| HL 海罗光电有限公司 Hello Lighting co.,LTD | Specification document |
|---|---|
| | www.hello-lighting.com |

# SPECIFICATION
# OF
# LCD MODULE

## MODULE NO.: HL173T04-01

**Customer Approval:**

☐ Accept ☐ Reject

| | SIGNATURE | DATE |
|---|---|---|
| PREPARED BY | | |
| CHECKED BY | | |
| APPROVED BY | | |

**DOCUMENT REVISION HISTORY**

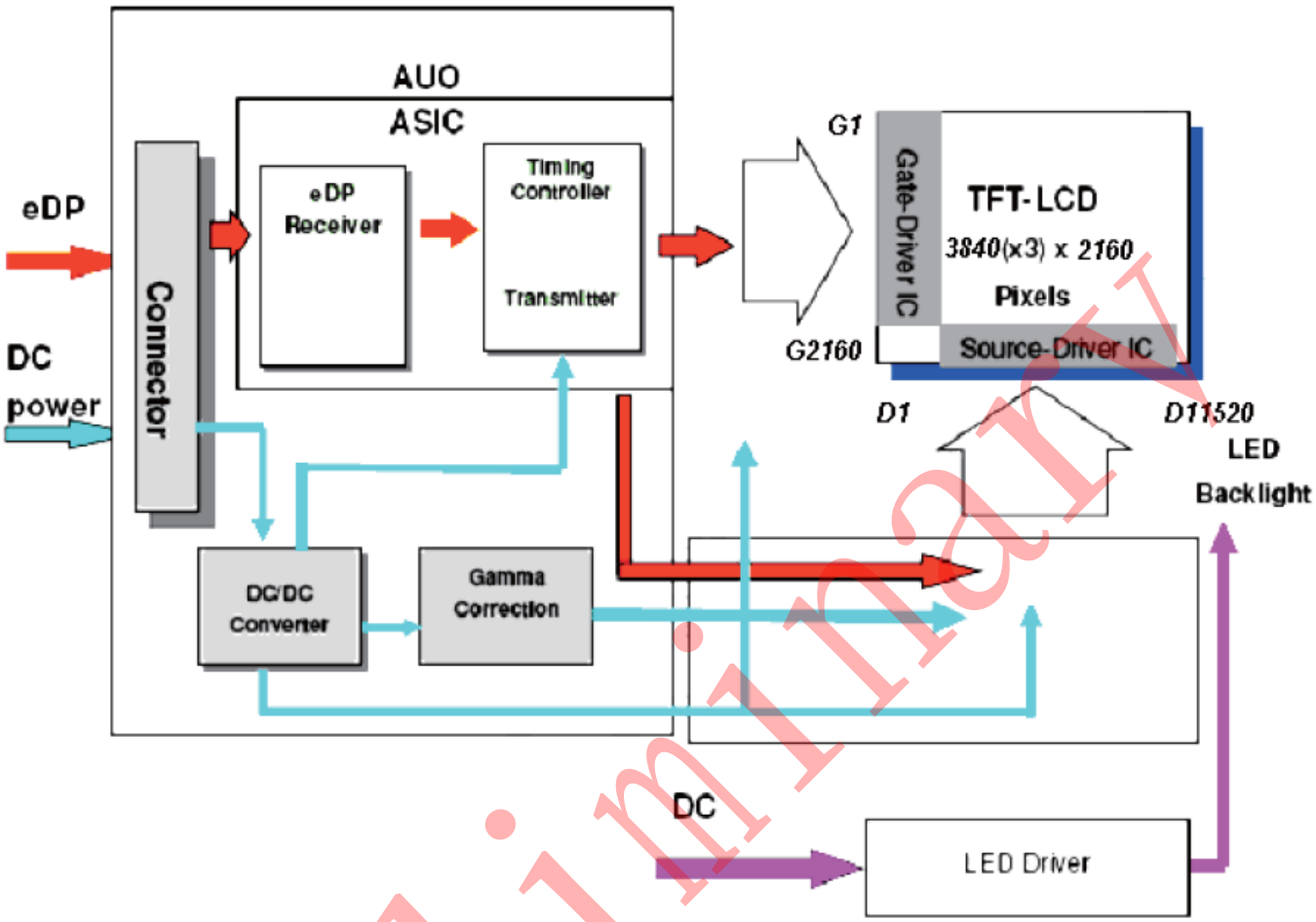
| Sample Version | Doc. Version | DATE | DESCRIPTION | CHECKED BY |
|---|---|---|---|---|
| A1 | A1 | 2021-4-25 | First Release. | |

