

When the system enters System ON mode and an HFCLK clock is requested, the PLL is automatically started. When clock requests stop, the PLL automatically stops.

HFCLK clocks are only available to the HFCLK controllers when the system is in System ON mode.

An HFCLK source can run before being started by the relevant clock request. This reduces start-up time but causes increased power consumption. An example of this would be to keep the PLL running during sleep by using the task [PLLSTART](#).

The XOSC must be started when crystal clock accuracy is required. The crystal is started by triggering the task [XOSTART](#). When the crystal reaches the correct amplitude and frequency, the PLL automatically locks to the crystal and generates the event [XOSTARTED](#). At the same time, the crystal oscillator is performing an XOTUNE. When that process finishes, the event [XOTUNED](#) is generated indicating the signal from the crystal oscillator is accurately tuned.

**Note:** The crystal oscillator quality indicated by the XOSTARTED event is sufficient for all peripherals except RADIO and when calibrating the 32.768 kHz oscillator. Before using RADIO, ensure that the event [XOTUNED](#) has been generated. This ensures the highest quality crystal signal is available.

If the crystal oscillator requires the XOTUNE process to be repeated, the device generates the event [XOTUNEERROR](#). When that happens, the [XOTUNE](#) task must be triggered. Do not trigger this task at the same time that RADIO is running (meaning RADIO must not be in the RX or TX states).

A new START task can be initiated after one has already been triggered, but before the corresponding STARTED event is generated. In this case, only one STARTED event will be generated, corresponding to the last triggered START task. Triggering a START task after the STARTED event from a previous triggered START tasks is generated, generates a new STARTED event.

The amount of time between a START task and its corresponding STARTED event may differ depending on whether the HFCLK source is already running or in the process of starting. The amount of time before a STARTED event may vary when a different HFCLK source is configured before triggering a new START task. Different crystal types also have different start-up times, see [OSCILLATORS — Oscillator control](#) on page 86 for details.

HFXO must be running to use [RADIO](#), [NFCT](#), [UARTE](#), or to calibrate the 32.768 kHz RC oscillator. Using HFXO will also improve [SAADC](#) performance by reducing clock jitter. When using serial communication peripherals such as [SPIM](#), [SPIS](#), [TWIM](#), and [TWIS](#), the HFXO must be running to achieve the highest accuracy for the bit rate. When using the internal RC oscillator (HFINT), the frequency accuracy of the serial interface is limited to the accuracy of HFINT, see [High frequency clock source \(HFCLK\)](#) on page 897.

## 5.4.2 LFCLK controller

The system supports the following low frequency clock sources, as described in [Clock control](#) on page 71.

- 32.768 kHz RC oscillator (LFRC)
- 32.768 kHz crystal oscillator (LFXO)
- 32.768 kHz synthesized from HFCLK (LFSYNT)

LFXO can run in System OFF mode. The other clock sources only run in System ON mode.

The following LF clocks are available in the system.