



ADuCM350 + AD8233 Analysis

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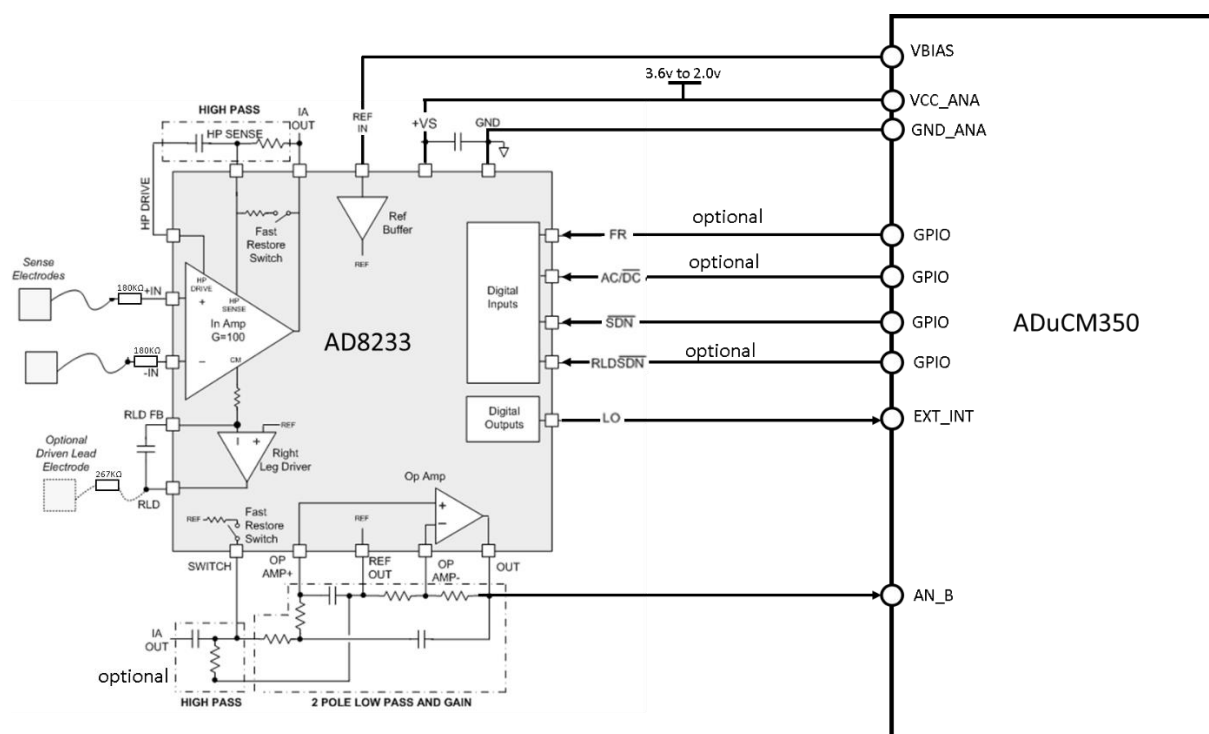
Revision History

<i>Date</i>	<i>Revision</i>
<i>11/21/2016</i>	<i>Rev. V1.0</i>

1. Introduction

This report explains how to obtain the ECG signal using the ADuCM350 and the AD8233. The ADuCM350 and the AD8233's evaluation board have been used in this test.

AD8233 evaluation board is supplied to 3.3V_BOARD. Therefore, ADuCM350 and AD8233 are supplied to the same voltage. The AD8233_REFIN is connected to VBIAS. The AD8233's output is connected to AN_B. An ECG simulator has been connected to: +IN, -IN and RLD in the AD8233. The picture below shows the block diagram, it also includes the required lines to control the AD8233. Some of these control lines are optional and they can be tied to VCC or GND.

