



CV180X & CV181X MIPI User Guide

Version: 1.1.2

Release date: 2023-04-13

Copyright © 2020 CVITEK Co., Ltd. All rights reserved.

No part of this document may be reproduced or transmitted in any form or by any means without prior written consent of CVITEK Co., Ltd.

Contents

1	Disclaimer	2
2	MIPI User Guide	3
2.1	Overview	3
2.2	Important Concept	3
2.3	Function Description	5
2.4	API Reference	7
2.4.1	CVI_MIPI_SET_HS_MODE	8
2.4.2	CVI_MIPI_SET_DEV_ATTR	8
2.4.3	CVI_MIPI_RESET_SENSOR	10
2.4.4	CVI_MIPI_UNRESET_SENSOR	11
2.4.5	CVI_MIPI_RESET_MIPI	12
2.4.6	CVI_MIPI_ENABLE_SENSOR_CLOCK	12
2.4.7	CVI_MIPI_DISABLE_SENSOR_CLOCK	13
2.4.8	CVI_MIPI_SET_CROP_TOP	13
2.4.9	CVI_MIPI_SET_WDR_MANUAL	14
2.4.10	CVI_MIPI_SET_LVDS_FP_VS	15
2.4.11	CVI_VIP_MIPI_TX_SET_DEV_CFG	15
2.4.12	MSG_CMD_MIPI_TX_SET_DEV_CFG	16
2.4.13	CVI_VIP_MIPI_TX_GET_CMD	16
2.4.14	MSG_CMD_MIPI_TX_GET_CMD	17
2.4.15	CVI_VIP_MIPI_TX_SET_CMD	17
2.4.16	MSG_CMD_MIPI_TX_SET_CMD	18
2.4.17	CVI_VIP_MIPI_TX_ENABLE	18
2.4.18	MSG_CMD_MIPI_TX_ENABLE	18
2.4.19	CVI_VIP_MIPI_TX_DISABLE	19
2.4.20	MSG_CMD_MIPI_TX_DISABLE	19
2.4.21	CVI_VIP_MIPI_TX_SET_HS_SETTLE	19
2.4.22	MSG_CMD_MIPI_TX_SET_HS_SETTLE	20
2.4.23	CVI_VIP_MIPI_TX_GET_HS_SETTLE	20
2.4.24	MSG_CMD_MIPI_TX_GET_HS_SETTLE	21
2.5	Data Types	21
2.5.1	CVI_MIPI_IOC_MAGIC	22
2.5.2	MIPI_LANE_NUM	23
2.5.3	WDR_VC_NUM	23
2.5.4	SYNC_CODE_NUM	24
2.5.5	BT_DEMUX_NUM	24
2.5.6	MIPI_DEMUX_NUM	24
2.5.7	input_mode_e	25
2.5.8	img_size_s	25
2.5.9	rx_mac_clock_e	26

2.5.10	cam_pll_freq_e	26
2.5.11	mclock_pll_s	27
2.5.12	raw_data_type_e	28
2.5.13	mipi_wdr_mode_e	28
2.5.14	wdr_mode_e	29
2.5.15	lvds_sync_mode_e	30
2.5.16	lvds_bit_endian	31
2.5.17	lvds_vsync_type_e	31
2.5.18	lvds_fid_type_e	33
2.5.19	lvds_fid_type_s	34
2.5.20	lvds_vsync_type_s	34
2.5.21	lvds_dev_attr_s	35
2.5.22	dphy_s	36
2.5.23	mipi_demux_info_s	36
2.5.24	mipi_dev_attr_s	37
2.5.25	manual_wdr_attr_s	38
2.5.26	ttl_pin_func_e	38
2.5.27	ttl_src_e	39
2.5.28	bt_demux_mode_e	40
2.5.29	bt_demux_sync_s	40
2.5.30	bt_demux_attr_s	41
2.5.31	ttl_dev_attr_s	42
2.5.32	combo_dev_attr_s	43
2.5.33	crop_top_s	44
2.5.34	manual_wdr_s	45
2.5.35	vsync_gen_s	45
2.5.36	LANE_MAX_NUM	46
2.5.37	output_mode_e	46
2.5.38	video_mode_e	47
2.5.39	output_format_e	47
2.5.40	sync_info_s	48
2.5.41	combo_dev_cfg_s	49
2.5.42	cmd_info_s	50
2.5.43	get_cmd_info_s	51
2.5.44	hs_settle_s	52
2.6	Proc Information	53
2.6.1	MIPI_RX Proc information	53
2.7	FAQ	56
2.7.1	How to configure Land id	56
2.7.2	MIPI frequency Description	56
2.7.3	Manual WDR mode instructions	57

Revision History

Revision	Date	Description
1.0.0	2021/04/20	RD update by review
1.1.1	2021/06/21	Revise MIPI_TX ioctl
1.1.2	2023/04/13	Add 181X/180x details

1 Disclaimer



Terms and Conditions

The document and all information contained herein remain the CVITEK Co., Ltd' s ("CVITEK") confidential information, and should not disclose to any third party or use it in any way without CVITEK' s prior written consent. User shall be liable for any damage and loss caused by unauthority use and disclosure.

CVITEK reserves the right to make changes to information contained in this document at any time and without notice.

All information contained herein is provided in "AS IS" basis, without warranties of any kind, expressed or implied, including without limitation mercantability, non-infringement and fitness for a particular purpose. In no event shall CVITEK be liable for any third party' s software provided herein, User shall only seek remedy against such third party. CVITEK especially claims that CVITEK shall have no liable for CVITEK' s work result based on Customer' s specification or published shandard.

Contact Us

Address Building 1, Yard 9, FengHao East Road, Haidian District, Beijing, 100094, China

Building T10, UpperCoast Park, Huizhanwan, Zhancheng Community, Fuhai Street, Baoan District, Shenzhen, 518100, China

Phone +86-10-57590723 +86-10-57590724

Website <https://www.sophgo.com/>

Forum <https://developer.sophgo.com/forum/index.html>

2 MIPI User Guide

2.1 Overview

MIPI Rx can receive the signal of differential and DC(TTL) interface, convert the data into pixel data, and then transfer it to ISP module. Differential signal supports video input such as SubLVDS(Sub Low-Voltage Differential Signal), MIPI-CSI and HiSPi(High-Speed Serial Pixel Interface). DC signal supports Sensor RAW12, BT1120, BT656 and BT601.

2.2 Important Concept

- **MIPI**

MIPI (Mobile Industry Processor Interface) is a communication interface that uses D-PHY transmission specification and CSI-2 as protocol layer in physical layer.

- **Lane**

The physical layer is used to connect a pair of high-speed differential lines between the sender and the receiver. A lane can transmit clock or data. 1C4D refers to one clock lane and four data lanes.

- **LVDS**

Low voltage differential signaling (LVDS) refers to sub LVDS and HiSPi, which are developed from LVDS. The blanking zone and effective data are distinguished by synchronization code.

- **Synchronization Code**

MIPI-CSI uses standard short packets as synchronization signals. LVDS signal uses sync code as synchronization signal. LVDS has two synchronization modes:

- Use SOF/EOF to indicate the beginning and end of a frame.
- Use SOL/EOL to indicate the beginning and end of the line.

VBLANK				
HBLANK	SOF	Active Line 1	EOL	HBLANK
HBLANK	SOL	Active Line 2		HBLANK
HBLANK		Active Line 3		HBLANK
⋮		⋮		⋮
HBLANK		Active Line P-1		HBLANK
HBLANK		Active Line P		EOF
VBLANK				

Fig. 2.1: synchronization mode of SOF/EOF/SOL/EOL

- Use SAV invalid and EAV invalid indicate the beginning and end of VBLANK.

Use SAV valid and EAV valid indicate the beginning and end of the effective information (information line, H.OB and pixel data).

HBLANK	SAV Invalid	VBLANK	EAV Invalid	HBLANK
HBLANK		VBLANK		HBLANK
HBLANK		⋮		HBLANK
⋮		VBLANK		⋮
HBLANK	SAV Valid	Frame Information Line	EAV Valid	HBLANK
HBLANK		OB/ effective pixel		HBLANK
HBLANK		OB/ effective pixel		HBLANK
HBLANK		⋮		HBLANK
HBLANK		OB/ effective pixel		HBLANK
HBLANK	SAV Invalid	VBLANK	EAV Invalid	HBLANK
HBLANK		VBLANK		HBLANK
HBLANK		⋮		HBLANK
HBLANK		VBLANK		HBLANK

Fig. 2.2: SAV/EAV synchronization mode

- **DOL**

Sony's interleaved WDR mode is called digital overlap.

2.3 Function Description

MIPI RX supports differential video input interfaces of MiPI-CSI, sub-LVDS and HiSPi which having one channel of up to 4 lanes or two channels of up to 2 lanes, besides, these interfaces support lane interchange and PN interchange of differential signals. Note that if two input channels of the differential signal are used, the number of pin MIPIRX# must be divided into 0-2 and 3-5 with each group receiving the same input. MIPI RX also supports sensor TTL, BT1120, BT656 and BT601 parallel input interfaces, and supports lane function interchange except Clock lane. The specific lane distribution is shown in the table below :

Table 2.1: the distribution chart of supporting BT interfaces.
BGA package supports VI0~VI2, QFN package supports VI0.

VI0	PAD NAME	VI1	PAD NAME	VI2	PAD NAME
VI0_CLOCK	MIPIRX4N	V CLOCK	V_CLOCK	V CLOCK	V_CLOCK
VI0_D[0]	MIPIRX4P				
VI0_D[1]	MIPIRX3N				
VI0_D[2]	MIPIRX3P				
VI0_D[3]	MIPIRX2N				
VI0_D[4]	MIPIRX2P				
VI0_D[5]	MIPIRX1N				
VI0_D[6]	MIPIRX1P				
VI0_D[7]	MIPIRX0N				
VI0_D[8]	MIPIRX0P				
VI0_D[9]	M IPI_TXM0				
VI0_D[10]	M IPI_TXP0	V D[10]			
VI0_D[11]	M IPI_TXM1	V D[11]			
VI0_D[12]	M IPI_TXP1	V D[12]			
VI0_D[13]	M IPI_TXM2	V D[13]			
VI0_D[14]	M IPI_TXP2	V D[14]			
		V D[15]			
		V D[16]			
		V D[17]			
		V D[18]			

MIPI RX supports the demultiplexing of MIPI-CSI and can receive channel information from different channel ID.

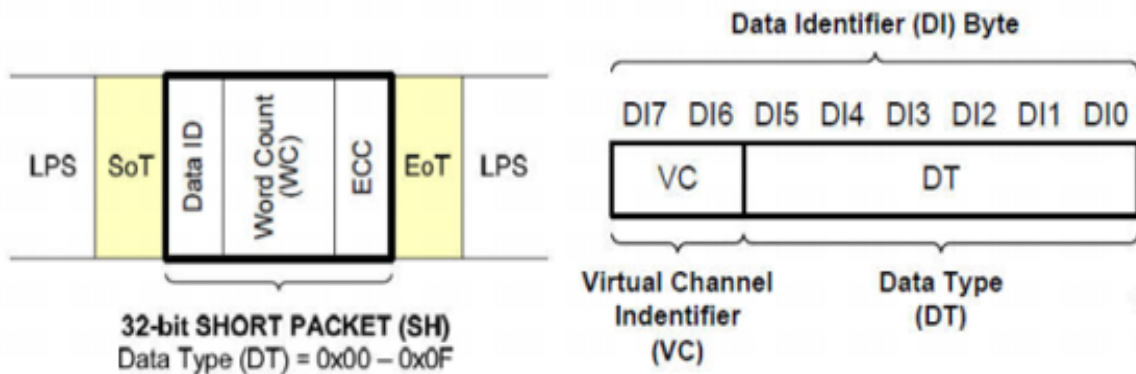


Fig. 2.3: The channel ID of MIPI-CSI

MIPI RX supports the demultiplexing of BT interfaces. The input end packages information coming from different channels in BT656 format. MIPI RX can restore each channel and then

solve the valid data with the corresponding synchronization code. Note that this mode only supports SDR.

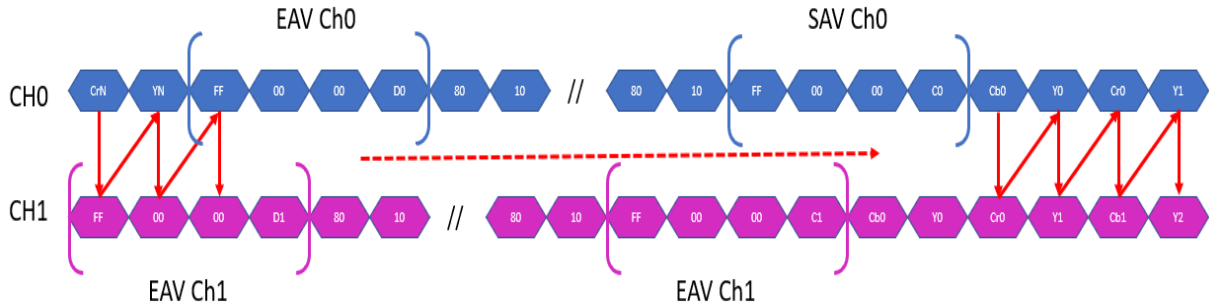


Fig. 2.4: The input with the support of BT demux mode

2.4 API Reference

MIPI Rx provides the function of docking sensor timing. The IOCTL interface is provided. The available commands are as follows:

- `CVI_MIPI_SET_HS_MODE` Set the Lane distribution mode of MIPI.
- `CVI_MIPI_SET_DEV_ATTR`: Set MIPI and parallel device properties.
- `CVI_MIPI_RESET_SENSOR`: Reset the sensor.
- `CVI_MIPI_UNRESET_SENSOR`: Undo reset the sensor.
- `CVI_MIPI_RESET_MIPI`: Reset MIPI Rx.
- `CVI_MIPI_ENABLE_SENSOR_CLOCK`: Turn on the CLOCK of SENSOR.
- `CVI_MIPI_DISABLE_SENSOR_CLOCK`: Turn off the CLOCK of SENSOR.
- `CVI_MIPI_SET_CROP_TOP`: Discard the first N data in each frame
- `CVI_MIPI_SET_WDR_MANUAL`: Turn on the WDR manual mode.
- `CVI_MIPI_SET_LVDS_FP_VS`: Set the time point of VSYNC generated in LVDS.

MIPI Tx provides the function of docking display and cascading.

The single OS provides an ioctl interface. The available commands are as follows:

- `CVI_VIP_MIPI_TX_SET_DEV_CFG` : Set the properties of the MIPI Tx device.
- `CVI_VIP_MIPI_TX_GET_CMD` : Read information from MIPI Tx device.
- `CVI_VIP_MIPI_TX_SET_CMD` : The device send command to MIPI Tx device.
- `CVI_VIP_MIPI_TX_ENABLE` : Enable MIPI Tx device.
- `CVI_VIP_MIPI_TX_DISABLE` : Disable MIPI Tx device.
- `CVI_VIP_MIPI_TX_SET_HS_SETTLE` : Set the settle timing of MIPI Tx in HS mode.

- *CVI_VIP_MIPI_TX_GET_HS_SETTLE* : obtain the settle timing of MIPI Tx in HS mode.

The dual OS provides an ioctl interface. The available commands are as follows:

- *MSG_CMD_MIPI_TX_SET_DEV_CFG*: Set the properties of the MIPI Tx device.
- *MSG_CMD_MIPI_TX_GET_CMD*: Read information from MIPI Tx device.
- *MSG_CMD_MIPI_TX_SET_CMD*: The device send command to MIPI Tx device.
- *MSG_CMD_MIPI_TX_ENABLE*: Enable MIPI Tx device.
- *MSG_CMD_MIPI_TX_DISABLE*: Disable MIPI Tx device.
- *MSG_CMD_MIPI_TX_SET_HS_SETTLE*: Set the settle timing of MIPI Tx in HS mode.
- *MSG_CMD_MIPI_TX_GET_HS_SETTLE*: obtain the settle timing of MIPI Tx in HS mode.

2.4.1 CVI_MIPI_SET_HS_MODE

【Description】

Relating functions are replaced by *CVI_MIPI_SET_DEV_ATTR*.

2.4.2 CVI_MIPI_SET_DEV_ATTR

【Description】

Set MIPI and parallel device properties.

【Parameter】

```
#define CVI_MIPI_SET_DEV_ATTR_IOW(CVI_MIPI_IOC_MAGIC, 0x01, struct combo_dev_
↪attr_t)
```

【Syntax】

Pointer of type *struct combo_dev_attr_t*

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

None

【Requirement】

- Header files: *cvi_vip_cif.h*

【Note】

- Before configuring CVI_MIPI_SET_DEV_ATTR, you need to use ISP interface to turn on the CLOCK of MIPI_RX. Please refer to ISP related documents for details.
- Before configuring CVI_MIPI_SET_DEV_ATTR, the following interfaces need to be configured:
 - Reset MIPI: the interface is CVI_MIPI_RESET_MIPI.
 - Turn on the CLOCK of Sensor: the interface is CVI_MIPI_ENABLE_SENSOR_CLOCK.
 - Reset Sensor: the interface is CVI_MIPI_RESET_SENSOR.
 - Undo reset Sensor: the interface is CVI_MIPI_UNRESET_SENSOR.
- The recommended configuration process are as follows:
 1. Turn on the CLOCK of ISP.
 2. Reset the docking Sensor.
 3. Reset MIPI Rx.
 4. Configure MIPI Rx device properties.
 5. Turn on all clocks connected to Sensor.
 6. Undo reset the docking Sensor.
- The recommended exit process are as follows:
 1. Reset the docking Sensor.
 2. Turn off all the clock connected to the Sensor.
 3. Reset MIPI Rx.
 4. Turn off the CLOCK of ISP.
- Operating the sensor reset signal line and clock signal line will have an effect on all sensors connected to the signal line.

【Related data types and Interfaces】

- CVI_MIPI_RESET_MIPI
- CVI_MIPI_ENABLE_SENSOR_CLOCK
- CVI_MIPI_DISABLE_SENSOR_CLOCK
- CVI_MIPI_RESET_SENSOR
- CVI_MIPI_UNRESET_SENSOR
- CVI_MIPI_RESET_SENSOR

2.4.3 CVI_MIPI_RESET_SENSOR

【Description】

Reset sensor

【Syntax】

```
#define CVI_MIPI_RESET_SENSOR_IOW(CVI_MIPI_IOC_MAGIC, 0x05, unsigned int)
```

【Parameter】

unsigned int. Sensor reset signal line number.

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

None

【Requirement】

- Header files: cvi_vip_cif.h

【Note】

- The sensor reset signal is bound to the corresponding dts.

```
mipi_rx: cif {
compatible = "cvitek,cif";
reg = <0x0 0x0a0c2000 0x0 0x2000>, <0x0 0x0a0d0000 0x0 0x1000>,
<0x0 0x0a0c4000 0x0 0x2000>;
reg-names = "csi_mac0", "csi_wrap0", "csi_mac1";
interrupts = <GIC_SPI 155 IRQ_TYPE_LEVEL_HIGH>,
<GIC_SPI 156 IRQ_TYPE_LEVEL_HIGH>;
interrupt-names = "csi0", "csi1";
snr-reset = <&porta 2 GPIO_ACTIVE_LOW>, <&porta 2 GPIO_ACTIVE_LOW>;
resets = <&rst RST_CSIPHY0>, <&rst RST_CSIPHY1>,
<&rst RST_CSIPHYORST_APB>, <&rst RST_CSIPHY1RST_APB>;
reset-names = "phy0", "phy1", "phy-apb0", "phy-apb1";
clocks = <&clock CV181X_CLOCK_CAM0>, <&clock CV181X_CLOCK_CAM1>, <&clock CV181X_
CLOCK_SRC_VIP_SYS_2>;
clock-names = "clock_cam0", "clock_cam1", "clock_sys_2";
};
```

2.4.4 CVI_MIPI_UNRESET_SENSOR

【Description】

Undo reset sensor.

【Syntax】

```
#define CVI_MIPI_UNRESET_SENSOR_IOW(CVI_MIPI_IOC_MAGIC, 0x06, unsigned int)
```

【Parameter】

unsigned int. Sensor reset signal line number.

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

None

【Requirement】

- Header files: `cvi_vip_cif.h`

【Note】

- The sensor reset signal is bound to the corresponding dts.

```
mipi_rx: cif {
compatible = "cvitek,cif";
reg = <0x0 0x0a0c2000 0x0 0x2000>, <0x0 0x0a0d0000 0x0 0x1000>,
<0x0 0x0a0c4000 0x0 0x2000>;
reg-names = "csi_mac0", "csi_wrap0", "csi_mac1";
interrupts = <GIC_SPI 155 IRQ_TYPE_LEVEL_HIGH>,
<GIC_SPI 156 IRQ_TYPE_LEVEL_HIGH>;
interrupt-names = "csi0", "csi1";
snr-reset = <&porta 2 GPIO_ACTIVE_LOW>, <&porta 2 GPIO_ACTIVE_LOW>;
resets = <&rst RST_CSIPHY0>, <&rst RST_CSIPHY1>,
<&rst RST_CSIPHYORST_APB>, <&rst RST_CSIPHY1RST_APB>;
reset-names = "phy0", "phy1", "phy-apb0", "phy-apb1";
clocks = <&clock CV181X_CLOCK_CAM0>, <&clock CV181X_CLOCK_CAM1>, <&clock CV181X_
CLOCK_SRC_VIP_SYS_2>;
clock-names = "clock_cam0", "clock_cam1", "clock_sys_2";
};
```

2.4.5 CVI_MIPI_RESET_MIPI

【Description】

Reset MIPI_Rx.

