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|-------------------------------------|--------|--------------|------|
| Shenzhen P&O Technology Co.,Limited | Rev No | Issued Date. | Page |
| | A | 2023.05.15 | 1/12 |

| | | | |
|------------------------|-------------------------|----------|--|
| Project Size. | 2.4 inch | | |
| Model No. | P024C128-CTP | | |
| Samples No. | | | |
| Product type. | 240xRGBx320 SPI mode | | |
| Signature by customer: | | | |
| | | | |
| Prepared | Checked | Approved | |
| | | | |

Shenzhen P&O Technology Co.,Limited

Email: polcd@polcd.com

Mobile: 86-136 0019 7172

1.0 GENERAL DESCRIPTION

| Item | Specification | Unit |
|-------------------------------|---------------------|----------|
| Screen Size | 2.4 inch | Diagonal |
| Number of Pixel | 240RGB(H)x320(V) | Pixels |
| Display area | 36.72(H)x48.96(V) | mm |
| Pixel pitch | 51(H)x153(V) | um |
| Outline Dimension | 42.72x60.26x3.35 | mm |
| Pixel arrangement | RGB Vertical Stripe | — — |
| Display mode | Normally White | — — |
| Viewing Direction(eye) | 12 0'CLOCK | — — |
| Gray inversion direction | -- | |
| Display Color | 262K | — — |
| Luminance(cd/m ²) | 260 | nit |
| Contrast Ratio | 250:1 | — — |
| Surface treatment | — — | — — |
| Interface | 4W SPI | |
| Back-light | LED Side-light type | — — |
| Drive IC | ST7789V | |
| CTP IC | FT6336U | |
| Operation Temperature | -20~70 | ℃ |
| Storage Temperature | -30~80 | ℃ |
| Weight | — — | g |

1.1 Features

- n 4W SPI interface.

1.2 Applications

- n MPOS Device.
- n Personal Navigation Device.
- n Other devices which require high quality displays.

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|-------------------------------------|--------|--------------|------|
| Shenzhen P&O Technology Co.,Limited | Rev No | Issued Date. | Page |
| | A | 2023.05.15 | 3/12 |

2.0 INPUT INTERFACE PIN ASSIGNMENT

FPC connector is used for electronics interface.

| PinNo. | Symbol | Function |
|--------|------------|---|
| 1 | GND | Ground |
| 2 | VCC | Power Supply. 2.8V |
| 3 | SDA | SPI interface input/output pin |
| 4 | SCK | Serial interface clock |
| 5 | CS | Chip select input pin |
| 6 | RESET | External reset input. |
| 7 | BL_A | LED back light(Anode) |
| 8 | BL_K | LED back light(Cathode) |
| 9 | NC | NC |
| 10 | RS | Display data/command selection pin in parallel |
| 11 | YU/CTP_RST | Touch the upper circuit CTP screen reset |
| 12 | XL/CTP_INT | Touch the left line CTP screen interrupt signal |
| 13 | YD/CTP_SDA | Touch the lower line CTP screen data signal |
| 14 | XR/CTP_SCL | Touch the right end line CTP screen clock signal |
| 15 | VCC | Power Supply |
| 16 | GND | Ground |

| | | | |
|-------------------------------------|--------|--------------|------|
| Shenzhen P&O Technology Co.,Limited | Rev No | Issued Date. | Page |
| | A | 2023.05.15 | 4/12 |

