



FORMIKE ELECTRONIC CO.,LTD

PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : KWH043ST12-F04 V.2 v1.0

【 ◆ 】 Preliminary Specification

【 】 Finally Specification

| | |
|---------------------|-------|
| CUSTOMER'S APPROVAL | |
| SIGNATURE: | DATE: |
| | |

| APPROVED BY | PM REVIEWD | PD REVIEWD | PREPARED BY |
|-------------|------------|------------|-------------|
| Deng | / | Deng | Roy |

Prepared By :

FORMIKE ELECTRONIC CO.,LTD

Address :Room A818 New Energy Building, NanHai Road, NanShan District, ShenZhen, China. 518054

TEL:(86) 755 88306921,88306931 FAX:(86) 755 88304615

Http:// www.wandisplay.com

- This specification is subject to change without notice.Please contact FORMIKE or it's representative before designing your product based on this specification.

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1. Record of Revision

| Version | Issued Date | Page | Content | Created or Modified by |
|---------|-------------|------|--------------|------------------------|
| 1.0 | 2013-01-24 | | New Creation | Deng |
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2. GENERAL DESCRIPTION

2.1 Description

KWH043ST12-F04 V.2 is a Transmissive type color active matrix liquid crystal display (LCD), which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT LCD panel, driver IC, FPC,TP and a backlight unit. The following table described the features of FORMIKE KWH043ST12-F04 V.2.

2.2 Application

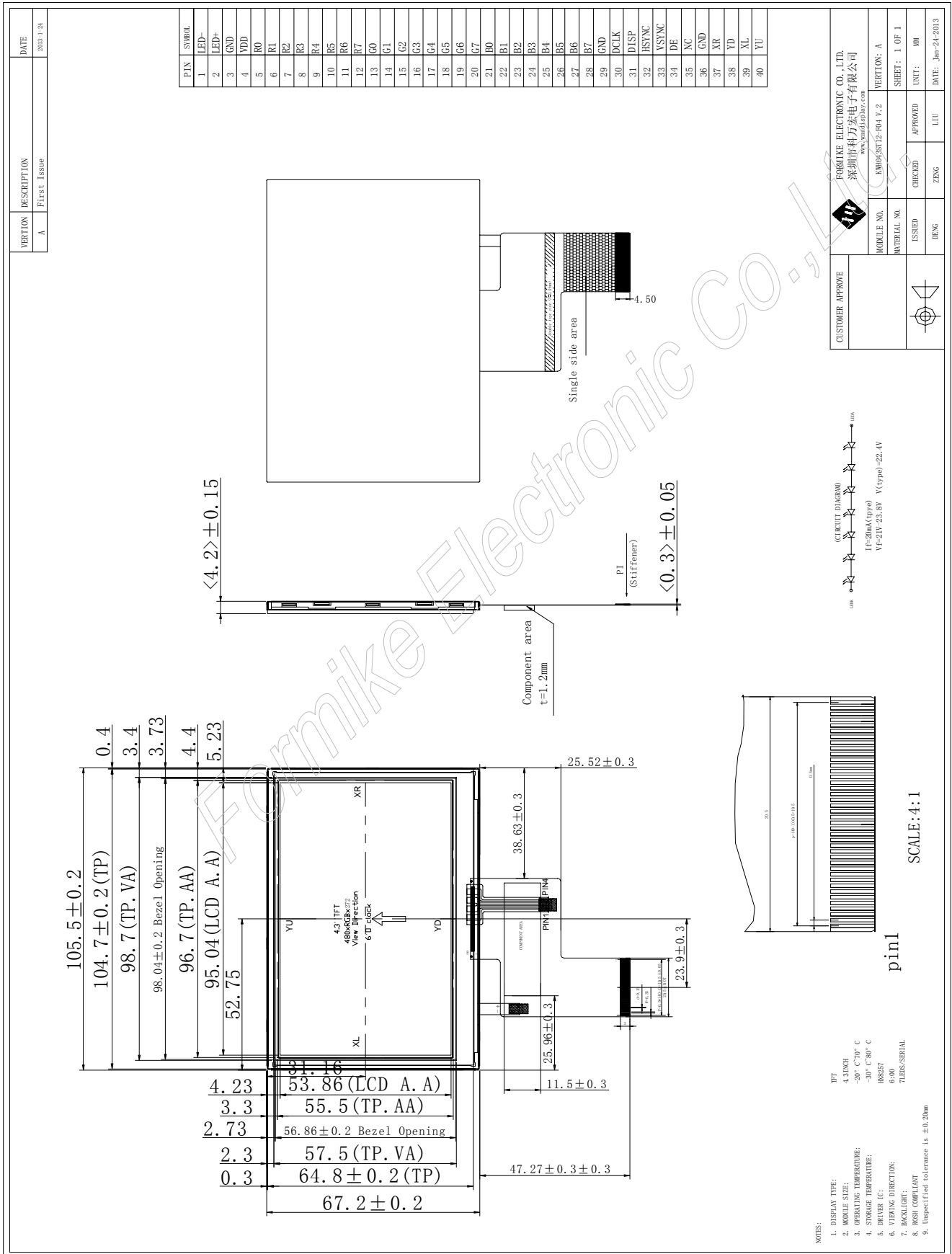
PDA , PMP, MP4, DVB-S, GPS, medical device, Portable Navigation
 Etc.

2.3 Features:

| Feature | Description |
|------------------------------------|------------------------------|
| Size | 4.3 inch |
| Display Mode | Normally White, Transmissive |
| Surface Treatment | Anti-glare |
| Resolution | 480 (RGB) x 272 |
| Display Format | R.G.B. Stripe type |
| Color | 16.7M color |
| Pixel Pitch (mm) | 0.198 x 0.198 |
| Inteface | R.G.B. 24 bit parallel data |
| Viewing Direction | 6 o'clock |
| Outline Dimension (W x H x D) (mm) | 105.5 x 67.2 x 4.2 |
| Active Area(H x V mm) | 95.04 x 53.856 |
| With/Without TSP | With TSP |
| LED Numbers | 7 LED serial type |
| Weight (g) | TBD |



3.0 Mechanical Drawing



4. ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Values | | Unit | Condition |
|---------------------|--------|--------|---------|------|-----------|
| | | Min. | Max. | | |
| Power Voltage | VDD | 0.3 | 5.0 | V | |
| Logic Input Signal | VIN | -0.3 | VDD+0.3 | V | |
| Logic Output Signal | VOUT | -0.3 | VDD+0.3 | V | |