【Syntax】

```
#define CVI_MIPI_RESET_MIPI_IOW(CVI_MIPI_IOC_MAGIC, 0x07, unsigned int)
```

【Parameter】

unsigned int. MIPI_RX device number.

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

None

【Requirement】

- Header files:cvi_vip_cif.h

【Note】

2.4.6 CVI_MIPI_ENABLE_SENSOR_CLOCK

【Description】

Turn on the sensor clock.

【Syntax】

```
#define CVI_MIPI_ENABLE_SENSOR_CLOCK_IOW(CVI_MIPI_IOC_MAGIC, 0x10, unsigned int)
```

【Parameter】

unsigned int. MIPI_Rx device number.

【Return Value】

Return Value	Description
0	Success
-1	fail and set errno

【Processor Difference】

none

【Requirement】

- Header files: cvi_vip_cif.h

【Note】

2.4.7 CVI_MIPI_DISABLE_SENSOR_CLOCK

【Description】

Turn off the clock of sensor.

【Syntax】

```
#define CVI_MIPI_DISABLE_SENSOR_CLOCK _IOW(CVI_MIPI_IOC_MAGIC, 0x11, unsigned_
↪ int)
```

【Parameter】

unsigned int.MIPI_Rx device number。

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

none

【Requirement】

- Header files: cvi_vip_cif.h

【Note】

2.4.8 CVI_MIPI_SET_CROP_TOP

【Description】

Discard the first n data in each frame

【Syntax】

```
#define CVI_MIPI_SET_WDR_MANUAL _IOW(CVI_MIPI_IOC_MAGIC, 0x21, struct crop_top_
↪ s)
```

【Parameter】

struct crop_top_s

【Return Value】

Return Value	Description
0	Success
-1	fail and seterrno

【Processor Difference】

none

【Requirement】

- Header files: `cvi_vip_cif.h`

【Note】

2.4.9 CVI_MIPI_SET_WDR_MANUAL

【Description】

Turn on WDR manual mode.

【Syntax】

```
#define CVI_MIPI_SET_WDR_MANUAL_IOCTL(CVI_MIPI_IOCTL_MAGIC, 0x21, struct manual_
↪wdr_s)
```

【Parameter】

`struct manual_wdr_s`

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

none

【Requirement】

- Header files: `cvi_vip_cif.h`

【Note】

2.4.10 CVI_MIPI_SET_LVDS_FP_VS

【Description】

Set the time point of VSYNC generation in sub-LVDS

【Syntax】

```
#define CVI_MIPI_SET_LVDS_FP_VS_IOW(CVI_MIPI_IOC_MAGIC, 0x22, struct vsync_gen_
↪s)
```

【Parameter】

struct vsync_gen_s

【Return Value】

Return Value	Description
0	Success
-1	fail and seterno

【Processor Difference】

none

【Requirement】

- Header files: cvi_vip_cif.h

【Note】

2.4.11 CVI_VIP_MIPI_TX_SET_DEV_CFG

【Description】

Set the properties of the MIPI Tx device.

【Syntax】

```
#define CVI_VIP_MIPI_TX_SET_DEV_CFG_IOW(CVI_VIP_MIPI_TX_IOC_MAGIC, 0x01,
↪struct combo_dev_cfg_s)
```

【Parameter】

MIPI Tx device properties, See the Description of combo_dev_cfg_s structure for details.

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

none

【Requirement】

- Header files: `cvi_mipi_tx.h`

【Note】

2.4.12 MSG_CMD_MIPI_TX_SET_DEV_CFG

The description, parameters, return value, processor difference, requirement, and note of this dual OS are the same as those of the single OS command `CVI_VIP_MIPI_TX_SET_DEV_CFG`.

【Syntax】

```
typedef enum tagMSG_MIPI_TX_CMD_E {
    MSG_CMD_MIPI_TX_SET_DEV_CFG = 0,
    MSG_CMD_MIPI_TX_SET_CMD,
    MSG_CMD_MIPI_TX_GET_CMD,
    MSG_CMD_MIPI_TX_ENABLE,
    MSG_CMD_MIPI_TX_DISABLE,
    MSG_CMD_MIPI_TX_SET_HS_SETTLE,
    MSG_CMD_MIPI_TX_GET_HS_SETTLE,
    MSG_CMD_MIPI_TX_BUFF
} MSG_MIPI_TX_CMD_E;
```

The definitions of subsequent commands for dual OS come from this enumeration and will not be described again.

2.4.13 CVI_VIP_MIPI_TX_GET_CMD

【Description】

Read information from MIPI Tx device.

【Syntax】

```
#define CVI_VIP_MIPI_TX_GET_CMD_IOWR(CVI_VIP_MIPI_TX_IOC_MAGIC, 0x04, struct_
↪get_cmd_info_s)
```

【Parameter】

See the Description of `get_cmd_info_s` structure for details.

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

processor type	support or not
CV1835	support, get_data_size max 4

【Requirement】

- Header files: cvi_mipi_tx.h

【Note】

2.4.14 MSG_CMD_MIPI_TX_GET_CMD

The description, parameters, return value, processor difference, requirement, and note of this dual OS are the same as those of the single OS command CVI_VIP_MIPI_TX_GET_CMD.

【Syntax】

See the Description of MSG_CMD_MIPI_TX_SET_DEV_CFG command for details.

2.4.15 CVI_VIP_MIPI_TX_SET_CMD

【Description】

The device sends commands to the MIPI Tx device.

【Syntax】

```
#define CVI_VIP_MIPI_TX_SET_CMD_IOW(CVI_VIP_MIPI_TX_IOC_MAGIC, 0x02, struct ↵
↵ cmd_info_s)
```

【Parameter】

See the Description of cmd_info_s structure for details.

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

None

【Requirement】

- Header files: cvi_mipi_tx.h

【Note】

2.4.16 MSG_CMD_MIPI_TX_SET_CMD

The description, parameters, return value, processor difference, requirement, and note of this dual OS are the same as those of the single OS command CVI_VIP_MIPI_TX_SET_CMD.

【Syntax】

See the Description of MSG_CMD_MIPI_TX_SET_DEV_CFG command for details.

2.4.17 CVI_VIP_MIPI_TX_ENABLE

【Description】

Enable Mipi TX device.

【Syntax】

```
#define CVI_VIP_MIPI_TX_ENABLE_ID(CVI_VIP_MIPI_TX_IOC_MAGIC, 0x03)
```

【Parameter】

none

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

None

【Requirement】

- Header files: cvi_mipi_tx.h

【Note】

After this API call, mipi will switch to HS mode.

2.4.18 MSG_CMD_MIPI_TX_ENABLE

The description, parameters, return value, processor difference, requirement, and note of this dual OS are the same as those of the single OS command CVI_VIP_MIPI_TX_ENABLE.

【Syntax】

See the Description of MSG_CMD_MIPI_TX_SET_DEV_CFG command for details.

2.4.19 CVI_VIP_MIPI_TX_DISABLE

【Description】

Disable MIPI Tx device.

【Syntax】

```
#define CVI_VIP_MIPI_TX_DISABLE_IO(CVI_VIP_MIPI_TX_IOC_MAGIC, 0x05)
```

【Parameter】

none

【Return Value】

Return Value	Description
0	success
-1	Failure, please refer to the error code.

【Processor Difference】

None

【Requirement】

- Header files: cvi_mipi_tx.h

【Note】

After this API call, mipi will switch to LP mode.

2.4.20 MSG_CMD_MIPI_TX_DISABLE

The description, parameters, return value, processor difference, requirement, and note of this dual OS are the same as those of the single OS command CVI_VIP_MIPI_TX_DISABLE.

【Syntax】

See the Description of MSG_CMD_MIPI_TX_SET_DEV_CFG command for details.

2.4.21 CVI_VIP_MIPI_TX_SET_HS_SETTLE

【Description】

Set the settle timing of MIPI Tx in HS mode.

【Syntax】

```
#define CVI_VIP_MIPI_TX_SET_HS_SETTLE_IOW(CVI_VIP_MIPI_TX_IOC_MAGIC, 0x06,   
↪ struct hs_settle_s)
```

【Parameter】

See the Description of `hs_settle_s` structure for details.

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

None

【Requirement】

- Header files: `cvi_mipi_tx.h`

【Note】

2.4.22 MSG_CMD_MIPI_TX_SET_HS_SETTLE

The description, parameters, return value, processor difference, requirement, and note of this dual OS are the same as those of the single OS command `CVI_VIP_MIPI_TX_SET_HS_SETTLE`.

【Syntax】

See the Description of `MSG_CMD_MIPI_TX_SET_DEV_CFG` command for details.

2.4.23 CVI_VIP_MIPI_TX_GET_HS_SETTLE

【Description】

Get the settle timing of MIPI Tx in HS mode.

【Syntax】

```
#define CVI_VIP_MIPI_TX_GET_HS_SETTLE_IOWR(CVI_MIPI_TX_IOC_MAGIC, 0x06, struct ↵
↵hs_settle_s)
```

【Parameter】

See the Description of `hs_settle_s` structure for details.

【Return Value】

Return Value	Description
0	Success
-1	Failure, please refer to the error code.

【Processor Difference】

None

【Requirement】

- Header files: `cvi_mipi_tx.h`

【Note】

2.4.24 MSG_CMD_MIPI_TX_GET_HS_SETTLE

The description, parameters, return value, processor difference, requirement, and note of this dual OS are the same as those of the single OS command `CVI_VIP_MIPI_TX_GET_HS_SETTLE`.

【Syntax】

See the Description of `MSG_CMD_MIPI_TX_SET_DEV_CFG` command for details.

2.5 Data Types

The Syntax of MIPI RX data type is as follows:

- `CVI_MIPI_IOC_MAGIC`: Magic number of MIPI Rx ioctl command.
- `MIPI_LANE_NUM`: The maximum number of lanes supported by MIPI devices of MIPI Rx.
- `WDR_VC_NUM`: define the maximum number of supported Virtual Channels.
- `SYNC_CODE_NUM`: Defines the number of synchronization codes for each virtual channel of LVDS.
- `input_mode_e`: MIPI Rx input interface type.
- `img_size_s`: The size of each frame of MIPI Rx input data.
- `rx_mac_clock_e`: the working clock supported by MAC.
- `cam_pll_freq_e`: The sensor reference clock of MIPI-RX output.
- `mclock_pll_s`: Sensor reference clock setting of MIPI-RX output.
- `raw_data_type_e`: MIPI Rx input data format.
- `mipi_wdr_mode_e`: MIPI-CSI WDR mode.
- `wdr_mode_e`: LVDS/HISPI WDR mode.
- `lvds_sync_mode_e`: LVDS synchronization mode.
- `lvds_bit_endian`: Big endian mode.
- `lvds_vsync_type_e`: The synchronization mode of LVDS in WDR mode.
- `lvds_fid_type_e`: LVDS frame identification ID type.
- `lvds_fid_type_s`: LVDS frame identification ID type.
- `lvds_vsync_type_s`: LVDS WDR synchronization Parameter.
- `lvds_dev_attr_s`: SubLVDS/HiSPi device properties.
- `dphy_s`: the properties of MIPI DPHY.

