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Battery Voltage Detection using the MC68SZ328

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1 Introduction

In the ADC portion of the ASP module of the MC68SZ328, 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 +/- 20mV at the 3V to 4.2V range.

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 MC68SZ328. As each input switch is enabled, its value is sampled and then disabled so the next signal can be switched on and measured.

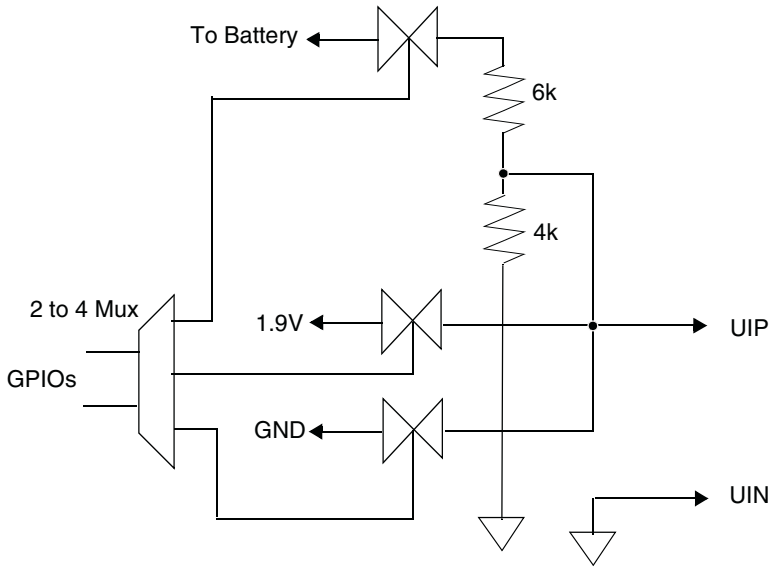

Figure 1. Suggested Battery Voltage Detection Circuit Diagram

There are three signals (battery voltage, 1.9 V reference, and 0V reference or ground) gated to the U-channel by three analog switches; the MC74HC4066 is a good choice for the analog switch.

The 1.9V and 0V source 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.

Since the input to the ADC cannot exceed 1.9V, it cannot be directly connected to the battery. A potential divider circuit should be used to reduce the battery signal presented to the UIP channel. For example, a lithium battery has a voltage range of approximately 3V to 4.2V, so a divider ratio of 3:2 is adequate to develop a voltage less than 1.9V. The total resistance of the divider circuit may range from a few K 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 MC68SZ328 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 (1.9 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 12 FIFO data is used to generate a mean sample value. With the value for 1.9V point and 0V 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 the measurement of the battery voltage. the switch controlling the battery voltage should be turned on and then a delay of approximately 100 ms is required for the battery voltage to become stable. Calculating the battery voltage is done by the following equation:

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

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

NOTES

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