Note: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above

5. ELECTRICAL CHARACTERISTICS

5.1. Operating conditions:

| Item | Symbol | Values | | | Unit | Remark |
|-------------------|--------|--------|------|------|------|---------------|
| | | Min. | Typ. | Max. | | |
| Power Supply | VDD | 3.0 | 3.3 | 3.6 | V | |
| Operating Current | IDD | - | 15 | - | mA | Black pattern |
| Frame frequency | Frame | - | 60 | 90 | Hz | |
| Dot Data Clock | DCLK | - | 9.0 | 15 | MHz | |
| Power Consumption | PLCD | - | 49.5 | - | mW | Black pattern |

5.2 LED driving conditions

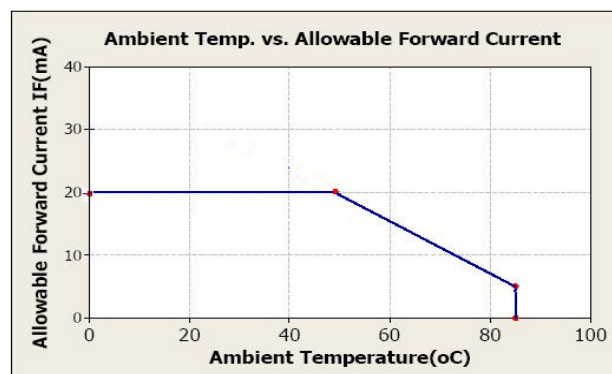
| Item | Symbol | Values | | | Unit | Remark |
|-------------------|--------|--------|------|------|------|--------|
| | | Min. | Typ. | Max. | | |
| Power Consumption | PLED | - | 462 | - | mW | |
| LED Current | If | - | 20 | - | mA | (1) |
| Backlight Voltage | Vb | - | 23.1 | - | V | (2) |

Ta = 25°C

Brightness to be decreased to 50% of the initial value

Note (1) 7 LEDs serial type

(2) Where If=20mA, Vb= PLED / If



6. DC CHARACTERISTICS

| Parameter | Symbol | Rating | | | Unit | Condition |
|--------------------------|-----------------|---------|------|---------|------|-----------|
| | | Min. | Typ. | Max. | | |
| Low level input voltage | V _{IL} | 0 | - | 0.3*VDD | V | |
| High level input voltage | V _{IH} | 0.7*VDD | - | VDD | V | |

7. Timing CHARATERISTICS

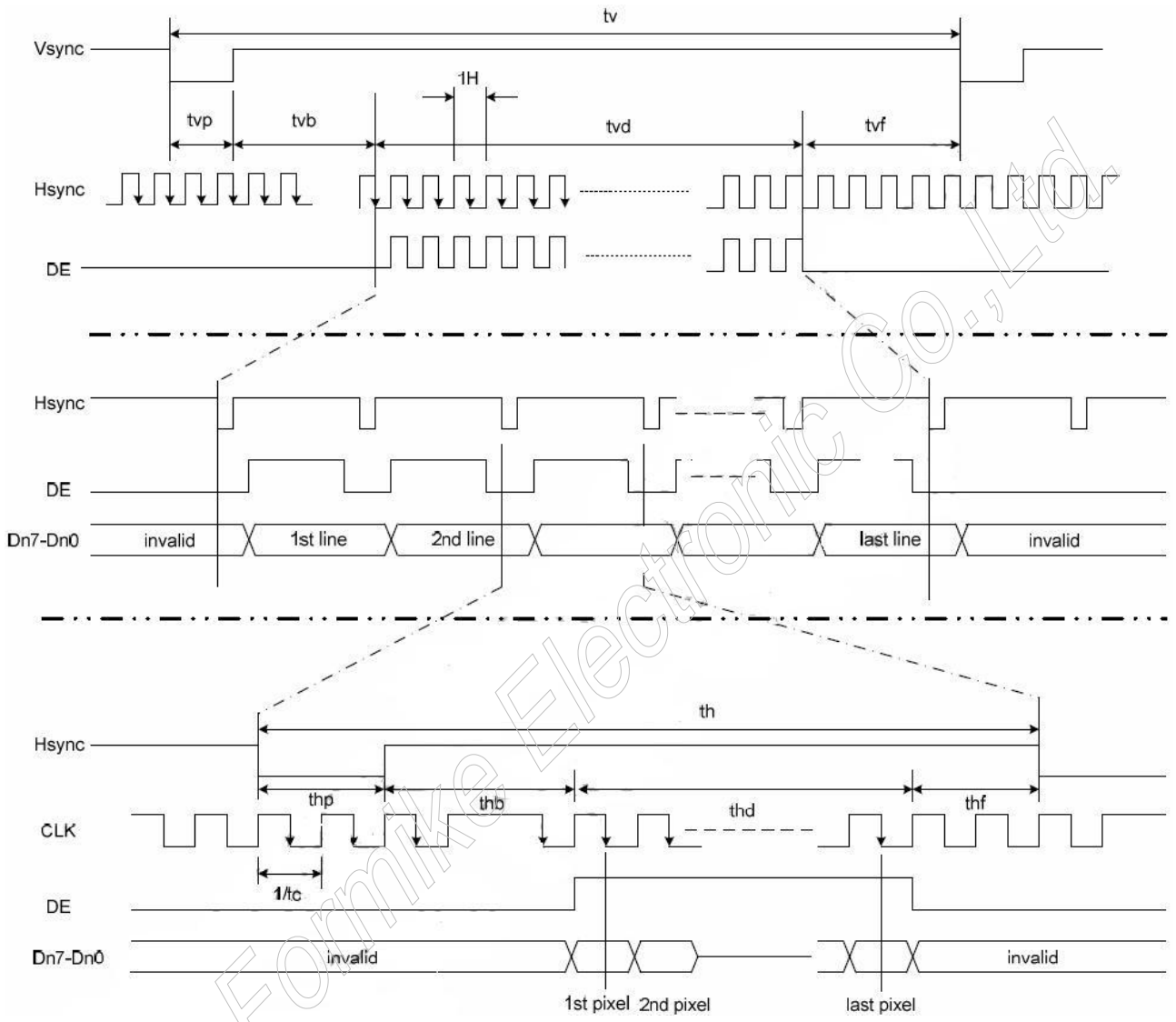
7.1 DC Timing Characteristics

| Signal | Item | Symbol | Min | Typ | Max | Unit | Note |
|--------|----------------|--------|-----|-----|-----|------|------|
| Dclk | Frequency | DCLK | - | 9.0 | 12 | MHZ | |
| Hsync | Period | TH | - | 525 | - | DCLK | (1) |
| | Pulse Width | Thp | 2 | 41 | - | DCLK | (2) |
| | Back-Porch | Thb | 2 | - | - | DCLK | (2) |
| | Display Period | Thd | - | 480 | - | DCLK | |
| | Front-Porch | Thf | 2 | - | - | DCLK | (2) |
| Vsync | Period | Tv | - | 286 | - | TH | |
| | Pulse Width | Tvp | 1 | 10 | - | TH | |
| | Back-Porch | Tvb | 1 | 2 | - | TH | |
| | Display Period | Tvd | - | 27 | - | TH | |
| | Front-Porch | Tvf | 1 | - | - | TH | |

