



TIM Linux driver



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1 Article purpose

This article introduces the TIM Linux[®] driver for the TIM internal peripheral^[1]:

- Which TIM features are supported by the driver
- How to configure, use and debug the driver
- What is the driver structure, and where the source code can be found.



2 Short description

The *TIM*^[1] Linux driver (kernel space) is based on the *PWM*, *IIO* and *counter* frameworks. It provides several functionalities:

MFD driver:

- handles registers, clock and DMA^[2] resources
- detects the TIM counter resolution, e.g. 16 or 32 bits.

PWM driver:

- detects the number of TIM channels.
- handles **PWM output** channels.
- handles **PWM capture** channels (input). Note that the PWM capture relies on DMA, which is handled by the MFD core.

IIO driver:

- handles hardware **trigger sources** (synchronously with PWM) for other internal peripherals such as ADC^[3], DAC^[4], DFSDM^[5].

counter driver:

- handles the **quadrature encoder** interface^[6].



3 Configuration

3.1 Kernel configuration

Activate the TIM^[1]Linux driver in the kernel configuration using the Linux Menuconfig tool: [Menuconfig](#) or [how to configure kernel](#).

Enable the following configurations (and their dependencies):

- CONFIG_MFD_STM32_TIMERS
- CONFIG_PWM_STM32
- CONFIG_IIO_STM32_TIMER_TRIGGER
- CONFIG_STM32_TIMER_CNT

```
Device Drivers --->
-> Multifunction device drivers --->
  <*> Support for STM32 Timers
-> Pulse-width modulation (PWM) support --->
  <*> STMicroelectronics STM32 PWM
-> Industrial I/O support --->
  -> Triggers - standalone --->
    <*> STM32 timer trigger
-> Counter support --->
  <*> STM32 Timer encoder counter driver
```

3.2 Device tree

Refer to the [TIM device tree configuration](#) article when configuring the TIM Linux kernel driver.



4 How to use

How to use PWM with sysfs interface

How to set up a TIM or LPTIM trigger using the sysfs interface

How to use the quadrature encoder with the sysfs interface



5 How to trace and debug

The *TIM*^[1] Linux driver can access the timer registers through REGMAP.

It comes with debugfs^[7] entries, which allow dumping registers:

```
$ cd /sys/kernel/debug/regmap
$ ls
40004000.timer  44000000.timer

$ cd 44000000.timer
$ cat registers
000: 00000081
004: 00000000
008: 00000000
00c: 00000000
...
```

It also comes with tracepoints^[8]:

```
$ cd /sys/kernel/debug/tracing
$ cat available_events | grep regmap
...
regmap:regmap_reg_read
regmap:regmap_reg_write
```



6 Source code location

The TIM Linux driver source code is composed of:

- `stm32-timers.c` MFD driver to handle common resources: registers, clock, dmas.
- `pwm-stm32.c` PWM driver to handle PWM channel(s).
- `stm32-timer-trigger.c` IIO driver to handle trigger source for other internal peripherals.
- `stm32-timer-cnt.c` counter driver to handle the quadrature encoder interface.
- `include/linux/mfd/stm32-timers.h` and `include/linux/iio/timer/stm32-timer-trigger.h` header files



7 References

- 1.01.11.21.3 TIM internal peripheral
- DMA_internal_peripheral
- ADC internal peripheral
- DAC internal peripheral
- DFSDM internal peripheral
- Incremental encoder Incremental encoder overview
- Debugfs
- Ftrace

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Multifunction device

Direct Memory Access

Pulse Width Modulation

Industrial I/O Linux® subsystem

Analog-to-digital converter. The process of converting a sampled analog signal to a digital code that represents the amplitude of the original signal sample.

Digital-to-analog converter (Electronic circuit that converts a binary number into a continuously varying value.)

Digital Filter for Sigma-Delta Modulator

Register map (Linux® registers map abstraction API)

Debug File System (See <https://en.wikipedia.org/wiki/Debugfs> for more details)