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# SPECIFICATION

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**ORTUSTECH**

**COM50H5N11ULC**

5.0“ – HD720 - MIPI

Version: 0.1

Date: 11.09.2020

Note: This specification is subject to change without prior notice

| Ver. | Date        | Page   | Description           |
|------|-------------|--------|-----------------------|
| 0.0  | Jul.8.2020  | -      | - Tentative issue     |
| 0.1  | Sep.11,2020 | P.12   | 7.1.1 Display Module  |
| A x2 |             | Change | Operating Current     |
|      |             | P.21   | 9.1 Power-ON Sequence |
|      |             | Change | SETPOWER Parameter 4  |

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## 1. Application

This Specification is applicable to 126.0mm (5.0 inch) Blanview TFT-LCD monitor for non-military use.

- ◎ TOPPAN PRINTING makes no warranty or assume no liability that use of this Product and/or any information including drawings in this Specification by Purchaser is not infringing any patent or other intellectual property rights owned by third parties, and TOPPAN PRINTING shall not grant to Purchaser any right to use any patent or other intellectual property rights owned by third parties. Since this Specification contains TOPPAN PRINTING's confidential information and copy right, Purchaser shall use them with high degree of care to prevent any unauthorized use, disclosure, duplication, publication or dissemination of TOPPAN PRINTING's confidential information and copy right.
- ◎ If Purchaser intends to use this Products for an application which requires higher level of reliability and/or safety in functionality and/or accuracy such as transport equipment (aircraft, train, automobile, etc.), disaster-prevention/security equipment or various safety equipment, Purchaser shall consult TOPPAN PRINTING on such use in advance.
- ◎ This Product shall not be used for application which requires extremely higher level of reliability and/or safety such as aerospace equipment, telecommunication equipment for trunk lines, control equipment for nuclear facilities or life-support medical equipment.
- ◎ It must be noted as an mechanical design manner, especial attention in housing design to prevent arcuation/flexure or caused by stress to the LCD module shall be considered.
- ◎ TOPPAN PRINTING assumes no liability for any damage resulting from misuse, abuse, and/or miss-operation of the Product deviating from the operating conditions and precautions described in the Specification.
- ◎ It shall be mutually conferred if nonconforming defect which result from unspecified cause in this specification arises.
- ◎ If any issue arises as to information provided in this Specification or any other information, TOPPAN PRINTING and Purchaser shall discuss them in good faith and seek solution.
- ◎ TOPPAN PRINTING assumes no liability for defects such as electrostatic discharge failure occurred during peeling off the protective film or Purchaser's assembly process.
- ◎ This Product is compatible for RoHS(2.0) directive.

| Object substance                                   | Maximum content [ppm] |
|----------------------------------------------------|-----------------------|
| Cadmium and its compound                           | 100                   |
| Hexavalent Chromium Compound                       | 1000                  |
| Lead & Lead compound                               | 1000                  |
| Mercury & Mercury compound                         | 1000                  |
| Polybrominated biphenyl series (PBB series)        | 1000                  |
| Polybrominated biphenyl ether series (PBDE series) | 1000                  |
| Bis(2-ethylhexyl)phthalate series (DEHP series)    | 1000                  |
| Butyl benzyl phthalate series (BBP series)         | 1000                  |
| Dibutyl phthalate series (DBP series)              | 1000                  |
| Diisobutyl phthalate series (DIBP series)          | 1000                  |

## 2. Outline Specifications

### 2.1 Features of the Product

- 5.0 inch diagonal display, 720 x RGB [H] x 1280 [V] dots.
- 24bitRGB ( 8-8-8 Format ) / 16.7 Million colors.
- MIPI DSI as high-speed interface. Video mode only.
- Timing generator [TG], Counter-electrode driving circuitry, Built-in power supply circuit.
- Various display controls and functional selection.
- Long life & High bright white LED back-light.
- Blanview TFT-LCD, improved outdoor readability.

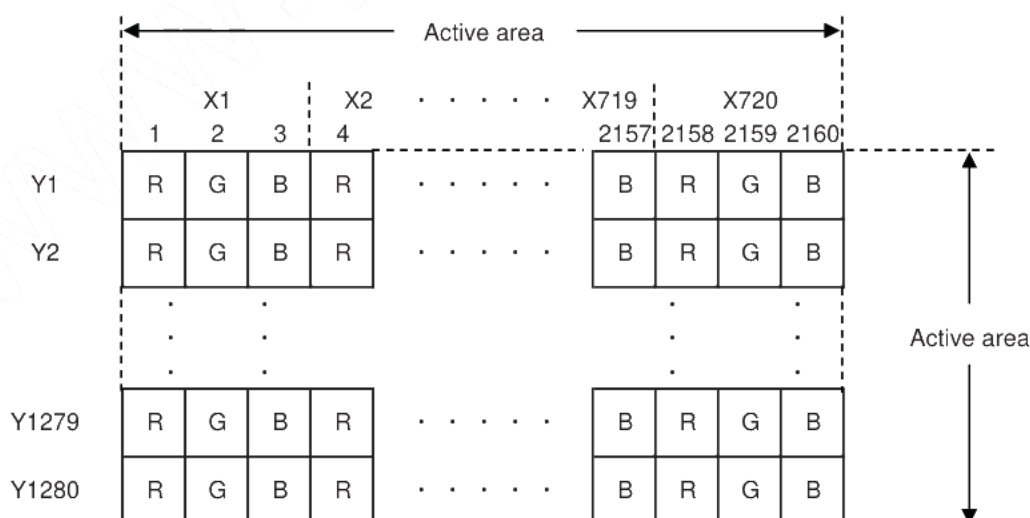
\* MIPI : Mobile Industrial Processor Interface , DSI : Display Serial Interface

|               | Indoor      |                                    | Outdoor     |                                    |
|---------------|-------------|------------------------------------|-------------|------------------------------------|
|               | Readability | Power Efficiency<br>(Battery Life) | Readability | Power Efficiency<br>(Battery Life) |
| Transmissive  | Good        | Good                               | Fair        | Poor                               |
| Transflective | Fair        | Poor                               | Good        | Good                               |
| Blanview      | Good        | Good                               | Good        | Good                               |

### 2.2 Display Method

| Items               | Specifications                                           | Remarks                    |
|---------------------|----------------------------------------------------------|----------------------------|
| Display type        | VA 16.7 Million colors.<br>Blanview, Normally black.     |                            |
| Driving method      | a-Si TFT Active matrix.<br>Line-scanning, Non-interlace. |                            |
| Dot arrangement     | RGB stripe arrangement.                                  | Refer to "Dot arrangement" |
| Signal input method | MIPI DSI 4-lanes : 4 data lanes and 1 clock lane         | in foot note 1             |
| Backlight type      | Long life & High bright white LED.                       |                            |
| NTSC ratio          | (50)%                                                    |                            |

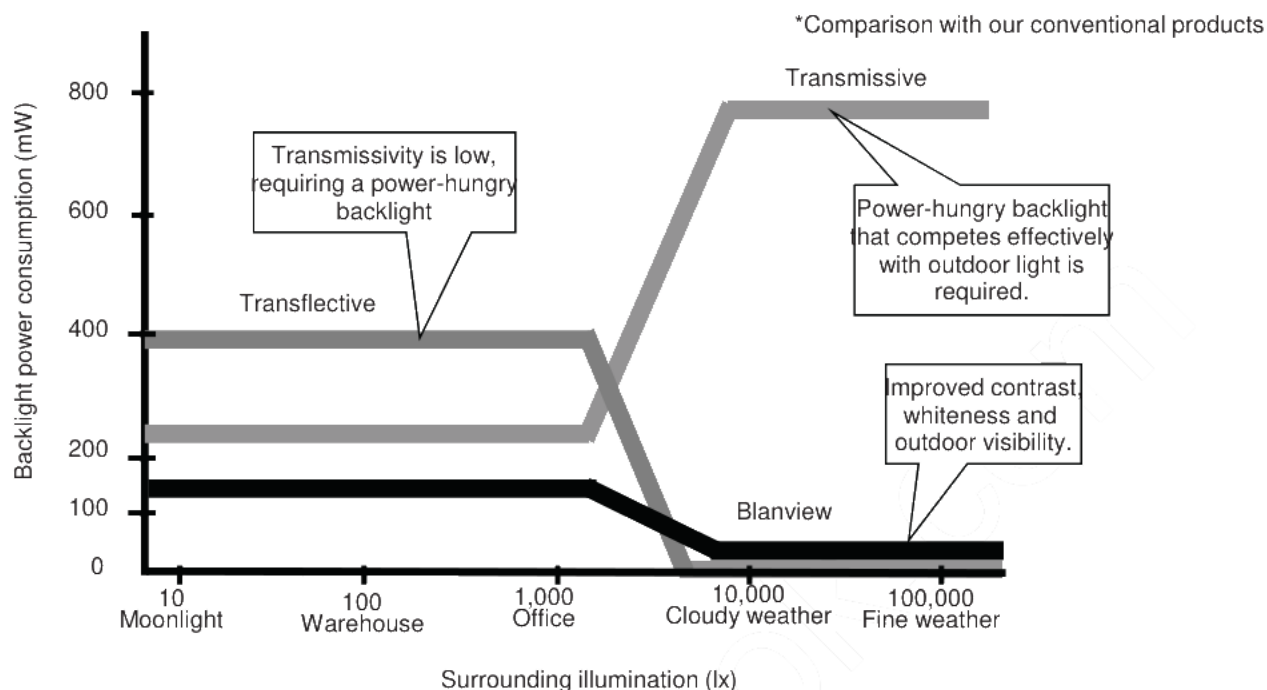
Foot note1: when use MIPI DSI 2-lanes, Please contact TOPPAN PRINTING.



Dot arrangement (FPC cable placed)

## &lt;Features of Blanview&gt;

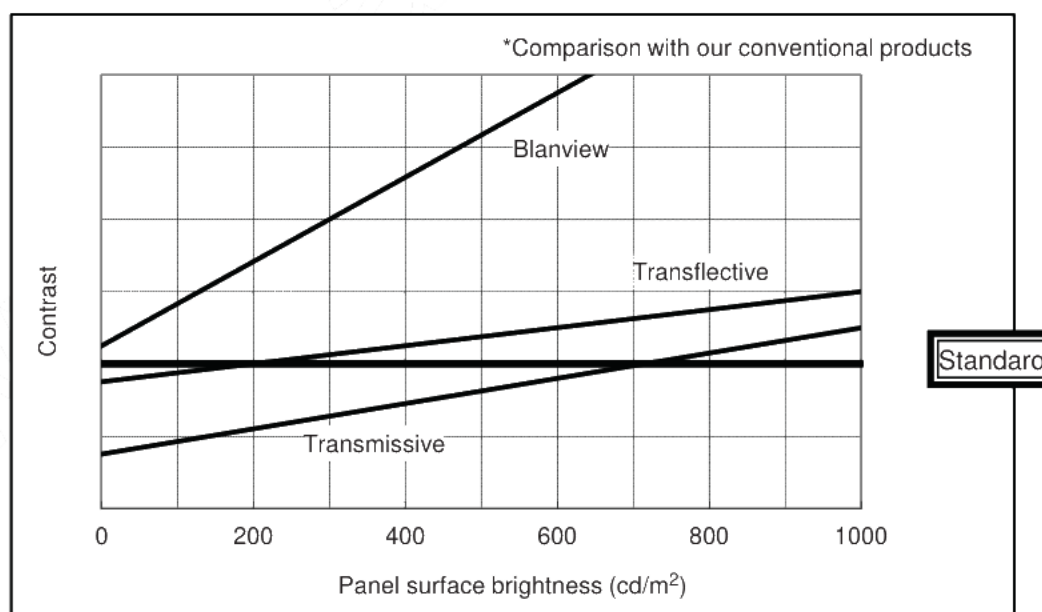
- Backlight power consumption required to assure visibility. (equivalent to 3.5"QVGA )



- Contrast characteristics under 100,000lx. (same condition as direct sunlight.)

With better contrast (higher contrast ratio), Blanview TFT-LCD has the best outdoor readability in three different types of TFT-LCD.

Below chart shows contrast value against panel surface brightness. (Horizontal: Panel surface brightness/ Vertical: Contrast value) LCD panel has enough outdoor readability above our Standard line. (TOPPAN PRINTING criteria)



## 3. Dimensions and Shape

## 3.1 Dimensions

| Items                             | Specifications                    | Unit | Remarks           |
|-----------------------------------|-----------------------------------|------|-------------------|
| Outline dimensions                | 67.84 [H] × 120.22 [V] × 2.15 [D] | mm   | Exclude FPC cable |
| Active area                       | 61.776[H] × 109.824[V]            | mm   | 126.0mm diagonal  |
| Number of dots                    | 2160[H] × 1280[V]                 | dot  |                   |
| Dot pitch                         | 28.6[H] × 85.8[V]                 | um   |                   |
| Surface hardness of the polarizer | 2                                 | H    | Load: 2.94N       |
| Weight                            | 34                                | g    |                   |



## 3.3 Serial № print (S-print)

## 1) Display Items

S-print indicates the least significant digit of manufacture year (1digit), manufacture month with below alphabet (1letter), model code (5characters), serial number (6digits).

\* Contents of Display

|   |   |      |       |
|---|---|------|-------|
| * | * | **** | ***** |
| - | - | -    | -     |
| a | b | c    | d     |

|   |                                                 |                                                   |                                  |                                  |
|---|-------------------------------------------------|---------------------------------------------------|----------------------------------|----------------------------------|
|   | Contents of display                             |                                                   |                                  |                                  |
| a | The least significant digit of manufacture year |                                                   |                                  |                                  |
| b | Manufacture month                               | Jan-A<br>Feb-B<br>Mar-C<br>Apr-D                  | May-E<br>Jun-F<br>Jul-G<br>Aug-H | Sep-I<br>Oct-J<br>Nov-K<br>Dec-L |
| c | Model code                                      | 50CBC (Made in Japan)<br>50CCC (Made in Malaysia) |                                  |                                  |
| d | Serial number                                   |                                                   |                                  |                                  |

\* Example of indication of Serial № print (S-print)

• Made in Japan

0L50CBC000125

means "manufactured in December 2020, 5.0" CB type, C specifications, serial number 000125"

• Made in Malaysia

0L50CCC000125

means "manufactured in December 2020, 5.0" CC type, C specifications, serial number 000125"

## 2) Location of Serial № print (S-print)

Refer to 3.2 "Outward Form".

## 3) Others

Please note that it is likely to disappear with an organic solvent about the Serial print.

## 4. Pin Assignment

| No. | Symbol   | Details                                                      | Remark                                                                  |
|-----|----------|--------------------------------------------------------------|-------------------------------------------------------------------------|
| 1   | GND      | Ground                                                       |                                                                         |
| 2   | NC       | Non connection                                               |                                                                         |
| 3   | LED+     | Backlight LED Anode                                          |                                                                         |
| 4   | NC       | Non connection                                               |                                                                         |
| 5   | LED-     | Backlight LED Cathode                                        |                                                                         |
| 6   | VDD      | Analog Power Supply                                          | VDD = 2.9V (TYP)                                                        |
| 7   | GND      | Ground                                                       |                                                                         |
| 8   | VCCIO    | DSI and I/O Power Supply                                     | VCCIO = 1.9V (TYP)                                                      |
| 9   | RESETB   | LCD Reset                                                    | L:Initialize<br>Power_ON Reset is Required when<br>Turning on the Power |
| 10  | GND      | Ground                                                       |                                                                         |
| 11  | TEST OUT | TEST Signal output                                           | Test Pin.<br>Please Open this pin                                       |
| 12  | GND      | Ground                                                       |                                                                         |
| 13  | DSI_D3P  | MIPI-DSI Data differential signal input pin<br>(Data lane 3) |                                                                         |
| 14  | DSI_D3N  | MIPI-DSI Data differential signal input pin<br>(Data lane 3) |                                                                         |
| 15  | GND      | Ground                                                       |                                                                         |
| 16  | DSI_D2P  | MIPI-DSI Data differential signal input pin<br>(Data lane 2) |                                                                         |
| 17  | DSI_D2N  | MIPI-DSI Data differential signal input pin<br>(Data lane 2) |                                                                         |
| 18  | GND      | Ground                                                       |                                                                         |
| 19  | DSI_CP   | MIPI-DSI Clock differential signal input pin                 |                                                                         |
| 20  | DSI_CN   | MIPI-DSI Clock differential signal input pin                 |                                                                         |
| 21  | GND      | Ground                                                       |                                                                         |
| 22  | DSI_D1P  | MIPI-DSI Data differential signal input pin<br>(Data lane 1) |                                                                         |
| 23  | DSI_D1N  | MIPI-DSI Data differential signal input pin<br>(Data lane 1) |                                                                         |
| 24  | GND      | Ground                                                       |                                                                         |
| 25  | DSI_D0P  | MIPI-DSI Data differential signal input pin<br>(Data lane 0) |                                                                         |
| 26  | DSI_D0N  | MIPI-DSI Data differential signal input pin<br>(Data lane 0) |                                                                         |
| 27  | GND      | Ground                                                       |                                                                         |

- Recommended connector : ( FH35C-27S-0.3SHW(50) /HIROSE ELECTRIC)
- Please make sure to check a consistency between pin assignment in "3.2 Outward Form" and your connector pin assignment when designing your circuit.  
Inconsistency in input signal assignment may cause a malfunction.
- Since FPC cable has gold plated terminals, gilt finish contact shoe connector is recommended.

