Osciladores sinusoidales
Trabajo Práctico 4

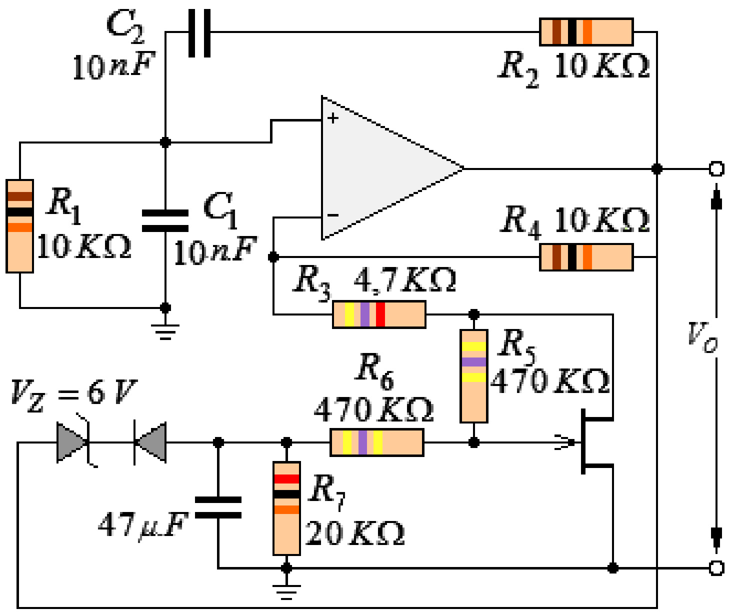
Problema 1

Cátedra: CIRCUITOS ELECTRÓNICOS II

Oscilador Puente de Wien

Problema Nº 1:

En el oscilador Puente de Wien de la figura se implementó un lazo de control automático, que corrige la ganancia del sistema cuando detecta que se sale del rango lineal de trabajo. Explicar el funcionamiento del mismo.



Oscilador Puente de Wien

$$T(s) = \frac{G(s)}{1 - G(s) \cdot H(s)}$$

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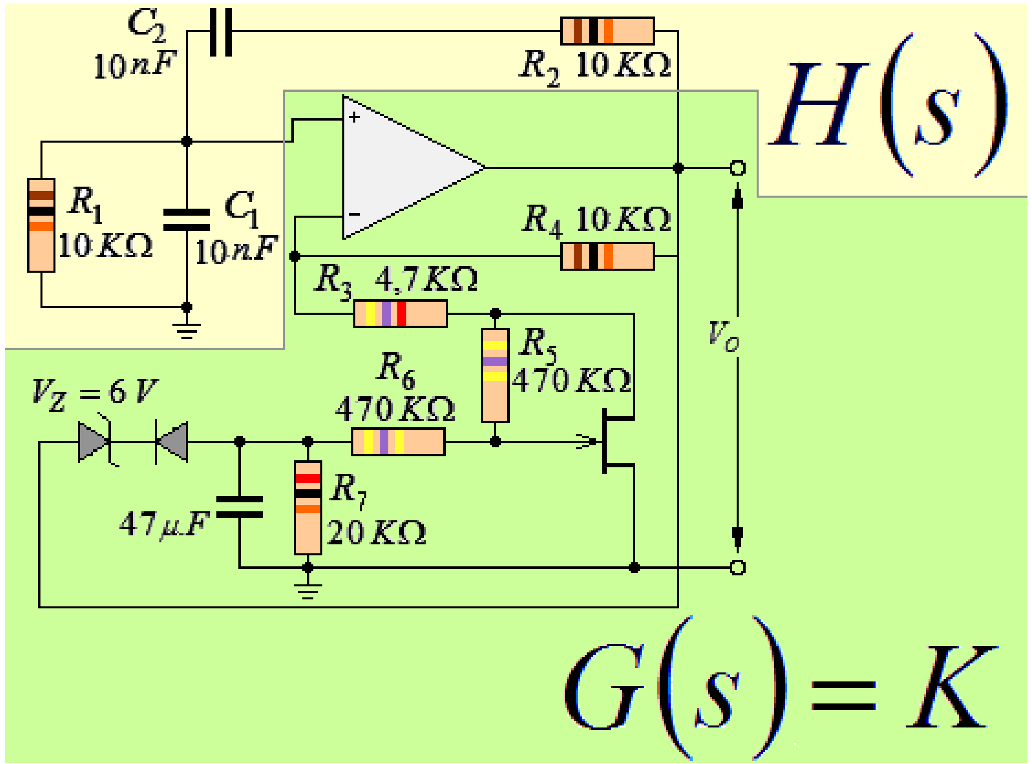
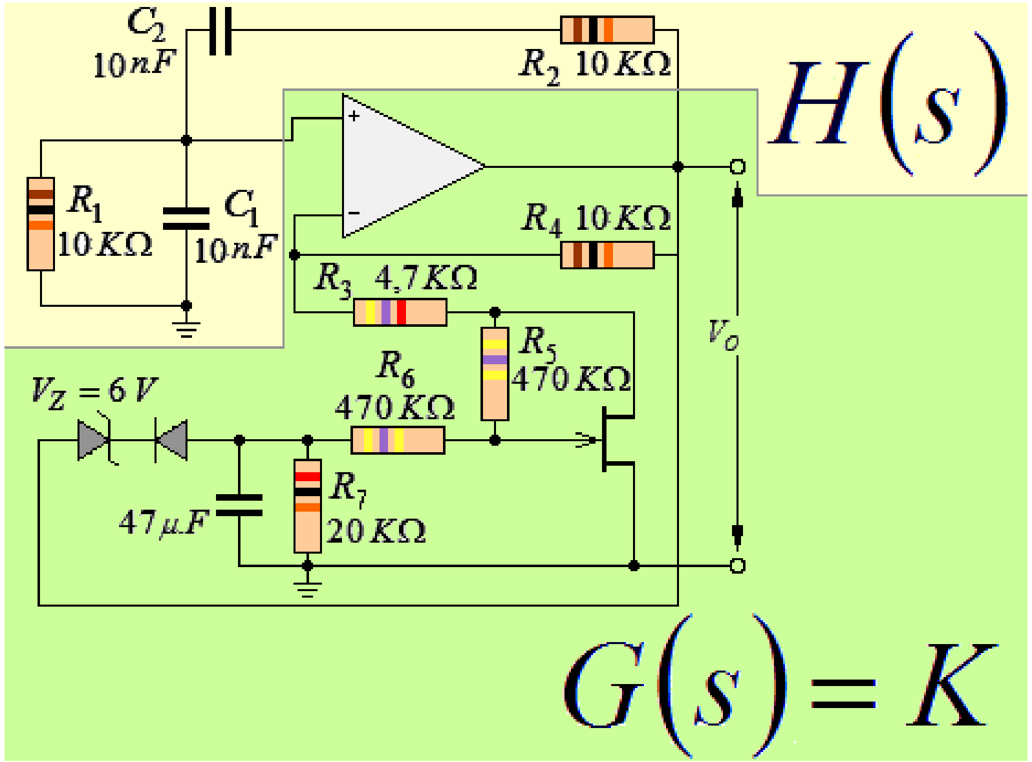


Oscilador Puente de Wien

$$T(s) = \frac{G(s)}{1 - G(s)\cdot H(s)}$$



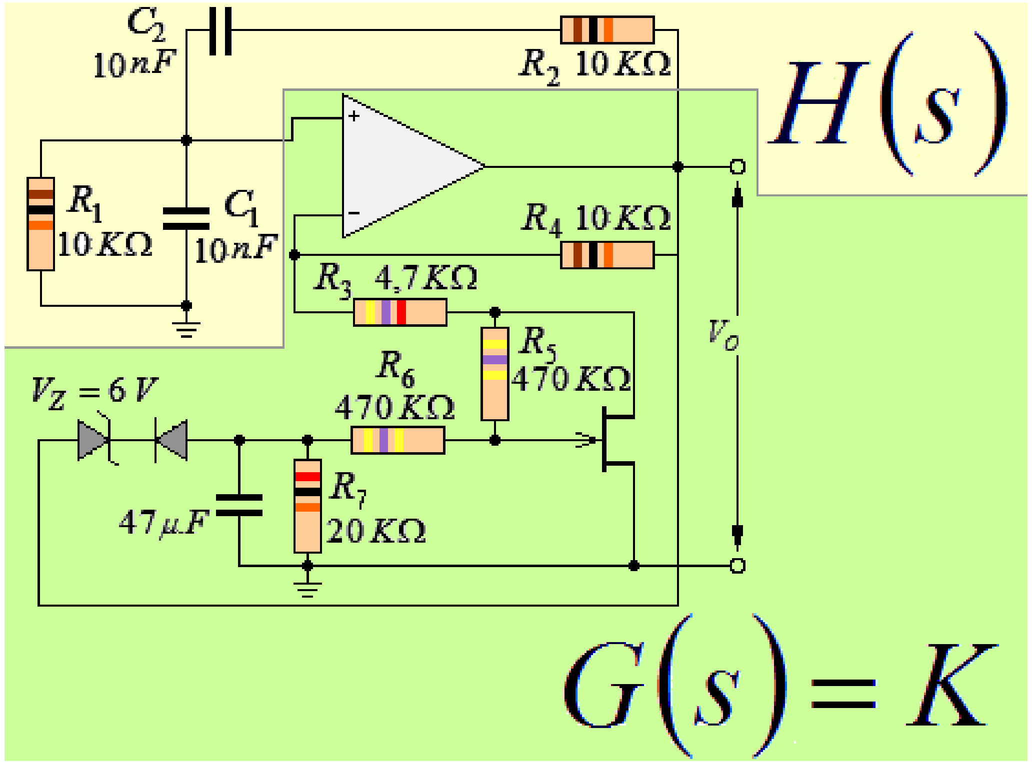
$$H(s) = \frac{v_{out}(s)}{v_{in}(s)} = \frac{Z_1(s)}{Z_1(s) + Z_2(s)}$$

$$G(s) = 1 + \frac{R_4}{R_3 + R_{FET}} = K$$

$$T(s) = \frac{K}{1 - \dfrac{K\cdot Z_1(s)}{Z_1(s)+Z_2(s)}} = \frac{K\cdot\left[Z_1(s)+Z_2(s)\right]}{Z_1(s)+Z_2(s)-K\cdot Z_1(s)} = \frac{K\cdot\left[Z_1(s)+Z_2(s)\right]\div Z_1(s)}{1+\left[Z_2(s)\div Z_1(s)\right]-K}$$

Oscilador Puente de Wien

$$T(s)=\frac{G(s)}{1-G(s)\cdot H(s)}$$



$$H(s)=\frac{v_{out}(s)}{v_{in}(s)}=\frac{Z_1(s)}{Z_1(s)+Z_2(s)}$$

$$G(s)=1+\frac{R_4}{R_3+R_{FET}}=K$$

$$T(s)=\frac{K}{1-\dfrac{K\cdot Z_1(s)}{Z_1(s)+Z_2(s)}}=\frac{K\cdot\left[Z_1(s)+Z_2(s)\right]}{Z_1(s)+Z_2(s)-K\cdot Z_1(s)}=\frac{K\cdot\left[Z_1(s)+Z_2(s)\right]\div Z_1(s)}{1+\left[Z_2(s)\div Z_1(s)\right]-K}$$

Oscilador Puente de Wien

$si: R_1 = R_2 \;\; y \;\; C_1 = C_2$

$$Z_1(s) = \frac{1}{1/R + s\,C} = \frac{R}{1 + s\,CR}$$

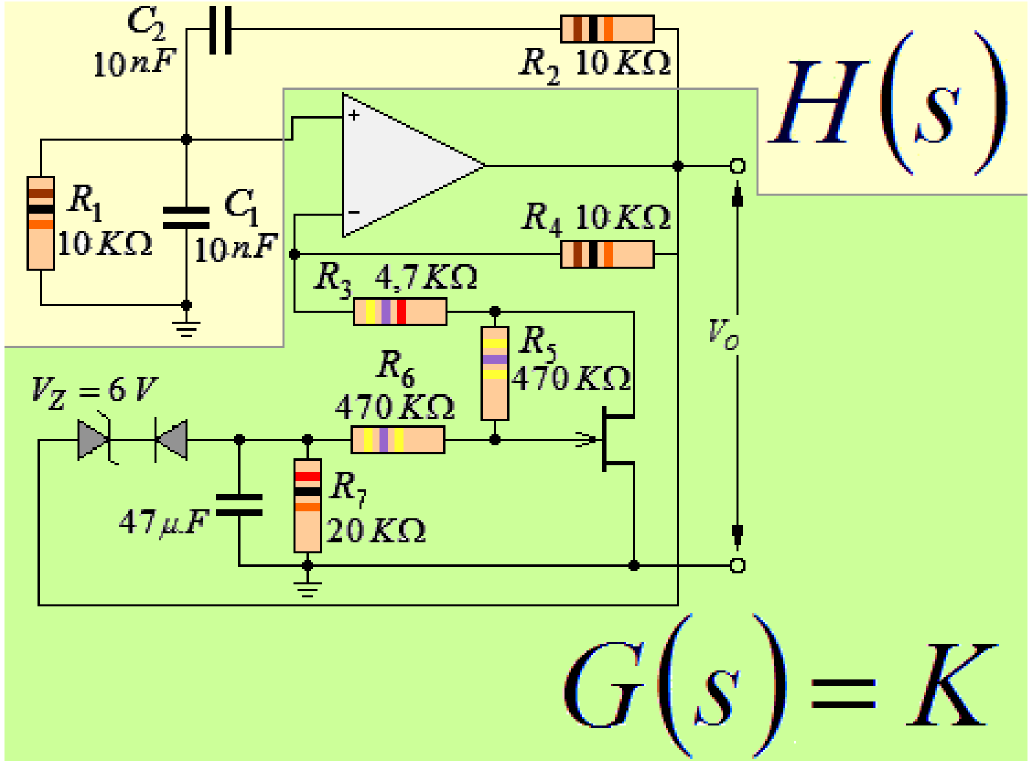
$$Z_2(s) = R + \frac{1}{s\,C} = \frac{s\,RC + 1}{s\,C}$$

$$D_{T(s)} = 1 + \left(Z_2(s) \div Z_1(s)\right) - K$$

$$D_{T(s)} = 1 + \left(\frac{s\,RC + 1}{s\,C} \div \frac{R}{1 + s\,CR}\right) - K$$

$$D_{T(s)} = s^2 + s\left(\frac{3}{RC} - \frac{K}{RC}\right) + \frac{1}{(RC)^2}$$

$$D_{T(s)} = s^2 + s\,\frac{2}{RC}\left(\frac{3 - K}{2}\right) + \frac{1}{(RC)^2}$$



$$T(s) = \frac{K}{1 - \dfrac{K \cdot Z_1(s)}{Z_1(s) + Z_2(s)}} = \frac{K \cdot \left[Z_1(s) + Z_2(s)\right]}{Z_1(s) + Z_2(s) - K \cdot Z_1(s)} = \frac{K \cdot \left[Z_1(s) + Z_2(s)\right] \div Z_1(s)}{1 + \left[Z_2(s) \div Z_1(s)\right] - K}$$

Oscilador Puente de Wien

$$si: R_1 = R_2 \;\; y \;\; C_1 = C_2 \qquad Z_1(s) = \frac{1}{1/R + s\,C} = \frac{R}{1 + s\,CR} \qquad Z_2(s) = R + \frac{1}{s\,C} = \frac{s\,RC + 1}{s\,C}$$

$$D_{T(s)} = 1 + \left(Z_2(s) \div Z_1(s)\right) - K$$

$$D_{T(s)} = 1 + \left(\frac{s\,RC + 1}{s\,C} \div \frac{R}{1 + s\,CR}\right) - K$$

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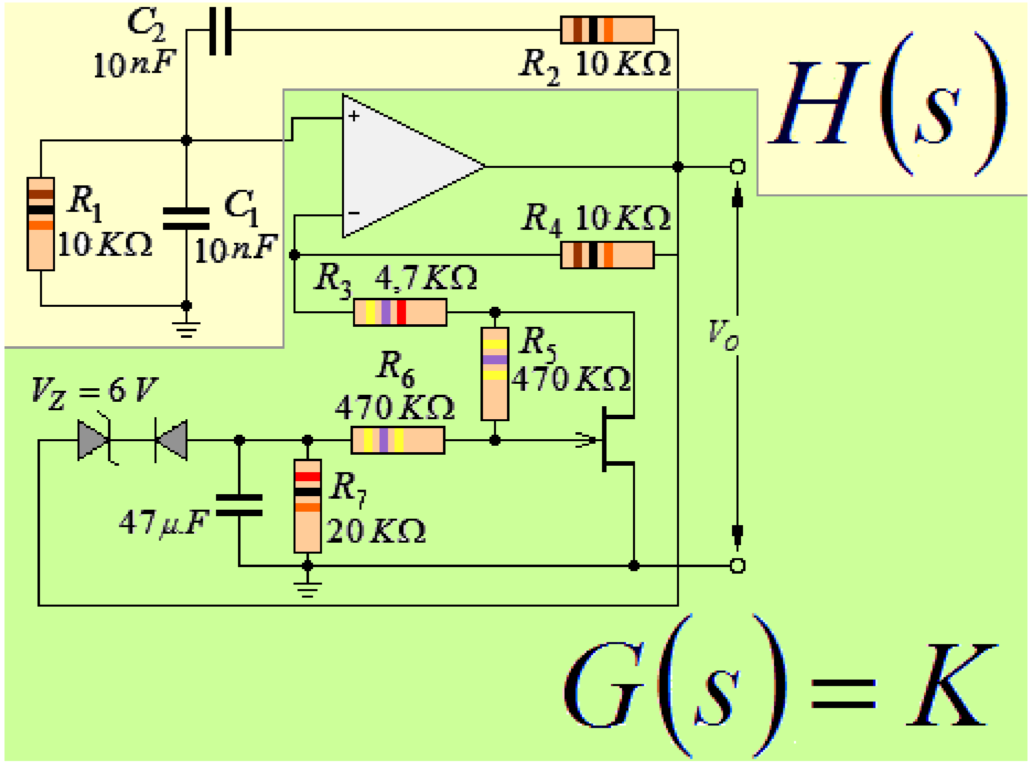


$$s^2 + s\,\frac{1}{RC}\,2\left(\frac{3-K}{2}\right) + \frac{1}{(RC)^2} = s^2 + s w_0 2\xi + w_0^2$$

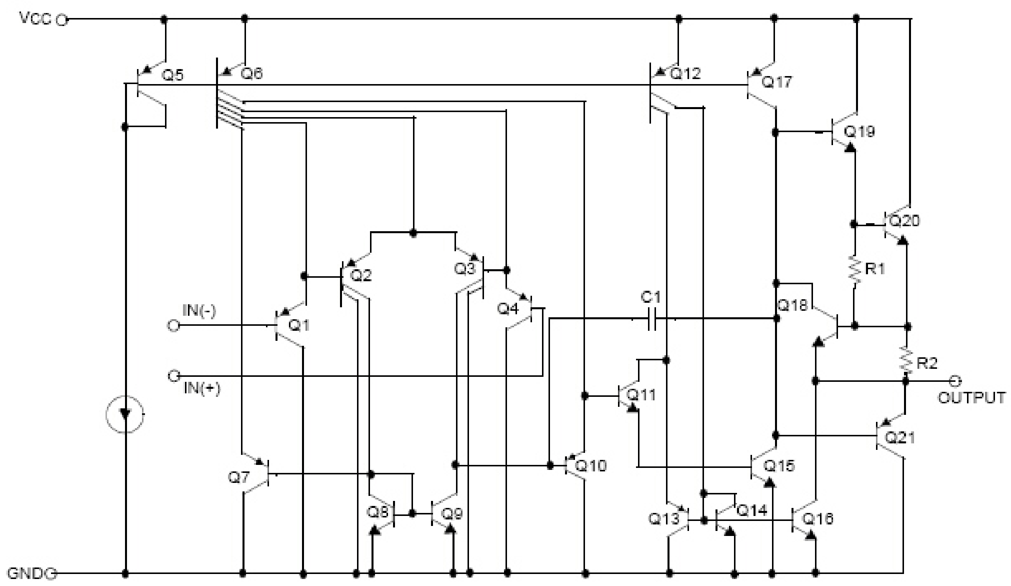
$$w_0 = \frac{1}{RC} \qquad \xi = \left(\frac{3-K}{2}\right)$$

LM2902,LM324/LM324A,LM224/LM224A

1 / 4 *LM* 324

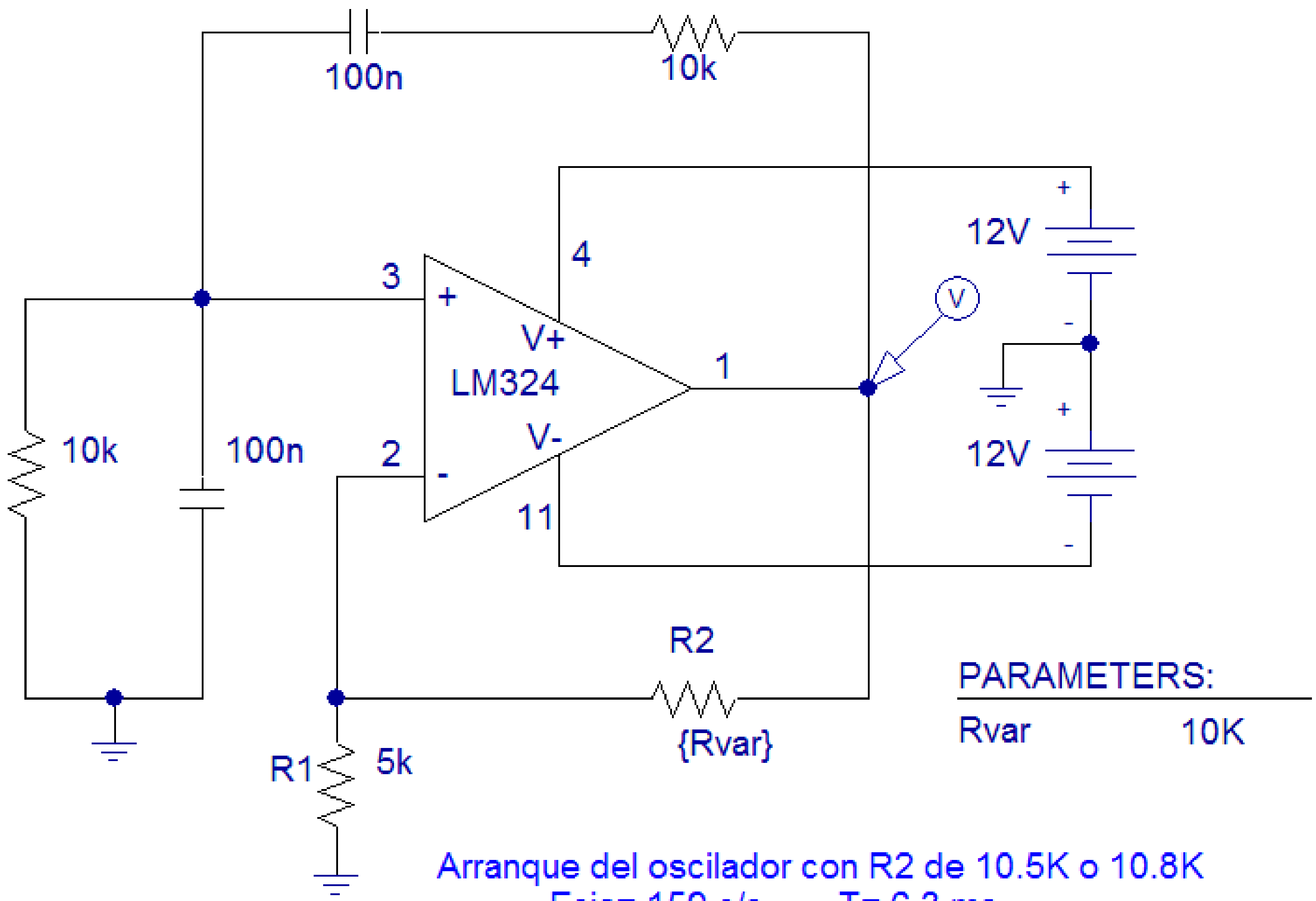
Schematic Diagram

(One Section Only)

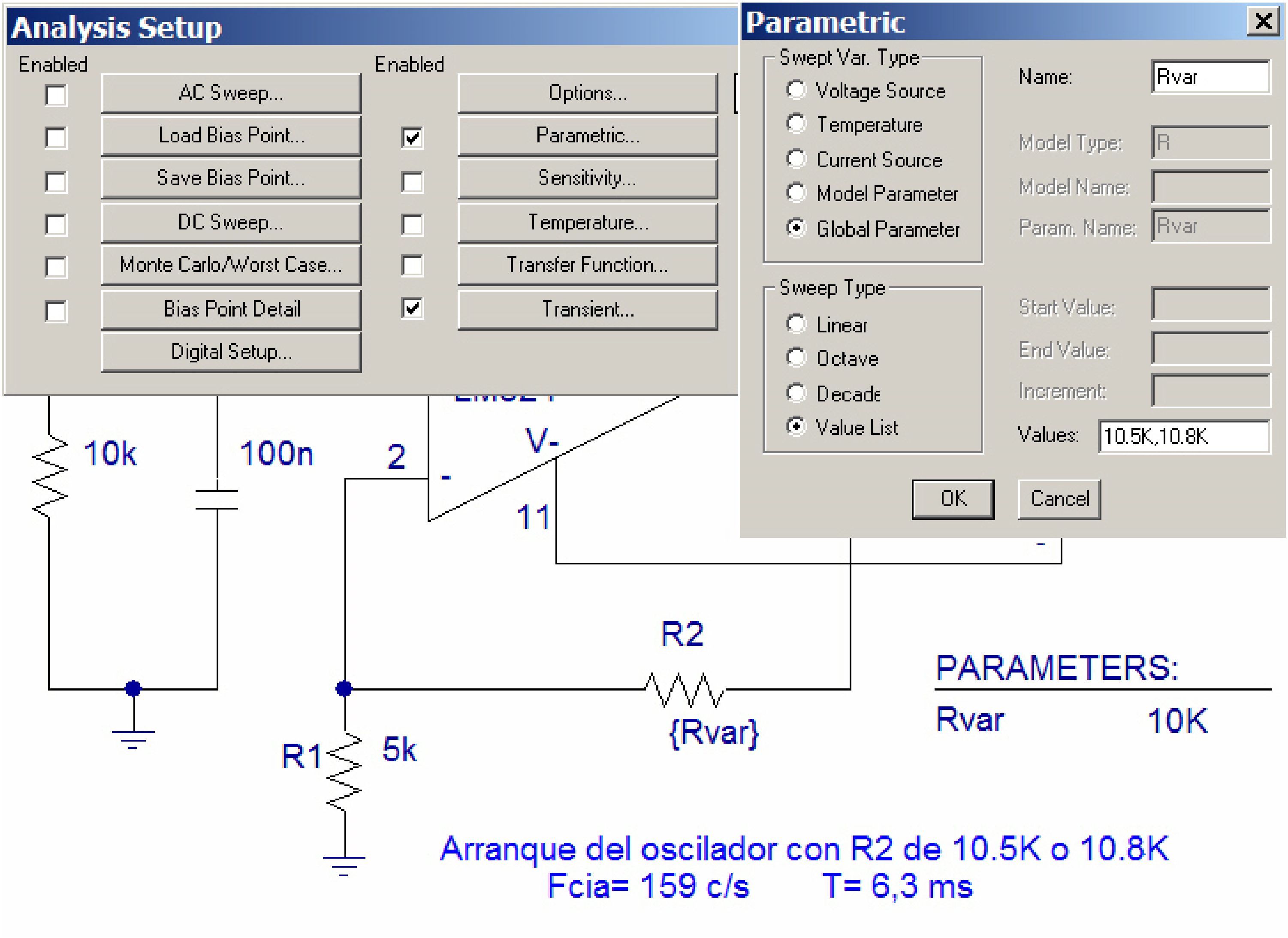


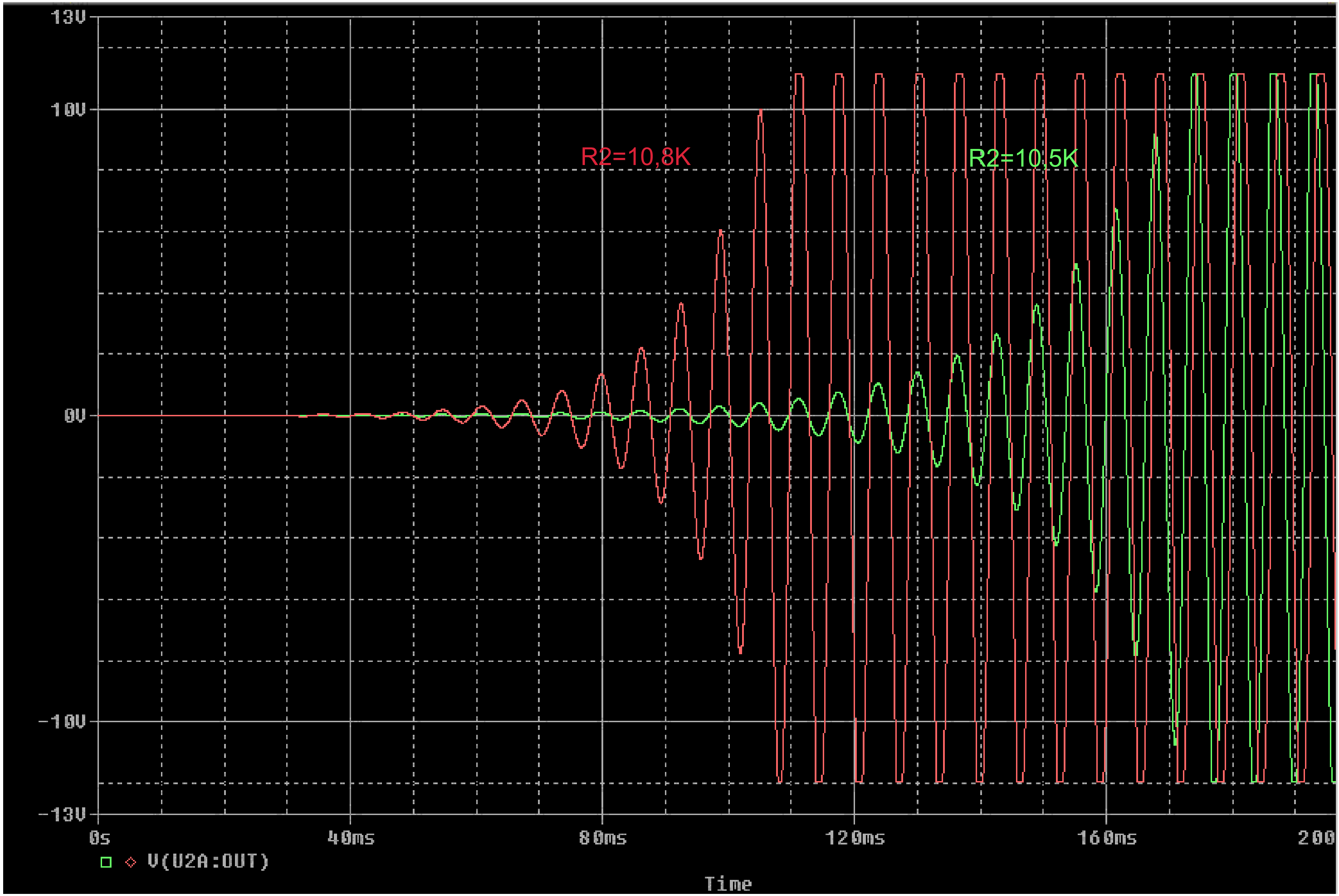
Absolute Maximum Ratings

Parameter	Symbol	LM224/LM224A	LM324/LM324A	LM2902	Unit
Power Supply Voltage	V_{CC}	±16 or 32	±16 or 32	±13 or 26	V
Differential Input Voltage	$V_{I(DIFF)}$	32	32	26	V
Input Voltage	V_I	-0.3 to +32	-0.3 to +32	-0.3 to +26	V
Output Short Circuit to GND $V_{CC} \leq 15V$, $T_A=25°C$(one Amp)	-	Continuous	Continuous	Continuous	-
Power Dissipation, $T_A=25°C$ 14-DIP 14-SOP	P_D	1310 640	1310 640	1310 640	mW
Operating Temperature Range	T_{OPR}	-25 ~ +85	0 ~ +70	-40 ~ +85	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	-65 ~ +150	-65 ~ +150	°C

