

# IDO-EVB2708-V1 Linux系统开发手册

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**IDO-EVB2708-V1**

**Linux系统开发手册**

深圳触觉智能科技有限公司

[www.industio.cn](http://www.industio.cn)

文档修订历史

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一、源码获取

百度网盘/EVB2708/Linux/软件资料/QT-SDK

二、SDK编译

推荐编译主机配置如下：

- 1. Ubuntu22.04 操作系统64位
- 2. 64 位 CPU
- 3. 16GB 物理内存+交换内存
- 4. 250GB 空闲的磁盘空间

开发环境搭建，在Ubuntu22.04上安装一些必要的开发依赖包，命令如下：

▼Shell

```
1 $ sudo apt-get update
2 $ sudo apt install -y git gnupg flex bison gperf build-essential zip curl\
3 libc6-dev libncurses5-dev:i386 x11proto-core-dev libx11-dev:i386 \
4 libreadline6-dev:i386 libgl1-mesa-glx:i386 libgl1-mesa-dev g++-multilib \
5 tofrodos python2 markdown libxml2-utils xsltproc zlib1g-dev:i386 gawk texin
fo \
6 gettext build-essential gcc libncurses5-dev bison flex zlib1g-dev gettext \
7 libssl-dev autoconf libtool linux-libc-dev:i386 wget patch dos2unix tree u-
boot-tools\
8 libelf-dev libncurses5
```

由于SDK打包后体积较大，我们在上传到百度云盘前把SDK包按照4GB大小分割了，因此下载后需要合并合并：

```
▼ Bash |
1 cat ido-evb2708_sdk_a* > ido-evb2708_sdk.tar.gz
```

解压：

```
▼ Bash |
1 tar -xvf ido-evb2708_sdk.tar.gz
```

步骤 1：进行 sdk 环境配置(目前只支持Debian和Ubuntu系统编译)

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```
1  ./build.sh config
2  =====ACTION List: mk_config ;=====
3  options :
4  All available platform:
5      0. android
6      1. linux
7  ▾ Choice [linux]: 1
8  All available linux_dev:
9      0. bsp
10     1. dragonboard
11     2. buildroot
12     3. debian
13     4. ubuntu
14 ▾ Choice [debian]: 3
15 All available kern_name:
16     0. linux-5.10
17     1. linux-5.15
18 ▾ Choice [linux-5.15]: 1
19 All available ic:
20     0. a523
21     1. a527
22     2. t527
23 ▾ Choice [t527]: 2
24 All available board:
25     0. demo_linux_aiot
26     1. demo_linux_aiot_nand
27     2. demo_linux_aiot_spinand
28 ▾ Choice [demo_linux_aiot]: 0
29 All available flash:
30     0. default
31     1. nor
32 ▾ Choice [default]: 0
33 All available rootfs files:
34     0. ido-evb2708-v1_debian.tar.gz
35     1. linaro-bullseye-gnome-arm64.tar.gz
36     2. linaro-bullseye-lite-arm64.tar.gz
37     3. linaro-bullseye-lxde-arm64.tar.gz
38     4. linaro-bullseye-xfce-arm64.tar.gz
39 ▾ Choice [ido-evb2708-v1_debian.tar.gz]: 0
40 Setup BSP files
```

步骤 2: 编译整个 SDK

```
▼ Shell |
1 ./build.sh
```

步骤 3: 打包固件

```
▼ Shell |
1 ./build.sh pack
```

固件生成路径: `out/t527_xxx.img`



### 三、uboot编译与更新

当用户开发过程中改好uboot的代码或者uboot的设备树后，可以单独编译uboot源码

```
▼ Shell |
1 ./build.sh bootloader
2 ./build.sh pack
```

uboot 更新并编译完成，然后还需要打包成 img 文件，最后才能烧写对应的分区更新到开发板（点击单或多分区下载，子选项全不勾选则会烧录uboot分区）

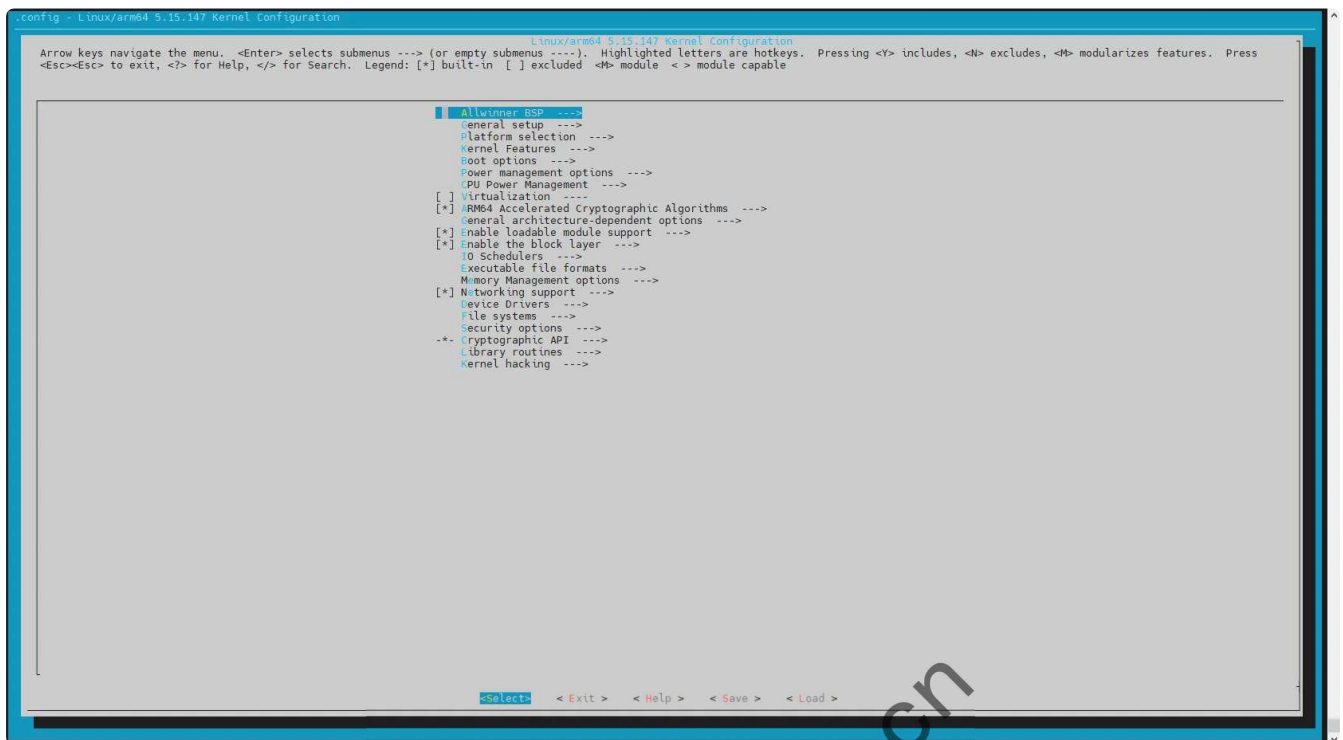


## 四、内核编译与更新

### 4.1、配置内核

执行下面命令，打开 menuconfig 配置

```
1 ./build.sh menuconfig
```



执行下面命令，保存 menuconfig 中的操作配置

```
1 ./build.sh saveconfig
```

## 4.2、单独编译kernel

当用户开发过程中改好kernel的代码或者kernel的设备树后，可以单独编译kernel源码

```
1 ./build.sh kernel
2 ./build.sh pack
```

kernel 更新并编译完成，然后还需要打包成 img 文件，最后才能烧写对应的分区更新到开发板



## 五、如何修改linux的根文件系统

步骤 1: 拷贝相应的 rootfs 文件到 sdk 目录下的 `/debian/compressed_files/` 目录下(格式是xxx.tar.gz)，如果已有相应的 rootfs，可以不用拷贝。

步骤 2: 清除sdk目录下的 `/out/t527/demo_linux_aiot/debian/rootfs_def/` 目录，

步骤 3: 执行 `./build.sh config`。若前两个步骤执行无误，则在选择 `All available rootfs files:` 配置上会多出一个 `xxx.tar.gz`，根据对应编号选择rootfs即可。



## 六、如何修改linux的dts

**注：**若根据《SDK编译》一章的默认配置进行配置，则dts在sdk中的位置如下。

### 6.1、修改uboot的dts

uboot dts位于 `<linux_top_path>/device/config/chips/t527/configs/demo_linux_aio  
t/uboot-board.dts`

### 6.2、修改kernel的dts

kernel dts位于 `<linux_top_path>/device/config/chips/t527/configs/demo_linux_aio  
t/linux-5.15/board.dts`

## 七、驱动开发

### 7.1、Display

## HDMI

公共配置: `bsp/configs/linux-5.15/sun55iw3p1.dtsi`

