

Specifications for Blanview TFT-LCD Monitor

Version 1.0

MODEL COM40H4M66ULC

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



ORTUS TECHNOLOGY CO., LTD.
Sales Dept. Industrial Application

Approved by

T. Tamura

Checked by

ORTUS TECHNOLOGY CO., LTD.
Product Quality Assurance

Approved by

H. Konya

Checked by

E. Takabe

Prepared by

M. Ijiri

Version History

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1. Application

This Specification is applicable to 10.08cm (4.0 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.
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- ◎ 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.
- ◎ 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.
- ◎ 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

- 4.0 inch diagonal display, 480 x RGB [H] x 800 [V] dots.
- 24bitRGB (8-8-8 Format) / 16.7 Million colors.
- MIPI DSI as high-speed interface. Video mode only.
- Timing generator [TG], Counter-electrode driving circuitry, Built-in power supply circuit.
- Various display controls and functional selection.
- Long life & High bright white LED back-light.
- Blanview TFT-LCD, improved outdoor readability.

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

| | Indoor | | Outdoor | |
|---------------|-------------|---------------------------------|-------------|---------------------------------|
| | Readability | Power Efficiency (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 | 16.7 Million colors. Blanview, Normally black. | |
| Driving method | a-Si TFT Active matrix. Line-scanning, Non-interface. | |
| Dot arrangement | RGB stripe arrangement. | Refer to "Dot arrangement" |
| Signal input method | MIPI DSI 2-lanes : 2 data lanes and 1 clock lane | |
| Backlight type | Long life & High bright white LED. | |

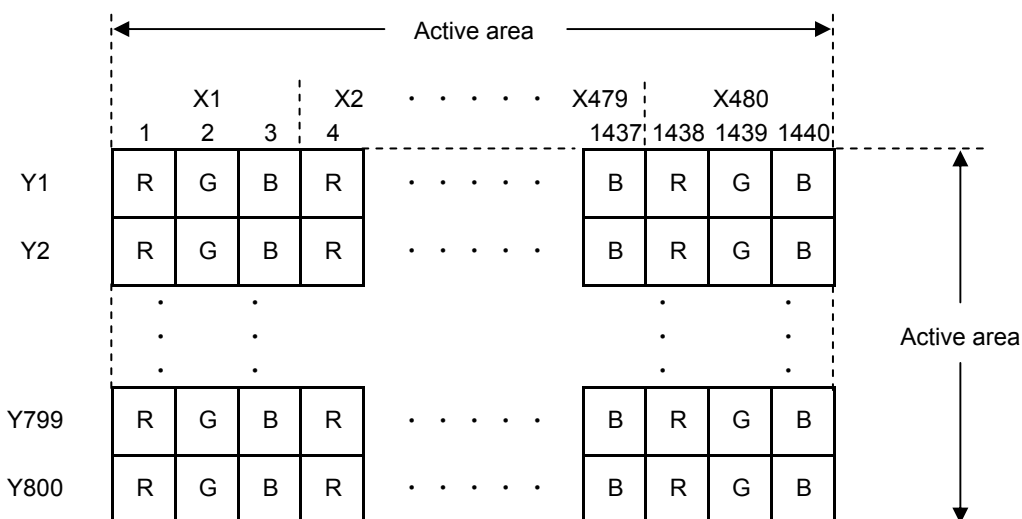
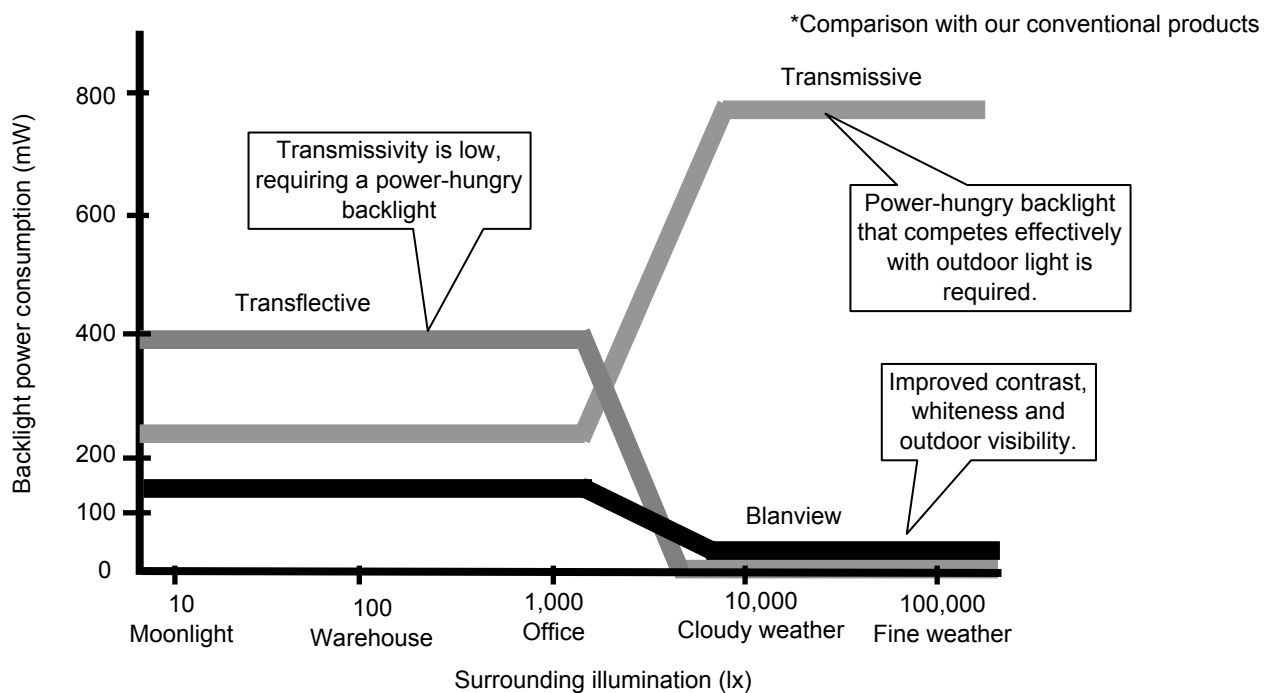


Fig.1 Dot arrangement (FPC cable placed right.)

<Features of Blanview>

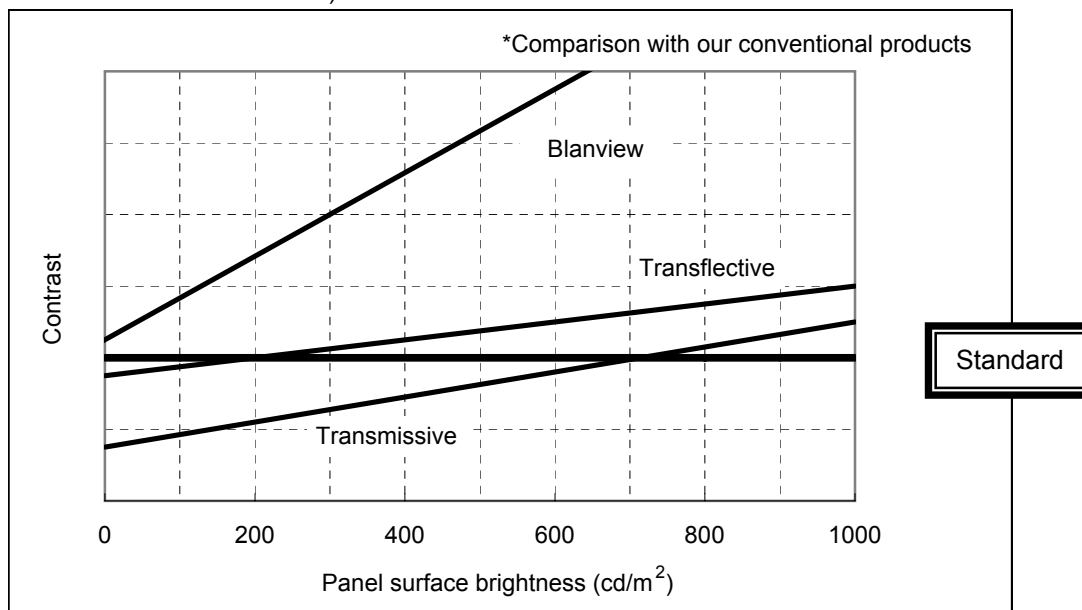
- Backlight power consumption required to assure visibility. (equivalent to 3.5"QVGA)



- 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

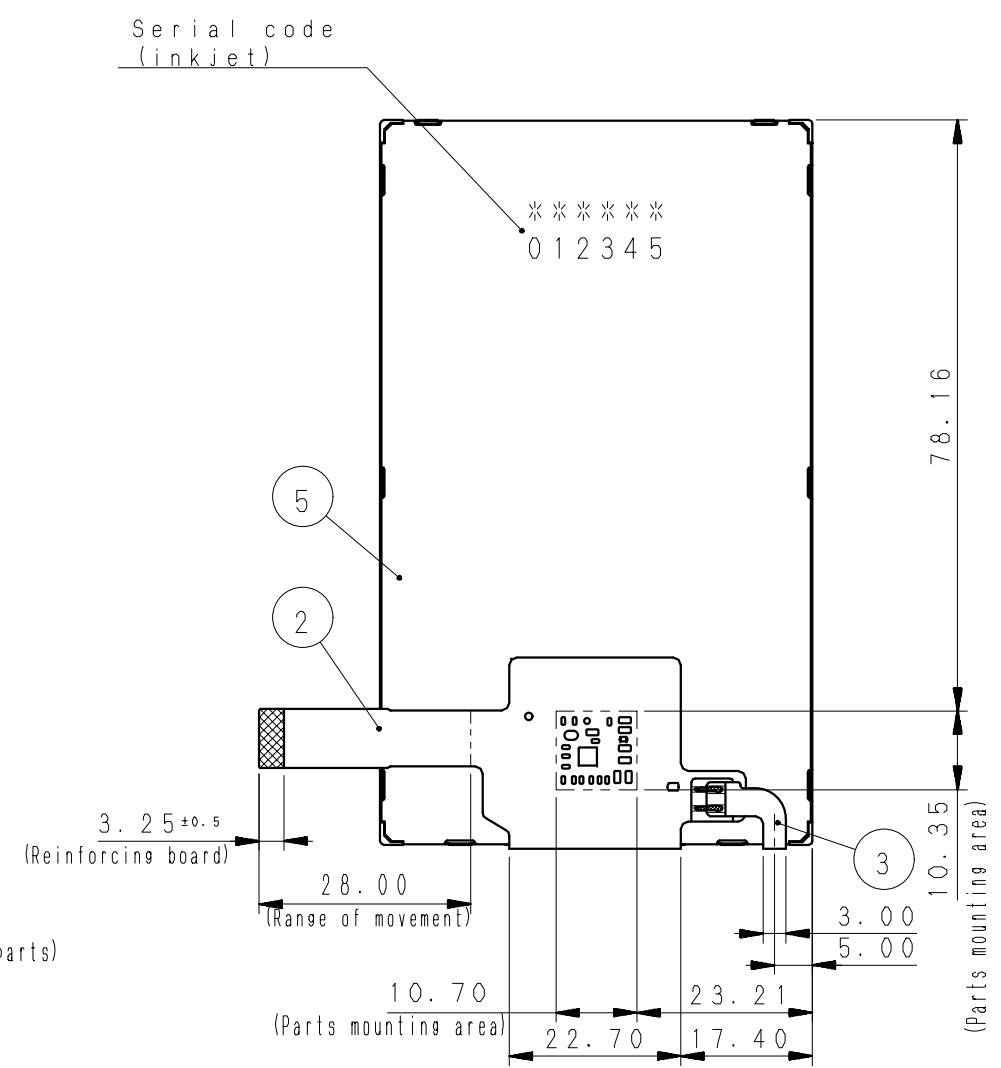
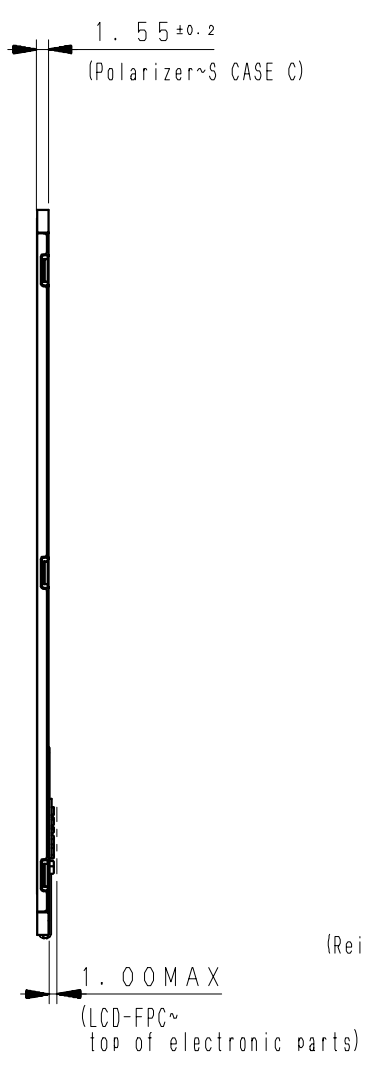
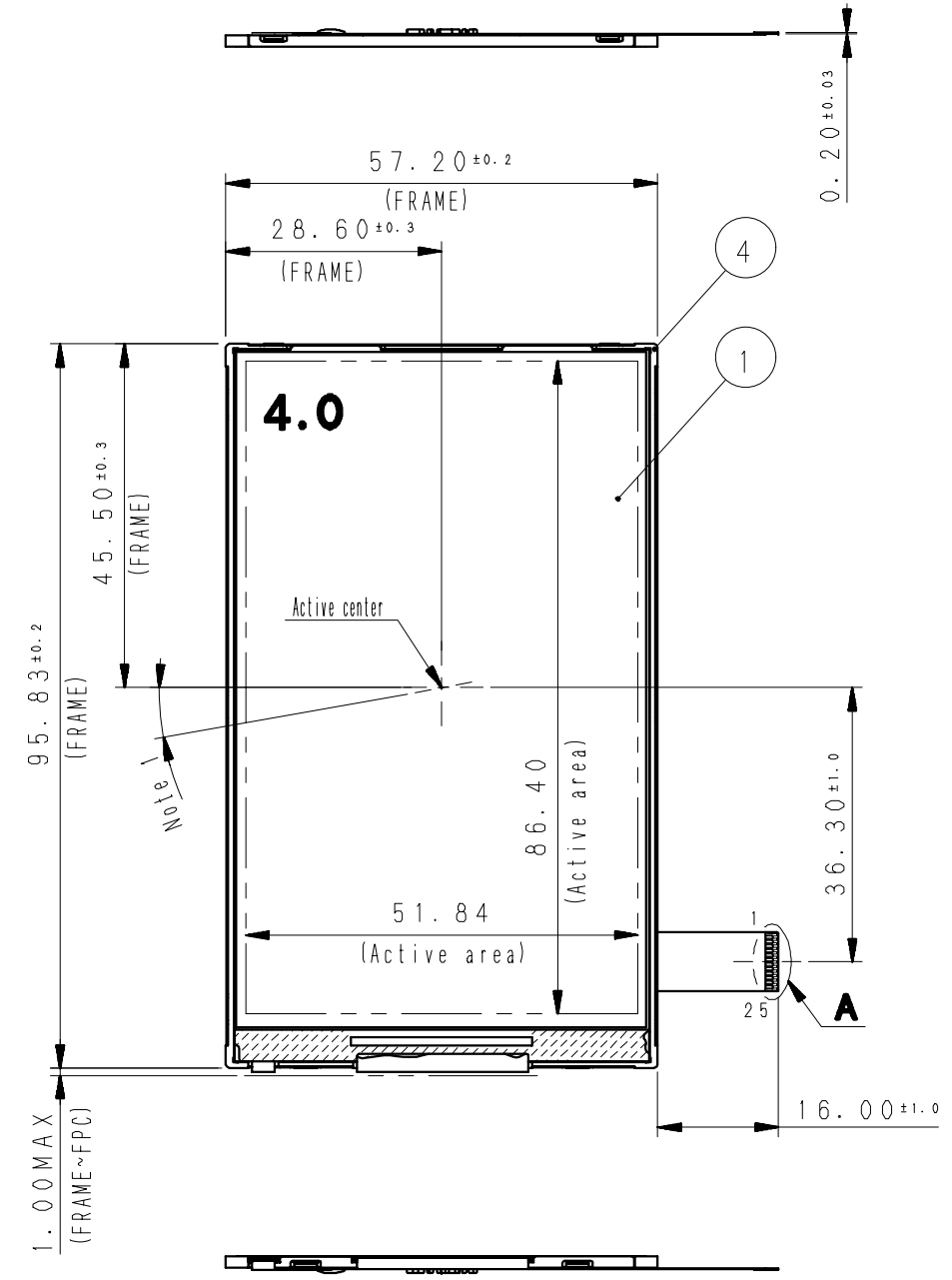
3.1 Dimensions

| Items | Specifications | Unit | Remarks |
|-----------------------------------|-------------------------------|------|-------------------|
| Outline dimensions | 57.2[H] × 95.83[V] × 1.55 [D] | mm | Exclude FPC cable |
| Active area | 51.84[H] × 86.40[V] | mm | 10.08cm diagonal |
| Number of dots | 1440[H] × 800[V] | dot | |
| Dot pitch | 36.00[H] × 108.00[V] | um | |
| Surface hardness of the polarizer | 2 | H | Load: 200g |
| Weight | 16.5 | g | Include FPC cable |

