ORIENT DISPLAY

*Your Total LCD Solution Provider*

http://www.orientdisplay.com

# SPECIFICATION
# FOR
# LCD MODULE

## MODULE NO: AFD1024600A1L-10.1N6NTM
## VERSION NO.: V1.0

Customer's Approval:

| | |
|---|---|
| | |

| | SIGNATURE | DATE |
|---|---|---|
| PREPARED BY | | |
| CHECKED BY | | |
| APPROVED BY | | |

Orient Display (NA) Ltd.
145 Royal Crest Court Unit 42, Markham ON L3R9Z4 Canada
Tel: (905) 477-1166 Fax: (905) 477-1782

Orient Display (USA) Corp.
14925 SE Allen Road, Suite 203B, Bellevue, WA 98006
Tel: (425) 698-1938 Fax: (425) 698-1852

## RECORD OF REVISION

| Version | Revised Date | Page | Content |
|---|---|---|---|
| V1.0 | 2013/11/25 | -- | First Issued |
| | | | |
| | | | |
| | | | |
| | | | |

# TABLE OF CONTENTS

# 1. GENERAL DESCRIPTION

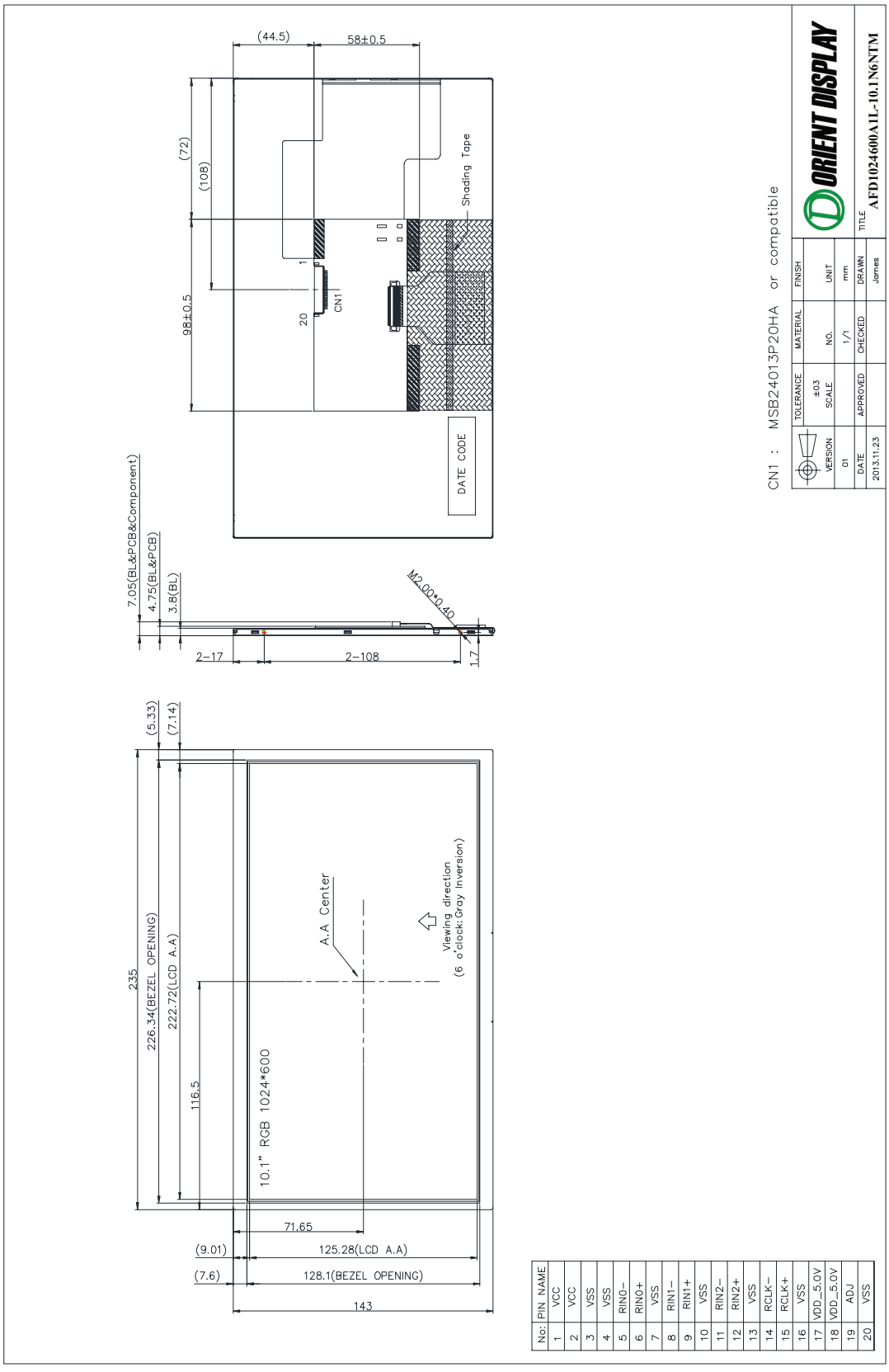
## 1.1 Description

The specifications is model AFD1024600A1L-10.1N6NTM is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT LCD panel, a driving circuit, a back light system. This TFT LCD has a 10.1 (16:9) inch diagonally measured active display area with WSGA (1024 horizontal by 600 vertical pixels) resolution.