```

1      hdmi: hdmi@5520000 {
2          compatible = "allwinner,sunxi-hdmi";
3          reg = <0x0 0x05520000 0x0 0x100000>;
4          interrupts = <GIC_SPI 93 IRQ_TYPE_LEVEL_HIGH>;
5          clocks = <&ccu CLK_HDMI>,
6                  <&ccu CLK_HDMI_24M>,
7                  <&ccu CLK_HDMI_CEC>,
8                  <&ccu CLK_TCONTV>;
9          clock-names = "clk_hdmi",
10                      "clk_hdmi_24M",
11                      "clk_cec",
12                      "clk_tcon_tv";
13          resets = <&ccu RST_BUS_HDMI_SUB>,
14                  <&ccu RST_BUS_HDMI_MAIN>;
15          reset-names = "rst_bus_sub",
16                      "rst_bus_main";
17          assigned-clocks = <&ccu CLK_HDMI>;
18          assigned-clock-rates = <0>, <0>;
19          power-domains = <&pd1 A523_PCK_V00>;
20
21          status = "disabled";
22          ports {
23              #address-cells = <1>;
24              #size-cells = <0>;
25              hdmi_in: port@0 {
26                  #address-cells = <1>;
27                  #size-cells = <0>;
28                  reg = <0>;
29              hdmi_in_tcon2: endpoint@0 {
30                  reg = <0>;
31                  remote-endpoint = <&tcon2_
32                      out_hdmi>;
33              };
34          };
35      };
36

```

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```
1 &hdmi {
2     bldo3-supply = <&reg_bldo3>;
3     hdmi_power0 = "bldo3";
4     hdmi_power_cnt = <1>;
5
6     hdmi_hdcp1x_enable = <1>;
7     hdmi_hdcp2x_enable = <0>;
8     hdmi_cec_enable = <0>;
9
10    inno_phy = <
11        25000 165000 0x01000102 0x1c1c1c1c 0x00000000 0x00000000
12        165000 340000 0x01040506 0x1c1c1c1c 0x00000000 0x03030300
13        340000 600000 0x010f0f0f 0x1c1c1c1c 0x00000000 0x00000000
14    >;
15    status = "okay";
16 };
```

## eDP

公共配置: bsp/configs/linux-5.15/sun55iw3p1.dtsi

```

1  drm_edp: drm_edp@5720000 {
2      compatible = "allwinner,drm-edp";
3      reg = <0x0 0x05720000 0x0 0x4000>;
4      interrupts = <GIC_SPI 144 IRQ_TYPE_LEVEL_HIGH>;
5      power-domains = <&pd1 A523_PCK_V00>;
6      clocks = <&ccu CLK_BUS_EDP>,
7              <&ccu CLK_EDP>,
8              <&ccu CLK_HDMI_24M>;
9      clock-names = "clk_bus_edp", "clk_edp", "clk_24m_e
dp";
10
11      resets = <&ccu RST_BUS_EDP>;
12      reset-names = "rst_bus_edp";
13
14      assigned-clocks = <&ccu CLK_EDP>;
15      assigned-clock-parents = <&ccu CLK_PLL_VIDE01_4X>;
16      status = "disabled";
17      ports {
18          #address-cells = <1>;
19          #size-cells = <0>;
20          edp_in: port@0 {
21              #address-cells = <1>;
22              #size-cells = <0>;
23              reg = <0>;
24              edp_in_tcon3: endpoint@0 {
25                  reg = <0>;
26                  remote-endpoint = <&tcon3_
out_edp>;
27              };
28          };
29          edp_out: port@1 {
30              #address-cells = <1>;
31              #size-cells = <0>;
32              reg = <1>;
33          };
34      };
35  };

```

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```

1  edp_panel: edp_panel {
2      compatible = "edp-general-panel";
3      status = "disabled";
4      //enable0-gpios = <&pio PD 20 GPIO_ACTIVE_HIGH>;
5      power0-supply = <&reg_dcdc4>;
6      backlight = <&edp_panel_backlight>;
7      panel-timing {
8          clock-frequency = <154577920>; /* pixel clock */
9          hactive = <1920>;
10         hback-porch = <120>;
11         hfront-porch = <88>;
12         hsync-len = <32>;
13         vactive = <1080>;
14         vback-porch = <71>;
15         vfront-porch = <28>;
16         vsync-len = <5>;
17         /* hor_sync_polarity */
18         hsync-active = <1>;
19         /* ver_sync_polarity */
20         vsync-active = <1>;
21     };
22     ports {
23         #address-cells = <1>;
24         #size-cells = <0>;
25         panel_in: port@0 {
26             #address-cells = <1>;
27             #size-cells = <0>;
28             reg = <0>;
29             edp_panel_in: endpoint@0 {
30                 reg = <0>;
31                 remote-endpoint = <&edp_panel_out
32             };
33         };
34     };
35 };
36
37 &drm_edp {
38     status = "disabled";
39
40     edp_colordepth = <8>; /* 6/8/10/12/16 */
41     edp_color_fmt = <0>; /* 0:RGB 1: YUV444 2: YUV422 */
42
43     vcc-edp-supply = <&reg_blldo3>;
44     vdd-edp-supply = <&reg_dcdc2>;

```

```

45     ports {
46         edp_out: port@1 {
47             #address-cells = <1>;
48             #size-cells = <0>;
49             reg = <1>;
50             edp_panel_out: endpoint@0 {
51                 reg = <0>;
52                 remote-endpoint = <&edp_panel_in>;
53             };
54         };
55     };
56 };
57

```

## MIPI

公共配置: `bsp/configs/linux-5.15/sun55iw3p1.dtsi`

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```

1      dsi1: dsi1@5508000 {
2          compatible = "allwinner,dsi1";
3          reg = <0x0 0x05508000 0x0 0xfff>;
4          interrupts = <GIC_SPI 95 IRQ_TYPE_LEVEL_HIGH>;
5          clocks = <&ccu CLK_DSI1>,
6                  <&ccu CLK_BUS_DSI1>,
7                  <&dsi1combophy CLK_DSI_HS>,
8                  <&dsi1combophy CLK_DSI_LS>;
9          clock-names = "dsi_clk",
10                       "dsi_gating_clk",
11                       "displl_hs",
12                       "displl_ls";
13          resets = <&ccu RST_BUS_DSI1>;
14          reset-names = "dsi_rst_clk";
15          assigned-clocks = <&ccu CLK_DSI1>;
16          assigned-clock-parents = <&ccu CLK_PLL_PERI0_150M
>;
17          phys = <&dsi1combophy>;
18          phy-names = "combophy";
19          status = "disabled";
20          ports {
21              #address-cells = <1>;
22              #size-cells = <0>;
23              dsi1_in: port@0 {
24                  reg = <0>;
25                  #address-cells = <1>;
26                  #size-cells = <0>;
27                  dsi1_in_tcon1: endpoint@0 {
28                      reg = <0>;
29                      remote-endpoint = <&tcon1_
out_dsi1>;
30                      };
31                  dsi1_in_tcon0: endpoint@1 {
32                      reg = <1>;
33                      remote-endpoint = <&tcon0_
out_dsi1>;
34                      };
35              };
36          };
37      };

```

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```

1 // 设置屏幕上的背光
2 backlight1: backlight1 {
3     compatible = "pwm-backlight";
4     status = "okay";
5     brightness-levels = <
6         0 1 2 3 4 5 6 7
7         .....
8         248 249 250 251 252 253 254 255>;
9     // 设置背光初始值
10    default-brightness-level = <200>;
11    pwms = <&pwm0 2 5000000 0>;
12 };
13
14 &dsi1 {
15     status = "okay";
16     pinctrl-names = "active", "sleep";
17     pinctrl-0 = <&dsi1_4lane_pins_a>;
18     pinctrl-1 = <&dsi1_4lane_pins_b>;
19     ports {
20         dsi1_out: port@1 {
21             reg = <1>;
22             dsi1_out_panel: endpoint@0 {
23                 reg = <0>;
24                 remote-endpoint = <&mipi_panel_in_dsi1>;
25             };
26         };
27     };
28     panel: panel@0 {
29         compatible = "allwinner,virtual-panel";
30         status = "okay";
31         reg = <0>;
32         power0-supply = <&reg_clldo4>;
33         power1-supply = <&reg_clldo1>;
34
35         reset-gpios = <&pio PB 3 GPIO_ACTIVE_HIGH>; //reset
36         dsi,flags = <MIPI_DSI_MODE_VIDEO>;
37         dsi,lanes = <4>;
38         dsi,format = <0>;
39         backlight = <&backlight1>;
40         panel-init-sequence = [
41             05 78 01 11
42             05 14 01 29
43         ];
44
45         panel-exit-sequence = [

```