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

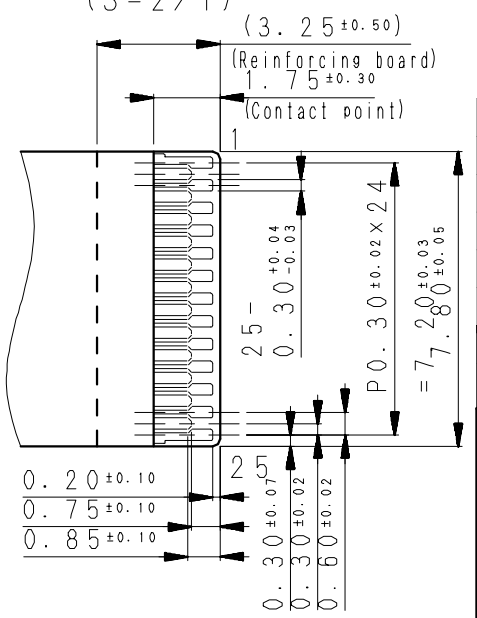
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3.2 Outward Form



Detail A
(S=2/1)

| PIN ARRANGEMENT | | | |
|-----------------|---------|-----|---------|
| No. | | No. | |
| 2 | LED- | 1 | GND |
| 4 | VDD | 3 | LED+ |
| 6 | PVSS | 5 | VDD |
| 8 | TEST4 | 7 | VCC10 |
| 10 | ID1 | 9 | TEST3 |
| 12 | TEST1 | 11 | ID2 |
| 14 | GND | 13 | TEST2 |
| 16 | GND | 15 | RESETB |
| 18 | DSI_D0N | 17 | DSI_D0P |
| 20 | DSI_CN | 19 | GND |
| 22 | GND | 21 | DSI_CP |
| 24 | DSI_D1N | 23 | DSI_D1P |
| | | 25 | GND |



- Note 1. Angular deviation of LCD cell from the TFT-LCD monitor's reference axis shall be less than $\pm 40'$.
- 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. Recommended FPC connector. For LCD : HIROSE, part number: FH35RW-25S-0.3SHW(50)
- Note 4. Refer to "12.CRITERIA OF JUDGMENT" about the appearance specification of a polarizer.

| | 7 | | | |
|---------------|------|-----------|----------------|------------------------------------|
| | 6 | | | |
| S CASE C | 5 | | SUS | |
| FRAME | 4 | | PC | |
| LED FPC | 3 | | | |
| LCD FPC | 2 | | | |
| TFT-LCD PANEL | 1 | | | Glass substrate thickness=0.2+0.2t |
| PART NAME | ITEM | PART CODE | MATERIAL GRADE | REMARK |

| | | | |
|--------------------|-----------------------------|--------------------|---------|
| APPROVED Hashizume | GENERAL TOLERANCE ± 0.5 | SCALE 1/1 | UNIT mm |
| CHECKED Hiranobu | ISSUE (Y:M:D) 11:08:26 | MODEL COM40H4M66** | |
| CHECKED | NAME | | |
| DESIGN Masuda | | | |
| DRAW Masuda | | | |

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| | | | |
|-------------|------|-------|------|
| DRAWING No. | REV. | SHEET | DIV. |
|-------------|------|-------|------|

OUTLINE-D4M66

3.3 Serial No. 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 | <table border="1"> <tr> <td>Jan-A</td> <td>May-E</td> <td>Sep-I</td> </tr> <tr> <td>Feb-B</td> <td>Jun-F</td> <td>Oct-J</td> </tr> <tr> <td>Mar-C</td> <td>Jul-G</td> <td>Nov-K</td> </tr> <tr> <td>Apr-D</td> <td>Aug-H</td> <td>Dec-L</td> </tr> </table> | Jan-A | May-E | Sep-I | Feb-B | Jun-F | Oct-J | Mar-C | Jul-G | Nov-K | Apr-D | Aug-H | Dec-L |
| Jan-A | May-E | Sep-I | | | | | | | | | | | |
| Feb-B | Jun-F | Oct-J | | | | | | | | | | | |
| Mar-C | Jul-G | Nov-K | | | | | | | | | | | |
| Apr-D | Aug-H | Dec-L | | | | | | | | | | | |
| c | <table border="1"> <tr> <td>Model code</td> <td>40BCC (Made in Japan)</td> </tr> <tr> <td></td> <td>40BDC (Made in Malaysia)</td> </tr> <tr> <td></td> <td>40BEC (Made in China)</td> </tr> </table> | Model code | 40BCC (Made in Japan) | | 40BDC (Made in Malaysia) | | 40BEC (Made in China) | | | | | | |
| Model code | 40BCC (Made in Japan) | | | | | | | | | | | | |
| | 40BDC (Made in Malaysia) | | | | | | | | | | | | |
| | 40BEC (Made in China) | | | | | | | | | | | | |
| d | Serial number | | | | | | | | | | | | |

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

•Made in Japan

2D40BCC000125

means "manufactured in April 2012, 4.0" BC type, C specifications, serial number 000125"

•Made in Malaysia

2D40BDC000125

means "manufactured in April 2012, 4.0" BD type, C specifications, serial number 000125"

•Made in China

2D40BEC000125

means "manufactured in April 2012, 4.0" BE type, C specifications, serial number 000125"

2) Location of Serial No. 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 | GND | Ground | | P |
| 2 | LED- | Backlight LED Cathode | | P |
| 3 | LED+ | Backlight LED Anode | | P |
| 4 | VDD | Analog Power Supply | VDD = 3.3V (TYP) | P |
| 5 | VDD | Analog Power Supply | VDD = 3.3V (TYP) | P |
| 6 | GND | Ground(PVSS) | | P |
| 7 | VCCIO | DSI and I/O Power Supply | VCCIO = 1.8V (TYP) | P |
| 8 | TEST 4 | Serial communication pin for shipping inspection | Please connect this pin to GND. | I |
| 9 | TEST 3 | Serial communication pin for shipping inspection | Please connect this pin to GND. | I |
| 10 | ID1 | ID check | Output level is GND. | O |
| 11 | ID2 | ID check | Output level is GND. | O |
| 12 | TEST 1 | Serial communication pin for shipping inspection | Please connect this pin to VCCIO(1.8V) | I |
| 13 | TEST 2 | Serial communication pin for shipping inspection | Please connect this pin to VCCIO(1.8V) | I |
| 14 | GND | Ground | | P |
| 15 | RESETB | LCD Reset | L:Initialize Power_ON Reset is Required when Turning on the Power | I |
| 16 | GND | Ground | | P |
| 17 | DSI_D0P | MIPI-DSI Data differential signal input pin (Data lane 0) | | IO |
| 18 | DSI_D0N | MIPI-DSI Data differential signal input pin (Data lane 0) | | IO |
| 19 | GND | Ground | | P |
| 20 | DSI_CN | MIPI-DSI Clock differential signal input pin | | I |
| 21 | DSI_CP | MIPI-DSI Clock differential signal input pin | | I |
| 22 | GND | Ground | | P |
| 23 | DSI_D1P | MIPI-DSI Data differential signal input pin (Data lane 1) | | I |
| 24 | DSI_D1N | MIPI-DSI Data differential signal input pin (Data lane 1) | | I |
| 25 | GND | Ground | | P |

- Recommended connector : (FH35RW-25S-0.3SHW(50) /HIROSE ELECTRIC)
- Please make sure to check a consistency between pin assignment in "3.2 Outward Form" and your connector pin assignment when designing your circuit.
Inconsistency in input signal assignment may cause a malfunction.
- Since FPC cable has gold plated terminals, gilt finish contact shoe connector is recommended.

5. Absolute Maximum Rating

GND=0V

| Item | Symbol | Condition | Rating | | Unit | Applicable terminal |
|----------------------------------|--------|--|--------|-----------|------|-----------------------------------|
| | | | MIN | MAX | | |
| Supply voltage | VDD | Ta=25 °C | -0.3 | 4.6 | V | VDD |
| DSI and I/O Power Supply voltage | VCCIO | | -0.3 | 4.6 | V | VCCIO |
| Input voltage for logic | VI | | -0.3 | VCCIO+0.3 | V | RESETB TEST1-4 |
| DSI Input voltage | VDSIIN | | -0.15 | 1.45 | V | DSI_D0P/N , DSI_D1P/N DSI_CP/N |
| LED forward current | IL | Ta = 25 °C | - | 35 | mA | LED+ - LED- |
| | | Ta = 70 °C | - | 15 | | |
| Storage temperature range | Tstg | | -30 | 80 | °C | |
| Storage humidity range | Hstg | Non condensing in an environmental moisture at or less than 40 °C 90%RH. | | | | |

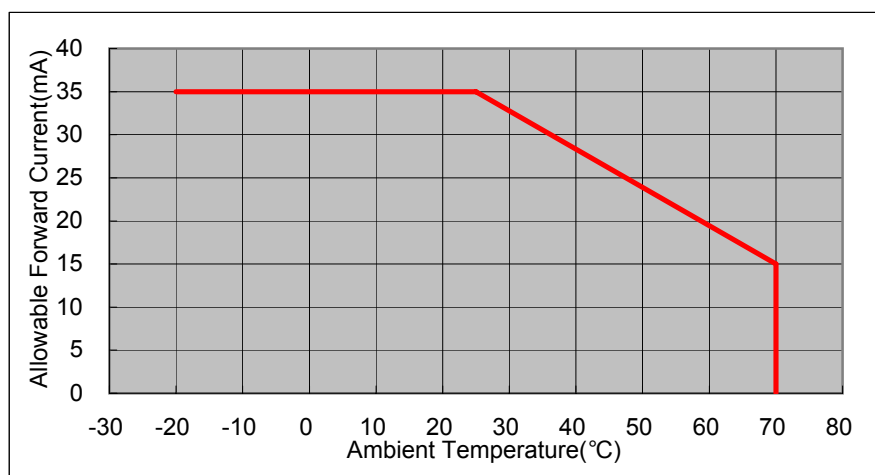
6. Recommended Operating Conditions

GND=0V

| Item | Symbol | Condition | Rating | | | Unit | Applicable terminal |
|----------------------------------|--------|------------|--|-----|-------|------|------------------------------------|
| | | | MIN | TYP | MAX | | |
| Supply voltage | VDD | | 2.7 | 3.3 | 3.6 | V | VDD |
| DSI and I/O Power Supply voltage | VCCIO | | 1.7 | 1.8 | 1.9 | V | VCCIO |
| Input voltage for logic | VI | | 0 | - | VCCIO | V | RESETB TEST1-4 |
| DSI Input voltage | VI | | -0.05 | - | 1.35 | V | DSI_D0P/N DSI_D1P/N DSI_CP/N |
| Operational temperature range | Top | Note1,2 | -20 | 25 | 70 | °C | Panel surface temperature |
| Operating humidity range | Hop | Ta ≤ 30 °C | 20 | - | 80 | % | |
| | | Ta > 30 °C | Non condensing in an environmental moisture at or less than 30 °C 80%RH. | | | | |

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

Note 2: Acceptable Forward Current to LED is up to 15 mA, when Ta=+70 °C.
Do not exceed Allowable Forward Current shown on the chart below.



7. Characteristics

7.1 DC Characteristics

7.1.1 Display Module

(Unless otherwise noted, Ta=25 °C, VDD=3.3V, VCCIO=1.8V, GND=0V)

| Item | Symbol | Condition | Rating | | | Unit | Applicable terminal |
|----------------------|--------|-------------------|-----------|------|-----------|------|---------------------|
| | | | MIN | TYP | MAX | | |
| Input Signal Voltage | VIH | VCCIO=1.7-1.9V | 0.7×VCCIO | - | VCCIO | V | RESETB |
| | VIL | | 0 | - | 0.3×VCCIO | V | TEST1-4 |
| Operating Current | IDD | fDSICLK=150 MHz | - | 12.5 | 25.0 | mA | VDD |
| | ICCIO | Color bar display | - | 3.3 | 6.6 | mA | VCCIO |
| Sleep_mode Current | IDDS | Clock/Data=LP11 | - | 43 | 100 | uA | VDD |
| | ICCIOS | Sleep_mode | - | 10 | 100 | uA | VCCIO |

7.1.2 MIPI DSI Interface

| Item | Symbol | Condition | Rating | | | Unit | Note |
|-------|-------------------------------------|-------------|--------|-----|-----|------|------|
| | | | MIN | TYP | MAX | | |
| HS-RX | Differential input high threshold | VIDTH | - | - | 110 | mV | |
| | Differential input low threshold | VIDTL | -110 | - | - | mV | |
| | Single-ended input high voltage | VIHHS | - | - | 460 | mV | |
| | Single-ended input low voltage | VILHS | -40 | - | - | mV | |
| | Common-mode voltage HS receive mode | VCMRXD C | 70 | - | 330 | mV | |
| | Differential input impedance | ZID | 80 | 100 | 125 | Ohm | |
| LP-RX | Logic 1 input voltage | VIH | 880 | - | - | mV | |
| | Logic 0 input voltage | VIL | - | - | 550 | mV | |
| LP-TX | Thevenin output low level | VOL | -50 | - | 50 | mV | |
| | Thevenin output high level | VOH | 1.1 | 1.2 | 1.3 | V | |
| | Output impedance of LP transmitter | ZOLP | 110 | - | - | Ohm | |
| CD-RX | Logic 1 contention threshold | VIHCD | 450 | - | - | mV | |
| | Logic 0 contention threshold | VILCD | - | - | 220 | mV | |