Note1: Thd=480 DCLK, Thf=2 DCLK, Thp= 41
 525 DCLK= 480 + 2 + 41 + 2 (DCLK)

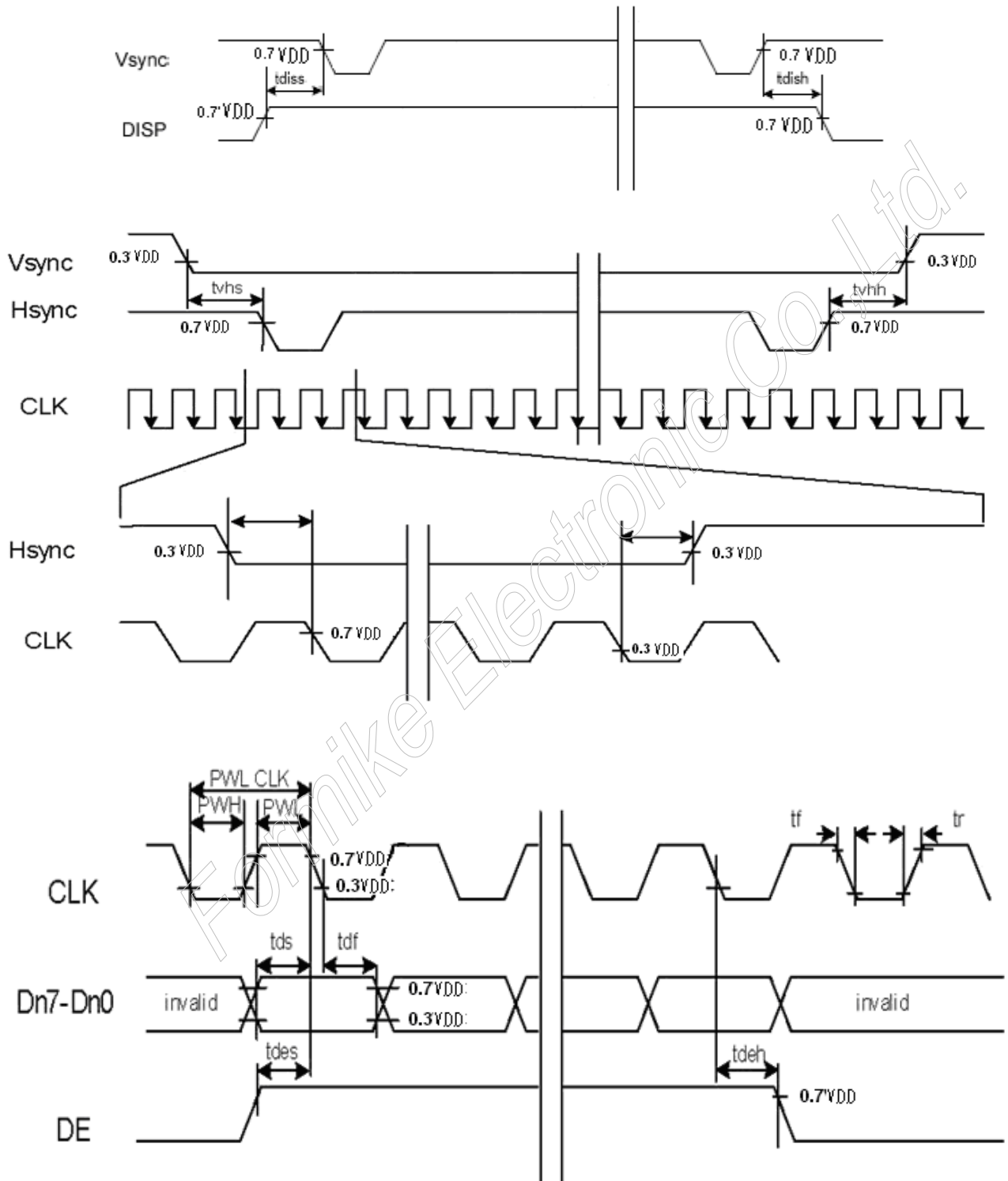
hb=2 DCLK

Note2: Thf+ Thp+ Thb >44



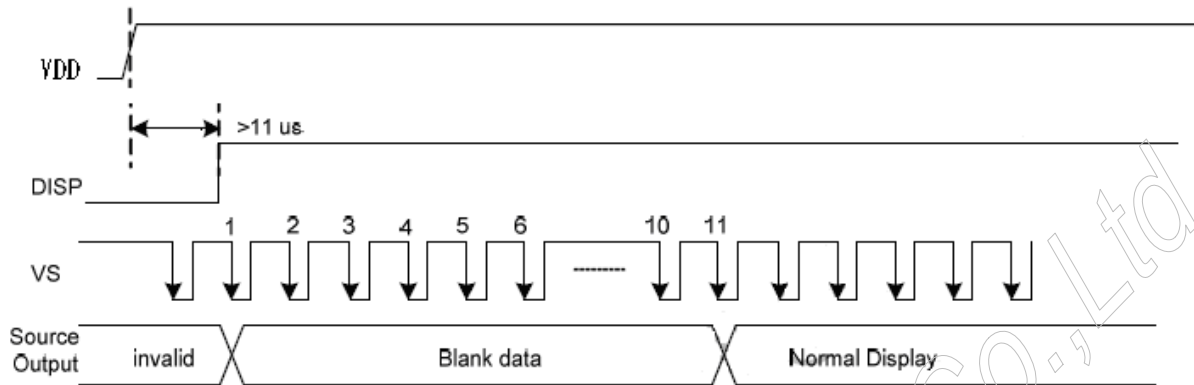
7.2 AC Timing Characteristics

| Parameter | Symbol | Spec. | | | Unit |
|-------------------------|------------------|-------|-----|-----|------|
| | | Min | Typ | Max | |
| DISP setup time | t_{diss} | 10 | | | ns |
| DISP hold time | t_{dish} | 10 | | | ns |
| Clock period | $PW_{CLK}^{(2)}$ | 66.7 | - | - | ns |
| Clock pulse high period | $PWH^{(2)}$ | 26.7 | - | - | ns |
| Clock pulse low period | $PWL^{(2)}$ | 26.7 | - | - | ns |
| Hsync setup time | t_{hs} | 10 | - | - | n |
| Hsync hold time | t_{hh} | 10 | - | - | |
| Data setup time | t_{ds} | 10 | - | | ns |
| Data hold time | t_{dh} | 10 | - | | ns |
| DE setup time | t_{des} | 10 | - | | ns |
| DE hold time | t_{deh} | 10 | | | ns |
| Vsync setup time | t_{vhs} | 10 | | - | ns |
| Vsync hold time | t_{vhh} | 10 | | - | ns |

