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# SPECIFICATION
# FOR
# LCD MODULE

# MODULE NO: AFS240320TG-2.8-U010001-Full
# REVISION NO: 00

Customer's Approval:

|                            | SIGNATURE | DATE |
|----------------------------|-----------|------|
| PREPARED BY (RD ENGINEER)  |           |      |
| CHECKED BY                 |           |      |
| APPROVED BY                |           |      |

## DOCUMENT REVISION HISTORY

| Version | DATE | DESCRIPTION | CHANGED BY |
|---------|------|-------------|------------|
| 00 | Nov-05-2011 | First Issue | |

# CONTENTS

# 1. Features & Mechanical Specifications

| Item | Contents | Unit |
|---|---|---|
| | **LCD** | |
| **LCD Type** | TFT / Transmissive / Normally White | -- |
| **Viewing direction** | 12 O'clock | -- |
| **Backlight** | White LED x 4 | -- |
| **Interface** | 8080-16bit parallel bus interface | -- |
| **Driver IC** | ILI9341 | -- |
| **Outline Dimension** | 50.0(W) × 69.2(H) × 2.8(T) | mm |
| **Glass area (W×H×T)** | 46.2 ×60.9 /64.75 × 0.5 | mm |
| **Active area (W×H)** | 43.2 × 57.6 | mm |
| **Number of Dots** | 240(RGB) × 320 | -- |
| **Dot pitch (W×H)** | 0.06 × 0.18 | mm |
| **Pixel pitch (W×H)** | 0.18 × 0.18 | mm |
| **Operating Temperature** | -20 ～ +70 | ℃ |
| **Storage temperature** | -30 ～ +80 | ℃ |

# 2. Dimensional Outline
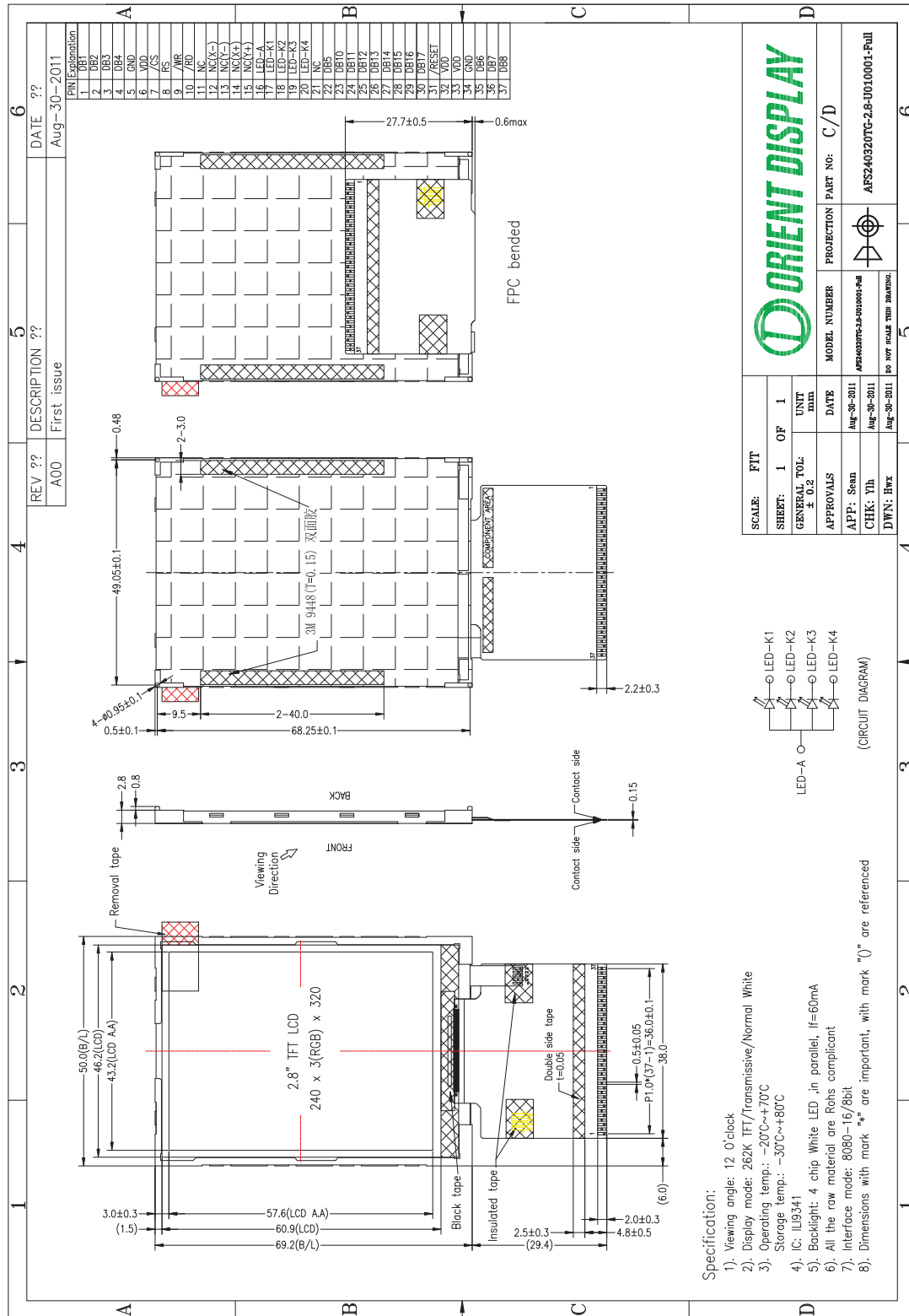
Figure 1. Dimensional outline

**PIN Explanation**

| PIN | Explanation |
|---|---|
| 1 | DB1 |
| 2 | DB2 |
| 3 | DB3 |
| 4 | DB4 |
| 5 | GND |
| 6 | VDD |
| 7 | /CS |
| 8 | RS |
| 9 | /WR |
| 10 | /RD |
| 11 | NC |
| 12 | NC(X−) |
| 13 | NC(Y−) |
| 14 | NC(X+) |
| 15 | NC(Y+) |
| 16 | LED−A |
| 17 | LED−K1 |
| 18 | LED−K2 |
| 19 | LED−K3 |
| 20 | LED−K4 |
| 21 | NC |
| 22 | NC |
| 23 | DB5 |
| 24 | DB10 |
| 25 | DB11 |
| 26 | DB12 |
| 27 | DB13 |
| 28 | DB14 |
| 29 | DB15 |
| 30 | DB16 |
| 31 | DB17 |
| 32 | /RESET |
| 33 | VDD |
| 34 | VDD |
| 35 | GND |
| 36 | DB6 |
| 37 | DB7 |
| 38 | DB8 |