3.0 OPTICAL CHARACTERISTICS

3.1 Optical specification

| Item | | Symbol | Condition | Min | Type | Max | Unit | Note |
|---------------------------------|-------|------------|--|-------|-------|-------|-------------------|-----------|
| White luminance (Center) | | Lv | Θ=0 Normal Viewing Angle I _{BL} =80mA | -- | 260 | -- | cd/m ² | (4)(5)(7) |
| Response time | | Tr+Tf | | -- | 30 | -- | ms | (3) |
| Contrast ratio | | CR | | -- | 250 | -- | -- | (2)(4) |
| Color Chromaticity (CIE1931) | white | Wx | | 0.288 | 0.308 | 0.328 | | (6) |
| | | Wy | 0.305 | 0.325 | 0.345 | | | |
| Viewing Angle | Hor | ΘL | CR≥10 | -- | 45 | -- | | (1) |
| | | ΘR | | -- | 45 | -- | | |
| | Ver | ΘU | | -- | 45 | -- | | |
| | | ΘD | | -- | 20 | -- | | |
| Brightness uniformity | | Avg | Θ=0 | 80 | 90 | -- | % | (5) |
| Color Gamut | | NTSC | Θ=0 | -- | 56 | -- | % | (6) |
| Optima View Direction | | 12 O'CLOCK | | | | | | (1) |

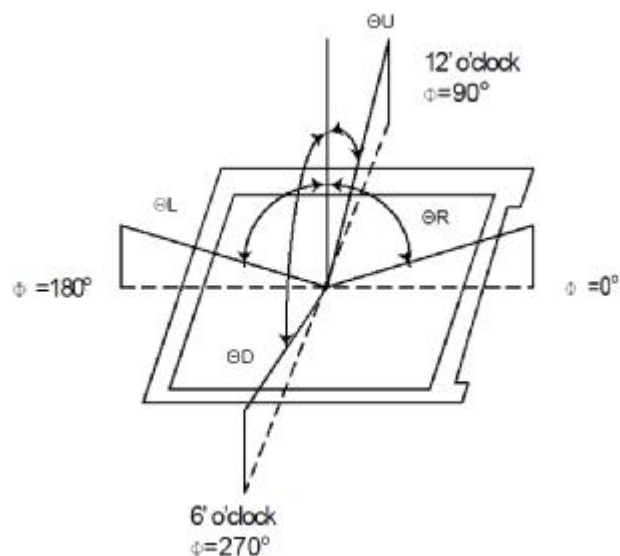
3.2 Measuring Condition

- n Measuring surrounding: dark room
- n LED current IL: 80mA
- n Ambient temperature: $25 \pm 2^{\circ}C$
- n 15min. warm-up time

3.3 Measuring Equipment

- n BM-7
- n Measuring spot size: 20 ~ 21 mm

Note (1) Definition of Viewing Angle

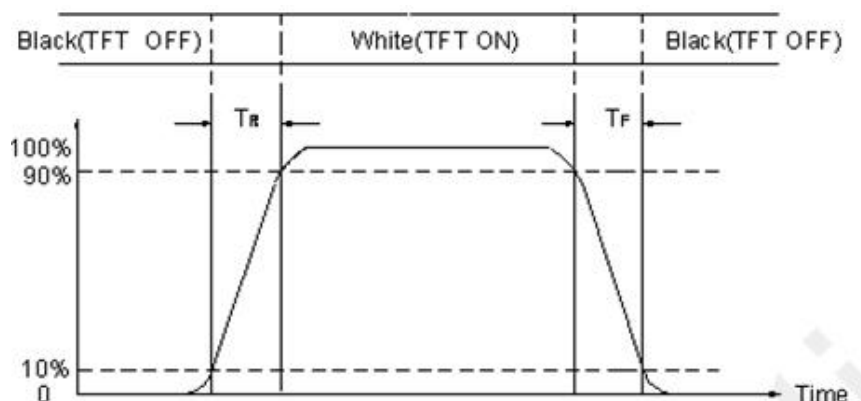


Note (2) Definition of Contrast Ratio(CR):

