

第1章 数字逻辑基础

1.1 什么是数字电路？与模拟电路相比，数字电路具有哪些特点？

答：处理数字信号并能完成数字运算的电路系统称为数字电路。特点：采用二进制，结构简单易于集成；可用于数值计算和逻辑运算；抗干扰，精度高；便于长期存储和远程传输，保密性好，通用性强。

1.2 模拟电路与数字电路之间的联系纽带是什么？

答：模拟电路与数字电路之间的联系纽带是模-数或数-模转换。

1.3 举例说明我们身边的模拟信号和数字信号。

答：我们身边常见的模拟信号有：温度、速度、压力、流量、亮度等等；而常见的数字信号有：开关、二极管的状态、电灯的状态等。

1.4 把下列二进制数转换成十进制数。

- (1) $(11000101)_2 = (197)_{10}$ (2) $(0.01001)_2 = (0.28)_{10}$ (3) $(1010.001)_2 = (10.125)_{10}$
(4) $(01011100)_2 = (92)_{10}$ (5) $(11.01101)_2 = (3.40625)_{10}$ (6) $(111.11001)_2 = (7.78125)_{10}$

1.5 把下列十进制数转换成二进制数。

- (1) $(12.0625)_{10} = (1100.0001)_2$ (2) $(127.25)_{10} = (1111111.01)_2$ (3) $(101)_{10} = (1100101)_2$
(4) $(51.125)_{10} = (110011.001)_2$ (5) $(87.625)_{10} = (1010111.101)_2$ (6) $(191)_{10} = (10111111)_2$

1.6 把下列二进制数分别转换成十进制数、八进制数和十六进制数。

- (1) $(11010111.110)_2 = (431.75)_{10} = (657.6)_8 = (1AF.C)_{16}$
(2) $(1101111.0110)_2 = (111.375)_{10} = (157.3)_8 = (6F.6)_{16}$
(3) $(11111.1010)_2 = (31.625)_{10} = (37.5)_8 = (1F.A)_{16}$
(4) $(100001111.10)_2 = (271.5)_{10} = (417.4)_8 = (10F.8)_{16}$
(5) $(1000111.0010)_2 = (71.125)_{10} = (107.1)_8 = (47.2)_{16}$
(6) $(10001.1111)_2 = (17.9375)_{10} = (21.74)_8 = (11.F)_{16}$

1.7 把下列八进制数分别转换成十进制数、十六进制数和二进制数。

- (1) $(623.77)_8 = (403.98)_{10} = (193.FC)_{16} = (110010011.111111)_2$
(2) $(701.53)_8 = (449.671875)_{10} = (1C1.AC)_{16} = (111000001.101011)_2$
(3) $(23.07)_8 = (19.109375)_{10} = (16.1C)_{16} = (010110.000111)_2$
(4) $(156.72)_8 = (110.90625)_{10} = (6E.E8)_{16} = (1101110.111010)_2$
(5) $(353.17)_8 = (235.234375)_{10} = (EB.3C)_{16} = (11101011.001111)_2$
(6) $(73.71)_8 = (59.890625)_{10} = (3B.E4)_{16} = (111011.111001)_2$

1.8 把下列十六进制数分别转换成十进制数、八进制数和二进制数。

- (1) $(2AC5.D)_{16} = (10949.81)_{10} = (25305.64)_8 = (10101011000101.1101)_2$
(2) $(1FB9.F)_{16} = (8121.9375)_{10} = (17671.74)_8 = (1111110111001.1111)_2$
(3) $(B2C85.E)_{16} = (732293.875)_{10} = (2626205.7)_8 = (10110010110010000101.111)_2$
(4) $(6BE7.F)_{16} = (27623.9375)_{10} = (65747.74)_8 = (110101111100111.1111)_2$
(5) $(5CAC5.AB)_{16} = (379589.668)_{10} = (1345305.526)_8 = (1011100101011000101.10101011)_2$
(6) $(9AF1.A)_{16} = (39665.625)_{10} = (115361.5)_8 = (1001101011110001.1010)_2$