- `mipi_demux_info_s`: the properties of MIPI in demultiplexing mode.
- `mipi_dev_attr_s`: MIPI-CSI device properties.
- `manual_wdr_attr_s`: Manual WDR mode Parameter.
- `ttl_pin_func_e`: the config function of TTL/BT interfaces.
- `ttl_src_e`: the input source of TTL/BT interfaces.
- `bt_demux_mode_e`: the number of channels of BT in demultiplexing mode.
- `bt_demux_sync_s`: the synchronization code config of BT in demultiplexing mode.
- `bt_demux_attr_s`: the device properties of BT in demultiplexing mode.
- `ttl_dev_attr_s`: the TTL/BT devices' properties.
- `combo_dev_attr_s`: combo device properties.
- `crop_top_s`: Discard the row data attribute at the beginning.
- `manual_wdr_s`: Manual WDR mode setting.
- `vsync_gen_s`: SUBLVDS Vertical synchronization signal properties.

The Syntax of MIPI RX data type is as follows:

- `LANE_MAX_NUM`: Maximum number of lanes supported by a MIPI Tx device.
- `output_mode_e`: MIPI Tx output mode
- `video_mode_e`: MIPI Tx video mode
- `output_format_e`: MIPI Tx output format
- `sync_info_s`: MIPI Tx device synchronization information
- `combo_dev_cfg_s`: MIPI Tx device properties
- `cmd_info_s`: Retrieve information from MIPI Tx device
- `get_cmd_info_s`: Retrieve information from MIPI Tx device
- `hs_settle_s`: the information of settle of MIPI Tx devices in HS mode.

2.5.1 CVI_MIPI_IOC_MAGIC

【Description】

MIPI Rx ioctl magic number of command

【Syntax】

```
#define CVI_MIPI_IOC_MAGIC      'm'
```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.2 MIPI_LANE_NUM

【Description】

The maximum number of lanes supported by a MIPI Rx device.

【Syntax】

```
#define MIPI_LANE_NUM 4
```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.3 WDR_VC_NUM

【Description】

Define the maximum number of virtual channels supported

【Definition】

```
#define WDR_VC_NUM 2
```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.4 SYNC_CODE_NUM

【Description】

Defines the number of synchronization codes for each virtual channel of LVDS.

【Definition】

```
#define SYNC_CODE_NUM 4
```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.5 BT_DEMUX_NUM

【Description】

Define the maximum number of channels supported when using bt demux function.

【Definition】

```
#define BT_DEMUX_NUM 4
```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.6 MIPI_DEMUX_NUM

【Definition】

Defines the maximum number of virtual channels supported when using the mipi demux function.

【Definition】

```
#define MIPI_DEMUX_NUM 4
```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.7 input_mode_e

【Description】

MIPI Rx input interface type.

【Definition】

```
enum input_mode_e {
    INPUT_MODE_MIPI = 0,
    INPUT_MODE_SUBLVDS,
    INPUT_MODE_HISPI,
    INPUT_MODE_CMOS,
    INPUT_MODE_BT1120,
    INPUT_MODE_BT601_19B_VHS,
    INPUT_MODE_BT656_9B,
    INPUT_MODE_CUSTOM_0,
    INPUT_MODE_BT_DEMUX,
    INPUT_MODE_BUTT
};
```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.8 img_size_s

【Description】

The size of each frame of MIPI Rx input data.

【Definition】

```
struct img_size_s {
    unsigned int width;
```

(continues on next page)

(continued from previous page)

```

    unsigned int    height;
};

```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.9 rx_mac_clock_e

【Description】

MAC supports working clock.

【Definition】

```

enum rx_mac_clock_e {
    RX_MAC_CLOCK_200M = 0,
    RX_MAC_CLOCK_400M,
    RX_MAC_CLOCK_500M,
    RX_MAC_CLOCK_600M,
    RX_MAC_CLOCK_BUTT,
};

```

【Processor Difference】

none.

【Note】

Please refer to 1.7.2 for the relationship between MAC clock and MIPI clock.

【Related Data Type and Interface】

none

2.5.10 cam_pll_freq_e

【Description】

The sensor reference clock of MIPI-RX output.

【Definition】

```
enum cam_pll_freq_e {
    CAMPLL_FREQ_NONE = 0,
    CAMPLL_FREQ_37P125M,
    CAMPLL_FREQ_25M,
    CAMPLL_FREQ_27M,
    CAMPLL_FREQ_24M,
    CAMPLL_FREQ_26M,
    CAMPLL_FREQ_NUM
};
```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.11 mclock_pll_s

【Description】

Sensor reference clock setting of MIPI-RX output.

【Definition】

```
struct mclock_pll_s {
    unsigned int    cam;
    enum cam_pll_freq_e  freq;
};
```

【Member】

Member	Description
cam	0: output is CAM_MCLOCK0 1: output is CAM_MCLOCK1
freq	The output reference Sensor clocktion

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.12 raw_data_type_e

【Description】

MIPI Rx data format。

【Definition】

```
enum raw_data_type_e {
    RAW_DATA_8BIT = 0,
    RAW_DATA_10BIT,
    RAW_DATA_12BIT,
    YUV422_8BIT,    /* MIPI-CSI only */
    YUV422_10BIT,  /* MIPI-CSI only*/
    RAW_DATA_BUTT
};
```

【Processor Difference】

none.

【Note】

YUV422_8BIT and YUV422_10BIT are only supported in MIPI-CSI mode

【Related Data Type and Interface】

none

2.5.13 mipi_wdr_mode_e

【Description】

MIPI-CSI WDR mode。

【Definition】

```
enum mipi_wdr_mode_e {
    CVI_MIPI_WDR_MODE_NONE = 0,
    CVI_MIPI_WDR_MODE_VC,
    CVI_MIPI_WDR_MODE_DT,
    CVI_MIPI_WDR_MODE_DOL,
    CVI_MIPI_WDR_MODE_MANUAL, /* SOI case */
    CVI_MIPI_WDR_MODE_BUTT
};
```

【Member】

Member	Description
CVI_MIPI_WDR_MODE_NONE	Linear mode
CVI_MIPI_WDR_MODE_VC	MIPI-CSI Virtual Channel mode
CVI_MIPI_WDR_MODE_DT	MIPI-CSI Data Type mode
CVI_MIPI_WDR_MODE_DOL	Sony DOL LI mode
CVI_MIPI_WDR_MODE_MANUAL	WDR manual mode

【Processor Difference】

none.

【Note】

- CVI_MIPI_WDR_MODE_VC is suitable for the sensor that uses MIPI-CSI Virtual Channel ID to distinguish long exposure line and short exposure line.
- CVI_MIPI_WDR_MODE_DT is suitable for sensors that use MIPI-CSI Data Type ID to distinguish long exposure line and short exposure line. Note that long exposure and short exposure must start and end at the same frame.
- CVI_MIPI_WDR_MODE_DOL is suitable for using SONY MIPI-CSI Line Information mode.
- CVI_MIPI_WDR_MODE_Manual uses custom rules to determine long exposure line and short exposure line.

【Related Data Type and Interface】

none

2.5.14 wdr_mode_e

【Description】

Sub-LVDS/HISPI WDR mode.

【Definition】

```
enum wdr_mode_e {
    CVI_WDR_MODE_NONE = 0,
    CVI_WDR_MODE_2F,
    CVI_WDR_MODE_3F,
    CVI_WDR_MODE_DOL_2F,
    CVI_WDR_MODE_DOL_3F,
    CVI_WDR_MODE_DOL_BUTT
};
```

【Member】

Member	Description
CVI_WDR_MODE_NONE	Linear mode
CVI_WDR_MODE_2F	General double exposure WDR
CVI_WDR_MODE_3F	General three exposure WDR
CVI_WDR_MODE_DOL_2F	Sony DOL-2 WDR
CVI_WDR_MODE_DOL_3F	Sony DOL-3 WDR

【Processor Difference】

none.

【Note】

- CVI_WDR_MODE_2F is suitable for general MIPI-CSI/HiSPi interleaved WDR.
- CVI_WDR_MODE_DOL_2F is suitable for Sony Sub-LVDS DOL-2 WDR.
- CV181x dose not support CVI_WDR_MODE_3F and CVI_WDR_MODE_DOL_3F.
- CV180X no support WDR mode.
- **【Related Data Type and Interface】**
none

2.5.15 lvds_sync_mode_e

【Description】

LVDS synchronization mode.

【Definition】

```
enum lvds_sync_mode_e {
    LVDS_SYNC_MODE_SOF = 0,
    LVDS_SYNC_MODE_SAV,
    LVDS_SYNC_MODE_BUTT
};
```

【Member】

Member	Description
LVDS_SYNC_MODE_SOF	SOF, EOF, SOL, EOL. please refer to figure 2-1
LVDS_SYNC_MODE_SAV	Invalid SAV, invalid EAV, valid SAV, valid EAV. please refer to figure 2-2.

【Processor Difference】

none.

【Note】

- LVDS_SYNC_MODE_SOF is suitable for HiSPi Packetize-SP mode.
- LVDS_SYNC_MODE_SAV is suitable for sub-LVDS and HiSPi Streaming-SP mode.
- When input is INPUT_MODE_HISPI and the synchronization mode is LVDS_SYNC_MODE_SAV。MIPI-Rx switches to HiSPi Streaming-SP mode.

【Related Data Type and Interface】

none

2.5.16 lvds__bit__endian

【Description】

Bit endian mode.

【Definition】

```
enum lvds_bit_endian {
    LVDS_ENDIAN_LITTLE = 0,
    LVDS_ENDIAN_BIG,
    LVDS_ENDIAN_BUTT
};
```

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.17 lvds__vsync__type__e

【Description】

The synchronization mode of LVDS in WDR mode.

【Definition】

```
enum lvds_vsync_type_e {
    LVDS_VSYNC_NORMAL = 0,
    LVDS_VSYNC_SHARE,
    LVDS_VSYNC_HCONNECT,
    LVDS_VSYNC_BUTT
};
```

【Member】

Member	Description
LVDS_VSYNC_NORMAL	Normal short exposure frames have independent SOF-EOF, SOL-EOL or invalid-SAV-invalid-EAV, valid SAV-valid EAV
LVDS_VSYNC_SHARE	Share short exposure frames share a pair of SOF-EOF marks, and the first few lines of short exposure are filled with fixed values
LVDS_VSYNC_HCONNECT	Horizontal short exposure frames share a pair of SAV-EAV marks, and there is a fixed period of blanking between the long and short exposure frames.

