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# Datasheet

## Ortustech

### COM22H2P16ULC

OR-20-008

# Specifications for

## Blanview TFT-LCD Monitor

Version 3.0

**MODEL COM22H2P16ULC**

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

Customer's Approval

Signature:

Name:

Section:

Title:

Date:

# ORTUSTECH

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## Version History

| Ver.                      | Date          | Page | Description  |
|---------------------------|---------------|------|--|
| 1.0                       | Dec. 6, 2013  | -    | - First issue  |
| 2.0<br>△ <sub>A</sub> ×3  | Feb. 18, 2015 | 4    | add 1. Applicati Note                                    |
|                           |               | 10   | correction 4. Pin Assignmer Error correct                |
|                           |               | 33   | correction 17.3 Precautions for Operatic Note            |
| 3.0<br>△ <sub>B</sub> ×12 | Nov. 7, 2018  | 3    | correction Contents                                      |
|                           |               | 4    | correction 5.64cm→56.4mm                                 |
|                           |               | 8    | correction connector name                                |
|                           |               | 11   | correction Order of the terminal                         |
|                           |               | 25   | correction LCD7000→LCD7200                               |
|                           |               | 26   | correction LCD7000→LCD7200, -10°C→-20°C                  |
|                           |               | 29   | add Surface discharge test                               |
|                           |               | 34   | correction Storage Condition for Shipping Cartons        |
|                           |               | 35   | add Warranty   |
|                           |               | 36   | correction LCD7000→LCD7200, 220mm→290mm                  |
|                           |               | 37   | correction LCD7000→LCD7200                               |
|                           |               | 38   | correction LCD7000→LCD7200, Diameter of measuring point: |

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## 1. Application

 This Specification is applicable to 56.4mm (2.2 inch) Blanview TFT-LCD monitor for non-military use.

- ⊙ ORTUS TECHNOLOGY 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 ORTUS TECHNOLOGY shall not grant to Purchaser any right to use any patent or other intellectual property rights owned by third parties. Since this Specification contains ORTUS TECHNOLOGY'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 ORTUS TECHNOLOGY'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 ORTUS TECHNOLOGY 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 a mechanical design manner, especial attention in housing design to prevent arcuation/flexure or caused by stress to the LCD module shall be considered.
- ⊙ ORTUS TECHNOLOGY 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.
- ⊙ ORTUS TECHNOLOGY is not responsible for any nonconformities and defects that are not specified in this specifications.
- ⊙ If any issue arises as to information provided in this Specification or any other information, ORTUS TECHNOLOGY and Purchaser shall discuss them in good faith and seek solution.
- ⊙ ORTUS TECHNOLOGY 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 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                  |

## 2. Outline Specifications

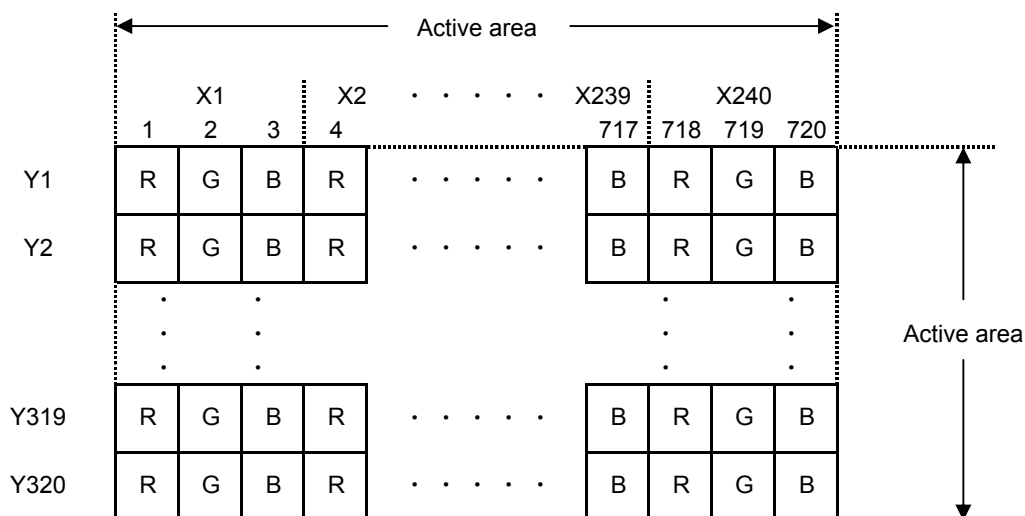
### 2.1 Features of the Product

- 2.2 inch diagonal display, 240 x RGB [H] x 320 [V] dots.
- 6-bit / 262,144 colors.
- Single power supply ( 2.8V )
- Timing generator [TG], Counter-electrode driving circuitry, Built-in power supply circuit.
- High bright white LED back-light.

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

### 2.2 Display Method

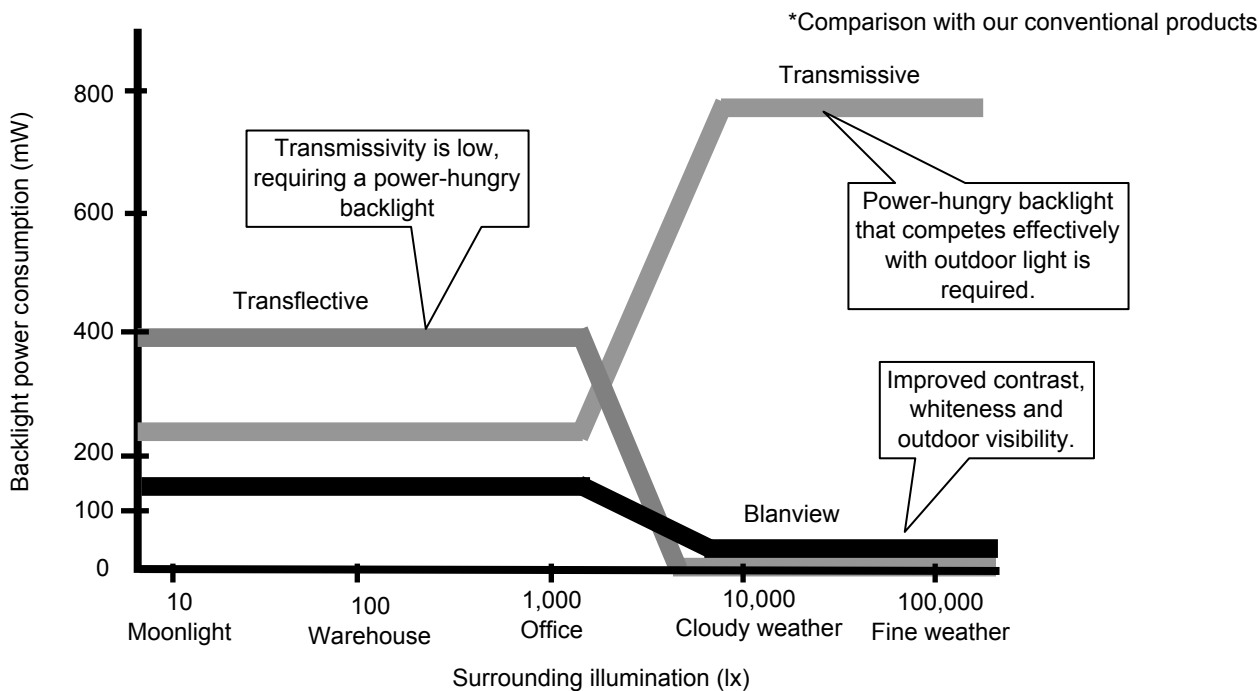
| Items               | Specifications   | Remarks                          |
|---------------------|--|----------------------------------|
| Display type        | 262,144 colors.<br>Blanview, Normally black.             | Color filter<br>NTSC ratio : 35% |
| Product description | LCD monitor with internal CPU interface circuit          |                                  |
| Driving method      | a-Si TFT Active matrix.<br>Line-scanning, Non-interlace. |                                  |
| Dot arrangement     | RGB stripe arrangement.                                  | Refer to "Dot arrangement"       |
| Signal input method | System interface with 18 bit bus width                   |                                  |
| Backlight           | High brightness LED, side light                          |                                  |



Dot arrangement (FPC cable placed left side)

<Features of Blanview>

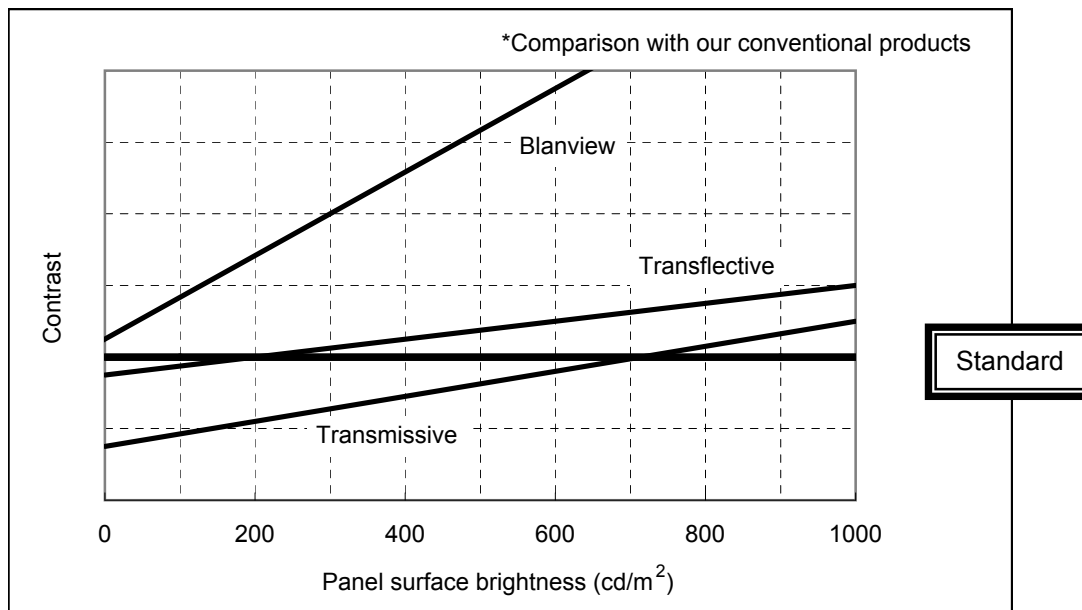
- Backlight power consumption required to assure visibility. (equivalent to 3.5"QVGA )



- 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. (ORTUS TECHNOLOGY criteria)





## 3. Dimensions and Shape

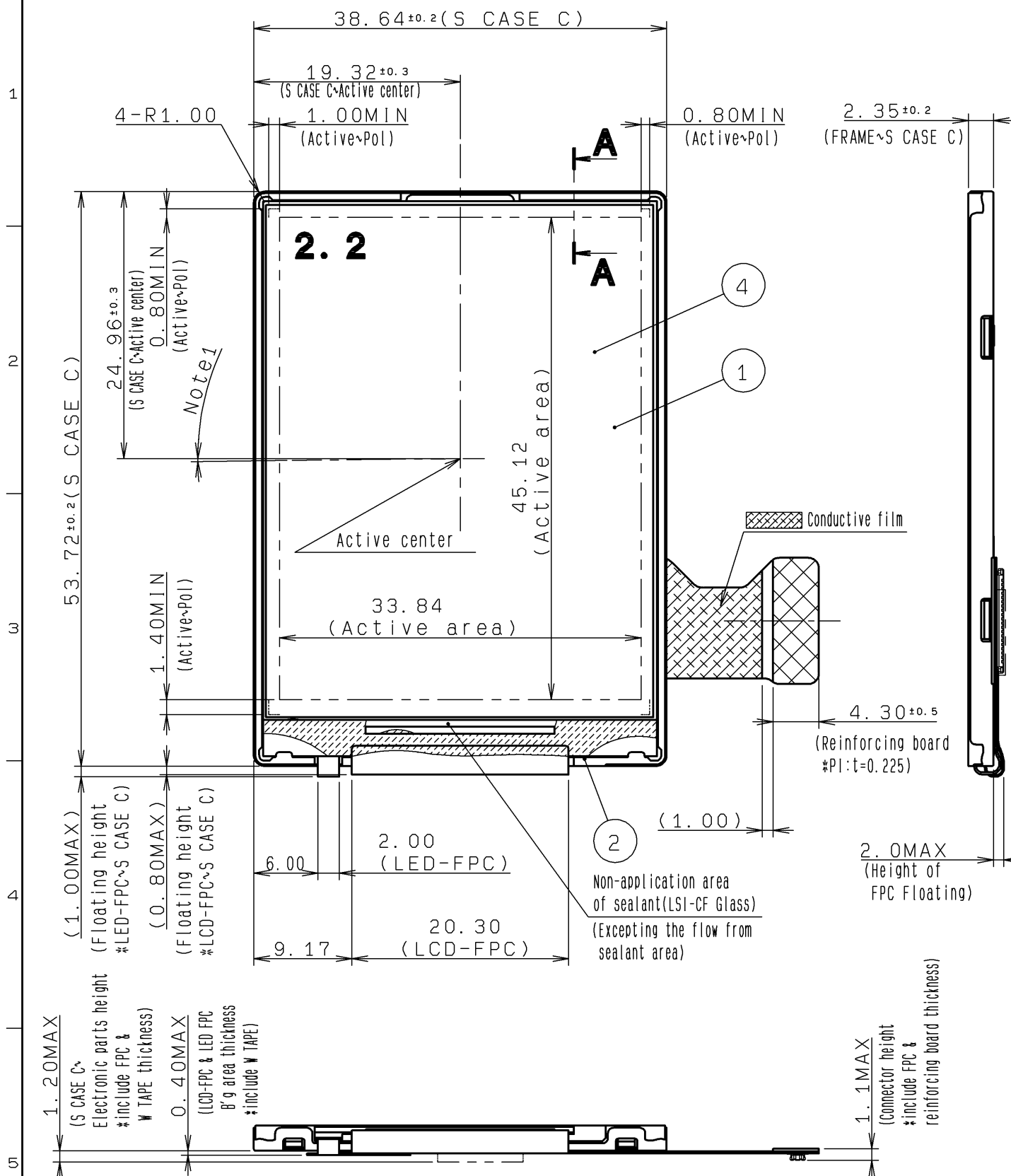
## 3.1 Dimensions

| Items                             | Specifications                | Unit | Remarks                             |
|-----------------------------------|-------------------------------|------|-------------------------------------|
| Outline dimensions                | 38.64[H] × 53.72[V] × 2.35[D] | mm   | Exclude FPC cable and parts on FPC. |
| Active area                       | 33.84[H] × 45.12[V]           | mm   | Diagonal: 2.22inch                  |
| Number of dots                    | 240 × RGB [H] × 320[V]        | dot  |                                     |
| Dot pitch                         | 47[H] × 141[V]                | um   |                                     |
| Surface hardness of the polarizer | 3                             | H    | Load:2.0N                           |
| Weight                            | 11                            | g    | Include FPC cable                   |

