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Datasheet

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COM24H2P39ULC

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Specifications for

Blanview TFT-LCD Monitor

(2.4" QVGA 240 x RGB x 320 Portrait)

Version 1.0

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

MODEL COM24H2P39ULC

| |
|---------------------|
| Customer's Approval |
| Signature: |
| Name: |
| Section: |
| Title: |
| Date: |

ORTUSTECH

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1. Application

This Specification is applicable to 60.0mm (2.4 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 an mechanical design manner, especial attention in housing design to prevent arcuation/flexureor 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.
- ◎ It shall be mutually conferred if nonconforming defect which result from unspecified cause in this specification arises.
- ◎ If any issue arises as to information provided in this Specification or any other information, 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

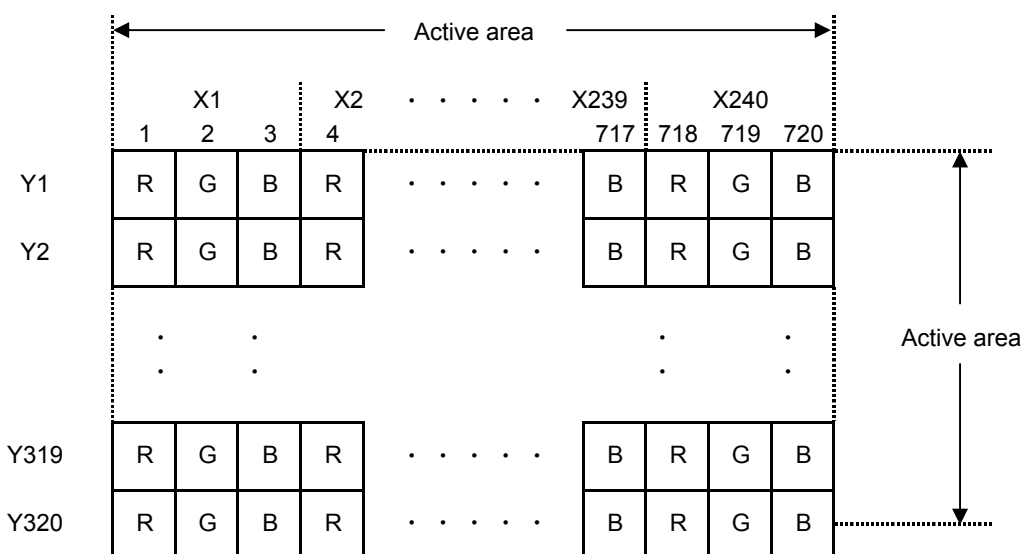
2.1 Features of the Product

- 2.4 inch diagonal display, 720 [H] x 320 [V] dots. 240RGB x 320 pixel.
- 6-bit / 262,144 colors.
- Single power supply operation of 2.7V.
- Timing generator [TG], Counter-electrode driving circuitry, Built-in power supply circuit.
- Long life & High bright white LED back-light.
- Blanview TFT-LCD, improved outdoor readability.

| | 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 | VA type 262,144 colors Blanview, Normally Black | |
| Driving method | a-Si TFT Active matrix Line-scanning, Non-interlace | |
| Dot arrangement | RGB stripe arrangement | Refer to "Dot arrangement" |
| Signal input method | 6-bit Data : Parallel interface | |
| Backlight type | Long life & High bright white LED | |
| NTSC ratio | 50% | |



Dot arrangement (FPC cable placed left side)

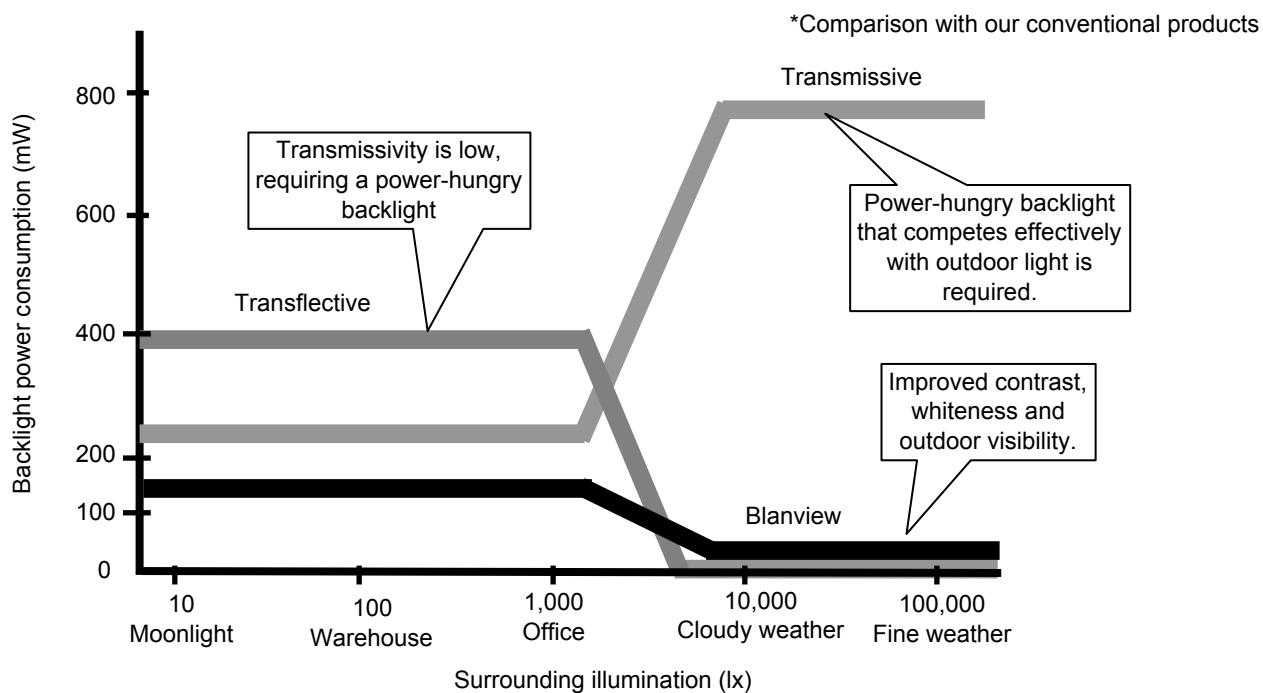
3. Dimensions and Shape

3.1 Dimensions

| Items | Specifications | Unit | Remarks |
|-----------------------------------|-------------------------------|------|---------------------------------------|
| Outline dimensions | 42.50[H] × 58.50[V] × 2.55[D] | mm | exclude FPC and components on the FPC |
| Active area | 36.00[H] × 48.00[V] | mm | 6.00cm diagonal |
| Number of dots | 720[H] × 320[V] | dot | |
| Dot pitch | 50.0[H] × 150.0[V] | μm | |
| Surface hardness of the polarizer | 2 | H | |
| Weight | 13.6 | g | Include FPC cable |

<Features of Blanview>

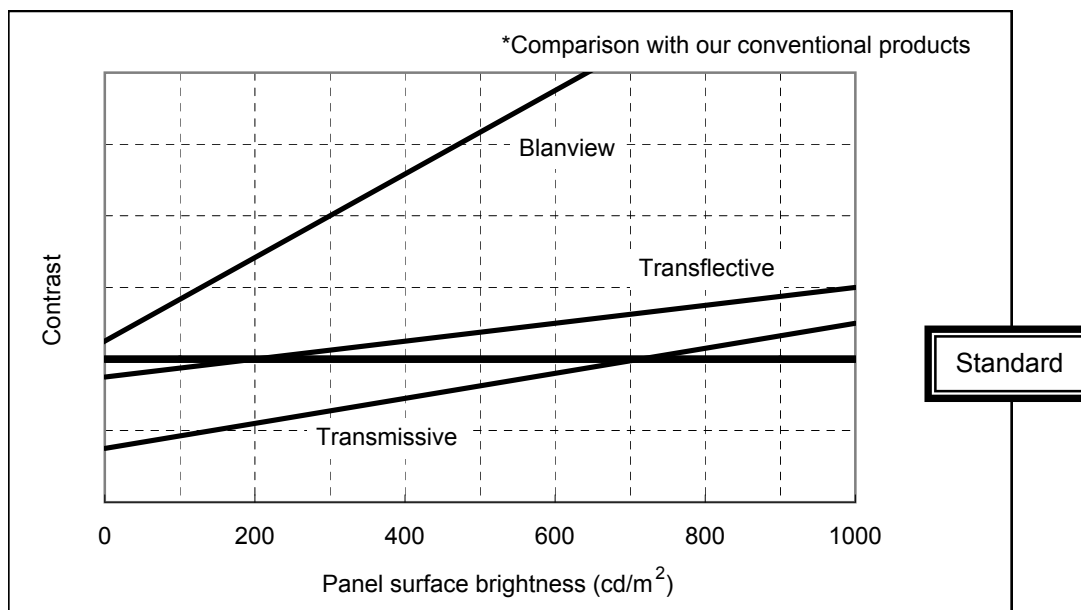
- Backlight power consumption required to assure visibility. (equivalent to 3.5"QVGA)



- 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.