## 5. Absolute Maximum Rating

GND=0V

| Item                             | Symbol | Condition                                                                | Rating |           | Unit | Applicable terminal                                    |
|----------------------------------|--------|--------------------------------------------------------------------------|--------|-----------|------|--------------------------------------------------------|
|                                  |        |                                                                          | MIN    | MAX       |      |                                                        |
| Supply voltage                   | VDD    | Ta=25 °C                                                                 | -0.3   | 4.4       | V    | VDD                                                    |
| DSI and I/O Power Supply voltage | VCCIO  |                                                                          | -0.3   | 3.6       | V    | VCCIO                                                  |
| Input voltage for logic          | VI     |                                                                          | -0.3   | VCCIO+0.3 | V    | RESETB                                                 |
| DSI Input voltage                | VDSIIN |                                                                          | -0.15  | 1.45      | V    | DSI_D0P/N DSI_D2P/N<br>DSI_D1P/N DSI_D3P/N<br>DSI_CP/N |
| LED forward current              | IL     | Ta = 25 °C                                                               | -      | 35        | mA   | LED+ - LED-                                            |
|                                  |        | Ta = 70 °C                                                               | -      | 15        |      |                                                        |
| Storage temperature range        | Tstg   |                                                                          | -30    | 80        | °C   |                                                        |
| Storage humidity range           | Hstg   | Non condensing in an environmental moisture at or less than 40 °C 90%RH. |        |           |      |                                                        |

## 6. Recommended Operating Conditions

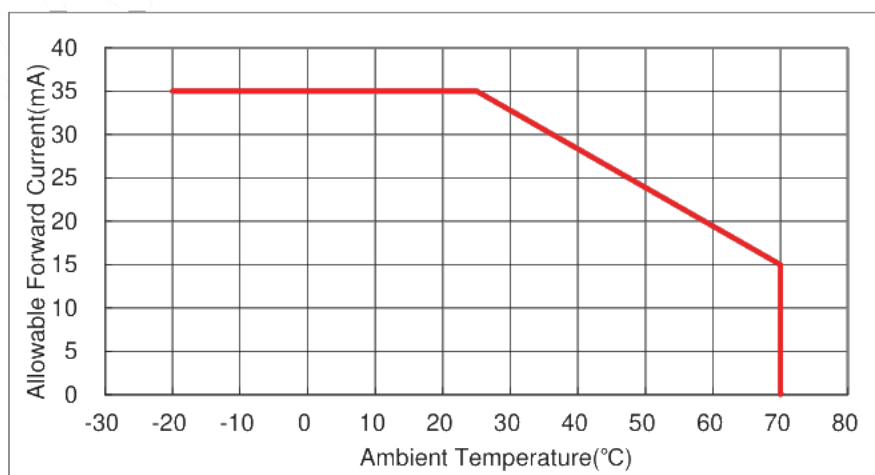
GND=0V

| Item                             | Symbol | Condition | Rating                                                                   |     |       | Unit | Applicable terminal                                    |
|----------------------------------|--------|-----------|--------------------------------------------------------------------------|-----|-------|------|--------------------------------------------------------|
|                                  |        |           | MIN                                                                      | TYP | MAX   |      |                                                        |
| Supply voltage                   | VDD    |           | 2.8                                                                      | 2.9 | 3.0   | V    | VDD                                                    |
| DSI and I/O Power Supply voltage | VCCIO  |           | 1.8                                                                      | 1.9 | 2.0   | V    | VCCIO                                                  |
| Input voltage for logic          | VI     |           | 0                                                                        | -   | VCCIO | V    | RESETB                                                 |
| DSI Input voltage                | VDSIIN |           | -0.15                                                                    | -   | 1.45  | V    | DSI_D0P/N DSI_D2P/N<br>DSI_D1P/N DSI_D3P/N<br>DSI_CP/N |
| Operational temperature range    | Top    | Note1,2   | -20                                                                      | 25  | 70    | °C   | Panel surface temperature                              |
| Operating humidity range         | Hop    | Ta<=40 °C | 20                                                                       | -   | 85    | %    |                                                        |
|                                  |        | Ta>40 °C  | Non condensing in an environmental moisture at or less than 40 °C 85%RH. |     |       |      |                                                        |

Note1: This monitor is operatable in this temperature range. With regard to optical characteristics, refer to Item 11."CHARACTERISTICS".

Note 2: Acceptable Forward Current to LED is up to 15 mA, when Ta=+70 °C.

Do not exceed Allowable Forward Current shown on the chart below.



## 7. Electrical Characteristics

## 7.1 DC Characteristics



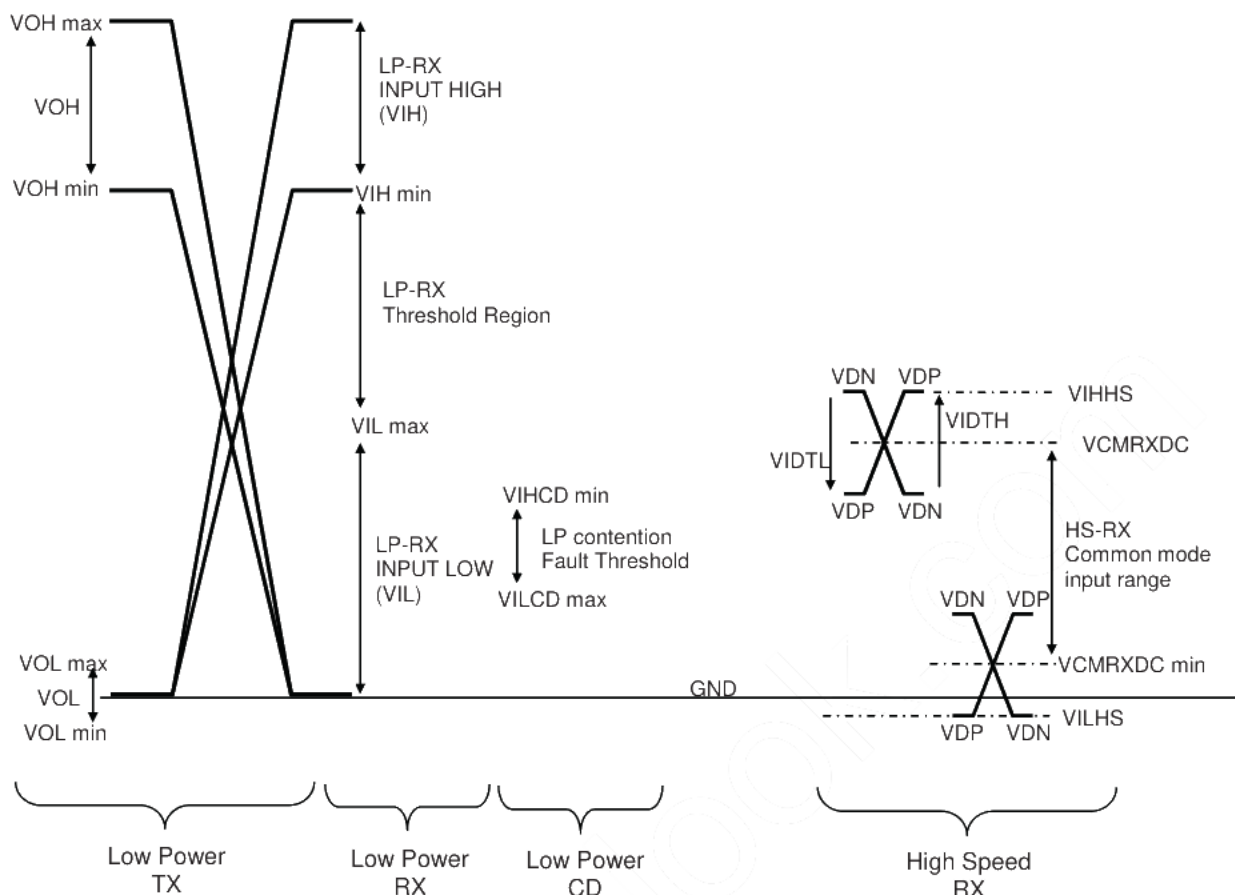
## 7.1.1 Display Module

(Unless otherwise noted, Ta=25 °C, VDD=2.9V, VCCIO=1.9V, GND=0V)

| Item                  | Symbol | Condition                       | Rating    |      |           | Unit | Applicable terminal |
|-----------------------|--------|---------------------------------|-----------|------|-----------|------|---------------------|
|                       |        |                                 | MIN       | TYP  | MAX       |      |                     |
| Input Signal Voltage  | VIH    | VCCIO=1.8-2.0V                  | 0.8×VCCIO | -    | VCCIO     | V    | RESETB              |
|                       | VIL    |                                 | 0         | -    | 0.2×VCCIO | V    |                     |
| Operating Current     | IDD    | fDSICLK=150 MHz                 | -         | (44) | (88)      | mA   | VDD                 |
|                       | ICCIO  | Color bar display               | -         | (15) | (30)      | mA   | VCCIO               |
| Sleep_mode Current    | IDDS   | Clock/Data=LP11                 | -         | (75) | (150)     | uA   | VDD                 |
|                       | ICCIOS | Sleep_mode                      | -         | (30) | (100)     | uA   | VCCIO               |
| Output Signal Voltage | VOH    | VCCIO=1.8-2.0V<br>IOH/L=+/- 1mA | 0.8×VCCIO | -    | VCCIO     | V    | PWM                 |
|                       | VOL    |                                 | 0         | -    | 0.2×VCCIO | V    |                     |

## 7.1.2 MIPI DSI Interface

| Item  | Symbol                              | Condition | Rating |     |     | Unit | Note |
|-------|-------------------------------------|-----------|--------|-----|-----|------|------|
|       |                                     |           | MIN    | TYP | MAX |      |      |
| HS-RX | Differential input high threshold   | VIDTH     | -      | -   | 70  | mV   |      |
|       | Differential input low threshold    | VIDTL     | -70    | -   | -   | mV   |      |
|       | Single-ended input high voltage     | VIHHS     | -      | -   | 460 | mV   |      |
|       | Single-ended input low voltage      | VILHS     | -40    | -   | -   | mV   |      |
|       | Common-mode voltage HS receive mode | VCMRXD C  | 70     | -   | 330 | mV   |      |
|       | Differential input impedance        | ZID       | 80     | 100 | 125 | Ohm  |      |
| LP-RX | Logic 1 input voltage               | VIH       | 880    | -   | -   | mV   |      |
|       | Logic 0 input voltage               | VIL       | -      | -   | 550 | mV   |      |
| LP-TX | Thevenin output low level           | VOL       | -50    | -   | 50  | mV   |      |
|       | Thevenin output high level          | VOH       | 1.1    | 1.2 | 1.3 | V    |      |
|       | Output impedance of LP transmitter  | ZOLP      | 110    | -   | -   | Ohm  |      |
| CD-RX | Logic 1 contention threshold        | VIHCD     | 450    | -   | -   | mV   |      |
|       | Logic 0 contention threshold        | VILCD     | -      | -   | 200 | mV   |      |



The signal levels for the LP and HS.

### 7.1.3 Backlight

| Item                                 | Symbol | Condition                       | Rating |       |       | Unit | Applicable terminal |
|--------------------------------------|--------|---------------------------------|--------|-------|-------|------|---------------------|
|                                      |        |                                 | MIN    | TYP   | MAX   |      |                     |
| Forward current                      | IL25   | Ta=25 °C                        | --     | 10    | 35    | mA   | LED+ - LED-         |
|                                      | IL70   | Ta=70 °C                        | --     | --    | 15    | mA   |                     |
| Forward voltage<br>(*Reference only) | VL     | Ta=25 °C<br>IL=(10.0)mA         | 20.6*  | 22.0* | 23.2* | V    |                     |
| Estimated Life<br>of LED             | LL     | Ta=25 °C<br>IL=(10.0)mA<br>Note | --     | 50000 | --    | hrs  |                     |

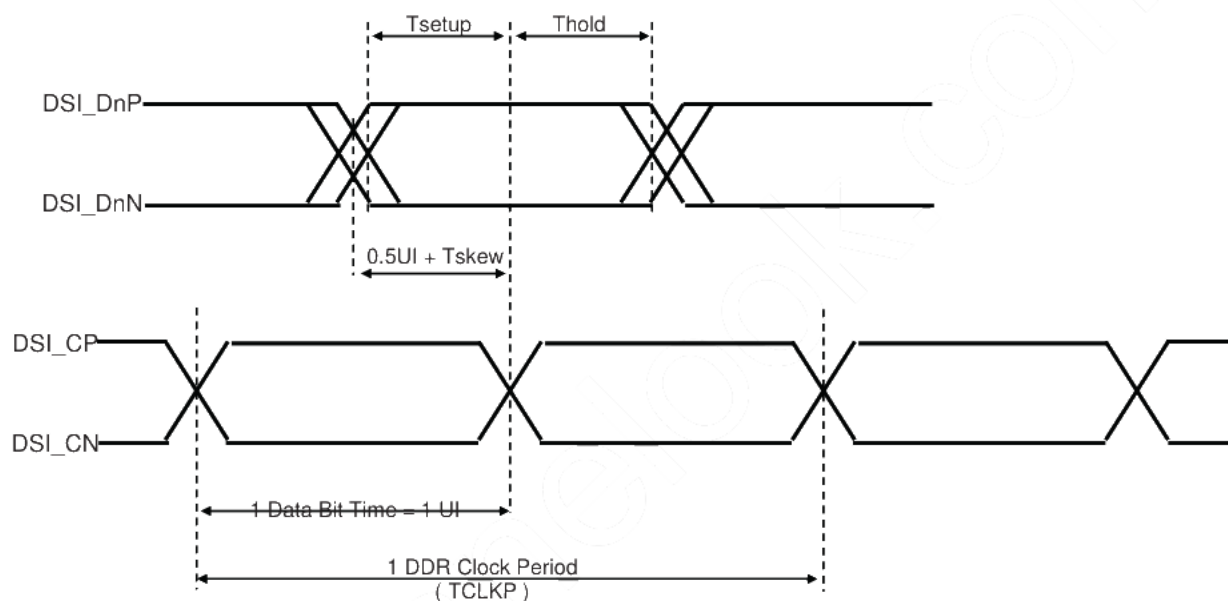
- Note:
- The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.
  - This figure is given as a reference purpose only, and not as a guarantee.
  - This figure is estimated for an LED operating alone.
- As the performance of an LED may differ when assembled as a monitor together with a TFT panel due to different environmental temperature.
- Estimated lifetime could vary on a different temperature and usually higher temperature could reduce the life significantly.