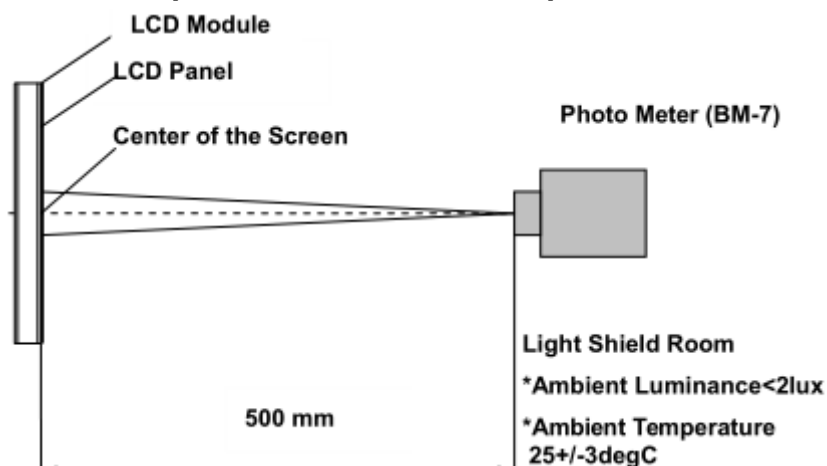
Measured at the center point of panel

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

Note (3) Definition of Response Time: Sum of TR and TF



Note (4) Definition of optical measurement setup



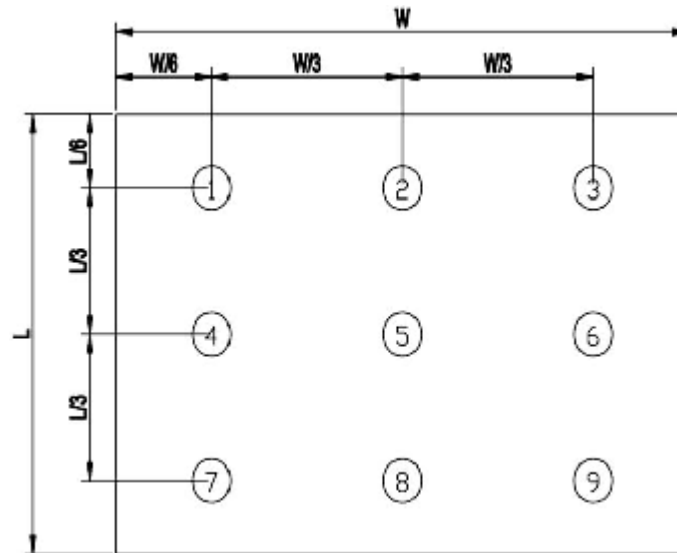
Note (5) Definition of brightness uniformity

The luminance uniformity is calculated by using following formula.

$$\Delta B_p = B_p (\text{Min.}) / B_p (\text{Max.}) \times 100 (\%)$$

$B_p (\text{Max.})$ = Maximum brightness in 9 measured spots

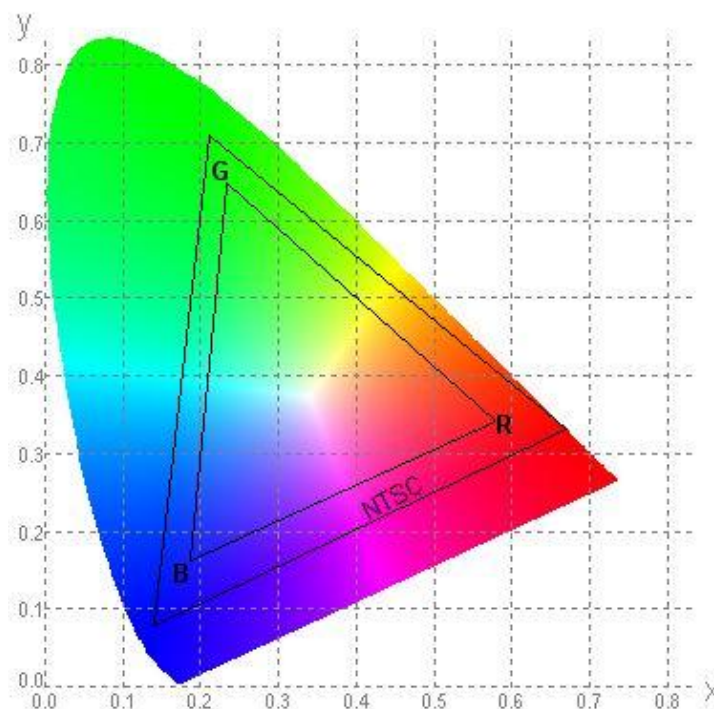
$B_p (\text{Min.})$ = Minimum brightness in 9 measured spots .