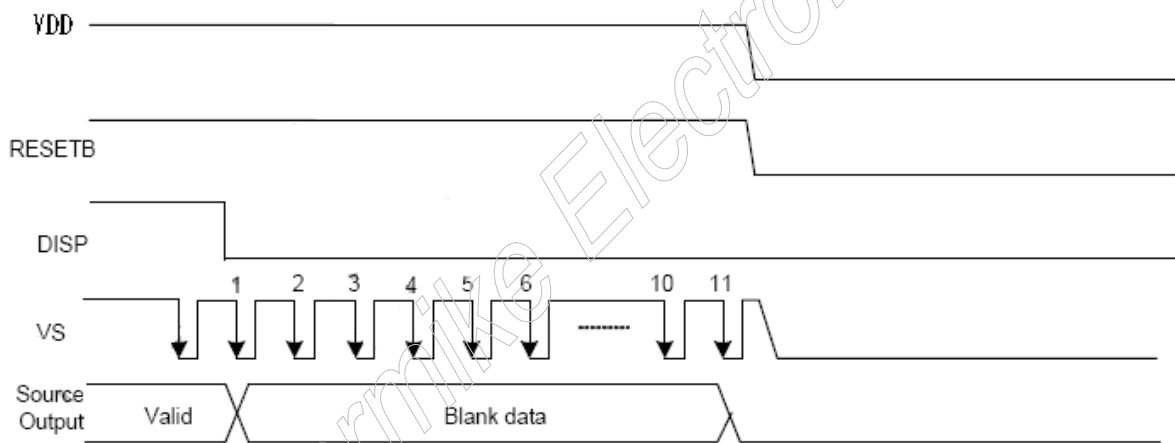


7.3 Power Sequence

The LCD panel power ON/OFF sequence is as below.



Power On Sequence



Power Off Sequence

8. OPTICAL CHARACTERISTIC

| Item | Symbol | Condition | Min | Typ | Max | Unit | Note |
|--------------------|--------|----------------------------|------|------|------|-------------------|--------|
| Brightness | | | 350 | 400 | - | cd/m ² | |
| Response time | TR | $\Theta=0$ | - | 15 | - | ms | (3)(5) |
| | TF | | - | 15 | - | ms | |
| Contrast ratio | CR | At optimized viewing angle | 450 | 550 | - | - | (4) |
| Color Chromaticity | White | Wx | 0.26 | 0.31 | 0.36 | - | (2)(6) |
| | | Wy | 0.28 | 0.33 | 0.38 | | |
| Viewing Angle | Hor. | Θ_R | 50 | 70 | - | - | (1) |
| | | Θ_L | 50 | 70 | - | | |
| | Ver. | ϕ_H | 40 | 55 | - | | |
| | | ϕ_L | 50 | 70 | - | | |
| Uniformity | | | 75 | 80 | | % | (8) |

 $5\pm 2^{\circ}\text{C}$, ILED=20mA

Note 1: Definition of viewing angle range

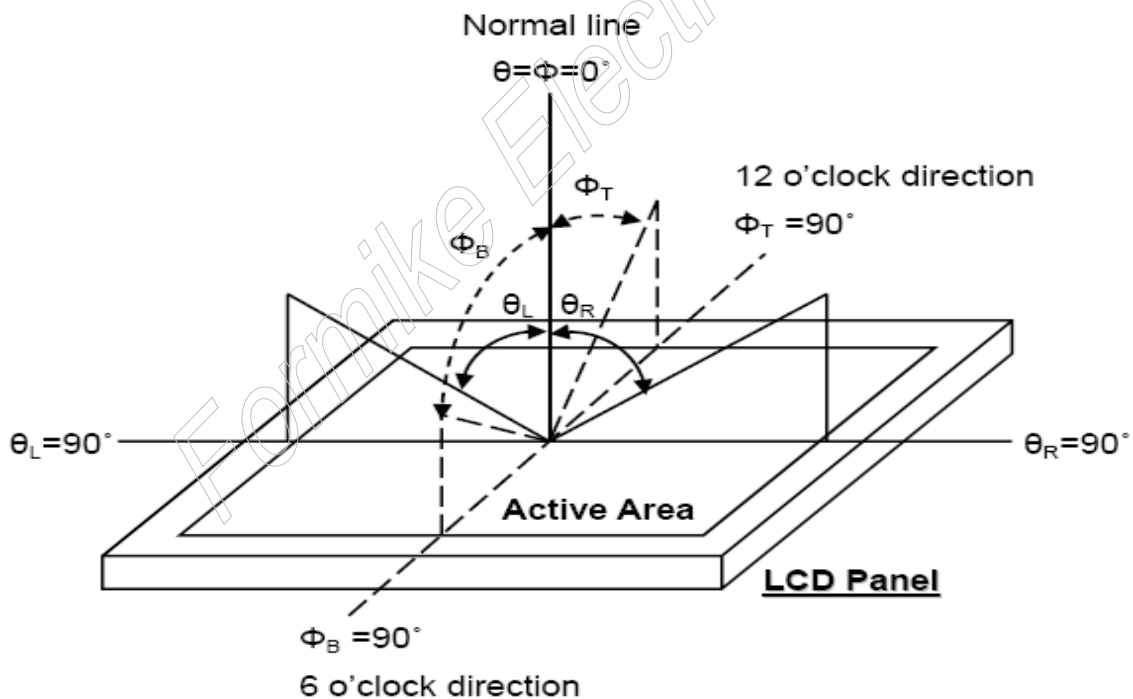


Fig. 8-1 Definition of viewing angle

Note 2: Test equipment setup:

After stabilizing and leaving the panel alone at a driven temperature for 10 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7 luminance meter 1.0° field of view at a distance of 50cm and normal direction.