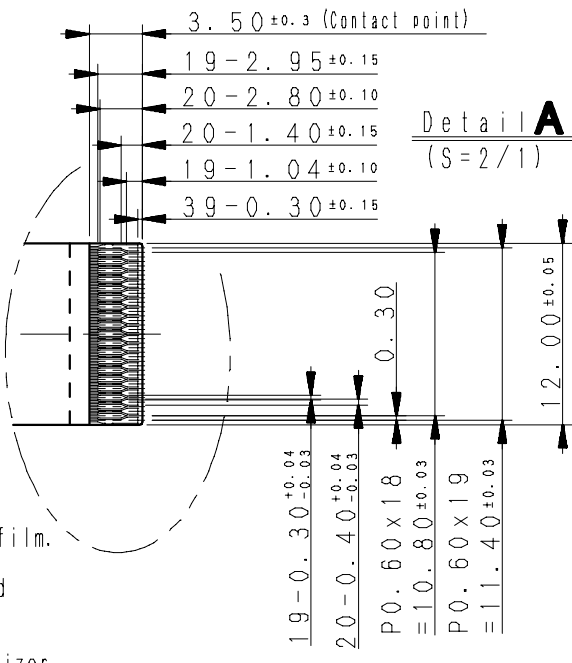
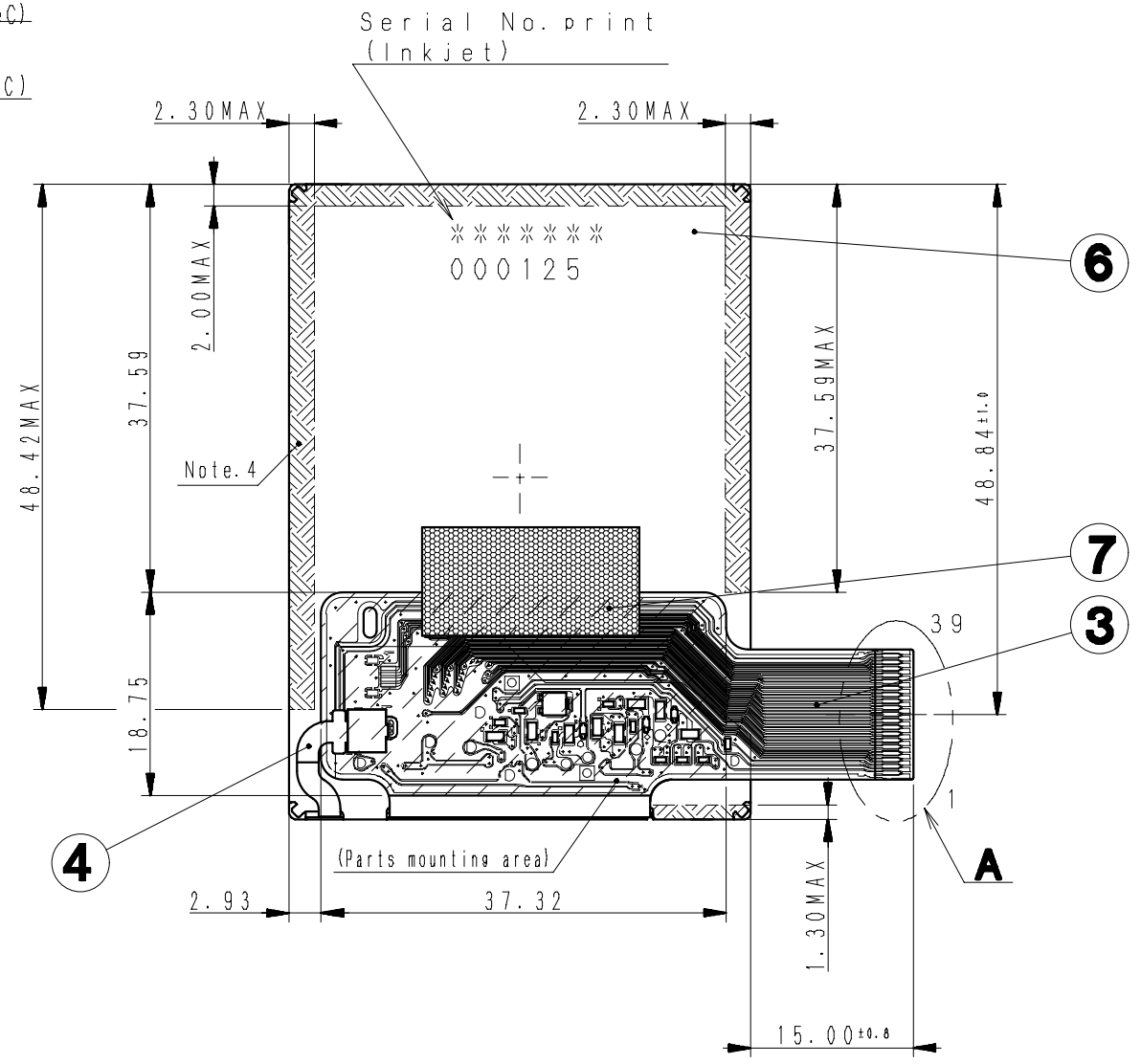
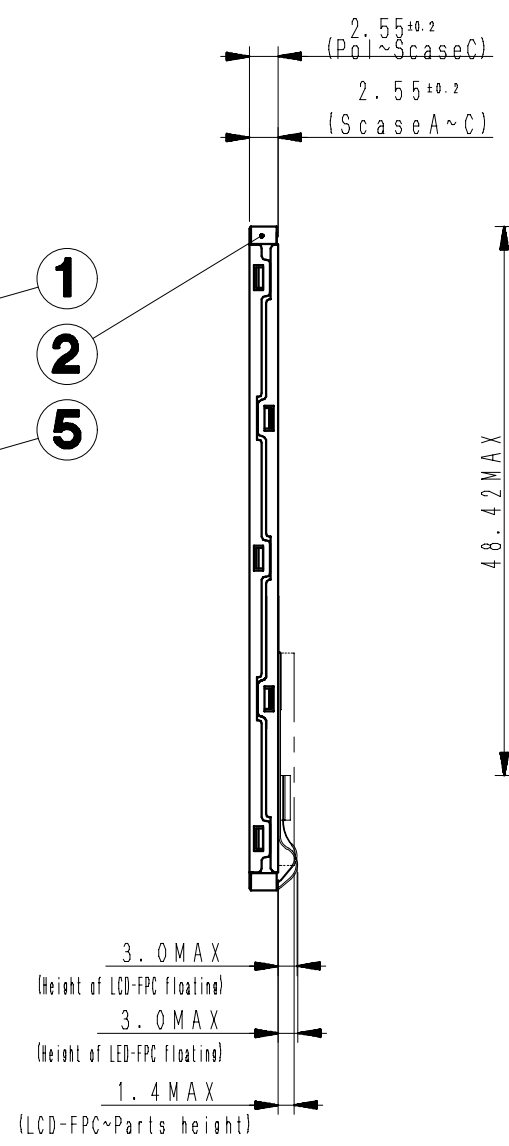
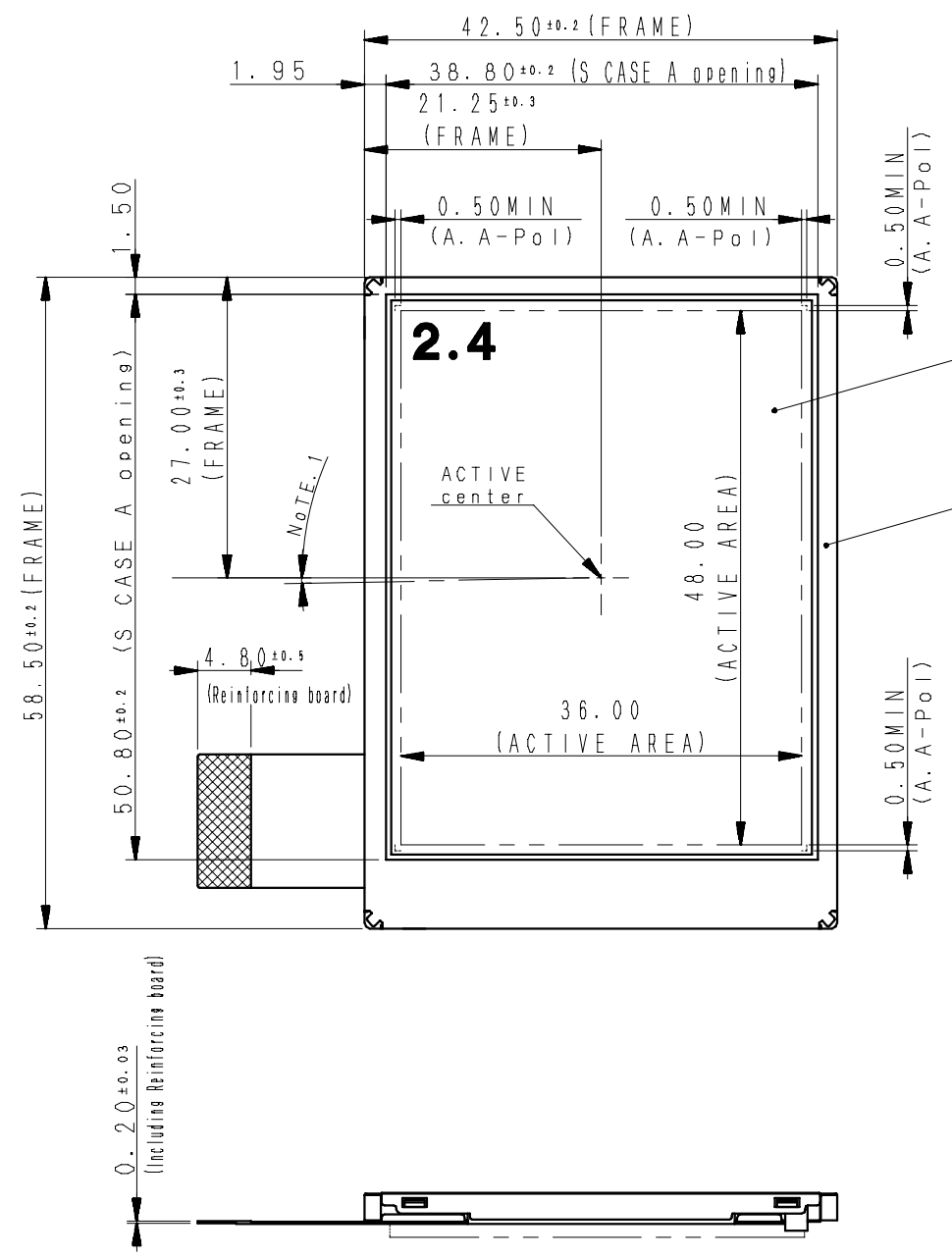
Below chart shows contrast value against panel surface brightness. (Horizontal: Panel surface brightness/ Vertical: Contrast value) LCD panel has enough outdoor readability above our Standard line. (ORTUS TECHNOLOGY criteria)



| | | | | | | |
|--------|---------|--------|--------------|----------|---------|----------|
| EC No. | REV.No. | REVISE | DATE (Y:M:D) | APPROVED | CHECKED | PREPARED |
|--------|---------|--------|--------------|----------|---------|----------|

(7/42)
16TLM004
Issue; Apr. 28, 2016

3.2 Outward Form



| I-TAPE | 8 | | | |
|-----------|------|-----------|--------------------------------|--------|
| S CASE C | 7 | | | |
| S CASE A | 6 | | | |
| LED-FPC | 5 | | | |
| LCD-FPC | 4 | | | |
| FRAME | 3 | | PC | |
| LCD | 2 | | Glass substrate thickness=0.5t | |
| PART NAME | ITEM | PART CODE | MATERIAL GRADE | REMARK |

| | | | | |
|-------------------------|---------------------------|------------------------|------------|--|
| APPROVED K.Hashizume | GENERAL TOLERANCE ±0.5 | SCALE FREE (2/1) | UNIT mm | ORTUSTECH ORTUS TECHNOLOGY CO., LTD. DO NOT DUPLICATE, CONFIDENTIAL AND PROPRIETARY |
| CHECKED J.Hiranobu | ISSUE (Y:M:D) 16:01:20 | MODEL COM24H2P39U** | | |
| CHECKED | NAME | | | DRAWING No. |
| DESIGN J.Hiranobu | | | | REV. |
| DRAW J.Hiranobu | | OUTLINE-D2P39 | | RJD527905D301 |

- Note 1. Angular deviation of LCD cell from the TFT-LCD monitor's reference axis shall be less than [±40'].
- Note 2. Recommended FPC connectors
For LCD : HIROSE, part number: FH23-39S-0.3SHW (05)
- Note 3. Protective film is affixed on front surface of the screen.
Location tolerance of the protective film shall be ±1.5 mm to the polarizing film.
- Note 4. In case TFT-LCD monitor is fixed to the case of your product, it's recommended that monitor is fixed in to area.
- Note 5. Refer to "13. CRITERIA OF JUDGMENT" about the appearance specification of a polarizer.

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 Feb-B Mar-C Apr-D | May-E Jun-F Jul-G Aug-H | Sep-I Oct-J Nov-K Dec-L |
| c | Model code | 24BHC (Made in Japan) 24BJC (Made in Malaysia) | | |
| d | Serial number | | | |

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

•Made in Japan

6J24BHC000125

means "manufactured in October 2016, 2.4" BH type, C specifications, serial number 000125"

•Made in Malaysia

6J24BJC000125

means "manufactured in October 2016, 2.4" BJ 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 | Function | I/O | Processing of Unused |
|-----|--------|---|-----|----------------------|
| 1 | VSS | GND | P | - |
| 2 | VSS | GND | P | - |
| 3 | VCI | Power supply for main circuit | P | - |
| 4 | IOVCC | Power supply for I/O circuit | P | - |
| 5 | VSS | GND | P | - |
| 6 | RESETB | Reset signal (Lo-active) | I | - |
| 7 | CSB | Chip selection signal (Lo: Select, Hi: Unselect) | I | - |
| 8 | RS | Register selection signal (Lo:index, Hi:command / Display data) | I | - |
| 9 | WRB | Write signal | I | - |
| 10 | VSS | GND | P | - |
| 11 | D0 | Data I/O | I | GND |
| 12 | D1 | Data I/O | I | GND |
| 13 | D2 | Data I/O | I | GND |
| 14 | D3 | Data I/O | I | GND |
| 15 | D4 | Data I/O | I | GND |
| 16 | D5 | Data I/O | I | GND |
| 17 | D6 | Data I/O | I | GND |
| 18 | D7 | Data I/O | I | GND |
| 19 | D8 | Data I/O | I | GND |
| 20 | D9 | Data I/O | I | GND |
| 21 | D10 | Data I/O | I | GND |
| 22 | D11 | Data I/O | I | GND |
| 23 | D12 | Data I/O | I | GND |
| 24 | D13 | Data I/O | I | GND |
| 25 | D14 | Data I/O | I | GND |
| 26 | D15 | Data I/O | I | GND |
| 27 | D16 | Data I/O (16-bit interface should be fixed to VSS) | I | GND |
| 28 | D17 | Data I/O (16-bit interface should be fixed to VSS) | I | GND |
| 29 | VSS | GND | P | - |
| 30 | BS0 | Interface mode setting terminal | I | - |
| 31 | BS1 | Interface mode setting terminal | I | - |
| 32 | RDB | Read signal | I | IOVCC |
| 33 | NC | OPEN | - | OPEN |
| 34 | NC | OPEN | - | OPEN |
| 35 | NC | OPEN | - | OPEN |
| 36 | NC | OPEN | - | OPEN |
| 37 | TE | Synchronization signal output | O | OPEN |
| 38 | BLH | LED drive power source. (Anode side) | P | - |
| 39 | BLL | LED drive power source. (Cathode side) | P | - |

Note :

- Recommended connector : Hirose FH23 series "FH23-39S-0.3SHW(05) "
- In the circuit design, the terminal array of connector for use with terminal sequence of the "3.2 Outward Form", please be sure to check.
If the array of the signal input to the product is different, it may cause a malfunction.
- FPC of the terminal has been decorated with gold-plated.
Connector contact terminals is recommended the use of gold-plated products.
- Interface mode setting terminals are fixed as follows on the FPC.
BS2=GND