```

46             05 00 01 28
47             05 78 01 10
48         };
49     };
50     display-timings {
51         native-mode = <&mipi_timing0>;
52         mipi_timing0:timing0 {
53             clock-frequency = <156408000>; /* pixel cl
54             hback-porch = <50>;
55             hactive = <1200>;
56             hfront-porch = <70>;
57             hsync-len = <10>;
58             vback-porch = <20>;
59             vactive = <1920>;
60             vfront-porch = <16>;
61             vsync-len = <4>;
62             // unused now
63             /*
64             hsync-active = <0>;
65             vsync-active = <0>;
66             de-active = <1>;
67             pixelclk-active = <1>;
68             */
69         };
70     };
71     ports {
72         mipi_panel_in_dsi1: endpoint@0 {
73             reg = <0>;
74             remote-endpoint = <&dsil_out_panel>;
75         };
76     };
77 };
78

```

## LVDS

公共配置: `bsp/configs/linux-5.15/sun55iw3p1.dtsi`

```

1  lvds0: lvds0@0001000 {
2      compatible = "allwinner,lvds0";
3      clocks = <&dsi0combophy CLK_LVDS_OR_RGB>;
4      clock-names = "lvds_pclk";
5      resets = <&ccu RST_BUS_LVDS0>;
6      reset-names = "rst_bus_lvds";
7      phys = <&dsi0combophy>, <&dsi1combophy>;
8      phy-names = "combophy0", "combophy1";
9      status = "disabled";
10
11     ports {
12         #address-cells = <1>;
13         #size-cells = <0>;
14         lvds0_in: port@0 {
15             #address-cells = <1>;
16             #size-cells = <0>;
17             reg = <0>;
18             lvds0_in_tcon0: endpoint@0 {
19                 reg = <0>;
20                 remote-endpoint = <&tcon0_
21 out_lvds0>;
22             };
23         };
24     };
25

```

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```
1
2     lvds_panel: lvds_panel@0 {
3         compatible = "sunxi-lvds";
4         status = "okay";
5         reg = <0>;
6         power0-supply = <&reg_bldo3>;
7         power1-supply = <&reg_dcdc4>;
8         power2-supply = <&reg_dcdc2>;
9         enable-gpios = <&pio PD 20 GPIO_ACTIVE_HIGH>;
10        backlight = <&backlight0>;
11        bus-format = <MEDIA_BUS_FMT_RGB888_1X7X4_SPWG>;
12
13        //power-delay-ms = <50>;
14
15        display-timings {
16            native-mode = <&lvds_timing1>;
17            lvds_timing0: timing0 {
18                clock-frequency = <74871600>;
19                hback-porch = <70>;
20                hactive = <1280>;
21                hfront-porch = <83>;
22                hsync-len = <18>;
23                vback-porch = <13>;
24                vactive = <800>;
25                vfront-porch = <37>;
26                vsync-len = <10>;
27            };
28            lvds_timing1: timing1 {
29                clock-frequency = <148500000>;
30                hback-porch = <88>;
31                hactive = <1920>;
32                hfront-porch = <132>;
33                hsync-len = <60>;
34                vback-porch = <9>;
35                vactive = <1080>;
36                vfront-porch = <4>;
37                vsync-len = <32>;
38            };
39        };
40        port {
41            lvds_panel_in: endpoint {
42                remote-endpoint = <&lvds_panel_out>;
43            };
44        };
45    };
```

```

46
47 &lvds0 {
48     status = "okay";
49
50     /*
51     *     if == 1 : lvds0+1
52     *     if == 0 : lvds0
53     */
54     #if 1
55
56     dual-channel = <0>;
57     pinctrl-0 = <&lvds0_pins_a>, <&lvds1_pins_a>;
58     pinctrl-1 = <&lvds0_pins_b>, <&lvds1_pins_b>;
59
60     #else
61
62     dual-channel = <0>;
63     pinctrl-0 = <&lvds0_pins_a>;
64     pinctrl-1 = <&lvds0_pins_b>;
65
66     #endif
67
68     pinctrl-names = "active", "sleep";
69     ports {
70         port@1 {
71             reg = <1>;
72             lvds_panel_out: endpoint@0 {
73                 reg = <0>;
74                 remote-endpoint = <&lvds_panel_in>;
75             };
76         };
77     };
78 };

```

## 7.2、DI/DO

Linux SDK中DTS配置参考：[device/config/chips/t527/configs/demo\\_linux\\_aiot/linux-5.15/board.dts](#)

```
1  ido_dido: ido-dido {  
2      compatible="ido,di-do";  
3      gpio-di0 = <&pio PI 13 GPIO_ACTIVE_HIGH>;  
4      gpio-di1 = <&pio PI 14 GPIO_ACTIVE_HIGH>;  
5  
6      gpio-do0 = <&pio PB 6 GPIO_ACTIVE_HIGH>;  
7      gpio-do1 = <&pio PI 8 GPIO_ACTIVE_HIGH>;  
8      status = "okay";  
9  };
```

驱动参考: `bsp/drivers/misc/ido_dido.c`

## 7.3、Can

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```
1  awlink0: awlink@0x0{  
2      #address-cells = <1>;  
3      #size-cells = <0>;  
4      compatible = "allwinner,t527-awlink";  
5      device_type = "awlink0";  
6      awlink-pin = <1>;  
7      id = <0>;  
8      status = "okay";  
9  };  
10  
11 awlink1: awlink@0x1{  
12     #address-cells = <1>;  
13     #size-cells = <0>;  
14     compatible = "allwinner,t527-awlink";  
15     device_type = "awlink1";  
16     awlink-pin = <0>;  
17     id = <1>;  
18     status = "okay";  
19 };
```

## 7.4、Uart

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```
1  /* uart/232/485 */
2
3  &uart3 { /* rs485配置 */
4      pinctrl-names = "default", "sleep";
5      pinctrl-0 = <&uart3_pins_a>;
6      pinctrl-1 = <&uart3_pins_b>;
7      sunxi,uart-rs485 = <1>;
8      sunxi,uart-485fl = <0>;
9      sunxi,uart-485oe-gpios = <&pio PI 10 GPIO_ACTIVE_HIGH>;
10     status = "okay";
11 };
12
13 &uart4 { /* rs232配置 */
14     pinctrl-names = "default", "sleep";
15     pinctrl-0 = <&uart4_pins_a>;
16     pinctrl-1 = <&uart4_pins_b>;
17     status = "okay";
18 };
```

## 7.5、GPIO

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

全志的GPIO号在 `bsp/include/sunxi-gpio.h` 中定义

```

1  leds {
2      compatible = "gpio-leds";
3      pinctrl-names = "default", "sleep";
4      status = "okay";
5      myled {
6          label = "myled";
7          /* GPIO号计算方法:
8           * PH 13 = 32 * (8 - 1) + 13 = 237
9           * H 为字母表第8个字母, 所以PH为 32 * (8 - 1)
10          * 所以下节点的定义为: 使能gpio237为高电平
11          */
12          gpios = <&pio PH 13 GPIO_ACTIVE_HIGH>;
13          default-state = "on";
14      };
15 };
16

```

## 7.6、PCIe

Linux SDK中的DTS配置参考: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```

1  &pcie {
2      reset-gpios = <&pio PH 11 GPIO_ACTIVE_HIGH>;
3      wake-gpios = <&pio PH 12 GPIO_ACTIVE_HIGH>;
4      pcie1v8-supply = <&reg_bldo3>;
5      pcie3v3-supply = <&reg_dcdc4>;
6      status = "okay";
7  };

```

## 7.7、RTC

EVB2708-V1开发板采用HYM8563作为RTC (Real Time Clock)

HYM8563是一款低功耗CMOS实时时钟/日历芯片, 它提供一个可编程的时钟输出, 一个中断输出和一个掉电检测器, 所有的地址和数据都通过I2C总线接口串行传递。最大总线速度为400Kbits/s, 每次读写

数据后，内嵌的字地址寄存器会自动递增。

Linux SDK中的DTS配置参考：[device/config/chips/t527/configs/demo\\_linux\\_aiot/linux-5.15/board.dts](#)

▼ Shell

```
1 &twi5 {
2     clock-frequency = <400000>;
3     pinctrl-0 = <&twi5_pins_default>;
4     pinctrl-1 = <&twi5_pins_sleep>;
5     pinctrl-names = "default", "sleep";
6     twi_drv_used = <1>;
7     twi-supply = <&reg_dcdc4>;
8     status = "okay";
9
10     hym8563: hym8563@51 {
11         compatible = "haoyu,hym8563";
12         reg = <0x51>;
13         #clock-cells = <0>;
14         clock-frequency = <32768>;
15         clock-output-names = "hym8563";
16         pinctrl-names = "default";
17         status = "okay";
18     };
19 };
```

驱动参考：[kernel/linux-5.15/drivers/rtc/rtc-hym8563.c](#)

## 7.8、Ethernet

公共配置：[bsp/configs/linux-5.15/sun55iw3p1.dtsi](#)