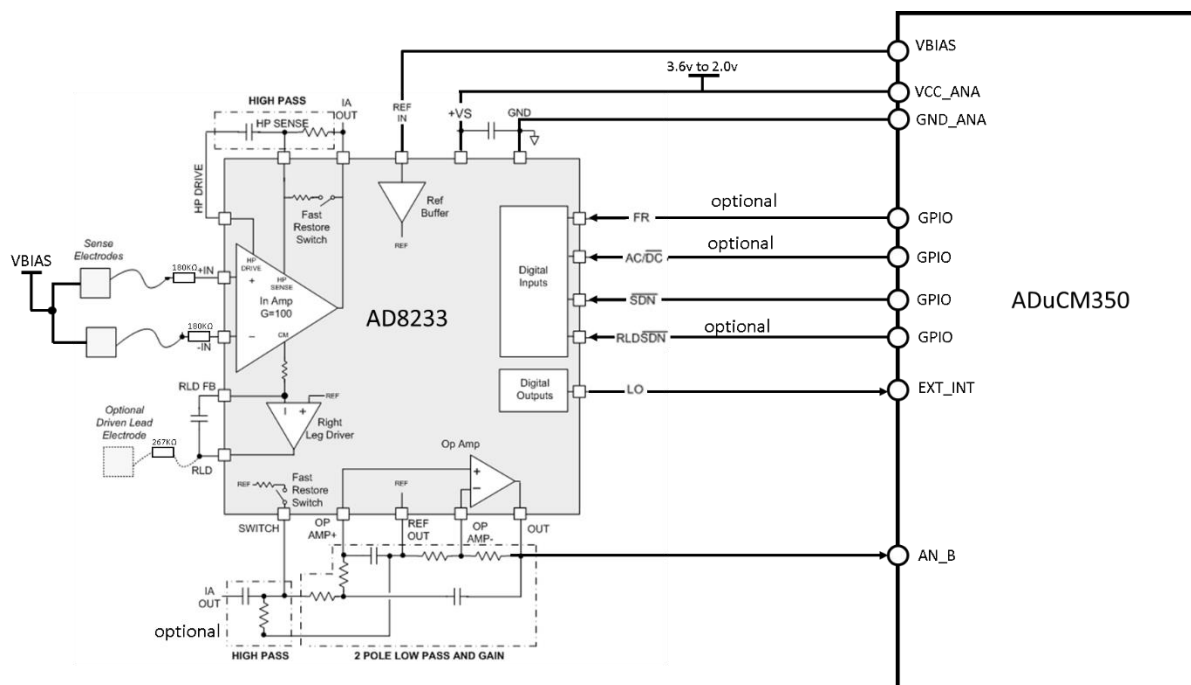


The ADuCM350's firmware used in this analysis can be found in the ADuCM350's examples folder. This example code is called AuxChanMeasurement. The value of the constant DUR has been modified to 5000000, the rest of the code has not been modified.

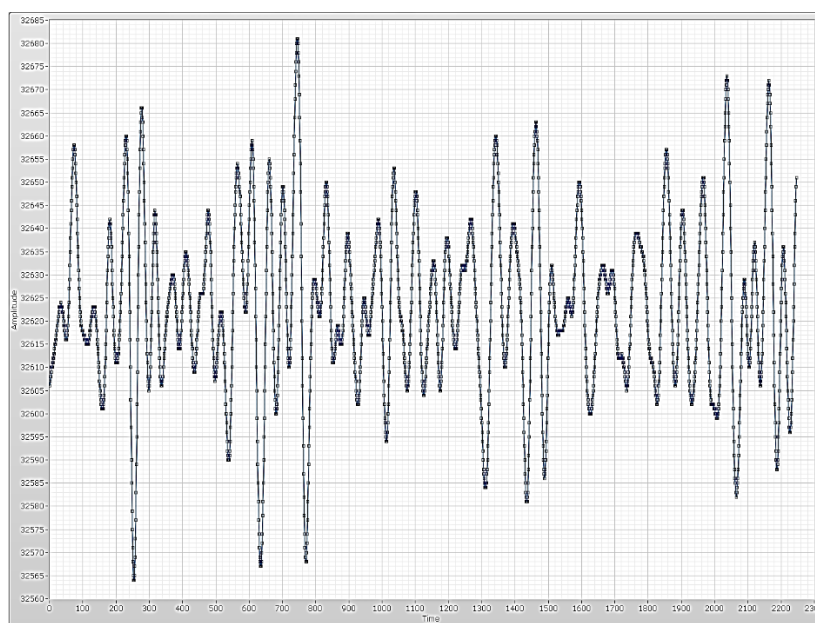
2. Measurements

2.1. Input Noise

The first test has been to short-circuit the +IN and -IN pins and connect them to VBIAS.



The obtained signal is shown below.



As the reader can observe, the difference between the maximum value and the minimum value is 117 LSBs. This means the noise is: $117 \cdot 54.9 \text{ uV/LSB} = 6.423 \text{ mV}_{pp}$. The AD8233 gain is 1100, thus, the noise in the AD8233's input is: $6.423 \text{ mV}_{pp} / 1100 = 5.84 \text{ uV}_{pp}$.

