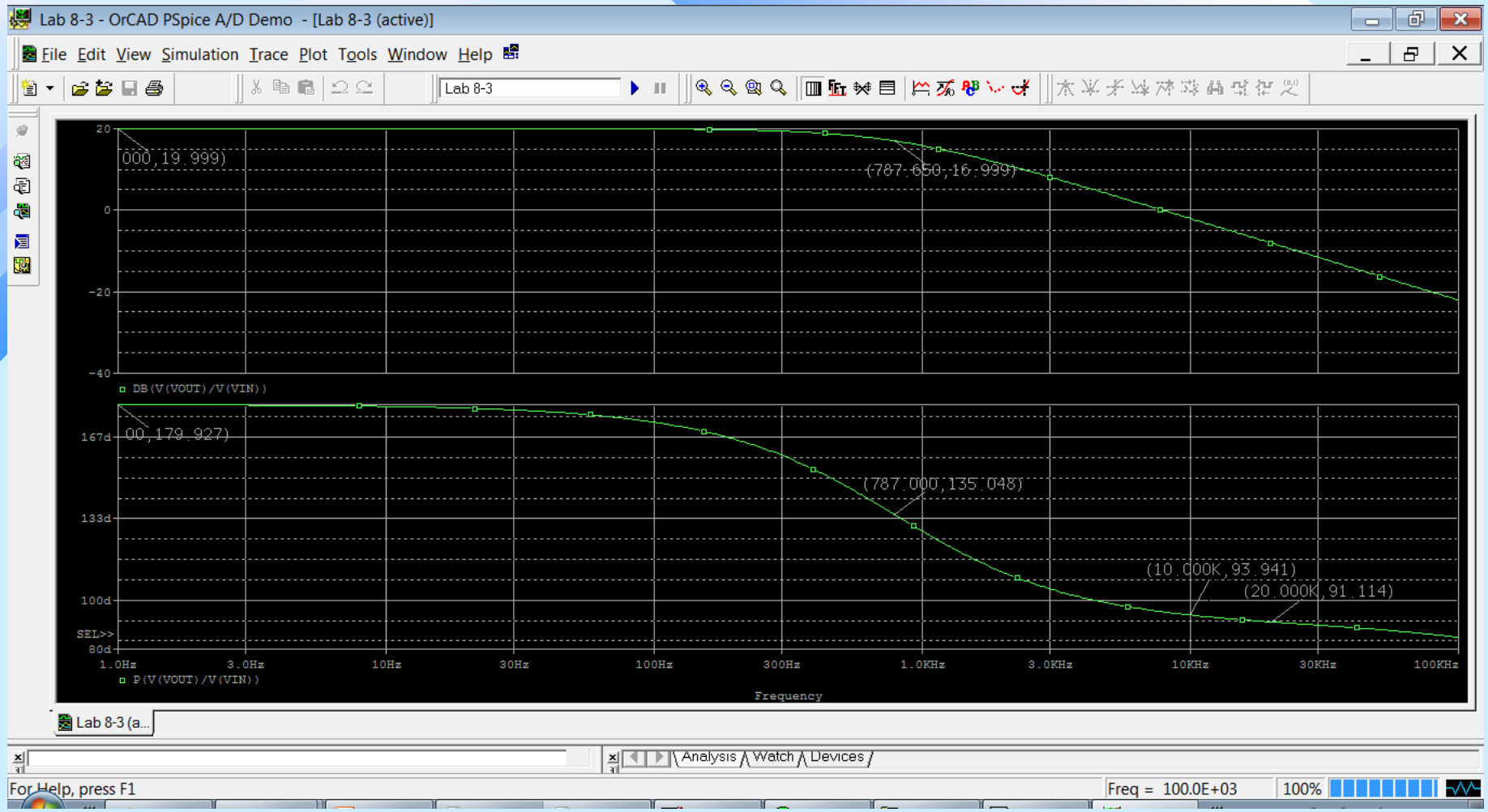


 to mark the value

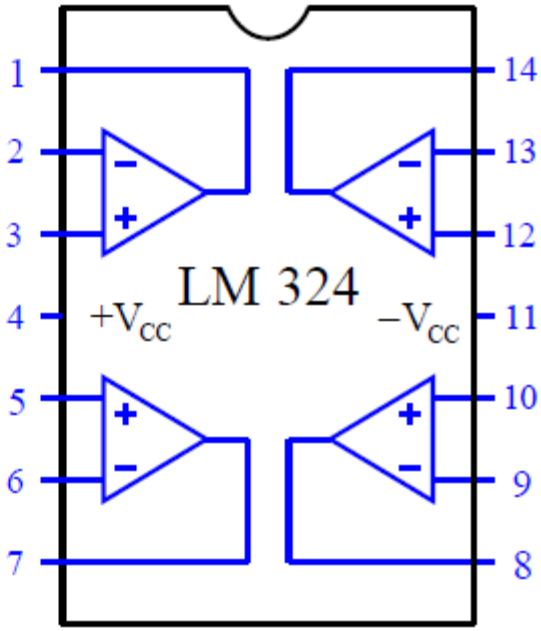
cursor search 



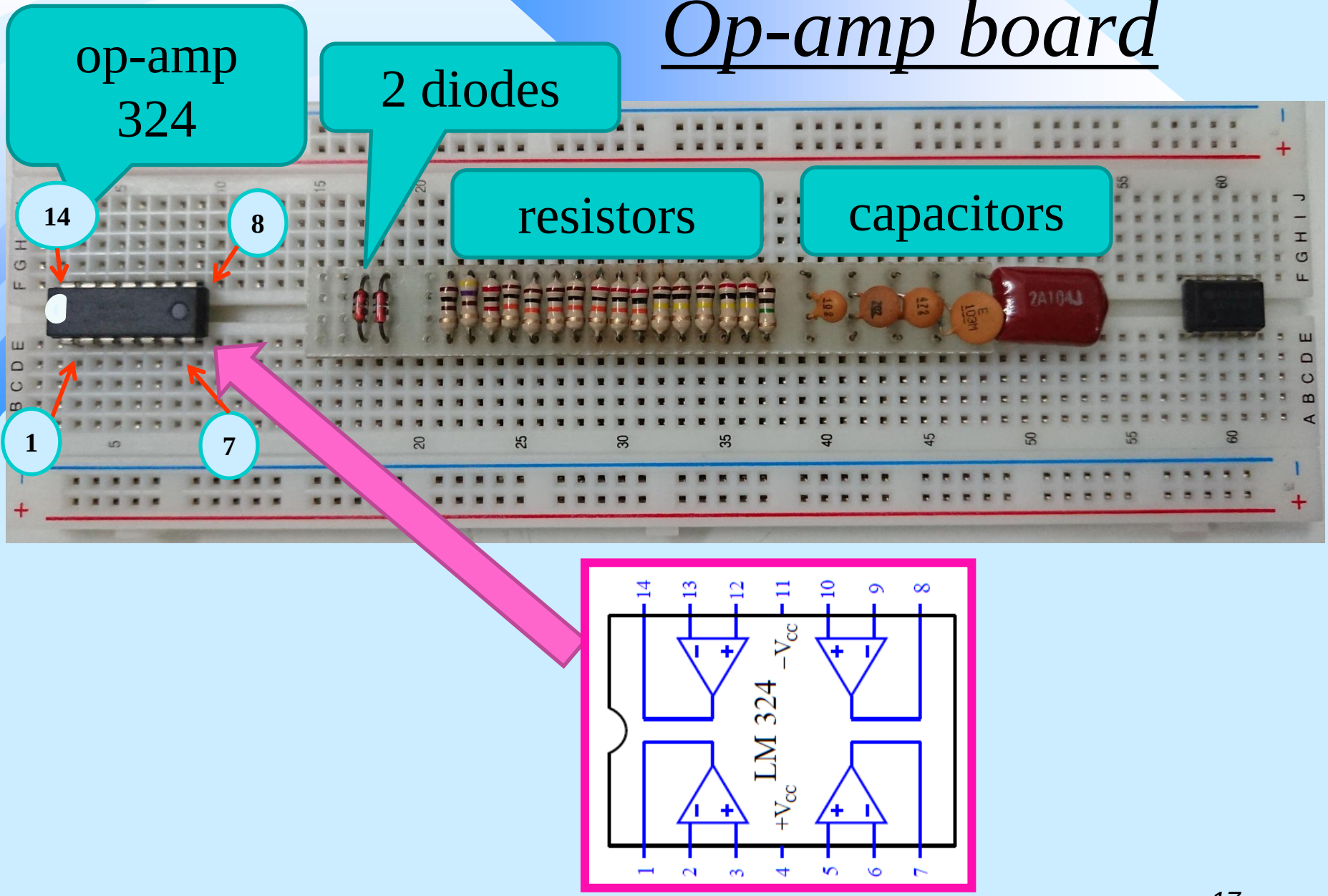
 to mark the value


Lab 8-3 - OrCAD PSpice A/D Demo - [Lab 8-3 (active)]
File Edit View Simulation Trace Plot Tools Window Help
Lab 8-3
20
0
-20
-40
000,19.999)
(787.650,16.999)
DB(V(VOUT)/V(VIN))
167d
133d
100d
SEL>>
80d
00,179.927)
(787.000,135.048)
(10.000K,93.941)
(20.000K,91.114)
1.0Hz
3.0Hz
10Hz
30Hz
100Hz
300Hz
1.0KHz
3.0KHz
10KHz
30KHz
100KHz
P(V(VOUT)/V(VIN))
Frequency
Lab 8-3 (a...
Analysis
Watch
Devices
For Help, press F1
Freq = 100.0E+03
100%