| REV ?? | DESCRIPTION ?? | DATE ?? |
|---|---|---|
| A00 | First issue | Aug−30−2011 |

**Specification:**
1). Viewing angle: 12 O'clock
2). Display mode: 262K TFT/Transmissive/Normal White
3). Operating temp.: −20℃~+70℃
    Storage temp.: −30℃~+80℃
4). IC: ILI9341
5). Backlight: 4 chip White LED, in parallel, If=60mA
6). All the raw material are Rohs complicant
7). Interface mode: 8080−16/8bit
8). Dimensions with mark "*" are important, with mark "()" are referenced

(CIRCUIT DIAGRAM)

LED−A O

LED−K1
LED−K2
LED−K3
LED−K4

FPC bended

2.8" TFT LCD
240 x 3(RGB) x 320

Removal tape
Viewing Direction
FRONT
BACK
Contact side
Black tape
Insulated tape
Double side tape t=0.05
COMPONENT AREA

3M 9448 (T=0.15) 双面胶

27.7±0.5
0.6max
49.05±0.1
0.48
2−3.0
68.25±0.1
2−40.0
9.5
4−Ø0.95±0.1
0.5±0.1
2.2±0.3
2.8
0.8
0.15

50.0(B/L)
46.2(LCD)
43.2(LCD A.A)
57.6(LCD A.A)
60.9(LCD)
69.2(B/L)
3.0±0.3
(1.5)
0.5±0.05
P1.0*(37−1)=36.0±0.1
38.0
(6.0)
2.0±0.3
2.5±0.3
4.8±0.5
(29.4)

**ORIENT DISPLAY**

| MODEL NUMBER | AFS240320TG-2.8-U010001-Full |
|---|---|
| PROJECTION | |
| PART No: | C/D |
| SCALE: | FIT |
| SHEET: 1 | OF 1 |
| UNIT | mm |
| GENERAL TOL: ± 0.2 | DATE |
| APPROVALS | |
| APP: Sean | Aug−30−2011 |
| CHK: Yih | Aug−30−2011 |
| DWN: Hwx | Aug−30−2011 |

DO NOT SCALE THIS DRAWING.

# 3. Block Diagram



Figure 2. Block diagram

# 4. Pin Description

| PIN No. | SYMBOL | Function |
|---------|--------|----------|
| 1~4 | DB1~DB4 | Data Bus |
| 5 | GND | Ground |
| 6 | VDD | Power supply |
| 7 | /CS | Chip Select Signal ( "Low" enable) |
| 8 | RS | Display data or command selection pin<br>RS ='1': display data or parameter.<br>RS ='0': command. |
| 9 | /WR | Write signal. |
| 10 | /RD | Read signal. |
| 11 | NC | No Connection |
| 12 | NC(X-) | No Connection |
| 13 | NC(Y-) | No Connection |
| 14 | NC(X+) | No Connection |
| 15 | NC(Y+) | No Connection |
| 16 | LED_A | Backlight LED Anode |
| 17 | LED_K1 | Backlight LED1 Cathode |
| 18 | LED_K2 | Backlight LED2 Cathode |
| 19 | LED_K3 | Backlight LED3 Cathode |
| 20 | LED_K4 | Backlight LED4 Cathode |
| 21 | NC | No Connection |
| 22 | DB5 | Data Bus |
| 23~30 | DB10~DB17 | Data Bus |
| 31 | /RESET | Reset pin. (Active Low) |
| 32,33 | VDD | Power supply |
| 34 | GND | Ground |
| 35~37 | DB6~DB8 | Data Bus |

**Interface Note**:

| R1 | R2 | Interface Mode |
|----|----|----------------|
| Open | Short | 8080-8bit interface: DB17~DB10 |
| Short | Open | 8080-16bit interface: DB17～DB10, DB8～DB1 (Default Mode) |

1. Unused pins should connect to GND.
2. R1, R2 are SMT component on LCM FPC.

# 5. Absolute Maximum Ratings

| Item | Symbol | Rating | Unit |
|---|---|---|---|
| Supply Voltage range | VDD | -0.3 to +4.6 | V |
| Operating Temperature range | TOP | -20 to +70 | ℃ |
| Storage Temperature range | TST | -30 to +80 | ℃ |

# 6. Electrical Characteristics

**DC Characteristics**

| Item | Symbol | Min. | Type. | Max. | Unit |
|---|---|---|---|---|---|
| Logic Supply Voltage | VDD | 2.5 | 2.8 | 3.3 | V |

# 7. Backlight Characteristics

White LED $\times$ 4 **(Ta = 25°C)**

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Forward Voltage | VF | IF = 60mA | - | 3.2 | - | V |
| Uniformity | $\triangle$Bp | - | 80 | - | - | % |
| Luminance for LCD | Lv | IF = 60mA | 1000 | - | - | cd/m$^2$ |

