Hitachi America, Ltd.

Application Engineering
TechNote

A/D Conversion Accuracy in Low Voltage operation

This document provides some information on the Absolute Accuracy of the A/D Converter of the H8/510 device when operated in the 3V environment. Normally, during the A/D conversion, the actual input voltage employed to generate a certain binary code may deviate from the calculated voltage required to generate the same binary code. This calculated voltage is actually taken from the center point of the resolution band. For instance, an A/D converter with 10-bit resolution will have a 5mV resolution unit for each binary code. Hence, 0mV to 5mV refers to the binary code 0000000000 with a calculated voltage being 2.5mV, and 5mV to 10mV refers to the binary code 0000000001 with a calculated voltage being 7.5mV, and so on. The Absolute Accuracy is in the unit of LSB.

On the H8/510, the Absolute Accuracy for the 3V spec operating at 5MHz has the same value as the 5V spec operating at a higher frequency, namely ± 4 LSB. However, it tends to have a better Accuracy when operated at a lower clock frequency as shown in the following figures. The Accuracy becomes +2 LSB and -1 LSB if the freqency is below 2.5MHz, whereas it is ± 4 LSB if the frequency is above 5MHz (Table 19-7 of the databook).   Fig.1 shows the relationship between the Absolute Accuracy vs clock frequency at 3V. Fig. 2 shows the relationship between the Absolute Accuracy vs AVcc at 2.5MHz operation.   Fig. 3 shows the Absolute Accuracy at a higher frequency in a 3V environment. MORE IMPORTANTLY, it should be noted that these are the characterization data of a few samples of the H8/510 device, and by no means suggest any guaranteed values.
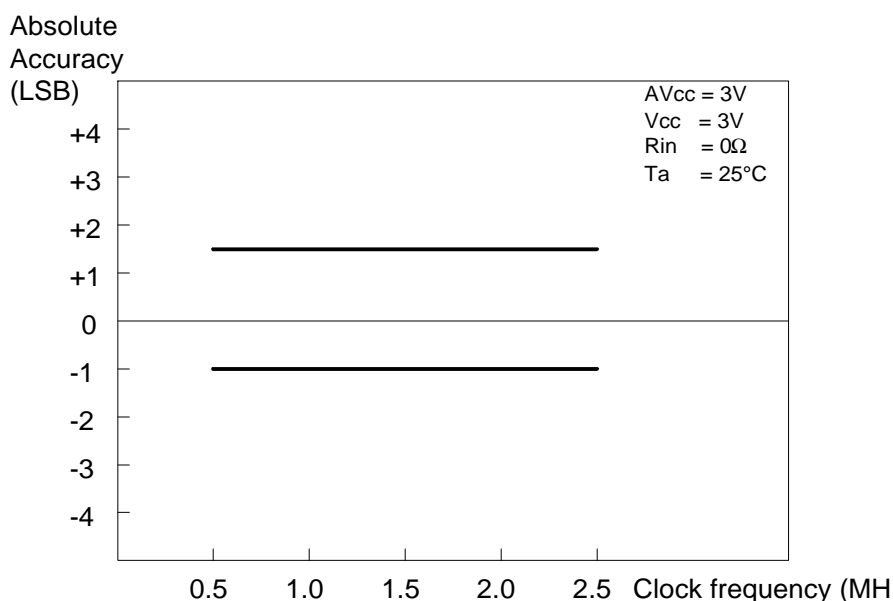

