TABLE 4.1

BJT Bias Configurations

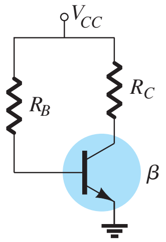
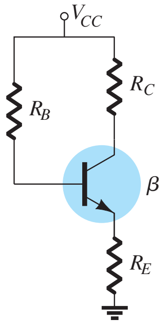
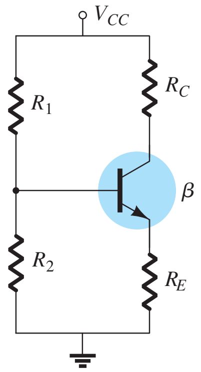
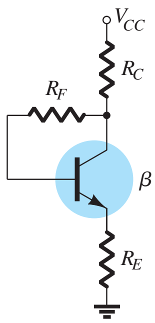
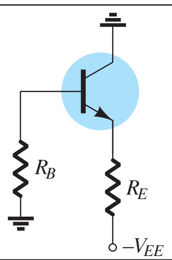
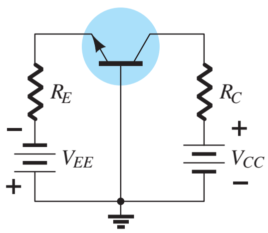
Type	Configuration	Pertinent Equations
Fixed-bias		$I_B = \dfrac{V_{CC} - V_{BE}}{R_B}$ $I_C = \beta I_B, I_E = (\beta + 1)I_B$ $V_{CE} = V_{CC} - I_C R_C$
Emitter-bias		$I_B = \dfrac{V_{CC} - V_{BE}}{R_B + (\beta + 1)R_E}$ $I_C = \beta I_B, I_E = (\beta + 1)I_B$ $R_i = (\beta + 1)R_E$ $V_{CE} = V_{CC} - I_C(R_C + R_E)$
Voltage-divider bias		EXACT: $R_{Th} = R_1 \| R_2, E_{Th} = \dfrac{R_2 V_{CC}}{R_1 + R_2}$ $I_B = \dfrac{E_{Th} - V_{BE}}{R_{Th} + (\beta + 1)R_E}$ $I_C = \beta I_B, I_E = (\beta + 1)I_B$ $V_{CE} = V_{CC} - I_C(R_C + R_E)$ APPROXIMATE: $\beta R_E \geq 10R_2$ $V_B = \dfrac{R_2 V_{CC}}{R_1 + R_2}, V_E = V_B - V_{BE}$ $I_E = \dfrac{V_E}{R_E}, I_B = \dfrac{I_E}{\beta + 1}$ $V_{CE} = V_{CC} - I_C(R_C + R_E)$
Collector-feedback		$I_B = \dfrac{V_{CC} - V_{BE}}{R_F + \beta(R_C + R_E)}$ $I_C = \beta I_B, I_E = (\beta + 1)I_B$ $V_{CE} = V_{CC} - I_C(R_C + R_E)$
Emitter-follower		$I_B = \dfrac{V_{EE} - V_{BE}}{R_B + (\beta + 1)R_E}$ $I_C = \beta I_B, I_E = (\beta + 1)I_B$ $V_{CE} = V_{EE} - I_E R_E$
Common-base		$I_E = \dfrac{V_{EE} - V_{BE}}{R_E}$ $I_B = \dfrac{I_E}{\beta + 1}, I_C = \beta I_B$ $V_{CE} = V_{EE} + V_{CC} - I_E(R_C + R_E)$ $V_{CB} = V_{CC} - I_C R_C$

