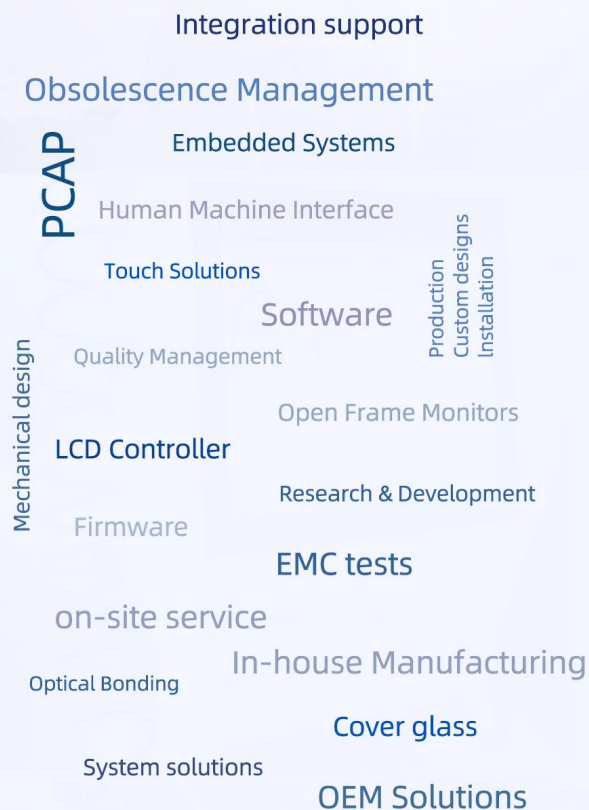


# INDUSTRIAL STRENGTH... Start Your Application From YOURITECH





# Specifications for

## **Blanview TFT-LCD Monitor**

### **( 4.1" QVGA 320 x 240 x RGB Landscape)**

Version 1.0

(Please be sure to check the specifications latest version. )

MODEL COM41H4P21ULC

Customer's Approval

Signature :

Name :

Section :

Title :

Date :

# ORTUSTECH

TOPPAN INC.  
Electronics Division  
Technological Development Department III



Approved by

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Checked by

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Prepared by

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## TOPPAN INC.

## Version History

| Ver.                                                  | Date        | Page    | Description |                                                      |
|-------------------------------------------------------|-------------|---------|-------------|------------------------------------------------------|
| 0.0                                                   | Sep.26,2022 | -       | -           | Tentative issue                                      |
| <div> <div>△</div> <div>A</div> <div>×5</div> </div>  | Dec.13,2022 | P.3     | Add         | Contents                                             |
|                                                       |             | P.10    | Add         | 9.1 Driving Circuit Example                          |
|                                                       |             | P.20-22 | Delete      | 4. Pin Assignment                                    |
|                                                       |             |         | Delete      | Function                                             |
|                                                       |             |         | Add         | 9. Circuit                                           |
| <div> <div>△</div> <div>B</div> <div>×1</div> </div>  | Apr.28,2023 | P.8     | Add         | 9.1 Driving Circuit Example                          |
|                                                       |             |         | Correct     | Contents number(9.2 LED Circuit)                     |
| 0.2                                                   | Apr.28,2023 | P.8     | Change      | 3.2 Outward Form                                     |
| <div> <div>△</div> <div>B</div> <div>×1</div> </div>  |             |         | Change      | FPC shape                                            |
| 1.0                                                   | Oct.27,2023 | -       | -           | First issue                                          |
| <div> <div>△</div> <div>C</div> <div>×21</div> </div> |             | All     | All         | All                                                  |
|                                                       |             |         | Change      | Company name logo font                               |
|                                                       |             | P.1     | Change      | Cover                                                |
|                                                       |             | P.5     | Change      | Department name                                      |
|                                                       |             |         | Add         | 2.2 Display Method                                   |
|                                                       |             | P.7     | Add         | NTSC ratio                                           |
|                                                       |             |         | Add         | 3.1 Dimensions                                       |
|                                                       |             | P.11    | Add         | Specifications                                       |
|                                                       |             |         | Delete      | 4. Pin Assignment                                    |
|                                                       |             | P.12    | Delete      | Error delete(Recommended connector)                  |
|                                                       |             |         | Add         | 5. Absolute Maximum Rating                           |
|                                                       |             |         | Add         | Rating                                               |
|                                                       |             |         | Add         | 6. Recommended Operating Conditions                  |
|                                                       |             |         | Add         | Note 2/graph                                         |
|                                                       |             | P.13    | Add         | 7.1.1 Display Module                                 |
|                                                       |             |         | Add         | Rating                                               |
|                                                       |             |         | Add         | 7.1.2 Backlight                                      |
|                                                       |             | P.19    | Add         | Condition / Rating                                   |
|                                                       |             |         | Add         | 8.2 Standby / Power Off Sequence                     |
|                                                       |             |         | Correct     | Error correct                                        |
|                                                       |             | P.23    | Add         | 10.1 Optical Characteristics                         |
|                                                       |             |         | Add         | BL current / Rating/White Chromaticity Range         |
|                                                       |             | P.24    | Add         | 10.2 Temperature Characteristics                     |
|                                                       |             |         | Add         | BL current / Specification                           |
|                                                       |             | P.25    | Add         | 11.1 Defective Display and Screen Quality            |
|                                                       |             |         | Add         | Signal condition / BL current                        |
|                                                       |             |         | Add         | 12. Reliability Test                                 |
|                                                       |             | P.27    | Add         | number of failures /number of examinations           |
|                                                       |             |         | Add         | Applied voltage (Surface discharge test)             |
|                                                       |             | P.28    | Add         | Contrast ratio                                       |
|                                                       |             | P.29    | Add         | 13. Packing Specifications                           |
|                                                       |             |         | Add         | Packing Specifications                               |
|                                                       |             | P.31    | Add         | 14.3 Precautions for Operation                       |
|                                                       |             |         | Delete      | Error delete                                         |
|                                                       |             | P.32    | Delete      | 14.4 Storage Condition for Shipping Cartons          |
|                                                       |             |         | Add         | Maximum piling up                                    |
|                                                       |             | P.33    | Add         | 14.5 Precautions for Peeling off the Protective film |
|                                                       |             |         | Add         | Work Method                                          |
|                                                       |             | P.34    | Add         | APPENDIX                                             |
|                                                       |             |         | Add         | BL current                                           |
|                                                       |             | P.35    | Add         | 2. Test Method                                       |
|                                                       |             |         | Delete      | Error delete                                         |

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## 1. Application

This Specification is applicable to 103.2 mm (4.1 inch) Blanview TFT-LCD monitor for non-military use.

- ◎ TOPPAN 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 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'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'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 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 caused by stress to the LCD module shall be considered.
- ◎ TOPPAN 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 and Purchaser shall discuss them in good faith and seek solution.
- ◎ TOPPAN 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

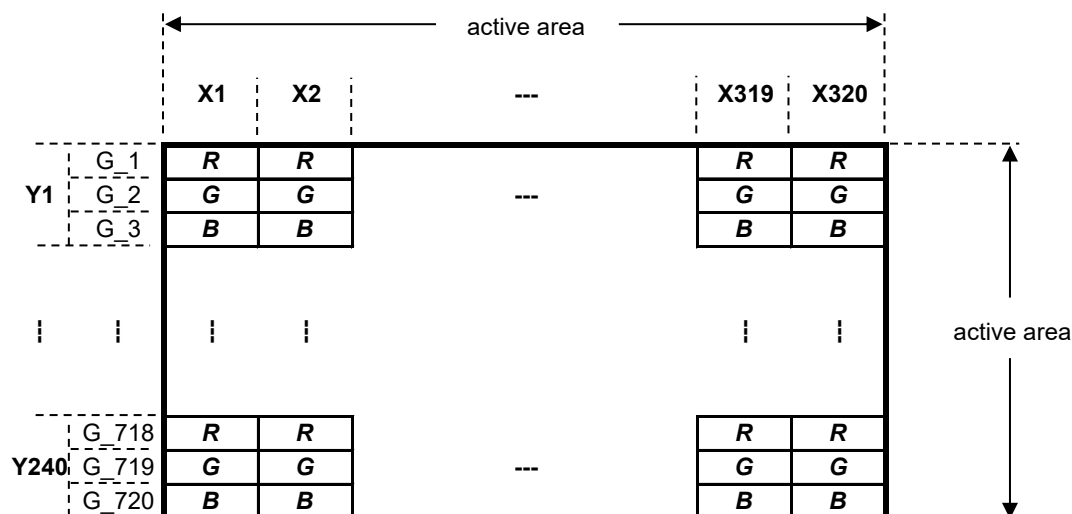
### 2.1 Features of the Product

- 4.1 inch diagonal display, 320 [H] x 240RGB [V] dots.
- 8-bit 16,777,216 color display capability.
- 3.0V voltage single power source.
- Timing generator [TG], Counter-electrode driving circuitry, Built-in power supply circuit.
- Power save (Standby) mode capable.
- Long life & High bright white LED back-light.
- Blanview TFT-LCD, improved outdoor readability.

|               | 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

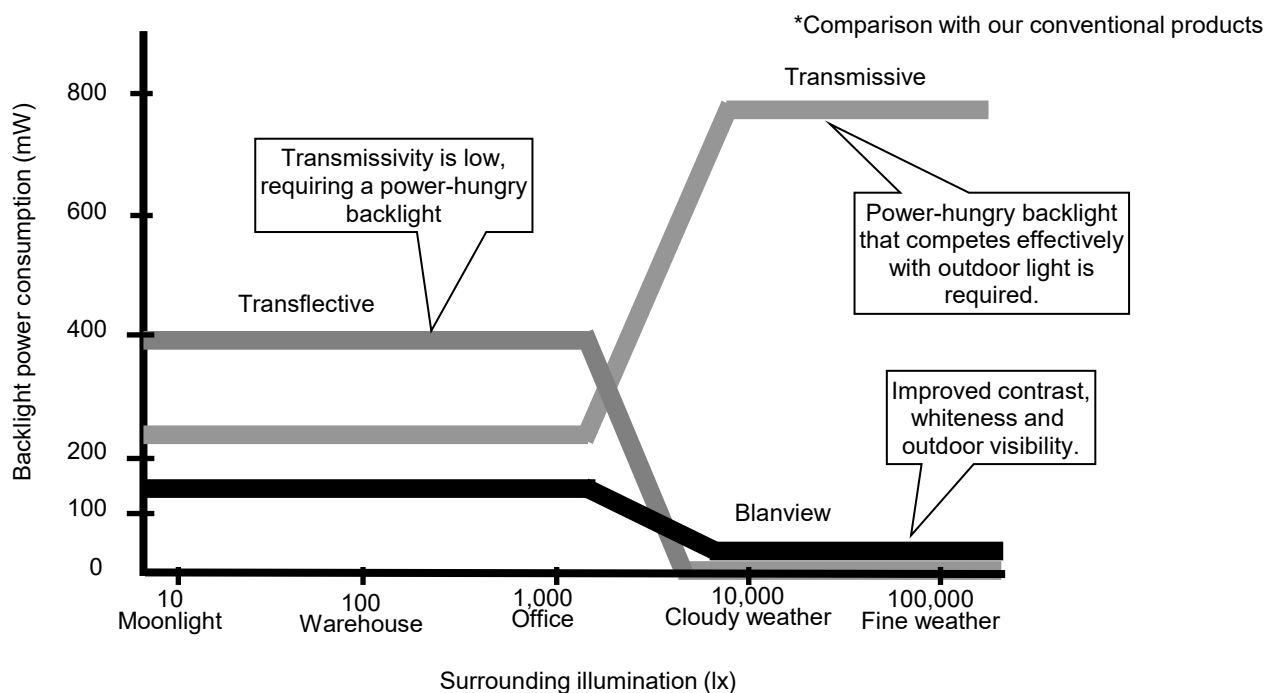
| Items               | Specifications                                           | Remarks                    |
|---------------------|----------------------------------------------------------|----------------------------|
| Display type        | VA type 16,777,216 colors.<br>Blanview, Normally black.  |                            |
| Driving method      | a-Si TFT Active matrix.<br>Line-scanning, Non-interlace. |                            |
| Dot arrangement     | RGB horizontal stripe arrangement.                       | Refer to "Dot arrangement" |
| Signal input method | 8-bit RGB, parallel input.                               |                            |
| Backlight type      | Long life & High bright white LED.                       |                            |
| NTSC ratio          | 50%                                                      |                            |