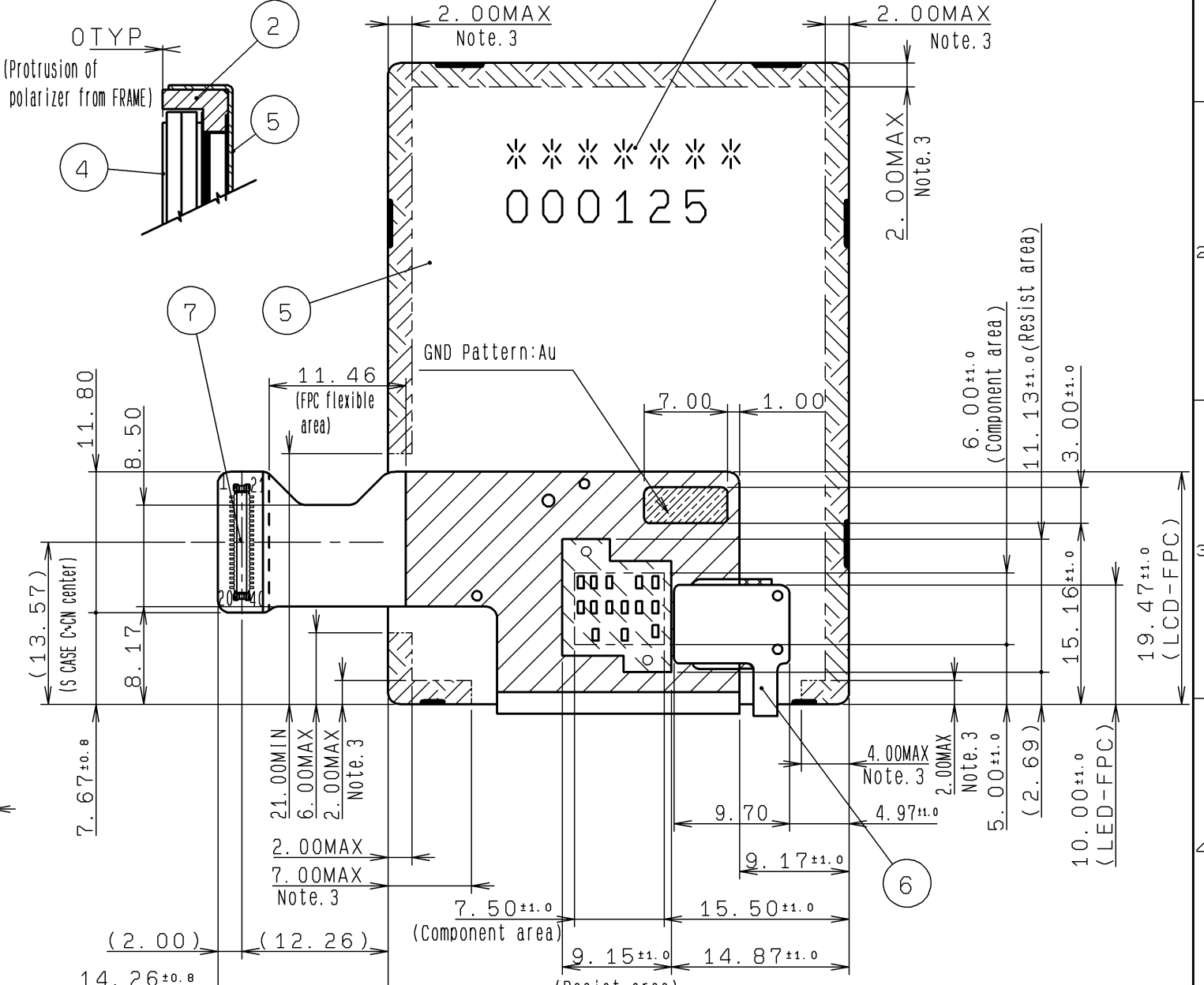
3.2 Outward form

|        |          |                            |              |          |         |          |
|--------|----------|----------------------------|--------------|----------|---------|----------|
| EC No. | REV. No. | REVISE                     | DATE (Y:M:D) | APPROVED | CHECKED | PREPARED |
|        | △X1      | User connector is changed. | 18:10:23     | 敷地       | 木下      | 木下       |

(8/38)  
13TLM054  
Issue:Nov.7,2018



Sec. A-A  
(S=5/1)



- Note 1. Angular deviation of LCD cell from the TFT-LCD monitor's reference axis shall be less than [±40'].
- Note 2. 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.
- Note 3. In case TFT-LCD monitor is fixed to the case of your product, it's recommended that monitor is fixed in to [hatched] area.

|           |   |                     |                                     |
|-----------|---|---------------------|-------------------------------------|
| CONNECTOR | 7 | AXE640124/Panasonic | User side:AXE540127/Panasonic       |
| LED-FPC   | 6 |                     |                                     |
| S CASE C  | 5 |                     | SUS (t=0.15)                        |
| POLARIZER | 4 |                     | with protection sheet               |
| LCD-FPC   | 3 |                     |                                     |
| FRAME     | 2 |                     | PC                                  |
| TFT-LCD   | 1 |                     | Glass substrate thickness=0.5t±0.5t |

| PART NAME   | ITEM                   | PART CODE           | MODEL NUMBER | REMARK   |
|-------------|------------------------|---------------------|--------------|--|
| APPROVED 橋爪 | GENERAL TOLERANCE ±0.5 | SCALE 2/1           | UNIT mm      | <b>ORTUSTECH</b><br>ORTUS TECHNOLOGY CO., LTD.<br>DO NOT DUPLICATE, CONFIDENTIAL AND PROPRIETARY |
| CHECKED 木下  | ISSUE (Y:M:D) 13:11:20 | MODEL COM22H2P16U** |              |  |
| CHECKED     | NAME                   |                     |              | DRAWING No. REV. SHEET DIV.  |
| DESIGN 荻野   |                        |                     |              |  |
| DRAW 荻野     |                        |                     |              |  |

OUTLINE-D2P16

RJD525358D201 B

### 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                                      | 22CGC (Made in Japan)<br>22CHC (Made in Malaysia) |                                  |                                  |
| d                   | Serial number                                   |   |                                  |                                  |

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

###### •Made in Japan

4J22CGC000125

means "manufactured in October 2014, 2.2" CG type, C specifications, serial number 000125"

###### •Made in Malaysia

4J22CHC000125

means "manufactured in October 2014, 2.2" CH type, C specifications, serial number 000125"

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

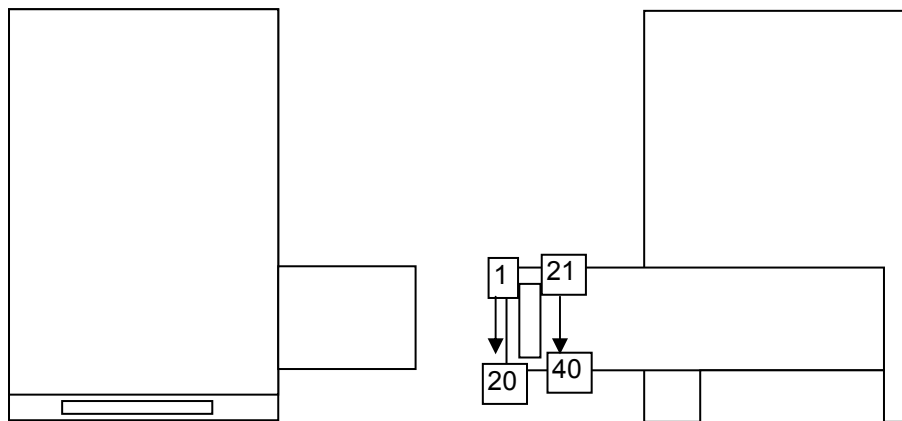
Refer to 3.2 "Outward Form".

#### 3)Others

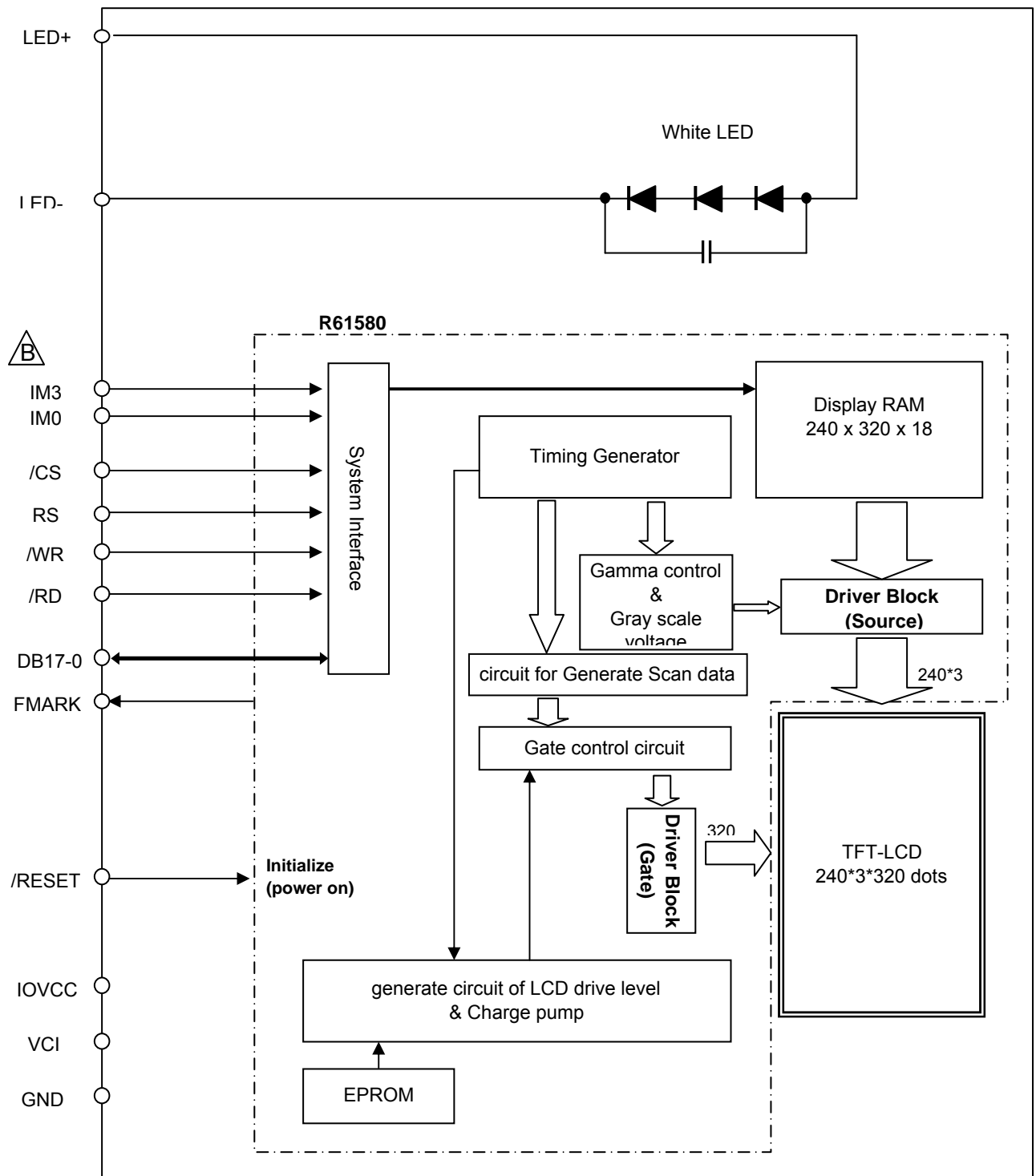
Please note that it is likely to disappear with an organic solvent about the Serial print.