TABLE 5.1

Unloaded BJT Transistor Amplifiers

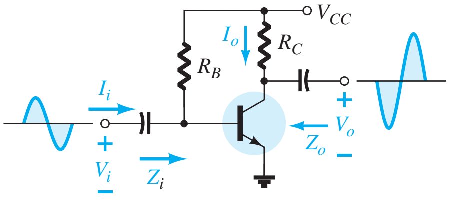
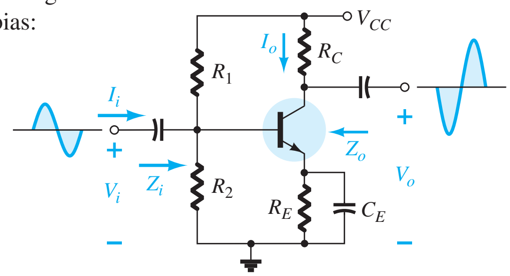
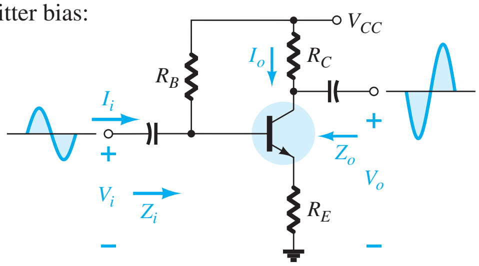
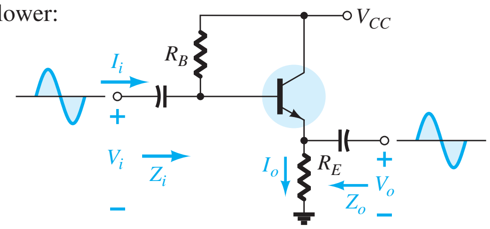
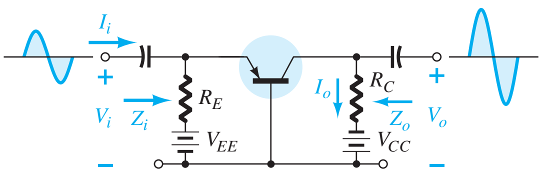
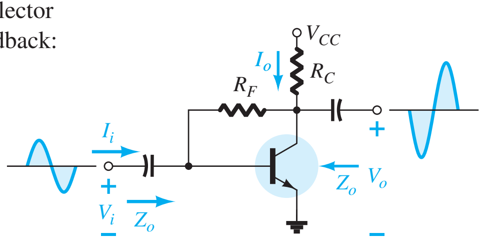
Configuration	Z_i	Z_o	A_v	A_i
Fixed-bias: 	Medium (1 kΩ) $= \boxed{R_B \parallel \beta r_e}$ $\cong \boxed{\beta r_e}$ $(R_B \geq 10\beta r_e)$	Medium (2 kΩ) $= \boxed{R_C \parallel r_o}$ $\cong \boxed{R_C}$ $(r_o \geq 10R_C)$	High (−200) $= \boxed{-\frac{(R_C \parallel r_o)}{r_e}}$ $\cong \boxed{-\frac{R_C}{r_e}}$ $(r_o \geq 10R_C)$	High (100) $= \boxed{\frac{\beta R_B r_o}{(r_o + R_C)(R_B + \beta r_e)}}$ $\cong \boxed{\beta}$ $(r_o \geq 10R_C,$ $R_B \geq 10\beta r_e)$
Voltage-divider bias: 	Medium (1 kΩ) $= \boxed{R_1 \parallel R_2 \parallel \beta r_e}$	Medium (2 kΩ) $= \boxed{R_C \parallel r_o}$ $\cong \boxed{R_C}$ $(r_o \geq 10R_C)$	High (−200) $= \boxed{-\frac{R_C \parallel r_o}{r_e}}$ $\cong \boxed{-\frac{R_C}{r_e}}$ $(r_o \geq 10R_C)$	High (50) $= \boxed{\frac{\beta(R_1 \parallel R_2)r_o}{(r_o + R_C)(R_1 \parallel R_2 + \beta r_e)}}$ $\cong \boxed{\frac{\beta(R_1 \parallel R_2)}{R_1 \parallel R_2 + \beta r_e}}$ $(r_o \geq 10R_C)$
Unbypassed emitter bias: 	High (100 kΩ) $= \boxed{R_B \parallel Z_b}$ $Z_b \cong \beta(r_e + R_E)$ $\cong \boxed{R_B \parallel \beta R_E}$ $(R_E \gg r_e)$	Medium (2 kΩ) $= \boxed{R_C}$ (any level of r_o)	Low (−5) $= \boxed{-\frac{R_C}{r_e + R_E}}$ $\cong \boxed{-\frac{R_C}{R_E}}$ $(R_E \gg r_e)$	High (50) $\cong \boxed{-\frac{\beta R_B}{R_B + Z_b}}$
Emitter-follower: 	High (100 kΩ) $= \boxed{R_B \parallel Z_b}$ $Z_b \cong \beta(r_e + R_E)$ $\cong \boxed{R_B \parallel \beta R_E}$ $(R_E \gg r_e)$	Low (20 Ω) $= \boxed{R_E \parallel r_e}$ $\cong \boxed{r_e}$ $(R_E \gg r_e)$	Low ($\cong$1) $= \boxed{\frac{R_E}{R_E + r_e}}$ $\cong \boxed{1}$	High (−50) $\cong \boxed{-\frac{\beta R_B}{R_B + Z_b}}$
Common-base: 	Low (20 Ω) $= \boxed{R_E \parallel r_e}$ $\cong \boxed{r_e}$ $(R_E \gg r_e)$	Medium (2 kΩ) $= \boxed{R_C}$	High (200) $\cong \boxed{\frac{R_C}{r_e}}$	Low (−1) $\cong \boxed{-1}$
Collector feedback: 	Medium (1 kΩ) $= \boxed{\frac{r_e}{\frac{1}{\beta} + \frac{R_C}{R_F}}}$ $(r_o \geq 10R_C)$	Medium (2 kΩ) $\cong \boxed{R_C \parallel R_F}$ $(r_o \geq 10R_C)$	High (−200) $\cong \boxed{-\frac{R_C}{r_e}}$ $(r_o \geq 10R_C)$ $(R_F \gg R_C)$	High (50) $= \boxed{\frac{\beta R_F}{R_F + \beta R_C}}$ $\cong \boxed{\frac{R_F}{R_C}}$

