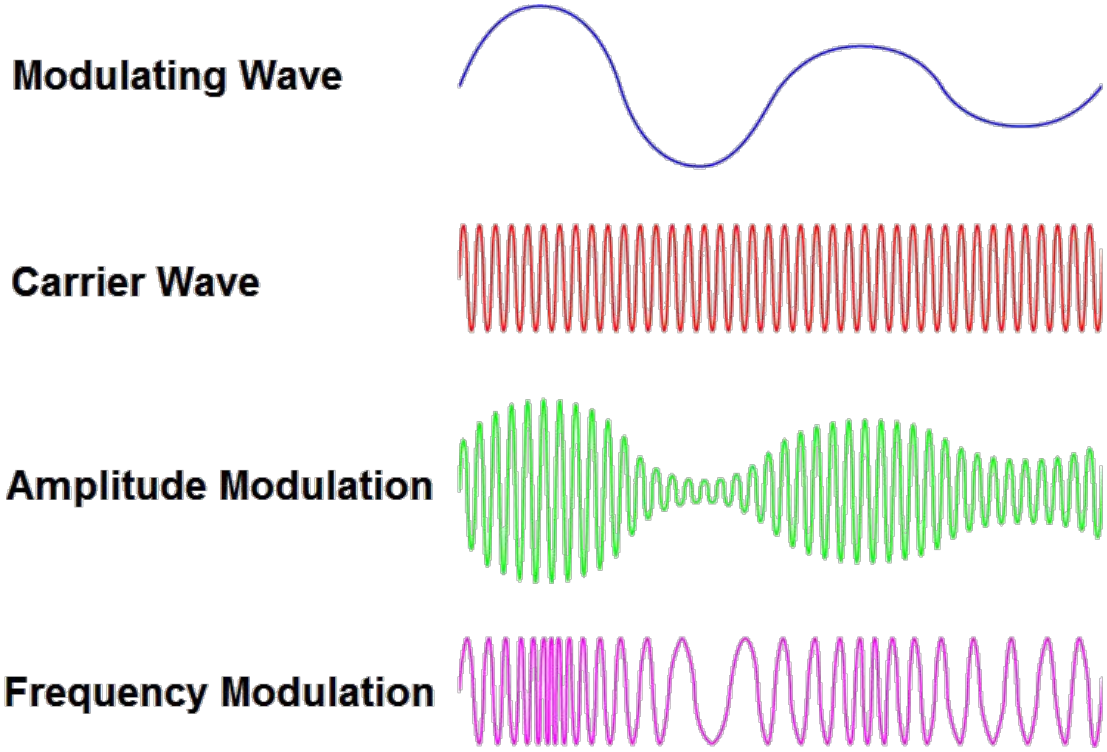
STM32 course

Timers as output

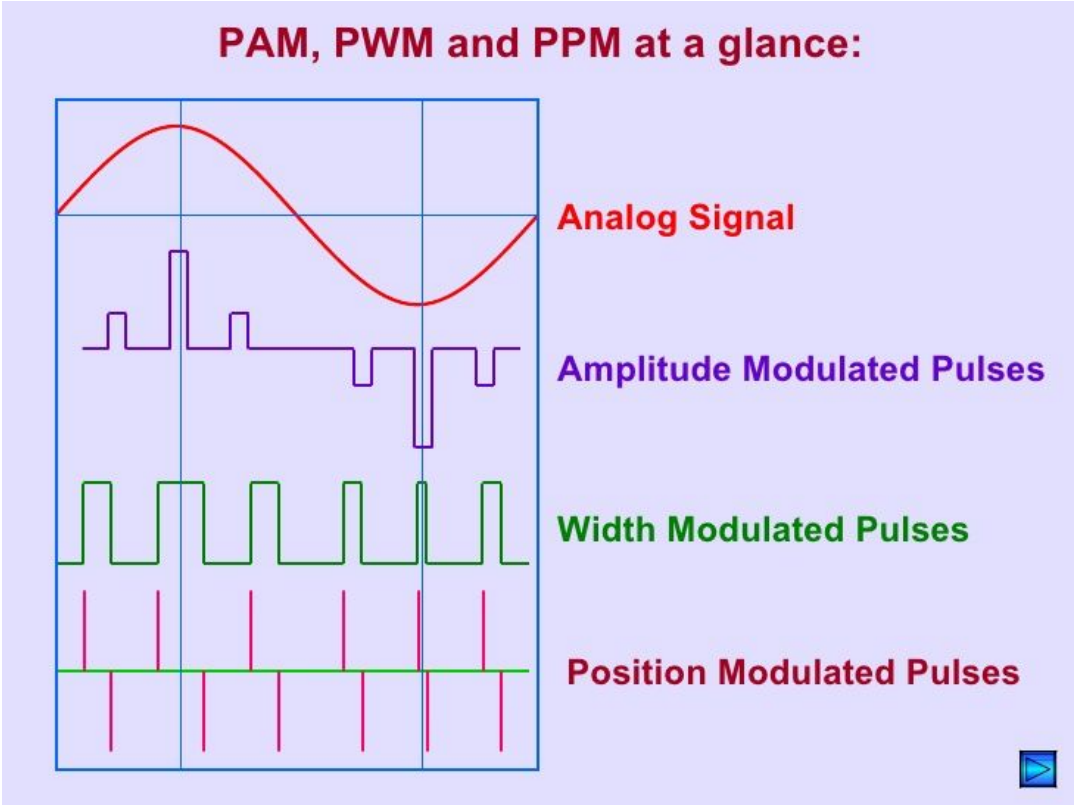
Outline

- Introduction to what is modulation
- What is PWM (briefly)
- Timer schematic diagram overview
- *Time Base Unit* and *Output Compare Unit* register sets
- PWM Zoo
- Advanced features