4. Pin Assignment

| No. | Symbol | Details                                   | Remark                              | IO |
|-----|--------|---|-------------------------------------|----|
| 1   | FMARK  | Frame Synchronizing Signal Output for LCD |                                     | O  |
| 2   | LED+   | LED anode                                 |                                     | P  |
| 3   | LED-   | LED cathode                               |                                     | P  |
| 4   | VCI    | Power Supply for logic regulator          |                                     | P  |
| 5   | GND    | Ground                                    |                                     | P  |
| 6   | NC     | Non connection                            |                                     | -  |
| 7   | IM0    | Interface select signal                   |                                     | I  |
| 8   | /CS    | Chip select signal                        | L: Selected , H: Not selected       | I  |
| 9   | /WR    | Write Signal                              |                                     | I  |
| 10  | GND    | Ground                                    |                                     | P  |
| 11  | DB1    | Data Input & Output                       |                                     | IO |
| 12  | DB3    | Data Input & Output                       |                                     | IO |
| 13  | DB5    | Data Input & Output                       |                                     | IO |
| 14  | DB6    | Data Input & Output                       |                                     | IO |
| 15  | DB8    | Data Input & Output                       |                                     | IO |
| 16  | DB10   | Data Input & Output                       |                                     | IO |
| 17  | GND    | Ground                                    |                                     | P  |
| 18  | DB13   | Data Input & Output                       |                                     | IO |
| 19  | DB15   | Data Input & Output                       |                                     | IO |
| 20  | DB17   | Data Input & Output                       |                                     | IO |
| 21  | GND    | Ground                                    |                                     | P  |
| 22  | LED+   | LED anode                                 |                                     | P  |
| 23  | LED-   | LED cathode                               |                                     | P  |
| 24  | IOVCC  | Power Supply for interface Circuit        |                                     | P  |
| 25  | NC     | Non connection                            |                                     | -  |
| 26  | IM3    | Interface select signal                   |                                     | I  |
| 27  | /RESET | Reset signal                              | L:Initialize                        | I  |
| 28  | RS     | Select the register                       | L: Index/status registers , H: Data | I  |
| 29  | /RD    | Read Signal                               |                                     | I  |
| 30  | DB0    | Data Input & Output                       |                                     | IO |
| 31  | DB2    | Data Input & Output                       |                                     | IO |
| 32  | DB4    | Data Input & Output                       |                                     | IO |
| 33  | GND    | Ground                                    |                                     | P  |
| 34  | DB7    | Data Input & Output                       |                                     | IO |
| 35  | DB9    | Data Input & Output                       |                                     | IO |
| 36  | DB11   | Data Input & Output                       |                                     | IO |
| 37  | DB12   | Data Input & Output                       |                                     | IO |
| 38  | DB14   | Data Input & Output                       |                                     | IO |
| 39  | DB16   | Data Input & Output                       |                                     | IO |
| 40  | GND    | Ground                                    |                                     | P  |



5. Block Diagram

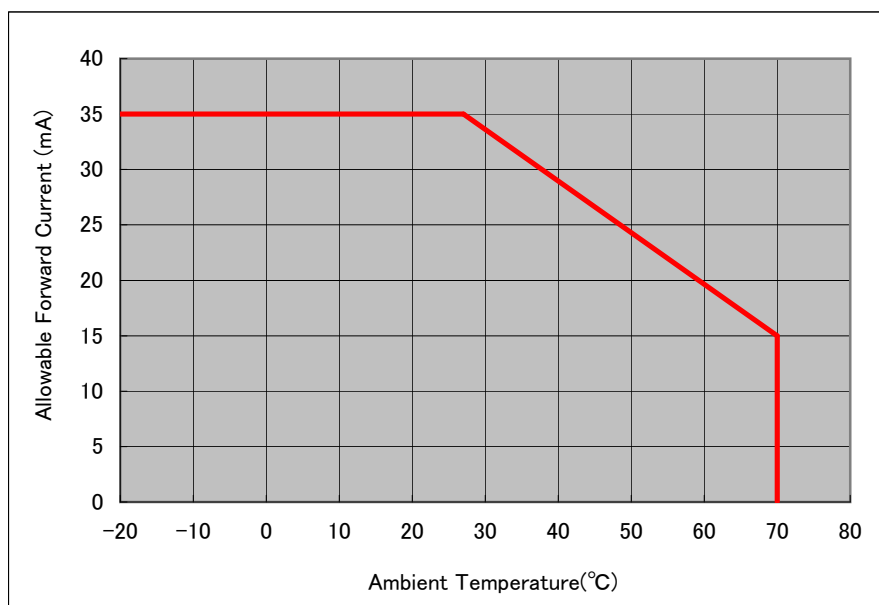


## 6. Absolute Maximum Rating

GND=0V

| Item                      | Symbol | Condition  | Rating |           | Unit | Applicable terminal                |
|---------------------------|--------|--|--------|-----------|------|------------------------------------|
|                           |        |  | MIN    | MAX       |      |                                    |
| Supply voltage            | VCI    | Ta = 25 °C   | -0.3   | 3.3       | V    | VCI                                |
| Logic interface voltage   | IOVCC  |  | -0.3   | 4.6       | V    | IOVCC                              |
| Input voltage for logic   | VI     |  | -0.3   | VCCIO+0.3 | V    | /CS, /RS, /WR, /RD, /RESET, DB17-0 |
| LED Forward current       | IL     | Ta = 25 °C   | --     | 35        | mA   | LED+ - LED-                        |
|                           |        | Ta = 70 °C   | --     | 15        | mA   |                                    |
| 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. |        |           |      |                                    |

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



## 7. Recommended Operating Conditions

GND=0V

| Item                          | Symbol | Condition           | Rating |     |       | Unit | Applicable terminal  |
|-------------------------------|--------|---------------------|--------|-----|-------|------|--|
|                               |        |                     | MIN    | TYP | MAX   |      |  |
| Supply voltage                | VCI    | Ta=-20~70°C         | 2.7    | 2.8 | 2.9   | V    | VCI  |
| Logic interface voltage       | IOVCC  |                     | 1.7    | 2.8 | 2.9   | V    | IOVCC  |
| Input voltage for logic       | VI     |                     | 0      | —   | IOVCC | V    | /CS, RS, /WR, /RD, /RESET, DB17-0  |
| LED Forward current           | IL     | Ta=-20~70°C         | -      | 6.0 | 20.0  | mA   | LED+ - LED-  |
| LED Forward voltage           | VL     | Ta=25°C<br>IL=6.0mA |        | 8.2 |       | V    |  |
| Operational temperature range | Top    | Note1               | -20    | 25  | 70    | °C   | Panel surface temperature  |
| Operating humidity range      | Hop    | Ta≤30°C             | 20     | —   | 80    | %    | Non condensing in an environmental moisture at or less than 30 °C 80%RH. |
|                               |        | Ta>30°C             |        |     |       |      |  |

Note1: This monitor is operatable in this temperature range. With regard to optical characteristics, refer to Item 13."CHARACTERISTICS".

## 8. Characteristics

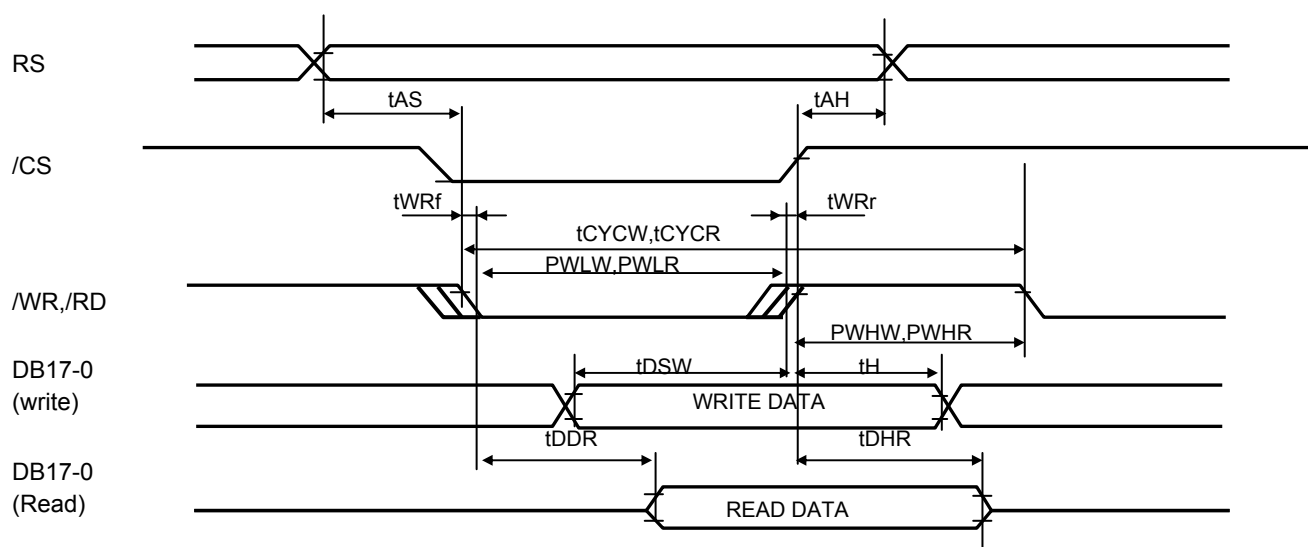
## 8.1 DC Characteristics

(Unless otherwise noted, Ta=25 °C, VCI=IOVCC=2.8V)

| Item                   | Symbol | Condition                         | Rating    |     |           | Unit | Applicable terminal       |
|------------------------|--------|-----------------------------------|-----------|-----|-----------|------|---------------------------|
|                        |        |                                   | MIN       | TYP | MAX       |      |                           |
| Input Signal Voltage 1 | VIH 1  | IOVCC=1.7-2.9V                    | 0.8×IOVCC | --  | IOVCC     | V    | /CS, RS, /WR, /RD, DB17-0 |
|                        | VIL 1  |                                   | 0         | --  | 0.2×IOVCC | V    |                           |
| Input Signal Voltage 2 | VIH 2  | IOVCC=1.7-2.9V                    | 0.9×IOVCC | --  | IOVCC     | V    | /RESET                    |
|                        | VIL 2  |                                   | 0         | --  | 0.1×IOVCC | V    |                           |
| Output Signal Voltage  | VOH    | IOH = -0.1 mA                     | 0.8×IOVCC | --  | IOVCC     | V    | DB17-0, FMARK             |
|                        | VOL    | IOL = 0.1 mA                      | 0         | --  | 0.2×IOVCC | V    |                           |
| Operating Current      | ICI    | Color bar display                 | --        | 9.0 | 18.0      | mA   | VCI + IOVCC               |
| Stand-by Current       | ICIS   | Other input with constant voltage | --        | -   | 2.0       | uA   | VCI + IOVCC               |

## 8.2 AC Characteristics

## 8.2.1 System I/F timing Characteristics



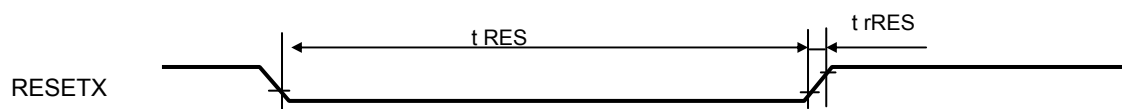
Note : PWLW and PWLR are determined by the overlap period of low /CS and low /WR or low /CS and low /RD.

$V_{CI}=2.7\sim 2.9[V]$ ,  $IOVCC=1.7\sim 2.9[V]$ ,  $T_a=-20\sim 70^{\circ}C$

| Item                          | Symbol        | Condition          | Rating |     | Unit |
|-------------------------------|---------------|--------------------|--------|-----|------|
|                               |               |                    | MIN    | MAX |      |
| Bus cycle time                | Write         | $t_{CYCW}$         | 75     | -   | ns   |
|                               | Read          | $t_{CYCR}$         | 450    | -   | ns   |
| /WR Low pulse width           | Write         | PWLW               | 40     | -   | ns   |
| /WR High pulse width          | Write         | PWHW               | 25     | -   | ns   |
| /RD Low pulse width           | Read          | PWLR               | 170    | -   | ns   |
| /RD High pulse width          | Read          | PWHR               | 250    | -   | ns   |
| Write / Read rise / fall time |               | $t_{WRr}, t_{WRf}$ | -      | 25  | ns   |
| Setup time                    | RS to /CS,/WR | $t_{AS}$           | 0      |     | ns   |
|                               | RS to /CS,/RD |                    | 10     |     | ns   |
| Address hold time             |               | $t_{AH}$           | 2      |     | ns   |
| Write data setup time         |               | $t_{DSW}$          | 25     |     | ns   |
| Write data hold time          |               | $t_H$              | 10     |     | ns   |
| Read data delay time          |               | $t_{DDR}$          | -      | 150 | ns   |
| Read data hold time           |               | $t_{DHR}$          | 5      | -   | ns   |



## 8.2.2 RESET Timing



VCI=2.7~2.9[V]、IOVCC=1.7~2.9[V]、Ta=-20~70°C

| Item                  | Symbol     | Condition | Rating |     |     | Unit |
|-----------------------|------------|-----------|--------|-----|-----|------|
|                       |            |           | MIN    | TYP | MAX |      |
| Reset low pulse width | $t_{RES}$  |           | 1      | —   | —   | ms   |
| Reset rise time       | $t_{rRES}$ |           | —      | —   | 10  | us   |

## 9. Interface

## 9.1 Interface mode

## Relation between GRAM data and Display data

The following figure illustrates the relationship between data on GRAM and display data through each interface.