- LVDS_VSYNC_NORMAL synchronization mode:

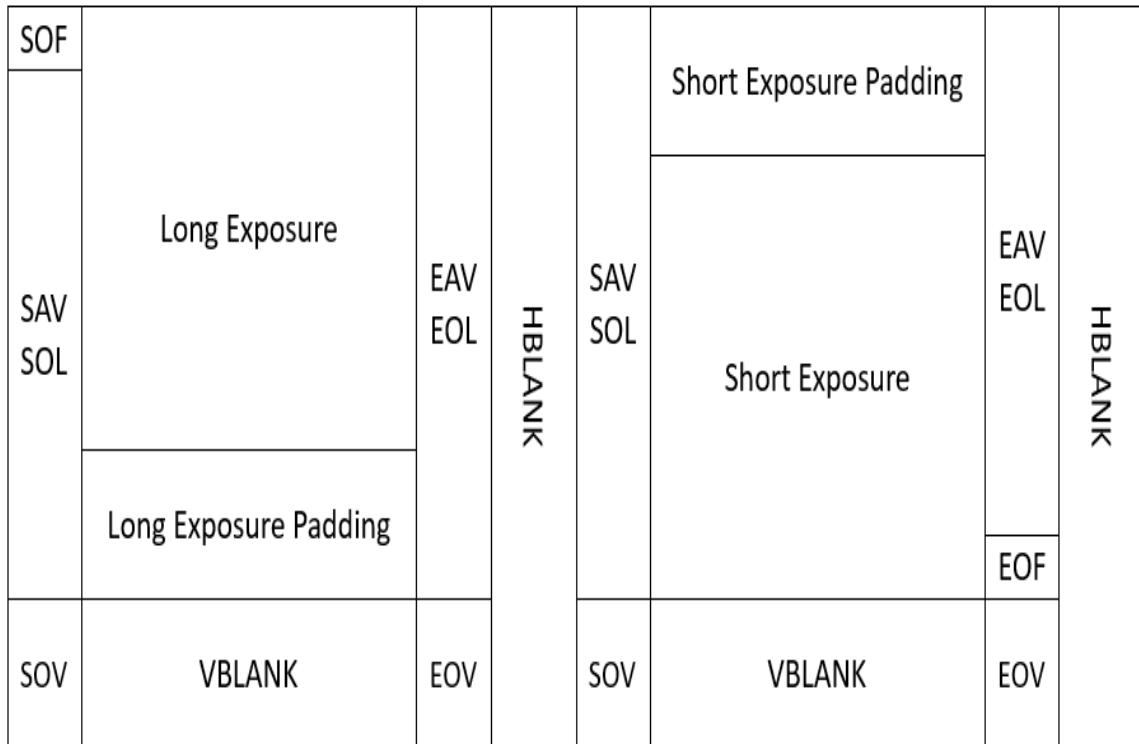


Fig. 2.5: LVDS_VSYNC_NORMAL synchronization mode.

- LVDS_VSYNC_HCONNECT synchronization mode:

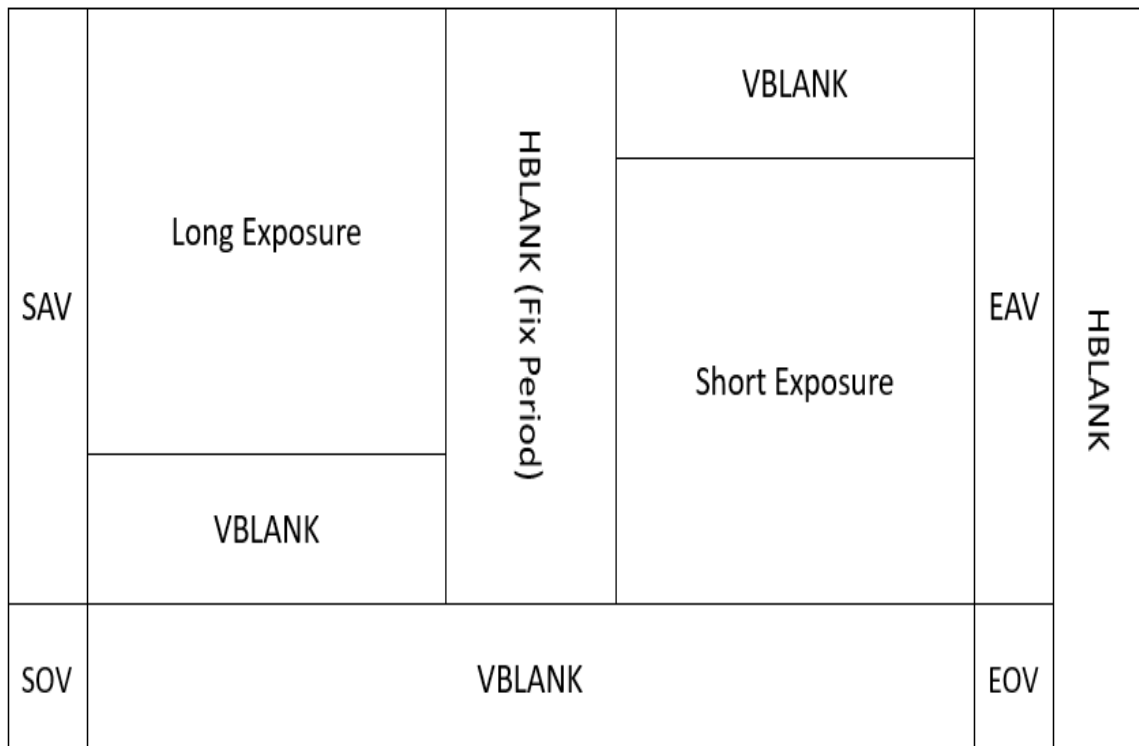


Fig. 2.6: LVDS_VSYNC_HCONNECT synchronization mode.

【Processor Difference】

none

【Note】

- LVDS_VSYNC_NORMAL is suitable for SONY sub-LVDS DOL-2 pattern 1 and HiSPi Packtized-SP WDR mode.
- LVDS_VSYNC_SHARE is suitable for HiSPi Streaming-SP WDR mode.
- LVDS_VSYNC_HCONNECT is suitable for SONY sub-LVDS DOL-2 pattern 2.

【Related Data Type and Interface】

none

2.5.18 lvds_fid_type_e

【Description】

LVDS frame identification ID type.

【Definition】

```
enum lvds_fid_type_e {
    LVDS_FID_NONE = 0,
    LVDS_FID_IN_SAV,
    LVDS_FID_BUTT,
};
```

【Member】

Member	Description
LVDS_FID_NONE	Do not use frame identification id
LVDS_FID_IN_SAV	The FID is inserted in the fourth field of the SAV.

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.19 lvds_fid_type_s

【Description】

LVDS frame identification ID type.

【Definition】

```
struct lvds_fid_type_s {
    enum lvds_fid_type_e    fid;
};
```

【Member】

Member	Description
fid	Frame identification type in LVDS DOL mode

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.20 lvds_vsync_type_s

【Description】

LVDS WDR synchronize Parameter.

【Definition】

```
struct lvds_vsync_type_s {
    enum lvds_vsync_type_e  sync_type;
    unsigned short          hblank1;
    unsigned short          hblank2;
};
```

【Processor Difference】

none

【Note】

- When sync_type is LVDS_VSYNC_HCONNECT, hblank1 and hblank2 should be configured to indicate the length of the blanking zone between long and short exposures.

【Related Data Type and Interface】

none

2.5.21 lvds_dev_attr_s

【Description】

LVDS/SubLVDS/HiSPi device properties.

【Definition】

```

struct lvds_dev_attr_s {
    enum wdr_mode_e          wdr_mode;
    enum lvds_sync_mode_e    sync_mode;
    enum raw_data_type_e     raw_data_type;
    enum lvds_bit_endian     data_endian;
    enum lvds_bit_endian     sync_code_endian;
    short                    lane_id[MIPI_LANE_NUM+1];
    short                    sync_code[MIPI_LANE_NUM][WDR_VC_NUM+1][SYNC_CODE_NUM];
    struct lvds_vsync_type_s vsync_type;
    struct lvds_fid_type_s   fid_type;
    char                     pn_swap[MIPI_LANE_NUM+1];
};

```

【Member】

Member	Description
wdr_mode	WDR mode
sync_mode	LVDS synchronization mode
raw_data_type	Type of data transferred
data_endian	Data endian
sync_code_endian	Synchronization code size mode
lane_id	The corresponding relationship between sensor and MIPI RX Lane
sync_code	Each virtual channel has four synchronization codes. According to different synchronization modes, they represent the synchronization codes of SOF/EOF/ SOL/EOL or invalid SAV/invalid EAV/ valid SAV/valid EAV respectively.
vsync_type	vsync type, when wdr_mod is in DOL mode and sync_mode is in LVDS_SYNC_MODE_SAV, you need to configure the type of vsync
fid_type	Frame identification type
pn_swap	Positive/negative line exchange or not

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.22 dphy__s

【Description】

MIPI RX DPHY device properties.

【Definition】

```
struct mipi_dev_attr_s {
    unsigned char    enable;
    unsigned char    hs_settle;
};
```

【Member】

Member	Description
enable	Turn on the property setting of MIPI RX DPHY.
hs_settle	hs settle time

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.23 mipi_demux_info_s

【Description】

MIPI CSI use the property setting of Virtual Channel demultiplexing.

【Definition】

```
struct mipi_demux_info_s {
    unsigned int    demux_en;
    unsigned char    vc_mapping[MIPI_DEMUX_NUM];
};
```

【Member】

Member	Description
demux_en	Turn on mipi virtual channel demultiplexing.
vc_mapping	Set the corresponding relationship of ISP channel and mipi virtual channel. Such as vc_mapping = {0, 2, 3, 1}, ISP ch0 indicates vc=0; ch1 indicates vc=2; ch2 indicates vc=3; ch3 indicates vc=1.

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.24 mipi_dev_attr_s

【Description】

MIPI-CSI devices' property.

【Definition】

```

struct mipi_dev_attr_s {
    enum raw_data_type_e          raw_data_type;
    short                        lane_id[MIPI_LANE_NUM+1];
    enum mipi_wdr_mode_e         wdr_mode;
    short                        data_type[WDR_VC_NUM];
    char                          pn_swap[MIPI_LANE_NUM+1];
};

```

【Member】

Member	Description
wdr_mode	WDR mode
raw_data_type	The type of transmitted data.
lane_id	The corresponding relationship between the sender (sensor) and the receiver (MIPI Rx) lane.
data_type	When WDR mode is CVI_MIPI_WDR_MODE_DT, the corresponding data type of each WDR frames.
pn_swap	Whether Positive and negative line are swapped.