## 1.2 Features:

| No. | Item | Specification | Unit |
|---|---|---|---|
| 1 | Panel Size | 10.1” | Inch |
| 2 | Number of Pixels | 1024 (W) x RGB x 600 (H) | Pixels |
| 3 | Active Area | 222.72 (W) × 125.28 (H) | mm |
| 4 | Pixel Pitch | 0.2175 (W) x 0.2088 (H) | mm |
| 5 | Outline Dimension | 235 (W) × 143 (H) × 3.8 (T) | mm |
| 6 | Number of Colors | 262K | - - |
| 7 | Display Mode | TN / Normally White / Transmissive | - - |
| 8 | Viewing Direction | 12 o’clock (best view) | - - |
| | | 6 o’clock (gray inversion) | |
| 9 | Display Format | RGB vertical stripe | - - |
| 10 | Surface Treatment | Anti-Glare, Hard-Coating (3H) | - - |
| 11 | Contrast Ratio | 500 (Typ.) | - - |
| 12 | Luminance (cd/m^2) | 450 (typical) | cd/m2 |
| 13 | Interface | LVDS 6 bit Interface | - - |
| 14 | Backlight | White LED | - - |
| 15 | Operation Temperature | -10 ~ 50 | °C |
| 16 | Storage Temperature | -20 ~ 60 | °C |
| 17 | Weight | TBD | g |

## 2. MECHANICAL SPECIFICATION



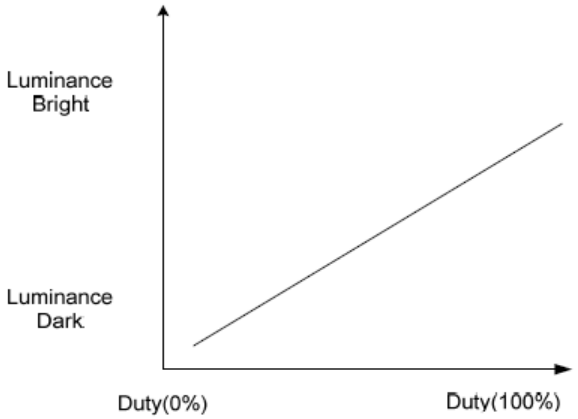

| No: | PIN NAME |
|---|---|
| 1 | VCC |
| 2 | VCC |
| 3 | VSS |
| 4 | VSS |
| 5 | RIN0- |
| 6 | RIN0+ |
| 7 | VSS |
| 8 | RIN1- |
| 9 | RIN1+ |
| 10 | VSS |
| 11 | RIN2- |
| 12 | RIN2+ |
| 13 | VSS |
| 14 | RCLK- |
| 15 | RCLK+ |
| 16 | VSS |
| 17 | VDD_5.0V |
| 18 | VDD_5.0V |
| 19 | ADJ |
| 20 | VSS |

**3. PIN DESCRIPTION** (Connector Part No: MSB24013P20HA or equivalent)

| Pin No. | Symbol | I/O | Function | Remark |
|---|---|---|---|---|
| 1 | VCC | P | Power Supply Logic voltage +3.3V | |
| 2 | VCC | P | Power Supply Logic voltage +3.3V | |
| 3 | VSS | P | Ground | |
| 4 | VSS | P | Ground | |
| 5 | RIN0- | I | Negative LVDS differential data input | |
| 6 | RIN0+ | I | Positive LVDS differential data input | |
| 7 | VSS | P | Ground | |
| 8 | RIN1- | I | Negative LVDS differential data input | |
| 9 | RIN1+ | I | Positive LVDS differential data input | |
| 10 | VSS | P | Ground | |
| 11 | RIN2- | I | Negative LVDS differential data input | |
| 12 | RIN2+ | I | Positive LVDS differential data input | |
| 13 | VSS | P | Ground | |
| 14 | RCLK- | I | Negative LVDS differential clock input | |
| 15 | RCLK+ | I | Positive LVDS differential clock input | |
| 16 | VSS | P | Ground | |
| 17 | VDD_5V | P | Power Supply LED voltage +5V | |
| 18 | VDD_5V | P | Power Supply LED voltage +5V | |
| 19 | ADJ | I | Back-light Dimming control | |
| 20 | VSS | P | Ground | |

Notes:

1) ADJ is brightness control Pin. The larger of the pulse duty is, the higher of the brightness.
2) ADJ signal is 0~3.3V.Operation frequency is 20KHz




3) VSS PIN must be grounding, cannot be floating.

# 4. ABSOLUTE MAXIMUM RATINGS

## 4.1 Electrical Absolute Rating

### 4.1.1 TFT LCD Module

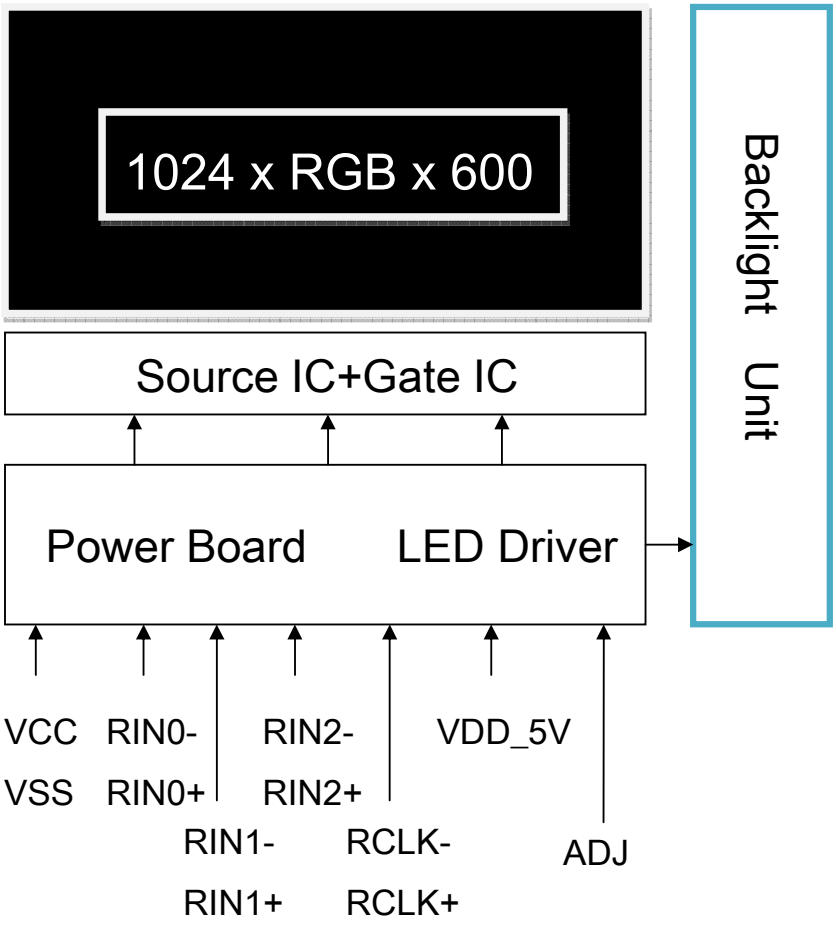
| Item | Symbol | Values | | Unit | Note |
|---|---|---|---|---|---|
| | | Min | Max. | | |
| Power supply voltage | VCC | -0.3 | 4.0 | V | |
| Power supply voltage | VDD_5V | 0 | 6.0 | V | |

