PRE-INFORME PRÁCTICA DE LABORATORIO N°. 3

Juliana Garzon Fajardo [1], Jose Luis Mazuera Cardenas[2], Gabriela Quintero Moreno[3]

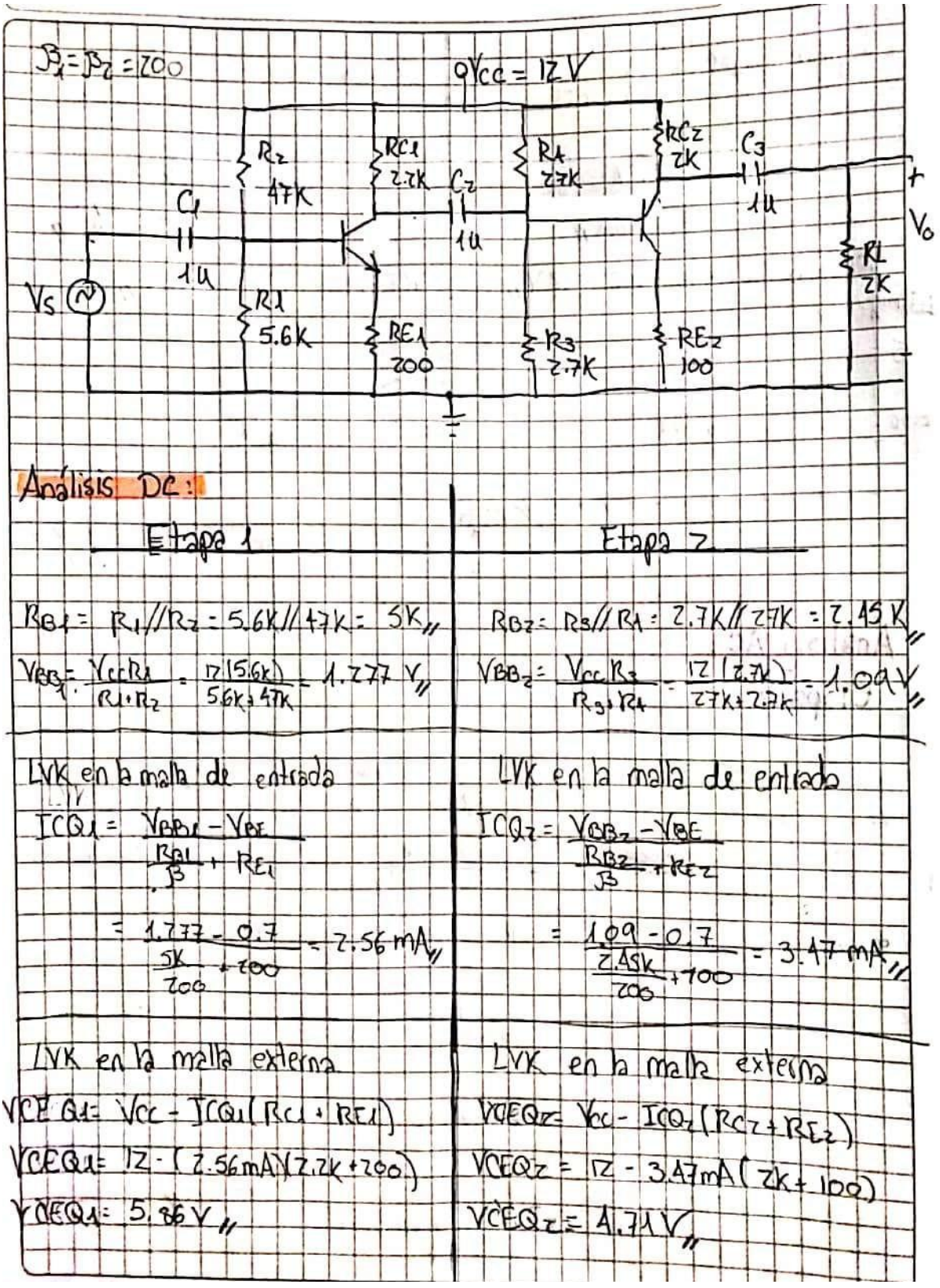
8959024[1],8958129[2], 8957920[3]

juligf2001@javerianacali.edu.co[1], jmazuera24@javerianacali.edu.co[2],
gabyquimo@javerianacali.edu.co[3]

Hernan Dario Vargas Cardona

Universidad Javeriana Cali, Facultad de ingeniería y ciencias, Laboratorio de electrónica análoga.
Laboratorio #3
Santiago de Cali, Colombia
(Realización 19 abril 2022 / Initiation april 19th, 2022)
(Entrega 20 abril 2022/ Submission april 20th, 2022)

