



# Specification for Approval

Customer: \_\_\_\_\_

Model Name: AM-168384-029A

| Supplier Approval |              |             | Customer approval |
|-------------------|--------------|-------------|-------------------|
| R&D Designed      | R&D Approved | QC Approved |                   |
| Sam               | Peng Jun     |             |                   |



Revise Records

| Rev. | Date       | Contents                  | Written | Approved |
|------|------------|---------------------------|---------|----------|
| A    | 2024-04-02 | Preliminary Specification | sam     | Peng Jun |
|      |            |                           |         |          |
|      |            |                           |         |          |
|      |            |                           |         |          |
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Special Notes

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| Note1. |  |
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## 1 General Description and Features

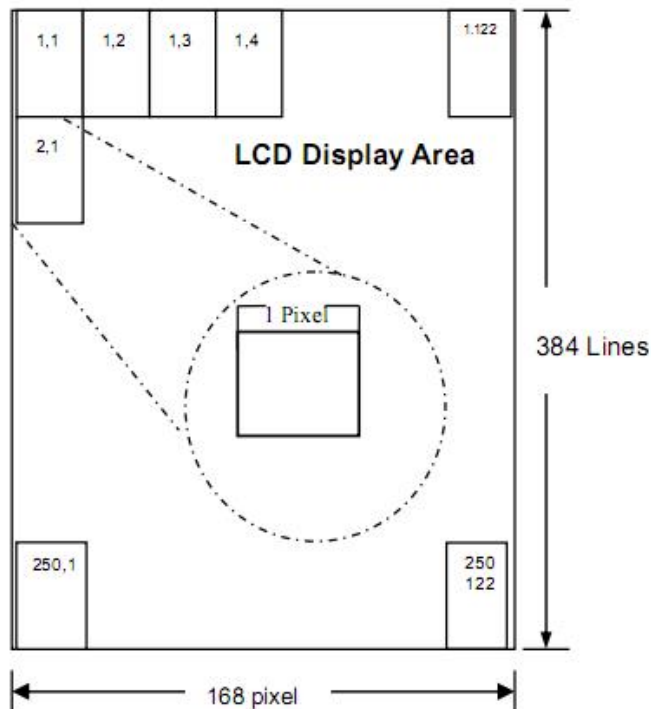
AM-168384-029A is a mono active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. It is a reflective type display operating in the total reflection. This TFT LCD has a 2.9 inch diagonally measured active display area with 168 horizontal by 384 vertical pixel resolution

### 1.1 Features

- 2.9 inch configuration
- Mono by 2 Grey signal input
- ROHS Compliance

### 1.2 LCD Module

| Item               | Specification                       | Unit     |
|--------------------|-------------------------------------|----------|
| Screen Size        | 2.9 inches                          | Diagonal |
| Display Resolution | 168(H) x RGB x 384(V)               | Dot      |
| Pixel Pitch        | 0.1732 (H) x 0.17408(V)             | mm       |
| Active Area        | 29.0976 (H) x 66.84672(V)           | mm       |
| Outline Dimension  | 31.0976(W) x 70.94672 (H) x0.72 (D) | mm       |
| Display Mode       | Normally white                      | --       |
| Surface Treatment  | Anti-glare (AG05)                   | --       |
| Viewing Direction  | All                                 | --       |
| Driver IC          | ST7306                              |          |



## 2 Mechanical Information

| Item        |                | Min.     | Typ.     | Max.     | Unit | Note |
|-------------|----------------|----------|----------|----------|------|------|
| Module Size | Horizontal (H) | 30.9976  | 31.0976  | 31.1976  | mm   | --   |
|             | Vertical (V)   | 70.84672 | 70.94672 | 71.04672 | mm   | (1)  |
|             | Thickness (T)  | 0.71     | 0.72     | 0.73     | mm   | (1)  |

Note (1) Not include FPC.

Refer to the Dimensional Outlines for further information.

### 3 Absolute Max. Ratings

#### 3.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

( $T_a=25\pm 2^\circ\text{C}$ ,  $V_{SS}=\text{GND}=0$ )

| Item                  | Symbol    | Min. | Max. | Unit | Note    |
|-----------------------|-----------|------|------|------|---------|
| Storage temperature   | $T_{STG}$ | -30  | 80   | °C   | (1)     |
| Operating temperature | $T_{OPR}$ | -20  | 70   | °C   | (1,2,3) |

Note (1) 95 % RH Max. ( $40^\circ\text{C} \geq T_a$ ). Maximum wet-bulb temperature at  $39^\circ\text{C}$  or less. ( $T_a > 40^\circ\text{C}$ )  
No condensation.

Note (2) In case of below  $0^\circ$ , the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character

Note (3) Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at  $+25^\circ\text{C}$ .

#### 3.2 Electrical Absolute Rating

( $T_a=25\pm 2^\circ\text{C}$ ,  $V_{SS}=\text{GND}=0$ )

| Item                           | Symbol  | Value |          | Unit | Condition |
|--------------------------------|---------|-------|----------|------|-----------|
|                                |         | Min.  | Max.     |      |           |
| I/O Power Supply Voltage       | VDDI    | -0.3  | +4       | V    |           |
| Analog Power Supply Voltage    | VDDA    | -0.3  | +4       | V    |           |
| Reference Power Supply Voltage | VDDR    | -0.3  | +4       | V    |           |
| LCD Driver Supply Voltage      | AVDD    | -0.3  | +6.4     | V    |           |
|                                | VSH-VSL | -0.3  | +6.2     | V    |           |
|                                | VGH-VGL | -0.3  | +33      | V    |           |
| Logic Input Voltage Range      | VIN     | -0.3  | VDDI+0.5 | V    |           |
| Logic Output Voltage Range     | VO      | -0.3  | VDDI+0.5 | V    |           |

## 4 Electrical Characteristics

### 4.1 TFT-LCD Module

| Parameter                          | Symbol            | Condition          | Specification |      |         | Unit | Related Pins |
|------------------------------------|-------------------|--------------------|---------------|------|---------|------|--------------|
|                                    |                   |                    | MIN.          | TYP. | MAX.    |      |              |
| Power & Operation Voltage          |                   |                    |               |      |         |      |              |
| Analog Power Supply (Normal Mode)  | VDDA\VDDR         | Analog Power       | 2.55          |      | 3.6     | V    |              |
| Digital Power Supply (Normal Mode) | VDDI              | I/O Supply Voltage | 1.65          |      | 3.6     | V    |              |
| Power Supply (1.8V Mode)           | VDDA\VDDR<br>VDDI | Single Power       | 1.7           | 1.8  | 1.9     | V    |              |
| Gate Driver High Voltage           | VGH               |                    | 8.0           |      | 16.5    | V    | Note 1       |
| Gate Driver Low Voltage            | VGL               |                    | -15.0         |      | -6.0    | V    |              |
| Gate Driver Supply Voltage         |                   | VGH-VGL            | 14.0          |      | 31.5    | V    | Note 2       |
| Input / Output                     |                   |                    |               |      |         |      |              |
| Logic-High Input Voltage           | VIH               |                    | 0.7VDDI       |      | VDDI    | V    |              |
| Logic-Low Input Voltage            | VIL               |                    | VSS           |      | 0.3VDDI | V    |              |
| Logic-High Output Voltage          | VOH               | IOH = -<br>1.0mA   | 0.8VDDI       |      | VDDI    | V    |              |
| Logic-Low Output Voltage           | VOL               | IOL =<br>+1.0mA    | VSS           |      | 0.2VDDI | V    |              |
| Input Leakage Current              | IIL               | IOH = -<br>1.0mA   | -0.1          |      | +0.1    | uA   |              |

Notes:

1. When evaluating the maximum and minimum of VGH, VDD=2.8V.
2. The maximum value of |VGH-VGL| can not over 32.0V.

## 5 Input Terminal Pin Assignment

### 5.1 CN1 Pin Assignment

(Reference Connector: Hirose\_FH12A-10S-0.5SH(55))

| Pin No | Symbol | Description                                                               | Input/Output | Note |
|--------|--------|---------------------------------------------------------------------------|--------------|------|
| 1      | GND    | Power Ground                                                              | P            |      |
| 2      | VCC    | Power Supply (Analog)                                                     | P            |      |
| 3      | IOVCC  | Power Supply (Digital)                                                    | P            |      |
| 4      | CS     | Chip select input pin.                                                    | P            |      |
| 5      | AO     | Determines whether the access is related to data or command.              | I            |      |
| 6      | RESET  | Reset input pin                                                           | I            |      |
| 7      | SCL    | Serial input clock                                                        | I            |      |
| 8      | SDA    | Serial input data                                                         | I            |      |
| 9      | TE     | Tearing effect signal is used to synchronize MCU to frame memory writing. | I            |      |
| 10     | GND    | Power Ground                                                              | I            |      |



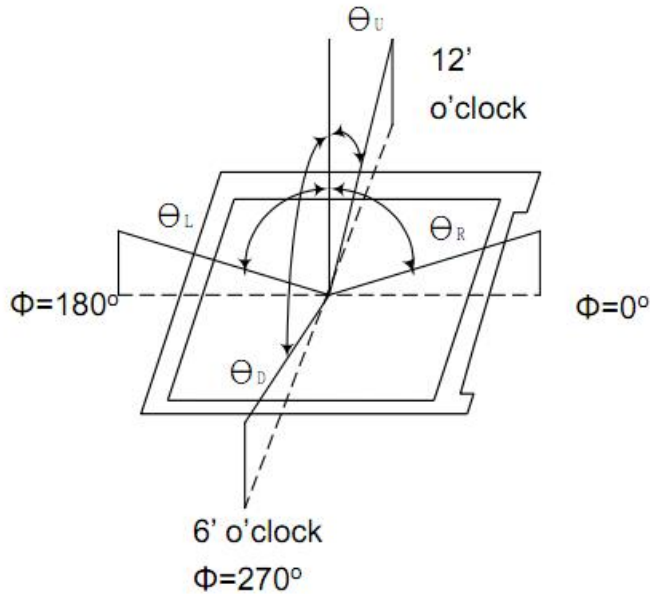
## 6 Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room

Measuring equipment: BM-7A

| Item                                  |       | Symbol         | Condition                                | Min. | Typ.    | Max. | Unit | Note                                                                     |
|---------------------------------------|-------|----------------|------------------------------------------|------|---------|------|------|--------------------------------------------------------------------------|
| White Reflectance<br>(with Polarizer) |       | Rw (%)         | $\Theta=0$<br>Normal<br>viewing<br>angle | —    | 45.06   | —    | %    | (4)<br>Measuring with<br>polarizer<br>Reference Only<br>Base on Vop=4.5V |
| Contrast Ratio                        |       | CR             | —                                        | —    | 15      | —    | —    | (1)(2) Base on<br>Vop=4.5V                                               |
| Color<br>Chromaticity<br>(CIE1931)    | White | W <sub>x</sub> | —                                        | —    | (0.300) | —    | —    | (1)(4)<br>Measuring with<br>polarizer<br>Reference Only                  |
|                                       |       | W <sub>y</sub> | —                                        | —    | (0.330) | —    | —    |                                                                          |
| Viewing Angle                         | Hor.  | $\Theta_L$     | CR>2                                     | —    | 60      | —    | —    | (1)(4)<br>Measuring with<br>polarizer<br>Reference Only                  |
|                                       |       | $\Theta_R$     |                                          | —    | 60      | —    |      |                                                                          |
|                                       | Ver.  | $\Theta_U$     |                                          | —    | 60      | —    |      |                                                                          |
|                                       |       | $\Theta_D$     |                                          | —    | 60      | —    |      |                                                                          |

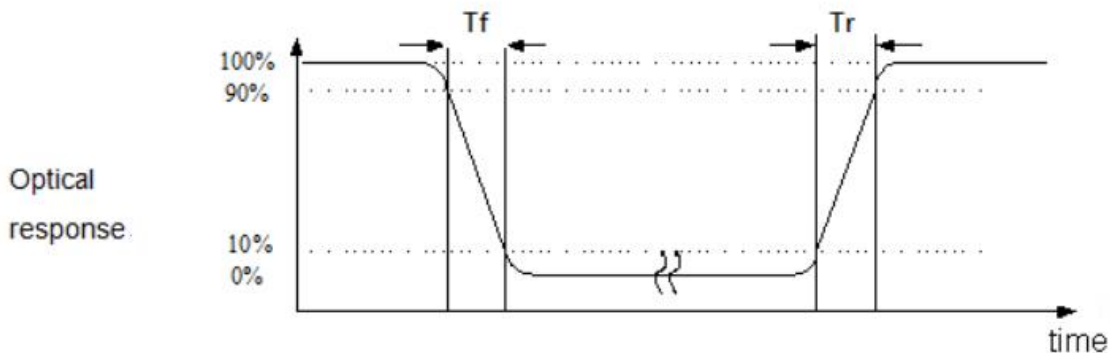
Note (1) Definition of Viewing Angle:



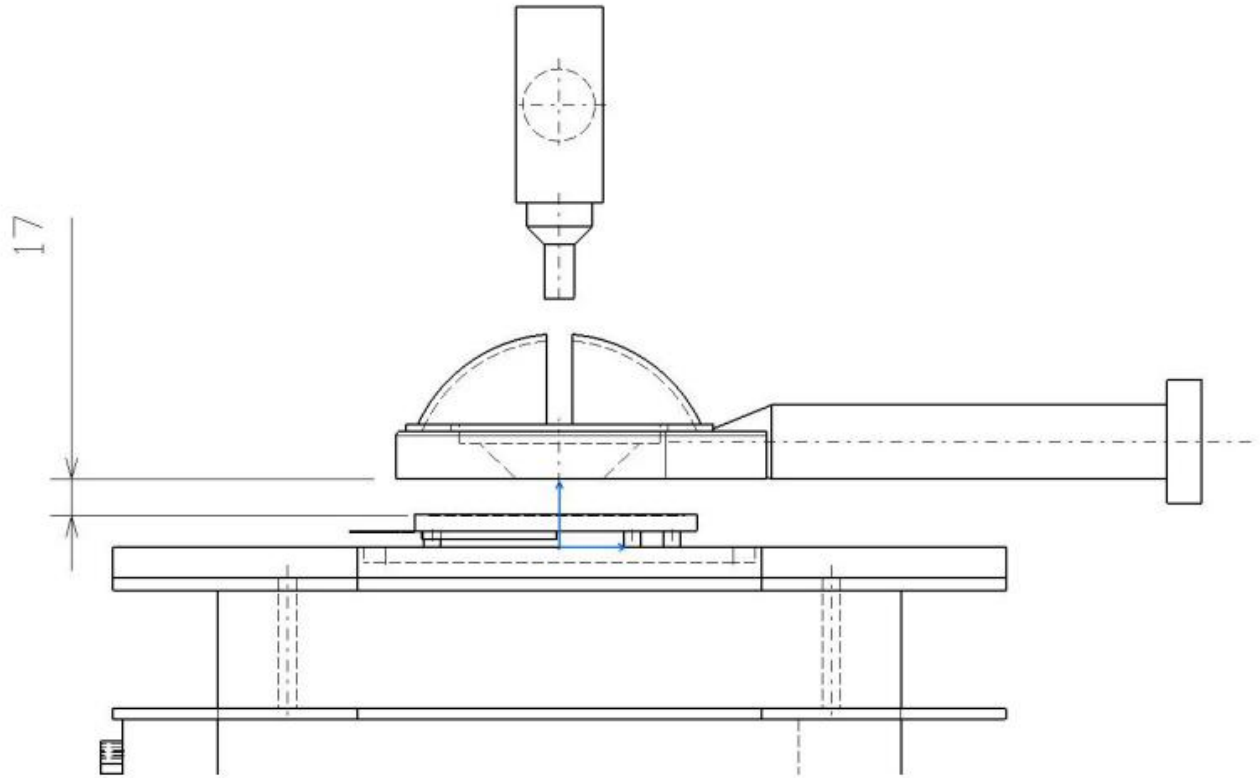
Note (2) Definition of Contrast Ratio (CR) :  
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note (3) Definition of Response Time : Sum of  $T_R$  and  $T_F$

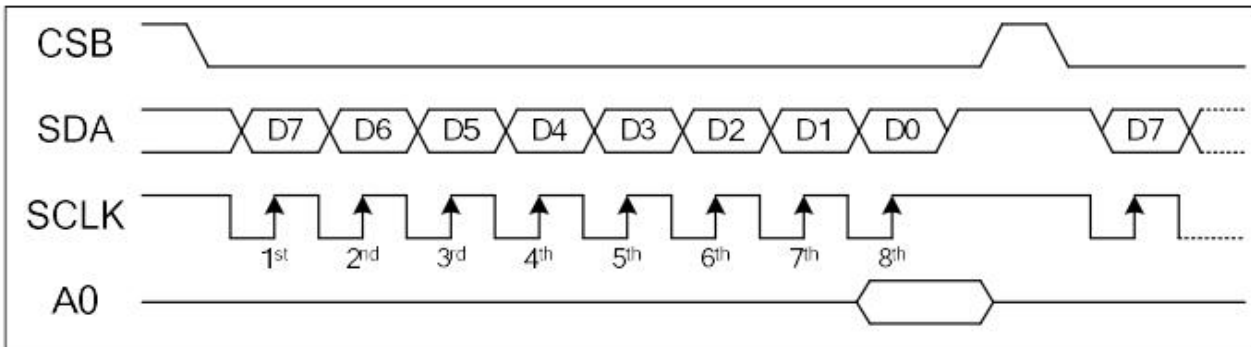


Note (4) Definition of optical measurement setup

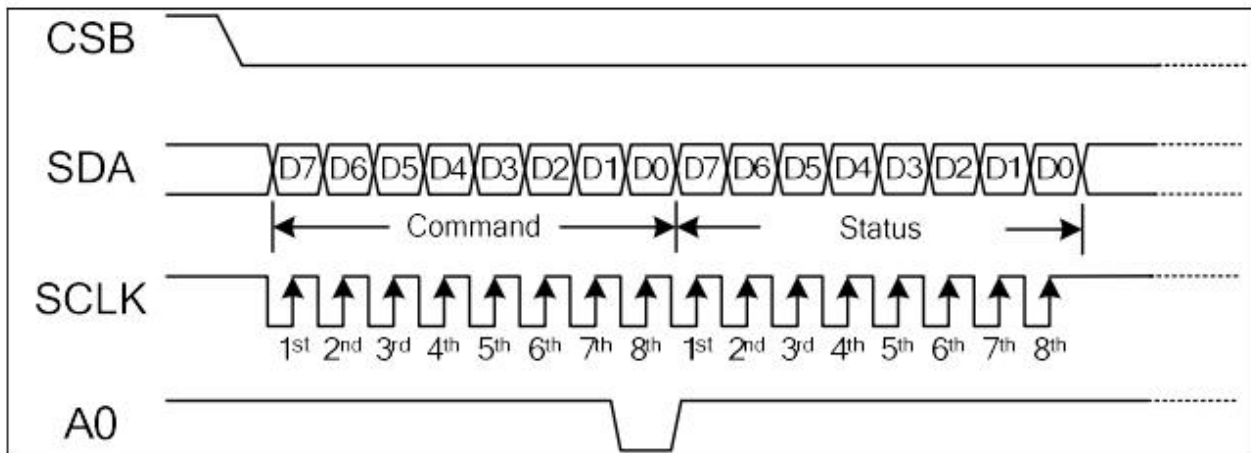


## 7 AC Characteristics

### 7.1 Interface Timing



**Write Operation of 4-Line SPI**



**Read Status Operation of 4-Line SPI**

## 7.2 Power ON/OFF sequence

VDDI and VDDA can be applied in any order.

VDDA and VDDI can be power down in any order.

During power off, if LCD is in the Sleep Out mode, VDDA and VDDI must be powered down minimum 120msec after RSTB has been released.

During power off, if LCD is in the Sleep In mode, VDDI or VDDA can be powered down minimum 0msec after RSTB has been released.

CSB can be applied at any timing or can be permanently grounded. RSTB has priority over CSB.

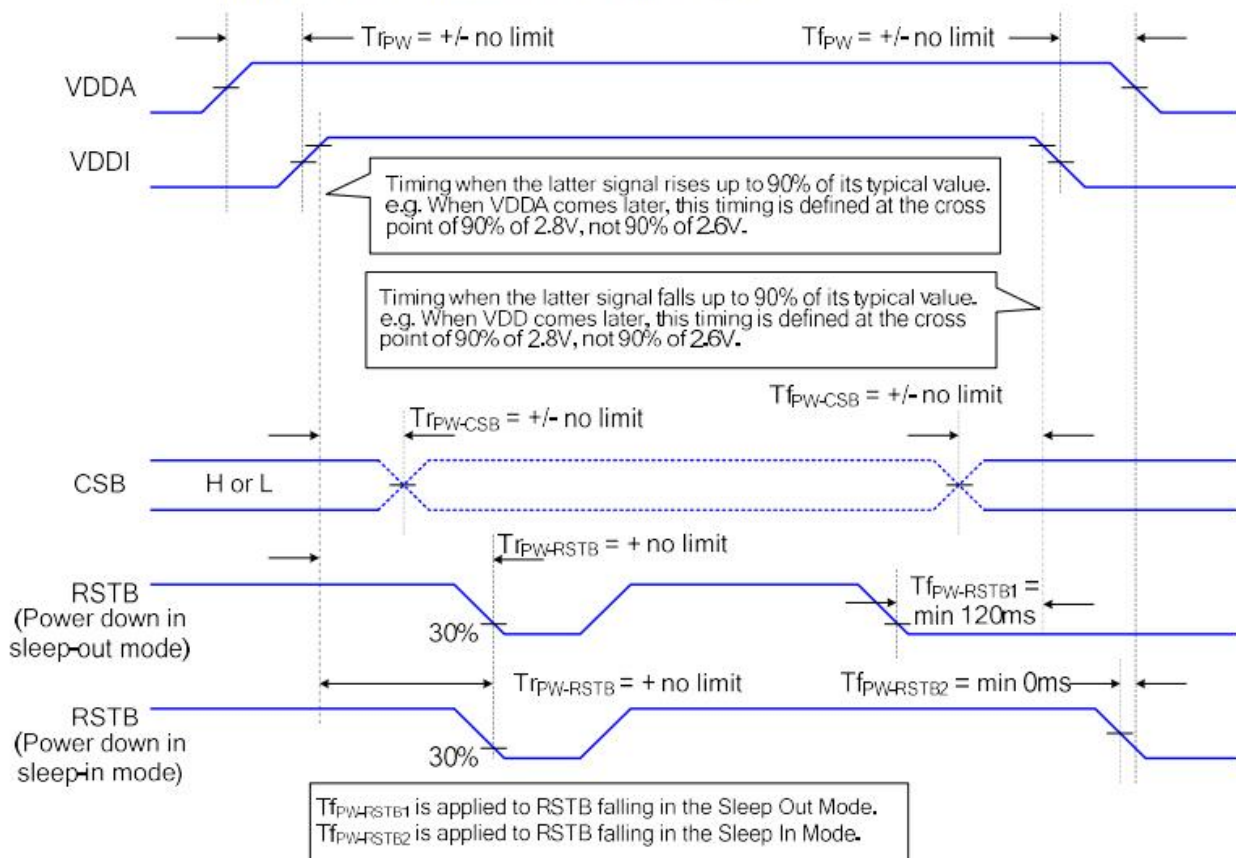
*Note 1: There will be no damage to the display module if the power sequences are not met.*

*Note 2: There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.*

*Note 3: There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence.*

*Note 4: If RSTB line is not held stable by host during Power On Sequence as defined in the sequence below, then it will be necessary to apply a Hardware Reset (RSTB) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.*

The power on/off sequence is illustrated below



## 8 Test

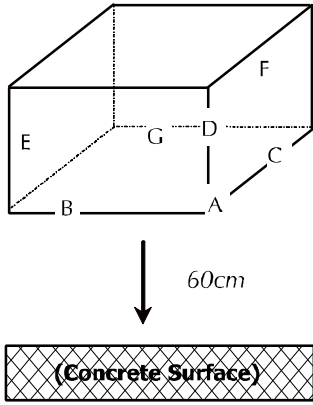
No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.

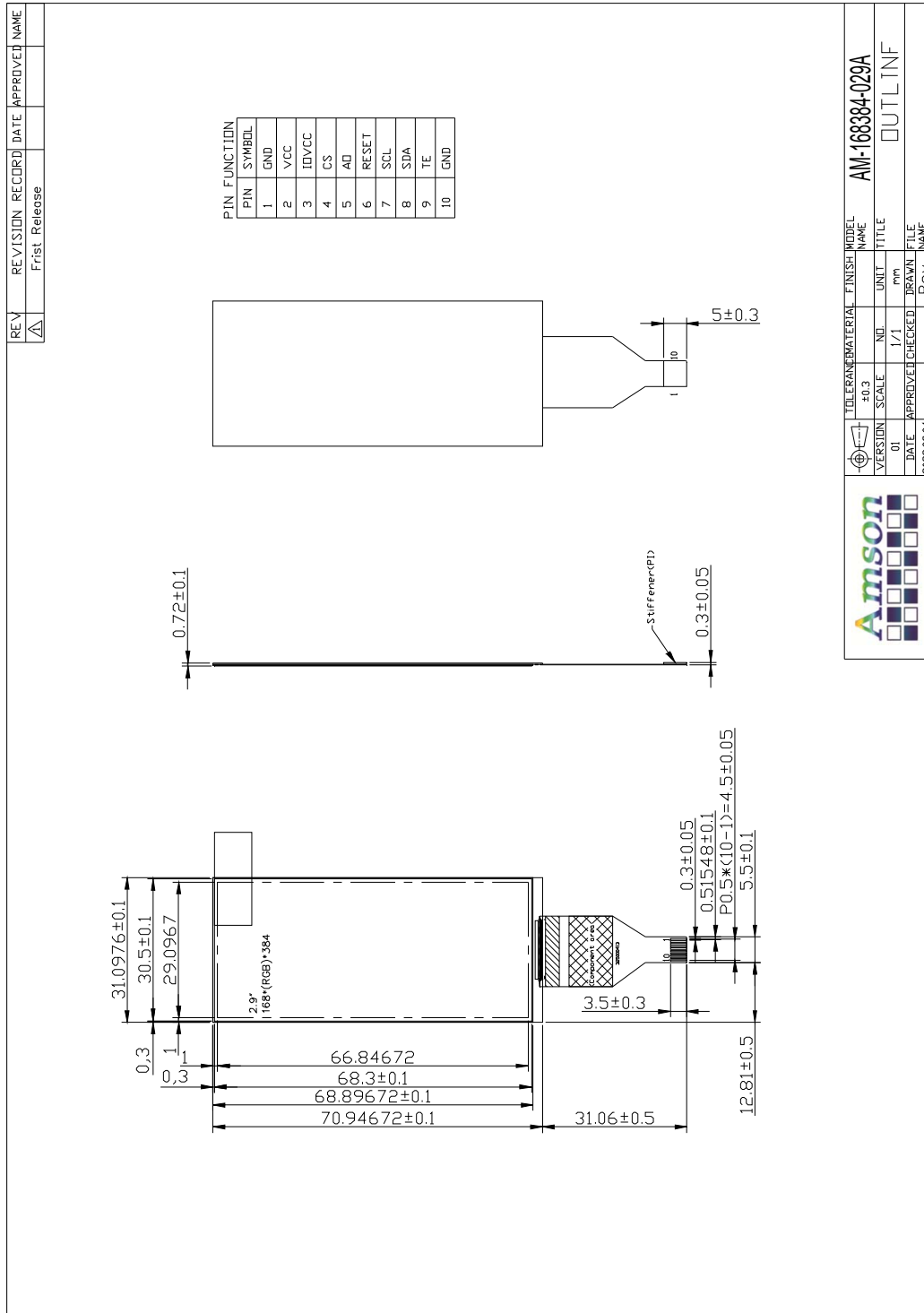
Temperature:  $20 \pm 5^\circ\text{C}$ .

Humidity:  $65 \pm 5\% \text{RH}$ .

Tests will be not conducted under functioning state.

| No. | Parameter                                         | Condition                                                                                                                                                                                                                                                                                                                                                      | Notes |
|-----|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1   | High Temperature Operating                        | $70^\circ\text{C} \pm 2^\circ\text{C}$ , 240hrs (Operation state).                                                                                                                                                                                                                                                                                             |       |
| 2   | Low Temperature Operating                         | $-20^\circ\text{C} \pm 2^\circ\text{C}$ , 240hrs (Operation state).                                                                                                                                                                                                                                                                                            | 1     |
| 3   | High Temperature Storage                          | $80^\circ\text{C} \pm 2^\circ\text{C}$ , 240hrs.                                                                                                                                                                                                                                                                                                               | 2     |
| 4   | Low Temperature Storage                           | $-30^\circ\text{C} \pm 2^\circ\text{C}$ , 240hrs.                                                                                                                                                                                                                                                                                                              | 1,2   |
| 5   | High Temperature and High Humidity Operation Test | $60^\circ\text{C} \pm 2^\circ\text{C}$ , 90%, 240hrs                                                                                                                                                                                                                                                                                                           | 1,2   |
| 6   | Vibration Test                                    | Total fixed amplitude: 1.5mm.<br>Vibration Frequency: 10–55Hz.<br>One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes.                                                                                                                                                                                                                              | 3     |
| 7.  | Drop Test                                         | <p>To be measured after dropping from 60cm high on the concrete surface in packing state.</p>  <p><i>Dropping method corner dropping:</i></p> <p><i>A corner: Once edge dropping.</i></p> <p><i>B, C, D edge: Once face dropping.</i></p> <p><i>E, F, G face: Once.</i></p> |       |

## 9 Dimensional outlines





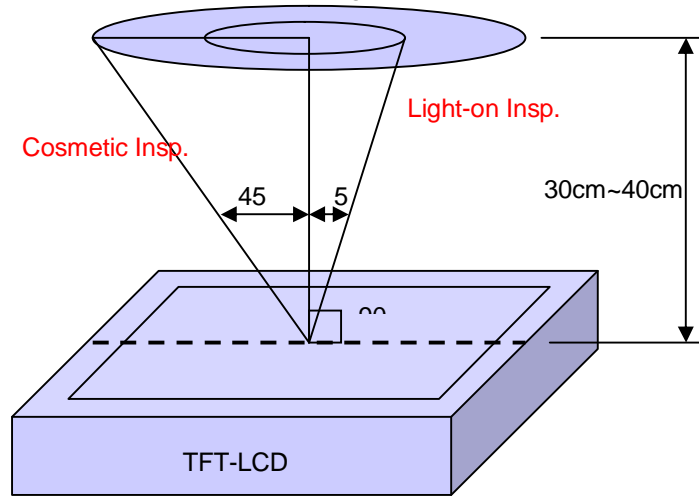
## 10 Incoming Inspection Standards

### 10.1 Inspection and Environment Conditions

#### 10.1.1 Inspection Conditions:

- (1) Inspection Distance: 35 cm±5cm
- (2) View Angle : Light-on Inspection Angle : ±5°

Cosmetic Inspection Angle : ±45°



( perpendicular to LCD panel surface)

#### 10.1.2 Environment Conditions:

|                      |                       |                   |
|----------------------|-----------------------|-------------------|
| Ambient Temperature  |                       | 23°C±5°C          |
| Ambient Humidity     |                       | 55±10%RH          |
| Ambient Illumination | Cosmetic Inspection   | more than 600 Lux |
|                      | Functional Inspection | 300~500 Lux       |

#### 10.1.3 Sampling Conditions:

- (1) Lot Size: Quantity of shipment lot per model

#### (2) Sampling Method:

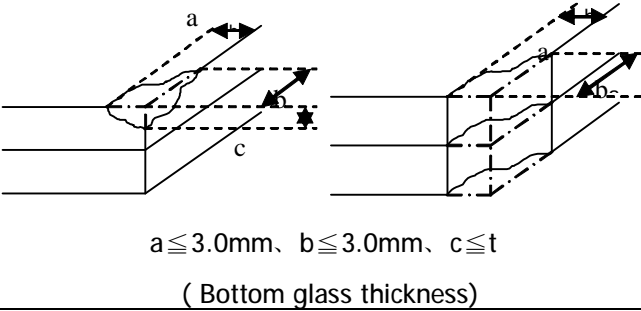
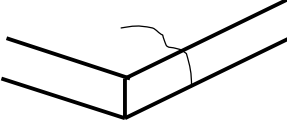
|               |              |                                    |
|---------------|--------------|------------------------------------|
| Sampling Plan |              | MIL-STD-105E                       |
|               |              | Normal Inspection, Single Sampling |
|               |              | Level II                           |
| AQL           | Major Defect | 1.0%                               |
|               | Minor Defect | 1.5%                               |

- (3) The classification of Major(MA) and Minor(MI) defects is shown as 3. Inspection Criteria.



## 10.1.4 Inspection Criteria

### 10.1.4.1 Cosmetic Inspection(Panel):

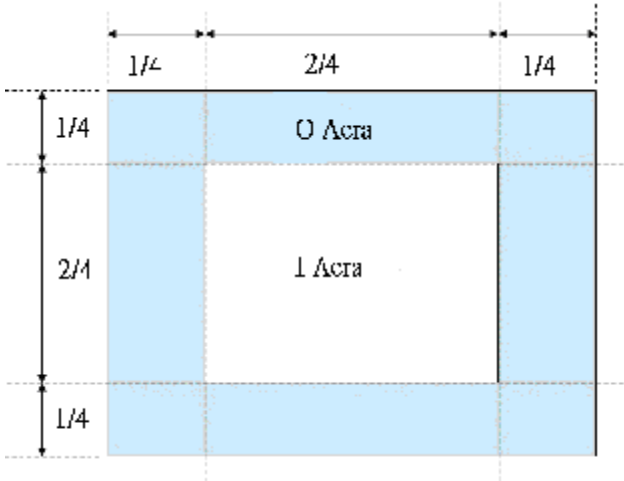
| Item                                  | Judgment Criteria                                                                                                                                                                                                                                                                           | Classification |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| Chipping on Panel                     |  <p><math>a \leq 3.0\text{mm}</math>, <math>b \leq 3.0\text{mm}</math>, <math>c \leq t</math><br/>( Bottom glass thickness)</p>                                                                           | MA             |
| Scratch on Panel<br>*Note-2           | <p><math>W \leq 0.05\text{mm}</math> or <math>L &lt; 5\text{mm}</math>: Ignored<br/> <math>0.05\text{mm} &lt; W \leq 0.1\text{mm}</math> and <math>L \leq 5\text{mm}</math>: <math>N \leq 5</math><br/> <math>W &gt; 0.1\text{mm}</math> or <math>L &gt; 5\text{mm}</math>: Not allowed</p> | MI             |
| Bubble or Dent on Panel<br>*Note-3    | <p><math>D \leq 0.2\text{mm}</math>: Ignored<br/> <math>0.2\text{mm} &lt; D \leq 0.3\text{mm}</math>: <math>N \leq 5</math><br/> <math>D &gt; 0.3\text{mm}</math>: Not allowed</p>                                                                                                          | MI             |
| Panel Crack                           |  <p>Not Allowed crack</p>                                                                                                                                                                                | MA             |
| Bezel Deformation                     | Obvious deformation is not allowed.                                                                                                                                                                                                                                                         | MI             |
| Bezel Oxidation                       | Not allowed if it rusts continuously over 1 cm (It is out of warranty with rusted tin plate)                                                                                                                                                                                                | MI             |
| Bezel Scratch                         | $L \leq 20\text{mm}$ , $W \leq 0.2$ , $N \leq 3$                                                                                                                                                                                                                                            | MI             |
| Metal Squash Dent /Flange(Front Side) | $D(W) \leq 1, L \leq 3, N \leq 3;$                                                                                                                                                                                                                                                          | MI             |
| B/L High Voltage Wire Denudation      | Not allowed                                                                                                                                                                                                                                                                                 | MA             |
| Polarizer flaw or leak out resin      | Defect is defined as the active area.                                                                                                                                                                                                                                                       | MI             |

|                   |                                              |    |
|-------------------|----------------------------------------------|----|
| Outline Dimension | Must in Spec, refer to related product spec. | MI |
|-------------------|----------------------------------------------|----|

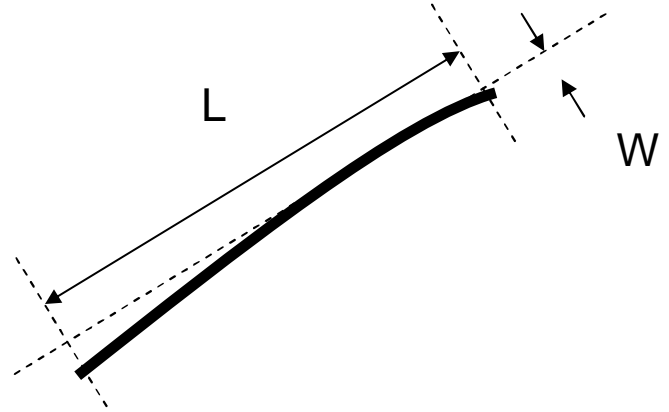
10.1.4.2 Functional Inspection:

| Item                                                                                                                                                                                                                                                          | Judgment Criteria                                                                                                                                                                                          |                                        |                     | Classification |    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------------|----------------|----|
|                                                                                                                                                                                                                                                               | Area(Note1)                                                                                                                                                                                                | I                                      | O                   |                |    |
| Point Defect                                                                                                                                                                                                                                                  | Bright dot                                                                                                                                                                                                 | Random                                 | 1                   |                | MI |
|                                                                                                                                                                                                                                                               |                                                                                                                                                                                                            | 2 dots adjacent                        | 0                   | 0              |    |
|                                                                                                                                                                                                                                                               |                                                                                                                                                                                                            | 3 dots adjacent or more                | 0                   | 0              |    |
|                                                                                                                                                                                                                                                               | Dark dot                                                                                                                                                                                                   | Random                                 | 2                   |                |    |
|                                                                                                                                                                                                                                                               |                                                                                                                                                                                                            | 2 dots adjacent                        | 0                   |                |    |
|                                                                                                                                                                                                                                                               |                                                                                                                                                                                                            | 3 dots adjacent or more                | 0                   | 0              |    |
|                                                                                                                                                                                                                                                               | Total Dot Defect                                                                                                                                                                                           |                                        | 3                   |                |    |
|                                                                                                                                                                                                                                                               | Distance                                                                                                                                                                                                   | Distance between Bright and Bright dot | $L \geq 5\text{mm}$ |                |    |
|                                                                                                                                                                                                                                                               |                                                                                                                                                                                                            | Distance between Bright and Dark dot   | $L \geq 5\text{mm}$ |                |    |
|                                                                                                                                                                                                                                                               |                                                                                                                                                                                                            | Distance between Dark dot              | $L \geq 5\text{mm}$ |                |    |
| (1) It is defined as Point Defect if defect area $> 0.5\text{dot}$<br>(2) It is ignored if defect area $\leq 0.5\text{dot}$<br>(3) Weak point defect will be defined as Bright Dot if it can be observed through ND filter 5% ( Full Screen Black Inspection) |                                                                                                                                                                                                            |                                        |                     |                |    |
| Line Defect                                                                                                                                                                                                                                                   | Obvious vertical or horizontal line defect is not allowed.                                                                                                                                                 |                                        |                     | MA             |    |
| Mura                                                                                                                                                                                                                                                          | Not allowed if it can be observed through ND Filter 5 %                                                                                                                                                    |                                        |                     | MI             |    |
| Foreign Material in spot shape<br>*Note-3                                                                                                                                                                                                                     | $D \leq 0.2\text{mm}$ : Ignored<br>$0.2\text{mm} < D \leq 0.5\text{mm}$ : $N \leq 8$<br>$D > 0.5\text{mm}$ : Not allowed                                                                                   |                                        |                     | MI             |    |
| Foreign Material in line or spiral shape<br>*Note-4                                                                                                                                                                                                           | $W \leq 0.05\text{mm}$ or $L \leq 5\text{mm}$ : Ignored<br>$0.05\text{mm} < W \leq 0.2\text{mm}$ and $L 1.0\text{mm} \leq 5\text{mm}$ : $N \leq 8$<br>$W > 0.2\text{mm}$ or $L > 5\text{mm}$ : Not allowed |                                        |                     | MI             |    |
| Display Function Abnormal                                                                                                                                                                                                                                     | No Malfunction can be allowed                                                                                                                                                                              |                                        |                     | MA             |    |

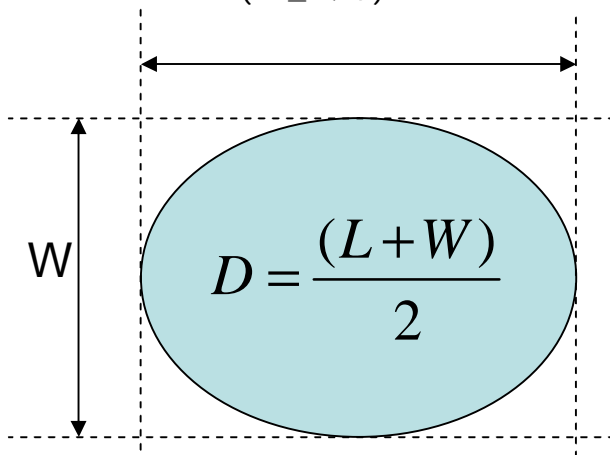
Note-1 : I/O Area Definition



Note-2 : Polarizer Scratch



Note-3 : Spot Foreign Material  
( $W \geq L / 4$ )



Note-4 : Line or Spiral Foreign Material  
( $W < L / 4$ )

