

Summer-2019 UM-SJTU JI Ve311 Lab #2

Instructor: Dr. Chang-Ching Tu

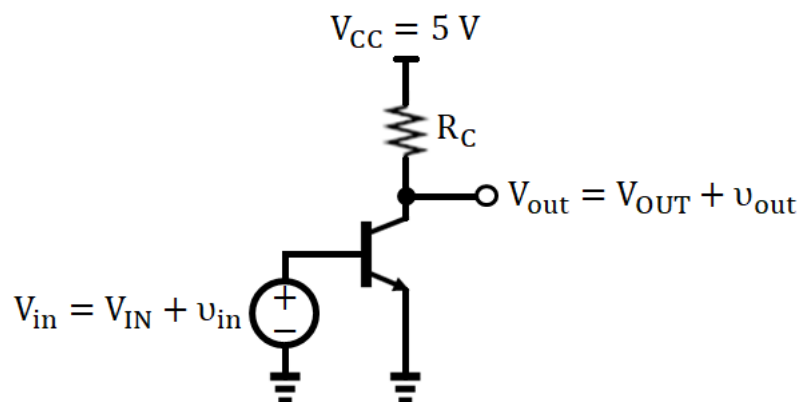
Due: 10:00 am, July 04, 2019 (Thursday) in class

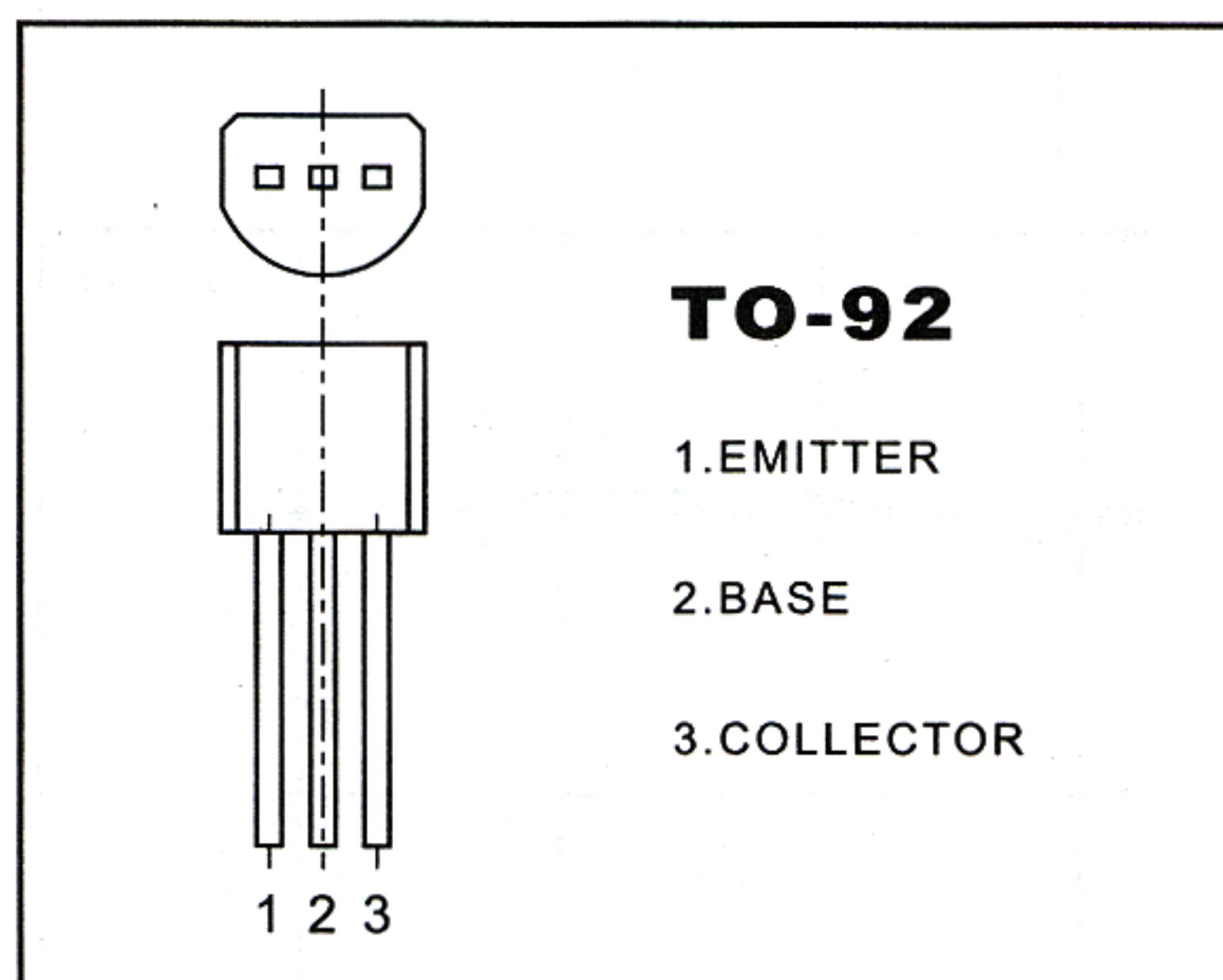
Note:

