BJT BIAS CIRCUITS AND DC MEASUREMENTS

Part II: Laboratory assignment

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Team

Team no.

Student	Last name	First name	Signature
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1 Assignment

For *each* circuit of figure 1 on the following page:

1 Assemble the circuit on the breadboard and use the bench power supply to generate the $V_s = 12\,\mathrm{V}$ supply voltage. The BJT should be a PN2222 (PN2222 data sheet) (**before connecting the device, check the pinout from the data sheet!**).

2 Measure with the *handheld* digital multimeter I_B, I_C, V_{BE} and V_{CE}.

3 Evaluate the uncertainties of the above measurements.

4 Estimate the instrument loading error for I_C and V_{CE}.

5 Measure with the *bench* digital multimeter I_B, I_C, V_{BE} and V_{CE}.

6 Evaluate the uncertainties of the above measurements.

7 Estimate the instrument loading error for I_C and V_{CE}.

8 Report the above measurements in tables 1,2, 3 and 4, respectively for each circuit.

9 Remeasure I_C, and now touch also the BJT case with a finger, heating it up (keep the finger for around a minute). How much does I_C change when you touch the case?

10 Compare the results obtained in the above and comment whether the measurements with the handled and bench multimeters are compatible with each other or not, explain possible discrepancies, and compared the results obtained in the lab with those obtained in the analysis of part 1. Report the comments in the form of page 7. Discuss also the observed change in I_C with respect to the sensitivies obtained in the analysis of part 1.

Upload the filled PDF form, one upload for each team, by April 15, 2024.

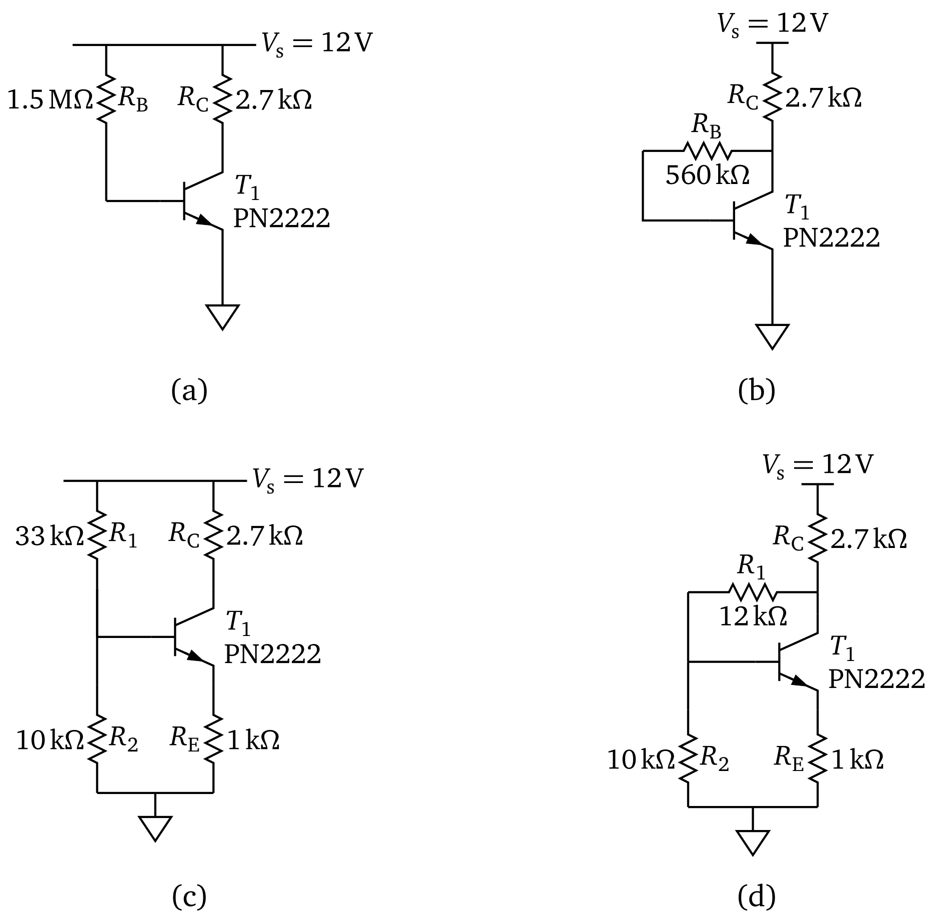

Figure 1: DC bias circuits

Table 1: Results for the circuit of figure 1(a).