Note (6) Definition of Color of CIE1931 Coordinate and NTSC Ratio.

Color gamut:

$$S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$



Note (7) Measured the luminance of white state at center point.

| | | | |
|-------------------------------------|--------|--------------|------|
| Shenzhen P&O Technology Co.,Limited | Rev No | Issued Date. | Page |
| | A | 2023.05.15 | 7/12 |

4.0 ELECTRICAL CHARACTERISTICS

4.1 TFT LCD Module

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|------------------------|--------|---------|------|---------|------|--------|
| Analog supply voltage | VDD | 2.4 | 2.8 | 3.3 | V | |
| Digital supply voltage | VDDI | 1.65 | 1.8 | 3.3 | | |
| Input signal Voltage | VIH | 0.7VDDI | - | VDDI | V | |
| | VIL | GND | - | 0.3VDDI | V | |

4.2 Back-Light Unit

The backlight system is an edge-lighting type with 4 LED Dies.

The characteristics of the LED are shown in the following tables.

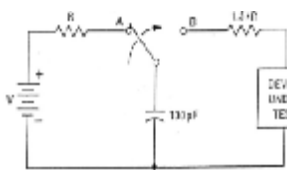
| Item | Symbol | Min | Typ | Max | Unit | Note |
|-------------------------|--------|-----|-------|-------|------|--------|
| LED current | IL | - | 60 | 80 | mA | (2) |
| LED voltage | VL | - | 2.8 | 3.2 | V | |
| Operating LED life time | Hr | - | 20000 | 15000 | Hour | (1)(2) |

Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition: $T_a=25\pm3\text{ }^{\circ}\text{C}$, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at $T_a=25^{\circ}\text{C}$ and $IL=80\text{mA}$. The LED lifetime could be decreased if operating IL is larger than 100mA. The constant current driving method is suggested.

