SigmaStar Camera PWM User Guide

Version 0.1

REVISION HISTORY

Revision No.	Description	Date
0.1	• Initial release	12/18/2019

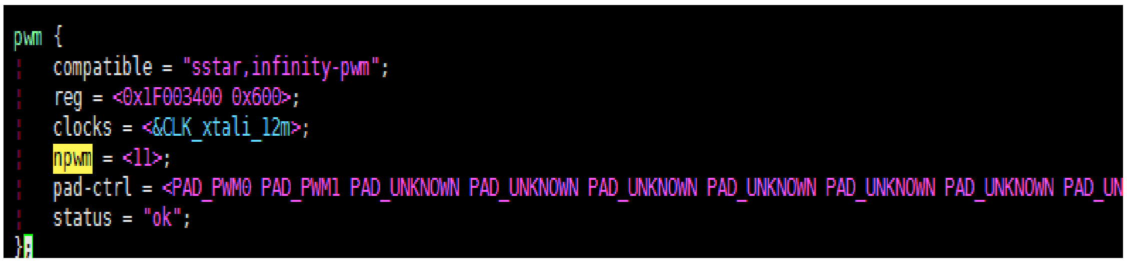
TABLE OF CONTENTS

1. PWM PARAMETERS

- Duty_cycle :
  - For example: echo 25 > duty_cycle ➔ it will generate 25% duty cycle
- Period (= "Frequency")
  - For example: echo 2000 > period ➔ it will generate 2 KHz waveform
- Polarity :
  - For example: echo inversed > polarity ➔ it will inverse output waveform. The default is normal.
- Enable/disable :
  - For example: echo 1 > enable ➔ it will enable output waveform.

2. THE PWM KERNEL SETTINGS

2.1. Setting DTS

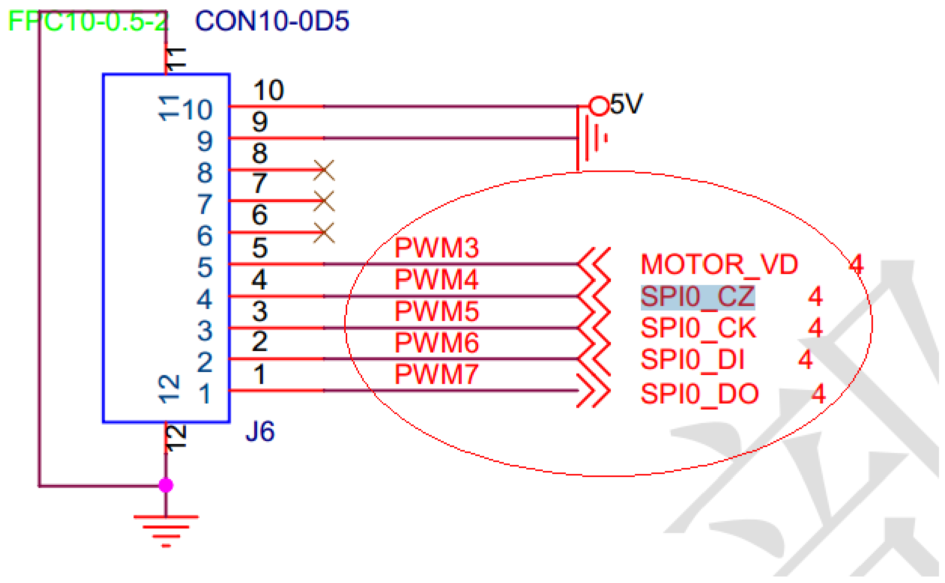


```
pwm {
    compatible = "sstar,infinity-pwm";
    reg = <0x1F003400 0x600>;
    clocks = <&CLK_xtali_12m>;
    npwm = <11>;
    pad-ctrl = <PAD_PWM0 PAD_PWM1 PAD_UNKNOWN PAD_UNKNOWN PAD_UNKNOWN PAD_UNKNOWN PAD_UNKNOWN PAD_UNKNOWN PAD_UN
    status = "ok";
};
```