a. ANÁLISIS TEÓRICO DEL AMPLIFICADOR

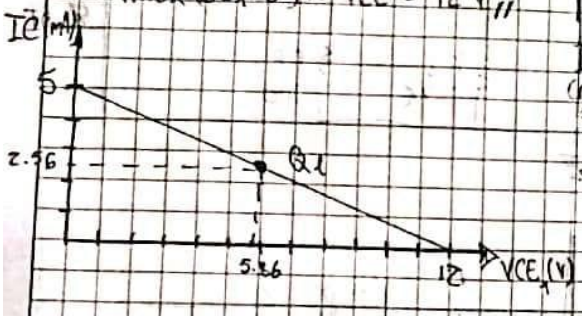


$I_{C_1 max}\ (V_{CE_1}=0) = \frac{V_{CC}}{R_{C_1}+R_{E_1}}$

$= \frac{12}{2.2K+200}$

$= 5\ mA$ //

$V_{CE_1 max}\ (I_{C_1}=0) = V_{CC} = 12\ V$ //

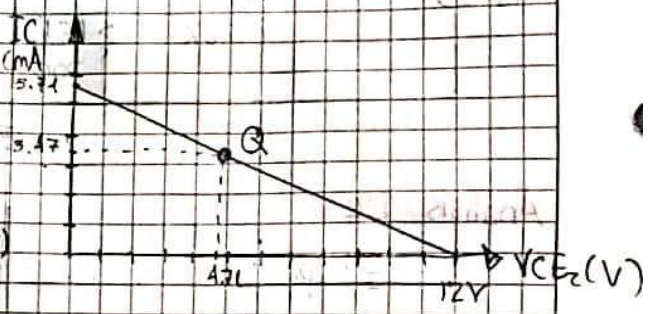


$I_{C_2 max}\ (V_{CE_2}=0) = \frac{V_{CC}}{R_{C_2}+R_{E_2}}$

$= \frac{12}{2K+100}$

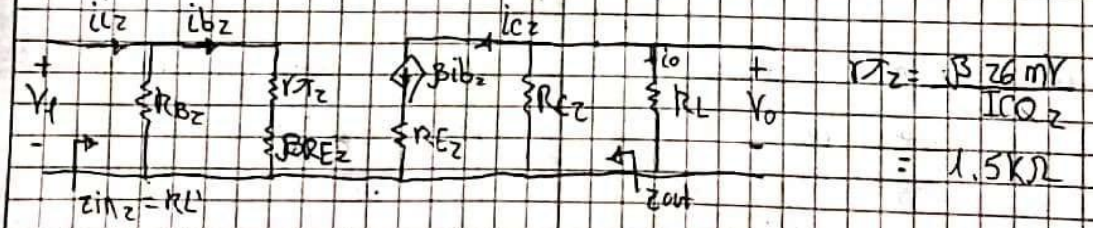
$= 5.71\ mA$ //

$V_{CE_2 max}\ (I_{C_2}=0) = 12\ V$ //



Análisis AC:

Etapa 2:



$r'_{\pi_2} = \frac{\beta\ 26\ mV}{I_{CQ_2}}$

$= 1.5K\Omega$

- $A_{V_2} = \frac{V_o}{V_1}$ → $V_o = i_o R_{L_2}$; $i_o = \frac{-\beta i_{b_2} R_{C_2}}{R_{C_2}+R_{L_2}}$

$V_o = \frac{-\beta i_{b_2} R_{C_2}}{R_{C_2}+R_{L_2}} \cdot R_{L_2} = -\beta i_{b_2} (R_{C_2} // R_{L_2})$

→ $V_1 = i_{b_2} (r'_{\pi_2} + \beta R_{E_2})$

$A_{V_2} = \frac{-\beta (R_{C_2} // R_{L_2})}{r'_{\pi_2} + \beta R_{E_2}} = \frac{-200\ (2K // 2K)}{1.5K + 100\ (100)} = -9.30$ //

TEMA / MATERIA | DÍA | MES | AÑO

- $A_{Iz} = \frac{i_o}{i_{iz}} \rightarrow i_o = \frac{-\beta i_{b_2} R_{C_2}}{R_{C_2} + R_L}$, $i_{b_2} = \frac{i_{i_2} R_{B_2}}{R_{B_2} + r_{\pi_2} + \beta R_{E_2}}$

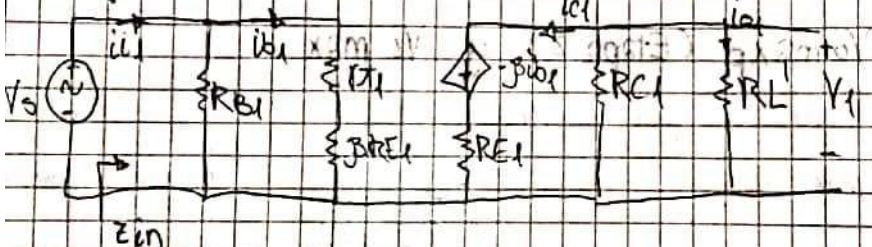
$$A_{Iz} = \frac{i_o}{i_{iz}} = \frac{-\beta R_{C_2}}{R_{C_2} + R_{L_2}} \cdot \frac{R_{B_2}}{R_{B_2} + r_{\pi_2} + \beta R_{E_2}}$$

$$= \frac{-200(2k)}{2k + 2k} \cdot \frac{2.45K}{2.45K + 1.5K + 200(100)}$$

$$= -10.23 \text{ //}$$

- $Z_{in_2} = R_{B_2} // (r_{\pi_2} + \beta R_{E_2}) = 2.45K // (1.5K + 200(100)) = 2.2K\Omega = R_L'$ //
- $Z_{out} = R_{C_2} = 2K\Omega$ //

