



MICROCHIP

dsPIC30F Peripheral Module

Output Compare Module



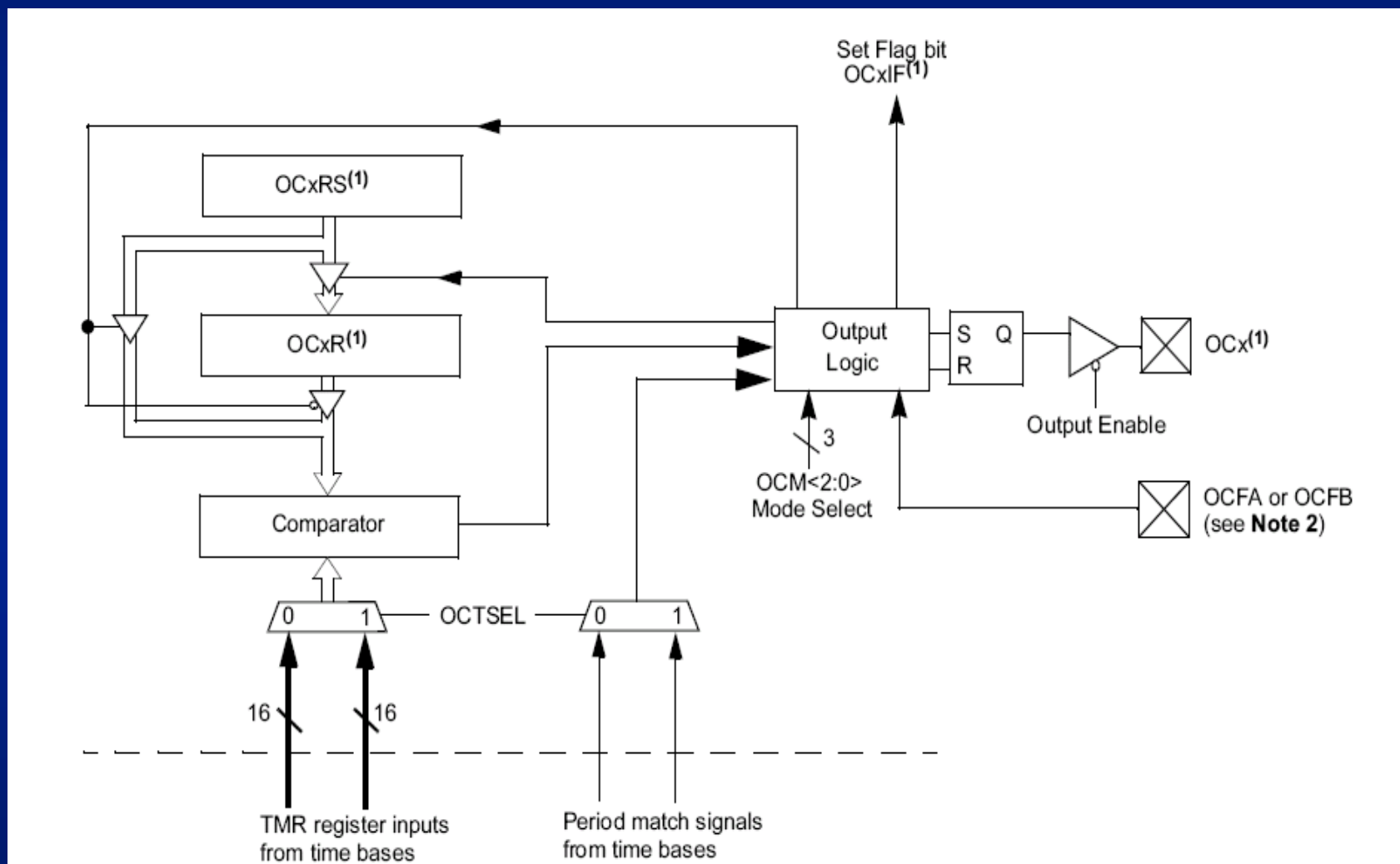
MICROCHIP

輸出比較模組

Output Compare Module

- Simple Compare Match Mode:
 - ❖ 16-bit Compare
 - ❖ Resolution = Instruction Cycle
 - ❖ Set, Reset or Toggle Pin
- Dual Compare Mode:
 - ❖ Single Pulse
 - ❖ Continuous pulse
- Simple PWM Mode
 - ❖ With FAULT Protection Input
- Timer 2 or Timer 3 as time-base
- Up to 8 Output Compare / PWM Channels

