TIM Linux driver

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Contents

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 and IIO 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].
- 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

```
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
```

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 and 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

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)