ECE 372A Spring 2015 - Lecture 5

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Outline

Timers

Reference Material

Section 14 in the PIC24F Family Reference Manual
Section 13 and 14 in the PIC32 Data Sheet

Timer Applications

Relevant Applications

- Delays (Waveform generation, Pulse-Width Modulation)

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- Measuring elapsed time (Real-Time Clock and Calendar, Watchdog Timer)

Oscillator Configurations

Foundation of Timers

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- PIC32MX has many oscillator configurations for the sake of power and speed trade-offs.

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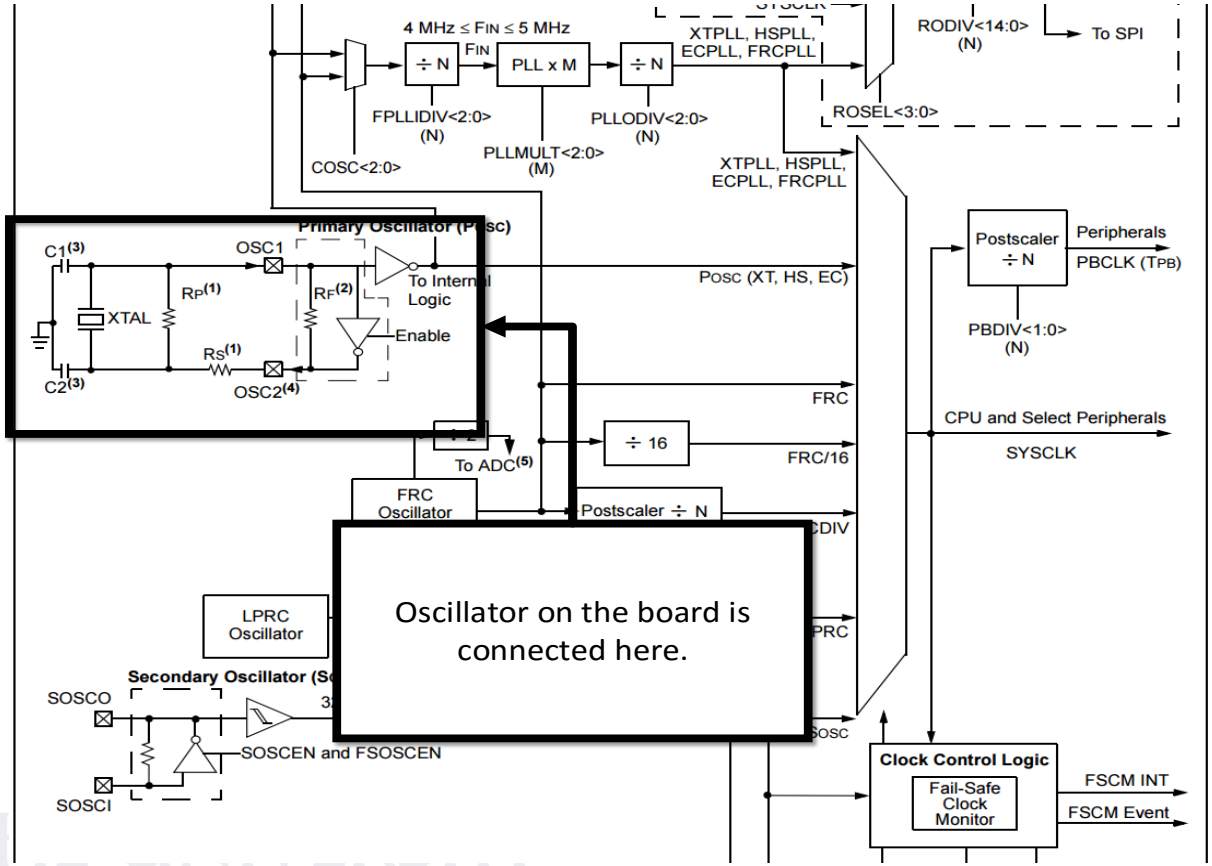
- Section 6 of the Family Reference Manual for details.