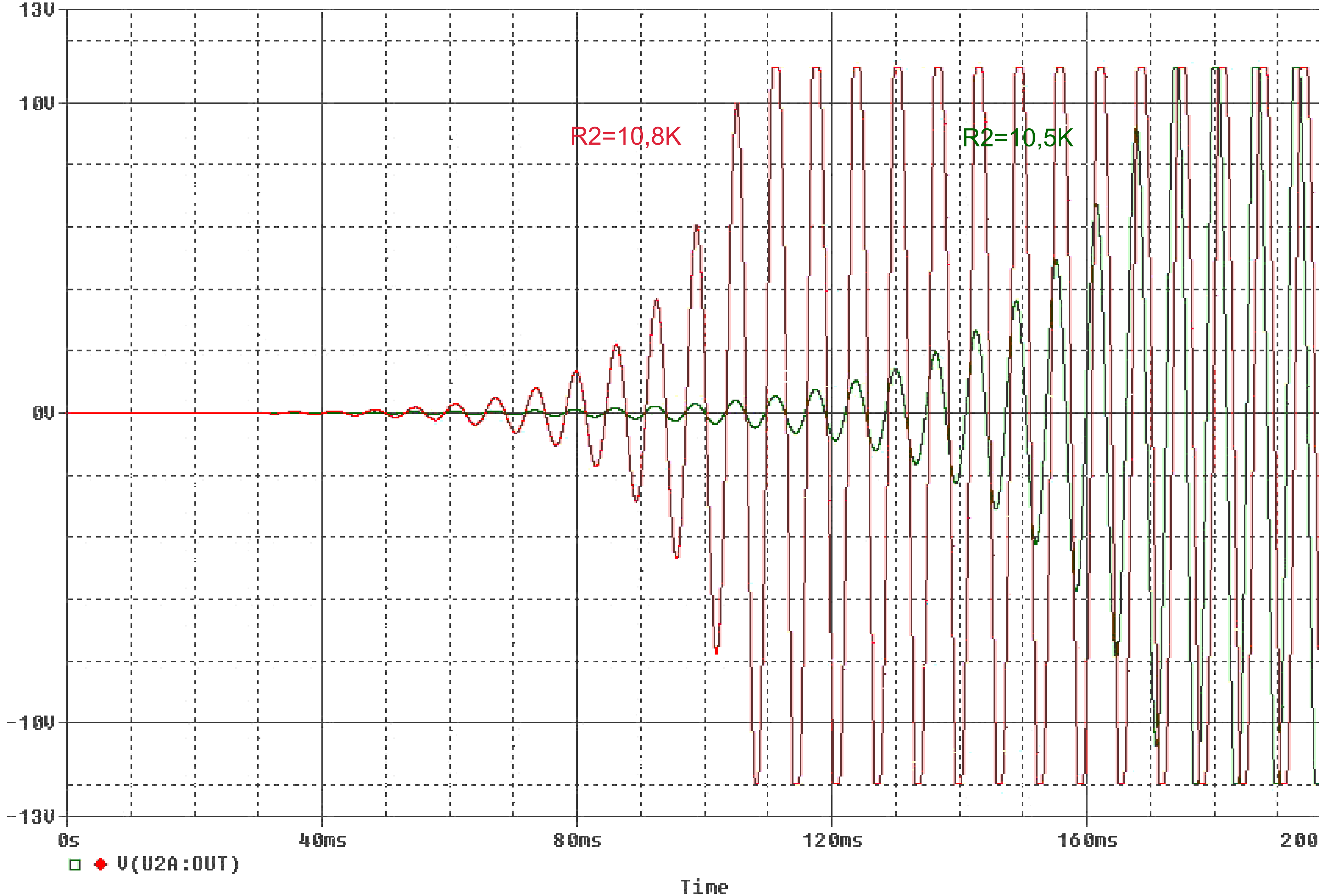


Arranque del oscilador con R2 de 10.5K o 10.8K
Fcia= 159 c/s T= 6,3 ms

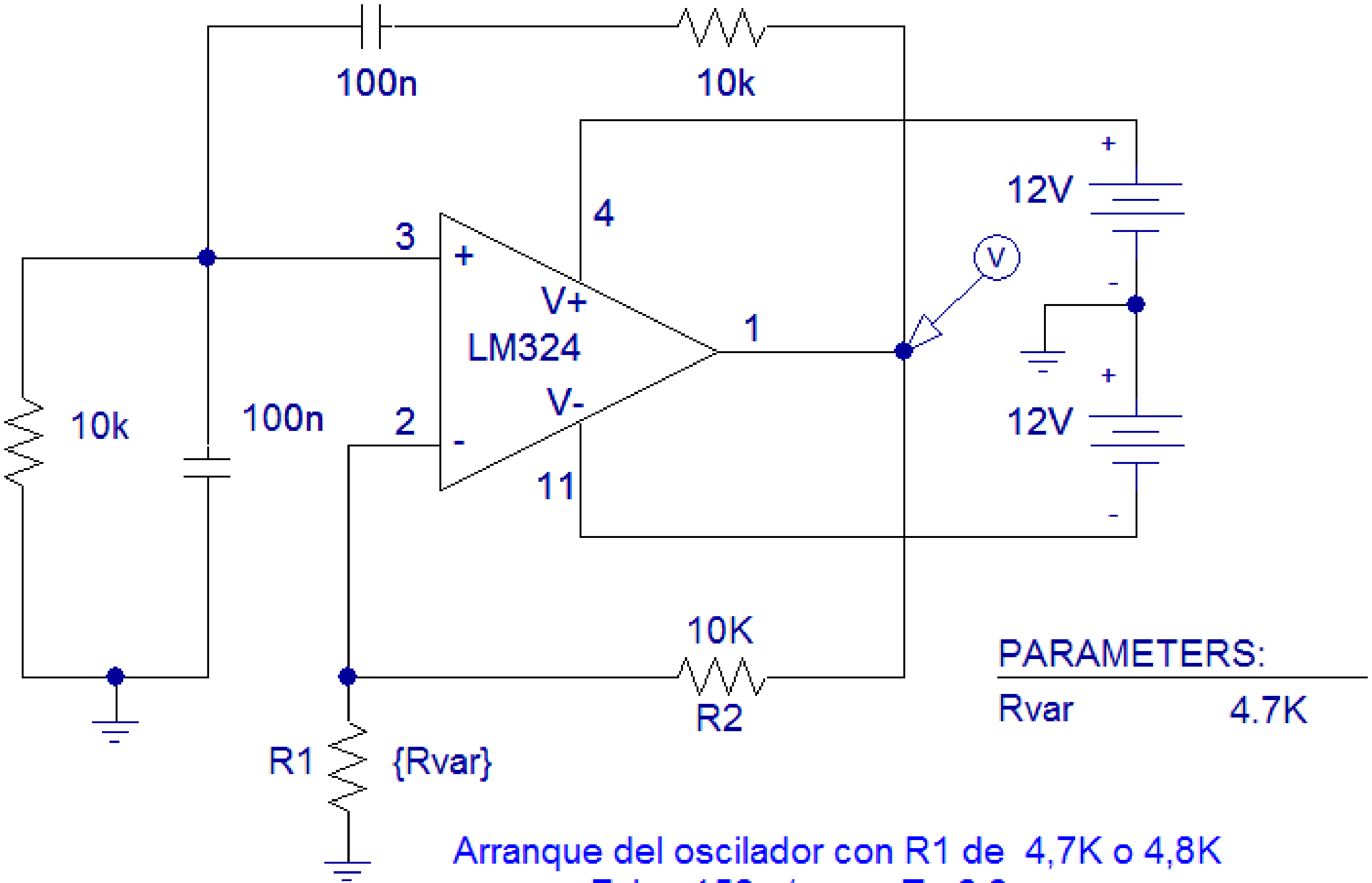

Analysis Setup
Enabled
AC Sweep...
Load Bias Point...
Save Bias Point...
DC Sweep...
Monte Carlo/Worst Case...
Bias Point Detail
Digital Setup...
Enabled
Options...
Parametric...
Sensitivity...
Temperature...
Transfer Function...
Transient...
Parametric
Swept Var. Type
Voltage Source
Temperature
Current Source
Model Parameter
Global Parameter
Name: Rvar
Model Type: R
Model Name:
Param. Name: Rvar
Sweep Type
Linear
Octave
Decade
Value List
Start Value:
End Value:
Increment:
Values: 10.5K,10.8K
OK
Cancel
10k
100n
2
V-
11
R2
{Rvar}
R1
5k
PARAMETERS:
Rvar 10K
Arranque del oscilador con R2 de 10.5K o 10.8K
Fcia= 159 c/s T= 6,3 ms



Respuesta del oscilador con dos valores distintos de R2

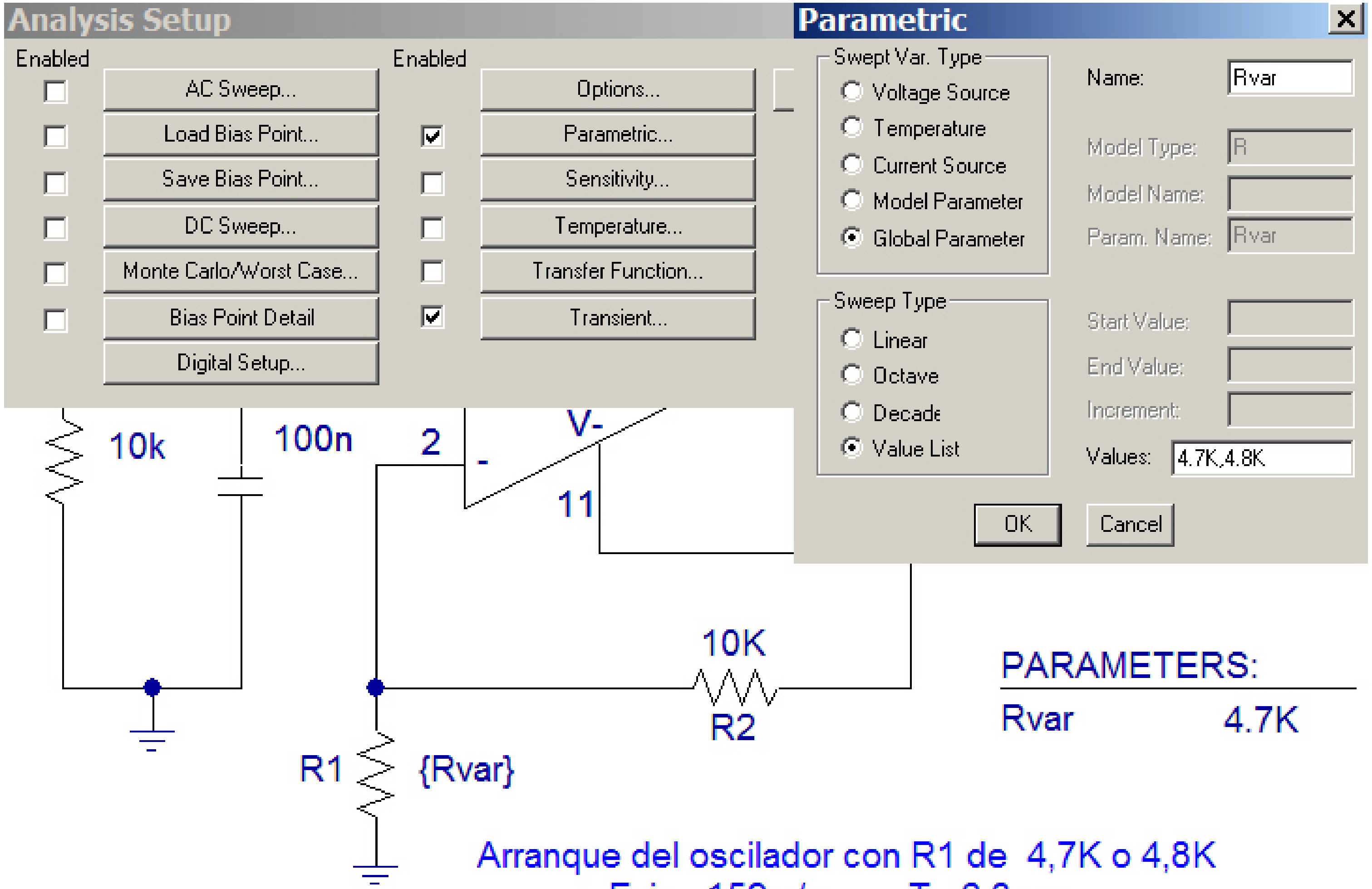


Respuesta del oscilador con dos valores distintos de R2

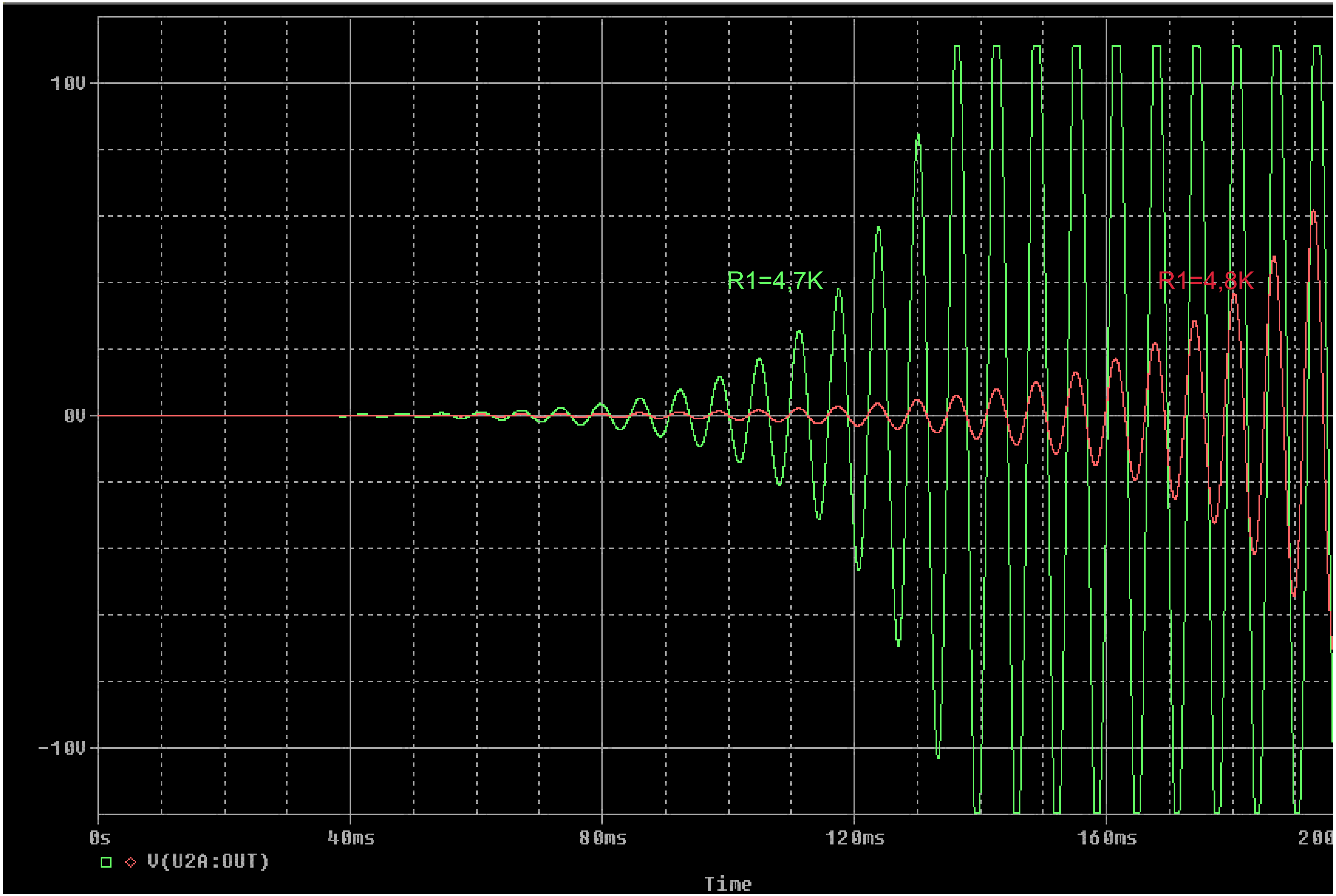


Arranque del oscilador con R1 de 4,7K o 4,8K

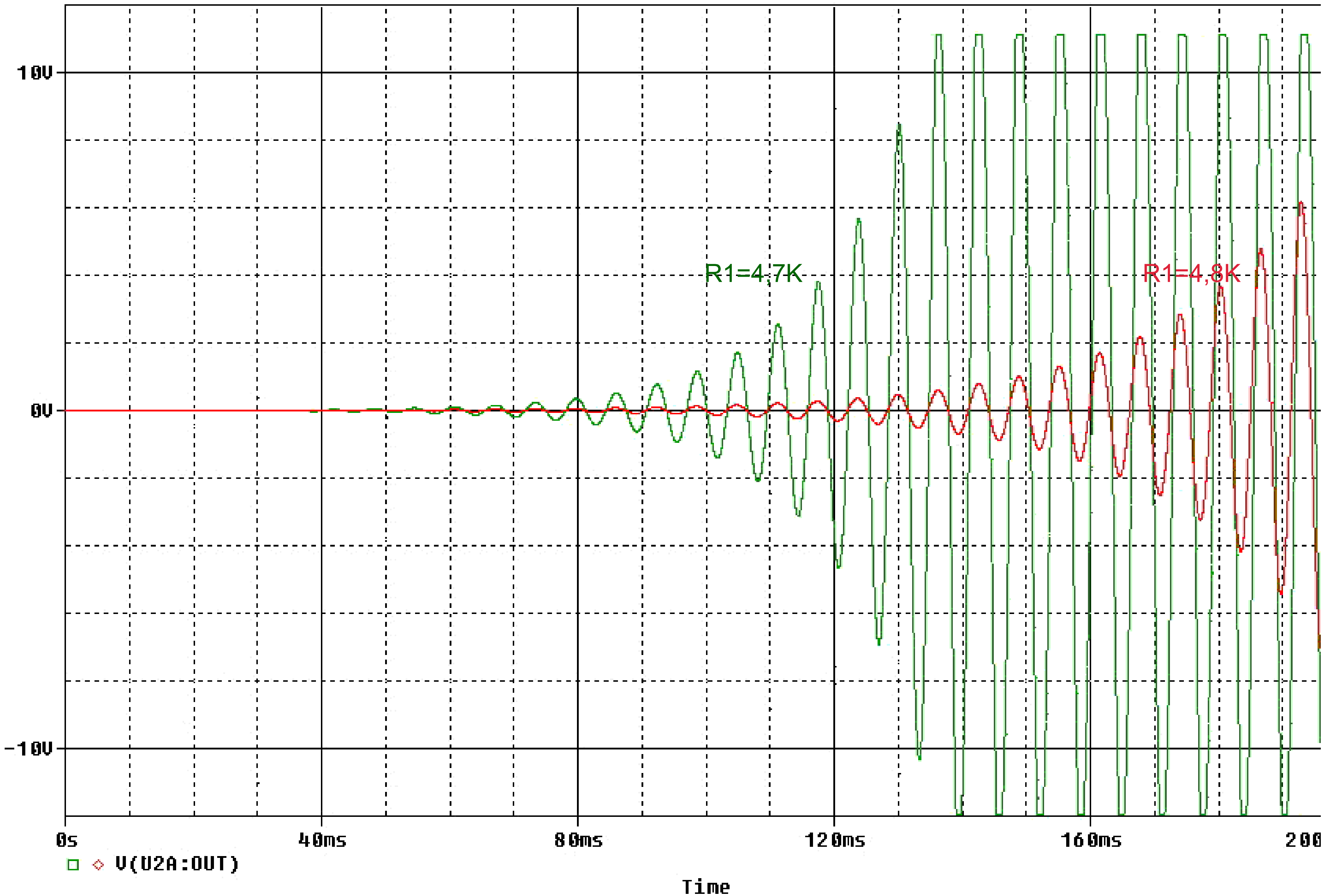
Fcia= 159 c/s.　　T= 6,3 ms



Arranque del oscilador con R1 de 4,7K o 4,8K
Fcia= 159 c/s.   T= 6,3 ms



Respuesta del oscilador con dos valores distintos de R1



Respuesta del oscilador con dos valores distintos de R1

Microsemi
SCOTTSDALE DIVISION

1N746 thru 1N759A, -1 and 1N4370 thru 1N4372A, -1 DO-35

Silicon 500 mW Zener Diodes

ELECTRICAL CHARACTERISTICS* @ 25°C

JEDEC TYPE NO. (NOTE1)	NOMINAL ZENER VOLTAGE V_Z @ I_{ZT} (NOTE 2)	ZENER TEST CURRENT I_{ZT}	MAXIMUM ZENER IMPEDANCE Z_{ZT} @ I_{ZT} (NOTE 3)	MAXIMUM REVERSE CURRENT I_R @ V_R = 1 VOLT		MAXIMUM ZENER CURRENT I_{ZM} (NOTE 4)	TYPICAL TEMP COEFF. OF ZENER VOLTAGE α_{VZ}
				@25°C	@+150°C		
	VOLTS	mA	OHMS	µA	µA	mA	%/°C
1N4370	2.4	20	30	100	200	150	-.085
1N4371	2.7	20	30	75	150	135	-.080
1N4372	3.0	20	29	50	100	120	-.075
1N746	3.3	20	28	10	30	110	-.066
1N747	3.6	20	24	10	30	100	-.058
1N748	3.9	20	23	10	30	95	-.046
1N749	4.3	20	22	2	30	85	-.033
1N750	4.7	20	19	2	30	75	-.015
1N751	5.1	20	17	1	20	70	+/-.010
1N752	5.6	20	11	1	20	65	+.030
1N753	6.2	20	7	.1	20	60	+.049
1N754	6.8	20	5	.1	20	55	+.053
1N755	7.5	20	6	.1	20	50	+.057
1N756	8.2	20	8	.1	20	45	+.060
1N757	9.1	20	10	.1	20	40	+.061
1N758	10.0	20	17	.1	20	35	+.062
1N759	12.0	20	30	.1	20	30	+.062

* JEDEC Registered Data

NOTE 1: Standard tolerance on JEDEC types shown is +/- 10%. Suffix letter A denotes +/- 5% tolerance; suffix letter C denotes +/- 2%; and suffix letter D denotes +/- 1% tolerance.

NOTE 2: Voltage measurements to be performed 20 seconds after application of dc test current.

NOTE 3: Zener impedance derived by superimposing on I_{ZT}, a 60 cps, rms ac current equal to 10% I_{ZT} (2mA ac). See MicroNote 202 for typical zener Impedance variation with different operating currents.

NOTE 4: Allowance has been made for the increase in V_Z due to Z_Z and for the increase in junction temperature as the unit approaches thermal equilibrium at the power dissipation of 400 mW.

