Freescale Semiconductor
Application Note

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Battery Voltage Detection Using the i.MX1

MC9328MX1

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Contents

1 Abstract

In the ADC portion of the ASP module there is an auxiliary input channel (U-channel) that can be used for low voltage measurement. It is possible to use it to build a battery voltage detection circuit with an accuracy of approximately ±20 mV at the 3 V–4.2 V range.

This document applies to the MC9328MX1 device, called i.MX1 throughout.

2 Circuit Description

A small number of external components are required to use the ADC to measure battery voltage. The circuit shown in Figure 1 is composed of three analog switches that are controlled by the programmed GPIO lines of the i.MX1. As each input switch is enabled, its value is sampled and then disabled so the next signal and be switched on and measured.

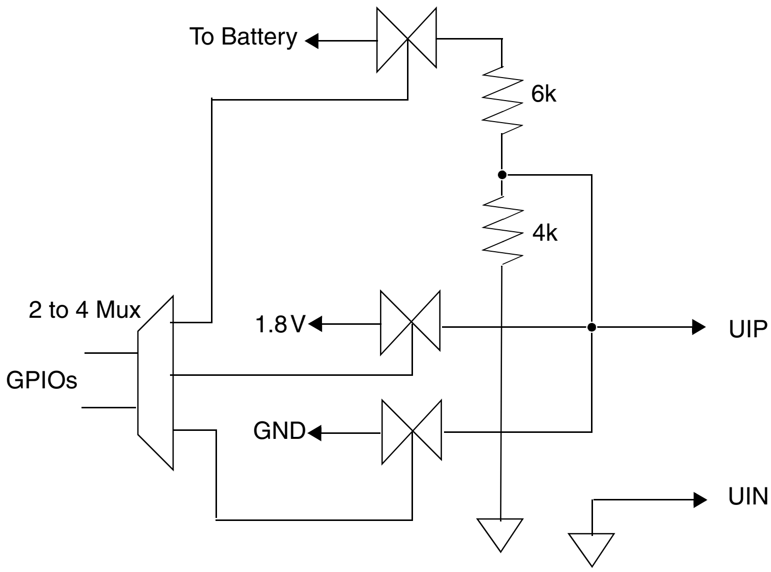

Figure 1. Suggested Battery Voltage Detection Circuit Diagram

There are three signals (battery voltage, 1.8 V reference, and 0 V reference or ground) gated to the U-channel by three analog switches; the MC74HC4066 is the recommended choice for the analog switch.

The 1.8 V and 0 V sources are used to calibrate the reference points for the ADC. From the sample values of these references the software determines the mapping curve of input voltage to output samples.

Because the input to the ADC cannot exceed 1.8 V, it cannot be directly connected to the battery. A potential divider circuit must be used to reduce the battery signal presented to the UIP channel. For example, a lithium battery has a voltage range of approximately 3 V to 4.2 V, so a divider ratio of 3:2 is adequate to develop a voltage less than 1.8 V. The total resistance of the divider circuit may range from a few kilo-ohms to 10k ohms. Low tolerance type resistors are recommended for use in the divider, to minimize any error introduced by software.

NOTE

Because the analog switches are controlled by GPIO lines from the i.MX1 using an optional 2-to-4 decoder is recommend to reduce the number of GPIO lines needed to control the three switches.

3 Software Description

This section provides a high-level description of the software algorithm used to determine the battery voltage levels. The process involves two parts: calibration and battery voltage measurement.

- Calibration—Each of the two reference input voltages (1.8 V and 0 V) should be sampled to generate a mean value. It is recommended that all three signals be sampled 12 times to enhance the accuracy of the readings. Each set of the 12 FIFO data is used to generate a mean sample value. With the value for 1.8 V point and 0 V point established, the *slope* and *offset* of the mapping can be calculated. These calculations are based on the assumption that the ADC is linear over the range.

- Battery voltage measurement—Before each measurement of the battery voltage the switch to control the battery voltage must be turned on and a delay of approximately 100 ms is required for the battery voltage to become stable. To calculate the battery voltage use the following equation:

$$\text{Voltage} = ((\text{Sample} - \text{Offset}) / \text{Slope}) * \text{Scaler} \quad \textit{Eqn. 1}$$

Where offset is the sample value for 0 V input and *scaler* is the potential divider ratio (2.5 in this example).

4 Revision History

Table 1 shows the revision history of this document.

Table 1. Revision History

Rev.	Author	Description
0	Cliff Wong	Initial Version
1	Dave Mejia	Applied Freescale template.

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