Oscillator Configurations



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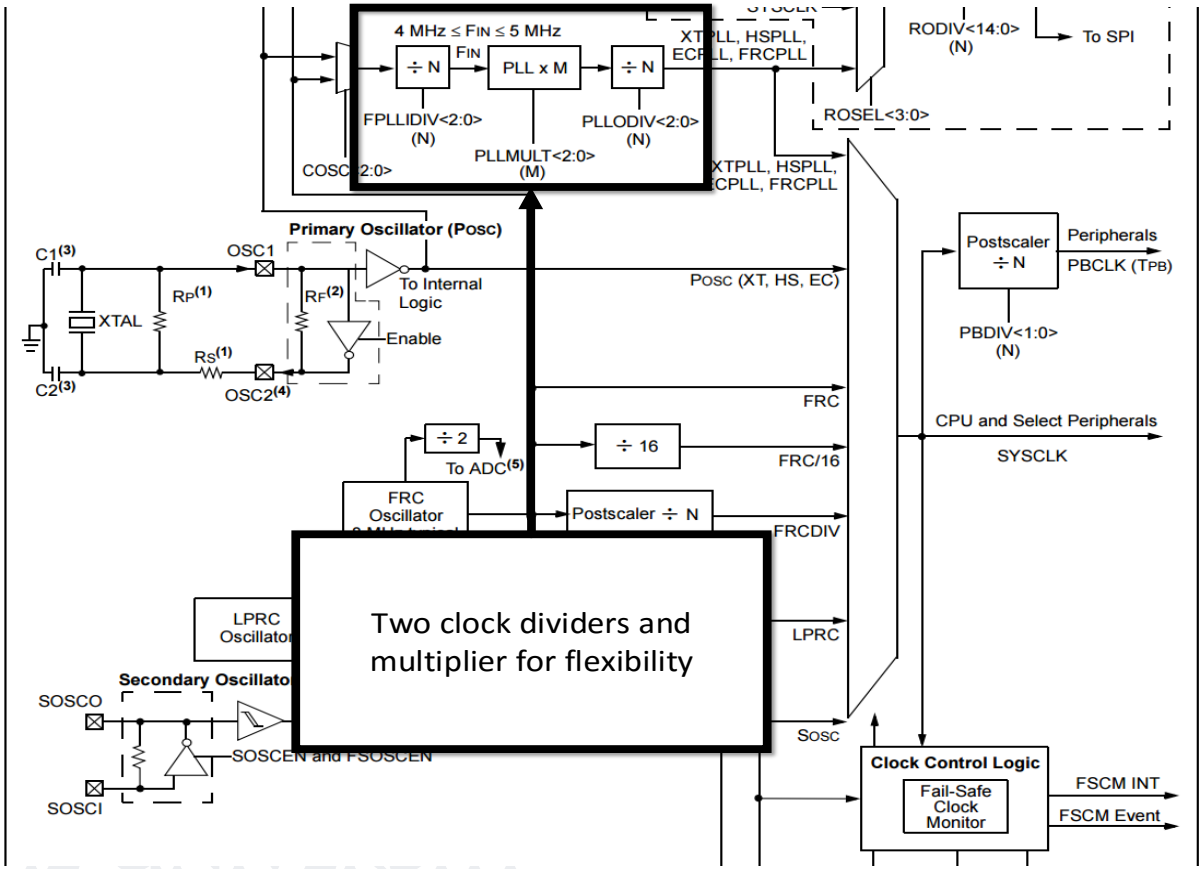

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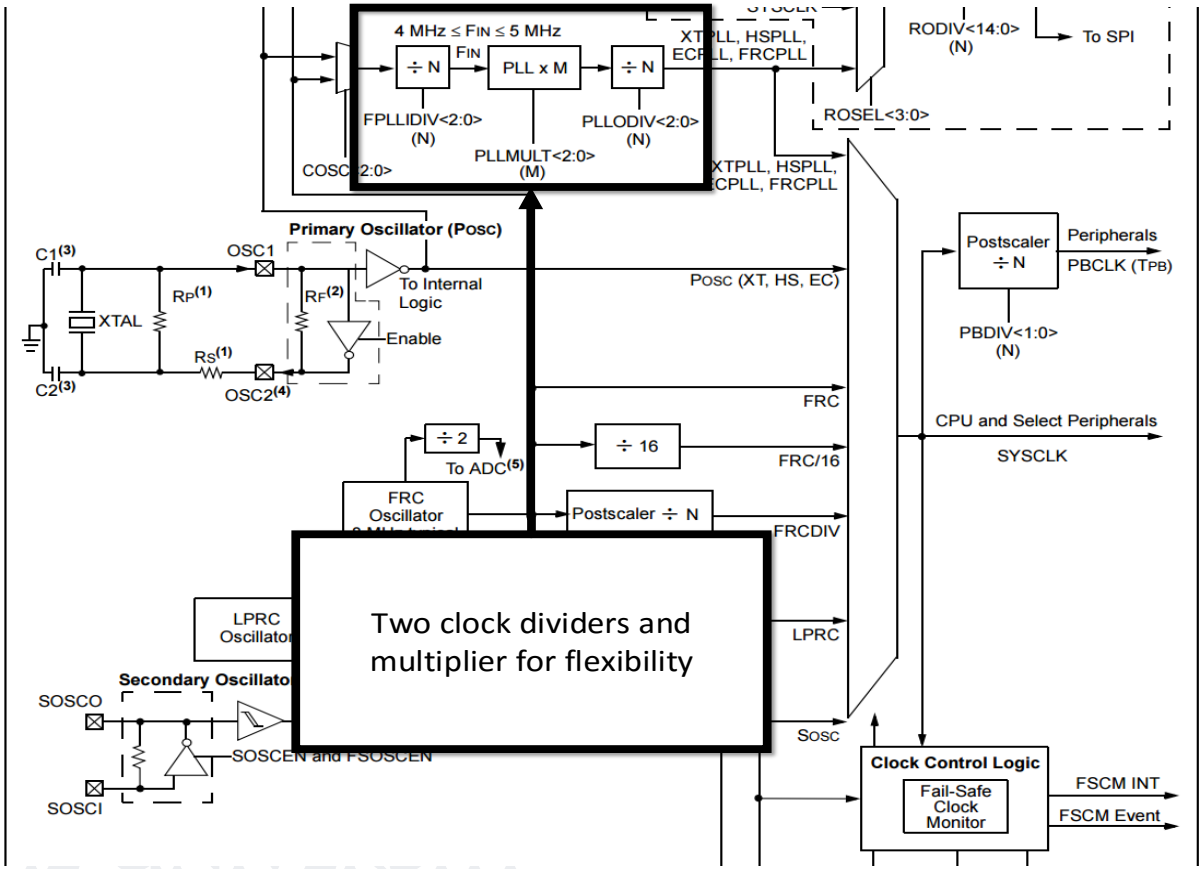