TABLE 5.2

BJT Transistor Amplifiers Including the Effect of R_s and R_L

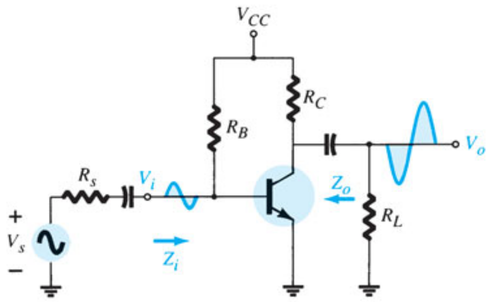
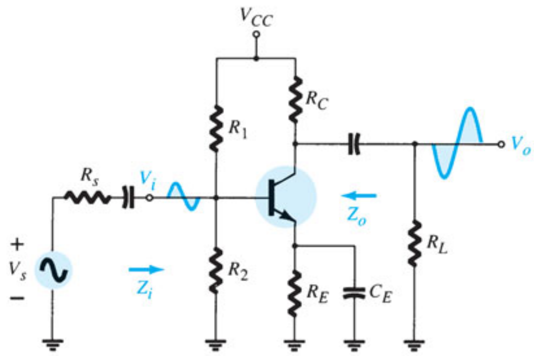
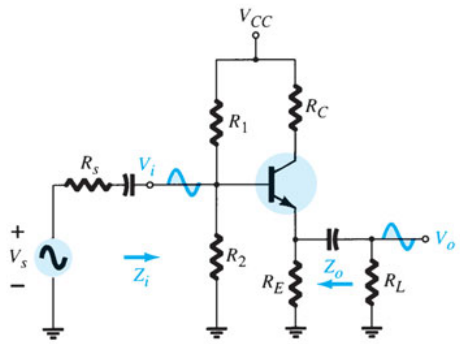
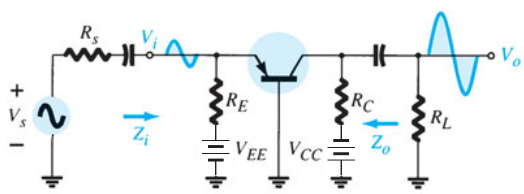
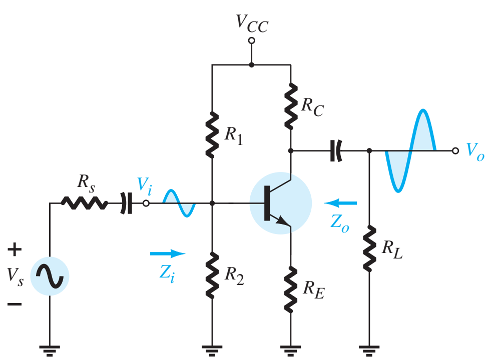
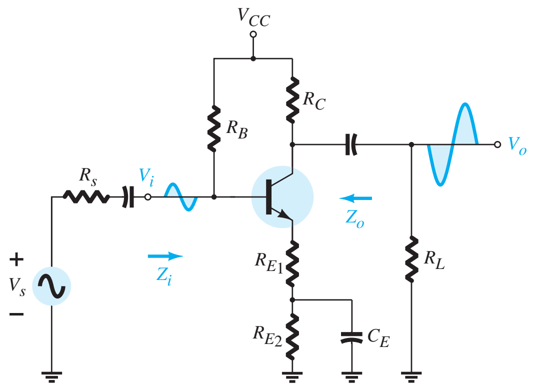
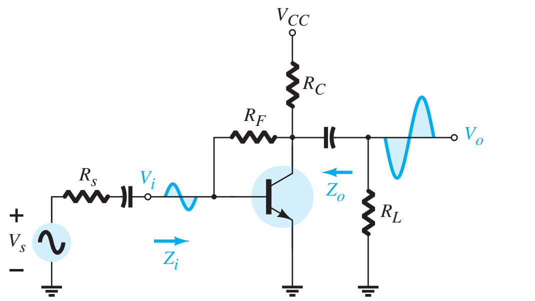
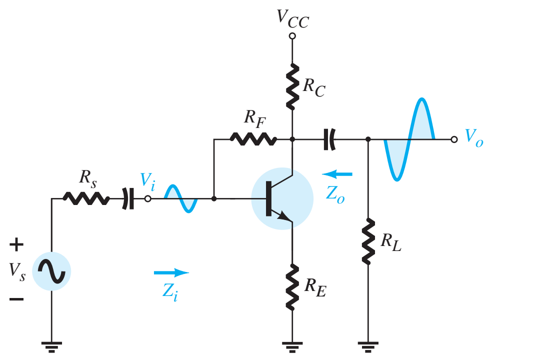
Configuration	$A_{v_L} = V_o/V_i$	Z_i	Z_o
	$\dfrac{-(R_L\Vert R_C)}{r_e}$	$R_B\Vert\beta r_e$	R_C
	Including r_o: $-\dfrac{(R_L\Vert R_C\Vert r_o)}{r_e}$	$R_B\Vert\beta r_e$	$R_C\Vert r_o$
	$\dfrac{-(R_L\Vert R_C)}{r_e}$	$R_1\Vert R_2\Vert\beta r_e$	R_C
	Including r_o: $\dfrac{-(R_L\Vert R_C\Vert r_o)}{r_e}$	$R_1\Vert R_2\Vert\beta r_e$	$R_C\Vert r_o$
	$\cong 1$	$R'_E = R_L\Vert R_E$ $R_1\Vert R_2\Vert\beta(r_e + R'_E)$	$R'_s = R_s\Vert R_1\Vert R_2$ $R_E\Vert\left(\dfrac{R'_s}{\beta} + r_e\right)$
	Including r_o: $\cong 1$	$R_1\Vert R_2\Vert\beta(r_e + R'_E)$	$R_E\Vert\left(\dfrac{R'_s}{\beta} + r_e\right)$
	$\cong \dfrac{-(R_L\Vert R_C)}{r_e}$	$R_E\Vert r_e$	R_C
	Including r_o: $\cong \dfrac{-(R_L\Vert R_C\Vert r_o)}{r_e}$	$R_E\Vert r_e$	$R_C\Vert r_o$
	$\dfrac{-(R_L\Vert R_C)}{R_E}$	$R_1\Vert R_2\Vert\beta(r_e + R_E)$	R_C
	Including r_o: $\dfrac{-(R_L\Vert R_C)}{R_E}$	$R_1\Vert R_2\Vert\beta(r_e + R_e)$	$\cong R_C$