### 4.1.2 Environment Absolute Rating

| Item | Symbol | Values | | | Unit | Note |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max. | | |
| Operating Temperature | Topa | -10 | | 50 | °C | Ambient temperature |
| Storage Temperature | Tstg | -20 | | 60 | °C | |

## 5. BLOCK DIAGRAM

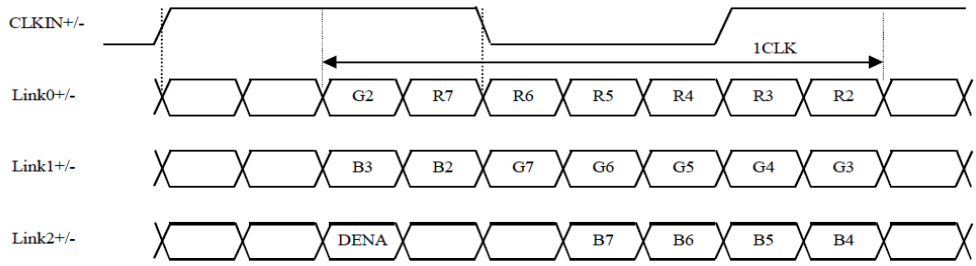
### 5.1 TFT LCD Module



## 6. Relationship Between Displayed Color and Input

### 6.1 6 bit

| | Display | MSB LSB R5 | R4 | R3 | R2 | R1 | R0 | MSB LSB G5 | G4 | G3 | G2 | G1 | G0 | MSB LSB B5 | B4 | B3 | B2 | B1 | B0 | Gray scale level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Basic color | Black | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | - |
| | Blue | L | L | L | L | L | L | L | L | L | L | L | L | H | H | H | H | H | H | - |
| | Green | L | L | L | L | L | L | H | H | H | H | H | H | L | L | L | L | L | L | - |
| | Light Blue | L | L | L | L | L | L | H | H | H | H | H | H | H | H | H | H | H | H | - |
| | Red | H | H | H | H | H | H | L | L | L | L | L | L | L | L | L | L | L | L | - |
| | Purple | H | H | H | H | H | H | L | L | L | L | L | L | H | H | H | H | H | H | - |
| | Yellow | H | H | H | H | H | H | H | H | H | H | H | H | L | L | L | L | L | L | - |
| | White | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | - |
| Gray scale of Red | Black | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L0 |
| | Dark ↑ ↓ Light | L | L | L | L | L | H | L | L | L | L | L | L | L | L | L | L | L | L | L1 |
| | | L | L | L | L | H | L | L | L | L | L | L | L | L | L | L | L | L | L | L2 |
| | | : | | | | | | : | | | | | | : | | | | | | L3...L60 |
| | | H | H | H | H | L | H | L | L | L | L | L | L | L | L | L | L | L | L | L61 |
| | | H | H | H | H | H | L | L | L | L | L | L | L | L | L | L | L | L | L | L62 |
| | Red | H | H | H | H | H | H | L | L | L | L | L | L | L | L | L | L | L | L | Red L63 |
| Gray scale of Green | Black | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L0 |
| | Dark ↑ ↓ Light | L | L | L | L | L | L | L | L | L | L | L | H | L | L | L | L | L | L | L1 |
| | | L | L | L | L | L | L | L | L | L | L | H | L | L | L | L | L | L | L | L2 |
| | | : | | | | | | : : | | | | | | : : | | | | | | L3...L60 |
| | | L | L | L | L | L | L | H | H | H | H | L | H | L | L | L | L | L | L | L61 |
| | | L | L | L | L | L | L | H | H | H | H | H | L | L | L | L | L | L | L | L62 |
| | Green | L | L | L | L | L | L | H | H | H | H | H | H | L | L | L | L | L | L | Green L63 |
| Gray scale of Blue | Black | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L0 |
| | Dark ↑ ↓ Light | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | H | L1 |
| | | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | H | L | L2 |
| | | : | | | | | | : | | | | | | : | | | | | | L3...L60 |
| | | L | L | L | L | L | L | L | L | L | L | L | L | H | H | H | H | L | H | L61 |
| | | L | L | L | L | L | L | L | L | L | L | L | L | H | H | H | H | H | L | L62 |
| | Blue | L | L | L | L | L | L | L | L | L | L | L | L | H | H | H | H | H | H | Blue L63 |
| Gray scale of White & Black | Black | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L0 |
| | Dark ↑ ↓ Light | L | L | L | L | L | H | L | L | L | L | L | H | L | L | L | L | L | H | L1 |
| | | L | L | L | L | H | L | L | L | L | L | H | L | L | L | L | L | H | L | L2 |
| | | : | | | | | | : | | | | | | : | | | | | | L3...L60 |
| | | H | H | H | H | L | H | H | H | H | H | L | H | H | H | H | H | L | H | L61 |
| | | H | H | H | H | H | L | H | H | H | H | H | L | H | H | H | H | H | L | L62 |
| | White | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H | White L63 |