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.25 manual_wdr_attr_s

【Description】

Manual WDR mode Parameter.

【Definition】

```
struct manual_wdr_attr_s {
    unsigned int          manual_en;
    unsigned short       l2s_distance;
    unsigned short       lsef_length;
    unsigned int         discard_padding_lines;
    unsigned int         update;
};
```

【Member】

Member	Description
manual_en	Manual switch of WDR.
l2s_distance	The distance from the first long exposure to the first short exposure in a frame, the unit is the number of rows.
lsef_length	The number of long/short exposure lines.
discard_padding_lines	Whether the sensor outputs the padding line as a valid line.
update	Whether to force the settings to be updated. If not, the setting will wait for the next synchronization signal to be updated.

【Processor Difference】

none

【Note】

- When HiSPi is input and sync_type is LVDS_VSYNC_SHARE, need to turn on the manual WDR mode and set Parameter.
- When MIPI-CSI is input and wdr mode is CVI_MIPI_WDR_MODE_MANUAL, need to turn on the manual WDR mode and set Parameter.

【Related Data Type and Interface】

none

2.5.26 ttl_pin_func_e

【Description】

The config functions of TTL/BT interface.

【Definition】

```
enum ttl_pin_func_e {
    TTL_PIN_FUNC_VS,
    TTL_PIN_FUNC_HS,
    TTL_PIN_FUNC_VDE,
    TTL_PIN_FUNC_HDE,
    TTL_PIN_FUNC_D0,
    TTL_PIN_FUNC_D1,
    TTL_PIN_FUNC_D2,
    TTL_PIN_FUNC_D3,
    TTL_PIN_FUNC_D4,
    TTL_PIN_FUNC_D5,
    TTL_PIN_FUNC_D6,
    TTL_PIN_FUNC_D7,
    TTL_PIN_FUNC_D8,
    TTL_PIN_FUNC_D9,
    TTL_PIN_FUNC_D10,
    TTL_PIN_FUNC_D11,
    TTL_PIN_FUNC_D12,
    TTL_PIN_FUNC_D13,
    TTL_PIN_FUNC_D14,
    TTL_PIN_FUNC_D15,
    TTL_PIN_FUNC_NUM,
};
```

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.27 ttl_src_e

【Description】

The input source of TTL/BT interfaces.

【Definition】

```
enum ttl_src_e {
    TTL_VI_SRC_VI0 = 0,
    TTL_VI_SRC_VI1,
    TTL_VI_SRC_VI2,          /* BT demux */
    TTL_VI_SRC_NUM
};
```

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

Please refer to the tabel 2-1.

2.5.28 bt_demux_mode_e

【Description】

The channels' number of BT demultiplexing mode.

【Definition】

```
enum bt_demux_mode_e {
    BT_DEMUX_DISABLE = 0,
    BT_DEMUX_2,
    BT_DEMUX_3,
    BT_DEMUX_4,
};
```

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

None

2.5.29 bt_demux_sync_s

【Description】

The synchronization code setting of BT demultiplexing mode.

【Definition】

```
struct bt_demux_sync_s {
    unsigned char sav_vld;
    unsigned char sav_blk;
    unsigned char eav_vld;
    unsigned char eav_blk;
};
```

【Member】

Member	Description
sav_vld	The SAV of the valid data interval
sav_blk	The SAV of blank data interval.
eav_vld	The EAV of the valid data interval
eav_blk	The EAV of blank data interval.

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

None

2.5.30 bt_demux_attr_s

【Description】

The property setting of BT in demultiplexing mode.

【Definition】

```

struct bt_demux_attr_s {
    signed char          func[TTL_PIN_FUNC_NUM];
    unsigned short      v_fp;
    unsigned short      h_fp;
    unsigned short      v_bp;
    unsigned short      h_bp;
    enum bt_demux_mode_e mode;
    unsigned char        sync_code_part_A[3]; /* sync code 0~2 */
    struct bt_demux_sync_s sync_code_part_B[BT_DEMUX_NUM]; /* sync
↪code 3 */
    char                 yc_exchg;
};

```

【Member】

Member	Description
func	The corresponding input source of BT interface is the lane number of TTL_VI_SRC_VI2. Index is the logic function of BT, as for value please refer to table 1-1. Such as, func[TTL_PIN_FUNC_D0] = 5, indicates the BT signal' s D0 receive VI2_D[5], namely pad name VIVO_D5.
v_fp	The front porch in vertical direction
h_fp	The front porch in horizontal direction
v_bp	The back porch in vertical direction
h_bp	The back porch in horizontal direction
mode	The channel' s number of BT in demultiplexing mode.
sync_code_part_A	The synchronization code between 0 ~ 2 of BT in demultiplexing mode
sync_code_part_B	The BT demultiplexing mode' s synchronization code 3
yc_exchg	BIT0 to BIT3 represent the sequence exchange of Y Cb/Cr bytes from CH0 to CH3, where 1 indicates the exchange and 0 indicates the non-exchange.

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

None

2.5.31 ttl_dev_attr_s

【Description】

The property setting of TTL/BT interface.

【Definition】

```

struct ttl_dev_attr_s {
    enum ttl_src_e          vi;
    signed char            func[TTL_PIN_FUNC_NUM];
    unsigned short         v_bp;
    unsigned short         h_bp;
};

```

【Member】

Member	Description
vi	Input source of the TTL/BT interface. The allowed value is TTL_VI_SRC_VI0 or TTL_VI_SRC_VI1
func	The BT interface is corresponding with the lane number of input source. Index is the logic function of BT, as for value please refer to label 1-1. Such as, when vi = TTL_VI_SRC_VI1, func[TTL_PIN_FUNC_D0] = 5, indicates BT signal' s D0 receive VI1_D[5], namely pad name VIVO_D5.
v_bp	The back porch in vertical direction
h_bp	The back porch in horizontal direction

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

None

2.5.32 combo_dev_attr_s

【Description】

Combo device properties, because MIPI Rx can interface with CSI-2, sub-LVDS, HiSPi and other time sequences, MIPI Rx is called a combo device.

【Definition】

```

struct combo_dev_attr_s {
    enum input_mode_e          input_mode;
    enum rx_mac_clock_e       mac_clock;
    struct mclock_pll_s      mclock;
    union {
        struct mipi_dev_attr_s  mipi_attr;
        struct lvds_dev_attr_s  lvds_attr;
        struct ttl_dev_attr_s   ttl_attr;
        struct bt_demux_attr_s  bt_demux_attr;
    };
    unsigned int              devno;
    struct img_size_s         img_size;
    struct manual_wdr_attr_s  wdr_manu;
};

```

【Member】

Member	Description
input_mode	Input interface type
mac_clock	MIPI RX MAC clock setting
mclock	Sensor reference clock setting of MIPI RX output
mipi_attr	If input_mode is configured as INPUT_MODE_MIPI, mipi_attr must be configured
lvds_attr	If input_mode is configured as INPUT_MODE_SUBLVDS/INPUT_MODE_HISPI, lvds_attr must be configured
devno	MIPI-Rx device number
img_size	Input frame size
wdr_manu	Manual WDR properties

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.33 crop_top_s

【Description】

Discard the beginning row data.

【Definition】

```

struct crop_top_s {
    unsigned int          devno;
    unsigned int          crop_top;
    unsigned int          update;
};

```

【Member】

Member	Description
devno	MIPI-Rx device number
crop_top	The number of rows to discard at the beginning
update	Whether to force the settings to be updated. If not, the setting will wait for the next synchronization signal to update.

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.34 manual_wdr_s

【Description】

Manual WDR mode setting.

【Definition】

```
struct manual_wdr_s {
    unsigned int          devno;
    struct manual_wdr_attr_s attr;
};
```

【Member】

Member	Description
devno	MIPI-Rxdevice number
attr	Manual WDR properties

【Processor Difference】

none

【Note】

none

【Related Data Type and Interface】

none

2.5.35 vsync_gen_s

【Description】

Manual WDR mode setting.

【Definition】

```
struct vsync_gen_s {
    unsigned int          devno;
    unsigned int          distance_fp;
};
```

【Member】

Member	Description
devno	MIPI-Rxdevice number
distance_fp	When input_mode is INPUT_MODE_SUBLVDS , the time point at which the vertical synchronization signal is generated.

【Processor Difference】

none

【Note】

- The Sub-LVDS does not have its own vertical synchronization signal, so MIPI-Rx has to generate and send it to ISP. distance_fp can adjust the vertical synchronization time to increase the front porch.

【Related Data Type and Interface】

none

2.5.36 LANE_MAX_NUM

【Description】

The maximum number of lanes supported by a MIPI TX device.

【Definition】

```
#define MIPI_LANE_NUM 4
```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.37 output_mode_e

【Description】

MIPI Tx output mode.

【Definition】

```
enum output_mode_e
{
OUTPUT_MODE_CSI = 0x0, /* csi mode */ OUTPUT_MODE_DSI_VIDEO
↪ = 0x1, /* dsi video mode */
```

(continues on next page)

(continued from previous page)

```

OUTPUT_MODE_DSI_CMD      = 0x2,      /* dsi command mode */
OUTPUT_MODE_BUTT
} output_mode_t;

```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.38 video_mode_e

【Description】

MIPI Tx video mode.

【Definition】

```

enum video_mode_e {
    BURST_MODE                = 0x0,
    NON_BURST_MODE_SYNC_PULSES = 0x1,
    NON_BURST_MODE_SYNC_EVENTS = 0x2,
};

```

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.39 output_format_e

【Description】

MIPI Tx output format.

【Definition】

```

enum output_format_e {
    OUT_FORMAT_RGB_16_BIT      = 0x0,
    OUT_FORMAT_RGB_18_BIT      = 0x1,
};

```

(continues on next page)

(continued from previous page)

```

OUT_FORMAT_RGB_24_BIT          = 0x2,
OUT_FORMAT_RGB_30_BIT          = 0x3,
OUT_FORMAT_YUV420_8_BIT_NORMAL = 0x4,
OUT_FORMAT_YUV420_8_BIT_LEGACY = 0x5,
OUT_FORMAT_YUV422_8_BIT        = 0x6,

OUT_FORMAT_BUTT

};

```

【Processor Difference】

processor type	support or not
CV181x	Does not support YUV420
CV180x	Does not support YUV420

【Note】

none.

【Related Data Type and Interface】

none

2.5.40 sync_info_s

【Description】

MIPI Tx device synchronization information.

