

TIM device tree configuration

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1 Article purpose

The purpose of this article is to explain how to configure the *timer (TIM)*^[1] **when the peripheral is assigned to Linux® OS:**

- Configuring the timer **peripheral** to enable PWM, trigger or quadrature encoder.
- Configuring the **board**, e.g. TIM pins.

The configuration is performed using the **device tree mechanism**^[2].

It is used by the [TIM Linux driver](#) that registers relevant information in [PWM](#) and [IIO](#) frameworks.

2 DT bindings documentation

The *TIM internal peripheral*^[1] is a multifunction device (MFD).

Each function is represented by a separate DT binding document:

- *STM32 TIM MFD device tree bindings*^[3] document deals with core resources (e.g. registers, clock, DMAs)
- *STM32 TIM PWM device tree bindings*^[4] document deals with PWM resources (e.g. PWM input/output pins)
- *STM32 TIM IIO trigger/encoder device tree bindings*^[5] document deals with other internal peripheral triggering and quadrature encoder resources

3 DT configuration

This hardware description is a combination of both STM32 microprocessor and board device tree files. Refer to [Device tree](#) for more explanations about device tree file split.

The **STM32CubeMX** can be used to generate the board device tree. Refer to [How to configure the DT using STM32CubeMX](#) for more details.

3.1 DT configuration (STM32 level)

TIM nodes are declared in `stm32mp157c.dtsi`^[6].

DT root node (e.g. `timers1...`) and **DT child nodes** describe the [TIM features](#) such as:

- PWM
- trigger and quadrature encoder

They also describe hardware parameters such as registers address, clock and DMA.

```
timers1: timer@address {
    compatible = "st,stm32-timers";           /* timer common resources */
    ...
    pwm {
        compatible = "st,stm32-pwm";        /* PWM*/
    };
    timer@0 {
        compatible = "st,stm32h7-timer-trigger"; /* trigger and quadrature enc
        reg = <0>;                             /* trigger identifier (e.g. 0
    };
};
```



This device tree part is related to STM32 microprocessors. It must be kept as is, without being modified by the end-user.

3.2 DT configuration (board level)

This part is used to configure and enable the TIM hardware used on the board:

- Enabling **DT root node** for the TIM instances in use (e.g. `timers1...`) by setting **status = "okay"**;
- Enabling **DT child node(s)** for the feature(s) in use (PWM input/output, trigger and quadrature encoder) by setting **status = "okay"**;
- Configuring pins in use via `pinctrl` through **pinctrl-0**, **pinctrl-1** and **pinctrl-names**.

3.3 DT configuration examples

3.3.1 TIM configured in PWM mode and trigger source

The example below shows how to configure **TIM1 channel 1** to act as:

- **PWM output on PE9**, e.g. TIM1_CH1 (See [pinctrl device tree configuration](#) and [GPIO internal peripheral](#))
- **trigger source** (synchronous with PWM) for other internal peripheral such as [STM32 ADC](#)

Note: The PWM output does not require any DMA channel. Disable them if they are configured by default in the .dtsi file.

```
pwm1_pins_a: pwm1-0 {
    pins {
        pinmux = <STM32_PINMUX('E', 9, AF1)>; /* select TIM1_CH1 alternate
        bias-pull-down;
        drive-push-pull;
        slew-rate = <0>;
    };
};

pwm1_sleep_pins_a: pwm1-sleep-0 {
    pins {
        pinmux = <STM32_PINMUX('E', 9, ANALOG)>; /* configure 'PE9' as analog
    };
};
```

```
&timers1 {
    status = "okay";
    /delete-property/dmas; /* spare all DMA channels sin
    /delete-property/dma-names;
    pwm {
        pinctrl-0 = <&pwm1_pins_a>; /* configure PWM on TIM1_CH1
        pinctrl-1 = <&pwm1_sleep_pins_a>;
        pinctrl-names = "default", "sleep";
        status = "okay"; /* enable PWM on TIM1 */
    };
    timer@0 {
        status = "okay"; /* enable trigger on TIM1 */
    };
};
```