## 7.2 AC Characteristics

## 7.2.1 HS-RX Specifications

(Unless otherwise noted, Ta=25 °C, VDD=2.9V, VCCIO=1.9V, GND=0V)

| Item                     | Symbol   | Condition | Rating |     |      | Unit | Applicable terminal              |
|--------------------------|----------|-----------|--------|-----|------|------|----------------------------------|
|                          |          |           | MIN    | TYP | MAX  |      |                                  |
| DSICLK Frequency         | f DSICLK |           | 40     | -   | 250  | MHz  | DSI_CP/N                         |
| DSICLK Cycle time        | TCLKP    |           | 4.0    | -   | 25.0 | ns   |                                  |
| DSI Data Transfer Rate   | UI       |           | 2.0    | -   | 12.5 | ns   | DSI_D0P/N, DSI_D1P/N             |
|                          | t DSIR   |           | 80     | -   | 500  | Mbps | DSI_D2P/N, DSI_D3P/N             |
| Data to Clock Setup Time | Tsetup   |           | 0.15   | -   | -    | UI   | DSI_D0P/N, DSI_D1P/N             |
| Clock to Data Hold Time  | Thold    |           | 0.15   | -   | -    | UI   | DSI_D2P/N, DSI_D3P/N<br>DSI_CP/N |



Data to Clock Timing Definitions

## 7.2.2 LP-TX Specifications

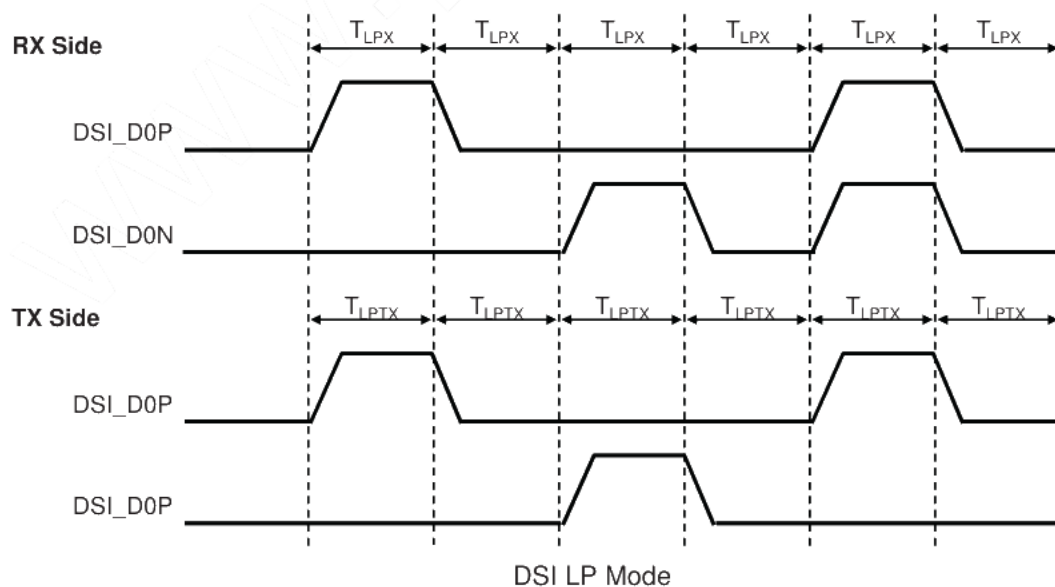
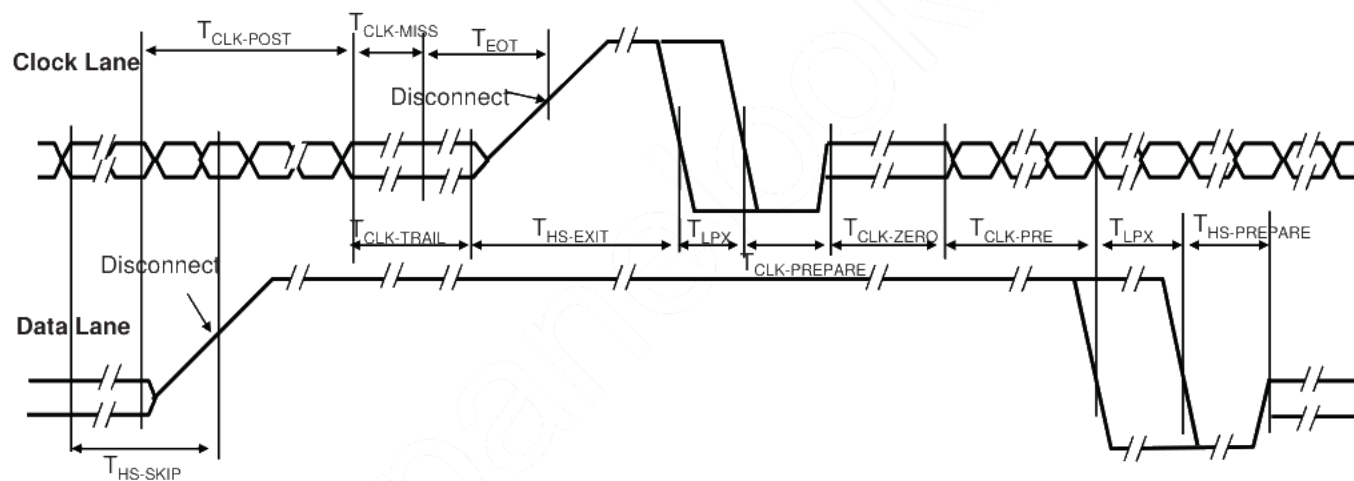
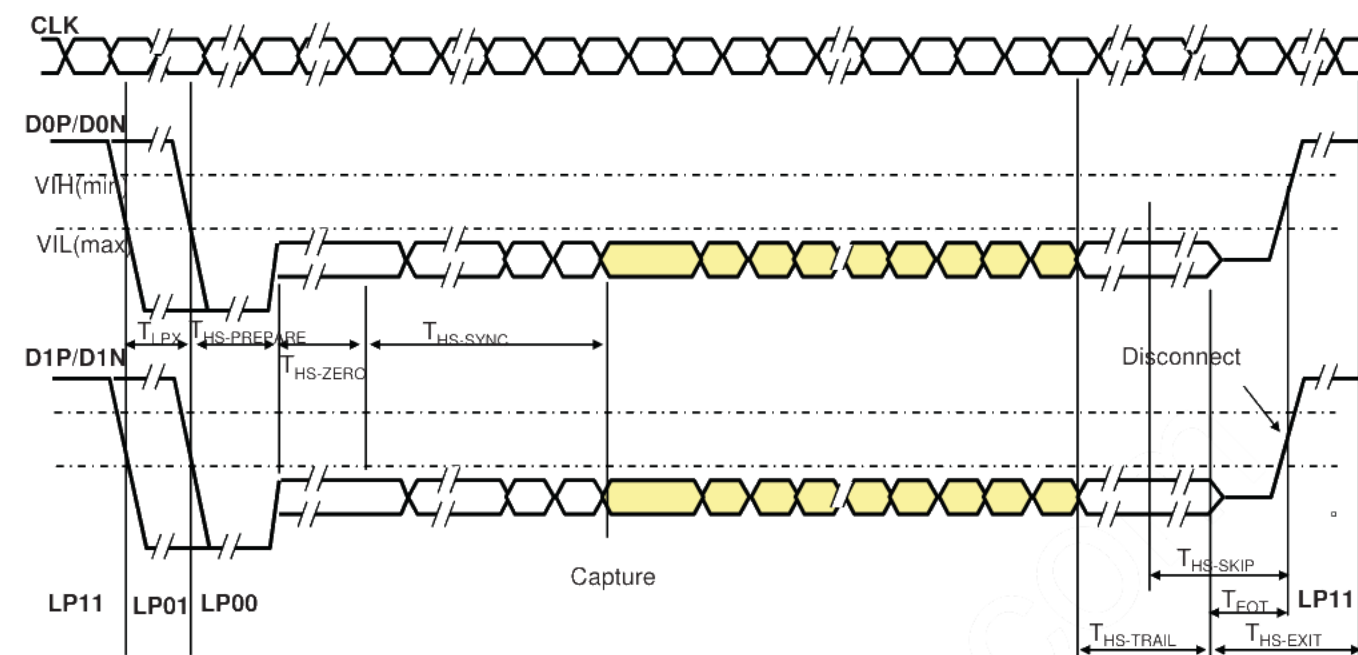
(Unless otherwise noted, Ta=25 °C, VDD=2.9V, VCCIO=1.9V, GND=0V)

| Item                | Symbol                     | Condition    | Rating |     |     | Unit  | Applicable terminal |
|---------------------|----------------------------|--------------|--------|-----|-----|-------|---------------------|
|                     |                            |              | MIN    | TYP | MAX |       |                     |
| 15% - 85% rise time | TRLP                       |              | -      | -   | 25  | ns    | DSI_D0P/N           |
| 85% - 15% fall time | TFLP                       |              | -      | -   | 25  | ns    |                     |
| Slew rate           | $\Delta V / \Delta t_{SR}$ | Cload = 70pF | -      | -   | 150 | mV/ns |                     |

## 7.2.3 RX/TX Specifications

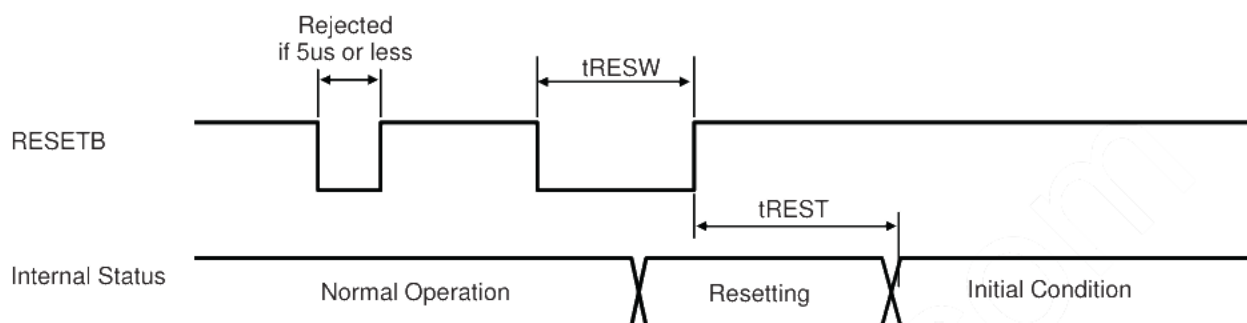
(Unless otherwise noted,  $T_a=25^{\circ}\text{C}$ ,  $V_{DD}=2.9\text{V}$ ,  $V_{CCIO}=1.9\text{V}$ ,  $GND=0\text{V}$ )

| Item                                           | Description                                                                                                               | Rating                                                         |                        |                                | Unit |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|------------------------|--------------------------------|------|
|                                                |                                                                                                                           | MIN                                                            | TYP                    | MAX                            |      |
| $T_{\text{HS-PREPARE}}$                        | Time to drive LP00 to prepare for HS transmission                                                                         | 40 ns + 4UI                                                    | -                      | 85 ns + 6UI                    |      |
| $T_{\text{HS-PREPARE}} + T_{\text{HS-ZERO}}$   | $T_{\text{HS-PREPARE}}$ + Time to drive HS0 before the SYNC sequence                                                      | 145 ns + 10UI                                                  | -                      | -                              |      |
| $T_{\text{HS-TRAIL}}$                          | Time to drive flipped differential state after last payload data bit of a HS transmission burst                           | $\max(n \cdot 8\text{UI}, 60 \text{ ns} + n \cdot 4\text{UI})$ | -                      | -                              |      |
| $T_{\text{HS-EXIT}}$                           | Time to drive LP11 after HS burst                                                                                         | 100                                                            | -                      | -                              | ns   |
| $T_{\text{TA-GO}}$                             | Time to drive LP00 after turnaround Request                                                                               | $4 \cdot T_{\text{LPTX}}$                                      |                        |                                |      |
| $T_{\text{TA-SURE}}$                           | Time out before new TX side starts driving                                                                                | $T_{\text{LPTX}}$                                              | -                      | $2 \cdot T_{\text{LPTX}}$      |      |
| $T_{\text{TA-GET}}$                            | Time to drive LP00 by new TX                                                                                              | $5 \cdot T_{\text{LPTX}}$                                      |                        |                                |      |
| $T_{\text{LPX}}$                               | Length of any Low Power state period                                                                                      | 50                                                             | -                      | -                              | ns   |
| Ratio $T_{\text{LPX}}$                         | Ratio of $T_{\text{LPX}}(\text{MASTER})/T_{\text{LPX}}(\text{SLAVE})$ between Master and Slave side                       | 2/3                                                            | -                      | 3/2                            |      |
| $T_{\text{CLK-POST}}$                          | Time that the transmitter shall continue sending HS clock after the last associated Data Lane has transitioned to LP mode | 60 ns + 52UI                                                   | -                      | -                              |      |
| $T_{\text{CLK-PREPARE}} + T_{\text{CLK-ZERO}}$ | $T_{\text{CLK-PREPARE}}$ + time for lead HS-0 drive period before starting Clock                                          | 300                                                            | -                      | -                              | ns   |
| $T_{\text{CLK-PRE}}$                           | Time that the HS clock shall be driven prior to any associated Data Lane beginning the transition from LP to HS mode      | 8                                                              | -                      | -                              | UI   |
| $T_{\text{CLK-PREPARE}}$                       | Time to drive LP-00 to prepare for HS clock transmission                                                                  | 38                                                             | -                      | 95                             | ns   |
| $T_{\text{CLK-TRAIL}}$                         | Time to drive HS differential state after last payload clock bit of a HS transmission burst                               | 60                                                             | -                      | -                              | ns   |
| $T_{\text{EOT}}$                               | Time from start of $T_{\text{HS-TRAIL}}$ period to start of LP-11 state                                                   | -                                                              | -                      | 105 ns + $n \cdot 12\text{UI}$ |      |
| $T_{\text{LPTX1}}$                             | Length of Low-Power TX state period in case of using DSI clock                                                            | -                                                              | $n \cdot \text{DSITX}$ | -                              | UI   |
| $T_{\text{LPTX2}}$                             | Length of Low-Power TX state period in case of using internal OSC clock                                                   | -                                                              | 1/fosc                 | -                              | ns   |



## 7.2.4 Reset input timing

| Item                  | Symbol | Condition        | Rating |     |     | Unit | Remark |
|-----------------------|--------|------------------|--------|-----|-----|------|--------|
|                       |        |                  | MIN    | TYP | MAX |      |        |
| Reset Low Pulse width | tRESW  |                  | 20     | -   | -   | us   |        |
| Reset Complete time   | tREST  | during Sleep In  | 10     | -   | -   | ms   |        |
|                       |        | during Sleep Out | 120    | -   | -   | ms   |        |