## 7. ELECTRICAL CHARACTERISTICS

### 7.1 TFT LCD Module

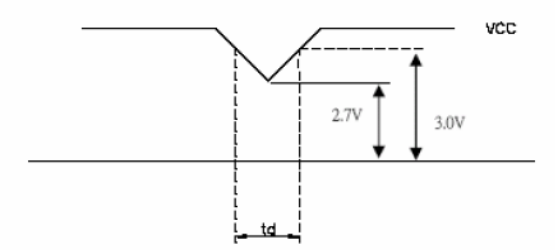
| Item | Symbol | Values | | | Unit | Remark |
|---|---|---|---|---|---|---|
| | | Min | Typ. | Max. | | |
| Supply Voltage | VCC | 3.0 | 3.3 | 3.6 | V | |
| | VDD_5V | 4.5 | 5.0 | 5.5 | V | |
| | VRF | - | - | 100 | mV p-p | Ripple voltage |
| Differential Input High Threshold | VTH | - | - | +100 | mV | Vcm=+1.2V |
| Differential Input Low Threshold | VTL | -100 | - | - | mV | Vcm=+1.2V |
| Magnitude differential Input Voltage | [Vid] | 100 | - | 600 | mV | |
| Common Mode Voltage | Vcm | 0.9 | 1.2 | 1.5 | V | |
| Common Mode Voltage Offest | △Vcm | - | - | 50 | mV | Vcm=+1.2V |
| Supply Current | ICC | - | 190 | 250 | mA | VCC=3.3V |
| | IDD | - | (650) | (800) | mA | VDD_5V=5V |
| ADJ frequency | ADJ | 19K | 20K | 21K | Hz | |
| ADJ input voltage | VIH | 3.0 | - | 3.3 | V | |
| | VIL | 0 | - | 0.3 | V | |
| LED life time | | 30000 | - | - | Hr | Note1 |

Note (1): The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25℃ 60% RH.

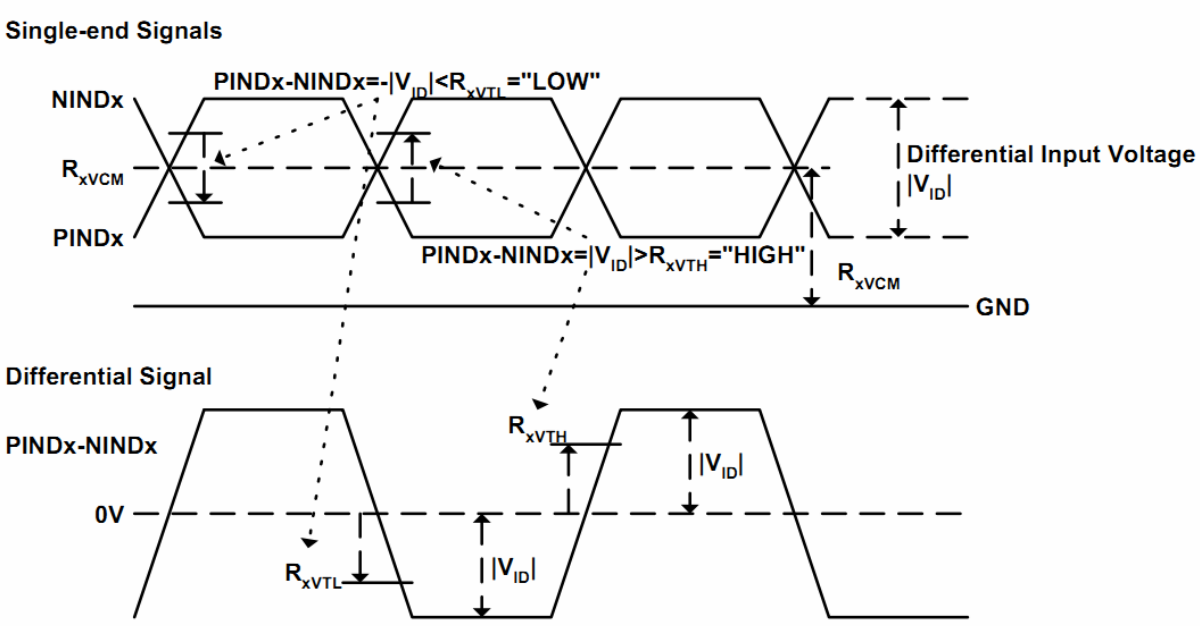
Note (2): VCC-dip condition

a. 2.7 V ≤VCC <3.0V, td ≤ 10 ms

b. VCC＞3.0V, VCC-dip condition should be the same with VCC-turn-on condition。



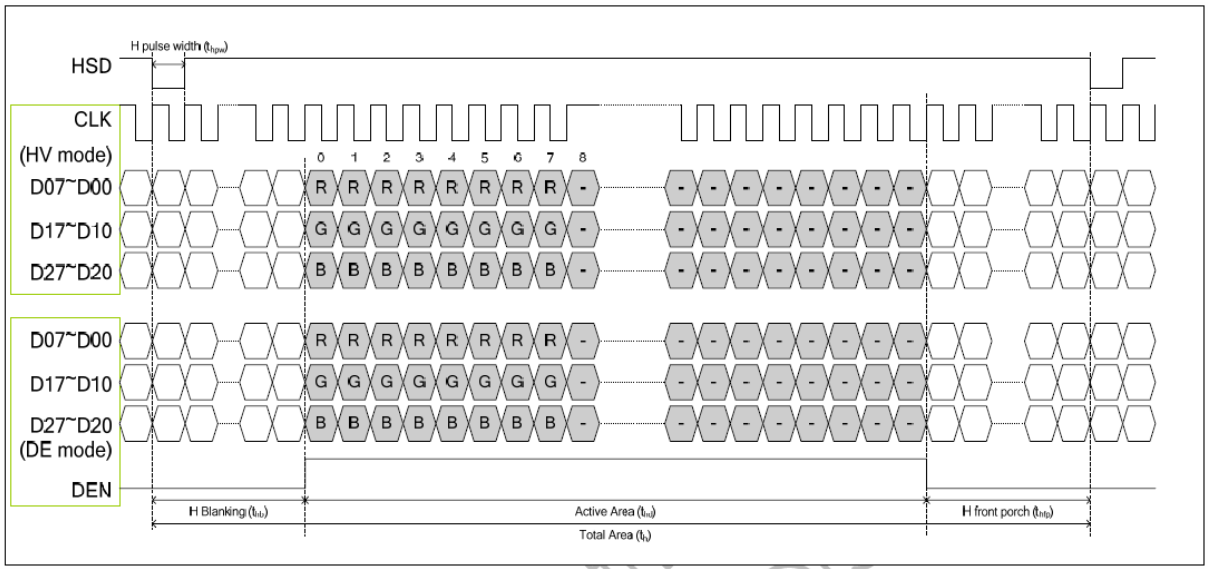
Note (3): The built-in LVDS receiver is compatible with (ANSI/TIA/TIA-644 ) standard.