1.9 把下列十进制数转换成五进制数。

- (1) $(432.13)_{10} = (3212.0316)_5$ (2) $(7132.3)_{10} = (212012.12)_5$
(3) $(52.93)_{10} = (202.43)_5$ (5) $(212.78)_{10} = (1322.34)_5$
(6) $(382.013)_{10} = (3012.03)_5$ (7) $(43.75)_{10} = (133.34)_5$

1.10 用 8421BCD 码表示下列十进制数。

- (1) $(42.78)_{10} = (0100\ 0010.0111\ 1000)_{8421BCD}$
- (2) $(103.65)_{10} = (0001\ 0000\ 0011.0110\ 0101)_{8421BCD}$
- (3) $(9.04)_{10} = (1001.0000\ 0100)_{8421BCD}$
- (4) $(102.08)_{10} = (0001\ 0000\ 0010.0000\ 1000)_{8421BCD}$
- (5) $(412.12)_{10} = (0100\ 0001\ 0010.0001\ 0010)_{8421BCD}$
- (6) $(70.124)_{10} = (0111\ 0000.0001\ 0010\ 0100)_{8421BCD}$

1.11 把下列 8421BCD 码表示成十进制数。

- (1) $(0101\ 1000)_{8421BCD} = (58)_{10}$
- (2) $(1001\ 0011\ 0101)_{8421BCD} = (935)_{10}$
- (3) $(0011\ 0100.0111\ 0001)_{8421BCD} = (34.71)_{10}$
- (4) $(0111\ 0101.0110)_{8421BCD} = (75.6)_{10}$

1.12 把下列 8421BCD 码表示成二进制数。

- (1) $(1000)_{8421BCD} = (1000)_2$
- (2) $(0011\ 0001)_{8421BCD} = (1111)_2$
- (3) $(1000\ 1000)_{8421BCD} = (88)_{10} = (11111)_2$
- (4) $(1001\ 1011)_{8421BCD}$ 无效的 8421BCD 码

1.13 把下列 8421BCD 码与 5421BCD 码互换。

- (1) $(1001\ 0011)_{8421BCD} = (93)_{10} = (1100\ 0011)_{5421BCD}$
- (2) $(1100\ 0101)_{5421BCD} = (95)_{10} = (1001\ 0101)_{8421BCD}$
- (3) $(0110\ 0011)_{8421BCD} = (63)_{10} = (1001\ 0011)_{5421BCD}$
- (4) $(1001\ 0011)_{5421BCD} = (63)_{10} = (0110\ 0011)_{8421BCD}$

1.14 填空。

- (1) $(58.23)_{10} = (111010.01)_2 = (72.2)_8 = (0101\ 1000.0010\ 0011)_{8421BCD}$
- (2) $(0001\ 1000\ 1001.0011\ 0101)_{8421BCD} = (189.35)_{10} = (10111101.0110)_2$

1.15 填写下表中的空格。

| 原码 | 反码 | 补码 | 偏移码 |
|------------|------------|------------|------------|
| 1,0010 | 1,1101 | 1,1110 | 0,1110 |
| 0,1010.01 | 0,1010.01 | 0,1010.01 | 1,1010.01 |
| 1,00110.10 | 1,11001.01 | 1,11001.10 | 0,11001.10 |
| 1,0000 | 1,1111 | 1,0000 | 0,0000 |

1.16 求下列二进制数的补码和反码。

| 原码 | 补码 | 反码 |
|---------------|-----------|-----------|
| (1) 1,1010101 | 1,0101011 | 1,0101010 |
| (2) 0,0111000 | 0,0111000 | 0,0111000 |
| (3) 1,0000001 | 1,1111111 | 1,1111110 |
| (4) 1,10000 | 1,10000 | 1,01111 |

1.17 求下列十进制数的二进制数原码、反码和补码表示。

| | 原码 | 补码 | 反码 |
|-------------------|-------------|-------------|-------------|
| (1) $(+418)_{10}$ | 0,110100010 | 0,110100010 | 0,110100010 |
| (2) $(-52)_{10}$ | 1,110100 | 1,001100 | 1,001011 |
| (3) $(-39)_{10}$ | 1,100111 | 1,011001 | 1,011000 |

| | | | |
|-------------------|-----------|-----------|-----------|
| (4) $(+112)_{10}$ | 0,1110000 | 0,1110000 | 0,1110000 |
| (5) $(-12)_{10}$ | 1,1100 | 1,0100 | 1,0011 |
| (6) $(-89)_{10}$ | 1,1011001 | 1,0100111 | 1,0100110 |

