

Display Elektronik GmbH

DATA SHEET

TFT MODULE

**DEM 480272G1 TMH-PW-N
(C-TOUCH)**

**4,3“ TFT +
Projective Capacitive TP**

Product Specification

Ver.: 2

17.03.2017

CONTENTS

1. GENERAL INFORMATION 4

2. ABSOLUTE MAXIMUM RATINGS 4

3. ELECTRICAL CHARACTERISTICS 4

4. BACKLIGHT CHARACTERISTICS..... 4

5. TOUCH PANEL CHARACTERISTICS 5

6. EXTERNAL DIMENSIONS 6

7. ELECTRO-OPTICAL CHARACTERISTICS 7

8. INTERFACE DESCRIPTION 9

9. AC CHARACTERISTICS.....10

10. POWER SEQUENCE12

11. RELIABILITY TEST CONDITIONS.....13

12. INSPECTION CRITERION14

13. HANDLING PRECAUTIONS23

14. PRECAUTION FOR USE24

1. GENERAL INFORMATION

| No. | Item | Contents | Unit |
|-----|--------------------------------|---------------------------------|------|
| 1 | LCD size | 4.3 inch (Diagonal) | / |
| 2 | LCD type | TN/Normally white/ Transmissive | / |
| 3 | Viewing direction(eye) | 12 O'clock | / |
| 4 | Gray scale inversion direction | 6 O'clock | / |
| 5 | Resolution(H*V) | 480 *272Pixels | / |
| 6 | Module size (L*W*H) | 105.50*67.20*4.85 | mm |
| 7 | Active area (L*W) | 95.04*53.856 | mm |
| 8 | Pixel pitch (L*W) | 0.198*0.198 | mm |
| 9 | Interface type | RGB interface | / |
| 10 | Module power consumption | TBD | W |
| 11 | Back light type | LED | / |
| 12 | Driver IC | ILI6480BQ OR COMPATIBLE | / |
| 13 | Weight | TBD | g |

2. ABSOLUTE MAXIMUM RATINGS

| Item | Symbol | Min. | Max. | Unit |
|--|--------|------|---------------|------|
| Power supply input voltage(TFT Module) | VDD | -0.3 | 5.0 | V |
| Backlight current (normal temp.) | ILED | - | 50 | mA |
| Operation temperature | Top | -20 | 70 | °C |
| Storage temperature | Tst | -30 | 80 | °C |
| Humidity | RH | - | 90%(Max60 °C) | RH |

3. ELECTRICAL CHARACTERISTICS**DC CHARACTERISTICS (at Ta=25°C)**

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|--|--------|---------|------|---------|------|------|
| Power supply input voltage(TFT Module) | VDD | 3.0 | 3.3 | 3.6 | V | |
| I/O logic voltage | VDDIO | 1.8 | - | 3.3 | V | |
| Input voltage 'H' level | VIH | 0.7VDDI | - | VDDI | V | |
| Input voltage 'L' level | VIL | VSS | - | 0.3VDDI | V | |
| Power supply current | IVDD | - | TBD | - | mA | |
| TFT gate on voltage | VGH | - | N/A | - | V | |
| TFT gate off voltage | VGL | - | N/A | - | V | |
| Analog power supply voltage | AVDD | - | N/A | - | V | |
| Differential input common mode voltage | Vcom | - | N/A | - | V | |

4. BACKLIGHT CHARACTERISTICS**(at Ta=25°C,RH=60%)**

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|-----------------------|--------|---------------------------|------|------|------|-----------|
| LED forward voltage | VF | - | 15.0 | 16.0 | V | IF=20*2mA |
| LED forward current | IF | - | 40 | - | mA | |
| LED power consumption | PLED | - | 0.60 | - | W | Note1 |
| Number of LED | - | | 10 | | PCS | |
| Connection mode | - | 5 in series 2 in parallel | | | / | |
| LED life-time | - | 50000 | - | - | Hrs | Note2 |

Note1: Calculator value for reference: $IF \cdot VF = PLED$

Note2: The LED life-time define as the estimated time to 50% degradation of initial brightness at Ta=25°C and IF =40mA. The LED lifetime could be decreased if operating IF is larger than 40mA.

5. TOUCH PANEL CHARACTERISTICS

(at Ta=25°C)

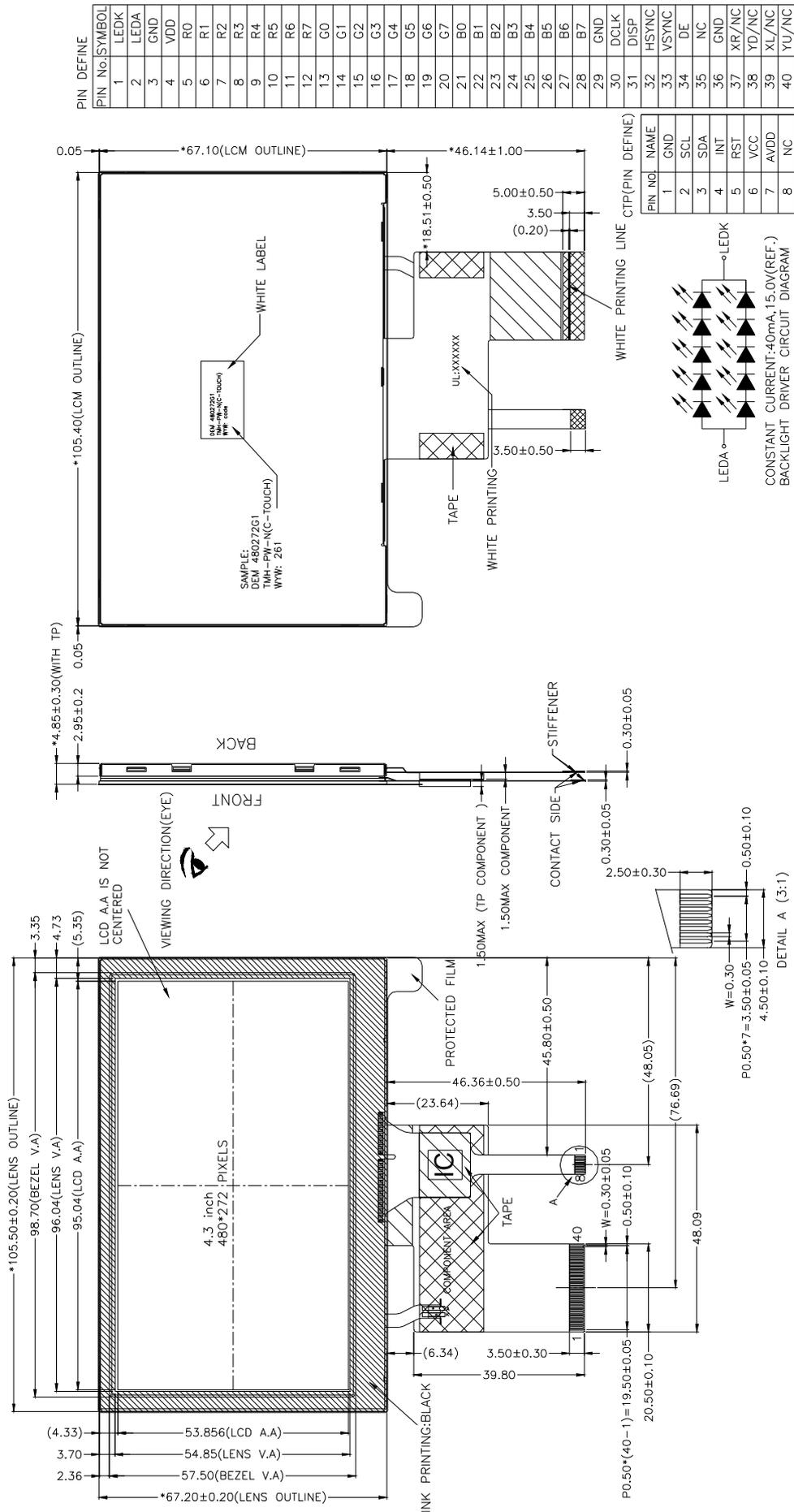
| FPC Design | Item | Description | Note |
|------------|-------------------------|-----------------|------|
| [√] COF | IC solution on TP Model | MXT224E | |
| | Touch Count Max | 5 point | |
| | Display Resolution* | 480*272 | |
| | Interface Type * | I2C | |
| | I2C Slave Address* | 0x4A | |
| | Origin of Coordinate* | Top left corner | |
| [] COB | IC solution on Broad* | / | |
| | Driving Channels | / | |
| | Sensing Channels | / | |