# 1. MECHANICAL SPECIFICATIONS:

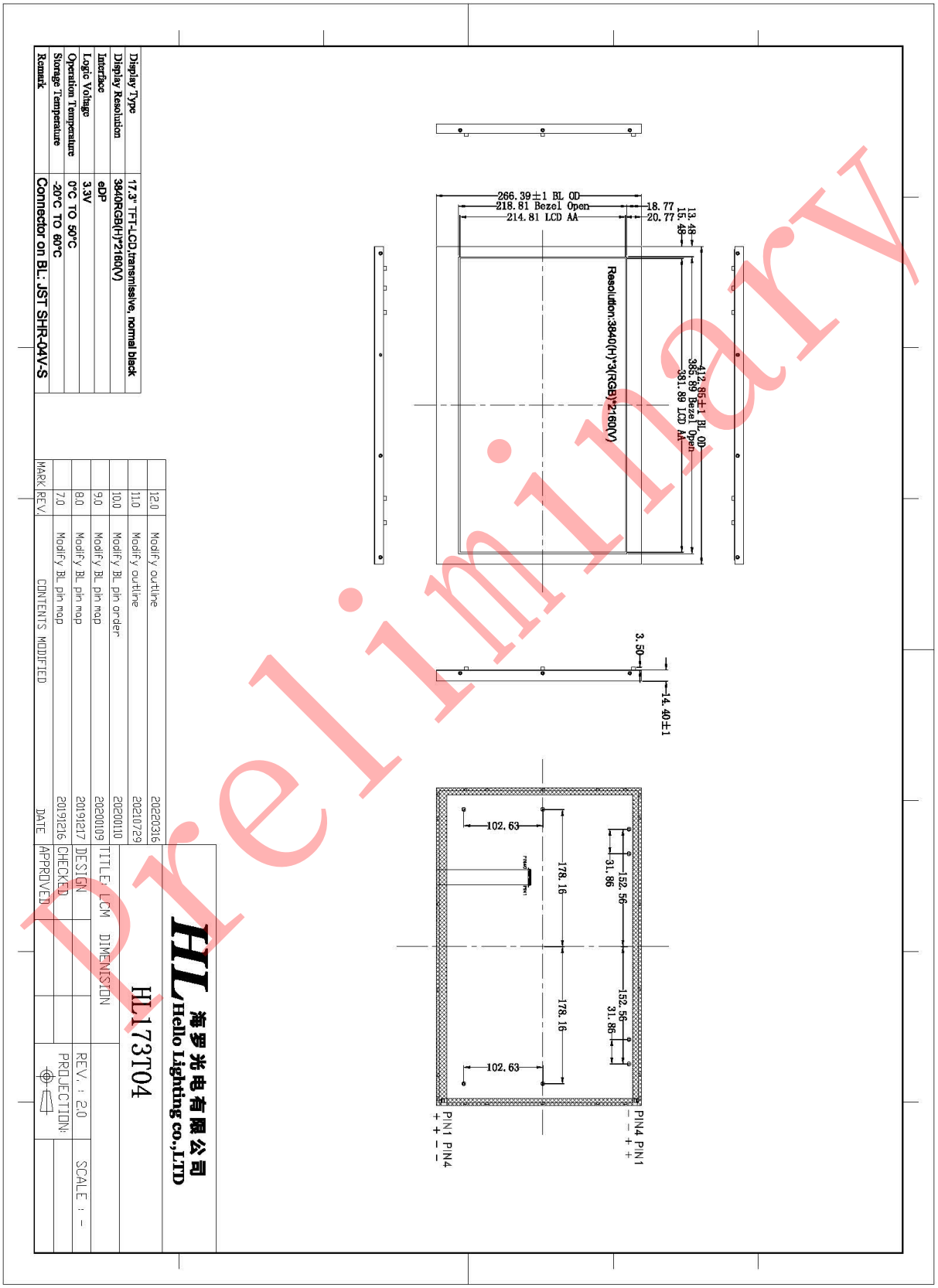
| ITEM | SPECIFICATION | UNIT |
|---|---|---|
| **OUTLINE DIMEMSIONS** | 412.85(W) X266.39(H) X14.4(D) | mm |
| **DISPLAY SIZE** | 17.3 | inch |
| **PIXEL PITCH** | 99.45X99.45 | um |
| **NUMBER OF DOTS** | 3840*（RGB）*2160 | - |
| **DISPLAY COLORS** | 16.7M(8bit) | - |
| **PIXEL ARRANGEMENT** | Pixels RGB stripes arrangement | - |
| **DISPLAY MODE** | Transmissive mode, normally black | - |
| **SURFACE TREATMENT** | Advanced Anti-glare treatment of the front polarizer (3H) | - |

***See attached drawing for details.**

## 2.BLOCK DIAGRAM:



# 3.DIMENSIONAL



# 4. INTERFACE:

## 4.1 PIN MAP

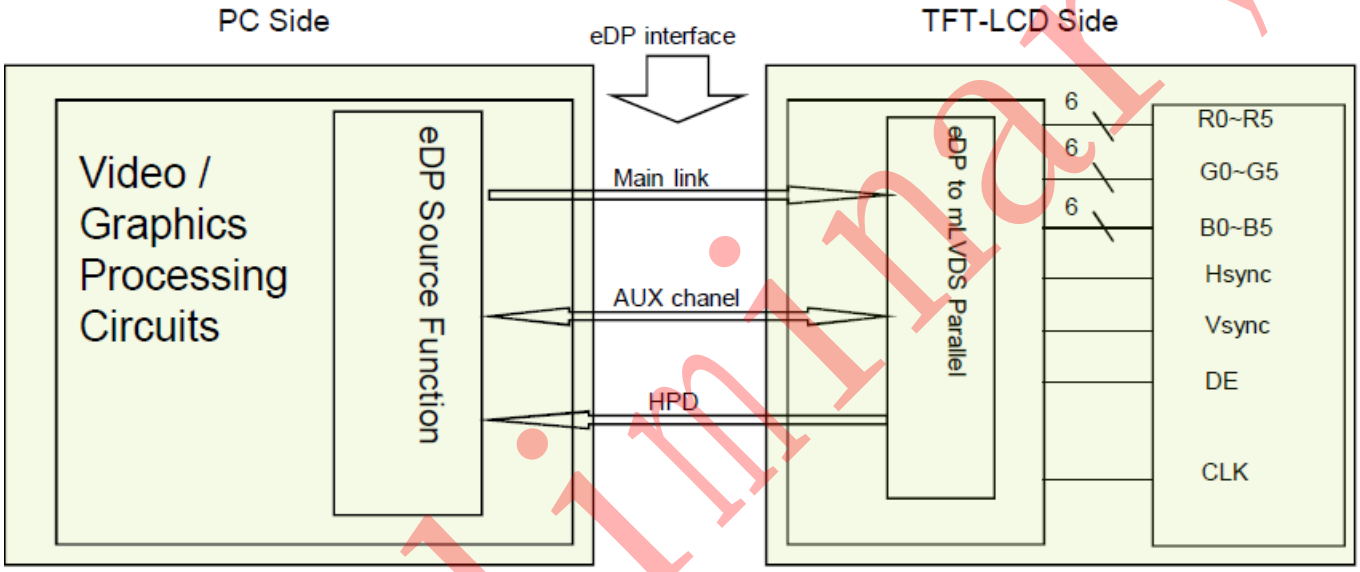
LCD Connector : IPEX 20453-240T-03 or Equivalent