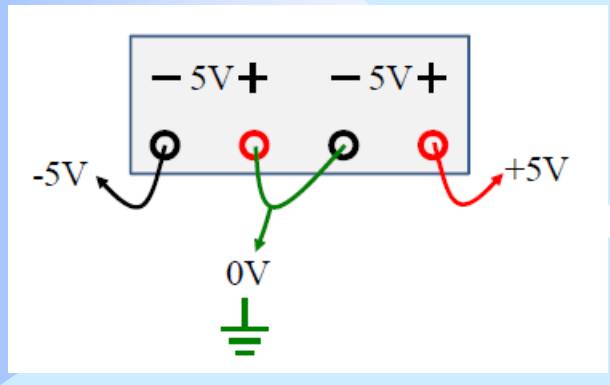
Lab 8 Op-Amp II



Op-amp board


op-amp
324
2 diodes
resistors
capacitors
14
8
1
7
LM 324
$-V_{CC}$
$+V_{CC}$
14 13 12 11 10 9 8
1 2 3 4 5 6 7

How to build +5V/- 5V supply



This is not the ground

Set both CH1 and CH2 to 5V

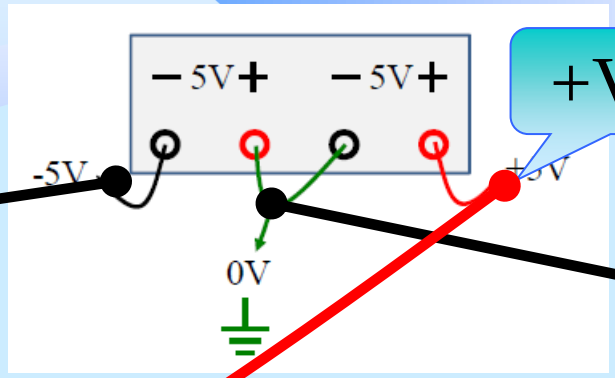
-5V

+5V

This is Ground for all circuits

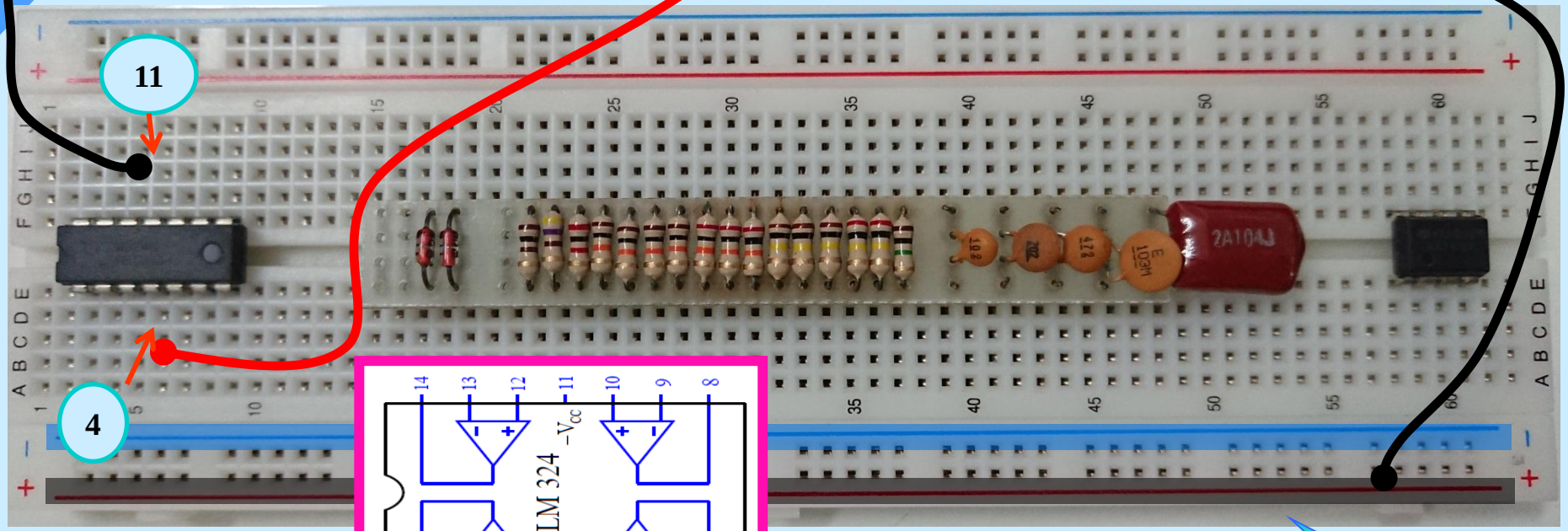
Connect supply voltages

