



RAYSTAR

RAYSTAR Optronics, Inc.
曜凌光電股份有限公司



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RFH1010J-AYW-MNN

SPECIFICATION

CUSTOMER:

| | |
|-------------|--|
| APPROVED BY | |
| PCB VERSION | |
| DATE | |

FOR CUSTOMER USE ONLY

| SALES BY | APPROVED BY | CHECKED BY | PREPARED BY |
|----------|-------------|------------|-------------|
| | | | |

Release DATE:

TFT Display Inspection Specification: <https://www.raystar-optronics.com/download/products.htm>

Precaution in use of TFT module: <https://www.raystar-optronics.com/download/declaration.htm>

Revision History

| VERSION | DATE | REVISED PAGE NO. | Note |
|---------|------------|------------------|-------------|
| 0 | 2021/10/08 | | First issue |

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1.Module Classification Information

| R | F | H | 101 | 0J | - | A | Y | W | - | M | N | N |
|----------|----------|----------|------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1 | 2 | 3 | 4 | 5 | - | 6 | 7 | 8 | - | 9 | 10 | 11 |

| Item | Description | |
|-------------|---|--|
| 1 | R : Raystar Optronics Inc. | |
| 2 | Display Type : F→TFT Type, J→ Custom TFT | |
| 3 | Solution: A: 128x160 B:320x234 C:320x240 D:480x234 E:480x272 F:800x480 G:640x480 H:1024x600 I:320x480 J:240x320 K:1280x800 L:240x400 M:1024x768 N:128x128 O:480x800 P:640x320 Q:800x600 S:480x128 T:800x320 | |
| 4 | Display Size : 10.1" TFT | |
| 5 | Version Code. | |
| 6 | Model Type: A : TFT LCD E : TFT+FR+CONTROL BOARD J : TFT+FR+A/D BOARD N : TFT+FR+A/D BOARD+CONTROL BOARD S : TFT+FR+POWER BOARD (DC TO DC) 1 : TFT+CONTROL BOARD | 6 : TFT+FR H : TFT+D/V BOARD I : TFT+FR+D/V BOARD B : TFT+POWER BD |
| 7 | Polarizer Type, Temperature range, View direction | I→Transmissive, W. T, 6:00 ; C→Transmissive, N. T, 6:00 L→Transmissive, W.T,12:00 ; F→Transmissive, N.T,12:00 Y→Transmissive,W.T, IPS TFT ; A→Transmissive, N.T, IPS TFT Z→Transmissive, W.T, O-TFT R→Transmissive, Super W.T, O-TFT N→Transmissive, Super W.T, 6:00; Q→Transmissive, Super W.T, 12:00 V→Transmissive, Super W.T, VA TFT |
| 8 | Backlight | W : LED, White H : LED, High Light White F : CCFL, White |
| 9 | Driver Method | D: Digital A: Analog L : LVDS M:MIPI |
| 10 | Interface | N : without control board A : 8Bit B : 16Bit S:SPI Interface R: RS232 U:USB I: I2C |
| 11 | TS | N : Without TS S : resistive touch panel C : capacitive touch panel capacitive touch panel (G-F-F) G : capacitive touch panel(G-G) |

2.Summary

TFT 10.1" is a color active matrix thin film transistor (TFT) liquid crystal display without polarizer. This model is composed of amorphous silicon TFT as a switching device.

This TFT LCD has a 10.1" wide (16:9) diagonally measured active display area with WVGA (1024 horizontal by 600 vertical pixel) resolution. Each pixel is divided into Red, Green, Blue dots which are arranged in vertical stripes.

RAYSTAR OPTRONICS

3.General Specifications

- Size: 10.1 inch
- Dot Matrix: 1024 RGB X 600 dots
- Module dimension: 235(W) x143(H) x 5.05(D) mm
- Active area: 222.72 (H) x 125.28(V) mm
- Pixel pitch: 0.2175(W) x 0.2088(H) mm
- LCD type: TFT, Normally Black, Transmissive
- TFT Interface: 4-Lanes MIPI
- Driver IC: EK79007AD3 + EK73217BCGA or equivalent
- Viewing Angle: 85/85/85/85
- Aspect Ratio: 16:9
- Backlight Type: LED, Normally White
- With /Without TP: Without TP
- Surface: Anti-Glare

*Color tone slight changed by temperature and driving voltage.

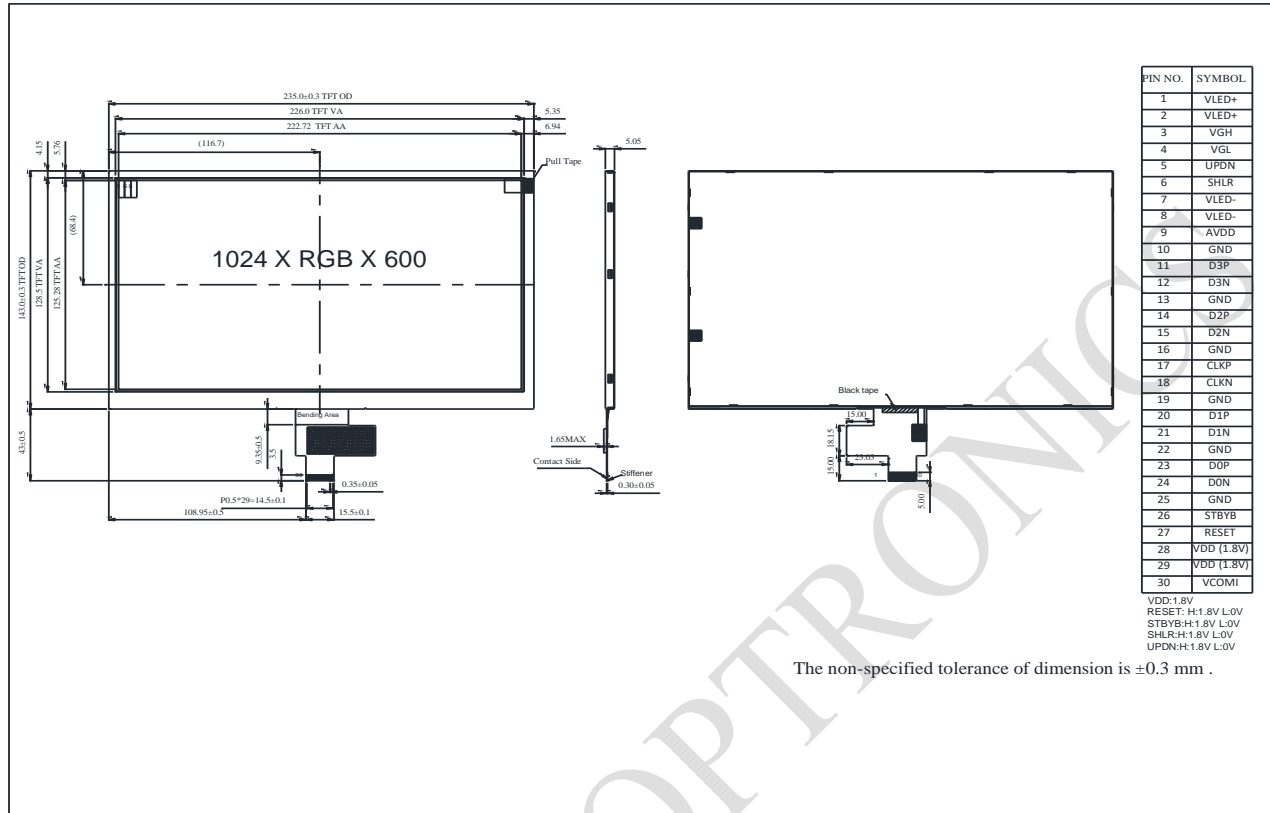
4.Interface

4.1. TFT LCD MODULE

| Pin No. | Symbol | Description |
|---------|--------|--|
| 1 | VLED+ | LED Anode |
| 2 | VLED+ | LED Anode |
| 3 | VGH | Positive power for TFT |
| 4 | VGL | Negative power for TFT |
| 5 | UPDN | Gate up or down scan control. UPDN = "L", STV2 output vertical start pulse and UD pin output logical "L" to Gate driver. (default) UPDN = "H", STV1 output vertical start pulse and UD pin output logical "H" to Gate driver |
| 6 | SHLR | Source right or left sequence control. SHLR = "L", shift left: last data = S1←S2←S3.....←S1536 = first data. SHLR = "H", shift right: first data = S1→S2→S3.....→S1536 = last data.(default) |
| 7 | VLED- | LED Cathode |
| 8 | VLED- | LED Cathode |
| 9 | AVDD | Analog power |
| 10 | GND | Digital ground |
| 11 | D3P | MIPI data input. |
| 12 | D3N | MIPI data input. |
| 13 | GND | Digital ground |
| 14 | D2P | MIPI data input. |
| 15 | D2N | MIPI data input. |
| 16 | GND | Digital ground |
| 17 | CLKP | MIPI clock input |
| 18 | CLKN | MIPI clock input |
| 19 | GND | Digital ground |
| 20 | D1P | MIPI data input. |
| 21 | D1N | MIPI data input. |
| 22 | GND | Digital ground |
| 23 | D0P | MIPI data input. |
| 24 | D0N | MIPI data input. |
| 25 | GND | Digital ground |

| | | |
|----|------------|---|
| 26 | STBYB | Standby mode. STBYB = "H", normal operation(default) STBYB = "L", timing controller, source driver will turn off, all output are GND. |
| 27 | RESET | Global reset pin. Active Low to enter Reset State. Normally pull high. Connecting with an RC reset circuit for stability. |
| 28 | VDD (1.8V) | Digital power |
| 29 | VDD (1.8V) | Digital power |
| 30 | VCOMI | Common voltage |

5. Contour Drawing



6. Absolute Maximum Ratings

| Item | Symbol | Min | Typ | Max | Unit |
|-----------------------|--------|-----|-----|-----|------|
| Operating Temperature | TOP | -20 | — | +70 | °C |
| Storage Temperature | TST | -30 | — | +80 | °C |

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

1. Temp. ≤60°C, 90% RH MAX. Temp. >60°C, Absolute humidity shall be less than 90% RH at 60°C

7. Electrical Characteristics

7.1. Typical Operation Conditions (At Ta = 25 °C,)

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|--------------------------------------|--------|-------|-------|------|------|-------|
| Digital Power Supply Voltage For LCD | VDD | 1.71 | 1.8 | 1.89 | V | Note1 |
| Analog Power Supply Voltage | AVDD | 9.89 | 10.2 | 10.5 | V | - |
| Gate On Power Supply Voltage | VGH | 19.4 | 20.0 | 20.6 | V | - |
| Gate Off Power Supply Voltage | VGL | -10.3 | -10.0 | -9.7 | V | - |
| Common Power Supply Voltage | VCOMI | 4.0 | 4.3 | 4.6 | V | Note2 |

Note1: VDD setting should match the signals output voltage (refer to Note 3) of customer's system board.

Note 2. Please adjust VCOMI to make the flicker level be minimum.