Housing : IPEX 20455-040E-76

| NO. | PIN NAME | Description |
|---|---|---|
| 1 | NC | No connection |
| 2 | H_GND | Ground |
| 3 | Lane3_N | eDP RX Channel 3 Negative |
| 4 | Lane3_P | eDP RX Channel 3 Positive |
| 5 | H_GND | Ground |
| 6 | Lane2_N | eDP RX Channel 2 Negative |
| 7 | Lane2_P | eDP RX Channel 2 Positive |
| 8 | H_GND | Ground |
| 9 | Lane1_N | eDP RX Channel 1 Negative |
| 10 | Lane1_P | eDP RX Channel 1 Positive |
| 11 | H_GND | Ground |
| 12 | Lane0_N | eDP RX Channel 0 Negative |
| 13 | Lane0_P | eDP RX Channel 0 Positive |
| 14 | H_GND | Ground |
| 15 | AUX_CH_P | eDP AUX CH Positive |
| 16 | AUX_CH_N | eDP AUX CH Negative |
| 17 | H_GND | Ground |
| 18 | LCD_VCC | Power Supply, 3.3V (Typ.) |
| 19 | LCD_VCC | Power Supply, 3.3V (Typ.) |
| 20 | LCD_VCC | Power Supply, 3.3V (Typ.) |
| 21 | LCD_VCC | Power Supply, 3.3V (Typ.) |
| 22 | LCD Self Test | No connection |
| 23 | LCD_GND | Ground |
| 24 | LCD_GND | Ground |
| 25 | LCD_GND | Ground |
| 26 | LCD_GND | Ground |
| 27 | HPD | Hot Plug Detect Output |
| 28 | NC | No connection |
| 29 | NC | No connection |
| 30 | NC | No connection |
| 31 | NC | No connection |
| 32 | NC | No connection |

| | | |
|---|---|---|
| 33 | NC | No connection |
| 34 | NC | No connection |
| 35 | NC | No connection |
| 36 | NC | No connection |
| 37 | NC | No connection |
| 38 | NC | No connection |
| 39 | NC | No connection |
| 40 | NC | No connection |

## 4.2 EDP INTERFACE

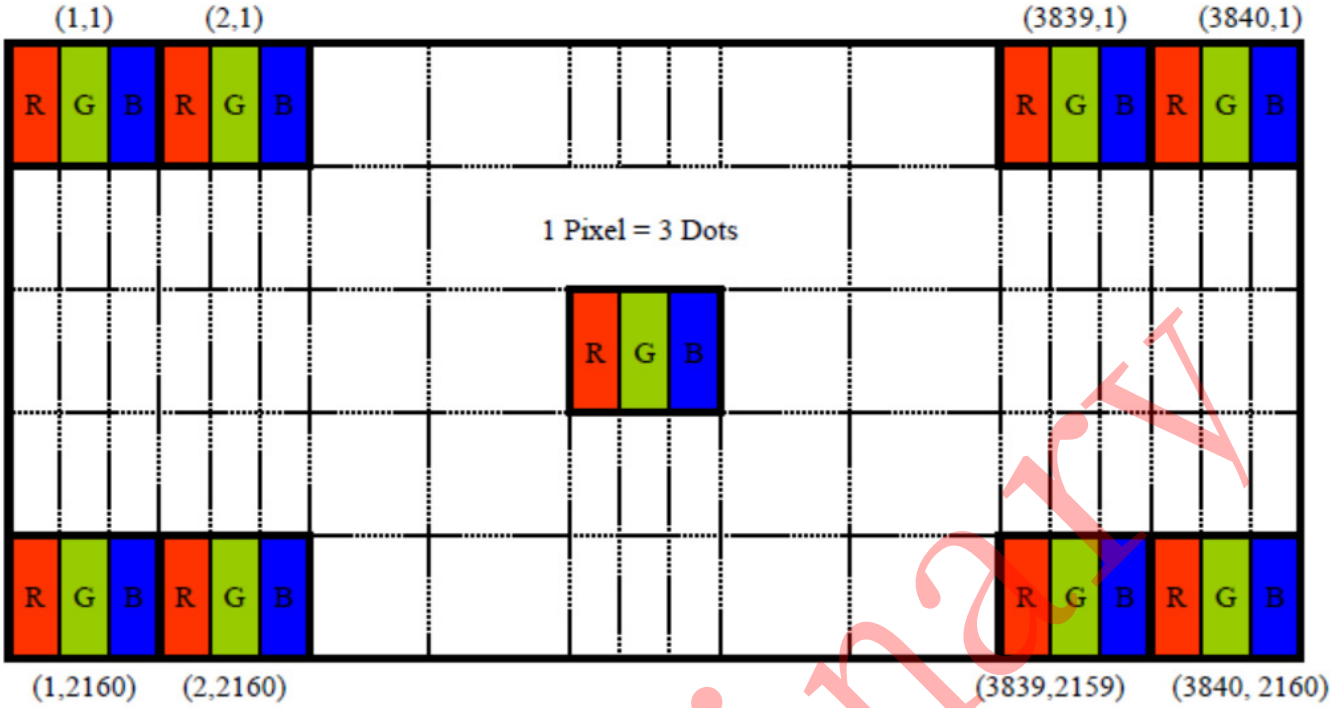



Note. Transmitter : NT71871C or equivalent.
Transmitter is not contained in Module

eDP input signal

| Lane 0 | Lane 1 | Lane 2 | Lane 3 |
|---|---|---|---|
| R0-7:0 | R1-7:0 | R2-7:0 | R3-7:0 |
| G0-7:0 | G1-7:0 | G2-7:0 | G3-7:0 |
| B0-7:0 | B1-7:0 | B2-7:0 | B3-7:0 |
| R4-7:0 | R5-7:0 | R6-7:0 | R7-7:0 |
| G4-7:0 | G5-7:0 | G6-7:0 | G7-7:0 |
| B4-7:0 | B5-7:0 | B6-7:0 | B7-7:0 |
| R8-7:0 | R9-7:0 | R10-7:0 | R11-7:0 |
| G8-7:0 | G9-7:0 | G10-7:0 | G11-7:0 |
| B8-7:0 | B9-7:0 | B10-7:0 | B11-7:0 |

