DEFINITIONS (4/4 points)

Please match the following terms with the letter of their appropriate definitions.

monotonic
B **Answer:** B

precision
D **Answer:** D

figure of merit
A **Answer:** A

resolution
C **Answer:** C

A. A combination of the number of bits in the ADC, how fast can we sample the ADC, and how much energy does it take to operate the ADC.

B. An ADC that has no missing codes as the analog input slowly rises.

C. The smallest distinguishable change in ADC input.

D. The number of different analog inputs that can be reliably measured by the ADC.

Help

EXPLANATION

Monotonic means if the input voltage rises, the digital output will also rise. If the input voltage decreases, the digital output will decrease. More formally it means the slope between input and output always has the same sign. A noisy ADC will have fluctuations in its bottom bits, resulting in a nonmonotonic ADC.

The ADC on the TM4C123 has 12 bits; this means there are 4096 different voltages it can measure. We say the **precision** is 12 bits or 4096 alternatives

The ADC on the TM4C123 has a **resolution** of about 0.8mV. This means if the input voltage were to increase by 0.8mV, we should be able to detect the change.

When comparing one ADC to another, **figure of merit** includes bandwidth, power, and the number of bits. There are many formal definitions. One measure of speed is bandwidth, which is the maximum frequency the input can oscillate. One simple figure of merit is

FOM = **f** $2^{\mathbf{ENOB}}$

where **f** is the bandwidth and **ENOB** is the effective number of bits of the ADC. This equation says adding one bit is as important as making it go twice as fast.

Check Hide Answer

ADC RESOLUTION (1/1 point)

An ADC has a range of 0 to 5V and needs a resolution of 10mV, how many bits are required? In other words what is the smallest number of ADC bits that would satisfy the requirements?

9

\[9\]

Answer: 9

EXPLANATION

The precision is 5V/10mV=500 alternatives, requiring 9 bits.

Check Hide Answer

Help

DISTANCE MEASUREMENT (1/1 point)

An embedded system will use an ADC to measure a distance. The measurement system range is -10 to +10 cm and a resolution of 0.01 cm. What is the smallest number of ADC bits that can be used?

11

\[11\]

Answer: 11

EXPLANATION

Precision in alternatives is range/resolution. Range is (+10 - -10) = 20cm. Resolution is 0.01cm. Precision is 20/0.01 = 2000 alternatives. We need at least 11 bits for the ADC

Check Hide Answer

ADC INPUT VOLTAGE (1/1 point)

The TM4C123 has a 0 to 3.3V 12-bit ADC. What will be the digital output of the ADC if the input voltage is 0.75 V? Give the answer in decimal.

931

\[931\]

Answer: 931

EXPLANATION

The output is 4096*0.75/3.3= 930.90=931

Check Hide Answer

ADC INPUT VOLTAGE (1/1 point)

An 8-bit ADC (different from the TM4C123) has an input range of 0 to +10 volts and an output range of 0 to 255 (called straight binary). What digital value will be returned when an input of +7.5 volts is sampled?

Give your answer as a decmal number

192

\[192\]

Answer: 192

EXPLANATION

ADC output is 7.5/10*256 = 3*256/4 = 3*64 = 192.

Help

Check Hide Answer

ADC SOFTWARE (1/1 point)

We first sample the ADC in the usual way. Let result be the 12-bit ADC sample.

Which of the following codes will set voltage to the equivalent value in mV? For example if the input is 1.234V then the software will set voltage equal to 1234.

- voltage=(result/4096)*3300;
- voltage=(result/3300)*4096;
- voltage=(result*3300)/4096; ✔
- voltage=(result*4096)/3300;
- voltage=(result/4096)/3300;
- voltage=(result*4096)*3300;

EXPLANATION

Think of the units. The units of 3300 is in mV. So it is either (result/4096)*3300 or (result*3300)/4096. (result>>12)*3300 will always yield 0 (due to dropout).

Check Hide Answer

SAMPLING RATE (1/1 point)

An embedded system will use an ADC to measure sound. The range of sounds we to measure span from 100 Hz to 10 kHz.

What is the slowest rate at which we could sample the ADC and still have a faithful representation of the sound in the digital samples? Give your answer in Hz.

20200

\[20200\]

Answer: 20000

EXPLANATION

According to the Nyquist Theorem we must sample at least 20000 times/sec.

Check Hide Answer

Help