

APEX

APEX SCIENCE & ENGINEERING CORP

(OPTOELECTRONIC DIV.)

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TAP01166PFE40N

ROHS

DATA SHEET

Acceptance

| ISSUE | VERSION | APPROVER | CHECKER | ENGINEER |
|---|---------|---|---------|---|
|  | A |  | |  |

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|------------------------------|---------------|-----------------------|-----------------|---------------------|
| Messrs. | | | | |
| Product Specification | Model: | TAP01166PFE40N | Rev. NO. | Issued Date. |
| | | | A | Dec.14,18 |

Record of Revisions

| Rev | Date | Sub-Model | Description of change |
|-----|------------|----------------|--|
| A | 2018.12.14 | TAP01166PFE40N | Preliminary Product Specification was first issued. |

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1. General description

1.1 Introduction

APEX model TAP01166PFE40N is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT LCD panel, a driving circuit and a back light system. This TFT LCD has a 7.0 (16:9) inch diagonally measured active display area with Full HD (1920 horizontal by 1080 vertical pixel) resolution.

1.2 Features

11.6 (16:9 diagonal) inch configuration

Edp(Embedded display port) Ver1.2 interface

Edp Transfer rate Specification :Edp1.2/2.7 Gbps/2lane

LED Backlight

RoHS Compliance

1.3 Applications

Mobile NB,

Personal Navigation Device

Multimedia applications and Others AV system

1.4 General information

| Item Specificatio | n | Unit |
|-------------------|------------------------------|--------|
| Outline Dimension | 267.72 x 164.42x 6.1 (Typ.) | mm |
| Display area | 256.32(H) x144.18(V) | mm |
| Number of Pixel | 1920 RGB(H) x 1080(V) | pixels |
| Pixel pitch | 0.1335(H) x 0.1335(V) | mm |
| Pixel arrangement | RGB Vertical stripe | |
| Display mode | Normally black(FFS) | |
| Surface treatment | Antiglare, Hard-Coating(3H) | |
| Weight | 103(Typ.) | g |
| Back-light | Single LED (Side-Light type) | |
| Power Consumption | B/L System TBD | w |

1.5 Mechanical Information

| item | Min. | Typ. | Max. | Unit |
|---------------|--------|--------|--------|------|
| Module Size | | | | |
| Horizontal(H) | 267.42 | 267.72 | 268.02 | mm |
| Vertical(V) | 164.12 | 164.42 | 164.72 | mm |
| Depth(D) | 5.8 | 6.1 | 6.4 | mm |

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2.0 ABSOLUTE MAXIMUM RATINGS

2.1 Electrical Absolute Rating

2.1.1 TFT LCD Module

| Item Sym | bol | Min. | Max. | Unit. | Note |
|----------------------|-----|------|------|-------|-------|
| Power supply voltage | Vcc | -0.3 | 4.0 | V | GND=0 |
| | | | | V | GND=0 |
| | | | | V | GND=0 |
| | | | | V | |
| | | | | V | |
| Input Voltage(eDP) | V1 | -0.3 | 1.5 | V | |

2.1.2 Back-Light Unit

| Item Sy | mbol | MIN. | TYP. | MAX. | Unit | Note |
|-------------------|------|------|------|------|------|-----------|
| Forward voltage | Vf | -- | 30 | 33 | V | (1)(2)(3) |
| Forward current | If | -- | 180 | | mA | (1)(2)(3) |
| Power Consumption | PBL | -- | 5.4 | 6 | W | |

Note:

(1) Permanent damage may occur to the LCD module if beyond this specification. Functional operation should be restricted to the conditions described under normal operating conditions.

(2) $T_a = 25 \pm 2^\circ\text{C}$

(3) Test Condition: LED current 180 mA

2.2 Environment Absolute Rating

| Item | Symbol | Min. | Max. | Unit | Remarks |
|------------------------------|-------------|------------|------------|------------------|---------|
| Operating Temperature | Topa | -20 | +70 | $^\circ\text{C}$ | |
| Storage Temperature | Tstg | -30 | +80 | $^\circ\text{C}$ | |