<18bit interface> IM3 = 1 , IM0 = 0

| Input pins  | DB17 | DB16 | DB15 | DB14 | DB13 | DB12 | DB11 | DB10 | DB9 | DB8 | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|-------------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Instruction | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9  | IB8  | *   | IB7 | IB6 | IB5 | IB4 | IB3 | IB2 | IB1 | IB0 | *   |
| data        | R5   | R4   | R3   | R2   | R1   | R0   | G5   | G4   | G3  | G2  | G1  | G0  | B5  | B4  | B3  | B2  | B1  | B0  |

262,144 colors

<16bit interface> IM3 = 0 , IM0 = 0

| Input pins                       | DB17  | DB16 | DB15 | DB14 | DB13 | DB12 | DB11 | DB10 | DB9 | DB8 | DB7 | DB6 | DB5   | DB4 | DB3 | DB2 | DB1 | DB0 |
|----------------------------------|-------|------|------|------|------|------|------|------|-----|-----|-----|-----|-------|-----|-----|-----|-----|-----|
| Instruction                      | IB15  | IB14 | IB13 | IB12 | IB11 | IB10 | IB9  | IB8  | Lo  | IB7 | IB6 | IB5 | IB4   | IB3 | IB2 | IB1 | IB0 | Lo  |
| single transfer mode: TRIREG = 0 |       |      |      |      |      |      |      |      |     |     |     |     |       |     |     |     |     |     |
| data                             | R5/R0 | R4   | R3   | R2   | R1   | G5   | G4   | G3   | Lo  | G2  | G1  | G0  | B5/B0 | B4  | B3  | B2  | B1  | Lo  |

65,536 colors

2-transfer mode: TRIREG = 1, DFM = 0

|      |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| data | 1st | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | Lo | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | Lo |
|      | 2nd | B1 | B0 | *  | *  | *  | *  | *  | *  | Lo | *  | *  | *  | *  | *  | *  | *  | *  | Lo |

262,144 colors

2-transfer mode: TRIREG = 1, DFM = 1

|      |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| data | 1st | *  | *  | *  | *  | *  | *  | *  | *  | Lo | *  | *  | *  | *  | *  | *  | R5 | R4 | Lo |
|      | 2nd | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | Lo | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 | Lo |

262,144 colors

<9bit interface> IM3 = 1 , IM0 = 1

| Input pins  | DB17 | DB16 | DB15 | DB14 | DB13 | DB12 | DB11 | DB10 | DB9 | DB8 | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |    |
|-------------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| Instruction | 1st  | IB15 | IB14 | IB13 | IB12 | IB11 | IB10 | IB9  | IB8 | *   | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo |
|             | 2nd  | IB7  | IB6  | IB5  | IB4  | IB3  | IB2  | IB1  | IB0 | *   | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo |
| data        | 1st  | R5   | R4   | R3   | R2   | R1   | R0   | G5   | G4  | G3  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo |
|             | 2nd  | G2   | G1   | G0   | B5   | B4   | B3   | B2   | B1  | B0  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo |

262,144 colors

<8bit interface> IM3 = 0 , IM0 = 1

| Input pins                  | DB17 | DB16  | DB15 | DB14 | DB13  | DB12 | DB11 | DB10 | DB9 | DB8 | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |    |
|-----------------------------|------|-------|------|------|-------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| Instruction                 | 1st  | IB15  | IB14 | IB13 | IB12  | IB11 | IB10 | IB9  | IB8 | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo |
|                             | 2nd  | IB7   | IB6  | IB5  | IB4   | IB3  | IB2  | IB1  | IB0 | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo |
| 2-transfer mode: TRIREG = 0 |      |       |      |      |       |      |      |      |     |     |     |     |     |     |     |     |     |     |    |
| data                        | 1st  | R5/R0 | R4   | R3   | R2    | R1   | G5   | G4   | G3  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo |
|                             | 2nd  | G2    | G1   | G0   | B5/B0 | B4   | B3   | B2   | B1  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo  | Lo |

65,536 colors

3-transfer mode: TRIREG = 1, DFM = 0

|      |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| data | 1st | *  | *  | *  | *  | *  | *  | R5 | R4 | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo |
|      | 2nd | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo |
|      | 3rd | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo |

262,144 colors

3-transfer mode: TRIREG = 1, DFM = 1

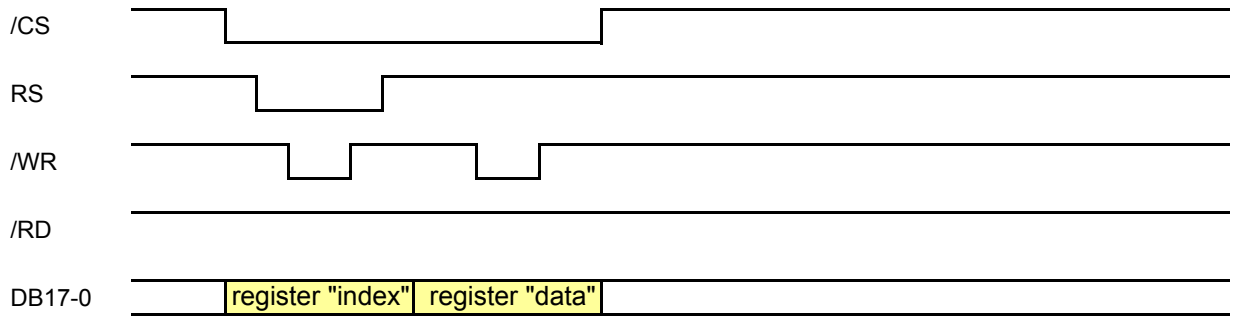
|      |     |    |    |    |    |    |    |   |   |    |    |    |    |    |    |    |    |    |    |
|------|-----|----|----|----|----|----|----|---|---|----|----|----|----|----|----|----|----|----|----|
| data | 1st | R5 | R4 | R3 | R2 | R1 | R0 | * | * | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo |
|      | 2nd | G5 | G4 | G3 | G2 | G1 | G0 | * | * | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo |
|      | 3rd | B5 | B4 | B3 | B2 | B1 | B0 | * | * | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo | Lo |

262,144 colors

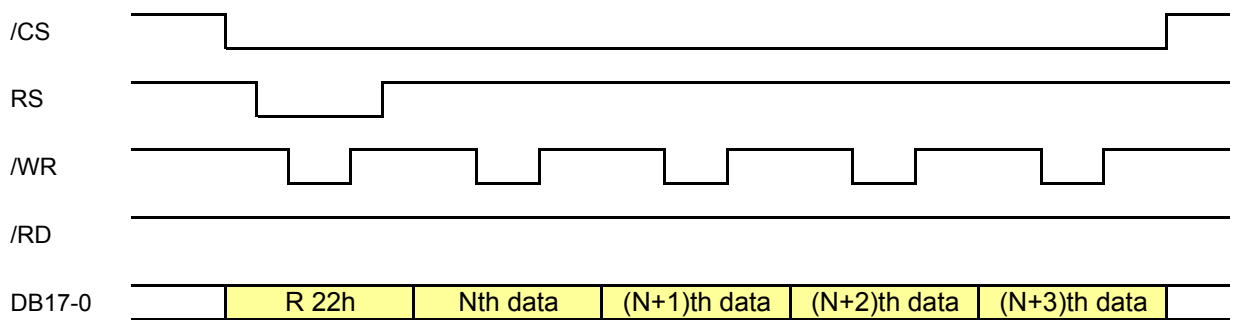
### 9.2 System interface timing

Send registers and data in accordance with the following transfer format.

#### a) Write to register



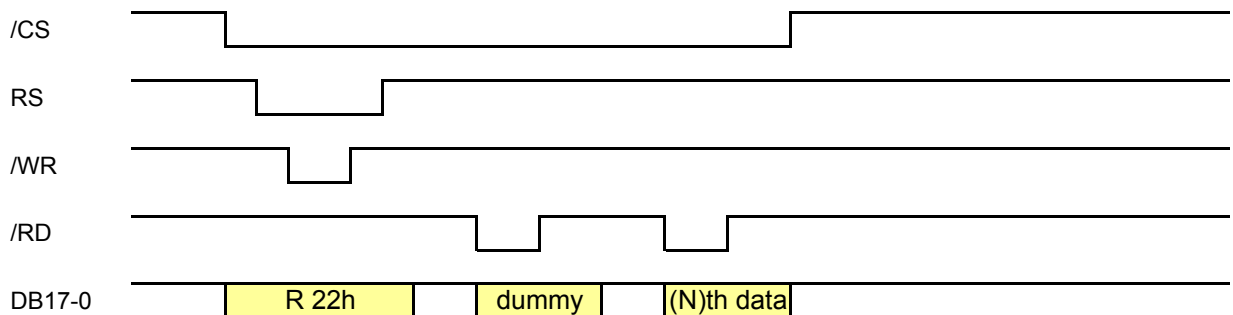
#### b) Write to GRAM



#### c) Read from register



#### d) Read from GRAM



\* If you want to continue reading, please set the new address because it does not address the auto-increment.

## 10. Register List

| IR   | Registers Name          | IB15          | IB14     | IB13 | IB12     | IB11 | IB10     | IB9 | IB8      | IB7      | IB6      | IB5      | IB4      | IB3      | IB2 | IB1 | IB0 |
|------|-------------------------|---------------|----------|------|----------|------|----------|-----|----------|----------|----------|----------|----------|----------|-----|-----|-----|
|      | Index Register (RS=0)   | *             | *        | *    | *        | *    | *        | *   | *        | IR7      | IR6      | IR5      | IR4      | IR3      | IR2 | IR1 | IR0 |
| R00h | Driver Code Read        | Read out only |          |      |          |      |          |     |          |          |          |          |          |          |     |     |     |
|      | Initial 1580h           | 0             | 0        | 0    | 1        | 0    | 1        | 0   | 1        | 1        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | recommend               | -             | -        | -    | -        | -    | -        | -   | -        | -        | -        | -        | -        | -        | -   | -   | -   |
| R01h | Driver Output Control 1 | 0             | 0        | 0    | 0        | 0    | SM       | 0   | SS       | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | Initial 0000h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | recommend 0500h         | 0             | 0        | 0    | 0        | 0    | 1        | 0   | 1        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
| R02h | LCD Driving Control     | 0             | 0        | 0    | 0        | 0    | 0        | BC0 | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | NW0 |
|      | Initial 0000h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | recommend 0200h         | 0             | 0        | 0    | 0        | 0    | 0        | 1   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
| R03h | Entry Mode              | TRI REG       | DFM      | 0    | BGR      | 0    | 0        | 0   | 0        | ORG      | 0        | I/D[1:0] | AM       | 0        | 0   | 0   | 0   |
|      | Initial 0030h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 1        | 1        | 0        | 0   | 0   | 0   |
|      | recommend 1030h         | 0             | 0        | 0    | 1        | 0    | 0        | 0   | 0        | 0        | 0        | 1        | 1        | 0        | 0   | 0   | 0   |
| R07h | Display Control 1       | 0             | 0        | 0    | PTD E    | 0    | 0        | 0   | BAS EE   | 0        | 0        | 0        | 0        | COL      | 0   | 0   | 0   |
|      | Initial 0000h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | recommend 0100h         | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 1        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
| R08h | Display Control 2       | FP[7:0]       |          |      |          |      |          |     | BP[7:0]  |          |          |          |          |          |     |     |     |
|      | Initial 0808h           | 0             | 0        | 0    | 0        | 1    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 1        | 0   | 0   | 0   |
|      | recommend 0503h         | 0             | 0        | 0    | 0        | 0    | 1        | 0   | 1        | 0        | 0        | 0        | 0        | 0        | 0   | 1   | 1   |
| R09h | Display Control 3       | 0             | 0        | 0    | 0        | 0    | PTS[2:0] | 0   | 0        | 0        | PTG      | 0        | ISC[3:0] | 0        | 0   | 0   | 1   |
|      | Initial 0001h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 1   |
|      | recommend 0001h         | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 1   |
| R0Ah | Display Control 4       | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | FMA RKO  | FM[2:0]  | 0   | 0   | 0   |
|      | Initial 0000h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | recommend 0008h         | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 1        | 0        | 0   | 0   | 0   |
| R0Ch | RGB I/F Control 1       | 0             | ENC[2:0] | 0    | 0        | 0    | 0        | RM  | 0        | 0        | DM[1:0]  | 0        | 0        | RIM[1:0] | 0   | 0   | 0   |
|      | Initial 0000h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | recommend 0000h         | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
| R0Dh | FMARK Position          | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | FMP[8:0] |          |          |          |          |     |     |     |
|      | Initial 0000h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | recommend 0000h         | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
| R0Eh | VCOML voltage Control   | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | VEM[1:0] | 0        | 0        | 0        | 0   | 0   | 0   |
|      | Initial 0030h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 1        | 1        | 0        | 0        | 0   | 0   | 0   |
|      | recommend 0030h         | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 1        | 1        | 0        | 0        | 0   | 0   | 0   |
| R0Fh | RGB I/F Control 2       | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | VSP L    | HSP L    | 0        | EPL | DPL | 0   |
|      | Initial 0000h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | recommend 0000h         | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
| R10h | Power Control 1         | 0             | 0        | 0    | 0        | 0    | BT[2:0]  | 0   | 0        | AP[1:0]  | 0        | DST B    | 0        | 0        | 0   | 0   | 0   |
|      | Initial 0530h           | 0             | 0        | 0    | 0        | 0    | 1        | 0   | 1        | 0        | 0        | 1        | 1        | 0        | 0   | 0   | 0   |
|      | recommend 0310h         | 0             | 0        | 0    | 0        | 0    | 0        | 1   | 1        | 0        | 0        | 0        | 1        | 0        | 0   | 0   | 0   |
| R11h | Power Control 2         | 0             | 0        | 0    | 0        | 0    | DC1[2:0] | 0   | DC0[2:0] | 0        | VC[2:0]  | 0        | 0        | 0        | 0   | 0   | 0   |
|      | Initial 0237h           | 0             | 0        | 0    | 0        | 0    | 0        | 1   | 0        | 0        | 0        | 1        | 1        | 0        | 1   | 1   | 1   |
|      | recommend 0231h         | 0             | 0        | 0    | 0        | 0    | 0        | 1   | 0        | 0        | 0        | 1        | 1        | 0        | 0   | 0   | 1   |
| R12h | Power Control 3         | 0             | 0        | 0    | VRH 0    | 0    | 0        | 0   | VCM R    | 1        | 0        | PSO N    | PON      | VRH[4:1] | 0   | 0   | 0   |
|      | Initial 018Fh           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 1        | 1        | 0        | 0        | 0        | 1        | 1   | 1   | 1   |
|      | recommend 018Ch         | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 1        | 1        | 0        | 0        | 0        | 1        | 1   | 0   | 0   |
| R13h | Power Control 4         | 0             | 0        | 0    | VDV[4:0] | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | Initial 0000h           | 0             | 0        | 0    | 0        | 0    | 0        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |
|      | recommend 1400h         | 0             | 0        | 0    | 1        | 0    | 1        | 0   | 0        | 0        | 0        | 0        | 0        | 0        | 0   | 0   | 0   |