Data input format



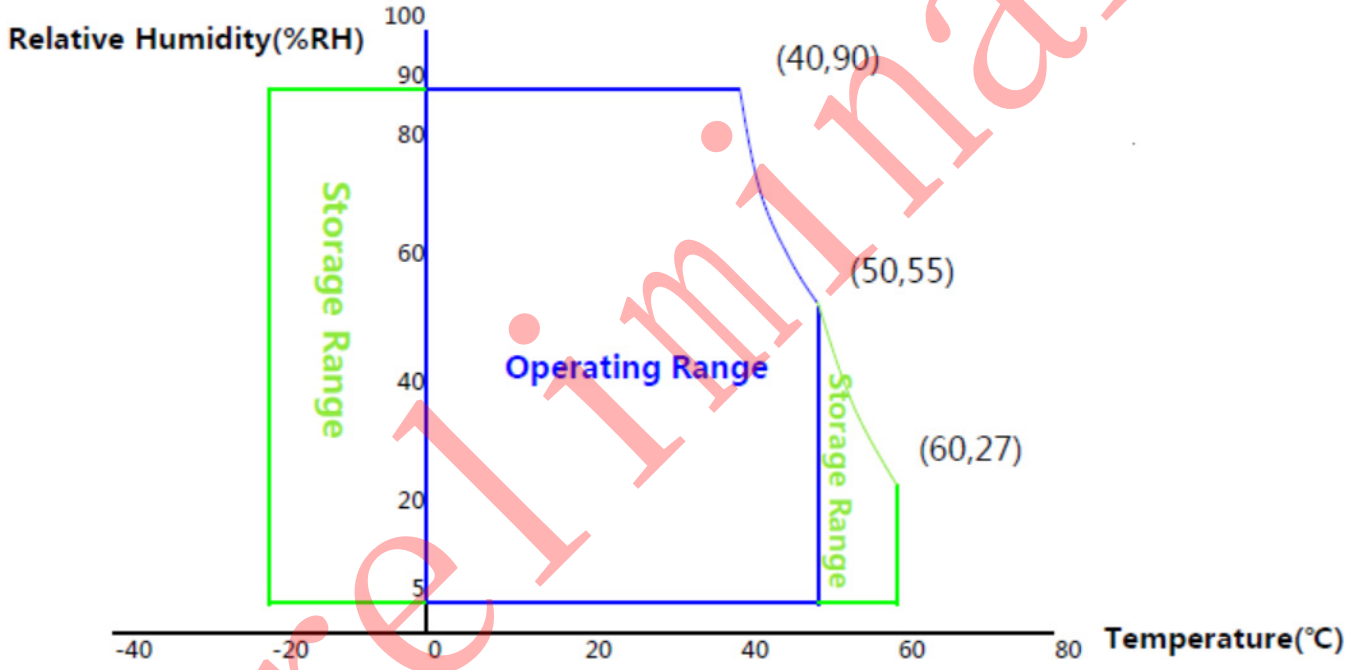
## 5. MAXIMUM ABSOLTE LIMIT:

| Item | Symbol | Value | Unit |
|---|---|---|---|
| **Power supply voltage** | LCD_VCC | GND-0.3 ~ 4 | V |
| **eDP input voltage** | Vedp | 0 - 2 | V |
| **Operating temperature** | Topr | 0 to 50 | °C |
| **Storage temperature** | Tstg | -20 to 60 | °C(3) |

Notes :

1. Permanent damage to the device may occur if maximum values are exceeded functional operation should be restricted to the condition described under normal operating conditions.
2. Temperature and relative humidity range are shown in the figure below.

90 % RH Max. ( 40 °C ≧ Ta) Maximum wet - bulb temperature at 39 °C or less. (Ta > 40 °C ) No condensation.



# 6.ELECTRICAL CHARACTERISTICS

## 6.1 DC Characteristics (Ta=25°C)

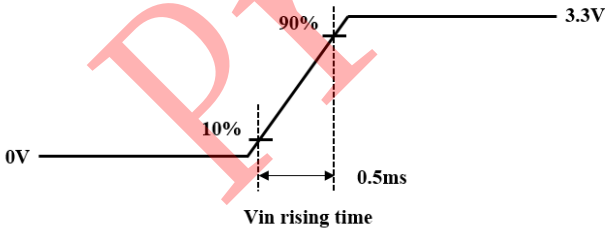
| Item | Symbol | Min | Type | Max | Unit |
|---|---|---|---|---|---|
| Voltage of power supply | LCD_VCC | 3.0 | 3.3 | 3.6 | V |
| Permissive Power Input Ripple | Vrf | -10%VCC | 90 | +10%VCC | V |
| Rush Current | $I_{RUSH}$ | - | - | 2 | A |
| LCD Power Supply Input Current | Mosaic | - | - | 485 | mA |
| | RGB | - | - | 606 | mA |
| LCD power consumption | Mosaic | - | - | 1.9 | W |
| | RGB | - | - | 2.0 | W |

Notes :

1. The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for 3.3V at 25 °C.
a) Mosaic pattern 8*8
b) R/G/B patterns

(a) (b)