Note 3: RESET, STBYB, U/D, L/R, SELB

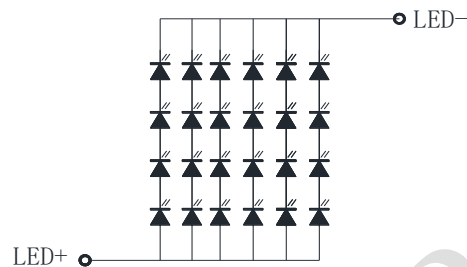
7.2. Current Consumption

| Item | Symbol | Values | | | Unit | Remark |
|--------------------|---------------------|--------|------|------|------|---------------|
| | | Min. | Typ. | Max. | | |
| Current for Driver | I _{VGH} | - | 0.5 | 1.0 | mA | VGH = 20.0V |
| | I _{VGL} | - | 1.4 | 2.1 | mA | VGL = -10.0V |
| | I _{VDD} | - | 16 | 24 | mA | VDD = 1.8V |
| | I _{AVDD} | - | 19 | 28.5 | mA | AVDD = 10.2V |
| | I _{VCOMIN} | - | 0 | - | mA | VCOMIN = 4.3V |

7.3. Backlight Driving Conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|---------------------------------------|--------|--------|------|------|------|--------|
| Supply voltage of white LED backlight | VL | 10.8 | 12.4 | 14.0 | V | Note 1 |
| Current for LED backlight | IL | - | 300 | - | mA | |
| LED life time | - | 50,000 | - | - | Hr | Note2 |

Note 1 : There are 1 Groups LED



CIRCUIT DIAGRAM

Note 2 : $T_a = 25\text{ }^{\circ}\text{C}$

Note 3 : Brightness to be decreased to 50% of the initial value

Note 4 : The single LED lamp case

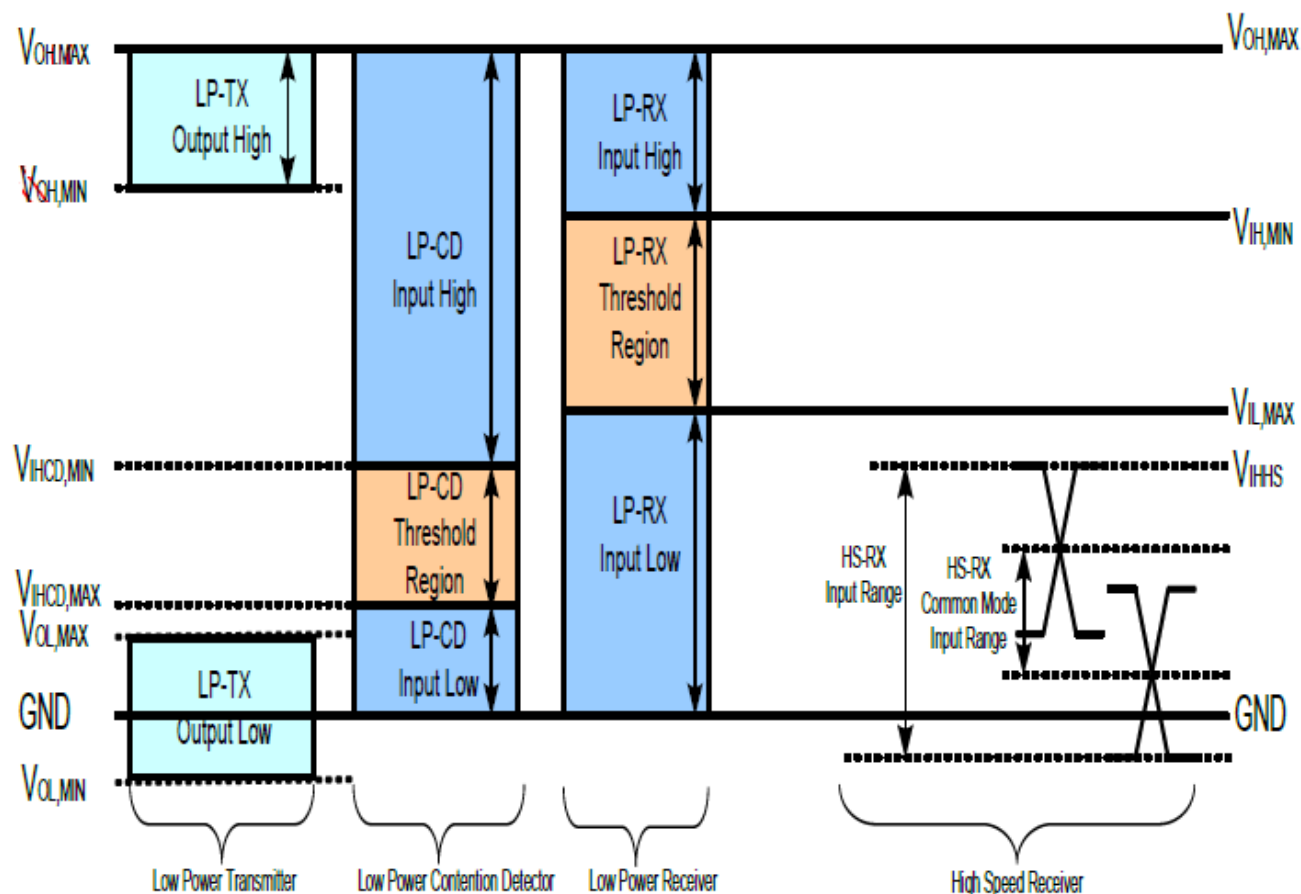
8.DC Electrical Characteristics

| 8.1. Parameter | Symbol | Rating | | | Unit | Condition |
|--------------------------|--------|--------|-----|--------|------|-----------|
| | | Min | Typ | Max | | |
| Low level input voltage | VIL | 0 | - | 0.3VDD | V | Note 1 |
| High level input voltage | VIH | 0.7VDD | - | VDD | V | |

Note 1:RESET,STBYB, UPDN, SHLR

8.2. MIPI Interface DC Characteristic

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|--|-----------------------|------|------|------|------|
| MIPI Characteristics for High Speed Receiver | | | | | |
| Single-ended input low voltage | V _{ILHS} | -40 | - | - | mV |
| Single-ended input high voltage | V _{IHHS} | - | - | 460 | mV |
| Common-mode voltage | V _{CDRXDC} | 70 | - | 330 | mV |
| Differential input impedance | Z _{ID} | | 100 | | ohm |
| HS transmit differential voltage(V _{OD} =V _{DP} -V _{DN}) | V _{OD} | 140 | 200 | 250 | mV |
| MIPI Characteristics for Low Power Mode | | | | | |
| Pad signal voltage range | V _I | -50 | - | 1350 | mV |
| Ground shift | V _{GNDSH} | -50 | - | 50 | mV |
| Logic 0 input threshold | V _{IL} | 0 | - | 550 | mV |
| Logic 1 input threshold | V _{IH} | 880 | - | 1350 | mV |
| Input hysteresis | V _{HYST} | 25 | - | - | mV |
| Output low level | V _{OL} | -50 | - | 50 | mV |
| Output high level | V _{OH} | 1.1 | 1.2 | 1.3 | V |
| Output impedance of Low Power Transmitter | Z _{OLP} | 80 | 100 | 125 | ohm |
| Logic 0 contention threshold | V _{ILCD,MAX} | - | - | 200 | mV |
| Logic 1 contention threshold | V _{IHCD,MIN} | 450 | - | - | mV |

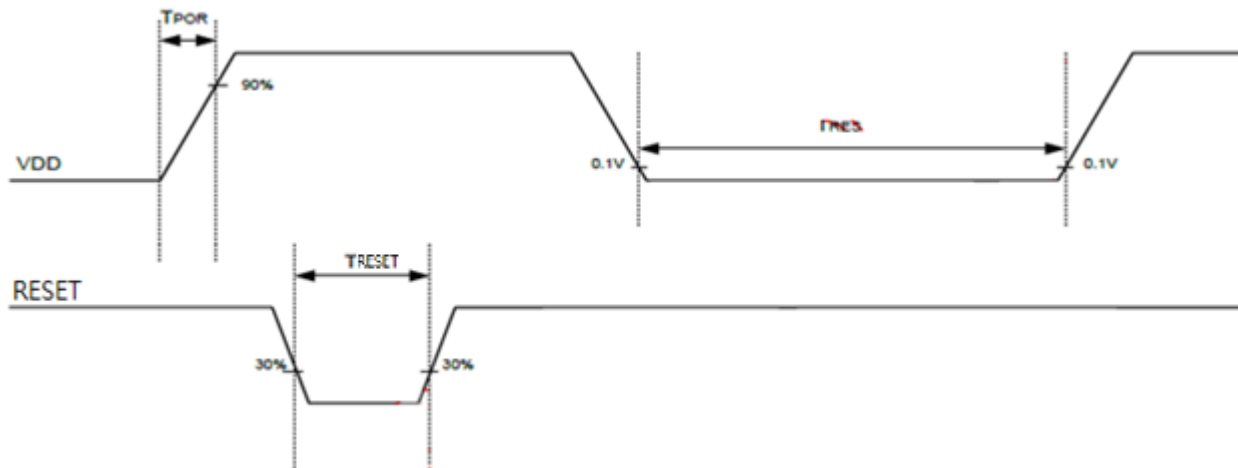


9.AC Electrical Characteristics

9.1. Basic AC Characteristic

VDD/RESET AC characteristic

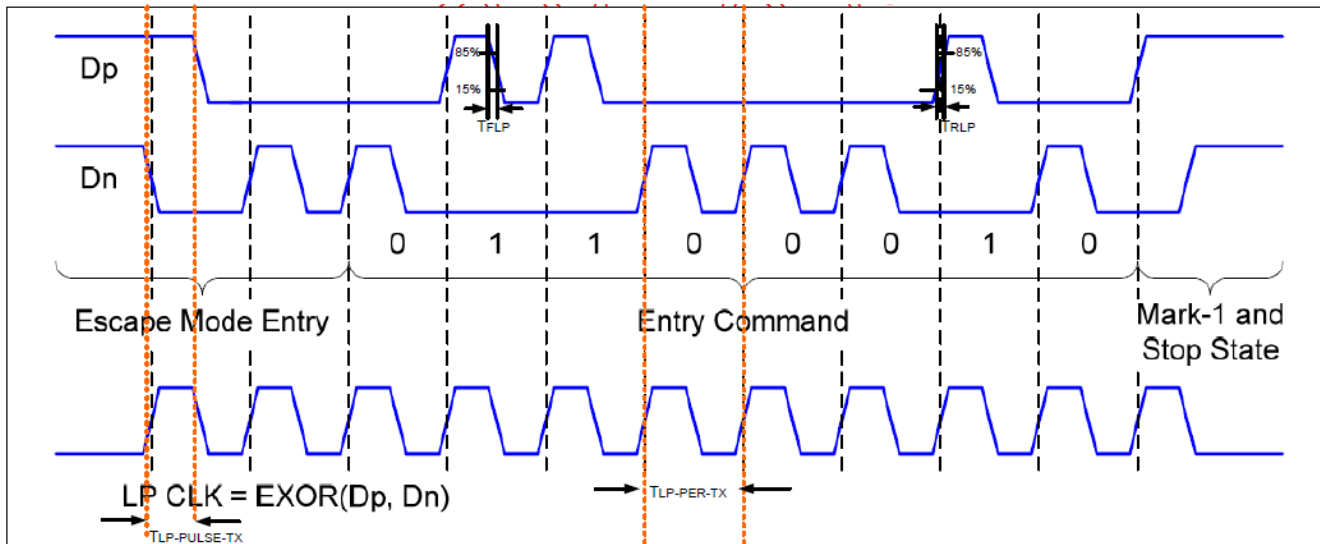
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|--------------------------|-------------|------|------|------|------|-------------------|
| VDD power slew rate | T_{POR} | - | - | 20 | ms | From 0 to 90% VDD |
| RESET active pulse width | T_{RESET} | 1 | - | - | ms | VDD=1.8V |
| VDD resettle time | T_{RES} | 1 | - | - | s | |



9.2. MIPI AC Characteristic

1. Transmitter AC Specification

| Parameter | Symbol | Min | Typ | Max | Units | Notes |
|--------------------------------------|----------------------------|-----|-----|-----|-------|-------|
| 15%~85% rising time and falling time | T_{RLP} / T_{FLP} | - | - | 25 | ns | - |
| 30%~85% rising time and falling time | T_{REOT} | - | - | 35 | ns | - |
| Pulse width of LP exclusive-OR clock | $T_{LP-PULSE-TX}$ | 40 | - | - | ns | - |
| | | 20 | - | - | ns | - |
| Period of the LP EXOR clock | $T_{LP-PER-TX}$ | 90 | - | - | mV/ns | - |
| Slew Rate @CLOAD =0pF | $\delta V / \delta t_{SR}$ | 30 | - | 500 | mV/ns | - |
| Slew Rate @CLOAD =5pF | | 30 | - | 200 | mV/ns | - |
| Slew Rate @CLOAD =20pF | | 30 | - | 150 | mV/ns | - |
| Slew Rate @CLOAD =70pF | | 30 | - | 100 | mV/ns | - |
| Load Capacitance | T_{RLP} | - | - | 70 | pF | - |