O.C. 方塊圖



O.C. Registers

- 每一個 OC 2. 都有獨自的暫存器組：
 - ❖ OCxCON : Control Register for each Channel
 - ❖ OCxR : Data Register for output compare channel (用於簡單比較輸出模式)
 - ❖ OCxRS : Secondary data register for the output compare channel (較複雜模式，需要用到兩個比較功能時使用)
- 每個 OC 都是獨立的運作

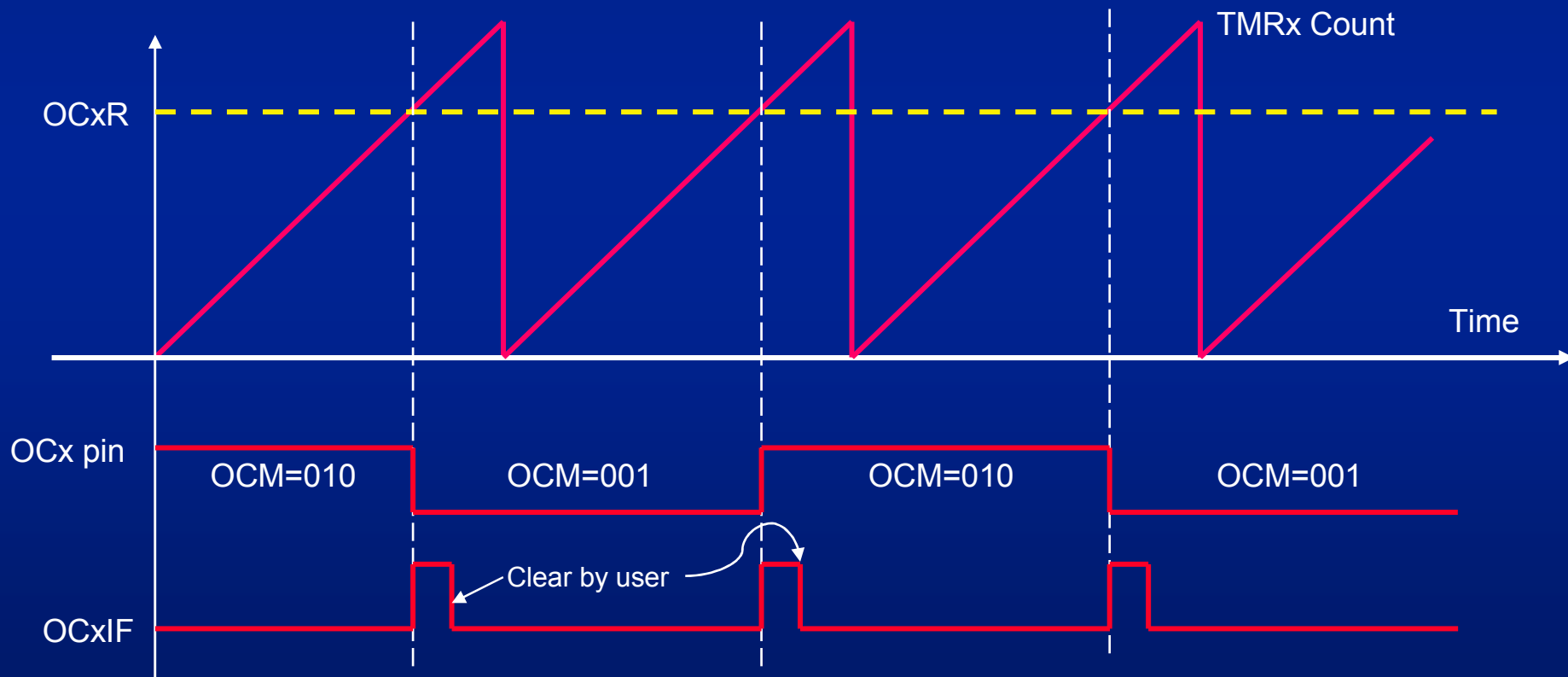
Output Compare Control

- OCxCON register
 - ❖ OCM<2:0> : Output Compare Mode Select bits
 - ❖ OCTSEL : Select Timer 2 or 3 for time base