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3.0 OPTICAL CHARACTERISTICS

3.1 Optical specification:

| Item | Symbol | Temp. | Min. | Typ. | Max. | Unit | Condition |
|-----------------------------------|----------|--------------|----------------|-------|--|---------|---|
| Response Time | Tr | 25°C | -- | 10 | 20 | msec | $\theta = 0^\circ, \phi = 0^\circ$ (Note 1,3) |
| | Tf | 25°C | -- | 15 | 30 | | |
| Contrast Rate | Cr | 25°C | 700 | 1000 | -- | -- | $\theta = 0^\circ, \phi = 0^\circ$ LED:ON, LIGHT:OFF(Note1,2) |
| Brightness | YL | 25°C | 450 | 500 | | Cd/m2 | (IL=180mA)(Note1,4) |
| Visual angle range front and rear | θ | 25°C | (θ L) | | | De-gree | $\phi = 0^\circ, CR \geq 10$ LED:ON LIGHT:OFF(Note 1,4) |
| | | | 80 | 89 | | | |
| | | | (θ R) | | | | |
| Visual angle range left and right | θ | 25°C | (θ U) | | | De-gree | $\phi = 90^\circ, CR \geq 10$ LED:ON LIGHT:OFF(Note 1,4) |
| | | | 80 | 89 | | | |
| | | | (θ D) | | | | |
| Brightness uniformity | BUNI | | 70 | | | % | $\Theta = 0$ (Note5,7) |
| Visual angle | | | all | | | | (Note 6) |
| Item | Symbol | Transmissive | | | Conditions | | |
| | | Min. | Typ. | Max. | | | |
| Red | XR | | | | Reference: CPT Panel, CIE (x, y) chromaticity (Note 1,4) | | |
| | YR | | | | | | |
| Green | XG | | | | | | |
| | YG | | | | | | |
| Blue | XB | | | | | | |
| | YB | | | | | | |
| White | XW 0.283 | | 0.313 | 0.343 | | | |
| | YW 0.299 | | 0.329 | 0.359 | | | |

3.2 Measuring Condition

Measuring surrounding: dark room ,LED current IL : 180mA

Ambient temperature: 25±2oC

15min. warm-up time.

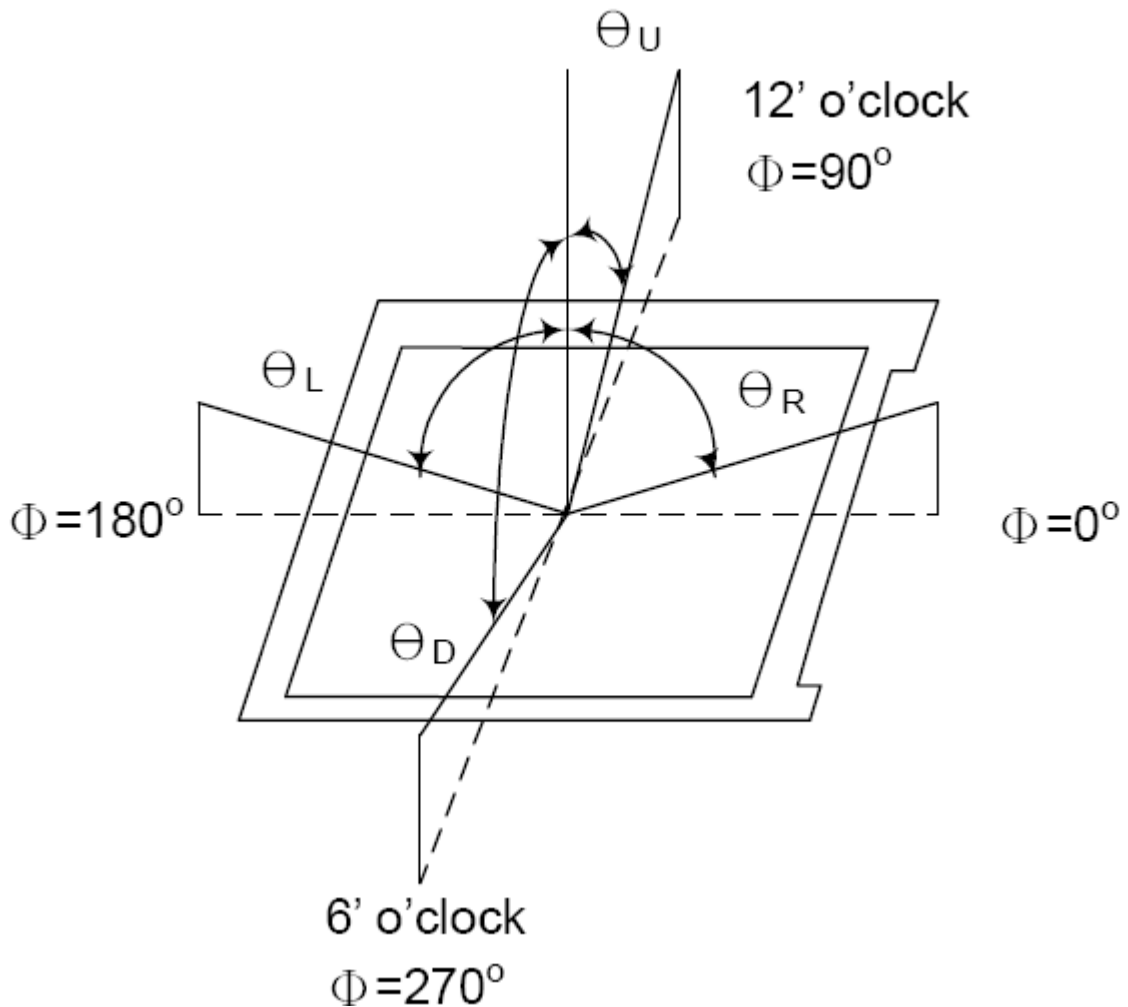
3.3 Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for