RESETB input timing

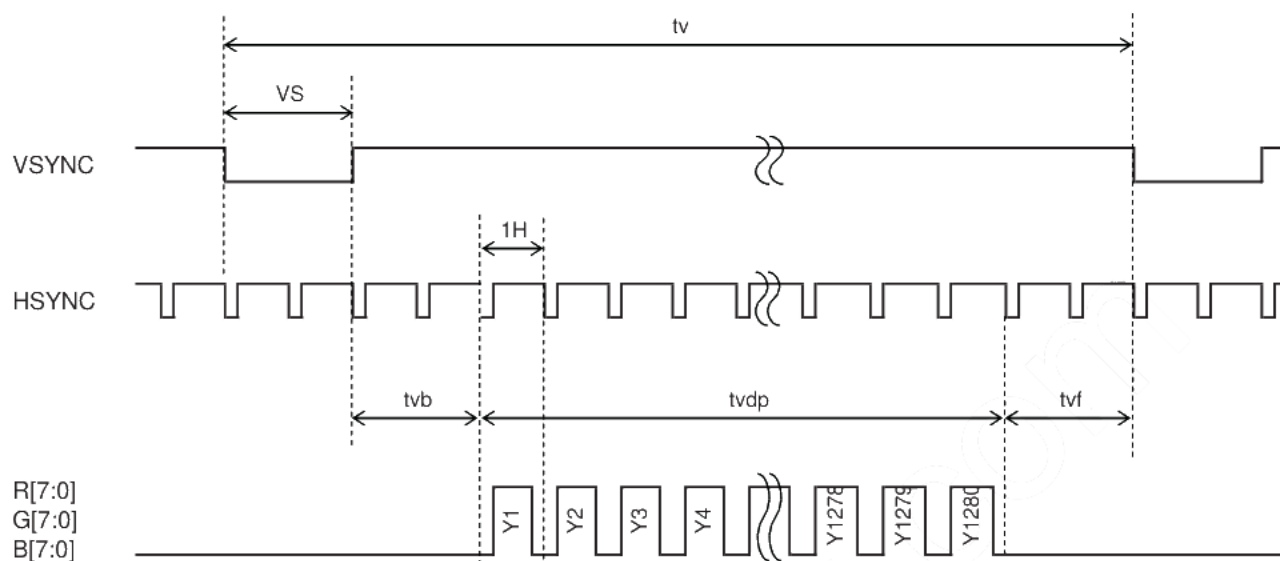
## 7.3 Input Timing Characteristics

| Item                        | Symbol      | Condition | Rating |      |     | Unit | Remark |
|-----------------------------|-------------|-----------|--------|------|-----|------|--------|
|                             |             |           | MIN    | TYP  | MAX |      |        |
| CLK Frequency               | fPCLK       |           | 62.5   | 67.3 | -   | MHz  | PCLK   |
| VSYNC Frequency             | Note fVSYNC |           | 54     | 58.1 | 66  | Hz   | VSYNC  |
| VSYNC Cycle                 | tv          |           | 1292   | 1292 | -   | H    |        |
| VSYNC Pulse Width           | VS          |           | 3      | 3    | -   | H    |        |
| Vertical Back Porch         | tvb         |           | 3      | 3    | -   | H    |        |
| Vertical Front Porch        | tvf         |           | 6      | 6    | -   | H    |        |
| Vertical data start Point   | VS+tvb      |           | 6      | 6    | -   | H    |        |
| Vertical Blanking Period    | VS+tvb+tvf  |           | 12     | 12   | -   | H    |        |
| Vertical Display Period     | tvdP        |           | --     | 1280 | --  | H    |        |
| HSYNC frequency             | fHSYNC      |           | 69.8   | 75.1 | -   | kHz  | HSYNC  |
| HSYNC Cycle                 | th          |           | -      | 896  | -   | CLK  |        |
| HSYNC Pulse Width           | HS          |           | -      | 15   | -   | CLK  |        |
| Horizontal Back Porch       | thb         |           | -      | 70   | -   | CLK  |        |
| Horizontal Front Porch      | thf         |           | -      | 91   | -   | CLK  |        |
| Horizontal data start Point | HS+thb      |           | -      | 85   | -   | CLK  |        |
| Horizontal Blanking Period  | HS+thb+thf  |           | -      | 176  | -   | CLK  |        |
| Horizontal Display Period   | thdP        |           | -      | 720  | -   | CLK  |        |

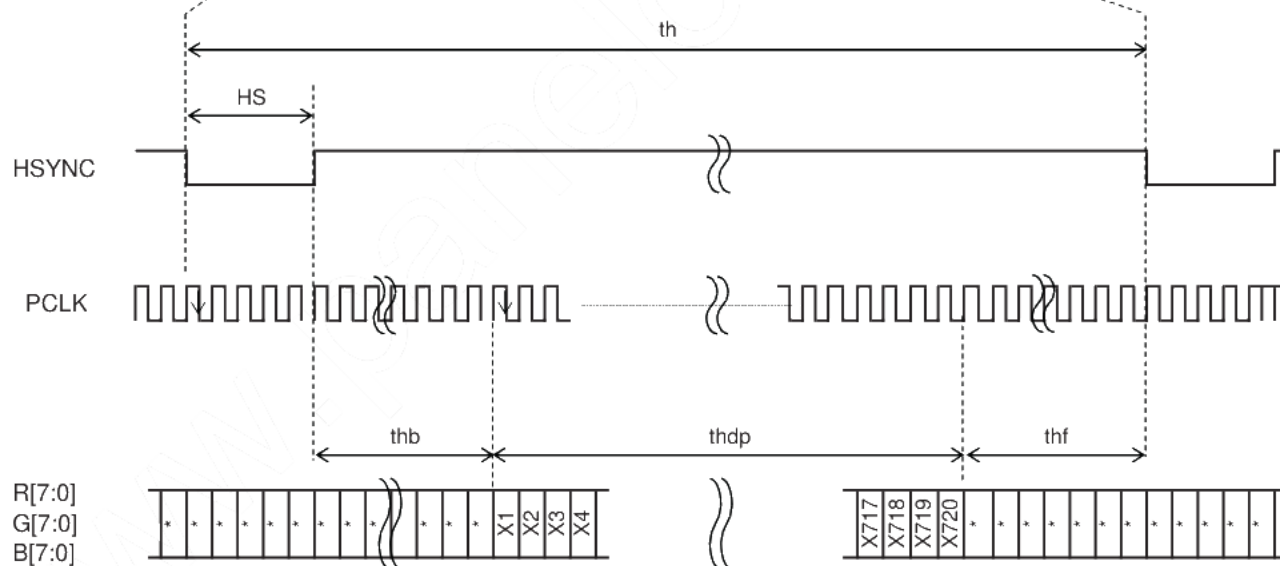
Note: This is recommended spec to get high quality picture on display. It is customer's risk to use out of this frequency.

## 7.4 Input Signal Timing Chart

## -Vertical Timing



## -Horizontal Timing



Timing Characteristics of input signals

## 8. About MIPI Interface

### 8.1 Version

The DSI incorporated in the LCD-Driver complies with the following standards.

MIPI DSI : Version 1.02

MIPI D-PHY : Version 1.00

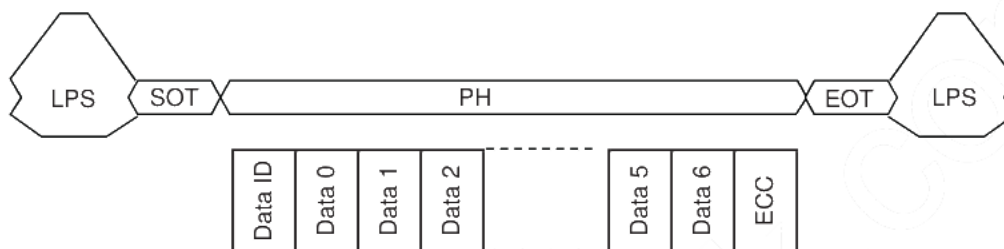
Data transfer mode : Video mode only.

Virtual Channel : Set to VC[1:0]=00.

It is recommended to turn DSI\_CLK off (LP 00) during the blanking period.

### 8.2 DSI protocol

- Short packets specify the payload length using the Data Type field and are from 2 to 9 bytes in length. Short packets is used for most Command Mode commands and associated parameters.



LPS : Low power state

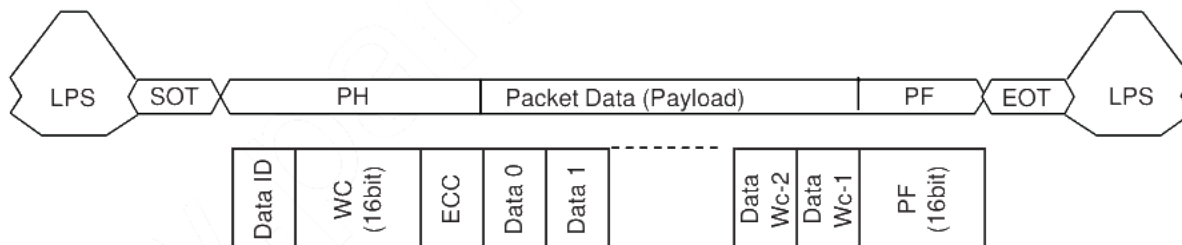
SOT : Start of Transmission

PH : Packet Header

DI(Data ID) : Contain Virtual Channel Identifier and Data Type

ECC : Error Correction Code

- Long packets specify the payload length using a two-byte Word Count field and then the payload maybe 0 to 65,541 bytes in length. Long packets permit transmission of large blocks of pixel or other data.



LPS : Low power state

SOT : Start of Transmission

PH : Packet Header

DI(Data ID) : Contain Virtual Channel Identifier and Data Type

WC(Word Count) : The receiver use WC to define packet end.

ECC : Error Correction Code

PF(Packet Footer) : Mean 16-bit Checksum.

### 8.3 Packet data types

LCD-Driver has the following restriction.

Generic short / Long Write Cmd is not supported.

It is only DCS Short / Long Write Cmd.

Processor to peripheral direction

| Data Type<br>Hex | Description                                             | Size  |
|------------------|---------------------------------------------------------|-------|
| 01 h             | Sync Event , V Sync Start (01,00,00,07)                 | Short |
| 11 h             | Sync Event , V Sync End (11,00,00,14)                   | Short |
| 21 h             | Sync Event , H Sync Start (21,00,00,12)                 | Short |
| 31 h             | Sync Event , H Sync End (31,00,00,01)                   | Short |
| 22 h             | Shut Down Peripheral Command (22,00,00,1E)              | Short |
| 32 h             | Turn On Peripheral Command (32,00,00,0D)                | Short |
| 05 h             | DCS WRITE , no parameters                               | Short |
| 15 h             | DCS WRITE , one parameters                              | Short |
| 06 h             | DCS READ , no parameters                                | Short |
| 37 h             | Set Maximum Return Packet Size                          | Short |
| 08 h             | End of Transmission Packet (08,0F,0F,01)                | Short |
| 09 h             | Null Packet , no data                                   | Long  |
| 19 h             | Blanking Packet , no data                               | Long  |
| 39 h             | DCS Long Write Command Packet                           | Long  |
| 0E h             | Packed Pixel Stream , 16-bit RGB , 5-6-5 Format         | Long  |
| 1E h             | Packed Pixel Stream , 18-bit RGB , 6-6-6 Format         | Long  |
| 2E h             | Loosely Packed Pixel Stream , 18-bit RGB , 6-6-6 Format | Long  |
| 3E h             | Packed Pixel Stream , 24-bit RGB , 8-8-8 Format         | Long  |

Peripheral to processor direction

| Data Type<br>Hex | Description                   | Size  |
|------------------|-------------------------------|-------|
| 02 h             | Acknowledge with Error Report | Short |
| 1C h             | DCS Long READ Response        | Long  |

### 8.4 Packet Footer on the long packet

After Packet Data, Packet Footer is added in Long packet. Packet Footer adds CRC calculated from Packet Data as Checksum.

Checksum(2byte) = CRC(Packet Data)

$CRC = X^{16} + X^{12} + X^5 + X^0$

## 9. Sequence

PH : Packet Header

PD : Packet Data

PF: Packet Footer (=Checksum)

 9.1 Power-ON Sequence

| 0 |                   | Function                                                                                                                                                                                                                                                         | DNC                                                                          | Command /Parameter                                                                                                  | Type           | Command/Parameter                                                                                                                |
|---|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------|
|   | Power on          | VDD, VCCIO On                                                                                                                                                                                                                                                    |                                                                              |                                                                                                                     |                |                                                                                                                                  |
|   | MIPI signal state | Keep CLKN/P, D0N/P, D1N/P<br>D2N/P, D3N/P in STOP state LP-11<br>(Must be set to LP-11 is all lanes<br>of MIPI before rising edge of<br>RESX.)                                                                                                                   |                                                                              |                                                                                                                     |                |                                                                                                                                  |
|   | Wait              | wait 1 msec or more                                                                                                                                                                                                                                              |                                                                              |                                                                                                                     |                |                                                                                                                                  |
|   | H/W RESET         | RESETB=1                                                                                                                                                                                                                                                         |                                                                              |                                                                                                                     |                |                                                                                                                                  |
|   | Wait              | wait 10 msec or more                                                                                                                                                                                                                                             |                                                                              |                                                                                                                     |                |                                                                                                                                  |
| 1 | SETEXTC           | Set extension command<br>Parameter 1<br>Parameter 2<br>Parameter 3                                                                                                                                                                                               | 0<br>1<br>1<br>1                                                             | B9h<br>FFh<br>83h<br>94h                                                                                            | PH<br>PD<br>PF | [39 04 00 2C]<br>[B9 FF 83 94]<br>[XX XX]                                                                                        |
| 2 | SETPOWER          | Set power<br>Parameter 1<br>Parameter 2<br>Parameter 3<br>Parameter 4<br>Parameter 5<br>Parameter 6<br>Parameter 7<br>Parameter 8<br>Parameter 9<br>Parameter 10<br>Parameter 11<br>Parameter 12<br>Parameter 13<br>Parameter 14<br>Parameter 15<br>Parameter 16 | 0<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | B1h<br>01h<br>00h<br>24h<br>09h<br>01h<br>12h<br>12h<br>26h<br>2Eh<br>1Dh<br>1Dh<br>57h<br>12h<br>01h<br>E6h<br>E2h | PH<br>PD<br>PF | [39, 11, 00, 33]<br>[B1 01 00 24 09 01 12 12 26 2E 1D<br>1D 57 12 01 E6 E2]<br>[XX XX]                                           |
| 3 | SETDISP           | Setdisp<br>Parameter 1<br>Parameter 2<br>Parameter 3<br>Parameter 4<br>Parameter 5<br>Parameter 6                                                                                                                                                                | 0<br>1<br>1<br>1<br>1<br>1                                                   | B2h<br>00h<br>C8h<br>04h<br>04h<br>00h<br>66h                                                                       | PH<br>PD<br>PF | [39, 07, 00, 2A]<br>[B2 00 C8 04 04 00 66]<br>[XX XX]                                                                            |
| 4 | INVOFF            | Exit_inversion_mode                                                                                                                                                                                                                                              | 0                                                                            | 20h                                                                                                                 | PH             | [05 20 00 23]                                                                                                                    |
| 5 | MADCTL            | Set_address_mode<br>Parameter 1                                                                                                                                                                                                                                  | 0<br>1                                                                       | 36h<br>00h                                                                                                          | PH             | [15 36 00 29]                                                                                                                    |
| 6 | COLMOD            | Set_pixel_format<br>Parameter 1( 24bit/pixel)                                                                                                                                                                                                                    | 0<br>1                                                                       | 3Ah<br>70h                                                                                                          | PH             | [15 3A 70 28]                                                                                                                    |
| 7 | SETCYC            | Set display waveform cycle<br>Parameter 1<br>Parameter 2<br>Parameter 3<br>Parameter 4<br>Parameter 5<br>Parameter 6                                                                                                                                             | 0<br>1<br>1<br>1<br>1<br>1                                                   | B4h<br>00h<br>06h<br>32h<br>10h<br>00h<br>32h                                                                       | PH<br>PD<br>PF | [39 1F 00 29]<br>[B4 00 06 32 10 00 32 10 00 32 10<br>08 27 01 4A 01 37 01 4A 07 30 30<br>01 01 43 01 43 01 61 61 01]<br>[XX XX] |