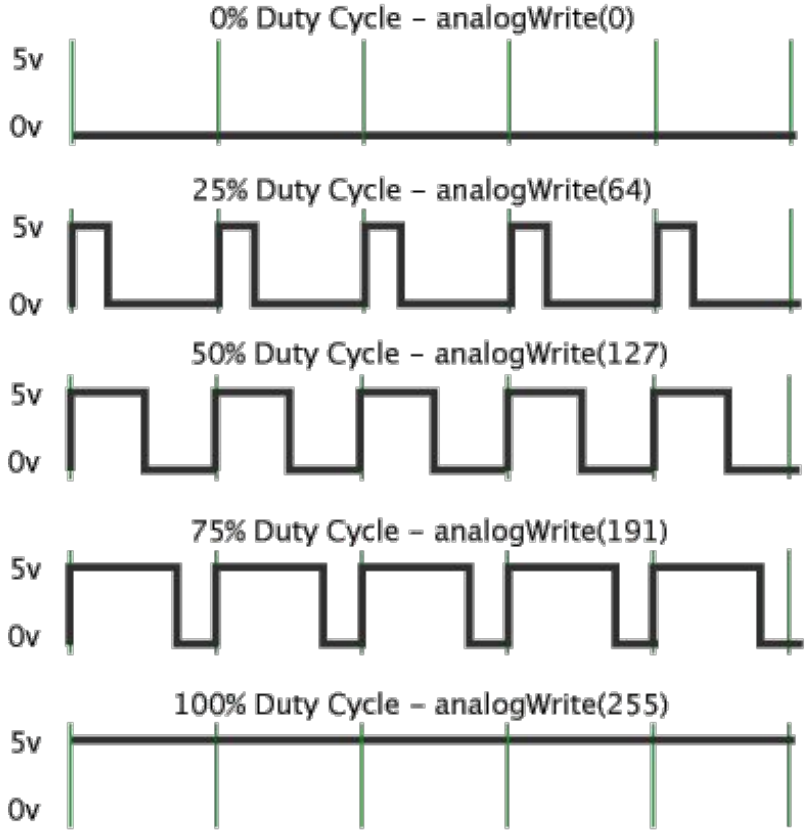
Analog modulation



Digital modulation



PWM

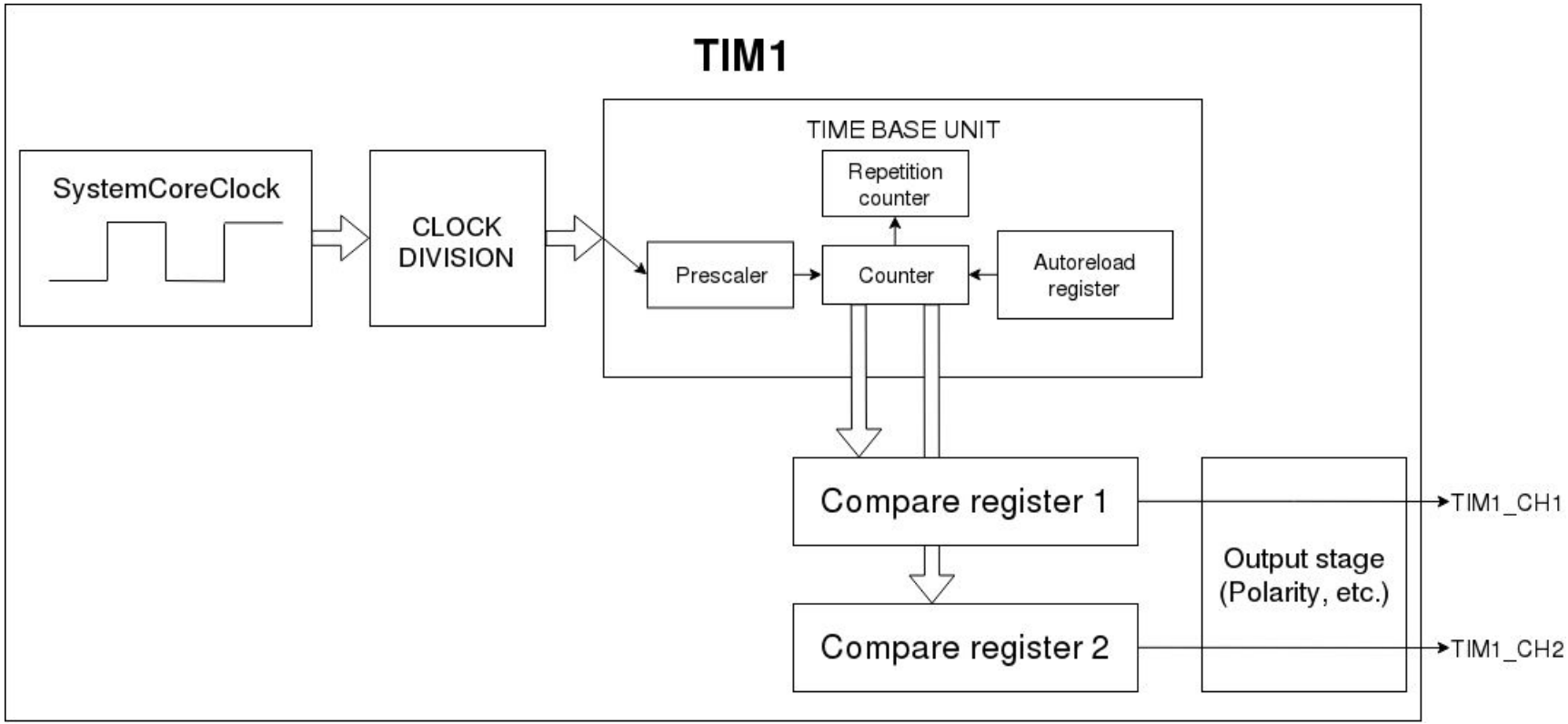

0% Duty Cycle – analogWrite(0)
5v
0v
25% Duty Cycle – analogWrite(64)
5v
0v
50% Duty Cycle – analogWrite(127)
5v
0v
75% Duty Cycle – analogWrite(191)
5v
0v
100% Duty Cycle – analogWrite(255)
5v
0v

