



## How to activate HSI and CSI oscillators calibration



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## 1 Article purpose

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The purpose of this article is to explain how to calibrate the HSI and CSI oscillators in the RCC, by using the TIM internal peripheral **TIM12** and/or **TIM15** assigned to the secure monitor (TF-A or OP-TEE).

These clocks are internal oscillators whose frequency can be affected by temperature and voltage variations. To achieve a good clock accuracy, it is important to provide a mechanism to compensate the effects of these variations.

The clock calibration algorithm is based on the comparison of a timer (fed by HSI or CSI) and a clock is derived from the HSE clock that is considered as always accurate.

TIM12 input 1 is connected to hsi\_cal\_ck

TIM12 input 2 is connected to csi\_cal\_ck

TIM15 input 7 is connected to hsi\_cal\_ck

TIM15 input 8 is connected to csi\_cal\_ck

Refer to *STM32MP15 reference manuals* for detailed information on the timers.

The algorithm is implemented in the secure monitor. It compares both clocks and programs a correction factor in the RCC peripheral. There are various ways to trigger this service:

- periodically by the secure monitor itself
- upon kernel request through a dedicated SMC
- upon Arm®Cortex®-M4 request through a SEV



## 2 How to activate the calibration

This is done in the secure monitor device tree, in the `stm32mp157c-<board>.dts` file.

### 2.1 Configuring the timers

The timers used for calibration must be dedicated in the secure context. It cannot be used at the same time by the non-secure world.

Example: `timer12-input1` is used for HSI and `timer12-input2` for CSI

```
&timers12 {
    secure-status = "okay";
    st,hsi-cal-input = <1>;
    st,csi_cal-input = <2>;
};
```

```
&timers15 {
    secure-status = "disabled";
    st,hsi-cal-input = <7>;
    st,csi_cal-input = <8>;
};
```

### 2.2 Enabling and configuring the calibration service

This can be done by enabling options inside the `clock device tree` section

High Speed Internal oscillator (STM32 clock source) or High Speed Synchronous Serial Interface (MIPI® Alliance standard)

Multi Speed Internal oscillator (STM32 clock source)

High Speed External oscillator (STM32 clock source)

Reset and Clock Control

Secure Monitor Call

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