| No. |          | Function     | DNC | Command /Parameter | Type | Command/Parameter                                                                                    |
|-----|----------|--------------|-----|--------------------|------|------------------------------------------------------------------------------------------------------|
|     |          | Parameter 7  | 1   | 10h                |      |                                                                                                      |
|     |          | Parameter 8  | 1   | 00h                |      |                                                                                                      |
|     |          | Parameter 9  | 1   | 32h                |      |                                                                                                      |
|     |          | Parameter 10 | 1   | 10h                |      |                                                                                                      |
|     |          | Parameter 11 | 1   | 08h                |      |                                                                                                      |
|     |          | Parameter 12 | 1   | 27h                |      |                                                                                                      |
|     |          | Parameter 13 | 1   | 01h                |      |                                                                                                      |
|     |          | Parameter 14 | 1   | 4Ah                |      |                                                                                                      |
|     |          | Parameter 15 | 1   | 01h                |      |                                                                                                      |
|     |          | Parameter 16 | 1   | 37h                |      |                                                                                                      |
|     |          | Parameter 17 | 1   | 01h                |      |                                                                                                      |
|     |          | Parameter 18 | 1   | 4Ah                |      |                                                                                                      |
|     |          | Parameter 19 | 1   | 07h                |      |                                                                                                      |
|     |          | Parameter 20 | 1   | 30h                |      |                                                                                                      |
|     |          | Parameter 21 | 1   | 30h                |      |                                                                                                      |
|     |          | Parameter 22 | 1   | 01h                |      |                                                                                                      |
|     |          | Parameter 23 | 1   | 01h                |      |                                                                                                      |
|     |          | Parameter 24 | 1   | 43h                |      |                                                                                                      |
|     |          | Parameter 25 | 1   | 01h                |      |                                                                                                      |
|     |          | Parameter 26 | 1   | 43h                |      |                                                                                                      |
|     |          | Parameter 27 | 1   | 01h                |      |                                                                                                      |
|     |          | Parameter 28 | 1   | 61h                |      |                                                                                                      |
|     |          | Parameter 29 | 1   | 61h                |      |                                                                                                      |
|     |          | Parameter 30 | 1   | 01h                |      |                                                                                                      |
| 8   | Not open |              | 0   | BFh                | PH   | [39, 05, 00, 36]                                                                                     |
|     |          | Parameter 1  | 1   | 06h                | PD   | [BF 06 02 00 04]                                                                                     |
|     |          | Parameter 2  | 1   | 02h                |      |                                                                                                      |
|     |          | Parameter 3  | 1   | 00h                | PF   | [XX XX]                                                                                              |
|     |          | Parameter 4  | 1   | 04h                |      |                                                                                                      |
| 9   | Not open |              | 0   | C7h                | PH   | [39, 05, 00, 36]                                                                                     |
|     |          | Parameter 1  | 1   | 00h                | PD   | [C7 00 10 00 10]                                                                                     |
|     |          | Parameter 2  | 1   | 10h                |      |                                                                                                      |
|     |          | Parameter 3  | 1   | 00h                | PF   | [XX XX]                                                                                              |
|     |          | Parameter 4  | 1   | 10h                |      |                                                                                                      |
| 10  | Not open |              | 0   | C6h                | PH   | [39, 03, 00, 09]                                                                                     |
|     |          | Parameter 1  | 1   | 08h                | PD   | [C6 08 08]                                                                                           |
|     |          | Parameter 2  | 1   | 08h                | PF   | [XX XX]                                                                                              |
| 11  | Not open |              | 0   | C0h                | PH   | [39, 03, 00, 09]                                                                                     |
|     |          | Parameter 1  | 1   | 0Ch                | PD   | [C0 0C 15]                                                                                           |
|     |          | Parameter 2  | 1   | 15h                | PF   | [XX XX]                                                                                              |
| 12  | SETGIP   | Set GIP      | 0   | D5h                | PH   | [39 21 00 3C]                                                                                        |
|     |          | Parameter 1  | 1   | 00h                |      |                                                                                                      |
|     |          | Parameter 2  | 1   | 00h                | PD   | [D5 00 00 00 00 0A 00 01 33 00 00 33 00 10 32 54 76 10 32 88 88 88 88 88 88 88 99 99 99 54 76 88 88] |
|     |          | Parameter 3  | 1   | 00h                |      |                                                                                                      |
|     |          | Parameter 4  | 1   | 00h                | PF   | [XX XX]                                                                                              |
|     |          | Parameter 5  | 1   | 0Ah                |      |                                                                                                      |
|     |          | Parameter 6  | 1   | 00h                |      |                                                                                                      |
|     |          | Parameter 7  | 1   | 01h                |      |                                                                                                      |
|     |          | Parameter 8  | 1   | 33h                |      |                                                                                                      |
|     |          | Parameter 9  | 1   | 00h                |      |                                                                                                      |
|     |          | Parameter 10 | 1   | 00h                |      |                                                                                                      |
|     |          | Parameter 11 | 1   | 33h                |      |                                                                                                      |

| No. |        | Function                             | DNC | Command /Parameter | Type | Command/Parameter |
|-----|--------|--------------------------------------|-----|--------------------|------|-------------------|
|     |        | Parameter 12                         | 1   | 00h                |      |                   |
|     |        | Parameter 13                         | 1   | 10h                |      |                   |
|     |        | Parameter 14                         | 1   | 32h                |      |                   |
|     |        | Parameter 15                         | 1   | 54h                |      |                   |
|     |        | Parameter 16                         | 1   | 76h                |      |                   |
|     |        | Parameter 17                         | 1   | 10h                |      |                   |
|     |        | Parameter 18                         | 1   | 32h                |      |                   |
|     |        | Parameter 19                         | 1   | 88h                |      |                   |
|     |        | Parameter 20                         | 1   | 88h                |      |                   |
|     |        | Parameter 21                         | 1   | 88h                |      |                   |
|     |        | Parameter 22                         | 1   | 88h                |      |                   |
|     |        | Parameter 23                         | 1   | 88h                |      |                   |
|     |        | Parameter 24                         | 1   | 88h                |      |                   |
|     |        | Parameter 25                         | 1   | 88h                |      |                   |
|     |        | Parameter 26                         | 1   | 99h                |      |                   |
|     |        | Parameter 27                         | 1   | 99h                |      |                   |
|     |        | Parameter 28                         | 1   | 99h                |      |                   |
|     |        | Parameter 29                         | 1   | 54h                |      |                   |
|     |        | Parameter 30                         | 1   | 76h                |      |                   |
|     |        | Parameter 31                         | 1   | 88h                |      |                   |
|     |        | Parameter 32                         | 1   | 88h                |      |                   |
| 13  | SETDGC | Set Digital Gamma Correction setting | 0   | C1h                | PH   | [39 80 00 23]     |
|     |        | Parameter 1                          | 1   | 01h                |      |                   |
|     |        | Parameter 2                          | 1   | 00h                |      |                   |
|     |        | Parameter 3                          | 1   | 06h                |      |                   |
|     |        | Parameter 4                          | 1   | 0Eh                |      |                   |
|     |        | Parameter 5                          | 1   | 16h                |      |                   |
|     |        | Parameter 6                          | 1   | 1Eh                |      |                   |
|     |        | Parameter 7                          | 1   | 26h                |      |                   |
|     |        | Parameter 8                          | 1   | 2Eh                | PD   |                   |
|     |        | Parameter 9                          | 1   | 36h                |      |                   |
|     |        | Parameter 10                         | 1   | 3Eh                |      |                   |
|     |        | Parameter 11                         | 1   | 46h                |      |                   |
|     |        | Parameter 12                         | 1   | 4Eh                |      |                   |
|     |        | Parameter 13                         | 1   | 56h                |      |                   |
|     |        | Parameter 14                         | 1   | 5Eh                |      |                   |
|     |        | Parameter 15                         | 1   | 66h                |      |                   |
|     |        | Parameter 16                         | 1   | 6Eh                | PF   |                   |
|     |        | Parameter 17                         | 1   | 76h                |      |                   |
|     |        | Parameter 18                         | 1   | 7Eh                |      |                   |
|     |        | Parameter 19                         | 1   | 86h                |      |                   |
|     |        | Parameter 20                         | 1   | 8Eh                |      |                   |
|     |        | Parameter 21                         | 1   | 96h                |      |                   |
|     |        | Parameter 22                         | 1   | 9Eh                |      |                   |
|     |        | Parameter 23                         | 1   | A6h                |      |                   |
|     |        | Parameter 24                         | 1   | AEh                |      |                   |
|     |        | Parameter 25                         | 1   | B6h                |      |                   |
|     |        | Parameter 26                         | 1   | BEh                |      |                   |
|     |        | Parameter 27                         | 1   | C6h                |      |                   |
|     |        | Parameter 28                         | 1   | CEh                |      |                   |
|     |        | Parameter 29                         | 1   | D6h                |      |                   |
|     |        | Parameter 30                         | 1   | DEh                |      |                   |
|     |        | Parameter 31                         | 1   | E6h                |      |                   |
|     |        | Parameter 32                         | 1   | EEh                |      |                   |

| No. |  | Function     | DNC | Command /Parameter | Type | Command/Parameter |
|-----|--|--------------|-----|--------------------|------|-------------------|
|     |  | Parameter 33 | 1   | F6h                |      |                   |
|     |  | Parameter 34 | 1   | FEh                |      |                   |
|     |  | Parameter 35 | 1   | 00h                |      |                   |
|     |  | Parameter 36 | 1   | 00h                |      |                   |
|     |  | Parameter 37 | 1   | 00h                |      |                   |
|     |  | Parameter 38 | 1   | 00h                |      |                   |
|     |  | Parameter 39 | 1   | 00h                |      |                   |
|     |  | Parameter 40 | 1   | 00h                |      |                   |
|     |  | Parameter 41 | 1   | 00h                |      |                   |
|     |  | Parameter 42 | 1   | 00h                |      |                   |
|     |  | Parameter 43 | 1   | 00h                |      |                   |
|     |  | Parameter 44 | 1   | 00h                |      |                   |
|     |  | Parameter 45 | 1   | 03h                |      |                   |
|     |  | Parameter 46 | 1   | 0Bh                |      |                   |
|     |  | Parameter 47 | 1   | 13h                |      |                   |
|     |  | Parameter 48 | 1   | 1Bh                |      |                   |
|     |  | Parameter 49 | 1   | 23h                |      |                   |
|     |  | Parameter 50 | 1   | 2Bh                |      |                   |
|     |  | Parameter 51 | 1   | 33h                |      |                   |
|     |  | Parameter 52 | 1   | 3Bh                |      |                   |
|     |  | Parameter 53 | 1   | 43h                |      |                   |
|     |  | Parameter 54 | 1   | 4Bh                |      |                   |
|     |  | Parameter 55 | 1   | 53h                |      |                   |
|     |  | Parameter 56 | 1   | 5Bh                |      |                   |
|     |  | Parameter 57 | 1   | 63h                |      |                   |
|     |  | Parameter 58 | 1   | 6Bh                |      |                   |
|     |  | Parameter 59 | 1   | 73h                |      |                   |
|     |  | Parameter 60 | 1   | 7Bh                |      |                   |
|     |  | Parameter 61 | 1   | 83h                |      |                   |
|     |  | Parameter 62 | 1   | 8Bh                |      |                   |
|     |  | Parameter 63 | 1   | 93h                |      |                   |
|     |  | Parameter 64 | 1   | 9Bh                |      |                   |
|     |  | Parameter 65 | 1   | A3h                |      |                   |
|     |  | Parameter 66 | 1   | ABh                |      |                   |
|     |  | Parameter 67 | 1   | B3h                |      |                   |
|     |  | Parameter 68 | 1   | BBh                |      |                   |
|     |  | Parameter 69 | 1   | C3h                |      |                   |
|     |  | Parameter 70 | 1   | CBh                |      |                   |
|     |  | Parameter 71 | 1   | D3h                |      |                   |
|     |  | Parameter 72 | 1   | DBh                |      |                   |
|     |  | Parameter 73 | 1   | E3h                |      |                   |
|     |  | Parameter 74 | 1   | EBh                |      |                   |
|     |  | Parameter 75 | 1   | F3h                |      |                   |
|     |  | Parameter 76 | 1   | FBh                |      |                   |
|     |  | Parameter 77 | 1   | 00h                |      |                   |
|     |  | Parameter 78 | 1   | 00h                |      |                   |
|     |  | Parameter 79 | 1   | 00h                |      |                   |
|     |  | Parameter 80 | 1   | 00h                |      |                   |
|     |  | Parameter 81 | 1   | 00h                |      |                   |
|     |  | Parameter 82 | 1   | 00h                |      |                   |
|     |  | Parameter 83 | 1   | 00h                |      |                   |
|     |  | Parameter 84 | 1   | 00h                |      |                   |
|     |  | Parameter 85 | 1   | 00h                |      |                   |
|     |  | Parameter 86 | 1   | 00h                |      |                   |

| No. |          | Function                        | DNC | Command /Parameter | Type | Command/Parameter                                                                                                                           |
|-----|----------|---------------------------------|-----|--------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------|
|     |          | Parameter 87                    | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 88                    | 1   | 08h                |      |                                                                                                                                             |
|     |          | Parameter 89                    | 1   | 10h                |      |                                                                                                                                             |
|     |          | Parameter 90                    | 1   | 18h                |      |                                                                                                                                             |
|     |          | Parameter 91                    | 1   | 1Eh                |      |                                                                                                                                             |
|     |          | Parameter 92                    | 1   | 26h                |      |                                                                                                                                             |
|     |          | Parameter 93                    | 1   | 2Eh                |      |                                                                                                                                             |
|     |          | Parameter 94                    | 1   | 36h                |      |                                                                                                                                             |
|     |          | Parameter 95                    | 1   | 3Eh                |      |                                                                                                                                             |
|     |          | Parameter 96                    | 1   | 46h                |      |                                                                                                                                             |
|     |          | Parameter 97                    | 1   | 4Eh                |      |                                                                                                                                             |
|     |          | Parameter 98                    | 1   | 56h                |      |                                                                                                                                             |
|     |          | Parameter 99                    | 1   | 5Eh                |      |                                                                                                                                             |
|     |          | Parameter 100                   | 1   | 66h                |      |                                                                                                                                             |
|     |          | Parameter 101                   | 1   | 6Eh                |      |                                                                                                                                             |
|     |          | Parameter 102                   | 1   | 76h                |      |                                                                                                                                             |
|     |          | Parameter 103                   | 1   | 7Eh                |      |                                                                                                                                             |
|     |          | Parameter 104                   | 1   | 86h                |      |                                                                                                                                             |
|     |          | Parameter 105                   | 1   | 8Eh                |      |                                                                                                                                             |
|     |          | Parameter 106                   | 1   | 96h                |      |                                                                                                                                             |
|     |          | Parameter 107                   | 1   | 9Eh                |      |                                                                                                                                             |
|     |          | Parameter 108                   | 1   | A6h                |      |                                                                                                                                             |
|     |          | Parameter 109                   | 1   | AEh                |      |                                                                                                                                             |
|     |          | Parameter 110                   | 1   | B6h                |      |                                                                                                                                             |
|     |          | Parameter 111                   | 1   | BEh                |      |                                                                                                                                             |
|     |          | Parameter 112                   | 1   | C6h                |      |                                                                                                                                             |
|     |          | Parameter 113                   | 1   | CEh                |      |                                                                                                                                             |
|     |          | Parameter 114                   | 1   | D6h                |      |                                                                                                                                             |
|     |          | Parameter 115                   | 1   | DEh                |      |                                                                                                                                             |
|     |          | Parameter 116                   | 1   | E6h                |      |                                                                                                                                             |
|     |          | Parameter 117                   | 1   | EDh                |      |                                                                                                                                             |
|     |          | Parameter 118                   | 1   | F5h                |      |                                                                                                                                             |
|     |          | Parameter 119                   | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 120                   | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 121                   | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 122                   | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 123                   | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 124                   | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 125                   | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 126                   | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 127                   | 1   | 00h                |      |                                                                                                                                             |
| 14  | SETGAMMA | Set gamma curve related setting | 0   | E0h                | PH   | [39 2B 00 05]                                                                                                                               |
|     |          | Parameter 1                     | 1   | 00h                | PD   | [E0 00 00 00 12 1D 34 13 2A 04 0C<br>12 16 19 16 16 0E 11 00 00 00 18<br>24 3F 16 2C 04 0D 10 16 18 16 16<br>10 11 07 16 06 0F 08 16 07 10] |
|     |          | Parameter 2                     | 1   | 00h                | PF   | [XX XX]                                                                                                                                     |
|     |          | Parameter 3                     | 1   | 00h                |      |                                                                                                                                             |
|     |          | Parameter 4                     | 1   | 12h                |      |                                                                                                                                             |
|     |          | Parameter 5                     | 1   | 1Dh                |      |                                                                                                                                             |
|     |          | Parameter 6                     | 1   | 34h                |      |                                                                                                                                             |
|     |          | Parameter 7                     | 1   | 13h                |      |                                                                                                                                             |
|     |          | Parameter 8                     | 1   | 2Ah                |      |                                                                                                                                             |
|     |          | Parameter 9                     | 1   | 04h                |      |                                                                                                                                             |
|     |          | Parameter 10                    | 1   | 0Ch                |      |                                                                                                                                             |
|     |          | Parameter 11                    | 1   | 12h                |      |                                                                                                                                             |
|     |          | Parameter 12                    | 1   | 16h                |      |                                                                                                                                             |