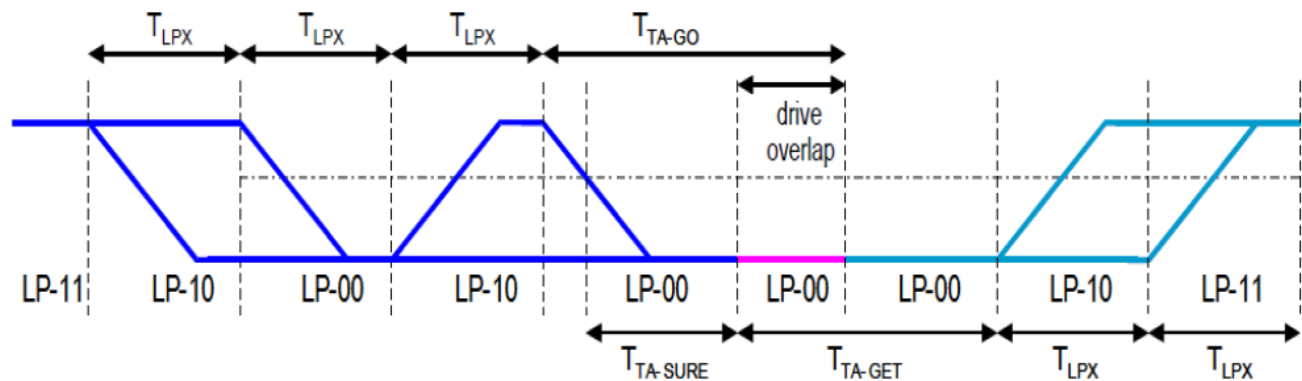


DP: MIPI_D1P / MIPI_D0P
 DN: MIPI_D1N / MIPI_D0N

2. Turnaround Procedure

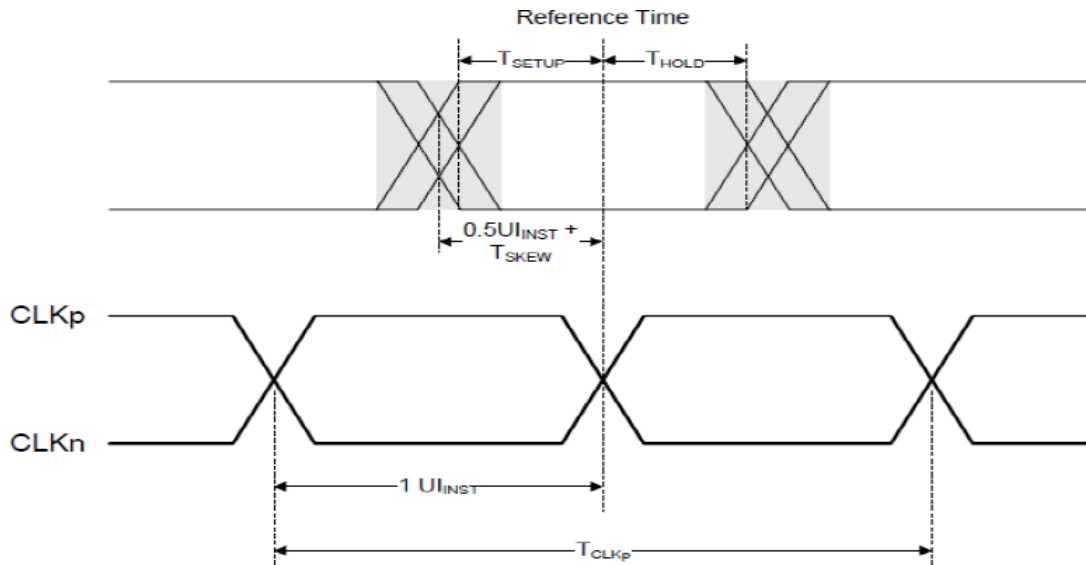
Turnaround Procedure Operation Timing Parameters

| Parameter | Symbol | Min | Typ | Max | Units |
|---|-----------------|-----------|------------|------------|-------|
| Length of any Low-Power state period: Master side | T_{LPX} | 50 | - | 75 | ns |
| Length of any Low-Power state period: Slave side | T_{LPX} | 50 | 55.56 | 58.34 | ns |
| Ratio of $T_{LPX}(\text{Master}) / T_{LPX}(\text{Slave})$ between Master and Slave side | Ratio T_{LPX} | 2/3 | - | 3/2 | |
| Time-out before new TX side start driving | $T_{TA-Sure}$ | T_{LPX} | - | $2T_{LPX}$ | ns |
| Time to drive LP-00 by new TX | T_{TA-GET} | - | $5T_{LPX}$ | - | ns |
| Time to drive LP-00 after Turnaround Request | T_{TA-GO} | - | $4T_{LPX}$ | - | ns |



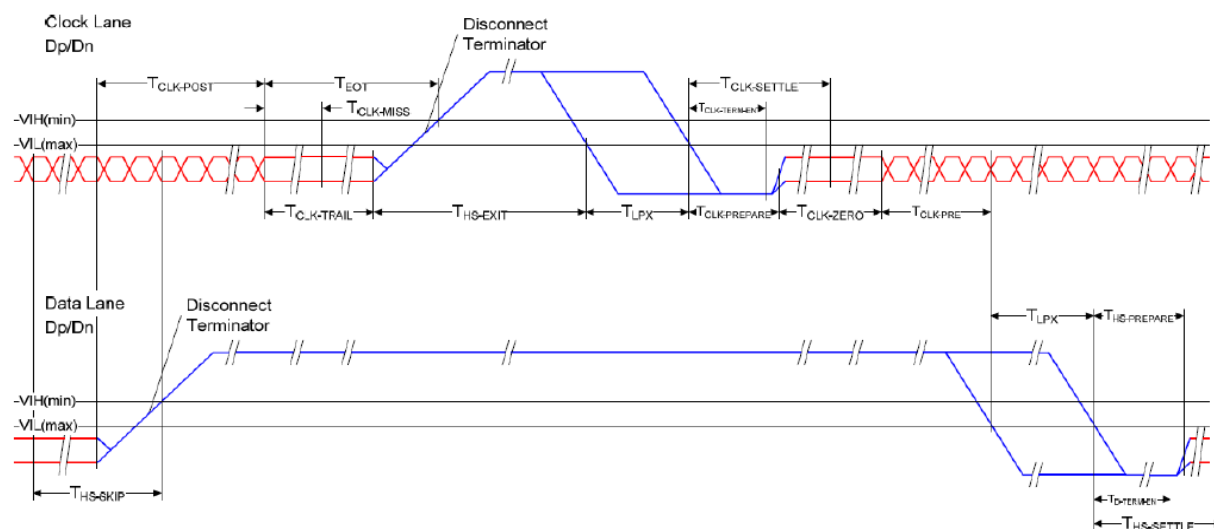
3.High speed transmission

| Parameter | Symbol | Min | Typ | Max | Units |
|--|-----------------|-------|-----|------|------------|
| UI instantaneous | U_{INST} | 2 | - | 12.5 | ns |
| Data to Clock Skew(measured at transmitter) | $T_{SKEW(TX)}$ | -0.15 | - | 0.15 | U_{INST} |
| Data to Clock Setup time(measured at receiver) | $T_{SETUP(RX)}$ | 0.15 | - | - | U_{INST} |
| Data to Clock Hold time(measured at receiver) | $T_{HOLD(RX)}$ | 0.15 | - | - | U_{INST} |
| 20%~80% rise time and fall time | T_R, T_F | 150 | - | - | ps |
| | | - | - | 0.3 | U_{INST} |