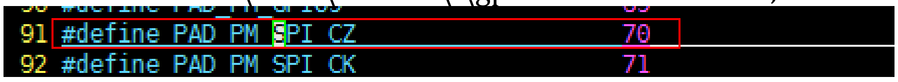
npwm=<11>; indicates there are 11 sets of pwm(s) for control;
pad-ctrl=<...>: to set pad config(s) due to GPIO sharing

- As an example above, it only set correct pads for PAD_PWM0 and PAD_PWM1. It only enable PWM0 and PWM1 among the 11 sets of pwm(s).

2.2. An Example of the Hardware Design

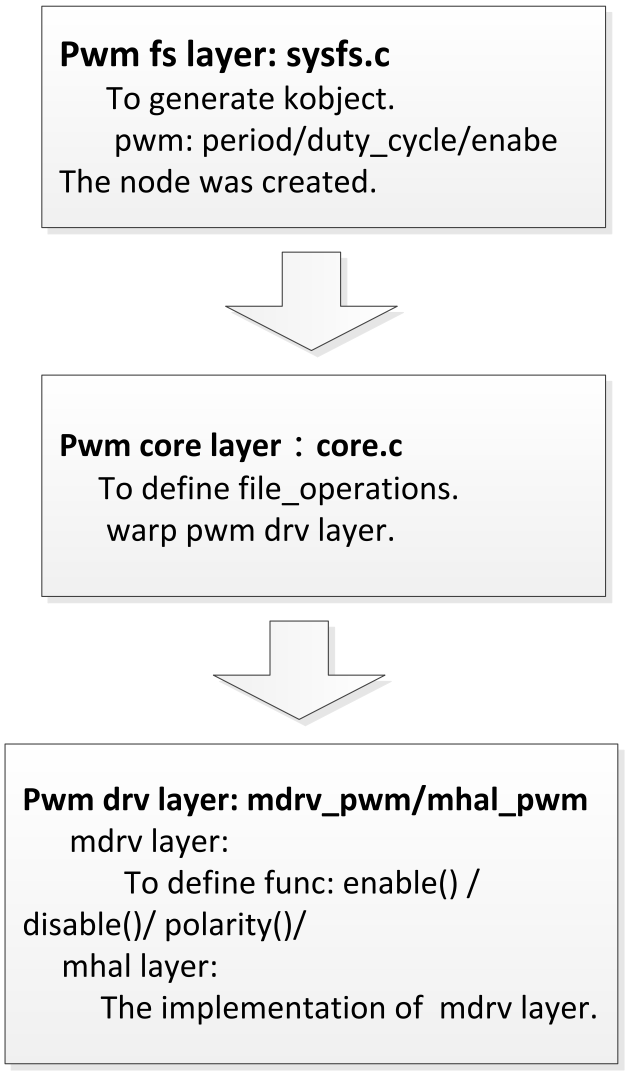


If you want to use PWM4, you need to enable it in the DTS pad-ctrl=<...> by the read pad name listed in drivers\sstar\include\ \gpio.h. From this case, it is PAD_PM_SPI_CZ.



```
#define PAD_PM_SPI_CZ              70
#define PAD_PM_SPI_CK              71
```

3. THE PWM DRIVER FRAMEWORK


Pwm fs layer: sysfs.c
To generate kobject.
pwm: period/duty_cycle/enabe
The node was created.
Pwm core layer ： core.c
To define file_operations.
warp pwm drv layer.
Pwm drv layer: mdrv_pwm/mhal_pwm
mdrv layer:
To define func: enable() / disable()/ polarity()/
mhal layer:
The implementation of mdrv layer.

