TB083

Detecting Multiple Voltages Using the PIC10F204/206 Comparator

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INTRODUCTION

The PIC10F204/206 microcontrollers have a built-in comparator which can be utilized to detect different discrete voltage levels. This technical brief describes one technique for detecting two or more such voltages as different trip points.

THEORY

This technique takes advantage of the properties of an RC network. An RC network, which is charged up to a known voltage, will have a voltage decay governed by an RC time constant, as shown in Equation 1.

EQUATION 1:

$$V_{OUT} = V_{IN} * e^{-t/RC}$$

VOUT = Volts, R = Ohms, t = Seconds, VIN = Volts, C = Farads

If the voltages and values of R and C are known, then the time t may be determined by re-evaluating the equation shown in Equation 2.

EQUATION 2:

$$t = -1*RC * In (V_{OUT}/V_{IN})$$

By knowing the time required for a given VOUT, a look-up table, (see AN556, "*Implementing A Table Read*"), in firmware, equates a given time to a given voltage. Using discrete times of interest, trip points are created which a microcontroller acts upon.

HARDWARE TECHNIQUE

Pins GP0/CIN+ and GP1/CIN-, of the PIC10F204/206 microcontrollers, can be switched between Digital mode and Analog mode under firmware control. By placing a known RC network on GP0/CIN+ and the voltage to be sampled on GP1/CIN-, firmware can detect discrete voltages.

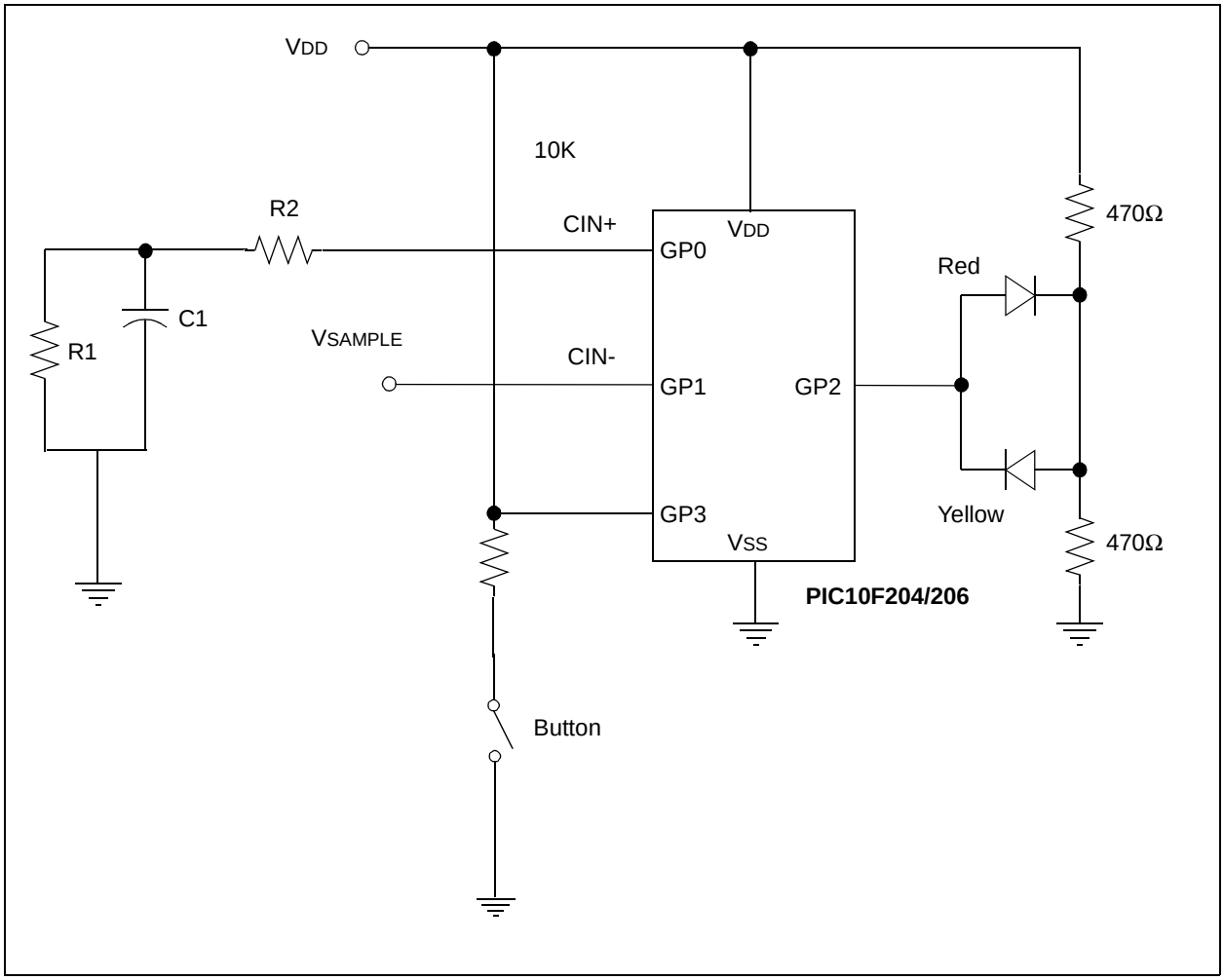
Application firmware sets pin GP0/CIN+ to Digital mode and applies a PWM signal to the pin to charge up the RC network to a known voltage higher than the sample voltage to be detected. Once the RC network is charged, pin GP0/CIN+ is switched to Analog mode and a comparator read made. By starting a timer and keeping track of the time interval for the comparator to trip, a time is determined which can be referenced to a look-up table in firmware for various voltage values. The size of the look-up table should be adjusted to cover the voltage regions of interest.

Application firmware will take different actions at different trip points such as providing a warning and then a shutdown.

In order to switch pin GP0/CIN+ from Analog mode to Digital mode and back again, use the CMPON control bit in the CMCON0 register (CMCON0<3>). By turning the comparator on, the pin is set to Analog mode. By turning the comparator off, the pin is set to Digital mode.

Note: The sampled voltage is assumed to be stable during the sampling period. Users should setup their firmware and look-up tables to search for time ranges rather than exact time intervals to adjust for sample voltages which drift.

FIGURE 1: EXAMPLE CIRCUIT



EXAMPLE CIRCUIT

In Figure 1, GP2 is used to drive both a warning yellow LED as well as a shut-down LED. A push button is present on GP3 to trigger a sample to take place.

The appropriate values for R1, R2 and C1 should be determined for the sample voltages and timings of interest. Correspondingly, the timer used to track the decay time and look-up table will need to be sized.

CONCLUSION

Detecting multiple discrete voltages is easily accomplished using the hardware and firmware technique described above. The capability to switch the comparator input pins from Analog Input mode to Digital Output mode and back again allow for a polled sampling scheme.

Note:	Voltage detection during Sleep is possible, but requires the user to cycle through the process of charging up the RC network compensating for the time delays in Reset, Reset service routine and re-establishing wake-on-comparator.

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