Etapa 1:



$$r_{\pi_1} = \frac{\beta (26mV)}{I_{CQ_1}}$$

$$r_{\pi_1} = \frac{200 (26mV)}{2.56 mA}$$

$$r_{\pi_1} = 2.03 K\Omega$$

- $A_{V_1} = \frac{V_1}{V_s}$ → $V_1 = i_{o_1} (R_L')$, $i_{o_1} = \frac{-\beta i_{b_1} R_{C_1}}{R_{C_1} + R_L'}$

$$V_1 = -\beta i_{b_1} (R_{C_1} // R_L')$$

$$V_s = i_{b_1} (r_{\pi_1} + \beta R_{E_1})$$

$$A_{V_1} = \frac{-\beta (R_{C_1} // R_L')}{r_{\pi_1} + \beta R_{E_1}} = \frac{-200(2.2K // 2K)}{2.03K + 200(200)} = -5.23 \text{ //}$$

- $A_{i1} = \frac{i_{o1}}{i_{i1}} \rightarrow i_{o1} = \frac{-\beta i_{b1} R_{C1}}{R_{C1} + R_L'}$, $i_{b1} = \frac{i_{i1} R_{B1}}{R_{B1} + r_{\pi 1} + \beta R_{E1}}$

$$A_{i1} = \frac{-\beta R_{C1}}{R_{C1} + R_L'} \cdot \frac{R_{B1}}{R_{B1} + r_{\pi 1} + \beta R_{E1}} = \frac{-200(2.2k)}{2.2k + 2.2k} \cdot \frac{5k}{5k + 203k + 200(200)}$$

$$= -10.63 \text{ A/A}$$

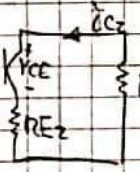
Entonces:

- $A_{VT} = A_{V1} \cdot A_{V2} = -9.30 \cdot -5.23 = 48.64$ V/V
- $A_{iT} = A_{i1} \cdot A_{i2} = -10.23 \cdot -10.63 = 108.74$ A/A
- $Z_{in} = R_{B1} // (r_{\pi 1} + \beta R_{E1}) = 4.47$ KΩ
- $Z_{out} = R_{C2} = 2$ KΩ

Para hallar $V_{o\,max\,p}$ (Etapa 2) y $V_{i\,max}$

Caso III: Punto Q por encima de MES

$V_{o\,max} = i_{o\,max} \cdot R_{L2}$, $i_{o\,max} = \frac{i_{c\,max} \cdot R_{C2}}{R_{C2} + R_L}$, $i_{c_2 max} = i_{C_2 max} - I_{CQ_2}$



$v_{ce} = -i_{c_2}([R_{C2} // R_L] + R_{E2})$

$v_{ce} = v_{CE} - V_{CEQ_2}$, $i_{c_2} = i_{C_2} - I_{CQ_2}$

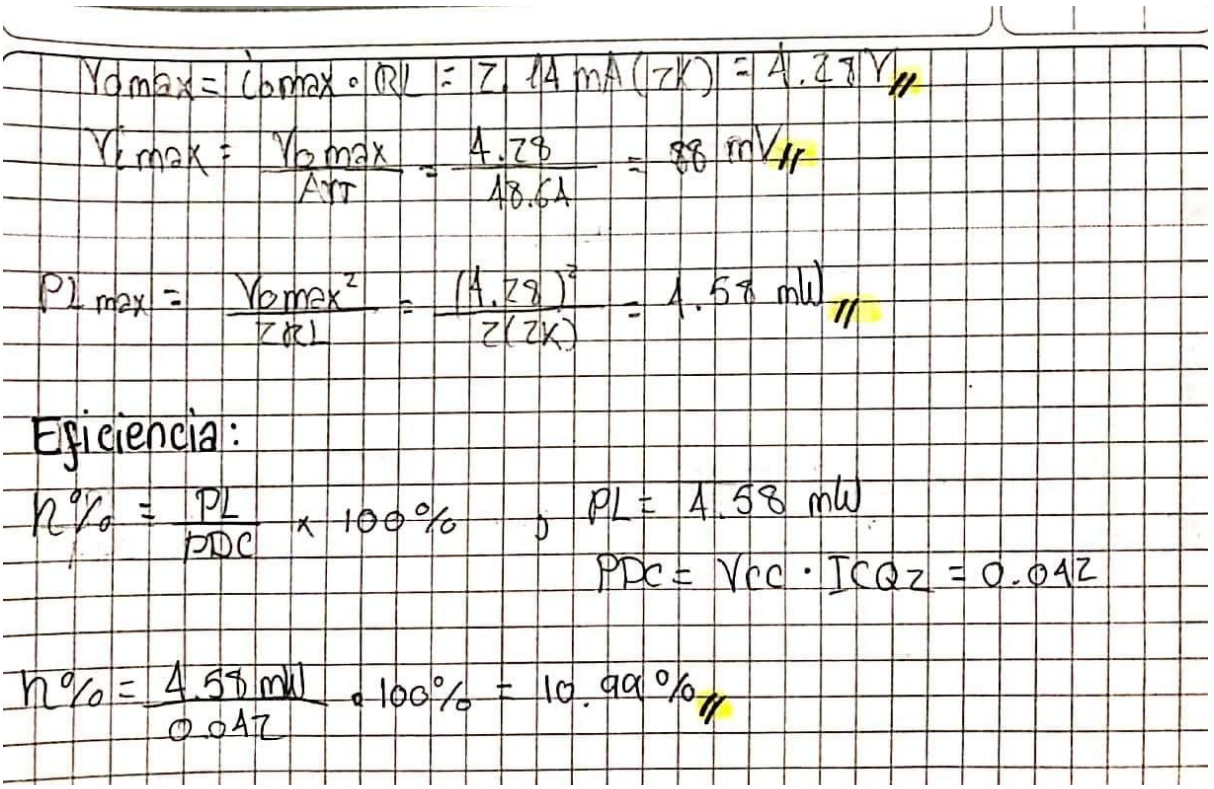
$v_{CE} - V_{CEQ_2} = -(i_C - I_{CQ})([R_{C2} // R_L] + R_{E2})$