Dot arrangement (FPC cable placed downside)

## &lt;Features of Blanview&gt;

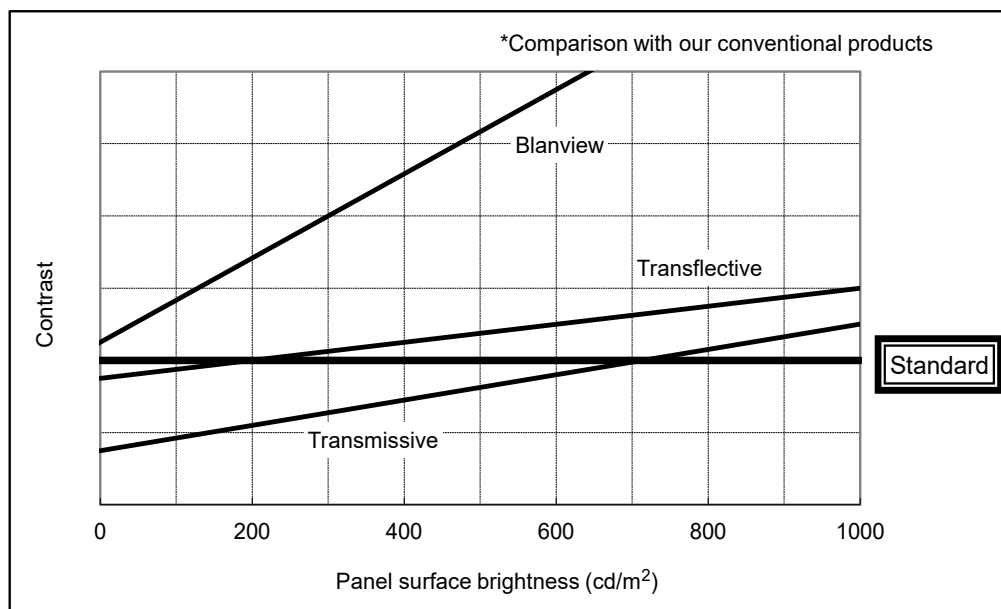
- Backlight power consumption required to assure visibility. (equivalent to 3.5"QVGA )



- 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 criteria)



## 3. Dimensions and Shape

 3.1 Dimensions

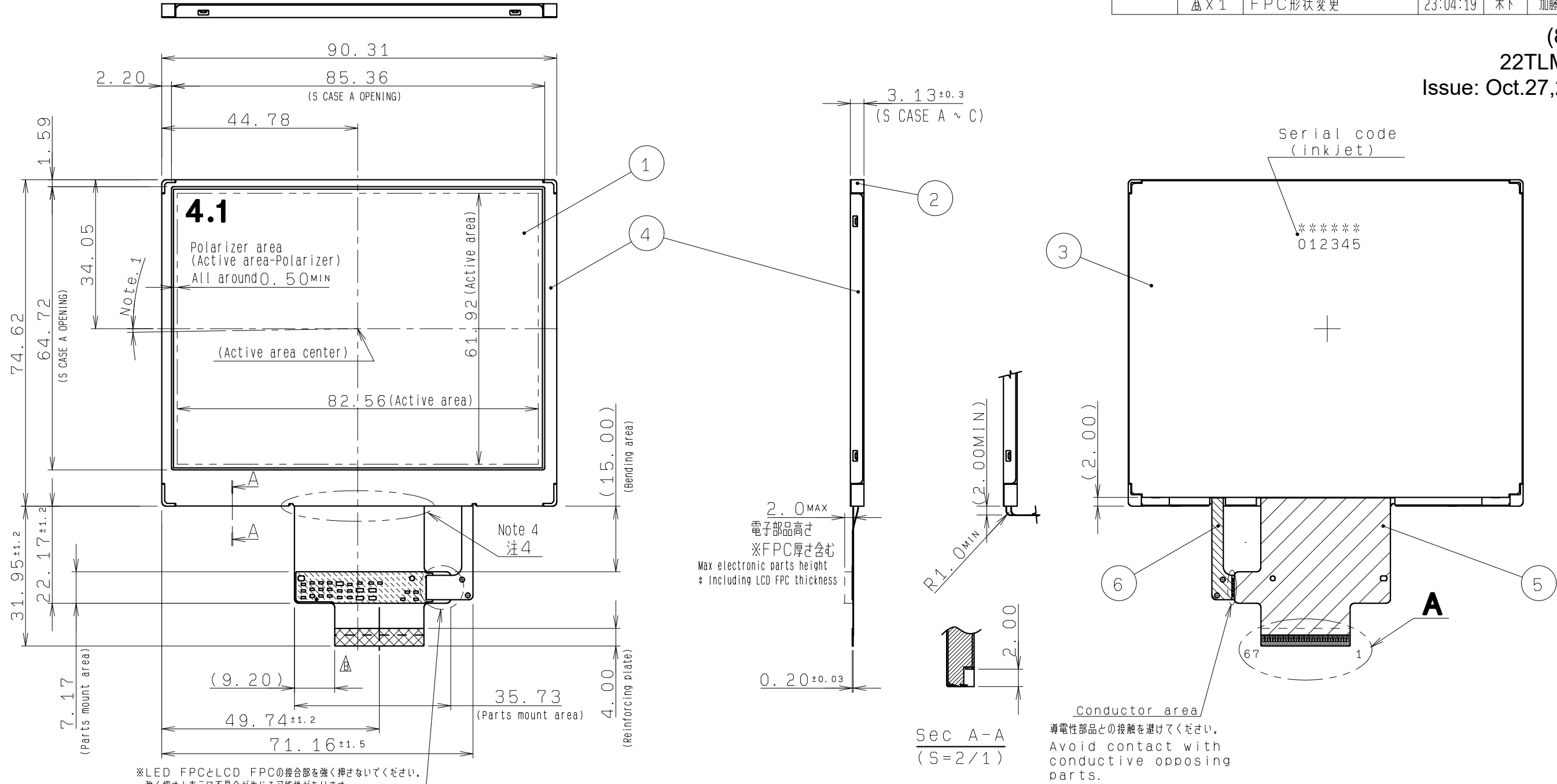
| Items                             | Specifications                | Unit | Remarks           |
|-----------------------------------|-------------------------------|------|-------------------|
| Outline dimensions                | 90.31[H] × 74.62[V] × 3.13[D] | mm   | Exclude FPC cable |
| Active area                       | 82.56[H] × 61.92[V]           | mm   | 103.2 mm diagonal |
| Number of dots                    | 320[H] × 720[V]               | dot  |                   |
| Dot pitch                         | 258[H] × 86[V]                | um   |                   |
| Surface hardness of the polarizer | 2                             | H    | Load: 4.90N       |
| Weight                            | 42                            | g    | Include FPC cable |



3.2 Outward Form

| EC No. | REV. No. | REVISE  | DATE<br>(Y:M:D) | APPROVED | CHECKED | PREPARED |
|--------|----------|---------|-----------------|----------|---------|----------|
|        | A x 1    | FPC形状変更 | 23:04:19        | 木下       | 加藤      | 前田       |

(8/35)  
22TLM081  
Issue: Oct.27,2023



※LED FPCとLCD FPCの接合部を強く押さないでください。  
強く押すと表示に不具合が生じる可能性があります。  
※Please don't push LED FPC&LCD FPC bonding  
area strongly.  
There is a possibility that trouble  
occurs in display when strongly pushing.

Note 1. Angular deviation of LCD cell from the TFT-LCD monitor's reference  
axis shall be less than [±40°].

注1. TFT PANELの角度スレは、モニター基準軸に対し【±40°】以下とする。

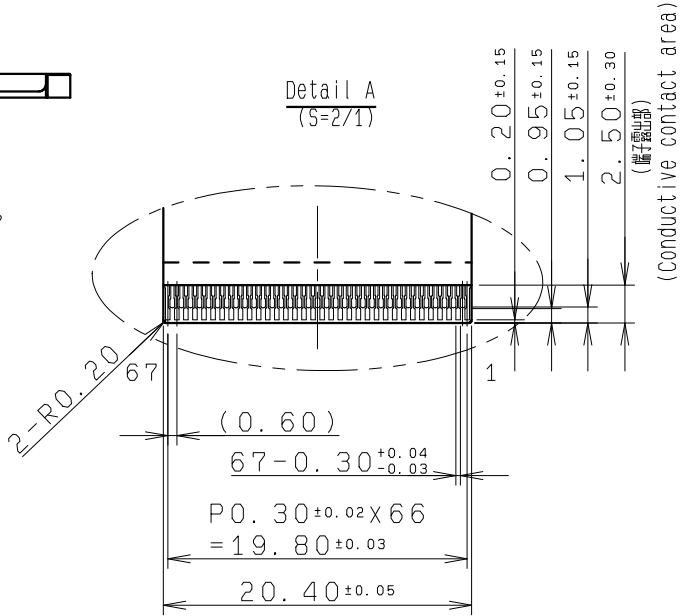
Note 2. Recommended FPC connectors  
HIROSE, part number : FH26G-67S-0.3SHBW(05) (Lower contact)

2. FPCの推奨コネクタの規格を下記に示す。  
ヒロセ電機 : FH26G-67S-0.3SHBW(05) (下接点)

Note 3. Protective film is affixed on front surface of the screen.  
Location tolerance of the protective film shall be ±1.5 mm  
to the polarizing film.