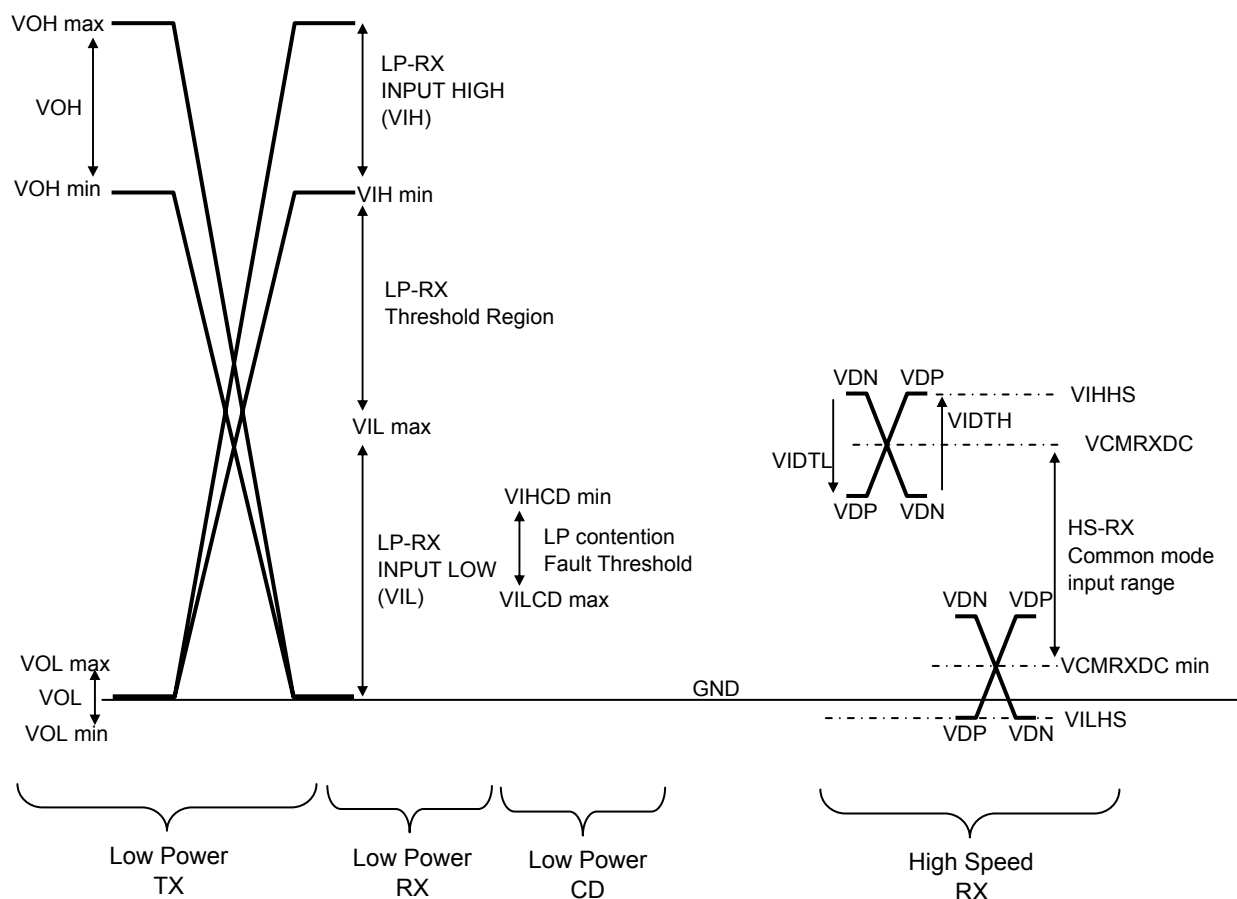


Fig.A The signal levels for the LP and HS .

7.1.3 Backlight

| Item | Symbol | Condition | Rating | | | Unit | Applicable terminal |
|-----------------------|--------|-----------------------------|--------|-------|------|------|---------------------|
| | | | MIN | TYP | MAX | | |
| Forward current | IL25 | Ta=25 °C | -- | 10 | 35 | mA | LED+ - LED- |
| | IL70 | Ta=70 °C | -- | -- | 15 | mA | |
| Forward voltage | VL | Ta=25 °C IL=10mA | -- | 20.1 | 22.1 | V | |
| Estimated Life of LED | LL | Ta=25 °C IL=10mA Note | -- | 20000 | -- | hrs | |

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

7.2 AC Characteristics

7.2.1 HS-RX Specifications

(Unless otherwise noted, $T_a=25\text{ }^\circ\text{C}$, $V_{DD}=3.3\text{V}$, $V_{CCIO}=1.8\text{V}$, $GND=0\text{V}$)

| Item | Symbol | Condition | Rating | | | Unit | Applicable terminal |
|--------------------------|----------|-----------|--------|-----|------|----------|-----------------------|
| | | | MIN | TYP | MAX | | |
| DSICLK Frequency | f DSICLK | Fig.B | 40 | - | 200 | MHz | DSI_CP/N |
| DSICLK Cycle time | TCLKP | | 5.0 | - | 25.0 | ns | |
| DSI Data Transfer Rate | UI | | 2.5 | - | 12.5 | ns | DSI_D0P/N , DSI_D1P/N |
| | t DSIR | | 80 | - | 400 | Mbps | |
| Data to Clock Setup Time | Tsetup | | 0.35 | - | - | UI | DSI_D0P/N , DSI_D1P/N |
| Clock to Data Hold Time | Thold | 0.25 | - | - | UI | DSI_CP/N | |

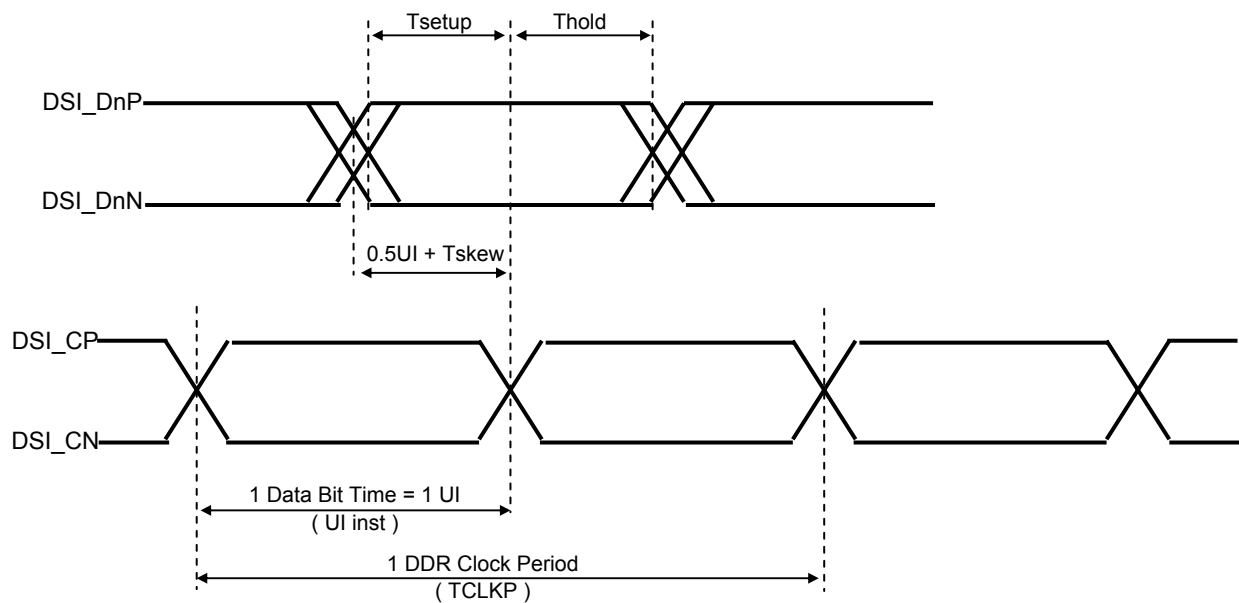


Fig.B Data to Clock Timing Definitions

7.2.2 LP-TX Specifications

(Unless otherwise noted, $T_a=25\text{ }^\circ\text{C}$, $V_{DD}=3.3\text{V}$, $V_{CCIO}=1.8\text{V}$, $GND=0\text{V}$)

| Item | Symbol | Condition | Rating | | | Unit | Applicable terminal |
|---------------------|----------------------------|---------------|--------|-----|-----|-------|---------------------|
| | | | MIN | TYP | MAX | | |
| 15% - 85% rise time | TRLP | | - | - | 25 | ns | DSI_D0P/N |
| 85% - 15% fall time | TFLP | | - | - | 25 | ns | DSI_D0P/N |
| Slew rate | $\Delta v / \delta t_{SR}$ | Clload = 70pF | 30 | - | 500 | mV/ns | DSI_D0P/N |

7.2.3 RX/TX Specifications

(Unless otherwise noted, $T_a=25\text{ }^\circ\text{C}$, $V_{DD}=3.3\text{V}$, $V_{CCIO}=1.8\text{V}$, $GND=0\text{V}$)

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

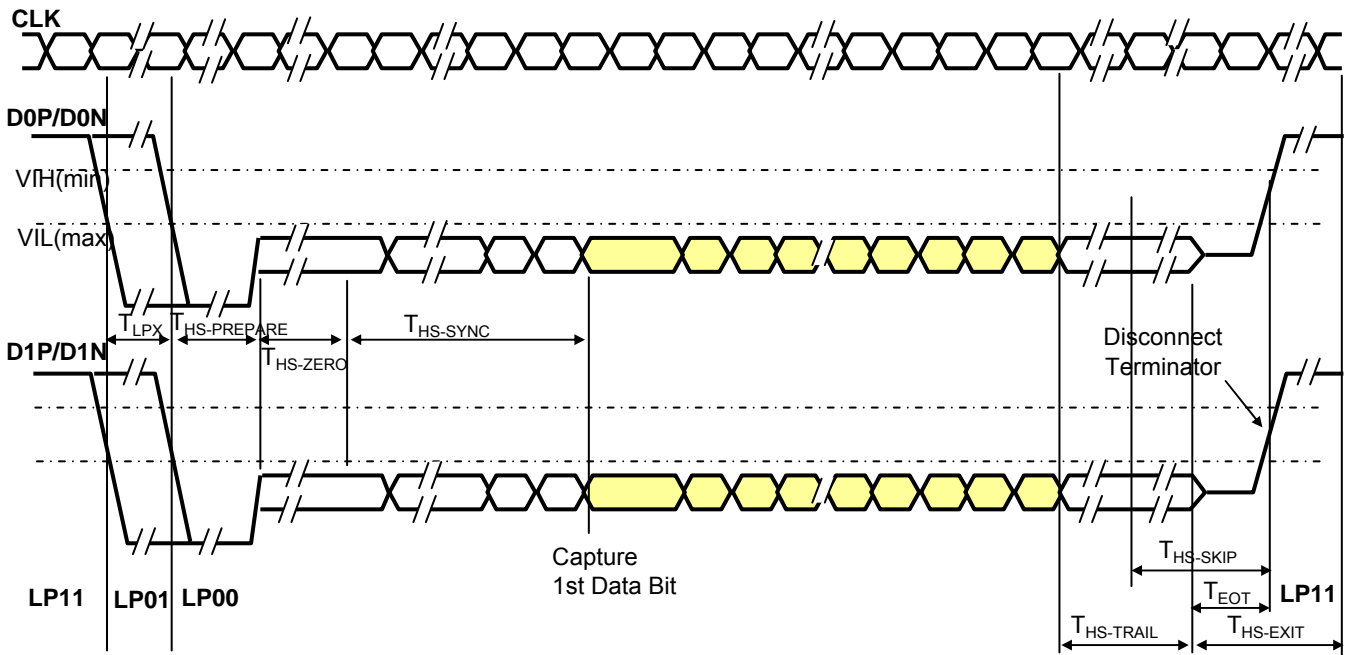


Fig.C HS Data Transmission in Bursts

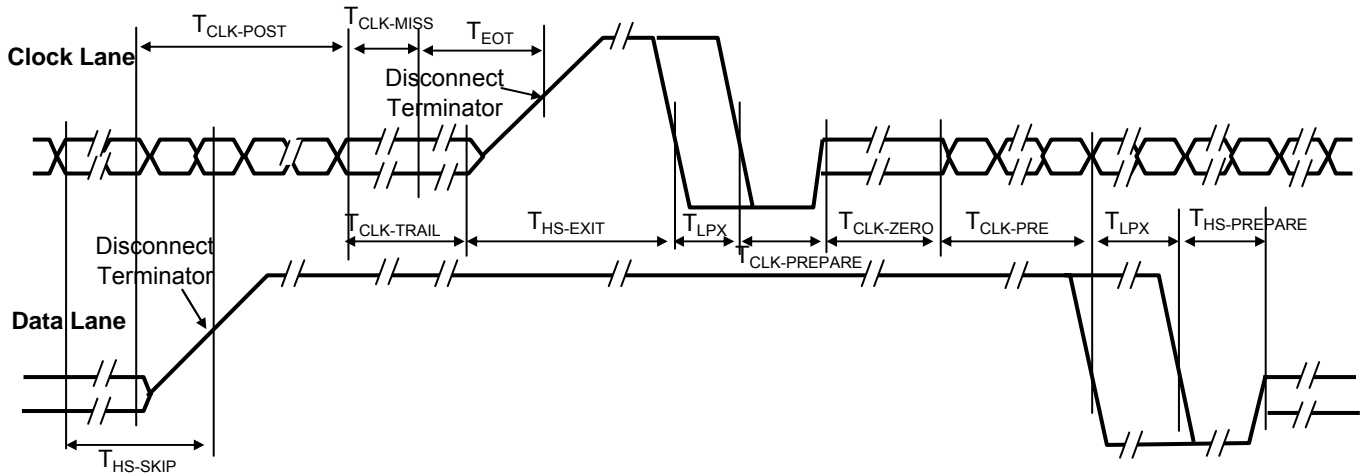


Fig.D Switching the Clock Lane between Clock Transmission and LP mode

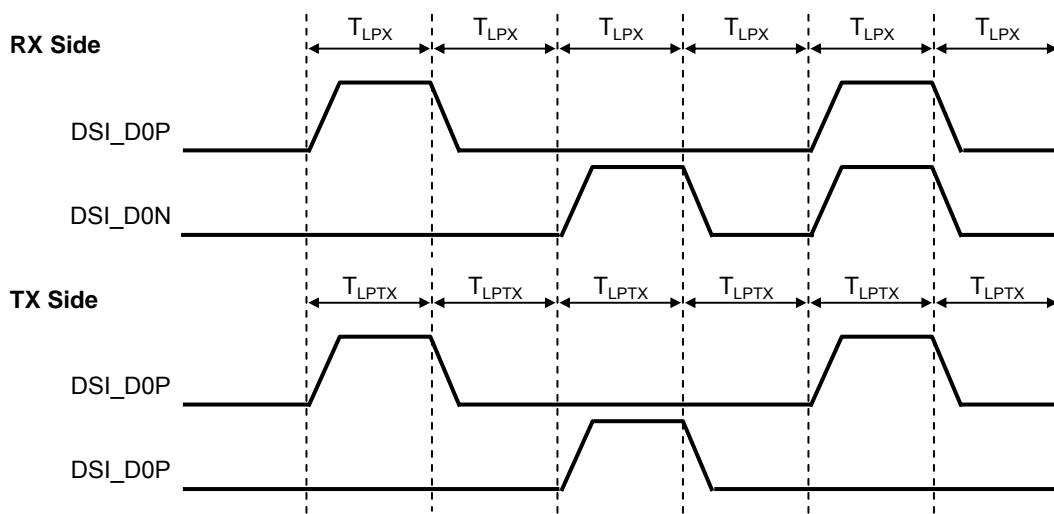


Fig.E DSI LP Mode

7.2.4 Reset input timing

| Item | Symbol | Condition | Rating | | | Unit | Remark |
|-----------------------|--------|------------------|--------|-----|-----|------|--------|
| | | | MIN | TYP | MAX | | |
| Reset Low Pulse width | tRESW | | 10 | - | - | us | |
| Reset Complete time | tREST | during Sleep In | - | - | 5 | ms | |
| | | during Sleep Out | - | - | 120 | ms | |