 - ❖ OCTFL : PWM FAULT Condition Status bit
 - ❖ OCSIDL : Stop Output Compare in IDLE Mode

U-0	U-0	R/W-0	U-0	U-0	U-0	U-0	U-0
-	-	OCSIDL	-	-	-	-	-
bit15	14	13	12	11	10	9	bit8
U-0	U-0	U-0	R-0,HC	R/W-0	R/W-0	R/W-0	R/W-0
-	-	-	OCFLT	OCTSEL	OCM<2:0>		
bit7	6	5	4	3	2	1	bit0

1. Compare Output 基本操作

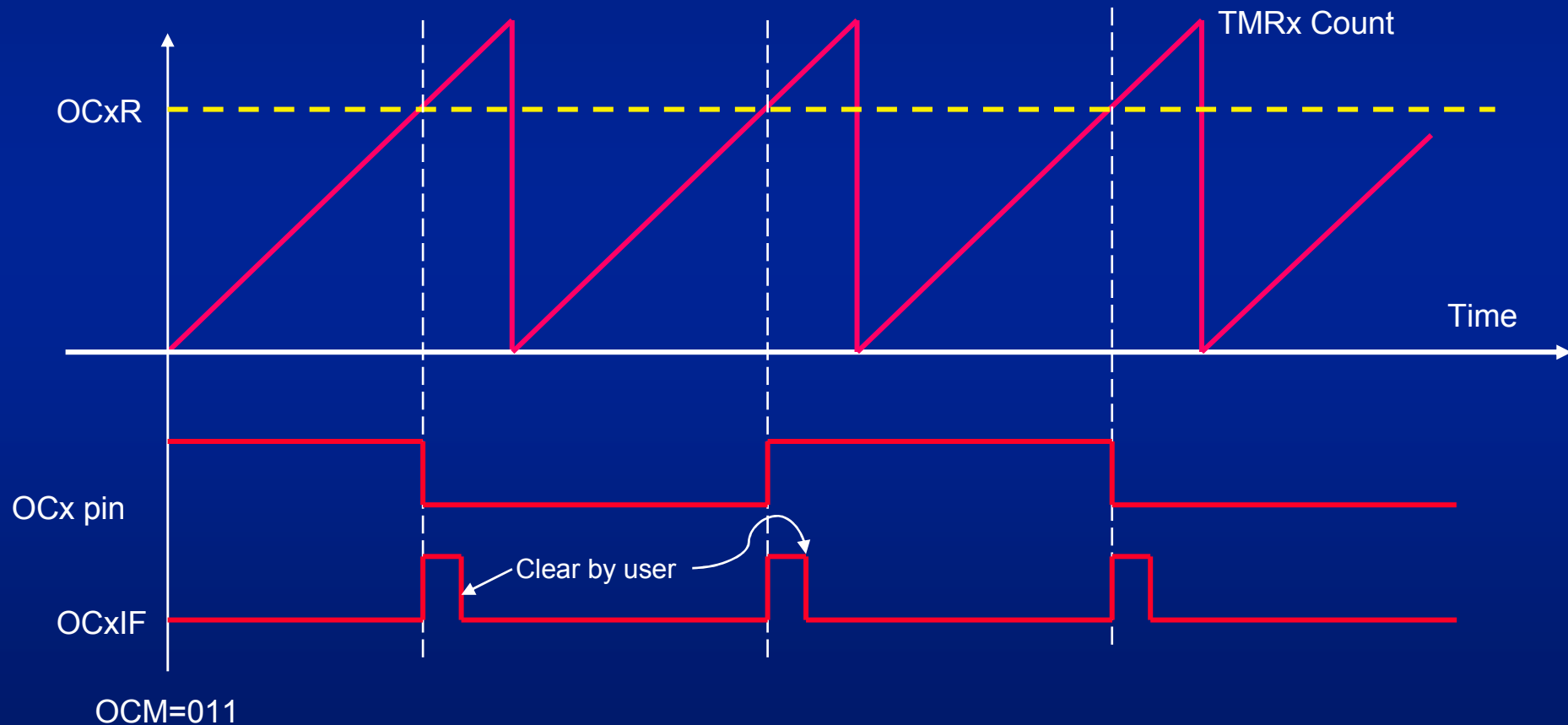
- Set OCM<2:0> = 000, Output Compare Channel is Disable
- Set OCM<2:0> = 001, 初始設定 OCx = 0，到達設定值 OCx = 1
- Set OCM<2:0> = 010, 初始設定 OCx = 1，到達設定值 OCx = 0