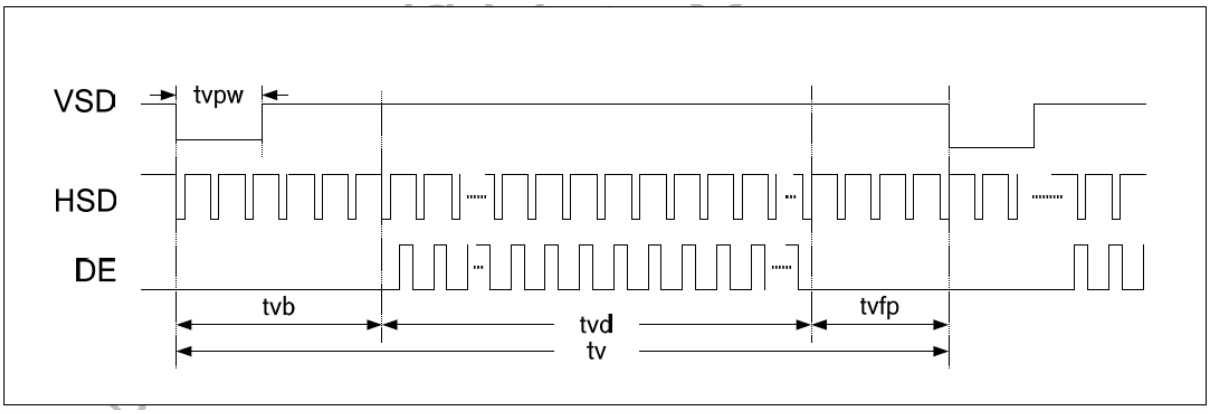


## 7.2 INTERFACE SPECIFICATIONS

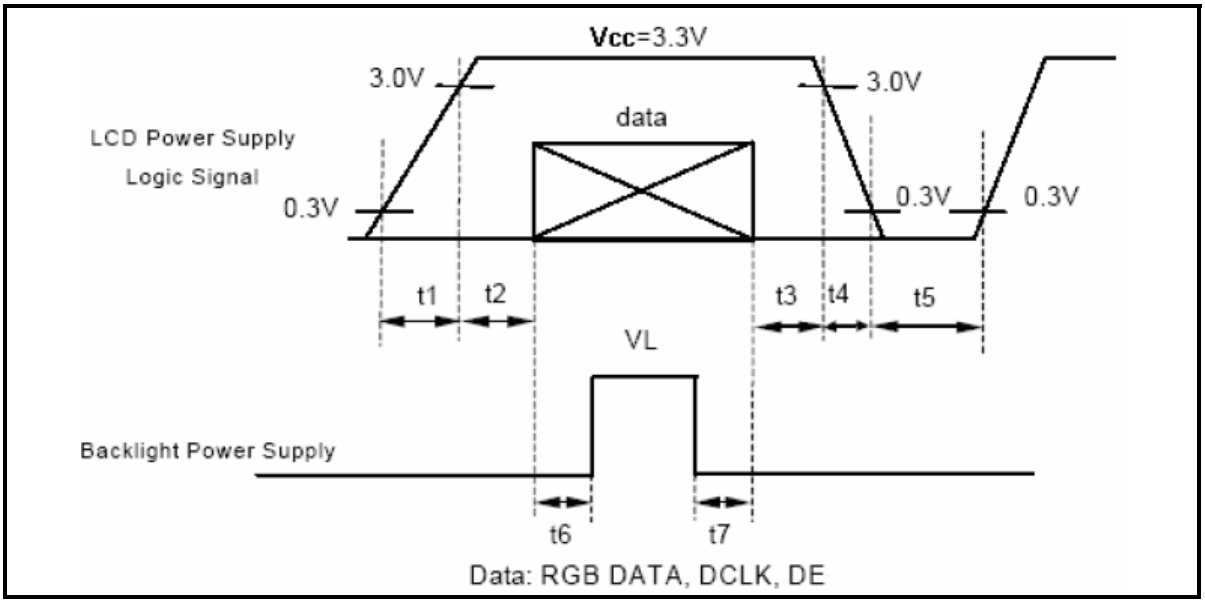
### 7.2.1 DE mode Input signal characteristics

| Signal | Parameter | Symbol | Min. | Typ. | Max. | Unit. | Note |
|---|---|---|---|---|---|---|---|
| DCLK | DCLK Frequency | fclk | 40.8 | 51.2 | 67.2 | MHz | |
| Horizontal | Horizontal display area | thd | - | 1024 | - | DCLK | |
| | HSD period time | th | 1114 | 1344 | 1400 | DCLK | |
| | HSD Blanking | thb+thfb | 90 | 320 | 376 | DCLK | |
| Vertical | Vertical display area | tvd | - | 600 | - | th | |
| | VSD period time | tv | - | 635 | - | th | |
| | VSD pulse width | tvb+tvfb | 10 | 35 | 200 | th | |