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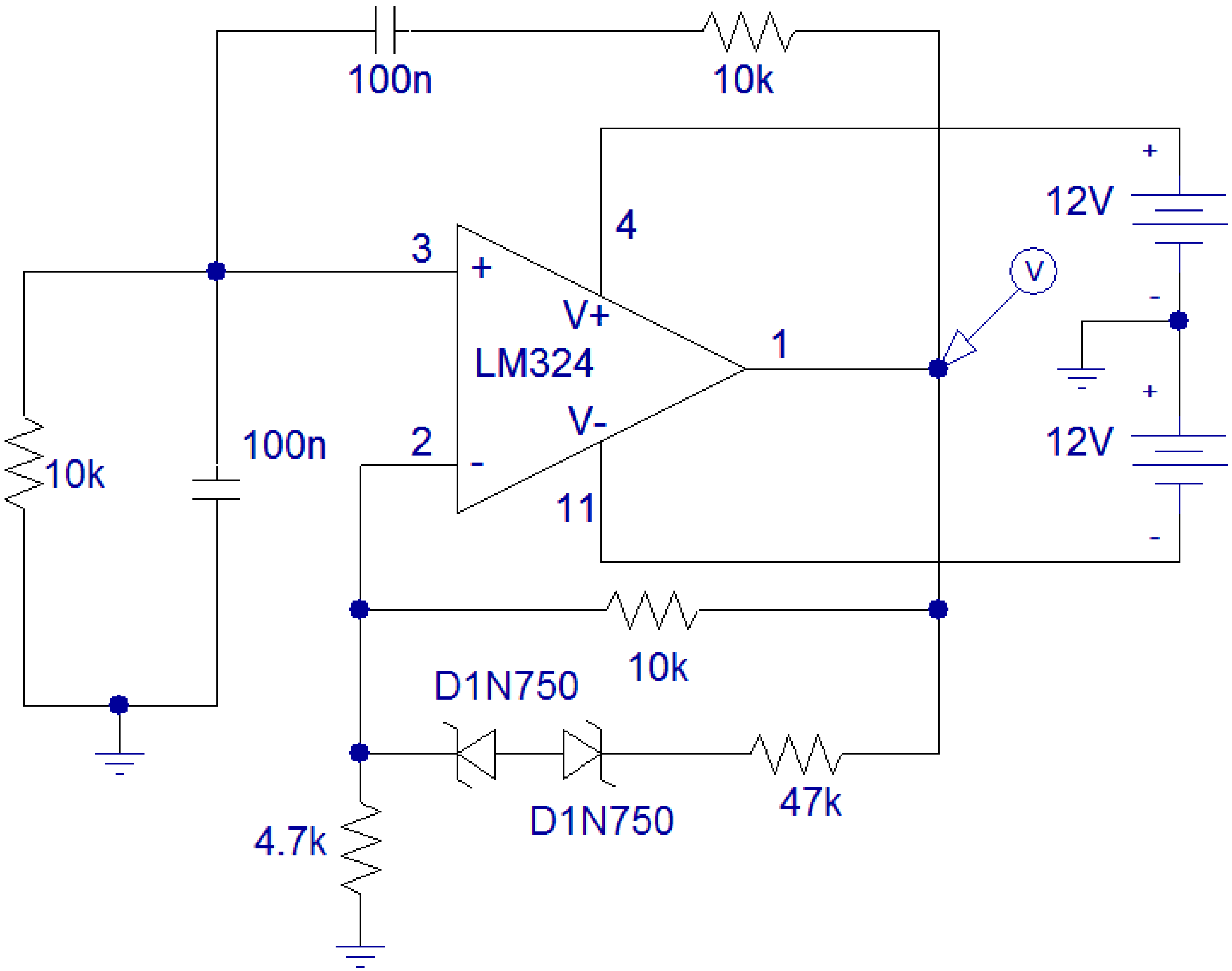
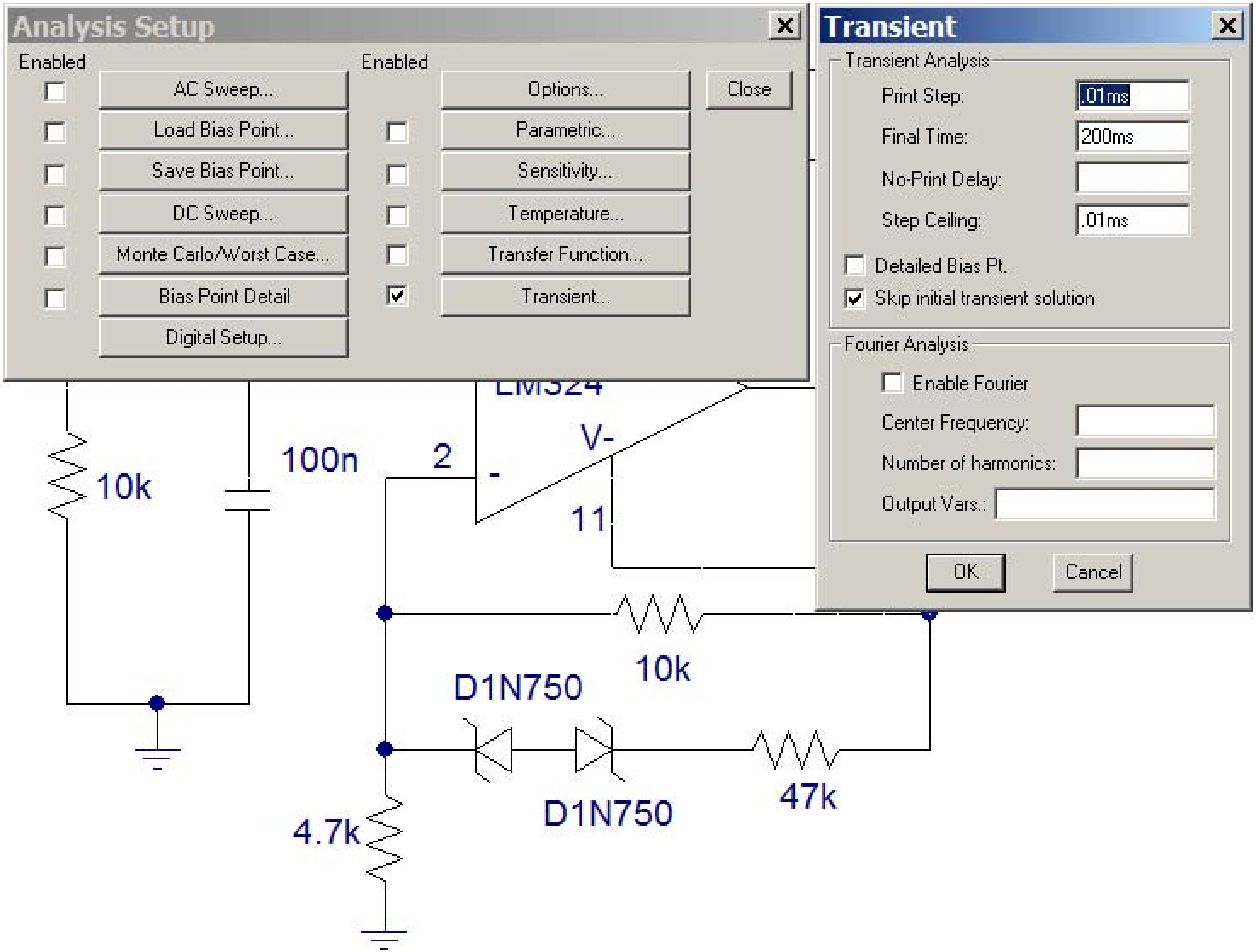
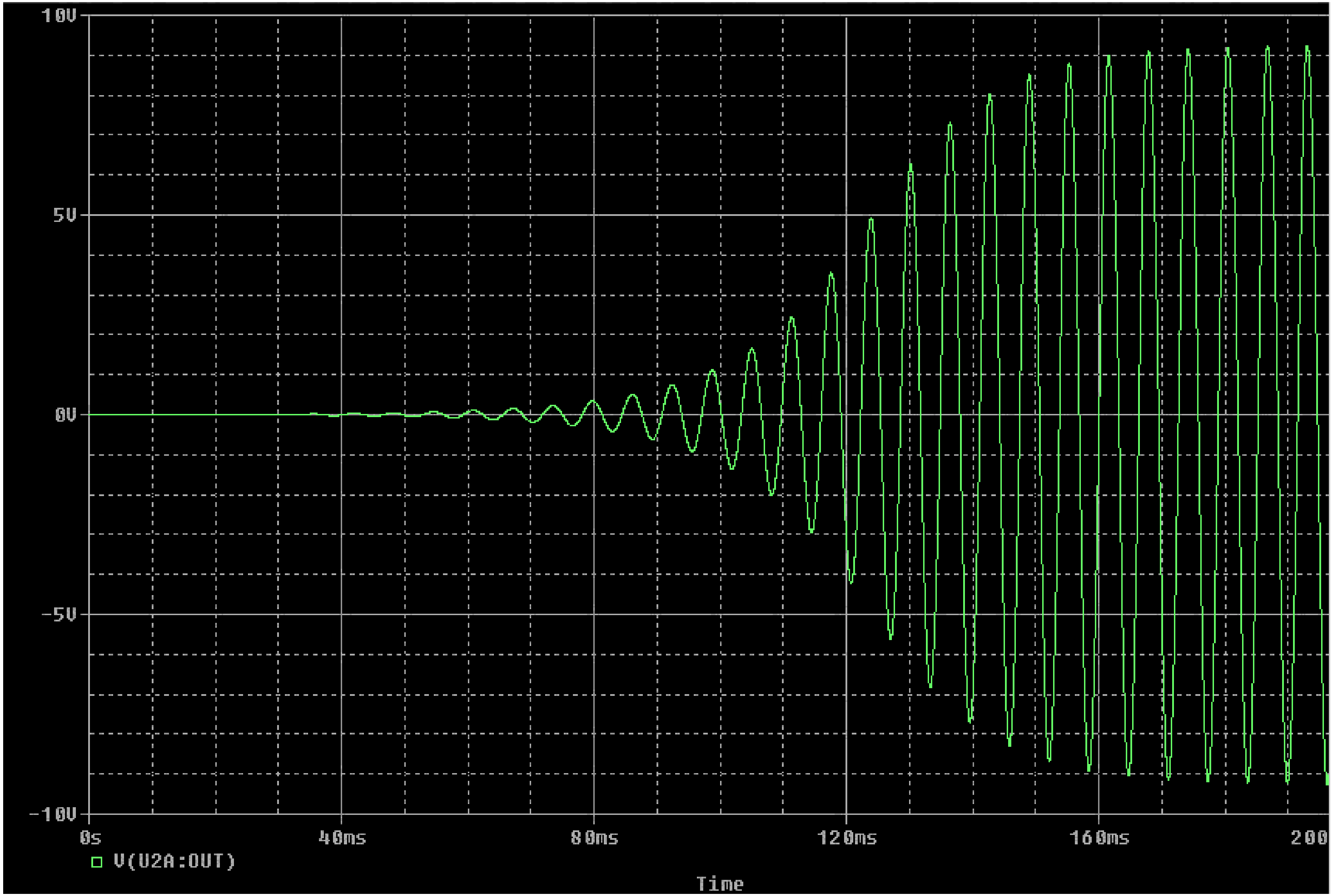
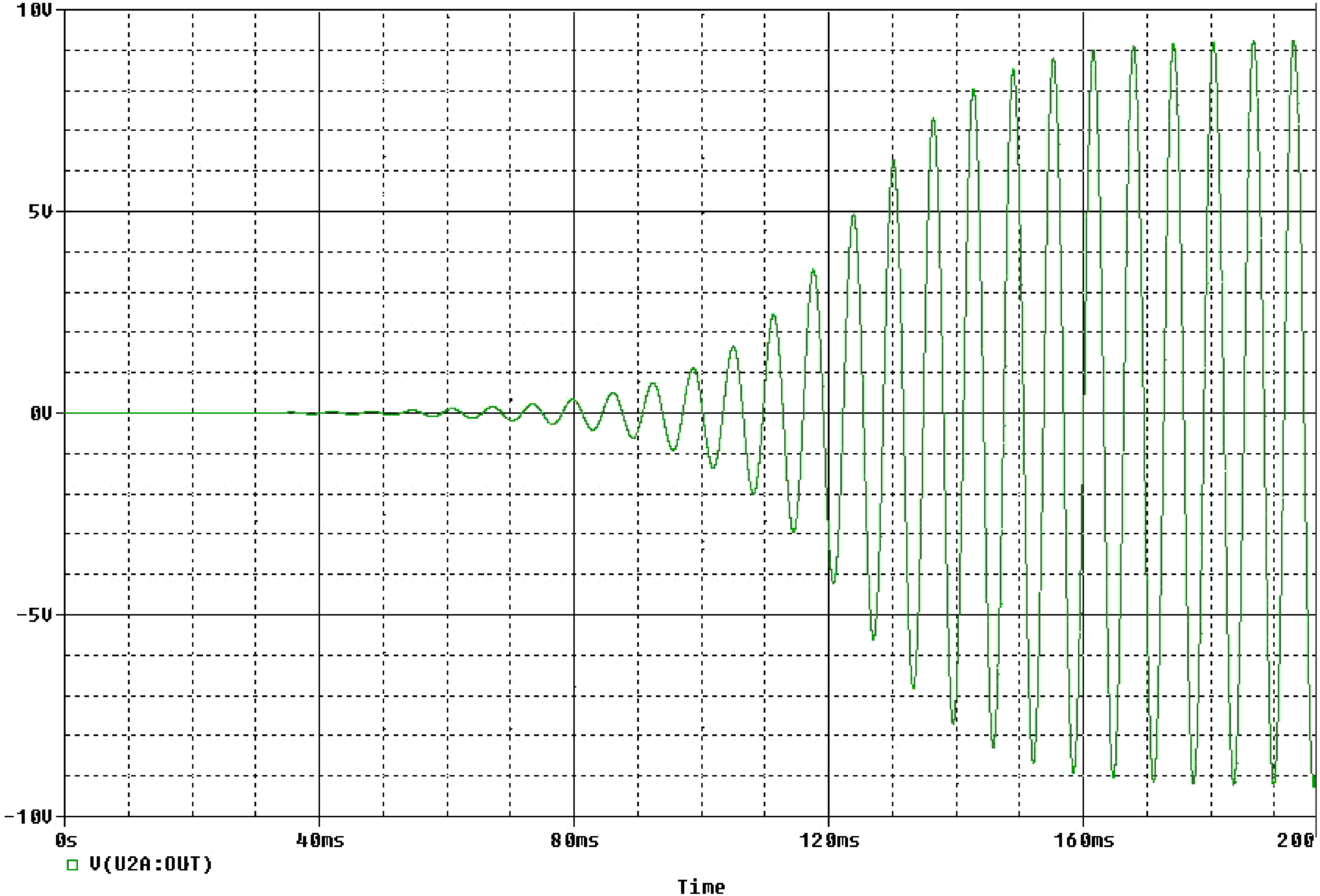

100n
10k
12V
+
-
4
3
+
V+
LM324
1
V
V-
2
-
11
10k
100n
12V
+
-
10k
D1N750
D1N750
47k
4.7k



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:
.01ms
Final Time:
200ms
No-Print Delay:
Step Ceiling:
.01ms
Detailed Bias Pt.
Skip initial transient solution
Fourier Analysis
Enable Fourier
Center Frequency:
Number of harmonics:
Output Vars.:
OK
Cancel
LM324
V-
2
-
11
10k
100n
10k
D1N750
D1N750
47k
4.7k