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**Chromaticity and BM-5A for other optical characteristics. Measuring spot size:
20 ~ 21 mm**

Note (1) Definition of Viewing Angle :



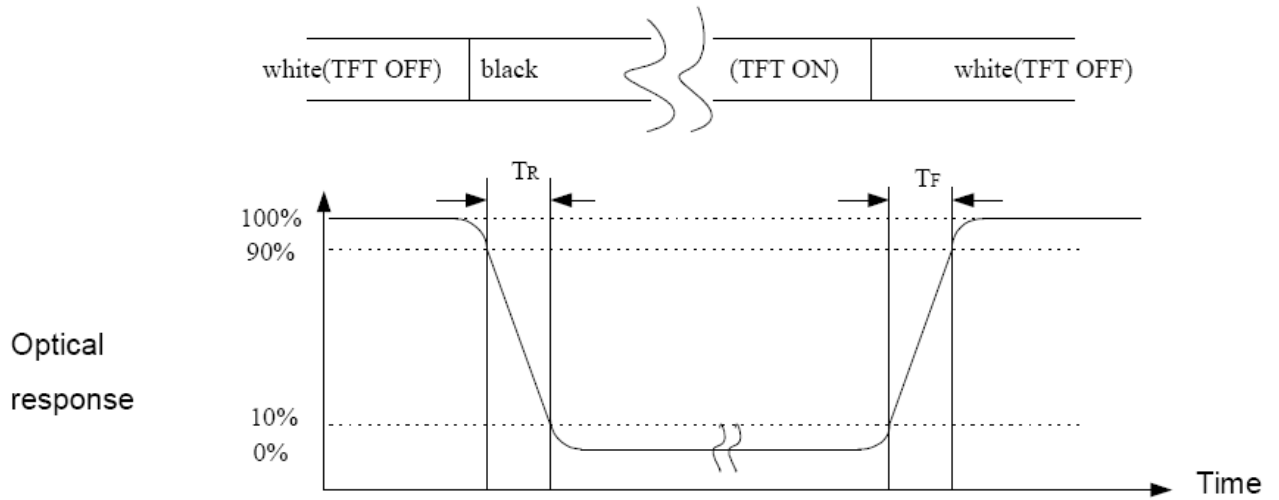
Note (2) Definition of Contrast Ratio (CR):

Measured at the center point of panel

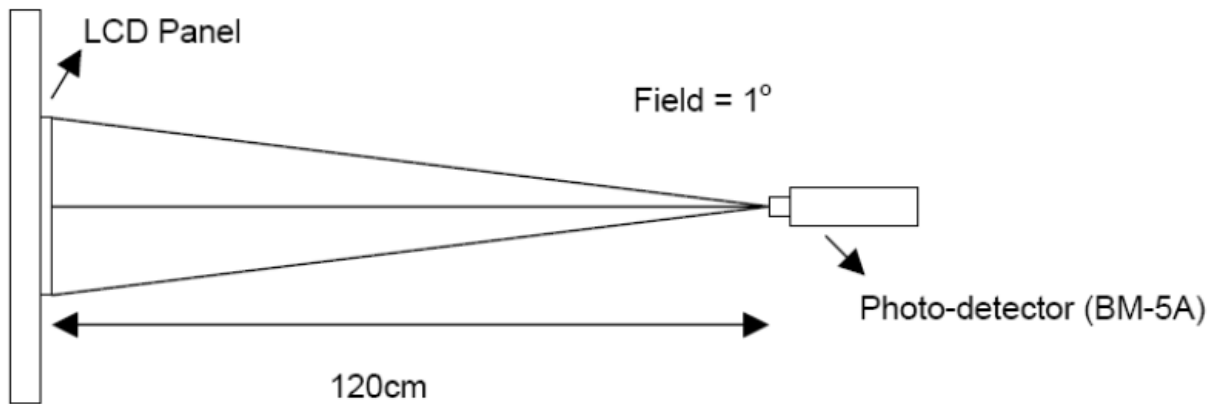
$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