### 7.3 Power On / Off Sequence




t1 ≤10ms : 1 sec≤ t5

50ms≤ t2 : 200ms ≤t6

0<t3 ≤50ms: 200ms≤ t7

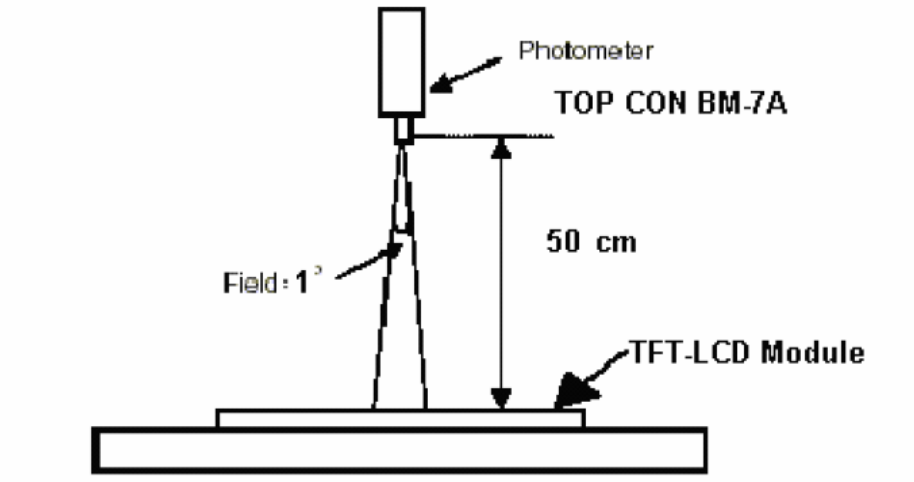
0<t4 ≤10ms

## 8. OPTICAL CHARACTERISTICS

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Brightness | | -- | Note1, Note 3, ($\theta = 0^\circ$, Normal Viewing Angle) | 360 | 450 | -- | cd/m2 |
| Uniformity | | B-uni | | 70 | 75 | - | % |
| Contrast Ratio | | CR | | 400 | 500 | -- | -- |
| Response Time | | Tr | | -- | 5 | 7 | ms |
| | | Tf | | -- | 20 | 28 | ms |
| Color Chromaticity | White | Wx | | 0.260 | 0.310 | 0.360 | -- |
| | | Wy | | 0.280 | 0.330 | 0.380 | -- |
| View angle | Horizontal | $\theta$ x+ | Center CR≥10 | 60 | 70 | -- | |
| | | $\theta$ x- | | 60 | 70 | -- | |
| | Vertical | $\theta$ Y+ | | 40 | 50 | -- | |
| | | $\theta$ Y- | | 50 | 60 | -- | |
| Image sticking | | tis | 2 hours | -- | -- | 2 | Sec |

Note：The following optical specifications shall be measured in a darkroom or equivalent state(ambient luminance ≤1 lux, and at room temperature). The operation temperature is 25°C±2°C. The measurement method is shown in Note1.

Note1: The method of optical measurement:

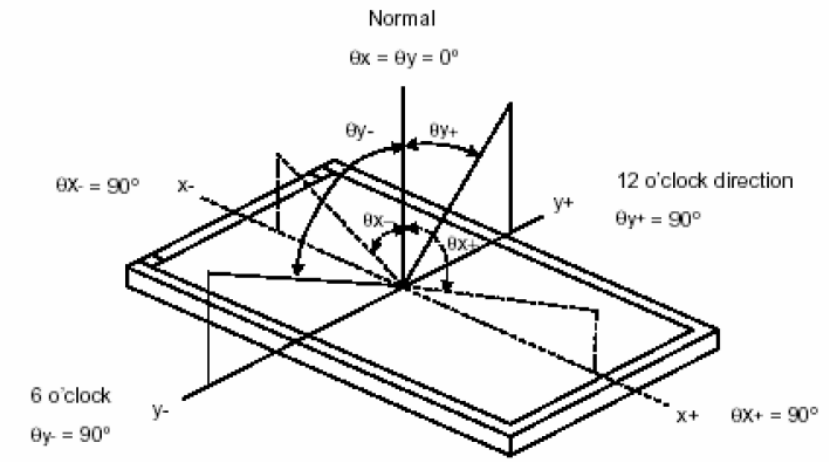



Note2: Measured at the center area of the panel and at the viewing angle of the $\theta$ x= $\theta$ y =0°

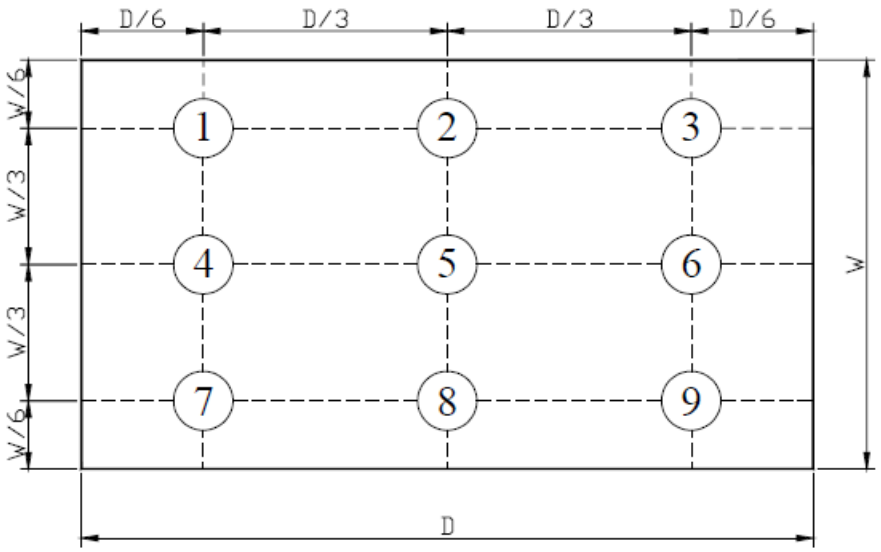
Note3: Definition of Contrast Ratio (CR):

CR = Luminance with all pixels in white state ÷ Luminance with all pixels in Black state

Note4: Definition of Viewing Angle:

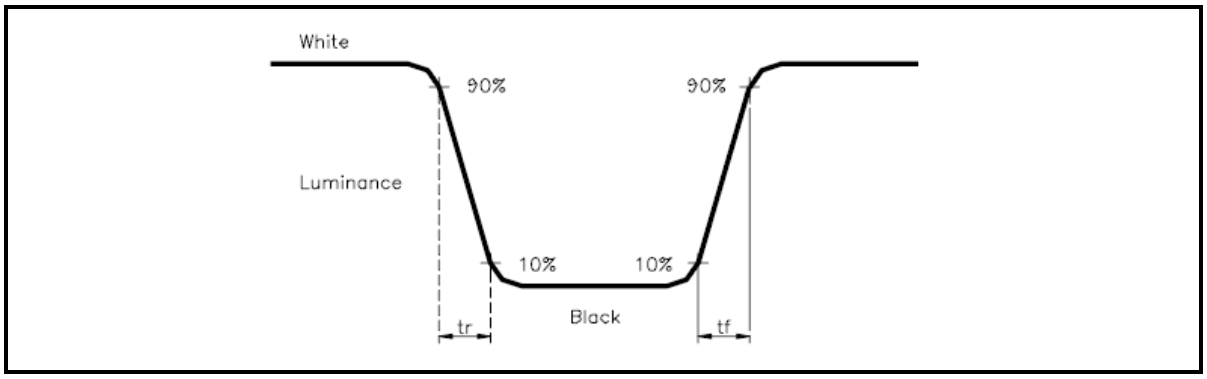



Note 5: Definition of Brightness Uniformity (B-uni):



