



## DAC Linux driver



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## Contents

1 Article purpose .....	2
2 Short Description .....	2
3 Configuration .....	2
<b>3.1 Kernel configuration .....</b>	<b>2</b>
<b>3.2 Device tree .....</b>	<b>3</b>
4 How to use .....	3
5 How to trace and debug .....	3
6 Source code location .....	4
7 References .....	4

## 1 Article purpose

This article introduces the Linux<sup>®</sup> driver for the DAC<sup>[1]</sup> internal peripheral:

- Which DAC 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 DAC Linux<sup>®</sup> driver (kernel space) is based on the IIO framework.

It implements the IIO **direct mode**, to perform single conversions independently on each channel.

## 3 Configuration

### 3.1 Kernel configuration

Activate the DAC<sup>[1]</sup> Linux<sup>®</sup> driver in the kernel configuration using the Linux Menuconfig tool: Menuconfig or how to configure kernel (enable CONFIG\_STM32\_DAC).

```
Device Drivers --->
  <*> Industrial I/O support --->
    Digital to analog converters --->
      <*> STMicroelectronics STM32 DAC
```

## 3.2 Device tree

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

## 4 How to use

In "IIO direct mode", conversions can be done directly via sysfs. See [How to do a simple DAC conversion using the sysfs interface](#).

## 5 How to trace and debug

Refer to [How to trace with dynamic debug](#) for how to enable debug logs in the driver and in the Framework.

Refer to [How to debug with debugfs](#) for how to access the DAC registers.

The DAC 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/40017000.dac/40017000.dac\:dac@1/
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 DAC 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**<sup>[2]</sup> usage can be verified by reading *clk\_summary*:

```
Board $> cat /sys/kernel/debug/clk/clk_summary | grep dac
dac12_k          0      0      0      32000      0 0
                 dac12      1      2      0      98303955 0 0
```

- **regulator**<sup>[3]</sup> tree and usage usage can be verified (e.g. use count, open count and 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`<sup>[4]</sup> usage can be verified by reading `pinmux-pins`:

```
Board $> cd /sys/kernel/debug/pinctrl/soc\:\:pin-controller@50002000/
Board $> cat pinmux-pins | grep dac
pin 4 (PA4): device 40017000.dac function analog group PA4
pin 5 (PA5): device 40017000.dac function analog group PA5 # check pins are assigned
to DAC and configured as "analog"
```

## 6 Source code location

The DAC source code is composed of:

- `stm32-dac-core` driver to handle common resources such as `clock` or `regulator` used as reference voltage and common registers.
- `stm32-dac` driver to handle the resources available for each DAC such as channel configuration or output buffer handling (power-down mode).

## 7 References

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

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

Industrial I/O Linux subsystem

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

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.