| IR   | Registers Name                      | IB15                | IB14 | IB13            | IB12        | IB11 | IB10            | IB9 | IB8      | IB7             | IB6 | IB5         | IB4             | IB3 | IB2 | IB1 | IB0 |
|------|-------------------------------------|---------------------|------|-----------------|-------------|------|-----------------|-----|----------|-----------------|-----|-------------|-----------------|-----|-----|-----|-----|
| R20h | Horizontal RAM Address Set          | 0                   | 0    | 0               | 0           | 0    | 0               | 0   | 0        | AD[7:0]         |     |             |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   | 0   |
|      | recommend                           | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   | 0   |
| R21h | Vertical RAM Address Set            | 0                   | 0    | 0               | 0           | 0    | 0               | 0   | AD[16:8] |                 |     |             |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
| R22h | Write/Read Data                     | RAM write/read data |      |                 |             |      |                 |     |          |                 |     |             |                 |     |     |     |     |
|      | Initial                             | ----                |      |                 |             |      |                 |     |          |                 |     |             |                 |     |     |     |     |
|      | recommend                           | ----                |      |                 |             |      |                 |     |          |                 |     |             |                 |     |     |     |     |
| R29h | VCOMH voltage Control               | 0                   | 0    | 0               | 0           | 0    | 0               | 0   | 0        | VCM1[6:0]       |     |             |                 |     |     |     |     |
|      | Initial                             | 00FFh               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 1               | 1   | 1           | 1               | 1   | 1   | 1   |     |
|      | recommend                           | 0065h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 1   | 1           | 0               | 0   | 1   | 0   |     |
| R30h | Gamma Control 1                     | 0                   | 0    | 0               | PR0P01[4:0] |      |                 |     | 0        | 0               | 0   | PR0P00[4:0] |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 0500h               | 0    | 0               | 0           | 0    | 0               | 1   | 0        | 1               | 0   | 0           | 0               | 0   | 0   | 0   | 0   |
| R31h | Gamma Control 2                     | PR0P04[3:0]         |      |                 | PR0P03[3:0] |      |                 |     | 0        | 0               | 0   | PR0P02[4:0] |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 3711h               | 0    | 0               | 1           | 1    | 0               | 1   | 1        | 1               | 0   | 0           | 0               | 1   | 0   | 0   | 0   |
| R32h | Gamma Control 3                     | 0                   | 0    | 0               | PR0P06[4:0] |      |                 |     | 0        | 0               | 0   | 0           | PR0P05[3:0]     |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 0605h               | 0    | 0               | 0           | 0    | 0               | 1   | 1        | 0               | 0   | 0           | 0               | 0   | 0   | 1   | 0   |
| R33h | Gamma Control 4                     | 0                   | 0    | 0               | PR0P08[4:0] |      |                 |     | 0        | 0               | 0   | PR0P07[4:0] |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 120Dh               | 0    | 0               | 0           | 1    | 0               | 0   | 1        | 0               | 0   | 0           | 0               | 0   | 1   | 1   | 0   |
| R34h | Gamma Control 5                     | 0                   | 0    | PIR0P3<br>[1:0] | 0           | 0    | PIR0P2<br>[1:0] | 0   | 0        | PIR0P1<br>[1:0] | 0   | 0           | PIR0P0<br>[1:0] |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 1202h               | 0    | 0               | 0           | 1    | 0               | 0   | 1        | 0               | 0   | 0           | 0               | 0   | 0   | 1   | 0   |
| R35h | Gamma Control 6                     | 0                   | 0    | 0               | PR0N01[4:0] |      |                 |     | 0        | 0               | 0   | PR0N00[4:0] |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 0D0Ah               | 0    | 0               | 0           | 0    | 1               | 1   | 0        | 1               | 0   | 0           | 0               | 0   | 1   | 0   | 1   |
| R36h | Gamma Control 7                     | PR0N04[3:0]         |      |                 | PR0N03[3:0] |      |                 |     | 0        | 0               | 0   | PR0N02[4:0] |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 3506h               | 0    | 0               | 1           | 1    | 0               | 1   | 0        | 1               | 0   | 0           | 0               | 0   | 0   | 1   | 1   |
| R37h | Gamma Control 8                     | 0                   | 0    | 0               | PR0N06[4:0] |      |                 |     | 0        | 0               | 0   | 0           | PR0N05[3:0]     |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 1107h               | 0    | 0               | 0           | 1    | 0               | 0   | 0        | 1               | 0   | 0           | 0               | 0   | 0   | 1   | 1   |
| R38h | Gamma Control 9                     | 0                   | 0    | 0               | PR0N08[4:0] |      |                 |     | 0        | 0               | 0   | PR0N07[4:0] |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 0005h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 1   | 0   | 1   |
| R39h | Gamma Control 10                    | 0                   | 0    | PIR0N3<br>[1:0] | 0           | 0    | PIR0N2<br>[1:0] | 0   | 0        | PIR0N1<br>[1:0] | 0   | 0           | PIR0N0<br>[1:0] |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 0212h               | 0    | 0               | 0           | 0    | 0               | 0   | 1        | 0               | 0   | 0           | 0               | 1   | 0   | 0   | 1   |
| R50h | Window Horizontal RAM Start Address | 0                   | 0    | 0               | 0           | 0    | 0               | 0   | 0        | HSA[7:0]        |     |             |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
| R51h | Window Horizontal RAM End Address   | 0                   | 0    | 0               | 0           | 0    | 0               | 0   | 0        | HEA[7:0]        |     |             |                 |     |     |     |     |
|      | Initial                             | 00EFh               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 1               | 1   | 1           | 0               | 1   | 1   | 1   | 1   |
|      | recommend                           | 00EFh               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 1               | 1   | 1           | 0               | 1   | 1   | 1   | 1   |
| R52h | Window Vertical RAM Start Address   | 0                   | 0    | 0               | 0           | 0    | 0               | 0   | VSA[8:0] |                 |     |             |                 |     |     |     |     |
|      | Initial                             | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
|      | recommend                           | 0000h               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 0               | 0   | 0           | 0               | 0   | 0   | 0   |     |
| R53h | Window Vertical RAM End Address     | 0                   | 0    | 0               | 0           | 0    | 0               | 0   | VEA[8:0] |                 |     |             |                 |     |     |     |     |
|      | Initial                             | 013Fh               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 1               | 0   | 0           | 1               | 1   | 1   | 1   | 1   |
|      | recommend                           | 013Fh               | 0    | 0               | 0           | 0    | 0               | 0   | 0        | 1               | 0   | 0           | 1               | 1   | 1   | 1   | 1   |

| IR   | Registers Name                  | IB15  | IB14 | IB13    | IB12 | IB11 | IB10       | IB9       | IB8        | IB7 | IB6         | IB5       | IB4 | IB3         | IB2 | IB1 | IB0      |   |
|------|---------------------------------|-------|------|---------|------|------|------------|-----------|------------|-----|-------------|-----------|-----|-------------|-----|-----|----------|---|
| R60h | Driver Output Control 2         | GS    | 0    | NL[5:0] |      |      |            |           | 0          | 0   | SCN[5:0]    |           |     |             |     |     |          |   |
|      | Initial                         | 2700h | 0    | 0       | 1    | 0    | 0          | 1         | 1          | 1   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | recommend                       | A700h | 1    | 0       | 1    | 0    | 0          | 1         | 1          | 1   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
| R61A | Base Image Display Control      | 0     | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | NDL | VLE | REV      |   |
|      | Initial                         | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | recommend                       | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
| R6Ah | Vertical Scroll Control         | 0     | 0    | 0       | 0    | 0    | 0          | 0         | VL[8:0]    |     |             |           |     |             |     |     |          |   |
|      | Initial                         | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | recommend                       | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
| R80h | Partial Image Display Position  | 0     | 0    | 0       | 0    | 0    | 0          | 0         | PTDPA[8:0] |     |             |           |     |             |     |     |          |   |
|      | Initial                         | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | recommend                       | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
| R81h | Partial Image Area (Start Line) | 0     | 0    | 0       | 0    | 0    | 0          | 0         | PTSA[8:0]  |     |             |           |     |             |     |     |          |   |
|      | Initial                         | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | recommend                       | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
| R82h | Partial Image Area (End Line)   | 0     | 0    | 0       | 0    | 0    | 0          | 0         | PTEA[8:0]  |     |             |           |     |             |     |     |          |   |
|      | Initial                         | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | recommend                       | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
| R90h | Panel I/F Control 1             | 0     | 0    | 0       | 0    | 0    | 0          | DIVI[1:0] | 0          | 0   | 0           | RTNI[4:0] |     |             |     |     |          |   |
|      | Initial                         | 0111h | 0    | 0       | 0    | 0    | 0          | 0         | 1          | 0   | 0           | 0         | 1   | 0           | 0   | 0   | 0        | 1 |
|      | recommend                       | 001Dh | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 1   | 1           | 1   | 1   | 0        | 1 |
| R91h | Panel I/F Control 1-1           | 0     | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | SPCWI[3:0]  |     |     |          |   |
|      | Initial                         | 0001h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
|      | recommend                       | 0003h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 1   | 1        | 1 |
| R92h | Panel I/F Control 2             | 0     | 0    | 0       | 0    | 0    | NOWI[2:0]  |           | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | Initial                         | 0100h | 0    | 0       | 0    | 0    | 1          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | recommend                       | 0100h | 0    | 0       | 0    | 0    | 1          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
| R93h | Panel I/F Control 3             | 0     | 0    | 0       | 0    | 0    | VEQWI[2:0] |           | 0          | 0   | 0           | 0         | 0   | MCPI[2:0]   |     |     |          |   |
|      | Initial                         | 0101h | 0    | 0       | 0    | 0    | 0          | 0         | 1          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
|      | recommend                       | 0201h | 0    | 0       | 0    | 0    | 0          | 1         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
| R94h | Panel I/F Control 4             | 0     | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | SDTI[2:0]   |     |     |          |   |
|      | Initial                         | 0001h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
|      | recommend                       | 0001h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
| R95h | Panel I/F Control 5             | 0     | 0    | 0       | 0    | 0    | 0          | DIVE[1:0] | 0          | 0   | RTNE[4:0]   |           |     |             |     |     |          |   |
|      | Initial                         | 001Fh | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 1         | 1   | 1           | 1   | 1   | 1        |   |
|      | recommend                       | 001Fh | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 1         | 1   | 1           | 1   | 1   | 1        |   |
| R96h | Panel I/F Control 5-1           | 0     | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | SPCWE[3:0]  |     |     |          |   |
|      | Initial                         | 0001h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
|      | recommend                       | 0001h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
| R97h | Panel I/F Control 6             | 0     | 0    | 0       | 0    | 0    | NOWE[2:0]  |           | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | Initial                         | 0100h | 0    | 0       | 0    | 0    | 0          | 0         | 1          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
|      | recommend                       | 0100h | 0    | 0       | 0    | 0    | 0          | 0         | 1          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 0 |
| R98h | Panel I/F Control 7             | 0     | 0    | 0       | 0    | 0    | VEQWE[2:0] |           | 0          | 0   | 0           | 0         | 0   | MCPE[2:0]   |     |     |          |   |
|      | Initial                         | 0101h | 0    | 0       | 0    | 0    | 0          | 0         | 1          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
|      | recommend                       | 0101h | 0    | 0       | 0    | 0    | 0          | 0         | 1          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
| R99h | Panel I/F Control 8             | 0     | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | SDTE[2:0]   |     |     |          |   |
|      | Initial                         | 0001h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
|      | recommend                       | 0001h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        | 1 |
| R9Ch | Panel I/F Control 9             | 0     | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | PCDIVH[2:0] |           | 0   | PCDIVL[2:0] |     |     |          |   |
|      | Initial                         | 0043h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 1           | 0         | 0   | 0           | 0   | 1   | 1        |   |
|      | recommend                       | 0043h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 1           | 0         | 0   | 0           | 0   | 1   | 1        |   |
| RA4h | NVM Calibration                 | 0     | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | CAL<br>B |   |
|      | Initial                         | 0000h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 0        |   |
|      | recommend                       | 0001h | 0    | 0       | 0    | 0    | 0          | 0         | 0          | 0   | 0           | 0         | 0   | 0           | 0   | 0   | 1        |   |

