ADC Linux driver

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Stable: 16.01.2020 - 15:02 / Revision: 16.01.2020 - 14:59

Contents

1 Article purpose

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

- Which ADC 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 ADC Linux® driver (kernel space) is based on the IIO framework. It supports two modes:

1. **IIO direct mode**: single capture on a channel (using interrupts)
2. **IIO triggered buffer mode**: capture on one or more channels (preferably using DMA).
   It uses the hardware triggers available in IIO. See TIM Linux driver and LPTIM Linux driver.

3 Configuration

3.1 Kernel configuration

Activate the ADC[1] Linux® driver in the kernel configuration using the Linux Menuconfig tool: Menuconfig or how to configure kernel (enable both CONFIG_STM32_ADC_CORE and CONFIG_STM32_ADC).

```
Device Drivers  --->
   <*> Industrial I/O support  --->
      Analog to digital converters  --->
         <*> STMicroelectronics STM32 adc core
         <*>   STMicroelectronics STM32 adc
```

3.2 Device tree

Refer to the ADC device tree configuration article when configuring the ADC Linux kernel driver.

4 How to use

In "**IIO direct mode**", the conversion result can be read directly from **sysfs** (refer to How to do a simple ADC conversion using the sysfs interface).

In "**IIO triggered buffer mode**", the configuration must be performed using **sysfs** first. Then, **character device** (/dev/iio: deviceX) is used to read data (refer to Convert one or more channels using triggered buffer mode).

5 How to trace and debug

Refer to How to trace with dynamic debug for how to **enable the debug logs** in the driver and in the framework.

Refer to How to debug with debugfs for how to **access the ADC registers**.

The ADC has system wide dependencies towards other key resources:

- **runtime power management** can be disabled, for example it may be forced **on** via *power/control* sysfs entry:

```
Board $> cd /sys/devices/platform/soc/48003000.adc/48003000.adc:adc@0
Board $> cat power/autosuspend_delay_ms
2000
Board $> cat power/control
auto                                    # kernel is allowed to automatically suspend
the ADC device after autosuspend_delay_ms
Board $> echo on > power/control        # force the kernel to resume the ADC device
(e.g. keep clocks and regulators enabled)
```

It might be useful to disable runtime power management, in order to dump registers by any means or to check clock and regulator usage (see example below).

- **clock**[2] usage can be verified by reading *clk_summary*:

```
Board $> cat /sys/kernel/debug/clk/clk_summary | grep adc
         adc12_k                      1        1        0    24000000          0 0
                  adc12               1        1        0   196607910          0 0
```

- **regulator**[3] tree and usage can be verified (e.g. use count, open count or regulator reference voltage) as follows:

```
Board $> cat /sys/kernel/debug/regulator/regulator_summary
 regulator                       use open bypass voltage current     min     max
---------------------------------------------------------------------------------
    v3v3                           4    5      0  3300mV     0mA  3300mV  3300mV
       vdda                        1    2      0  2900mV     0mA  2900mV  2900mV
          40017000.dac                                                0mV     0mV
          48003000.adc                                                0mV     0mV
```

- **pinctrl**[4] usage can be verified by reading *pinmux-pins*:

```
Board $> cd /sys/kernel/debug/pinctrl/soc\:pin-controller@50002000/
Board $> cat pinmux-pins | grep adc
pin 92 (PF12): device 48003000.adc function analog group PF12   # check pin is
assigned to ADC and is configured as "analog"
```

- **interrupts** can be verified by reading "interrupts":

```
Board $> cat /proc/interrupts
           CPU0       CPU1
 56:          2          0     dummy   0 Edge      48003000.adc:adc@0
```

6 Source code location

The ADC source code is composed of:

- stm32-adc-core driver to handle common resources such as clock (selection, prescaler), regulator used as reference voltage, interrupt and common registers.
- stm32-adc driver to handle the resources available for each ADC such as channel configuration and buffer handling.

7 References

- 1.01.1 ADC internal peripheral
- Clock overview
- Regulator overview
- Pinctrl overview

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.

Industrial I/O Linux subsystem

Direct Memory Access

System File System (See https://en.wikipedia.org/wiki/Sysfs for more details)