6.6 Calibrated Internal RC Oscillator

By default, the Internal RC Oscillator provides an approximate 8.0 MHz clock. Though voltage and temperature dependent, this clock can be very accurately calibrated by the user. See Table 26-1 on page 319 for more details. The device is shipped with the CKDIV8 Fuse programmed. See "System Clock Prescaler" on page 35 for more details.

This clock may be selected as the system clock by programming the CKSEL Fuses as shown in Table 6-10. If selected, it will operate with no external components. During reset, hardware loads the pre-programmed calibration value into the OSCCAL Register and thereby automatically calibrates the RC Oscillator. The accuracy of this calibration is shown as Factory calibration in Table 26-1 on page 319.

By changing the OSCCAL register from SW, see "OSCCAL – Oscillator Calibration Register" on page 37, it is possible to get a higher calibration accuracy than by using the factory calibration. The accuracy of this calibration is shown as User calibration in Table 26-1 on page 319.

When this Oscillator is used as the chip clock, the Watchdog Oscillator will still be used for the Watchdog Timer and for the Reset Time-out. For more information on the pre-programmed calibration value, see the section "Calibration Byte" on page 299.

Table 6-10. Internal Calibrated RC Oscillator Operating Modes(2)

Frequency Range(1) (MHz)	CKSEL3..0
7.3 - 8.1	0010

Notes: 1. This is the recommended CKSEL settings for the different frequency ranges.
2. If 8 MHz frequency exceeds the specification of the device (depends on V_{CC}), the CKDIV8 Fuse can be programmed in order to divide the internal frequency by 8.

When this Oscillator is selected, start-up times are determined by the SUT Fuses as shown in Table 6-11 on page 33.

Table 6-11. Start-up times for the internal calibrated RC Oscillator clock selection

Power Conditions	Start-up Time from Power-down and Power-save	Additional Delay from Reset (V_{CC} = 5.0V)	SUT1..0
BOD enabled	6 CK	14CK(1)	00
Fast rising power	6 CK	14CK + 4.1 ms	01
Slowly rising power	6 CK	14CK + 65 ms(2)	10
Reserved			11

Note: 1. If the RSTDISBL fuse is programmed, this start-up time will be increased to 14CK + 4.1 ms to ensure programming mode can be entered.
2. The device is shipped with this option selected.

6.7 128 kHz Internal Oscillator

The 128 kHz internal Oscillator is a low power Oscillator providing a clock of 128 kHz. The frequency is nominal at 3V and 25°C. This clock may be select as the system clock by programming the CKSEL Fuses to "11" as shown in Table 6-12.