3. 保護膜が表面側に貼られます。  
表面側保護膜貼付け位置は偏光板に対して【±1.5】とする。

Note 4. Exercise care not to apply any forces to the FPC holder of the S case A.  
4. S CASE AのFPC押さえ部先端には負荷の掛からないよう注意願います。



|               |      |           |                                |        |
|---------------|------|-----------|--------------------------------|--------|
| LED FPC       | 6    |           |                                |        |
| LCD FPC       | 5    |           |                                |        |
| S CASE A      | 4    |           | SUS(t=0.15)                    |        |
| S CASE C      | 3    |           | SUS(t=0.2)                     |        |
| Frame         | 2    |           | PC                             |        |
| TFT-LCD PANEL | 1    |           | Glass substrate thickness=0.5t |        |
| PART NAME     | ITEM | PART CODE | MODEL NUMBER                   | REMARK |

|             |                        |                     |         |                                                                                |      |       |      |
|-------------|------------------------|---------------------|---------|--------------------------------------------------------------------------------|------|-------|------|
| APPROVED 木下 | GENERAL TOLERANCE ±0.5 | SCALE 1/1(2/1)      | UNIT mm | <b>TOPPAN</b><br>TOPPAN INC.<br>DO NOT DUPLICATE, CONFIDENTIAL AND PROPRIETARY |      |       |      |
| CHECKED 加藤  | ISSUE (Y:M:D) 23:04:18 | MODEL CCM41T4P21U** |         |                                                                                |      |       |      |
| CHECKED     | NAME                   |                     |         | DRAWING No.                                                                    | REV. | SHEET | DIV. |
| DESIGN 前田創  |                        |                     |         |                                                                                |      |       |      |
| DRAW 前田創    |                        |                     |         |                                                                                |      |       |      |

OUTLINE-D4P21

RJD603972D301

A

/

ASS'Y

### 3.3 Serial Label (S-label)

#### 3.3.1 Display items

S-label 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                                      | 41BVC (Made in Japan)<br>41BWC (Made in Malaysia) |                                  |                                  |
| d | Serial number                                   |                                                   |                                  |                                  |

##### \* Example of indication of Serial label (S-label)

###### • Made in Japan

2L41BVC000125

means "manufactured in December 2022, 4.1" BV type, C specifications, serial number 000125"

###### • Made in Malaysia

2L41BWC000125

means "manufactured in December 2022, 4.1" BW type, C specifications, serial number 000125"

#### 3.3.2 Location of Serial Label (S-label)

Refer to 3.2 "Outward Form".

## 4. Pin Assignment

| No. | Symbol | Function                                                                         |
|-----|--------|----------------------------------------------------------------------------------|
| 1   | NC     | OPEN.                                                                            |
| 2   | D27    | Display data(B).<br>00h: Black<br>D20:LSB D27:MSB                                |
| 3   | D26    |                                                                                  |
| 4   | D25    |                                                                                  |
| 5   | D24    |                                                                                  |
| 6   | D23    |                                                                                  |
| 7   | D22    |                                                                                  |
| 8   | D21    |                                                                                  |
| 9   | D20    |                                                                                  |
| 10  | D17    | Display data(G).<br>00h: Black<br>D10:LSB D17:MSB                                |
| 11  | D16    |                                                                                  |
| 12  | D15    |                                                                                  |
| 13  | D14    |                                                                                  |
| 14  | D13    |                                                                                  |
| 15  | D12    |                                                                                  |
| 16  | D11    |                                                                                  |
| 17  | D10    |                                                                                  |
| 18  | D07    | Display data(R).<br>00h: Black<br>D00:LSB D07:MSB                                |
| 19  | D06    |                                                                                  |
| 20  | D05    |                                                                                  |
| 21  | D04    |                                                                                  |
| 22  | D03    |                                                                                  |
| 23  | D02    |                                                                                  |
| 24  | D01    |                                                                                  |
| 25  | D00    |                                                                                  |
| 26  | NC     | OPEN.                                                                            |
| 27  | STBY   | STBY:Standby signal. (Lo:Normal operation, Hi:Standby operation)                 |
| 28  | DE     | DE:Input data effective signal.                                                  |
| 29  | REV    | REV:Right/Left & Up/Down Display reverse. (Lo:Normal Display,Hi:Reverse Display) |
| 30  | VSNC   | Vertical sync signal input.(negative polarity)                                   |
| 31  | HSNC   | Horizontal sync signal input.(negative polarity)                                 |
| 32  | CLK    | Clock input for display.                                                         |
| 33  | VSS    | GND.                                                                             |
| 34  | MODE   | Connect to VDD or GND                                                            |
| 35  | POCB   | Power on clear. (Lo: active)                                                     |
| 36  | NC     | OPEN.                                                                            |
| 37  | NC     | OPEN.                                                                            |
| 38  | NC     | OPEN.                                                                            |
| 39  | NC     | OPEN.                                                                            |
| 40  | NC     | OPEN.                                                                            |
| 41  | NC     | OPEN.                                                                            |
| 42  | NC     | OPEN.                                                                            |
| 43  | NC     | OPEN.                                                                            |
| 44  | NC     | OPEN.                                                                            |
| 45  | VDD    | Power supply input.                                                              |

| No. | Symbol | Function                                 |
|-----|--------|------------------------------------------|
| 46  | NC     | OPEN.                                    |
| 47  | NC     | OPEN.                                    |
| 48  | VSS    | GND.                                     |
| 49  | VSS    | GND.                                     |
| 50  | VSS    | GND.                                     |
| 51  | NC     | OPEN.                                    |
| 52  | NC     | OPEN.                                    |
| 53  | NC     | OPEN.                                    |
| 54  | NC     | OPEN.                                    |
| 55  | NC     | OPEN.                                    |
| 56  | NC     | OPEN.                                    |
| 57  | NC     | OPEN.                                    |
| 58  | NC     | OPEN.                                    |
| 59  | NC     | OPEN.                                    |
| 60  | NC     | OPEN.                                    |
| 61  | NC     | OPEN.                                    |
| 62  | BLL2   | LED drive power source 2. (Cathode side) |
| 63  | BLH2   | LED drive power source 2. (Anode side)   |
| 64  | NC     | OPEN.                                    |
| 65  | NC     | OPEN.                                    |
| 66  | BLH1   | LED drive power source 1. (Anode side)   |
| 67  | BLL1   | LED drive power source 1. (Cathode side) |



- Recommended connector : HIROSE ELECTRIC CO.,LTD. FH26 series [FH26G-67S-0.3SHBW(05)]
- Please refer to the section "3.2 Outward Form" for terminal order.
- Since FPC cable has gold plated terminals, gilt finish contact shoe connector is recommended.



## 5. Absolute Maximum Rating

VSS=0V

| Item                      | Symbol | Condition                                                              | Rating |         | Unit | Applicable terminal                                                    |
|---------------------------|--------|------------------------------------------------------------------------|--------|---------|------|------------------------------------------------------------------------|
|                           |        |                                                                        | MIN    | MAX     |      |                                                                        |
| Supply voltage            | VDD    | Ta=25°C                                                                | -0.3   | 5.0     | V    | VDD                                                                    |
| Input voltage for logic   | VI     |                                                                        | -0.3   | VDD+0.3 | V    | POCB,CLK,VSYN,HSYN,<br>D[27:20],D[17:10],D[07:00],<br>MODE,DE,STBY,REV |
| LED forward current       | IL     | Ta = 25°C                                                              | --     | 35      | mA   | BLH1 - BLL1                                                            |
|                           |        | Ta = 70°C                                                              | --     | 15      |      | BLH2 - BLL2                                                            |
| Storage temperature range | Tstg   |                                                                        | -30    | 80      | °C   |                                                                        |
| Storage humidity range    | Hstg   | Non condensing in an environmental moisture at or less than 40°C90%RH. |        |         |      |                                                                        |

Note: Please set "Power-on" and "Power-off" sequences in accordance with the "Power On Sequence" described later.



## 6. Recommended Operating Conditions

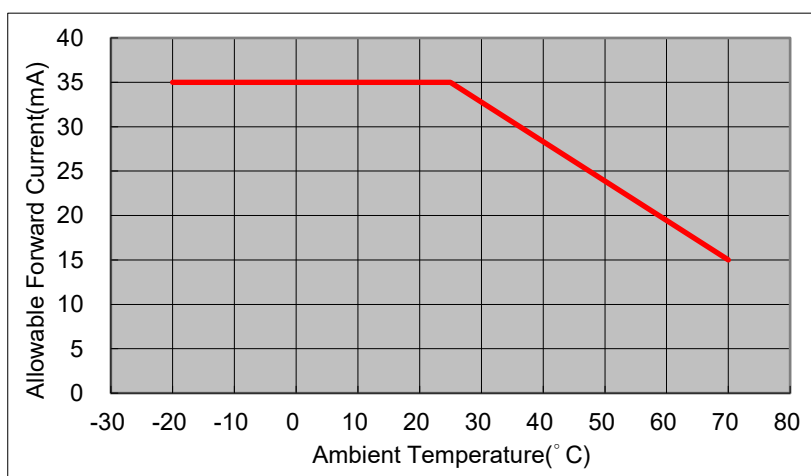
VSS=0V

| Item                          | Symbol | Condition    | Rating                                                                  |     |     | Unit | Applicable terminal                                                          |
|-------------------------------|--------|--------------|-------------------------------------------------------------------------|-----|-----|------|------------------------------------------------------------------------------|
|                               |        |              | MIN                                                                     | TYP | MAX |      |                                                                              |
| Supply voltage                | VDD    |              | 2.7                                                                     | 3.0 | 3.6 | V    | VDD                                                                          |
| Input voltage for logic       | VI     | VDD=2.7~3.6V | 0                                                                       | --  | VDD | V    | POCB,CLK,VSYNC,<br>HSYNC,D[27:20],<br>D[17:10],D[07:00],<br>MODE,STBY,DE,REV |
| 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° C85%RH. |     |     |      |                                                                              |

Note 1: This monitor is operable in this temperature range. With regard to optical characteristics, refer to Item 10. "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=3.0V, VSS=0V)

| Item                       | Symbol | Condition                               | Rating  |     |         | Unit | Applicable terminal                                                           |
|----------------------------|--------|-----------------------------------------|---------|-----|---------|------|-------------------------------------------------------------------------------|
|                            |        |                                         | MIN     | TYP | MAX     |      |                                                                               |
| Input voltage<br>for logic | VIH    | VDD=2.7 to 3.6V                         | 0.7×VDD | --  | VDD     | V    | CLK, VSYNC, HSYNC,<br>DE, D[27:20], D[17:10],<br>D[07:00], POCB,<br>STBY, REV |
|                            | VIL    |                                         | 0       | --  | 0.3×VDD | V    |                                                                               |
| Pull up<br>resister value  | Rpu    |                                         | 29      | 30  | 31      | kΩ   | POCB<br>Note                                                                  |
| Operating<br>Current       | IDD    | Input Timing = TYP<br>Color bar display | --      | 21  | 42      | mA   | VDD                                                                           |
| Standby<br>Current         | IDDs   | Other input with constant<br>voltage.   | --      | 100 | 155     | uA   | VDD                                                                           |

Note: Even if the POCB terminal is not directly controlled,  
it operates as the Power-on-clear by connecting a 1uF external capacitor.