# 8. Electro-Optical Characteristics

(Taransmittance、contrast、RT、viewing angle results are using CPT LC+ CPT EWV Polarizer +Corresponding Backlight, reference only)

| ITEM | | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT | REMARK |
|---|---|---|---|---|---|---|---|---|
| Transmittance | | T | | | (5.8) | | % | |
| Contrast Ratio | | CR | θ =ψ= 0° | | (300) | | -- | Note 3 |
| Response Time | | Tr+ Tf | θ =ψ= 0° | | (25) | | ms | Note 4 |
| Viewing Angle | Upper | θ | CR≧10 | | (60) | | ° | Note 5 |
| | Down | | | | (55) | | ° | |
| | Right | ψ | | | (50) | | ° | |
| | Left | | | | (50) | | ° | |
| Color Filter Chromacicity | White | x | θ=φ= 0° | (0.288) | (0.308) | (0.328) | -- | Note 6 |
| | | y | | (0.319) | (0.339) | (0.359) | -- | |
| | | Y | | (27.1) | (30.1) | (33.1) | -- | |
| | Red | x | θ=φ= 0° | (0.632) | (0.652) | (0.672) | -- | |
| | | y | | (0.311) | (0.331) | (0.351) | -- | |
| | | Y | | (14.8) | (17.8) | (20.8) | -- | |
| | Green | x | θ=φ= 0° | (0.294) | (0.314) | (0.334) | -- | |
| | | y | | (0.555) | (0.575) | (0.595) | -- | |
| | | Y | | (53.7) | (57.7) | (61.7) | -- | |
| | Blue | x | θ=φ= 0° | (0.118) | (0.138) | (0.158) | -- | |
| | | y | | (0.112) | (0.132) | (0.152) | -- | |
| | | Y | | (11.8) | (14.8) | (17.8) | -- | |
| | NTSC | | | -- | (61) | -- | % | |

Note 1. Ambient condition：25℃±2℃，60±10%RH，under 10 Lunx in the darkroom。
Lighting the LCM and measuring after 10 minutes.
Note 2. Measure device：BM-5AS (TOPCON)，viewing cone=1°，$I_{Led}$=20 mA。



L=500mm
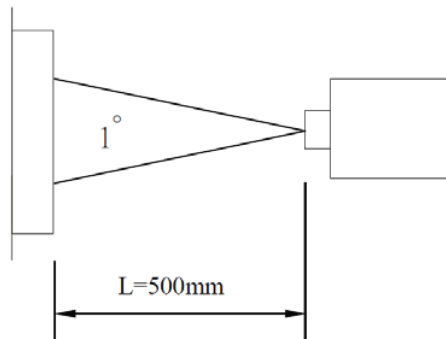
Note 3. Definition of Contrast Ratio：
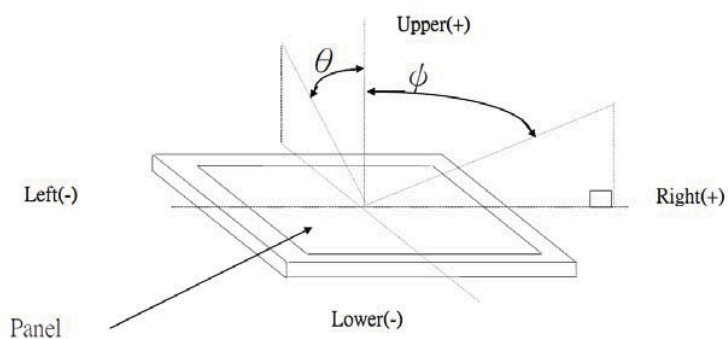CR = White Luminance (ON) / Black Luminance (OFF)

Note 4. Definition of response time：The response time is defined as the time interval between the 10% and 90% amplitudes.
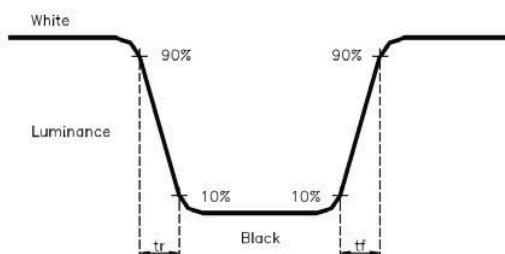


Note 5. Definition of view angle(θ，ψ)：



Note 6. Light source: C light.

# 9. Instruction Description

**Regulative Command Set**

| Command Function | D/CX | RDX | WRX | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Hex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No Operation | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00h |
| Software Reset | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 01h |
| Read Display Identification Information | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 04h |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | | | | ID1 [7:0] | | | | | XX |
| | 1 | ↑ | 1 | XX | | | | ID2 [7:0] | | | | | XX |
| | 1 | ↑ | 1 | XX | | | | ID3 [7:0] | | | | | XX |
| Read Display Status | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 09h |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | | | D [31:25] | | | | | X | 00 |
| | 1 | ↑ | 1 | XX | X | D [22:20] | | | D [19:16] | | | | 61 |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | D [10:8] | | | 00 |
| | 1 | ↑ | 1 | XX | D [7:5] | | | X | X | X | X | X | 00 |
| Read Display Power Mode | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0Ah |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | | | D [7:2] | | | | 0 | 0 | 08 |
| Read Display MADCTL | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0Bh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | | | D [7:2] | | | | 0 | 0 | 00 |
| Read Display Pixel Format | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0Ch |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | RIM | DPI [2:0] | | | X | DBI [2:0] | | | 06 |
| Read Display Image Format | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0Dh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | D [2:0] | | | 00 |
| Read Display Signal Mode | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0Eh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | | | D [7:2] | | | | 0 | 0 | 00 |
| Read Display Self-Diagnostic Result | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0Fh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | D [7:6] | | X | X | X | X | X | X | 00 |
| Enter Sleep Mode | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 10h |
| Sleep OUT | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 11h |
| Partial Mode ON | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 12h |
| Normal Display Mode ON | 0 | 1 | ↑ | XX | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 13h |
| Display Inversion OFF | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 20h |
| Display Inversion ON | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 21h |
| Gamma Set | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 26h |
| | 1 | 1 | ↑ | XX | | | GC [7:0] | | | | | | 01 |
| Display OFF | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 28h |
| Display ON | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 29h |
| Column Address Set | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 2Ah |
| | 1 | 1 | ↑ | XX | | | SC [15:8] | | | | | | XX |
| | 1 | 1 | ↑ | XX | | | SC [7:0] | | | | | | XX |
| | 1 | 1 | ↑ | XX | | | EC [15:8] | | | | | | XX |
| | 1 | 1 | ↑ | XX | | | EC [7:0] | | | | | | XX |
| Page Address Set | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 2Bh |
| | 1 | 1 | ↑ | XX | | | SP [15:8] | | | | | | XX |
| | 1 | 1 | ↑ | XX | | | SP [7:0] | | | | | | XX |
| | 1 | 1 | ↑ | XX | | | EP [15:8] | | | | | | XX |
| | 1 | 1 | ↑ | XX | | | EP [7:0] | | | | | | XX |