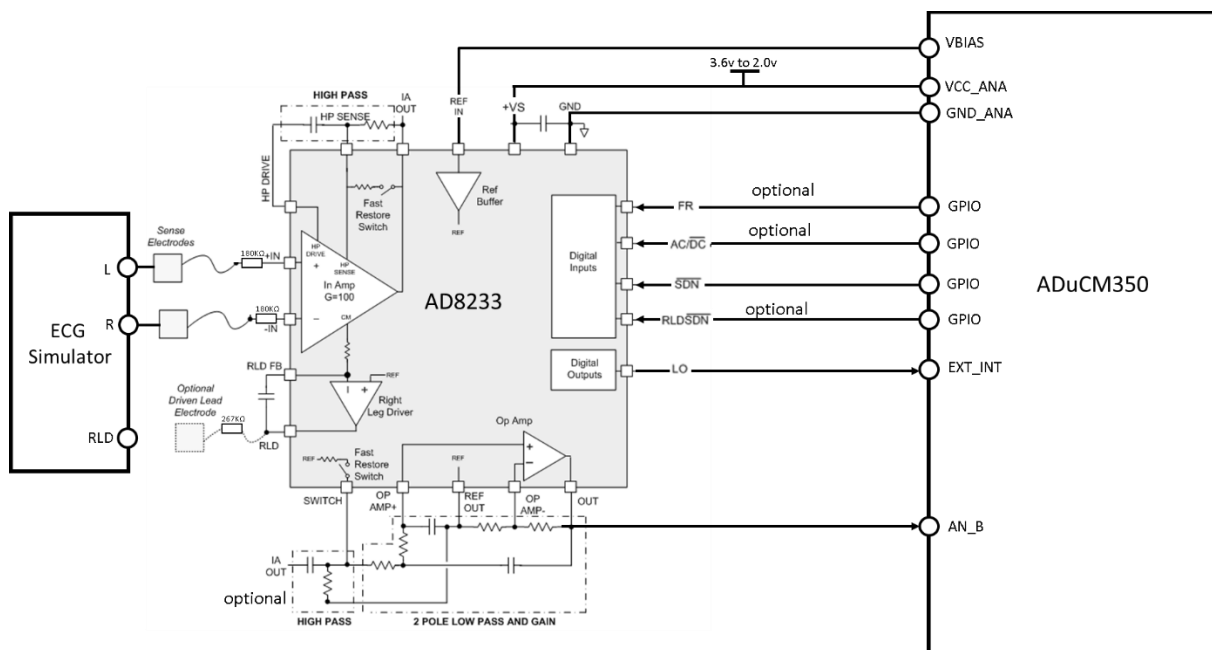
The picture below shows the AD8233 noise at 0V is 9.8uVpp typically. It means the system is not degrading the AD8233 performance, we are getting the best performance we can get with the AD8233.

Specification	AD8232	New Design (AD8233)
Supply Current Typ @ 27C	180uA	60uA
.5 to 40 Hz Noise Typ, 0V differential, 27C	18.5uV pk-pk	9.8uV pk-pk
.5 to 40 Hz Noise Typ, +/- 300mV differential, 27C	22uV pk-pk	16.82uV pk-pk
.05 to 150Hz Noise Typ, 0V differential, 27C	25.6uV pk-pk	15.1uV pk-pk
.05 to 150Hz Noise Typ, +/-300mV differential, 27C	30.6uV pk-pk	25uV pk-pk
DC/60Hz CMRR Min, +/-300mV differential, 0-70C	105/74.6dB	109/78.2dB