2. Calculated value for reference (VLED × ILED)
3. Measure condition




Vin rising time

## 6.2 Backlight Electrical-optical Characteristics

| Item | Symbol | MIN | TYP | MAX | UNIT | Test Condition | Note |
|---|---|---|---|---|---|---|---|
| **Supply Voltage** | Vf | | 68.2 | 70.4 | V | | - |
| **Supply Current** | If | - | 700 | - | mA | - | 2string total |
| **Reverse Voltage** | Vr | - | - | 5 | V | 10uA | |
| **Power dissipation** | Pd | - | 47.74 | - | W | - | |
| **Uniformity for LCM** | - | 80 | - | - | % | | - |
| **Life Time** | - | 30000 | - | - | Hr | | - |
| **Backlight Color** | White | | | | | | |

NOTE:

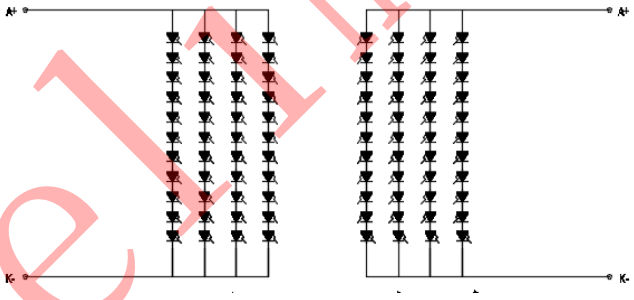
1. Average Luminous Intensity of P1-P9
2. Uniformity = Min/Max * 100%
3. LED life time defined as follows: The final brightness is at 70% of original brightness

   Measured Method: (X*Y: Light Area)(Left Draft as follow)

   Internal Circuit Diagram(Right Draft as follow)

   (Effective spatial Distribution)

   Hole Diameter ø 3mm ; 1 to 9 per Position Measured Luminous:



4. BL connector: JST SHR-04V-S

# 7 TIMING

## 7.1 Timing characteristics

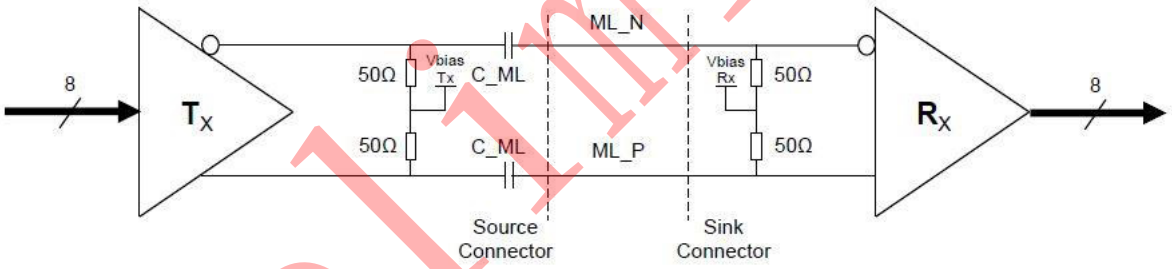
The HL173T04-01 is operated by the DE only

| Item | | Symbols | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Clock | Frequency | 1/Tc | 355.52 | 533.25 | 586.6 | MHz |
| | High Time | Tch | - | 4/7 | - | Tc |
| | Low Time | Tcl | - | 3/7 | - | Tc |
| Frame Period | | Tv | 3900 | 4000 | 4050 | lines |
| | | | - | 60 | - | Hz |
| | | | 25 | 16.7 | 15.15 | ms |
| Vertical Display Period | | Tvd | - | 2160 | - | lines |
| One line Scanning Period | | Th | 2180 | 2222 | 2240 | clocks |
| Horizontal Display Period | | Thd | - | 3840 | - | clocks |

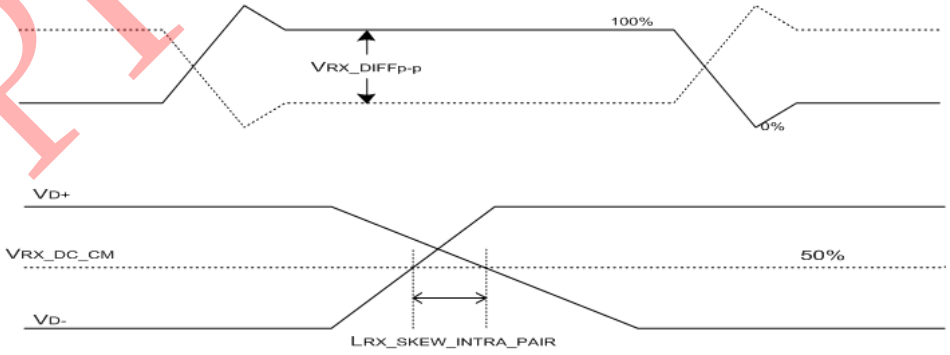
Note : The above is as optimized setting.

## 7.2 eDP Rx Interface Timing Parameter

| Item | Symbol | Min | Typ | Max | Unit | Remark |
|---|---|---|---|---|---|---|
| Spread spectrum clock (Link clock down-spreading) | ssc | - | 0.5 | | % | |
| Differential peak-to-peak input voltage at package pins | VRX-DIFFp-p | 120 | - | - | mV | |
| Rx input DC common mode voltage | VRX_DC_CM | 0 | - | 2.0 | V | |
| Differential termination resistance | RRX-DIFF | 72.3 | 85 | 97.8 | Ω | |
| Single-ended termination resistance | RRX-SE | 36.15 | 42.5 | 48.9 | Ω | |
| Rx short circuit current limit | IRX_SHORT | - | - | 50 | mA | |
| Intra-pair skew at Rx package pins (HBR) RX intra-pair skew tolerance at HBR | LRX_SKEW_ INTRA_PAIR | - | - | 60 | ps | |
| AC Coupling Capacitor | CSOURCE_ML | 75 | | 200 | nF | Source side |