| Command | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Memory Write | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 2Ch |
| | 1 | 1 | ↑ | D [17:0] | | | | | | | | | XX |
| Color SET | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 2Dh |
| | 1 | ↑ | 1 | XX | | | R00 [5:0] | | | | | | XX |
| | 1 | ↑ | 1 | XX | | | Rnn [5:0] | | | | | | XX |
| | 1 | ↑ | 1 | XX | | | R31 [5:0] | | | | | | XX |
| | 1 | ↑ | 1 | XX | | | G00 [5:0] | | | | | | XX |
| | 1 | ↑ | 1 | XX | | | Gnn [5:0] | | | | | | XX |
| | 1 | ↑ | 1 | XX | | | G64 [5:0] | | | | | | XX |
| | 1 | ↑ | 1 | XX | | | B00 [5:0] | | | | | | XX |
| | 1 | ↑ | 1 | XX | | | Bnn [5:0] | | | | | | XX |
| | 1 | ↑ | 1 | XX | | | B31 [5:0] | | | | | | XX |
| Memory Read | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 2Eh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | D [17:0] | | | | | | | | | XX |
| Partial Area | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 30h |
| | 1 | 1 | ↑ | XX | SR [15:8] | | | | | | | | 00 |
| | 1 | 1 | ↑ | XX | SR [7:0] | | | | | | | | 00 |
| | 1 | 1 | ↑ | XX | ER [15:8] | | | | | | | | 01 |
| | 1 | 1 | ↑ | XX | ER [7:0] | | | | | | | | 3F |
| Vertical Scrolling Definition | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 33h |
| | 1 | 1 | ↑ | XX | TFA [15:8] | | | | | | | | 00 |
| | 1 | 1 | ↑ | XX | TFA [7:0] | | | | | | | | 00 |
| | 1 | 1 | ↑ | XX | VSA [15:8] | | | | | | | | 01 |
| | 1 | 1 | ↑ | XX | VSA [7:0] | | | | | | | | 40 |
| | 1 | 1 | ↑ | XX | BFA [15:8] | | | | | | | | 00 |
| | 1 | 1 | ↑ | XX | BFA [7:0] | | | | | | | | 00 |
| Tearing Effect Line OFF | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 34h |
| Tearing Effect Line ON | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 35h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | X | M | 00 |
| Memory Access Control | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 36h |
| | 1 | 1 | ↑ | XX | MY | MX | MV | ML | BGR | MH | X | X | 00 |
| Vertical Scrolling Start Address | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 37h |
| | 1 | 1 | ↑ | XX | VSP [15:8] | | | | | | | | 00 |
| | 1 | 1 | ↑ | XX | VSP [7:0] | | | | | | | | 00 |
| Idle Mode OFF | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 38h |
| Idle Mode ON | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 39h |
| Pixel Format Set | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 3Ah |
| | 1 | 1 | ↑ | XX | X | DPI [2:0] | | | X | DBI [2:0] | | | 66 |
| Write Memory Continue | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 3Ch |
| | 1 | 1 | ↑ | D [17:0] | | | | | | | | | XX |
| Read Memory Continue | 0 | 1 | ↑ | XX | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 3Eh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | D [17:0] | | | | | | | | | XX |
| Set Tear Scanline | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 44h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | X | STS [8] | 00 |
| | 1 | 1 | ↑ | XX | STS [7:0] | | | | | | | | 00 |
| Get Scanline | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 45h |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | GTS [9:8] | | 00 |
| | 1 | ↑ | 1 | XX | GTS [7:0] | | | | | | | | 00 |
| Write Display Brightness | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 51h |
| | 1 | 1 | ↑ | XX | DBV [7:0] | | | | | | | | 00 |

| Command Function | D/CX | RDX | WRX | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Hex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Read Display Brightness | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 52h |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | DBV [7:0] | | | | | | | | 00 |
| Write CTRL Display | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 53h |
| | 1 | 1 | ↑ | XX | X | X | BCTRL | X | DD | BL | X | X | 00 |
| Read CTRL Display | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 54h |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | X | X | BCTRL | X | DD | BL | X | X | 00 |
| Write Content Adaptive Brightness Control | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 55h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | C [1:0] | | 00 |
| Read Content Adaptive Brightness Control | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 56h |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | C [1:0] | | 00 |
| Write CABC Minimum Brightness | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 5Eh |
| | 1 | 1 | ↑ | XX | CMB [7:0] | | | | | | | | 00 |
| Read CABC Minimum Brightness | 0 | 1 | ↑ | XX | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 5Fh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | CMB [7:0] | | | | | | | | 00 |
| Read ID1 | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | DAh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | Module's Manufacture [7:0] | | | | | | | | XX |
| Read ID2 | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | DBh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | LCD Module / Driver Version [7:0] | | | | | | | | XX |
| Read ID3 | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | DCh |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | LCD Module / Driver ID [7:0] | | | | | | | | XX |

