

Diode, transistor and MOSFET

Solutions · step by step

- 01**
1. The diode conducts with zero drop in this model.
 2. The resistor receives all 5 V.
 3. $I = 5 \text{ mA}$.

$$I = \frac{5}{1000} = 5 \text{ mA}$$

- 02**
1. Diode blocks.
 2. $I = 0 \text{ A}$.
 3. Resistor voltage = 0 V; diode takes source voltage.

- 03**
1. Resistor voltage: $5 - 0.7 = 4.3 \text{ V}$.
 2. $I = UR/R$.
 3. $I = 4.3 \text{ mA}$.

$$I = \frac{5 - 0.7}{1000} = 4.3 \text{ mA}$$

- 04**
1. Resistor must drop 3 V.
 2. Current in A: 0.01 A.
 3. $R = 300 \Omega$.

$$R = \frac{5 - 2}{0.010} = 300 \Omega$$

Diode, transistor and MOSFET

Solutions · step by step

- 05**
1. $I = 3/330 = 9.09 \text{ mA}$.
 2. $P = 3^2/330$.
 3. $P = 27.27 \text{ mW}$.

$$P_R = \frac{3^2}{330} = 27.27 \text{ mW}$$

- 06**
1. Lower forward voltage gives maximum current.
 2. Maximum $I = 3.2/330 = 9.70 \text{ mA}$.
 3. Minimum $I = 2.8/330 = 8.48 \text{ mA}$.

$$8.48 \text{ mA} \leq I \leq 9.70 \text{ mA}$$

- 07**
1. Current changes continuously with voltage.
 2. Temperature and diode type affect the curve.
 3. 0.7 V is a simplified calculation assumption.

- 08**
1. Collector current = $\beta \cdot$ base current.
 2. $100 \cdot 0.1 \text{ mA} = 10 \text{ mA}$.
 3. Valid only while the external circuit permits it.

$$I_C = \beta I_B = 10 \text{ mA}$$

Diode, transistor and MOSFET

Solutions · step by step

- 09**
1. Load voltage: 4.8 V.
 2. Divide by 100 Ω.
 3. Collector current = 48 mA.

$$I_C = \frac{5 - 0.2}{100} = 48 \text{ mA}$$

- 10**
1. Divide load current by forced gain.
 2. Base current = $48/10 = 4.8 \text{ mA}$.
 3. The driver must be able to supply it.

$$I_B = \frac{48 \text{ mA}}{10} = 4.8 \text{ mA}$$

- 11**
1. Base resistor voltage is 2.5 V.
 2. $R = 2.5/0.0048$.
 3. Base resistor = 521 Ω; check actual driver and datasheet.

$$R_B = \frac{3.3 - 0.8}{0.0048} \approx 521 \Omega$$

- 12**
1. $P = \text{saturated VCE} \cdot \text{collector current}$.
 2. $0.2 \text{ V} \cdot 0.048 \text{ A}$.
 3. $P = 9.6 \text{ mW}$, excluding base and switching losses.

$$P_{CE} = 0.2 \cdot 0.048 = 9.6 \text{ mW}$$

Diode, transistor and MOSFET

Solutions · step by step

- 13**
1. Across the coil.
 2. Cathode to positive, anode to collector.
 3. It blocks during on-time and carries coil current at turn-off.

- 14**
1. $P = I^2 \cdot R$.
 2. Square current: 4 A^2 .
 3. $P = 0.2 \text{ W}$.

$$P = I^2 R = 2^2 \cdot 0.05 = 0.2 \text{ W}$$

- 15**
1. New resistance: 0.1Ω .
 2. $P = 4 \cdot 0.1$.
 3. Conduction loss doubles to 0.4 W .

$$P = 4 \cdot 0.1 = 0.4 \text{ W}$$

- 16**
1. Multiply ON dissipation by duty cycle.
 2. $0.2 \cdot 0.4$.
 3. Mean = 0.08 W .

$$P_{avg} = DP_{on} = 0.08 \text{ W}$$

Diode, transistor and MOSFET

Solutions · step by step

- 17**
1. No, threshold is specified at a very small test current.
 2. On-resistance must be specified at a suitable gate voltage.
 3. Also check current, temperature and driver.

- 18**
1. Each cycle supplies Q_G .
 2. Mean current = $Q_G \cdot f$.
 3. Mean = 0.2 mA; brief peaks can be much larger.

$$I_{avg} = Q_G f = 10 \text{ nC} \cdot 20 \text{ kHz} = 0.2 \text{ mA}$$

- 19**
1. Current = charge/time.
 2. $10 \cdot 10^{-9} / 100 \cdot 10^{-9}$.
 3. $I = 0.1 \text{ A} = 100 \text{ mA}$.

$$I \approx \frac{Q_G}{t} = 100 \text{ mA}$$

- 20**
1. Use a suitable gate-source pulldown.
 2. It provides a defined OFF state when the driver is high-impedance.
 3. Check pin startup state, leakage and driver capability.