ไฟ บวก ลบ และ ground
ให้ต่อค้างไว้แบบนี้ทุกวงจร



-Vcc

+Vcc



Gnd

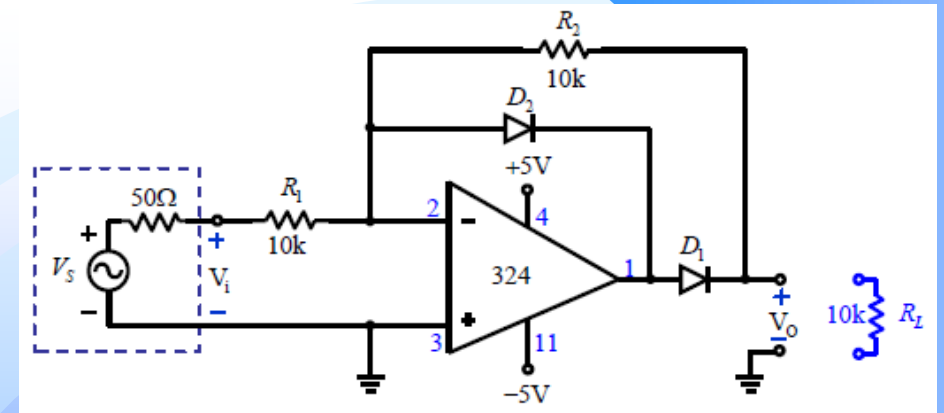


Fig. 1.1

Vout

1

2

3

Gnd

Vin

Apply 100Hz , 1 Vp-p sine

- Apply 100Hz , 1 Vp-p sine wave as input signal
- Measure and sketch $V_i, V_o, V_{(-)}$ in Fig 1.2a.

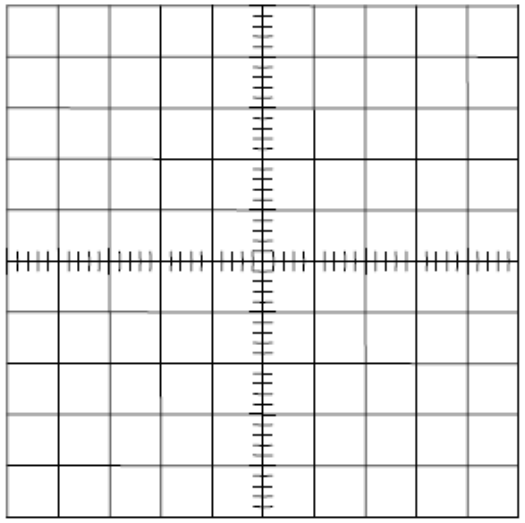


Fig. 1.2a

- Connect R_L, then measure and sketch $V_i, V_o, V_{(-)}$ in Fig 1.1b.