## 11. Sequence

## 11.1 Power ON Sequence

( 1/2 )

| No.                     |                                  | Function                             | Register | recommend | Remarks |
|-------------------------|----------------------------------|--------------------------------------|----------|-----------|---------|
| 1                       | Power ON                         | VCI,IOVCC ON                         |          |           |         |
| 2                       |                                  | /RESET=0                             |          |           |         |
| 3                       | Wait                             | 1msec or more                        |          |           |         |
| 4                       |                                  | /RESET=1                             |          |           |         |
| 5                       | Wait                             | 2msec or more                        |          |           |         |
| 6                       | data transfer<br>synchronization | RS=0                                 | -        | 0000 h    |         |
|                         |                                  | RS=0                                 | -        | 0000 h    |         |
|                         |                                  | RS=0                                 | -        | 0000 h    |         |
|                         |                                  | RS=0                                 | -        | 0000 h    |         |
| 7                       |                                  | NVM Calibration                      | RA4h     | 0001 h    |         |
| 8                       | Wait                             | 0.2msec or more                      |          |           |         |
| 9                       | Instruction<br>user setting      | Driver Output Control 2              | R60h     | A700 h    |         |
|                         |                                  | Display Control 2                    | R08h     | 0503 h    |         |
|                         |                                  | Gamma Control 1                      | R30h     | 0500 h    |         |
|                         |                                  | Gamma Control 2                      | R31h     | 3711 h    |         |
|                         |                                  | Gamma Control 3                      | R32h     | 0605 h    |         |
|                         |                                  | Gamma Control 4                      | R33h     | 120D h    |         |
|                         |                                  | Gamma Control 5                      | R34h     | 1202 h    |         |
|                         |                                  | Gamma Control 6                      | R35h     | 0D0A h    |         |
|                         |                                  | Gamma Control 7                      | R36h     | 3506 h    |         |
|                         |                                  | Gamma Control 8                      | R37h     | 1107 h    |         |
|                         |                                  | Gamma Control 9                      | R38h     | 0005 h    |         |
|                         |                                  | Gamma Control 10                     | R39h     | 0212 h    |         |
|                         |                                  | Panel I/F Control 1                  | R90h     | 001D h    |         |
|                         |                                  | Power Control 1                      | R10h     | 0310 h    |         |
|                         |                                  | Power Control 2                      | R11h     | 0231 h    |         |
|                         |                                  | Power Control 3                      | R13h     | 1400 h    |         |
| Power Control 4         | R12h                             | 01BC h                               |          |           |         |
| 10                      | Wait                             | wait 100 msec or more                |          |           |         |
| 11                      | Other mode setting               | Driver Output Control 1              | R01h     | 0500 h    |         |
|                         |                                  | LCD Driving Control                  | R02h     | 0200 h    |         |
|                         |                                  | Entry Mode                           | R03h     | 1030 h    |         |
|                         |                                  | Display Control 3                    | R09h     | 0001 h    |         |
|                         |                                  | Display Control 4                    | R0Ah     | 0008 h    |         |
|                         |                                  | RGB I/F Control 1                    | R0Ch     | 0000 h    |         |
|                         |                                  | FMARK Position                       | R0Dh     | 0000 h    |         |
|                         |                                  | VCOML voltage Control                | R0Eh     | 0030 h    |         |
|                         |                                  | RGB I/F Control 2                    | R0Fh     | 0000 h    |         |
|                         |                                  | Window Horizontal RAM Start Address  | R50h     | 0000 h    |         |
|                         |                                  | Window Horizontal RAM End Address    | R51h     | 00EF h    |         |
|                         |                                  | Window Vertical RAM Start Address    | R52h     | 0000 h    |         |
|                         |                                  | Window Vertical RAM End Address      | R53h     | 013F h    |         |
|                         |                                  | Base Image Display Control           | R61h     | 0000 h    |         |
| Vertical Scroll Control | R6Ah                             | 0000 h                               |          |           |         |
| 12                      | Partical Display<br>Control      | Partial Image Display Position       | R80h     | 0000 h    |         |
|                         |                                  | Partial Image RAM Start Line Address | R81h     | 0000 h    |         |
|                         |                                  | Partial Image RAM End Line Address   | R82h     | 0000 h    |         |

( 2/2 )

| No. |                         | Function                      | Register | recommend | Remarks |
|-----|-------------------------|-------------------------------|----------|-----------|---------|
| 13  | Panel interface Control | Panel interface control 1-1   | R91h     | 0003 h    |         |
|     |                         | Panel interface control 2     | R92h     | 0100 h    |         |
|     |                         | Panel interface control 3     | R93h     | 0201 h    |         |
|     |                         | Panel interface control 4     | R94h     | 0001 h    |         |
|     |                         | Back Light Control            | RC0h     | 0000 h    |         |
| 14  | Test Register           | Test Register                 | RF3h     | 0020 h    |         |
| 15  | Address Setting         | Horizontal RAM Address Set    | R20h     | 0000 h    |         |
|     |                         | Vertical RAM Address Set      | R21h     | 0000 h    |         |
|     | Data transfer           | GRAM Data Write               | R22h     | **** h    |         |
| 16  | Display ON              | Display Control 1             | R07h     | 0100 h    |         |
| 17  | Wait                    | wait 34 msec(2 frame) or more |          |           |         |
| 18  | Back-Light ON           |                               |          |           |         |

## 11.2 Power OFF Sequence

| No. |               | Function              | Register | recommend | Remarks       |
|-----|---------------|-----------------------|----------|-----------|---------------|
| 1   | Power OFF     | Display Control 1     | R07h     | 0000 h    | BASEE=0       |
| 2   | Power Control | Power Control 3       | R12h     | 018C h    | PSON=0, PON=0 |
| 3   | Wait          | wait 120 msec or more |          |           |               |
| 4   |               | VCI,IOVCC OFF         |          |           |               |

## 11.3 Deep-Standby Sequence

| No. |               | Function             | Register | recommend | Remarks       |
|-----|---------------|----------------------|----------|-----------|---------------|
| 1   | Display OFF   | Display Control 1    | R07h     | 0000 h    | BASEE=0       |
| 2   | Power Control | Power Control 3      | R12h     | 018C h    | PSON=0, PON=0 |
| 3   | Wait          | wait 1 frame or more |          |           |               |
| 4   | Power Control | Power Control 1      | R10h     | 0634 h    |               |

## 11.4 Deep-Standby Release Sequence

| No. |                   | Function                  | Register | recommend | Remarks |
|-----|-------------------|---------------------------|----------|-----------|---------|
| 1   | Dummy             | DB = 0000 h               |          | 0000 h    |         |
|     |                   | DB = 0000 h               |          | 0000 h    |         |
| 2   | Wait              | wait 1 msec or more       |          |           |         |
| 3   | Dummy             | DB = 0000 h               |          | 0000 h    |         |
|     |                   | DB = 0000 h               |          | 0000 h    |         |
|     |                   | DB = 0000 h               |          | 0000 h    |         |
|     |                   | DB = 0000 h               |          | 0000 h    |         |
| 3   | Wait              | wait 1 msec or more       |          |           |         |
| 4   | Power ON Sequence | Power ON Sequence No.7 -- |          |           |         |



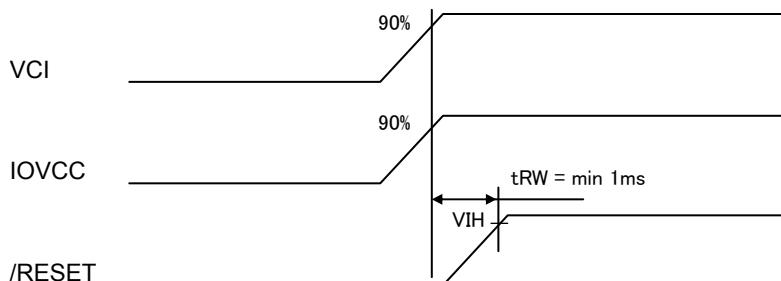
## 11.5 Refresh Sequence

To prevent false operation by static electricity and such, please refresh register setting as follows regularly.

| No.                     |                               | Function                             | Register | recommend | Remarks |
|-------------------------|-------------------------------|--------------------------------------|----------|-----------|---------|
| 1                       | data transfer synchronization | RS=0                                 | -        | 0000 h    |         |
|                         |                               | RS=0                                 | -        | 0000 h    |         |
|                         |                               | RS=0                                 | -        | 0000 h    |         |
|                         |                               | RS=0                                 | -        | 0000 h    |         |
| 2                       |                               | NVM Calibration                      | RA4h     | 0001 h    |         |
| 3                       | Wait                          | 0.2msec or more                      |          |           |         |
| 4                       | Instruction user setting      | Driver Output Control 2              | R60h     | A700 h    |         |
|                         |                               | Display Control 2                    | R08h     | 0503 h    |         |
|                         |                               | Gamma Control 1                      | R30h     | 0500 h    |         |
|                         |                               | Gamma Control 2                      | R31h     | 3711 h    |         |
|                         |                               | Gamma Control 3                      | R32h     | 0605 h    |         |
|                         |                               | Gamma Control 4                      | R33h     | 120D h    |         |
|                         |                               | Gamma Control 5                      | R34h     | 1202 h    |         |
|                         |                               | Gamma Control 6                      | R35h     | 0D0A h    |         |
|                         |                               | Gamma Control 7                      | R36h     | 3506 h    |         |
|                         |                               | Gamma Control 8                      | R37h     | 1107 h    |         |
|                         |                               | Gamma Control 9                      | R38h     | 0005 h    |         |
|                         |                               | Gamma Control 10                     | R39h     | 0212 h    |         |
|                         |                               | Panel I/F Control 1                  | R90h     | 001D h    |         |
|                         |                               | Power Control 1                      | R10h     | 0310 h    |         |
|                         |                               | Power Control 2                      | R11h     | 0231 h    |         |
|                         |                               | Power Control 3                      | R13h     | 1400 h    |         |
| Power Control 4         | R12h                          | 01BC h                               |          |           |         |
| 5                       | Wait                          | wait 100 msec or more                |          |           |         |
|                         |                               | Driver Output Control 1              | R01h     | 0500 h    |         |
|                         |                               | LCD Driving Control                  | R02h     | 0200 h    |         |
|                         |                               | Entry Mode                           | R03h     | 1030 h    |         |
|                         |                               | Display Control 3                    | R09h     | 0001 h    |         |
|                         |                               | Display Control 4                    | R0Ah     | 0008 h    |         |
|                         |                               | RGB I/F Control 1                    | R0Ch     | 0000 h    |         |
|                         |                               | FMARK Position                       | R0Dh     | 0000 h    |         |
|                         |                               | VCOML voltage Control                | R0Eh     | 0030 h    |         |
|                         |                               | RGB I/F Control 2                    | R0Fh     | 0000 h    |         |
|                         |                               | Window Horizontal RAM Start Address  | R50h     | 0000 h    |         |
|                         |                               | Window Horizontal RAM End Address    | R51h     | 00EF h    |         |
|                         |                               | Window Vertical RAM Start Address    | R52h     | 0000 h    |         |
|                         |                               | Window Vertical RAM End Address      | R53h     | 013F h    |         |
|                         |                               | Base Image Display Control           | R61h     | 0000 h    |         |
| Vertical Scroll Control | R6Ah                          | 0000 h                               |          |           |         |
| 6                       | Partical Display Control      | Partial Image Display Position       | R80h     | 0000 h    |         |
|                         |                               | Partial Image RAM Start Line Address | R81h     | 0000 h    |         |
|                         |                               | Partial Image RAM End Line Address   | R82h     | 0000 h    |         |
| 7                       | Panel interface Control       | Panel interface control 1-1          | R91h     | 0003 h    |         |
|                         |                               | Panel interface control 2            | R92h     | 0100 h    |         |
|                         |                               | Panel interface control 3            | R93h     | 0201 h    |         |
|                         |                               | Panel interface control 4            | R94h     | 0001 h    |         |
|                         |                               | Back Light Control                   | RC0h     | 0000 h    |         |
| 8                       | Test Register                 | Test Register                        | RF3h     | 0020 h    |         |
| 9                       | Address Setting               | Horizontal RAM Address Set           | R20h     | 0000 h    |         |
|                         |                               | Vertical RAM Address Set             | R21h     | 0000 h    |         |
|                         | Data transfer                 | GRAM Data Write                      | R22h     | **** h    |         |
| 10                      | Display ON                    | Display Control 1                    | R07h     | 0100 h    |         |

### 11.6 Power Supply ON Sequence

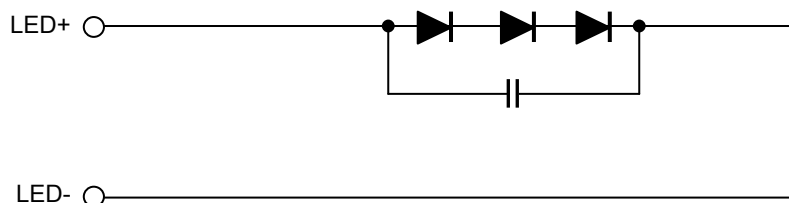
We recommend that you supplied at the same time VCI and IOVCC. However, there is no problem even if the supply IOVCC later than VCI. Please release the reset from at least 1ms after each power supply.



