

## 8-pin Flash PIC® Microcontroller Tips ‘n Tricks

### Tip #13.2 Reading a Sensor With Higher Accuracy – Charge Balancing Method

1. Sensor charges a capacitor
2. Reference resistor discharges the capacitor
3. Modulate reference resistor to maintain constant average charge in the capacitor
4. Use comparator to determine modulation

To improve resolution beyond 10 or 12 bits, a technique called “Charge Balancing” can be used. The basic concept is for the MCU to maintain a constant voltage on a capacitor by either allowing the charge to build through a sensor or discharge through a reference resistor. A timer is used to sample the capacitor voltage on regular intervals until a predetermined number of samples are counted. By counting the number of times the capacitor voltage is over an arbitrary threshold, the sensor voltage is determined.

The comparator and comparator voltage reference ( $CV_{REF}$ ) on the PIC12F629/675 are ideal for this application.

1. GP1 average voltage =  $CV_{REF}$
2. Time base as sampling rate
3. At the end of each time base period:
  - If  $GP1 > CV_{REF}$ , then GP2 Output Low
  - If  $GP1 < CV_{REF}$ , then GP2 Input mode
4. Accumulate the GP2 lows over many samples
5. Number of samples determines resolution
6. Number of GP2 lows determine effective duty cycle of  $R_{REF}$

Figure 13-3