5. Absolute Maximum Rating

VSS=0V

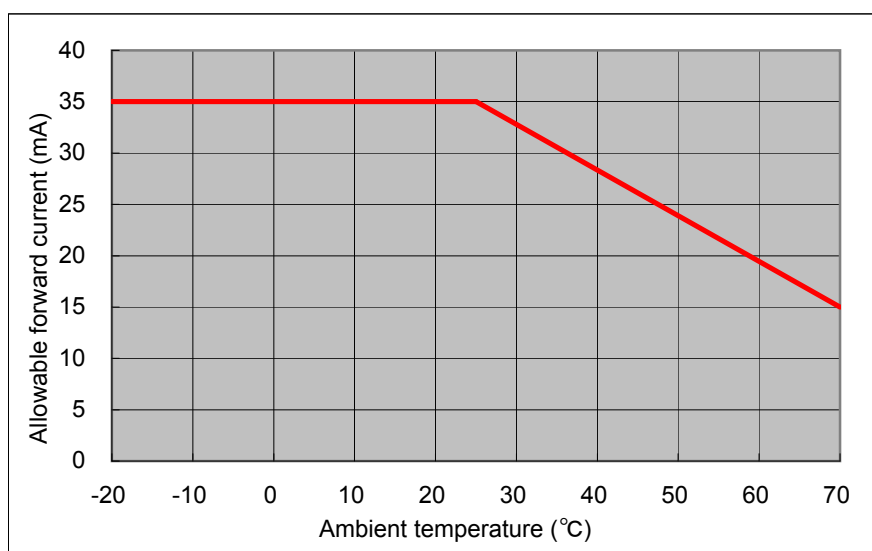
| Item | Symbol | Condition | Rating | | Unit | Applicable terminal |
|---------------------------|--------|--|--------|-----------|------|--------------------------------------|
| | | | MIN | MAX | | |
| Supply voltage | VCI | Ta=25°C | -0.3 | 4.6 | V | VCI |
| Supply voltage | IOVCC | | -0.3 | VCI | V | IOVCC |
| Input voltage for logic | VI | | -0.3 | IOVCC+0.3 | V | RESETB,CSB,RS,WRB,D0-D17,BS0,BS1,RDB |
| LED Forward current | IL | Ta=25°C | — | 35.0 | mA | BLH - BLL |
| | | Ta=70°C | — | 15.0 | | |
| Storage temperature range | Tstg | | -30 | 80 | °C | |
| Storage atmospheric range | Hstg | 40°C90%RH or less of moisture content with no condensation | | | | |

6. Recommended Operating Conditions

VSS=0V

| Item | Symbol | Condition | Rating | | | Unit | Applicable terminal |
|-------------------------------|--------|-----------|--|-----|-------|------|--------------------------------------|
| | | | MIN | TYP | MAX | | |
| Supply voltage | VCI | Ta=25°C | 2.6 | 2.7 | 3.6 | V | VCI |
| Supply voltage | IOVCC | | 1.65 | VCI | VCI | V | IOVCC |
| Input voltage for logic | VI | | 0 | — | IOVCC | V | RESETB,CSB,RS,WRB,D0-D17,BS0,BS1,RDB |
| Operational temperature range | Top | *note | -20 | 25 | 70 | °C | LCD Panel surface temperature |
| Operating humidity range | Hop | Ta ≤ 40°C | 20 | — | 85 | % | |
| | | Ta > 40°C | 40°C85%RH or less of moisture content with no condensation | | | | |

note : The maximum value of LED Forward current "IL", do not exceed the following allowable current value.



7. Characteristics

7.1 DC Characteristics

7.1.1 Display section

(Unless otherwise noted, Ta=25°C, VCI=2.7V, IOVCC=2.7V, VSS=0V)

| Item | Symbol | Condition | Rating | | | Unit | Applicable terminal |
|-----------------------|--------|---|-----------|-----|-----------|------|--|
| | | | MIN | TYP | MAX | | |
| Input Signal Voltage | VIH | | 0.7×IOVCC | — | IOVCC | V | RESETB,CSB,RS,WRB, D0-D17,BS0,BS1,RDB |
| | VIL | | 0 | — | 0.3×IOVCC | V | |
| Output Signal Voltage | VOH | IOH = -0.1mA | 0.8×IOVCC | — | — | V | D0-D17,TE |
| | VOL | IOL = 0.1mA | — | — | 0.2×IOVCC | V | |
| Operating Current | ICI | Color bar/Still image display state *note | — | 8.0 | 16.0 | mA | VCI |
| | IOICC | | — | 0.6 | 1.2 | mA | IOVCC |
| Standby Current | ICI | Other input with constant voltage | — | 1.0 | 2.0 | uA | VCI |
| | IOICC | | — | 6.0 | 20.0 | uA | IOVCC |

note : CPU is not accessing the display RAM, still image display state (Color bar display)

7.1.2 Backlight section

| Item | Symbol | Condition | Rating | | | Unit | Applicable terminal |
|-----------------------|--------|-------------------------|--------|--------|------|------|---------------------|
| | | | MIN | TYP | MAX | | |
| Forward current | IL25 | Ta=25°C | — | 7.5 | 35.0 | mA | BLH - BLL |
| | IL70 | Ta=70°C | — | — | 15.0 | mA | |
| Forward voltage | VL | Ta=25°C, IL=7.5mA | — | 5.4 | 5.6 | V | |
| Estimated Life of LED | LL | Ta=25°C, IL=7.5mA *note | — | 50,000 | — | hr | |

note :

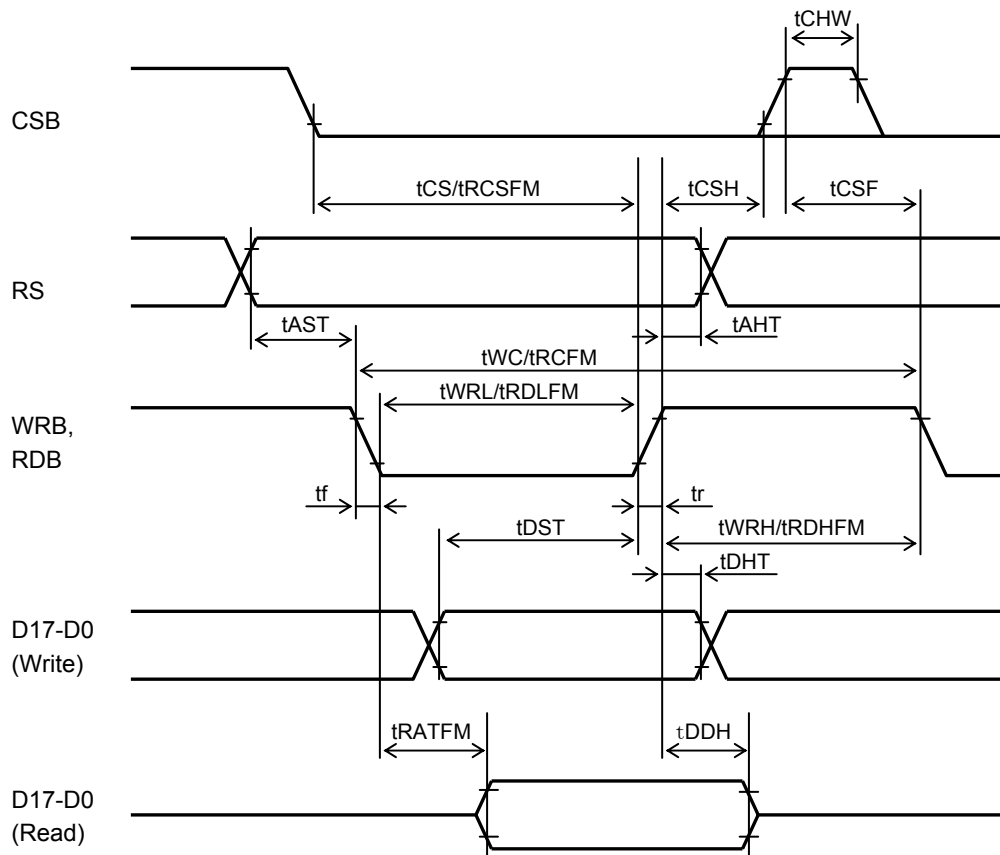
- The lifetime of the LED is defined as a period till the brightness of the LED decreases to the half of its initial value.
 - This figure is given as a reference purpose only, and not as a guarantee.
 - This figure is estimated for an LED operating alone.
- As the performance of an LED may differ when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

7.2 AC Characteristics

(Unless otherwise noted, $T_a=25^\circ\text{C}$, $V_{CI}=2.7\text{V}$, $\text{IOVCC}=2.7\text{V}$, $V_{SS}=0\text{V}$)

| Item | Symbol | Condition | Rating | | Unit |
|------------------------------|-------------|-----------|--------|-----|------|
| | | | MIN | MAX | |
| Address setup time | t_{AST} | RS | 10 | - | ns |
| Address hold time | t_{AHT} | RS | 10 | - | ns |
| CSB "High" level pulse width | t_{CHW} | CSB | 0 | - | ns |
| CSB setup time | t_{CS} | CSB-WRB | 35 | - | ns |
| | t_{RCSFM} | CSB-RDB | 180 | - | ns |
| CSB wait time | t_{CSF} | CSB | 10 | - | ns |
| CSB hold time | t_{CSH} | CSB | 10 | - | ns |
| WRB bus cycle time | t_{WC} | WRB | 100 | - | ns |
| WRB "High" level pulse width | t_{WRH} | WRB | 15 | - | ns |
| WRB "Low" level pulse width | t_{WRL} | WRB | 20 | - | ns |
| RDB bus cycle time | t_{RCFM} | WRB | 250 | - | ns |
| RDB "High" level pulse width | t_{RDHFM} | WRB | 15 | - | ns |
| RDB "Low" level pulse width | t_{RDLFM} | WRB | 180 | - | ns |
| WEB data setup time | t_{DST} | D17-D0 | 10 | - | ns |
| WEB data hold time | t_{DHT} | D17-D0 | 10 | - | ns |
| RDB data delay time | t_{RATFM} | D17-D0 | - | 340 | ns |
| RDB output disable time | t_{DDH} | D17-D0 | 20 | 80 | ns |
| Input signal rise time | t_r | | - | 15 | ns |
| Input signal fall time | t_f | | - | 15 | ns |

All timing is defined as the reference to the 30-70% of IOVCC.



9. Register list

| Register | | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----------|----------------------------------|---------|-----------|----|----|----|-------|-------|-------|-------|
| R01h | Display Mode control | * | * | * | * | * | IDMON | INVON | NORON | PTLON |
| | Initial value | (0006h) | | | | | 0 | 1 | 1 | 0 |
| | Recommended value | (0002h) | | | | | 0 | 0 | 1 | 0 |
| R02h | Column address start 2 | * | SC[15:8] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R03h | Column address start 1 | * | SC[7:0] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R04h | Column address end 2 | * | EC[15:8] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R05h | Column address end 1 | * | EC[7:0] | | | | | | | |
| | Initial value | (00EFh) | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| | Recommended value | (00EFh) | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| R06h | Row address start 2 | * | SP[15:8] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R07h | Row address start 1 | * | SP[7:0] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R08h | Row address end 2 | * | EP[15:8] | | | | | | | |
| | Initial value | (0001h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Recommended value | (0001h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| R09h | Row address end 1 | * | EP[7:0] | | | | | | | |
| | Initial value | (003Fh) | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Recommended value | (003Fh) | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| R0Ah | Partial area start row 2 | * | PSL[15:8] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R0Bh | Partial area start row 1 | * | PSL[7:0] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R0Ch | Partial area end row 2 | * | PEL[15:8] | | | | | | | |
| | Initial value | (0001h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Recommended value | (0001h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| R0Dh | Partial area end row 1 | * | PEL[7:0] | | | | | | | |
| | Initial value | (003Fh) | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Recommended value | (003Fh) | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| R0Eh | Vertical Scroll Top fixed area 2 | * | TFA[15:8] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R0Fh | Vertical Scroll Top fixed area 1 | * | TFA[7:0] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R10h | Vertical Scroll height area 2 | * | VSA[15:8] | | | | | | | |
| | Initial value | (0001h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Recommended value | (0001h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| R11h | Vertical Scroll height area 1 | * | VSA[7:0] | | | | | | | |
| | Initial value | (0040h) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0040h) | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| R12h | Vertical Scroll Button area 2 | * | BFA[15:8] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Register | | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----------|---------------------------------|------------|------------|----|----------|-----|------------|----------|-----------|----------|
| R13h | Vertical Scroll Button area 1 | * | BFA[7:0] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R14h | Vertical Scroll Start address 2 | * | VSP[15:8] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R15h | Vertical Scroll Start address 1 | * | VSP[7:0] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R16h | Memory Access control | * | MY | MX | MV | * | BGR | * | * | * |
| | Initial value | (0000h) | 0 | 0 | 0 | | 0 | | | |
| | Recommended value | (0008h) | 0 | 0 | 0 | | 1 | | | |
| R18h | Gate Scan control | * | * | * | * | * | * | * | SCROLL_ON | SM |
| | Initial value | (0000h) | | | | | | | 0 | 0 |
| | Recommended value | (0001h) | | | | | | | 0 | 1 |
| R19h | OSC Control 1 | * | CADJ[3:0] | | | | CUADJ[2:0] | | | OSC_EN |
| | Initial value | (0086h) | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| | Recommended value | (0087h) | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| R1Ah | OSC Control 2 | * | * | * | * | * | * | * | * | OSC_TEST |
| | Initial value | (0000h) | | | | | | | | 0 |
| | Recommended value | (0000h) | | | | | | | | 0 |
| R1Bh | Power Control 1 | * | GAS ENB | * | * | PON | DK | XDK | VLCD_TRI | STB |
| | Initial value | (0000h) | 0 | | | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0014h) | 0 | | | 1 | 0 | 1 | 0 | 0 |
| R1Ch | Power Control 2 | * | * | * | * | * | * | AP[2:0] | | |
| | Initial value | (0004h) | | | | | | 1 | 0 | 0 |
| | Recommended value | (0004h) | | | | | | 1 | 0 | 0 |
| R1Dh | Power Control 3 | * | * | * | * | * | * | VC1[2:0] | | |
| | Initial value | (0004h) | | | | | | 1 | 0 | 0 |
| | Recommended value | (0005h) | | | | | | 1 | 0 | 1 |
| R1Eh | Power Control 4 | * | * | * | * | * | * | VC3[2:0] | | |
| | Initial value | (0000h) | | | | | | 0 | 0 | 0 |
| | Recommended value | (0000h) | | | | | | 0 | 0 | 0 |
| R1Fh | Power Control 5 | * | * | * | * | * | VRH[3:0] | | | |
| | Initial value | (0006h) | | | | | 0 | 1 | 1 | 0 |
| | Recommended value | (0007h) | | | | | 0 | 1 | 1 | 1 |
| R20h | Power Control 6 | * | BT[3:0] | | | | * | * | * | * |
| | Initial value | (0060h) | 0 | 1 | 1 | 0 | | | | |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | | | | |
| R21h | Power Control 7 | * | * | * | FS1[1:0] | | * | * | FS0[1:0] | |
| | Initial value | (0010h) | | | 0 | 1 | | | 0 | 0 |
| | Recommended value | (0010h) | | | 0 | 1 | | | 0 | 0 |
| R22h | Write Data | GRAM Write | | | | | | | | |
| | Initial value | (0000h) | | | | | | | | |
| | Recommended value | (0000h) | | | | | | | | |
| R23h | Cycle Control 1 | * | N_DC[7:0] | | | | | | | |
| | Initial value | (0095h) | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Recommended value | (0095h) | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| R24h | Cycle Control 2 | * | PI_DC[7:0] | | | | | | | |
| | Initial value | (0095h) | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Recommended value | (0095h) | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |

| Register | | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----------|-------------------------|---------|-----------------|----|---------------------|--------|----------------|------------|------|-----|
| R25h | Cycle Control 3 | * | I_DC[7:0] | | | | | | | |
| | Initial value | (00FFh) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Recommended value | (00FFh) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| R26h | Display Control 1 | * | PT[1:0] | | GON | DTE | D[1:0] | | * | * |
| | Initial value | (00A0h) | | 1 | 0 | 1 | 0 | 0 | 0 | |
| | Recommended value | (00BCh) | | 1 | 0 | 1 | 1 | 1 | 1 | |
| R27h | Display Control 2 | * | * | * | * | * | N_BP[3:0] | | | |
| | Initial value | (0002h) | | | | | 0 | 0 | 1 | 0 |
| | Recommended value | (0002h) | | | | | 0 | 0 | 1 | 0 |
| R28h | Display Control 3 | * | * | * | * | * | N_FP[3:0] | | | |
| | Initial value | (0002h) | | | | | 0 | 0 | 1 | 0 |
| | Recommended value | (0003h) | | | | | 0 | 0 | 1 | 1 |
| R29h | Display Control 4 | * | * | * | * | * | PI_BP[3:0] | | | |
| | Initial value | (0002h) | | | | | 0 | 0 | 1 | 0 |
| | Recommended value | (0008h) | | | | | 1 | 0 | 0 | 0 |
| R2Ah | Display Control 5 | * | * | * | * | * | PI_FP[3:0] | | | |
| | Initial value | (0002h) | | | | | 0 | 0 | 1 | 0 |
| | Recommended value | (0008h) | | | | | 1 | 0 | 0 | 0 |
| R2Bh | Power Control 11 | * | * | * | PI_PRE_REFRESH[1:0] | | BLANK_DIV[3:0] | | | |
| | Initial value | (0000h) | | | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | | | 0 | 0 | 0 | 0 | 0 | 0 |
| R2Ch | Display Control 6 | * | * | * | * | * | I_BP[3:0] | | | |
| | Initial value | (0002h) | | | | | 0 | 0 | 1 | 0 |
| | Recommended value | (0008h) | | | | | 1 | 0 | 0 | 0 |
| R2Dh | Display Control 7 | * | * | * | * | * | I_FP[3:0] | | | |
| | Initial value | (0002h) | | | | | 0 | 0 | 1 | 0 |
| | Recommended value | (0008h) | | | | | 1 | 0 | 0 | 0 |
| R35h | Display Control 9 | * | EQS[7:0] | | | | | | | |
| | Initial value | (0009h) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | Recommended value | (0009h) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| R36h | Display Control 10 | * | EQP[7:0] | | | | | | | |
| | Initial value | (0009h) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | Recommended value | (0009h) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| R37h | Display Control 12 | * | * | * | PTG[1:0] | | ISC[3:0] | | | |
| | Initial value | (0000h) | | | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | | | 0 | 0 | 0 | 0 | 0 | 0 |
| R38h | RGB interface control 1 | * | * | * | * | RGB_EN | DPL | HSPL | VSPL | EPL |
| | Initial value | (0000h) | | | | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | | | | 0 | 0 | 0 | 0 | 0 |
| R39h | RGB interface control 2 | * | DOTCLK_DIV[7:0] | | | | | | | |
| | Initial value | (0000h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R3Ah | Cycle Control 1 | * | N_RTN[3:0] | | | | * | N_NW[2:0] | | |
| | Initial value | (0001h) | | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Recommended value | (00A1h) | | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| R3Bh | Cycle Control 2 | * | PI_RTN[3:0] | | | | * | PI_NW[2:0] | | |
| | Initial value | (0001h) | | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Recommended value | (00A1h) | | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| R3Ch | Cycle Control 3 | * | I_RTN[3:0] | | | | * | I_NW[2:0] | | |
| | Initial value | (00F0h) | | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| | Recommended value | (00A0h) | | 1 | 0 | 1 | 0 | 0 | 0 | 0 |

| Register | | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----------|-------------------|---------|------------|----------|------------|------------------------|-------------|----------|------------|-----|
| R3Dh | Cycle Control 4 | * | * | * | DIV_I[1:0] | | DIV_PI[1:0] | | DIV_N[1:0] | |
| | Initial value | (0000h) | | | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | | | 0 | 0 | 0 | 0 | 0 | 0 |
| R3Eh | Cycle Control 5 | * | SON[7:0] | | | | | | | |
| | Initial value | (0038h) | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| | Recommended value | (002Dh) | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| R40h | Cycle Control 6 | * | GDON[7:0] | | | | | | | |
| | Initial value | (0003h) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | Recommended value | (0003h) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| R41h | Cycle Control 7 | * | GDOF[7:0] | | | | | | | |
| | Initial value | (00F8h) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| | Recommended value | (00CCh) | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| R42h | BGP Control | * | * | * | * | V _{BGP} OF | BGP[3:0] | | | |
| | Initial value | (0008h) | | | | 0 | 1 | 0 | 0 | 0 |
| | Recommended value | (0008h) | | | | 0 | 1 | 0 | 0 | 0 |
| R43h | VCOM Control 1 | * | VCOMG | * | * | * | * | * | * | * |
| | Initial value | (0080h) | 1 | | | | | | | |
| | Recommended value | (0080h) | 1 | | | | | | | |
| R44h | VCOM Control 2 | * | * | VCM[6:0] | | | | | | |
| | Initial value | (005Ah) | | 1 | 0 | 1 | 1 | 0 | 1 | 0 |
| | Recommended value | (007Fh) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| R45h | VCOM Control 3 | * | * | * | * | VDV[4:0] | | | | |
| | Initial value | (0011h) | | | | 1 | 0 | 0 | 0 | 1 |
| | Recommended value | (0014h) | | | | (1) | (0) | (1) | (0) | (0) |
| R46h | r Control 1 | * | GSEL | CP1[2:0] | | | * | CP0[2:0] | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0083h) | (1) | (0) | (0) | (0) | | (0) | (1) | (1) |
| R47h | r Control 2 | * | * | CN1[2:0] | | | * | CN0[2:0] | | |
| | Initial value | (0000h) | | 0 | 0 | 0 | | 0 | 0 | 0 |
| | Recommended value | (0031h) | | | (1) | (1) | | (0) | (0) | (1) |
| R48h | r Control 3 | * | * | NP1[2:0] | | | * | NP0[2:0] | | |
| | Initial value | (0000h) | | 0 | 0 | 0 | | 0 | 0 | 0 |
| | Recommended value | (0001h) | | (0) | (0) | (0) | | (0) | (0) | (1) |
| R49h | r Control 4 | * | * | NP3[2:0] | | | * | NP2[2:0] | | |
| | Initial value | (0000h) | | 0 | 0 | 0 | | 0 | 0 | 0 |
| | Recommended value | (0056h) | | (1) | (0) | (1) | | (1) | (1) | (0) |
| R4Ah | r Control 5 | * | * | NP5[2:0] | | | * | NP4[2:0] | | |
| | Initial value | (0000h) | | 0 | 0 | 0 | | 0 | 0 | 0 |
| | Recommended value | (0024h) | | (0) | (1) | (0) | | (1) | (0) | (0) |
| R4Bh | r Control 6 | * | * | NN1[2:0] | | | * | NN0[2:0] | | |
| | Initial value | (0000h) | | 0 | 0 | 0 | | 0 | 0 | 0 |
| | Recommended value | (0005h) | | (0) | (0) | (0) | | (1) | (0) | (1) |
| R4Ch | r Control 7 | * | * | NN3[2:0] | | | * | NN2[2:0] | | |
| | Initial value | (0000h) | | 0 | 0 | 0 | | 0 | 0 | 0 |
| | Recommended value | (0000h) | | (0) | (0) | (0) | | (0) | (0) | (0) |
| R4Dh | r Control 8 | * | * | NN5[2:0] | | | * | NN4[2:0] | | |
| | Initial value | (0000h) | | 0 | 0 | 0 | | 0 | 0 | 0 |
| | Recommended value | (0067h) | | (1) | (1) | (0) | | (1) | (1) | (1) |
| R4Eh | r Control 9 | * | CGMP1[1:0] | | CGMP0[1:0] | | OP0[3:0] | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0001h) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (1) |

| Register | | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----------|--------------------|---------|------------------|---------------|------------|----------|-----------|-----------|------------|------------|
| R4Fh | r Control 10 | * | CGMP3 | CGMP2 | * | OP1[4:0] | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (001Fh) | (0) | (0) | (0) | (1) | (1) | (1) | (1) | (1) |
| R50h | r Control 11 | * | CGMN1[1:0] | | CGMN0[1:0] | ON0[3:0] | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (000Fh) | (0) | (0) | (0) | (0) | (1) | (1) | (1) | (1) |
| R51h | r Control 12 | * | CGMN3 | CGMN2 | * | ON1[4:0] | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (000Ah) | (0) | (0) | (0) | (0) | (1) | (0) | (1) | (0) |
| R52h | OTP Control 1 | * | OTP_MASK[7:0] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R53h | OTP Control 2 | * | OTP_INDEX[7:0] | | | | | | | |
| | Initial value | (00FFh) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Recommended value | (00FFh) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| R54h | OTP Control 3 | * | OTP_LOAD_DISABLE | DCCLK_DISABLE | OTP_POR | OTP_PWE | OTP_PTM | 0 | VPP_SELECT | OTP_PROG |
| | Initial value | (0008h) | 0 | 0 | 0 | 0 | 1 | | 0 | 0 |
| | Recommended value | (0008h) | 0 | 0 | 0 | 0 | 1 | | 0 | 0 |
| R64h | Internal Use 16 | * | ID1[7:0] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R65h | Internal Use 17 | * | * | ID2[6:0] | | | | | | |
| | Initial value | (0000h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R66h | Internal Use 18 | * | ID3[7:0] | | | | | | | |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R67h | Internal Use 19 | * | ID4[7:0] | | | | | | | |
| | Initial value | (0047h) | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| | Recommended value | (0047h) | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| R70h | Internal Use 28 | * | * | GS | SS | TE_MODE | TEON | CSEL[2:0] | | |
| | Initial value | (0006h) | | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| | Recommended value | (0066h) | | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| R72h | Data control | * | * | * | DFM[1:0] | | * | * | TRI[1:0] | |
| | Initial value | (0000h) | | | 0 | 0 | | | 0 | 0 |
| | Recommended value | (0000h) | | | 0 | 0 | | | 0 | 0 |
| R90h | Display Control 8 | * | SAP[7:0] | | | | | | | |
| | Initial value | (000Ah) | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| | Recommended value | (007Fh) | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| R91h | Display Control 11 | * | GEN_OFF[7:0] | | | | | | | |
| | Initial value | (0014h) | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| | Recommended value | (0014h) | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| R93h | OSC Control 3 | * | * | * | * | * | RADJ[3:0] | | | |
| | Initial value | (000Fh) | | | | | 1 | 1 | 1 | 1 |
| | Recommended value | (000Fh) | | | | | 1 | 1 | 1 | 1 |
| R94h | SAP Idle mode | * | SAP_[7:0] | | | | | | | |
| | Initial value | (000Ah) | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| | Recommended value | (000Ah) | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| R95h | DCCLK SYNC TO CL1 | * | * | * | * | * | * | * | * | DCCLK_SYNC |
| | Initial value | (0000h) | | | | | | | | 0 |
| | Recommended value | (0001h) | | | | | | | | 1 |
| R96h | TEST1 | * | * | * | * | * | * | * | * | TEST1 |
| | Initial value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recommended value | (0000h) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