| Parameter | Min. | Typ. | Max. | Unit |
|---------------------------|------|------|------|------|
| Interface Signal Voltage* | 1.8 | 3.3 | 3.6 | V |
| Power Voltage* | 2.6 | 3.3 | 3.6 | V |
| Power ripple* | - | - | 50 | MV |

Note1: The detail refer to the Specification for IC.

Note2: “*”means that the item is optional according to the product requirement.

6. EXTERNAL DIMENSIONS



7. ELECTRO-OPTICAL CHARACTERISTICS

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark | Note |
|------------------------|----------|--|--------------|------|--------------|-------------------|------------------|--------|
| Response time | Tr+ Tf | - | - | 15 | 24 | ms | FIG.1 | Note 4 |
| Contrast ratio | Cr | | 380 | 500 | - | - | FIG.2 | Note 1 |
| Surface luminance | Lv | $\theta=0^\circ$ | 550 | 600 | - | cd/m ² | FIG.2 | Note 2 |
| Luminance uniformity | Yu | $\theta=0^\circ$ | 75 | 80 | - | % | FIG.2 | Note 3 |
| NTSC | - | $\theta=0^\circ$ | - | 70 | - | % | FIG.2 | Note 5 |
| Viewing angle | θ | $\varnothing=90^\circ$ | 60 | 70 | - | deg | FIG.3 | Note 6 |
| | | $\varnothing=270^\circ$ | 40 | 50 | - | deg | FIG.3 | |
| | | $\varnothing=0^\circ$ | 60 | 70 | - | deg | FIG.3 | |
| | | $\varnothing=180^\circ$ | 60 | 70 | - | deg | FIG.3 | |
| CIE (x,y) chromaticity | Red x | $\theta=0^\circ$ $\varnothing=0^\circ$ Ta=25°C | Typ -0.04 | TBD | Typ +0.04 | - | FIG.2 CIE1931 | Note 5 |
| | Red y | | | TBD | | - | | |
| | Green x | | | TBD | | - | | |
| | Green y | | | TBD | | - | | |
| | Blue x | | | TBD | | - | | |
| | Blue y | | | TBD | | - | | |
| | White x | | | TBD | | - | | |
| | White y | | | TBD | | - | | |

Note1. Definition of contrast ratio

Contrast ratio (Cr) is defined mathematically by the following formula.
For more information see FIG.2.

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

Measured at the center area of the LCD

Note2. Definition of surface luminance

Surface luminance is the luminance with all pixels displaying white.
For more information see FIG.2.

$$L_v = \text{Average Surface Luminance with all white pixels}(P_1, P_2, P_3, \dots, P_n)$$

Note3. Definition of luminance uniformity

The luminance uniformity in surface luminance is determined by measuring luminance at each test position 1 through n, and then dividing the maximum luminance of n points luminance by minimum luminance of n points luminance. For more information see FIG.2.

$$Y_u = \frac{\text{Minimum surface luminance with all white pixels } (P_1, P_2, P_3, \dots, P_n)}{\text{Maximum surface luminance with all white pixels } (P_1, P_2, P_3, \dots, P_n)}$$

Note4. 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_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.
For additional information see FIG1.

Note5. Definition of color chromaticity (CIE1931)

CIE (x,y) chromaticity, The x,y value is determined by screen active area center position P5. For more information see FIG.2.

Note6. Definition of viewing angle

Viewing angle is the angle at which the contrast ratio is greater than 10. angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface.
For more information see FIG.3.

For viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope or DMS series Instruments or compatible. For contrast ratio, Surface Luminance, Luminance uniformity and CIE, the testing data is base on TOPCON's BM-5or BM-7 photo detector or compatible.

Note: For TFT module, Gray scale reverse occurs in the direction of panel viewing angle.

FIG.1. The definition of response Time

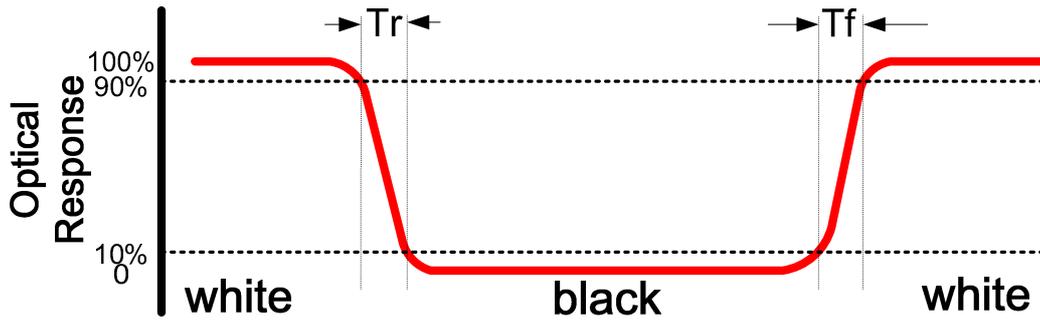


FIG.2. Measuring method for contrast ratio, surface luminance, luminance uniformity, CIE (x,y) chromaticity

Size : $S \leq 5"$ (see Figure a)

A : 5 mm B : 5 mm

H, V : Active area

Light spot size $\varnothing = 5\text{mm}$ (BM-5) or $\varnothing = 7.7\text{mm}$ (BM-7) 50cm distance or compatible distance from the LCD surface to detector lens.

test spot position : see Figure a.

measurement instrument : TOPCON's luminance meter BM-5 or BM-7 or compatible (see Figure c).

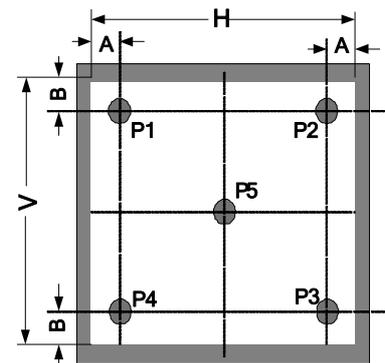


Figure a

Size : $5" < S \leq 12.3"$ (see Figure b)

H, V : Active area

Light spot size $\varnothing = 5\text{mm}$ (BM-5) or $\varnothing = 7.7\text{mm}$ (BM-7) 50cm distance or compatible distance from the LCD surface to detector lens.

test spot position : see Figure b.

measurement instrument : TOPCON's luminance meter BM-5 or BM-7 or compatible (see Figure c).