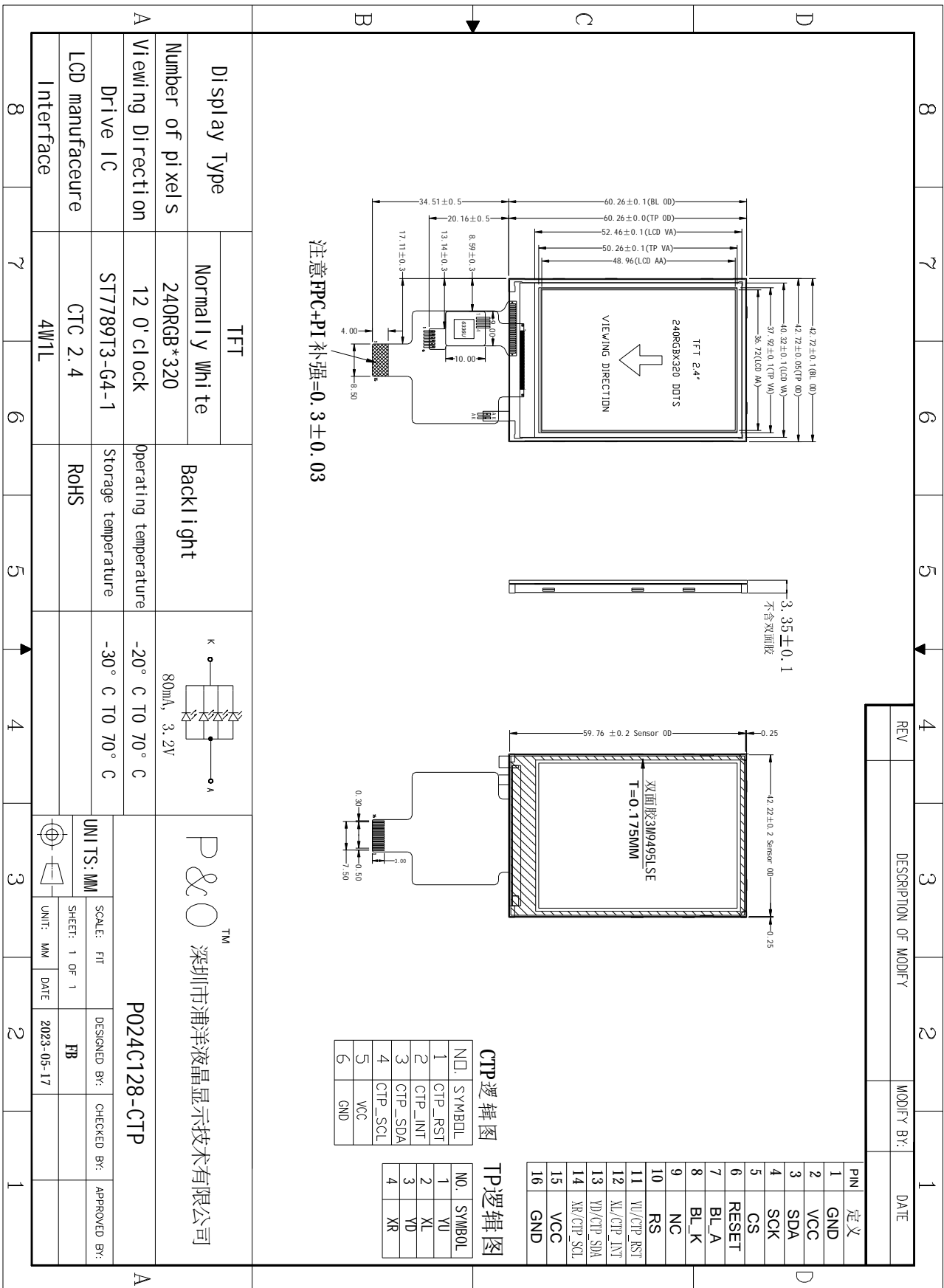
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|-------------------------------------|--------|--------------|------|
| Shenzhen P&O Technology Co.,Limited | Rev No | Issued Date. | Page |
| | A | 2023.05.15 | 8/12 |

5.0 Reliability conditions

| NO | Item | Conditions | Notes |
|----|--|--|-------|
| 1 | High Temperature Storage | Ta=80°C ±2°C, 72hrs | |
| 2 | Low Temperature Storage | Ta=-30°C ±2°C, 72hrs | |
| 3 | High Temperature Operation | Ta=70°C ±2°C, 72hrs(Operation state) | |
| 4 | Low Temperature Operation | Ta=-20°C ±2°C, 72hrs(Operation state) | |
| 5 | High Temperature and High Humidity (Storage) | Ta=+60°C, 90%RH, 72hrs | |
| 6 | Thermal Cycling Test (non operation) | -20°C (30min) → +70°C (30min), 10cycles | |
| 7 | Electro static Discharge | <p>Human Body Mode 100pF ± 10%/1500 Ω ± 1% Air ± 8kV / contact ± 6kV Consecutive 10times/ Each discharge</p>  | |
| 8 | Vibration test(with carton) | <p>Total fixed amplitude:15mm Vibration Frequency :10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes</p> | |
| 9 | Drop (with carton) | <p>Height: 60cm 1 corner, 3 edges, 6 surfaces</p> | |

Note: There is no display function NG issue occurred, all the cosmetic specification is judged before the reliability stress.