1.18 求下列各数的二进制数偏移码表示。

(1) $(+325)_{10}$

(原码) $(0,101000101)_2 =$ (补码) $(0,101000101)_2 =$ (偏移码) $(1,101000101)_2$

(2) $(-78)_{10}$

(原码) $(1,1001110)_2 =$ (补码) $(1,0110010)_2 =$ (偏移码) $(0,0110010)_2$

(3) $(-78)_{10}$

(原码) $(1,1001110)_2 =$ (补码) $(1,0110010)_2 =$ (偏移码) $(0,0110010)_2$

(4) $(+125)_{10}$

(原码) $(0,1111101)_2 =$ (补码) $(0,1111101)_2 =$ (偏移码) $(1,1111101)_2$

(5) $(-28)_{10}$

(原码) $(1,11100)_2 =$ (补码) $(1,00100)_2 =$ (偏移码) $(0,00100)_2$

(6) $(-108)_{10}$

(原码) $(1,1101100)_2 =$ (补码) $(1,0010100)_2 =$ (偏移码) $(0,0010100)_2$

1.19 求下列各数的二进制数原码、反码、补码及偏移码表示。

| | 原码 | 反码 | 补码 | 偏移码 |
|-------------------|----------------|----------------|----------------|----------------|
| (1) $(+312)_8$ | 0,011001010 | 0,011001010 | 0,011001010 | 1,011001010 |
| (2) $(-75)_8$ | 1,111101 | 1,000010 | 1,000011 | 0,000011 |
| (3) $(-25)_5$ | 不存在这样的 5 进制表示 | | | |
| (3) $(+B73)_{16}$ | 0,101101110011 | 0,101101110011 | 0,101101110011 | 1,101101110011 |
| (4) $(-C82)_{16}$ | 1,110010000010 | 1,001101111101 | 1,001101111110 | 0,001101111110 |
| (2) $(-75)_{10}$ | 1,1001011 | 1,0110100 | 1,0110101 | 0,0110101 |

1.20 用二进制补码运算求下列各式的值。

$$\begin{aligned} (1) (+51)_{10} + (+32)_{10} &= (0,0110011)_{\text{原,补}} + (0,0100000)_{\text{原,补}} \\ &= (0,1010011)_{\text{原}} = (+83)_{10} \end{aligned}$$

$$\begin{aligned} (2) (-51)_{10} + (-32)_{10} &= (1,0110011)_{\text{原}} + (1,0100000)_{\text{原}} \\ &= (1,1001101)_{\text{补}} + (1,1100000)_{\text{补}} \\ &= (1,0101101)_{\text{补}} = (1,1010011)_{\text{原}} = (-83)_{10} \end{aligned}$$

$$\begin{aligned} (3) (+51)_{10} + (-32)_{10} &= (0,110011)_{\text{原}} + (1,100000)_{\text{原}} \\ &= (0,110011)_{\text{补}} + (1,100000)_{\text{补}} \\ &= (0,010011)_{\text{补}} = (0,010011)_{\text{原}} = (+19)_{10} \end{aligned}$$

$$\begin{aligned} (4) (-51)_{10} + (+32)_{10} &= (1,110011)_{\text{原}} + (0,100000)_{\text{原}} \\ &= (1,001101)_{\text{补}} + (0,100000)_{\text{补}} \\ &= (1,101101)_{\text{补}} = (1,010011)_{\text{原}} = (-19)_{10} \end{aligned}$$

1.21 用二进制补码运算求 $(10011.10)_2$ $(01100.01)_2$ 。

$$\begin{aligned} \text{答: } (10011.10)_2 - (01100.01)_2 &= (0,10011.10)_{\text{补}} + (1,10011.11)_{\text{补}} \\ &= (0,00111.01)_{\text{补}} = (0,00111.01)_{\text{原}} \end{aligned}$$