4. STANDARD LINUX PWM CONTROL IN KERNEL

4.1. Controlling PWM at Console

1. Export PWM number (for example USB PAD_PWM0)
   Command:
   ```
   cd /sys/class/pwm/pwmchip0
   echo 0 > export
   ```
2. Set period (frequency) / duty_cycle / polarity / enable
   Command:
   ```
   cd pwm0
   echo xxxx > period
   ```
   In our driver implementation, xxxx indicates output frequency.
   For example, echo 2000 > period will generate 2KHz waveform.

   ```
   echo xx > duty_cycle
   ```
   For example, echo 25 > duty_cycle will generate 25% duty cycle.

   ```
   echo inversed > polarity
   ```
   Inverse output waveform, default is normal.

   ```
   echo 1 > enable
   ```
   Enable output waveform.

Operations at user mode:
Open a node;
Write a node;

4.2. 在 User mode Console 下控制 Motor

1. Motor hierarchy
   - Group 0
     - PWM 0
     - PWM 1
     - PWM 2
     - PWM 3
   - Group 1
     - PWM 4
     - PWM 5
     - PWM 6
     - PWM 7
   - Group 2
     - PWM 8
     - PWM 9
     - PWM 10

2. Cd 馬達控制路徑

   Command:

   ```
   cd /sys/devices/virtual/mstar/motor
   ```

3. Set mode/period(frequency) / Begin/End / round number/enable/hold/stop

   - mode

     Command:

     ```
     echo PWM_ID enable > group_mode
     ```

     ex : echo 0 1 > group_mode # 設定 PWM0 為馬達模式

     ex : echo 0 0 > group_mode # 取消 PWM0 為馬達模式

   - period

     Command:

     ```
     echo PWM_ID period > group_period
     ```

     In our driver implementation, xxxx indicates output frequency
     ex: echo 0 2000 > group_period # PWM0 will generate 2KHz waveform

   - begin

     Command:

     ```
     echo PWM_ID begin > group_begin
     ```

     ex: echo 0 100 > group_begin # PWM0 will generate duty_cycle starting from 100/1000 of the period

- end

Command:

```
echo PWM_ID end > group_end
```

ex: echo 0 250 > group_end # PWM0 will generate duty_cycle ending at 250/1000 of the period

- Round mode

Command:

```
echo GROUP_ID round > group_round
```

ex: echo 0 10000 > group_round # Group 0 will generate 10000 period of waveform.

If need to **continue** set a new round after last round completed, set new arguments before the end of the round, than it will continue create a new round.

```
ex: echo 0 10000 > group_round
 (During 10000 rounds)
 echo 0 2000 > group_period
     echo 0 100 > group_begin
     echo 0 250 > group_end
     echo 0 20000 > group_round   #
```

Group 0 will generate 10000 period of waveform first, and continue generate 20000 period of waveform after that.

- enable

Command:

```
echo GROUP_ID enable > group_enable
```

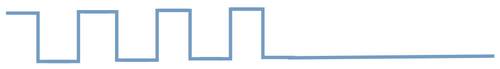
ex: echo 0 1 > group_enable # Group 0 start generating the waveform
ex: echo 0 0 > group_enable # Group 0 stop generating the waveform

- Hold mode

Command:

```
echo GROUP_ID > group_hold
```

ex: echo 0 > group_hold # Group 0 hold the last complete waveform

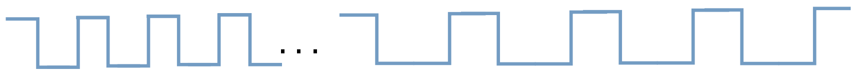


After enable, if set new arguments **before set group_hold**, it will generate new waveform rather than hold the last complete waveform.

Ex:

echo 0 1 > group_enable

echo 0 2000 > group_period
echo 0 100 > group_begin
echo 0 250 > group_end
echo 0 > group_hold



- stop

Command:

echo GROUP_ID > group_stop

ex: echo 0 > group_stop # Group 0 immediately stop the waveform