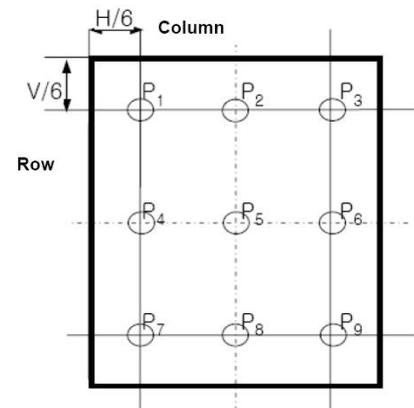


Figure b

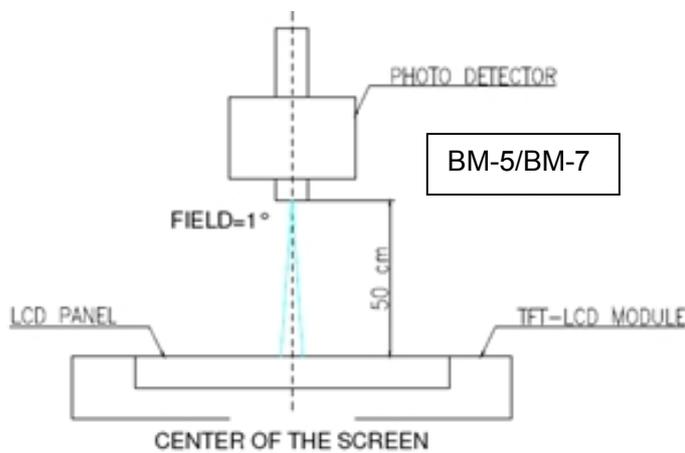
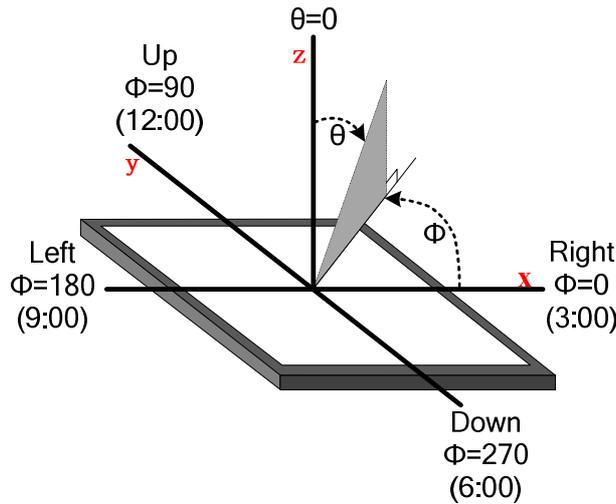


Figure c

FIG.3. The definition of viewing angle



8. INTERFACE DESCRIPTION

TFT Module Interface description

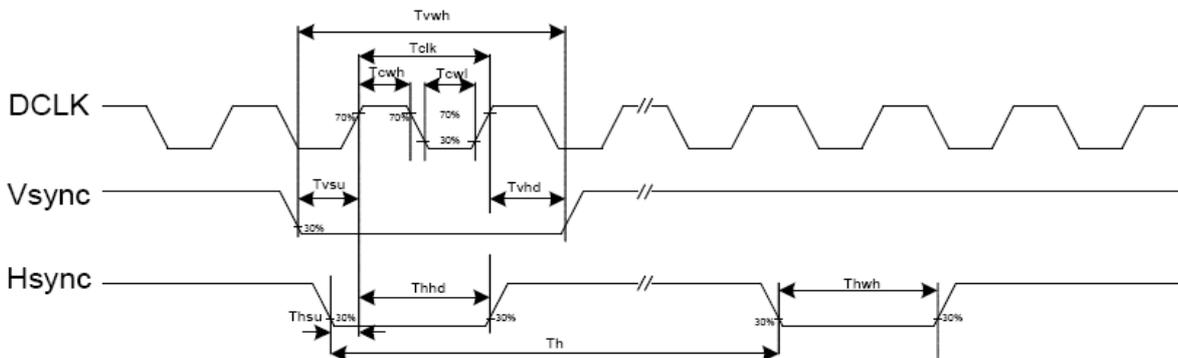
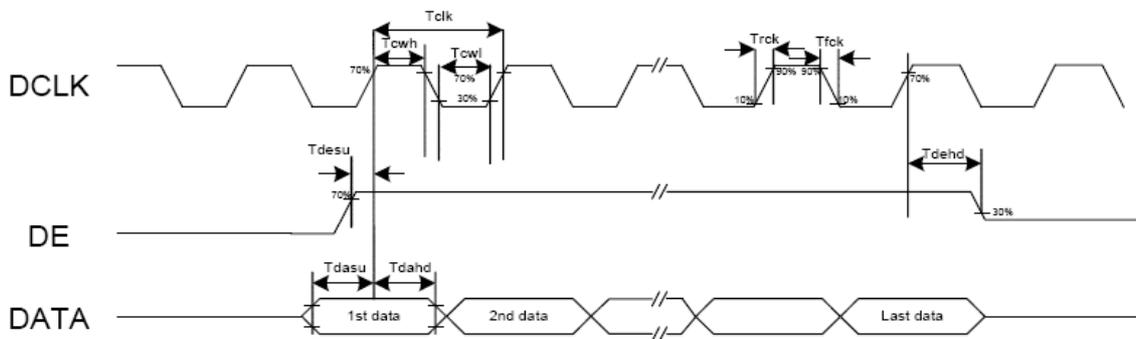
| Interface No. | Name | I/O or connect to | Description |
|---------------|------------|-------------------|---------------------------------------|
| 1 | LEDK | P | Power for LED backlight(Cathode) |
| 2 | LEDA | P | Power for LED backlight(Anode) |
| 3 | GND | P | Ground |
| 4 | VDD | P | Power for LCD |
| 5-12 | Red(0-7) | I | Red data |
| 13-20 | Green(0-7) | I | Green data |
| 21-28 | Blue(0-7) | I | Blue data |
| 29 | GND | I | Ground |
| 30 | DCLK | I | Data enable signal; normally pull low |
| 31 | DISP | I | Display on/off |
| 32 | HSYNC | I | Horizontal sync input. |
| 33 | VSYNC | I | Vertical sync input |
| 34 | DE | I | Data enable |
| 35 | NC | / | / |
| 36 | GND | P | Power ground |
| 37 | NC | / | / |
| 38 | NC | / | / |
| 39 | NC | / | / |
| 40 | NC | / | / |

CTP interface description

| Interface No. | Name | I/O or connect to | Description |
|---------------|------|-------------------|------------------------|
| 1 | GND | P | Ground |
| 2 | SCL | I | Serial interface clock |
| 3 | SDA | I/O | Serial interface date |
| 4 | INT | O | State change interrupt |
| 5 | RST | I | Reset low |
| 6 | VCC | P | Digital Power of CTP |
| 7 | AVDD | P | Analog power of CTP |
| 8 | NC | / | / |