10. Sequence

10.1 Power-ON Sequence

| | Function | Register | Recom | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|--------------------------------------|-----------------------|----------|-------|-------|------------|----------|---------------------|------------|----------------|----------|----------|------------|
| | RESETB=1 | | | | | | | | | | | |
| | wait 1 msec or more | | | | | | | | | | | |
| | RESETB=0 | | | | | | | | | | | |
| | wait 10 usec or more | | | | | | | | | | | |
| | RESETB=1 | | | | | | | | | | | |
| | wait 120 msec or more | | | | | | | | | | | |
| TEST1 setting | TEST1 | R96h | 01h | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| OSC control setting | OSC Control 1 | R19h | 87h | * | CADJ[3:0] | | | CUADJ[2:0] | | | OSC_EN | |
| | | | | | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| | wait 10 msec or more | | | | | | | | | | | |
| Display OFF setting | Display Control 1 | R26h | 80h | * | PT[1:0] | | GON | DTE | D[1:0] | | * | * |
| | | | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Power Control 1 | R1Bh | 0Ch | * | GAS_ENB | * | * | PON | DK | XDK | VLCD_TRI | STB |
| | | | | | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | VCOM Control 1 | R43h | 00h | * | VCOM_G | * | * | * | * | * | * | * |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power supply setting initializing | Power Control 6 | R20h | 00h | * | BT[3:0] | | | * | * | * | * | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Power Control 5 | R1Fh | 07h | * | * | * | * | * | VRH[3:0] | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| | VCOM Control 2 | R44h | 7Fh | * | * | VCM[6:0] | | | | | | |
| | | | | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | VCOM Control 3 | R45h | (14h) | * | * | * | * | VDV[4:0] | | | | |
| | | | | | (0) | (0) | (0) | (1) | (0) | (1) | (0) | (0) |
| | Power Control 3 | R1Dh | 05h | * | * | * | * | * | * | VC1[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | Power Control 4 | R1Eh | 00h | * | * | * | * | * | * | VC3[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power supply operation start setting | Power Control 2 | R1Ch | 04h | * | * | * | * | * | * | AP[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | Power Control 1 | R1Bh | 14h | * | GAS_ENB | * | * | PON | DK | XDK | VLCD_TRI | STB |
| | | | | | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| | wait 40 msec or more | | | | | | | | | | | |
| | VCOM Control 1 | R43h | 80h | * | VCOM_G | * | * | * | * | * | * | * |
| | | | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power control setting | BGP Control | R42h | 08h | * | * | * | * | VBGP_OE | BGP[3:0] | | | |
| | | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | Cycle Control 1 | R23h | 95h | * | N_DC[7:0] | | | | | | | |
| | | | | | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Cycle Control 2 | R24h | 95h | * | PI_DC[7:0] | | | | | | | |
| | | | | | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Cycle Control 3 | R25h | FFh | * | I_DC[7:0] | | | | | | | |
| | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Power Control 7 | R21h | 10h | * | * | * | FS1[1:0] | | * | * | FS0[1:0] | |
| | | | | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | Power Control 11 | R2Bh | 00h | * | * | * | PI_PRE_REFRESH[1:0] | | BLANK_DIV[3:0] | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | DCCLK SYNC TO CL1 | R95h | 01h | * | * | * | * | * | * | * | * | DCCLK_SYNC |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

| | Function | Register | Recom | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------------------------|-------------------------|----------|---------|--------------|-----------------|----------|----------|----------|------------|-----------|-------|----------|
| OSC control setting | OSC Control 2 | R1Ah | 00h | * | * | * | * | * | * | * | * | OSC_TEST |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | OSC Control 3 | R93h | 0Fh | * | * | * | * | * | RADJ[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | |
| r control setting | Internal Use 28 | R70h | 66h | * | * | GS | SS | TE | TEON | CSEL[2:0] | | |
| | | | | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | |
| | Gate Scan control | R18h | 01h | * | * | * | * | * | * | SCROL | SM | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| r control setting | r Control 1 | R46h | (83h) | * | GSEL | CP1[2:0] | | | * | CP0[2:0] | | |
| | | | | (1) | (0) | (0) | (0) | (0) | (0) | (1) | (1) | |
| | r Control 2 | R47h | (31h) | * | * | CN1[2:0] | | | * | CN0[2:0] | | |
| | | | | (0) | (0) | (1) | (1) | (0) | (0) | (0) | (1) | |
| | r Control 3 | R48h | (01h) | * | * | NP1[2:0] | | | * | NP0[2:0] | | |
| | | | | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (1) | |
| | r Control 4 | R49h | (56h) | * | * | NP3[2:0] | | | * | NP2[2:0] | | |
| | | | | (0) | (1) | (0) | (1) | (0) | (1) | (1) | (0) | |
| | r Control 5 | R4Ah | (24h) | * | * | NP5[2:0] | | | * | NP4[2:0] | | |
| | | | | (0) | (0) | (1) | (0) | (0) | (1) | (0) | (0) | |
| | r Control 6 | R4Bh | (05h) | * | * | NN1[2:0] | | | * | NN0[2:0] | | |
| | | | | (0) | (0) | (0) | (0) | (0) | (1) | (0) | (1) | |
| r Control 7 | R4Ch | (00h) | * | * | NN3[2:0] | | | * | NN2[2:0] | | | |
| | | | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | | |
| r Control 8 | R4Dh | (67h) | * | * | NN5[2:0] | | | * | NN4[2:0] | | | |
| | | | (0) | (1) | (1) | (0) | (0) | (1) | (1) | (1) | | |
| r Control 9 | R4Eh | (01h) | * | CGMP1[1:0] | CGMP0[1:0] | OP0[3:0] | | | | | | |
| | | | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (1) | | |
| r Control 10 | R4Fh | (1Fh) | * | CGMP3 | CGMP2 | * | OP1[4:0] | | | | | |
| | | | (0) | (0) | (0) | (1) | (1) | (1) | (1) | (1) | | |
| r Control 11 | R50h | (0Fh) | * | CGMN1[1:0] | CGMN0[1:0] | ON0[3:0] | | | | | | |
| | | | (0) | (0) | (0) | (0) | (1) | (1) | (1) | (1) | | |
| r Control 12 | R51h | (0Ah) | * | CGMN3 | CGMN2 | * | ON1[4:0] | | | | | |
| | | | (0) | (0) | (0) | (0) | (1) | (0) | (1) | (0) | | |
| RGB interface control setting | RGB interface control 1 | R38h | 00h | * | * | * | * | RGB_EN | DPL | HSPL | VSPL | EPL |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| RGB interface control setting | RGB interface control 2 | R39h | 00h | * | DOTCLK_DIV[7:0] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Display control setting | Display Control 2 | R27h | 02h | * | * | * | * | * | N_BP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| | Display Control 3 | R28h | 03h | * | * | * | * | * | N_FP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | |
| | Display Control 4 | R29h | 08h | * | * | * | * | * | PI_BP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| | Display Control 5 | R2Ah | 08h | * | * | * | * | * | PI_FP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| | Display Control 6 | R2Ch | 08h | * | * | * | * | * | I_BP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| | Display Control 7 | R2Dh | 08h | * | * | * | * | * | I_FP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| Display Control 9 | R35h | 09h | * | EQS[7:0] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | | |
| Display Control 10 | R36h | 09h | * | EQP[7:0] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | | |
| Display Control 11 | R91h | 14h | * | GEN_OFF[7:0] | | | | | | | | |
| | | | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | | |
| Display Control 12 | R37h | 00h | * | * | * | PTG[1:0] | | ISC[3:0] | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

| | Function | Register | Recom | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---------------------------------|----------------------------------|----------|-------|-----------|-------------|------------|----|-------------|------------|------------|-------|-------|
| Display control setting | Display Mode control | R01h | 02h | * | * | * | * | * | IDMON | INVON | NORON | PTLON |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| | Cycle Control 1 | R3Ah | A1h | * | N_RTN[3:0] | | | * | N_NW[2:0] | | | |
| | | | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | |
| | Cycle Control 2 | R3Bh | A1h | * | PI_RTN[3:0] | | | * | PI_NW[2:0] | | | |
| | | | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | |
| | Cycle Control 3 | R3Ch | A0h | * | I_RTN[3:0] | | | * | I_NW[2:0] | | | |
| | | | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | |
| Cycle Control 4 | R3Dh | 00h | * | * | * | DIV_I[1:0] | | DIV_PI[1:0] | | DIV_N[1:0] | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Cycle Control 5 | R3Eh | 2Dh | * | SON[7:0] | | | | | | | | |
| | | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | | |
| Cycle Control 6 | R40h | 03h | * | GDON[7:0] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | | |
| Cycle Control 7 | R41h | CCh | * | GDOF[7:0] | | | | | | | | |
| | | | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | | |
| Patial Image Display setting | Partial area start row 2 | R0Ah | 00h | * | PSL[15:8] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Partial area start row 1 | R0Bh | 00h | * | PSL[7:0] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Partial area end row 2 | R0Ch | 01h | * | PEL[15:8] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | |
| Partial area end row 1 | R0Dh | 3Fh | * | PEL[7:0] | | | | | | | | |
| | | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| Vertical Scroll setting | Vertical Scroll Top fixed area 2 | R0Eh | 00h | * | TFA[15:8] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Vertical Scroll Top fixed area 1 | R0Fh | 00h | * | TFA[7:0] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Vertical Scroll height area 2 | R10h | 01h | * | VSA[15:8] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| | Vertical Scroll height area 1 | R11h | 40h | * | VSA[7:0] | | | | | | | |
| | | | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Vertical Scroll Button area 2 | R12h | 00h | * | BFA[15:8] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Vertical Scroll Button area 1 | R13h | 00h | * | BFA[7:0] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Vertical Scroll Start address 2 | R14h | 00h | * | VSP[15:8] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Vertical Scroll Start address 1 | R15h | 00h | * | VSP[7:0] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Window address setting | Column address start 2 | R02h | 00h | * | SC[15:8] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Column address start 1 | R03h | 00h | * | SC[7:0] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Column address end 2 | R04h | 00h | * | EC[15:8] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Column address end 1 | R05h | EFh | * | EC[7:0] | | | | | | | |
| | | | | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | |
| | Row address start 2 | R06h | 00h | * | SP[15:8] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Row address start 1 | R07h | 00h | * | SP[7:0] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Row address end 2 | R08h | 01h | * | EP[15:8] | | | | | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | |
| Row address end 1 | R09h | 3Fh | * | EP[7:0] | | | | | | | | |
| | | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| Memory Access control | R16h | 08h | * | MY | MX | MV | * | BGR | * | * | * | |
| | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | |
| Data control | R72h | 00h | * | * | * | DFM[1:0] | | * | * | TRI[1:0] | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

| | Function | Register | Recom | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------------------------|----------------------|----------|-------|-----------------|-----------|-----|--------|--------|----|----|----|----|
| Window address setting | Write Data | R22h | | GRAM Write Data | | | | | | | | |
| | wait 60 msec or more | | | | | | | | | | | |
| Display on setting | SAP Idle mode | R94h | 0Ah | * | SAP_[7:0] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| | Display Control 8 | R90h | 7Fh | * | SAP[7:0] | | | | | | | |
| | | | | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Display Control 1 | R26h | 84h | * | PT[1:0] | GON | DTE | D[1:0] | | * | * | |
| | | | | | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | wait 40 msec or more | | | | | | | | | | | |
| | Display Control 1 | R26h | A4h | * | PT[1:0] | GON | DTE | D[1:0] | | * | * | |
| | | | | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | |
| Display Control 1 | R26h | ACh | * | PT[1:0] | GON | DTE | D[1:0] | | * | * | | |
| | | | | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | |
| wait 40 msec or more | | | | | | | | | | | | |
| Display Control 1 | R26h | BCh | * | PT[1:0] | GON | DTE | D[1:0] | | * | * | | |
| | | | | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| TEST1 setting | TEST1 | R96h | 00h | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

10.2 Power-OFF Sequence (Standby mode transition sequence)

| | Function | Register | Recom | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----------------------|----------------------|----------|-------|---------|-----------|-----|--------|--------|------------|----------|----------|--------|
| TEST1 setting | TEST1 | R96h | 01h | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Display Control 1 | R26h | B8h | * | PT[1:0] | GON | DTE | D[1:0] | | * | * | |
| | | | | | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| | wait 40 msec or more | | | | | | | | | | | |
| | Display Control 1 | R26h | A8h | * | PT[1:0] | GON | DTE | D[1:0] | | * | * | |
| | | | | | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| | Display Control 1 | R26h | 84h | * | PT[1:0] | GON | DTE | D[1:0] | | * | * | |
| | | | | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | |
| wait 40 msec or more | | | | | | | | | | | | |
| Display Control 1 | R26h | 80h | * | PT[1:0] | GON | DTE | D[1:0] | | * | * | | |
| | | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Power off setting | Display Control 8 | R90h | 00h | * | SAP[7:0] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Power Control 2 | R1Ch | 00h | * | * | * | * | * | * | AP[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Power Control 1 | R1Bh | 04h | * | GAS ENB | * | * | PON | DK | XDK | VLCD_TRI | STB |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| VCOM Control 1 | R43h | 00h | * | VCOM G | * | * | * | * | * | * | * | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power Control 1 | R1Bh | 0Ch | * | GAS ENB | * | * | PON | DK | XDK | VLCD_TRI | STB | |
| | | | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| TEST1 setting | TEST1 | R96h | 00h | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power off setting | Power Control 1 | R1Bh | 0Dh | * | GAS ENB | * | * | PON | DK | XDK | VLCD_TRI | STB |
| | | | | | | | | | | | | |
| OSC control setting | OSC Control 1 | R19h | 86h | * | CADJ[3:0] | | | | CUADJ[2:0] | | | OSC_EN |
| | | | | | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |

10.3 Sleep Release Sequence

| | Function | Register | Recom | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
|---------------------|--------------------------------------|-----------------|-------|---------|------------|---------|----------|-------|------------|----------|--------------|--------|---|
| OSC control setting | OSC Control 1 | R19h | 87h | * | CADJ[3:0] | | | | CUADJ[2:0] | | | OSC_EN | |
| | | | | | 1 | 0 | 0 | 0 | 0 | 1 | 1 | | 1 |
| | wait 10 msec or more | | | | | | | | | | | | |
| | Power Control 1 | R1Bh | 0Ch | * | GAS ENB | * | * | PON | DK | XDK | VLCD _TRI | STB | |
| | | | | | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | |
| | Power supply setting initializing | Power Control 6 | R20h | 00h | * | BT[3:0] | | | | * | * | * | * |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | Power Control 5 | R1Fh | 07h | * | * | * | * | * | VRH[3:0] | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | |
| | | VCOM Control 2 | R44h | 7Fh | * | * | VCM[6:0] | | | | | | |
| | | | | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | | VCOM Control 3 | R45h | (14h) | * | * | * | * | VDV[4:0] | | | | |
| | | | | | (0) | (0) | (0) | (1) | (0) | (1) | (0) | (0) | |
| | | Power Control 3 | R1Dh | 05h | * | * | * | * | * | * | VC1[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | |
| | | Power Control 4 | R1Eh | 00h | * | * | * | * | * | * | VC3[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Power supply operation start setting | Power Control 2 | R1Ch | 04h | * | * | * | * | * | * | AP[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | |
| | Power Control 1 | R1Bh | 14h | * | GAS ENB | * | * | PON | DK | XDK | VLCD _TRI | STB | |
| | | | | | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | |
| | wait 40 msec or more | | | | | | | | | | | | |
| | VCOM Control 1 | R43h | 80h | * | VCOM G | * | * | * | * | * | * | * | |
| | | | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | wait 60 msec or more | | | | | | | | | | | | |
| Display on setting | Display Control 8 | R90h | 7Fh | * | SAP[7:0] | | | | | | | | |
| | | | | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| TEST1 setting | TEST1 | R96h | 01h | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| Display on setting | Display Control 1 | R26h | 84h | * | PT[1:0] | | GON | DTE | D[1:0] | | * | * | |
| | | | | | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | |
| | wait 40 msec or more | | | | | | | | | | | | |
| | Display Control 1 | R26h | A4h | * | PT[1:0] | | GON | DTE | D[1:0] | | * | * | |
| | | | | | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | |
| | Display Control 1 | R26h | ACh | * | PT[1:0] | | GON | DTE | D[1:0] | | * | * | |
| | | | | | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | |
| | wait 40 msec or more | | | | | | | | | | | | |
| | Display Control 1 | R26h | BCh | * | PT[1:0] | | GON | DTE | D[1:0] | | * | * | |
| | | | | | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| TEST1 setting | TEST1 | R96h | 00h | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

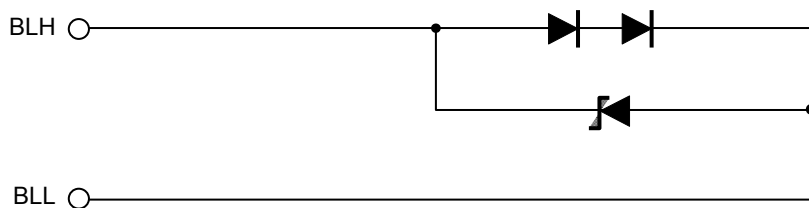
10.4 Refresh Sequence

| | Function | Register | Recom | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|--------------------------------------|-------------------|----------|-------|-------|------------|----------|-------------------------|-------------|----------------|-----------|---------------|----------------|
| OSC control setting | OSC Control 1 | R19h | 87h | * | CADJ[3:0] | | | CUADJ[2:0] | | | OSC_EN | |
| | | | | | 1 | 0 | 0 | 0 | 0 | 1 | | 1 |
| Power supply setting initializing | Power Control 6 | R20h | 00h | * | BT[3:0] | | | * | * | * | * | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Power Control 5 | R1Fh | 07h | * | * | * | * | * | VRH[3:0] | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| | VCOM Control 2 | R44h | 7Fh | * | * | VCM[6:0] | | | | | | |
| | | | | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | VCOM Control 3 | R45h | (14h) | * | * | * | * | VDV[4:0] | | | | |
| | | | | (0) | (0) | (0) | (1) | (0) | (1) | (0) | (0) | |
| | Power Control 3 | R1Dh | 05h | * | * | * | * | * | * | VC1[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | Power Control 4 | R1Eh | 00h | * | * | * | * | * | * | VC3[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power supply operation start setting | Power Control 2 | R1Ch | 04h | * | * | * | * | * | * | AP[2:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | Power Control 1 | R1Bh | 14h | * | GAS ENB | * | * | PON | DK | XDK | VLCD _TRI | STB |
| | | | | | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| | VCOM Control 1 | R43h | 80h | * | VCOM G | * | * | * | * | * | * | * |
| | | | | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Power control setting | BGP Control | R42h | 08h | * | * | * | * | VBGP _OE | BGP[3:0] | | | |
| | | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | Cycle Control 1 | R23h | 95h | * | N_DC[7:0] | | | | | | | |
| | | | | | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Cycle Control 2 | R24h | 95h | * | PI_DC[7:0] | | | | | | | |
| | | | | | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Cycle Control 3 | R25h | FFh | * | I_DC[7:0] | | | | | | | |
| | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Power Control 7 | R21h | 10h | * | * | * | FS1[1:0] | | * | * | FS0[1:0] | |
| | | | | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | Power Control 11 | R2Bh | 00h | * | * | * | PI_PRE_ REFRESH[1:0] | | BLANK_DIV[3:0] | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | DCCLK SYNC TO CL1 | R95h | 01h | * | * | * | * | * | * | * | * | DCCLK _SYNC |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| OSC control setting | OSC Control 2 | R1Ah | 00h | * | * | * | * | * | * | * | * | OSC_ TEST |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | OSC Control 3 | R93h | 0Fh | * | * | * | * | * | RADJ[3:0] | | | |
| | | | | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| | Internal Use 28 | R70h | 66h | * | * | GS | SS | TE MODE | TEON | CSEL[2:0] | | |
| | | | | | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| | Gate Scan control | R18h | 01h | * | * | * | * | * | * | * | SCROL L_ON | SM |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

| | Function | Register | Recom | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------------------------|-------------------------|----------|---------|--------------|-----------------|----------|-------------|----------|------------|----------|-------|-----|
| r control setting | r Control 1 | R46h | (83h) | * | GSEL | CP1[2:0] | | | * | CP0[2:0] | | |
| | | | | (1) | (0) | (0) | (0) | (0) | (0) | (1) | (1) | |
| | r Control 2 | R47h | (31h) | * | * | CN1[2:0] | | | * | CNO[2:0] | | |
| | | | | (0) | (0) | (1) | (1) | (0) | (0) | (0) | (1) | |
| | r Control 3 | R48h | (01h) | * | * | NP1[2:0] | | | * | NP0[2:0] | | |
| | | | | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (1) | |
| | r Control 4 | R49h | (56h) | * | * | NP3[2:0] | | | * | NP2[2:0] | | |
| | | | | (0) | (1) | (0) | (1) | (0) | (1) | (1) | (0) | |
| | r Control 5 | R4Ah | (24h) | * | * | NP5[2:0] | | | * | NP4[2:0] | | |
| | | | | (0) | (0) | (1) | (0) | (0) | (1) | (0) | (0) | |
| | r Control 6 | R4Bh | (05h) | * | * | NN1[2:0] | | | * | NNO[2:0] | | |
| | | | | (0) | (0) | (0) | (0) | (0) | (1) | (0) | (1) | |
| r Control 7 | R4Ch | (00h) | * | * | NN3[2:0] | | | * | NN2[2:0] | | | |
| | | | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | | |
| r Control 8 | R4Dh | (67h) | * | * | NN5[2:0] | | | * | NN4[2:0] | | | |
| | | | (0) | (1) | (1) | (0) | (0) | (1) | (1) | (1) | | |
| r Control 9 | R4Eh | (01h) | * | CGMP1[1:0] | CGMP0[1:0] | OP0[3:0] | | | | | | |
| | | | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (1) | |
| r Control 10 | R4Fh | (1Fh) | * | CGMP3 | CGMP2 | * | OP1[4:0] | | | | | |
| | | | (0) | (0) | (0) | (1) | (1) | (1) | (1) | (1) | (1) | |
| r Control 11 | R50h | (0Fh) | * | CGMN1[1:0] | CGMN0[1:0] | ON0[3:0] | | | | | | |
| | | | (0) | (0) | (0) | (0) | (1) | (1) | (1) | (1) | | |
| r Control 12 | R51h | (0Ah) | * | CGMN3 | CGMN2 | * | ON1[4:0] | | | | | |
| | | | (0) | (0) | (0) | (0) | (1) | (0) | (1) | (0) | | |
| RGB interface control setting | RGB interface control 1 | R38h | 00h | * | * | * | * | RGB_EN | DPL | HSPL | VSPL | EPL |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| RGB interface control setting | RGB interface control 2 | R39h | 00h | * | DOTCLK_DIV[7:0] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Display control setting | Display Control 2 | R27h | 02h | * | * | * | * | * | N_BP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| | Display Control 3 | R28h | 03h | * | * | * | * | * | N_FP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | |
| | Display Control 4 | R29h | 08h | * | * | * | * | * | PI_BP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| | Display Control 5 | R2Ah | 08h | * | * | * | * | * | PI_FP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| | Display Control 6 | R2Ch | 08h | * | * | * | * | * | I_BP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| | Display Control 7 | R2Dh | 08h | * | * | * | * | * | I_FP[3:0] | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| | Display Control 9 | R35h | 09h | * | EQS[7:0] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | |
| | Display Control 10 | R36h | 09h | * | EQP[7:0] | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | |
| Display Control 11 | R91h | 14h | * | GEN_OFF[7:0] | | | | | | | | |
| | | | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | | |
| Display Control 12 | R37h | 00h | * | * | * | PTG[1:0] | | ISC[3:0] | | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Display Mode control | R01h | 02h | * | * | * | * | * | IDMON | INVON | NORON | PTLON | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | | |
| Cycle Control 1 | R3Ah | A1h | * | N_RTN[3:0] | | | | * | N_NW[2:0] | | | |
| | | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | | |
| Cycle Control 2 | R3Bh | A1h | * | PI_RTN[3:0] | | | | * | PI_NW[2:0] | | | |
| | | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | | |
| Cycle Control 3 | R3Ch | A0h | * | I_RTN[3:0] | | | | * | I_NW[2:0] | | | |
| | | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | | |
| Cycle Control 4 | R3Dh | 00h | * | * | DIV_I[1:0] | | DIV_PI[1:0] | | DIV_N[1:0] | | | |
| | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

| | Function | Register | Recom | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|------------------------------|----------------------------------|----------|-------|----------|------------|-----|----------|--------|-----|----------|----|----|
| Display control setting | Cycle Control 5 | R3Eh | 2Dh | * | SON[7:0] | | | | | | | |
| | | | | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| | Cycle Control 6 | R40h | 03h | * | GDON[7:0] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | Cycle Control 7 | R41h | CCh | * | GDOF[7:0] | | | | | | | |
| | | | | | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| Patial Image Display setting | Partial area start row 2 | R0Ah | 00h | * | PSL[15:8] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Partial area start row 1 | R0Bh | 00h | * | PSL[7:0] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Partial area end row 2 | R0Ch | 01h | * | PEL[15:8] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Partial area end row 1 | R0Dh | 3Fh | * | PEL[7:0] | | | | | | | |
| | | | | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| Vertical Scroll setting | Vertical Scroll Top fixed area 2 | R0Eh | 00h | * | TFA[15:8] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Vertical Scroll Top fixed area 1 | R0Fh | 00h | * | TFA[7:0] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Vertical Scroll height area 2 | R10h | 01h | * | VSA[15:8] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Vertical Scroll height area 1 | R11h | 40h | * | VSA[7:0] | | | | | | | |
| | | | | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Vertical Scroll Button area 2 | R12h | 00h | * | BFA[15:8] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Vertical Scroll Button area 1 | R13h | 00h | * | BFA[7:0] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Vertical Scroll Start address 2 | R14h | 00h | * | VSP[15:8] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Vertical Scroll Start address 1 | R15h | 00h | * | VSP[7:0] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Window address setting | Column address start 2 | R02h | 00h | * | SC[15:8] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Column address start 1 | R03h | 00h | * | SC[7:0] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Column address end 2 | R04h | 00h | * | EC[15:8] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Column address end 1 | R05h | EFh | * | EC[7:0] | | | | | | | |
| | | | | | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| | Row address start 2 | R06h | 00h | * | SP[15:8] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Row address start 1 | R07h | 00h | * | SP[7:0] | | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Row address end 2 | R08h | 01h | * | EP[15:8] | | | | | | | | |
| | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Row address end 1 | R09h | 3Fh | * | EP[7:0] | | | | | | | |
| | | | | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Memory Access control | R16h | 08h | * | MY | MX | MV | * | BGR | * | * | * |
| | | | | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | Data control | R72h | 00h | * | * | * | DFM[1:0] | * | * | TRI[1:0] | | |
| | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Display on setting | SAP Idle mode | R94h | 0Ah | * | SAP_I[7:0] | | | | | | | |
| | | | | | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| | Display Control 8 | R90h | 7Fh | * | SAP[7:0] | | | | | | | |
| | | | | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Display Control 1 | R26h | BCh | * | PT[1:0] | GON | DTE | D[1:0] | * | * | | |
| | | | | | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| TEST1 setting | TEST1 | R96h | 00h | * | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