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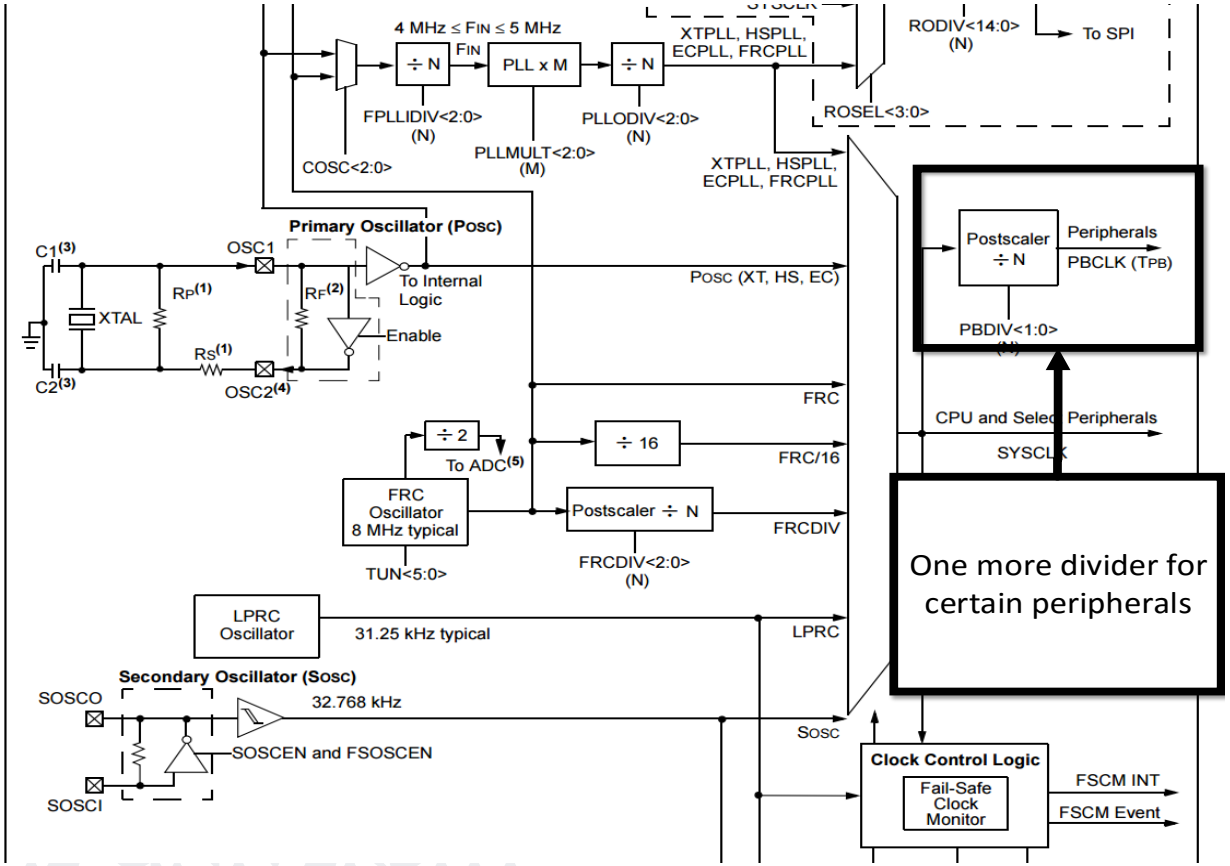