【Definition】

```

struct sync_info_s {
    unsigned short  vid_hsa_pixels;
    unsigned short  vid_hbp_pixels;
    unsigned short  vid_hfp_pixels;
    unsigned short  vid_hline_pixels;
    unsigned short  vid_vsa_lines;
    unsigned short  vid_vbp_lines;
    unsigned short  vid_vfp_lines;
    unsigned short  vid_active_lines;
    unsigned short  edpi_cmd_size;
    bool            vid_vsa_pos_polarity;
    bool            vid_hsa_pos_polarity;
};

```

【Member】

Member	Description
vid_hsa_pixels	Horizontal sync-pulse' s number of pixels
vid_hbp_pixels	Horizontal back-porch' s number of pixels
vid_hfp_pixels	Horizontal front-porch' s number of pixels
vid_hline_pixels	Horizontal image active' s number of pixels
vid_vsa_lines	Vertical sync-pulse' s number of rows
vid_hbp_pixels	Vertical back-porch' s number of rows
vid_hfp_pixels	Vertical front-porch' s number of rows
vid_active_pixels	Vertical image active' s number of rows
edpi_cmd_size	Number of bytes of write memory command. The value is invalid in video mode and is set to hact in command mode.
vid_vsa_pos_polarity;	Horizontal sync-pulse polarity
vid_hsa_pos_polarity;	Vertical sync-pulse polarity

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

none

2.5.41 combo_dev_cfg_s

【Description】

MIPI Tx device properties.

【Definition】

```

struct combo_dev_cfg_s {
    unsigned int      devno;
    enum mipi_tx_lane_id  lane_id[LANE_MAX_NUM];
    enum output_mode_e  output_mode;
    enum video_mode_e   video_mode;
    enum output_format_e output_format;
    struct sync_info_s  sync_info;
    unsigned int      phy_data_rate;
    unsigned int      pixel_clock;
    bool              lane_pn_swap[LANE_MAX_NUM];
};

```

【Member】

Member	Description
devno	MIPI Tx device number
lane_id	The corresponding relationship between the sender (vo) and the receiver (MIPI Tx) Lane Unused lane is set to - 1.
output_mode	MIPI Tx output mode.
video_mode	MIPI Tx video mode.
output_format	MIPI Tx output mode.
sync_info	MIPI Tx' s synchronization information of the device.
phy_data_rate	MIPI Tx output rate, Description of the rate range of each lane in MIPI Tx high speed mode.
pixel_clock	Pixel clock. The unit is KHz
lane_pn_swap	Whether the P/N in Lane setting need to be swapped.

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

CVI_VIP_MIPI_TX_SET_DEV_CFG, MSG_CMD_MIPI_TX_SET_DEV_CFG

2.5.42 cmd_info_s

【Description】

Give the MIPI Tx device the initialization information.

【Definition】

```

struct cmd_info_s {
    unsigned int    devno;
    unsigned short data_type;
    unsigned short cmd_size;
#ifdef __arm__
    unsigned char  *cmd;
    unsigned int   padding;
#else
    unsigned char  *cmd;
#endif
};

```

【Member】

Member	Description
devno	MIPI Tx device number
data_type	Command data type
cmd_size	Number of command data bytes, range: (0, 128).
cmd_data	Command data address pointer, which needs to be assigned by the user.

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

CVI_VIP_MIPI_TX_SET_CMD, MSG_CMD_MIPI_TX_SET_CMD

2.5.43 get_cmd_info_s

【Description】

Retrieve information from MIPI Tx device.

【Definition】

```

struct get_cmd_info_s {
    unsigned int    devno;
    unsigned short  data_type;
    unsigned short  data_param;
    unsigned short  get_data_size;
#ifdef __arm__
    unsigned int    padding1;
    unsigned char   *get_data;
    unsigned int    padding2;
#else
    unsigned int    padding1;
    unsigned char   *get_data;
#endif
};

```

【Member】

Member	Description
devno	MIPI Tx device number
data_type	Command data type
data_param	Data Parameter: the first parameter is the lower eight bits, the second parameter is the higher eight bits, and 0 is filled when not in use
get_data_size	Expected number of data bytes, range: (0, 4).
get_data	The obtained data storage address pointer needs to be assigned by the user.

【Processor Difference】

none.

【Note】

none.

【Related Data Type and Interface】

CVI_VIP_MIPI_TX_GET_CMD, MSG_CMD_MIPI_TX_GET_CMD

2.5.44 hs_settle_s

【Description】

The settle information of MIPI Tx devices in HS mode.

【Definition】

```
struct hs_settle_s {
    unsigned char    prepare;
    unsigned char    zero;
    unsigned char    trail;
};
```

【Member】

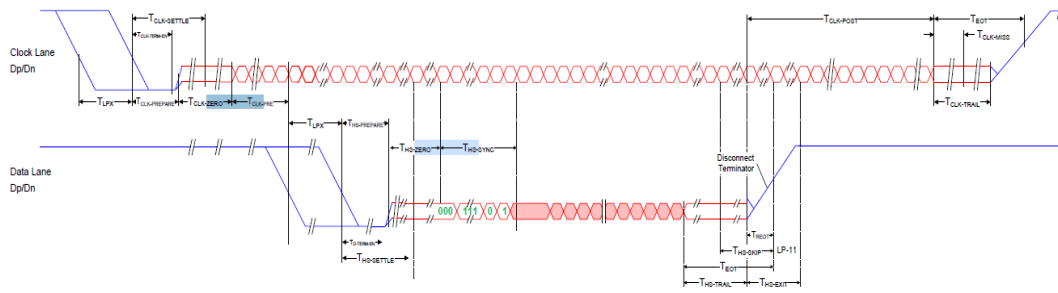
Member	Description
prepare	Prepare T value for the preposition after LP->HS
zero	After enter into HS, the T that is 0 before output data
trail	When HS->LP, the extra number of T before the end of HS and after the end of data

【Processor Difference】

none.

【Note】

High-Speed Data Transmission in Normal Mode



【Related Data Type and Interface】

None

2.6 Proc Information

2.6.1 MIPI_RX Proc information

When MIPI_Rx is working normally, the count of various error interrupts in the proc message should be 0. If not, please check whether the MIPI_Rx related properties are configured correctly.

【Debug information】

```
Module: [MIPI_RX], Build Time[#1 SMP PREEMPT Thu Apr 29 11:18:57 CST 2021]

-----Combo DEV ATTR-----
  Devno WorkMode DataType  WDRMode      LinkId      PN Swap  SyncMode
↔DataEndian  SyncCodeEndian
   0     MIPI     RAW12    NONE   2, 3, 1, 4, 0  1, 1, 1, 1, 1  N/A
↔     N/A     N/A

-----MIPI info-----
Devno EccErr CrcErr HdrErr WcErr fifofull  decode
   0   0   0   0   2   0  raw12
Physical:  D0   D1   D2   D3   D4   D5
           0   0   0   0   0   0
Digital:  D0   D1   D2   D3   CK_HS CK_ULPS CK_STOP  CK_
↔ERR  Deskew
           hs_idle hs_idle hs_idle hs_idle  1   0   0
↔   0   idle
```

【Debugging information analysis】

- MIPI Rx receives MIPI-CSi/SubLVDS/HiSPi/TTL signals from sensor through PHY Wrapper, and detects and aligns synchronization header by corresponding interface in MAC.
- MAC merges the data of each Lane into Pixel data and sends the data to the later ISP.

- PHY Wrapper is provided by Pixel clock of sensor. The clock in MAC is the same as that in ISP.
- The later ISP is needed if want to handle the Crop of data.

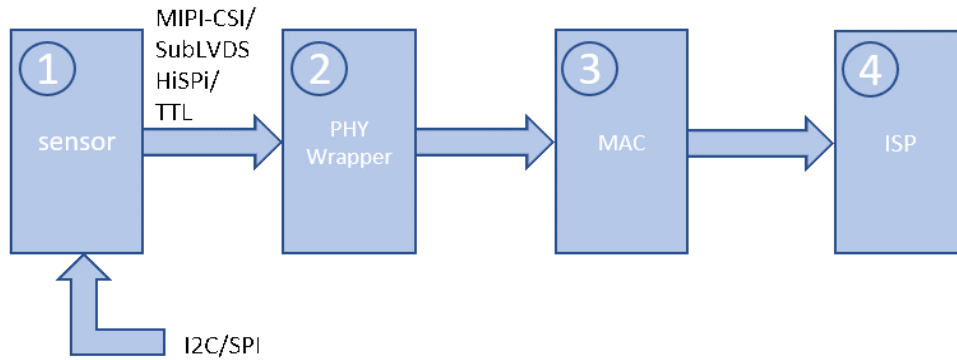


Fig. 2.7: Data sample diagram

【Parameter Description】

Parameter		Description
MIPI DEV ATTR	Devno	MIPI device number
	WorkMode	MIPI device working mode: MIPI/ SUB-LVDS/HISPI/CMOS and other modes
	DataType	RAW8/RAW10/RAW12 and other types
	WDRMode	WDR mode: <ul style="list-style-type: none"> • NONE • VC • DT • DOL • MANUAL
	LaneId	Lane id
	PN Swap	The swap of PN signal
LVDS DEV ATTR	Devno	MIPI device number
	WorkMode	MIPI device work mode: MIPI/ SUB-LVDS/HISPI/CMOS and so on
	DataType	RAW8/RAW10/RAW12 and so on

continues on next page

Table 2.2 – continued from previous page

Parameter	Description	
WDRMode	<p>WDR mode:</p> <ul style="list-style-type: none"> • NONE • 2To1 • 3To1 • DOL2To1 • DOL3To1 	
LaneId	Lane id	
PN Swap	The swap of PN signal	
SyncMode	<p>The synchronization code mode of LVDS:</p> <ul style="list-style-type: none"> • SOF • SAV 	
DataEndian	The Bite endian mode of Data	
SyncCodeEndian	The Bite endian mode of synchronization code	
MIPI Info (Visible only in MIPI mode)	Devno	MIPI device number
	EccErr	Interrupt count for ECC errors
	CrcErr	Interrupt count for CRC errors
	HdrErr	Interrupt count for HDR Flag errors
	WcErr	Interrupt count for Word Count errors
	fifofull	Interrupt count for Fifofull errors
	Physical: D0	Information received by MIPIRX_PAD0
	Physical: D1	Information received by MIPIRX_PAD1
	Physical: D2	Information received by MIPIRX_PAD2
	Physical: D3	Information received by MIPIRX_PAD3
	Physical: D4	Information received by MIPIRX_PAD4
	Physical: D5	Information received by MIPIRX_PAD5
	Digital: D0	Sensor data lane 0 state
	Digital: D1	Sensor data lane 1 state
	Digital: D2	Sensor data lane 2 state
	Digital: D3	Sensor data lane 3 state
	CK_HS/CK_ULPS/CK_STOP/CK_ERB	Sensor data lane state
Deskew	The result of Deskew	

2.7 FAQ

2.7.1 How to configure Land id

Land id corresponds to short lane_id[MIPI_LANE_NUM+1] in mipi_dev_attr_s or short lane_id[MIPI_LANE_NUM+1] in lvds_dev_attr_s, where the index number of the lane_id array represents the lane ID of the Sensor, the index number 0 represents the sensor clock, and the index number 1 represents the sensor Lane 0. The value of the land_id array represents the lane ID of MIPI-Rx, and 0 represents MIPIRX1_PAD0, 1 for MIPIRX1_PAD1. The unused Lane will be replaced by its corresponding lane_id is configured to - 1.