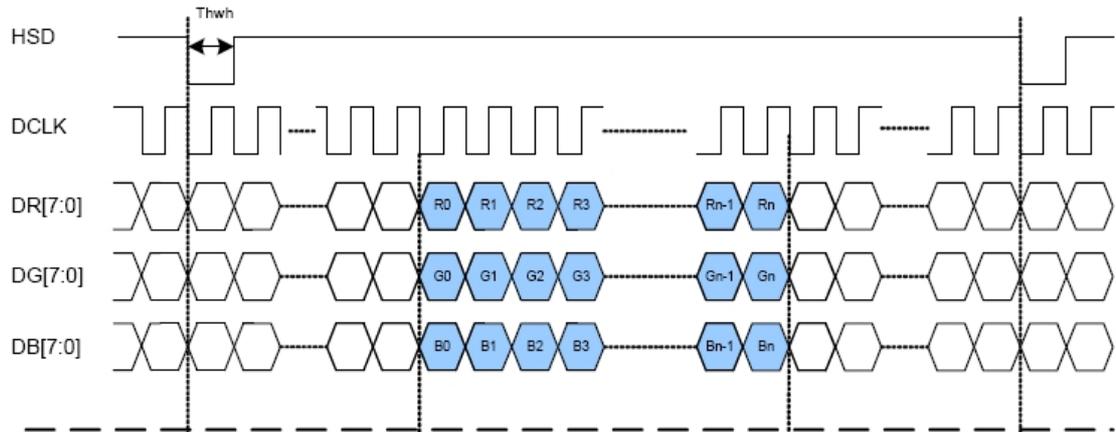
9. AC CHARACTERISTICS

| Input Output timing | | | | | | |
|--------------------------------------|-------|------|----|-----|------|----------------------------------|
| DCLK clock time | Tclk | 33.3 | - | - | ns | DCLK=30MHz |
| DCLK clock low period | Tcwl | 40 | - | 60 | % | |
| DCLK clock high period | Tcwh | 40 | - | 60 | % | |
| Clock rising time | Trck | 9 | - | - | ns | |
| Clock falling time | Tfck | 9 | - | - | ns | |
| HSD width | Thwh | 1 | - | - | DCLK | |
| HSD period time | Th | 55 | 60 | 65 | us | |
| HSD setup time | Thsu | 12 | - | - | ns | |
| HSD hold time | Thhd | 12 | - | - | ns | |
| VSD width | Tvwh | 1 | - | - | Th | |
| VSD setup time | Tvsu | 12 | - | - | ns | |
| VSD hold time | Tvhd | 12 | - | - | ns | |
| Data setup time | Tdasu | 12 | - | - | ns | |
| Data hold time | Tdahd | 12 | - | - | ns | |
| DE setup time | Tdesu | 12 | - | - | ns | |
| DE hold time | Tdehd | 12 | - | - | ns | |
| Source output setting time | Tsst | - | - | TBD | us | 10% to 90% CL=60pF, RL=2Kohm |
| Gate output setting time | Tgst | - | - | TBD | ns | 10% to 90%, CL=60pF |
| VCOM output setting time | Tcst | - | - | TBD | us | 10% to 90%, CL=40nF, RL=50ohm |
| Time from VSD to 1st line data input | Tvs | 3 | 8 | 31 | Th | HV mode By HDL[4:0] setting |

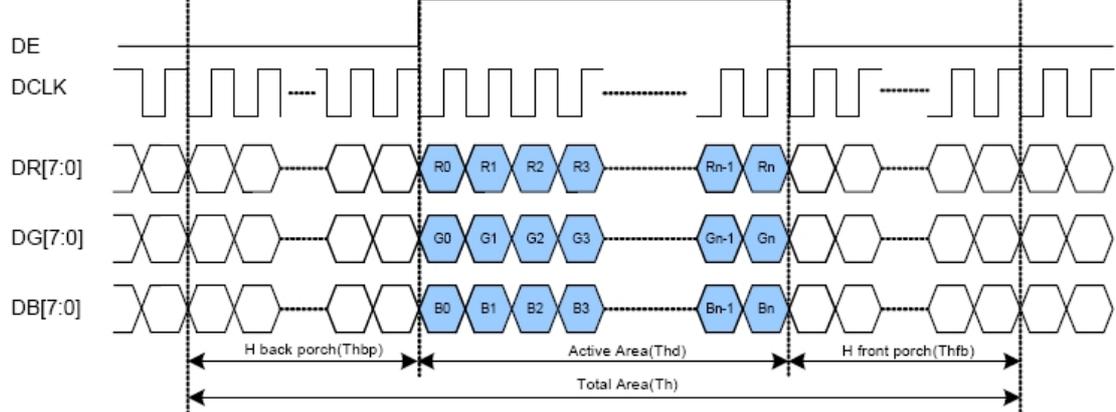


| Parameter | Symbol | Value | | | Unit |
|------------------|--------|-------|------|------|------|
| | | Min. | Typ. | Max. | |
| DCLK frequency | fclk | 5 | 9 | 12 | MHz |
| VSD period time | Tv | 277 | 288 | 400 | H |
| VSD display area | Tvd | 272 | | | H |
| VSD back porch | Tvb | 3 | 8 | 31 | H |
| VSD front porch | Tvfp | 2 | 8 | 97 | H |
| HSD period time | Th | 520 | 525 | 800 | DCLK |
| HSD display area | Thd | 480 | | | DCLK |
| HSD back porch | Thbp | 36 | 40 | 255 | DCLK |
| HSD front porch | Thfp | 4 | 5 | 65 | DCLK |

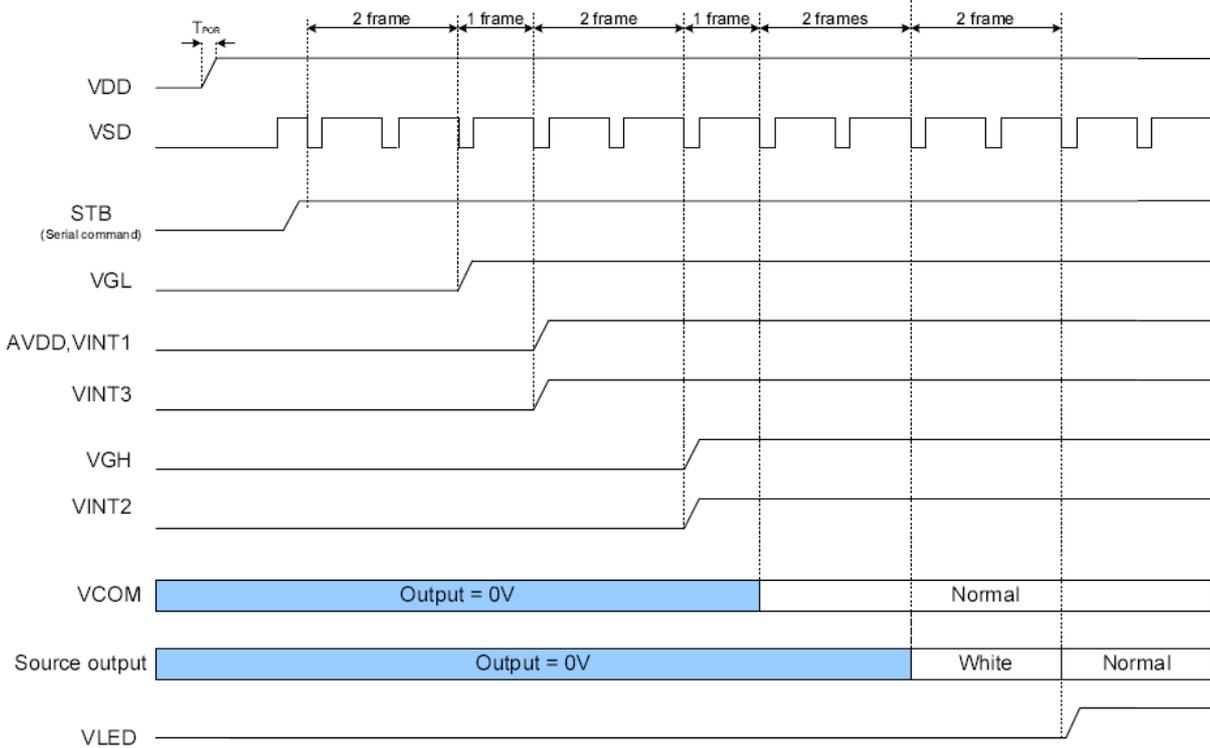
(HV Mode)