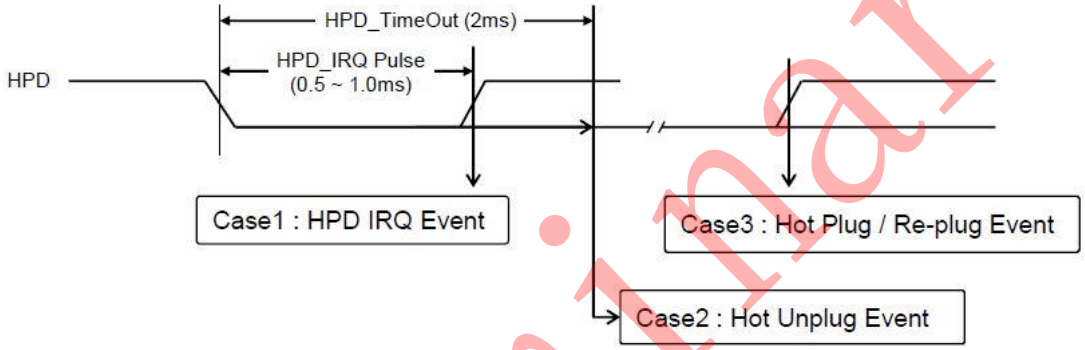

Main link differential pair




VRX-DIFFp-p & LRX_SKEW_INTRA_PAIR

| Item | Symbol | Min | Typ | Max | Unit | Remark |
|---|---|---|---|---|---|---|
| HPD voltage | $V_{HPD}$ | 2.25 | - | 3.6 | V | |
| Hot Plug Detection Threshold | - | 2.0 | - | - | V | Source side Detecting |
| Hot Unplug Detection Threshold | - | - | - | 0.8V | V | |
| HPD_IRQ Pulse Width | HPD_IRQ | 0.5 | - | 1 | ms | |
| HPD_TimeOut | - | 2.0 | - | - | ms | |

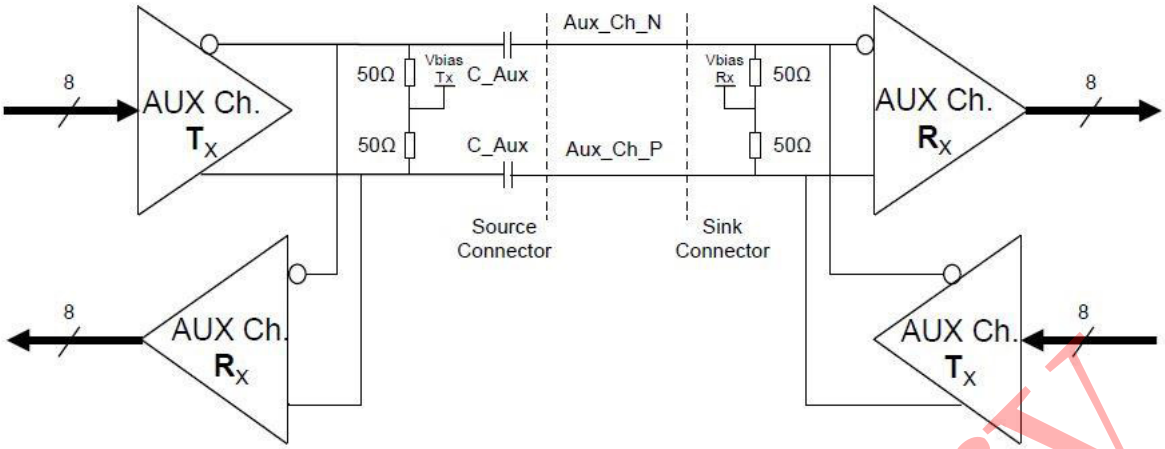
HPD Characteristics




HPD Events

| Item | Symbol | Min | Typ | Max | Unit | Remark |
|---|---|---|---|---|---|---|
| AUX unit interval | UIAUX | 0.4 | 0.5 | 0.6 | Us | |
| AUX peak-to-peak input differential voltage | VAUX-RX-DIFFp-p | 0.29 | - | 1.38 | V | |
| AUX CH termination DC resistance | RAUX-TERM | 80 | 100 | 120 | Ohm | |
| AUX DC common mode voltage | VAUX-DC-CM | 0 | - | 2 | V | |
| AUX turn around common mode voltage | VAUX-TURN-CM | - | - | 0.3 | V | |
| AUX short circuit current limit | IAUX-SHORT | - | - | 90 | mA | |
| AUX AC Coupling Capacitor | CSOURCE-AUX | 75 | - | 200 | nf | Source side |