PWM parameters

- Frequency - Time Base Unit
- Duty cycle - Output Compare Unit
- Accuracy - Time Base Unit

Each timer has one TBU and several OCUs - channels.

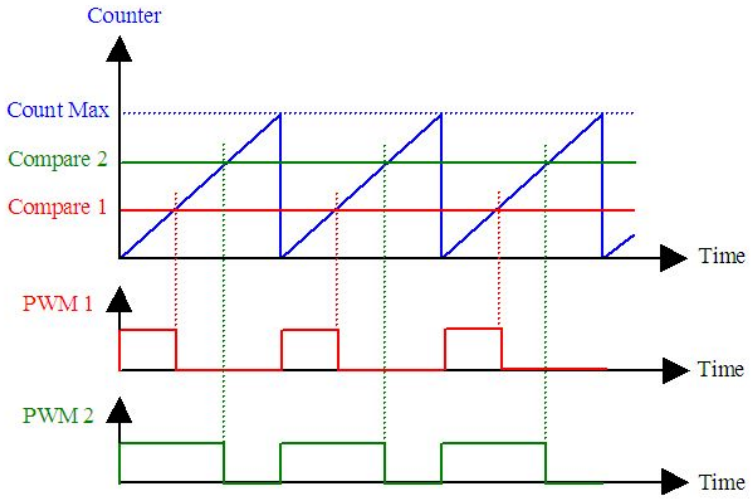
Timer schematic diagram



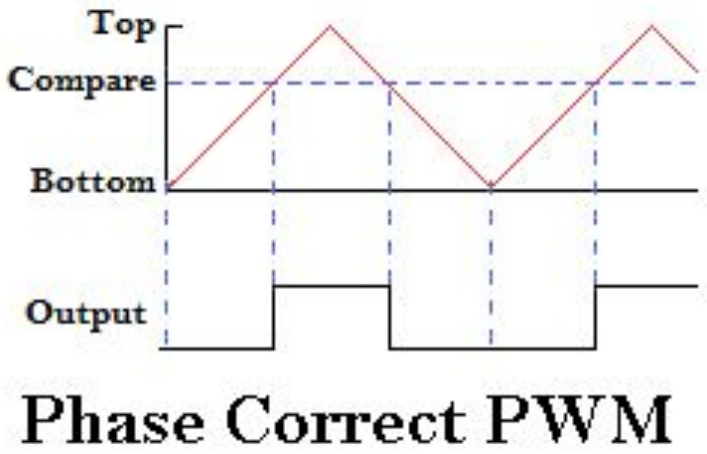
Time Base Unit registers

- Counter register
- Counter mode register (UP/DOWN/CENTER)
- Autoreload register
- Clock division register
- Prescaler register
- Repetition counter

Counter Mode



UP or DOWN



CENTER_UP,
CENTER_DOWN or
CENTER_UP_DOWN

Output Compare Unit registers

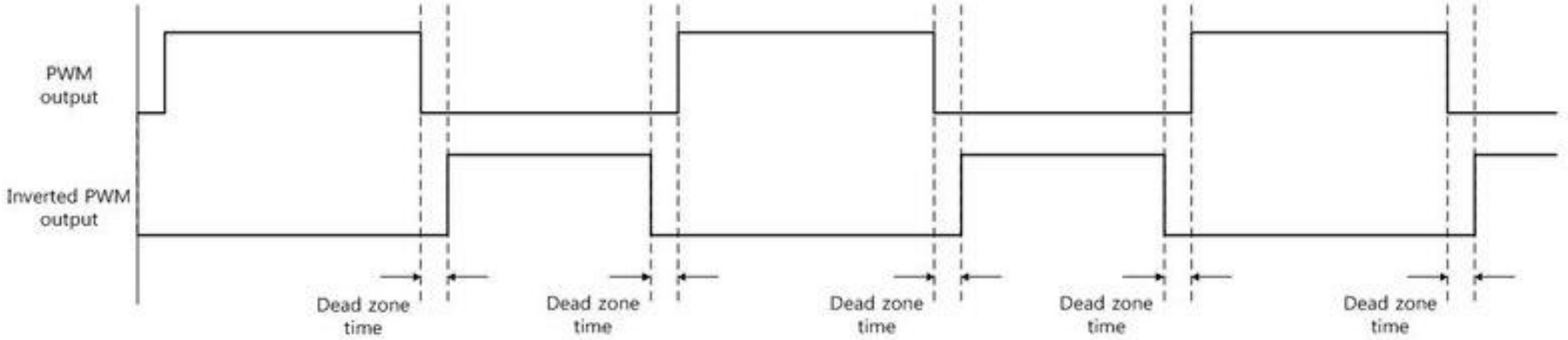
- **Compare value register.** Example for **25%** duty cycle: CompareValue = (Autoreload_Value / 4).
- **OC Mode register (PWM1/PWM2)**
- **OCPolarity, OCNPolarity**
- **OC State register (ENABLE/DISABLE) — enables pin**
- **OCN State register (ENABLE/DISABLE) — enables complementary pin**

