Programmable logic controllers (plc)

Topic: Programmable Logic Controllers Signals in PLC systems 2) Numbering systems and Resolution 3) Decimal to Binary, BCD and Hexadecimal conversion and 2’s complement of given number.

Keywords: current, voltage, signal, binary, decimal, hexadecimal, BCD, resolution, ADC

1. Signals in PLC systems

[a]Commonly used analog signals in PLC systems: 2 different types of analog signals used with PLC systems can be identified as current and voltage. A current signal can be used to denote the level of fluid in a tank. Typical value of current is 4 to 20mA. A voltage signal can be used for indication in a system measuring load. Typical value is identified as 0 to 5V. [1]

[b]Example of what a signal value might represent: Let us consider measurement of level in a tank. The magnitude of current can be used as a reference to know the depth. For instance, 12mA current signal can indicate half filled tank. Similarly, a 5V signal value shows that system is currently bearing maximum load of its total capacity.

Explanation for requirement of analog signal: Analog signals used in PLC systems represent different variables such as temperature, pressure, motion, level, etc. These analog signals generated are processed into a standard form through a signal conditioning unit and fed to further equipment for digital conversion.

2. Numbering systems and Resolution

Given: Output voltage range from 0 to 2. 56V DC represents temperature from 0 to 256 degrees C. 2 ADCs are used; 8 bit and 12 bit.

To find: Resolution of each ADC

Solution: For 8 bit ADC:

Levels of quantization = 28 = 256 levels

ADC resolution = (2. 56V – 0V)/ 256 = 0. 01 V/level = 10 mV/level

For 12 bit ADC:

Levels of quantization = 212 = 4096 levels

ADC resolution = (2. 56V – 0V)/4096 = 0. 625 mV/level

1 degrees centigrade change in temperature is represented by 0. 001V at the output of amplifier.

3. Given: Decimal number = 16

a) Express in binary, BCD, hexadecimal format

Decimal to Binary:

To convert any decimal number into binary, we divide it by 2, keep track of remainder and write the corresponding binary coefficient.

Integer value Binary coefficient

61/2 = 30 1

30/2 = 15 0

15/2 = 7 1

7/2 = 3 1

3/2 = 1 1

Hence we have (61)10 = (111101)2

Decimal to Hexadecimal:

To convert decimal into hexadecimal, we divide decimal number by 16, keep track of remainder and write the corresponding hexadecimal coefficient.

Integer value Hexadecimal coefficient

61/16 = 3 13 = D

Hence we have (61) 10 = (3D)16

b) Determine 2’s complement binary value as a negative number using 7

bits and one sign bit

The given number is 61. It is represented in binary as 111101.

We now represent it in sign format as follows: 1 0111101

Here 1 indicates negative sign and 0111101 is the binary equivalent of decimal 61.

Two’s complement is obtained by first writing the 1’s complement of given number by inverting all bits and then adding one to the resultant.

1 0111101 = sign representation of given number

0 1000010 = 1’s complement of given number

+1

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0 1000011 = 2’s complement of given number

Sources:

[1] Findarticles Web Site, Bnet business network, November 18, 2008,