| Extended Command Set | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command Function | D/CX | RDX | WRX | D17-8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Hex |
| RGB Interface Signal Control | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | B0h |
| | 1 | 1 | ↑ | XX | ByPass_MODE | RCM [1:0] | | X | VSPL | HSPL | DPL | EPL | 40 |
| Frame Control (In Normal Mode) | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | B1h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | DIVA [1:0] | | 00 |
| | 1 | 1 | ↑ | XX | X | X | X | RTNA [4:0] | | | | | 1B |
| Frame Control (In Idle Mode) | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | B2h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | DIVB [1:0] | | 00 |
| | 1 | 1 | ↑ | XX | X | X | X | RTNB [4:0] | | | | | 1B |
| Frame Control (In Partial Mode) | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | B3h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | DIVC [1:0] | | 00 |
| | 1 | 1 | ↑ | XX | X | X | X | RTNC [4:0] | | | | | 1B |
| Display Inversion Control | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | B4h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | NLA | NLB | NLC | 02 |
| Blanking Porch Control | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | B5h |
| | 1 | 1 | ↑ | XX | 0 | VFP [6:0] | | | | | | | 02 |
| | 1 | 1 | ↑ | XX | 0 | VBP [6:0] | | | | | | | 02 |
| | 1 | 1 | ↑ | XX | 0 | 0 | 0 | HFP [4:0] | | | | | 0A |
| | 1 | 1 | ↑ | XX | 0 | 0 | 0 | HBP [4:0] | | | | | 14 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Display Function Control | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | B6h |
| | 1 | 1 | ↑ | XX | X | X | X | X | PTG [1:0] | | PT [1:0] | | 0A |
| | 1 | 1 | ↑ | XX | REV | GS | SS | SM | ISC [3:0] | | | | 82 |
| | 1 | 1 | ↑ | XX | X | X | NL [5:0] | | | | | | 27 |
| | 1 | 1 | ↑ | XX | X | X | PCDIV [5:0] | | | | | | XX |
| Entry Mode Set | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | B7h |
| | 1 | 1 | ↑ | XX | X | X | X | X | 0 | GON | DTE | GAS | 07 |
| Backlight Control 1 | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | B8h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | 1 | ↑ | XX | X | X | X | X | TH_UI [3:0] | | | | 04 |
| Backlight Control 2 | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | B9h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | 1 | ↑ | XX | TH_MV [3:0] | | | | TH_ST [3:0] | | | | B8 |
| Backlight Control 3 | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | BAh |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | 1 | ↑ | XX | X | X | X | X | DTH_UI [3:0] | | | | 04 |
| Backlight Control 4 | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | BBh |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | 1 | ↑ | XX | DTH_MV [3:0] | | | | DTH_ST [3:0] | | | | C9 |
| Backlight Control 5 | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | BCh |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | 1 | ↑ | XX | DIM2 [3:0] | | | | X | DIM1 [2:0] | | | 44 |
| Backlight Control 7 | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | BEh |
| | 1 | 1 | ↑ | XX | PWM_DIV [7:0] | | | | | | | | 0F |
| Backlight Control 8 | 0 | 1 | ↑ | XX | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | BFh |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | LEDONR | LEDONPOL | LEDPWMOPL | 00 |
| Power Control 1 | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | C0h |
| | 1 | 1 | ↑ | XX | X | X | VRH [5:0] | | | | | | 26 |
| Power Control 2 | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | C1h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | BT [2:0] | | | 00 |
| VCOM Control 1 | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | C5h |
| | 1 | 1 | ↑ | XX | X | VMH [6:0] | | | | | | | 31 |
| | 1 | 1 | ↑ | XX | X | VML [6:0] | | | | | | | 3C |
| VCOM Control 2 | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | C7h |
| | 1 | 1 | ↑ | XX | nVM | VMF [6:0] | | | | | | | C0 |
| NV Memory Write | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | D0h |