```

1  mdio0: mdio0@4500048 {
2      compatible = "allwinner,sunxi-mdio";
3      #address-cells = <1>;
4      #size-cells = <0>;
5      reg = <0x0 0x04500048 0x0 0x8>;
6      status = "disabled";
7  gmac0_phy0: ethernet-phy@1 {
8      /* RTL8211F (0x001cc916) */
9      reg = <1>;
10     max-speed = <1000>; /* Max speed capabili
11 ty */
12     reset-gpios = <&pio PH 19 GPIO_ACTIVE_LOW
13 >;
14     /* PHY datasheet rst time */
15     reset-assert-us = <10000>;
16     reset-deassert-us = <150000>;
17 };
18 gmac0: gmac0@4500000 {
19     compatible = "allwinner,sunxi-gmac";
20     reg = <0x0 0x04500000 0x0 0x10000>,
21         <0x0 0x03000030 0x0 0x4>;
22     interrupts = <GIC_SPI 46 IRQ_TYPE_LEVEL_HIGH>;
23     interrupt-names = "gmacirq";
24     clocks = <&ccu CLK_GMAC0>, <&ccu CLK_GMAC0_25M>;
25     clock-names = "gmac", "phy25m";
26     resets = <&ccu RST_BUS_GMAC0>;
27     phy-handle = <&gmac0_phy0>;
28     status = "disabled";
29 };
30
31 gmac1: ethernet@4510000 {
32     compatible = "allwinner,sunxi-gmac-200", "snps,dwm
33 ac-4.20a";
34     reg = <0x0 0x04510000 0x0 0x10000>,
35         <0x0 0x03000034 0x0 0x4>;
36     interrupts = <GIC_SPI 47 IRQ_TYPE_LEVEL_HIGH>;
37     interrupt-names = "macirq";
38     clocks = <&ccu CLK_GMAC1>, <&ccu CLK_GMAC1_MBUS_GA
39 TE>, <&ccu CLK_GMAC1_25M>;
40     clock-names = "stmmaceth", "pclk", "phy25m";
41     resets = <&ccu RST_BUS_GMAC1>;
42     reset-names = "stmmaceth";
43     phy-handle = <&gmac1_phy0>;

```

```

42 power-domains = <&pd1 A523_PCK_V01>;
43 status = "disabled";
44
45
46 snps,fixed-burst;
47
48 snps,axi-config = <&gmac1_stmmac_axi_setup>;
49 snps,mtl-rx-config = <&gmac1_mtl_rx_setup>;
50 snps,mtl-tx-config = <&gmac1_mtl_tx_setup>;
51
52 gmac1_stmmac_axi_setup: stmmac-axi-config {
53     snps,wr_osr_lmt = <0xf>;
54     snps,rd_osr_lmt = <0xf>;
55     snps,blen = <256 128 64 32 16 8 4>;
56 };
57
58 gmac1_mtl_rx_setup: rx-queues-config {
59     snps,rx-queues-to-use = <1>;
60     queue0 {};
61 };
62
63 gmac1_mtl_tx_setup: tx-queues-config {
64     snps,tx-queues-to-use = <1>;
65     queue0 {};
66 };
67
68 mdio1: mdio1@1 {
69     compatible = "snps,dwmac-mdio";
70     #address-cells = <1>;
71     #size-cells = <0>;
72     gmac1_phy0: ethernet-phy@1 {
73         compatible = "ethernet-phy-ieee80
74 2.3-c22";
75         reg = <0x1>;
76         max-speed = <1000>; /* Max speed
77 capability */
78         reset-gpios = <&pio PJ 27 GPIO_ACT
79 IVE_LOW>;
80         /* PHY datasheet rst time */
81         reset-assert-us = <10000>;
82         reset-deassert-us = <150000>;
83     };
84 };

```

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```
1 &mdio0 {
2     status = "okay";
3     gmac0_phy0: ethernet-phy@1 {
4         reset-gpios = <&pio PH 8 GPIO_ACTIVE_LOW>;
5     };
6 };
7
8 &gmac0 {
9     phy-mode = "rgmii";
10    pinctrl-names = "default", "sleep";
11    pinctrl-0 = <&gmac0_pins_default>;
12    pinctrl-1 = <&gmac0_pins_sleep>;
13    sunxi,phy-clk-type = <0>;
14    tx-delay = <2>;
15    rx-delay = <13>;
16
17    gmac3v3-supply = <&reg_cldo3>;
18    status = "okay";
19 };
20
21
22 &gmac1 {
23     phy-mode = "rgmii";
24     pinctrl-names = "default", "sleep";
25     pinctrl-0 = <&gmac1_pins_default>;
26     pinctrl-1 = <&gmac1_pins_sleep>;
27     aw,soc-phy25m;
28     tx-delay = <2>;
29     rx-delay = <13>;
30     dwmac3v3-supply = <&reg_cldo3>;
31     status = "okay";
32     mdio1: mdio1@1 {
33         gmac1_phy0: ethernet-phy@1 {
34             reset-gpios = <&pio PJ 10 GPIO_ACTIVE_LOW>;
35         };
36     };
37
38 };
39
```

## 7.9、i2c

全志公司的 twi 总线兼容 i2c 总线协议，是一种简单、双向二线制同步串行总线。它只需要两根线即可在连接于总线上的器件之间传送信息。TWI 控制器支持的标准通信速率为 100kbps，最高通信速率可以达到 400kbps。全志的 twi 控制器支持以下功能：

- 支持主机模式和从机模式；
- 主机模式下支持dma传输；
- 主机模式下在多个 主机模式下的总线仲裁；
- 主机模式下支持时钟同步，位和字节等待；
- 从机模式下支持地址检测中断；
- 支持7bit从机地址和10bit从机地址；
- 支持常规的i2c协议模式和自定义传输模式。

sunxi 平台支持多路 TWI，包含 TWI 与 S\_TWI。

公共配置： `bsp/configs/linux-5.15/sun55iw3p1.dtsi`

```
1 twi0: twi@5002000 {
2     #address-cells = <1>;
3     #size-cells = <0>;
4     compatible = "allwinner,sun50i-twi"; /* 具体的设备，用于驱动和设备的绑定 */
5     device_type = "twi0"; /* 设备节点名称，用于sys_config.fex匹配 */
6     reg = <0x0 0x02502000 0x0 0x3ff>; /* 设备使用的地址 */
7     interrupts = <GIC_SPI 10 IRQ_TYPE_LEVEL_HIGH>; /* 设备使用的中断：中断号、中
    断类型 */
8     clocks = <&ccu CLK_TWI0>, <&ccu CLK_APB1>; /* 设备使用的时钟 */
9     clock-names = "bus", "apb"; /* 使用的时钟名 */
10    resets = <&ccu RST_BUS_TWI0>; /* 设备使用的复位时钟 */
11    dmas = <&dma 43>, <&dma 43>; /* 设备使用的dma通道号 */
12    dma-names = "tx", "rx"; /* 设备使用的dma通道名 */
13    status = "disabled"; /* 设备是否使用， dtsi中设为disabled，在board.dts中设置
    */
14 }
```

为了在 TWI 总线驱动代码中区分每一个 TWI 控制器，需要在 Device Tree 中的 aliases 节点中为每一个 TWI 节点指定别名：

```

1 aliases {
2     twi0 = &twi0;
3     twi1 = &twi1;
4     twi2 = &twi2;
5     twi3 = &twi3;
6     ...
7 }

```

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

别名形式为字符串“twi”加连续编号的数字，在 TWI 总线驱动程序中可以通过 `of_alias_get_id()` 函数获取对应 TWI 控制器的数字编号，从而区别每一个 TWI 控制器。

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```

1 &twi0 {
2     clock-frequency = <400000>; /* TWI控制器的时钟频率 */
3     pinctrl-names = "default", "sleep"; /* 设备使用的pin脚名称 */
4     pinctrl-0 = <&twi0_pins_default>; /* 设备使用的pin脚配置 (default) */
5     pinctrl-1 = <&twi0_pins_sleep>; /* 设备使用的pin脚配置 (sleep) */
6     twi_drv_used = <1>; /* 是否启用drv模式传输数据: 0-engine模式, 1-drv模式 */
7     twi-supply = <&reg_dcdc1>; /* regulator相关配置 */
8     status = "okay"; /* 设备是否使用 */
9     eeprom@50 { /* eeprom从设备 */
10         compatible = "atmel,24c16"; /* eeprom从设备对应的设备驱动compatible, 用于
            驱动和设备的绑定 */
11         reg = <0x50>; /* eeprom从设备地址为0x50 */
12         status = "disabled"; /* eeprom从设备status */
13     };
14 }

```

其中，TWI 速率由“clock-frequency”属性配置，最大支持 400K。

对于 twi0 中引用的 pin 口，具体的配置如下：