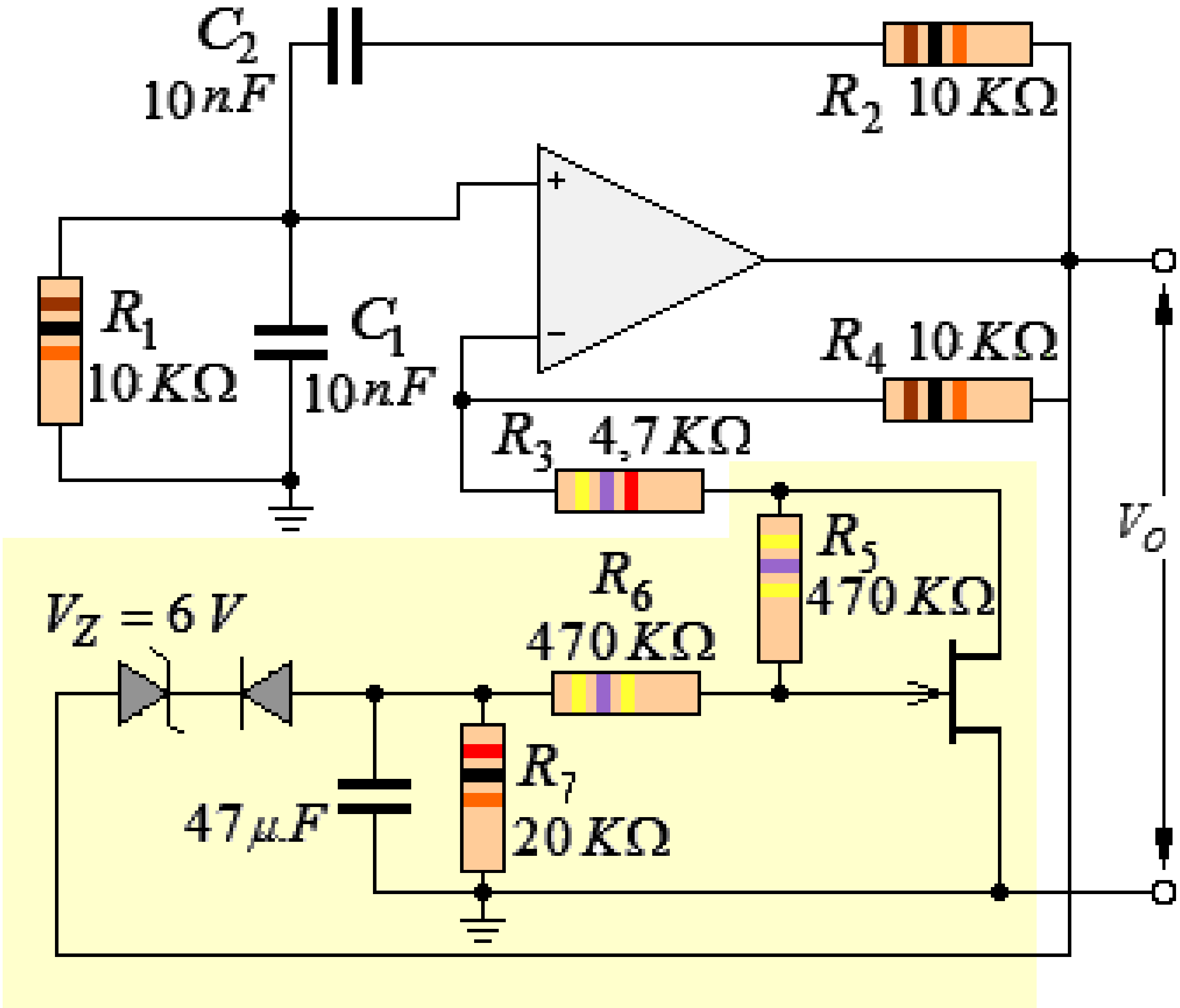


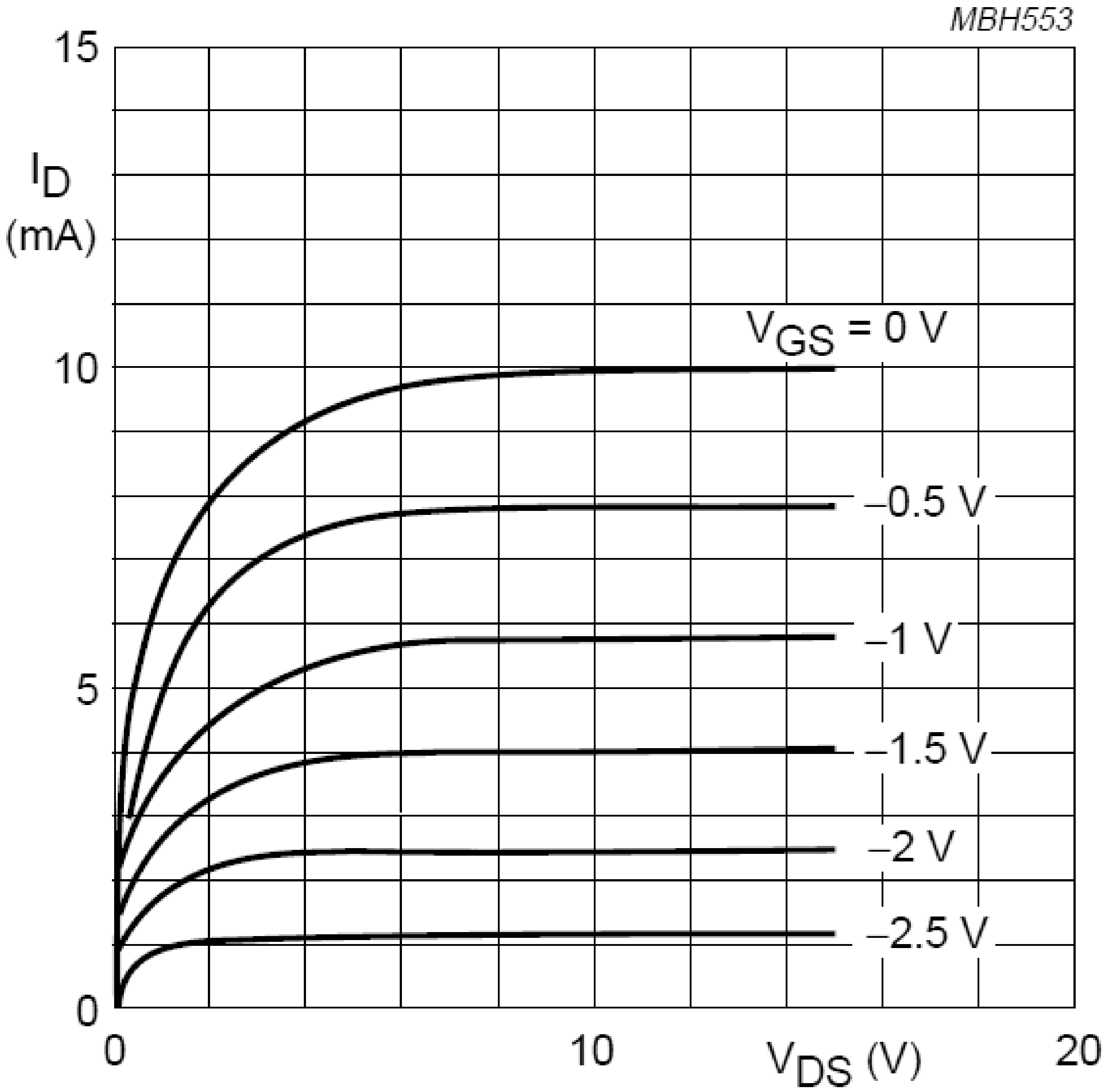
Respuesta del oscilador con la ganancia controlada con zeners



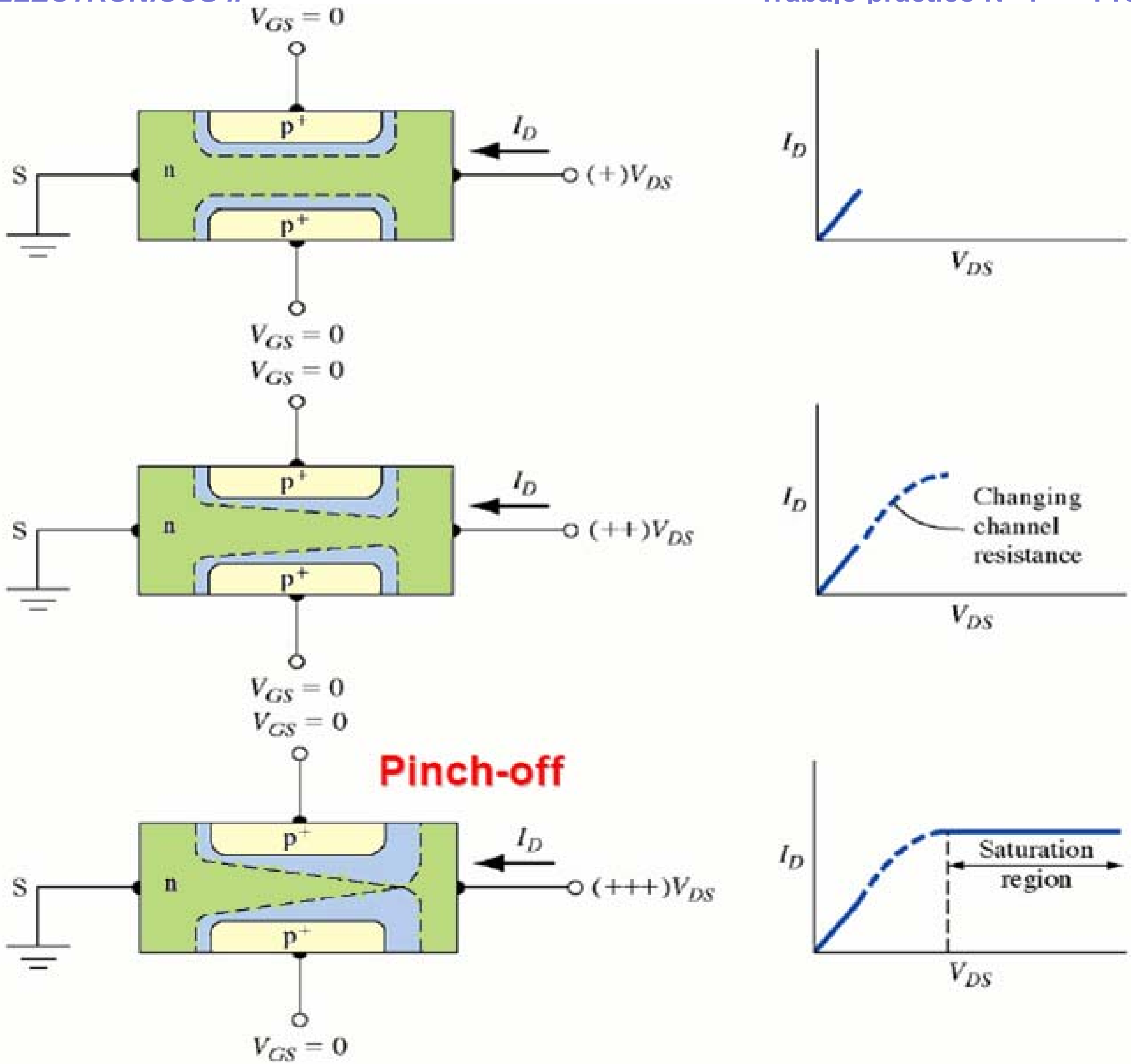
Respuesta del oscilador con la ganancia controlada con zeners

Oscilador Puente de Wien

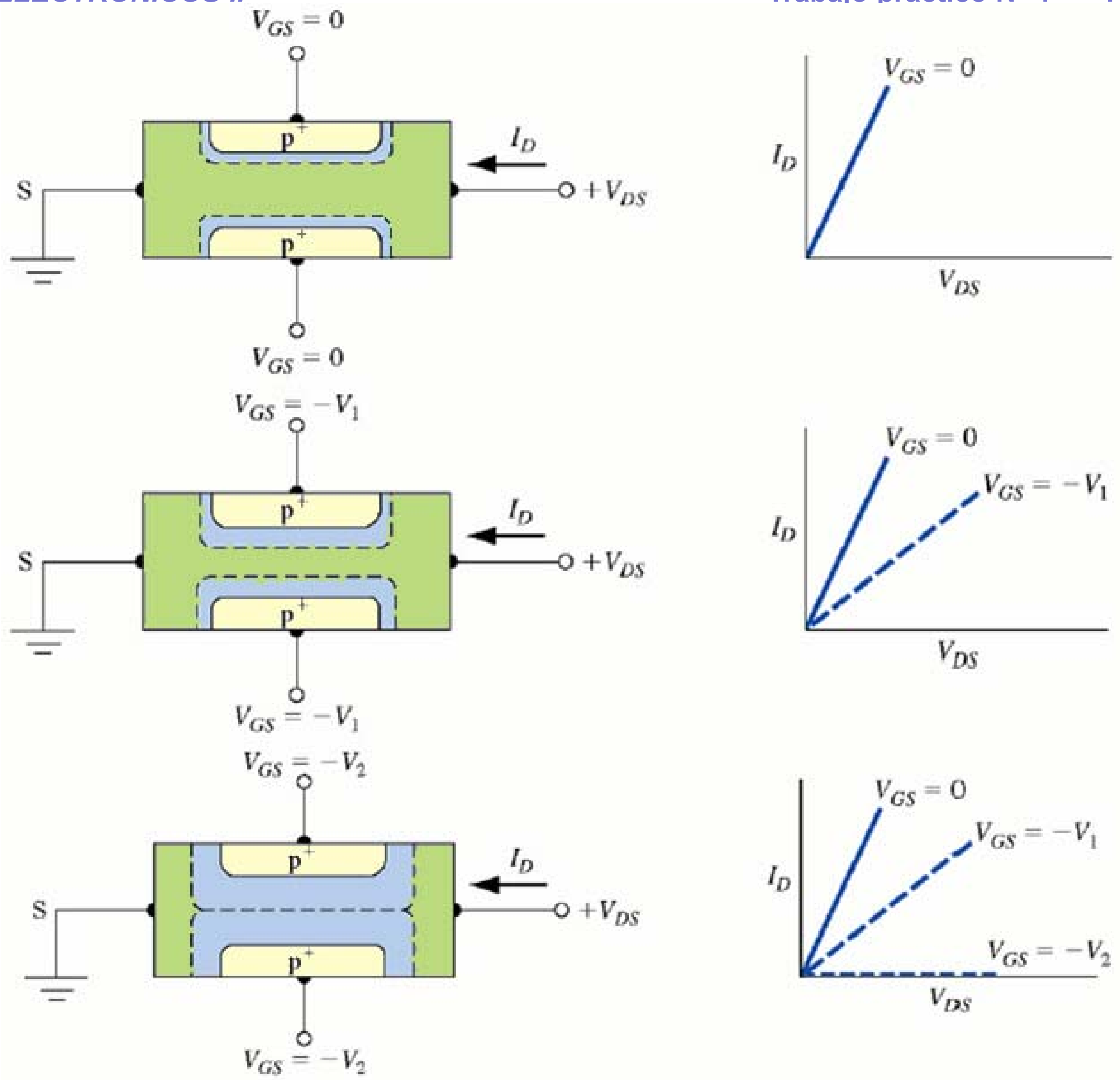




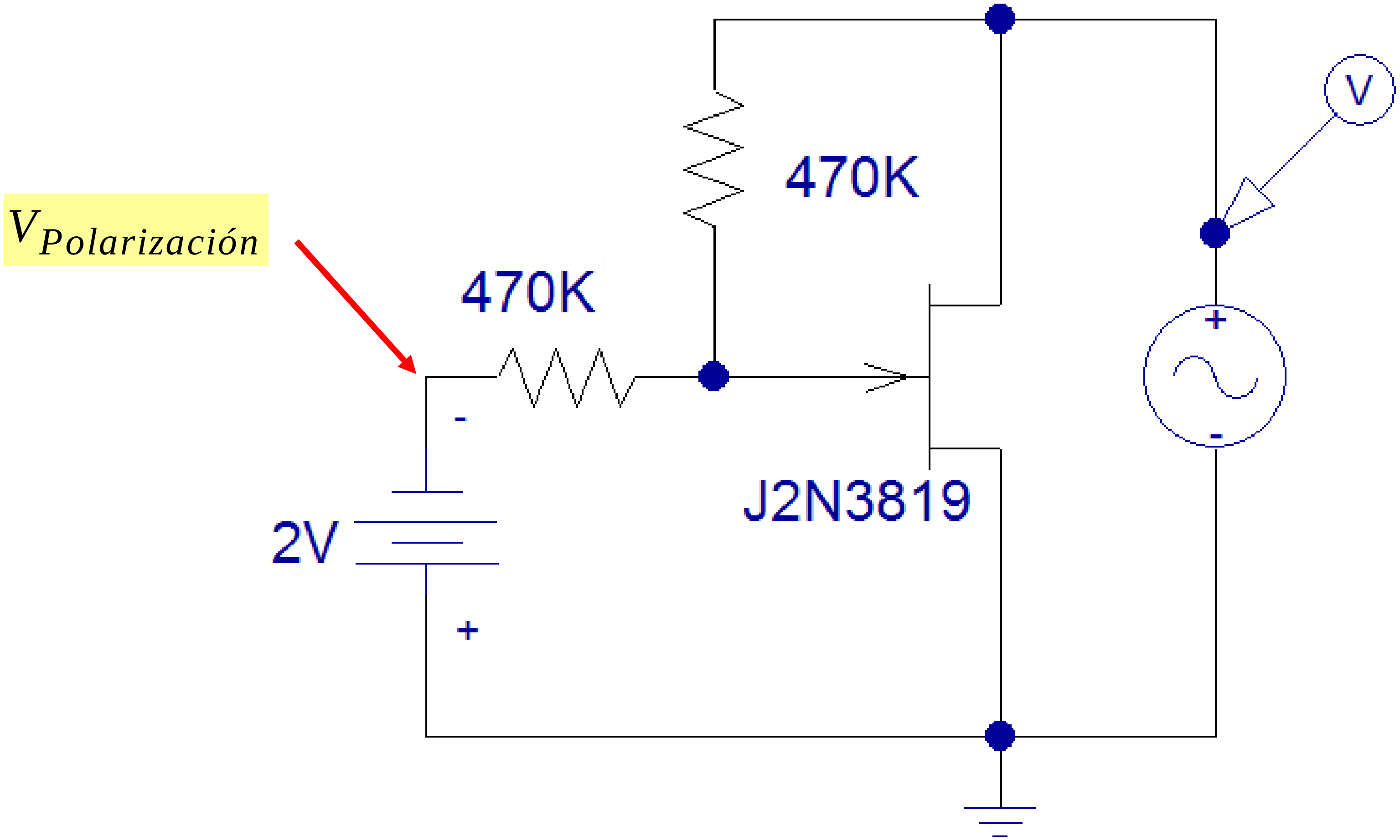
Output characteristics for BF245B:

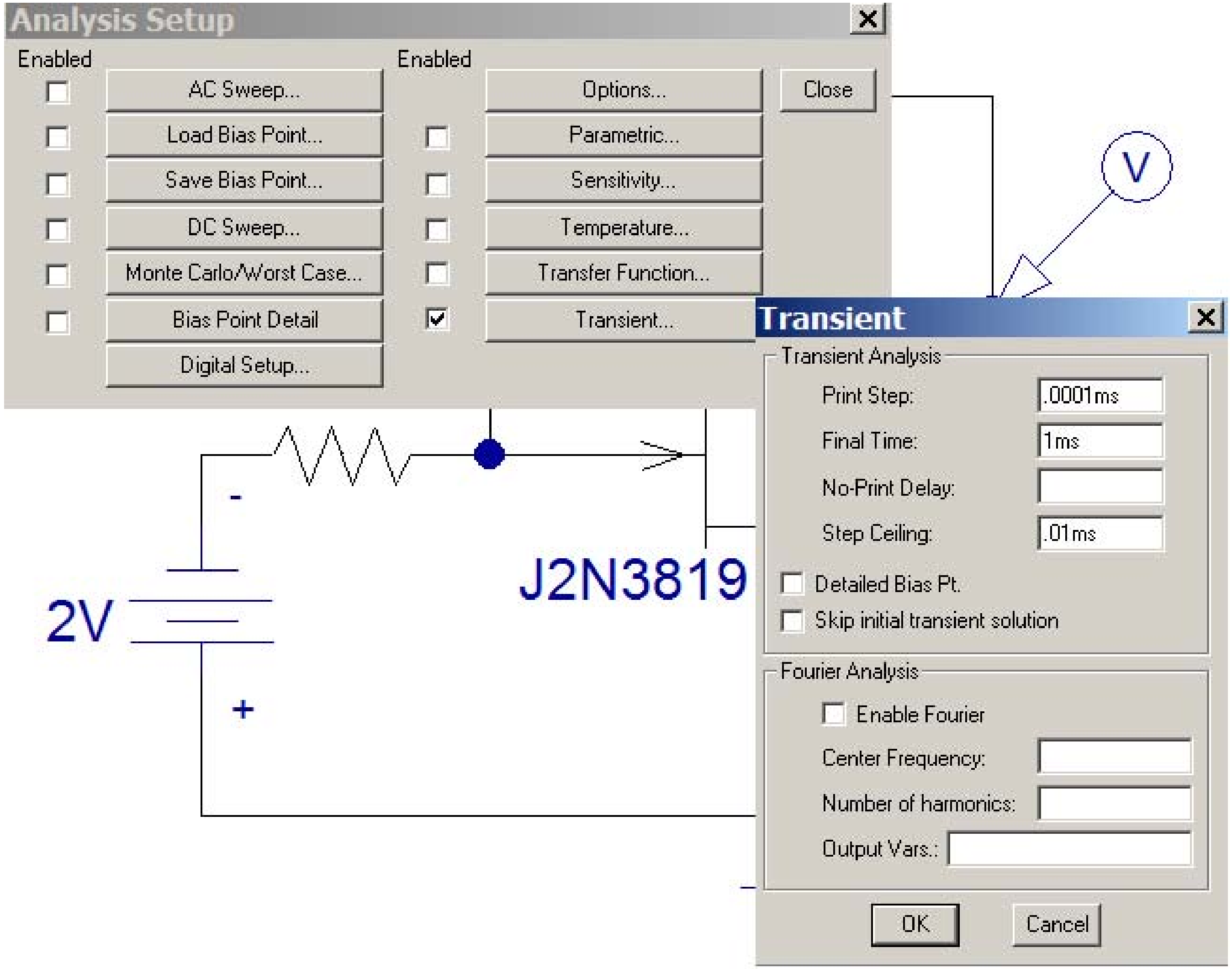


After pinch-off: $I_D \neq f(V_D)$; $I_D = f(V_G)$ - current source

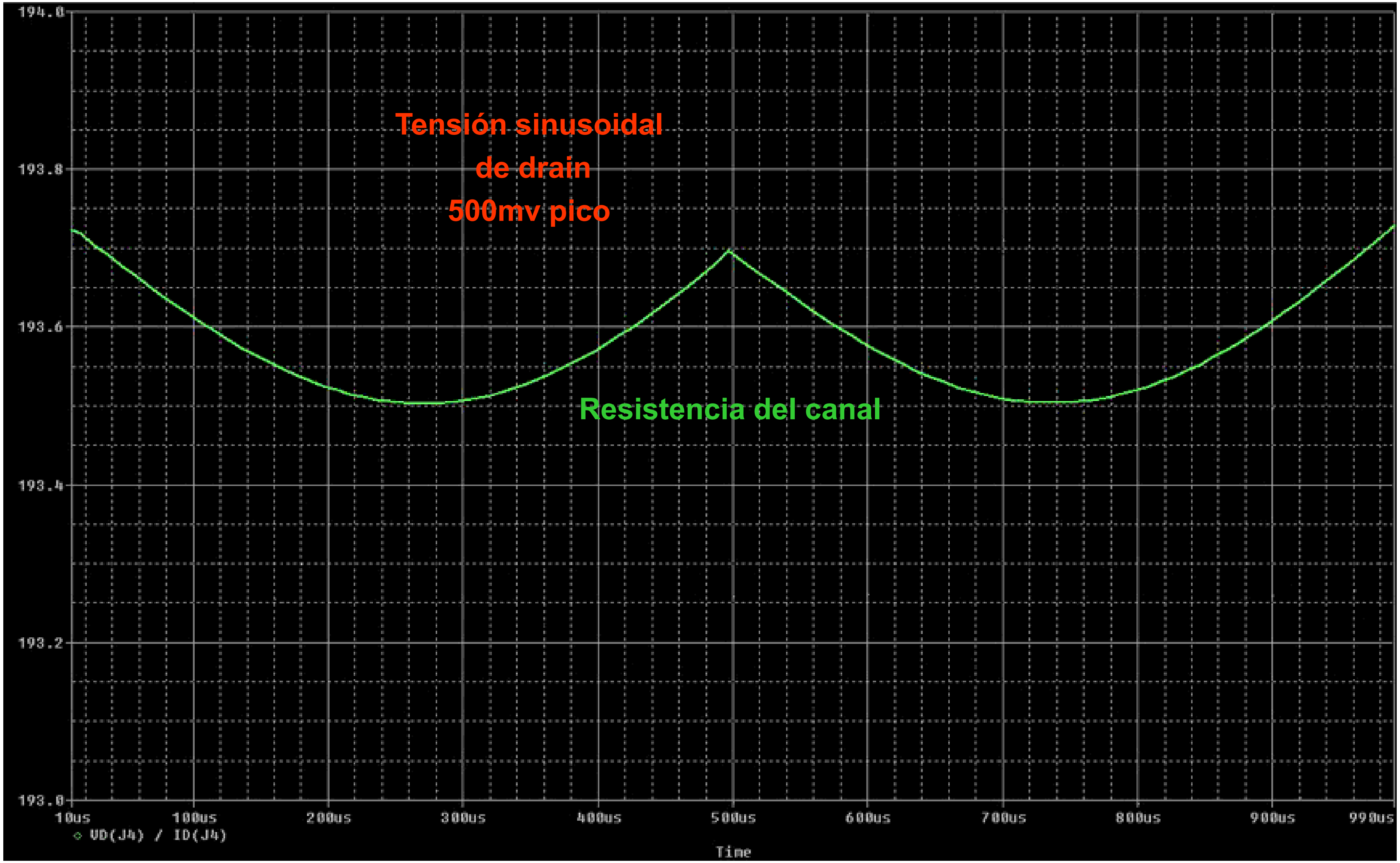


V_G controls the channel width → V_G control I_d

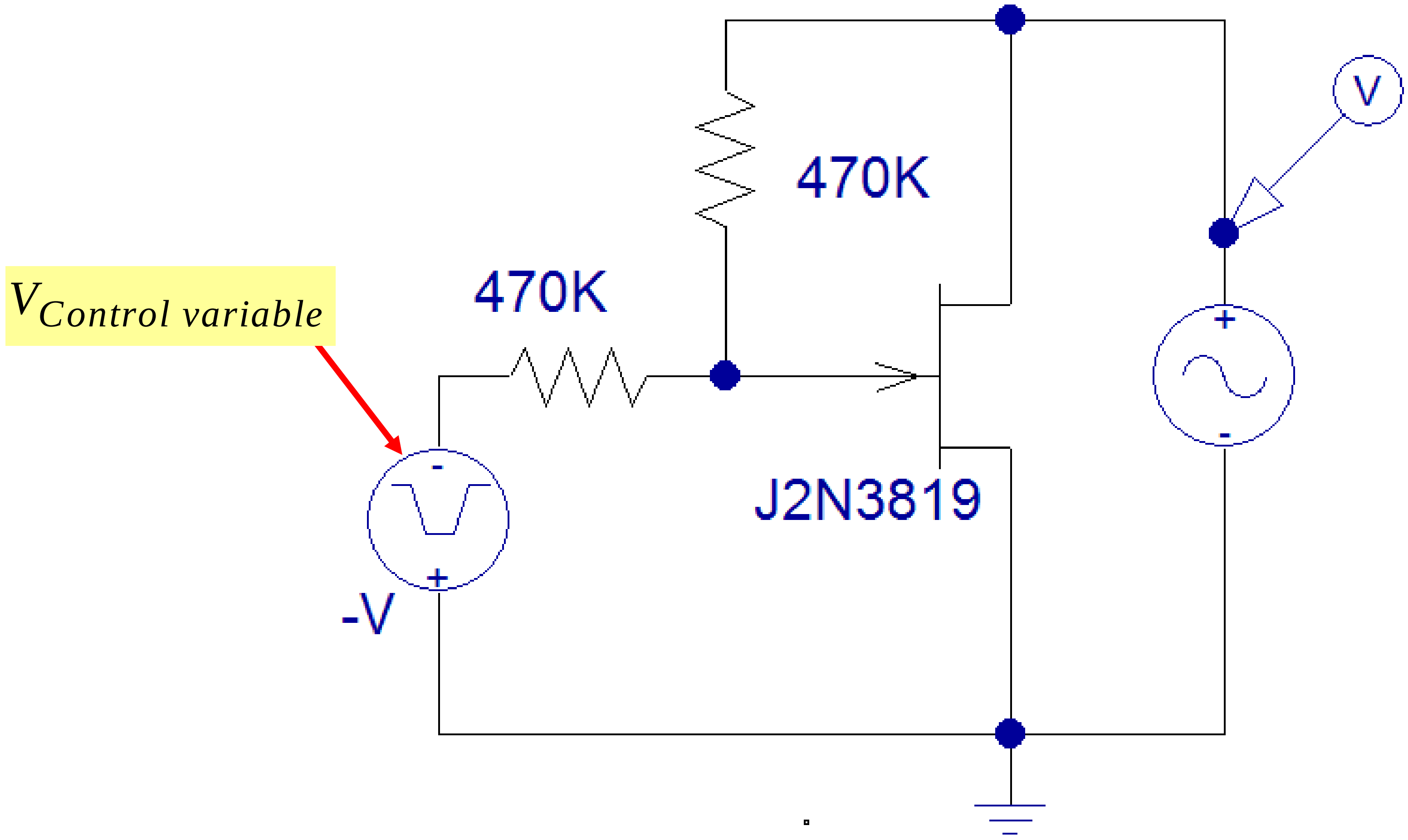

$V_{Polarización}$
470K
470K
V
+
-
-
2V
+
J2N3819

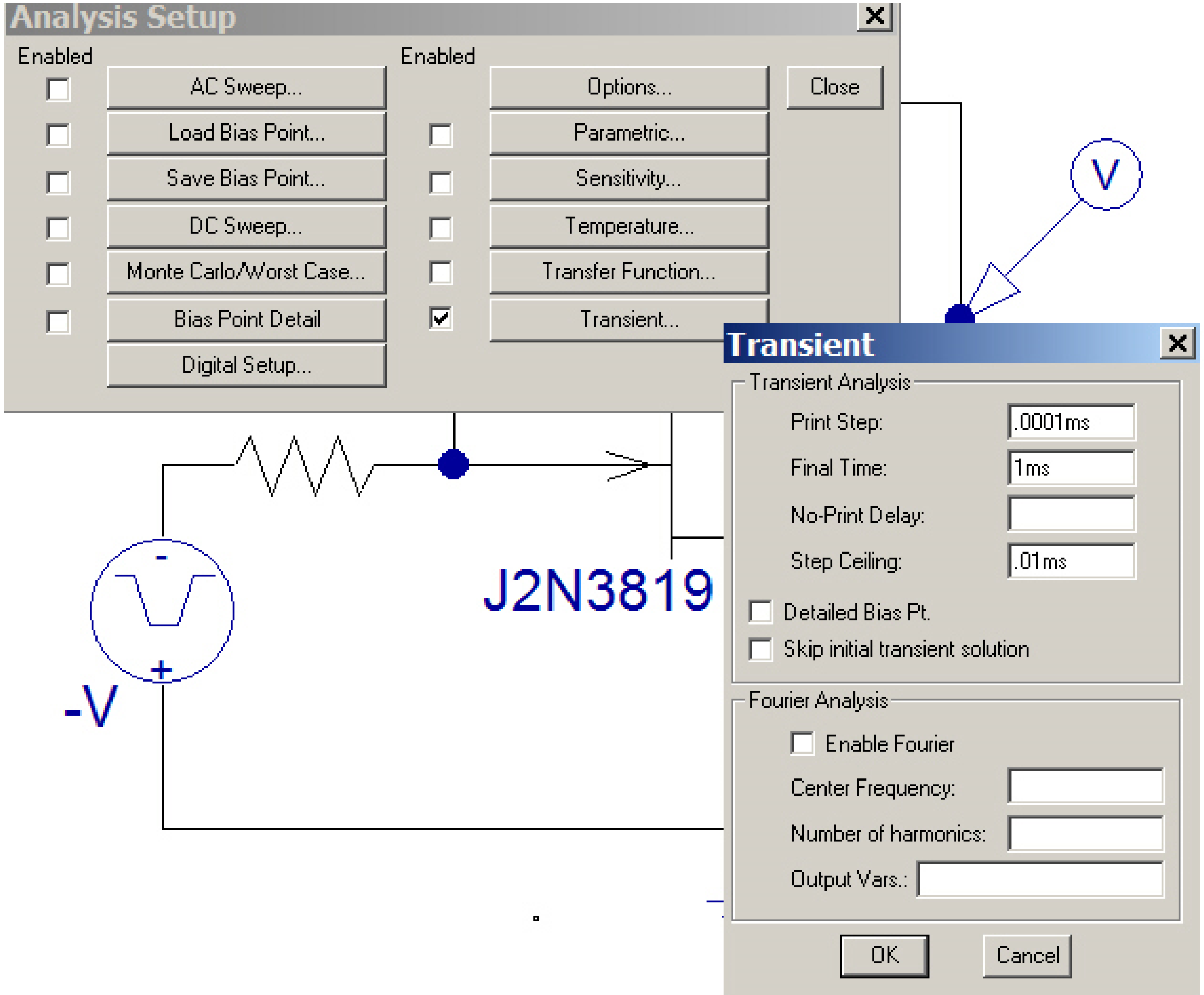


Analysis Setup
Enabled
AC Sweep...
Load Bias Point...
Save Bias Point...
DC Sweep...
Monte Carlo/Worst Case...
Bias Point Detail
Digital Setup...
Enabled
Options...
Parametric...
Sensitivity...
Temperature...
Transfer Function...
Transient...
Close
V
-
2V
+
J2N3819
Transient
Transient Analysis
Print Step: .0001ms
Final Time: 1ms
No-Print Delay:
Step Ceiling: .01ms
Detailed Bias Pt.
Skip initial transient solution
Fourier Analysis
Enable Fourier
Center Frequency:
Number of harmonics:
Output Vars.:
OK
Cancel