| | 1 | 1 | ↑ | XX | X | X | X | X | X | PGM_ADR [2:0] | | | 00 |
| | 1 | 1 | ↑ | XX | PGM_DATA [7:0] | | | | | | | | XX |
| NV Memory Protection Key | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | D1h |
| | 1 | 1 | ↑ | XX | KEY [23:16] | | | | | | | | 55 |
| | 1 | 1 | ↑ | XX | KEY [15:8] | | | | | | | | AA |
| | 1 | 1 | ↑ | XX | KEY [7:0] | | | | | | | | 66 |
| NV Memory Status Read | 0 | 1 | ↑ | XX | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | D2h |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| | 1 | ↑ | 1 | XX | X | ID2_CNT [2:0] | | | X | ID1_CNT [2:0] | | | XX |
| | 1 | ↑ | 1 | XX | BUSY | VMF_CNT [2:0] | | | X | ID3_CNT [2:0] | | | XX |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | ↑ | 1 | XX | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | D3h |
| | 1 | ↑ | 1 | XX | X | X | X | X | X | X | X | X | XX |
| Read ID4 | 1 | ↑ | 1 | XX | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00 |
| | 1 | ↑ | 1 | XX | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 93 |
| | 1 | ↑ | 1 | XX | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 41 |
| | 0 | 1 | ↑ | XX | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | E0h |
| | 1 | 1 | ↑ | XX | X | X | X | X | VP0 [3:0] | | | | 08 |
| | 1 | 1 | ↑ | XX | X | X | VP1 [5:0] | | | | | | 0E |
| | 1 | 1 | ↑ | XX | X | X | VP2 [5:0] | | | | | | 12 |
| | 1 | 1 | ↑ | XX | X | X | X | X | VP4 [3:0] | | | | 05 |
| | 1 | 1 | ↑ | XX | X | X | X | VP6 [4:0] | | | | | 03 |
| | 1 | 1 | ↑ | XX | X | X | X | X | VP13 [3:0] | | | | 09 |
| Positive Gamma Correction | 1 | 1 | ↑ | XX | X | VP20 [6:0] | | | | | | | 47 |
| | 1 | 1 | ↑ | XX | VP36 [3:0] | | | | VP27 [3:0] | | | | 86 |
| | 1 | 1 | ↑ | XX | X | VP43 [6:0] | | | | | | | 2B |
| | 1 | 1 | ↑ | XX | X | X | X | X | VP50 [3:0] | | | | 0B |
| | 1 | 1 | ↑ | XX | X | X | X | VP57 [4:0] | | | | | 04 |
| | 1 | 1 | ↑ | XX | X | X | X | X | VP59 [3:0] | | | | 00 |
| | 1 | 1 | ↑ | XX | X | X | VP61 [5:0] | | | | | | 00 |
| | 1 | 1 | ↑ | XX | X | X | VP62 [5:0] | | | | | | 00 |
| | 1 | 1 | ↑ | XX | X | X | X | X | VP63 [3:0] | | | | 00 |
| | 0 | 1 | ↑ | XX | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | E1h |
| | 1 | 1 | ↑ | XX | X | X | X | X | VN0 [3:0] | | | | 08 |
| | 1 | 1 | ↑ | XX | X | X | VN1 [5:0] | | | | | | 1A |
| | 1 | 1 | ↑ | XX | X | X | VN2 [5:0] | | | | | | 20 |
| | 1 | 1 | ↑ | XX | X | X | X | X | VN4 [3:0] | | | | 07 |
| | 1 | 1 | ↑ | XX | X | X | X | VN6 [4:0] | | | | | 0E |
| | 1 | 1 | ↑ | XX | X | X | X | X | VN13 [3:0] | | | | 05 |
| Negative Gamma Correction | 1 | 1 | ↑ | XX | X | VN20 [6:0] | | | | | | | 3A |
| | 1 | 1 | ↑ | XX | VN36 [3:0] | | | | VN27 [3:0] | | | | 8A |
| | 1 | 1 | ↑ | XX | X | VN43 [6:0] | | | | | | | 40 |
| | 1 | 1 | ↑ | XX | X | X | X | X | VN50 [3:0] | | | | 04 |
| | 1 | 1 | ↑ | XX | X | X | X | VN57 [4:0] | | | | | 18 |
| | 1 | 1 | ↑ | XX | X | X | X | X | VN59 [3:0] | | | | 0F |
| | 1 | 1 | ↑ | XX | X | X | VN61 [5:0] | | | | | | 3F |
| | 1 | 1 | ↑ | XX | X | X | VN62 [5:0] | | | | | | 3F |
| | 1 | 1 | ↑ | XX | X | X | X | X | VN63 [3:0] | | | | 0F |
| Digital Gamma Control 1 | 0 | 1 | ↑ | XX | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | E2h |
| 1st Parameter | 1 | 1 | ↑ | XX | RCA0 [3:0] | | | | BCA0 [3:0] | | | | XX |
| : | 1 | 1 | ↑ | XX | RCAx [3:0] | | | | BCAx [3:0] | | | | XX |
| 16th Parameter | 1 | 1 | ↑ | XX | RCA15 [3:0] | | | | BCA15 [3:0] | | | | XX |
| Digital Gamma Control 2 | 0 | 1 | ↑ | XX | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | E3h |
| 1st Parameter | 1 | 1 | ↑ | XX | RFA0 [3:0] | | | | BFA0 [3:0] | | | | XX |
| : | 1 | 1 | ↑ | XX | RFAx [3:0] | | | | BFAx [3:0] | | | | XX |
| 64th Parameter | 1 | 1 | ↑ | XX | RFA63 [3:0] | | | | BFA63 [3:0] | | | | XX |
| | 0 | 1 | ↑ | XX | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | F6h |
| Interface Control | 1 | 1 | ↑ | XX | MY_EOR | MX_EOR | MV_EOR | X | BGR_EOR | X | X | WEMODE | 01 |
| | 1 | 1 | ↑ | XX | X | X | EPF [1:0] | | X | X | MDT [1:0] | | 00 |
| | 1 | 1 | ↑ | XX | X | X | ENDIAN | X | DM [1:0] | | RM | RIM | 00 |