 7.1.2 Backlight

| Item                     | Symbol | Condition                    | Rating |        |      | Unit | Applicable terminal        |
|--------------------------|--------|------------------------------|--------|--------|------|------|----------------------------|
|                          |        |                              | MIN    | TYP    | MAX  |      |                            |
| Forward current          | IL25   | Ta=25° C                     | --     | 5.3    | 35.0 | mA   | BLH1 - BLL1<br>BLH2 - BLL2 |
|                          | IL70   | Ta=70° C                     | --     | --     | 15.0 | mA   |                            |
| Forward voltage          | VL     | Ta=25° C, IL= 5.3 mA         | --     | 13.1   | 13.6 | V    |                            |
| Estimated Life<br>of LED | LL     | Ta=25° C, IL= 5.3 mA<br>Note | --     | 50,000 | --   | hrs  |                            |

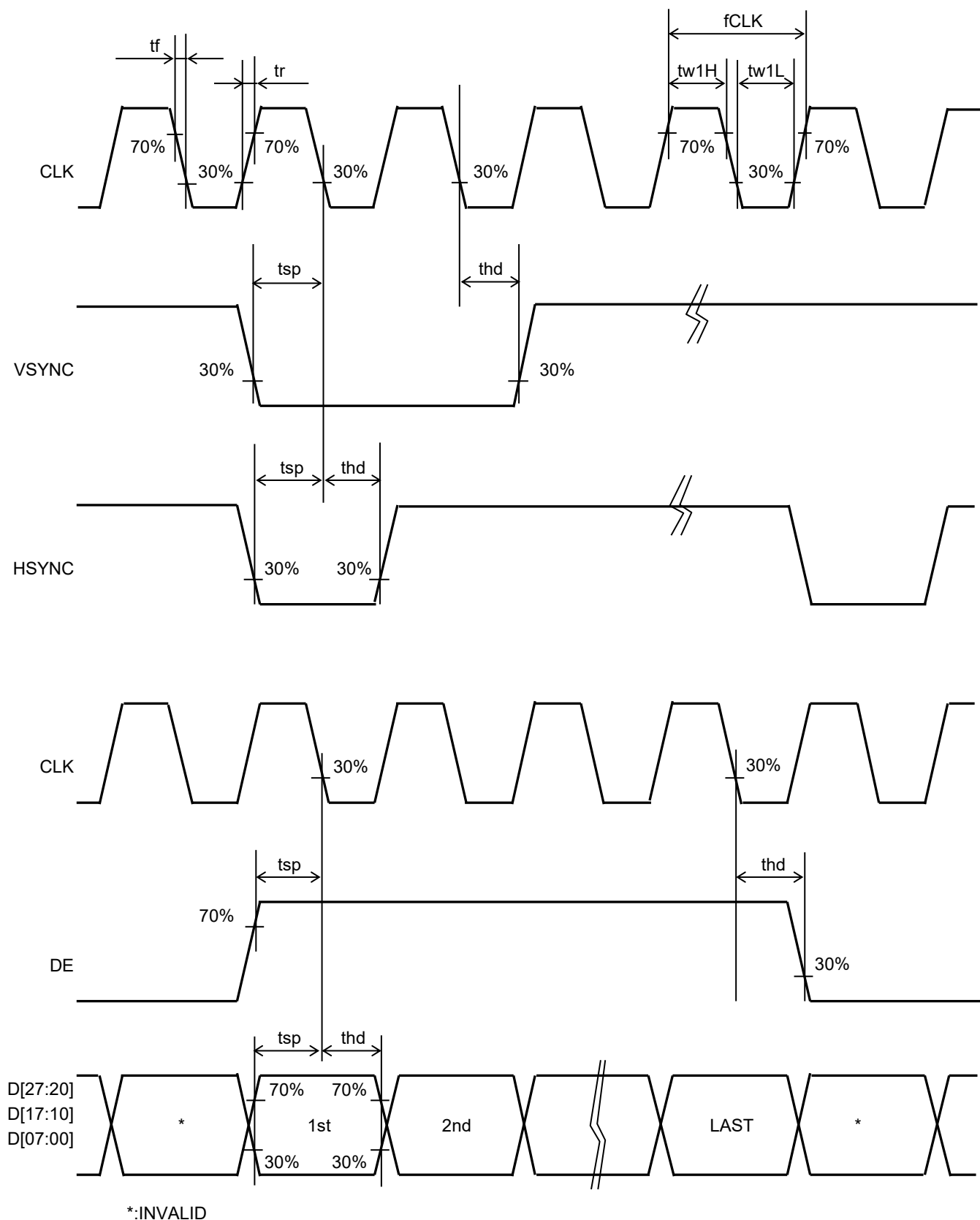
Note: - The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.  
 - This figure is given as a reference purpose only, and not as a guarantee.  
 - This figure is estimated for an LED operating alone.  
 As the performance of an LED may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

## 7.2 AC Characteristics

(Unless otherwise noted, Ta=25° C, VDD=3.0V, VSS=0V)

| Item             | Symbol | Condition       | Rating |      |     | Unit | Applicable terminal                                       |
|------------------|--------|-----------------|--------|------|-----|------|-----------------------------------------------------------|
|                  |        |                 | MIN    | TYP  | MAX |      |                                                           |
| CLK Low period   | tw1L   | 0.3×VDD or less | 26.4   | --   | --  | ns   | CLK                                                       |
| CLK High period  | tw1H   | 0.7×VDD or more | 26.4   | --   | --  | ns   |                                                           |
| Setup time 1     | tsp    |                 | 10     | --   | --  | ns   | CLK, HSYNC, VSYNC,<br>D[27:20], D[17:10],<br>D[07:00], DE |
| Hold time 1      | thd    |                 | 16     | --   | --  | ns   |                                                           |
| CLK rising time  | tr     |                 | --     | --   | 10  | ns   | CLK                                                       |
| CLK falling time | tf     |                 | --     | --   | 10  | ns   |                                                           |
| CLK frequency    | fCLK   |                 | --     | 6.75 | 9.0 | MHz  |                                                           |

## Switching Waveform Characteristics





## 7.3 Input Timing Characteristics

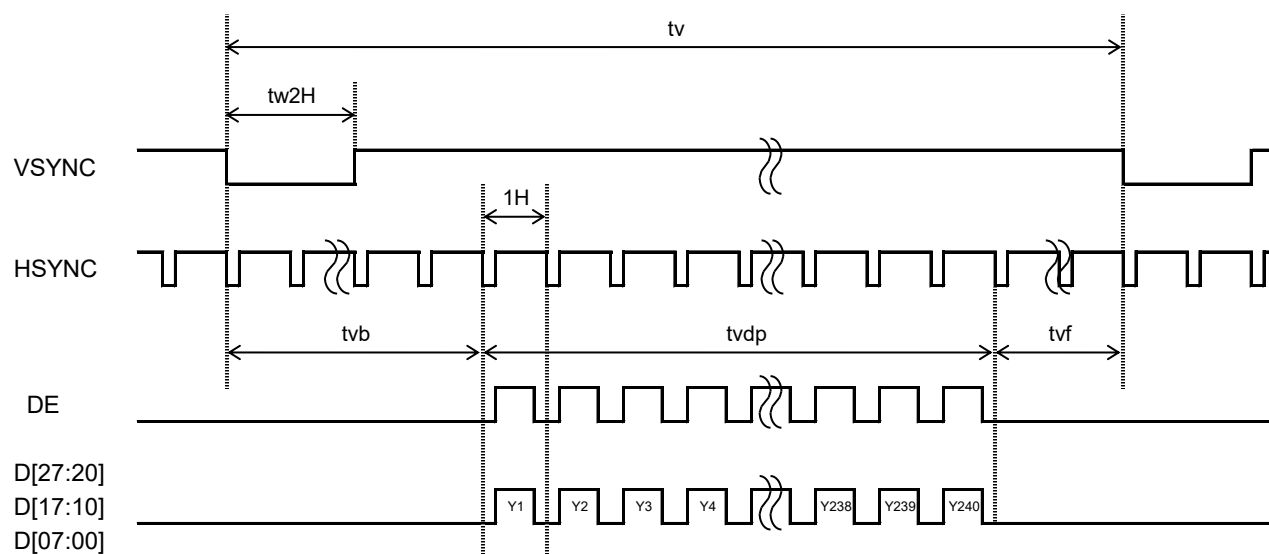
(Unless otherwise noted, Ta=25°C, VDD=3.0V, VSS=0V)

| Item                      | Symbol | Rating   |      |     | Unit | Applicable terminal                            |
|---------------------------|--------|----------|------|-----|------|------------------------------------------------|
|                           |        | MIN      | TYP  | MAX |      |                                                |
| CLK frequency             | fCLK   | --       | 6.75 | 9.0 | MHz  | CLK                                            |
| VSYNC frequency      Note | fVSYNC | 54       | 60   | 66  | Hz   | VSYNC                                          |
| VSYNC signal cycle time   | tv     | 245      | 262  | 291 | H    | VSYNC, HSYNC                                   |
| VSYNC pulse width         | tw2H   | 1        | 3    | --  | H    |                                                |
| Vertical back porch       | tvb    | tw2H + 2 | 6    | 21  | H    |                                                |
| Vertical front porch      | tvf    | 2        | 16   | 30  | H    |                                                |
| Vertical display period   | tvd    | 240      |      |     | H    | VSYNC, HSYNC, DE, D[27:20], D[17:10], D[07:00] |
| HSYNC frequency           | fHSYNC | 15.73    |      |     | kHz  | HSYNC                                          |
| HSYNC signal cycle time   | th     | 390      | 429  | 574 | CLK  | HSYNC, CLK                                     |
| HSYNC pulse width         | tw3H   | 1        | --   | --  | CLK  |                                                |
| Horizontal back porch     | thb    | tw3H + 1 | 42   | 127 | CLK  | HSYNC, DE, CLK                                 |
| Horizontal front porch    | thf    | 1        | 67   | 127 | CLK  |                                                |
| Horizontal display period | thdp   | 320      |      |     | CLK  | DE, D[27:20], D[17:10], D[07:00], CLK          |
| DE pulse width            | tw4H   | 320      |      |     | CLK  | DE, CLK                                        |