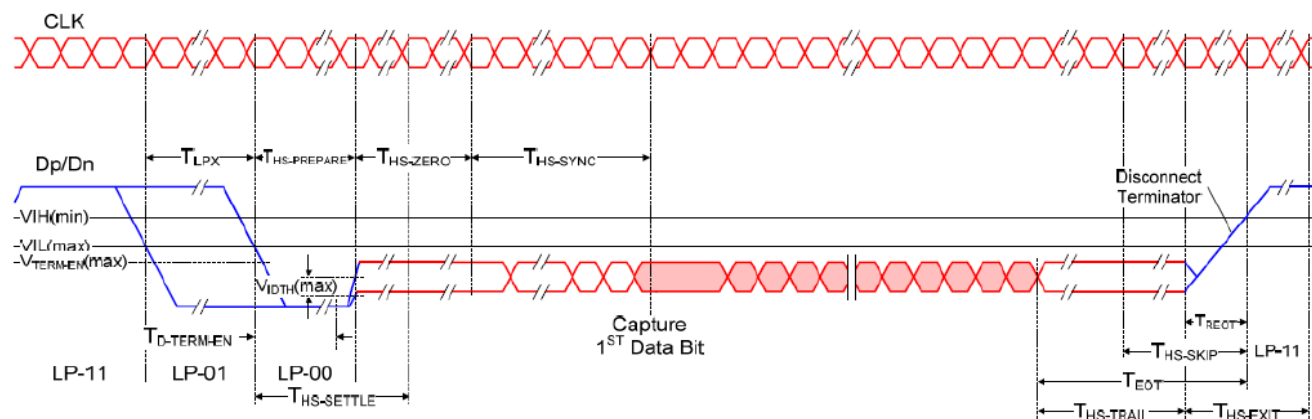


CLKP: MIPI_CLKP
CLKN: MIPI_CLKN

CLKN: MIPI_CLKN



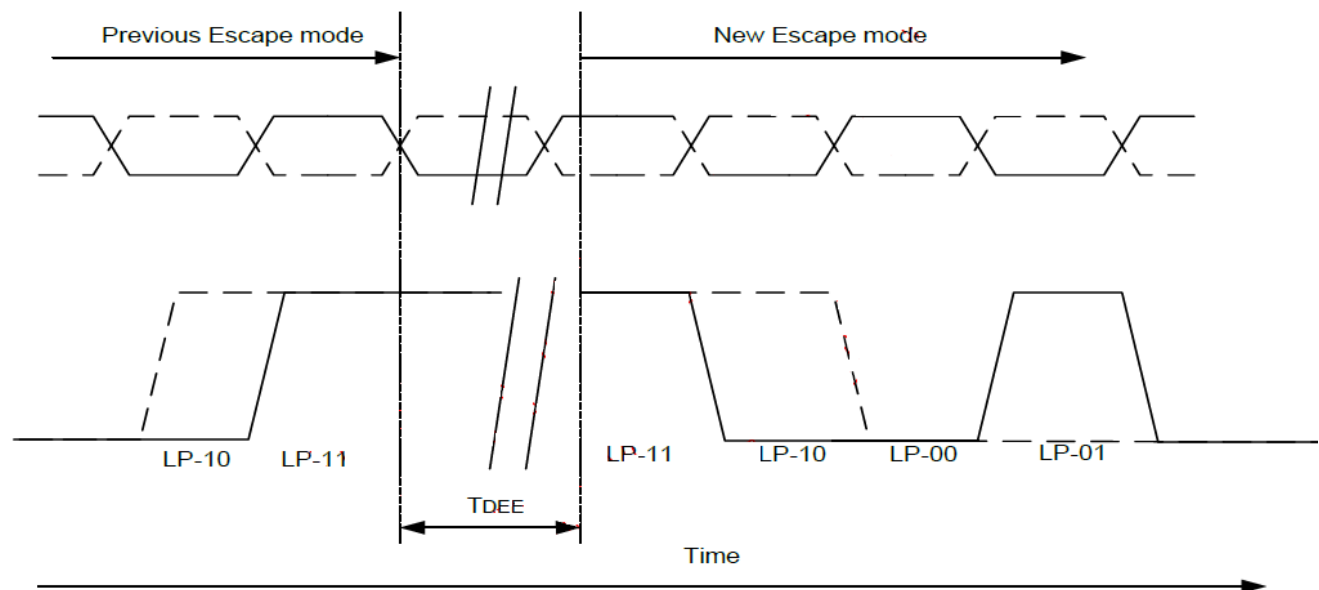
Data Transm



6.LP11 timing request between data transformation

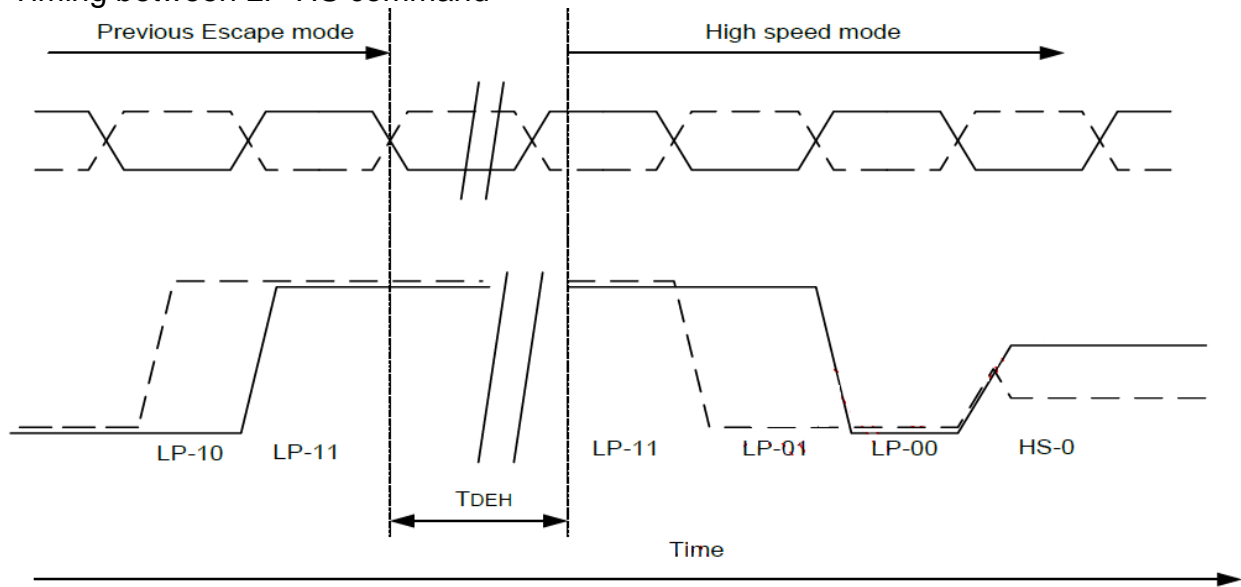
When Clock lane of DSI TX chip always keeps High speed mode, then Clock lane never go back to Low power mode. If Date lane of TX chip needs to transmit the next new data transmission or sequence, after the end of Low power mode or High speed mode or BTA. Then TX chip needs to keep LP-11 stop state before the next new data transmission, no matter in Low power mode or High speed mode or BTA. The LP-11 minimum timing is required for RX chip in the following 9 conditions, include of LP—LP, LP—HS, HS— LP, HS— HS, BTA— BTA, LP— BTA, BTA— LP, HS— BTA, and BTA— HS. This rule is suitable for short or long packet between TX and RX data transmission.

(1) Timing between LP-LP command



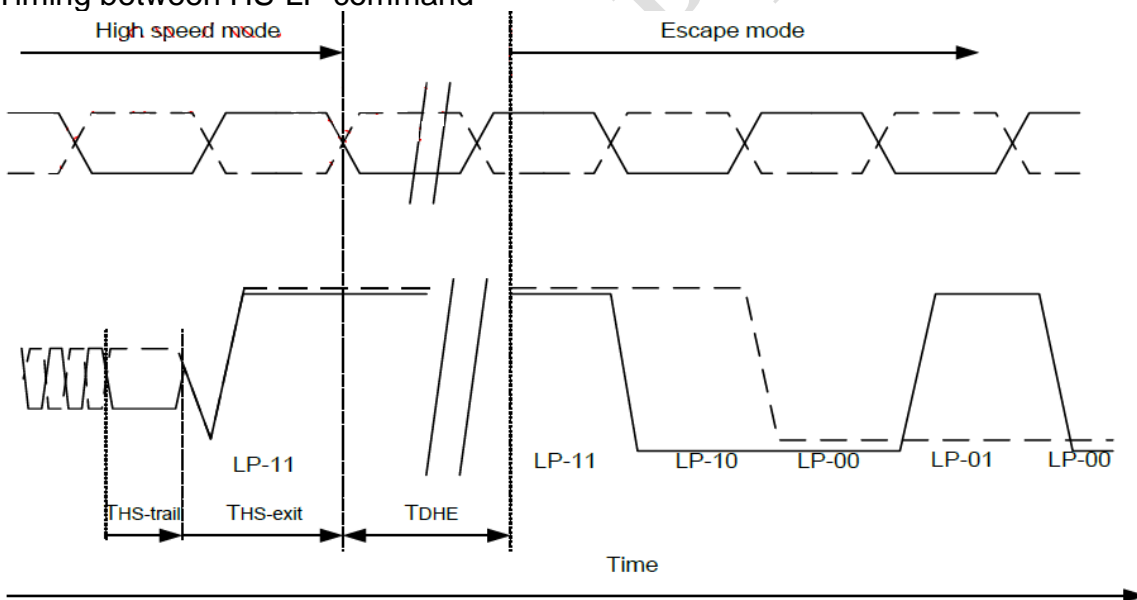
| Parameter | Symbol | Min | Typ | Max | Unit |
|---|--------|-----|-----|-----|------|
| LP-11 delay to start of the new Escape Mode Entry | TDEE | 150 | - | - | ns |

(2) Timing between LP-HS command



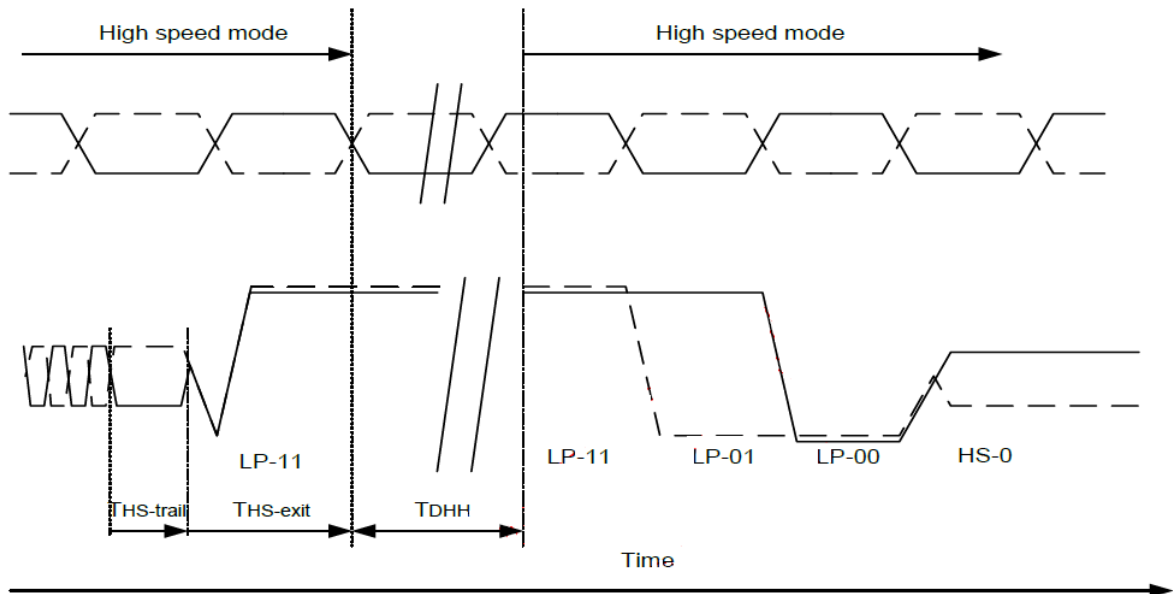
| Parameter | Symbol | Min | Typ | Max | Unit |
|--|--------|---------------|-----|-----|------|
| LP-11 delay to start of the Entering High Speed Mode | TDEH | Max(150,32UI) | - | - | ns |

(3) Timing between HS-LP command



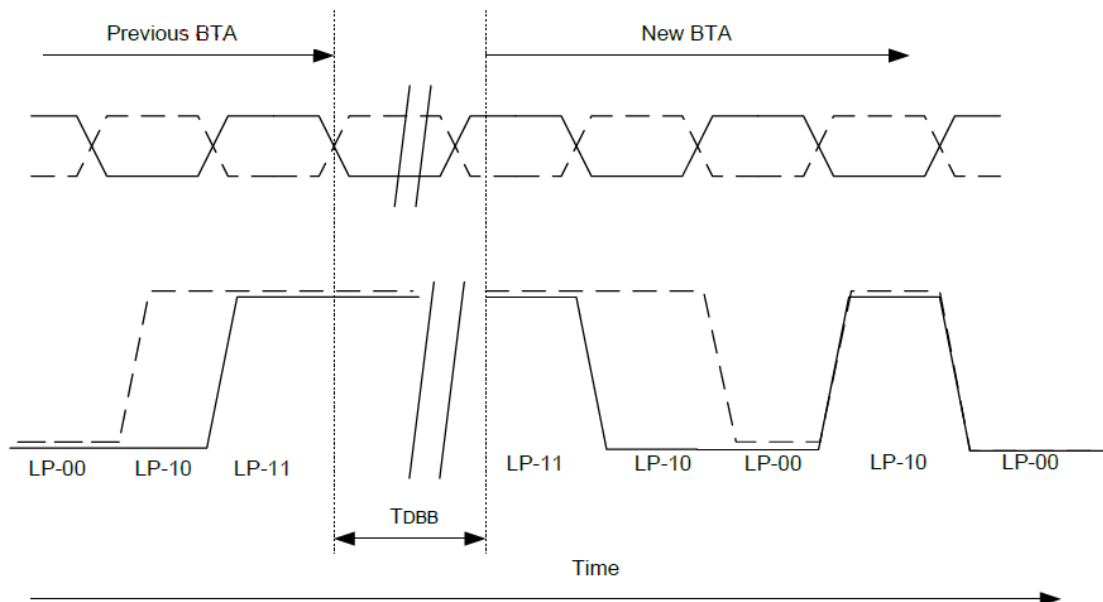
| Parameter | Symbol | Min | Typ | Max | Unit |
|---|--------|---------------|-----|-----|------|
| LP-11 delay to start of the Escape Mode Entry | TDHE | Max(150,32UI) | - | - | ns |