| No. |              | Function                    | DNC | Command /Parameter | Type | Command/Parameter               |
|-----|--------------|-----------------------------|-----|--------------------|------|---------------------------------|
|     |              | Parameter 13                | 1   | 19h                |      |                                 |
|     |              | Parameter 14                | 1   | 16h                |      |                                 |
|     |              | Parameter 15                | 1   | 16h                |      |                                 |
|     |              | Parameter 16                | 1   | 0Eh                |      |                                 |
|     |              | Parameter 17                | 1   | 11h                |      |                                 |
|     |              | Parameter 18                | 1   | 00h                |      |                                 |
|     |              | Parameter 19                | 1   | 00h                |      |                                 |
|     |              | Parameter 20                | 1   | 00h                |      |                                 |
|     |              | Parameter 21                | 1   | 18h                |      |                                 |
|     |              | Parameter 22                | 1   | 24h                |      |                                 |
|     |              | Parameter 23                | 1   | 3Fh                |      |                                 |
|     |              | Parameter 24                | 1   | 16h                |      |                                 |
|     |              | Parameter 25                | 1   | 2Ch                |      |                                 |
|     |              | Parameter 26                | 1   | 04h                |      |                                 |
|     |              | Parameter 27                | 1   | 0Dh                |      |                                 |
|     |              | Parameter 28                | 1   | 10h                |      |                                 |
|     |              | Parameter 29                | 1   | 16h                |      |                                 |
|     |              | Parameter 30                | 1   | 18h                |      |                                 |
|     |              | Parameter 31                | 1   | 16h                |      |                                 |
|     |              | Parameter 32                | 1   | 16h                |      |                                 |
|     |              | Parameter 33                | 1   | 10h                |      |                                 |
|     |              | Parameter 34                | 1   | 11h                |      |                                 |
|     |              | Parameter 35                | 1   | 07h                |      |                                 |
|     |              | Parameter 36                | 1   | 16h                |      |                                 |
|     |              | Parameter 37                | 1   | 06h                |      |                                 |
|     |              | Parameter 38                | 1   | 0Fh                |      |                                 |
|     |              | Parameter 39                | 1   | 08h                |      |                                 |
|     |              | Parameter 40                | 1   | 16h                |      |                                 |
|     |              | Parameter 41                | 1   | 07h                |      |                                 |
|     |              | Parameter 42                | 1   | 10h                |      |                                 |
| 15  | SETCABC      | Set CABC Control            | 0   | C9h                | PH   | [39 0A 00 36]                   |
|     |              | Parameter 1                 | 1   | 0Fh                |      |                                 |
|     |              | Parameter 2                 | 1   | 00h                | PD   | [C9 0F 00 1E 1E 00 00 00 01 3E] |
|     |              | Parameter 3                 | 1   | 1Eh                |      |                                 |
|     |              | Parameter 4                 | 1   | 1Eh                | PF   | [XX XX]                         |
|     |              | Parameter 5                 | 1   | 00h                |      |                                 |
|     |              | Parameter 6                 | 1   | 00h                |      |                                 |
|     |              | Parameter 7                 | 1   | 00h                |      |                                 |
|     |              | Parameter 8                 | 1   | 01h                |      |                                 |
|     |              | Parameter 9                 | 1   | 3Eh                |      |                                 |
| 16  | WRDISBV      | Write display brightness    | 0   | 51h                | PH   | [15 51 FF 3C]                   |
|     |              | Parameter 1(255/255)        | 1   | FFh                |      |                                 |
| 17  | WRCTRLD      | Write CTRL display(PWM OFF) | 0   | 53h                | PH   | [15 53 00 13]                   |
|     |              | Parameter 1                 | 1   | 00h                |      |                                 |
| 18  | SETVDC       | SETVDC                      | 0   | BCh                | PH   | [15 BC 07 0B]                   |
|     |              | Parameter 1                 | 1   | 07h                |      |                                 |
|     | Wait         | wait 5 msec or more         |     |                    |      |                                 |
| 19  | SETPANEL     | Set panel                   | 0   | CCh                | PH   | [15 CC 09 10]                   |
|     |              | Parameter 1                 | 1   | 09h                |      |                                 |
|     | Wait         | wait 50 msec or more        |     |                    |      |                                 |
| 20  | SETMIPI      | Set_MIPI_control            | 0   | BAh                | PH   | [15 BA 03 00]                   |
|     |              | Parameter 1( 4 lane)        | 1   | 03h                |      |                                 |
| 21  | SLEEP OUT    | Sleep out                   | 0   | 11h                | PH   | [05 11 00 36]                   |
|     | Wait         | wait 200 msec or more       |     |                    |      |                                 |
| 22  | DISPON       | Display on                  | 0   | 29h                | PH   | [05 29 00 1C]                   |
|     | Wait         | wait 50 msec or more        |     |                    |      |                                 |
| 23  | Video stream |                             |     |                    |      |                                 |

PH :Packet Header

PD :Packet Data

PF:Packet Footer (=Checksum)

## 9.2 Power-OFF Sequence

| No. |               | Function              | DNC | Command /Parameter | Type | Command/Parameter |
|-----|---------------|-----------------------|-----|--------------------|------|-------------------|
| 1   | DISPOFF       | Display off           | 0   | 28h                | PH   | [05 28 00 06]     |
| 2   | SLPIN         | Sleep in              | 0   | 10h                | PH   | [05 10 00 2C]     |
|     | Wait          | wait 120 msec or more |     |                    |      |                   |
| 3   | Video signals | Video signals stop    |     |                    |      |                   |
| 4   | RESETB        | RESETB off(low)       |     |                    |      |                   |

↓  
Power off

## 9.3 Sleep Sequence

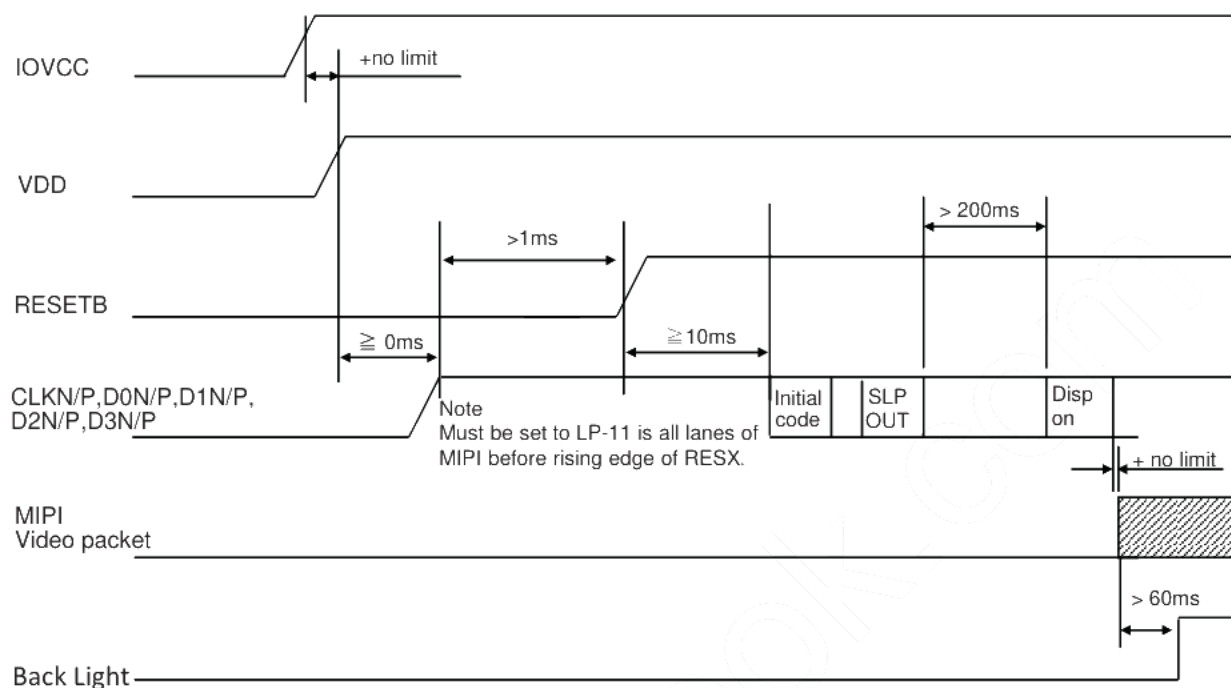
| No. |               | Function              | DNC | Command /Parameter | Type | Command/Parameter |
|-----|---------------|-----------------------|-----|--------------------|------|-------------------|
| 1   | SLPIN         | Sleep in              | 0   | 10h                | PH   | [05 10 00 2C]     |
|     | Wait          | wait 120 msec or more |     |                    |      |                   |
| 2   | Video signals | Video signals stop    |     |                    |      |                   |

## 9.4 Sleep Release Sequence

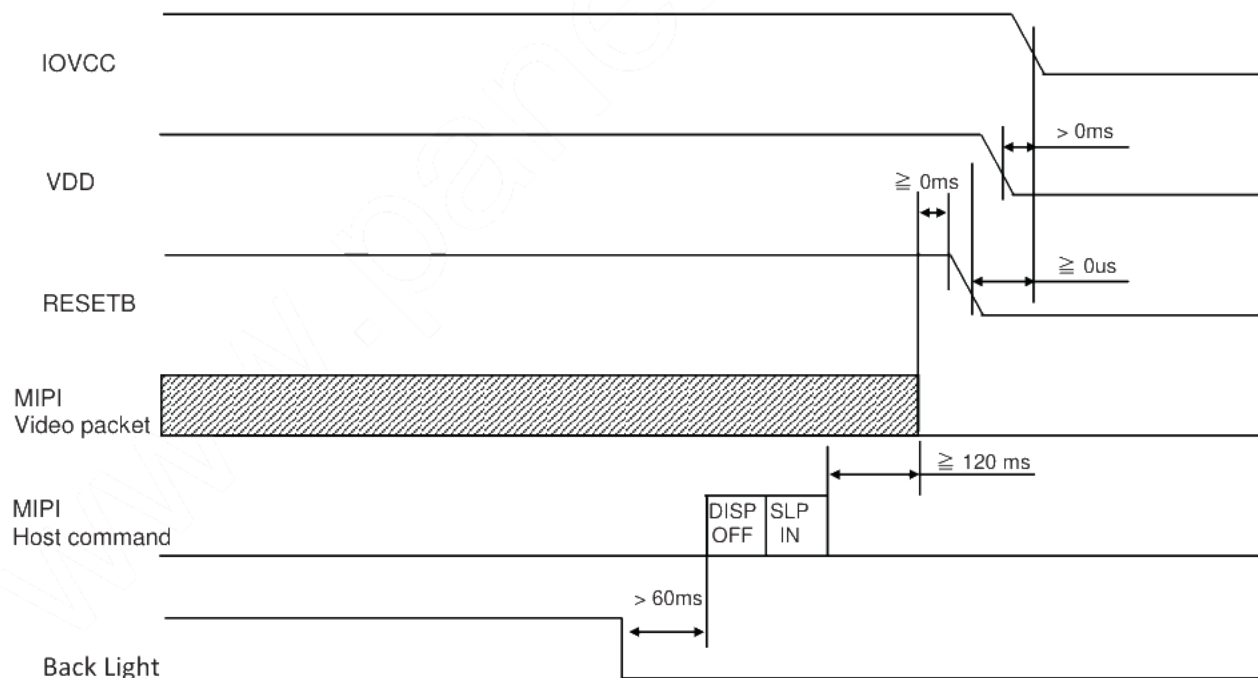
| No. |               | Function              | DNC | Command /Parameter | Type | Command/Parameter |
|-----|---------------|-----------------------|-----|--------------------|------|-------------------|
| 1   | Video signals | Video signals start   |     |                    |      |                   |
|     | Wait          | wait 120 msec or more |     |                    |      |                   |
| 2   | SLPOUT        | Sleep out             | 0   | 11h                | PH   | [05 11 00 36]     |

## 9.5. External Power on/off Sequence

## Power ON

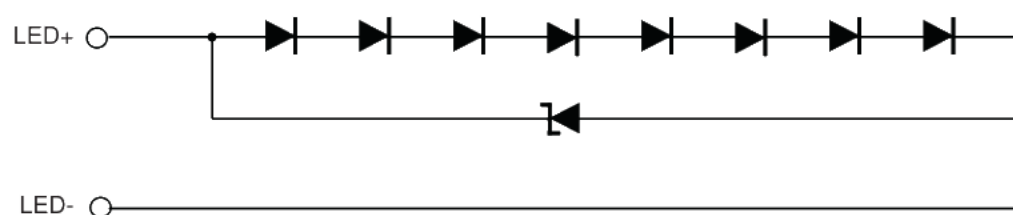


## Power OFF



\* It is recommended that backlight is turned ON after display-on and turned OFF before entering display-off.

## 10. LED Circuit



## 11. Characteristics

## 11.1 Optical Characteristics

&lt; Measurement Condition &gt;

Measuring instruments: CS2000 (KONICA MINOLTA), LCD7200 (OTSUKA ELECTRONICS), EZcontrastXL88 (ELDIM)

Driving condition: VDD=2.9V, VCCIO=1.9V

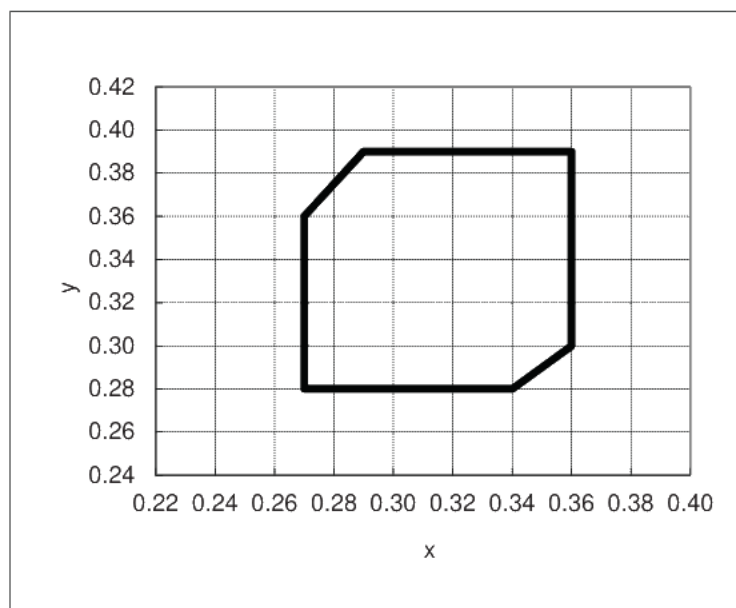
Optimized VCOMDC

Backlight: IL=(10.0)mA

Measured temperature: Ta=25° C

| Item                    | Symbol        | Condition    | MIN                               | TYP                                                                                      | MAX   | Unit              | Note № | Remark |
|-------------------------|---------------|--------------|-----------------------------------|------------------------------------------------------------------------------------------|-------|-------------------|--------|--------|
| Response time           | Rise time     | TON          | [Data]=(00)h→(FF)h                | —                                                                                        | —     | (60)              | ms     | 1      |
|                         | Fall time     | TOFF         | [Data]=(FF)h→(00)h                | —                                                                                        | —     | (40)              | ms     |        |
| Contrast ratio          | Backlight ON  | CR           | [Data]=(FF)h / (00)h              | (400)                                                                                    | (800) | —                 | 2      |        |
|                         | Backlight OFF |              | —                                 | (3.0)                                                                                    | —     | —                 |        |        |
| Viewing angle           | Left          | θL           | [Data]=(FF)h / (00)h<br>CR ≥ (10) | (80)                                                                                     | —     | —                 | 3      |        |
|                         | Right         | θR           |                                   | (80)                                                                                     | —     | —                 |        |        |
|                         | Up            | φU           |                                   | (80)                                                                                     | —     | —                 |        |        |
|                         | Down          | φD           |                                   | (80)                                                                                     | —     | —                 |        |        |
| White Chromaticity      | x             |              |                                   | White chromaticity range                                                                 |       |                   | 4      |        |
|                         | y             |              |                                   |                                                                                          |       |                   |        |        |
| Burn-in                 |               |              |                                   | No noticeable burn-in image shall be observed after (2) hours of window pattern display. |       |                   | 5      |        |
| Center brightness       |               | [Data]=(FF)h | (260)                             | (400)                                                                                    | —     | cd/m <sup>2</sup> | 6      |        |
| Brightness distribution |               | [Data]=(FF)h | (70)                              | —                                                                                        | —     | %                 | 7      |        |

\* Note number 1 to 7: Refer to the APPENDIX of "Reference Method for Measuring Optical Characteristics".



