

## 7.2 A/D Acquisition Requirements

For the A/D converter to meet its specified accuracy, the charge holding capacitor (CHOLD) must be allowed to fully charge to the input channel voltage level. The analog input model is shown in Figure 7-3. The source impedance ( $R_S$ ) and the internal sampling switch ( $R_{SS}$ ) impedance directly affect the time required to charge the capacitor CHOLD. The sampling switch ( $R_{SS}$ ) impedance varies over the device voltage ( $V_{DD}$ ), see Figure 7-3. The maximum recommended impedance for analog sources is 10 k $\Omega$ . As the impedance is decreased, the acquisition time may be decreased.

After the analog input channel is selected (changed), this acquisition must be done before the conversion can be started.

To calculate the minimum acquisition time, Equation 7-1 may be used. This equation assumes that 1/2 LSB error is used (1024 steps for the A/D). The 1/2 LSB error is the maximum error allowed for the A/D to meet its specified resolution.

To calculate the minimum acquisition time,  $T_{ACQ}$ , see the PICmicro™ Mid-Range Reference Manual (DS33023).

### EQUATION 7-1: ACQUISITION TIME

$$\begin{aligned}
 T_{ACQ} &= \text{Amplifier Settling Time} + \\
 &\quad \text{Hold Capacitor Charging Time} + \\
 &\quad \text{Temperature Coefficient} \\
 &= T_{AMP} + T_C + T_{COFF} \\
 T_C &= 2\mu s + T_C + [( \text{Temperature} - 25^\circ\text{C} ) (0.05\mu s/^\circ\text{C})] \\
 &= CHOLD (R_{IC} + R_{SS} + R_S) \ln(1/2047) \\
 &= 120\text{pF} (1\text{k}\Omega + 7\text{k}\Omega + 10\text{k}\Omega) \ln(0.0004885) \\
 &= 16.47\mu s \\
 T_{ACQ} &= 2\mu s + 16.47\mu s + [(50^\circ\text{C} - 25^\circ\text{C}) (0.05\mu s/^\circ\text{C})] \\
 &= 19.72\mu s
 \end{aligned}$$

- Note 1:** The reference voltage ( $V_{REF}$ ) has no effect on the equation, since it cancels itself out.
- Note 2:** The charge holding capacitor (CHOLD) is not discharged after each conversion.
- Note 3:** The maximum recommended impedance for analog sources is 10 k $\Omega$ . This is required to meet the pin leakage specification.

FIGURE 7-3: ANALOG INPUT MODEL