### 11.7 Power Supply OFF Sequence

We recommend that you removed at the same time VCI and IOVCC. However, there is no problem even if IOVCC OFF faster than VCI .

## 12. About LED Driving Circuit



## 13. Characteristics



## 13.1 Optical Characteristics

&lt; Measurement Condition &gt;

Measuring instruments: CS1000 (KONICA MINOLTA), LCD7200(OTSUKA ELECTRONICS),  
EZcontrast160D (ELDIM)

Driving condition: VCI=IOVCC=2.8V  
Optimized VCOMDC

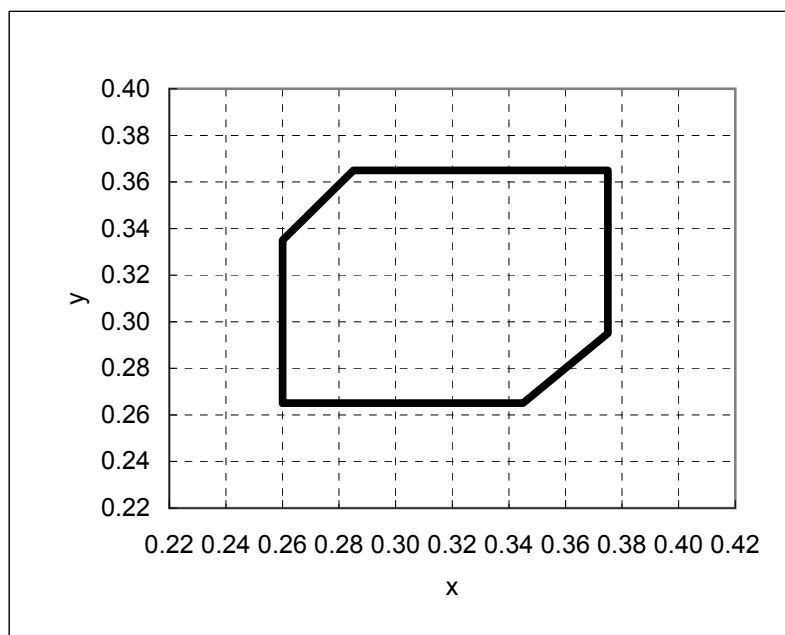
Backlight: IL=6.0mA

Measured temperature: Ta=25° C

| Item                    | Symbol        | Condition  | MIN   | TYP | MAX | Unit              | Note No. | Remark |   |
|-------------------------|---------------|------------|---|-----|-----|-------------------|----------|--------|---|
| Response time           | Rise time     | TON        | [Data]=<br>00h→3Fh  | —   | —   | 60                | ms       | 1 ※    |   |
|                         | Fall time     | TOFF       | [Data]=<br>3Fh→00h  | —   | —   | 40                | ms       |        |   |
| Contrast ratio          | Backlight ON  | CR         | [Data]=<br>3Fh / 00h  | —   | 800 | —                 |          | 2      |   |
|                         | Backlight OFF |            |   | —   | 4.0 | —                 |          |        |   |
| Viewing angle           | Left          | θL         | [Data]=<br>3Fh / 00h<br>CR ≥ 10   | —   | 80  | —                 | deg      | 3 ※    |   |
|                         | Right         |            |   | θR  | —   | 80                |          |        | — |
|                         | Up            |            |   | φU  | —   | 80                |          |        | — |
|                         | Down          |            |   | φD  | —   | 80                |          |        | — |
| White Chromaticity      | x             | [Data]=3Fh | White chromaticity range  |     |     |                   | 4        |        |   |
|                         | y             |            |   |     |     |                   |          |        |   |
| Burn-in                 |               |            | No noticeable burn-in image should be observed after 2 hours of window pattern display. |     |     |                   | 5        |        |   |
| Center brightness       |               | [Data]=3Fh | 280   | 400 | —   | cd/m <sup>2</sup> | 6        |        |   |
| Brightness distribution |               | [Data]=3Fh | 70  | —   | —   | %                 | 7        |        |   |

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

※ Measured in the form of LCD module.



【White Chromaticity Range】

| x     | y     |
|-------|-------|
| 0.260 | 0.265 |
| 0.345 | 0.265 |
| 0.375 | 0.295 |
| 0.375 | 0.365 |
| 0.285 | 0.365 |
| 0.260 | 0.335 |

White Chromaticity Range

### **B** 13.2 Temperature Characteristics

< Measurement Condition >

Measuring instruments: CS1000 (KONICA MINOLTA), LCD7200 (OTSUKA ELECTRONICS)

Driving condition: VCI=IOVCC=2.8V

Optimized VCOMDC

Backlight: IL=6.0mA

| 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   | 200 msec or less | 30 msec or less  | ※ |
| Display Quality |           | No noticeable display defect or uniformity should be observed. |                  | Use the criteria for judgment specified in the section 14. |   |

※ Measured in the form of LCD module.

### 13.3 Service Life of Backlight

< Definition >

When the center luminance drops to 50% of the initial value, the back light is considered to have reached the end of its effective service life.

Backlight: IL=6.0mA

|                  | Average life | Ambient temperature |
|------------------|--------------|---------------------|
| Continuously lit | 10000hr      | 25±5°C              |

Average life means the period which the survival rate falls under 50%.

14. Criteria of Judgment

14.1 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]: 3Fh, 2Ah, 00h (3steps)  
 Observation distance 30 cm  
 Illuminance 200 to 350 lx  
 Backlight IL=6.0mA

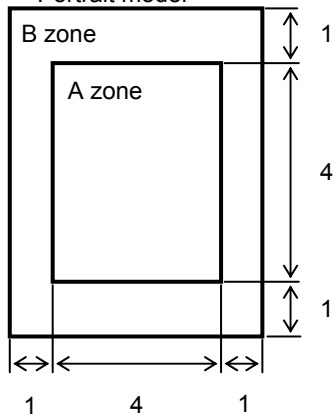
| Defect item     |  | Defect content   | Criteria   |            |
|-----------------|--|--|--|------------|
| Display Quality | Line defect  | Black, white or color line, 3 or more neighboring defective dots   | Not exists   |            |
|                 | Dot defect   | Uneven brightness on dot-by-dot 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]=00h  |  |            |
|                 |  | Low bright dot: Visible through 5% ND filter at [Data]=00h<br>Dark dot: Appear dark through white display at [Data]=2Ah<br>Inisible through 5% ND filter at [Data]=00h |  | ignored    |
| Screen Quality  | Dirt   | Uneven brightness (white stain, black stain etc)   | Invisible through 1% ND filter                                   |            |
|                 | Foreign particle   | Point-like   | $0.25\text{mm} < \varphi$  | N=0        |
|                 |  |  | $0.20\text{mm} < \varphi \leq 0.25\text{mm}$                     | $N \leq 2$ |
|                 |  |  | $\varphi \leq 0.20\text{mm}$                                     | Ignored    |
|                 |  | Liner  | $3.0\text{mm} < \text{length and } 0.08\text{mm} < \text{width}$ | N=0        |
|                 | $\text{length} \leq 3.0\text{mm}$ or $\text{width} \leq 0.08\text{mm}$ |  | Ignored  |            |
| Others          |  | Use boundary sample for judgment when necessary  |  |            |

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

<Portrait 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)

## 14.2 Screen and Other Appearance

## Testing conditions

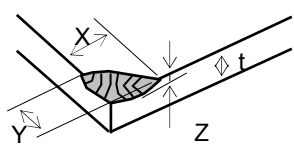
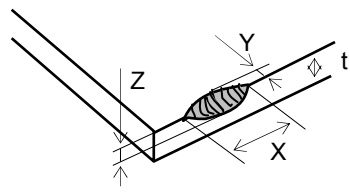
Observation distance

30cm

Illuminance

1200~2000 lx

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

| Item              | Appearance   | Criteria  |
|-------------------|--|---|
| Glass<br>Chipping | Corner area<br> | Unit: mm<br>$X \leq 3$<br>$Y \leq 3$<br>$Z \leq t$ (t:glass thickness)<br>$X, Y \leq 0.5$ is ignored. |
|                   | Others<br>    | Unit: mm<br>$X \leq 5$<br>$Y \leq 1$<br>$Z \leq t$ (t:glass thickness)<br>$X, Y \leq 0.5$ is ignored. |
|                   | Progressive crack  | None  |

## 15. Reliability Test

| Test item                     |   | Test condition  |            | number of failures<br>/number of examinations |
|-------------------------------|---|---|------------|---|
| Durability test               | High temperature storage                        | Ta=80° C  | 240hr      | 0 / 3   |
|                               | Low temperature storage                         | Ta=-30° C   | 240hr      | 0 / 3   |
|                               | High temperature & high humidity storage        | Ta=60° C, RH=90%<br>non condensing  | 240hr      | 0 / 3   |
|                               | High temperature operation                      | Tp=70° C  | 240hr      | 0 / 3   |
|                               | Low temperature operation                       | Tp=-20° C   | 240hr      | 0 / 3   |
|                               | High temp & humid operation                     | Tp=40° C, RH=90%<br>non condensing  | 240hr      | 0 / 3   |
|                               | Thermal shock storage                           | -30←→80° C(30min/30min)   | 100 cycles | 0 / 3   |
| 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.   |            | 0 / 3   |
|                               | Surface discharge test<br>(Non operation)       | C=250pF, R=100Ω, V=±8kV<br>Each 5 times of discharge in both polarities<br>on the center of screen with the case grounded.  |            | 0 / 3   |
|                               | Vibration test                                  | Total amplitude 1.5mm, f=10~55Hz, X,Y,Z<br>directions for each 2 hours  |            | 0 / 3   |
|                               | Impact test                                     | Use ORTUS TECHNOLOGY 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. |            | 0 / 3   |
| 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<br>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.)

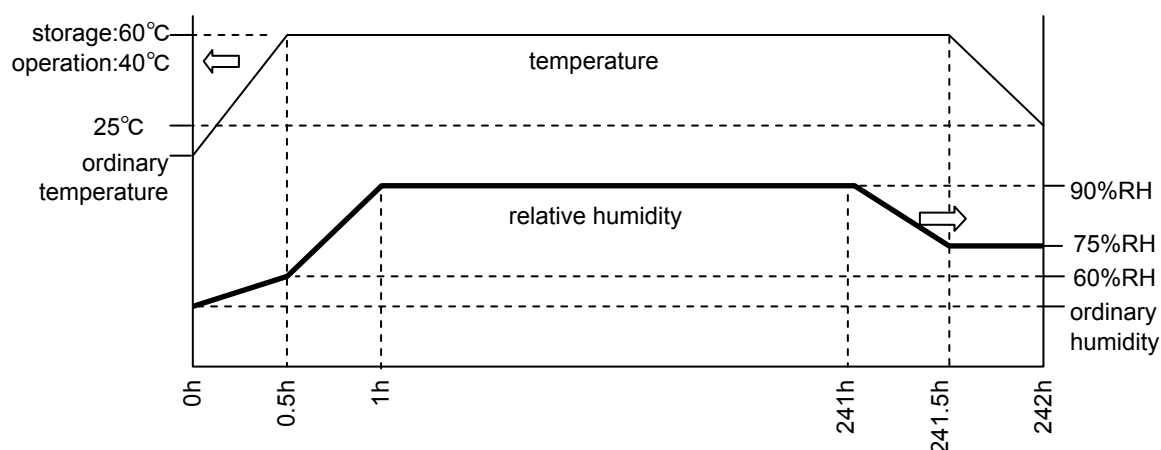
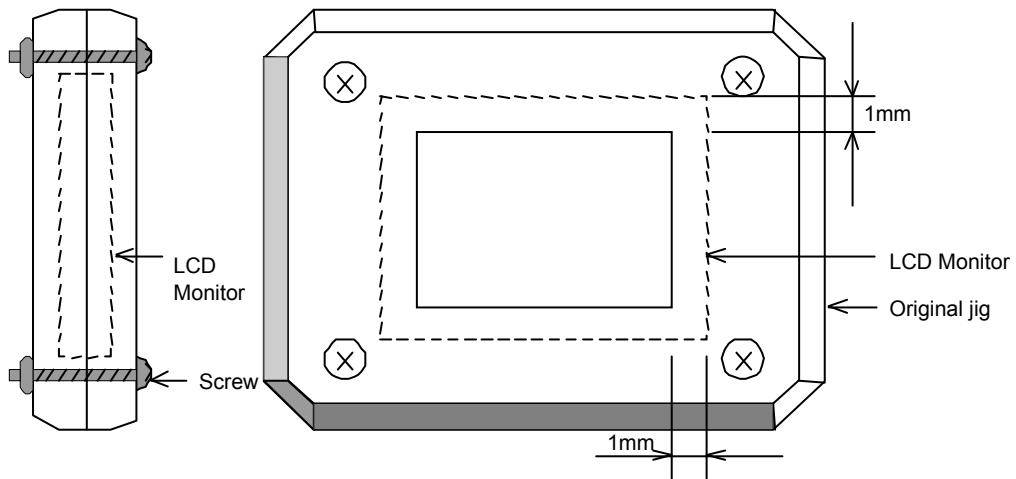