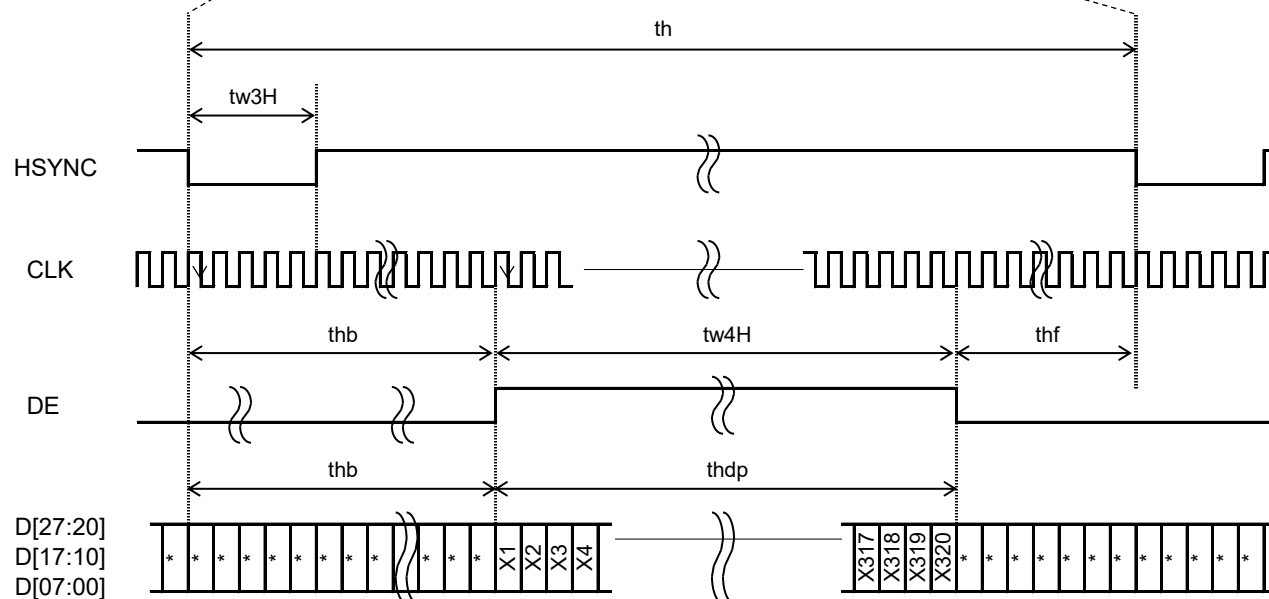
Note: This is recommended spec to get high quality picture on display. It is customer's risk to use out of this frequency.