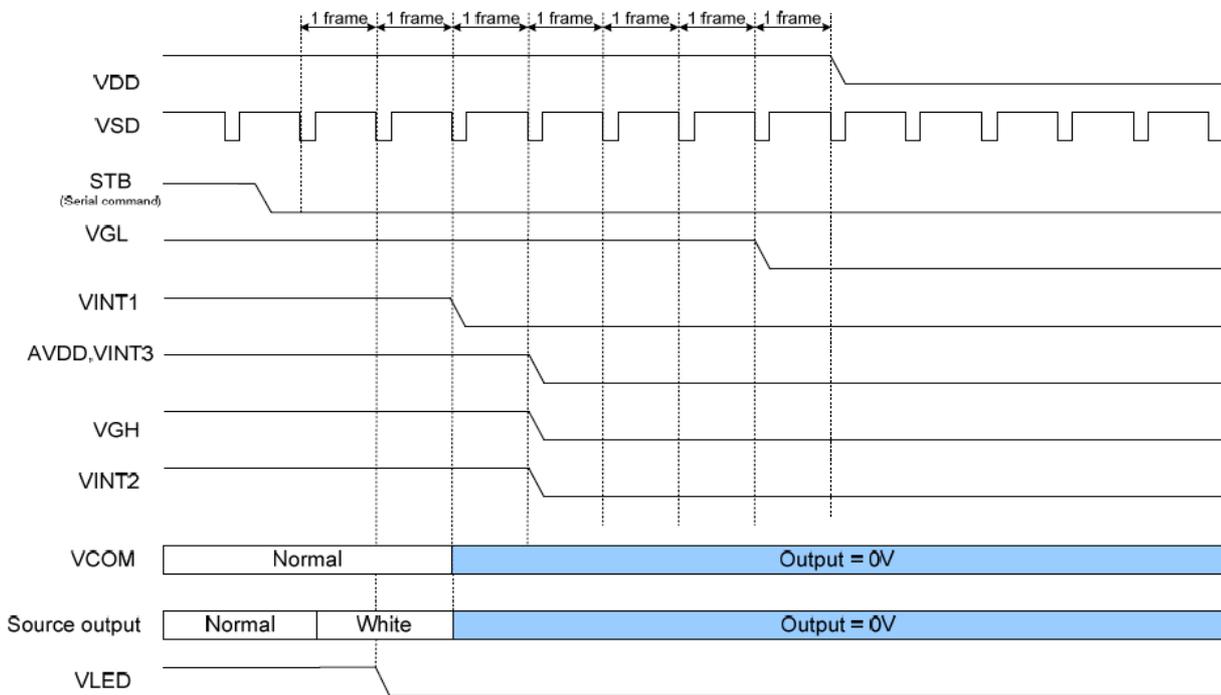
(DE Mode)



10. POWER SEQUENCE



Power On Sequence



Power Off Sequence

11. RELIABILITY TEST CONDITIONS

| No. | Test item | Test condition | Inspection after test | |
|------|----------------------------|--|--|-----------------|
| 11.1 | High temperature storage | +80°C±2°C/240 hours | Inspection after 2~4hours storage at room temperature, the sample shall be free from defects : 1. Current changing value before test and after test is 50% larger; 2. Function defect : Non-display, abnormal-display, missing lines, Short lines, ITO corrosion; 3. Visual defect : Air bubble in the LCD, Seal leak, Glass crack. | |
| 11.2 | Low temperature storage | -30°C±2°C/240 hours | | |
| 11.3 | High temperature operating | +70°C±2°C/120 hours | | |
| 11.4 | Low temperature operating | -20°C±2°C/120 hours | | |
| 11.5 | Temperature cycle storage | -30°C ~25°C ~ +80°C /10cycles (30min.) (10min.) (30min.) | | |
| 11.6 | Damp proof test | +50°C*90% RH/120 hours | | |
| 11.7 | Vibration test | Frequency : 250 r/min Amplitude : 1 Inch Time: 45 min | | |
| 11.8 | Dropping test | Drop direction: 1 corner/3 edges/6 sides 10 time | | |
| | | Packing weight(kg) | | Drop height(cm) |
| | | <11 | | 80±1.6 |
| | | 11 ≤G<21 | 60±1.2 | |
| | | 21 ≤G<31 | 50±1.0 | |
| | | 31 ≤G<40 | 40±0.8 | |
| 11.9 | ESD test | Air discharge: ±8KV, 10time Contact discharge: ±4KV, 10time | | |

Remark :

- The test samples should be applied to only one test item.
- Sample size for each test item is 3~5pcs.
- For High temperature high humidity test, Pure water (Resistance>10MΩ) should be used.
- In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.
- EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
- Failure judgment criterion: Basic specification, Electrical characteristic, Mechanical characteristic, Optical characteristic.

12. INSPECTION CRITERION

12.1 Objective

The TFT test criterion are set to formalize TFT quality standards for DISPLAY with reference to those of the customer for inspection, release and acceptance of finished TFT products in order to guarantee the quality of TFT products required by the customer.

12.2. Scope

The criterion is applicable to all the TFT products manufactured by DISPLAY.

12.3. Equipment for Inspection

Electrical tester, electrical testing machines, vernier calipers, microscopes, magnifiers, anti-static wrist straps, finger cots, labels, tri-phase cold and hot shock machine, constant temperature and humidity chamber, backlight table, ovens for high-low temperature experiments, refrigerators, constant voltage power supply (DC), desk Lamps, etc.

12.4. Sampling Plan and Reference Standards

12.4.1 Sampling plan :

Refer to National Standard GB/T 2828.1---2012/ISO2859-1:1999, level II of normal levels :

Major defect: AQL 0.4

Minor defect: AQL 1.0

12.4.2 GB/T 2828.1---2012/ISO2859-1:1999 Sampling check procedure in count

12.4.3 GB/T 18910. Standard for LCM parts

12.4.4 GB/T24213-2008 Basic Environmental Test Procedures for Electrical and Electronic Products

12.4.5 IPC-A-610E Acceptability of Electronic Assemblies

12.5. Inspection Conditions and Inspection Reference

12.5.1 Inspection environment: temperature: 23±3□; humidity: 45~75%RH; cleanliness: 10000 grade;

12.5.2 Inspection distance: 30cm±5cm.

Black Booth or Black Background

12.5.3

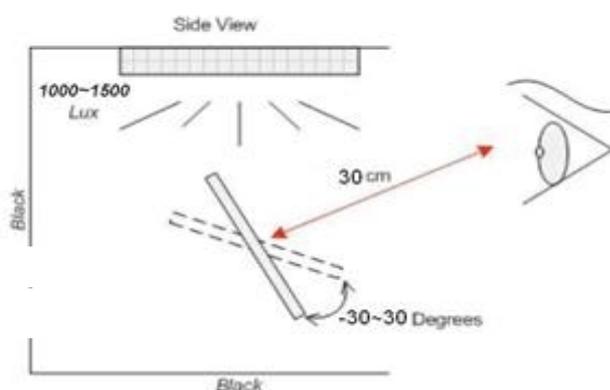
up->down;horizontal rotate angle:±30°,left->right

12.5.4

(product) inspection luminance is 800~1200Lux;

12.5.5

12.5.6



white

12.5.7 Area partition:

12.5.7.1 A area: front side visible area - BM(Black Mask), the area encircled by blue lines.

12.5.7.2 B area: four broadside(inspect from broadside) area & FPC area, encircled by green lines.



12.5.8 Defect type:

12.5.8.1 A area defect type:

Line defect (scratch、soft flocks、fibre)、dot defect (white dot、black dot、same color dot、different color dot、dust、bubble)、surface stain、pin-hole、light leak、scratch.