(4) Timing between HS-HS command



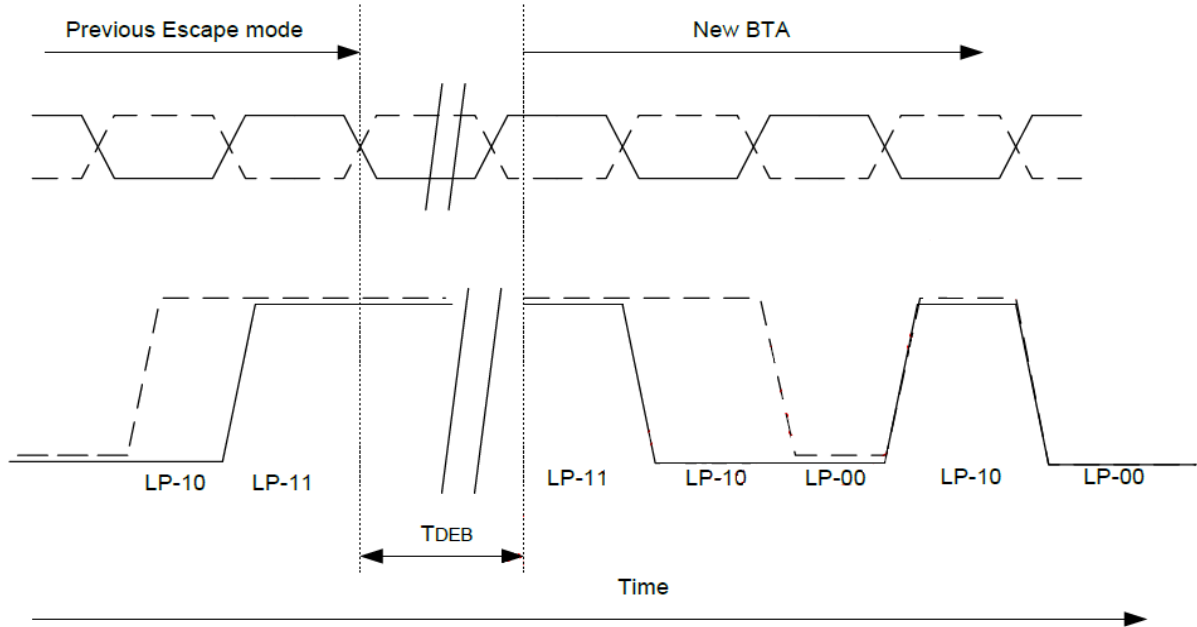
| Parameter | Symbol | Min | Typ | Max | Unit |
|--|------------------|---------------|-----|-----|------|
| LP-11 delay to start of the Entering High Speed Mode | T _{DHH} | Max(150,32UI) | - | - | ns |

(5) Timing between BTA-BTA command



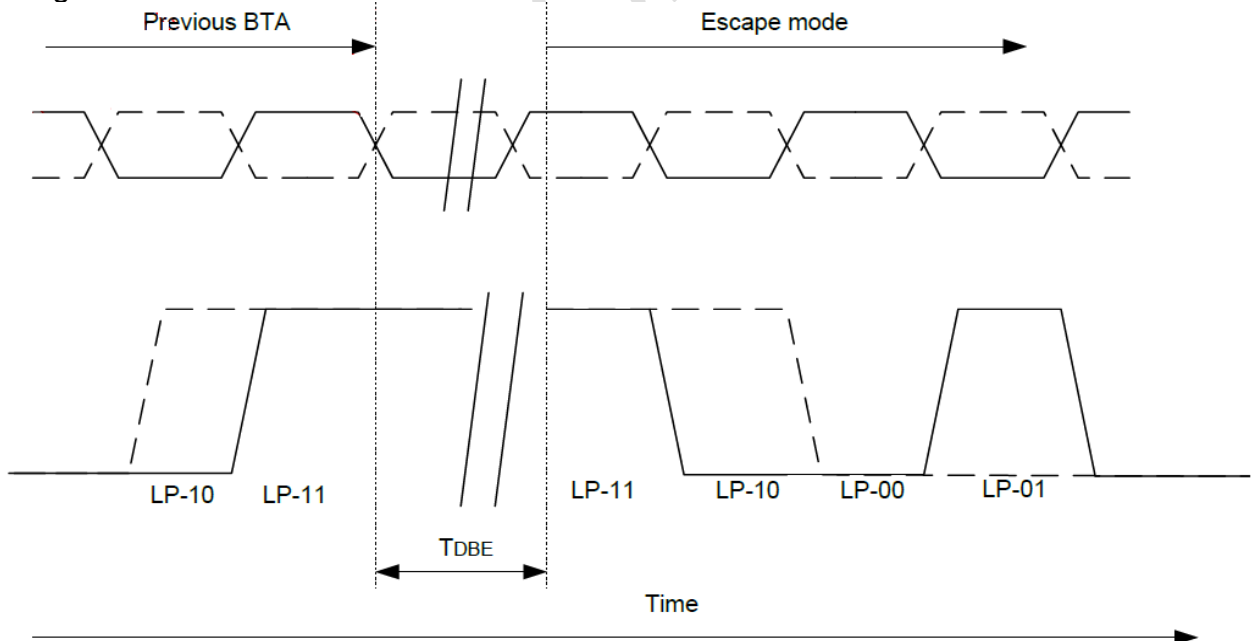
| Parameter | Symbol | Min | Typ | Max | Unit |
|-------------------------------------|------------------|-----|-----|-----|------|
| LP-11 delay to start of the new BTA | T _{DBB} | 150 | - | - | ns |

(6) Timing between LP-BTA command

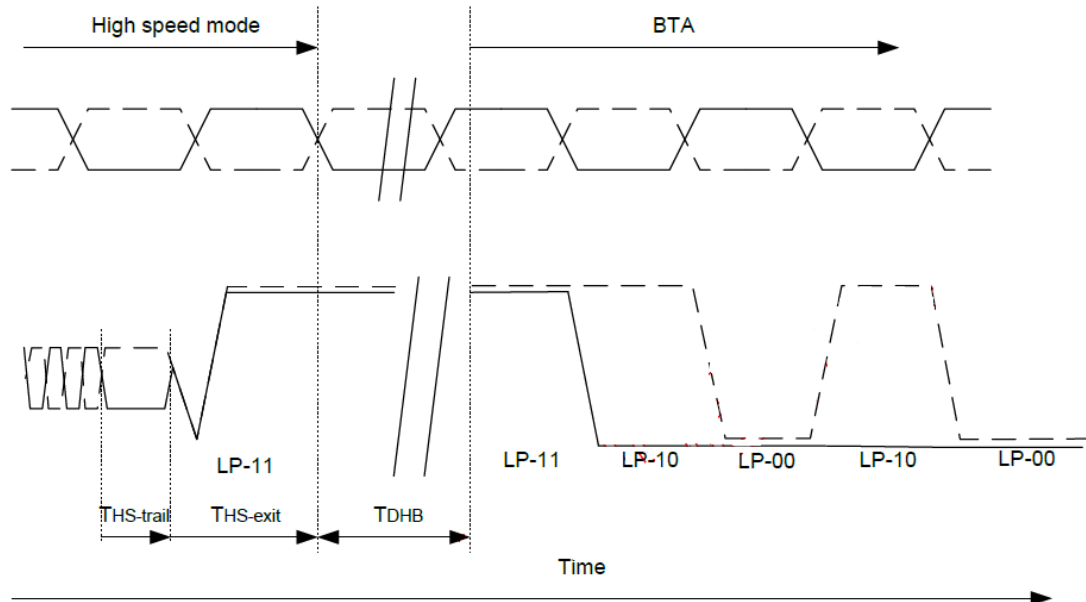


| Parameter | Symbol | Min | Typ | Max | Unit |
|-------------------------------------|--------|-----|-----|-----|------|
| LP-11 delay to start of the new BTA | TDEB | 150 | - | - | ns |

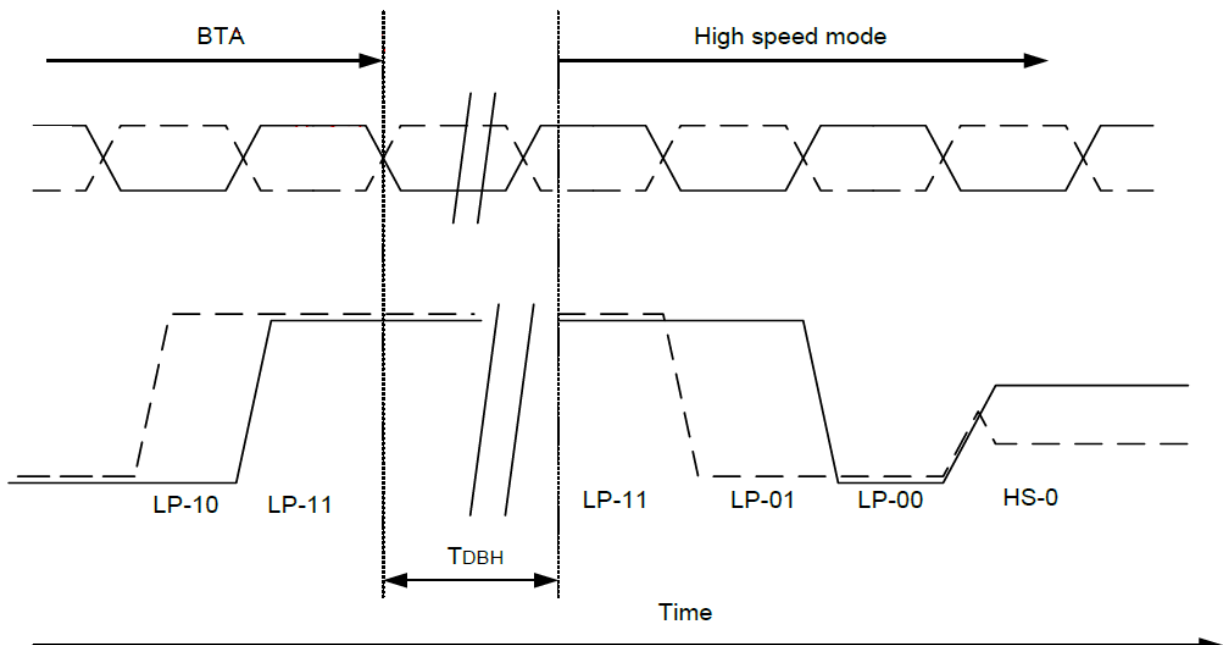
(7) Timing between BTA-LP command



| Parameter | Symbol | Min | Typ | Max | Unit |
|---|--------|-----|-----|-----|------|
| LP-11 delay to start of the Escape Mode Entry | TDBE | 150 | - | - | ns |

(8) Timing between HS-BTA command


| Parameter | Symbol | Min | Typ | Max | Unit |
|---------------------------------|--------|---------------|-----|-----|------|
| LP-11 delay to start of the BTA | TDBH | Max(150,32UI) | - | - | ns |

(9) Timing between BTA-HP command


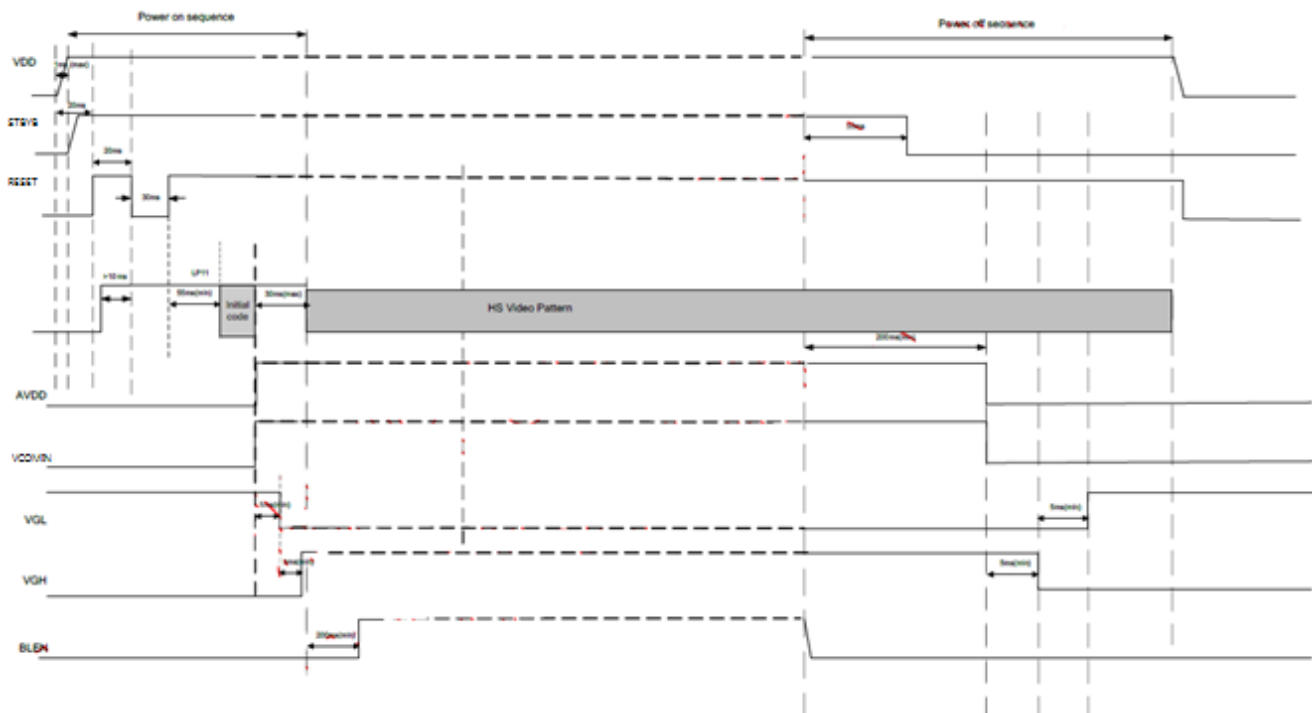
| Parameter | Symbol | Min | Typ | Max | Unit |
|--|--------|---------------|-----|-----|------|
| LP-11 delay to start of the Entering High Speed Mode | TDBH | Max(150,32UI) | - | - | ns |