OC Mode; OC(N) Polarity

Mode	Counter < CCR	Counter ≥ CCR
PWM mode 1 (Low True)	Active	Inactive
PWM mode 2 (High True)	Inactive	Active

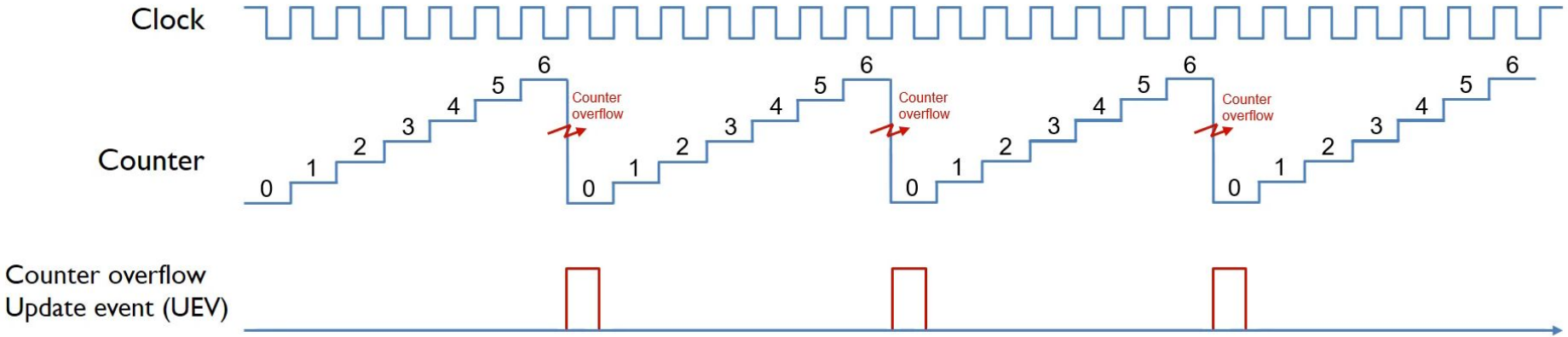
Polarity	Active	Inactive
Active High	High Voltage	Low Voltage
Active Low	Low Voltage	High Voltage

OC(N) State


PWM output
Inverted PWM output
Dead zone time
Dead zone time
Dead zone time
Dead zone time
Dead zone time

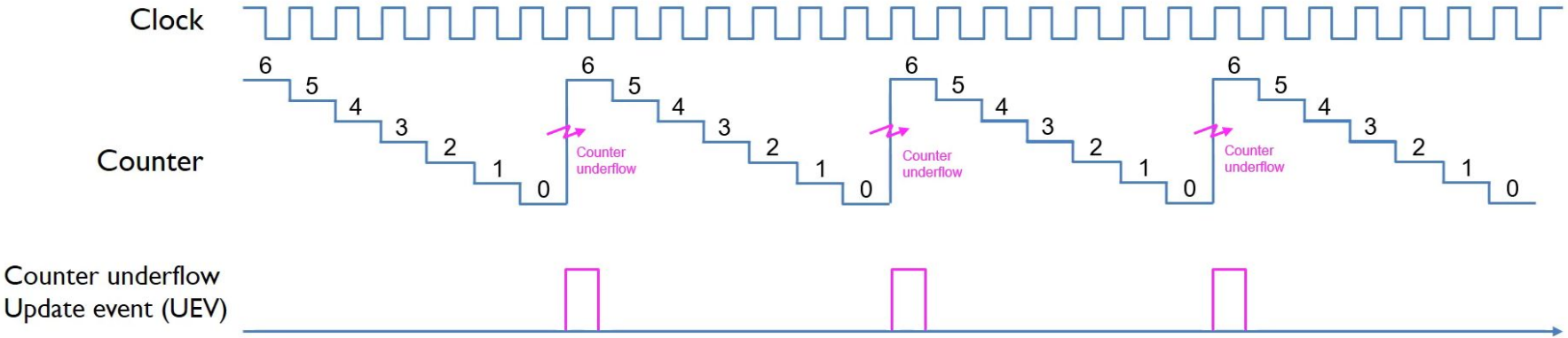
UEV MODES

Up-counting mode(UEV)



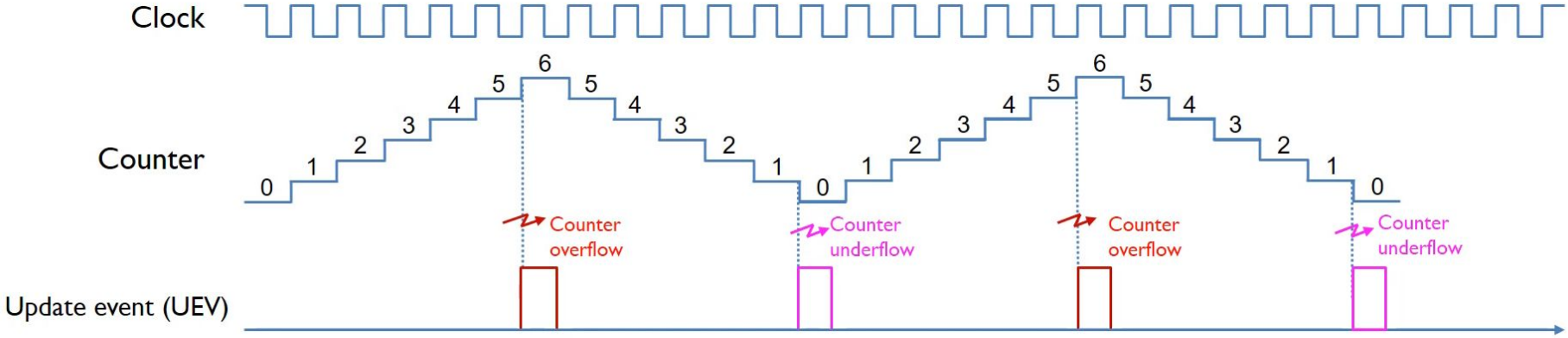
Autoreload register = 6
Repetition counter = 0