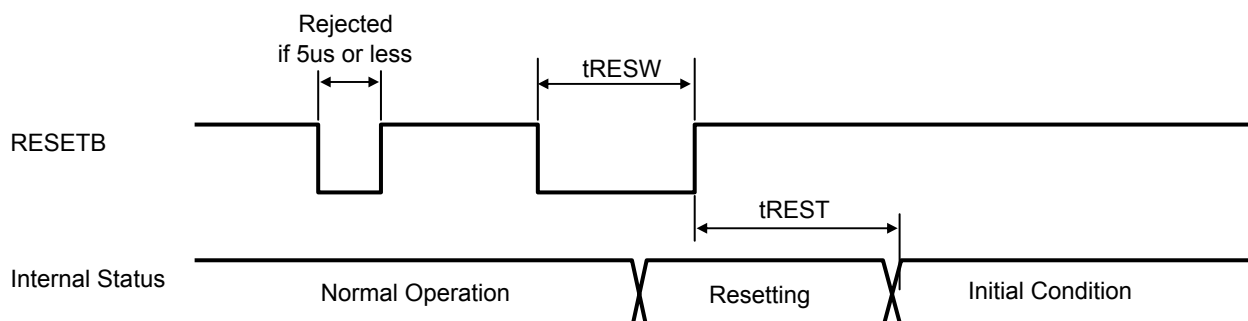


Fig.F RESETB input timing

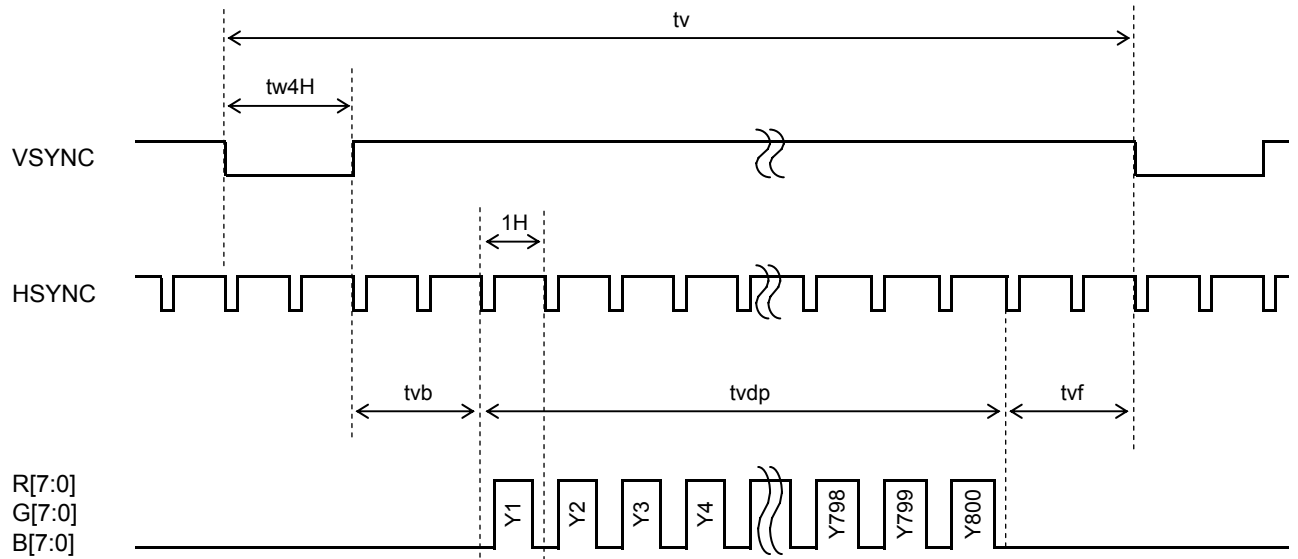
7.3 Input Timing Characteristics

| Item | Symbol | Condition | Rating | | | Unit | Remark |
|-----------------------------|--------------|-----------|--------|-------|------|------|--------|
| | | | MIN | TYP | MAX | | |
| CLK Frequency | fPCLK | Fig.G | 20.3 | 25.0 | 32.2 | MHz | PCLK |
| VSYNC Frequency | Note fVSYNC | | 54 | 57.46 | 66 | Hz | VSYNC |
| VSYNC Cycle | tv | | 818 | 824 | 950 | H | |
| VSYNC Pulse Width | tw4H | | 6 | 8 | 50 | H | |
| Vertical Back Porch | tvb | | 6 | 8 | 50 | H | |
| Vertical Front Porch | tvf | | 6 | 8 | 50 | H | |
| Vertical Display Period | tvdP | | -- | 800 | -- | H | |
| HSYNC frequency | fHSYNC | | 38.8 | 48.6 | 53.4 | kHz | HSYNC |
| HSYNC Cycle | th | 506 | 528 | 664 | CLK | | |
| HSYNC Pulse Width | tw5H | 6 | 16 | 174 | CLK | | |
| Horizontal Back Porch | thb | 6 | 16 | 174 | CLK | | |
| Horizontal Front Porch | thf | 6 | 16 | 174 | CLK | | |
| Horizontal data start Point | tw5H+thb | 20 | -- | 179 | CLK | | |
| Horizontal Blanking Period | tw5H+thb+thf | 26 | -- | 184 | CLK | | |
| Horizontal Display Period | thdp | -- | 480 | -- | CLK | | |

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

7.4 Input Signal Timing Chart

-Vertical Timing



-Horizontal Timing

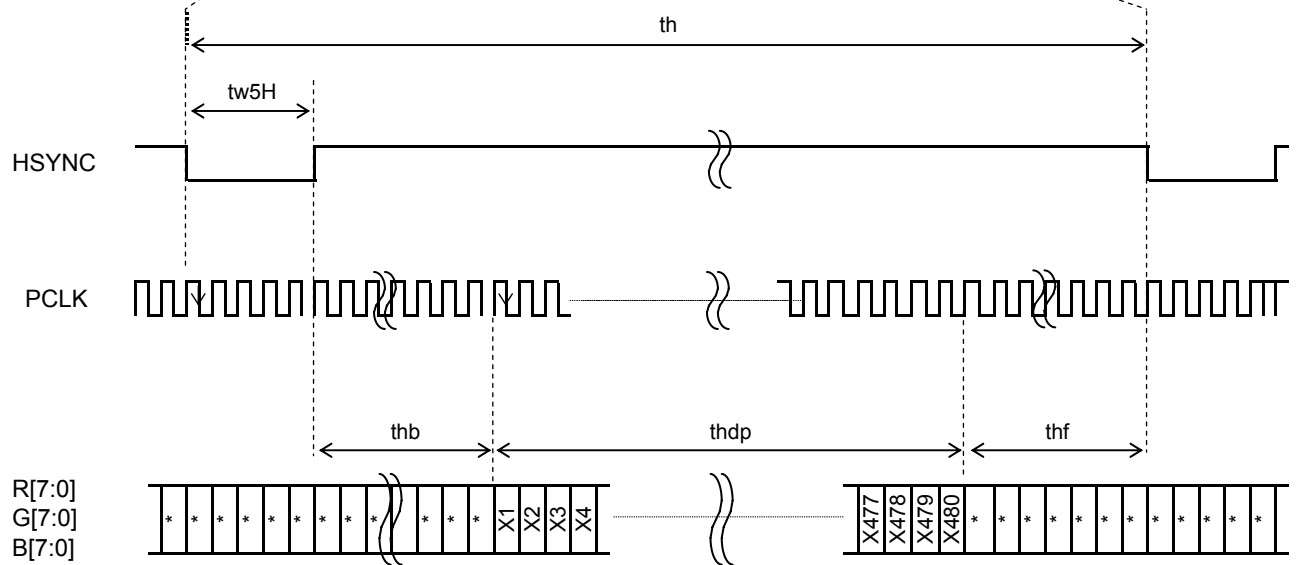


Fig.G Timing Characteristics of input signals

8. About MIPI Interface

8.1 Version

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

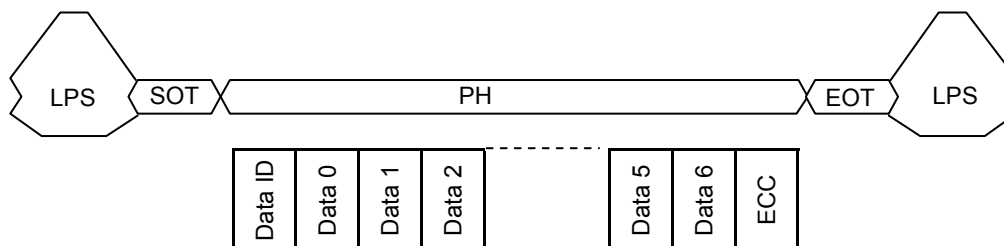
MIPI DSI : Version 1.01

MIPI D-PHY : Version 1.00

Data transfer mode : Video mode only.

8.2 DSI protocol

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



LPS : Low power state

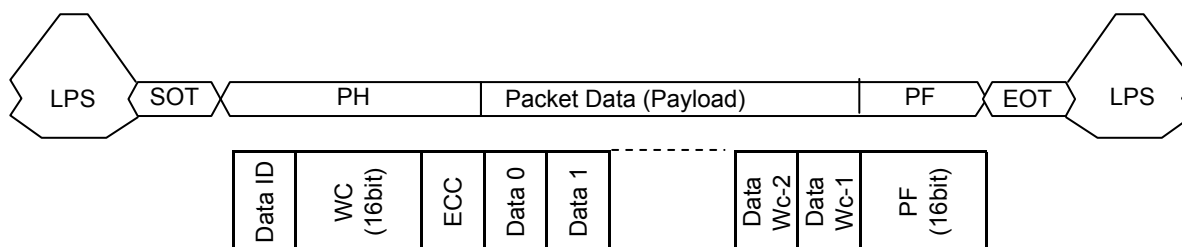
SOT : Start of Transmission

PH : Packet Header

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

ECC : Error Correction Code

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



LPS : Low power state

SOT : Start of Transmission

PH : Packet Header

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

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

ECC : Error Correction Code

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

8.3 Packet data types

LCD-Driver has the following restriction.

Generic short / Long Write Cmd is not supported.

It is only DCS Short / Long Write Cmd.

Processor to peripheral direction

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

Peripheral to processor direction

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

8.4 Packet Footer on the long packet

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

Checksum(2byte) = CRC(Packet Data)

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

8.5 Instruction List

| Register | | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----------|-----------------|-----|-----------|---------------|-----------|----------|-------------|----------|---------|-----|
| R00h | NOP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| R01h | SWRESET | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| R06h | RDRED | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| R07h | RDGREEN | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| R08h | RDBLUE | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| R0Ah | RDDPM | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| R0Bh | RDDMADCTL | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| R0Ch | RDDCOLMOD | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| R0Dh | RDDIM | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| R0Eh | RDDSM | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| R0Fh | RDDSDR | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| R10h | SLPIN | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| R11h | SLPOUT | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| R20h | INVOFF | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| R21h | INVON | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| R26h | GAMSET | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| | Parameter 1 | 1 | GC[7:0] | | | | | | | |
| | recommend | | - | - | - | - | - | - | - | - |
| R28h | DISPOFF | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| R29h | DISPON | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| R36h | MADCTL | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| | Parameter 1 | 1 | - | - | - | - | BGR | - | SS | GS |
| | recommend | | - | - | - | - | - | - | - | - |
| R3Ah | COLMOD | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| | Parameter 1 | 1 | - | CSEL_RGB[2:0] | | | - | - | - | - |
| | recommend (70h) | | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| RB1h | SETPOWER | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| | Parameter 1 | 1 | - | VSN_EN | VSP_EN | VGL_EN | VGH_EN | - | VDDN_HZ | SLP |
| | recommend (78h) | | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| | Parameter 2 | 1 | - | FS[12:10] | | | - | AP[2:0] | | |
| | recommend (24h) | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| | Parameter 3 | 1 | - | - | - | - | BT[3:0] | | | |
| | recommend (04h) | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| | Parameter 4 | 1 | DT[1:0] | | DC[1:0] | | DC_DIV[3:0] | | | |
| | recommend (02h) | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | Parameter 5 | 1 | - | DTPS[2:0] | | | - | DTP[2:0] | | |
| | recommend (02h) | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | Parameter 6 | 1 | - | DTNS[2:0] | | | - | DTN[2:0] | | |
| | recommend (03h) | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | Parameter 7 | 1 | - | - | - | BTP[4:0] | | | | |
| | recommend (10h) | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | Parameter 8 | 1 | - | - | - | BTN[4:0] | | | | |
| | recommend (10h) | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | Parameter 9 | 1 | VRHP[7:0] | | | | | | | |
| | recommend (34h) | | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| | Parameter 10 | 1 | VRHN[7:0] | | | | | | | |
| | recommend (3Ch) | | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| | Parameter 11 | 1 | - | - | VRMP[5:0] | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Parameter 12 | 1 | - | - | VRMN[5:0] | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

| Register | | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-----------------|-----------------|--------------|------------|----|----|----|---------|------|------|-----|
| RB3h | SETRGBIF | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| | Parameter 1 | 1 | - | - | - | - | DPL | HSPL | VSPL | EPL |
| | recommend (01h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| RB4h | SETCYC | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| | Parameter 1 | 1 | - | - | - | - | NW[1:0] | | - | - |
| | recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Parameter 2 | 1 | SON[7:0] | | | | | | | |
| | recommend (08h) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | Parameter 3 | 1 | SOFF[7:0] | | | | | | | |
| | recommend (6Eh) | | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| | Parameter 4 | 1 | EQS[7:0] | | | | | | | |
| | recommend (07h) | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| | Parameter 5 | 1 | EQN[7:0] | | | | | | | |
| | recommend (01h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Parameter 6 | 1 | GDON[7:0] | | | | | | | |
| | recommend (01h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Parameter 7 | 1 | GDOFF[7:0] | | | | | | | |
| | recommend (62h) | | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| Parameter 8 | 1 | GVSSP1[7:0] | | | | | | | | |
| recommend (01h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| Parameter 9 | 1 | GVSSP12[7:0] | | | | | | | | |
| recommend (57h) | | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | |
| RB9h | SETEXTC | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 |
| | Parameter 1 | 1 | EXTC1[7:0] | | | | | | | |
| | recommend (FFh) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Parameter 2 | 1 | EXTC2[7:0] | | | | | | | |
| | recommend (83h) | | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | Parameter 3 | 1 | EXTC3[7:0] | | | | | | | |
| recommend (63h) | | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | |
| RBAh | DSI Control | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Parameter 1 | 1 | | | | | | | | |
| | recommend (80h) | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Parameter 2 | 1 | | | | | | | | |
| | recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Parameter 3 | 1 | | | | | | | | |
| | recommend (10h) | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | Parameter 4 | 1 | | | | | | | | |
| | recommend (08h) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | Parameter 5 | 1 | | | | | | | | |
| | recommend (08h) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | Parameter 6 | 1 | | | | | | | | |
| | recommend (10h) | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | Parameter 7 | 1 | | | | | | | | |
| recommend (7Ch) | | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | |
| Parameter 8 | 1 | | | | | | | | | |
| recommend (6Eh) | | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | |
| Parameter 9 | 1 | | | | | | | | | |
| recommend (6Dh) | | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | |
| Parameter 10 | 1 | | | | | | | | | |
| recommend (0Ah) | | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | |

DSI_Control continues to the next page.