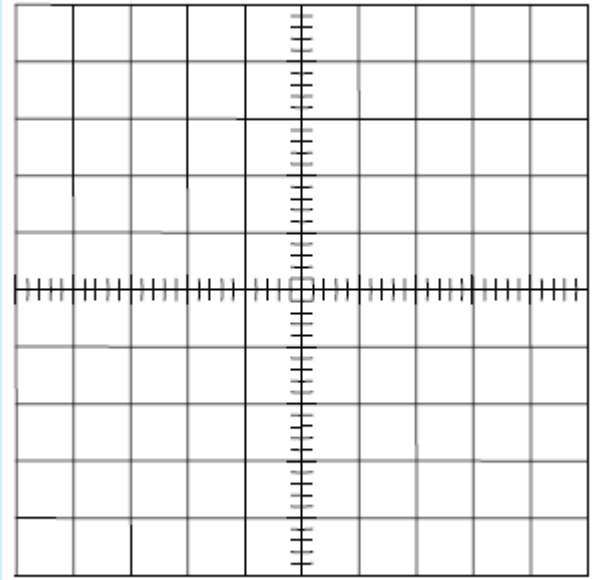


Fig. 1.2b

1.2 - Build a circuit as shown in Fig. 1.2

ต่อเพิ่มจากข้อ 1.1

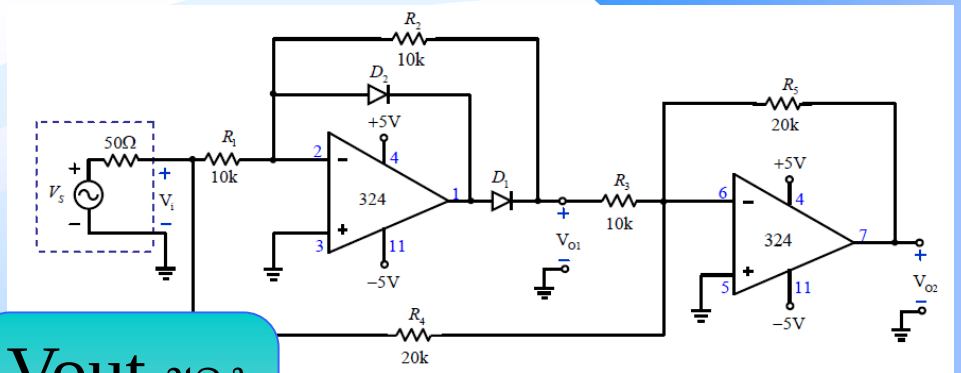


Fig. 1.2

Vout ของข้อ 1.1

Vout

7

5

6

Gnd

Vin

Apply 100Hz , 1 Vp-p sine

applying 100Hz 1 Vp-p sine-wave as input

measure V_{01} and V_{02} with CH2. Sketch all waveforms in Fig 1.2a.

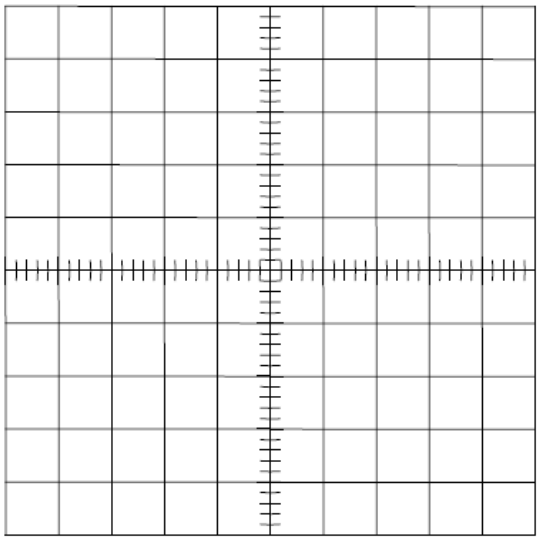


Fig. 1.2 a

Reverse direction of diode D1, D2 ,

measure and sketch V_i , V_{01} , V_{02} in Fig. 1.2b.

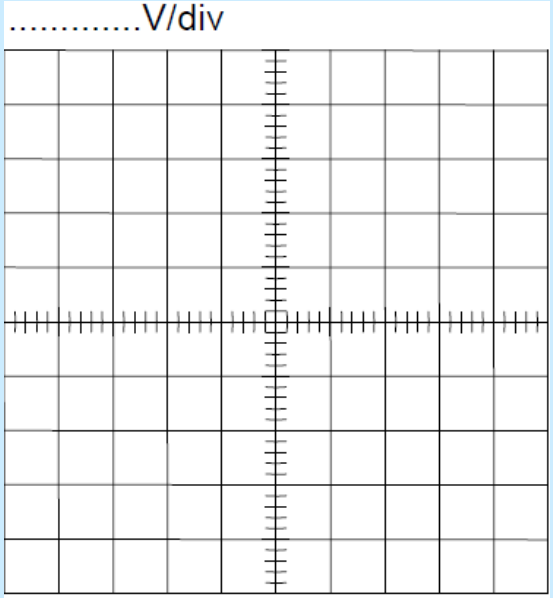
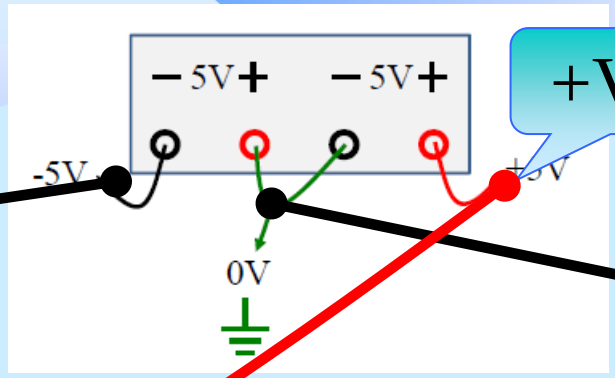