- (1) Please use A4 size papers.
- (2) Remember to obtain TA's signature after finishing the lab session.

1. [Common-Emitter Amplifier]

- (a) [40%] Design and build a common-emitter amplifier on breadboard which has a voltage gain $A_v > 10$, using npn BJT (S9013). Plot V_{OUT} vs V_{IN} . (Hint: First choose an appropriate R_C . Second, perform DC sweep to find out a V_{IN} at which the magnitude of slope is more than 10. At the same time, make sure the BJT is in the forward-active region. If not working, change for another R_C and repeat the DC analysis again.)
- (b) [30%] For $V_{in} = V_{IN} + 0.1\sin(2\pi 10^2 \cdot \text{time})$, plot $V_{out} = V_{OUT} + v_{out}$ vs time. Confirm that the amplitude of v_{out} is equal to $0.1 \times A_v$.
- (c) [30%] For $V_{in} = V_{IN} + 0.1\sin(2\pi 10^7 \cdot \text{time})$, plot $V_{out} = V_{OUT} + v_{out}$ vs time. Is the amplitude of v_{out} still equal to $0.1 \times A_v$? If not, explain the reasons.





FEATURES

Power dissipation

P_{CM} : 0.625W ($T_{amb}=25^{\circ}C$)

Collector current

I_{CM} : -0.5 A

Collector-base voltage

$V_{(BR)CBO}$: 40 V

Operating and storage junction temperature range

T_J, T_{stg} : $-55^{\circ}C$ to $+150^{\circ}C$

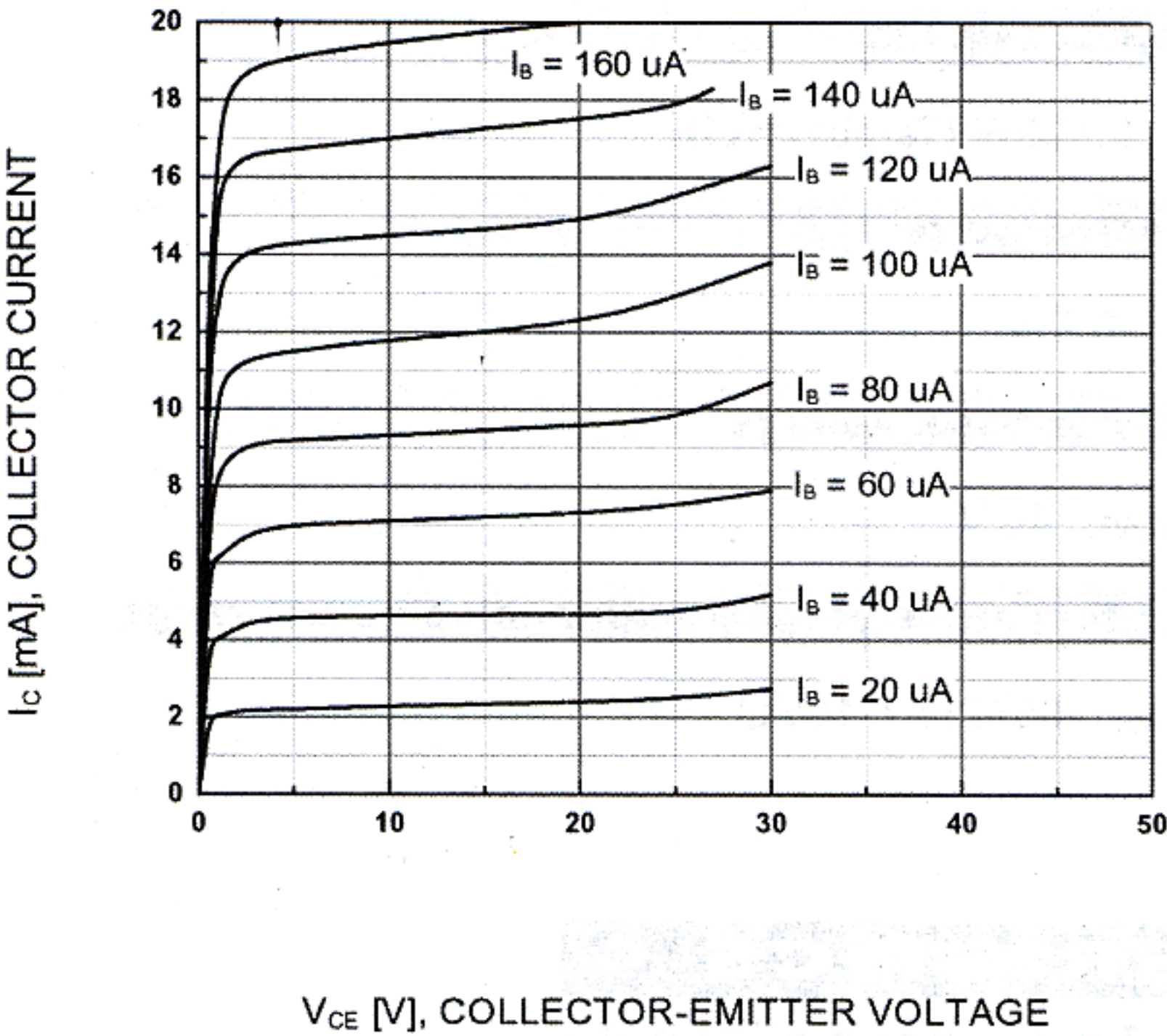
ELECTRICAL CHARACTERISTICS

($T_{amb}=25^{\circ}C$ unless otherwise specified)