12.5.8.2 B area defect type:

Broken、crack/chipping、FPC defect

12.5.9 Undefined items or other special items, refer to mutual agreement and limited sample.If criterion does not match product specifications/ technical requirement, both should be subject to special inspection criterion agreed by customer.

12.6. Defects and Acceptance Standards

12.6.1 Electrical properties test

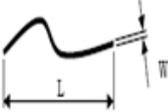
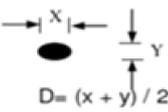
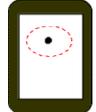
Check in DISPLAY tester.The program will release result automatically. There are “OK”、 “PASS” 、 “NG”and the final judgment must be“OK”“PASS”,and we need to pass the draw line test.

Refer to 《**serise IC test program》

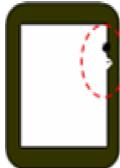
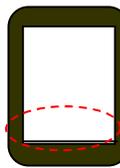
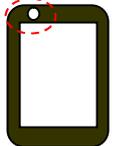
| No. | Defects | Descriptions | Accepted standard | MAJ. | MIN. |
|----------|----------------------------------|---|-------------------|------|------|
| 12.6.1.1 | Short | Measured data has much difference compared with normal;line is not stable | Reject | √ | |
| 12.6.1.2 | Open | Measured data has no change.Line is open | Reject | √ | |
| 12.6.1.3 | No reaction | No reaction and there is no line in screen | Reject | √ | |
| 12.6.1.4 | Mis-display/ abnormal display | Screen has display but line is open or bent | Reject | √ | |
| 12.6.1.5 | Button no reaction | Press the button but no reaction | Reject | √ | |
| 12.6.1.6 | Button not correct | Press the button .Reaction is not stable | Reject | √ | |

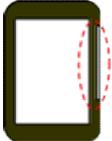
12.6.2 Appearance inspection

12.6.2.1 Dot/line defect

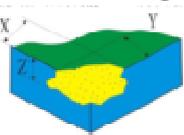
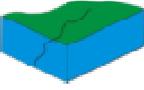
| Defect | ≤5" | 5~10" | 10~15" | >15" | Accepted standard | MAJ. | MIN. |
|---|--|---|--|--|-------------------|------|------|
| S/C , line defect W:width L:length  | Tactile S/C->NG | Tactile S/C->NG | Tactile S/C->NG | Tactile S/C->NG | Reject | | √ |
| | W≤0.03mm, ->OK; Density is high ->NG | W≤0.05mm, ->OK; Density is high ->NG | W≤0.05mm, ->OK; Density is high ->NG | W≤0.05mm, ->OK; Density is high ->NG | Accept | | √ |
| | 0.03mm<W≤0.10mm, L≤5mm quantity≤4 distance>10mm | 0.05mm<W≤0.1mm, L≤8mm quantity≤6 distance>10mm | 0.05mm<W≤0.1mm, L≤10mm quantity≤6 distance>10mm | 0.05mm<W≤0.1mm, L≤20mm quantity≤8 distance>10mm | Accept | | √ |
| | W>0.10mm L>5mm | W>0.1mm L>8mm | W>0.1mm L>10mm | W>0.1mm L>20mm | Reject | | √ |
| Dot defect D:Diameter   | W≤0.10mm, ->OK; | W≤0.15mm, ->OK; | W≤0.15mm, ->OK; | W≤0.15mm, ->OK; | Accept | | √ |
| | 0.10mm<D≤0.25mm quantity≤4 distance>10mm | 0.15mm<D≤0.30mm quantity≤6 distance>10mm | 0.15mm<D≤0.40mm quantity≤6 distance>10mm | 0.20mm<D≤0.50mm quantity≤5 distance>10mm | Accept | | √ |
| | D>0.25mm | D>0.30mm | D>0.40mm | D>0.50mm | Reject | | √ |

12.6.2.2 LENS defect

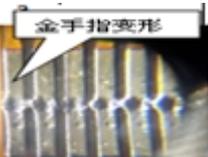
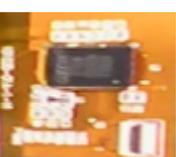
| Defect | Description | Accepted standard | MAJ. | MIN. |
|---|--|-------------------|------|------|
| Printing zigzag  | zigzag width which is almost the same with VA area W≤0.15mm | Accept | | √ |
| | zigzag width which is almost the same with VA area W>0.15mm | Reject | | √ |
| Wire mark  | ≤0.15mm | Accept | | √ |
| | >0.15mm | Reject | | √ |
| Ink pinhole  | Invisible with reflector light | Accept | | √ |
| Ink film defect | Ink film:s/c、 soft flocks、 fibre Ink film stain/color shift:refer to limited sample Ink film foreign material/scratch: refer to 6.2.1 visible area | Accept | | √ |

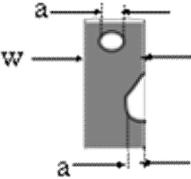
| | | | | |
|---|---|--------|---|---|
| | judgment | | | |
| Ink light leak  | Broadside light leak width≤0.15mm Each side light leak quantity≤1 | Accept | | √ |
| Ink color shift | Refer to limited sample | | | √ |
| font, glass silver line (ink area) width≥0.2mm  | D≤0.20mm; N≤2 ↑ | Accept | | √ |
| | D>0.20mm | Reject | | √ |
| | Refer to limited sample, if it's out of spec | Reject | | √ |
| word/color error | Word or color or position is different from drawing and sample. | Reject | √ | |
| word missing width≤0.2mm  | height, a≤1/4h, width≤1/2w | Accept | | √ |
| Font thickness different and color nonuniform  | Refer to limited sample, if it's out of spec | Reject | | √ |
| IR/video/ Receive hole /Button hole | Irregular hole , offside, refer to drawing | Accept | | √ |
| | Foreign material/scratch exist in hole, refer to 6.2.1 | Reject | | √ |
| LENS broadside foreign material | Width≤ 0.15mm | Accept | | √ |
| Ink spill | LENS broadside or receive hole or button hole have ink spill defect, refer to limited sample. | Accept | | √ |

12.6.2.3 Breakage

| Defect | ≤5" | 5~10" | 10~15" | >15" | Accepted standard | MAJ. | MIN. |
|---|---|-------------------------------------|-------------------------------------|-------------------------------------|-------------------|------|------|
| LENS breakage  | X≤0.3mm, Y≤0.3mm, one side ≤1 | X≤0.3mm, Y≤0.4mm, one side ≤1 | X≤0.4mm, Y≤0.4mm, one side ≤1 | X≤0.5mm, Y≤0.5mm, one side ≤1 | Accept | | √ |
| | X>0.3mm, Y>0.3mm | X>0.3mm, Y>0.4mm | X>0.4mm, Y>0.4mm | X>0.5mm, Y>0.5mm | Reject | | √ |
| Sensor breakage | Not affect ITO line, not lengthen,function test is OK And be non-visual after attaching Lens | | | | Accept | | √ |
| | affect ITO line and be visual | | | | Reject | | √ |
| Glass crack  | Crack lengthen to outside | | | | Accept | | √ |
| | Crack lengthen to inside | | | | Reject | | √ |