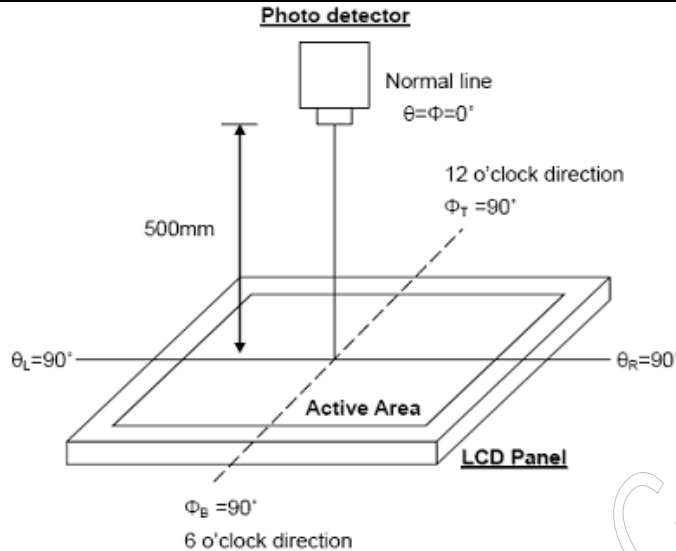


Fig. 8-2 Optical measurement system setup

Note 3: Definition of Response time:

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time, T_r , is the time between photo detector output intensity changed from 90% to 10%. And fall time, T_f , is the time between photo detector output intensity changed from 10% to 90%.

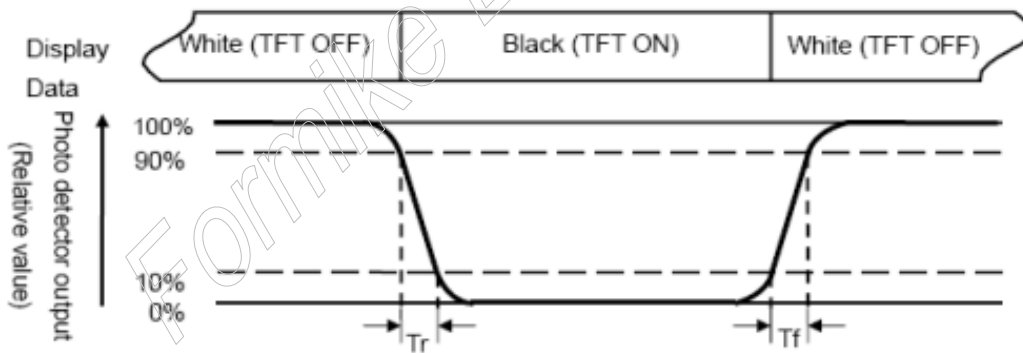


Fig. 3-3 Definition of response time

Note 4: Definition of contrast ratio:

The contrast ratio is defined as the following expression.

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

Note 5: White $V_i = V_{i50} \pm 1.5V$

Black $V_i = V_{i50} \pm 2.0V$

“±” means that the analog input signal swings in phase with VCOM signal.

“±” means that the analog input signal swings out of phase with VCOM signal.

The 100% transmission is defined as the transmission of LCD panel when all the input terminals

of module are electrically opened.

Note 6: Definition of color chromaticity (CIE 1931)

Color coordinates measured at the center point of LCD

Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

Note 8 : Uniformity (U) = $\frac{\text{Brightness (min)}}{\text{Brightness (max)}} \times 100\%$

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9. INTERFACE

9.1. LCM PIN Definition (Connector type : 40Pin / 0.5mm pitch / Top contact) - Hirose : FH12 series

| Pin | Symbol | I/O | Function | Remark |
|-----|--------|-----|-----------------------|--------|
| 1 | VLED- | I | LED Ground | |
| 2 | VLED+ | I | LED Power | |
| 3 | GND | I | Ground | |
| 4 | VDD | I | Power Supply (+3.3 V) | |
| 5 | R0 | I | Red Data Bit0 (LSB) | |
| 6 | R1 | I | Red Data Bit1 | |
| 7 | R2 | I | Red Data Bit2 | |
| 8 | R3 | I | Red Data Bit3 | |
| 9 | R4 | I | Red Data Bit4 | |
| 10 | R5 | I | Red Data Bit5 | |
| 11 | R6 | I | Red Data Bit6 | |
| 12 | R7 | I | Red Data Bit7 (MSB) | |
| 13 | G0 | I | Green Data Bit0 (LSB) | |
| 14 | G1 | I | Green Data Bit1 | |
| 15 | G2 | I | Green Data Bit2 | |
| 16 | G3 | I | Green Data Bit3 | |
| 17 | G4 | I | Green Data Bit4 | |
| 18 | G5 | I | Green Data Bit5 | |
| 19 | G6 | I | Green Data Bit6 | |
| 20 | G7 | I | Green Data Bit7 (MSB) | |
| 21 | B0 | I | Blue Data Bit0 (LSB) | |
| 22 | B1 | I | Blue Data Bit1 | |
| 23 | B2 | I | Blue Data Bit2 | |
| 24 | B3 | I | Blue Data Bit3 | |
| 25 | B4 | I | Blue Data Bit4 | |
| 26 | B5 | I | Blue Data Bit5 | |
| 27 | B6 | I | Blue Data Bit6 | |
| 28 | B7 | I | Blue Data Bit7 (MSB) | |
| 29 | GND | I | Ground | |
| 30 | DCLK | I | Dot Data Clock | |
| 31 | DISP | I | Display On/Off | Note 1 |
| 32 | Hsync | I | Horizontal Sync Input | |
| 33 | Vsync | I | Vertical Sync Input | |