10.Function Description

10.1. Power On/Off Sequence

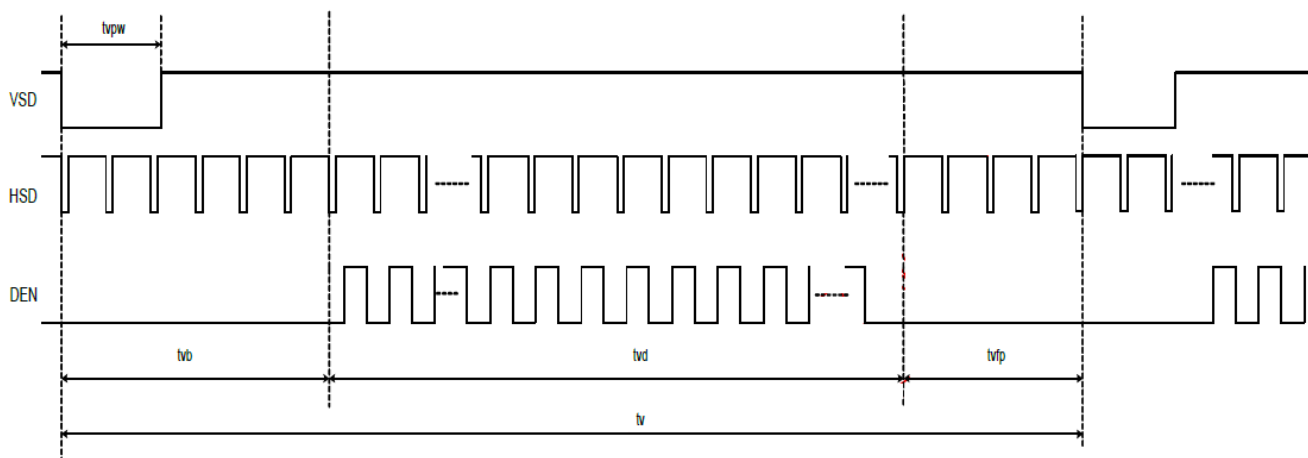
In order to prevent IC from power on reset fail, the rising time (TPOR) of the digital power supply VDD should be maintained within the given specifications. Refer to “AC Characteristics” for more detail on timing.

Power On/Off Sequence



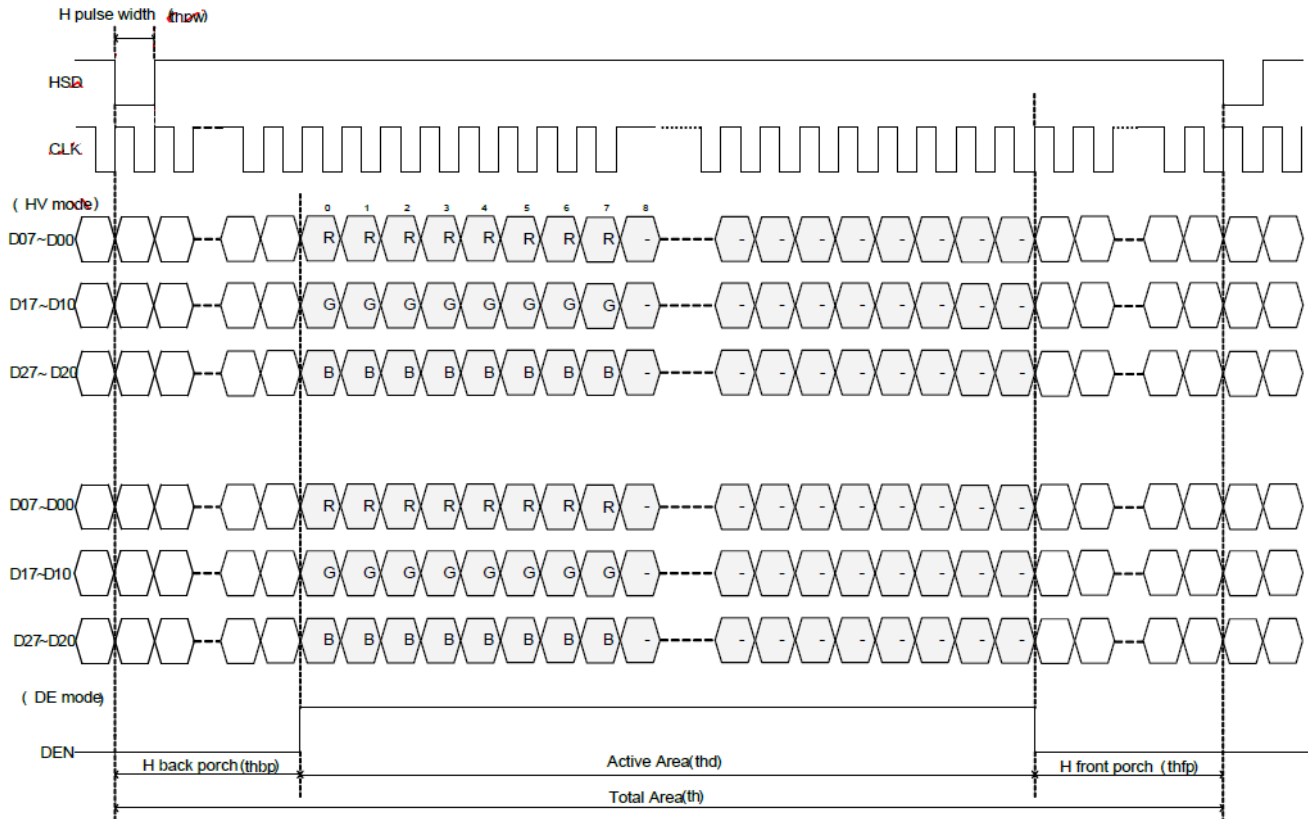
Note: CLK and Data Lanes should keep in LP11(stop state) before RESET.

10.2. Vertical input timing



Vertical input timing

10.3. Horizontal input timing



Horizontal input timing

10.4. Input Timing Table (2Lane)

For 1024RGB x 600 panel

DE mode

| Parameter | Symbol | Value | | | Unit |
|---------------------------------|----------|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| DCLK frequency @Frame rate=60hz | fclk | 40.8 | 51.2 | | Mhz |
| Horizontal display area | thd | | 1024 | | DCLK |
| HSYNC period time | th | 1114 | 1344 | | DCLK |
| HSYNC blanking | thb+thfp | 90 | 320 | | DCLK |
| Vertical display area | Tvd | | 600 | | H |
| VSYNC period time | Tv | 610 | 635 | | H |
| VSYNC blanking | Tvb+Tvp | 10 | 35 | | H |

HV mode

Horizontal input timing

| Parameter | | Symbol | Value | | | Unit |
|---------------------------------|------|--------|-------|------|------|------|
| Horizontal display area | | thd | 1024 | | | DCLK |
| DCLK frequency@ Frame rate=60hz | | fclk | Min. | Typ. | Max. | Mhz |
| | | | 44.9 | 51.2 | | |
| 1 Horizontal Line | | th | 1200 | 1344 | | DCLK |
| HSYNC pulse width | Min. | thpw | 1 | | | |
| | Typ. | | 70 | | | |
| | Max. | | 140 | | | |
| HSYNC blanking | | thb | 160 | 160 | | |
| HSYNC front porch | | thfp | 16 | 160 | | |

HV mode

Vertical input timing

| Parameter | Symbol | Value | | | Unit |
|-----------------------|--------|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| Vertical display area | tvd | 600 | | | H |
| VSYNC period time | tv | 624 | 635 | | H |
| VSYNC pulse width | tpw | 1 | 20 | | H |
| VSYNC back porch | tvb | 23 | 23 | | H |
| VSYNC front porch | tvfp | 1 | 12 | | H |

11.MIPI Interface

11.1. MIPI INTERFACE (MOBILE INDUSTRY PROCESSING INTERFACE)

The Display Serial Interface standard defines protocols between a host processor and peripheral devices that adhere to MIPI Alliance standards for mobile device interfaces. The DSI standard builds on existing standards by adopting pixel formats and command set defined in MIPI Alliance standards.

DSI-compliant peripherals support either of two basic modes of operation: Command Mode and Video Mode. Which mode is used depends on the architecture and capabilities of the peripheral. The mode definitions reflect the primary intended use of DSI for display interconnect, but are not intended to restrict DSI from operating in other applications.

Command Mode refers to operation in which transactions primarily take the form of sending commands and data to a peripheral, such as a display module, that incorporates a display controller. The display controller may include local registers. Systems using Command Mode write to, and read from, the registers. The host processor indirectly controls activity at the peripheral by sending commands, parameters and data to the display controller. The host processor can also read display module status information. Command Mode operation requires a bidirectional interface.

Video Mode refers to operation in which transfers from the host processor to the peripheral take the form of a real-time pixel stream. In normal operation, the display module relies on the host processor to provide image data at sufficient bandwidth to avoid flicker or other visible artifacts in the displayed image. Video information should only be transmitted using High Speed Mode. To reduce complexity and cost, systems that only operate in Video Mode may use a unidirectional data path.

MIPI Lane Configuration:

| | MCU (Master) Display Module (Slave) |
|------------|---|
| Clock Lane | Unidirectional Lane <ul style="list-style-type: none"> • Clock Only • Escape Mode (ULPS Only) |
| Data Lane0 | Bi-directional Lane <ul style="list-style-type: none"> ● Forward High-Speed ● Bi-directional Escape Mode ● Bi-directional LPDT |
| Data Lane1 | Unidirectional <ul style="list-style-type: none"> ● Forward High speed |

11.2. Display Serial Interface (DSI)

Video Mode Communication

Video Mode peripherals require pixel data delivered in real time. This section specifies the format and timing of DSI traffic for this type of display module.

Transmission Packet Sequences

DSI supports several formats, or packet sequences, for Video Mode data transmission. The peripheral's timing requirements dictate which format is appropriate. These terms are used throughout the following sections:

Non-Burst Mode with Sync Pulses — enables the peripheral to accurately reconstruct original video timing, including sync pulse widths.

Non-Burst Mode with Sync Events — similar to above, but accurate reconstruction of sync pulse widths is not required, so a single Sync Event is substituted.

Burst mode — RGB pixel packets are time-compressed, leaving more time during a scan line for LP mode(saving power) or for multiplexing other transmissions onto the DSI link.

In the following figures the Blanking or Low-Power Interval (BLLP) is defined as a period during which video packets such as pixel-stream and sync event packets are not actively transmitted to the peripheral. To enable PHY synchronization the host processor should periodically end HS transmission and drive the Data Lanes to the LP state. This transition should take place at least once per frame; shown as LPM in the figures in this section. It is recommended to return to LP state once per scanline during the horizontal blanking time. Regardless of the frequency of BLLP periods, the host processor is responsible for meeting all documented peripheral timing requirements. Note, at lower frequencies BLLP periods will approach, or become, zero.