2. Single Compare Toggle Output

- $OCM<2:0> = 011$, 符合設定值實轉態
 - ❖ $PR2 > OCxR$ (必要條件，否則將無法滿足比較條件)



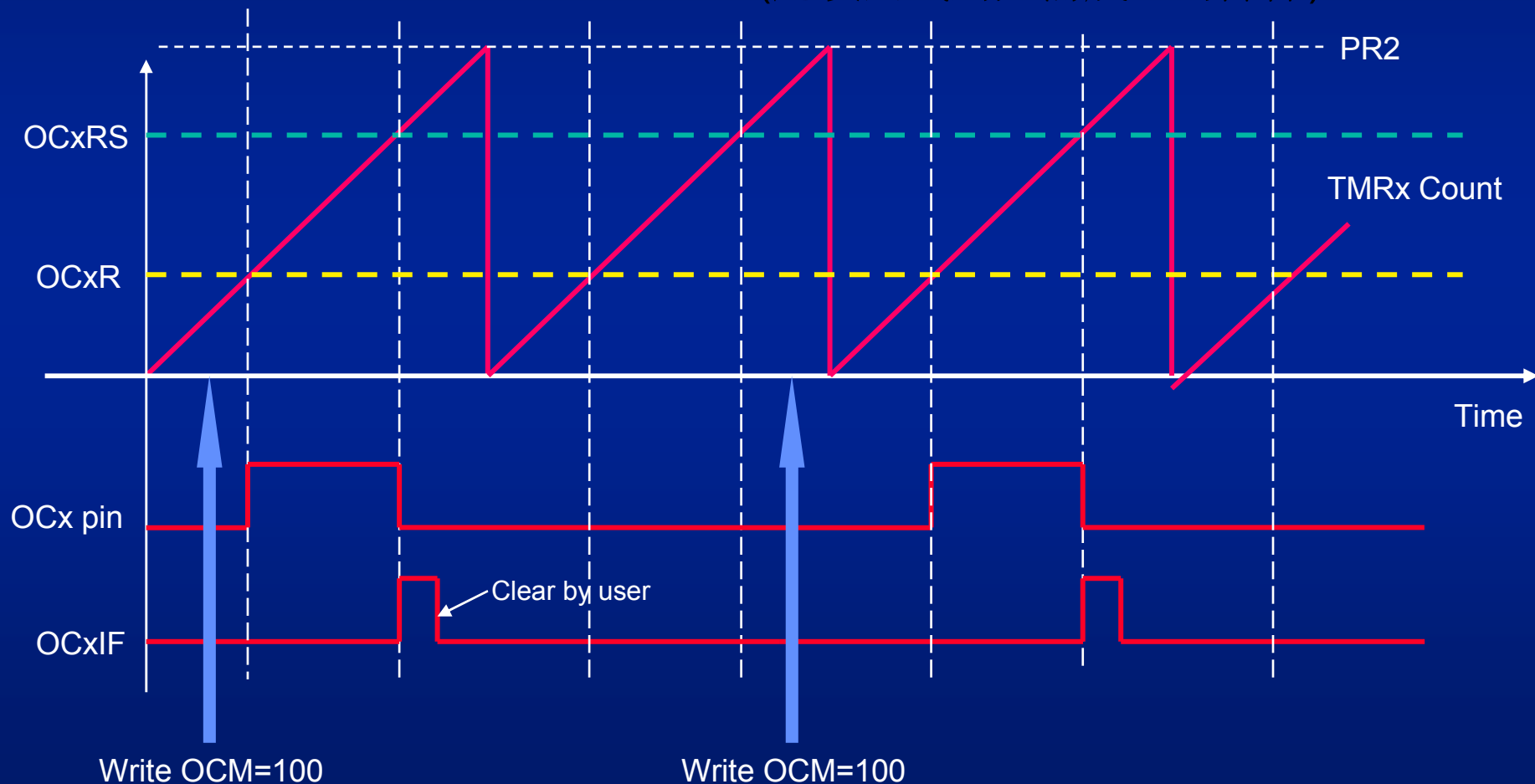
雙比較模式輸出

- The Function can configured two Dual Compare mode
 - ❖ Signal Output Pulse mode
 - ❖ $OCM<2:0> = 100$
 - ❖ Continuous Output Pulse mode