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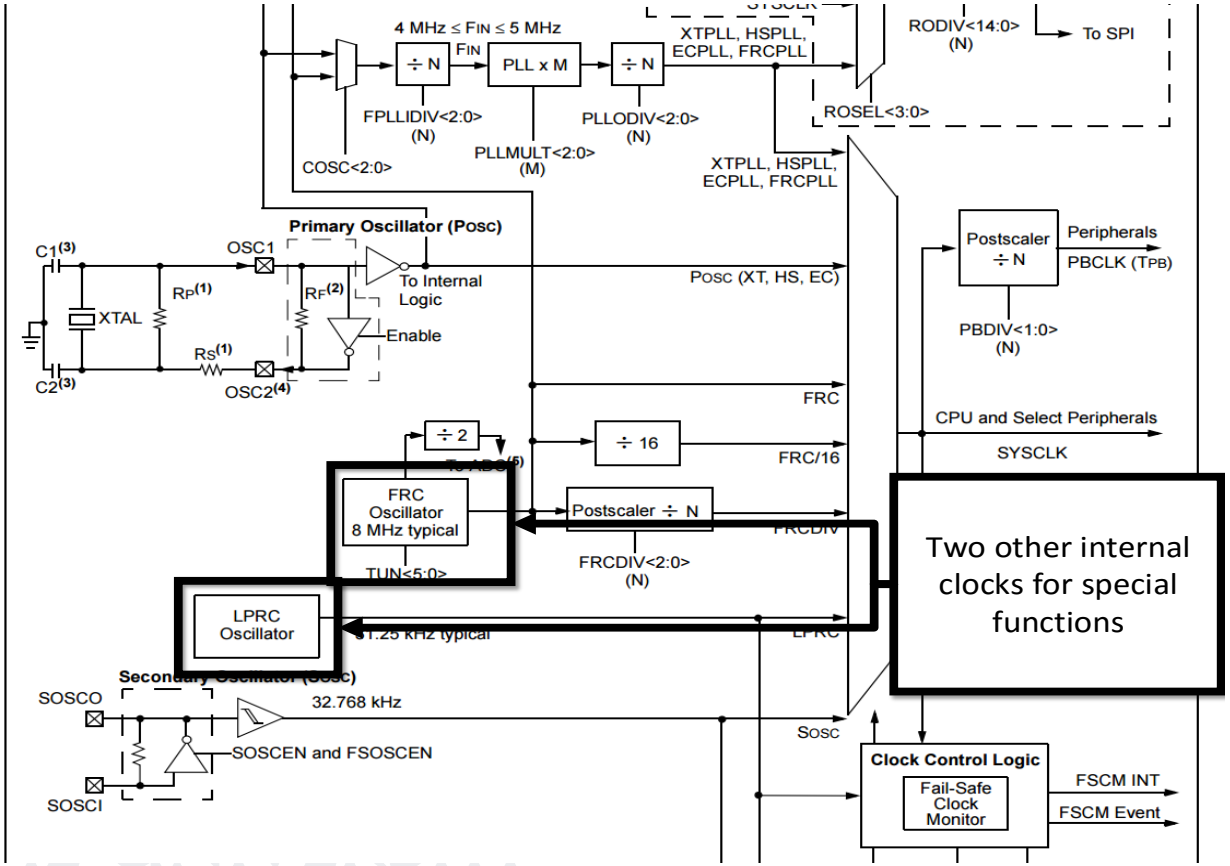