Fig. 1.2 b

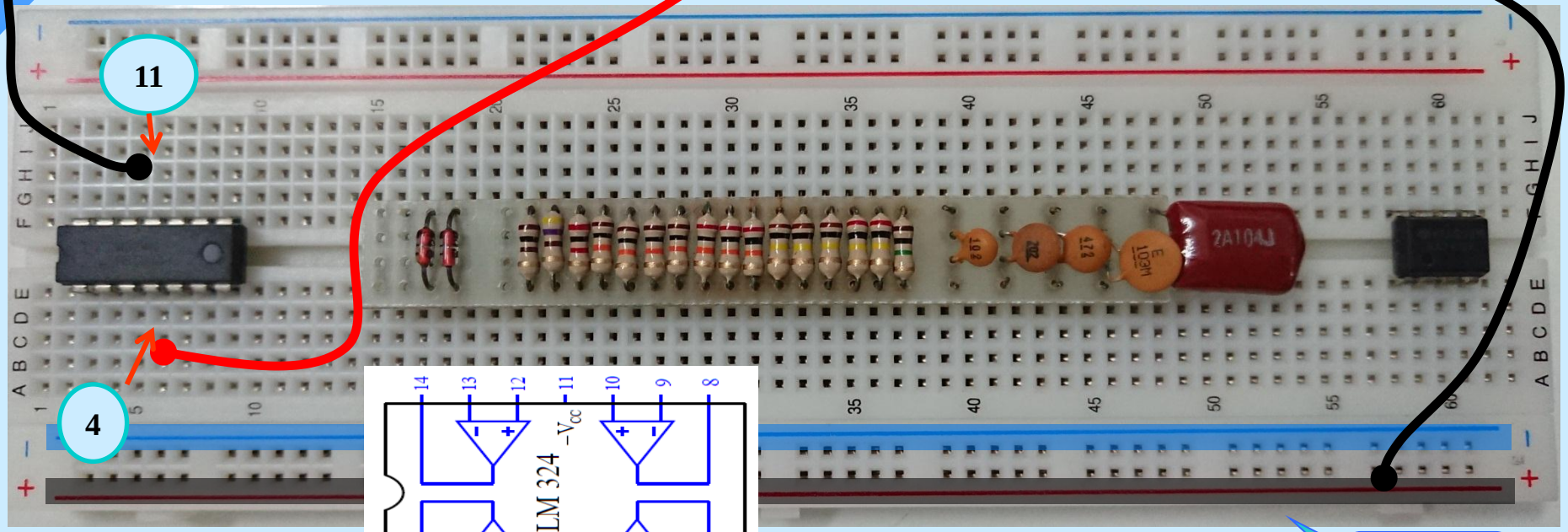
Connect supply voltages

ไฟ บวก ลบ และ ground
ให้ต่อค้างไว้แบบนี้ทุกวงจร



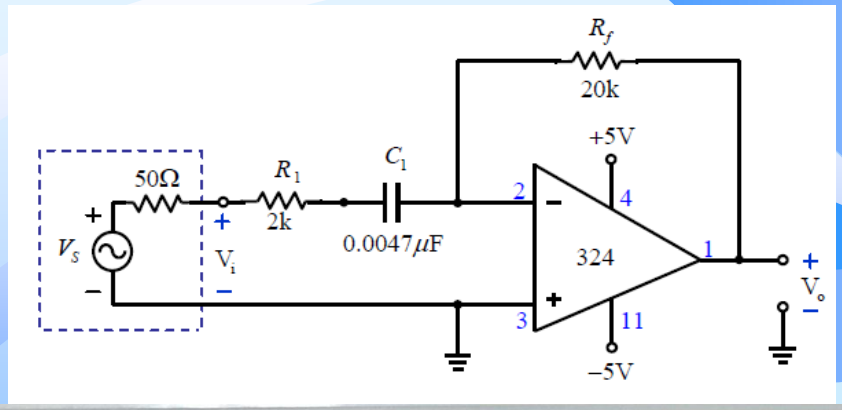
-Vcc

+Vcc

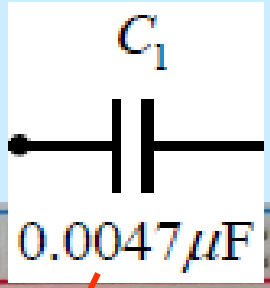


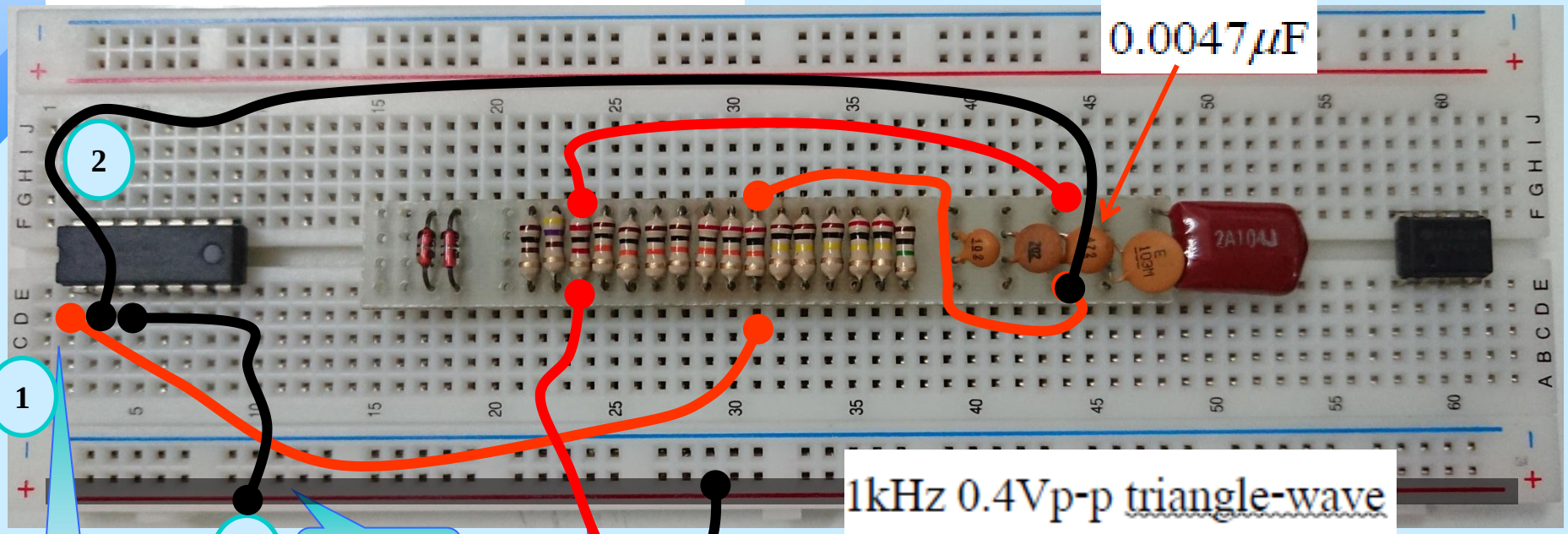
Gnd

Section 2. Study differentiator circuit



ไฟ บวก ลบ และ ground ให้ต่อค้างไว้ทุกวงจร





1kHz 0.4Vp-p triangle-wave as input signal.