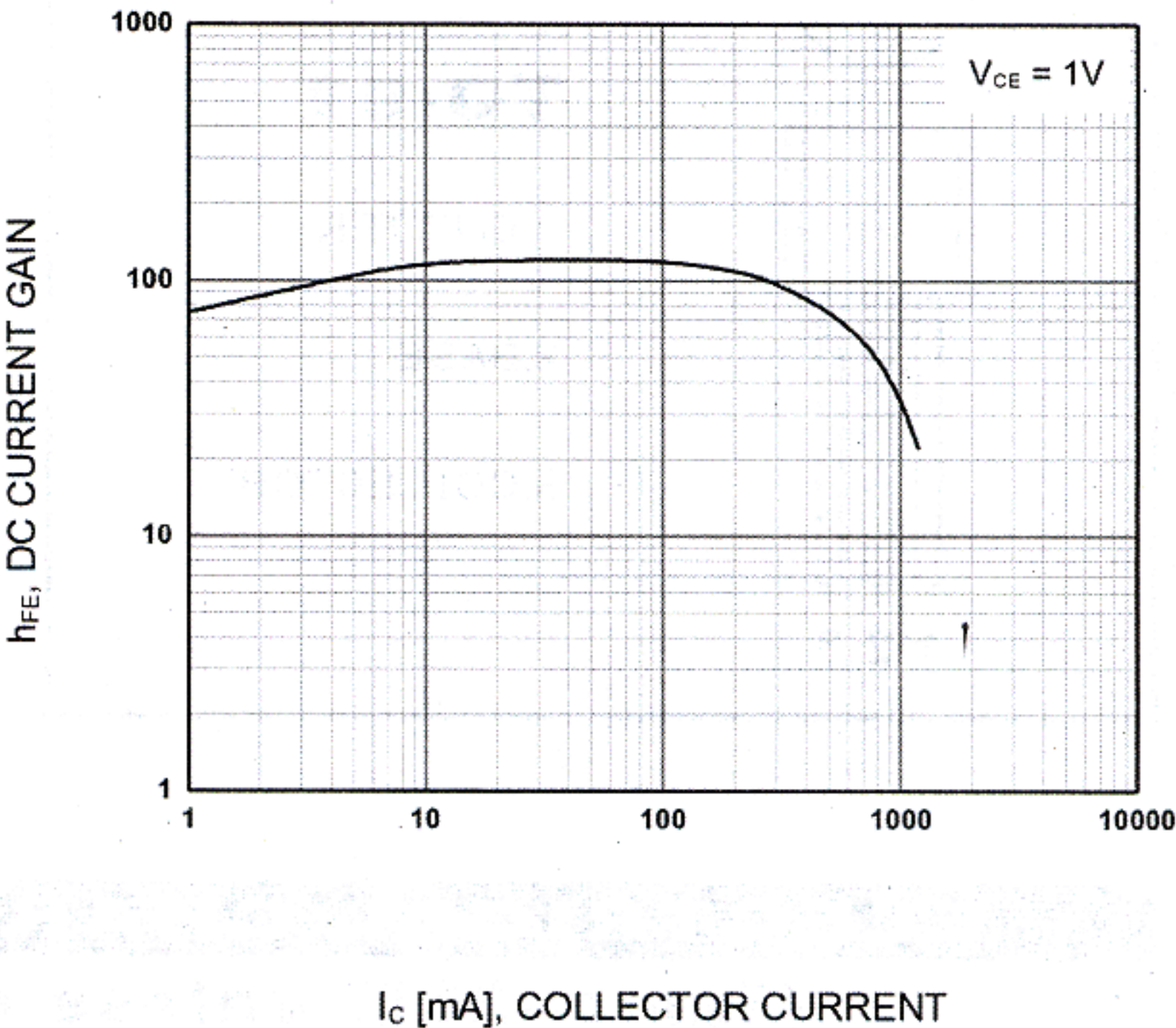
| Parameter | Symbol | Test conditions | MIN | MAX | UNIT |
|--------------------------------------|---------------|--|-----|-----|---------|
| Collector-base breakdown voltage | $V_{(BR)CBO}$ | $I_C = 100 \mu A, I_E = 0$ | 45 | | V |
| Collector-emitter breakdown voltage | $V_{(BR)CEO}$ | $I_C = 0.1 mA, I_B = 0$ | 25 | | V |
| Emitter-base breakdown voltage | $V_{(BR)EBO}$ | $I_E = 100 \mu A, I_C = 0$ | 5 | | V |
| Collector cut-off current | I_{CBO} | $V_{CB} = 40 V, I_E = 0$ | | 0.1 | μA |
| Collector cut-off current | I_{CEO} | $V_{CE} = 20 V, I_B = 0$ | | 0.1 | μA |
| Emitter cut-off current | I_{EBO} | $V_{EB} = 5 V, I_C = 0$ | | 0.1 | μA |
| DC current gain | $h_{FE(1)}$ | $V_{CE} = 1 V, I_C = 50 mA$ | 64 | 300 | |
| | $h_{FE(2)}$ | $V_{CE} = 1 V, I_C = 500 mA$ | 40 | | |
| Collector-emitter saturation voltage | V_{CEsat} | $I_C = 500 mA, I_B = 50 mA$ | | 0.6 | V |
| Base-emitter saturation voltage | V_{BEsat} | $I_C = 500 mA, I_B = 50 mA$ | | 1.2 | V |
| Base-emitter voltage | V_{BE} | $I_E = 100 mA$ | | 1.4 | V |
| Transition frequency | f_T | $V_{CE} = 6 V, I_C = -20 mA$ $f = 30 MHz$ | 150 | | MHz |