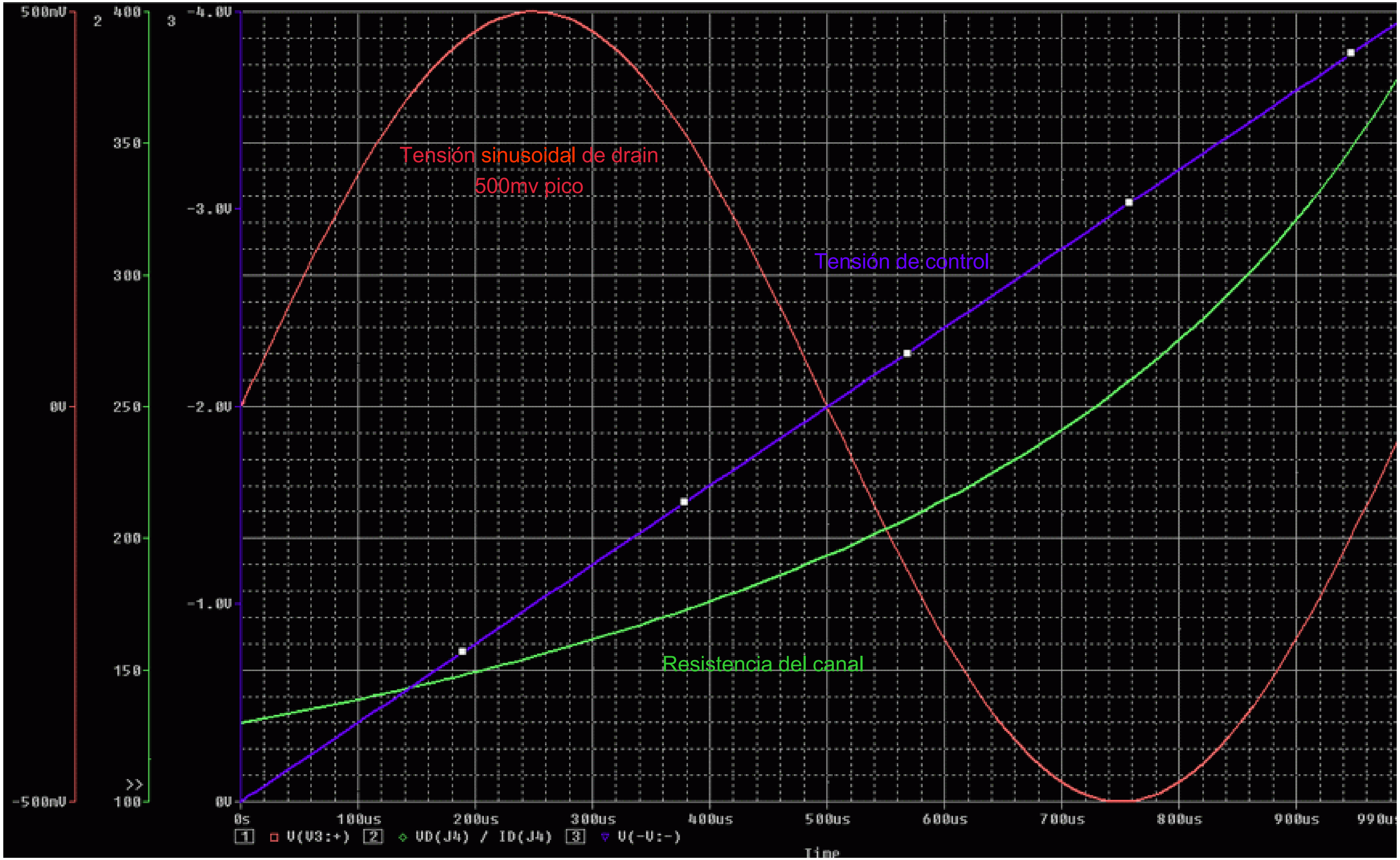


Medición de la resistencia del canal del JFET con Vg fija y Vc sinusoidal

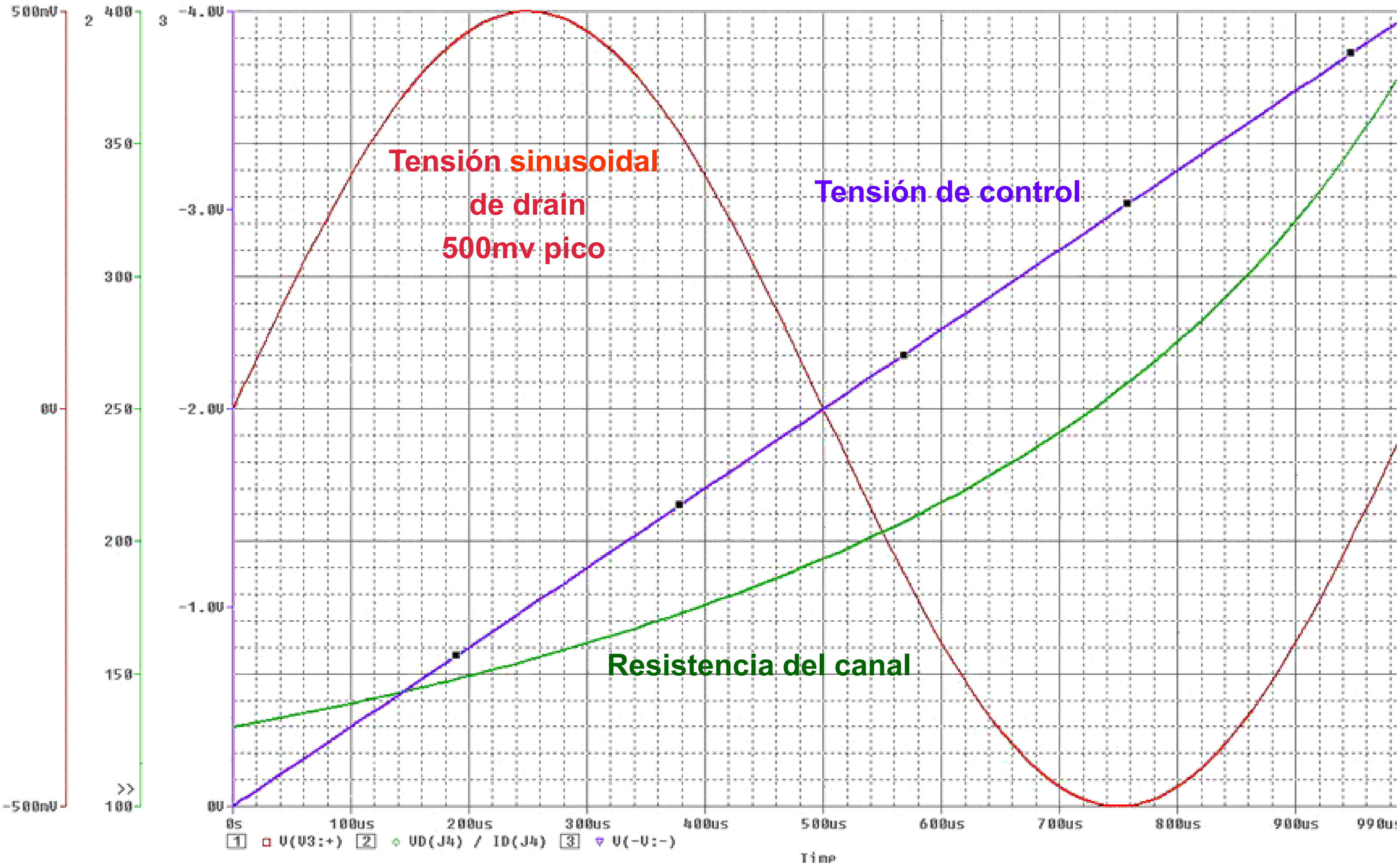

$V_{Control\ variable}$
470K
470K
V
+
-
J2N3819
-
+
-V



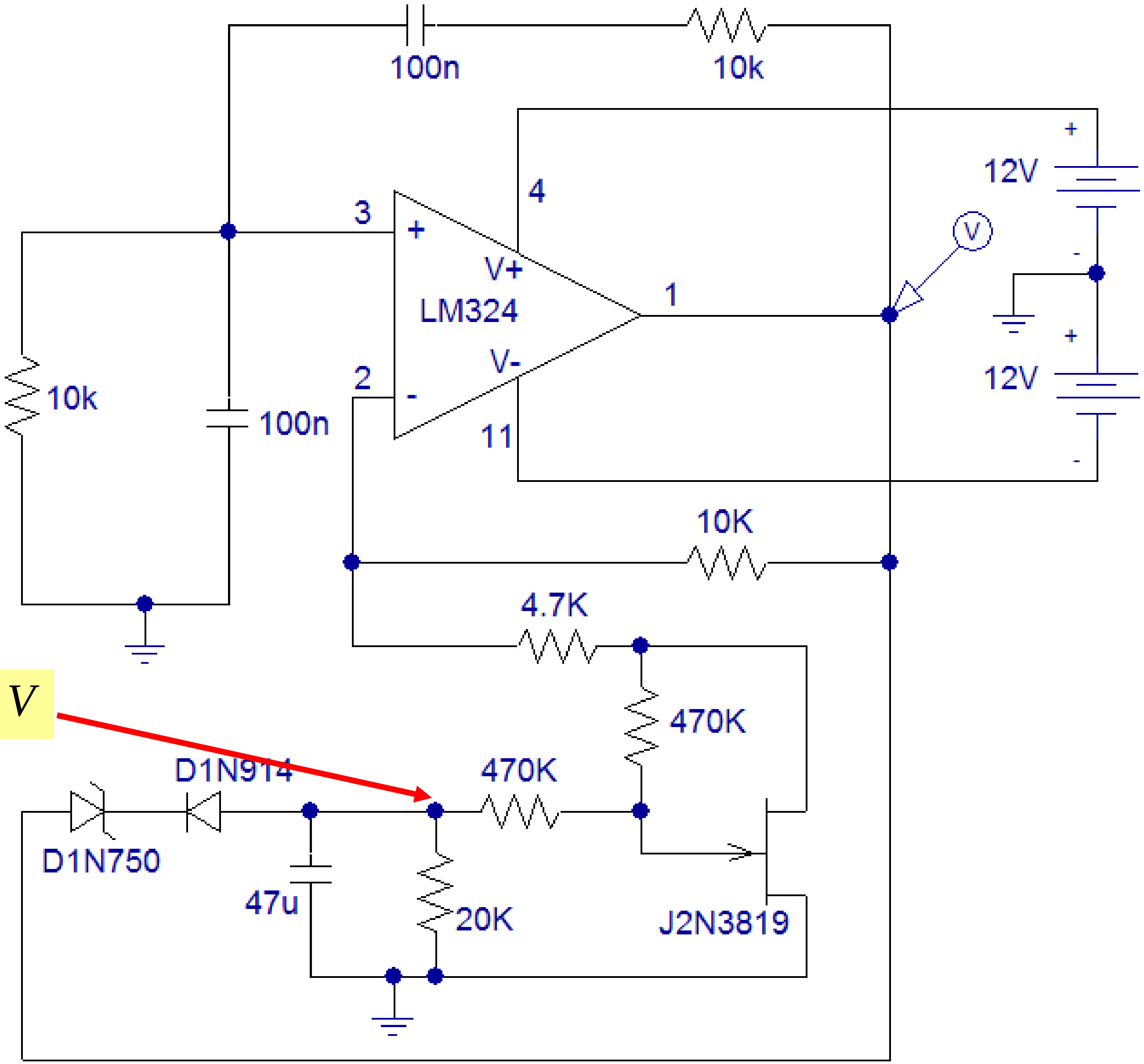
Analysis Setup
Enabled
AC Sweep...
Load Bias Point...
Save Bias Point...
DC Sweep...
Monte Carlo/Worst Case...
Bias Point Detail
Digital Setup...
Enabled
Options...
Parametric...
Sensitivity...
Temperature...
Transfer Function...
Transient...
Close
V
-V
J2N3819
Transient
Transient Analysis
Print Step: .0001ms
Final Time: 1ms
No-Print Delay:
Step Ceiling: .01ms
Detailed Bias Pt.
Skip initial transient solution
Fourier Analysis
Enable Fourier
Center Frequency:
Number of harmonics:
Output Vars.:
OK
Cancel



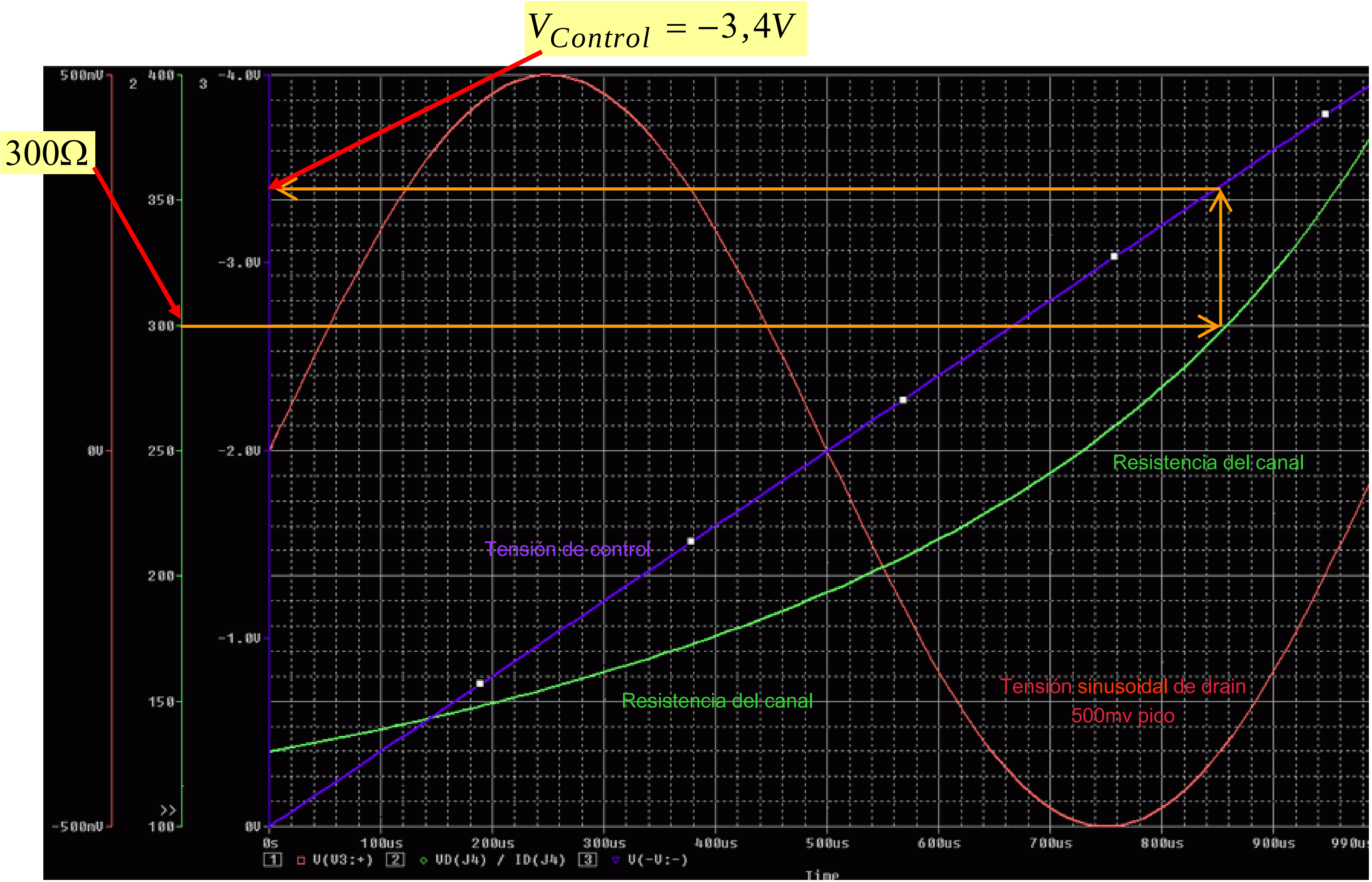
Medición de la resistencia del canal del JFET con Vg rampa y Vc sinusoidal



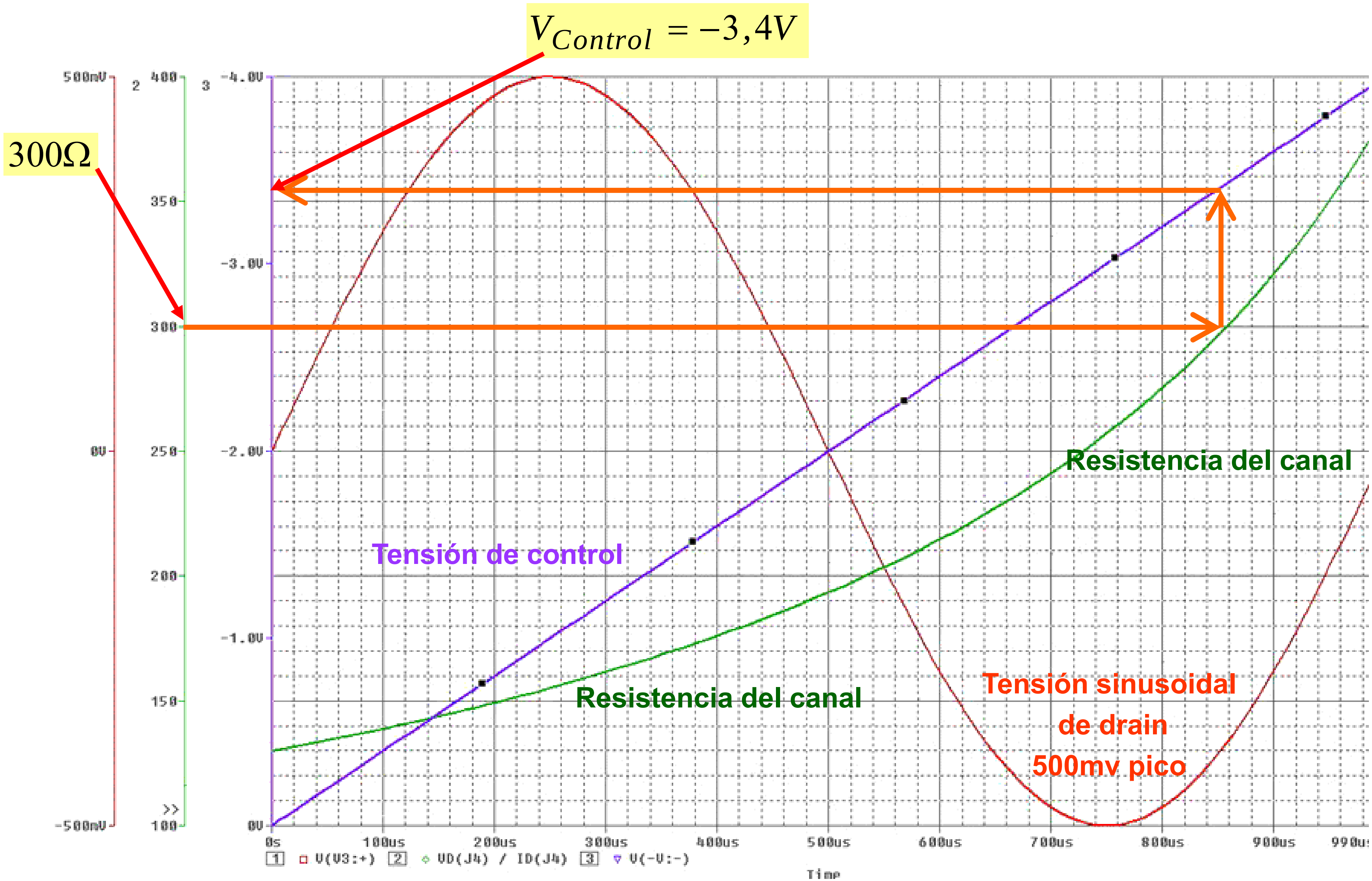
Medición de la resistencia del canal del JFET con Vg rampa y Vc sinusoidal


100n
10k
12V
12V
4
3
+
V+
LM324
V-
1
V
2
-
11
10k
100n
10K
4.7K
470K
D1N914
470K
D1N750
47u
20K
J2N3819

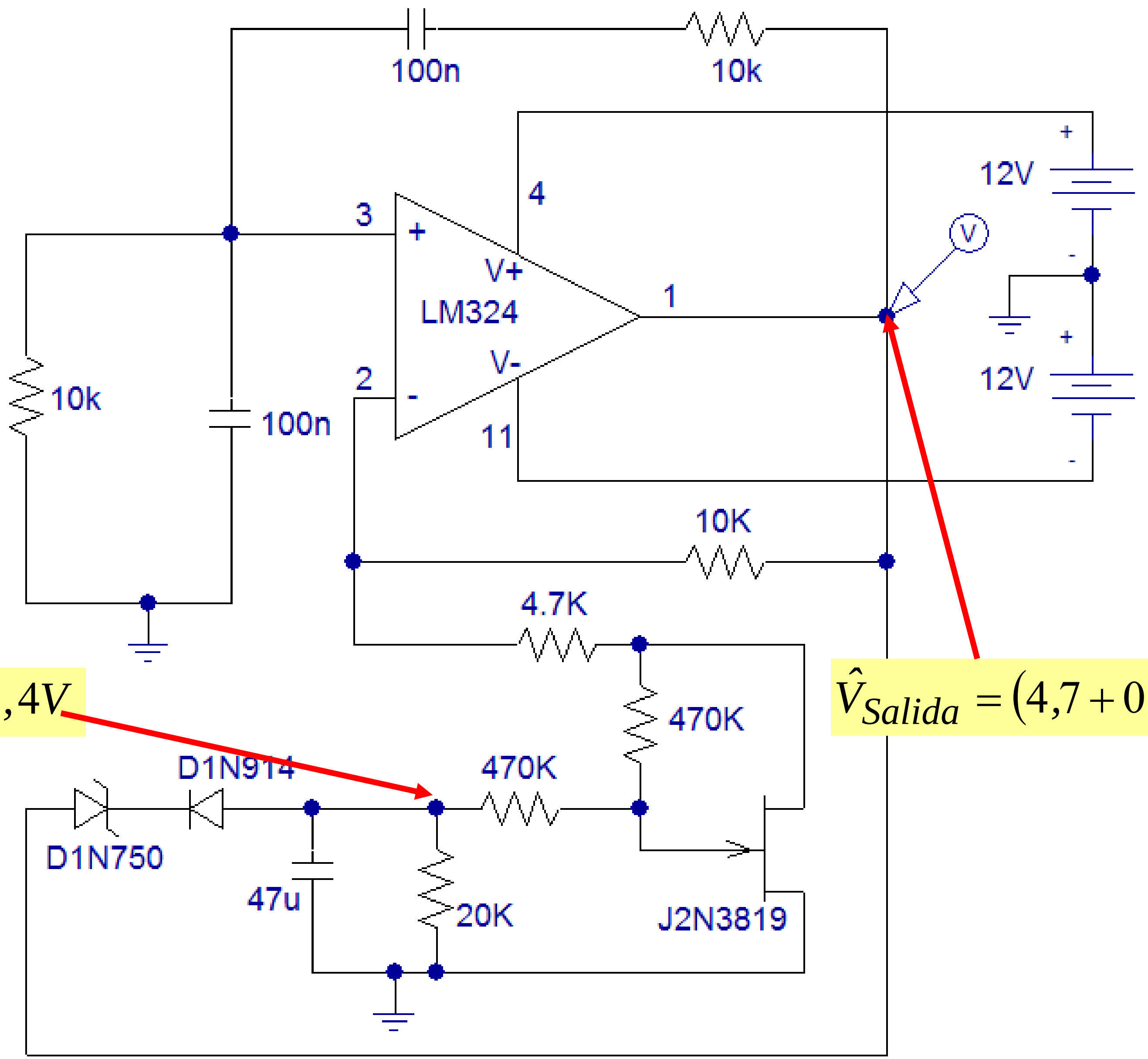
$V_{Control} = ?\ V$



Obtención de la tensión Vg necesaria para obtener 300Ω en la resistencia del canal