2.2. Two electrodes measurement ECG simulator 60 BPM

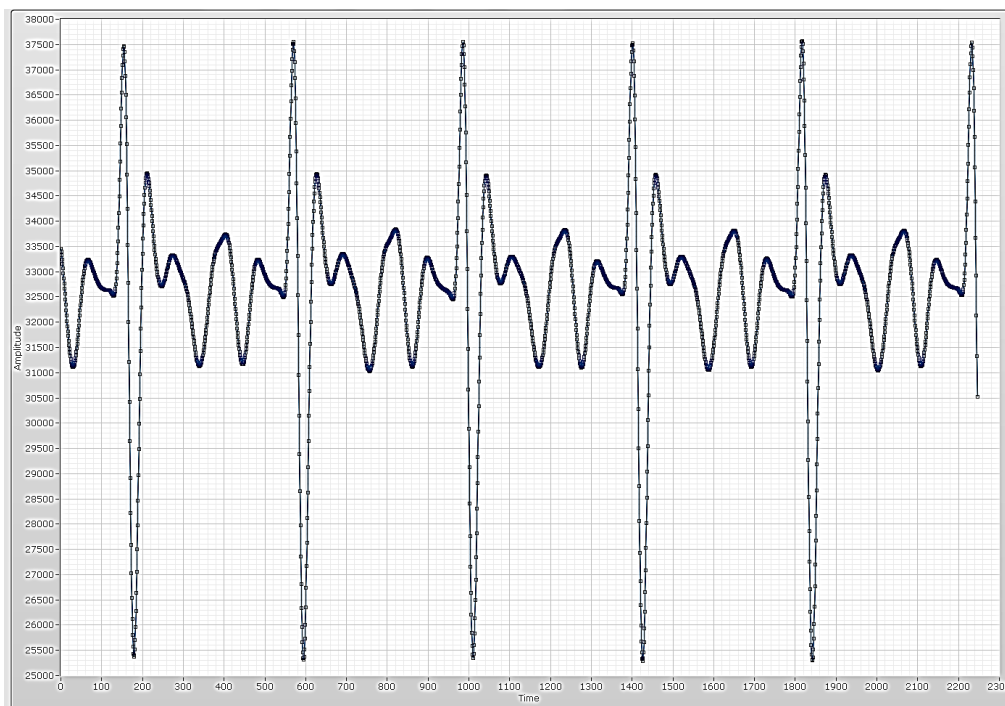
After checking the ADuMC350's performance we have tested the system using an ECG simulator. The ECG bandwidth applied in this study has been the sport bandwidth, the sport bandwidth is: 7-24Hz. This bandwidth is the recommended bandwidth if the system must obtain the Heart rate. This bandwidth makes the system more robust in front of motion artifacts, although the ECG waveform is altered.

The circuit under test and the results are shown in the pictures below.



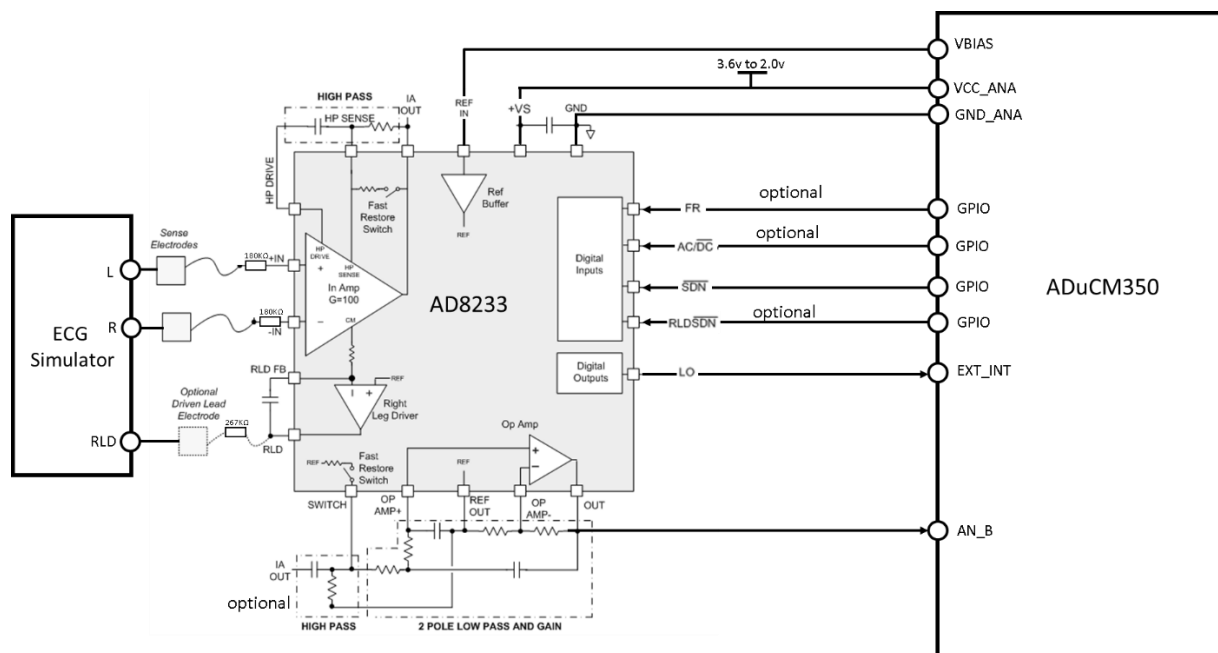
2.3. Two electrodes measurement ECG simulator 130 BPM

Same experiment has been carried out with 130bpm. The obtained signal is shown below.