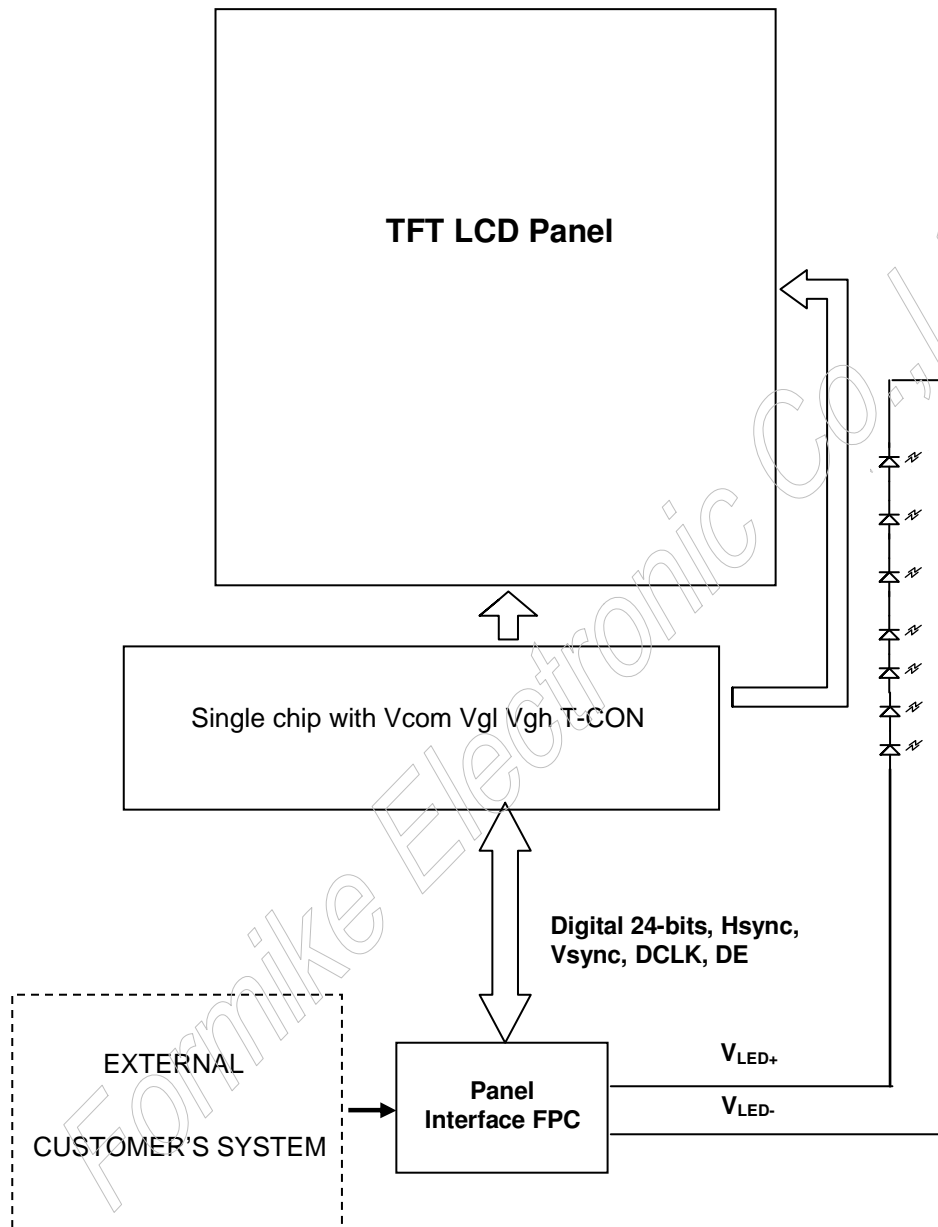
| | | | | |
|----|-----|---|---------------------|--------|
| 34 | DE | I | Data Enable Control | Note 2 |
| 35 | NC | I | No Connect | |
| 36 | GND | I | Ground | |
| 37 | TP | I | XR | |
| 38 | TP | I | YD | |
| 39 | TP | I | XL | |
| 40 | TP | I | YU | |

Note1: During set to DISP=" H ", input data are valid. During set to DISP=" L ", input data are invalid and white display data is written to data register automatically.

Note2: DE=" H ": data can be access, DE=" L ": data cannot be access

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10. BLOCK DIAGRAM



11. QUALITY ASSURANCE

| No. | Test Items | Test Condition | REMARK |
|-----|---|--|---------------|
| 1 | High Temperature Storage Test | Ta=80°C Dry 240h | |
| 2 | Low Temperature Storage Test | Ta=-30°C Dry 240h | |
| 3 | High Temperature Operation Test | Ta=70°C Dry 240h | |
| 4 | Low Temperature Operation Test | Ta=-20°C Dry 240h | |
| 5 | High Temperature and High Humidity Operation Test | Ta=60°C 90%RH 240h | |
| 6 | Electro Static Discharge Test | Panel surface / top case Contact / Air : ±6KV / ±8KV , 150pF , 330Ω | Non-operating |
| 7 | Shock Test (non-operating) | Shock Level : 180G Waveform: Half Sinusoidal wave Shock Time : 2ms 3 Axis for all six faces/ each | |
| 8 | Vibration Test (non-operating) | Frequency Range: 10~500Hz/ Sweep: 1.5G Amplitude: 0.37 oct/min For 3 Axis 1hrs/axis | |
| 9 | Thermal Shock Test | -30°C (0.5Hr) ~ +80°C (0.5Hr) for 100 cycles | |

Note1: The test samples have recovery time for 4 hours at room temperature before the function check.
 In the standard conditions, there is no display function NG issue occurred.

Note2: All the cosmetic specifications are judged before the reliability stress.

12.PRECAUTIONS FOR USE

12.1.Safety

- (1) Do not swallow any liquid crystal, even if there is no proof that liquid crystal is poisonous.
- (2) If the LCD panel breaks, be careful not to get liquid crystal to touch your skin.
- (3) If skin is exposed to liquid crystal, wash the area thoroughly with alcohol or soap.

12.2.Storage Conditions

- (1) Store the panel or module in a dark place where the temperature is $23\pm 5^{\circ}\text{C}$ and the humidity is below $50\pm 20\%\text{RH}$.
- (2) Store in anti-static electricity container.
- (3) Store in clean environment, free from dust, active gas, and solvent.
- (4) Do not place the module near organics solvents or corrosive gases.
- (5) Do not crush, shake, or jolt the module.
- (6) Do not exposed to direct sun light of fluorescent lamps.

12.3.Installing LCD Module

Attend to the following items when installing the LCD Module.

- (1) Cover the surface with a transparent protective plate or touch panel to protect the polarizer and LC cell.
- (2) When assembling the LCD Module into other equipment, the spacer to the bit between the LCD Module and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be $\pm 0.1\text{mm}$.

12.4.Precautions For Operation

- (1) Viewing angle varies with the change of liquid crystal driving voltage (V_0). Adjust V_0 to show the best contrast.
- (2) Driving the LCD in the voltage above the limit will shorten its lifetime.
- (3) Response time is greatly delayed at temperature below the operating

temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.

- (4) When turning the power on, input each signal after the positive/negative voltage becomes stable.
- (5) Do not apply water or any liquid on product which composed of T/P.

12.5.Handling Precautions

- (1) Avoid static electricity which can damage the CMOS LSI; please wear the wrist strap when handling.
- (2) The polarizing plate of the display is very fragile. so, please handle it very carefully.
- (3) Do not give external shock.
- (4) Do not apply excessive force on the surface; it may cause display abnormal .
- (5) Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.
- (6) Do not use ketonics solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.
- (7) Do not operate it above the absolute maximum rating.
- (8) Do not remove the panel or frame from the module.
- (9) Do not apply water or any liquid on product, which composed of T/P.