TABLE 5.2 *(Continued)*

BJT Transistor Amplifiers Including the Effect of R_s and R_L

Configuration	$A_{v_L} = V_o/V_i$	Z_i	Z_o
	$\dfrac{-(R_L \Vert R_C)}{R_{E_1}}$	$R_B \Vert \beta(r_e + R_{E_1})$	R_C
	Including r_o: $\dfrac{-(R_L \Vert R_C)}{R_{E_t}}$	$R_B \Vert \beta(r_e + R_E)$	$\cong R_C$
	$\dfrac{-(R_L \Vert R_C)}{r_e}$	$\beta r_e \Vert \dfrac{R_F}{\lvert A_v \rvert}$	R_C
	Including r_o: $\dfrac{-(R_L \Vert R_C \Vert r_o)}{r_e}$	$\beta r_e \Vert \dfrac{R_F}{\lvert A_v \rvert}$	$R_C \Vert R_F \Vert r_o$
	$\dfrac{-(R_L \Vert R_C)}{R_E}$	$\beta R_E \Vert \dfrac{R_F}{\lvert A_v \rvert}$	$\cong R_C \Vert R_F$
	Including r_o: $\cong \dfrac{-(R_L \Vert R_C)}{R_E}$	$\cong \beta R_E \Vert \dfrac{R_F}{\lvert A_v \rvert}$	$\cong R_C \Vert R_F$

packaged system relates to the actual amplifier or network. The system of Fig. 5.61 is called a two-port system because there are two sets of terminals—one at the input and the other at the output. At this point it is particularly important to realize that

the data surrounding a packaged system is the no-load data.

This should be fairly obvious because the load has not been applied, nor does it come with the load attached to the package.

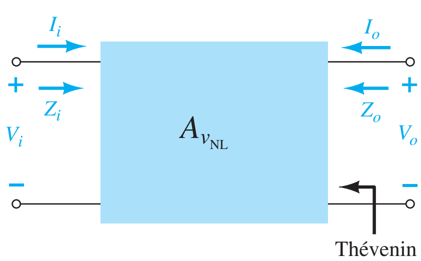


FIG. 5.61
Two-port system.