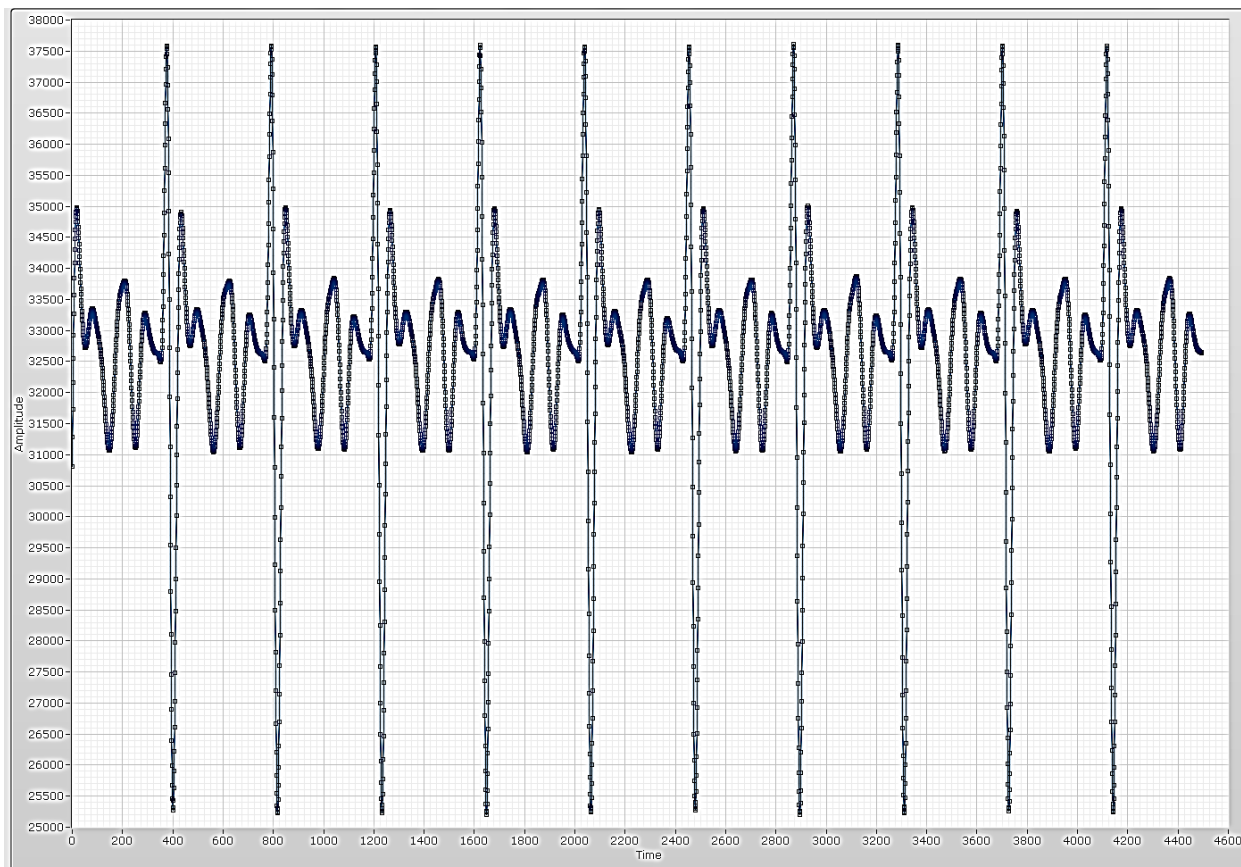


2.4. Three electrodes measurement ECG simulator 60 BPM

The experiments were being repeated with 3 electrodes. In this case, the RLD is also used. The results with the emulator are shown below.



2.5. Three electrodes measurement ECG simulator 130 BPM



3. Conclusions

The ADuCM350 and the AD8233 are 100% compatible and the ADuCM350's ADC provides plenty resolution. Besides, the AD8233's reference can be generated by the ADuCM350. The rest of functionalities can be perfectly carried out by this system.