6.0 OUTLINE DIMENSION



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|-------------------------------------|--------|--------------|-------|
| Shenzhen P&O Technology Co.,Limited | Rev No | Issued Date. | Page |
| | A | 2023.05.15 | 10/12 |

7.0 Items and Criteria:

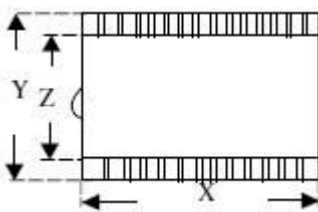
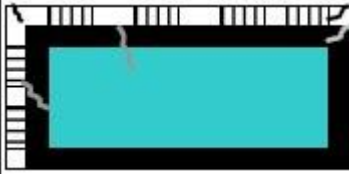
7.1 Guarantee

APEX warrants the quality of our products for **1 year** (from the date of delivery). If there are functional defects found during the period of warranty, the defective products would be replaced on a one-to-one basis. Apex would not be responsible for any direct /indirect liabilities consequential to any parties.

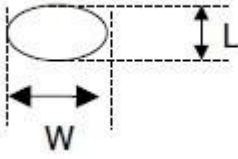
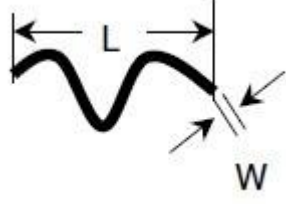
All the products should be stored or used as specified conditions described in these sheets. If module productions are not stored or used as specified conditions, herein, it will be void the **1 year** warranty(guarantee).

7.2 Visual inspection criterion in cosmetic

(1) Glass defect

| Glass defect | | | |
|--------------|------------------|--------------------------|--|
| NO | Defect | Criteria | Remark |
| 1 | Dimension(Minor) | By engineering diagram |  |
| 2 | Cracks(Major) | Extensive crack 【Reject】 |  |

(2) LCM appearance defect

| NO | Defect | Criteria | | Remark |
|----|-----------------------|--|-----------------|---|
| 1 | Round type(Minor) | Spec | Permissible Qty | 1. $\psi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A.  |
| | | $\psi \leq 0.10\text{mm}$ | Disregard | |
| | | $0.10\text{mm} < \psi \leq 0.20\text{mm}$ | 3 | |
| | | $0.20\text{mm} < \psi$ | 0 | |
| 2 | Line type(Minor) | Spec | Permissible Qty | 1. L: Length, W: Width 2. Disregard if out of A.A.  |
| | | $W \leq 0.03\text{mm}$ | Disregard | |
| | | $L \leq 3.0\text{mm}$ and $0.03\text{mm} < W \leq 0.05\text{mm}$ | 2 | |
| | | $L \leq 3.0\text{mm}$ and $0.05\text{mm} < W \leq 0.10\text{mm}$ | 1 | |
| | | $W > 0.10\text{mm}$ or $L > 3.0\text{mm}$ | 0 | |
| 3 | Polarizer dent(Minor) | Spec. | Permissible Qty | 1. $\psi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. |
| | | $\psi \leq 0.20\text{mm}$ | Disregard | |
| | | $0.20\text{mm} < \psi \leq 0.30\text{mm}$ | 2 | |
| | | $0.30\text{mm} < \psi \leq 0.50\text{mm}$ | 1 | |

| | | | |
|-------------------------------------|--------|--------------|-------|
| Shenzhen P&O Technology Co.,Limited | Rev No | Issued Date. | Page |
| | A | 2023.05.15 | 11/12 |