CLASSIFICATION OF $h_{FE(1)}$

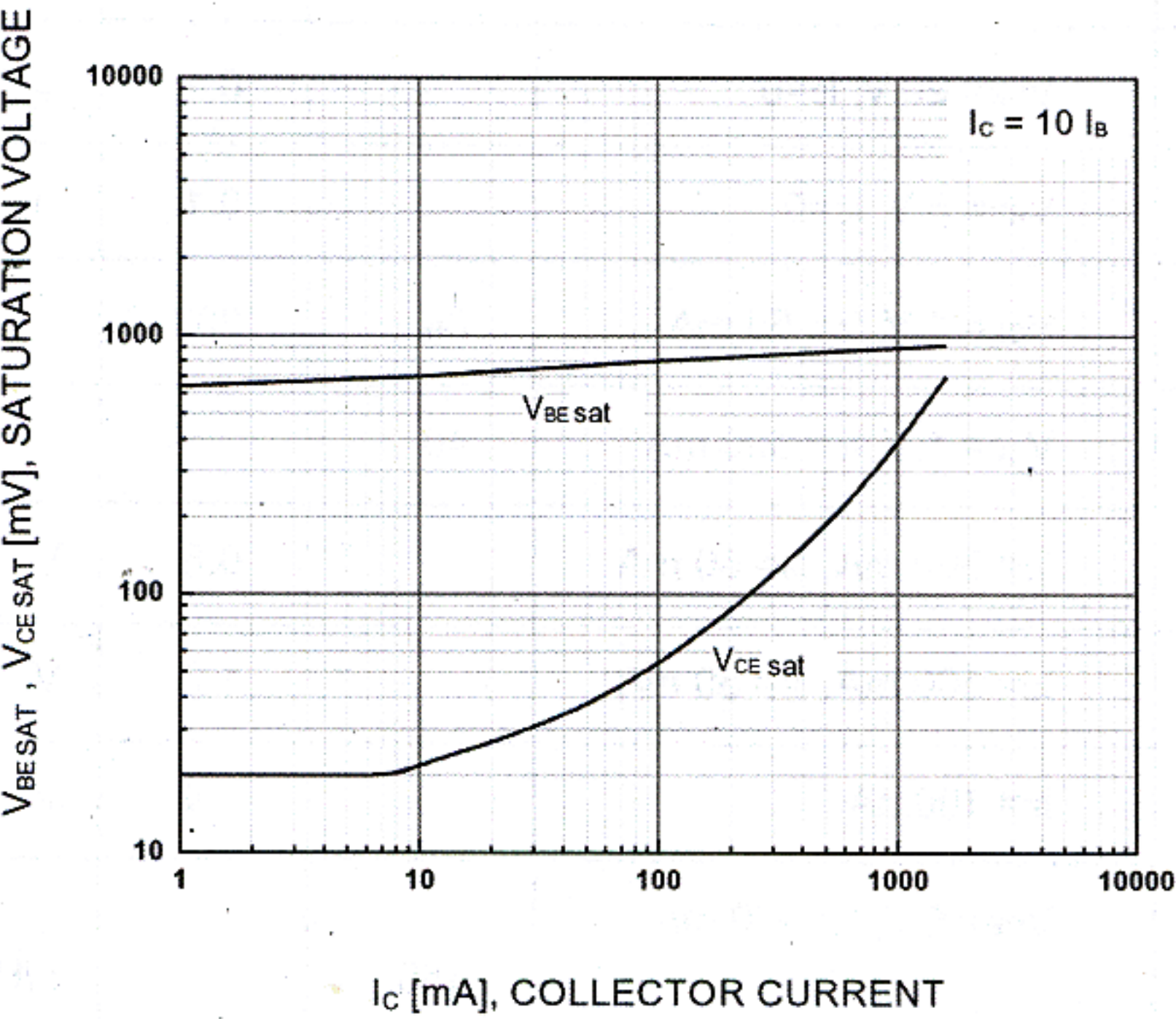
| Rank | D | E | F | G | H | I |
|-------|-------|--------|--------|---------|---------|---------|
| Range | 64-91 | 78-112 | 96-135 | 112-166 | 144-202 | 190-300 |