# 10. AC Characteristics
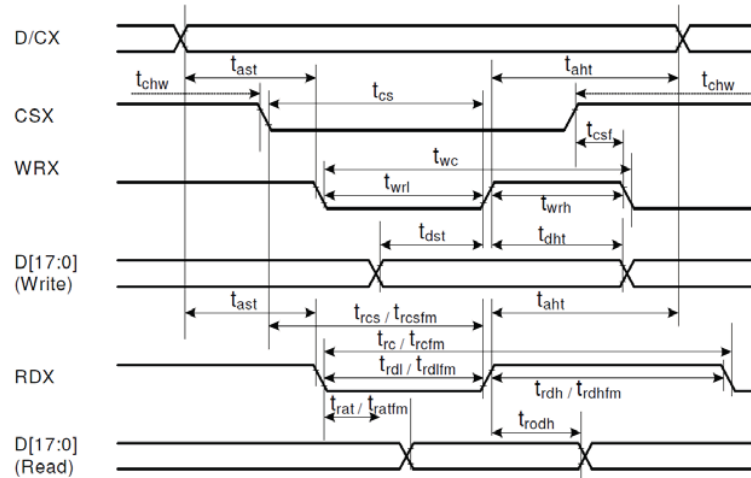


| Signal | Symbol | Parameter | min | max | Unit | Description |
|---|---|---|---|---|---|---|
| DCX | tast | Address setup time | 0 | - | ns | |
| | taht | Address hold time (Write/Read) | 0 | - | ns | |
| CSX | tchw | CSX "H" pulse width | 0 | - | ns | |
| | tcs | Chip Select setup time (Write) | 15 | - | ns | |
| | trcs | Chip Select setup time (Read ID) | 45 | - | ns | |
| | trcsfm | Chip Select setup time (Read FM) | 355 | - | ns | |
| | tcsf | Chip Select Wait time (Write/Read) | 10 | - | ns | |
| WRX | twc | Write cycle | 66 | - | ns | |
| | twrh | Write Control pulse H duration | 15 | - | ns | |
| | twrl | Write Control pulse L duration | 15 | - | ns | |
| RDX (FM) | trcfm | Read Cycle (FM) | 450 | - | ns | |
| | trdhfm | Read Control H duration (FM) | 90 | - | ns | |
| | trdlfm | Read Control L duration (FM) | 355 | - | ns | |
| RDX (ID) | trc | Read cycle (ID) | 160 | - | ns | |
| | trdh | Read Control pulse H duration | 90 | - | ns | |
| | trdl | Read Control pulse L duration | 45 | - | ns | |
| D[17:0], D[17:10]&D[8:1], D[17:10], D[17:9] | tdst | Write data setup time | 10 | - | ns | For maximum CL=30pF For minimum CL=8pF |
| | tdht | Write data hold time | 10 | - | ns | |
| | trat | Read access time | - | 40 | ns | |
| | tratfm | Read access time | - | 340 | ns | |
| | trod | Read output disable time | 20 | 80 | ns | |

Note: Ta = -30 to 70 ℃, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, VSS=0V.

# 11.Quality Specifications

**All The raw material are Rohs complicant.**

## 11.1 Standard of the product appearance test

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps.

Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM

and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.
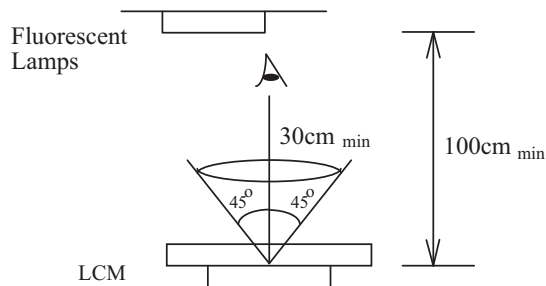


Definition of zone:
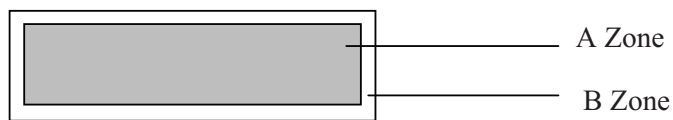


A Zone: viewing area
B Zone: outside viewing area

## 11.2 Specification of quality assurance
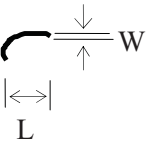
AQL inspection standard
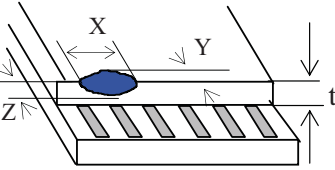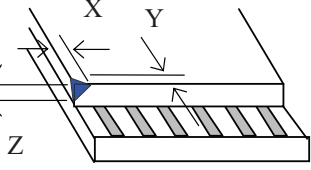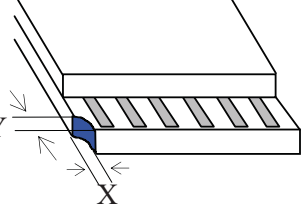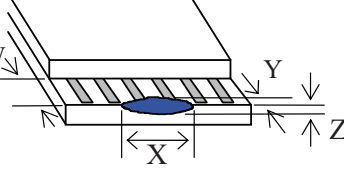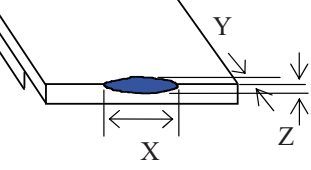
Sampling method: MIL-STD-105E, Level II, single sampling
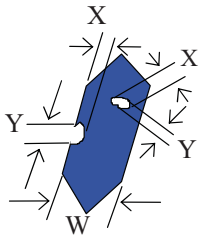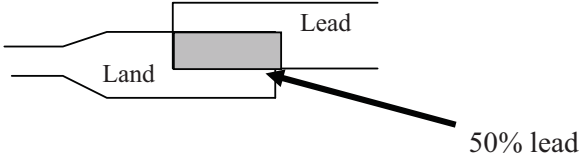
**Defect classification (Note: * is not including)**
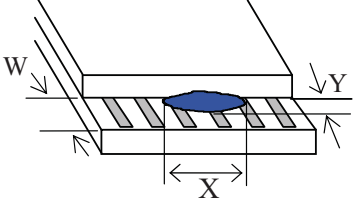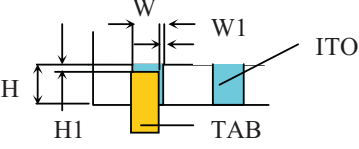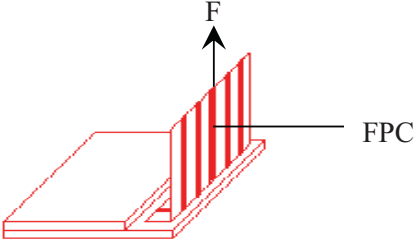
| Classify | | Item | Note | AQL |
|---|---|---|---|---|
| Major | Display state | Short or open circuit | | 0.65 |
| | | LC leakage | 1 | |
| | | Flickering | | |
| | | No display | | |
| | | Wrong viewing direction | | |
| | | Contrast defect (dim, ghost) | 2 | |
| | | Back-light | 1,8 | |
| | Non-display | Flat cable or pin reverse | 10 | |
| | | Wrong or missing component | 11 | |
| Minor | Display state | Background color deviation | 2 | 1.0 |
| | | Black spot and dust | 3 | |
| | | Line defect, Scratch | 4 | |
| | | Rainbow | 5 | |
| | | Chip | 6 | |
| | | Pin hole | 7 | |
| | Polarizer | Protruded | 12 | |
| | | Bubble and foreign material | 3 | |
| | Soldering | Poor connection | 9 | |
| | Wire | Poor connection | 10 | |
| | TAB | Position, Bonding strength | 13 | |

