

## LCD 调试文档

### LCD 接口类型

RGB

LVDS

MIPI

EDP

### 调试细节

RGB: 供电、复位、时序、像素时钟、RGB 类型

LVDS: 供电、复位、时序、像素时钟、LVDS 类型

MIPI: 供电、复位、时序、像素时钟、MIPI 时钟、MIPI 命令、MIPI 数据模式

EDP: 供电、复位、时序、像素时钟

### 调试步骤

- 1、如果是设备树的，查找当前 SDK 的主 dts，可看《平台主要路径.pdf》
- 2、打开 DTS 文件，在前面有#include rp-lcd\*\*\*.dtsi，查找包含的 dtsi。

```
41 /dts-v1/;
42
43 #include <dt-bindings/pwm/pwm.h>
44 #include <dt-bindings/input/input.h>
45 #include "rk3288.dtsi"
46 #include "rk3288-android.dtsi"
47 // #include "lcd-rpdzkj-hdmi.dtsi"
48 // #include "lcd-rpdzkj-hdmi-4k.dtsi"
49 // #include "lcd-rpdzkj-lvds-10_1_1024_600.dtsi"
50 // #include "lcd-rpdzkj-mipi-10_1_1920_1200.dtsi"
51 // #include "lcd-rpdzkj-mipi-7_800_1280.dtsi"
52 // #include "lcd-rpdzkj-mipi-5_720_1280.dtsi"
53 // #include "lcd-rpdzkj_dual_lvds.dtsi"
54 // #include "lcd-rpdzkj_dual_lvds_1920x1080_13.3inch.dtsi"
55 // #include "lcd-edp.dtsi"
56 // #include "dual-lcd-rpdzkj-lvds-10-1024-mipi-10-1920.dtsi"
57 #include "lcd-rpdzkj-mipi-7-1200-1920.dtsi"
58 // #include "lcd-rpdzkj-mipi-7-1024-600.dtsi"
59
```

### 3、打开 DTS 对应的目录，查看已经支持的 LCD

king_rp_3288_8.1 > kernel > arch > arm > boot > dts >				▼	🔄	搜索"dts"
名称	修改日期	类型	大小			
🔒 dual-lcd-rpdzkj-lvds-10-1024-mipi-10-1920.dtsi	2020/3/23 14:24	DTSI 文件	14 KB			
🔒 lcd-edp.dtsi	2020/3/23 14:24	DTSI 文件	6 KB			
🔒 lcd-edp_back.dtsi	2019/8/23 11:51	DTSI 文件	9 KB			
🔒 lcd-rpdzkj_dual_lvds.dtsi	2020/3/23 14:24	DTSI 文件	12 KB			
🔒 lcd-rpdzkj_dual_lvds_1920x1080_13.3inch.dtsi	2020/3/23 14:24	DTSI 文件	7 KB			
🔒 lcd-rpdzkj_dual_lvds-pro3288-ahxj.dtsi	2020/3/24 13:52	DTSI 文件	12 KB			
🔒 lcd-rpdzkj_lvds-1280-800.dtsi	2020/3/10 10:45	DTSI 文件	12 KB			
🔒 lcd-rpdzkj-hdmi.dtsi	2020/3/23 14:23	DTSI 文件	6 KB			
🔒 lcd-rpdzkj-hdmi-4k.dtsi	2020/3/23 14:23	DTSI 文件	6 KB			
🔒 lcd-rpdzkj-lvds-10_1_1024_600.dtsi	2020/3/23 14:23	DTSI 文件	11 KB			
🔒 lcd-rpdzkj-lvds-10-800-1280-qhfr.dtsi	2020/3/28 14:23	DTSI 文件	7 KB			
🔒 lcd-rpdzkj-mipi-5.5-720-1280.dtsi	2019/8/23 11:51	DTSI 文件	16 KB			
🔒 lcd-rpdzkj-mipi-5_720_1280.dtsi	2020/3/23 14:24	DTSI 文件	16 KB			
🔒 lcd-rpdzkj-mipi-5_720_1280_old.dtsi	2019/8/23 11:51	DTSI 文件	15 KB			
🔒 lcd-rpdzkj-mipi-7_800_1280.dtsi	2020/3/23 11:23	DTSI 文件	7 KB			
🔒 lcd-rpdzkj-mipi-7-1024-600.dtsi	2020/3/25 14:47	DTSI 文件	8 KB			
🔒 lcd-rpdzkj-mipi-7-1200-1920.dtsi	2020/3/23 14:24	DTSI 文件	8 KB			
🔒 lcd-rpdzkj-mipi-8_800_1280-js.dtsi	2020/6/5 11:40	DTSI 文件	12 KB			
🔒 lcd-rpdzkj-mipi-10.1-800-1280-zcla.dtsi	2020/4/16 17:45	DTSI 文件	14 KB			
🔒 lcd-rpdzkj-mipi-10_1_1920_1200.dtsi	2020/3/23 14:23	DTSI 文件	11 KB			
📄 Makefile	2019/8/23 11:51	文件	1 KB			
🔒 rk3288.dtsi	2020/5/25 14:04	DTSI 文件	65 KB			

4、根据 LCD 接口类型选定一个对应的 lcd\*\*\*.dtsi 进行调试，在 dts 文件包含这个 lcd\*\*\*.dtsi 比如是 MIPI 接口的显示屏，就选择一个 MIPI 的 dtsi 进行调试。

5、查看显示屏的数据手册，获取分辨率、接口类型，时序、像素时钟

- ( ) Preliminary Specification
- (●) Final Specification

Title	7.0" WUXGA (1200 x RGB x 1920) TFT LCD		
BUYER		SUPPLIER	LG Display Co., Ltd.
MODEL	Thor	MODEL	LD070WU2
		Suffix	SM01

分辨率 1200\*1920

3-2. Interface (Input Terminal)

This LCD employs one interface connections, a 40pin connector is used for the module electronics interface.  
(LCM : AXT640124, Panasonic, Mating : AXT540124, Panasonic)

Table 4. Module Connection Pin Configuration

Pin#	Signal	Pin#	Signal
1	GND	2	LED_VOLTAGE+
3	GND	4	LED_VOLTAGE+
5	MIPI_D4+	6	GND
7	MIPI_D4-	8	LED6_RETURN
9	GND	10	LED5_RETURN
11	MIPI_D3+	12	LED4_RETURN
13	MIPI_D3-	14	LED3_RETURN
15	GND	16	LED2_RETURN
17	MIPI_CLK+	18	LED1_RETURN
19	MIPI_CLK-	20	RSVD_BIST
21	GND	22	PWM_OUT
23	MIPI_D2+	24	PWM_IN
25	MIPI_D2-	26	GND
27	GND	28	1.8V
29	MIPI_D1+	30	1.8V
31	MIPI_D1-	32	GND
33	GND	34	VSYS
35	RSVD MFG SDA	36	VSYS
37	RSVD MFG SCL	38	VSYS
39	GND	40	GND

MIPI 接口 4lane

3-4. Signal Timing Specification

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications.

Table 6. Timing Table

ITEM	Symbol		Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	$f_{CLK}$	-	-	-	MHz	
Hsync	Period	$t_{HP}$	-	1360	-	tCLK	
	Width	$t_{WH}$	-	10	-		
	Width-Active	$t_{WHA}$	-	1200	-		
Vsync	Period	$t_{VP}$	-	1960	-	tHP	
	Width	$t_{WV}$	-	10	-		
	Width-Active	$t_{WVA}$	-	1920	-		
Data Enable	Horizontal back porch	$t_{HBP}$	-	35	-	tCLK	
	Horizontal front porch	$t_{HFP}$	-	115	-		
	Vertical back porch	$t_{VBP}$	-	20	-	tHP	
	Vertical front porch	$t_{VFP}$	-	10	-		

- 时序
- Hfp 115
- Hbp 35
- Hsa 10
- Vfp 10
- Vbp 20
- Vsa 10

很多情况下国内的屏厂提供出来的时序是这样的

ITEM	Symbol		Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	$f_{CLK}$	-	-	-	MHz	
Hsync	Period	$t_{HP}$	-	1360	-	tCLK	
	Width	$t_{WH}$	-	10	-		
	Width-Active	$t_{WHA}$	-	1200	-		
Vsync	Period	$t_{VP}$	-	1960	-	tHP	
	Width	$t_{WV}$	-	10	-		
	Width-Active	$t_{WVA}$	-	1920	-		

- Hfp  $(1360-1200-10) / 2 = 75$
- Hbp  $(1360-1200-10) / 2 = 75$
- Hsa 10
- Vfp  $(1960-1920-10) / 2 = 15$
- Vbp  $(1960-1920-10) / 2 = 15$
- Vsa 10

MIPI 时钟：需要与屏厂确认（1200\*1920 的 MIPI 时钟大概是 1000MB）

```
119 dsi0 {
120     status = "okay";
121     rockchip, lane-rate = <960>;
122
123     panel: panel {
124         compatible = "simple-panel-dsi";
125         reg = <0>;
126         backlight = <backlight>;
127     cmd_later_reset = <0>;
128     enable-gpios = <gpio7 2 GPIO_ACTIVE_HIGH>;
129     reset-gpios = <gpio7 3 GPIO_ACTIVE_HIGH>;
130     //power-supply = <vcc_lcd>;
131     dsi, flags = <(MIPI_DSI_MODE_VIDEO | MIPI_DSI_MODE_VIDEO_BURST |
132                 MIPI_DSI_MODE_LPM | MIPI_DSI_MODE_EOT_PACKET)>;
133     dsi, format = <MIPI_DSI_FMT_RGB888>;
134     dsi, lanes = <4>;
135     reset-delay-ms = <20>;
136     init-delay-ms = <20>;
137     enable-delay-ms = <120>;
138     prepare-delay-ms = <120>;
139     status = "okay";
```

像素时钟：

```
189     disp_timings: display-timings {
190         native-mode = <timing0>;
191
192         timing0: timing0 {
193             clock-frequency = <160000000>;
194             hactive = <1200>;
195             vactive = <1920>;
196             hback-porch = <75>;
197             hfront-porch = <75>;
198             vback-porch = <15>;
199             vfront-porch = <15>;
200             hsync-len = <10>;
201             vsync-len = <10>;
202             hsync-active = <0>;
203             vsync-active = <0>;
204             de-active = <0>;
205             pixelclk-active = <0>;
206         };
207     };
```

计算方式：(h+hbp+hfp+hsa)\*(v+vbp+vfp+vsa)\*60

MIPI 命令：需要屏厂提供

```
119 dsi0 {
120     status = "okay";
121     rockchip, lane-rate = <960>;
122
123     panel: panel {
124         compatible = "simple-panel-dsi";
125         reg = <0>;
126         backlight = <backlight>;
127     cmd_later_reset = <0>;
128     enable-gpios = <gpio7 2 GPIO_ACTIVE_HIGH>;
129     reset-gpios = <gpio7 3 GPIO_ACTIVE_HIGH>;
130     //power-supply = <vcc_lcd>;
131     dsi, flags = <(MIPI_DSI_MODE_VIDEO | MIPI_DSI_MODE_VIDEO_BURST |
132                  MIPI_DSI_MODE_LPM | MIPI_DSI_MODE_EOT_PACKET)>;
133     dsi, format = <MIPI_DSI_FMT_RGB888>;
134     dsi, lanes = <4>;
135     reset-delay-ms = <20>;
136     init-delay-ms = <20>;
137     enable-delay-ms = <120>;
138     prepare-delay-ms = <120>;
139     status = "okay";
140
141     panel-init-sequence = [
142         39 00 03 b7 50 00
143         39 00 03 b8 00 00
144         39 10 03 b9 00 00
145         39 10 03 ba 14 42
146         39 10 03 bb 03 00
147         39 60 03 b9 01 00
148         39 10 03 de 03 00
149         39 60 03 c9 02 23
150
151         39 00 02 b0 00
152         39 00 06 14 08 b0 00 22 00
153         39 30 02 b4 0c
154         39 40 03 b6 3a d3
155         39 50 02 51 e6
156         39 30 02 53 2c
```

按以上红色框的规则填写

解析： 39 00 03 b7 50 00

39: 命令类型

00: 写命令后的延时 (ms)

03: 3 个数据写进去 (后面一共 3 个数据)

b7 : 地址

50 00: 数据

解析 39 00 06 14 08 b0 00 22 00

39: 命令类型

00: 写命令后的延时 (ms)

06: 6 个数据写进去 (后面一共 6 个数据)

14: 地址

08 b0 00 22 00: 数据



MIPI 显示模式：与屏厂确认，一般都是 video 模式

```
119 dsi0 {
120     status = "okay";
121     rockchip, lane-rate = <960>;
122
123     panel: panel {
124         compatible = "simple-panel-dsi";
125         reg = <0>;
126         backlight = <&backlight>;
127     cmd_later_reset = <0>;
128     enable-gpios = <&gpio7 2 GPIO_ACTIVE_HIGH>;
129     reset-gpios = <&gpio7 3 GPIO_ACTIVE_HIGH>;
130     //power-supply = <&vcc_lcd>;
131     dsi, flags = <(MIPI_DSI_MODE_VIDEO | MIPI_DSI_MODE_VIDEO_BURST |
132                 MIPI_DSI_MODE_LPM | MIPI_DSI_MODE_EOT_PACKET)>;
133     dsi, format = <MIPI_DSI_FMT_RGB888>;
134     dsi, lanes = <4>;
135     reset-delay-ms = <20>;
136     init-delay-ms = <20>;
137     enable-delay-ms = <120>;
138     prepare-delay-ms = <120>;
139     status = "okay";
140 }
```

供电与复位

```
119 dsi0 {
120     status = "okay";
121     rockchip, lane-rate = <960>;
122
123     panel: panel {
124         compatible = "simple-panel-dsi";
125         reg = <0>;
126         backlight = <&backlight>;
127     cmd_later_reset = <0>;
128     enable-gpios = <&gpio7 2 GPIO_ACTIVE_HIGH>;
129     reset-gpios = <&gpio7 3 GPIO_ACTIVE_HIGH>;
130     //power-supply = <&vcc_lcd>;
131     dsi, flags = <(MIPI_DSI_MODE_VIDEO | MIPI_DSI_MODE_VIDEO_BURST |
132                 MIPI_DSI_MODE_LPM | MIPI_DSI_MODE_EOT_PACKET)>;
133     dsi, format = <MIPI_DSI_FMT_RGB888>;
134     dsi, lanes = <4>;
135     reset-delay-ms = <20>;
136     init-delay-ms = <20>;
137     enable-delay-ms = <120>;
138     prepare-delay-ms = <120>;
139     status = "okay";
140 }
```

细节调试

### 1、时序

不同的平台需要细调，修改前后沿的值，调节显示效果或偏移情况

### 2、像素时钟

修改像素时钟，改变显示帧率，提高显示效果与稳定性

### 3、MIPI 时钟

RK 平台的 MIPI 时钟比较智能，当你指定 MIPI 时钟的时候，CPU 按你的时钟进行输出，当不设置的时候，会根据显示屏的像素时钟进行输出。具体要根据调试效果来调整。

关于屏厂 MIPI 命令样式与修改

假设我们调试一个新平台，首先要看懂平台里的代码对 MIPI 命令的配置，理解每个参数的含义，再把显示的屏的 MIPI 命令填写进去

我们从屏厂那边拿到的初始化一般是这样的

```
1  0x24//HSA
2  0x04//VSA
3  0x76//HBP
4  0x0C//VBP
5  0x76//HFP
6  0x0F//VFP
7
8
9  //////////////////////////////////////
10
11
12
13  SPI_3W_SET_CMD(0xB9);
14  SPI_3W_SET_PAs(0xFF);//1
15  SPI_3W_SET_PAs(0x83);//2
16  SPI_3W_SET_PAs(0x94);//3
17  DelayX1ms(5);
18
19  SPI_3W_SET_CMD(0xBA);
20  SPI_3W_SET_PAs(0x13);//1
21  SPI_3W_SET_PAs(0x82);//2
22  SPI_3W_SET_PAs(0x00);//3
23  SPI_3W_SET_PAs(0x16);//4
24  SPI_3W_SET_PAs(0xC5);//5
25  SPI_3W_SET_PAs(0x00);//6
26  SPI_3W_SET_PAs(0x10);//7
27  SPI_3W_SET_PAs(0xFF);//8
28  SPI_3W_SET_PAs(0x0F);//9
29  SPI_3W_SET_PAs(0x24);//10
30  SPI_3W_SET_PAs(0x03);//11
31  SPI_3W_SET_PAs(0x21);//12
32  SPI_3W_SET_PAs(0x24);//13
33  SPI_3W_SET_PAs(0x25);//14
34  SPI_3W_SET_PAs(0x20);//15
35  SPI_3W_SET_PAs(0x08);//16
```



## 时序配置

```
386         disp_timings: display-timings {
387             native-mode = <timing0>;
388
389             timing0: timing0 {
390                 clock-frequency = <700000000>;
391                 hactive = <800>;
392                 vactive = <1280>;
393                 hback-porch = <118>;
394                 hfront-porch = <118>;
395                 vback-porch = <12>;
396                 vfront-porch = <15>;
397                 hsync-len = <30>;
398                 vsync-len = <4>;
399                 hsync-active = <0>;
400                 vsync-active = <0>;
401                 de-active = <0>;
402                 pixelclk-active = <0>;
403             };
404
```

## MIPI 命令配置

```
142     panel-init-sequence = [
143
144         39 05 04 B9 FF 83 94
145         39 05 11 BA 13 82 00 16 C5 00 10 FF 0F 24 03 21 24 25 20 08
```

## LVDS 类型

```
172 &lvd_panel {
173     status = "okay";
174     compatible = "simple-panel";
175     backlight = <&backlight>;
176     bus-format = <MEDIA_BUS_FMT_RGB888_1X24>;
177     enable-gpios = <&gpio7 4 GPIO_ACTIVE_LOW>;
178     prepare-delay-ms = <100>;
179     enable-delay-ms = <100>;
180
181     pinctrl-0 = <&lcd_en>;
182     rockchip,data-mapping = "vesa"; //""jeida"
183     rockchip,data-width = <24>; //<18>
184     rockchip,output = "lvds";
185
186     display-timings {
187         native-mode = <&timing0>;
188         timing0: timing0 {
189             clock-frequency = <600000000>;
190             hactive = <1280>;
191             vactive = <800>;
192             hback-porch = <30>;
193             hfront-porch = <20>;
194             vback-porch = <23>;
195             vfront-porch = <12>;
196             hsync-len = <10>;
197             vsync-len = <3>;
198             hsync-active = <0>;
199             vsync-active = <0>;
200             de-active = <0>;
201             pixelclk-active = <0>;
202         };
203     };
204 };
```

## RGB 类型

```
61 disp_timings: display-timings {
62     native-mode = <timing0>;
63     timing0: timing0 {
64         screen-type = <SCREEN RGB>;
65         out-face    = <OUT_P888>;
66         clock-frequency = <350000000>;
67         hactive = <800>;
68         vactive = <480>;
69         hback-porch = <20>;
70         hfront-porch = <30>;
71         vback-porch = <80>;
72         vfront-porch = <30>;
73         hsync-len = <10>;
74         vsync-len = <3>;
75         hsync-active = <0>;
76         vsync-active = <0>;
77         de-active = <0>;
78         pixelclk-active = <0>;
79         swap-rb = <0>;
80         swap-rg = <0>;
81         swap-gb = <0>;
82         ddr-change-notify-screen = <0>;
83     };
84 };
```

RGB 类型有几种，不同的内核版本对这定义还不一样，具体要查看调用，查找头文件包含的宏，细改。