## 7.4 Driving Timing Chart

## -Vertical Timing

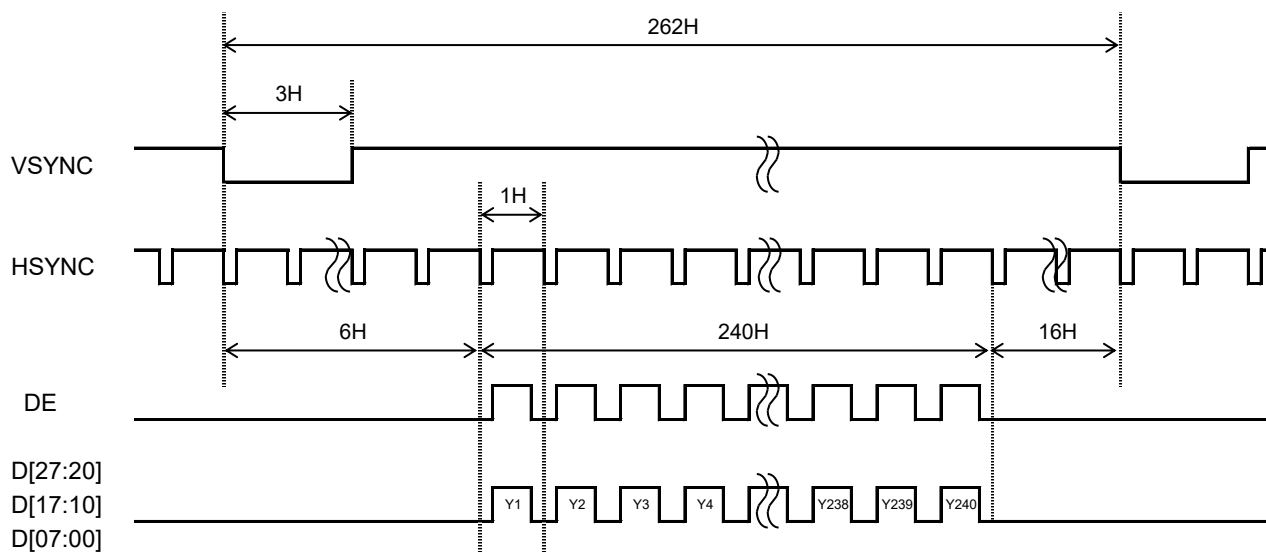


## -Horizontal Timing

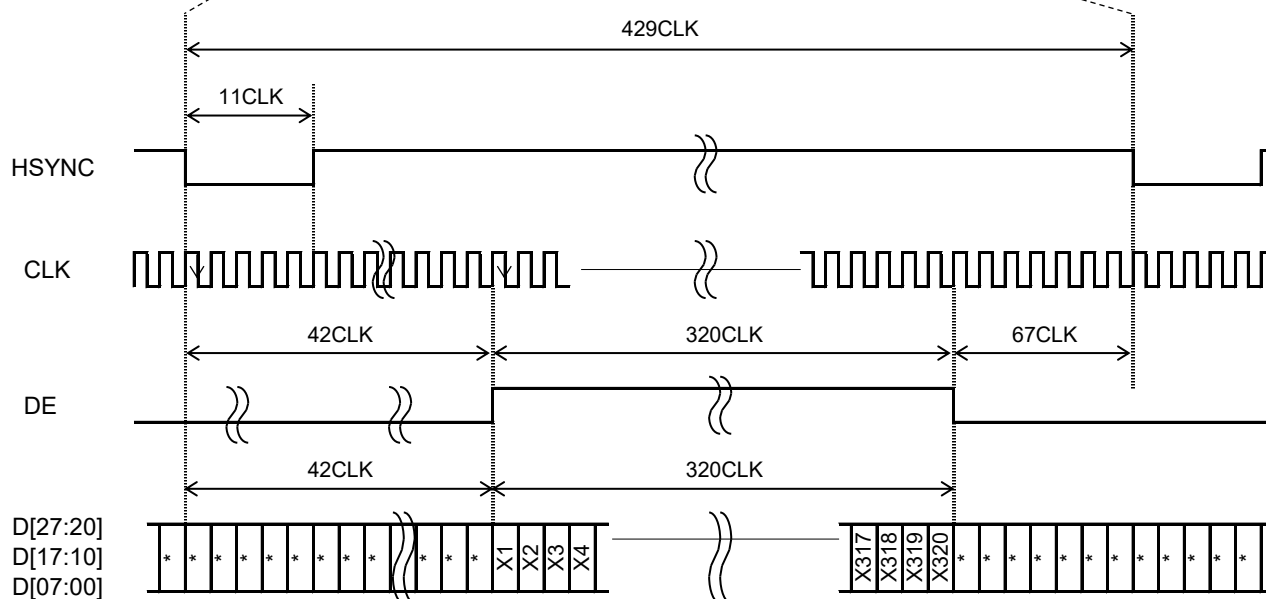


## 7.5 Example of Driving Timing Chart (fCLK=6.75MHz)

## -Vertical Timing

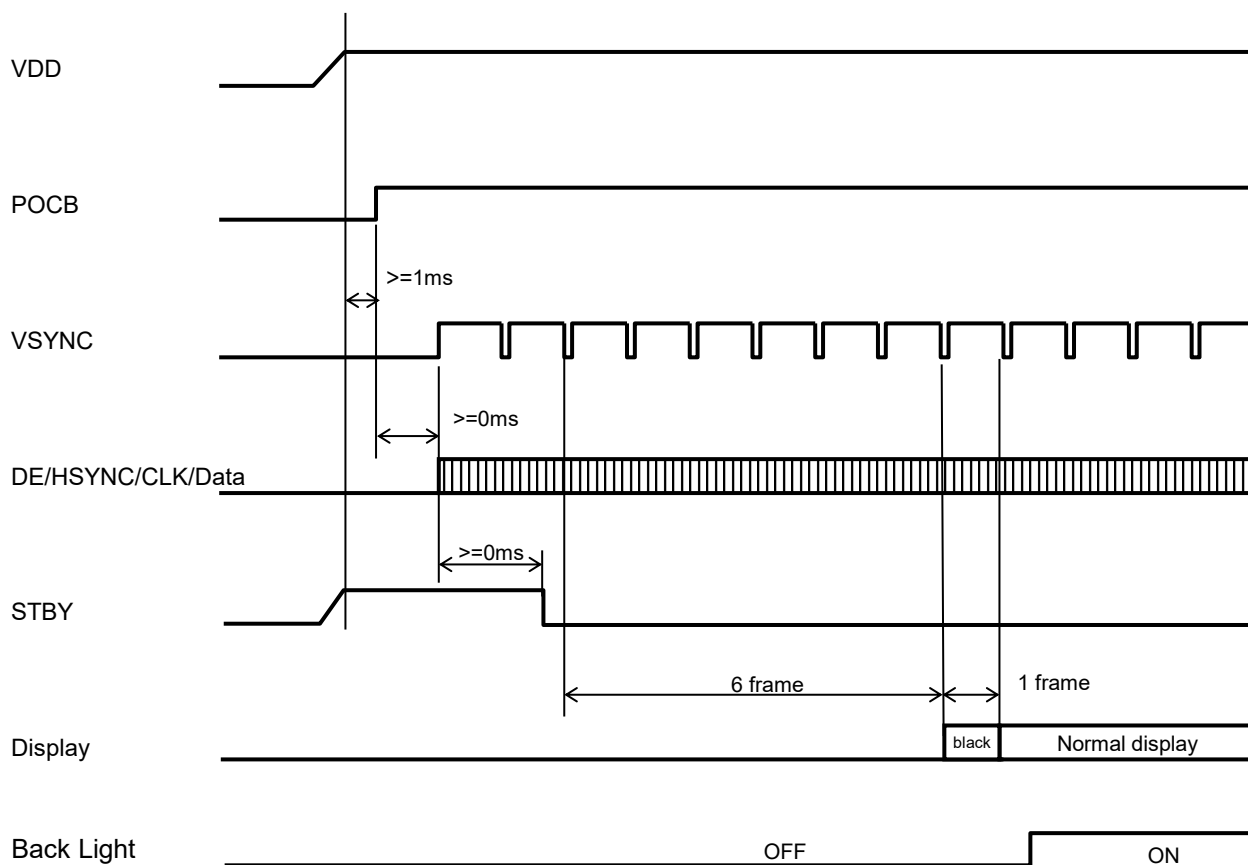


## -Horizontal Timing

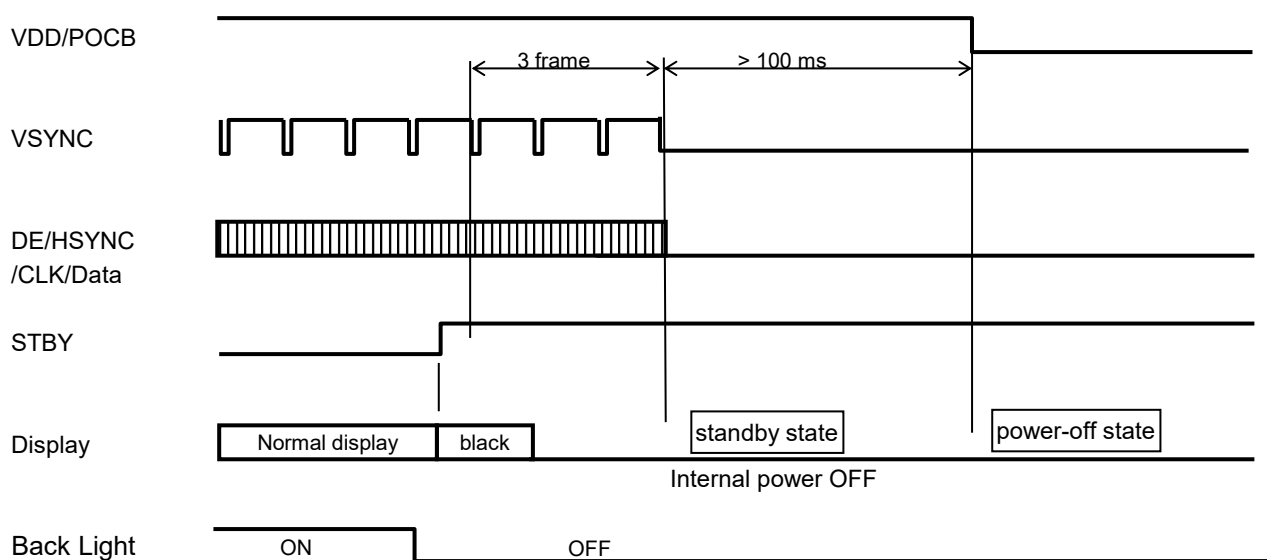


## 8. Description of Operation

### 8.1 Power On Sequence



### 8.2 Standby / Power Off Sequence



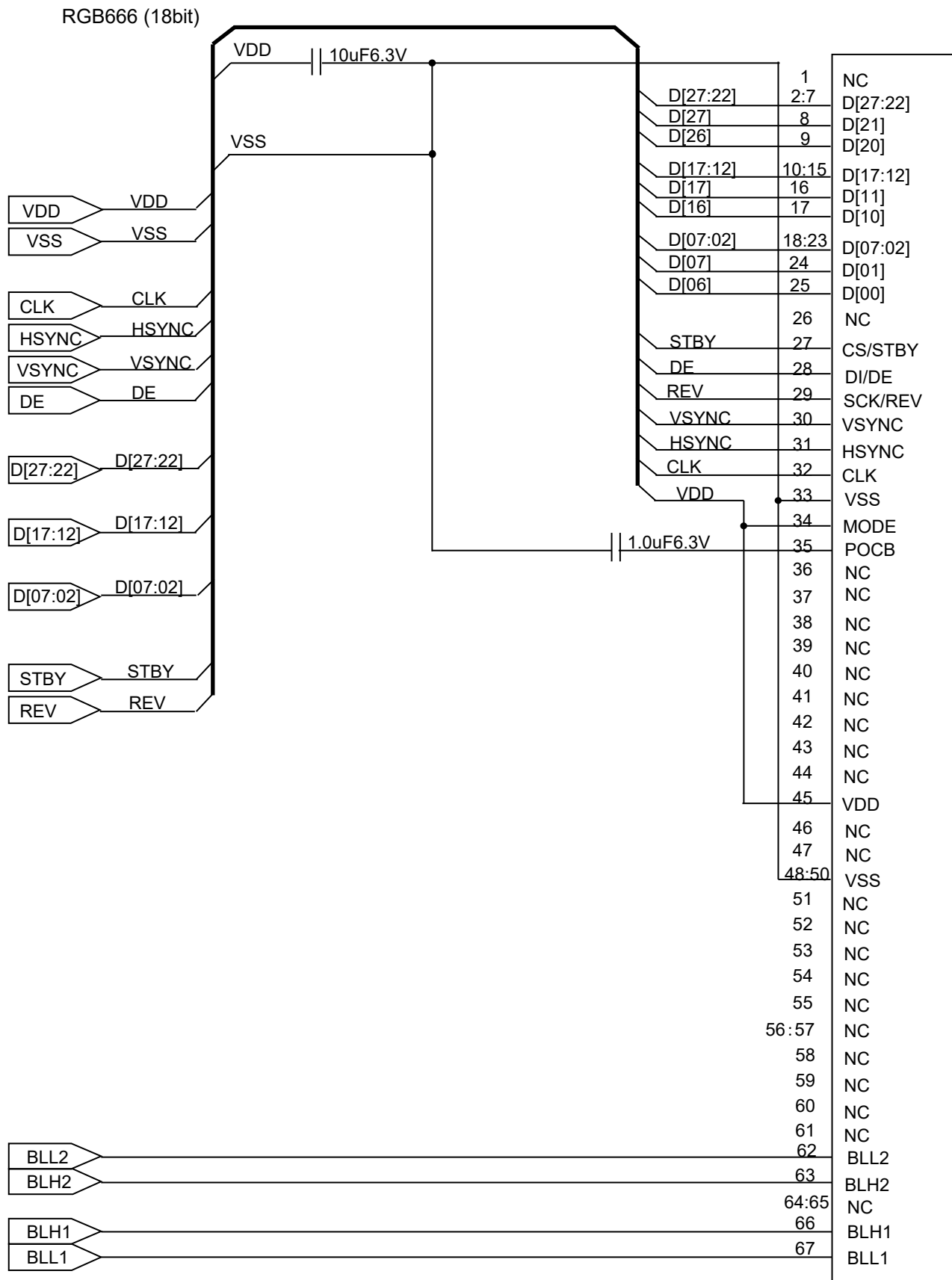
If CLK and VSYNC signals are stopped or the power supply is turned off to a regulated frame or less, the afterimage might remain.

## 9.1 Driving Circuit Example

### RGB888 (24bit)

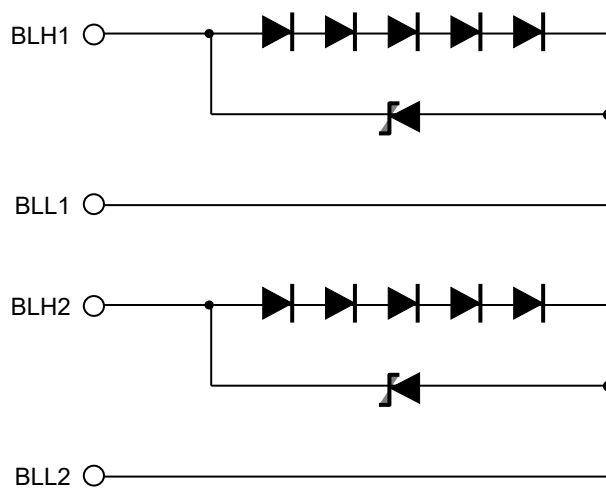


This circuit is solely for reference purpose and optimum circuit and components values may be different. User's due consideration and evaluation must be given to this circuit design and component values prior to their intended use.

**TFT LCD MODULE REFERENCE CIRCUIT**

This circuit is solely for reference purpose and optimum circuit and components values may be different.  
User's due consideration and evaluation must be given to this circuit design and component values prior to their intended use.

## 9.2 LED Circuit



## 10. Characteristics

 10.1 Optical Characteristics

(Measurement Condition)

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

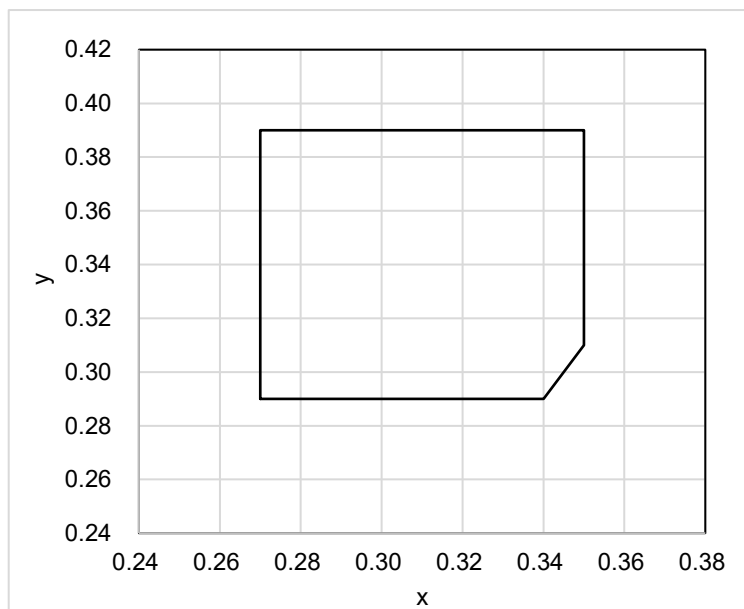
Driving condition: VDD=3.0V, VSS=0V, Optimized VCOMDC

Backlight: IL= 5.3 mA

Measured temperature: Ta = 25°C

| Item                    |           | Symbol | Condition                       | MIN                                                                                    | TYP | MAX | Unit              | Note № | Remark |
|-------------------------|-----------|--------|---------------------------------|----------------------------------------------------------------------------------------|-----|-----|-------------------|--------|--------|
| Response time           | Rise time | TON    | [Data]=<br>00h ← → FFh          | -                                                                                      | -   | 100 | ms                | 1      |        |
|                         | Fall time | TOFF   |                                 |                                                                                        |     |     |                   |        |        |
| Contrast ratio          |           | CR     | [Data]=<br>FFh / 00h            | 480                                                                                    | 800 | -   |                   | 2      |        |
| Viewing angle           | Left      | θL     | [Data]=<br>FFh / 00h<br>CR ≥ 10 | 80                                                                                     | -   | -   | deg               | 3      |        |
|                         | Right     | θR     |                                 | 80                                                                                     | -   | -   | deg               |        |        |
|                         | Up        | φU     |                                 | 80                                                                                     | -   | -   | deg               |        |        |
|                         | Down      | φD     |                                 | 80                                                                                     | -   | -   | deg               |        |        |
| White Chromaticity      |           | x      | [Data]= FFh                     | White chromaticity range                                                               |     |     |                   | 4      |        |
|                         |           | y      |                                 |                                                                                        |     |     |                   |        |        |
| Center Brightness       |           |        | [Data]= FFh                     | 350                                                                                    | 500 | -   | cd/m <sup>2</sup> | 5      |        |
| Brightness distribution |           |        | [Data]= FFh                     | 70                                                                                     | -   | -   | %                 | 6      |        |
| Burn-in                 |           |        |                                 | No noticeable burn-in image shall be observed after 2 hours of window pattern display. |     |     |                   | 7      |        |

