

$$\frac{V_{in} - V_-}{R_1} = \frac{V_- - V_{out}}{R_2} \quad (30.27)$$

$$V_{out} = (-V_-) \cdot A_{OL}(f) \quad (30.28)$$

$$A_{OL}(f) = \frac{A_{OLDC}}{1 + j \frac{f}{f_{3dB}}} \quad (\text{Fig. 30.21})$$

$$V_{in} - V_- = \frac{R_1}{R_2} V_- - \frac{R_1}{R_2} V_{out}$$

$$V_- = -\frac{V_{out}}{A_{OL}(f)}$$

$$V_{in} + \frac{V_{out}}{A_{OL}(f)} = -\frac{R_1}{R_2} \cdot \frac{V_{out}}{A_{OL}(f)} - \frac{R_1}{R_2} V_{out}$$

$$-V_{in} = V_{out} \left(\frac{1}{A_{OL}(f)} + \frac{R_1}{R_2} \cdot \frac{1}{A_{OL}(f)} + \frac{R_1}{R_2} \right)$$

$$-V_{in} = V_{out} \left(\frac{1 + j \frac{f}{f_{3dB}}}{A_{OLDC}} + \frac{R_1}{R_2} \frac{1 + j \frac{f}{f_{3dB}}}{A_{OLDC}} + \frac{R_1}{R_2} \right)$$

$$-V_{in} = V_{out} \left(\frac{1}{A_{OLDC}} + j \frac{f}{A_{OLDC} \cdot f_{3dB}} + \frac{R_1}{A_{OLDC} R_2} + \frac{R_1}{R_2} \left(1 + j \frac{f}{A_{OLDC} \cdot f_{3dB}} \right) \right)$$

SINCE $f_{in} \approx f_{3dB} \cdot A_{OLDC}$ (Fig. 30.21) $\ll \frac{R_1}{R_2}$

$$\frac{R_1}{A_{OLDC} R_2} \ll \frac{1}{A_{OLDC}} \ll \frac{R_1}{R_2}$$

We CAN write

$$-V_{in} \approx V_{out} \left(\frac{R_1}{R_2} + j \frac{f}{f_{uw}} \left(1 + \frac{R_1}{R_2} \right) \right)$$

OR

$$\frac{V_{out}}{V_{in}} \approx \frac{-\frac{R_2}{R_1}}{1 + j \frac{f}{f_{uw}} \left(\frac{R_2}{R_1} + 1 \right)}$$

$$\frac{V_{out}}{V_{in}} \approx \frac{-\frac{R_2}{R_1}}{1 + j \frac{f}{f_{uw}} \left(\frac{R_1}{R_1 + R_2} \right)}$$

OR

$$\left| \frac{R_2}{R_1} \right| \cdot f_{3dB} \approx f_{uw} \cdot \left(\frac{R_1}{R_1 + R_2} \right)$$

$$\text{GAIN} \cdot \text{BW} = \frac{R_2}{R_1} \cdot f_{uw} \cdot \frac{R_1}{R_1 + R_2}$$

OR

$$\text{GAIN} \cdot \text{BW} = \frac{R_2}{R_1 + R_2} \cdot f_{uw} \quad (30.32)$$