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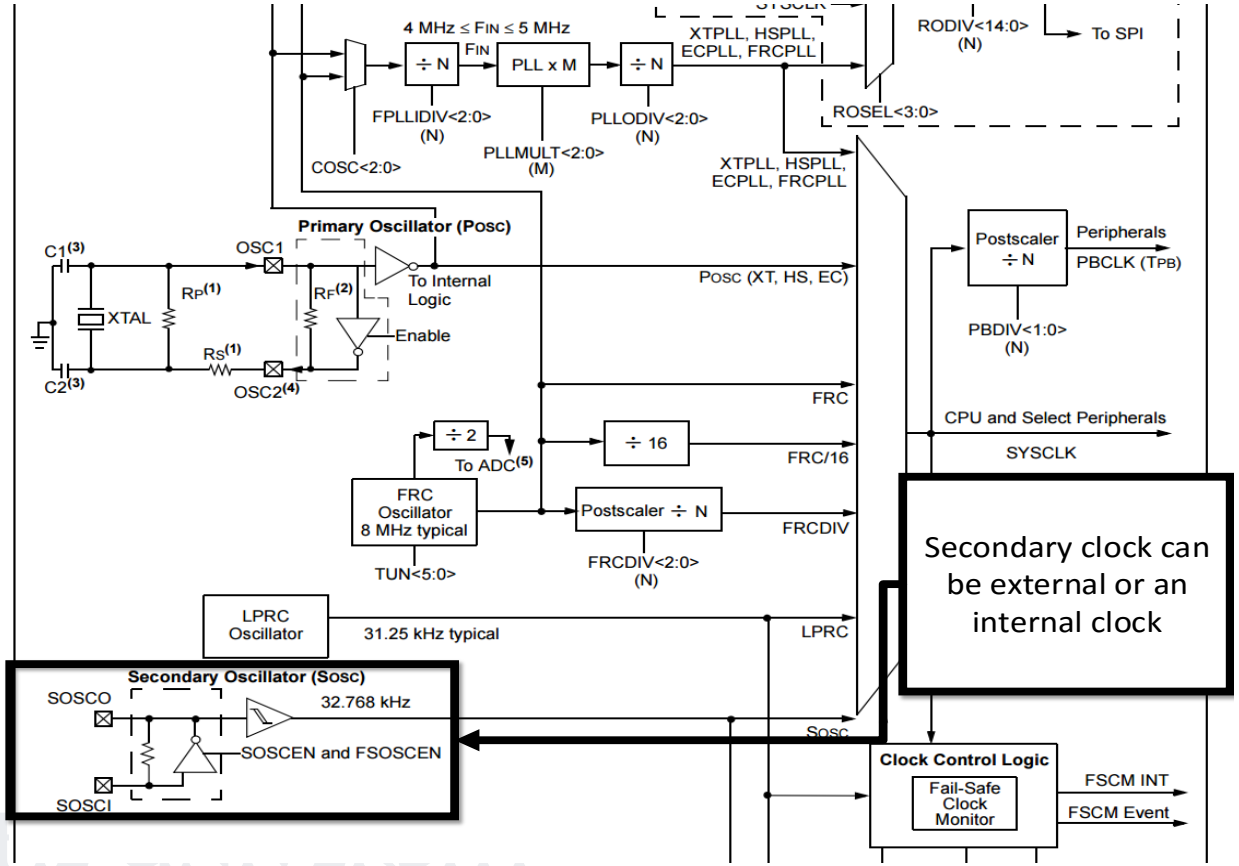

Oscillator Configurations

Lab 0 Code

- In the config.h file there are a few defines that set the clock

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Timer Details

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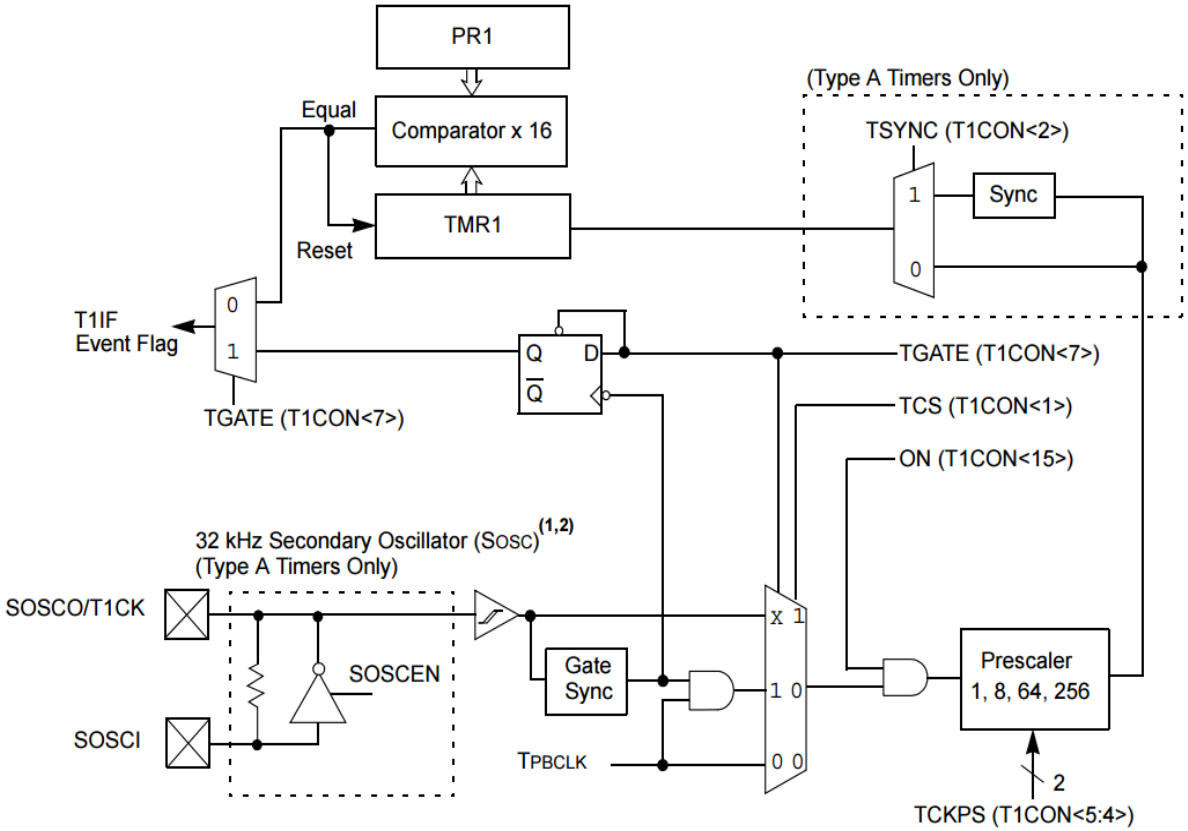
- Five total timers. Each are used for different purposes, but have a basic common structure
- Oscillator determines the time resolution, maximum timing interval, and if the timer will work in sleep, idle, or deep sleep modes. (Modes may be covered later.)
- Timers are operated by PBCLK (Different from the system clock)