12.6.Warranty

- (1) The period is within 12 months since the date of shipping out under normal using and storage conditions.
- (2) The warranty will be avoided in case of defect induced by customer.

1. Incoming Inspection

Both parties agree that the inspection specifications of TFT-LCD Modules (hereinafter known as "Modules") stipulated hereunder is the only and final standard applicable in the process of inspection. Formike shall be under no liability or obligation (including incidental loss, products liability or other consequential loss) whatsoever for any defect in quality or performance or shortage in quantity of the Modules that have passed such inspection.

2. Liability

2.1 Inspection Deadline

The Customer should inspect the Modules either at the Delivery Point or within twenty (20) calendar days after arrival at the Delivery Destination.

2.2 Notification of Rejection

The Customer may reject one or more defective or non-conforming Modules if the Modules fail to meet the AQL (Acceptable Quality Level) and pass the inspection. In that case, the customer should notify FORMIKE of the rejection by either documents or mail within in three (3) business days from the date of reception of the Modules. Otherwise, the Modules shall be deemed to have met the AQL and passed the inspection.

3. Inspection Specifications

Both parties agree that the inspection shall contain and follow the inspection specifications stipulated in the attachment, including:

3.1 Scope

3.2 Sampling Plan

3.3 Panel Inspection Condition

3.4 Display Quality

3.5 Mechanics Specifications

3.6 Notification for Storage Handling

4. Limited Warranty

Formike represents and warrants that all Modules shall (i) conform to the specifications set hereunder, and (ii) be free from any defects in material and workmanship for twelve (12) months after the Customer's acceptance or deemed acceptance. Formike will replace, rework or refund the Customer for the defective or non-conforming Modules at Formike's option, provided that the Customer (i) promptly informs Formike of the defects or non-conformities within the warranty period, (ii) complies with the specifications and conditions hereunder, and (iii) complies with Formike's procedure for Modules replacement, reworking and/or return. The warranty period for the Modules replaced or reworked shall be the remaining term for such Modules.

5. THE WARRANTIES AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, TERMS OR CONDITIONS, EXPRESS OR IMPLIED, EITHER IN FACT OR BY OPERATION OF LAW, STATUTORY OR OTHERWISE, INCLUDING WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH ARE EXPRESSLY DISCLAIMED. FORMIKE'S WARRANTIES HEREIN APPLY ONLY TO THE CUSTOMER AND ARE NOT TO BE EXTENDED TO ANY THIRD PARTY.

6. Governing Law

This Agreement shall be governed and construed in accordance with the laws of the The Government of the Hong Kong Special Administrative Region. Both parties agree to submit any dispute, which cannot be amicably resolved, to Hong Kong District Court for the first instance.

Inspection Specifications

1. Scope

Specifications contain

- 1.1 Display Quality Evaluation
- 1.2 Mechanics Specification

2. Sampling Plan

Unless there is other agreement, the sampling plan for incoming inspection shall follow MIL-STD-105E.

- 2.1 Lot size: Quantity per shipment as one lot (different model as different lot).
- 2.2 Sampling type: Normal inspection, single sampling.
- 2.3 Sampling level: Level II.
- 2.4 AQL: Acceptable Quality Level
Major defect: AQL=0.65
Minor defect: AQL=1.0

3. Panel Inspection Condition

3.1 Environment:

Room Temperature: $25\pm 5^{\circ}\text{C}$.

Humidity: $65\pm 5\%$ RH.

Illumination: 300 ~ 700 Lux.

3.2 Inspection Distance:

35 ± 5 cm

3.3 Inspection Angle:

The vision of inspector should be perpendicular to the surface of the Module.

3.4 Inspection time

Perceptibility Test Time:20 seconds max.

4. Display Quality

4.1 Function Related:

The function defects of line defect, abnormal display, and no display are considered Major defects.

5. Mechanics specifications

As for the outside dimensions and weight of the Modules, please refer to product specifications for more details.

6. Notification for Storage Handling

6.1 Storage:

- 6.1.1 Environment condition must be within the product specifications, otherwise the Module might be damaged.
- 6.1.2 Pile of stacking shall follow the instruction of **FORMIKE**.

6.2 Handling:

- 6.2.1 Twisting or Bending of the Module is prohibited.
- 6.2.2 All chemicals are unfit for use unless otherwise instructed by **FORMIKE**.
- 6.2.3 Plugging in & unplugging:
 - The power must be turned off before plugging in or unplugging the Module.
- 6.2.4 ESD protection:
 - The Module must not be touched without proper grounding.
- 6.2.5 High Voltage:
 - The rear side of Module must not be touched without protection.
- 6.2.6 Power sequence:
 - Shall follow the instruction of **FORMIKE**.

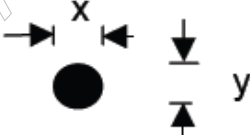
7. Inspection Criteria

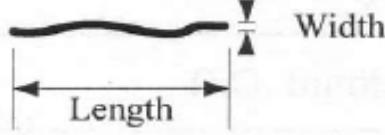
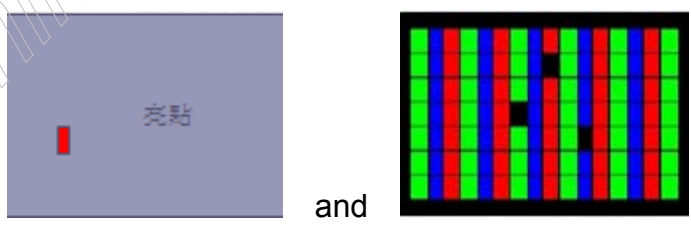
Defects are classified as major defects and minor defects according to the degree of defectiveness defined herein.

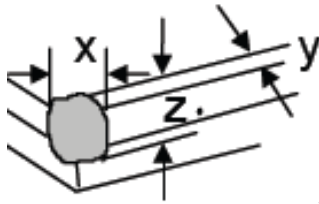
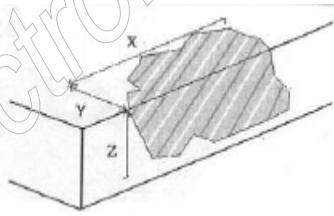
7.1 Major defect

| Item No | Items to be inspected | Inspection Standard |
|---------|------------------------|--|
| 5.1.1 | All functional defects | 1) No display 2) Display abnormally 3) Short circuit 4) line defect |
| 5.1.2 | missing | Missing function component |
| 5.1.3 | Crack | Glass Crack |

7.2 Minor defect

| Item No | Items to be inspected | Inspection standard | |
|---------|---|---|---------------------|
| 7.2.1 | Spot Defect Including Black spot White spot Pinhole Foreign particle Polarizer dirt | For dark/white spot is defined $\varphi = (x+y) / 2$  | |
| | | Size φ (mm) | Acceptable Quantity |
| | | $\varphi \leq 0.15$ | Ignore |
| | | $0.15 < \varphi \leq 0.30$ | 3 |
| | | $0.30 < \varphi$ | Not allowed |

| | | | | | |
|-------------------|---|--|---------------------|---------------------|-------|
| 7.2.2 | Line Defect Including Black line White line Scratch | Define:  | | | |
| | | Width(mm) Length(mm) | | Acceptable Quantity | |
| | | $W \leq 0.03$ | | Ignore | |
| | | $0.03 < W \leq 0.1$ | $L \leq 4.0$ | 3 | |
| | | $0.1 < W$ $L > 4.0$ | Not allowed | | |
| 7.2.3 | Polarizer Dent/Bubble | Size ϕ (mm) | | Acceptable Quantity | |
| | | $\phi \leq 0.25$ | | Ignore | |
| | | $0.25 < \phi \leq 0.5$ | | 3 | |
| | | $0.5 < \phi$ | | 0 | |
| 7.2.4 | Electrical Dot Defect | Bright and Black dot define:  | | | |
| | | Inspection pattern: Full white、 Full black、 Red、 green and blue screens | | | |
| | | Item | Acceptable Quantity | | |
| | | | I area | O area | Total |
| | | Black dot defect | 1 | 3 | 3 |
| Bright dot defect | 1 | 1 | 1 | | |
| Total Dot | 2 | 4 | 4 | | |

| | | | |
|-------|--------------|---|--|
| 7.2.5 | Glass defect | 1. Corner Fragment: | |
| | |  | |
| | | Size(mm) | Acceptable Quantity |
| | | $X \leq 3\text{mm}$ $Y \leq 3\text{mm}$ $Z \leq T$ | Ignore T: Glass thickness X: Length Y: Width Z: thickness |
| | | 2. Side Fragment: | |
| | |  | |
| | | Size(mm) | Acceptable Quantity |
| | | $X \leq 5.0\text{mm}$ $Y \leq 1\text{mm}$ $Z \leq T$ | Ignore T: Glass thickness X: Length Y: Width Z: thickness |

Note: 1. Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.

2. The distance between two bright dot defects (red, green, blue, and white) should be larger than 15mm.

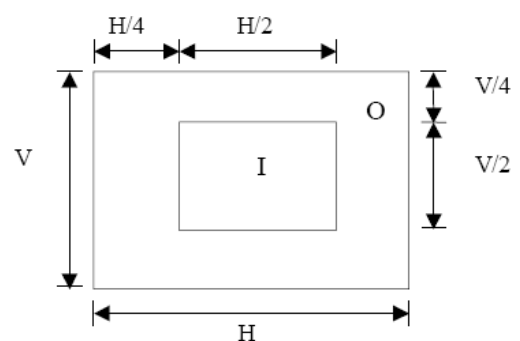
3. The distance between black dot defects or black and bright dot defects should be more than 5mm apart.

4. The definitions of the inner display area

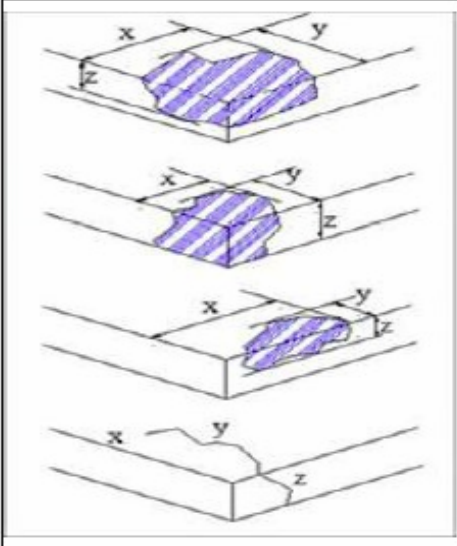
And outer display area

I: Inner display area

O: Outer display area



8. Inspection Standard of touch screen

| Item | Specifications (mm) | | Description |
|--|---|----------------------|-----------------------------|
| Scratch | $W \leq 0.03$ | $L \leq 20$ | Ignore |
| | $0.03 < W \leq 0.05$ | $L \leq 10$ | 3 accepted defect |
| | $W > 0.05$ or $W \leq 0.03$ or $0.03 < W < 0.05$ | $L > 20$ $L > 10$ | Reject |
| Lint (Fibrous materials, Hair adhesive, and other colorful lint) | $W \leq 0.03$ | $L \leq 5$ | Ignore |
| | $0.03 < W \leq 0.05$ | $L \leq 5$ | Two or less accepted defect |
| | $W > 0.05$ or $L > 5$ | | Reject |
| Hollow Spot or Protuberance Spot | $D \leq 0.4$ | | Accept |
| | $D > 0.4$ | | Reject |
| Opaque Spot | $D < 0.2$ | | Ignore |
| | $0.2 \leq D \leq 0.3$ | | Accept 3 spots |
| | $D > 0.3$ | | Reject |
| Translucent Defect | $D \leq 0.3$ | | Ignore |
| | $0.3 < D \leq 0.60$ | | Accept |
| | $D > 0.6$ | | Reject |
| Water Stain | In View area | | Reject |
| | In Active Area as following | $L \leq 20$ | Ignore |
| | $W \leq 3$ or $D \leq 3$ $3 < W \leq 10$ or $3 < D \leq 10$ $W > 10$ or $D > 10$ or $L > 20$ | | Accept Reject |
| Newton Ring | Inspect criteria by limiting sample a. The distance between produce and eye is about 30cm b. The angle between eye and lighting source is 60 degree c. The lightness of environment is 500 Lux | | |
| Crack |  <p>Corner :</p> <p>$X \neq 3.0\text{mm}$ and $Y \neq 3.0\text{mm}$ and $Z < \text{Glass Thickness}$</p> <p>Corner :</p> <p>$X \neq 1.0\text{mm}$ and $Y \neq 1.0\text{mm}$ and $Z = \text{Glass Thickness}$</p> <p>Edges :</p> <p>$X \neq 6.0\text{mm}$ and $Y \neq 2.0\text{mm}$ and $Z < \text{Glass Thickness}$</p> <p>Cracks : Reject</p> | | |