$$CL = \frac{(C1' \cdot C2')}{(C1' + C2')}$$

$$C1' = C_{INT} + C_{pcb1}$$
$$C2' = C_{INT} + C_{pcb2}$$

Figure 14: Load capacitance equation for internal capacitors

C_{INT} is the value of the internal capacitors. C_{pcb1} and C_{pcb2} are stray capacitance on the PCB.

The internal capacitor must be configured before starting the high-frequency crystal oscillator using the XOSTART task. To enable the internal capacitors, find the correct value for C_{INT} in the field OSCILLATORS.XOSC32M.CONFIG.INTCAP using the following equation.

```
INTCAP = (((CAPACITANCE-5.5)*(FICR->XOSC32MTRIM.SLOPE+791)) +
          FICR->XOSC32MTRIM.OFFSET*4)/256
```

The equation has the following variables:

- `CAPACITANCE` is the desired capacitor value of C_{INT} in pF, holding any value between 4.0 pF and 17.0 pF in 0.25 pF steps.
- `FICR->XOSC32MTRIM` are factory trim values which vary between devices.

After HFXO starts, the device uses the internal capacitor together with the external crystal after configuration.

5.5.1.1 Using external capacitors

It is possible to use external capacitors after disabling the internal capacitor.

When using external capacitors, the load capacitance (CL) is the total capacitance seen by the crystal across its terminals. It is calculated by the following equation.

$$CL = \frac{(C1' \cdot C2')}{(C1' + C2')}$$

$$C1' = C1 + C_{pcb1} + C_{pin}$$
$$C2' = C2 + C_{pcb2} + C_{pin}$$

Figure 15: Load capacitance equation for external capacitors

C1 and C2 are the external capacitors. C_{pcb1} and C_{pcb2} are stray capacitance on the PCB. C_{pin} is the pin input capacitance on pins **XC1** and **XC2**.

When using external capacitors, disable the internal capacitor by setting OSCILLATORS.XOSC32M.CONFIG.INTCAP to `0`.

5.5.1.2 Crystal selection

Several crystals are supported by the 32 MHz crystal oscillator.

The following figure shows a simple model of a crystal. It has R-L-C series components, called equivalent series resistance (ESR), motional capacitance ($C_{0=N}$), and motional inductance (L_M). The capacitor in parallel, C_0 , is called the shunt capacitance, and models the package capacitance.