| Register | | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
|----------|-----------------|-----|----------|----|----|----|----|----|----|--------|--|
| | Parameter 11 | 1 | | | | | | | | | |
| | recommend (01h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| | Parameter 12 | 1 | | | | | | | | | |
| | recommend (80h) | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Parameter 13 | 1 | | | | | | | | | |
| | recommend (43h) | | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | |
| RC1h | SETDGCLUT | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | |
| | Parameter 1 | 1 | - | - | - | - | - | - | - | DGC_EN | |
| | recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Parameter 2 | 1 | D1[7:0] | | | | | | | | |
| | recommend (3Ch) | | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| | Parameter 3 | 1 | D2[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 4 | 1 | D3[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 5 | 1 | D4[7:0] | | | | | | | | |
| | recommend (3Ch) | | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| | Parameter 6 | 1 | D5[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 7 | 1 | D6[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 8 | 1 | D7[7:0] | | | | | | | | |
| | recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Parameter 9 | 1 | D8[7:0] | | | | | | | | |
| | recommend (3Ch) | | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| | Parameter 10 | 1 | D9[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 11 | 1 | D10[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 12 | 1 | D11[7:0] | | | | | | | | |
| | recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Parameter 13 | 1 | D12[7:0] | | | | | | | | |
| | recommend (3Ch) | | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| | Parameter 14 | 1 | D13[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 15 | 1 | D14[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 16 | 1 | D15[7:0] | | | | | | | | |
| | recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Parameter 17 | 1 | D16[7:0] | | | | | | | | |
| | recommend (3Ch) | | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | |
| | Parameter 18 | 1 | D17[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 19 | 1 | D18[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Parameter 20 | 1 | D19[7:0] | | | | | | | | |
| | recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Parameter 21 | 1 | D20[7:0] | | | | | | | | |
| | recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |

SETDGCLUT continues to the next page.

| Register | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
|-----------------|-----|----------|----|----|----|----|----|----|----|--|
| Parameter 22 | 1 | D21[7:0] | | | | | | | | |
| recommend (C1h) | | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | |
| Parameter 23 | 1 | D22[7:0] | | | | | | | | |
| recommend (A8h) | | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| Parameter 24 | 1 | D23[7:0] | | | | | | | | |
| recommend (8Ch) | | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | |
| Parameter 25 | 1 | D24[7:0] | | | | | | | | |
| recommend (59h) | | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | |
| Parameter 26 | 1 | D25[7:0] | | | | | | | | |
| recommend (35h) | | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | |
| Parameter 27 | 1 | D26[7:0] | | | | | | | | |
| recommend (15h) | | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | |
| Parameter 28 | 1 | D27[7:0] | | | | | | | | |
| recommend (F3h) | | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | |
| Parameter 29 | 1 | D28[7:0] | | | | | | | | |
| recommend (D2h) | | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | |
| Parameter 30 | 1 | D29[7:0] | | | | | | | | |
| recommend (BBh) | | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | |
| Parameter 31 | 1 | D30[7:0] | | | | | | | | |
| recommend (8Eh) | | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | |
| Parameter 32 | 1 | D31[7:0] | | | | | | | | |
| recommend (0Fh) | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | |
| Parameter 33 | 1 | D32[7:0] | | | | | | | | |
| recommend (09h) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | |
| Parameter 34 | 1 | D33[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 35 | 1 | D34[7:0] | | | | | | | | |
| recommend (FFh) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Parameter 36 | 1 | D35[7:0] | | | | | | | | |
| recommend (FFh) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Parameter 37 | 1 | D36[7:0] | | | | | | | | |
| recommend (EAh) | | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 38 | 1 | D37[7:0] | | | | | | | | |
| recommend (AAh) | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 39 | 1 | D38[7:0] | | | | | | | | |
| recommend (A5h) | | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | |
| Parameter 40 | 1 | D39[7:0] | | | | | | | | |
| recommend (55h) | | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| Parameter 41 | 1 | D40[7:0] | | | | | | | | |
| recommend (50h) | | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | |
| Parameter 42 | 1 | D41[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 43 | 1 | D42[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 44 | 1 | D43[7:0] | | | | | | | | |
| recommend (EAh) | | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 45 | 1 | D44[7:0] | | | | | | | | |
| recommend (CFh) | | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | |
| Parameter 46 | 1 | D45[7:0] | | | | | | | | |
| recommend (A8h) | | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |

SETDGCLUT continues to the next page.

| Register | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
|-----------------|-----|----------|----|----|----|----|----|----|----|--|
| Parameter 47 | 1 | D46[7:0] | | | | | | | | |
| recommend (81h) | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| Parameter 48 | 1 | D47[7:0] | | | | | | | | |
| recommend (5Fh) | | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | |
| Parameter 49 | 1 | D48[7:0] | | | | | | | | |
| recommend (3Eh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | |
| Parameter 50 | 1 | D49[7:0] | | | | | | | | |
| recommend (25h) | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | |
| Parameter 51 | 1 | D50[7:0] | | | | | | | | |
| recommend (06h) | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | |
| Parameter 52 | 1 | D51[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 53 | 1 | D52[7:0] | | | | | | | | |
| recommend (D0h) | | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | |
| Parameter 54 | 1 | D53[7:0] | | | | | | | | |
| recommend (B3h) | | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | |
| Parameter 55 | 1 | D54[7:0] | | | | | | | | |
| recommend (97h) | | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | |
| Parameter 56 | 1 | D55[7:0] | | | | | | | | |
| recommend (7Fh) | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Parameter 57 | 1 | D56[7:0] | | | | | | | | |
| recommend (65h) | | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | |
| Parameter 58 | 1 | D57[7:0] | | | | | | | | |
| recommend (4Ah) | | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 59 | 1 | D58[7:0] | | | | | | | | |
| recommend (2Fh) | | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | |
| Parameter 60 | 1 | D59[7:0] | | | | | | | | |
| recommend (16h) | | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | |
| Parameter 61 | 1 | D60[7:0] | | | | | | | | |
| recommend (FDh) | | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | |
| Parameter 62 | 1 | D61[7:0] | | | | | | | | |
| recommend (10h) | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | |
| Parameter 63 | 1 | D62[7:0] | | | | | | | | |
| recommend (CAh) | | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 64 | 1 | D63[7:0] | | | | | | | | |
| recommend (AFh) | | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | |
| Parameter 65 | 1 | D64[7:0] | | | | | | | | |
| recommend (99h) | | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | |
| Parameter 66 | 1 | D65[7:0] | | | | | | | | |
| recommend (74h) | | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | |
| Parameter 67 | 1 | D66[7:0] | | | | | | | | |
| recommend (43h) | | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | |
| Parameter 68 | 1 | D67[7:0] | | | | | | | | |
| recommend (2Ch) | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | |
| Parameter 69 | 1 | D68[7:0] | | | | | | | | |
| recommend (09h) | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | |
| Parameter 70 | 1 | D69[7:0] | | | | | | | | |
| recommend (F1h) | | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | |
| Parameter 71 | 1 | D70[7:0] | | | | | | | | |
| recommend (D3h) | | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | |

SETDGCLUT continues to the next page.

| Register | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
|-----------------|-----|----------|----|----|----|----|----|----|----|--|
| Parameter 72 | 1 | D71[7:0] | | | | | | | | |
| recommend (C1h) | | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | |
| Parameter 73 | 1 | D72[7:0] | | | | | | | | |
| recommend (A2h) | | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | |
| Parameter 74 | 1 | D73[7:0] | | | | | | | | |
| recommend (6Bh) | | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | |
| Parameter 75 | 1 | D74[7:0] | | | | | | | | |
| recommend (10h) | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | |
| Parameter 76 | 1 | D75[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 77 | 1 | D76[7:0] | | | | | | | | |
| recommend (FFh) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Parameter 78 | 1 | D77[7:0] | | | | | | | | |
| recommend (FFh) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Parameter 79 | 1 | D78[7:0] | | | | | | | | |
| recommend (2Ah) | | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 80 | 1 | D79[7:0] | | | | | | | | |
| recommend (AAh) | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 81 | 1 | D80[7:0] | | | | | | | | |
| recommend (91h) | | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | |
| Parameter 82 | 1 | D81[7:0] | | | | | | | | |
| recommend (55h) | | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | |
| Parameter 83 | 1 | D82[7:0] | | | | | | | | |
| recommend (50h) | | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | |
| Parameter 84 | 1 | D83[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 85 | 1 | D84[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 86 | 1 | D85[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 87 | 1 | D86[7:0] | | | | | | | | |
| recommend (C9h) | | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | |
| Parameter 88 | 1 | D87[7:0] | | | | | | | | |
| recommend (9Ch) | | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | |
| Parameter 89 | 1 | D88[7:0] | | | | | | | | |
| recommend (77h) | | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | |
| Parameter 90 | 1 | D89[7:0] | | | | | | | | |
| recommend (53h) | | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | |
| Parameter 91 | 1 | D90[7:0] | | | | | | | | |
| recommend (34h) | | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | |
| Parameter 92 | 1 | D91[7:0] | | | | | | | | |
| recommend (1Ch) | | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | |
| Parameter 93 | 1 | D92[7:0] | | | | | | | | |
| recommend (FBh) | | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | |
| Parameter 94 | 1 | D93[7:0] | | | | | | | | |
| recommend (20h) | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 95 | 1 | D94[7:0] | | | | | | | | |
| recommend (C5h) | | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | |
| Parameter 96 | 1 | D95[7:0] | | | | | | | | |
| recommend (AAh) | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |

SETDGCLUT continues to the next page.

| Register | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
|-----------------|-----|-----------|----|----|----|----|----|----|----|--|
| Parameter 97 | 1 | D96[7:0] | | | | | | | | |
| recommend (8Ch) | | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | |
| Parameter 98 | 1 | D97[7:0] | | | | | | | | |
| recommend (73h) | | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | |
| Parameter 99 | 1 | D98[7:0] | | | | | | | | |
| recommend (59h) | | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | |
| Parameter 100 | 1 | D99[7:0] | | | | | | | | |
| recommend (41h) | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | |
| Parameter 101 | 1 | D100[7:0] | | | | | | | | |
| recommend (28h) | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | |
| Parameter 102 | 1 | D101[7:0] | | | | | | | | |
| recommend (10h) | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | |
| Parameter 103 | 1 | D102[7:0] | | | | | | | | |
| recommend (F6h) | | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | |
| Parameter 104 | 1 | D103[7:0] | | | | | | | | |
| recommend (DCh) | | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | |
| Parameter 105 | 1 | D104[7:0] | | | | | | | | |
| recommend (C4h) | | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | |
| Parameter 106 | 1 | D105[7:0] | | | | | | | | |
| recommend (AAh) | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 107 | 1 | D106[7:0] | | | | | | | | |
| recommend (93h) | | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | |
| Parameter 108 | 1 | D107[7:0] | | | | | | | | |
| recommend (6Ah) | | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 109 | 1 | D108[7:0] | | | | | | | | |
| recommend (40h) | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 110 | 1 | D109[7:0] | | | | | | | | |
| recommend (25h) | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | |
| Parameter 111 | 1 | D110[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 112 | 1 | D111[7:0] | | | | | | | | |
| recommend (E8h) | | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | |
| Parameter 113 | 1 | D112[7:0] | | | | | | | | |
| recommend (CAh) | | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | |
| Parameter 114 | 1 | D113[7:0] | | | | | | | | |
| recommend (B7h) | | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | |
| Parameter 115 | 1 | D114[7:0] | | | | | | | | |
| recommend (9Ch) | | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | |
| Parameter 116 | 1 | D115[7:0] | | | | | | | | |
| recommend (1Ah) | | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | |
| Parameter 117 | 1 | D116[7:0] | | | | | | | | |
| recommend (05h) | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | |
| Parameter 118 | 1 | D117[7:0] | | | | | | | | |
| recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Parameter 119 | 1 | D118[7:0] | | | | | | | | |
| recommend (3Fh) | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Parameter 120 | 1 | D119[7:0] | | | | | | | | |
| recommend (FEh) | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| Parameter 121 | 1 | D120[7:0] | | | | | | | | |
| recommend (2Ah) | | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | |

SETDGCLUT continues to the next page.

| Register | | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|----------|--------------------|-----|---------------|------------|--------------|--------------|---------|---------|----------|----------|
| | Parameter 122 | 1 | D121[7:0] | | | | | | | |
| | recommend (AAh) | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| | Parameter 123 | 1 | D122[7:0] | | | | | | | |
| | recommend (95h) | | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Parameter 124 | 1 | D123[7:0] | | | | | | | |
| | recommend (55h) | | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Parameter 125 | 1 | D124[7:0] | | | | | | | |
| | recommend (50h) | | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| | Parameter 126 | 1 | D125[7:0] | | | | | | | |
| | recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Parameter 127 | 1 | D126[7:0] | | | | | | | |
| | recommend (00h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| RCCh | SETDGCLUT | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Parameter 1 | | - | - | - | SM_PANE | SS_PANE | GS_PANE | REV_PANE | BGR_PANE |
| | recommend (0Bh) | | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| RE0h | SET SIP READ INDEX | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| | Parameter 1 | | - | - | G1_VRP0[5:0] | | | | | |
| | recommend (01h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Parameter 2 | 1 | G1_CGMP0[1:0] | | G1_VRP1[5:0] | | | | | |
| | recommend (48h) | | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| | Parameter 3 | 1 | G1_CGMP1[1:0] | | G1_VRP2[5:0] | | | | | |
| | recommend (4Dh) | | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| | Parameter 4 | 1 | G1_CGMP2[1:0] | | G1_VRP3[5:0] | | | | | |
| | recommend (4Eh) | | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| | Parameter 5 | 1 | G1_CGMP3[1:0] | | G1_VRP4[5:0] | | | | | |
| | recommend (58h) | | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| | Parameter 6 | 1 | G1_CGMP[5:4] | | G1_VRP5[5:0] | | | | | |
| | recommend (F6h) | | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 |
| | Parameter 7 | 1 | - | G1_PRP0[6] | - | G1_PKP0[4:0] | | | | |
| | recommend (0Bh) | | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| | Parameter 8 | 1 | G1_PRP0[5:4] | | - | G1_PKP1[4:0] | | | | |
| | recommend (4Eh) | | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| | Parameter 9 | 1 | G1_PRP0[3:2] | | - | G1_PKP2[4:0] | | | | |
| | recommend (12h) | | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| | Parameter 10 | 1 | G1_PRP0[1:0] | | - | G1_PKP3[4:0] | | | | |
| | recommend (D5h) | | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Parameter 11 | 1 | - | G1_PRP1[6] | - | G1_PKP4[4:0] | | | | |
| | recommend (15h) | | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Parameter 12 | 1 | G1_PRP1[5:4] | | - | G1PKP5[4:0] | | | | |
| | recommend (95h) | | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Parameter 13 | 1 | G1_PRP1[3:2] | | - | G1PKP6[4:0] | | | | |
| | recommend (55h) | | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Parameter 14 | 1 | G1_PRP1[1:0] | | - | G1PKP7[4:0] | | | | |
| | recommend (8Eh) | | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| | Parameter 15 | 1 | - | - | - | G1PKP8[4:0] | | | | |
| | recommend (11h) | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| | Parameter 16 | 1 | - | - | G1_VRN0[5:0] | | | | | |
| | recommend (01h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Parameter 17 | 1 | G1_CGMN0[1:0] | | G1_VRN1[5:0] | | | | | |
| | recommend (48h) | | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |

SET_SIP_READ_INDEX continues to the next page.