Table2.Reliability Criteria

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

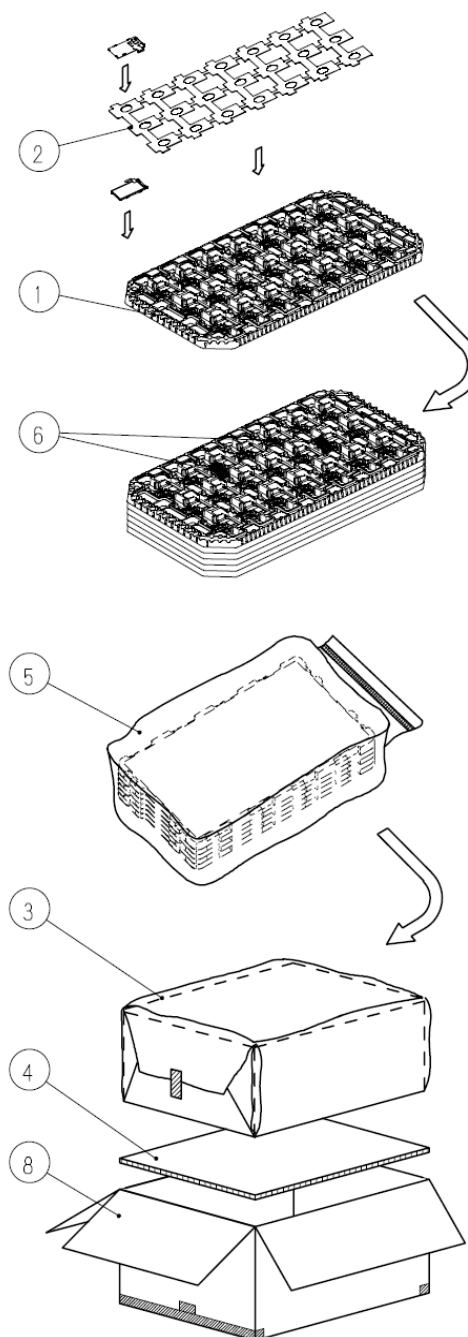
| item            | Standard                              | Remarks      |
|-----------------|---------------------------------------|--------------|
| Display quality | No visible abnormality shall be seen. |              |
| Contrast ratio  | 40 or more                            | Backlight ON |

ORTUS TECHNOLOGY Original Jig





## 16. Packing Specifications



Step1. Each product is to be placed in one of the cut-outs of the tray with it's the LCD display side facing upward, and foam-sheet is put on products.(21 pieces/1 step)  
Each product is to be placed on the FORM SHEET with the LCD display surface facing downward.(42 pieces/trays)

Step 2. Each tray filled with products is to be piled up in stack of 5.  
One empty tray is to be put on the top of stack of 5 trays.

Step 3. 2 packs of moisture absorbers are to be placed on the top tray as shown in the drawing.  
Put piled trays into a sealing bag.

Step 4. Vacuum and seal the bag with the vacuum sealing machine.

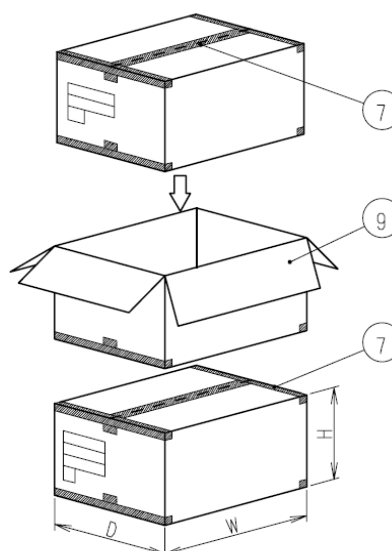
Step 5. The piled trays are to be wrapped with a bubble cushioning sheet, and to be fixed with adhesive tape.

Step 6. A corrugated board is to be placed in the bottom of an outer carton.  
The wrapped trays are to be put on the corrugated board in the outer carton.  
Another corrugated board is to be placed on the top of the inserted carton box.

Step 7. The outer carton is to be sealed in H-shape with packing tape as shown in the drawing.  
The model number, quantity of products, and shipping date are to be printed on the 2 opposite side of the outer carton with black ink.  
If necessary, shipping labels or impression markings are to be put on the outer carton.

Step 8. The outer carton is to be inserted into a extra outer carton with same direction.  
The extra outer carton needs to sealed with in H-shape with packing tape as shown in the drawing.

Step 9. The model number, quantity of products, and shipping date are to be printed on the 2 opposite sides of the extra outer carton with black ink.  
If necessary, shipping labels or impression markings are to be put on the extra outer carton.



Remark: The return of packing materials is not required.

| Packing item name    | Specs., Material            |
|----------------------|-----------------------------|
| ① Tray               | A-PET(Antistatic)           |
| ② Foam sheet         | Antistatic Polyethylene     |
| ③ B sheet A          | Antistatic air babble sheet |
| ④ Inner board        | Corrugated cardboard        |
| ⑤ Sealing bag        |                             |
| ⑥ Drier              | Moisture absorber           |
| ⑦ Packing tape       |                             |
| ⑧ Outer carton       | Corrugated cardboard        |
| ⑨ Extra outer carton | Corrugated cardboard        |

| Dimension of extra outer carton            |       |
|--|-------|
| D : Approx.                                | 337mm |
| W : Approx.                                | 618mm |
| H : Approx.                                | 179mm |
| Quantity of products packed in one carton: | 210   |
| Gross weight : Approx.                     | 5.0kg |

## 17. Handling Instruction

## 17.1 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 medial 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.**

## 17.2 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) The FPC cable is a design very weak to the bend and the pull as it is fixed with the tape.  
Do not bend or pull the FPC cable or carry the TFT monitor by holding the FPC cable.
- 8) Peel off the protective film on the TFT monitors during mounting process.  
Refer to the section 17.5 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) Please make it to the structure to suppress surroundings of the front polarizer for the display irregularity prevention.

## 17.3 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.

**B** 17.4 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.
- 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 ORTUS.

### 17.5 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.

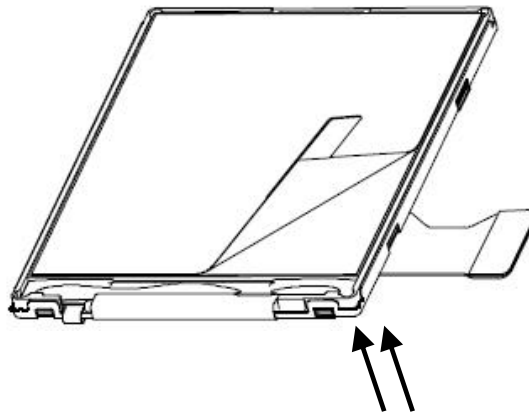
#### A) Work Environment

- 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. 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 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 right.  
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.



Direction of blowing air  
(Optimize air direction and the distance)

### 17.6 Warranty

ORTUS 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

**B** 1. Measurement Condition (Backlight ON)

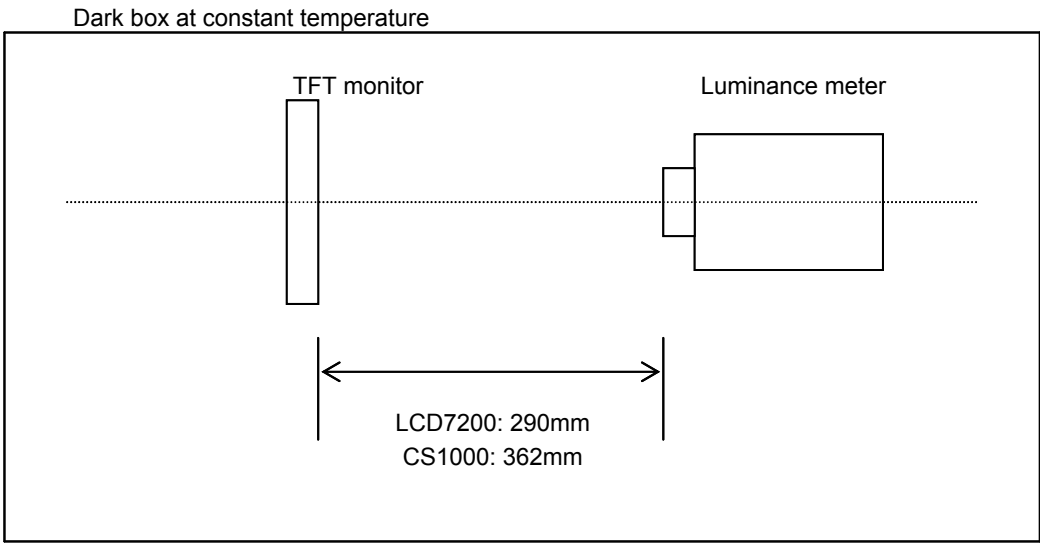
Measuring instruments: CS1000 (KONICA MINOLTA), LCD7200(OTSUKA ELECTRONICS), EZcontrast160D (ELDIM)

Driving condition: Refer to the section "Optical Characteristics"

Measured temperature: 25°C unless specified

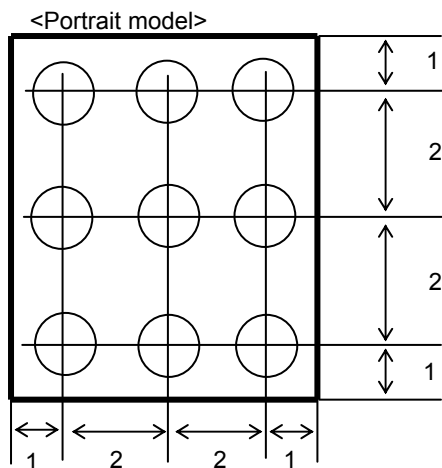
Measurement system: See the chart below. The luminance meter is placed on the normal line of measurement system.

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.



Dimensional ratio of active area

Backlight IL=6.0mA

**B** Measurement Condition (Contrast ratio Backlight OFF only)

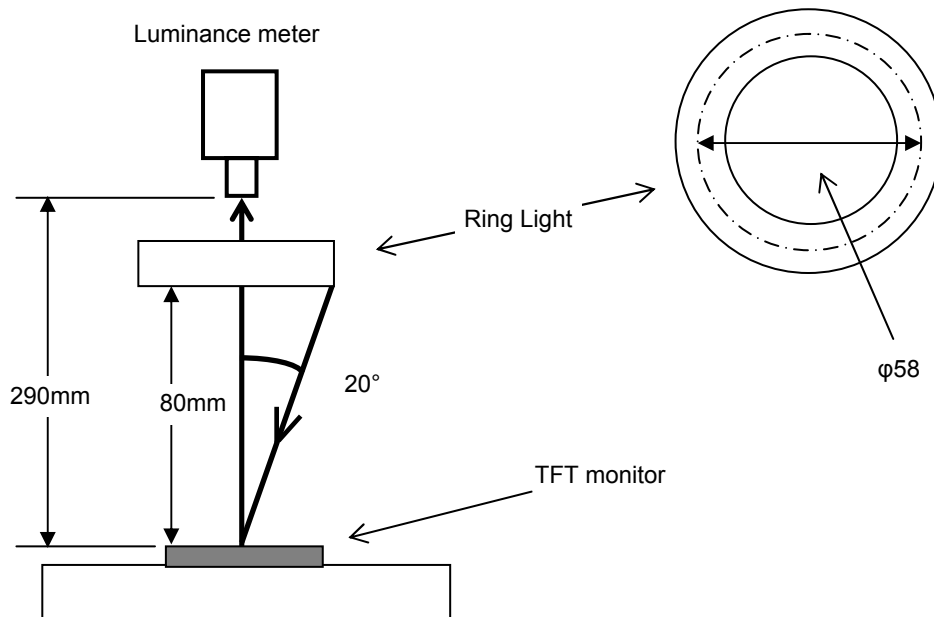
Measuring instruments: LCD7200(OTSUKA ELECTRONICS),Ring Light(40,000 lx,φ58)

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 style="text-align: center;">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]=00h</p> <p>White display [Data]=3Fh</p> <p>TON</p> <p>Rise time</p> <p>TOFF</p> <p>Fall time</p> |
| 2      | Contrast ratio                            | <p>Measure maximum luminance Y1([Data]=3Fh) 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.</p> <p style="text-align: center;">Contrast ratio = Y1/Y2</p> <p style="text-align: center;">Diameter of measuring point: 8mmφ(CS1000)</p> <p style="text-align: center;">Diameter of measuring point: 3mmφ(LCD7200)</p> | CS1000<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.   | EZcontrast160D       |  |
| 4      | White chromaticity                        | <p>Measure chromaticity coordinates x and y of CIE1931 colorimetric system at [Data] = 3Fh</p> <p style="text-align: center;">Color matching function: 2°view</p>  | CS1000               |  |
| 5      | Burn-in                                   | Visually check burn-in image on the screen after 2 hours of "window display" ([Data]=3Fh/00h ).  |                      | At optimized<br>VCOMDC   |
| 6      | Center brightness                         | Measure the brightness at the center of the screen.  | CS1000               |  |
| 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>   | CS1000               |  |



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