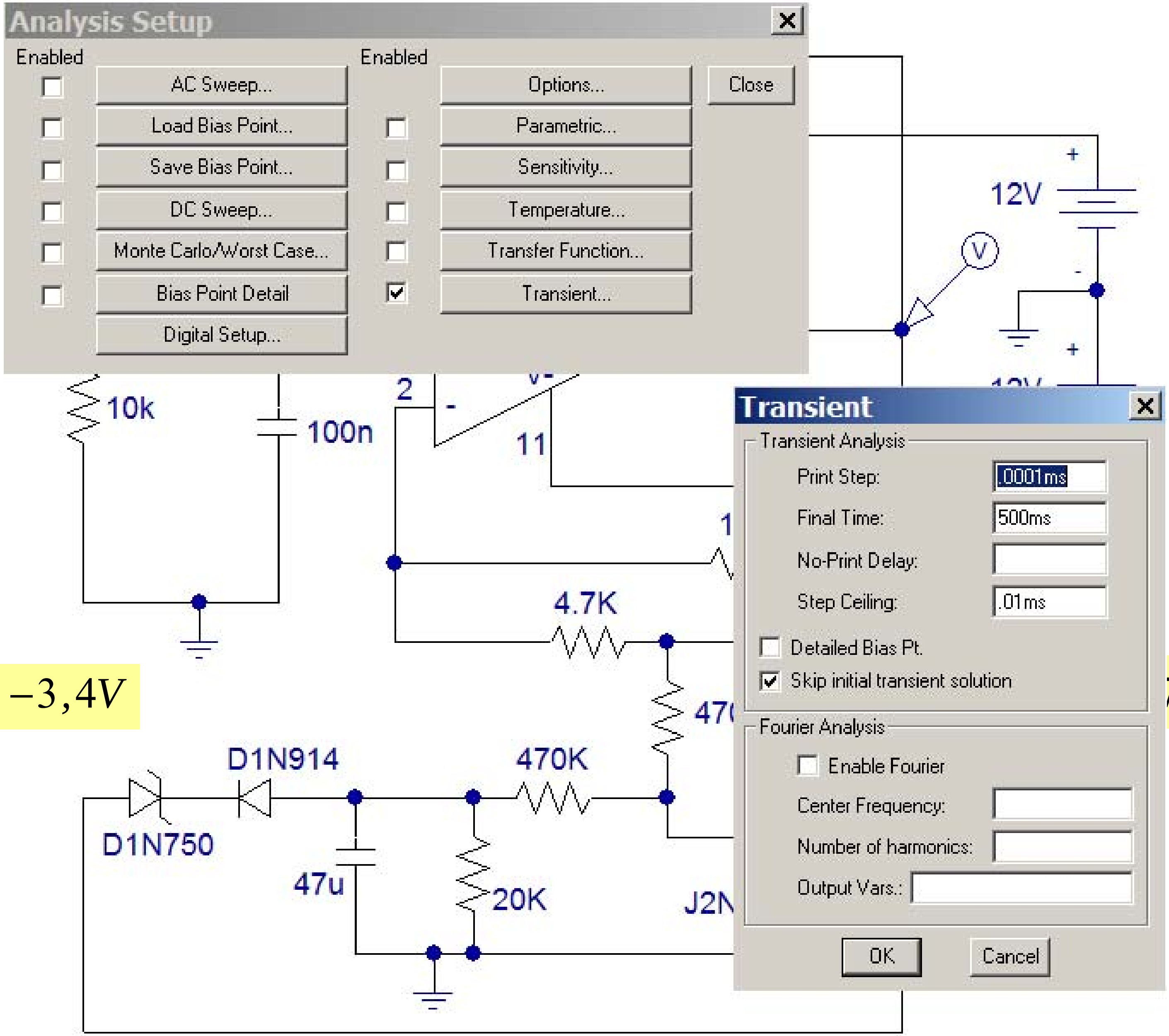


Obtención de la tensión Vg necesaria para obtener 300Ω en la resistencia del canal



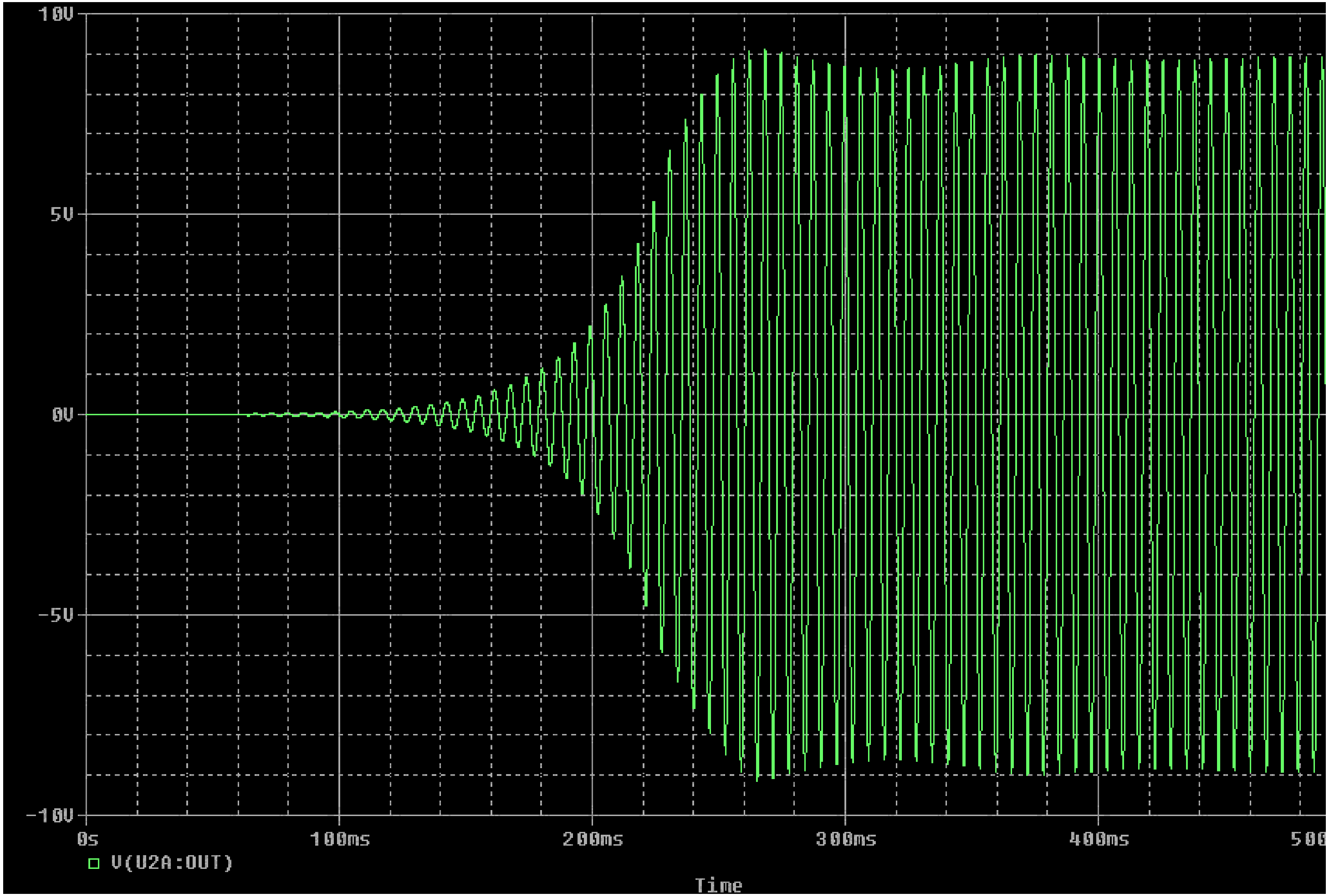
$$V_{Control} = -3,4V$$

$$\hat{V}_{Salida} = (4,7 + 0,7 + 3,4)V = 8,8V$$

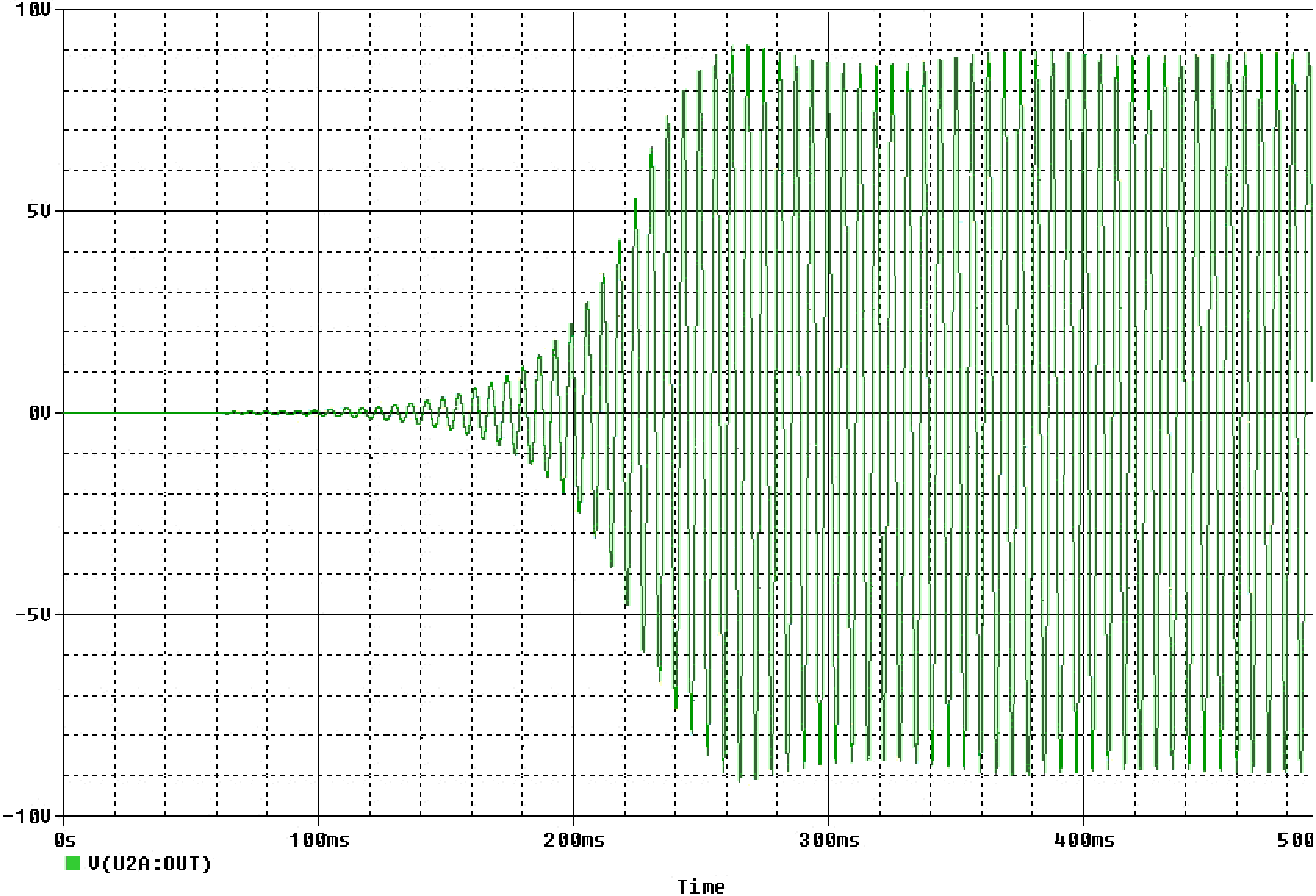


$$V_{Control} = -3,4V$$

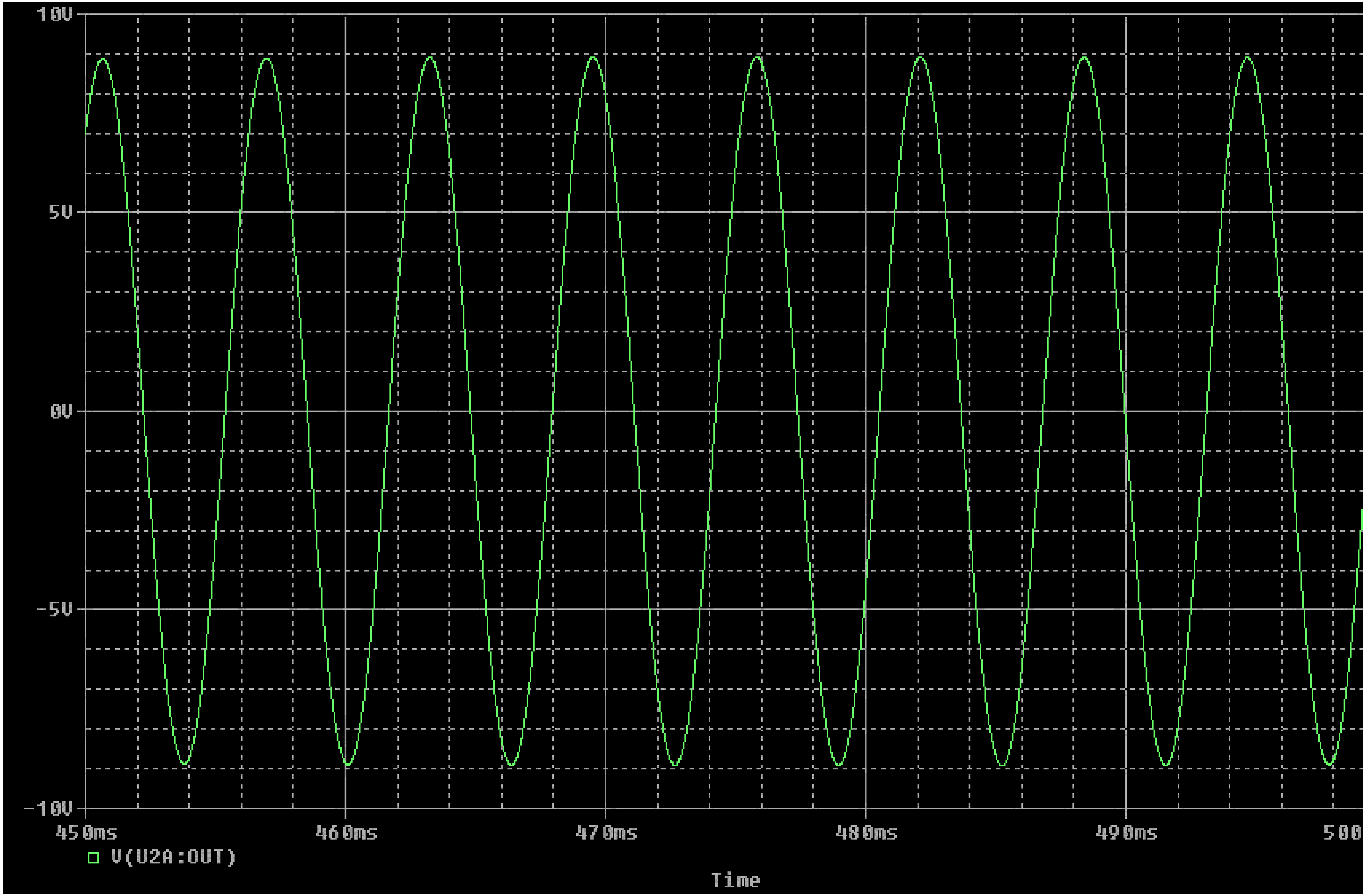
$$7 + 3,4)V = 8,8V$$



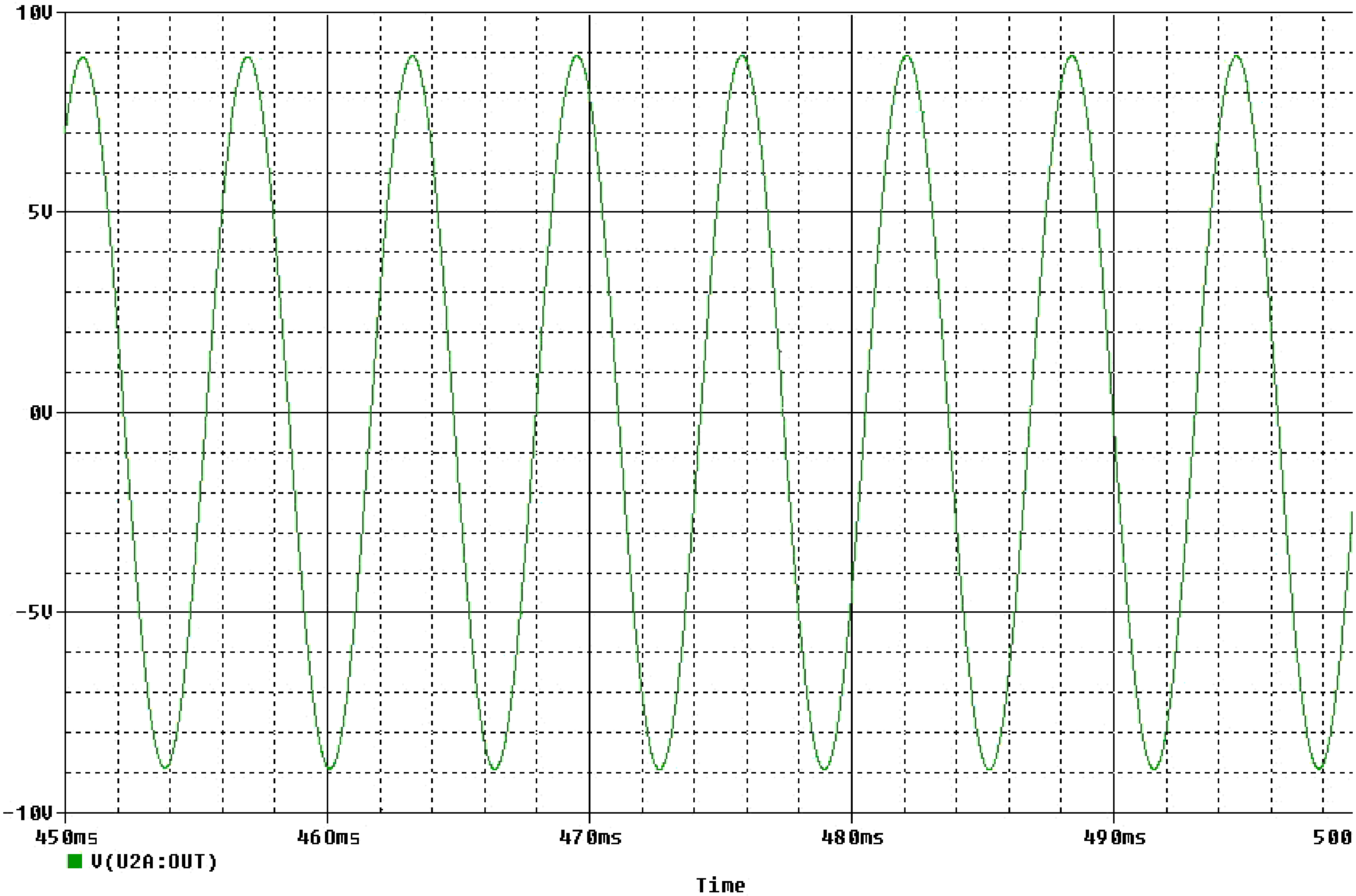
Respuesta del oscilador con la ganancia controlada con JFET



Respuesta del oscilador con la ganancia controlada con JFET



Respuesta del oscilador con la ganancia controlada con JFET ampliada



Respuesta del oscilador con la ganancia controlada con JFET ampliada