$$i_{C_2 max}(v_{CE} = 0) = \frac{V_{CEQ_2}}{[R_{C2} // R_L] + R_{E2}} + I_{CQ}$$

$$i_{c_2 max} = \left(\frac{V_{CEQ_2}}{[R_{C2} // R_L] + R_{E2}} + I_{CQ}\right) - I_{CQ}$$

$$i_{c_2 max} = \frac{4.71}{[2k // 2k] + 100} = 4.28 \text{ mA}$$

$$i_{o\,max} = \frac{4.28 \text{ mA}\,(2k)}{2k + 2k} = 2.14 \text{ mA}$$



Etapa 1

DC:

ICQ1: **2.56mA,** ***VCEQ1:*** **5.86v**

AC:

AV1: **-5.23,** ***Ai1:*** **-10.63**

Etapa 2

DC:

ICQ2: **3.47mA,** ***VCEQ2:*** **4.71v**

AC:

AV2: **-9.3,** ***Ai2:*** **-10.23**

AVT: **48.64**

AiT: **108.74**

Zin: **4.47KΩ**

Zout: **2KΩ**

Vomax: **4.28V**

Vimax: **88mV**

PLmax: **4.58mW**

n%: **10.99%**

b. SIMULACIONES

Resultados obtenidos en simulaciones:

Etapa 1

ICQ1 **= 2.638mA**

VBB1 = 1.200 V

VCE1 = 6.196 V

Vo1 =0.357812V

Vi1= 69.989mV

Av1 **= 5.112**

Ii1 = 16.244uA

Io1 = 166.410 uA

Ai1 **= 10.244**

Etapa 2

ICQ2 **= 3.595mA**

VBB2 = 1.040 V

VCE2 = 4.810 V

Vi 2 = 1.3889 -1.031088 = 0.357812V

Vo2 = 3.0412V

Av2 **= 8.499**

Io2 = 1.5206 mA

Ii2 = 169.087 uA

Ai2 **= 8.989**

AMPLITUD MÁXIMA = 4.1379 V

FRECUENCIA CORTE BAJO = 74.589 Hz

FRECUENCIA CORTE ALTO = 2.719MHz

ANCHO DE BANDA **= 2.719MHz**

Vomax **= 3.042v**

Vimax **= 0.07v**

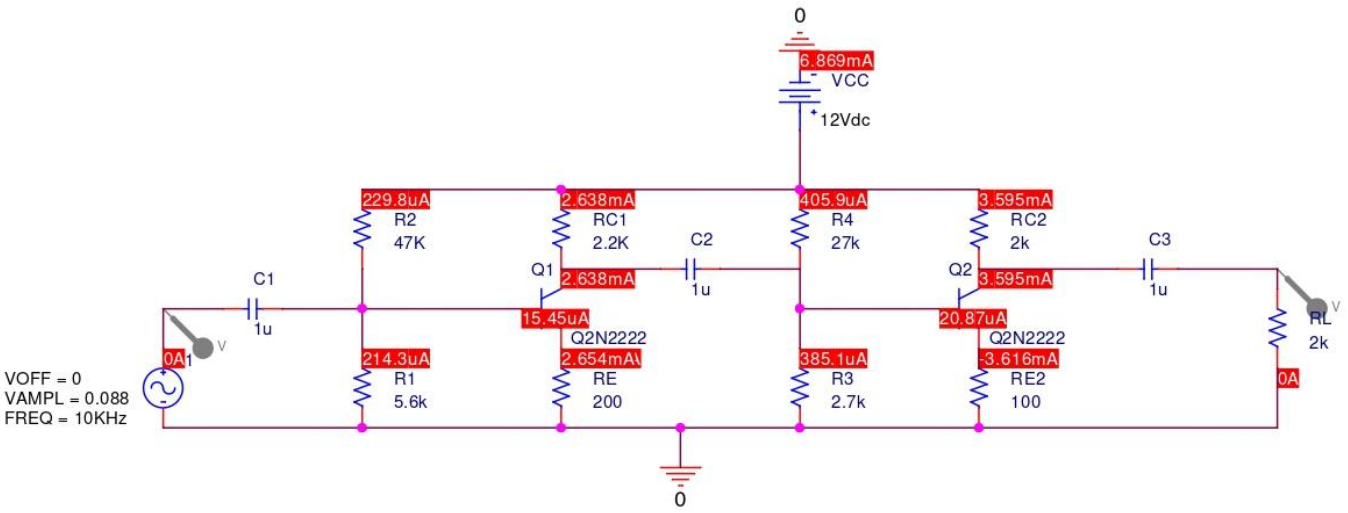
Iomax **= 1.71mA**

Iimax **= 19.55 uA**

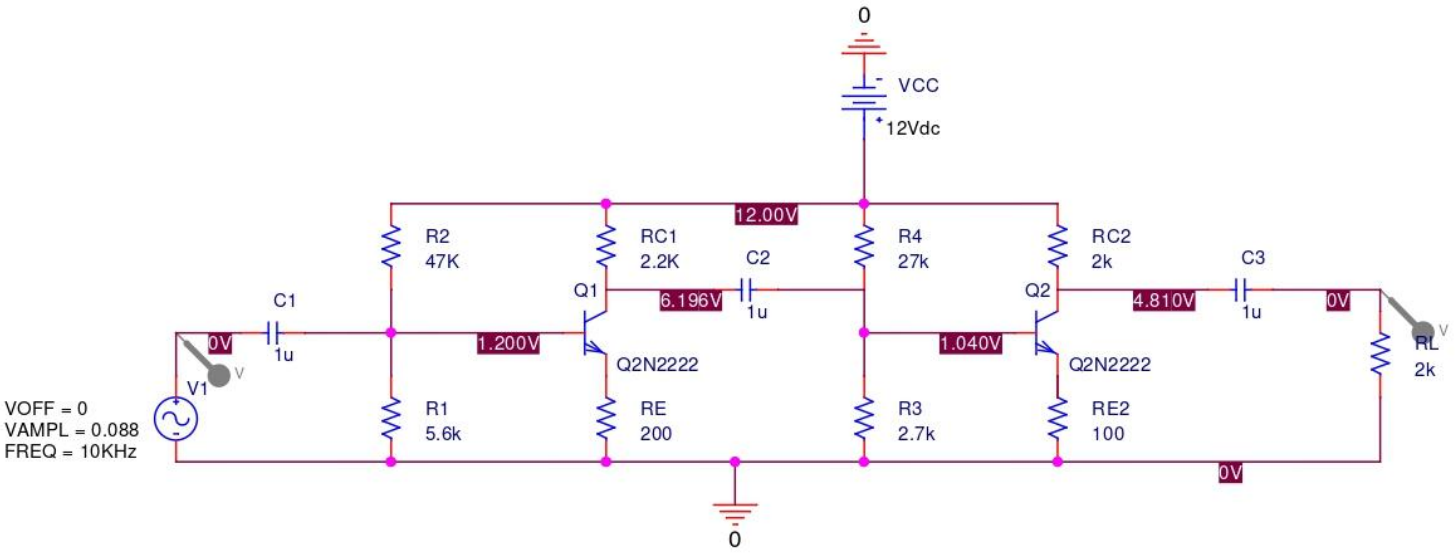
PL **= 2.568 mW**

n% = (PL/PDC) x 100% **= 6.083%**

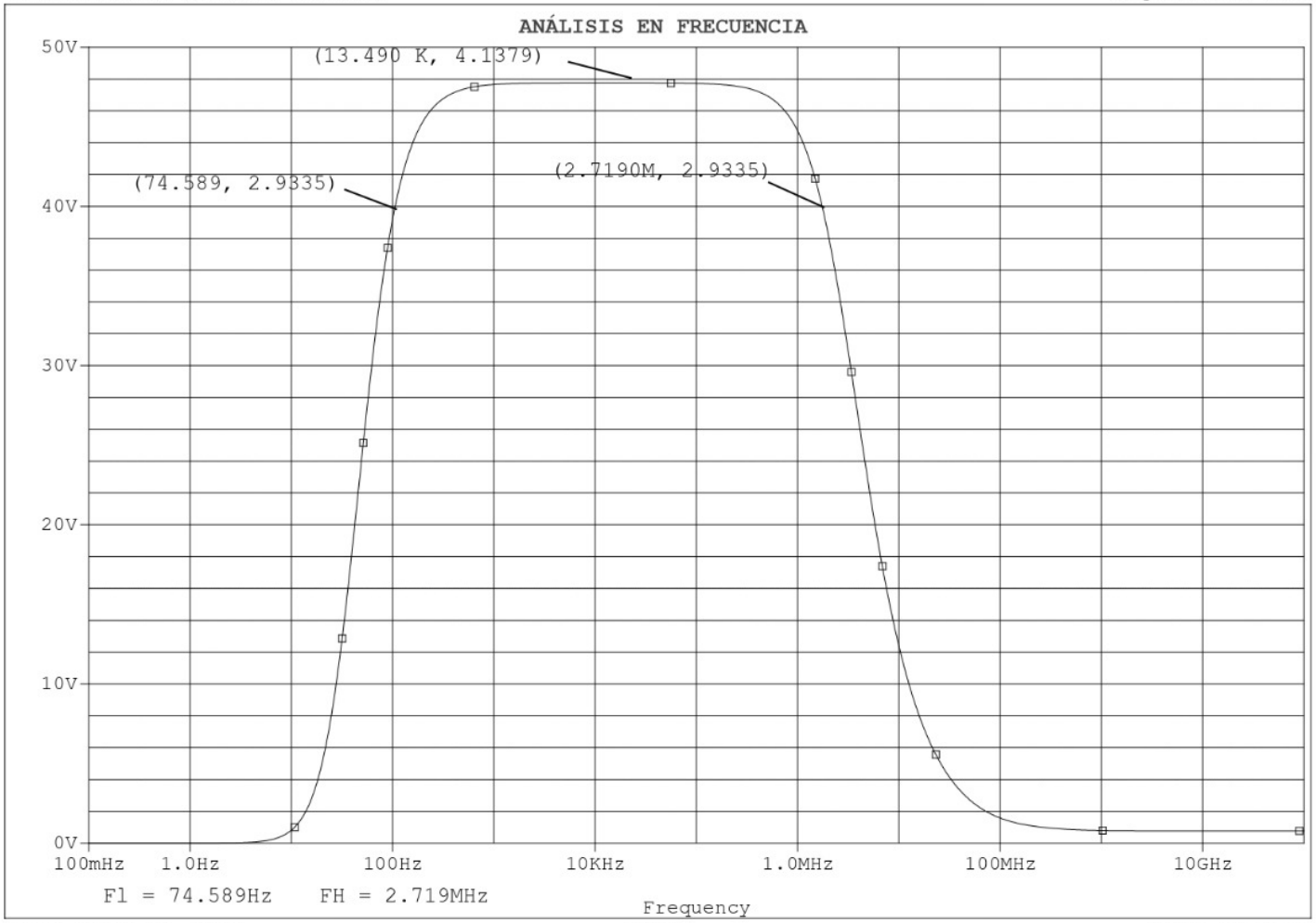
Corrientes DC



Voltajes DC



** Profile: "SCHEMATIC1-Sumulacion esta si" [c:\laboratorios analoga\prelab 3 este si-schematic1-sumul...
Date/Time run: 04/20/22 19:33:49 Temperature: 27.0