(3) FPC

| NO | Defect | Criteria | Remark |
|----|------------------------|--|--------|
| 1 | Copper peeling(Minor) | Copper peeling 【Reject】 | |
| 2 | Golden finger | FPC golden finger broken, dead fold, indentation makes FPC surface broken 【Reject】 Tin plating layer(or gold plating) scratch, but not hurt circuit 【Accept】 Except circuit, other position scratch but not expose metal wire 【Accept】 | |
| 3 | Pin | FPC PI layer delamination 【Reject】 Material and color are inconsistent with sample, FPC burrs 【Reject】 FPC Pin deformation but not affect function. 【Accept】 FPC Pin area is dirty 【Reject】 Other than FPC Pin area is dirty but not affect function 【Accept】 | |
| 4 | Golden finger | Golden finger edge has burrs,foreign material 【Reject】 Golden finger oxidation (dark), uneven electroplating, pinhole, foreign material 【Reject】 Golden finger soldering pad crack exceeds 1/3 length of soldering pad, and soldering pad crack exceed 2 Pins 【Reject】 Golden finger tin plating(or gold plating)scratch, but not hurt circuit 【Accept】 Other than golden finger area scratch but not expose metal circuit 【Accept】 | |
| 5 | FPC Silk printing | Ghosting, incomplete silk printing, wrong printing 【Reject】 | |
| 6 | FPC Circuit line width | Line width deviation exceed 1/3 line width 【Reject】 | |

(4) Black tape




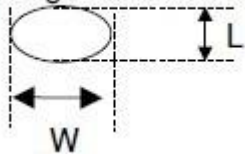
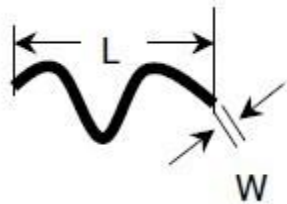
| NO | Defect | Criteria | Remark |
|----|----------------------|-------------------------------|--------|
| 1 | Shift(Minor) | IC exposed 【Reject】 | |
| 2 | No black tape(Minor) | No black tape 【Reject】 | |

(5) Silicon

| NO | Defect | Criteria | Remark |
|----|---------------------------|-----------------------------|--------|
| 1 | Amount of silicon (Minor) | ITO exposed 【Reject】 | |

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|-------------------------------------|--------|--------------|-------|
| Shenzhen P&O Technology Co.,Limited | Rev No | Issued Date. | Page |
| | A | 2023.05.15 | 12/12 |

7.3 Visual inspection criterion in electrical display

| NO | Defect | Criteria | | Remark |
|----|--------------------------------|--|-----------------|---|
| 1 | No display (Major) | Not allowed | |  |
| 2 | Missing line (Major) | Not allowed | |  |
| 3 | Darker or lighter Line (Major) | Not allowed | |  |
| 4 | Weak line(Major) | By limited sample | | |
| 5 | Bright / Dark point (Minor) | Spec. | Permissible Qty | 1:1sub-pixel: 1R or 1G or1B 2:Point defect area $\geq 1/2$ sub pixel. |
| | | Bright point | 1 | |
| | | Dark point | 2 | |
| 6 | Round type (Minor) | Spec | Permissible Qty | 1. $\psi=(L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A.  |
| | | $\psi \leq 0.10\text{mm}$ | Disregard | |
| | | $0.10\text{mm} < \psi \leq 0.20\text{mm}$ | 3 | |
| | | $0.20\text{mm} < \psi$ | 0 | |
| 7 | Line type (Minor) | Spec. | Permissible Qty | 1. L: Length, W: Width 2. Disregard if out of A.A.  |
| | | $W \leq 0.03\text{mm}$ | Disregard | |
| | | $L \leq 3.0\text{mm}$ and $0.03\text{mm} < W \leq 0.05\text{mm}$ | 2 | |
| | | $L \leq 3.0\text{mm}$ and $0.05\text{mm} < W \leq 0.10\text{mm}$ | 1 | |
| | | $W > 0.10\text{mm}$ or $L > 3.0\text{mm}$ | 0 | |
| 8 | Mura (Minor) | By 5% ND filter invisible | | |