12.6.2.4 FPC defect

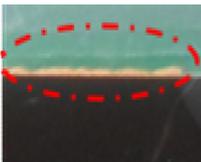
| Defect | Description | Accepted standard | MAJ. | MIN. |
|--|--|-------------------|------|------|
| FPC folding  | FPC is folding and can not restore-> Reject FPC is folding and can restore->compare with limited sample | Reject | | √ |
| FPC cover layer defect | FPC cover layer peeling off | Reject | | √ |
| FPC color shift and bubble | PI layer have color shift or bubbled due to high welding temperature or long welding time. | Reject | | √ |
| Golden finger defect  | peeling off、bonding deformed、glue remained、oxidized, stained | Reject | | √ |
| Joggle defect  | bent, broken, peeling off | Reject | | √ |
| FPC defect | (golden finger) dented, pin hole a≤w/3 | Accept | | √ |
| | open/scratch/cracked | Reject | | √ |

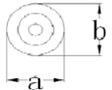
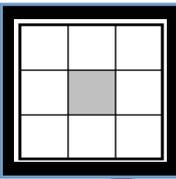
| | | | | |
|---|---|--------|--|---|
|  | oxidized, stained | Reject | | √ |
| FPC loophole | Soft loophole≤2.0mm, hard (PCB、PC、steel cover layer) loophole≤1.0mm | Accept | | √ |

12.6.2.5 Attaching defect (protective film/adhesive tape/foam/PC...)

| Defect | Description | Accepted standard | MAJ. | MIN. |
|---|---|-------------------|------|------|
| High temperature glue paper | 1.Glue paper attached in FPC doesn't cover component or FPC cove layer. 2.Glue paper attached in golden finger doesn't cover golden finger or peel off | Reject | | √ |
| Protective film | Clean、 attaching flat、 no shifting or bubble | Accept | | √ |
| | Protective film attaching bubble in VA: D≤2.0mm N≤5 distances≤20mm | Accept | | √ |
| | Protective film attaching bubble in VA: D>2.0mm N>5 distance>20mm | Reject | | √ |
| Tape | Attach position refer to the drawing | Accept | | √ |
| Foam | Gap spec:0.5+/-0.5mm, foam must be smaller than sensor edge side and can not enter into VA. | Accept | | √ |
| PC board/ adhesive tape | Tape must be smaller than LENS edge side and can not be folding ,dent or shifting. | Accept | | √ |
| Anti-explosion fim/Anti-glare film/blue film | Impression print refer to the limited sample | Accept | | √ |
| | Attach position refer to the drawing | Accept | | √ |

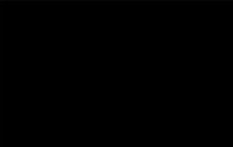
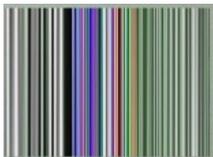
12.6.2.6 Others

| Defect | Description | Accepted standard | MAJ. | MIN. |
|---|--|-------------------|------|------|
|  | Insulation oil flow in VA area | Reject | | √ |
| | ACF/insulation oil flow in VA area | Reject | | √ |
| | Sensor edge side glue flow | Accept | | √ |
| IC/FPC gap glue | FPC gap glue:cover FPC connect point totally IC glue: cover IC line connect totally | Accept | | √ |
| | Glue height : follow the technology spec | Accept | | √ |

| | | | | |
|---|---|---------------|----------|----------|
| <p>Newton circles (rainbow)</p>  | <p>Circles quantity > 2</p> | <p>Reject</p> | | <p>√</p> |
| <p>Layering</p> | <p>LENS/Sensor layering</p> | <p>Reject</p> | <p>√</p> | |
| <p>Surface</p> | <p>Stain defect which can be removed by cleaning solvent and cloth Defect quantity ≤ 10% Lot total quantity → Accept Remark: defect product which is sorted out by AQL is not included in the 10% part. Unmovable stain refer to 6.2.1 specification.</p> | <p>Reject</p> | | <p>√</p> |
| <p>Isolation point</p>  <p>VA diagram</p> | <p>Gray area In 8X8mm area, all isolation points are missing</p> | <p>Reject</p> | | <p>√</p> |
| | <p>White area In 15X15mm area, all isolation points are missing</p> | <p>Reject</p> | | <p>√</p> |
| | <p>5mm within VA (black area), isolation points missing → Ignored</p> | <p>Accept</p> | | <p>√</p> |
| | <p>Isolation points are overlaid</p> | <p>Accept</p> | | <p>√</p> |

12.6.3 TFT defects and Inspection Criterion

12.6.3.1 Function items (Defect category MA)

| Defects | Inspection Criterion | Pictures | Inspection method/tools | Defect category |
|-----------------------------------|---|--|----------------------------|-----------------|
| <p>No display /reaction</p> | <p>shows no picture/display in normal connected situation. → Rejected</p> |  | <p>Naked eyes/ testers</p> | <p>MA</p> |
| <p>Missing segment</p> | <p>Shows missing lines in normal display</p> |  | <p>Naked eyes/ testers</p> | <p>MA</p> |
| <p>Image retention (sticking)</p> | <p>The previous picture stays in the next picture. Disappear time < 10s, OK; time > 10s, NG</p> |  | <p>Naked eyes/ testers</p> | <p>MA</p> |
| <p>Flicker</p> | <p>Not accepted</p> |  | <p>Naked eyes/ testers</p> | <p>MA</p> |
| <p>Display abnormal</p> | <p>Not accepted</p> |  | <p>Naked eyes/ testers</p> | <p>MA</p> |

| | | | | |
|--|--------------------|-------------------------|---|----------------------------|
| 12.6.3.2 LCD pixel dot defect(defect category: MI) | Display dim/bright | Refer to limited sample | / | Naked eyes/ limited sample |
| | Contrast | Refer to limited sample | / | Naked eyes/ limited sample |
| | White dot | Refer to dot criterion | / | Naked eyes |
| | White speckle | Refer to limited sample | / | Naked eyes/ limited sample |
| | Yellow speckle | Refer to limited sample | / | Naked eyes/ limited sample |

| Item | Inspection criterion | | | | |
|---------------------------------|----------------------|-------|---------|----------|------|
| | Size | S <5" | 5≤S<10" | 10≤S<15" | >15" |
| Color pixel dot defect(RGB dot) | | 1 | 2 | 2 | 3 |
| 2 connected bright dot | | 0 | 0 | 1 | 1 |
| 3 connected bright dot or more | | 0 | 0 | 0 | 0 |
| Bright dot quantity | | 1 | 2 | 3 | 4 |
| Random dark dot quantity | | 2 | 3 | 4 | 5 |
| 2 connected dark dot | | 1 | 1 | 2 | 2 |
| 3 connected dark dot or more | | 0 | 0 | 0 | 0 |
| Dark dot quantity | | 3 | 4 | 5 | 6 |
| Multi-bright dot | ND 5% hidden, OK | | | | |