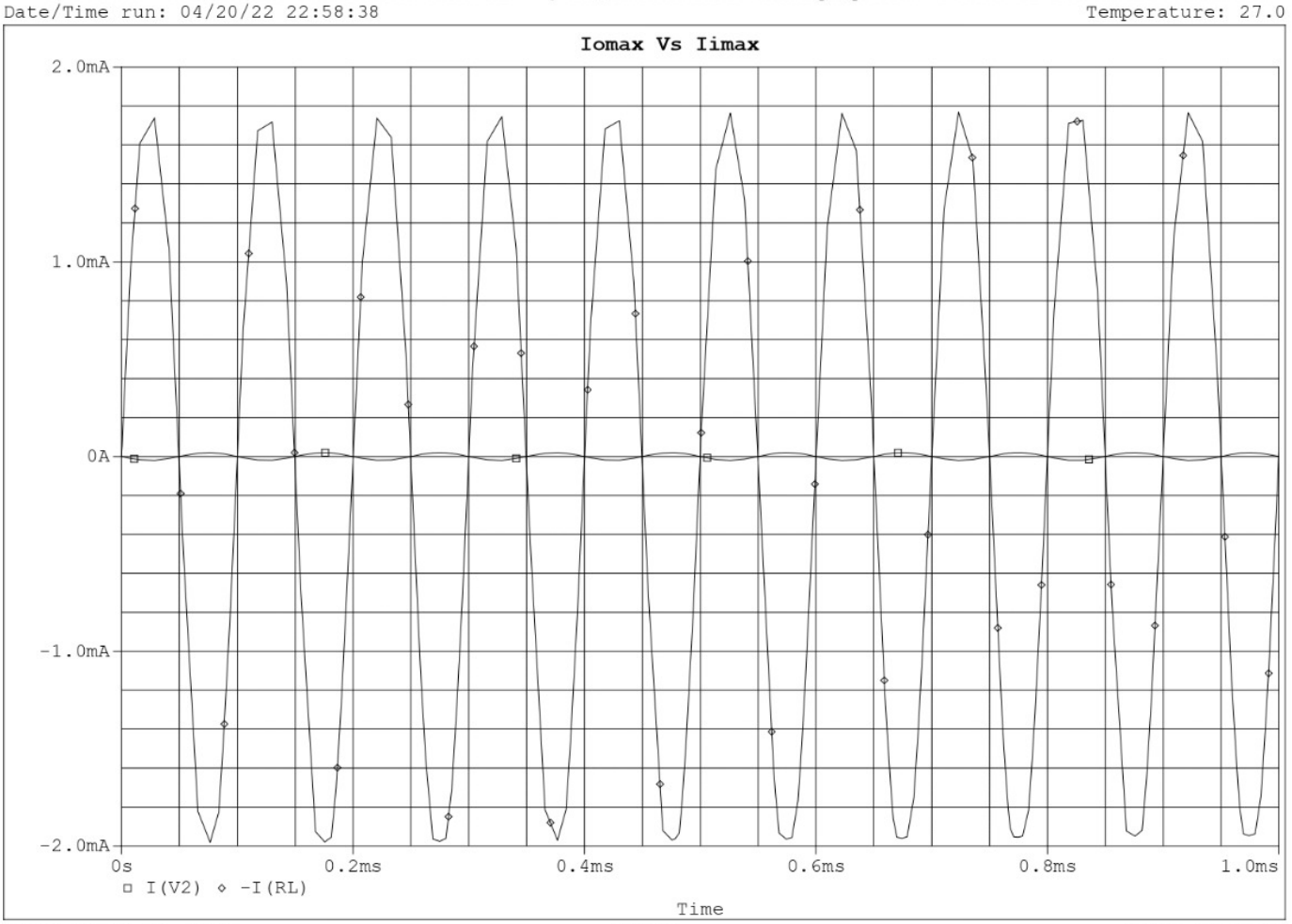


Date: April 20, 2022 Page 1 Time: 20:32:17

** Profile: "SCHEMATIC1-Sumulacion esta si" [c:\laboratorios analoga\prelab 3 este si-schematic1-sumul...
Date/Time run: 04/20/22 22:44:38 Temperature: 27.0

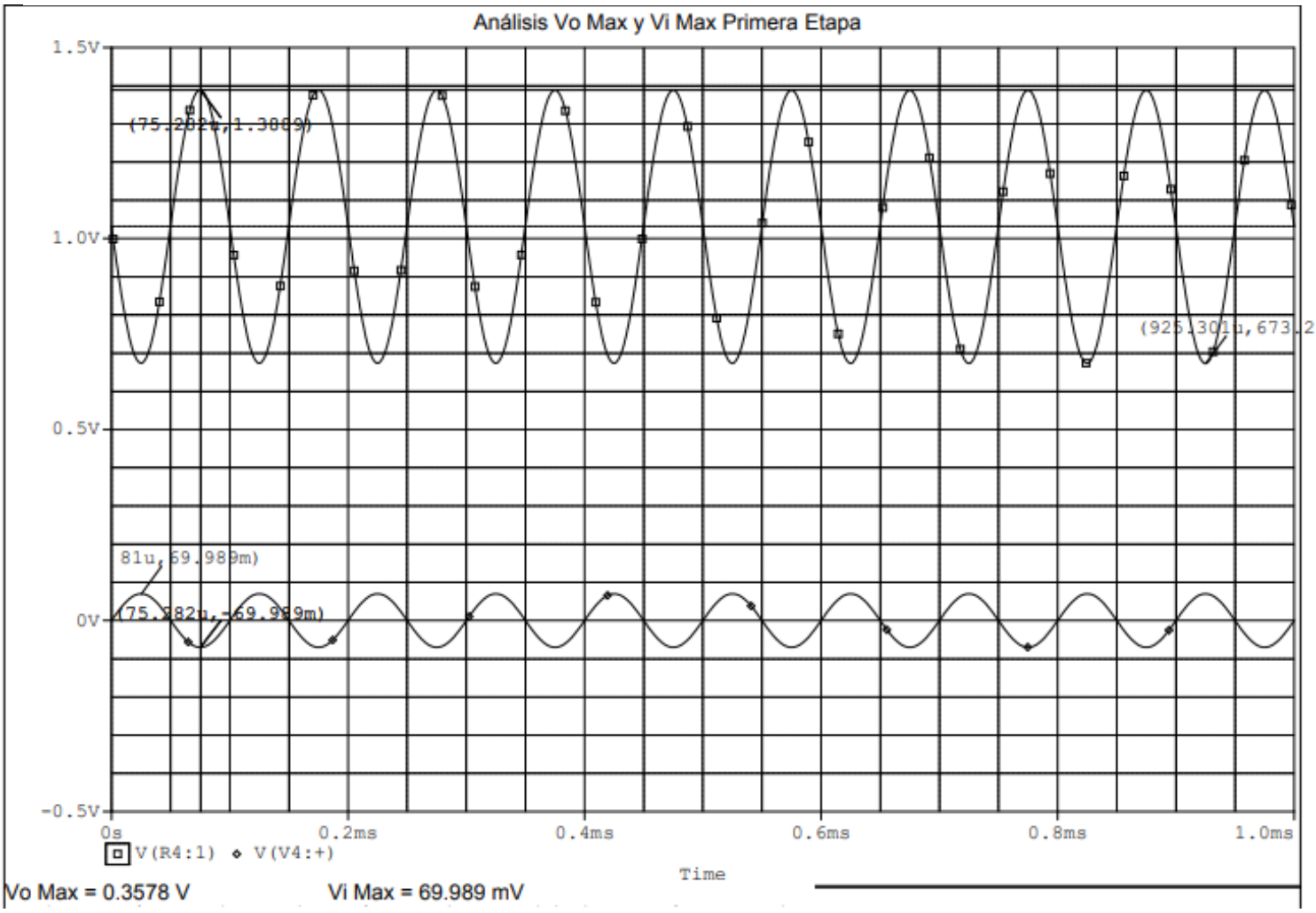
Date: April 20, 2022 Page 1 Time: 22:45:01