```

1 twi0_pins_a: twi0@0 {
2     pins = "PB0", "PB1"; /* 使用的引脚 */
3     function = "twi0"; /* 引脚功能 */
4     drive-strength = <10>; /* 引脚配置 */
5     bias-pull-up;
6 };
7 twi0_pins_b: twi0@1 {
8     pins = "PB0", "PB1"; /* 使用的引脚 */
9     function = "gpio_in"; /* 引脚功能 */
10 };

```

## 7.10、SPI

在不同的 SUNXI 硬件平台中，SPI 控制器的数目也不同，但对于每一个 SPI 控制器来说，在设备树中配置参数相似，平台设备树文件的路径为：bsp/configs/内核版本/CHIP.dtsi(CHIP 为研发代号，如 sun55iw3p1 等)：

公共配置：bsp/configs/linux-5.15/sun55iw3p1.dtsi

```

1 spi0: spi@4025000 {
2     #address-cells = <1>;
3     #size-cells = <0>;
4     compatible = "allwinner,sunxi-spi-v1.3"; // 具体的设备，用于驱动和设备的绑定
5     reg = <0x0 0x04025000 0x0 0x1000>; // 模块寄存器地址
6     interrupts = <GIC_SPI 16 IRQ_TYPE_LEVEL_HIGH>; // 总线中断号、中断类型
7     clocks = <&ccu CLK_PLL_PERI0_300M>, <&ccu CLK_SPI0>, <&ccu CLK_BUS_SPI0>;
8     // 设备使用的时钟
9     clock-names = "pll", "mod", "bus"; // 设备使用的时钟名称
10    resets = <&ccu RST_BUS_SPI0>; // 设备的reset时钟
11    dmas = <&dma 22>, <&dma 22>; // 控制器使用的dma通道号
12    dma-names = "tx", "rx"; // 控制器使用通道号对应的名字
13    clock-frequency = <100000000>; // 控制器支持的最大时钟频率（通常为100MHz）
14    sunxi,spi-num-cs = <1>; // 控制器支持的最大片选数量（一般CS0默认引出，CS1~3根据I
15    C平台决定）
16    status = "disabled"; // 控制器是否使能
17 };

```

为了在 SPI 总线驱动代码中区分每一个 SPI 控制器，需要在设备树中为每个 SPI 控制器指定别名：

```
1 aliases {
2     .....
3     spi0 = &spi0;
4     .....
5 }
```

别名形式为字符串“spi”加连续编号的数字，在 SPI 总线驱动程序中可以通过of\_alias\_get\_id函数获取对应 SPI 控制器的数字编号，从而区别每一个 SPI 控制器。

板级配置：`device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

引脚 PINMUX 配置

```
1 spi0_pins_default: spi0@0 {
2     pins = "PC12", "PC2", "PC4"; /* clk, mosi, miso */
3     function = "spi0";
4     drive-strength = <10>;
5 };
6 spi0_pins_cs: spi0@1 {
7     pins = "PC3";
8     function = "spi0";
9     drive-strength = <10>;
10    bias-pull-up; /* cs, hold, wp should be pulled up */
11 };
12 spi0_pins_sleep: spi0@2 {
13     pins = "PC12", "PC2", "PC4", "PC3";
14     function = "gpio_in";
15     drive-strength = <10>;
16 }
```

```
1 &spi0 {
2     pinctrl-0 = <&spi0_pins_default &spi0_pins_cs>;
3     pinctrl-1 = <&spi0_pins_sleep>;
4     pinctrl-names = "default", "sleep";
5     sunxi,spi-bus-mode = <SUNXI_SPI_BUS_MASTER>;
6     sunxi,spi-cs-mode = <SUNXI_SPI_CS_AUTO>;
7     status = "okay";
8 }
```

- sunxi,spi-num-cs: 定义该 SPI 控制器最多支持多少个片选。
- sunxi,spi-bus-mode: 定义 SPI 控制器所处的状态, 可配置为如下几种模式。
  - SUNXI\_SPI\_BUS\_MASTER: 处于 Master 模式, 外接 SPI Device。
  - SUNXI\_SPI\_BUS\_SLAVE: 处于 Slave 模式, 被其他 Master 访问。
  - SUNXI\_SPI\_BUS\_DBI: 处于 DBI 模式, 外接 DBI 屏幕。
  - SUNXI\_SPI\_BUS\_BIT: 处于 BIT 模式, 使用 3Wire 方式进行数据传输。
  - SUNXI\_SPI\_BUS\_NOR: 处于 NOR 模式, 用于外接 SPI Nor Flash 的情况。
  - SUNXI\_SPI\_BUS\_NAND: 处于 NAND 模式, 用于外接 SPI Nand Flash 的情况。
  - SUNXI\_SPI\_BUS\_CAMERA: 处于 CAMERA 模式, 用于外接 SPI Camera 的情况。
- sunxi,spi-cs-mode: 定义 SPI 控制器对片选的控制方式, 可配置为如下几种模式。
  - SUNXI\_SPI\_CS\_AUTO: 硬件自动控制, 不需要驱动或软件介入。
  - SUNXI\_SPI\_CS\_SOFT: 软件手动控制, 由驱动完成相关操作。

## 7.11、PWM

公共配置: `bsp/configs/linux-5.15/sun55iw3p1.dtsi`

以 pwm0 控制器为例, 其配置方法如下:

```

1      pwm0: pwm0@2000c00 {
2          #pwm-cells = <0x3>;
3          compatible = "allwinner,sunxi-pwm-v201";
4          reg = <0x0 0x02000c00 0x0 0x400>;
5          clocks = <&ccu CLK_PWM>;
6          interrupts = <GIC_SPI 19 IRQ_TYPE_LEVEL_HIGH>;
7          resets = <&ccu RST_BUS_PWM>;
8          pwm-number = <16>;
9          pwm-base = <0x0>;
10         sunxi-pwms = <&pwm0_0>, <&pwm0_1>, <&pwm0_2>, <&p
wm0_3>, <&pwm0_4>,
11         <&pwm0_5>, <&pwm0_6>, <&pwm0_7>, <&pwm0_8>, <&pwm
0_9>,
12         <&pwm0_10>, <&pwm0_11>, <&pwm0_12>, <&pwm0_13>,
13         <&pwm0_14>, <&pwm0_15>;
14         status = "okay";
15     };
16
17     pwm0_0: pwm0_0@2000c10 {
18         compatible = "allwinner,sunxi-pwm0";
19         pinctrl-names = "active", "sleep";
20         reg = <0x0 0x02000c10 0x0 0x4>;
21         reg_base = <0x02000c00>;
22         status = "disabled";
23     };
24
25     pwm0_1: pwm0_1@2000c11 {
26         compatible = "allwinner,sunxi-pwm1";
27         pinctrl-names = "active", "sleep";
28         reg = <0x0 0x02000c11 0x0 0x4>;
29         reg_base = <0x02000c00>;
30         status = "disabled";
31     };
32
33     pwm0_2: pwm0_2@2000c12 {
34         compatible = "allwinner,sunxi-pwm2";
35         pinctrl-names = "active", "sleep";
36         reg = <0x0 0x02000c12 0x0 0x4>;
37         reg_base = <0x02000c00>;
38         status = "disabled";
39     };
40
41     pwm0_3: pwm0_3@2000c13 {
42         compatible = "allwinner,sunxi-pwm3";
43         pinctrl-names = "active", "sleep";

```

```

44         reg = <0x0 0x02000c13 0x0 0x4>;
45         reg_base = <0x02000c00>;
46         status = "disabled";
47     };
48
49     pwm0_4: pwm0_4@2000c14 {
50         compatible = "allwinner,sunxi-pwm4";
51         pinctrl-names = "active", "sleep";
52         reg = <0x0 0x02000c14 0x0 0x4>;
53         reg_base = <0x02000c00>;
54         status = "disabled";
55     };
56
57     pwm0_5: pwm0_5@2000c15 {
58         compatible = "allwinner,sunxi-pwm5";
59         pinctrl-names = "active", "sleep";
60         reg = <0x0 0x02000c15 0x0 0x4>;
61         reg_base = <0x02000c00>;
62         status = "disabled";
63     };
64
65     pwm0_6: pwm0_6@2000c16 {
66         compatible = "allwinner,sunxi-pwm6";
67         pinctrl-names = "active", "sleep";
68         reg = <0x0 0x02000c16 0x0 0x4>;
69         reg_base = <0x02000c00>;
70         status = "disabled";
71     };
72
73     pwm0_7: pwm0_7@2000c17 {
74         compatible = "allwinner,sunxi-pwm7";
75         pinctrl-names = "active", "sleep";
76         reg = <0x0 0x02000c17 0x0 0x4>;
77         reg_base = <0x02000c00>;
78         status = "disabled";
79     };
80
81     pwm0_8: pwm0_8@2000c18 {
82         compatible = "allwinner,sunxi-pwm8";
83         pinctrl-names = "active", "sleep";
84         reg = <0x0 0x02000c18 0x0 0x4>;
85         reg_base = <0x02000c00>;
86         status = "disabled";
87     };
88
89     pwm0_9: pwm0_9@2000c19 {
90         compatible = "allwinner,sunxi-pwm9";
91         pinctrl-names = "active", "sleep";
92         reg = <0x0 0x02000c19 0x0 0x4>;

```

```

92         reg_base = <0x02000c00>;
93         status = "disabled";
94     };
95
96     pwm0_10: pwm0_10@2000c1a {
97         compatible = "allwinner,sunxi-pwm10";
98         pinctrl-names = "active", "sleep";
99         reg = <0x0 0x02000c1a 0x0 0x4>;
100        reg_base = <0x02000c00>;
101        status = "disabled";
102    };
103
104     pwm0_11: pwm0_11@2000c1b {
105         compatible = "allwinner,sunxi-pwm11";
106         pinctrl-names = "active", "sleep";
107         reg = <0x0 0x02000c1b 0x0 0x4>;
108         reg_base = <0x02000c00>;
109         status = "disabled";
110     };
111
112     pwm0_12: pwm0_12@2000c1c {
113         compatible = "allwinner,sunxi-pwm12";
114         pinctrl-names = "active", "sleep";
115         reg = <0x0 0x02000c1c 0x0 0x4>;
116         reg_base = <0x02000c00>;
117         status = "disabled";
118     };
119
120     pwm0_13: pwm0_13@2000c1d {
121         compatible = "allwinner,sunxi-pwm13";
122         pinctrl-names = "active", "sleep";
123         reg = <0x0 0x02000c1d 0x0 0x4>;
124         reg_base = <0x02000c00>;
125         status = "disabled";
126     };
127
128     pwm0_14: pwm0_14@2000c1e {
129         compatible = "allwinner,sunxi-pwm14";
130         pinctrl-names = "active", "sleep";
131         reg = <0x0 0x02000c1e 0x0 0x4>;
132         reg_base = <0x02000c00>;
133         status = "disabled";
134     };
135
136     pwm0_15: pwm0_15@2000c1f {
137         compatible = "allwinner,sunxi-pwm15";
138         pinctrl-names = "active", "sleep";
139         reg = <0x0 0x02000c1f 0x0 0x4>;
140         reg_base = <0x02000c00>;

```

140  
141

```
status = "disabled";  
};
```

参数的具体配置如下：

- compatible = "allwinner,sunxi-pwm-v201";表示用哪套设备和驱动绑定
- reg = <0x0 0x02000c00 0x0 0x400>; 寄存器的基地址
- clocks = <&ccu CLK\_PWM>;时钟配置
- interrupts = <GIC\_SPI 19 IRQ\_TYPE\_LEVEL\_HIGH>;中断号的配置
- resets = <&ccu RST\_BUS\_PWM>;复位配置
- pwm-number = <16>;控制器的 pwm 通道个数
- pwm-base = <0x0>;pwm 的起始基数
- sunxi-pwms = <&pwm0\_0>, <&pwm0\_1>, <&pwm0\_2>, <&pwm0\_3>, <&pwm0\_4>, <&pwm0\_5>, <&pwm0\_6>, <&pwm0\_7>, <&pwm0\_8>, <&pwm0\_9>, <&pwm0\_10>, <&pwm0\_11>, <&pwm0\_12>, <&pwm0\_13>, <&pwm0\_14>, <&pwm0\_15>; 控制器的具体通道

板级配置： device/config/chips/t527/configs/demo\_linux\_aiot/linux-5.15/board.  
dts

```

1  pwm0_3_pin_active: pwm0_3@0 {
2      pins = "PB0";
3      function = "pwm0_3";
4  };
5  pwm0_3_pin_sleep: pwm0_3@1 {
6      pins = "PB0";
7      function = "gpio_in";
8      bias-pull-down;
9  };
10 pwm0_7_pin_active: pwm0_7@0 {
11     pins = "PD22";
12     function = "pwm7";
13 };
14 pwm0_7_pin_sleep: pwm0_7@1 {
15     pins = "PD22";
16     function = "gpio_in";
17     bias-pull-down;
18 };
19 &pwm0_3 {
20     pinctrl-names = "active", "sleep";
21     pinctrl-0 = <&pwm0_3_pin_active>;
22     pinctrl-1 = <&pwm0_3_pin_sleep>;
23     status = "okay";
24 };
25 &pwm0_7 {
26     pinctrl-names = "active", "sleep";
27     pinctrl-0 = <&pwm0_7_pin_active>;
28     pinctrl-1 = <&pwm0_7_pin_sleep>;
29     status = "okay";
30 };

```

具体通道配置按照需求进行配置。

- pinctrl-names: 分别表示 pwm 的 io 口的两种工作状态；
- pinctrl-0、 pinctrl-1: pwm 两种工作状态的引脚参数设置；
- status: 模块设备的打开或关闭，当编译该模块时， status="okay";不编译时， status="disabled";。

## 7.12、Camera

公共配置: `bsp/configs/linux-5.15/sun55iw3p1.dtsi`

在 dtsi 文件中, 配置了该 SoC 的 CSI 控制器的通用配置信息, 一般不建议修改, 由 CSI 驱动维护者维护, 如果需要修改配置请修改板级设备树 board.dts, 板级设备树里面的内容会覆盖 dtsi 对应的信息。

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

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```

1 &vind0 {
2     /* CSI模块时钟频率， 计算公式： 帧率 x (vts) x (hts) x 位宽 x 1(wdr则为2) / 8
   / 1(双pixel则为2) / 1000000， 向上取整， 单位
3     为MH;*/
4     csi_top = <336000000>;
5
6     /* ISP时钟频率， 计算公式： 帧率 x (vts) x (hts) / 1000000， 向上取整， 单位为MH;
   */
7     csi_isp = <300000000>;
8
9     vind_mclkpin-supply = <&reg_aldo2>; /* 对应原理图中vcc-pe所采用的LD0 */
10    vind_mclkpin_vol = <1800000>;
11    vind_mcsipin-supply = <&reg_cldo1>; /* 对应原理图中vcc-mcsi所采用的LD0 */
12    vind_mcsipin_vol = <1800000>;
13    vind_mipipin-supply = <&reg_cldo3>; /* 对应原理图中vcc-pk所采用的LD0 */
14    vind_mipipin_vol = <3300000>;
15    status = "okay";
16
17    /* csi3常用于并口sensor， 并口sensor不经过SOC MIPI模块， 直接与csi3模块连接 */
18    /* sun8iw21p1(V853系列)则csi2可用于并口 */
19    csi3:csi@5823000 {
20        pinctrl-names = "default", "sleep";
21        /* 可根据实际情况选择BT656/BT1120协议， 若不使用并口sensor， 下面两个pinctrl属
   性应置为空 */
22        pinctrl-0 = <&ncsi_bt1120_pins_a>;
23        pinctrl-1 = <&ncsi_bt1120_pins_b>;
24        status = "okay";
25    };
26
27    /* ISP时分复用功能（TDM）， 若需使用ISP时分复用功能， 则需开启TDM离线模式 */
28    tdm0:tdm@0 {
29        work_mode = <0>; /* 0:在线模式， 1:离线模式， 根据使用需求进行配置 */
30    };
31
32    /* 由于只有一个ISP实体， isp00(isp0)为普通在线模式下的唯一实体ISP，
33    * isp01/02/03为ISP时分复用（离线模式下）的ISP虚体，
34    * 而isp10(isp4)和isp(isp5)则为纯虚拟出来的ISP虚体， 不具备ISP功能， 通常用于不使
   用ISP功能时做路由， 如YUV sensor。
35    */
36    isp00:isp@0 {
37        work_mode = <0>; /* 0:在线模式， 1:离线模式， 根据使用需求进行配置 */
38    };
39    .....
40
41

```

```

42  /* scaler00/10/20/30为真实scaler(vipp) , 其他均为虚拟出来的vipp, 与所用isp相
43  对应*/
44  scaler00:scaler@0 {
45      work_mode = <0>; /* 0:在线模式, 1:离线模式, 根据使用需求进行配置 */
46  };
47  .....
48  /* 对焦马达 */
49  actuator0:actuator@0 {
50      device_type = "actuator0";
51      actuator0_name = "ad5820_act";
52      actuator0_slave = <0x18>;
53      actuator0_af_pwdn = <>;
54      actuator0_afvdd = "afvcc-csi";
55      actuator0_afvdd_vol = <2800000>;
56      status = "disabled";
57  };
58
59  /* 闪光灯 */
60  flash0:flash@0 {
61      device_type = "flash0";
62      flash0_type = <2>; /* 0:FLASH_RELATING, 1:FLASH_EN_INDEPEND, 2:FLASH_
63  POWER */
64      flash0_en = <&r_pio PL 11 GPIO_ACTIVE_LOW>;
65      flash0_mode = <>;
66      flash0_flvdd = "";
67      flash0_flvdd_vol = <>;
68      status = "disabled";
69  }
70
71  sensor0:sensor@0 {
72      device_type = "sensor0";
73      sensor0_mname = "gc2053_mipi"; /* 需和sensor驱动中的SENSOR_NAME宏保持一
74  致, 否则将无法成功加载驱动 */
75      sensor0_twi_cci_id = <1>; /* sensor所使用的TWI总线号或者CCI的id。 */
76      sensor0_twi_addr = <0x6e>; /* sensor的twi地址 */
77      sensor0_mclk_id = <0>; /* sensor所使用的mclk的id */
78      sensor0_pos = "rear"; /* sensor的位置, 前置还是后置, 主要用在平板上, 其他场
79  景一般无需配置该项*/
80      sensor0_isp_used = <1>; /* 该sensor是否需要使用ISP */
81      sensor0_fmt = <1>; /* sensor输出图像格式类型: 0-yuv, 1-bayer raw rgb */
82      sensor0_stby_mode = <0>; /* 0-系统standby时sensor模组不掉电, 1-系统stan
83  dby时sensor模组掉电 */
84      sensor0_vflip = <0>; /*sensor画面垂直翻转使能开关*/
85      sensor0_hflip = <0>; /*sensor画面水平翻转使能开关*/
86      sensor0_iovdd-supply = <&reg_aldo2>; /* sensor IOVDD所用LD0编号, 具体参
87  考原理图 */
88      sensor0_iovdd_vol = <1800000>; /* sensor IOVDD所用LD0电压, 单位: 微伏 */

```

```

84     sensor0_avdd-supply = <&reg_bldo2>; /* sensor AVDD所用LD0编号，具体参考
85     原理图 */
86     sensor0_avdd_vol = <2800000>; /* sensor AVDD所用LD0电压，单位：微伏 */
87     sensor0_dvdd-supply = <&reg_dldo2>; /* sensor DVDD所用LD0编号，具体参考
88     原理图 */
89     sensor0_dvdd_vol = <1200000>; /* sensor DVDD所用LD0电压，单位：微伏 */
90     sensor0_power_en = <>; /* 模组POWER_EN电源使能GPIO配置，根据实际情况进行配
91     置 */
92     sensor0_reset = <&pio PA 18 1 0 1 0>; /* 模组RESET复位GPIO配置，根据实际
93     情况进行配置 */
94     sensor0_pwdn = <&pio PA 19 1 0 1 0>; /* 模组PWDN GPIO配置，根据实际情况进
95     行配置 */
96     flash_handle = <&flash0>; /* 配置当前sensor所绑定的闪光灯 */
97     act_handle = <&actuator0>; /* 配置当前sensor所绑定的对焦马达 */
98     status = "okay";
99 };
100
101 sensor1:sensor@1 {
102     .....
103 };
104
105 /* vinc节点说明：
106 * 1. vinc@X对应/dev/videoX节点
107 * 2. vinc00/10/20/30/40/50 (video0/4/8/12/16/17) 对应真实的bk0/1/2/3/4/
108 * 5，故在线模式下最多可支持6路视频输出
109 * 3. vinc01/02/03/11/12/13/21/22/23/31/32/33只在ISP时分复用（离线模式）的场
110 * 景下才会使用。
111 */
112 vinc00:vinc@0 {
113     vinc0_csi_sel = <0>; /* 该pipeline上parser的id，必须配置，且为有效id。 */
114     vinc0_mipi_sel = <0>; /* 该pipeline上mipi的id，使用并口sensor时不经过mip
115     i，此项配置为0xff。 */
116     vinc0_isp_sel = <0>; /* 该pipeline上isp的id，必须配置；
117
118     * 若isp只是表示路由而不做效果处理，则须配置为虚拟ISP( isp4/5)
119     */
120     vinc0_isp_tx_ch = <0>; /* 该pipeline上isp tx的通道id，必须配置，默认为0。
121
122     * 当sensor配置为多通道输出时，该ch可以配置0~3的值。
123     */
124     vinc0_tdm_rx_sel = <0>; /* 该pipeline上tdm rx的通道id， 必须配置，默认为
125     0；
126
127     * 当不使用tdm功能时，配置为0xff
128     */
129     vinc0_rear_sensor_sel = <0>; /* 该pipeline上使用的后置sensor的id；
130
131     * 通过该vincX节点 (videoX) 来抓取指定sensor的数据

```

```

123     */
124     vinc0_front_sensor_sel = <0>; /* 该pipeline上使用的前置sensor的id;
125
126     * 而一般情况下, 会配置成和上面rear_sensor_sel相同的id
127     * 即仅通过不同的vinc (video) 节点来区分不同摄像头
128     */
129     vinc0_sensor_list = <0>; /* 是否使用sensor_list功能来自适应不同的模组, 1
130 -使用, 0-不使用 */
131     work_mode = <0x0>; /* 0-在线模式, 1-离线模式, 根据实际情况进行配置
132     * 注: 只有vinc0/4/8/12可配置。
133     */
134     status = "okay"; /* vinc(video)节点使能开关, 根据实际情况配置为okay/disabl
135 e */
136 }
137
138     vinc01:vinc@1 {
139         vinc1_csi_sel = <2>;
140         vinc1_mipi_sel = <0xff>;
141         vinc1_isp_sel = <1>;
142         vinc1_isp_tx_ch = <1>;
143         vinc1_tdm_rx_sel = <1>;
144         vinc1_rear_sensor_sel = <0>;
145         vinc1_front_sensor_sel = <0>;
146         vinc1_sensor_list = <0>;
147         status = "disabled";
148     };
149     .....
150 }

```

## 7.13、USB

### usb2.0

公共配置: `bsp/configs/linux-5.15/sun55iw3p1.dtsi`

```

1      usbc0: usbc0@10 {
2          device_type = "usbc0";
3          compatible = "allwinner,sunxi-otg-manager";
4          reg = <0x0 0x10 0x0 0x1000>;
5          usb_port_type = <2>;
6          usb_detect_type = <1>;
7          usb_detect_mode = <0>;
8          usb_id_gpio;
9          usb_det_vbus_gpio;
10         usb_regulator_io = "nocare";
11         usb_wakeup_suspend = <0>;
12         usb_luns = <3>;
13         usb_serial_unique = <0>;
14         usb_serial_number = "20080411";
15         rndis_wceis = <1>;
16         status = "disabled";
17     };
18
19     udc:udc-controller@4100000 {
20         compatible = "allwinner,sunxi-udc";
21         reg = <0x0 0x04100000 0x0 0x1000>, /*udc base*/
22             <0x0 0x00000000 0x0 0x100>; /*sram base*/
23         interrupts = <GIC_SPI 29 IRQ_TYPE_LEVEL_HIGH>;
24         clocks = <&ccu CLK_USB_24M>, <&ccu CLK_USB0TG0>;
25         clock-names = "hosc", "bus_otg";
26         resets = <&ccu RST_USB_OTG0>, <&ccu RST_USB_PHY0_R
STN>;
27         reset-names = "otg", "phy";
28         status = "disabled";
29     };
30
31     ehci0:ehci0-controller@4101000 {
32         compatible = "allwinner,sunxi-ehci0";
33         reg = <0x0 0x04101000 0x0 0xFFF>, /*hci0 base*/
34             <0x0 0x00000000 0x0 0x100>, /*sram base*/
35             <0x0 0x04100000 0x0 0x1000>; /*otg base*/
36         interrupts = <GIC_SPI 30 IRQ_TYPE_LEVEL_HIGH>;
37         clocks = <&ccu CLK_USB_24M>, <&ccu CLK_USBEHCI0>;
38         clock-names = "hosc", "bus_hci";
39         resets = <&ccu RST_USB_EHCI0>, <&ccu RST_USB_PHY0_
RSTN>;
40         reset-names = "hci", "phy";
41         hci_ctrl_no = <0>;
42         status = "disabled";
43     };

```

```

44
45
46         ohci0:ohci0-controller@4101400 {
47             compatible = "allwinner,sunxi-ohci0";
48             reg = <0x0 0x04101400 0x0 0xFFF>, /*hci0 base*/
49                 <0x0 0x00000000 0x0 0x100>, /*sram base*/
50                 <0x0 0x04100000 0x0 0x1000>; /*otg base*/
51             interrupts = <GIC_SPI 31 IRQ_TYPE_LEVEL_HIGH>;
52             clocks = <&ccu CLK_USB_24M>, <&ccu CLK_USB0HCI0>,
53                 <&ccu CLK_USB0>;
54             clock-names = "hosc", "bus_hci", "ohci";
55             resets = <&ccu RST_USB_0HCI0>, <&ccu RST_USB_PHY0_
56                 RSTN>;
57             reset-names = "hci", "phy";
58             hci_ctrl_no = <0>;
59             status = "disabled";
60         };

```

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```

1      usbc1: usbc1@11 {
2          device_type = "usbc1";
3          reg = <0x0 0x11 0x0 0x1000>;
4          usb_regulator_io = "nocare";
5          usb_wakeup_suspend = <0>;
6          status = "disabled";
7      };
8
9      ehci1: ehci1-controller@4200000 {
10         compatible = "allwinner,sunxi-ehci1";
11         reg = <0x0 0x04200000 0x0 0xFFF>, /*ehci1 base*/
12             <0x0 0x00000000 0x0 0x100>, /*sram base*/
13             <0x0 0x04100000 0x0 0x1000>; /*otg base*/
14         interrupts = <GIC_SPI 32 IRQ_TYPE_LEVEL_HIGH>;
15         clocks = <&ccu CLK_USB_24M>, <&ccu CLK_USBEHCI1>;
16         clock-names = "hosc", "bus_hci";
17         resets = <&ccu RST_USB_EHCI1>, <&ccu RST_USB_PHY1_
RSTN>;
18         reset-names = "hci", "phy";
19         hci_ctrl_no = <1>;
20         status = "disabled";
21     };
22
23     ohci1: ohci1-controller@4200400 {
24         compatible = "allwinner,sunxi-ohci1";
25         reg = <0x0 0x04200400 0x0 0xFFF>, /*ohci1 base*/
26             <0x0 0x00000000 0x0 0x100>, /*sram base*/
27             <0x0 0x04100000 0x0 0x1000>; /*otg base*/
28         interrupts = <GIC_SPI 33 IRQ_TYPE_LEVEL_HIGH>;
29         clocks = <&ccu CLK_USB_24M>, <&ccu CLK_USB0HCI1>,
<&ccu CLK_USB1>;
30         clock-names = "hosc", "bus_hci", "ohci";
31         resets = <&ccu RST_USB_OHCI1>, <&ccu RST_USB_PHY1_
RSTN>;
32         reset-names = "hci", "phy";
33         hci_ctrl_no = <1>;
34         status = "disabled";
35     };
36

```

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```
1  reg_usb0_vbus: usb0-vbus {
2      compatible = "regulator-fixed";
3      regulator-name = "usb0-vbus";
4      regulator-min-microvolt = <5000000>;
5      regulator-max-microvolt = <5000000>;
6      regulator-enable-ramp-delay = <1000>;
7      gpio = <&pio PI 5 GPIO_ACTIVE_HIGH>;
8      enable-active-high;
9  };
10
11  reg_usb1_vbus: usb1-vbus {
12      compatible = "regulator-fixed";
13      regulator-name = "usb1-vbus";
14      regulator-min-microvolt = <5000000>;
15      regulator-max-microvolt = <5000000>;
16      regulator-enable-ramp-delay = <1000>;
17      //gpio = <&pio PB 3 GPIO_ACTIVE_HIGH>;
18      enable-active-high;
19  };
```

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```
1 # &usbc0 {
2     device_type = "usbc0";
3     usb_port_type = <0x2>;
4     usb_detect_type = <0x1>;
5     usb_detect_mode = <0x0>;
6     usb_id_gpio = <&r_pio PL 10 GPIO_ACTIVE_HIGH>;
7     enable-active-high;
8     usb_det_vbus_gpio = <&r_pio PM 5 GPIO_ACTIVE_HIGH>;
9     enable-active-high;
10    detvbus_io-supply = <&reg_bldo1>;
11    usb_regulator_io = "nocare";
12    usb_wakeup_suspend = <0>;
13    usb_luns = <3>;
14    usb_serial_unique = <0>;
15    usb_serial_number = "20080411";
16    rndis_wceis = <1>;
17    status = "okay";
18 };
19
20 # &udc {
21     det_vbus_supply = <&usb_power_supply>;
22     phy_range = <0x153>;
23     status = "okay";
24 };
25
26 # &ehci0 {
27     drvvbus-supply = <&reg_usb0_vbus>;
28     phy_range = <0x153>;
29     status = "okay";
30 };
31
32 # &ohci0 {
33     drvvbus-supply = <&reg_usb0_vbus>;
34     phy_range = <0x153>;
35     status = "okay";
36 };
37
```

## ▼ USB1配置

Shell

```
1 &usb1 {
2     device_type = "usb1";
3     usb_regulator_io = "nocare";
4     usb_wakeup_suspend = <0>;
5     status = "okay";
6 };
7
8 &ehci1 {
9     //drvvbus-supply = <&reg_usb1_vbus>;
10    phy_range = <0x153>;
11    status = "okay";
12 };
13
14 &ohci1 {
15     //drvvbus-supply = <&reg_usb1_vbus>;
16    phy_range = <0x153>;
17    status = "okay";
18 };
19
```

### usb3.0

公共配置: `bsp/configs/linux-5.15/sun55iw3p1.dtsi`

```

1      usbc2:usbc2@12 {
2          device_type = "usbc2";
3          compatible = "allwinner,sunxi-plat-dwc3";
4          reg = <0x0 0x12 0x0 0x1000>;
5          #address-cells = <2>;
6          #size-cells = <2>;
7          ranges;
8          aw,hcgen2-phygen1-quirk;
9          status = "disabled";
10
11      xhci2: xhci2-controller@4d00000 {
12          compatible = "snps,dwc3";
13          reg = <0x0 0x04d00000 0x0 0x100000>;
14          interrupts = <GIC_SPI 35 IRQ_TYPE_LEVEL_HI
GH>;
15          dr_mode = "otg"; /* dr_mode option: host,
peripheral, otg
16          clocks = <&ccu CLK_USB3_MBUS_GATE>, <&ccu
CLK_USB3_REF>,
17          <&ccu CLK_USB2_REF>, <&ccu CLK_US
B3_SUSPEND>;
18          clock-names = "bus_clk", "ref_clk3", "ref_
clk2", "suspend";
19          resets = <&ccu RST_USB_3>;
20          reset-names = "hci";
21          maximum-speed = "super-speed";
22          phy_type = "utmi";
23          snps,dis_enblslpm_quirk;
24          snps,dis-u1-entry-quirk;
25          snps,dis-u2-entry-quirk;
26          snps,dis_u3_susphy_quirk;
27          snps,dis_u2_susphy_quirk;
28          phys = <&u2phy>, <&combophy PHY_TYPE_USB3
>;
29          phy-names = "usb2-phy", "usb3-phy";
30          status = "disabled";
31      };
32  };
33
34  u2phy: phy@4e00000 {
35      compatible = "allwinner,sunxi-plat-phy";
36      reg = <0x0 0x04e00000 0x0 0x800>; /* Application R
egisters */
37      #phy-cells = <0>;
38      status = "disabled";

```

```

39         };
40
41     combophy: phy@4f00000 {
42         compatible = "allwinner,inno-combphy";
43         reg = <0x0 0x04f00000 0x0 0x80000>, /* Sub-System
44 Application Registers */
45         <0x0 0x04f80000 0x0 0x80000>; /* Combo INNO
PHY Registers */
46         reg-names = "phy-ctl", "phy-clk";
47         power-domains = <&pd1 A523_PCK_PCIE>;
48         phy_refclk_sel = <0>; /* 0:internal clk; 1:external
49 l clk */
50         clocks = <&ccu CLK_USB3_REF>, <&ccu CLK_PLL_PERI0_
200M>;
51         clock-names = "phyclk_ref", "refclk_par";
52         resets = <&ccu RST_BUS_PCIE_USB3>;
53         reset-names = "phy_rst";
54         #phy-cells = <1>;
55         status = "disabled";
56     };

```

板级配置: `device/config/chips/t527/configs/demo_linux_aiot/linux-5.15/board.dts`

```

1  &usbc2 {
2      device_type = "usbc2";
3      drvvbus-supply = <&reg_drivevbus>;
4      aw,vbus-shared-quirk; /* 若配置此项， 则drvvbus-supply不生效， 说明与其他端口
        共用vbus。 */
5      status = "okay";
6  };
7
8  &xhci2 {
9      dr_mode = "host"; /* 控制器支持的主从模式， 可选的配置为： host, periphera
        l, otg。 */
10     phys = <&u2phy>, <&combo1_usb>; /* 某些平台支持USB3.0使用COMB1需覆写phys节
        点。 */
11     status = "okay";
12 };
13
14 &u2phy {
15     status = "okay";
16 };
17
18 &combophy {
19     phy_use_sel = <1>; /* 0:PCIE; 1:USB3; 2:PCIE_USB3_U2 */ /* combophy的使
        用者配置， 0:PCIE; 1:USB3; 2:
20     PCIE_USB3_U2。 */
21     status = "okay";
22 };
23
24 &serdes {
25     status = "okay";
26 };

```

若仅使用 Host 功能接口，则需要配置相关选项以支持具体的功能：

- `dr_mode`：表示将控制器配置的模式，需要固定配置为 `host`
- `phy_use_sel`： `PCIE_USB3_U2`（即配置为 2）为新增模式，用于 `PCIE` 和 `USB3.0` 同时工作的场景，其中， `PCIE` 使用 `com-bophy`， `XHCI` 控制器使用 `U2 PHY`，此时 `USB3.0` 只支持高速传输，使用此模式时需要确认 `combophy` 驱动中已支持该项功能。
- `serdes`：仅适用于某些支持 `serdes` 子系统的平台的 `ComboPHY`，主要用于替换 `combophy` 节点，二选一即可。

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