AUX Characteristics



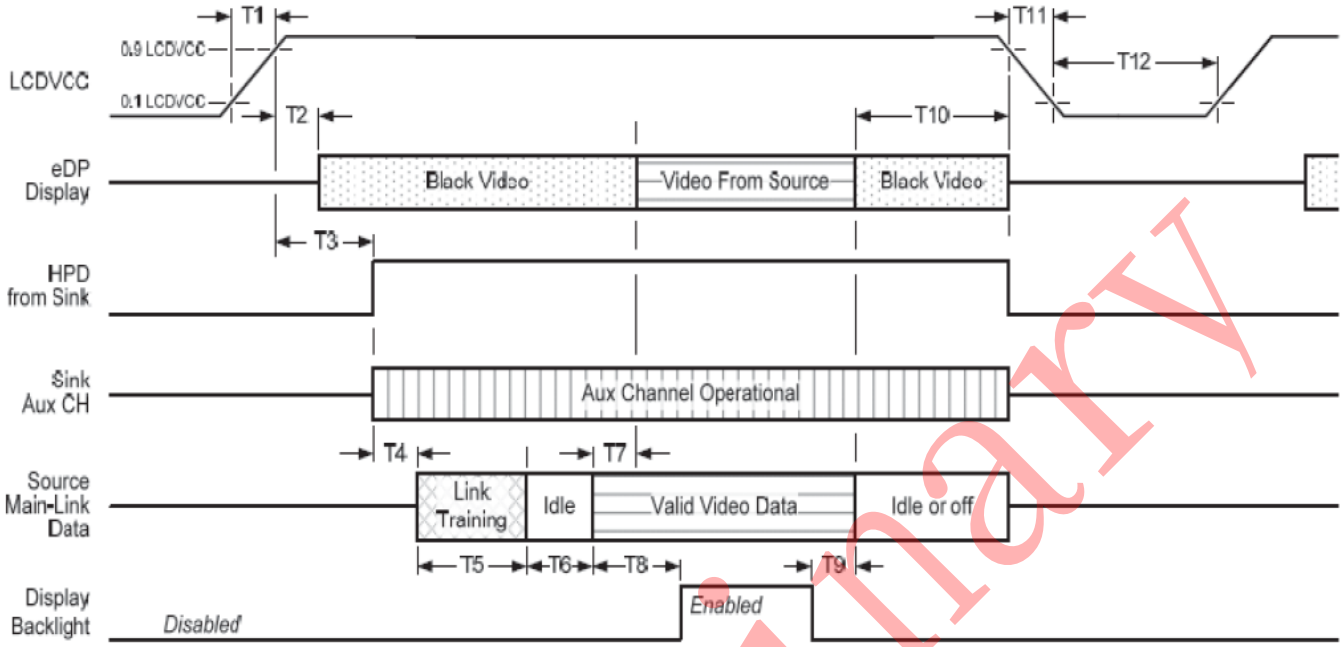

AUX differential pair

## 7.3 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

| Color & Gray Scale | | Input Data Signal | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Red Data | | | | | | | | Green Data | | | | | | | | Blue Data | | | | | | | |
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale of Red | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▵ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▵ | ↑ | | | | | | | | ↑ | | | | | | | | ↑ | | | | | | | |
| | ▿ | ↓ | | | | | | | | ↓ | | | | | | | | ↓ | | | | | | | |
| | Brighter | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▿ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Green | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▵ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▵ | ↑ | | | | | | | | ↑ | | | | | | | | ↑ | | | | | | | |
| | ▿ | ↓ | | | | | | | | ↓ | | | | | | | | ↓ | | | | | | | |
| | Brighter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▿ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Blue | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▵ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Darker | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | ▵ | ↑ | | | | | | | | ↑ | | | | | | | | ↑ | | | | | | | |
| | ▿ | ↓ | | | | | | | | ↓ | | | | | | | | ↓ | | | | | | | |
| | Brighter | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | ▿ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale of White | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ▵ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Darker | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | ▵ | ↑ | | | | | | | | ↑ | | | | | | | | ↑ | | | | | | | |
| | ▿ | ↓ | | | | | | | | ↓ | | | | | | | | ↓ | | | | | | | |
| | Brighter | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | ▿ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

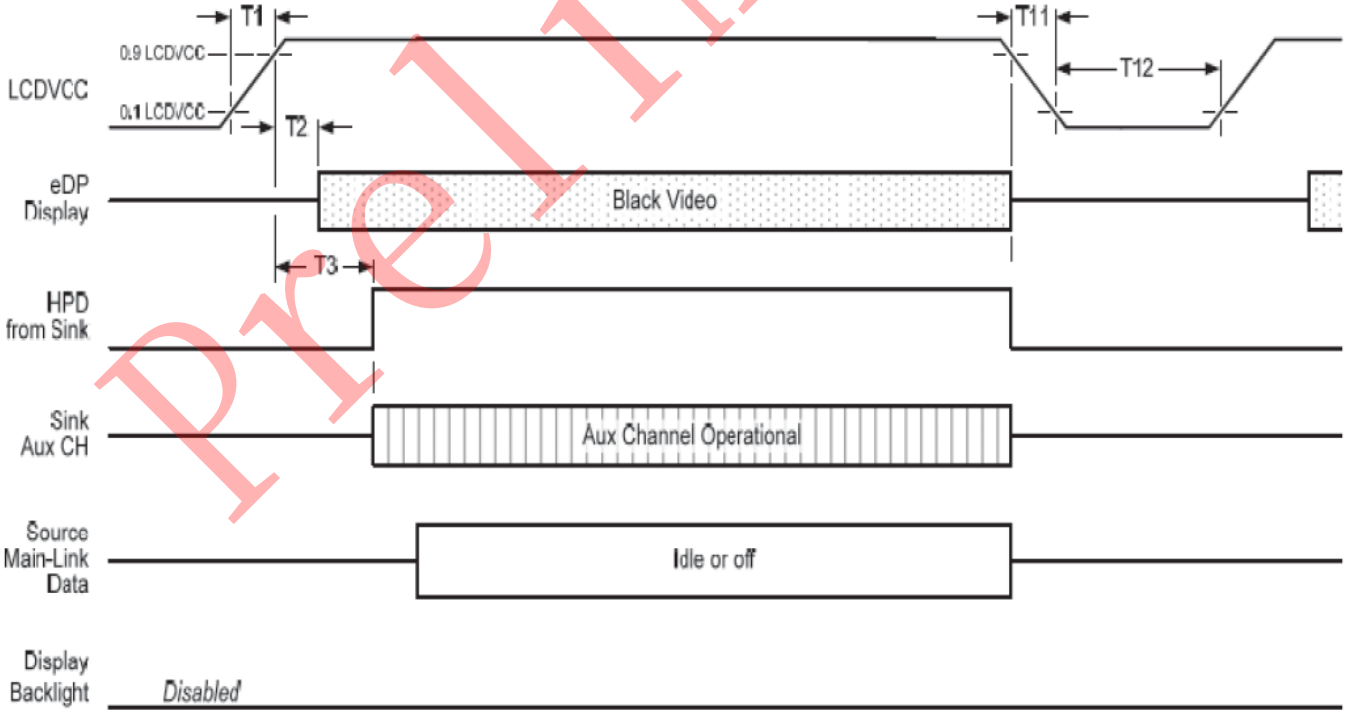
## 7.4 Power Sequence

Display Port panel power sequence:




Display port interface power up/down sequence, normal system operation

Display Port AUX_CH transaction only:




Display port interface power up/down sequence, AUX_CH transaction only

| Timing parameter | Description | Reqd. by | Limits | | | Notes |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| T1 | power rail rise time, 10% to 90% | source | 0.5ms | | 10ms | |
| T2 | delay from LCDVDD to black video generation | sink | 0ms | | 200ms | prevents display noise until valid video data is received from the source |
| T3 | delay from LCDVDD to HPD high | sink | 0ms | | 200ms | sink AUX_CH must be operational upon HPD high. |
| T4 | delay from HPD high to link training initialization | source | | | | allows for source to read link capability and initialize. |
| T5 | link training duration | source | | | | dependant on source link to read training protocol. |
| T6 | link idle | source | | | | Min accounts for required BS-Idle pattern.<br>Max allows for source frame synchronization. |
| T7 | delay from valid video data from source to video on display | sink | 0ms | | 50ms | max allows sink validate video data and timing. |
| T8 | delay from valid video data from source to backlight enable | source | | | | source must assure display video is stable. |
| T9 | delay from backlight disable to end of valid video data | source | | | | source must assure backlight is no longer illuminated. |
| T10 | delay from end of valid video data from source to power off | source | 0ms | | 500ms | |
| T11 | power rail fall time, 905 to 10% | source | | | 10ms | |
| T12 | power off time | source | 500ms | | | |

Note1: The sink must include the ability to generate black video autonomously. The sink must automatically enable black video under the follow conditions:

-upon LCDVDD power on(with in T2 max)-when the "Novideostream_Flag"(VB-ID Bit 3) is received from the source(at the end of T9)

-when no main link data, or invalid video data, is received from the source. Black video must be displayed within 64ms (typ) from the start of either condition. Video data can be deemed invalid based on MSA and timing information, for example.

Note2: The sink may implement the ability to disable the black video function, as described in Note 1, above, for system development and debugging purpose.

Note3: The sink must support AUX_CH polling by the source immediately following LCDVDD power on without causing damage to the sink device (the source can re-try if the sink is not ready). The sink must be able to respond to an AUX_CH transaction with the time specified within T3 max.

## 8. OPTICAL CHARACTERISTICS:

Driving the backlight

| No. | ITEM | | Symbol | Conditions | Specification | | | Unit | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | | |
| 1 | Response Time | | Tg | 25℃ | - | 25 | - | ms | (1)(2) |
| 2 | Contrast Rate | | Cr | θ=0, Normal viewing angle | 800 | 1000 | - | - | (1)(3) |
| 3 | Viewing Angle | Hor. | θL + θR | CR>10 | 170 | 178 | - | Deg | - |
| | | Ver. | Θ+ + Θ- | | 170 | 178 | - | | |
| 4 | Chromaticiry | White | x | Brightness is ON | Typ – 0.03 | TBD | Typ+0.03 | | |
| | | | y | | | TBD | | | |
| | | Red | x | | | TBD | | | |
| | | | y | | | TBD | | | |
| | | Green | x | | | TBD | | | |
| | | | y | | | TBD | | | |
| | | Blue | x | | | TBD | | | |
| | | | y | | | | | | |
| 5 | luminance | | L | | 1000 | 1500 | - | cd/m2 | |
| 6 | Color Gamut | | | | - | 100 | - | % | DCI P3 |
| 7 | White Variation | | δ W | | 80 | | | % | |

Measure Conditions:

1. Measure surrounding : dark room;
2. Ambient temperature: 25±2℃;
3. 30min.warm-up time.

**Note**

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o' clock direction and the vertical or 6, 12 o' clock direction with respect to the optical axis which is normal to the LCD surface.

2. Contrast measurements shall be made at viewing angle of = 0° and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Center Luminance of white is defined as the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.

4. The White luminance uniformity on LCD surface is then expressed as :

$\triangle Y$ = ( Minimum Luminance of 9points / Maximum Luminance of 9points ) * 100

5. The color chromaticity coordinates specified shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

6. Response time Tg is the average time required for display transition by switching the input signal as below table and is based on Frame rate fV =60Hz to optimize.

7. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (YA) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (YB) of that same area when any adjacent area is driven dark.

# 9. GENERAL PRECAUTIONS

## 9.1 Handling

(a) When the module is assembled, it should be attached to the system firmlyusing all mounting holes. Be careful not to twist and bend the module.

(b) Because the inverter uses high voltages, it should be disconnected from powersource before it is assembled or disassembled.

(c) Refrain from strong mechanical shock and / or any force to the module.In addition to damage, it may cause improper operation or damage to the moduleand CCFT back light.

(d) Note that polarizer films are very fragile and could be damaged easily.Do not press or scratch the surface harder than a HB pencil lead.

(e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.

(f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.

(g) Desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might cause permanent damage to the polarizer due to chemical reaction.

(h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.

(i) Protect the Module from static, or the CMOS Gate Array IC would be damaged.

(j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(k) Do not disassemble the Module.

(l) Do not pull or fold the lamp wire.

(m) Do not adjust the variable resistor located on the Module.

(n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized.

(o) Pins of I/F connector should not be touched directly with bare hands.

## 9.2 Storage

(a) Do not leave the Module in high temperature, and high humidity for a long time. It is highly recommended to store the Module with temperature from 0 to 35℃ and relative humidity of less than 70%.

(b) Do not store the TFT-LCD Module in direct sunlight.

(c) The Module should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.

## 9.3 Operation

(a) Do not connect or disconnect the Module in the "Power On" condition.

(b) Power supply should always be turned on/off by the item "Power on/off sequence"

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

(d) The cable between the back light connector and its inverter power supply should be connected directly with a minimized length. A longer cable between the back light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

## 9.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.

Normal condition is defined as below;

- Temperature : 20±15℃

- Humidity : 65±20%

- Display pattern : continually changing pattern (Not stationary)

(b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc.., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

## 9.5 Others

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the Module may be damaged.

(d) If the Module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen. To avoid image sticking, it is recommended to use a screen saver.

(e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

(f) Please contact SEC in advance when you display the same pattern for a long time.



**Hello Lighting co., ltd reserves the right to change this specification.**
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**- END -**