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



(White Chromaticity Range)

| x    | y    |
|------|------|
| 0.27 | 0.29 |
| 0.34 | 0.29 |
| 0.35 | 0.31 |
| 0.35 | 0.39 |
| 0.27 | 0.39 |

White Chromaticity Range





## 10.2 Temperature Characteristics

(Measurement Condition)

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

Driving condition: VDD=3.0V, VSS=0V, Optimized VCOMDC

Backlight: IL= 5.3 mA

| Item            |                             | Symbol           | Specification                                                    |                 | Remark       |
|-----------------|-----------------------------|------------------|------------------------------------------------------------------|-----------------|--------------|
|                 |                             |                  | Ta = -20 °C                                                      | Ta = 70 °C      |              |
| Response time   | Rise time<br>+<br>Fall time | TON<br>+<br>TOFF | 600 msec or less                                                 | 80 msec or less |              |
| Contrast ratio  |                             | CR               | 200 or more                                                      | 200 or more     | Backlight ON |
| Display Quality |                             |                  | No noticeable display defect or ununiformity should be observed. |                 |              |

## 11. Criteria of Judgment

 11.1 Defective Display and Screen Quality

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

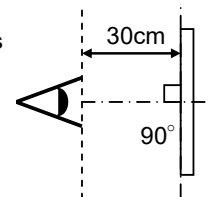
Driving Signal: Raster Patter (RGB, white, black)

Signal condition: [Data]:00h, A0h, FFh (3steps)

Observation distance: 30 cm

Illuminance: 200 to 350 lx

Backlight: IL= 5.3 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)<br>High bright dot: Visible through 2% ND filter at [Data]=00h<br>Low bright dot: Visible through 5% ND filter at [Data]=00h<br>Dark dot: Appear dark through white display at [Data]=A0h |                                   | Refer to table 1                                |
|                 |                  | Invisible through 5% ND filter at [Data]=00h                                                                                                                                                                                                                                                                           |                                   |                                                 |
|                 |                  | Acceptable                                                                                                                                                                                                                                                                                                             |                                   |                                                 |
|                 |                  |                                                                                                                                                                                                                                                                                                                        |                                   |                                                 |
| Screen Quality  | Stain            | Uneven brightness (white stain, black stain etc)                                                                                                                                                                                                                                                                       |                                   | Invisible through 1% ND filter.                 |
|                 | 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 |

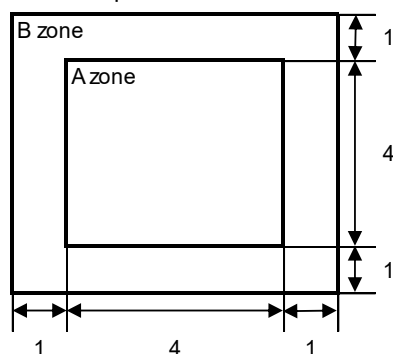
$\phi(\text{mm})$ : Average diameter = (major axis + minor axis)/2

Permissible number: N

Table1

| 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<br>Permissible distance between same color high bright dots (includes neighboring dots): 5 mm or more |
| B     | 2               | 4              | 4        | 6     |                                                                                                                                                                                                     |
| Total | 2               | 4              | 4        | 7     |                                                                                                                                                                                                     |

<Landscape model>



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)

## 11.2 Screen and Other Appearance

Testing conditions

Observation distance: 30 cm

Illuminance: 1200 ~ 2000 lx

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



## 12. Reliability Test

| Test item                     |                                              | Test condition                                                                                                                                                                                                             | number of failures /<br>number of examinations |
|-------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| Durability test               | High temperature storage                     | Ta = 80°C 240hrs                                                                                                                                                                                                           | 0 / 3                                          |
|                               | Low temperature storage                      | Ta = -30°C 240hrs                                                                                                                                                                                                          | 0 / 3                                          |
|                               | High temperature & high humidity storage     | Ta = 60°C, RH = 90%, non condensing ※                                                                                                                                                                                      | 0 / 3                                          |
|                               | High temperature operation                   | Tp = 70°C 240hrs                                                                                                                                                                                                           | 0 / 3                                          |
|                               | Low temperature operation                    | Tp = -20°C 240hrs                                                                                                                                                                                                          | 0 / 3                                          |
|                               | High temperature & high humidity operation   | Tp = 40°C, RH = 90%, non condensing ※                                                                                                                                                                                      | 0 / 3                                          |
|                               | Thermal shock storage                        | -30°C ↔ 80°C (30min / 30min) 100cycles                                                                                                                                                                                     | 0 / 3                                          |
| Mechanical environmental test | Electrostatic discharge test (Non operation) | Confirms to EIAJ ED-4701/300, C=200pF,R=0Ω,V=±200V<br>Each 3 times of discharge on and power supply and other terminals.                                                                                                   | 0 / 3                                          |
|                               | Surface discharge test (Non operation)       | C=250pF, R=100Ω, V=±12kV<br>Each 5 times of discharge in both polarities on the center of screen with the case grounded.                                                                                                   | 0 / 3                                          |
|                               | FPC tension test (FPC of LCD only)           | Pull the FPC with the force of 3N for 10 sec. in the direction - 90-degree to its original direction.                                                                                                                      | 0 / 3                                          |
|                               | FPC bend test (FPC of LCD only)              | Pull the FPC with the force of 3N for 10 sec. in the direction -180-degree to its original direction. Reciprocate it 3 times.                                                                                              | 0 / 3                                          |
|                               | Vibration test                               | Total amplitude 1.5mm, f=10~55Hz, X,Y,Z directions for each 2 hours                                                                                                                                                        | 0 / 3                                          |
|                               | Impact test                                  | Use TOPPAN original jig (see next page) and make an impact with peak acceleration of 1000m/s <sup>2</sup> for 6 msec with half sine-curve at 3 times to each X, Y, Z directions in conformance with JIS C 60068-2-27-2011. | 0 / 3                                          |
| Packing test                  | Packing vibration-proof test                 | Acceleration of 19.6m/s <sup>2</sup> with frequency of 10→55→10Hz, X,Y, Zdirection for each 30 minutes.                                                                                                                    | 0 / 1 packing                                  |
|                               | Packing drop test                            | Drop from 75cm high.<br>1 time to each 6 surfaces, 3 edges, 1 corner                                                                                                                                                       | 0 / 1 packing                                  |

Note: Ta=ambient temperature Tp=Panel temperature

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

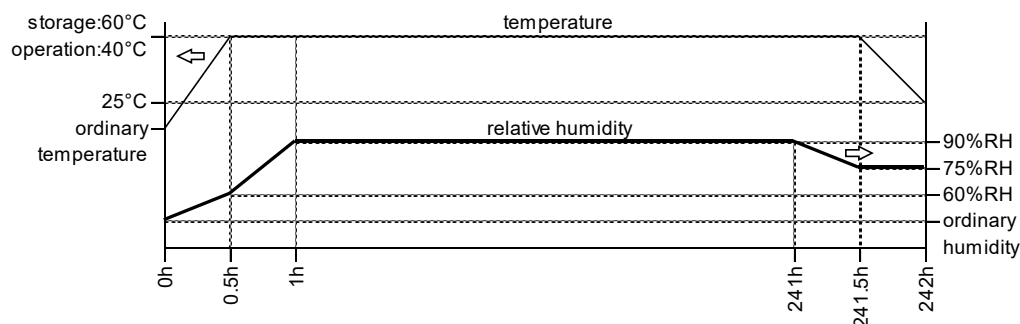


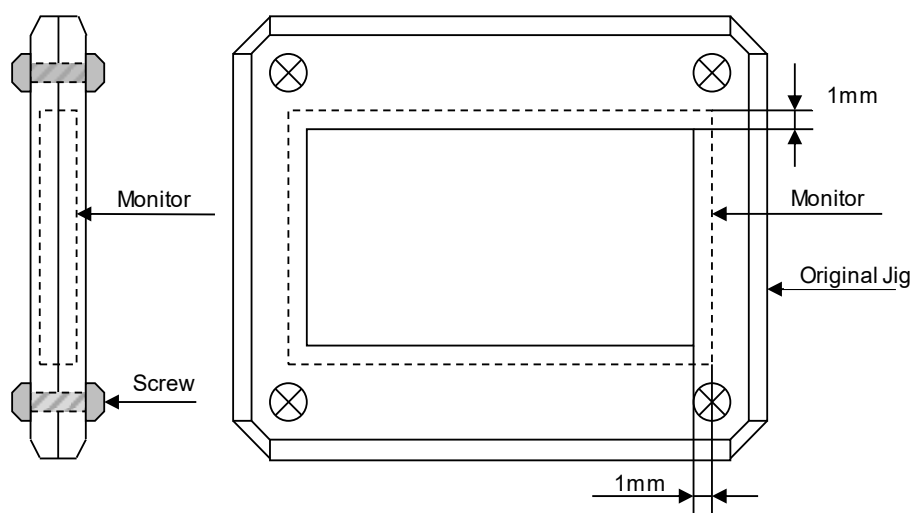


Table2. Reliability Criteria

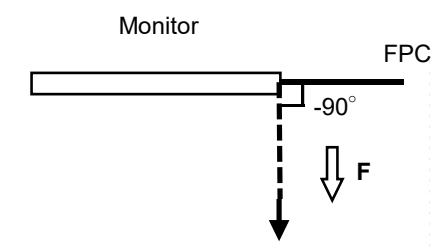
The parameters should be measured after leaving the monitor at the ordinary temperature for 24 hours or more after the test completion.