Down-counting mode(UEV)



Autoreload register = 6
Repetition counter = 0

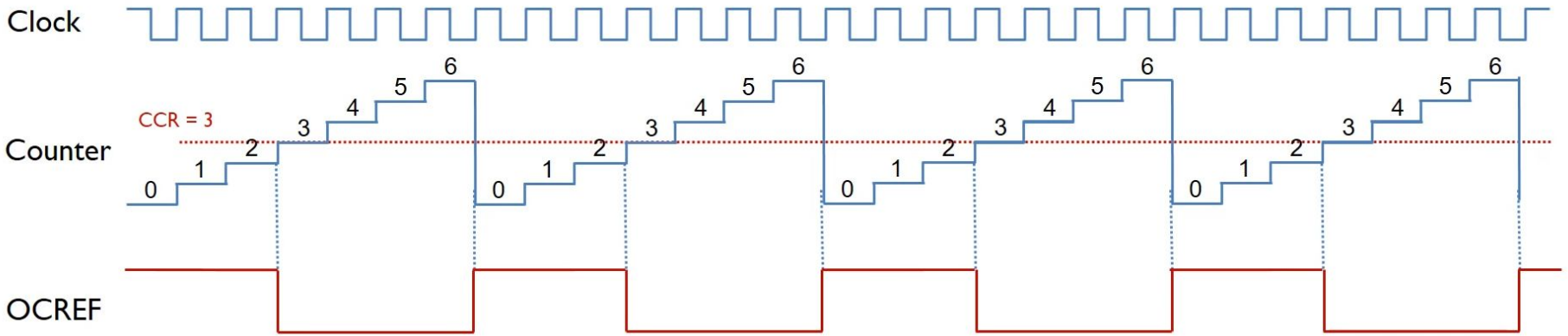
Center-aligned mode(UEV)



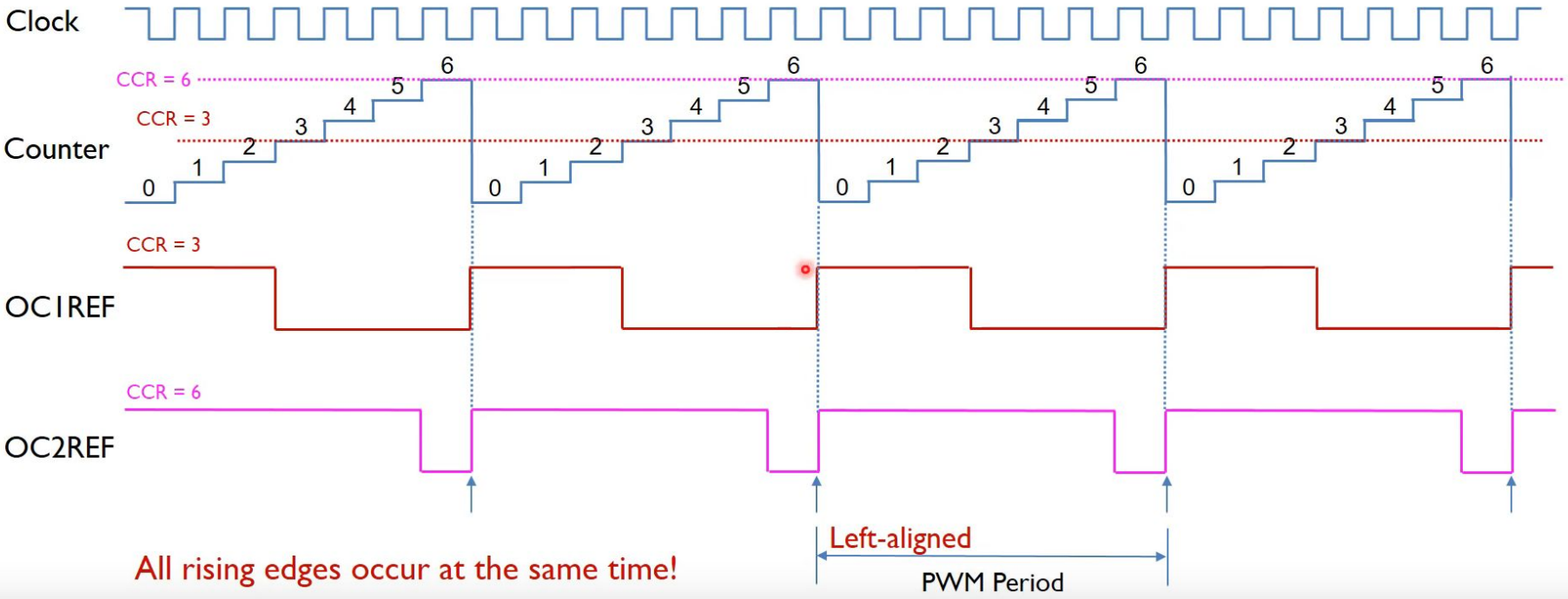
Autoreload register = 6
Repetition counter = 0