3.3.2 TIM configured in PWM input capture mode

The example below shows how to configure **TIM1 channel 1** in PWM input capture mode (e.g. period and duty cycle):

- Configure **PWM input on PE9**, e.g. TIM1_CH1 (See [pinctrl device tree configuration](#) and [GPIO internal peripheral](#))

A DMA channel is required and must be configured depending on the PWM input channel:

- Select **DMA channel 1**, "ch1", to capture **PWM input channel 1 and/or 2**
- Select **DMA channel 3**, "ch3", to capture **PWM input channel 3 and/or 4**

```

pwm1_in_pins_a: pwm1-in-0 {
    pins {
        pinmux = <STM32_PINMUX('E', 9, AF1)>; /* select TIM1_CH1 alternate
        bias-disable;
    };
};

pwm1_in_sleep_pins_a: pwm1-in-sleep-0 {
    pins {
        pinmux = <STM32_PINMUX('E', 9, ANALOG)>; /* configure 'PE9' as analog
    };
};

```

```

&timers1 {
    status = "okay";
    dmas = <&dmamux1 11 0x400 0x5>; /* Enable DMA "ch1" for PWM i
    dma-names = "ch1";
    pwm {
        pinctrl-0 = <&pwm1_in_pins_a>; /* configure PWM input pins,
        pinctrl-1 = <&pwm1_in_sleep_pins_a>;
        pinctrl-names = "default", "sleep";
        status = "okay"; /* enable PWM on TIM1 */
    };
};

```

3.3.3 TIM configured as quadrature encoder interface

The example below shows how to configure **TIM1** to interface with a quadrature encoder:

- **Configure PE9 and PJ11 as encoder input pins**, e.g. TIM1_CH1, TIM1_CH2 (see [pinctrl device tree configuration](#) and [GPIO internal peripheral](#))

```

tim1_in_pins_a: tim1-in-pins-0 {
    pins {
        pinmux = <STM32_PINMUX('E', 9, AF1)>, /* TIM1_CH1 */
        <STM32_PINMUX('J', 11, AF1)>; /* TIM1_CH2 */
        bias-disable;
    };
};

tim1_in_pins_sleep_a: tim1-in-pins-sleep-0 {
    pins {
        pinmux = <STM32_PINMUX('E', 9, ANALOG)>, /* TIM1_CH1 */
        <STM32_PINMUX('J', 11, ANALOG)>; /* TIM1_CH2 */
    };
};

```

```

&timers1 {
    status = "okay";
    /delete-property/dmas; /* spare all DMA channels sin
    /delete-property/dma-names;
    timer@0 {

```

```
pinctrl-0 = <&tim1_in_pins_a>; /* configure TIM1_CH1 and TIM1_CH2 */
pinctrl-1 = <&tim1_in_pins_sleep_a>;
pinctrl-names = "default", "sleep"; /* enable Encoder interface module */
status = "okay";
};
```

4 How to configure the DT using STM32CubeMX

The [STM32CubeMX](#) tool can be used to configure the STM32MPU device and get the corresponding [platform configuration device tree](#) files.

The STM32CubeMX may not support all the properties described in the above [DT bindings documentation](#) paragraph. If so, the tool inserts **user sections** in the generated device tree. These sections can then be edited to add some properties and they are preserved from one generation to another. Refer to [STM32CubeMX](#) user manual for further information.

5 References

Please refer to the following links for additional information:

1. ↑ [1.0 1.1 TIM internal peripheral](#)
2. ↑ [Device tree](#)
3. ↑ [Documentation/devicetree/bindings/mfd/stm32-timers.txt](#) , STM32 TIM MFD device tree bindings
4. ↑ [Documentation/devicetree/bindings/pwm/pwm-stm32.txt](#) , STM32 TIM PWM device tree bindings
5. ↑ [Documentation/devicetree/bindings/iio/timer/stm32-timer-trigger.txt](#) , STM32 TIM trigger/encoder device tree bindings
6. ↑ [stm32mp157c.dtsi](#) , STM32.dtsi file