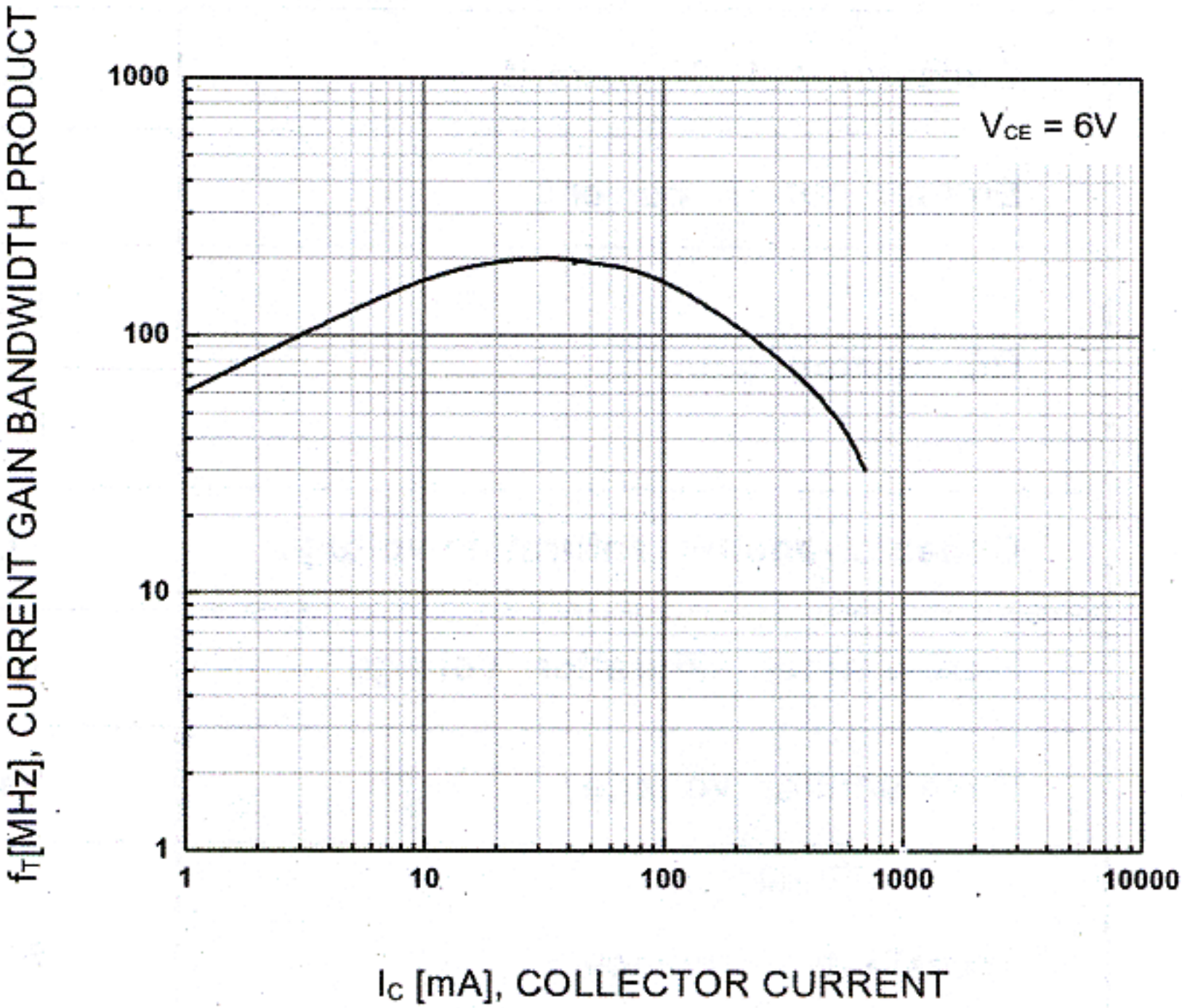
Static Characteristic



DC current Gain



Base-Emitter Saturation Voltage
Collector-Emitter Saturation Voltage



Current Gain Bandwidth Product