For example, the pin hardware connection between Mipi and sensor is shown in the following table.1

SENSOR pin	MIPI Lane pin
Clock Lane (index = 0)	MIPIRX1_PAD0 (value = 0)
Lane 0 (index = 1)	MIPIRX1_PAD1 (value = 1)
Lane 1 (index = 2)	MIPIRX1_PAD2 (value = 2)
Lane 2 (index = 3)	MIPIRX1_PAD3 (value = 3)
Lane 3 (index = 4)	MIPIRX1_PAD4 (value = 4)

The maximum number of lanes of MIPI plus clock is 5, so the lane_id configuration is as follows:

```
//索引 sensor clk, sensor_lane0, sensor_lane1, sensor_lane2, sensor_lane3
//
land_id={MIPIRX1_PAD0, MIPIRX1_PAD1, MIPIRX1_PAD2, MIPIRX1_PAD3,
MIPIRX1_PAD4}
```

2.7.2 MIPI frequency Description

Use the following formula to calculate the maximum frequency of MIPI per Lane and the working frequency of VI Mac:

$$\text{MAC_Freq} * \text{pixel_width} = \text{lane_num} * \text{MIPI_Freq} * 2$$

Where MAC_Freq is the working frequency of VI Mac, pixel_width is the pixel width, lane_num is the number of Mipi lanes, MIPI_Freq is the operating frequency of each lane.

If MAC clock is 400M, pixel_width = 12, lane_num = 4,

can support the fastest up to $\text{MIPI_Freq} = 400 * 12 / (4 * 2) = 600\text{MHz}$.

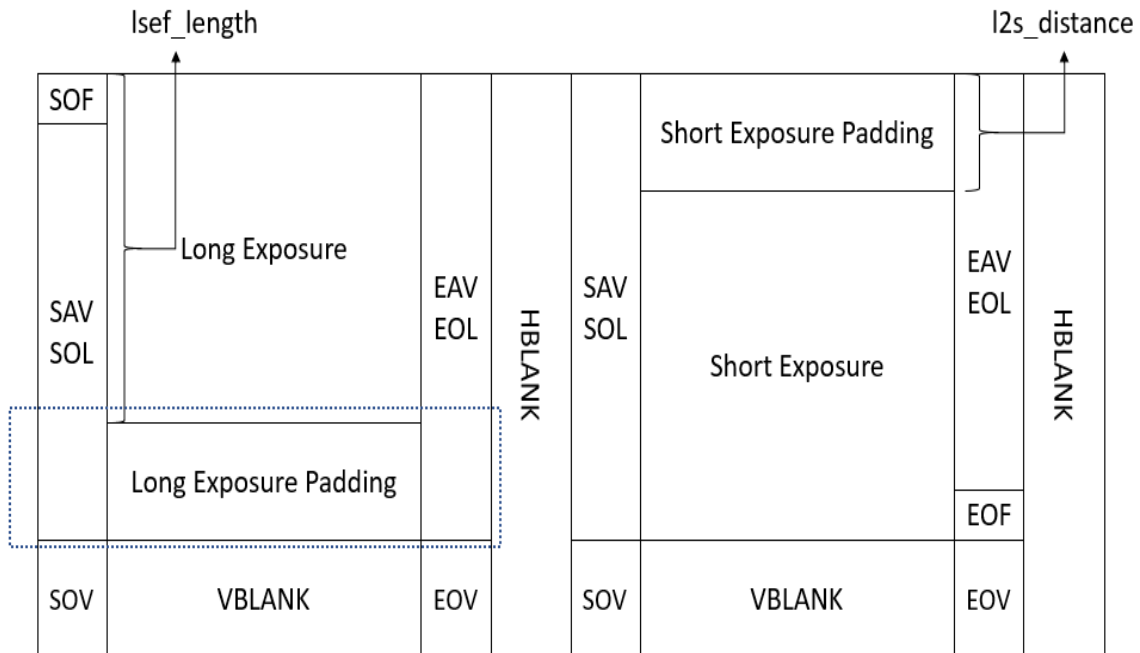
2.7.3 Manual WDR mode instructions

When the manual WDR mode is turned on, MIPI-Rx will allocate the received data to the long exposure frame and short exposure frame according to the following rules.

l2s_distance: The data from the first line to the *l2s_distance* line are long exposure data, and the long exposure and short exposure are staggered from the *l2s_distance*+1 line.

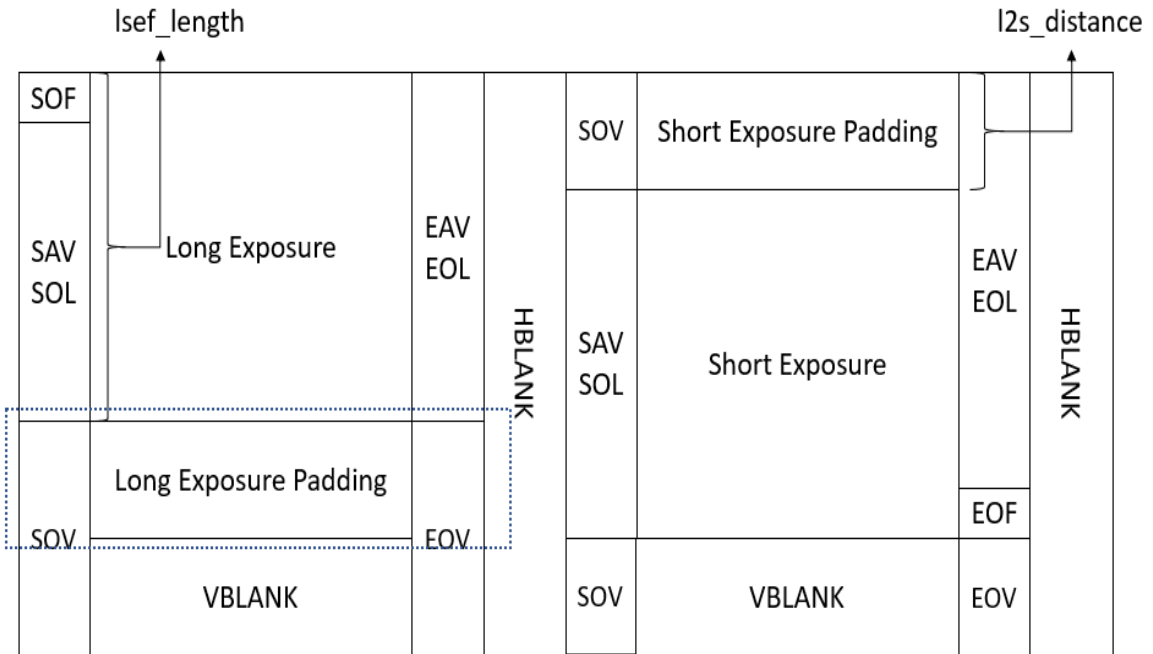
lsef_length: Line *lsef_length*+1 starts with short exposure frame data. Until the next vertical synchronization signal.

When *discard_padding_lines*=1, the line assignment method from 1 to *l2s_distance* is {long-ignore-long ignore} The allocation method from *l2s_distance*+1 to *lsef_length* is {long-short-long-short}. Line *lsef_length*+1 to the next vertical synchronization signal distribution mode is {short-ignore-short-ignore}.



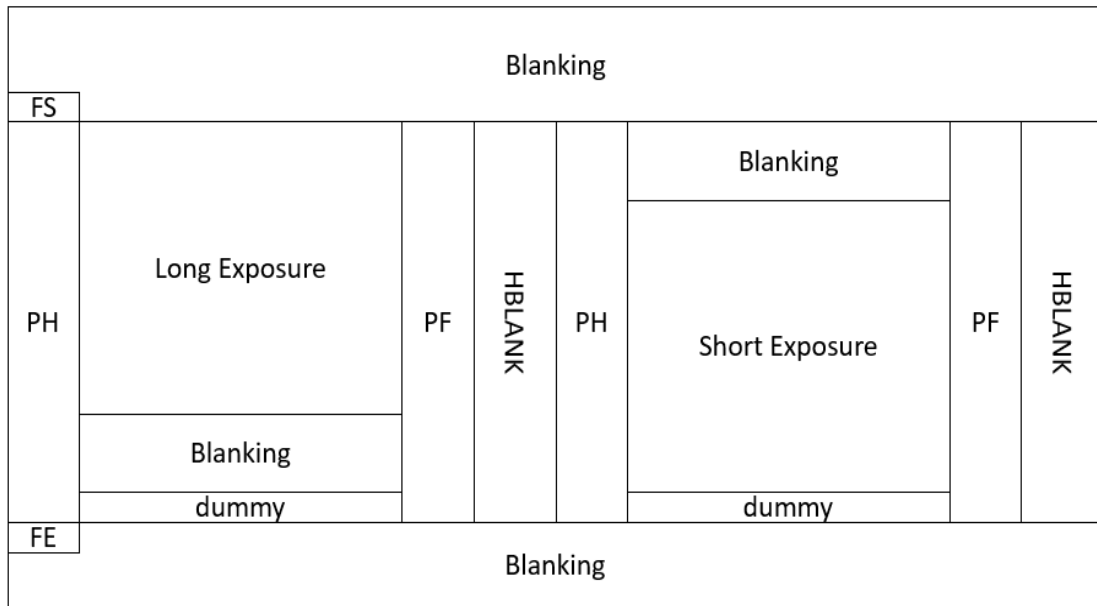
Padding data is sent as active lines, *discard_padding_lines* = 1

- When *discard_padding_lines*=0, the allocation method from 1 to *l2s_distance* is {long-long-long} The allocation method from *l2s_distance*+1 to *lsef_length* is {long-short-long-short}. Line *lsef_length*+1 to the next vertical synchronization signal allocation mode is {short-short-short}.



Padding data is sent as blanking lines, discard_padding_lines = 0

- MIPI-Rx must ensure that the number of rows of long exposure frame and short exposure frame sent to ISP is consistent.
- Adjust the short exposure length of sensor. It is possible that l2s_distance needs to be adjusted together.
- Some sensors may bring dummy line after sending effective data of short exposure. This will cause the number of rows of long exposure and short exposure to be inconsistent. You can set l2s_distance to 0, lsef_length to the maximum value of 0x1fff, discard_padding_lines to 1, that is, you can receive two long and short exposures with valid and dummy data, and then use ISP crop to locate them.



discard_padding_lines = 1
 l2s_distance = 0
 lsef_length = 1FFF