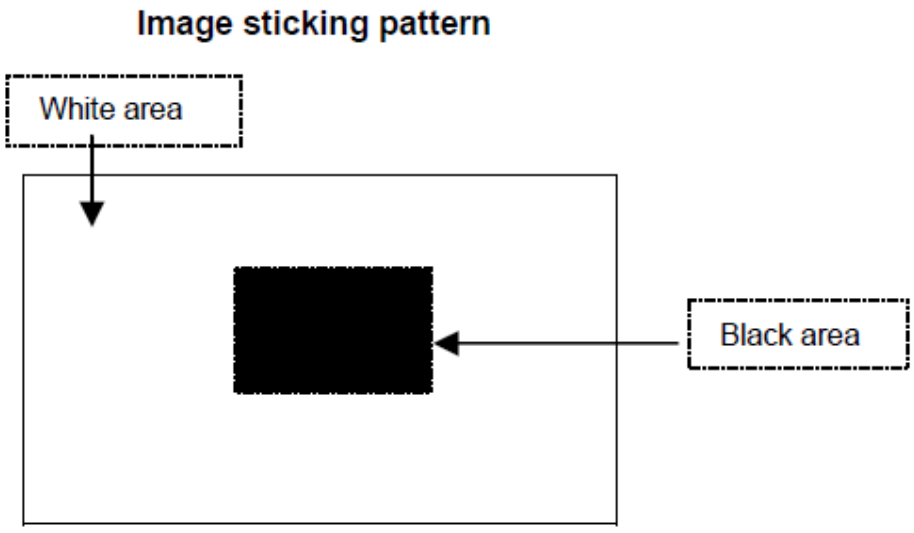

B-uni ＝(Minimum luminance of 9 points÷Maximum luminance of 9points)X100%

Note6: Definition of Response Time:
The Response Time is set initially by defining the “Rising Time (Tr)” and the “Falling Time (Tf)” respectively. Tr and Tf are defined as following figure




Note 7: Definition of Chromaticity:
The color coordinates (Wx,Wy),(Rx,Ry),(Gx,Gy),and (Bx,By) are obtained with all pixels in the viewing field at white, red, green, and blue states, respectively.

Note 8: Definition of Image sticking (tis):
Continuously display the test pattern shown in the figure below for 2 hours. Then display a completely white screen. The previous image shall not persist more than 2 sec at 25 ˚C



## 9. RELIABILITY

### 9.1 Test Condition

9.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : 25 ± 5°C

Humidity : 65 ± 5%

9.1.2 Operation

Unless specified otherwise, test will be conducted under function state.

9.1.3 Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

9.1.4 Test Frequency

In case of related to deterioration such as shock test. It will be conducted only once.

### 9.2 TESTS

| No. | ITEM | CONDITION CRITERION |
|---|---|---|
| 1 | High Temperature Storage | 60°C, 120 hrs |
| 2 | Low Temperature Storage | -20°C, 120 hrs |
| 3 | High Temperature Operating | 50°C, 120 hrs |
| 4 | Low Temperature Operating | -10°C, 120 hrs |
| 5 | High Temperature/Humidity Non-Operating | 50°C, 90%RH, 120 hrs |
| 6 | Temperature Shock Non-Operating | -20°C ←→ 60°C (0.5hr each), 25 cycles |
| 7 | Vibration Test Non-Operating | Frequency:0 ~ 55 Hz Amplitude:1.5 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z |
| 8 | Electro-static Discharge Non-Operating | 150pF,330Ω Air:± 8KV;Contact: ±6KV 10 times/point;4 points/panel face |

Note1: The test sample have recovery time for 24 hours at room temperature before the function check. In the standard conditions, there is no any touch panel function NG issue occurred.

### 9.3 JUDGMENT STANDARD

The judgment of the above test should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

## 9.4 INCOMING INSPECTION STANDARDS

<table>
<tr><th>No.</th><th>Parameter</th><th>Criteria</th></tr>
<tr><td rowspan="5">1</td><td rowspan="5">Operating</td><td>Display function: No Display malfunction (Major)</td></tr>
<tr><td>Contrast ratio (Black, White):<br>Does not meet specified range in the spec. (Major) (Note:3)</td></tr>
<tr><td>Line Defect: No obvious Vertical and Horizontal line defect in bright, dark and colored. (Major) (Note:1)</td></tr>
<tr><td>Point Defect : Active area ≤ 5 dots (Minor) (Note:1)
<table>
<tr><th rowspan="2">Item</th><th>Acceptable number</th><th rowspan="2">Total</th></tr>
<tr><th>Active Area</th></tr>
<tr><td>Bright</td><td>2</td><td rowspan="2">5</td></tr>
<tr><td>Dark</td><td>4</td></tr>
</table></td></tr>
<tr><td>Non-uniformity: Visible through 5%ND filter. (Minor)<br>Foreign material in Black or White spots shape (W>1/4L)
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td>D> 0.5</td><td>0</td><td rowspan="3">Minor</td><td rowspan="3">1.5</td></tr>
<tr><td>0.3 < D ≤ 0.5</td><td>5</td></tr>
<tr><td>D ≤ 0.3</td><td>*</td></tr>
</table>
D = (Long + Short) / 2 ＊ : Disregard<br>Foreign Material in Line or spiral shape (W≤1/4L) (Note: 4)
<table>
<tr><th>L (mm) / Zone W(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td>L >5</td><td>W>0.1</td><td>0</td><td rowspan="3">Minor</td><td rowspan="3">1.5</td></tr>
<tr><td>0.5 < L ≤ 5</td><td>0.03 < W≤0.1</td><td>5</td></tr>
<tr><td>L ≤0.5</td><td>W≤0.03</td><td>*</td></tr>
</table>
L : Length W : Width ＊ : Disregard</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">External Inspection (non-operating)</td><td>Dimension: Outline (Major)<br>Bezel appearance: uneven (Minor)<br>Scratch on the polarize: (Note:2)
<table>
<tr><th>L (mm) / Zone W(mm)</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td>--</td><td>W>0.1</td><td>0</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr>
<tr><td>L ≤ 3</td><td>W≤0.1</td><td>3</td></tr>
</table>
L : Length W : Width ＊ : Disregard</td></tr>
<tr><td>Dent or bubble on the polarize (Note:2)
<table>
<tr><th>Zone / Dimension</th><th>Acceptable number</th><th>Class Of Defects</th><th>AQL Level</th></tr>
<tr><td>D≤0.3</td><td>*</td><td rowspan="2">Minor</td><td rowspan="2">1.5</td></tr>
<tr><td>D≤0.5</td><td>3</td></tr>
</table>
D = (Long + Short) / 2 ＊ : Disregard</td></tr>
</table>

