Digital System Assignment 1

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Problem 1

Convert the complement and reverse code into signed decimal numbers.

Solves:

1. $(01001001)_{reverse} = (00110110)_2 = 2^5 + 2^4 + 2^2 + 2 = \boxed{+54}$
2. $(11100101)_{complement} = (11100101)_{reverse} = -(00011010)_2 = -(2^4 + 2^3 + 2) = \boxed{-26}$

Problem 2

There are three temperature detectors. When the detected temperature exceeds 60°C, the output control signal is 1; if the detected temperature is below 60°C, the output control signal is 0. When two or more temperature detectors output 0, the main controller outputs a 1 signal to automatically control the regulating equipment to increase the temperature to above 60°C. Please write out the truth table and logical expression for the main controller.

Solves:

Assume the three temperature detectors are T_1, T_2 and T_3, and the main controller is $Main$. The truth table is as follows:

T_1	T_2	T_3	$Main$
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

Therefore, the logical expression for the main controller is:

$$Main = \overline{T_1} \cdot \overline{T_2} \cdot \overline{T_3} + \overline{T_1} \cdot \overline{T_2} \cdot T_3 + \overline{T_1} \cdot T_2 \cdot \overline{T_3} + T_1 \cdot \overline{T_2} \cdot \overline{T_3} \tag{1}$$

$$= \sum m(0, 1, 2, 4) \tag{2}$$

or

$$Main = (T_1 + T_2 + T_3) \cdot (T_1 + T_2 + \overline{T_3}) \cdot (T_1 + \overline{T_2} + T_3) \cdot (\overline{T_1} + T_2 + T_3) \tag{3}$$

$$= \prod M(3, 5, 6, 7) \tag{4}$$