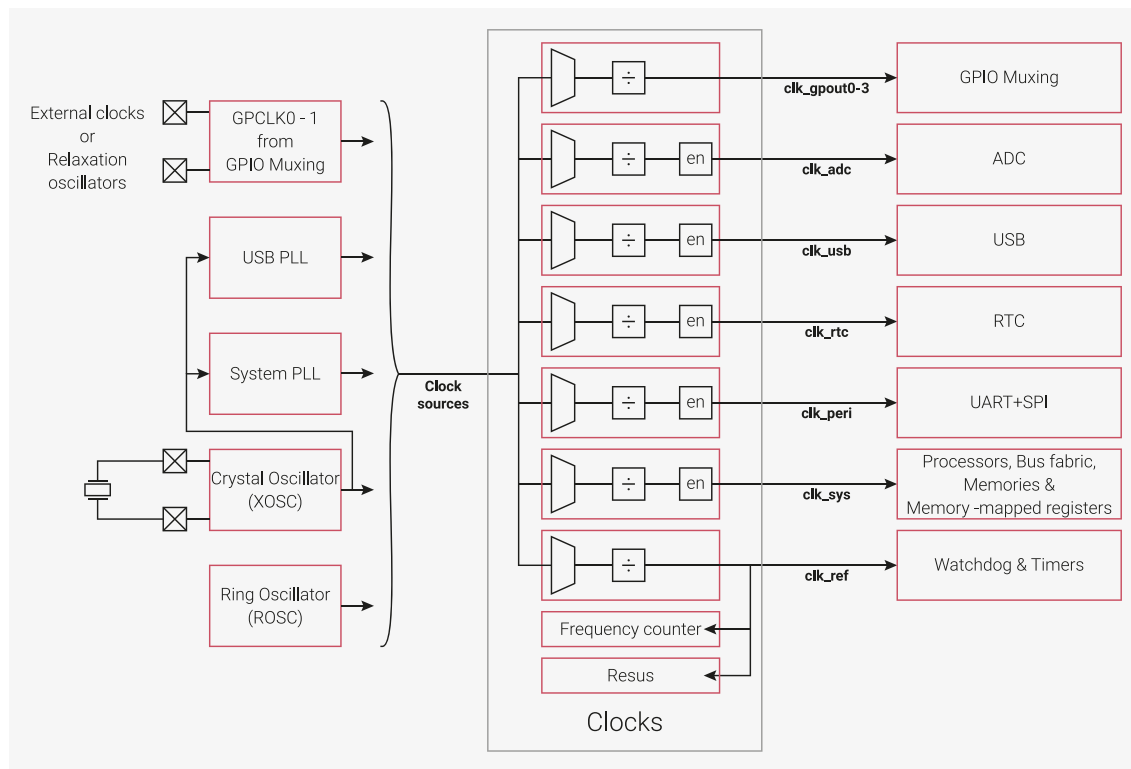


Figure 26. Clocks overview



For very low cost or low power applications where precise timing is not required, the chip can be run from the internal Ring Oscillator (ROSC). Alternatively the user can provide external clocks or construct simple relaxation oscillators using the GPIOs and appropriate external passive components. Where timing is more critical, the Crystal Oscillator (XOSC) can provide an accurate reference to the 2 on-chip PLLs to provide fast clocking at precise frequencies.

The clock generators select from the clock sources and optionally divide the selected clock before outputting through enable logic which provides automatic clock disabling in SLEEP mode.

An on-chip frequency counter facilitates debugging of the clock setup and also allows measurement of the frequencies of external clocks. The on-chip resus component restarts the system clock from a known good clock if it is accidentally stopped. This allows the software debugger to access registers and debug the problem.

The chip has an ultra-low power mode called DORMANT in which all on-chip clock sources are stopped to save power. External sources are not stopped and can be used to provide a clock to the on-chip RTC which can provide an alarm to wake the chip from DORMANT mode. Alternatively the GPIO interrupts can be configured to wake the chip from DORMANT mode in response to an external event.

Up to 4 generated clocks can be output to GPIOs at up to 50MHz. This allows the user to supply clocks to external devices, thus reducing component counts in power, space and cost sensitive applications.

2.14.2. Clock sources

The RP2040 can be run from a variety of clock sources. This flexibility allows the user to optimise the clock setup for performance, cost, board area and power consumption. The sources include the on-chip [Ring Oscillator](#), the [Crystal Oscillator](#), external clocks from GPIOs and the PLLs [PLL](#).

The list of clock sources is different per clock generator and can be found as enumerated values in the [CTRL](#) register. See [CLK_SYS_CTRL](#) as an example.

2.14.2.1. Ring Oscillator

The on-chip [Ring Oscillator](#) requires no external components. It runs automatically from power-up and is used to clock the processors during the initial boot stages. The startup frequency is typically 6MHz but varies with PVT (Process, Voltage