During the BLLP the DSI Link may do any of the following:

- Remain in Idle Mode with the host processor in LP-11 state and the peripheral in LP-RX.

- Transmit one or more non-video packets from the host processor to the peripheral using Escape Mode.

- Transmit one or more non-video packets from the host processor to the peripheral using HS Mode.

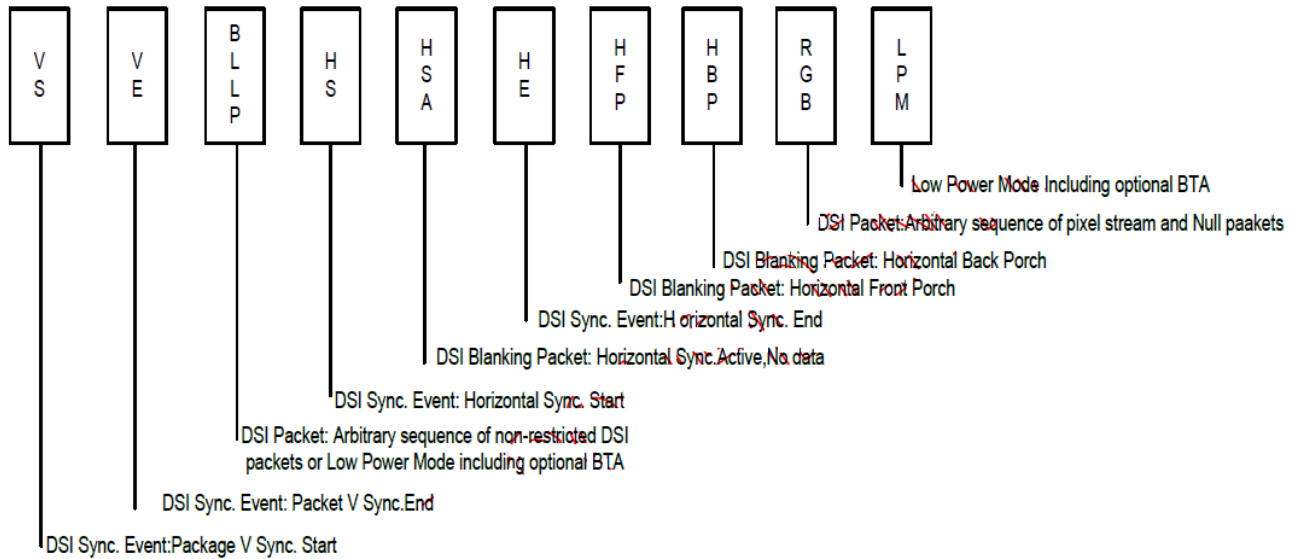
- If the previous processor-to-peripheral transmission ended with BTA, transmit one or more packets from the peripheral to the host processor using Escape Mode.

- Transmit one or more packets from the host processor to a different peripheral using a different Virtual Channel ID.

The sequence of packets within the BLLP or RGB portion of a HS transmission is arbitrary. The host processor may compose any sequence of packets, including iterations, within the limits of the packet format definitions. For all timing cases, the first line of a frame shall start with VS; all other lines shall start with HS. This is also true in the special case when $VSA+VBP=0$. Note that the position of synchronization packets, such as VS and HS, in time is of utmost importance since this has a direct impact on the visual performance of the display panel.

Normally, RGB pixel data is sent with one full scan line of pixels in a single packet. Individual pixels shall not be split across packets.

Transmission packet components used in the figures in this section are defined in Figure below unless otherwise specified.



DSI Video Mode Interface Timing Legend

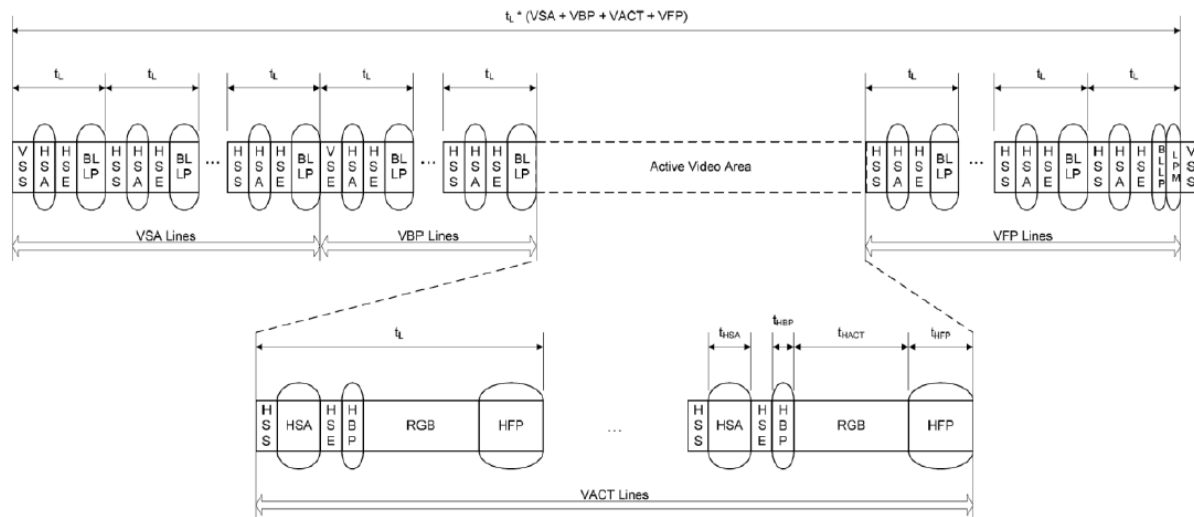
If a peripheral timing specification for HBP or HFP minimum period is zero, the corresponding Blanking Packet may be omitted. If the HBP or HFP maximum period is zero, the corresponding blanking packet shall be omitted.

Clock Requirements

A DSI host processor shall support continuous clock on the Clock Lane for display module that require it, so the host processor needs to keep the HS serial clock running.

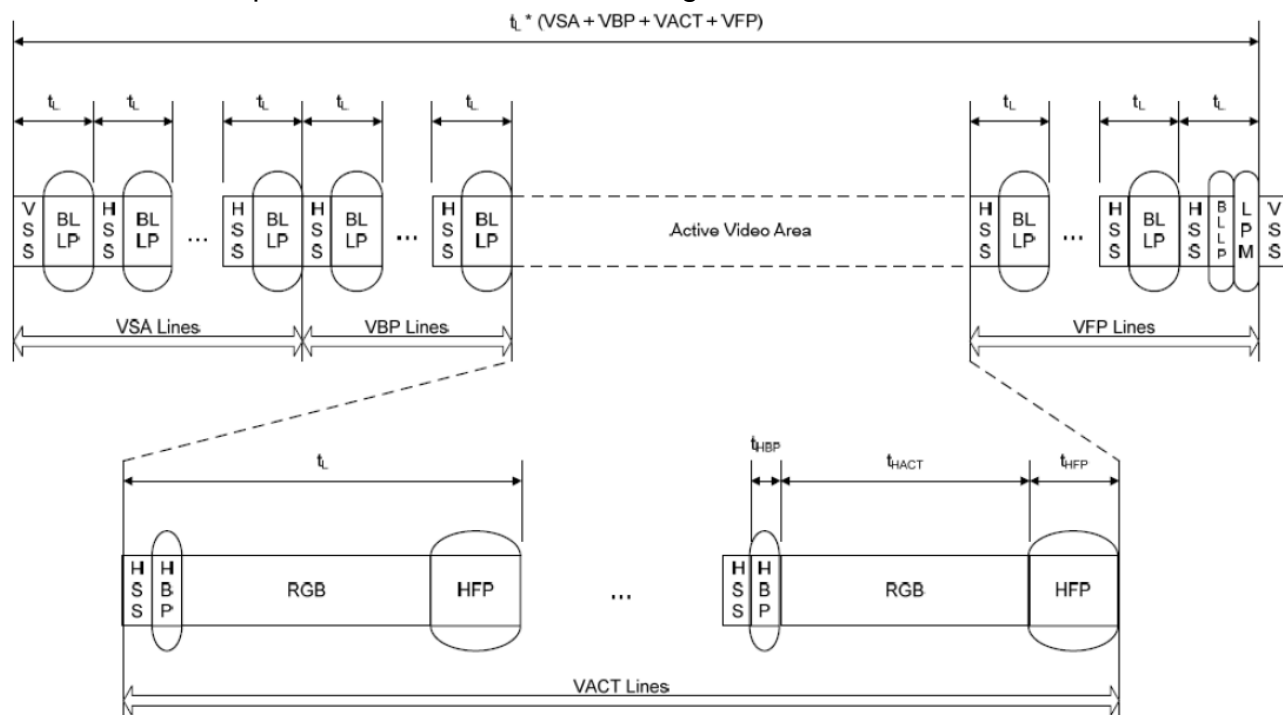
Non-Burst Mode with Sync Pulses

With this format, the goal is to accurately convey DPI-type timing over the DSI serial Link. This includes matching DPI pixel-transmission rates, and widths of timing events like sync pulses. Accordingly, synchronization periods are defined using packets transmitting both start and end of sync pulses. An example of this mode is shown in Figure below.



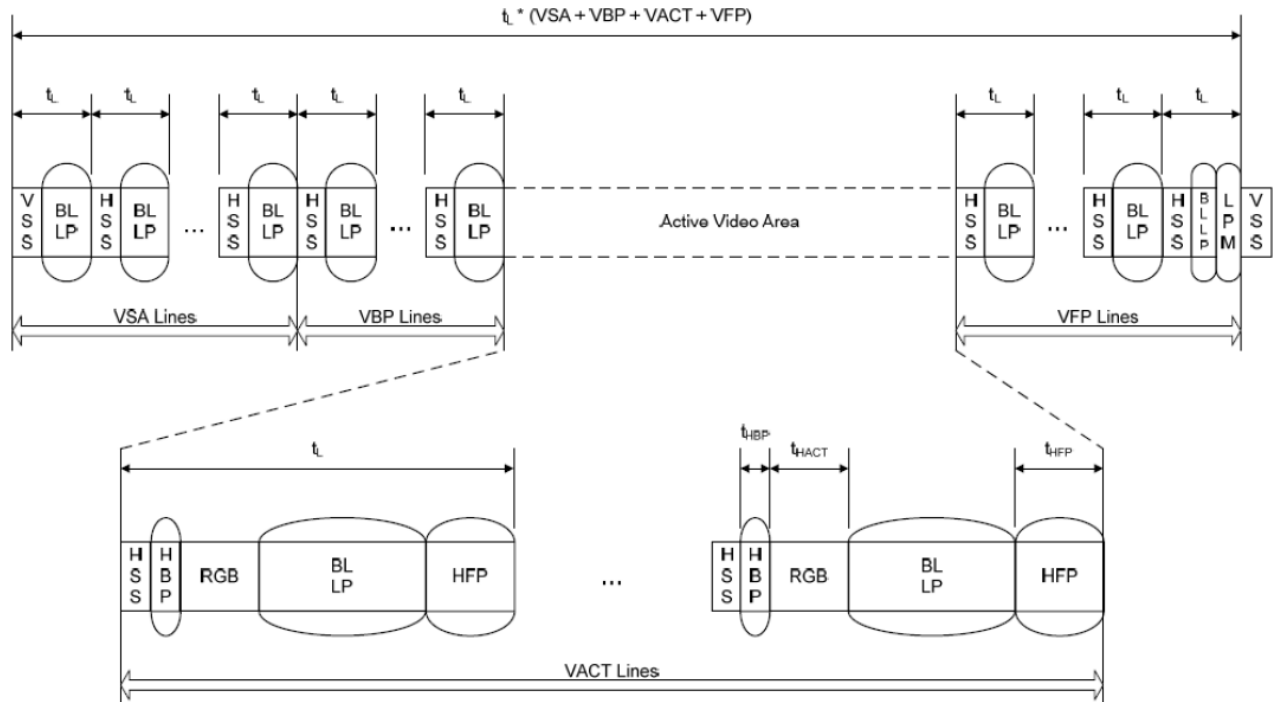
Normally, periods shown as I (Horizontal Sync Active), HBP (Horizontal Back Porch) and HFP (Horizontal Front Porch) are filled by Blanking Packets, with lengths (including packet overhead) calculated to match the period specified by the peripheral's data sheet. Alternatively, if there is sufficient time to transition from HS to LP mode and back again, a timed interval in LP mode may substitute for a Blanking Packet, thus saving power

This mode is a simplification of the format described in section “Non-Burst Mode with Sync Pulse”. Only the start of each synchronization pulse is transmitted. The peripheral may regenerate sync pulses as needed from each Sync Event packet received. Pixels are transmitted at the same rate as they would in a corresponding parallel display interface such as DPI-2. An example of this mode is shown in Figure below.