Fig. 1 A/D Absolute Accuracy vs Clock frequency

Fig.2 also shows that the Accuracy is slightly better for the AVcc to be at 4V than at 2.7V. Nevertheless, these figures have the clock frequency only running at a maximum of 2.5MHz.
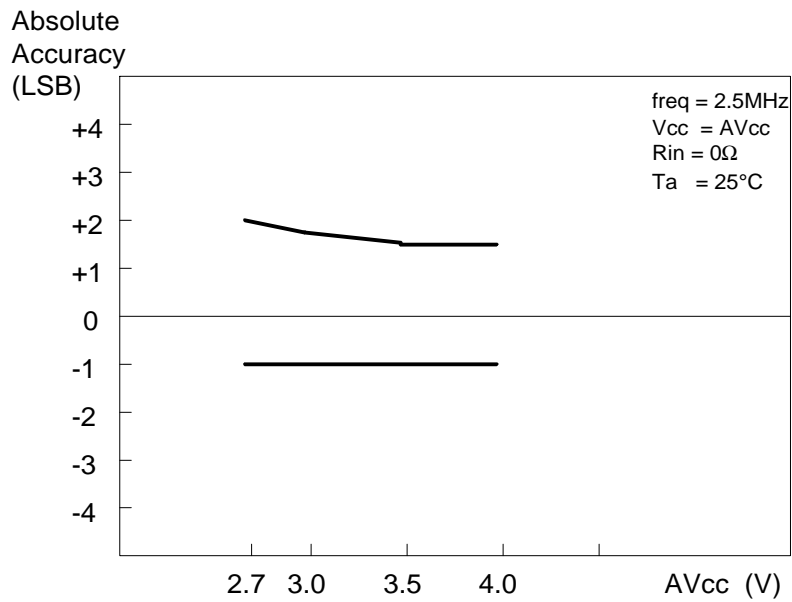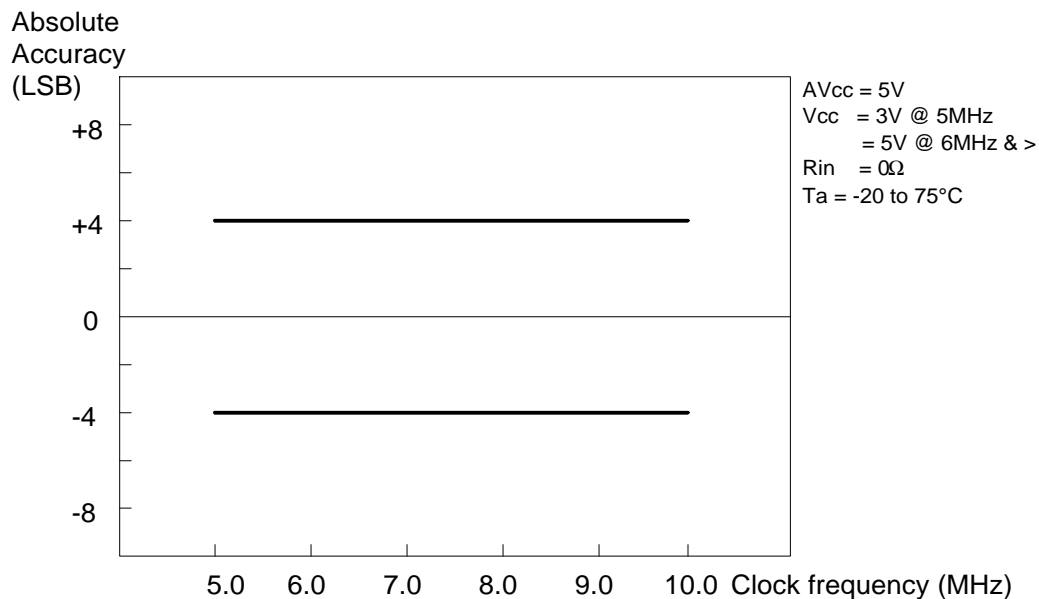
Absolute
Accuracy
(LSB)

freq = 2.5MHz
Vcc = AVcc
Rin = 0Ω
Ta = 25°C

+4
+3
+2
+1
0
-1
-2
-3
-4

2.7 3.0   3.5   4.0   AVcc (V)

Fig. 2 A/D Absolute Accuracy vs AVcc

Absolute
Accuracy
(LSB)

AVcc = 5V
Vcc = 3V @ 5MHz
    = 5V @ 6MHz & >
Rin = 0Ω
Ta = -20 to 75°C

+8

+4

0

-4

-8

5.0   6.0   7.0   8.0   9.0   10.0 Clock frequency (MHz)

Fig. 3 A/D Absolute Accuracy vs Clock frequency

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