PWM MODES

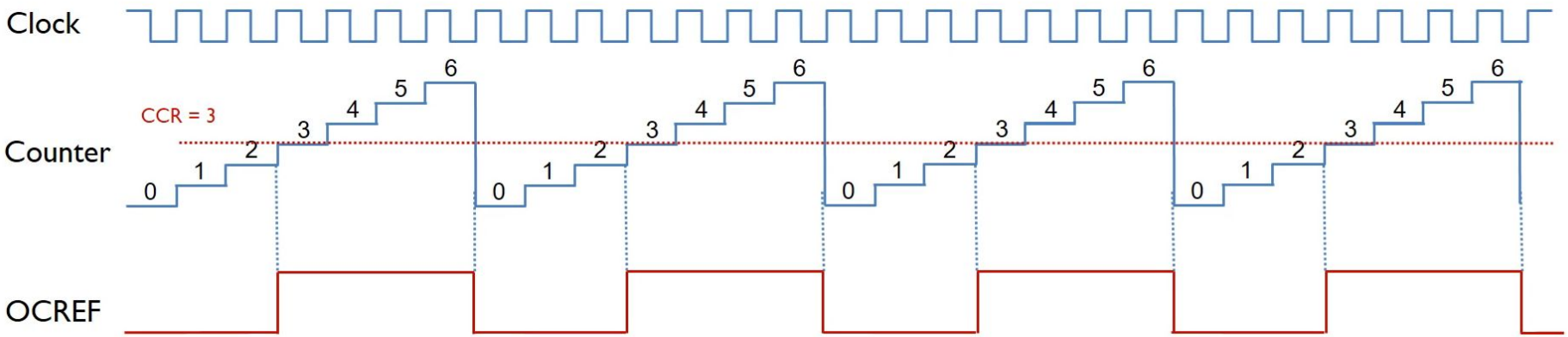
Upcounting low-true mode(PWM1)



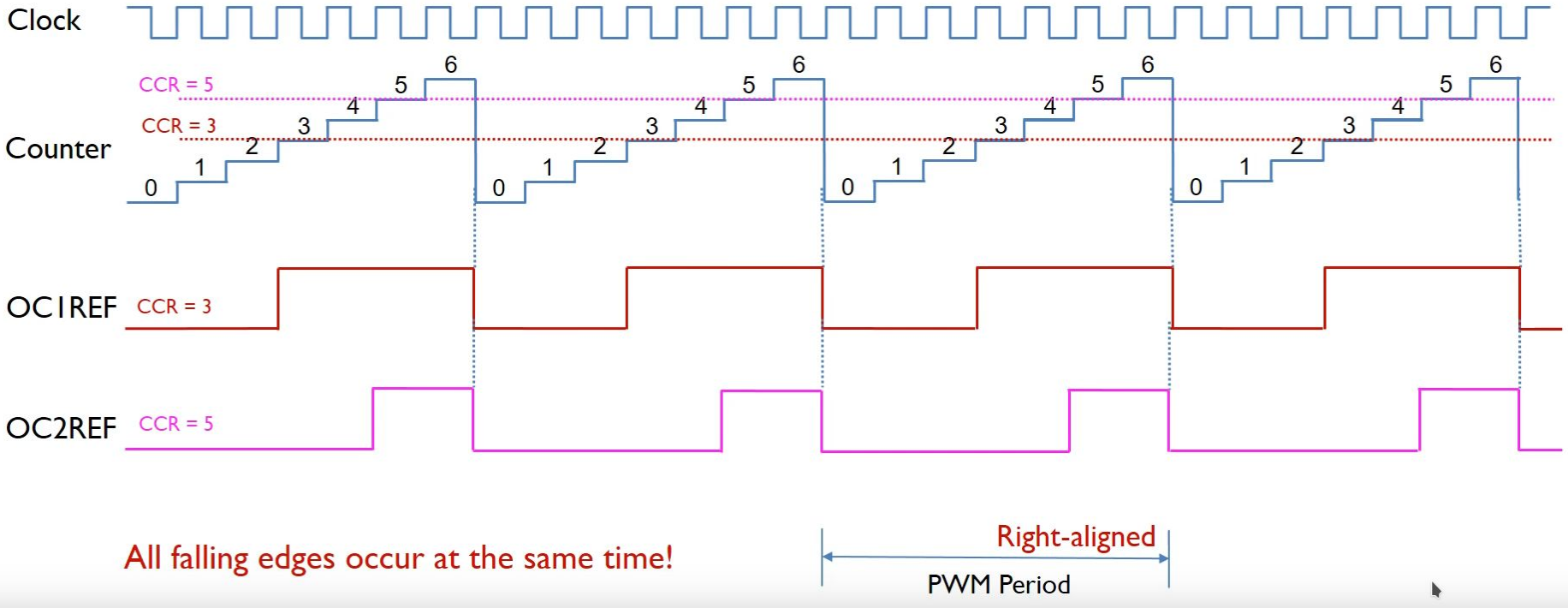
PWM1 mode(edge aligned)