【White Chromaticity Range】

| x      | y      |
|--------|--------|
| (0.27) | (0.36) |
| (0.27) | (0.28) |
| (0.34) | (0.28) |
| (0.36) | (0.30) |
| (0.36) | (0.39) |
| (0.29) | (0.39) |

## 11.2 Temperature Characteristics

< Measurement Condition >

Measuring instruments: CS2000 (KONICA MINOLTA), LCD7200 (OTSUKA ELECTRONICS)

Driving condition: VDD=2.9V, VCCIO=1.9V

Optimized VCOMDC

Backlight: IL=(10.0)mA

| Item            |           |      | Specification                                                    |                   | Remark       |
|-----------------|-----------|------|------------------------------------------------------------------|-------------------|--------------|
|                 |           |      | Ta = (-20)°C                                                     | Ta = 70 °C        |              |
| Contrast ratio  |           | CR   | (200) or more                                                    | (200) or more     | Backlight ON |
| Response time   | Rise time | TON  | (300) msec or less                                               | (50) msec or less |              |
|                 | Fall time | TOFF | (300) msec or less                                               | (30) msec or less |              |
| Display Quality |           |      | No noticeable display defect or ununiformity should be observed. |                   |              |

## 12. Criteria of Judgment

## 12.1 Defective Display and Screen Quality

Test Condition: Observed TFT-LCD monitor from front during operation with the following conditions

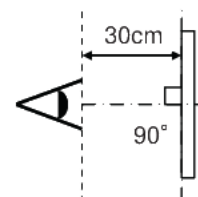
Driving Signal: Raster Patter (RGB, white, black)

Signal condition: [Data]:(00)h, (9D)h, (FF)h (3steps)

Observation distance: 30 cm

Illuminance: 200 to 350 lx

Backlight: IL=(10.0)mA



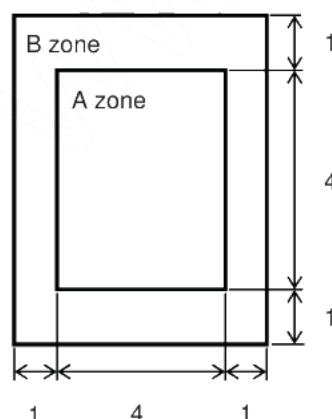
| Defect item                                                 |                              | Defect content                                                                                                               |                               | Criteria                                                                                           |
|-------------------------------------------------------------|------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------|
| Display Quality                                             | Line defect                  | Black, white or color line, 3 or more neighboring defective dots                                                             |                               | Not exists                                                                                         |
|                                                             | Dot defect                   | Uneven brightness on dot-by-dot base due to defective TFT or CF, or dust is counted as dot defect (brighter dot, darker dot) |                               | Refer to table 1                                                                                   |
|                                                             |                              | High bright dot: Visible through 2% ND filter at [Data]=(00)h                                                                |                               |                                                                                                    |
|                                                             |                              | Low bright dot: Visible through 5% ND filter at [Data]=(00)h                                                                 |                               |                                                                                                    |
| Dark dot: Appear dark through white display at [Data]=(9D)h |                              |                                                                                                                              |                               |                                                                                                    |
|                                                             |                              | Invisible through 5% ND filter at [Data]=(00)h                                                                               |                               | Acceptable                                                                                         |
| Screen Quality                                              | Stain                        | Uneven brightness (white stain, black stain etc)                                                                             |                               | Invisible through 5% ND filter at Black screen.<br>Invisible through 1% ND filter at other screen. |
|                                                             | Foreign particle             | Point-like                                                                                                                   | 0.25mm< φ                     | N=0                                                                                                |
|                                                             |                              |                                                                                                                              | 0.20mm< φ ≤0.25mm             | N≤2                                                                                                |
|                                                             |                              |                                                                                                                              | φ ≤0.20mm                     | Acceptable                                                                                         |
|                                                             |                              | Liner                                                                                                                        | 3.0mm<length and 0.08mm<width | N=0                                                                                                |
|                                                             | length≤3.0mm or width≤0.08mm |                                                                                                                              | Acceptable                    |                                                                                                    |
|                                                             | Others                       |                                                                                                                              |                               | Use boundary sample for judgment when necessary                                                    |

$\phi$ (mm): Average diameter = (major axis + minor axis)/2  
Permissible number: N

Table 1

| Area  | High bright dot | Low bright dot | Dark dot | Total | Criteria                                                                                           |
|-------|-----------------|----------------|----------|-------|----------------------------------------------------------------------------------------------------|
| A     | 0               | 2              | 2        | 3     | Permissible distance between same color bright dots (includes neighboring dots): 3 mm or more      |
| B     | 2               | 4              | 4        | 6     | Permissible distance between same color high bright dots (includes neighboring dots): 5 mm or more |
| Total | 2               | 4              | 4        | 7     |                                                                                                    |

&lt;Portrait model&gt;



Division of A and B areas

B area: Active area

Dimensional ratio between A and B areas: 1: 4: 1

(Refer to the left figure)

## 12.2 Screen and Other Appearance

## Testing conditions

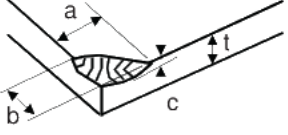
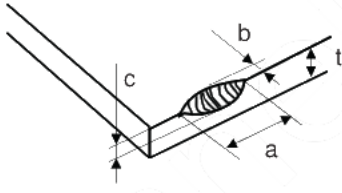
Observation distance

30cm

Illuminance

1200~2000 lx

| Item      |        | Criteria                                          | Remark                                                                               |
|-----------|--------|---------------------------------------------------|--------------------------------------------------------------------------------------|
| Polarizer | Flaw   | Ignore invisible defect when the backlight is on. | Applicable area:<br>Active area only<br>(Refer to the section<br>3.2 "Outward form") |
|           | Stain  |                                                   |                                                                                      |
|           | Dirt   |                                                   |                                                                                      |
|           | Bubble |                                                   |                                                                                      |
|           | Dust   |                                                   |                                                                                      |
|           | Dent   |                                                   |                                                                                      |
| S-case    |        | No functional defect occurs                       |                                                                                      |
| FPC cable |        | No functional defect occurs                       |                                                                                      |

| Item           | Appearance                                                                                       | Criteria                                                                                                                                                              |
|----------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Glass chipping | Corner area<br> | Unit:mm<br>$a \leq 3$<br>$b \leq 3$<br>$c \leq t$ (t: glass thickness)<br>$a, b \leq 0.5$ is acceptable<br>Maximum permissible number of chipping off on a side is 2. |
|                | Others<br>    | Unit:mm<br>$a \leq 5$<br>$b \leq 1$<br>$c \leq t$ (t: glass thickness)<br>$a, b \leq 0.5$ is acceptable<br>Maximum permissible number of chipping off on a side is 5. |
|                | Progressive crack                                                                                | None                                                                                                                                                                  |

## 13. Reliability Test

| Test item                     |                                                 | Test condition                                                                                                                                                                                                                                 |           | number of failures /<br>number of examinations |
|-------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------------------------------------|
| Durability test               | High temperature storage                        | Ta=80° C                                                                                                                                                                                                                                       | 240hrs    | TBD                                            |
|                               | Low temperature storage                         | Ta=-30° C                                                                                                                                                                                                                                      | 240hrs    | TBD                                            |
|                               | High temperature &<br>high humidity storage     | Ta=60° C, RH=90%<br>non condensing                                                                                                                                                                                                             | 240hrs ※  | TBD                                            |
|                               | High temperature operation                      | Tp=70° C                                                                                                                                                                                                                                       | 240hrs    | TBD                                            |
|                               | Low temperature operation                       | Tp=-20° C                                                                                                                                                                                                                                      | 240hrs    | TBD                                            |
|                               | High temp &<br>humid operation                  | Tp=40° C, RH=90%<br>non condensing                                                                                                                                                                                                             | 240hrs ※  | TBD                                            |
|                               | Thermal shock storage                           | (-30)←→80° C(30min/30min)                                                                                                                                                                                                                      | 100cycles | TBD                                            |
|                               | Lightfastness                                   | Xenon Blackpanel 63±3°C non-shower<br>450W/m <sup>2</sup> (300~700nm) non-operating                                                                                                                                                            |           | TBD                                            |
| Mechanical environmental test | Electrostatic discharge test<br>(Non operation) | Confirms to EIAJ ED-4701/300<br>C=200pF, R=0Ω, V=±200V<br>Each 3 times of discharge on and power supply<br>and other terminals.                                                                                                                |           | TBD                                            |
|                               | Surface discharge test<br>(Non operation)       | C=250pF, R=100Ω, V=±(TBD)kV<br>Each 5 times of discharge in both polarities<br>on the center of screen with the case grounded.                                                                                                                 |           | TBD                                            |
|                               | FPC tension test                                | Pull the FPC with the force of 3N for 10 sec.<br>in the direction - 90-degree to its original direction.                                                                                                                                       |           | TBD                                            |
|                               | FPC bend test                                   | Pull the FPC with the force of 3N for 10 sec.<br>in the direction -180-degree to its original direction.<br>Reciprocate it 3 times.                                                                                                            |           | TBD                                            |
|                               | Vibration test                                  | Total amplitude 1.5mm, f=10~55Hz, X,Y,Z<br>directions for each 2 hours                                                                                                                                                                         |           | TBD                                            |
|                               | Impact test                                     | Use TOPPAN PRINTING original jig<br>(see next page)and make an impact with<br>peak acceleration of 1000m/s <sup>2</sup> for 6 msec with<br>half sine-curve at 3 times to each X, Y, Z directions<br>in conformance with JIS C 60068-2-27-2011. |           | TBD                                            |
| Packing test                  | Packing vibration-proof test                    | Acceleration of 19.6m/s <sup>2</sup> with frequency of<br>10→55→10Hz, X,Y, Zdirection for each 30 minutes                                                                                                                                      |           | TBD                                            |
|                               | Packing drop test                               | Drop from 75cm high.<br>1 time to each 6 surfaces, 3 edges, 1 corner                                                                                                                                                                           |           | TBD                                            |

Note: Ta=ambient temperature Tp=Panel temperature

※ The profile of high temperature/humidity storage and High Temperature/humidity operation  
(Pure water of over 10MQ·cm shall be used.)

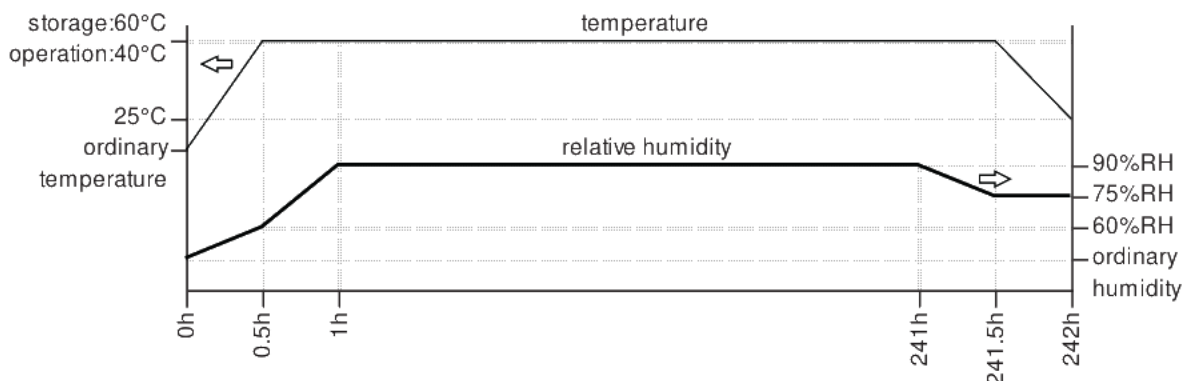
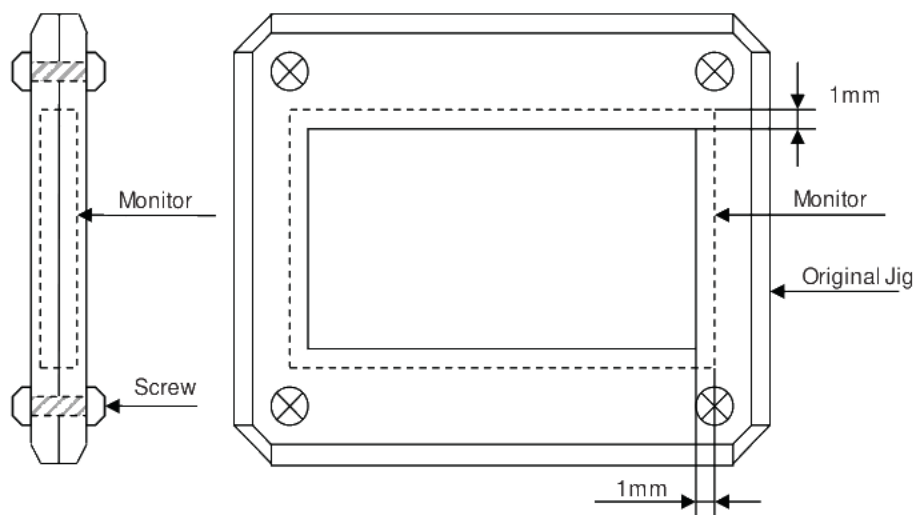


Table2.Reliability Criteria

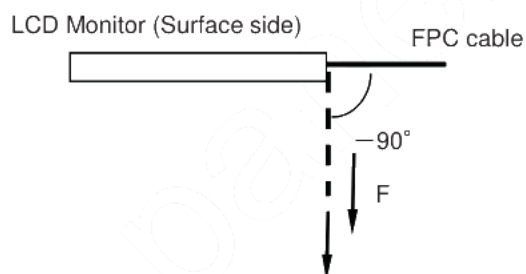
The parameters should be measured after leaving the monitor at the ordinary temperature for 24 hours or more after the test completion.

| item            | Standard                                                                               | Remarks      |
|-----------------|----------------------------------------------------------------------------------------|--------------|
| Display quality | No visible abnormality shall be seen.<br>(Except for unevenness by Pol deterioration.) |              |
| Contrast ratio  | 200 or more                                                                            | Backlight ON |

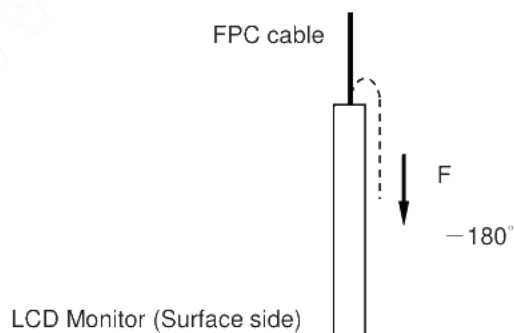
## TOPPAN PRINTING Original Jig



## Tension Test Method for FPC cable



## Bend Test Method for FPC cable



TOPPAN PRINTING CO.,LTD.

