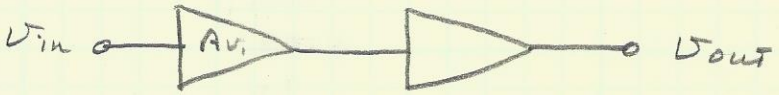
6-6 MULTISTAGE AMPLIFIERS (p. 301)

- "CASCADED AMPLIFIERS"
- GAIN IS PRODUCT OF INDIVIDUAL STAGES
- SYMBOLOGY OF AN AMP STAGE IS A "TRIANGLE"



$$A_{V(TOTAL)} = A_{V_1} \cdot A_{V_2}$$

$$V_{OUT} = A_{V(TOTAL)} \cdot V_{in}$$

- DECIBELS

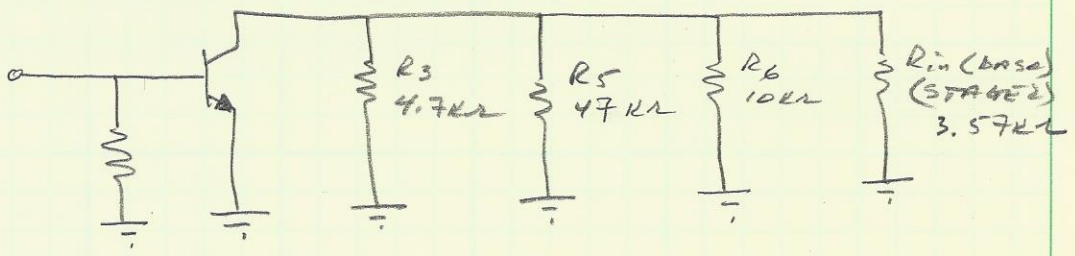
$$A_{V(dB)} = 20 \log_{10} A_V$$

CAPACITIVELY COUPLED MULTI-STAGE AMP (p. 302)

-(SEE FIG. 6-34 p. 302)

TO GET VOLTAGE GAIN OF STAGE #1 : CONSIDER LOADING EFFECT ON STAGE #1 OF STAGE 2.

AC EQUIVALENT OF FIRST STAGE:



SO, EFFECTIVE COLLECTOR RESISTANCE (AC-WISE) OF Q1 IS:

$$R_{C_1} = R_3 \parallel R_5 \parallel R_6 \parallel R_{in(BASE\,2)}$$

ALL IN PARALLEL TO AC GROUND.

BY ANALYSIS, LOOKING AT STAGE 2 TO FIND $R_{IN(BASE2)}$:

STAGES ARE IDENTICAL SO dc VALUES ARE SAME

$$V_B = \left(\frac{10}{57}\right)10V; \quad V_B = 1.75V$$

$$V_E = 1.75 - 0.7; \quad V_E = 1.05V$$

THEN: $I_{E_2} = 1.05V/1K$; $\boxed{I_{E_2} = 1.05mA}$

$$r'e = \frac{25mV}{I_E}; \quad \therefore \boxed{r'e = 23.81\Omega}$$

NOW, $R_{in(BASE2)}$:

$$R_{IN(BASE2)} = \beta_{AC}\, r'e \quad (R_E \text{ is BYPASS; NO SWAMPING } R_E)$$

$$R_{IN(BASE2)} = 150(23.81\Omega)$$

$$\boxed{R_{IN(BASE2)} = 3.571K\Omega}$$

THEREFORE, $R_{C_1} = R_3 \| R_5 \| R_6 \| R_{in(BASE2)}$

$$= 4.7K\Omega \| 47K\Omega \| 10K\Omega \| 3.571K\Omega$$

$$\boxed{R_{C_1} \cong 1.63K\Omega} \quad (1.6285K\Omega)$$

GAINS:

STAGE #1: $A_{V_1} = \dfrac{R_{C_1}}{r'e} = \dfrac{1.63K\Omega}{23.8\Omega}$

$$\boxed{A_{V_1} = 68.5}$$

STAGE #2: $A_{V_2} = \dfrac{R_7}{r'e}$ (R_7 = "R_{C_2}")

$$= \frac{4.7K\Omega}{23.8\Omega}$$

$$\boxed{A_{V_2} = 197}$$

OVERALL VOLTAGE GAIN

$$A_{V(TOTAL)} = A_{V_1} \cdot A_{V_2}$$
$$= (68.5)(197)$$

$$\boxed{A_{V(TOTAL)} = 13,521}$$

$$dB = 20 \log_{10} A_{V(TOTAL)}$$

$$= 20 \log_{10} (13521)$$

$$= 20 (4.131)$$

$$\boxed{A_{V(TOTAL)_{dB}} = 82.62 \text{ dB}}$$

TYPICAL PROCESS:

- DETERMINE "TYPE" OF AMPLIFIER IN EACH STAGE:
  - CE: WILL HAVE A GAIN
  - COMMON COLLECTOR (EMITTER FOLLOWER) AND COMMON BASE TOPOLOGIES WILL HAVE UNITY GAIN (i.e., $A_V = 1$)
- DC ANALYSIS OF EACH STAGE
- AC ANALYSIS: GET GAINS
- TOTAL GAIN IS PRODUCT OF STAGE GAINS.