	Handheld multimeter			Bench multimeter		
Quantity	Value	Uncert.	Loading error	Value	Uncert.	Loading error
$I_B/\mu A$						
I_C/mA						
V_{CE}/V						
V_{BE}/V						

Table 2: Results for the circuit of figure 1(b).

	Handheld multimeter			Bench multimeter		
Quantity	Value	Uncert.	Loading error	Value	Uncert.	Loading error
$I_B/\mu A$						
I_C/mA						
V_{CE}/V						
V_{BE}/V						

Table 3: Results for the circuit of figure 1(c).

	Handheld multimeter			Bench multimeter		
Quantity	Value	Uncert.	Loading error	Value	Uncert.	Loading error
$I_B/\mu A$						
I_C/mA						
V_{CE}/V						
V_{BE}/V						

Table 4: Results for the circuit of figure 1(d).

	Handheld multimeter			Bench multimeter		
Quantity	Value	Uncert.	Loading error	Value	Uncert.	Loading error
$I_B/\mu A$						
I_C/mA						
V_{CE}/V						
V_{BE}/V						

Uncertanities

Circuit A

Handheld

$\delta V_{CE} = \frac{0,3}{100} \times 9,20V + (3 \times 0,001\ V) = 0,03 = \%3$

$V_{CE} =$

$\delta V_{BE} = \frac{0,025}{100} \times 0,625V + (5 \times 0,0001\ V) = 0,0006$

$= \%\ 0,06$

$V_{BE} =$

$\delta I_B = \frac{0,25}{100} \times 8\mu A + (20 \times 0,01\mu A) = 0,22$

$= \%\ 22$

$I_B =$

$\delta I_C = \frac{0,15}{100} \times 1,072mA + (10 \times 0,001mA) = 0,011$

I_C

$= \%1$

Circuit B Handheld

$$\delta V_{CE} = \frac{0,03}{100} \times 7,44V + (3 \times 0,001) = 0,0052$$

$$= \% \, 0,52$$

$V_{CE} =$

$$\delta V_{BE} = \frac{0,025}{100} \times 0,63 + (5 \times 0,0001) = 0,00063$$

$$= \% \, 0,06$$

$V_{BE} =$

$$\delta I_B = \frac{0,25}{100} \times 12mA + (20 \times 0,01) = 0,23$$

$I_B =$

$$= \% \, 23$$

$$\delta I_C = \frac{0,15}{100} \times 1,746 + (10 \times 0,001) = 0,012$$

I_C

$$= \% \, 1,2$$

Circuit C) Handheld

Handheld

$$\delta V_{CE} = \frac{0{,}025}{100} \times 4{,}622\ V + 10 \times 0{,}0001 = 0{,}012$$

$$= \%\ 1{,}2$$

$$V_{CE} = (4{,}622 \mp 0{,}012)V$$

$$\delta V_{BE} = \frac{0{,}025}{100} \times 0{,}643V + 5 \times (0{,}1 \times 10^{-3}) = 0{,}00066$$

$$= \%\ 0{,}66$$

$$V_{BE} =$$

$$\delta I_B = \frac{0{,}25}{100} \times 270\mu A + (20 \times 0{,}01\mu A) = 0{,}875\mu A$$

$$= 0{,}000000875\ A$$

$$= \%\ 0{,}00087$$

$$I_B =$$

$$\delta I_C = \frac{0{,}15}{100} \times 2{,}03\ mA + (10 \times 0{,}001\ mA) = 0{,}013$$

$$= \%\ 1{,}3$$

$$I_C$$

Circuit D Handheld

$$\delta V_{CE} = \left(\frac{0{,}025}{100} \times 4{,}04\ V\right) + (10 \times 0{,}0001) = 0{,}0020$$
$$= \%\ 0{,}2$$

$V_{CE} =$

$$\delta V_{BE} = \left(\frac{0{,}025}{100} \times 0{,}64\,V\right) + (5 \times 0{,}0001) = 0{,}00066$$
$$= \%\ 0{,}6$$

$V_{BE} =$

$$\delta I_B = \left(\frac{0{,}25}{100} \times 269\ \mu A\right) + (20 \times 0{,}01) = 0{,}2672\,\mu A$$
$$= \%\ 26{,}72$$

$I_B =$

$$\delta I_C = \left(\frac{0{,}15}{100} \times 2{,}27\,mA\right) + (10 \times 0{,}001) = 0{,}0134$$

I_C

$$= \%\ 1{,}34$$

Comments on the results: