

**Table 9.** Start-up Times for the Crystal Oscillator Clock Selection

CKSELO	SUT1..0	Start-up Time from Power-down and Power-save	Additional Delay from Reset ( $V_{CC} = 5.0V$ )	Recommended Usage
0	00	258 CK <sup>(1)</sup>	4.1 ms	Ceramic resonator, fast rising power
0	01	258 CK <sup>(1)</sup>	65 ms	Ceramic resonator, slowly rising power
0	10	1K CK <sup>(2)</sup>	–	Ceramic resonator, BOD enabled
0	11	1K CK <sup>(2)</sup>	4.1 ms	Ceramic resonator, fast rising power
1	00	1K CK <sup>(2)</sup>	65 ms	Ceramic resonator, slowly rising power
1	01	16K CK	–	Crystal Oscillator, BOD enabled
1	10	16K CK	4.1 ms	Crystal Oscillator, fast rising power
1	11	16K CK	65 ms	Crystal Oscillator, slowly rising power

- Notes:
1. These options should only be used when not operating close to the maximum frequency of the device, and only if frequency stability at start-up is not important for the application. These options are not suitable for crystals.
  2. These options are intended for use with ceramic resonators and will ensure frequency stability at start-up. They can also be used with crystals when not operating close to the maximum frequency of the device, and if frequency stability at start-up is not important for the application.

## Low-frequency Crystal Oscillator

To use a 32.768 kHz watch crystal as the clock source for the device, the Low-frequency Crystal Oscillator must be selected by setting the CKSEL fuses to “1001”. The crystal should be connected as shown in Figure 18. By programming the CKOPT fuse, the user can enable internal capacitors on XTAL1 and XTAL2, thereby removing the need for external capacitors. The internal capacitors have a nominal value of 36 pF. Refer to the 32 kHz Crystal Oscillator application note for details on Oscillator operation and how to choose appropriate values for C1 and C2.

When this Oscillator is selected, start-up times are determined by the SUT fuses as shown in Table 10.

**Table 10.** Start-up Times for the Low-frequency Crystal Oscillator Clock Selection

SUT1..0	Start-up Time from Power-down and Power-save	Additional Delay from Reset ( $V_{CC} = 5.0V$ )	Recommended Usage
00	1K CK <sup>(1)</sup>	4.1 ms	Fast rising power or BOD enabled
01	1K CK <sup>(1)</sup>	65 ms	Slowly rising power
10	32K CK	65 ms	Stable frequency at start-up
11	Reserved		