Measure V_i and V_o with an oscilloscope

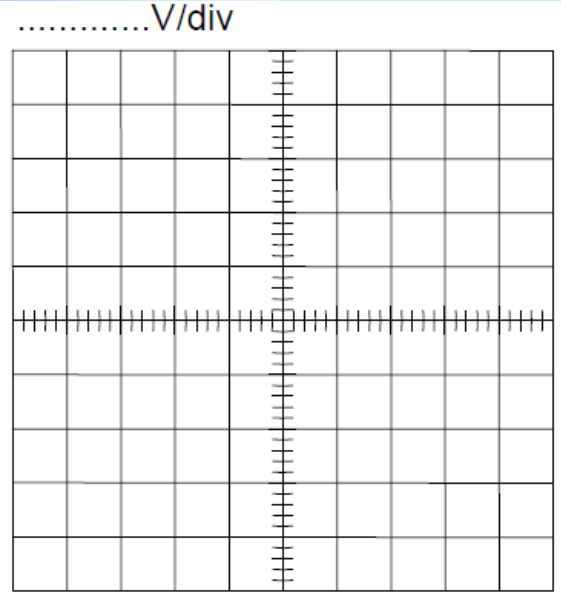


Fig. 2.1

Apply 0.4 Vp-p sine-wave by varying frequency

frequency

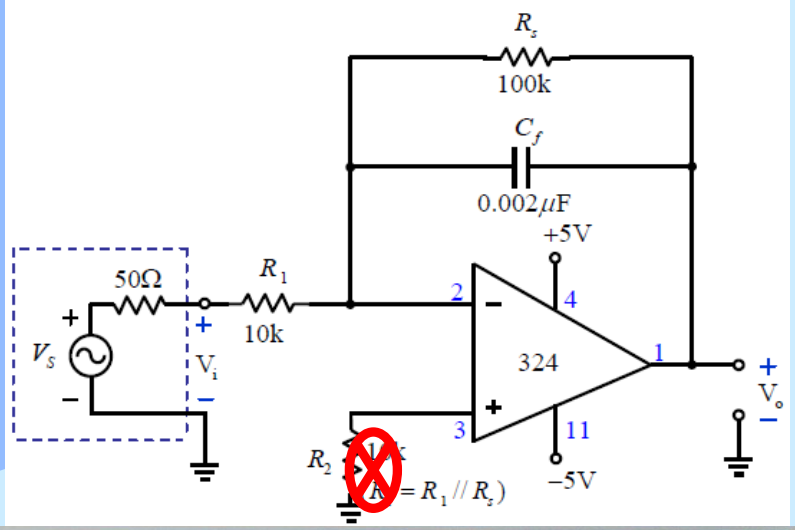
Table 2.1

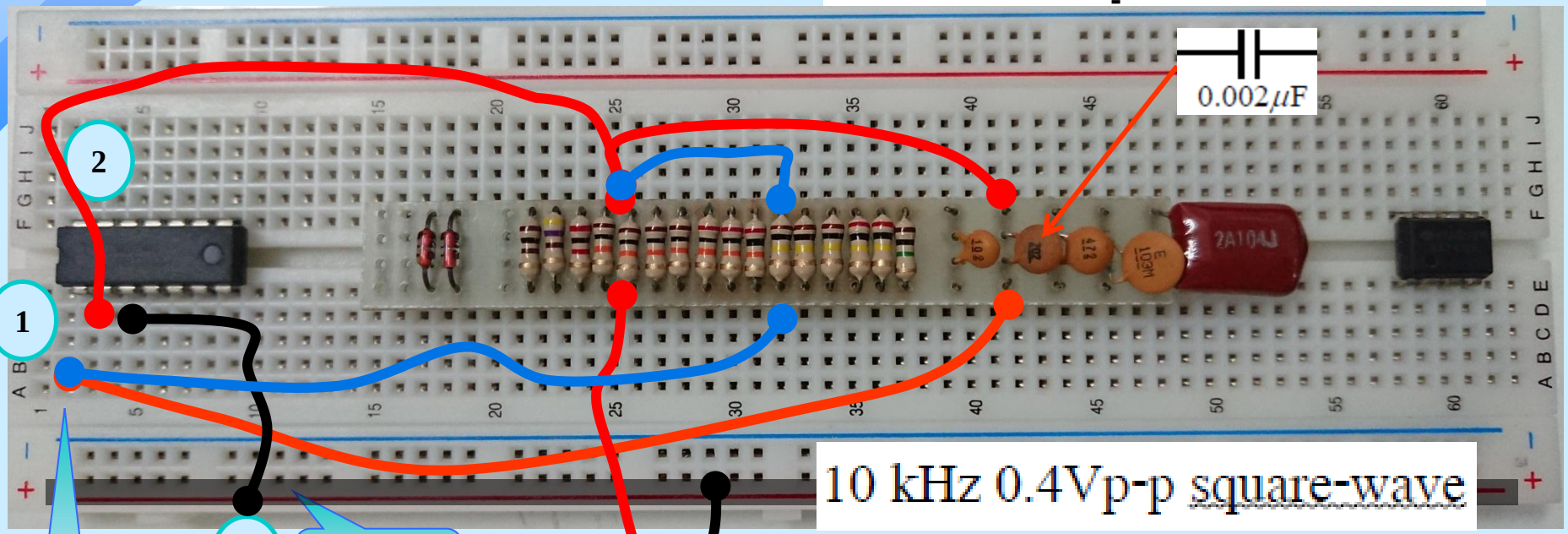
frequency	$V_{i,pp}$	$V_{o,pp}$	$\frac{V_{o,pp}}{V_{i,pp}}$	phase shift (V_o lead or lag V_i with ..... degree)
500 Hz				
1 kHz				
10 kHz				
40 kHz				

Observe from oscilloscope