 - ❖ $OCM<2:0> = 101$
- 需要動到兩個暫存器 **OCxR** 及 **OCxRS** 來比較
 - ❖ OCxR match with TMRx , 將 **OCx** 腳位拉成 **Hi**
 - ❖ OCxRS match with TMRx , 將 **OCx** 腳位拉成 **Low**

3. Signal Output Pulse mode

- $OCM\langle 2:0 \rangle = 100$

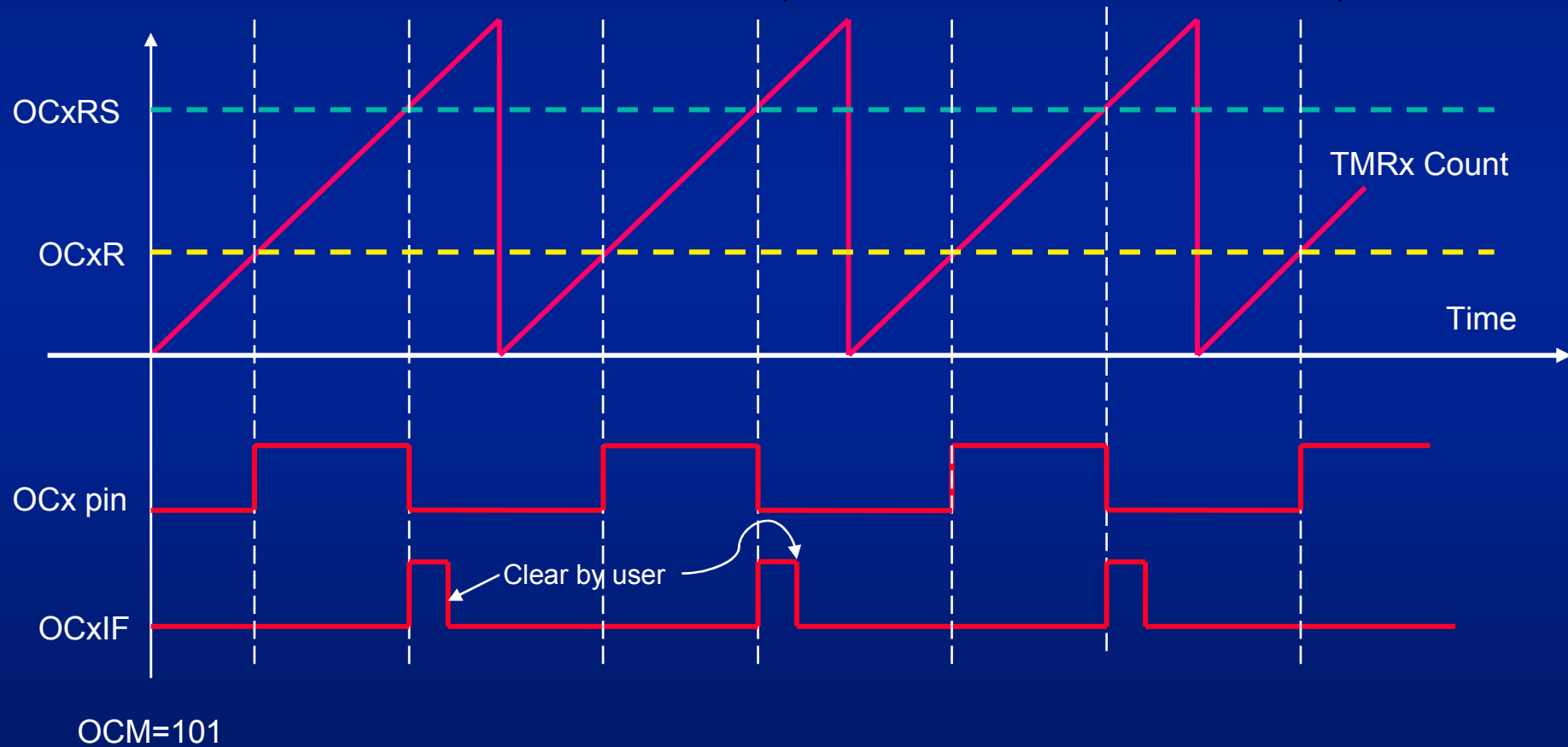
- ❖ $PR2 \geq OCxRS > OCxR$ (此項公式為必需成立的條件)