Remark: 2 bright dots distance DS≥15mm 2 dark dots distance DS≥5mm

- 1) Bright dot: Power on TFT and RGB dot in black display
- 2) Dark dot: Power on TFT and gray or black dot in RGB display
- 3) Multi-bright dot: Power on TFT and fluorescent tiny dot in black display(only visible in black display)

12.6.3.3 Backlight components

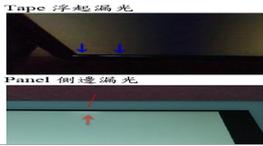
| No. | Item | Description | Accepted criterion | MAJ. | MIN. |
|------------|--------------------------|---|------------------------------|------|------|
| 12.6.3.3.1 | No backlight wrong Color | / | Rejected | √ | |
| 12.6.3.3.2 | Color deviation | When powered on, the LCD color differs from its sample and found that the color not conforming to the drawing after testing. | Refer to sample and drawing. | | √ |
| 12.6.3.3.3 | Brightness deviation | When powered on, the LCD brightness differs from its sample and is found after testing not conforming to the drawing; or if it conforms to the drawing but the brightness over ±40% than its typical value. | Refer to sample and drawing. | | √ |
| 12.6.3.3.4 | Uneven brightness | Uneven on the same LCD and out of the specification of the drawing. The no specification evenness= (the max value-the min value)/ mean value< 70%. | Refer to sample and drawing. | | √ |
| 12.6.3.3.5 | Spot/line /scratch | When power on, it has dirty spot, scratches and so on spot and line defects. | Refer to 6.2.1 | | √ |

12.6.3.4 Metal frame (Metal Bezel)

| No. | Item | Description | Accepted criterion | MAJ. | MIN. |
|------------|------------------------------|---|--------------------|------|------|
| 12.6.3.4.1 | Material & surface treatment | Metal frame/surface treatment do not conform to | Rejected | √ | |

| | | | | | |
|------------|---|---|--|---|--|
| | | the specifications. | | | |
| 12.6.3.4.2 | Tab twist Unconformity/ Tab not twisted | Wrong twist method or direction and twist tabs are not twisted as required. | Rejected | √ | |
| 12.6.3.4.3 | Bezel paint loss | Scratch/paint loss/Bezel surface concave-convex dot/dent | 1.Front surface: Paint peel off and scratch to the bottom Dot:D≤0.5mm, exceeds 3; Line:L≤3.0mm,W≤0.05mm exceeds 2; 2.Front dent, air bubble and side with paint peeling off scratch to the bottom Dot: D≤1.0mm, exceeds 3; Line:L≤3.0mm,W≤0.05mm, exceeds 2; | √ | |
| 12.6.3.4.4 | Bezel scratch | | | √ | |
| 12.6.3.4.5 | Painting peel off, discoloration, dent, and scratch | | | √ | |
| 12.6.3.4.6 | Burr | Burr(s) on metal bezel is so long as to get into viewing area. | Rejected | √ | |

12.6.3.5 Others

| No. | Item | Description | Accepted criterion | MAJ. | MIN. |
|------------|---------------------------|---|---|------|------|
| 12.6.3.5.1 | Assembly foreign material | Dot/linear stain after assembly backlight and diffuse film TP assembly foggy stain | Invisible when power on->OK Refer to 6.2.1 dot/line spec | | √ |
| 12.6.3.5.2 | Product mark | Missing, unclear, incorrect, or misplaced part | Rejected | | √ |
| 12.6.3.5.3 | Newton's rings | Area<1/6 screen area quantity≤1 | Accepted | | √ |
| 12.6.3.5.4 | Mura | 1.In black display ND 5% invisible ->OK; visible->NG 2.Naked eyes inspection RGB display invisible Black display, area<1/4 screen area | Refer to limited sample  | | √ |
| 12.6.3.5.5 | Light leak | 1.LCD edge (near backlight) shadow by LCD lamps irregular illuminate 2.Judge in black/white/gray display (slight leaky is yellowish, greenish, blueish ->NG);  | Refer to limited sample | | √ |
| 12.6.3.5.6 | Polarizer | 1.Polarizer slant.Cover VA and not over LCD edge 2.No unmovable stain or finger print in polarizer VA 3.Bubble/warped but not enter VA | Accepted | | √ |

12.6.4 General Appearance

12.6.4.1 Common function inspection equipment: micro calliper、vernier caliper、pencil hardness tester、

spectrophotometer 、 drop ball test.

| No. | Items | Spec |
|-----|----------------------------|----------------------------|
| 1 | Dimension | According to drawing |
| 2 | Curl | ≤0.3% -> OK, "S" curl ->NG |
| 3 | Surface hardness | According to drawing |
| 4 | VATT (550nm) | According to drawing |
| 5 | IR TT-- (550nm & 850nm) | According to drawing |
| 6 | Intensity (drop ball test) | According to drawing |

Remark: the criterion is common for all product and if some components are not included, just ignore it.

12.7 Others

Items not specified in this document or released on compromise should be inspected with reference to mutual agreement and limit samples.

13. HANDLING PRECAUTIONS

13.1 Mounting method

The LCD module consists of two thin glass plates with polarizers which easily be damaged. And since the module is so constructed as to be fixed by utilizing fitting holes in the printed circuit board. Extreme care should be needed when handling the LCD modules.

13.2 Caution of LCD handling and cleaning

When cleaning the display surface, Use soft cloth with solvent [recommended below] and wipe lightly :

- .Isopropyl alcohol
- .Ethyl alcohol

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent :

- .Water
- .Aromatics

Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns

Do not use the following solvent on the pad or prevent it from being contaminated :

- .Soldering flux
- .Chlorine (Cl) , Sulfur (S)

If goods were sent without being silicon coated on the pad, ITO patterns could be damaged due to the corrosion as time goes on.

If ITO corrosion happens by miss-handling or using some materials such as Chlorine (Cl), Sulfur (S) from customer, Responsibility is on customer.

13.3 Caution against static charge

The LCD module uses C-MOS LSI drivers, so we recommend that you :

Connect any unused input terminal to Vdd or Vss, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

13.4 Packing

Module employs LCD elements and must be treated as such.

- .Avoid intense shock and falls from a height.
- .To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity.

13.5 Caution for operation

- .It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage than the limit causes the shorter LCD life.
- .An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.
- .Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.
- .If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- .A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.
- .Usage under the maximum operating temperature, 50%Rh or less is required.
- .When fixed patterns are displayed for a long time, remnant image is likely to occur.

13.6 Storage

In the case of storing for a long period of time for instance, for years for the purpose of replacement use, the following ways are recommended.

- .Storing in an ambient temperature 10°C to 30°C, and in a relative humidity of 45% to 75%. Don't expose to sunlight or fluorescent light.
- .Storing in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it . And with no desiccant.
- .Placing in a dark place where neither exposure to direct sunlight nor light's keeping the storage temperature range.

- .Storing with no touch on polarizer surface by the anything else.

It is recommended to store them as they have been contained in the inner container at the time of delivery from us.

13.7 Safety

- .It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- .When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

14. PRECAUTION FOR USE

14.1 A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity. Judgment by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

14.2 On the following occasions, the handing of problem should be decided through discussion and agreement between responsible of the both parties.

- .When a question is arisen in this specification.
- .When a new problem is arisen which is not specified in this specifications.
- .When an inspection specifications change or operating condition change in customer is reported to DISPLAY, and some problem is arisen in this specification due to the change.
- .When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.