Timers Schematics



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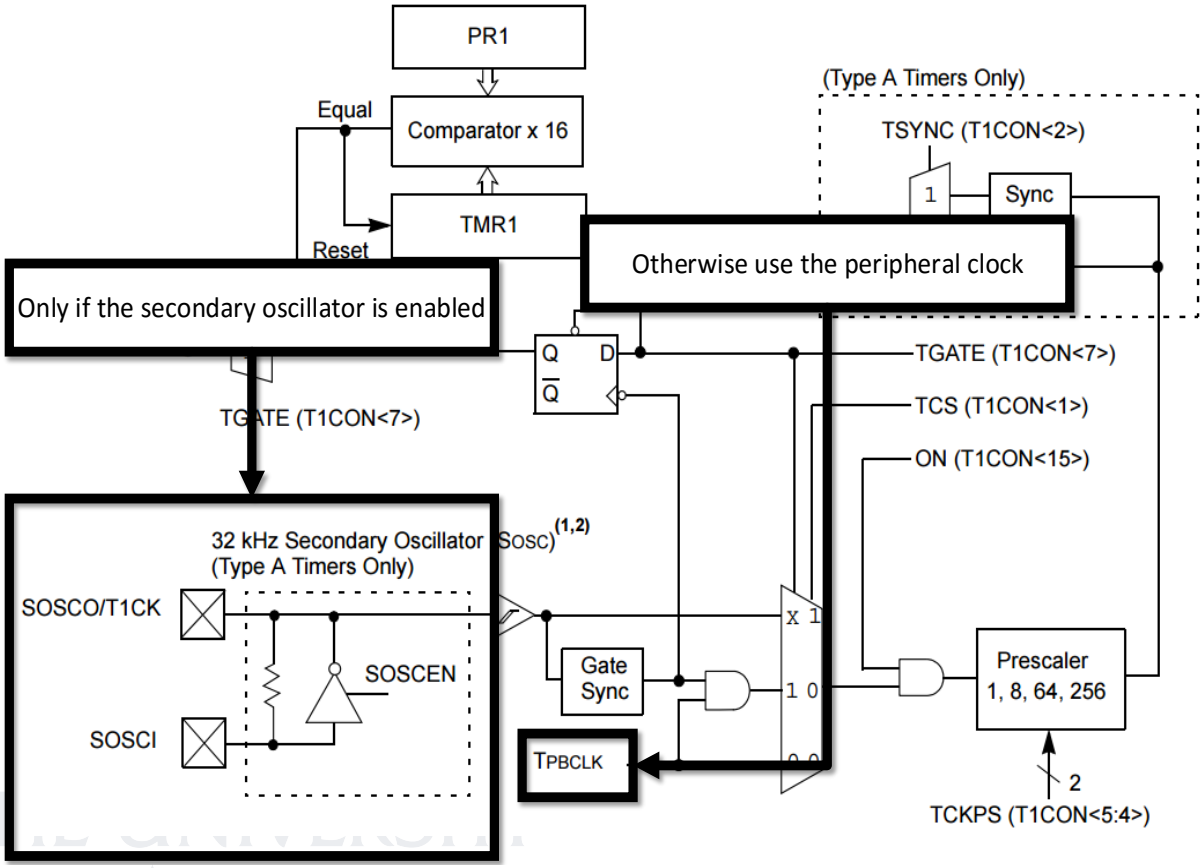