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

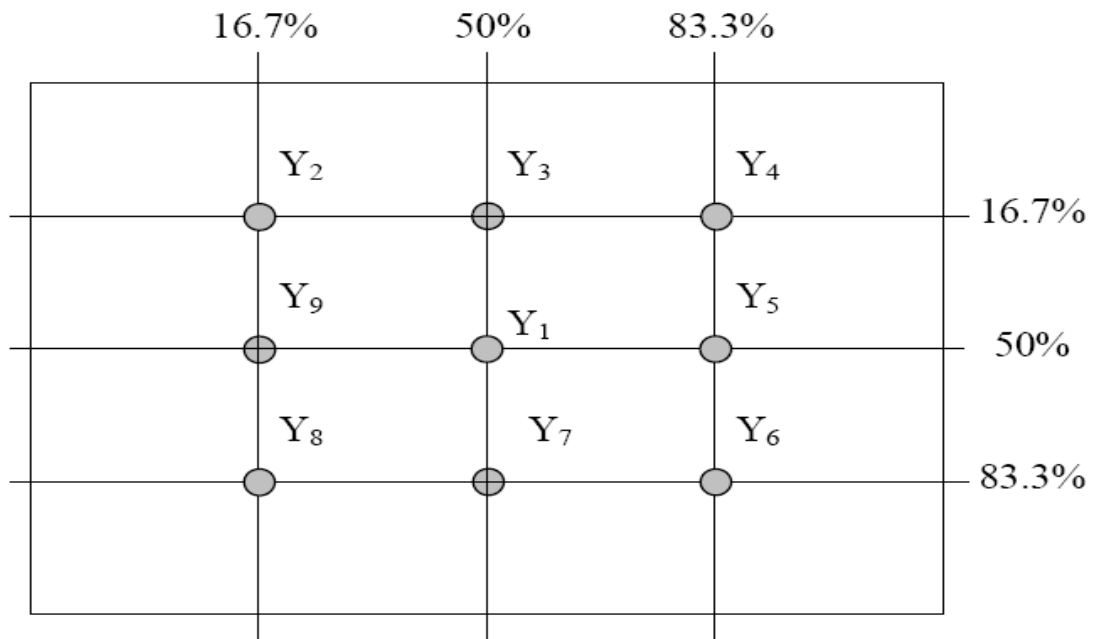


Note (4) Definition of optical measurement setup



| | | | |
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Note (5) Definition of brightness uniformity



$$\text{Luminance uniformity} = \frac{(\text{Min Luminance of 9 points})}{(\text{Max Luminance of 9 points})} \times 100\%$$

Note (6) Rubbing Direction (The different Rubbing Direction will cause the different optimal view direction).

Note (7) Measured at the brightness of the panel when all terminals of LCD panel are electrically open.

4.0 BLOCK DIAGRAM

4.1 TFT LCD Module



Display position of input data(V·H)