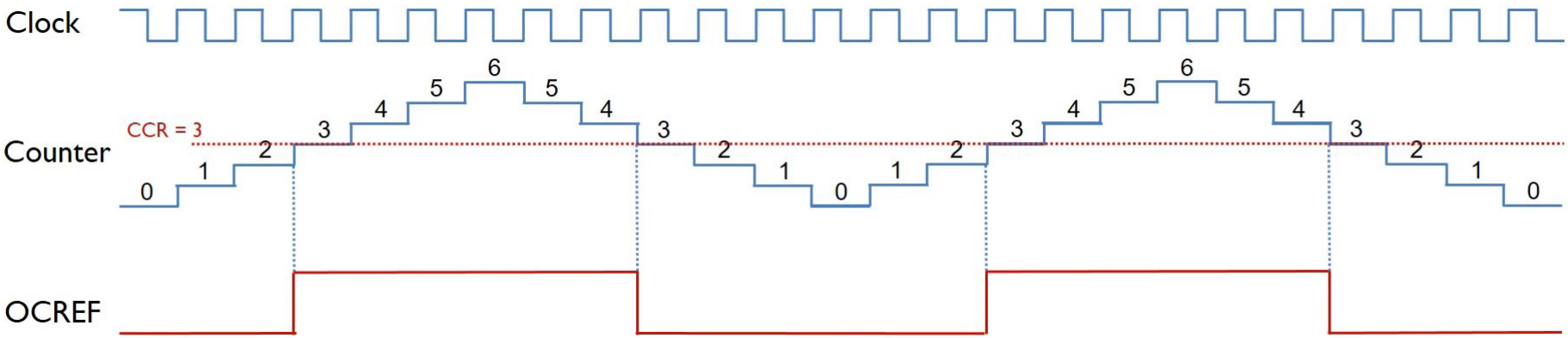
Upcounting high-true mode(PWM2)



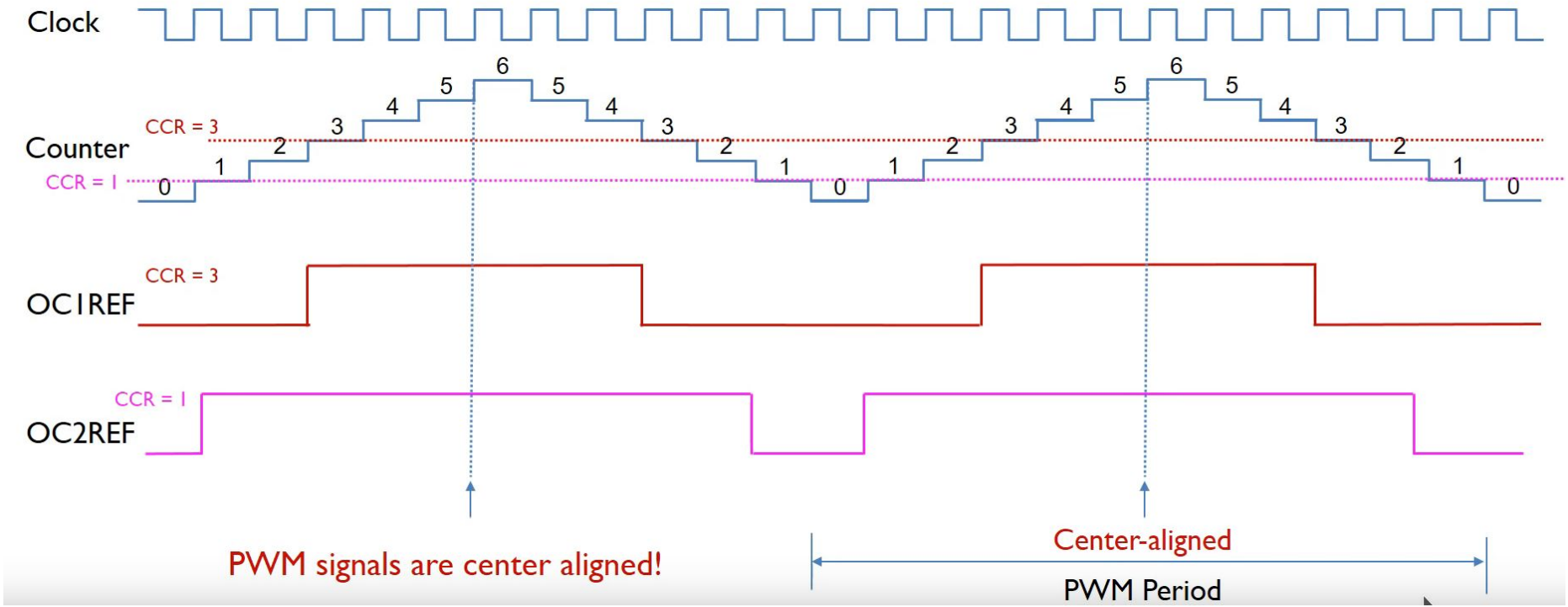
PWM2 mode(edge aligned)



PWM2 mode(center aligned, high-true)

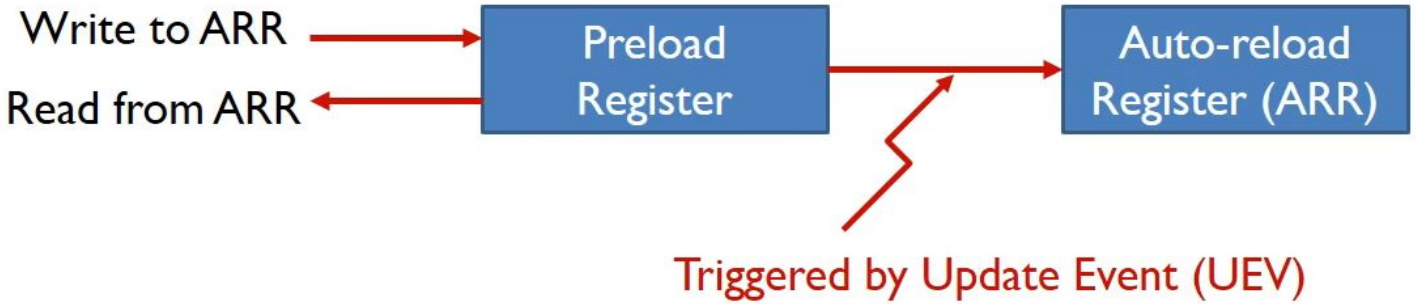


PWM2 mode(center aligned, high-true)