** Profile: "SCHEMATIC1-Sumulacion esta si" [c:\laboratorios analoga\prelab 3 este si-schematic1-sumul...
Date/Time run: 04/20/22 22:58:38 Temperature: 27.0

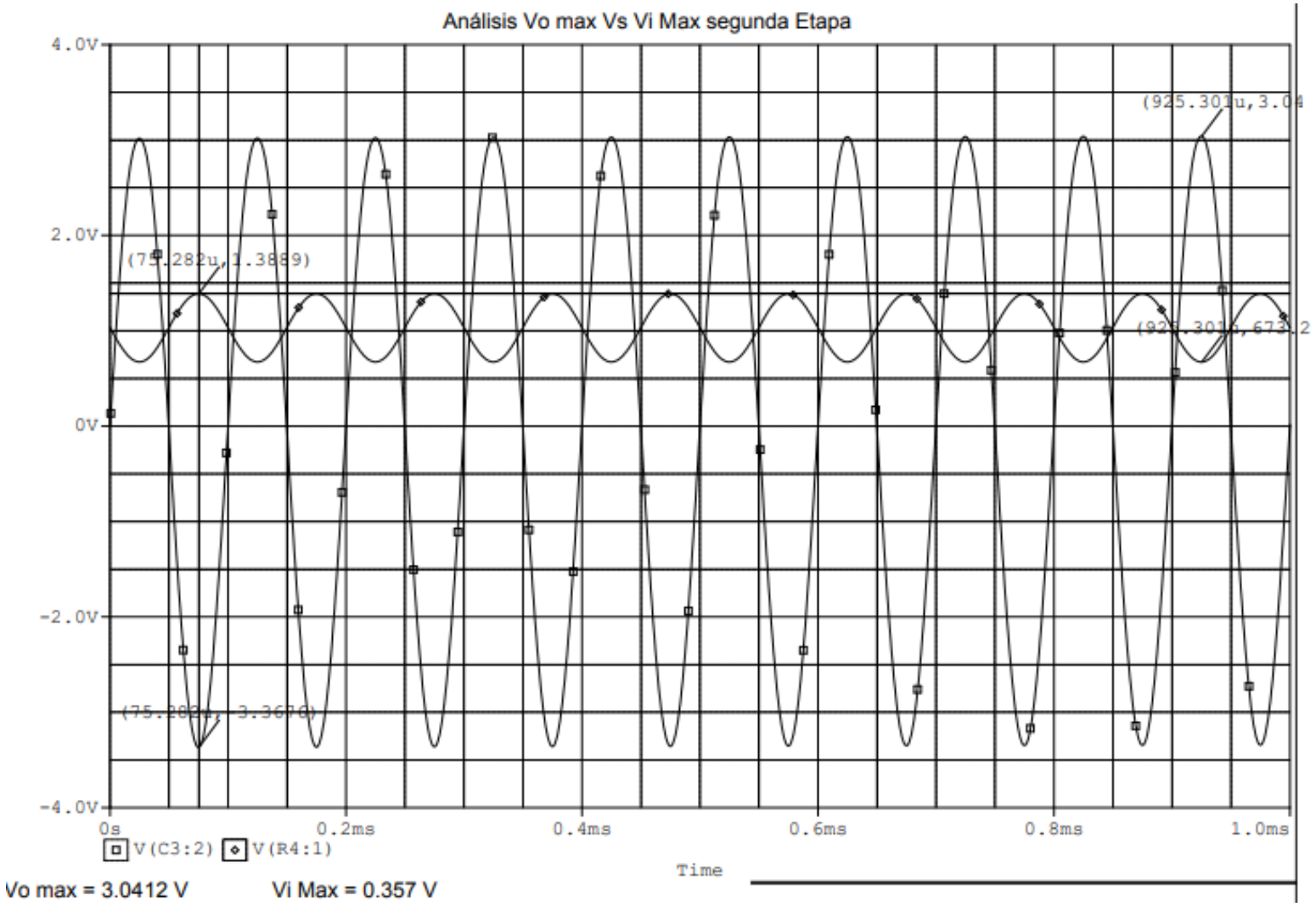


Date: April 20, 2022 Page 1 Time: 22:59:32

Iomax = 1.71mA Iimax = 19.55 uA



Vo Max = 0.3578 V Vi Max = 69.989 mV



Vo max = 3.0412 V Vi Max = 0.357 V

** Profile: "SCHEMATIC1-Bias" [C:\Program Files\Orcad\prelab 3-schematic1-bias.sim]
Date/Time run: 05/18/21 16:07:33 Temperature: 27.0

Io Max = 166.410 uA Ii = 16.244 uA


Io Max Vs Ii Max Segunda Etapa
2.0mA
0A
-2.0mA
(75.282u,169.087u)
0s
0.1ms
0.2ms
0.3ms
0.4ms
0.5ms
0.6ms
0.7ms
0.8ms
0.9ms
1.0ms
I(C2)
I(RL)
Time
Io Max = 1.52 mA
Ii Max = 169.087 uA