4.2 Edp interface

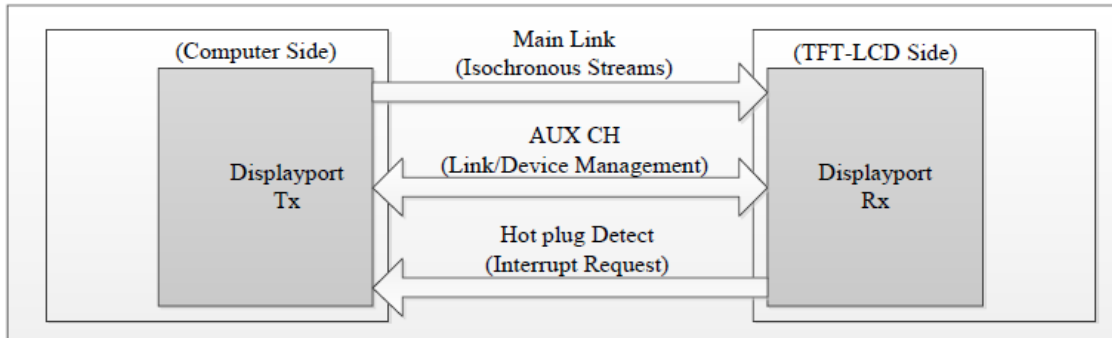


Fig.4-2-1 DP architecture

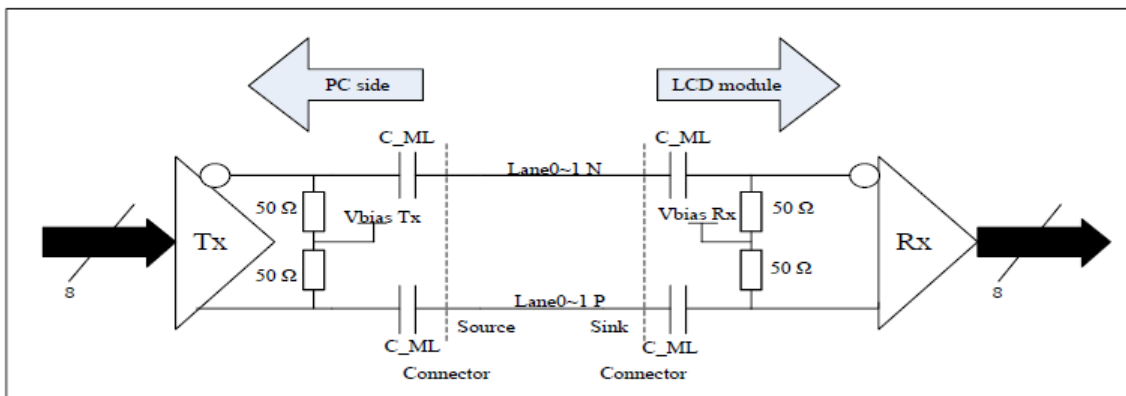


Fig.4-2-2 Main Link differential pair

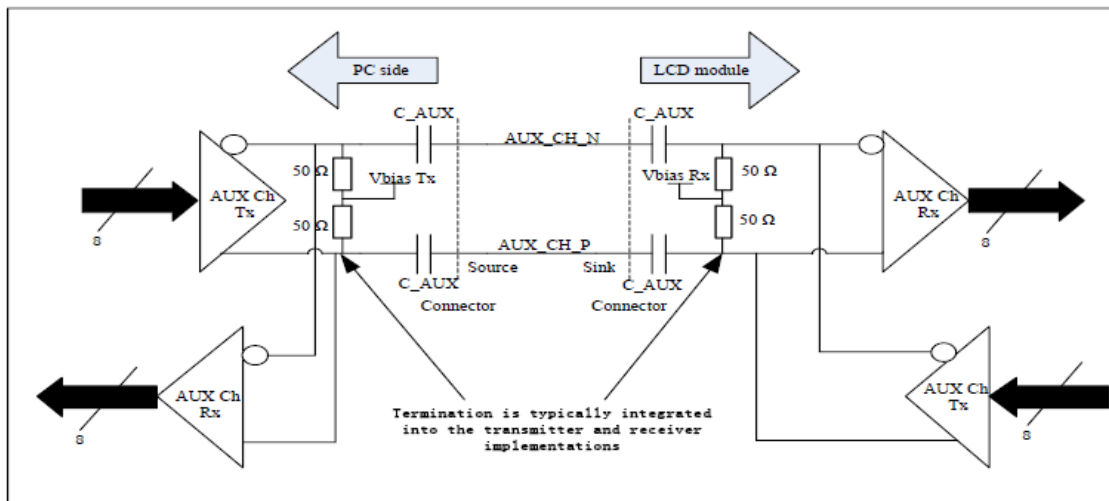


Fig.4-2-3 AUX Link differential pair

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| Lane0 | Lane1 |
|--------|--------|
| R0-7:0 | R1-7:0 |
| G0-7:0 | G1-7:0 |
| B0-7:0 | B1-7:0 |
| R2-7:0 | R3-7:0 |
| G2-7:0 | G3-7:0 |
| B2-7:0 | B3-7:0 |
| R4-7:0 | R5-7:0 |
| G4-7:0 | G5-7:0 |
| B4-7:0 | B5-7:0 |