| | | | |
|---|---|---|---|
| Class of defects | **Major** | AQL 0.65% | **Definition**<br>It is a defect that is likely to result in failure or to reduce materially the usability of the product for the intended function. |
| | **Minor** | AQL 1.5% | It is a defect that will not result in functioning problem with deviation classified. |

Note1:

(a)Bright point defect is defined as point defect of R,G,B with area >1/2 pixel respectively

(b)Dark point defect is defined as visible in full white pattern.

(c)Definition of distribution of point defect is as follows:

-minimum separation between dark point defects should be larger than 5mm.

-minimum separation between bright point defects should be larger than 5mm.

(d)Definition of joined bright point defect and joined dark point defect are as follows:

-Two or more joined bright point defects must be nil.

-Three joined dark point defects must be nil.

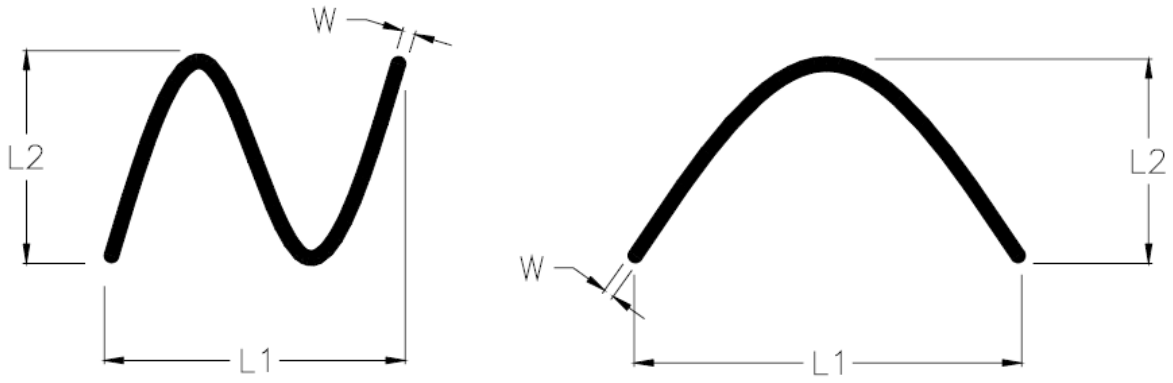
-Coupling of one dark and one bright point in junction is counted as one dark and bright spot with 1 pair maximum.

-Two Joined dark point is counted as two dark points with 2 pair maximum.

Note2: The external inspection should be conducted at the distance 30± 5cm between the eyes of inspector and the panel.

Note3: Luminance measurement for contrast ratio is at the distance 50± 5cm between the detective head and the panel with ambient luminance less than 1 lux. Contrast ratio is obtained at optimum view angle.

Note4: W-Width in mm , L-length of Max.(L1,L2) in mm.



### 9.5 Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.

Lot size: Quantity of shipment lot per model.

Sampling type: normal inspection, single sampling

Sampling table: MIL-STD-105E

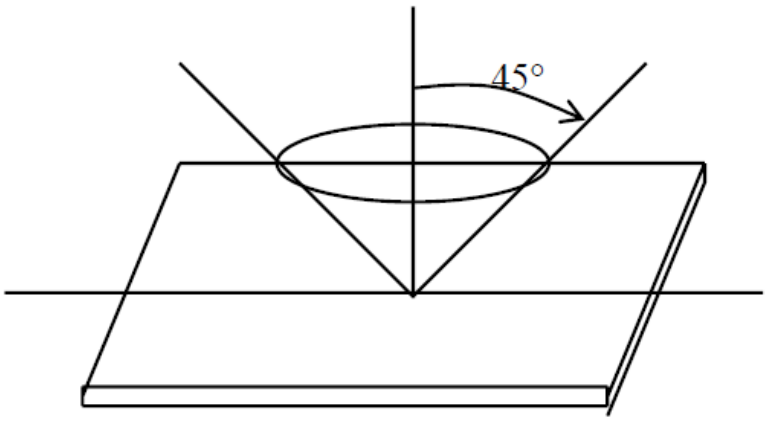
Inspection level: Level II

### 9.6 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light.

$\theta \leq 45^{\circ}$ inspection under non-operating condition.

$\theta \leq 5^{\circ}$ inspection under operating condition



## 10. PRECAUTION RELATING PRODUCT HANDLING

### 10.1 SAFETY

10.1.1 **If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.**

10.1.2 **If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.**

### 10.2 HANDLING

10.2.1 **Avoid any strong mechanical shock which can break the glass.**

10.2.2 **Avoid static electricity which can damage the CMOS LSI—When working with the module, be sure to ground your body and any electrical equipment you may be using.**

10.2.3 **Do not remove the panel or frame from the module.**

10.2.4 **The polarizing plate of the display is very fragile. So , please handle it very carefully, Do not touch, push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)**

10.2.5 **Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.**

10.2.6 **Do not touch the display area with bare hands , this will stain the display area.**

10.2.7 **Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.**

10.2.8 **To control temperature and time of soldering is 280 ± 10°C and 3-5 sec.**

10.2.9 **To avoid liquid (include organic solvent) stained on LCM.**

### 10.3 STORAGE

10.3.1 **Store the panel or module in a dark place where the temperature is 25°C ± 5°C and the humidity is below 65% RH.**

10.3.2 **Do not place the module near organics solvents or corrosive gases.**

10.3.3 **Do not crush, shake, or jolt the module.**