Section 3. Study integrator circuit

ไฟ บวก ลบ และ ground
ให้ต่อค้างไว้ทุกวงจร





10 kHz 0.4Vp-p square-wave

Measure V_i and V_o with an oscilloscope and sketch in Fig.3.1

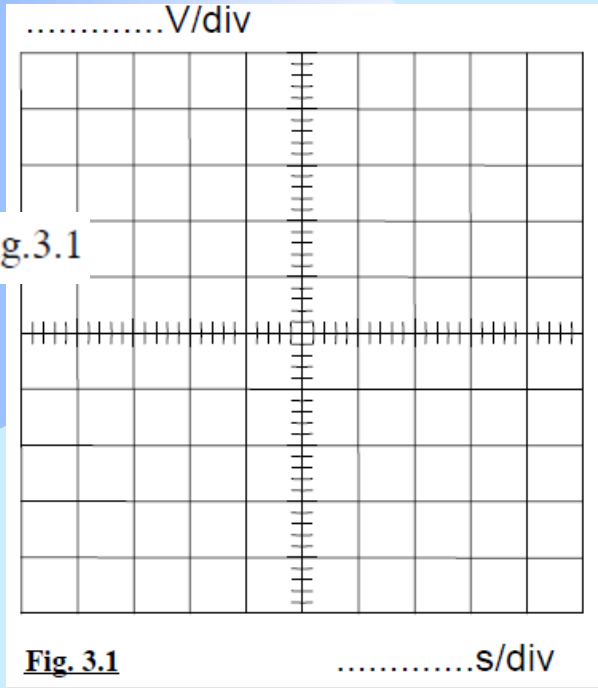


Fig. 3.1

0.4 Vp-p sine-wave by varying frequency

frequency

Table 3.1

frequency	$V_{i,pp}$	$V_{o,pp}$	$\frac{V_{o,pp}}{V_{i,pp}}$	phase shift (V_o lead or lag V_i with..... degree)
500 Hz				
10 kHz				
200 kHz				

Observe from oscilloscope