4. Continuous Output Pulse mode

- $OCM\langle 2:0 \rangle = 101$

❖ $PR2 \geq OCxRS > OCxR$ (此項公式為必需成立的條件)

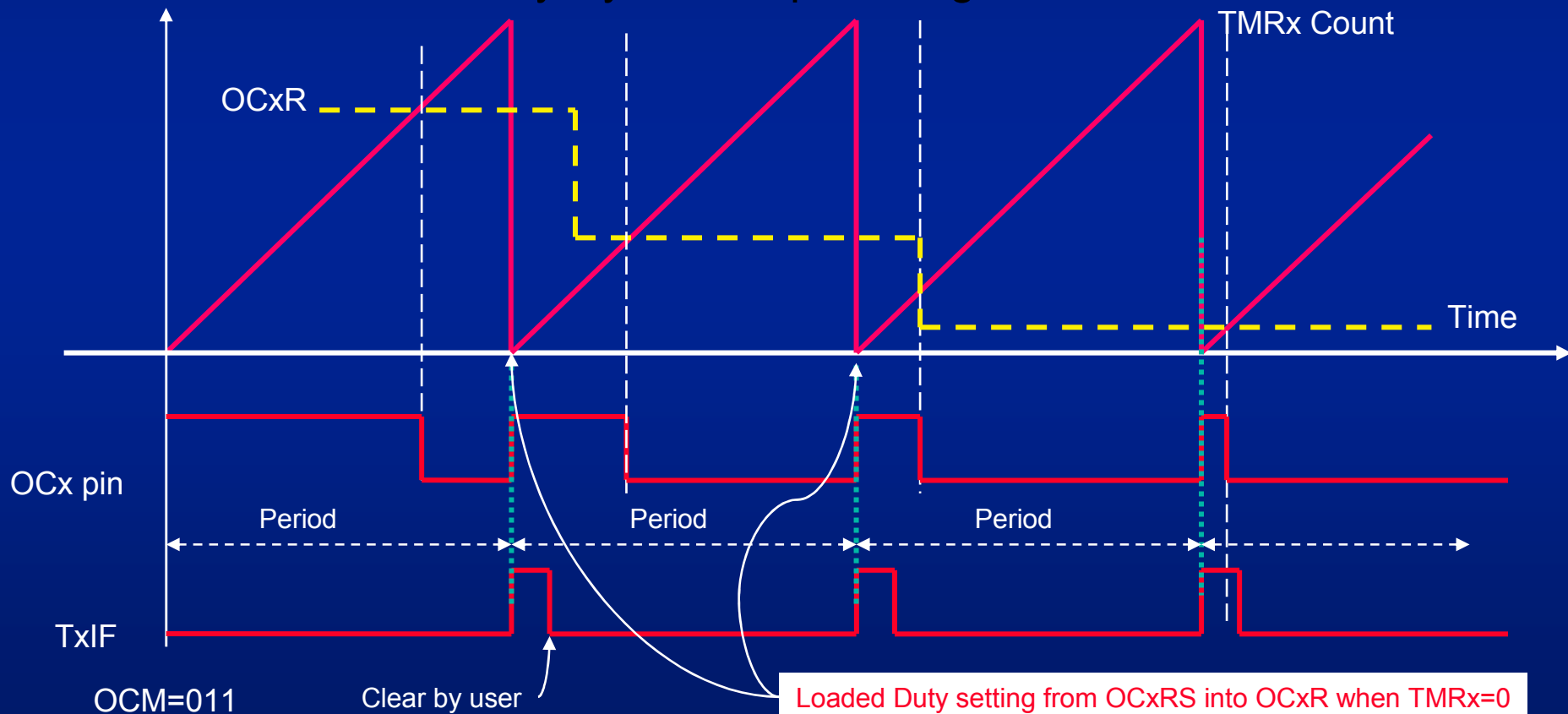


PWM Mode with FAULT

- OCM=110, PWM mode without the FAULT protection
- OCM=111, PWM mode with the FAULT protection
- FAULT input use both OCFA and OCFB pins
 - ❖ OCFA is associated PWM channel 1 ~ 4
 - ❖ OCFB is associated PWM channel 5 ~ 8
- Any FAULT is occurred the related PWM output pin will placed in high impedance
 - ❖ User may elect to provide a pull-up/down resistor
- Remove the FAULT condition
 - ❖ External FAULT signal has been remove
 - ❖ Re-write the OCM<2:0> to enable module again

5. PWM Output Mode

- $OCM\langle 2:0 \rangle = 11x$ **(PR2 \geq OCxRS)**
 - ❖ PR2 = Period Register, OCxRS = Duty Cycle Register