| Register | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|-------------------------|-----|----------------|------------|--------------|--------------|----|----|----|----|
| Parameter 18 | 1 | G1_CGMN1[1:0] | | G1_VRN2[5:0] | | | | | |
| recommend (4Dh) | | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| Parameter 19 | 1 | G1_CGMN2[1:0] | | G1_VRN3[5:0] | | | | | |
| recommend (55h) | | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| Parameter 20 | 1 | G1_CGMN3[1:0] | | G1_VRN4[5:0] | | | | | |
| recommend (5Fh) | | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| Parameter 21 | 1 | G1_CGMN[5:4] | | G1_VRN5[5:0] | | | | | |
| recommend (FDh) | | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| Parameter 22 | 1 | - | G1_NRN0[6] | - | G1_PKN0[4:0] | | | | |
| recommend (0Ah) | | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| Parameter 23 | 1 | G1_PRN0[5:4] | | - | G1_PKN1[4:0] | | | | |
| recommend (4Eh) | | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| Parameter 24 | 1 | G1_PRN0[3:2] | | - | G1_PKN2[4:0] | | | | |
| recommend (51h) | | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| Parameter 25 | 1 | G1_PRN0[1:0] | | - | G1_PKN3[4:0] | | | | |
| recommend (D3h) | | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| Parameter 26 | 1 | - | G1_PRN1[6] | - | G1_PKN4[4:0] | | | | |
| recommend (17h) | | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |
| Parameter 27 | 1 | G1_PRN1[5:4] | | - | G1_PKN5[4:0] | | | | |
| recommend (95h) | | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| Parameter 28 | 1 | G1_PRN1[3:2] | | - | G1_PKN6[4:0] | | | | |
| recommend (96h) | | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| Parameter 29 | 1 | G1_PRN1[1:0] | | - | G1_PKN7[4:0] | | | | |
| recommend (4Eh) | | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| Parameter 30 | 1 | - | - | - | G1_PKN8[4:0] | | | | |
| recommend (11h) | | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| RFEh SET SPI READ INDEX | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Parameter 1 | 1 | CMD_ADD[7:0] | | | | | | | |
| recommend | | - | - | - | - | - | - | - | - |
| RFFh SPIREAD | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Parameter 1 | 1 | CMD_DATA1[7:0] | | | | | | | |
| recommend | | - | - | - | - | - | - | - | - |
| Parameter 2 | 1 | ----- | | | | | | | |
| recommend | | - | - | - | - | - | - | - | - |
| Parameter 3 | 1 | CMD_DATA1[7:0] | | | | | | | |
| recommend | | - | - | - | - | - | - | - | - |

9. Sequence

9.1 Power-ON Sequence

PH :Packet Header

PD :Packet Data

PF:Packet Footer (=Checksum)

| No. | | Function | DNC | Command /Parameter | Type | Command/Parameter |
|---------------------------|---------------------------------|---|-----|--------------------|---|-------------------|
| | | RESETB=0 | | | | |
| | Power on | VDD, VCCIO on | | | | |
| | Wait | wait 10 msec or more | | | | |
| | | RESETB=1 | | | | |
| | MIPI signal state | keep CLKN, CLKP, D0N, D0P, D1N, D1P in STOP state (LP-11) | | | | |
| | Wait | wait 10 msec or more | | | | |
| 1 | Sleep out | Sleep out | 0 | 11h | PH | [05 11 00 36] |
| | Wait | wait 100 msec or more | | | | |
| 2 | Enable extended commands | Enable extended commands | 0 | B9h | PH | [39 04 00 2C] |
| Parameter 1 | | 1 | FFh | PD | [B9 FF 83 63] | |
| Parameter 2 | | 1 | 83h | PF | [XX XX] | |
| Parameter 3 | | 1 | 63h | | | |
| 3 | Set lane number/ operation mode | Two data lane, Sync Pulses mode *1 | 0 | BAh | PH | [39, 0E, 00, 15] |
| Parameter 1 | | 1 | 80h | PD | [BA 80 00 10 08 08 10 7C 6E 6D 0A 01 80 43] | |
| Parameter 2 | | 1 | 00h | PF | [XX XX] | |
| Parameter 3 | | 1 | 10h | | | |
| Parameter 4 | | 1 | 08h | | | |
| Parameter 5 | | 1 | 08h | | | |
| Parameter 6 | | 1 | 10h | | | |
| Parameter 7 | | 1 | 7Ch | | | |
| Parameter 8 | | 1 | 6Eh | | | |
| Parameter 9 | | 1 | 6Dh | | | |
| Parameter 10 | | 1 | 0Ah | | | |
| Parameter 11 | | 1 | 01h | | | |
| Parameter 12 | | 1 | 80h | | | |
| Parameter 13 | | 1 | 43h | | | |
| 4 | Memory access control | Memory access control | 0 | 36h | PH | [15 36 00 29] |
| Parameter 1 | | 1 | 00h | | | |
| 5 | Interface pixel format | Interface pixel format | 0 | 3Ah | PH | [15 3A 70 28] |
| Parameter 1(24bit/pixel) | | 1 | 70h | | | |
| | Wait | wait 5 msec or more | | | | |
| 6 | Set power | Set power | 0 | B1h | PH | [39 0D 00 13] |
| Parameter 1 | | 1 | 78h | PD | [B1 78 24 04 02 02 03 10 10 34 3C 3F 3F] | |
| Parameter 2 | | 1 | 24h | PF | [XX XX] | |
| Parameter 3 | | 1 | 04h | | | |
| Parameter 4 | | 1 | 02h | | | |
| Parameter 5 | | 1 | 02h | | | |
| Parameter 6 | | 1 | 03h | | | |
| Parameter 7 | | 1 | 10h | | | |
| Parameter 8 | | 1 | 10h | | | |
| Parameter 9 | | 1 | 34h | | | |
| Parameter 10 | | 1 | 3Ch | | | |
| Parameter 11 | | 1 | 3Fh | | | |
| Parameter 12 | | 1 | 3Fh | | | |

PH :Packet Header

PD :Packet Data

PF:Packet Footer (=Checksum)

| No. | | Function | DNC | Command /Parameter | Type | Command/Parameter | | |
|-----|---------------------------------|---------------------------------|--------------|---------------------|------|--|----|---------------|
| 7 | Set display waveform cycle | Set display waveform cycle | 0 | B4h | PH | [39 0A 00 36] | | |
| | | Parameter 1 | 1 | 00h | PD | [B4 00 08 6E 07 01 01 62 01 57] | | |
| | | Parameter 2 | 1 | 08h | PF | [XX XX] | | |
| | | Parameter 3 | 1 | 6Eh | | | | |
| | | Parameter 4 | 1 | 07h | | | | |
| | | Parameter 5 | 1 | 01h | | | | |
| | | Parameter 6 | 1 | 01h | | | | |
| | | Parameter 7 | 1 | 62h | | | | |
| | | Parameter 8 | 1 | 01h | | | | |
| | | Parameter 9 | 1 | 57h | | | | |
| 8 | Set panel | Set panel | 0 | CCh | PH | [15 CC 0B 22] | | |
| | | Parameter 1 | 1 | 0Bh | | | | |
| 9 | Set gamma curve related setting | Set gamma curve related setting | 0 | E0h | PH | [39 1F 00 29] | | |
| | | Parameter 1 | 1 | 01h | PD | [E0 01 48 4D 4E 58 F6 0B 4E 12 D5 15 95 55 8E 11 01 48 4D 55 5F FD 0A 4E 51 D3 17 95 96 4E 11] | | |
| | | Parameter 2 | 1 | 48h | | | | |
| | | Parameter 3 | 1 | 4Dh | PF | [XX XX] | | |
| | | Parameter 4 | 1 | 4Eh | | | | |
| | | Parameter 5 | 1 | 58h | | | | |
| | | Parameter 6 | 1 | F6h | | | | |
| | | Parameter 7 | 1 | 0Bh | | | | |
| | | Parameter 8 | 1 | 4Eh | | | | |
| | | Parameter 9 | 1 | 12h | | | | |
| | | Parameter 10 | 1 | D5h | | | | |
| | | Parameter 11 | 1 | 15h | | | | |
| | | Parameter 12 | 1 | 95h | | | | |
| | | Parameter 13 | 1 | 55h | | | | |
| | | Parameter 14 | 1 | 8Eh | | | | |
| | | Parameter 15 | 1 | 11h | | | | |
| | | Parameter 16 | 1 | 01h | | | | |
| | | Parameter 17 | 1 | 48h | | | | |
| | | Parameter 18 | 1 | 4Dh | | | | |
| | | Parameter 19 | 1 | 55h | | | | |
| | | Parameter 20 | 1 | 5Fh | | | | |
| | | Parameter 21 | 1 | FDh | | | | |
| | | Parameter 22 | 1 | 0Ah | | | | |
| | | Parameter 23 | 1 | 4Eh | | | | |
| | | Parameter 24 | 1 | 51h | | | | |
| | | Parameter 25 | 1 | D3h | | | | |
| | | Parameter 26 | 1 | 17h | | | | |
| | | Parameter 27 | 1 | 95h | | | | |
| | | Parameter 28 | 1 | 96h | | | | |
| | | Parameter 29 | 1 | 4Eh | | | | |
| | | Parameter 30 | 1 | 11h | | | | |
| | | | Wait | wait 5 msec or more | | | | |
| | | 10 | Display on | Display on | 1 | 29h | PH | [05 29 00 1C] |
| | | 11 | Video stream | | | | | ... |
| | | | | | | ... | | |
| | | | | | | ... | | |

*1 The described value is Sync Pulses mode in DSI interface.

If you want to changes the lane number/ operation mode. Please follow the under packet to change it.

Two data lane, Sync Pulses mode :

Packet header [39, 0E, 00, 15],

Packet data [BA 80 00 10 08 08 10 7C 6E 6D 0A 01 80 43],

Packet footer[XX XX]

Two data lane, Sync Events mode/Burst mode :

Packet header [39, 0E, 00, 15],

Packet data [BA 80 00 10 08 08 10 7C 6E 6D 0A 01 84 43],

Packet footer[XX XX]

One data lane, Sync Pulses mode :

Packet header [39, 0E, 00, 15],

Packet data [BA 80 00 10 08 08 10 7C 6E 6D 0A 00 80 43],

Packet footer[XX XX]

One data lane, Sync Events mode/Burst mode :

Packet header [39, 0E, 00, 15],

Packet data [BA 80 00 10 08 08 10 7C 6E 6D 0A 00 84 43],

Packet footer[XX XX]

9.2 Power-OFF Sequence

PH :Packet Header

PD :Packet Data

PF:Packet Footer (=Checksum)

| No. | | Function | DNC | Command /Parameter | Type | Command/Parameter |
|-----|---------------|-----------------------|-----|--------------------|------|-------------------|
| 1 | Display off | Display off | 0 | 28h | PH | [05 28 00 06] |
| | Wait | wait 5 msec or more | | | | |
| 2 | Sleep in | Sleep in | 0 | 10h | PH | [05 10 00 2C] |
| | Wait | wait 2 frames or more | | | | |
| 3 | Video signals | Video signals stop | | | | |

↓
Power off

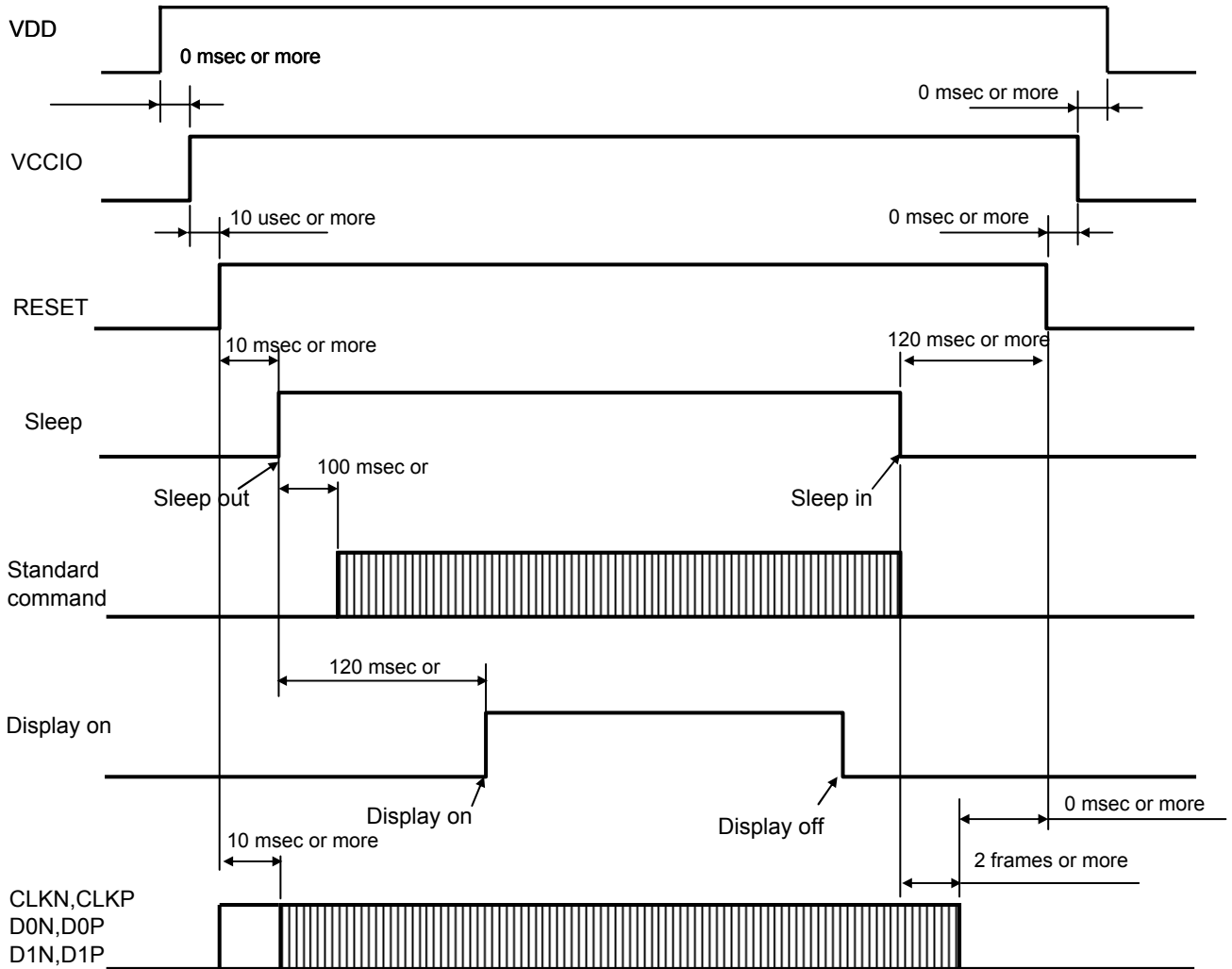
9.3 Sleep Sequence

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

9.4 Sleep Release Sequence

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

9.5 Power ON/OFF timing



9.6 Refresh Sequence

PH :Packet Header

PD :Packet Data

PF:Packet Footer (=Checksum)

| No. | | Function | DNC | Command /Parameter | Type | Command/Parameter |
|---------------------------|------------------------------------|------------------------------------|-----|--------------------|---|-------------------|
| 1 | Sleep out | Sleep out | 0 | 11h | PH | [05 11 00 36] |
| | Wait | wait 100 msec or more | | | | |
| 2 | Enable extended commands | Enable extended commands | 0 | B9h | PH | [39 04 00 2C] |
| Parameter 1 | | 1 | FFh | PD | [B9 FF 83 63] | |
| Parameter 2 | | 1 | 83h | PF | [XX XX] | |
| Parameter 3 | | 1 | 63h | | | |
| 3 | Set lane number/ operation mode | Two data lane, Sync Pulses mode *1 | 0 | BAh | PH | [39, 0E, 00, 15] |
| Parameter 1 | | 1 | 80h | PD | [BA 80 00 10 08 08 10 7C 6E 6D 0A 01 80 43] | |
| Parameter 2 | | 1 | 00h | PF | [XX XX] | |
| Parameter 3 | | 1 | 10h | | | |
| Parameter 4 | | 1 | 08h | | | |
| Parameter 5 | | 1 | 08h | | | |
| Parameter 6 | | 1 | 10h | | | |
| Parameter 7 | | 1 | 7Ch | | | |
| Parameter 8 | | 1 | 6Eh | | | |
| Parameter 9 | | 1 | 6Dh | | | |
| Parameter 10 | | 1 | 0Ah | | | |
| Parameter 11 | | 1 | 01h | | | |
| Parameter 12 | | 1 | 80h | | | |
| Parameter 13 | | 1 | 43h | | | |
| 4 | Memory access control | Memory access control | 0 | 36h | PH | [15 36 00 29] |
| Parameter 1 | | 1 | 00h | | | |
| 5 | Interface pixel format | Interface pixel format | 0 | 3Ah | PH | [15 3A 70 28] |
| Parameter 1(24bit/pixel) | | 1 | 70h | | | |
| | Wait | wait 5 msec or more | | | | |
| 6 | Set power | Set power | 0 | B1h | PH | [39 0D 00 13] |
| Parameter 1 | | 1 | 78h | PD | [B1 78 24 04 02 02 03 10 10 34 3C 3F 3F] | |
| Parameter 2 | | 1 | 24h | PF | [XX XX] | |
| Parameter 3 | | 1 | 04h | | | |
| Parameter 4 | | 1 | 02h | | | |
| Parameter 5 | | 1 | 02h | | | |
| Parameter 6 | | 1 | 03h | | | |
| Parameter 7 | | 1 | 10h | | | |
| Parameter 8 | | 1 | 10h | | | |
| Parameter 9 | | 1 | 34h | | | |
| Parameter 10 | | 1 | 3Ch | | | |
| Parameter 11 | | 1 | 3Fh | | | |
| Parameter 12 | | 1 | 3Fh | | | |