Fig.4-2-4 eDP 2lane 8bit input data mapping

| | | | |
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5.0 Interface Pin Connection

5.1 Driver interface of PWB

CN1(Edp Signal ,3.3V DC Supply)

| Terminal No. | Symbol | IO | Functions |
|--------------|----------|----|-------------------------------------|
| 1 | NC | P | Not connected |
| 2 | H-GND | P | High Speed ground |
| 3 | Lane1_N | I | Complement signal link Lane1 |
| 4 | Lane1_P | I | True signal Link Lane1 |
| 5 | H-GND | P | High Speed ground |
| 6 | Lane0_N | I | Complement signal link Lane0 |
| 7 | Lane0_P | I | True signal Link Lane0 |
| 8 | H-GND | P | High Speed ground |
| 9 | AUX_CH_P | I | True signal Auxiliary channel |
| 10 | AUX_CH_N | I | Complement signal Auxiliary channel |
| 11 | H_GND | P | High Speed ground |
| 12 | LCD_VCC | P | LCD logic and driver Power |
| 13 | LCD_VCC | P | LCD logic and driver Power |
| 14 | NC | -- | Not connected |
| 15 | LCD_GND | P | LCD logic and driver ground |
| 16 | LCD_GND | P | LCD logic and driver ground |
| 17 | HPD | O | Hpd signal Pin |
| 18 | NC | P | Not connected |
| 19 | NC | P | Not connected |
| 20 | NC | P | Not connected |
| 21 | NC | P | Not connected |
| 22 | NC | P | Not connected |
| 23 | NC | P | Not connected |
| 24 | NC | P | Not connected |
| 25 | NC | P | Not connected |
| 26 | NC | P | Not connected |
| 27 | NC | P | Not connected |
| 28 | NC | P | Not connected |
| 29 | NC | P | Not connected |
| 30 | NC | P | Not connected |

Notes:

| | | | |
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*1 P: POWER I: Input O: Output

The shielding case is connected with signal GND

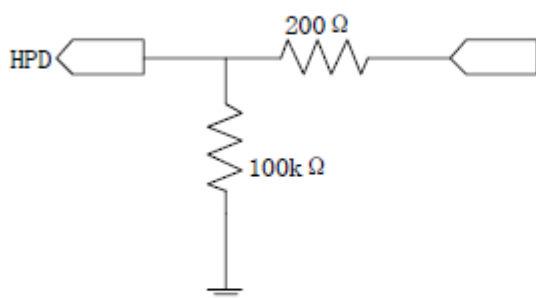
- Connector used :20455-030E-76 (I-PEX)
- Corresponding connector : 20453-030T (I-PEX)

(Panda is not responsible to its product quality, if the user applies a connector not corresponding to the above model.)

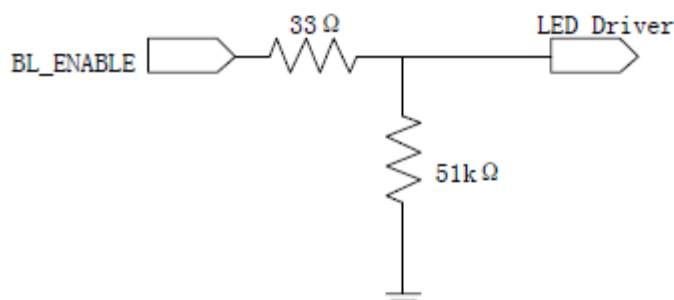
All terminals except NC terminal must be connected to input signal described as above or supply voltage or GND each.

[Note 4-1-1] Do not input any signals or any powers into a NC pin. Keep the NC pin open.

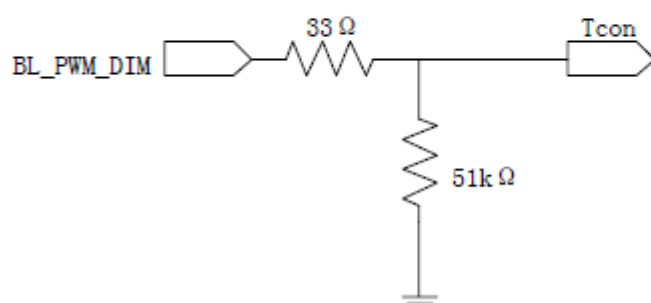
[Note 4-1-2] Output circuit is as below.