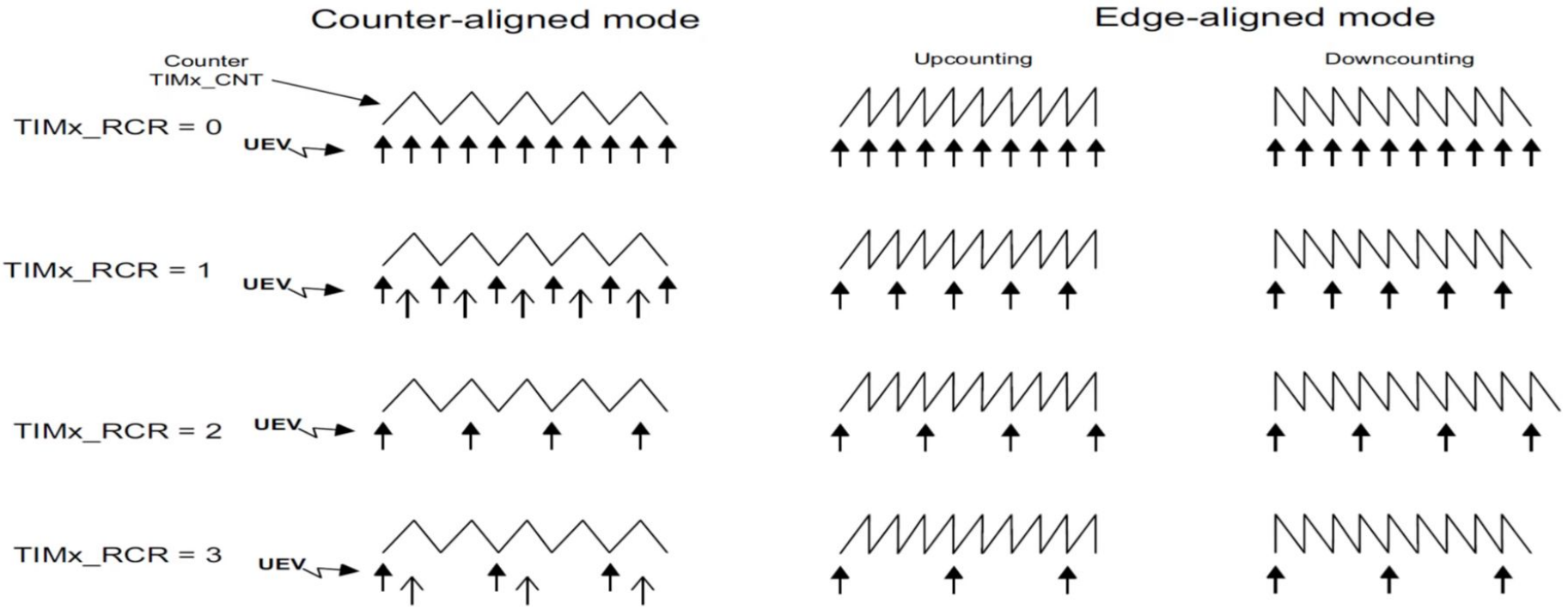
Preload register

ARPE = 1 (Syn Update)



ARPE = 0 (Asyn Update)

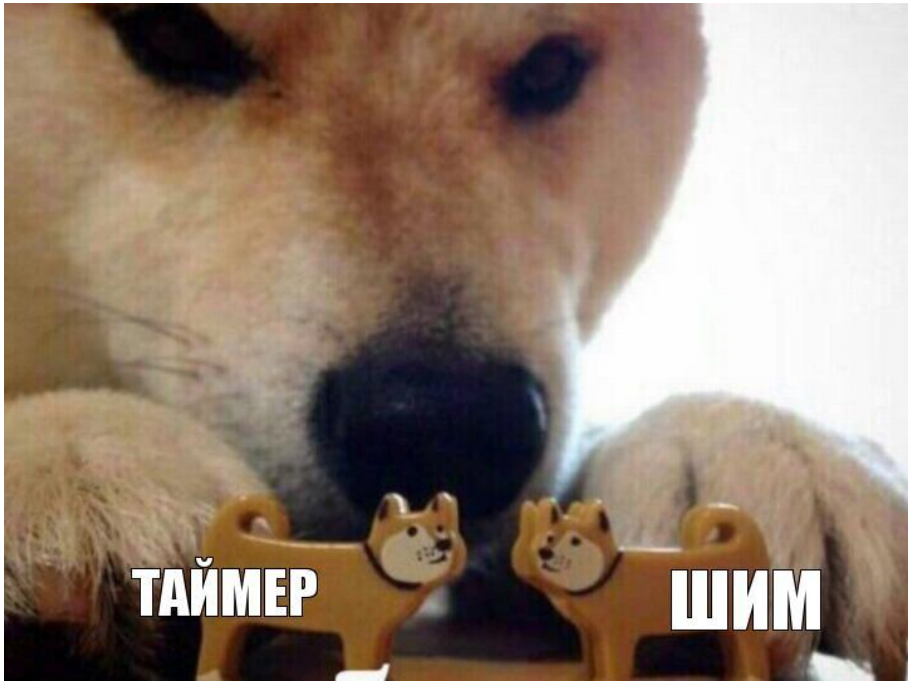
Repetition counter register



Other features to google

- Break unit
- Master/slave controller unit

For usage tutorial see my article



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Configuration sequence

1. Choose pin
2. Enable clock
3. Set pin for alternative function
4. Set up Time Base Unit
5. Set up Output Compare Unit
6. Enable Counter

QUESTIONS?