11. LED Circuit



12. Characteristics

12.1 Optical Characteristics

< Measurement Condition >

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

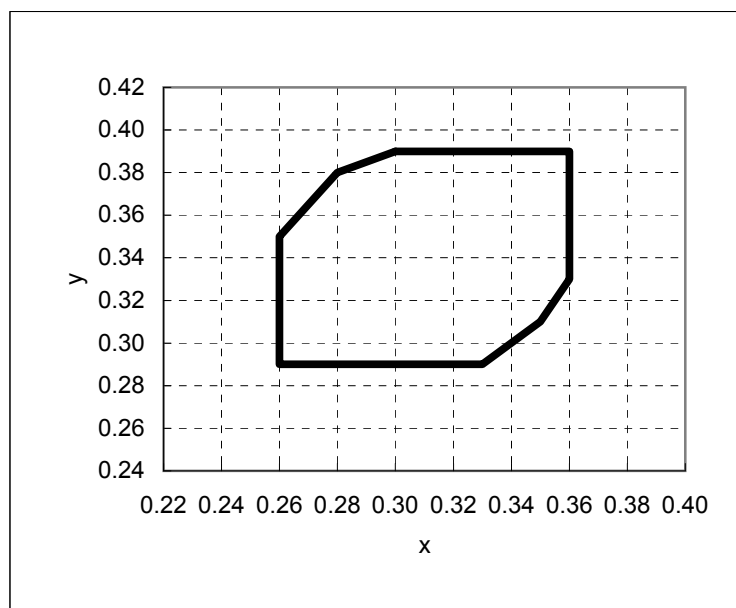
Driving condition: VCI=2.7V, IOVCC=2.7V, VSS=0V
Optimized VCOMDC

Backlight: IL=7.5mA

Measured temperature: Ta=25° C

| Item | | Symbol | Condition | MIN | TYP | MAX | Unit | Note No. | Remark |
|-------------------------|---------------|--------|---------------------------------|--|-----|-----|-------------------|----------|--------|
| Response time | Rise time | TON | [Data]= 00h → 3Fh | — | — | 60 | ms | 1 | |
| | Fall time | TOFF | [Data]= 3Fh → 00h | — | — | 40 | ms | | |
| Contrast ratio | Backlight ON | CR | [Data]= 3Fh / 00h | 400 | 800 | — | | 2 | |
| | Backlight OFF | | | — | 2 | — | | | |
| Viewing angle | Left | θL | [Data]= 3Fh / 00h CR ≥ 10 | 80 | — | — | deg | 3 | |
| | Right | θR | | 80 | — | — | deg | | |
| | Up | φU | | 80 | — | — | deg | | |
| | Down | φD | | 80 | — | — | deg | | |
| White Chromaticity | x | | White chromaticity range | | | | | 4 | |
| | y | | | | | | | | |
| Burn-in | | | | No noticeable burn-in image shall be observed after 2 hours of window pattern display. | | | | 5 | |
| Center brightness | | | [Data]=3Fh | 210 | 300 | — | cd/m ² | 6 | |
| Brightness distribution | | | [Data]=3Fh | 70 | — | — | % | 7 | |

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



White Chromaticity Range

【White Chromaticity Range】

| x | y |
|------|------|
| 0.30 | 0.39 |
| 0.28 | 0.38 |
| 0.26 | 0.35 |
| 0.26 | 0.29 |
| 0.33 | 0.29 |
| 0.35 | 0.31 |
| 0.36 | 0.33 |
| 0.36 | 0.39 |

12.2 Temperature Characteristics

< Measurement Condition >

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

Driving condition: VCI=2.7V, IOVCC=2.7V, VSS=0V

Optimized VCOMDC

Backlight: IL=7.5mA

| 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 | 600 msec or less | 50 msec or less | |
| | Fall time | TOFF | 400 msec or less | 30 msec or less | |
| Display Quality | | No noticeable display defect or nonuniformity should be observed. | | | |

13. Criteria of Judgment

13.1 Defective Display and Screen Quality

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

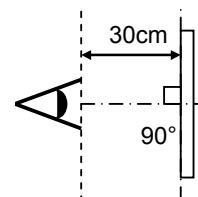
Driving Signal Raster Patter (RGB, white, black)

Signal condition [Data]: 00h, 28h, 3Fh (3steps)

Observation distance 30 cm

Illuminance 200 to 350 lx

Backlight IL=7.5mA



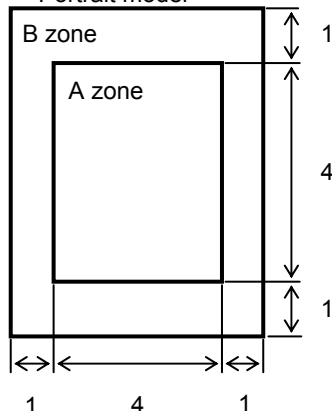
| Defect item | | Defect content | Criteria | |
|-----------------|---|--|--|------------|
| Display Quality | Line defect | Black, white or color line, 3 or more neighboring defective dots | Not exists | |
| | Dot defect | Uneven brightness on dot-by-dot base due to defective TFT or CF, or dust is counted as dot defect (brighter dot, darker dot) | Refer to table 1 | |
| | | High bright dot: Visible through 2% ND filter at [Data]=00h | ignored | |
| | | Low bright dot: Visible through 5% ND filter at [Data]=00h | | |
| | Dark dot: Appear dark through white display at [Data]=28h | | | |
| | | Invisible through 5% ND filter at [Data]=00h | | |
| Screen Quality | Dirt | Uneven brightness (white stain, black stain etc) | Invisible through 5% ND filter at Black screen. Invisible through 1% ND filter at other screen. | |
| | Foreign particle | Point-like | $0.25\text{mm} < \phi$ | N=0 |
| | | | $0.20\text{mm} < \phi \leq 0.25\text{mm}$ | $N \leq 2$ |
| | | | $\phi \leq 0.20\text{mm}$ | Ignored |
| | | Liner | $3.0\text{mm} < \text{length and } 0.08\text{mm} < \text{width}$ | N=0 |
| | | | $\text{length} \leq 3.0\text{mm or width} \leq 0.08\text{mm}$ | Ignored |
| Others | | | Use boundary sample for judgment when necessary | |

Permissible number: N

Table 1

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

13.2 Screen and Other Appearance

Testing conditions

Observation distance

30cm

Illuminance

1200~2000 lx

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

14. Reliability Test

| Test item | | Test condition | | number of failures /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% 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% non condensing | 240hr | 0 / 3 |
| | Thermal shock storage | -30←→80° C(30min/30min) | 100 cycles | 0 / 3 |
| Mechanical environmental test | Electrostatic discharge test (Non operation) | Confirms to EIAJ ED-4701/300 C=200pF,R=0Ω,V=±200V Each 3 times of discharge on and power supply and other terminals. | | 0 / 3 |
| | Surface discharge test (Non operation) | C=250pF, R=100Ω, V=±12kV Each 5 times of discharge in both polarities on the center of screen with the case grounded. | | 0 / 3 |
| | Vibration test | Total amplitude 1.5mm, f=10~55Hz, X,Y,Z directions for each 2 hours | | 0 / 3 |
| | Impact test | Use ORTUS TECHNOLOGY original jig (see next page)and make an impact with peak acceleration of 1000m/s ² for 6 msec with half sine-curve at 3 times to each X, Y, Z directions in conformance with JIS C 60068-2-27-2011. | | 0 / 3 |
| Packing test | Packing vibration-proof test | Acceleration of 19.6m/s ² with frequency of 10→55→10Hz, X,Y, Zdirection for each 30 minutes | | 0 / 1 packing |
| | Packing drop test | Drop from 75cm high. 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.)

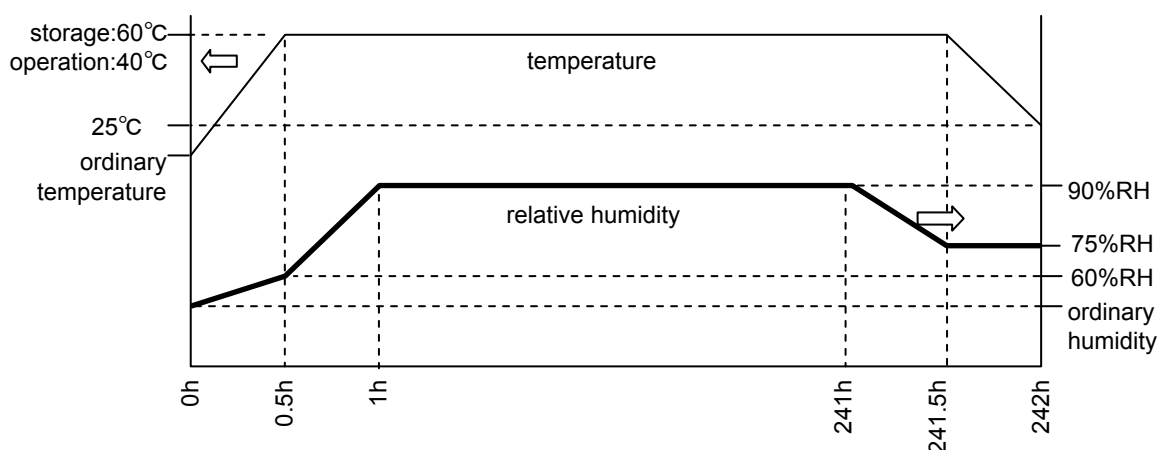
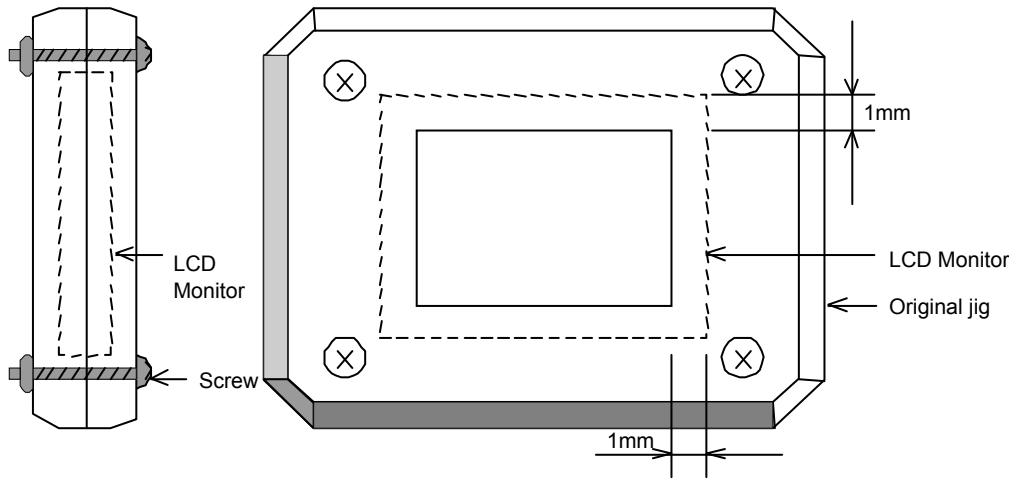


Table2.Reliability Criteria

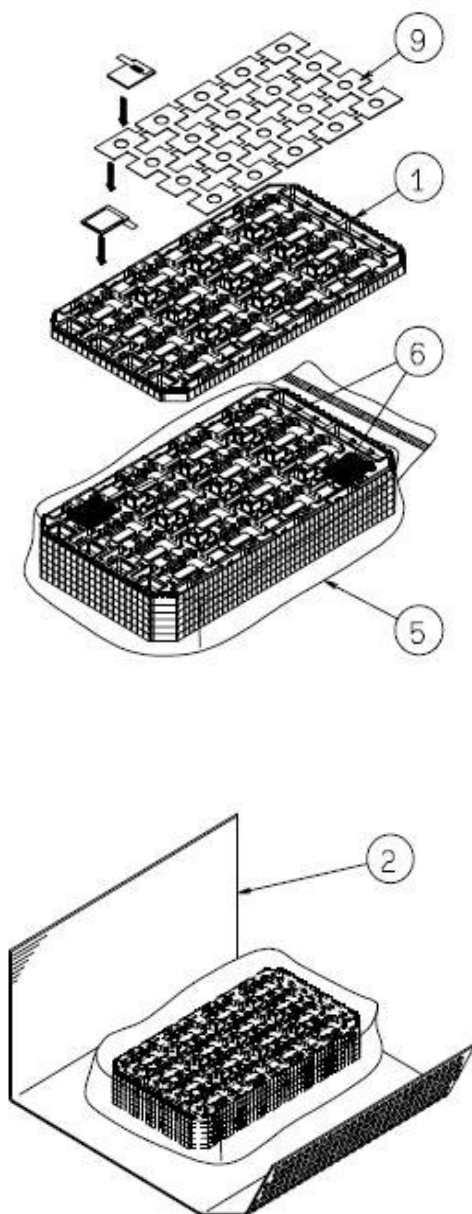
The parameters should be measured after leaving the monitor at the ordinary temperature for 24 hours or more after the test completion.