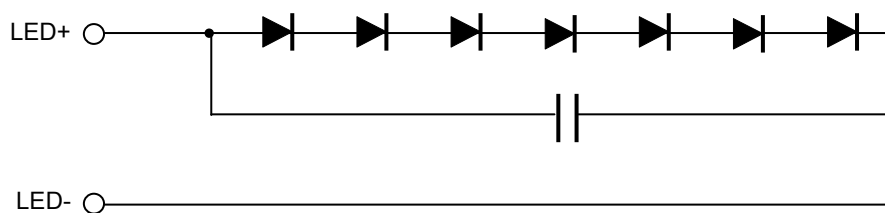
PH :Packet Header

PD :Packet Data

PF:Packet Footer (=Checksum)

| No. | | Function | DNC | Command /Parameter | Type | Command/Parameter | | |
|-----|---------------------------------|---------------------------------|------------|---------------------|------|--|----|---------------|
| 7 | Set display waveform cycle | Set display waveform cycle | 0 | B4h | PH | [39 0A 00 36] | | |
| | | Parameter 1 | 1 | 00h | PD | [B4 00 08 6E 07 01 01 62 01 57] | | |
| | | Parameter 2 | 1 | 08h | PF | [XX XX] | | |
| | | Parameter 3 | 1 | 6Eh | | | | |
| | | Parameter 4 | 1 | 07h | | | | |
| | | Parameter 5 | 1 | 01h | | | | |
| | | Parameter 6 | 1 | 01h | | | | |
| | | Parameter 7 | 1 | 62h | | | | |
| | | Parameter 8 | 1 | 01h | | | | |
| | | Parameter 9 | 1 | 57h | | | | |
| 8 | Set panel | Set panel | 0 | CCh | PH | [15 CC 0B 22] | | |
| | | Parameter 1 | 1 | 0Bh | | | | |
| 9 | Set gamma curve related setting | Set gamma curve related setting | 0 | E0h | PH | [39 1F 00 29] | | |
| | | Parameter 1 | 1 | 01h | PD | [E0 01 48 4D 4E 58 F6 0B 4E 12 D5 15 95 55 8E 11 01 48 4D 55 5F FD 0A 4E 51 D3 17 95 96 4E 11] | | |
| | | Parameter 2 | 1 | 48h | | | | |
| | | Parameter 3 | 1 | 4Dh | PF | [XX XX] | | |
| | | Parameter 4 | 1 | 4Eh | | | | |
| | | Parameter 5 | 1 | 58h | | | | |
| | | Parameter 6 | 1 | F6h | | | | |
| | | Parameter 7 | 1 | 0Bh | | | | |
| | | Parameter 8 | 1 | 4Eh | | | | |
| | | Parameter 9 | 1 | 12h | | | | |
| | | Parameter 10 | 1 | D5h | | | | |
| | | Parameter 11 | 1 | 15h | | | | |
| | | Parameter 12 | 1 | 95h | | | | |
| | | Parameter 13 | 1 | 55h | | | | |
| | | Parameter 14 | 1 | 8Eh | | | | |
| | | Parameter 15 | 1 | 11h | | | | |
| | | Parameter 16 | 1 | 01h | | | | |
| | | Parameter 17 | 1 | 48h | | | | |
| | | Parameter 18 | 1 | 4Dh | | | | |
| | | Parameter 19 | 1 | 55h | | | | |
| | | Parameter 20 | 1 | 5Fh | | | | |
| | | Parameter 21 | 1 | FDh | | | | |
| | | Parameter 22 | 1 | 0Ah | | | | |
| | | Parameter 23 | 1 | 4Eh | | | | |
| | | Parameter 24 | 1 | 51h | | | | |
| | | Parameter 25 | 1 | D3h | | | | |
| | | Parameter 26 | 1 | 17h | | | | |
| | | Parameter 27 | 1 | 95h | | | | |
| | | Parameter 28 | 1 | 96h | | | | |
| | | Parameter 29 | 1 | 4Eh | | | | |
| | | Parameter 30 | 1 | 11h | | | | |
| | | | Wait | wait 5 msec or more | | | | |
| | | 10 | Display on | Display on | 1 | 29h | PH | [05 29 00 1C] |

10. LED Circuit



11. Characteristics

11.1 Optical Characteristics

< Measurement Condition >

Measuring instruments: CS1000 (KONICA MINOLTA), LCD7000(OTSUKA ELECTRONICS),
EZcontrast160D (ELDIM)

Driving condition: VDD = 3.3V, VCCIO = 1.8V, GND=0V
Optimized VCOMDC

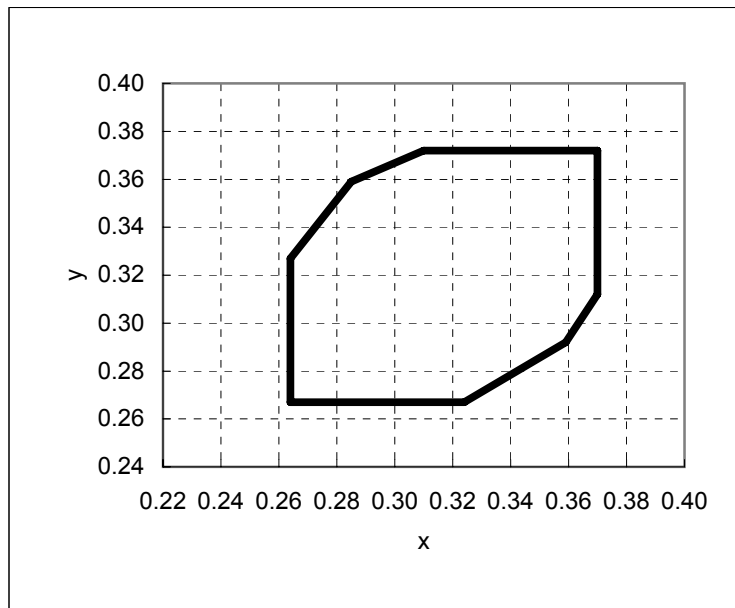
Backlight: IL=10mA

Measured temperature: Ta=25 °C

| Item | | Symbol | Condition | MIN | TYP | MAX | Unit | Note No. | Remark |
|-------------------------|---------------|--------|---------------------------------|---|-----|-----|-------------------|----------|--------|
| Response time | Rise time | TON | [Data]= 00h→FFh | — | — | 40 | ms | 1 | ※ |
| | Fall time | TOFF | [Data]= FFh→00h | — | — | 60 | ms | | |
| Contrast ratio | Backlight ON | CR | [Data]= FFh / 00h | — | 600 | — | | 2 | |
| | Backlight OFF | | | — | 5 | — | | | |
| Viewing angle | Left | θL | [Data]= 00h / FFh CR ≥ 10 | — | 80 | — | deg | 3 | ※ |
| | Right | θR | | — | 80 | — | deg | | |
| | Up | φU | | — | 80 | — | deg | | |
| | Down | φD | | — | 80 | — | deg | | |
| White Chromaticity | | x y | [Data]=FFh | White chromaticity range | | | | 4 | |
| Burn-in | | | | No noticeable burn-in image should be observed after 2 hours of window pattern display. | | | | 5 | |
| Center brightness | | | [Data]=FFh | 245 | 350 | — | cd/m ² | 6 | |
| Brightness distribution | | | [Data]=FFh | 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

【White Chromaticity Range】

| x | y |
|-------|-------|
| 0.310 | 0.372 |
| 0.285 | 0.359 |
| 0.264 | 0.327 |
| 0.264 | 0.267 |
| 0.324 | 0.267 |
| 0.359 | 0.292 |
| 0.370 | 0.312 |
| 0.370 | 0.372 |

11.2 Temperature Characteristics

< Measurement Condition >

Measuring instruments: CS1000 (KONICA MINOLTA), LCD7000(OTSUKA ELECTRONICS)

Driving condition: VDD = 3.3V, VCCIO = 1.8V, GND=0V

Optimized VCOMDC

Backlight: IL=10mA

| Item | | Specification | | Remark | |
|-----------------|-----------|---|------------------|--|---|
| | | Ta = -10 °C | Ta = 70 °C | | |
| Contrast ratio | CR | 200 or more | 200 or more | Backlight ON | |
| Response time | Rise time | TON | 200 msec or less | 30 msec or less | ※ |
| | Fall time | TOFF | 300 msec or less | 50 msec or less | ※ |
| Display Quality | | No noticeable display defect or nonuniformity should be observed. | | Use the criteria for judgment specified in the section 12. | |

※ Measured in the form of LCD module.

12. Criteria of Judgment

12.1 Defective Display and Screen Quality

Test Condition: Observed TFT-LCD monitor from front during operation with the following conditions
 Driving Signal Raster Patter (RGB in monochrome, white, black)
 Signal condition [Data] = FFh, 90h, 00h (3steps)
 Observation distance 30 cm
 Illuminance 200 to 350 lx
 Backlight IL=10mA

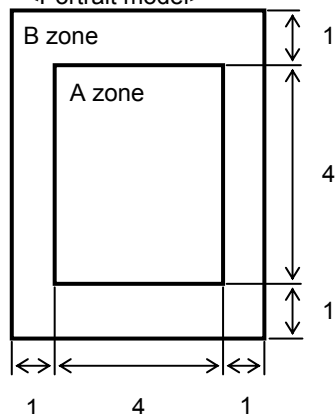
| Defect item | | Defect content | Criteria | |
|---|------------------|--|-------------------------------------|------------|
| Display Quality | Line defect | Black, white or color line, 3 or more neighboring defective dots | Not exists | |
| | Dot defect | Uneven brightness on dot-by-dot base due to defective TFT or CF, or dust is counted as dot defect (brighter dot, darker dot) High bright dot: Visible through 2% ND filter at [Data]=00h Low bright dot: Visible through 5% ND filter at [Data]=00h Dark dot: Appear dark through white display at [Data]=90h | Refer to table 1 | |
| Screen Quality | Dirt | Point-like uneven brightness (white stain, black stain etc) | Invisible through 1% ND filter | |
| | Foreign particle | Point-like | $0.25\text{mm} < \varphi$ | N=0 |
| | | | $0.20 < \varphi \leq 0.25\text{mm}$ | $N \leq 2$ |
| | | | $\varphi \leq 0.20\text{mm}$ | Ignored |
| | Liner | $3.0\text{mm} < \text{length and } 0.08\text{mm} < \text{width}$ | N=0 | |
| $\text{length} \leq 3.0\text{mm or width} \leq 0.08\text{mm}$ | | Ignored | | |
| Others | | Use boundary sample for judgment when necessary | | |

$\varphi(\text{mm})$: 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 Permissible distance between same color high bright dots (includes neighboring dots): 5 mm or more |
| B | 2 | 4 | 4 | 6 | |
| Total | 2 | 4 | 4 | 7 | |

<Portrait model>



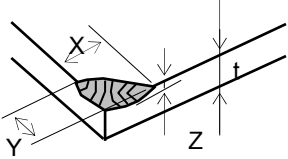
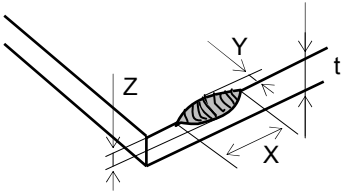
Division of A and B areas
 B area: Active area
 Dimensional ratio between A and B areas: 1: 4: 1 (Refer to the left figure)

12.2 Screen and Other Appearance

Testing conditions

| | |
|----------------------|--------------|
| Observation distance | 30cm |
| Illuminance | 1200~2000 lx |

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

| Item | Appearance | Criteria |
|-------------------|--|--|
| Glass Chipping | Corner area  | Unit: mm $X \leq 3$ $Y \leq 3$ $Z \leq t$ (t:glass thickness) In case that either x or y is less than 0.5mm, the other can be ignored. There shall be no crack that will expand. |
| | Others  | Unit: mm $X \leq 5$ $Y \leq 1$ $Z \leq t$ (t:glass thickness) In case that either x or y is less than 0.5mm, the other can be ignored. There shall be no crack that will expand. |
| | Progressive crack | None |

13. Reliability Test

| Test item | | Test condition | | number of failures /number of examinations |
|-------------------------------|---|---|------------|---|
| Durability test | High temperature storage | Ta=80° C | 240H | 0/3 |
| | Low temperature storage | Ta=-30° C | 240H | 0/3 |
| | High temperature & high humidity storage | Ta=60° C, RH=90% non condensing | 240H | 0/3 |
| | High temperature operation | Tp=70° C | 240H | 0/3 |
| | Low temperature operation | Tp=-20° C | 240H | 0/3 |
| | High temp & humid operation | Tp=40° C, RH=90% non condensing | 240H | 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 |
| | 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 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.)