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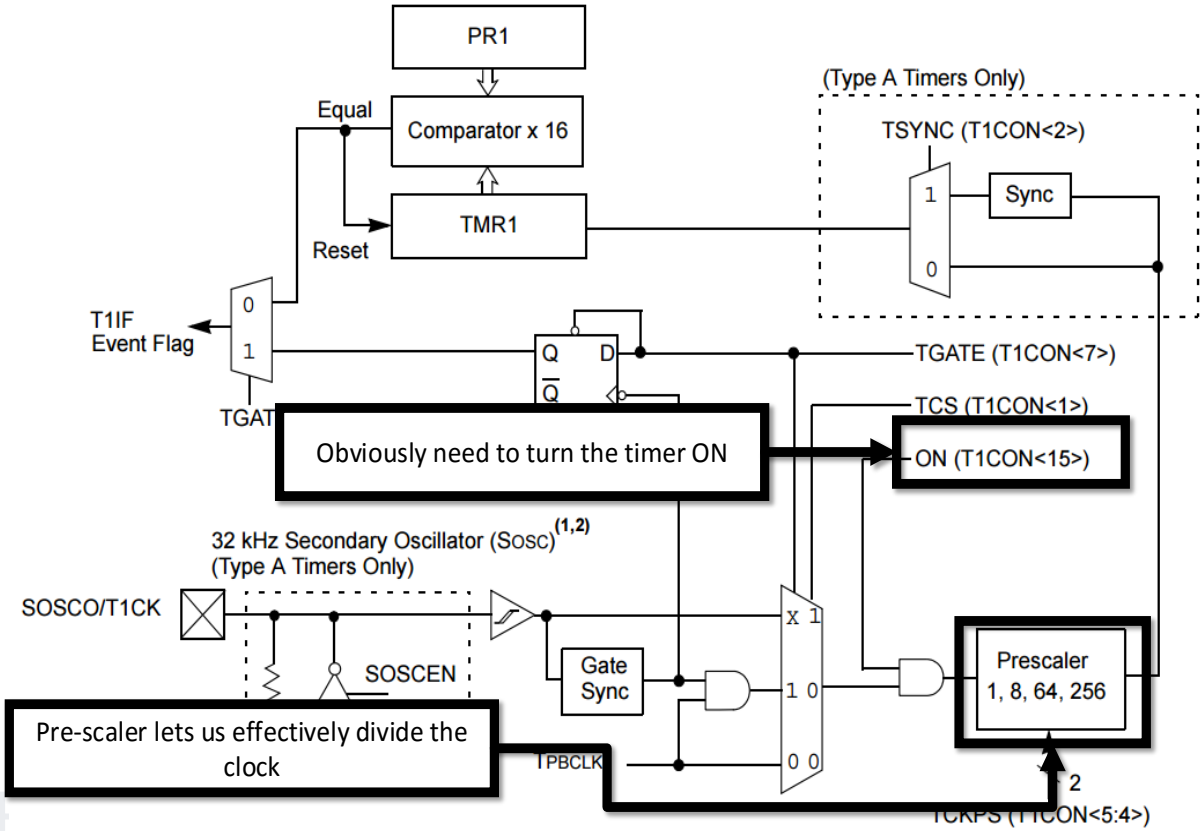

