



$$I = 100 \mu A$$

$$k_n W/L = 400 \mu A/V$$

$$V_D = 1 V$$

$$I = \frac{1}{2} k_n (W/L) (V_{GS} - V_t)^2$$

$$50 \mu A = \frac{1}{2} (400 \mu A/V^2) (V_{GS} - 1)^2$$

$$V_{GS} = 1.5 V$$

$$\text{Com } V_{G1} = V_{G2} = 0 V \quad ; \quad V_{GS} = V_G - V_S$$

$$V_S = 1.5 V$$

$$V_S = -1.5 V$$

$$\text{Com } V_{G1} = V_{G2} = 2 V \quad ; \quad V_{GS} = V_G - V_S$$

$$1.5 = 2 - V_S$$

$$V_S = 0.5 V$$

$$\text{Com } V_{G2} = 0$$

$$I_{D2} = (90\%) (50 \mu A) = 45 \mu A \quad ; \quad I_{D1} = 55 \mu A$$

$$I_{D2} \downarrow (10\%)$$

$$V_{GS2} = \sqrt{\frac{2 I_{D2}}{k_n}} + 1$$

$$V_{GS1} = \sqrt{\frac{2 I_{D1}}{k_n}}$$

$$V_{GS2} = 1.47 V$$

$$\therefore V_{G1} = V_{GS1} - V_{GS2}$$

$$= 1.52 V - 1.47 V$$

$$V_{S1} = 0.05 V$$

$$\uparrow I_{D2} \uparrow (10\%)$$

$$I_{D2} = 55 \mu A$$

$$I_{D1} = 45 \mu A$$

$$V_{GS2} = 1.52 V$$

$$V_{GS1} = 1.47 V$$

$$\therefore V_{G1} = -0.05 V$$

I_{D2}/I_{D1}	I_{D2}	I_{D1}	V_{GS2}	V_{GS1}	V_{LD}
1	50mA	50mA	1.15V	1.15V	0V
0.5	33.3mA	66.7mA	1.41V	1.58V	-0.17V
0.4	47.4mA	52.6mA	1.49V	1.51V	-0.02V
0.49	47.75mA	52.25mA	1.49V	1.50V	-0.01V

Con. $I_{D1}/I_{D2} = 20$ $V_{LD} = ?$

$$I = 100\text{mA} = I_{D1} + I_{D2} \quad \rightarrow I_{D1} = 20I_{D2}$$

$$100\text{mA} = 20I_{D2} + I_{D2}$$

$$I_{D2} = \frac{100\text{mA}}{21}$$

$$I_{D2} = 4.76\text{mA}$$

$$I_{D1} = 100\text{mA} - I_{D2}$$

$$I_{D1} = 95.2\text{mA}$$

$$V_{GS1} = \sqrt{\frac{2I_{D1}}{400\text{mA}}} + 1$$

$$V_{GS1} = 1.690\text{V}$$

$$V_{GS2} = \sqrt{\frac{2I_{D2}}{400\text{mA}}} + 1$$

$$V_{GS2} = 1.154\text{V}$$

$$V_{LD} = V_{GS1} - V_{GS2}$$

$$V_{LD} = V_{LD} = 0.536\text{V}$$