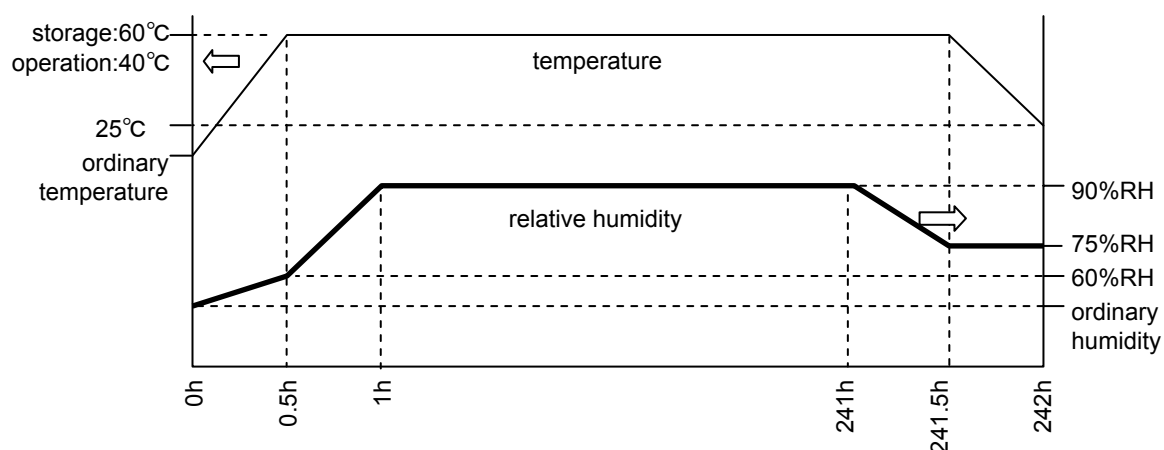
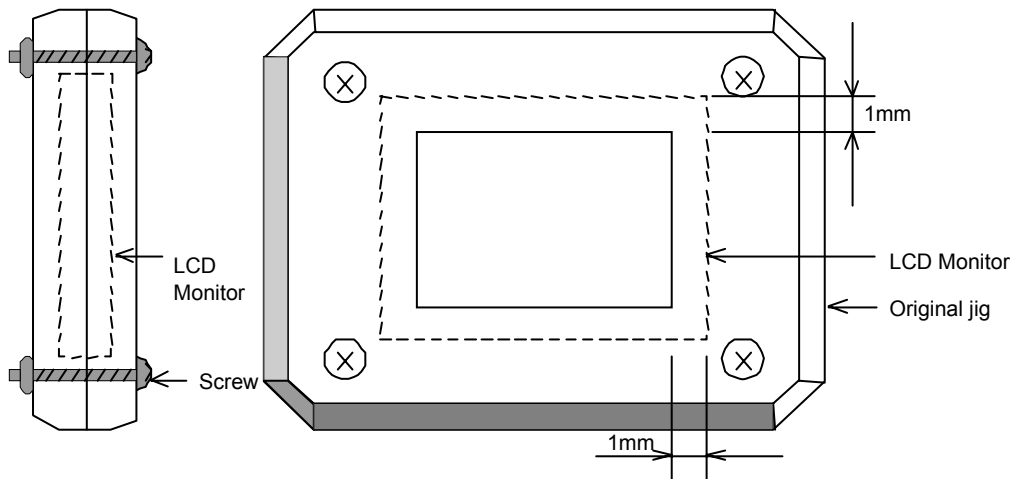


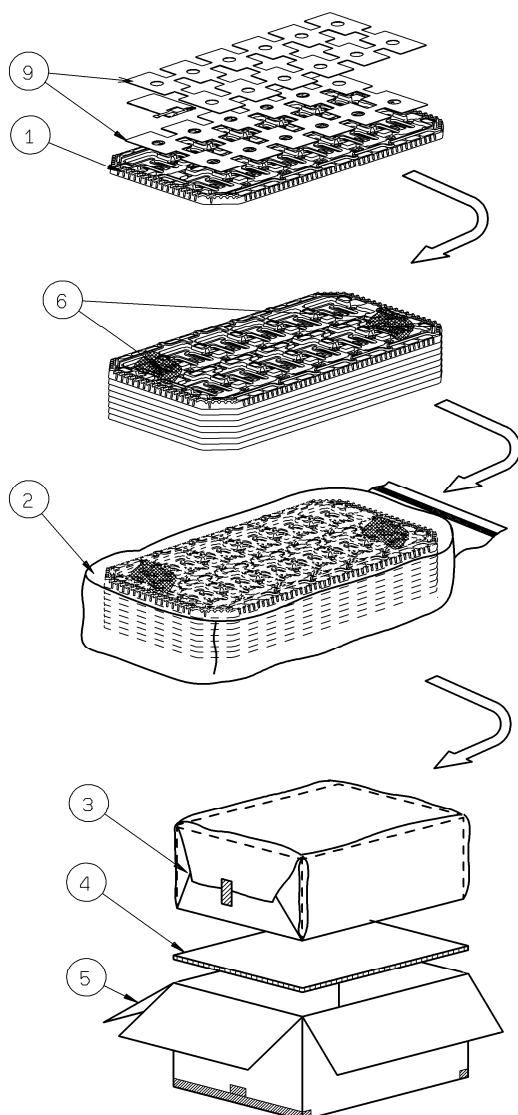
Table2. Reliability Criteria

Measure the parameters 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



14.PACKING SPECIFICATION

Step 1 Foam sheet is put on the tray.

Each product is to be placed in one of the cut-outs of the tray with the display surface facing downward.(12 products per tray)
Foam sheet is to be placed on the products in the tray.

Step 2 Each tray needs to be same orientation respect to the tray below or above it and the trays be in a stack of 7.

One empty tray is to be put on the top of stack of 7 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.

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

Step 4 The piled trays are to be wrapped with a bubble cushioning sheet, and to be fixed with adhesive tape.

Step 5 The inner board is put in the outer carton.

The wrapped trays are to be put in the outer carton.

Step 6 The outer carton needs to be sealed with packing tape as shown in the drawing.

The model number, quantity of products, and shipping date are to be printed on the outer carton.

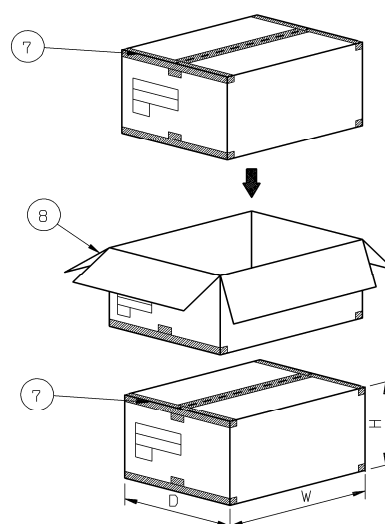
If necessary, shipping labels or impression markings are to be put on the outer carton.

Step 7 The outer carton is to be inserted into an extra outer carton with the same direction.

The extra outer carton needs to be sealed with packing tape as shown in the drawing.

Step 8 The model number, quantity of products, and shipping date are to be printed on the extra outer carton.

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 |
| ② Sealing bag | |
| ③ B sheet A | Anti-static air bubble sheet |
| ④ Inner board | Corrugated cardboard |
| ⑤ Outer carton | Corrugated cardboard |
| ⑥ Drier | Moisture absorber |
| ⑦ Packing tape | |
| ⑧ Extra outer carton | Corrugated cardboard |
| ⑨ Foam sheet | PE Anti-static |

| Dimension of extra outer carton | |
|--|-------------------|
| D : Approx. | (337mm) |
| W : Approx. | (618mm) |
| H : Approx. | (179mm) |
| Quantity of products packed in one carton: | 12pcs × 7 = 84pcs |
| Gross weight : Approx. | 4.5Kg |

15. Handling Instruction

15.1 Cautions for Handling LCD panels

**Caution**

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

15.2 Precautions for Handling

- 1) Wear finger tips at incoming inspection and for handling the TFT monitors to keep display quality and keep the working area clean.
Do not touch the surface of the monitor as it is easily scratched.
- 2) Wear grounded wrist-straps and use electrostatic neutralization blowers to prevent static charge and discharge when handling the TFT monitors as the LED in this TFT monitors is damageable to electrostatic discharge.
Designate an appropriate operating area, and set equipment, tools, and machines properly when handling this product.
- 3) Avoid strong mechanical shock including knocking, hitting or dropping to the TFT monitors for protecting their glass parts. Do not use the TFT monitors that have been experienced dropping or strong mechanical shock.
- 4) Do not use or storage the TFT monitors at high temperature and high humidity environment. Particularly, never use or storage the TFT monitors at a location where condensation builds up.
- 5) Avoid using and storing TFT monitors at a location where they are exposed to direct sunlight or ultraviolet rays to prevent the LCD panels from deterioration by ultraviolet rays.
- 6) Do not stain or damage the contacts of the FPC cable .
FPC cable needs to be inserted until it can reach to the end of connector slot.
During insertion, make sure to keep the cable in a horizontal position to avoid an oblique insertion.
Otherwise, it may cause poor contact or deteriorate reliability of the FPC cable.
- 7) 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 15.5 on how to peel off the protective film.
We are not responsible for electrostatic discharge failures or other defects occur when peeling off the protective film.
- 9) Please make it to the structure to suppress surroundings of the front polarizer for the display irregularity prevention.

15.3 Precautions for Operation

- 1) Since this TFT monitors are not equipped with light shielding for the driver IC, do not expose the driver IC to strong lights during operation as it may cause functional failures.
- 2) When turning off the power, turn off the input signal before or at the same timing of switching off the power.
- 3) Do not plug in or out the FPC cable while power supply is switch on.
Plug the FPC cable in and out while power supply is switched off.
- 4) Do not operate the TFT monitors in the strong magnetic field. It may break the TFT monitors.
- 5) Do not display a fixed image on the screen for a long time.
Use a screen-saver or other measures to avoid a fixed image displayed on the screen for a long time. Otherwise, it may cause burn-in image on the screen due the characteristics of liquid crystal.

15.4 Storage Condition for Shipping Cartons

Storage environment

- Temperature 0 to 40° C
- Humidity 60%RH or less
No-condensing occurs under low temperature with high humidity condition.
- Atmosphere No poisonous gas that can erode electronic components and/or wiring materials should be detected.
- Time period 3 months
- 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

15.5 Precautions for Peeling off the Protective film

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

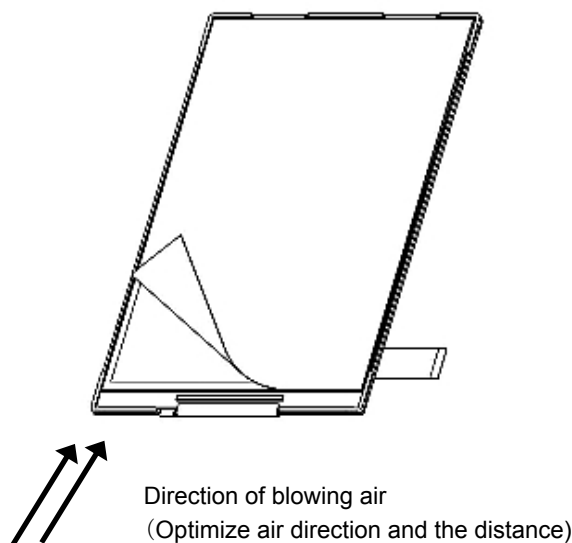
A) Work Environment

- a) Humidity: 50 to 70 %RH, Temperature 15 to 27° C
- b) Operators should wear conductive shoes, conductive clothes, conductive finger tips and grounded wrist-straps. 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 left when FPC is placed at the lower 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 left corner area of the protective film to prevent scratch on surface of TFT monitors.
- c) Peel off the adhesive tape slowly (spending more than 2 secs to complete) by pulling it to opposite direction.



APPENDIX

Reference Method for Measuring Optical Characteristics and Performance

1. Measurement Condition (Backlight ON)

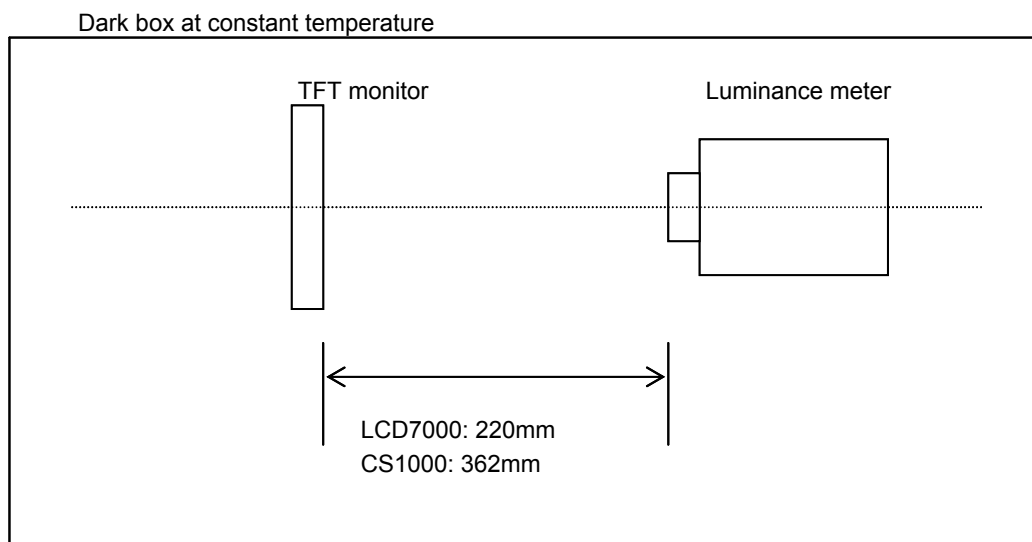
Measuring instruments: CS1000 (KONICA MINOLTA) , LCD7000(OTSUKA ELECTRONICS) ,EZcontrast160D (ELDIM)

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.

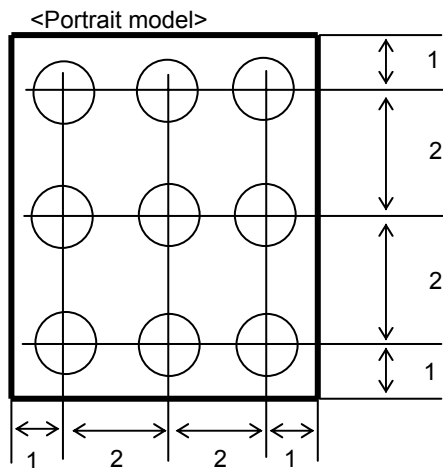
Measurement point: At the center of the screen unless otherwise specified



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.

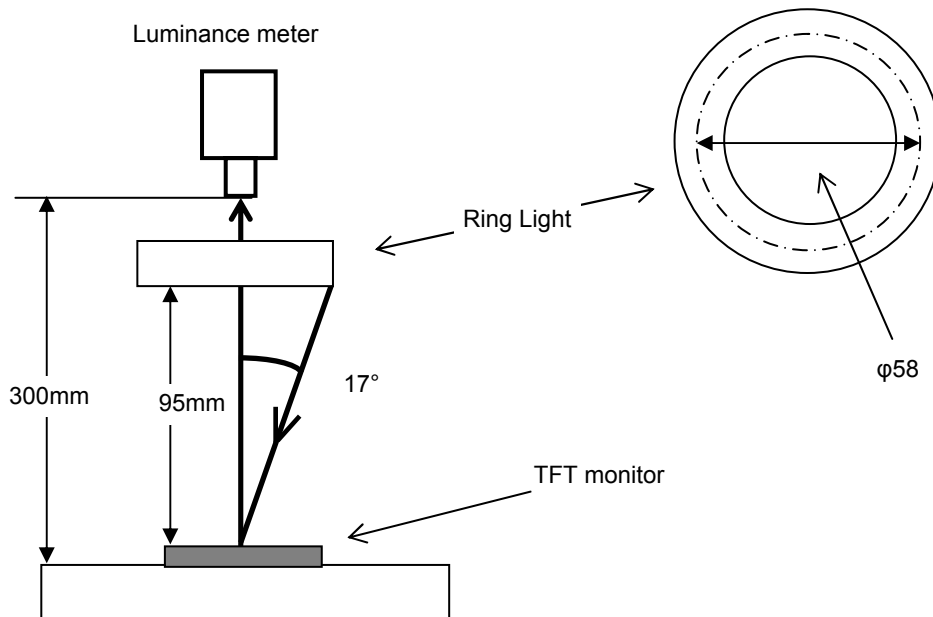


Dimensional ratio of active area

Backlight IL=10mA

Measurement Condition (Contrast ratio Backlight OFF only)

- Measuring instruments: LCD7000(OTSUKA ELECTRONICS),Ring Light(30,000 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> | LCD7000 | <p>Black display [Data]=00h</p> <p>White display [Data]=FFh</p> <p>TON</p> <p>Rise time</p> <p>TOFF</p> <p>Fall time</p> |
| 2 | Contrast ratio | <p>Measure maximum luminance Y1([Data]=FFh) and minimum luminance Y2([Data]=00h) at the center of the screen by displaying raster or window pattern. Then calculate the ratio between these two values.</p> <p style="text-align: center;">Contrast ratio = Y1/Y2</p> <p style="text-align: center;">Diameter of measuring point: 8mmφ</p> | CS1000 LCD7000 | 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] = FFh</p> <p style="text-align: center;">Color matching faction: 2°view</p> | CS1000 | |
| 5 | Burn-in | Visually check burn-in image on the screen after 2 hours of "window display" ([Data]=FFh/00h). | | 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 | |