 - ❖ OCxR = Duty Cycle Compare Register



OC Lab1

- 使用 OC1 作為一個標準的 PWM 輸出
 - ❖ 週期 (Period) 的控制為 Timer2，設定最大的輸出週期為 1023 (10-bit 解析度下)
 - ❖ 使用 VR2 (ADC) 當作 Duty Cycle 的輸入控制，輸入的 Duty 範圍從 0 到 1023
- APP020 Plus 上的 DIPSW 的設定
 - ❖ DSW4 : All Open
 - ❖ DSW3 : SW1 & SW2 Closed ; Select VR2 for ADC
 - ❖ DSW1 : SW1 & Sw2 Closed ; Select PGC/OGD for Debug pin
- OC1 (pin 23) 將會送出 14.40 KHz 的 PWM 脈衝到 LED11，調整 VR2 時將會改變 PWM 的 Duty Cycle，可以由 LED11 的亮度看出變化。(或用示波器看 pin 23 腳的 PWM 變化)

為何 PWM 週期 是14.4 KHz

- 你知道 Timer2 為本練習的 PWM Timebase 嗎?
- Timer2 是用 Fosc 還是 Fcy 來計數的?
- Timer2 在此練習擔任任何種腳色?
- Period 設成多少?

$F_{cy} = 7.372800\text{MHz} \times 16 / 2 = 14.7456 \text{ MHz}$
 $14.7456 \text{ MHz} / \text{Timer2 Period} =$
 $14.7456 / 1024 =$
 $14.4\text{KHz (PWM 輸出頻率)}$