**Note on defect classification**

| No. | Item | Criterion |
|---|---|---|
| 1 | Short or open circuit | Not allow |
| | LC leakage | |
| | Flickering | |
| | No display | |
| | Wrong viewing direction | |
| | Wrong Back-light | |
| 2 | Contrast defect | Refer to approval sample |
| | Background color deviation | |
| 3 | Point defect, Black spot, dust (including Polarizer)  $\phi = (X+Y)/2$ |  <br> Unit：mm |
| 4 | Line defect, Scratch |  <br> Unit: mm |
| 5 | Rainbow | Not more than two color changes across the viewing area. |

For item 3, Point defect table:

| Point Size | Acceptable Qty. |
|---|---|
| $\phi \leq 0.10$ | Disregard |
| $0.10 < \phi \leq 0.20$ | 3 |
| $0.20 < \phi \leq 0.25$ | 2 |
| $0.25 < \phi \leq 0.30$ | 1 |
| $\phi > 0.30$ | 0 |

For item 4, Line defect table:

| Line L | W | Acceptable Qty. |
|---|---|---|
| --- | $0.015 \geq W$ | Disregard |
| $3.0 \geq L$ | $0.03 \geq W$ | 2 |
| $2.0 \geq L$ | $0.05 \geq W$ | |
| $1.0 \geq L$ | $0.1 > W$ | 1 |
| --- | $0.05 < W$ | Applied as point defect |

| No | Item | Criterion |
|----|------|-----------|

**No: 6 — Item: Chip**

Remark:
- X: Length direction
- Y: Short direction
- Z: Thickness direction
- t: Glass thickness
- W: Terminal Width

Acceptable criterion

| X | Y | Z |
|---|---|---|
| $\leqslant 2$ | 0.5mm | $\leqslant t/2$ |

Acceptable criterion

| X | Y | Z |
|---|---|---|
| $\leqslant 2$ | 0.5mm | $\leqslant t$ |

Acceptable criterion

| X | Y | Z |
|---|---|---|
| $\leqslant 3$ | $\leqslant 2$ | $\leqslant t$ |
| shall not reach to ITO | | |

Acceptable criterion

| X | Y | Z |
|---|---|---|
| Disregard | $\leqslant 0.2$ | $\leqslant t$ |

Acceptable criterion

| X | Y | Z |
|---|---|---|
| $\leqslant 5$ | $\leqslant 2$ | $\leqslant t/3$ |

| No. | Item | Criterion |
|-----|------|-----------|
| 7 | Segment pattern<br>W = Segment width<br>$\phi = (X+Y)/2$ | (1) Pin hole<br><br>$\phi < 0.10$mm is acceptable.<br><br><table><tr><td>Point Size</td><td>Acceptable Qty</td></tr><tr><td>$\phi \leqslant 1/4W$</td><td>Disregard</td></tr><tr><td>$1/4W < \phi \leqslant 1/2W$</td><td>1</td></tr><tr><td>$\phi > 1/2W$</td><td>0</td></tr></table><br>Unit: mm |
| 8 | Back-light | (1)  The color of backlight should correspond its specification.<br>(2)  Not allow flickering |
| 9 | Soldering | (1)  Not allow heavy dirty and solder ball on PCB.<br>(The size of dirty refer to point and dust defect)<br>(2)  Over 50% of lead should be soldered on Land.<br><br>Lead<br>Land<br>50% lead |
| 10 | Wire | (1)  Copper wire should not be rusted<br>(2)  Not allow crack on copper wire connection.<br>(3)  Not allow reversing the position of the flat cable.<br>(4)  Not allow exposed copper wire inside the flat cable. |
| 11* | PCB | (1)  Not allow screw rust or damage.<br>(2)  Not allow missing or wrong putting of component. |

| No | Item | Criterion |
|----|------|-----------|
| 12 | Protruded<br><br>W: Terminal Width | <br><br>Acceptable criteria:<br>$Y \leq 0.4$ |
| 13 | TAB | 1. Position<br><br><br><br>$W1 \leqslant 1/3W$<br>$H1 \leqslant 1/3H$<br><br>2  FPC bonding strength test<br><br><br><br>P (=F/FPC bonding width) $\geqslant$650gf/cm ,(speed rate: 1mm/min)<br>5pcs per SOA (shipment) |
| 14 | Total no. of acceptable Defect | A. Zone<br><br>Maximum 2 minor non-conformities per one unit.<br>Defect distance: each point to be separated over 10mm<br><br>B. Zone<br><br>It is acceptable when it is no trouble for quality and assembly in customer's end product. |

## 11.3 Reliability of LCM

Reliability test condition:

| Item | Condition | Time (hrs) | Assessment |
|---|---|---|---|
| High temp. Storage | 60°C | 48 | |
| High temp. Operating | 50°C | 48 | |
| Low temp. Storage | -20°C | 48 | No abnormalities |
| Low temp. Operating | -10°C | 48 | in functions |
| Humidity | 40°C/ 90%RH | 48 | and appearance |
| Temp. Cycle | -20°C ← 25°C →80°C<br>(60 min ← 5 min → 60min) | 10cycles | |

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

## 11.4 Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

**General Precautions:**
1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not made any modification on the PCB without consulting Regal Honour.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

**Static Electricity Precautions:**
1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

**Soldering Precautions:**
1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 280°C±10°C
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

**Operation Precautions:**

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.

**Limited Warranty**

Orient Display LCDs and modules are not consumer products, but may be incorporated by Orient Display's customers into consumer products or components thereof, Orient Display does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of Orient Display is limited to repair or replacement on the terms set forth below. Orient Display will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between Orient Display and the customer, Orient Display will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with Orient Display general LCD inspection standard. (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.