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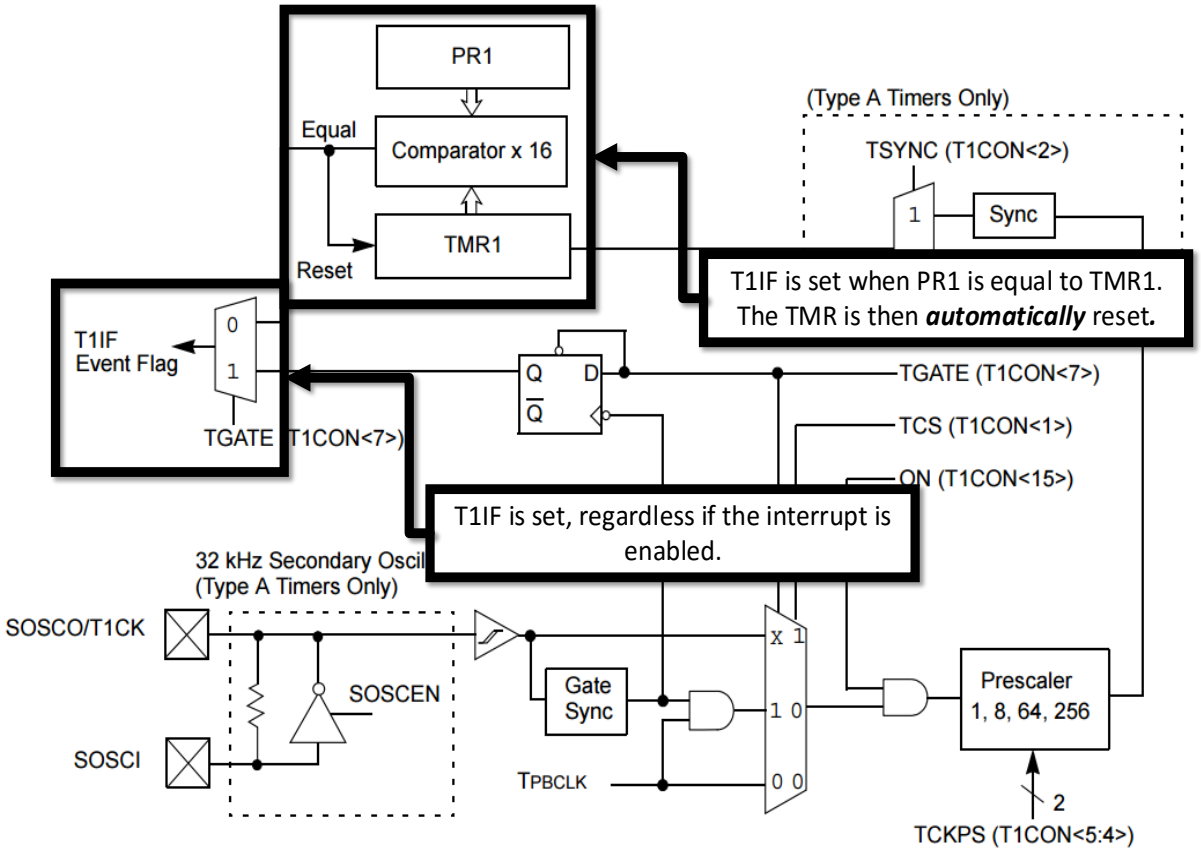

Timer SFRs

Important Registers

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1. TxCON (contains TCS, TON, TGATE, TSYNC, TCKPS)
2. PRx (Period register. Determines when the timer gets reset and the interrupt flag is raised.)
3. TMRx (Do not use for interrupts. You may use this for *measuring* delays.)

Timer Examples

Example 1

1. Using the oscillator on the development board, what value must PR be to get a 1 μs (10^{-6}s) timer? Assume an F_{cy} of 10 MHz
2. $PR = \frac{(1\mu s)(10MHz)}{(Prescalar)} - 1$

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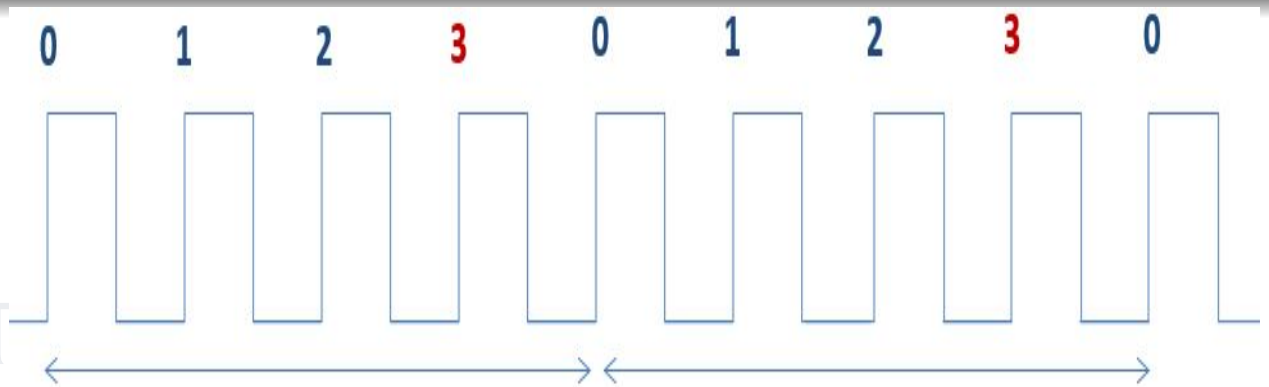
3. "-1" accounts for the extra clock cycle



Timer Examples

Formula

$$\text{In general } PR = \frac{(timedelay)(F_{cy})}{prescalar} \_ 1$$

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3. PR should be at least 9 to be at least $1\mu s$.

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2. $PR = \frac{(5*10^{-3})(5*10^{6})}{256} - 1 = 96.656$

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1. Using a prescalar of 256
2. 8 MHz oscillator
3. FPLLIDIV is 2, PLLMULT is 20, PLLDIV is 16 and PBDIV is 8
4. What PR is necessary to get a 5 msec timer?
5. $PR \approx 5$
6. PR should be at least 6.

Demonstration

Using 16-bit timers

1. Creating a delay
2. Measuring a time
3. Using a timer interrupt
4. 16-bit timer limitations