## 15. Handling Instruction

## 15.1 Cautions for Handling LCD panels

**Caution**

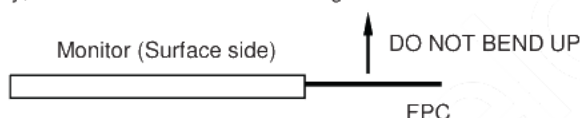
- (1) Do not make an impact on the LCD panel glass because it may break and you may get injured from it.
- (2) If the glass breaks, do not touch it with bare hands.  
(Fragment of broken glass may stick you or you cut yourself on it.)
- (3) If you get injured, receive adequate first aid and consult a medical doctor.
- (4) Do not let liquid crystal get into your mouth.  
(If the LCD panel glass breaks, try not let liquid crystal get into your mouth even toxic property of liquid crystal has not been confirmed.)
- (5) If liquid crystal adheres, rinse it out thoroughly.  
(If liquid crystal adheres to your cloth or skin, wipe it off with rubbing alcohol or wash it thoroughly with soap. If liquid crystal gets into eyes, rinse it with clean water for at least 15 minutes and consult an eye doctor.)
- (6) If you scrap this products, follow a disposal standard of industrial waste that is legally valid in the community, country or territory where you reside.
- (7) Do not connect or disconnect this product while its application products is powered on.
- (8) Do not attempt to disassemble or modify this product as it is precision component.
- (9) If a part of soldering part has been exposed, and avoid contact (short-circuit) with a metallic part of the case etc. about FPC of this model, please.  
Please insulate it with the insulating tape etc. if necessary.  
The defective operation is caused, and there is a possibility to generation of heat and the ignition.
- (10) Since excess current protection circuit is not built in this TFT module, there is the possibility that LCD module or peripheral circuit become feverish and burned in case abnormal operation is generated.  
We recommend you to add excess current protection circuit to power supply.
- (11) The devices on the FPC are damageable to electrostatic discharge, because the terminals of the devices are exposed.  
Wear grounded wrist-straps and use electrostatic neutralization blowers to prevent static charge and discharge when handling the TFT monitors.  
Designate an appropriate operating area, and set equipment, tools, and machines properly when handling this product.

**Caution**

**This mark is used to indicate a precaution or an instruction which, if not correctly observed, may result in bodily injury, or material damages alone.**

## 15.2 Precautions for Handling

- 1) Wear finger tips at incoming inspection and for handling the TFT monitors to keep display quality and keep the working area clean.  
Do not touch the surface of the monitor as it is easily scratched.
- 2) Wear grounded wrist-straps and use electrostatic neutralization blowers to prevent static charge and discharge when handling the TFT monitors as the LED in this TFT monitors is damageable to electrostatic discharge. Designate an appropriate operating area, and set equipment, tools, and machines properly when handling this product.
- 3) Avoid strong mechanical shock including knocking, hitting or dropping to the TFT monitors for protecting their glass parts. Do not use the TFT monitors that have been experienced dropping or strong mechanical shock.
- 4) Do not use or storage the TFT monitors at high temperature and high humidity environment. Particularly, never use or storage the TFT monitors at a location where condensation builds up.
- 5) Avoid using and storing TFT monitors at a location where they are exposed to direct sunlight or ultraviolet rays to prevent the LCD panels from deterioration by ultraviolet rays.
- 6) Do not stain or damage the contacts of the FPC cable .  
FPC cable needs to be inserted until it can reach to the end of connector slot.  
During insertion, make sure to keep the cable in a horizontal position to avoid an oblique insertion.  
Otherwise, it may cause poor contact or deteriorate reliability of the FPC cable.
- 7) Do not bend or pull the FPC cable or carry the TFT monitor by holding the FPC cable.  
Especially, it will cause mechanical damage or critical defect if FPC is pull up or bent up to short of display.



- 8) Peel off the protective film on the TFT monitors during mounting process.  
Refer to the section 15.5 on how to peel off the protective film.  
We are not responsible for electrostatic discharge failures or other defects occur when peeling off the protective film.
- 9) It is recommended to employ the structure of which polarizer peripheral area of LCD panel being pressed by cushioning materials, in order to prevent a cause of display brightness unevenness.
- 10) By reason of this model is made by thin glass, this model LCD is breakable.  
Please apply fitting of protection LCD surface. (ex. Covered acrylic board on LCD surface)

## 15.3 Precautions for Operation

- 1) Since this TFT monitors are not equipped with light shielding for the driver IC, do not expose the driver IC to strong lights during operation as it may cause functional failures.
- 2) In case of powering up or powering off this LCD module, be sure to comply the sequence as instructed in this specification.
- 3) Do not plug in or out the FPC cable while power supply is switch on.  
Plug the FPC cable in and out while power supply is switched off.
- 4) Do not operate the TFT monitors in the strong magnetic field. It may break the TFT monitors.
- 5) Do not display a fixed image on the screen for a long time.  
Use a screen-saver or other measures to avoid a fixed image displayed on the screen for a long time.  
Otherwise, it may cause burn-in image on the screen due the characteristics of liquid crystal.

## 15.4 Storage Condition for Shipping Cartons

## Storage environment

- Temperature 0 to 40° C
- Humidity 60%RH or less  
No-condensing occurs under low temperature with high humidity condition.
- Atmosphere No poisonous gas that can erode electronic components and/or wiring materials should be detected.
- Time period 1 year
- Unpacking To prevent damages caused by static electricity, anti-static precautionary measures (e.g. earthing, anti-static mat) should be implemented.  
After unpack, keep product in the appropriate condition, otherwise bubble seal of Protective film may be printed on Polarizer.
- Maximum piling up 7 cartons

## \*Conditions to storage after unpacking

## Storage environment

- Temperature 0 to 40° C
- Humidity 60%RH or less  
No-condensing occurs under low temperature with high humidity condition.
- Atmosphere No poisonous gas that can erode electronic components and/or wiring materials should be detected.
- Time period 1 year (Shelf life)
- Others Keep/ store away from direct sunlight  
Storage goods on original tray made by TOPPAN PRINTING.

### 15.5 Precautions for Peeling off the Protective film

The followings work environment and work method are recommended to prevent the TFT monitors from static damage or adhesion of dust when peeling off the protective films.

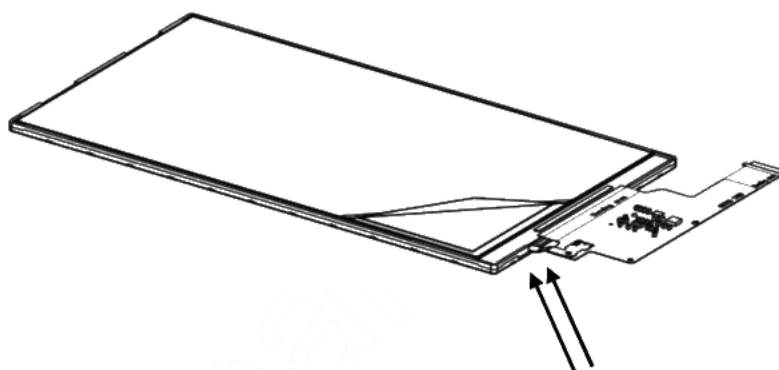
#### A) Work Environment

- a) Humidity: 50 to 70 %RH, Temperature 15 to 27°C
- b) Operators should wear conductive shoes, conductive clothes, conductive finger tips and grounded wrist-straps.  
Use an electrostatic neutralization blower.  
Anti-static treatment should be implemented to work area's floor.
- c) Use a room shielded against outside dust with sticky floor mat laid at the entrance to eliminate dirt.

#### B) Work Method

The following procedures should be taken to prevent the driver ICs from charging and discharging.

- a) Use an electrostatic neutralization blower to blow air on the TFT monitors to its lower left when FPC is placed at the bottom.  
Optimize direction of the blowing air and the distance between the TFT monitors and the electrostatic neutralization blower.
- b) Put an adhesive tape (Scotch tape, etc) at the lower left corner area of the protective film to prevent scratch on surface of TFT monitors.
- c) Peel off the adhesive tape slowly (spending more than 2 secs to complete) by pulling it to opposite direction.



Blower wind direction (Set an ion blower with its adequate conditions.)

### 15.6 Warranty

TOPPAN PRINTING is only liable to defective goods which is stored and used under the condition complying with this specifications and returned within 1 (one) year.

Warranty caused by manufacturing defect shall be conducted by replacement of goods or refundment at unit price.

**APPENDIX**

## Reference Method for Measuring Optical Characteristics and Performance

## 1. Measurement Condition (Backlight ON)

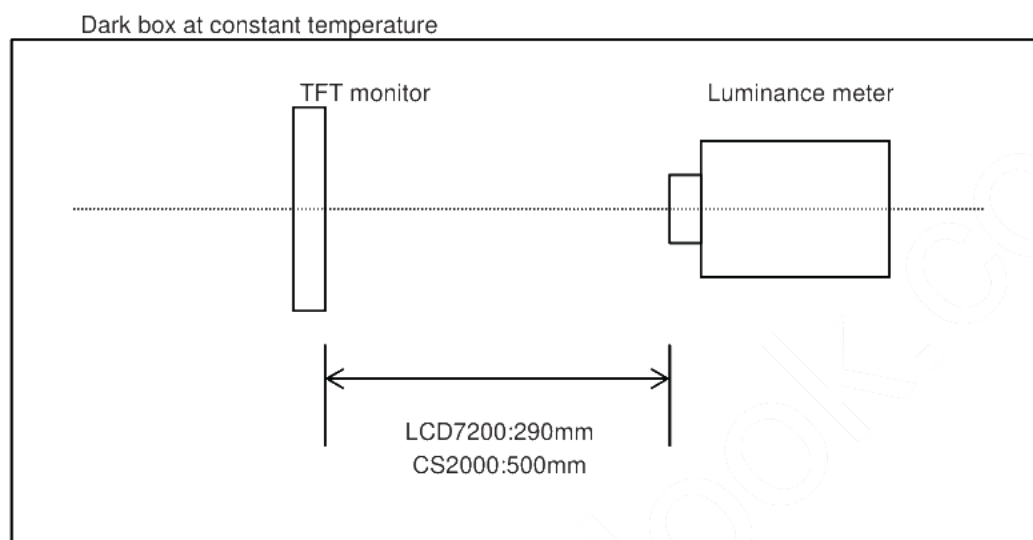
Measuring instruments: CS2000 (KONICA MINOLTA), LCD7200 (OTSUKA ELECTRONICS), EZcontrastXL88 (ELDIM)

Driving condition: Refer to the section "Optical Characteristics"

Measured temperature: 25°C unless specified

Measurement system: See the chart below. The luminance meter is placed on the normal line of measurement system.

Measurement point: At the center of the screen unless otherwise specified

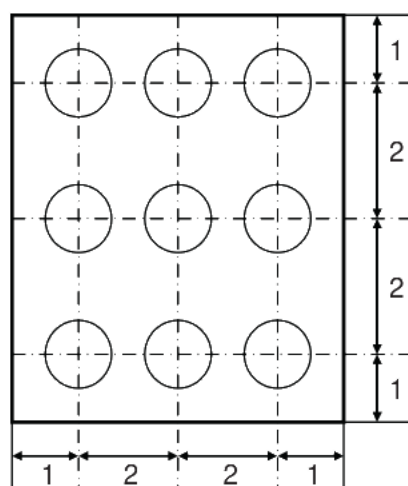


Measurement is made after 30 minutes of lighting of the backlight.

Measurement point: At the center point of the screen

Brightness distribution: 9 points shown in the following drawing.

&lt;Portrait model&gt;



Dimensional ratio of active area

Backlight

IL=(10.0)mA

Measurement Condition (Contrast ratio Backlight OFF only)

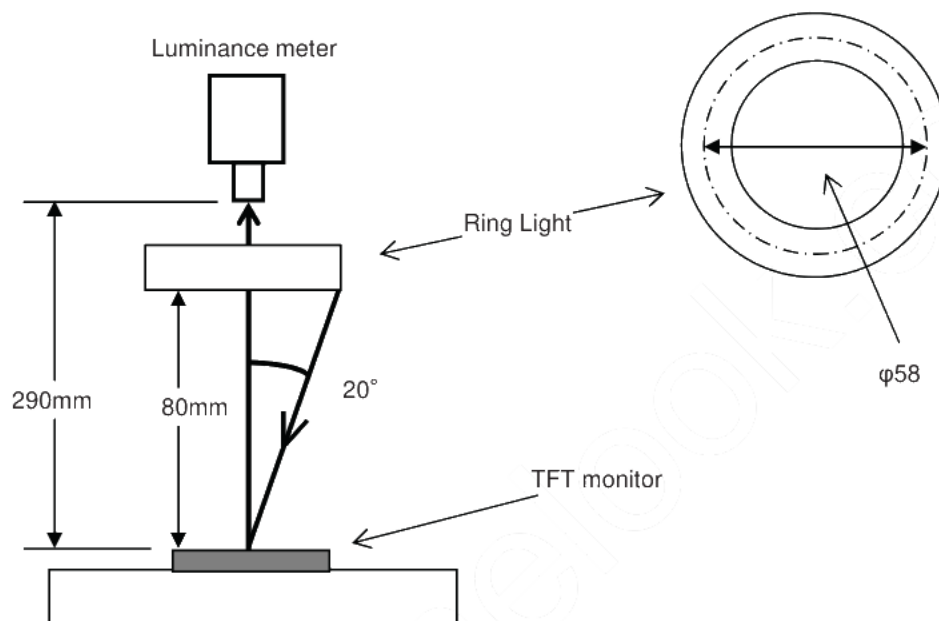
Measuring instruments: LCD7200(OTSUKA ELECTRONICS), Ring Light(40,000 lx,  $\phi 58$ )

Driving condition: Refer to the section "Optical Characteristics"

Measured temperature: 25°C unless specified

Measurement system: See the chart below.

Measurement point: At the center of the screen.



## 2. Test Method

| Notice | Item                                      | Test method                                                                                                                                                                                                                                                                                                                                        | Measuring instrument | Remark                                                                                                                       |
|--------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------|
| 1      | Response time                             | <p>Measure output signal waveform by the luminance meter when raster of window pattern is changed from white to black and from black to white.</p> <p>Black White Black</p> <p>White brightness</p> <p>100%</p> <p>90%</p> <p>10%</p> <p>0%</p> <p>Black brightness</p> <p>TON</p> <p>TOFF</p>                                                     | LCD7200              | <p>Black display [Data]=(00)h</p> <p>White display [Data]=(FF)h</p> <p>TON</p> <p>Rise time</p> <p>TOFF</p> <p>Fall time</p> |
| 2      | Contrast ratio                            | <p>Measure maximum luminance Y1([Data]=(FF)h) and minimum luminance Y2([Data]=(00)h) at the center of the screen by displaying raster or window pattern. Then calculate the ratio between these two values.</p> <p>Contrast ratio = Y1/Y2</p> <p>Diameter of measuring point: 7.8mmφ(CS2000)</p> <p>Diameter of measuring point: 3mmφ(LCD7200)</p> | CS2000<br>LCD7200    | Backlight ON<br>Backlight OFF                                                                                                |
| 3      | Viewing angle<br>Horizontalθ<br>Verticalφ | Move the luminance meter from right to left and up and down and determine the angles where contrast ratio is (10).                                                                                                                                                                                                                                 | EZcontrastXL88       |                                                                                                                              |
| 4      | White chromaticity                        | <p>Measure chromaticity coordinates x and y of CIE1931 colorimetric system at [Data] = (FF)h</p> <p>Color matching function: 2°view</p> <p>measurement angle: 1°</p>                                                                                                                                                                               | CS2000               |                                                                                                                              |
| 5      | Burn-in                                   | Visually check burn-in image on the screen after 2 hours of "window display" ([Data]=(00)h/(FF)h).                                                                                                                                                                                                                                                 |                      | At optimized VCOMDC                                                                                                          |
| 6      | Center brightness                         | Measure the brightness at the center of the screen.                                                                                                                                                                                                                                                                                                | CS2000               |                                                                                                                              |
| 7      | Brightness distribution                   | <p>(Brightness distribution) = 100 x B/A %</p> <p>A : max. brightness of the 9 points</p> <p>B : min. brightness of the 9 points</p>                                                                                                                                                                                                               | CS2000               |                                                                                                                              |