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

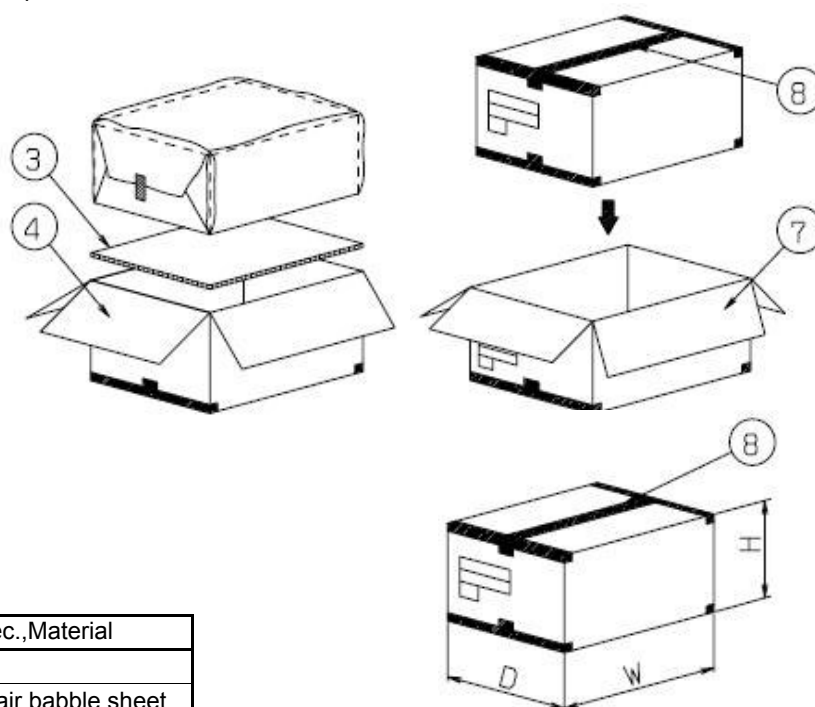
ORTUS TECHNOLOGY Original Jig



15. Packing Specifications



- Step1. • Each lower products are to be placed in one of the cut-outs of the tray with the LCD surface facing upward, and foam-sheet is put on products.
• Upper products are to be placed with the LCD surface facing downward.
- Step2. • Trays be in a stack of 5.
• One empty tray is to be put on the top of stack of 5 packed trays.
- Step3. • 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.
- Step4. • Vacuum and seal the sealing bag with the vacuum sealing machine.
- Step5. • The piled trays are to be wrapped with a bubble cushioning sheet., and to be fixed with adhesive tape.
- Step6. • 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.
- Step7. • 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 sides of the outer carton with black ink.
• In necessary, shipping labels or impression markings are to be put on the outer carton.
- Step8. • The outer carton is to be inserted into a extra outer carton with same orientation.
• The extra outer carton is to be sealed H-shape with packing tape as shown in the drawing.
- Step9. • 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.
• In necessary, shipping labels or impression markings are to be put on the extra outer carton.



| Packing item name | | Spec.,Material |
|-------------------|--------------------|------------------------------|
| ① | TRAY | A-PET |
| ② | B SHEET A | Anti-static air babble sheet |
| ③ | INNER BOARD | Corrugated cardboard |
| ④ | OUTER CARTON | Corrugated cardboard |
| ⑤ | SEALING BAG | |
| ⑥ | Drier | Moisture absorber |
| ⑦ | EXTRA OUTER CARTON | Corrugated cardboard |
| ⑧ | Packing tape | |
| ⑨ | FOAM SHEET | Anti-static polyethylene |

| Dimension of extra outer carton | |
|--|---------|
| D : Approx. | (337mm) |
| W: Approx. | (618mm) |
| H: Approx. | (179mm) |
| Quantity of products packed in one carton: | 200 |
| Gross weight : Approx. | 5.4Kg |

16. Handling Instruction

16.1 Cautions for Handling LCD panels

**Caution**

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

**Caution**

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

16.2 Precautions for Handling

- 1) Wear finger tips at incoming inspection and for handling the TFT monitors to keep display quality and keep the working area clean.
Do not touch the surface of the monitor as it is easily scratched.
- 2) Wear grounded wrist-straps and use electrostatic neutralization blowers to prevent static charge and discharge when handling the TFT monitors as the LED in this TFT monitors is damageable to electrostatic discharge. Designate an appropriate operating area, and set equipment, tools, and machines properly when handling this product.
- 3) Avoid strong mechanical shock including knocking, hitting or dropping to the TFT monitors for protecting their glass parts. Do not use the TFT monitors that have been experienced dropping or strong mechanical shock.
- 4) Do not use or storage the TFT monitors at high temperature and high humidity environment. Particularly, never use or storage the TFT monitors at a location where condensation builds up.
- 5) Avoid using and storing TFT monitors at a location where they are exposed to direct sunlight or ultraviolet rays to prevent the LCD panels from deterioration by ultraviolet rays.
- 6) Do not stain or damage the contacts of the FPC cable .
FPC cable needs to be inserted until it can reach to the end of connector slot.
During insertion, make sure to keep the cable in a horizontal position to avoid an oblique insertion.
Otherwise, it may cause poor contact or deteriorate reliability of the FPC cable.
- 7) Do not bend or pull the FPC cable or carry the TFT monitor by holding the FPC cable.
- 8) Peel off the protective film on the TFT monitors during mounting process.
Refer to the section 16.5 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.

16.3 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.

16.4 Storage Condition for Shipping Cartons

Storage environment

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

*Conditions to storage after unpacking

Storage environment

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

16.5 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.

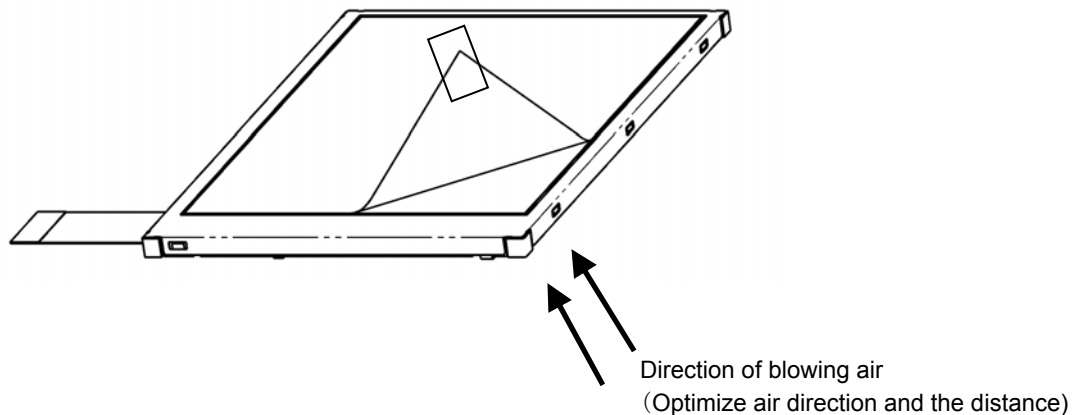
B) Work Method

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 left.

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.



16.6 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

1. Measurement Condition (Backlight ON)

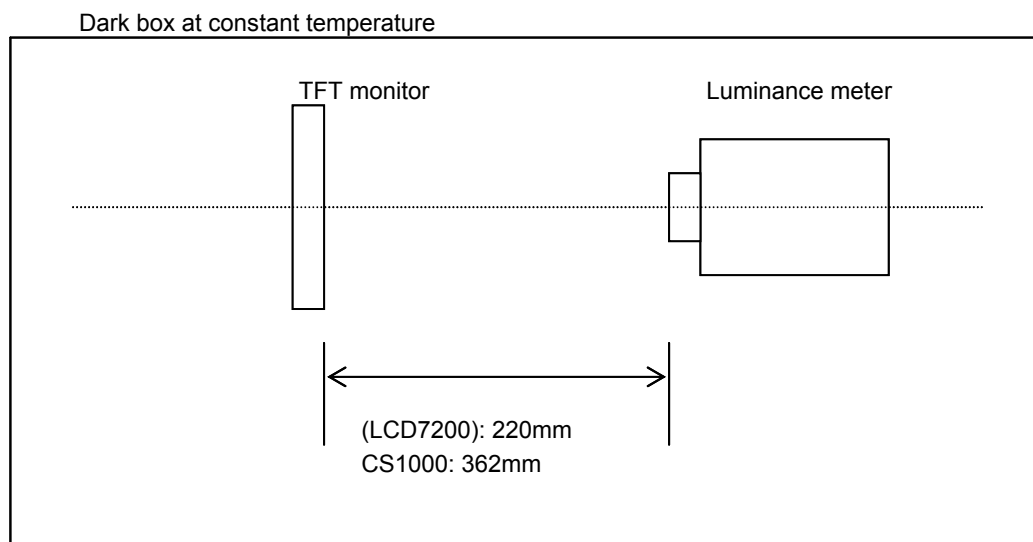
Measuring instruments: CS1000(KONICA MINOLTA), LCD7200(OTSUKA ELECTRONICS),EZcontrast160D (ELDIM)

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.

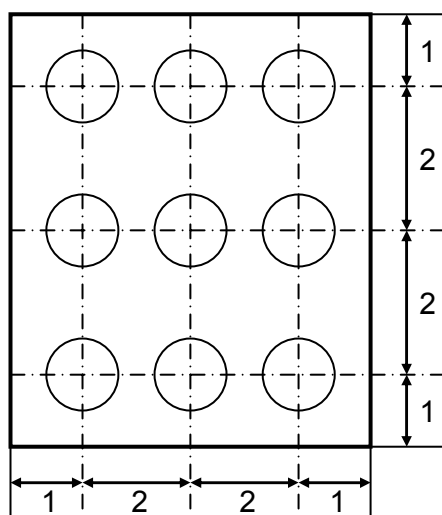
Measurement point: At the center of the screen unless otherwise specified



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.

<Portrait model>

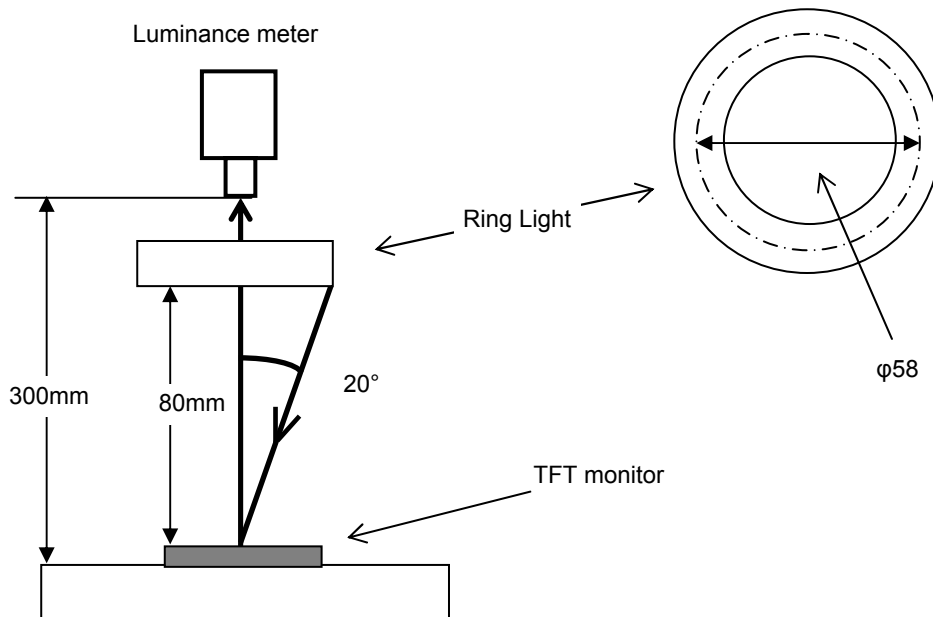


Dimensional ratio of active area

Backlight IL=7.5mA

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 LCD7200 | Backlight ON Backlight OFF |
| 3 | Viewing angle Horizontalθ 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]=00h/3Fh). | | At optimized 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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