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

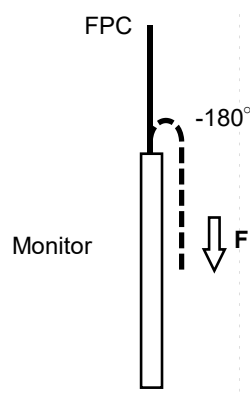
TOPPAN Original Jig



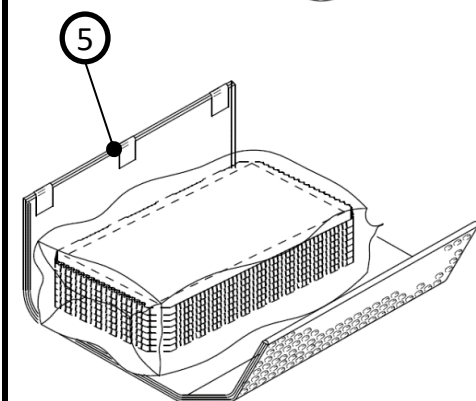
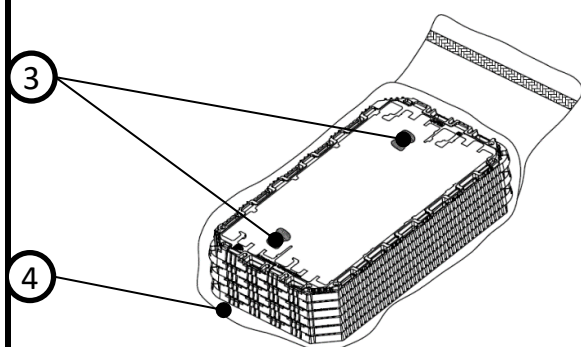
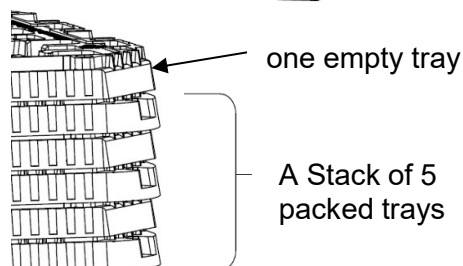
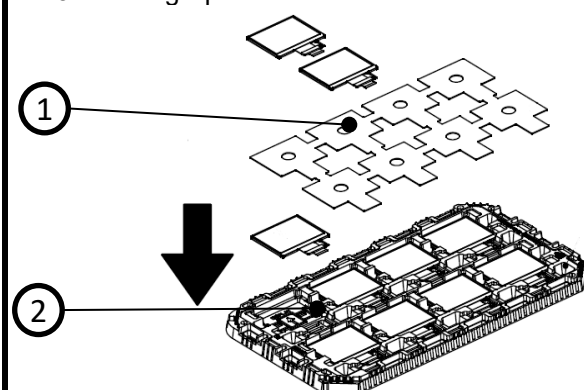
FPC tension test



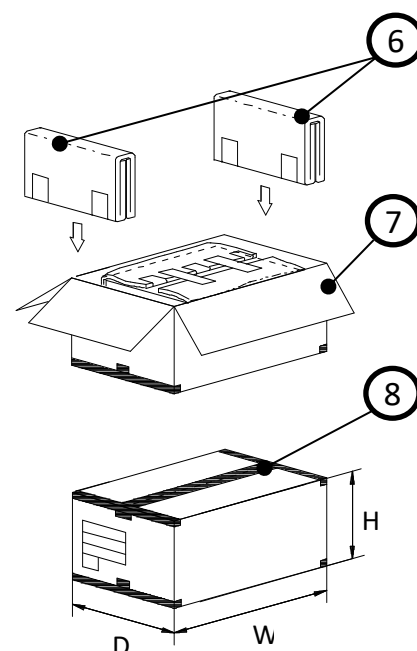
FPC bend test



## 13. Packing Specifications



- Step 1 Arrange a product with display side up according to the shape of the concavity part of the tray, and insert the foam-sheet on the products.(8 Module per the first stage)  
Arrange a product with display side up.  
(8Module per the second stage)
- Step 2 Each tray needs to be stacked with 180 degrees alternate to the tray under or over it and the trays be in a stack of 5.  
one empty tray is to be put on the top of stack of 5 packed trays.
- Step 3 Moisture absorbers are to be placed at the designated places (Panel pocket)  
one the top tray as shown in the drawing.  
A piles of trays is to be put into a sealing bag.
- Step 4 The sealing bag is to be sealed by vacuum sealing machine.
- Step 5 Cover the perimeter with a B SHEET A and tape it in place.
- Step 6 The wrapped trays are placed in the carton.
- Step 7 B SHEET B is to be inserted into a outer carton with same orientation.  
The outer carton is to be sealed in H-shape with packing tape as shown in the drawing.
- Step 8 The model number, quantity of products, and shipping date are to be printed on the 2 opposite sides of the other carton with black ink.  
Attach, stamp, or mark shipping lists if necessary.



Remark: The return of packing materials not required.

|   | Packing item name | Specs. Materials            |
|---|-------------------|-----------------------------|
| ① | Foam sheet        | Antistatic Polyethylene     |
| ② | Tray              | A-PET                       |
| ③ | Drier             | Moisture absorber           |
| ④ | Sealing bag       |                             |
| ⑤ | B SHEET A         | Antistatic air bubble sheet |
| ⑥ | B SHEET B         | Antistatic air bubble sheet |
| ⑦ | Outer Carton      | Corrugated cardboard        |
| ⑧ | Packing tape      |                             |

| Dimension of extra outer carton               |         |
|-----------------------------------------------|---------|
| D : Approx.                                   | (356mm) |
| W : Approx.                                   | (664mm) |
| H : Approx.                                   | (182mm) |
| Quantity of products packed in one carton: 80 |         |
| Gross weight : Approx. 5.5kg                  |         |

**TOPPAN INC.**

## 14. Handling Instruction

## 14.1 Cautions for Handling LCD panels

**Caution**

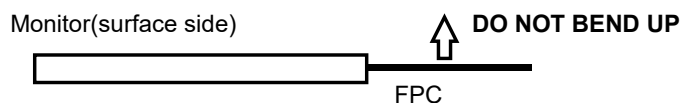
- (1) Do not make an impact on the LCD panel glass because it may break and you may get injured from it.
- (2) If the glass breaks, do not touch it with bare hands.  
(Fragment of broken glass may stick you or you cut yourself on it.)
- (3) If you get injured, receive adequate first aid and consult a 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.

**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.**

## 14.2 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 14.5 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.



## 14.3 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.





#### 14.4 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 8 cartons (excluding the bottom)

\*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.



#### 14.5 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.

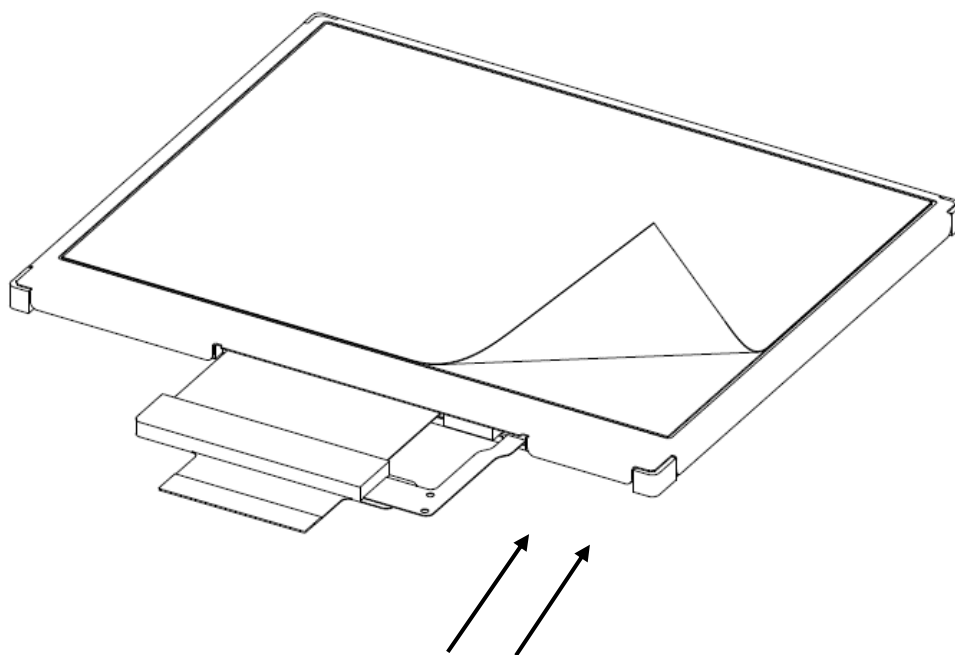
##### A) Work Environment

- 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.
- c) Anti-static treatment should be implemented to work area's floor.  
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 right 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 right 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.)

#### 14.6 Warranty

TOPPAN 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)

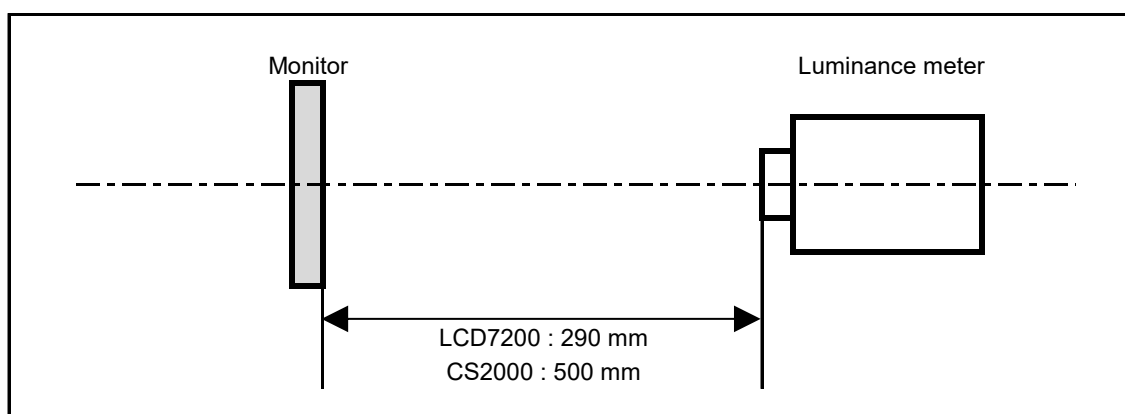
Driving condition: Refer to the section "Optical Characteristics"

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

Dark box at constant temperature

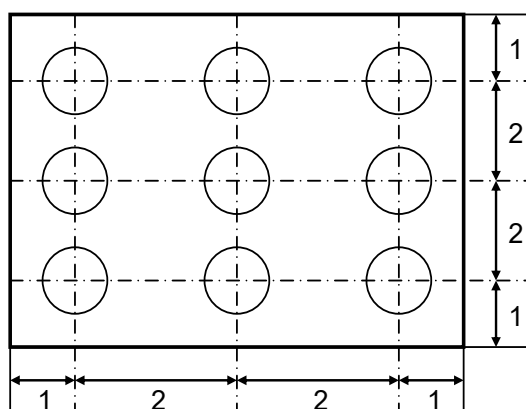


\*Measurement is made after 30 minutes of lighting of the backlight.

Measurement point: At the center point of the screen

Brightness distribution: 9 points shown in the following drawing.

<Landscape model>



Dimensional ratio of active area



Backlight

IL= 5.3 mA



## 2. Test Method

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