

STM32F4 Cube HAL

Tutorial-3, Timers and more on interrupts and ADC

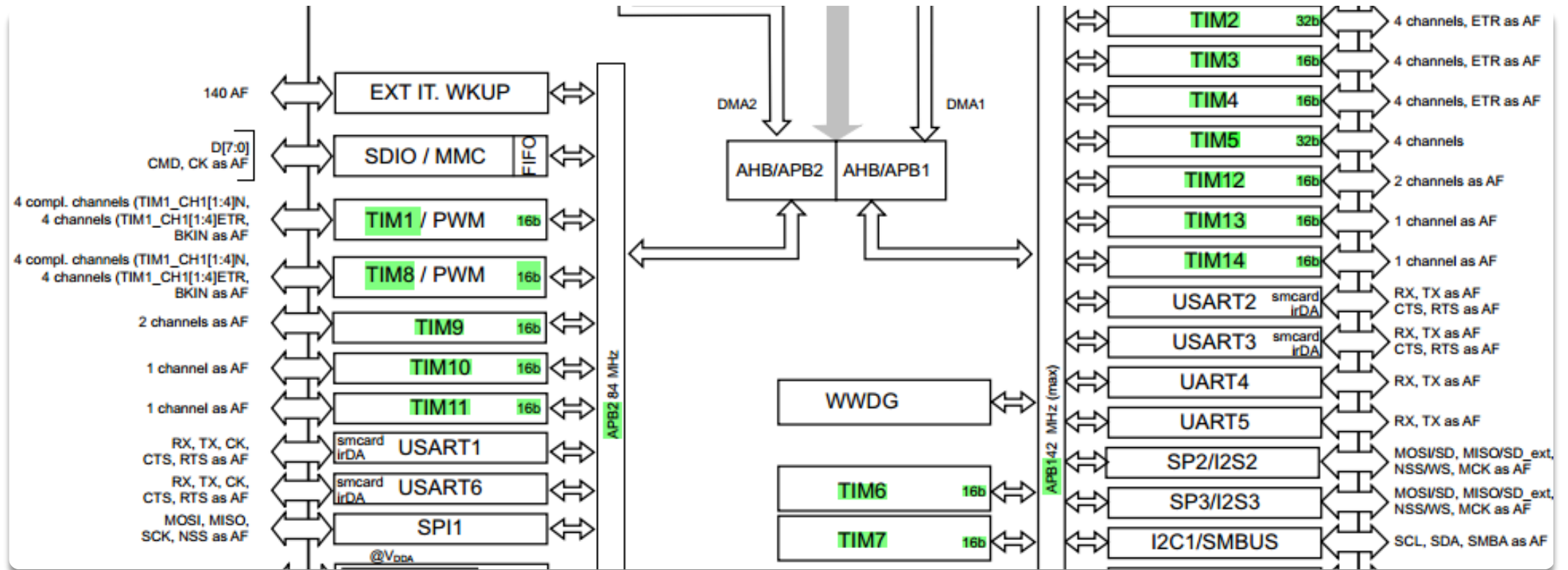
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WINTER 2018

Some notes

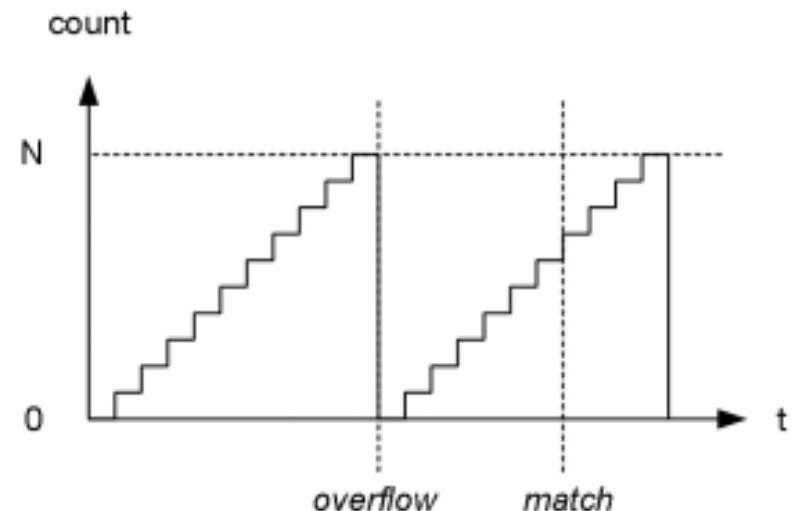
- ▶ Some parts of assignments are based on students decisions and comprehension to choose a parameter, as a real engineering work.
- ▶ When using the STM32F4 Discovery board, under **NO CIRCUMSTANCES** you are to use, configure or touch the pins **PORTA 13, PORTA 14** and **PORTB3**. Do not de-init or write to these pins.
- ▶ Why we need timers?

Peripheral Timers



How timers work

- ▶ *Desired timer Frequency* = $\frac{\text{Timer Input Frequency}}{\text{Prescaler} \times \text{Period}(N)}$.
- ▶ What is input frequency? Default is generated from the clock tree.
- ▶ Prescaler should never exceed 65536, its is a 16-bit register.
- ▶ Period could be up to $2^{16}-1$ or $2^{32}-1$, depending if it is a 16-or 32-bit timer.
- ▶ You can set another value (match) for other Purposes => such as PWM mode.



How timers work

- ▶ Timers can work in the interrupt mode same as other peripherals.
- ▶ They can be used as a trigger for other peripherals such as ADCs.
- ▶ Timers can operate as counters. **How?**
- ▶ They can generate pulses on GPIOs as well as software interrupts.

StopWatch for Timers

- ▶ If you want to use the stopwatch to measure the time of your timer interrupts, you need to do the following:
 - ▶ While in the debug mode:
 - From the menu bar => Peripherals => System Viewer => DBG
 - Now, check the box of the timer you are using.

ADC with External Trigger Source

- ▶ ADCs could work in three modes of polling, interrupt and DMA.
- ▶ These three modes are based on software calls (ADC_SOFTWARE_START) in which the user calls for a new conversion using ADC_START_XXX().
- ▶ You can use an external source such as a timer to trigger the ADC for a new conversion. **What is the advantage?**
- ▶ In this condition, the user only need to wait for the end of conversion.

What is PWM Signal

- ▶ Pulse Width Modulation (PWM) is a technique to encode a data/message into a pulse width.
- ▶ It can be used in power supplies to control the output voltage or current. Such as Buck, Boost and Buck/Boost switching power supplies.
- ▶ Similar applications: motor driver, light intensity controller, mobile/laptop charger.

Timers in PWM mode

- ▶ You can configure your timer in PWM mode, generating this pulse on a GPIO pin.
- ▶ It counts up from **0** to **Period**. Once the counter reaches a value called **Pulse**, the level of output pulse toggles.
- ▶ This change is from '1' to '0' in PWM1 mode and from '0' to '1' in PWM2.
- ▶ The counter can goes upward or downward.
- ▶ A timer might has more than one channel. The Period of channels are identical but their Pulse width can be different.