As with the previous Non-Burst Mode, if there is sufficient time to transition from HS to LP mode and back again, a timed interval in LP mode may substitute for a Blanking Packet, thus saving power.

In this mode, blocks of pixel data can be transferred in a shorter time using a time-compressed burst format. This is a good strategy to reduce overall DSI power consumption, as well as enabling larger blocks of time for other data transmissions over the Link in either direction. There may be a line buffer or similar memory on the peripheral to accommodate incoming data at high speed. Following HS pixel data transmission, the bus goes to Low Power Mode, during which it may remain idle, i.e. the host processor remains in LP-11 state, or LP transmission may take place in either direction. If the peripheral takes control of the bus for sending data to the host processor, its transmission time shall be limited to ensure data underflow does not occur from its internal buffer memory to the display device. An example of this mode is shown in Figure below



Similar to the Non-Burst Mode scenario, if there is sufficient time to transition from HS to LP mode and back again, a timed interval in LP mode may substitute for a Blanking Packet, thus saving power.

12.Optical Characteristics

| Item | | Symbol | Condition. | Min | Typ. | Max. | Unit | Remark |
|--------------------|-------|------------|---------------------------------------|-------|-------|-------|-------------------|-------------------|
| Response time | | Tr | $\theta=0^{\circ}$ 、 $\Phi=0^{\circ}$ | - | 10 | 20 | .ms | Note 3 |
| | | Tf | | - | 20 | 25 | .ms | |
| Contrast ratio | | CR | At optimized viewing angle | 600 | 800 | - | - | Note 4 |
| Color Chromaticity | White | Wx | $\theta=0^{\circ}$ 、 $\Phi=0$ | 0.252 | 0.302 | 0.352 | - | Note 2,6,7 |
| | | Wy | | 0.274 | 0.324 | 0.374 | - | |
| Viewing angle | Hor. | ΘR | $CR \geq 10$ | 80 | 85 | - | Deg. | Note 1 |
| | | ΘL | | 80 | 85 | - | | |
| | Ver. | ΦT | | 80 | 85 | - | | |
| | | ΦB | | 80 | 85 | - | | |
| Brightness | | - | - | 400 | 500 | - | cd/m ² | Center of display |
| Uniformity | | (U) | - | 70 | - | - | % | Note 5 |

Ta=25±2°C

Note 1: Definition of viewing angle range

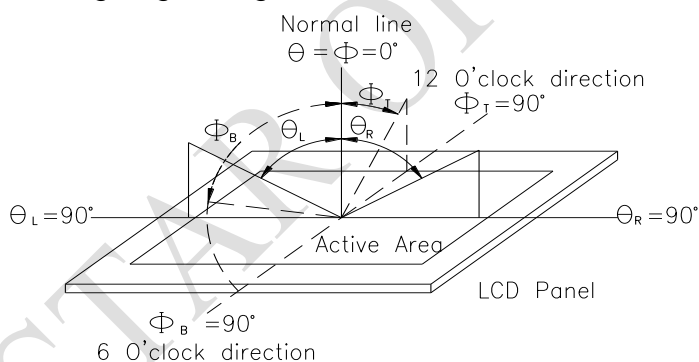


Fig. 12.1. Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 or BM-5 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

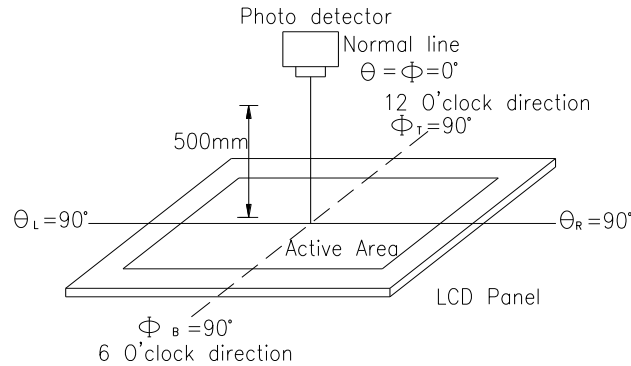
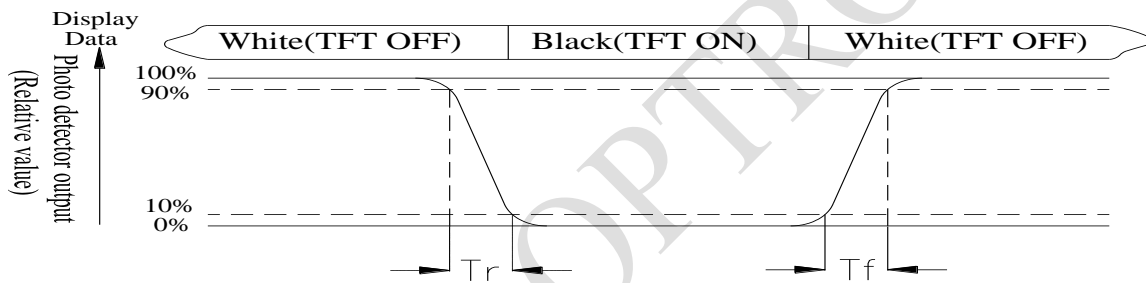


Fig. 12.2. Optical measurement system setup

Note 3: Definition of Response time:

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time, T_r , is the time between photo detector output intensity changed from 90% to 10%. And fall time, T_f , is the time between photo detector output intensity changed from 10% to 90%



Note 4: Definition of contrast ratio:

The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (reference the picture in below). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity (U) = $L_{min}/L_{max} \times 100\%$

L = Active area length

W = Active area width

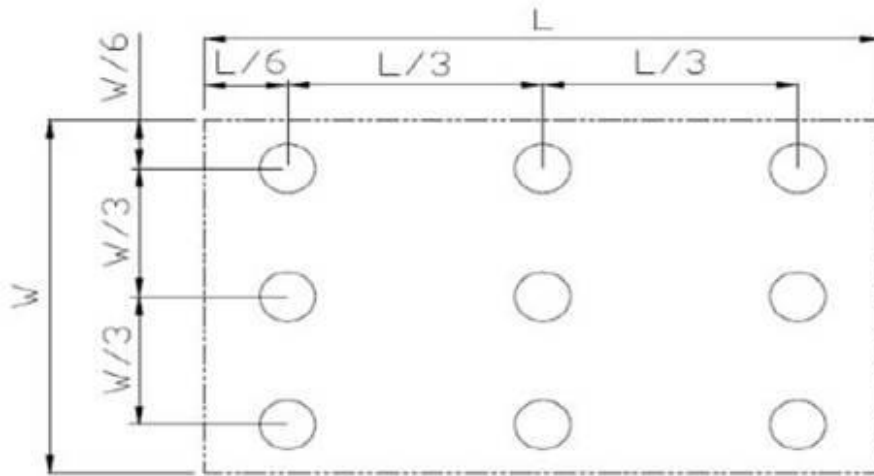


Fig 12.3. Definition of uniformity

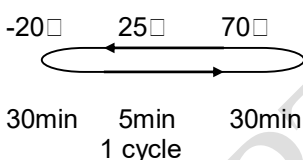
Note 6: Definition of color chromaticity (CIE 1931)

Color coordinates measured at the center point of LCD

Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

13. Reliability

Content of Reliability Test (Wide temperature, -20℃~70℃)

| Environmental Test | | | |
|-------------------------------------|--|---|------|
| Test Item | Content of Test | Test Condition | Note |
| High Temperature storage | Endurance test applying the high storage temperature for a long time. | 80℃ 200hrs | 2 |
| Low Temperature storage | Endurance test applying the low storage temperature for a long time. | -30℃ 200hrs | 1,2 |
| High Temperature Operation | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time. | 70℃ 200hrs | — |
| Low Temperature Operation | Endurance test applying the electric stress under low temperature for a long time. | -20℃ 200hrs | 1 |
| High Temperature/Humidity Operation | The module should be allowed to stand at 60℃,90%RH max | 60℃,90%RH 96hrs | 1,2 |
| Thermal shock resistance | <p>The sample should be allowed stand the following 10 cycles of operation</p>  | -20℃/70℃ 10 cycles | — |
| Vibration test | Endurance test applying the vibration during transportation and using. | Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes | 3 |
| Static electricity test | Endurance test applying the electric stress to the terminal. | VS=±600V(contact) ,±800v(air), RS=330Ω CS=150pF 10 times | — |

Note1: No dew condensation to be observed.

Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.

Note3: The packing have to including into the vibration testing.

14.Initial Code For Reference

command:

```
regw(0xB2,0x10); //Panel Control Register NW/2 Lanes
```

```
// 0x30=4LANE
```

```
// 0x20=3LANE
```

```
// 0x10=2LANE
```

```
regw(0x80,0x5B); //Gamma Control Register G2R/G1R
```

```
regw(0x81,0x47); //Gamma Control Register G4R/G3R
```

```
regw(0x82,0x84); //Gamma Control Register G6R/G5R
```

```
regw(0x83,0x88); //Gamma Control Register G8R/G7R
```

```
regw(0x84,0x88); //Gamma Control Register G10R/G9R
```

```
regw(0x85,0x23); //Gamma Control Register G12R/G11R
```

```
regw(0x86,0xB6); //Gamma Control Register G14R/G13R
```

* Use MIPI Short Packet (0x15) To Write Command and Parameter

LCM Sample Estimate Feedback Sheet

Module Number : _____

1、Panel Specification :

| | | |
|----------------------------|-------------------------------|-------------------------------------|
| 1. Panel Type : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. View Direction : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Numbers of Dots : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. View Area : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Active Area : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. Operating Temperature : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Storage Temperature : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8. Others : | _____ | |

2、Mechanical Specification :

| | | |
|-----------------------------|-------------------------------|-------------------------------------|
| 1. PCB Size : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. Frame Size : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Material of Frame : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. Connector Position : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Fix Hole Position : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. Backlight Position : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Thickness of PCB : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8. Height of Frame to PCB : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 9. Height of Module : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 10. Others : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

3、Relative Hole Size :

| | | |
|-----------------------------|-------------------------------|-------------------------------------|
| 1. Pitch of Connector : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. Hole size of Connector : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. Mounting Hole size : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4. Mounting Hole Type : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Others : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

4、Backlight Specification :

| | | |
|---|---|-------------------------------------|
| 1. B/L Type : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2. B/L Color : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3. B/L Driving Voltage (Reference for LED Type) : | <input type="checkbox"/> Pass <input type="checkbox"/> NG , _____ | |
| 4. B/L Driving Current : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5. Brightness of B/L : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6. B/L Solder Method : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7. Others : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

>> Go to page 2 <<

Module Number : _____

5 、 Electronic Characteristics of Module :

| | | |
|-----------------------------|-------------------------------|-------------------------------------|
| 1.Input Voltage : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 2.Supply Current : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 3.Driving Voltage for LCD : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 4.Contrast for LCD : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 5.B/L Driving Method : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 6.Negative Voltage Output : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 7.Interface Function : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 8.LCD Uniformity : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 9.ESD test : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |
| 10.Others : | <input type="checkbox"/> Pass | <input type="checkbox"/> NG , _____ |

6 、 Summary :
Sales signature : _____

Customer Signature : _____

Date : / /