[Note 4-1-3] Input circuit is as below.



[Note 4-1-4] Input circuit is as below.



6.0 ELECTRICAL CHARACTERISTICS

| Item Sym | bol | Min. | Type | Max. | Unit. | Note |
|----------------------|-------|------|------|------|-------|-----------|
| Power supply voltage | Vcc | 3.0 | 3.3 | 3.6 | V | GND=0 |
| | Vrp | | | 100 | mVp-p | Vcc=+3.3V |
| | | | | | V | GND=0 |
| | IDD - | | 212 | 364 | mA | AGND=0 |
| | Irush | | | 1.0 | A | |

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| | | | | | | |
|-----------------------|-----|-----|--|----|----|--|
| Operation Temperature | Top | -20 | | 70 | °C | |
| Storage Temperature | Tst | -30 | | 80 | °C | |

6.1 TFT LCD Module

| eDP HPD Signal Characteristics | | | | | | |
|--------------------------------|--------------------|------|---------|------|------|--------|
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
| HPD High level output voltage | VOH _{HPD} | | VDD-0.1 | - | | |
| HPD Low level output voltage | VOL _{HPD} | - | 0 | | | |

| eDP AUX Channel Characteristics | | | | | | |
|---------------------------------|--------------------------|------|------|------|------|--------------------|
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
| Unit Interval for AUX channel | UI _{AUX} | 0.4 | 0.5 | 0.6 | μS | |
| Peak-to-peak voltage at TP1 | V _{AUX-DIFF-PP} | 0.32 | - | 1.36 | V | |
| AUX DC Common mode Voltage | V _{AUX-DC-CM} | 0 | - | 2.0 | V | |
| AUX Short current limit | I _{AUX-SHORT} | - | - | 90 | mA | |
| AUX CH termination Resistor | R _{AUX-TERM} | - | 100 | - | Ω | Differential input |
| AUX AC coupling capacitor | C _{AUX} | 75 | - | 200 | nF | |
| Number of pre-charge pulses | Pre-charge pulses | 10 | - | 16 | - | |

| eDP Main Link Receiver Characteristics | | | | | | |
|--|---|------|------|------|------|--------|
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
| Link clock down spreading | Down_Spread_Amplitude | 0 | | 0.5 | % | |
| Differential Peak-to-peak Input Voltage at Rx package pins | V _{RX-DIFF-P} | 120 | - | 1200 | mV | |
| Differential Return Loss at 1.35GHz at Rx package pins | RL _{RX-DIFF} | 9 | - | - | dB | |
| Differential termination resistance | R _{RX-TERM} | - | 100 | - | Ω | |
| RX short circuit Current Limit | I _{RX-SHORT} | - | - | 50 | mA | |
| Lane Intra-pair Skew at RX package pins | T _{RX-SKEW-INTRA-PAIR-High-Bit-Rate} | - | - | 50 | ps | |

Messrs.

Product Specification

Model:

TAP01166PFE40N

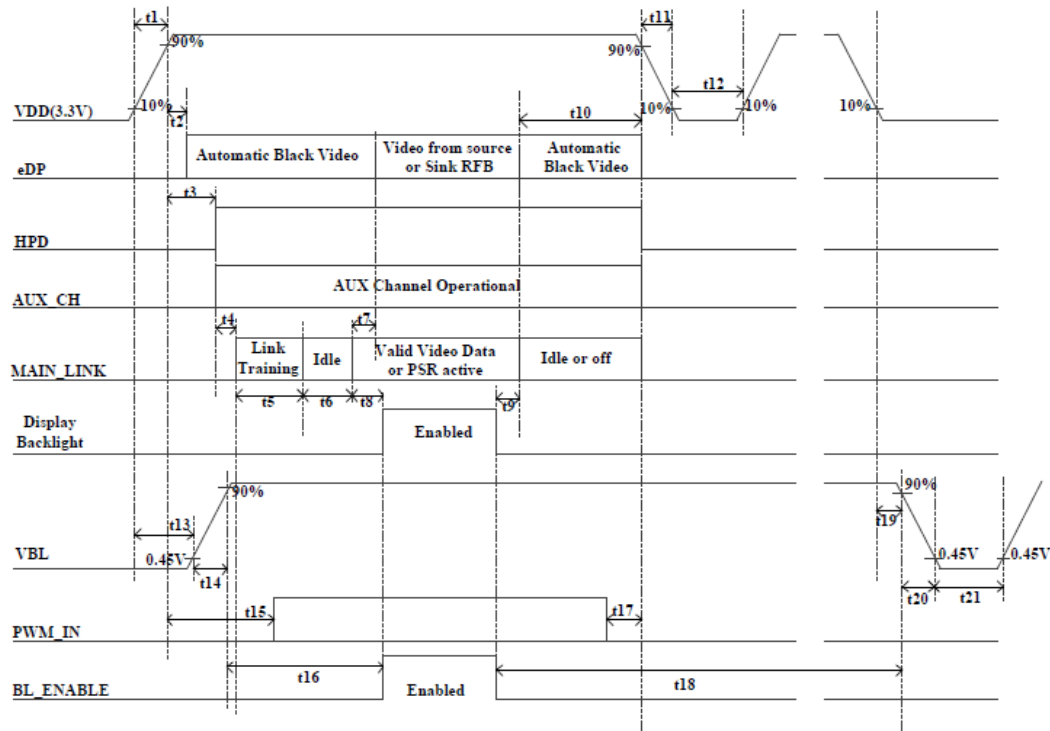
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[Note 6-1-1] ON-OFF conditions for supply voltage



[Note] Do not keep the interface signal high-impedance or unusual signal when power is on.

| Symbol | Min | Max | Unit | Note |
|--------|-----|-----|------|---------|
| t1 | 0.5 | 10 | ms | |
| t2 | 0 | 100 | ms | |
| t3 | 0 | 100 | ms | |
| t4 | - | - | ms | |
| t5 | - | - | ms | |
| t6 | - | - | ms | |
| t7 | 0 | 50 | ms | |
| t8 | | | ms | |
| t9 | | | ms | |
| t10 | 0 | 500 | ms | |
| t11 | 1 | 50 | ms | [Note1] |
| t12 | 500 | - | ms | |
| t13 | - | - | ms | |
| t14 | 0.5 | 10 | ms | |
| t15 | 100 | | ms | |
| t16 | - | - | ms | |
| t17 | 0 | - | ms | |
| t18 | - | - | ms | |
| t19 | - | - | ms | |
| t20 | 0.1 | - | ms | |
| t21 | 100 | | ms | |

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6.2 Back-Light Unit

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

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|-------------------------|--------|-------|------|------|------|--------|
| LED current | IL | - | 180 | | mA | (2) |
| LED Voltage | VL | - | 30 | 33 | V | |
| Operating LED life time | Hr | 50000 | - | | Hour | (1)(2) |

Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition: $T_a=25\pm 3\text{ }^\circ\text{C}$, typical IL value indicated in the above table until the brightness becomes less than 50%.

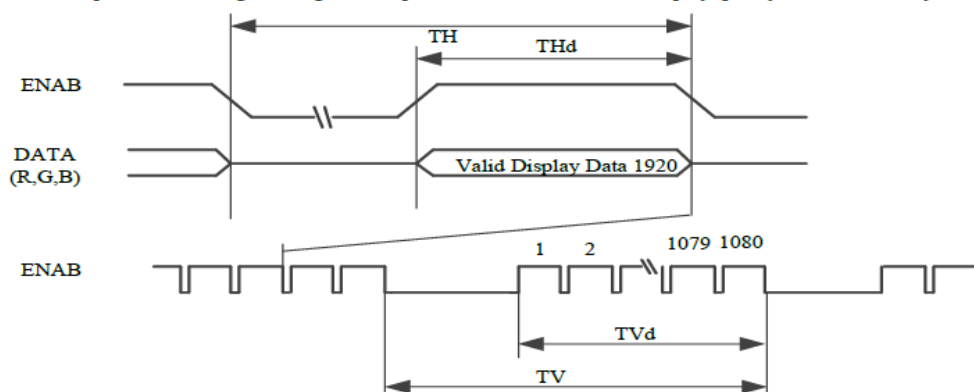
Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at $T_a=25^\circ\text{C}$ and $IL=180\text{mA}$. The LED lifetime could be decreased if operating IL is larger than 180mA. The constant current driving method is suggested.

6.3 AC Characteristics

VDD=+3.0V~+3.6, $T_a=-10^\circ\text{C}\sim+60^\circ\text{C}$

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
|--------------------|--------------------------|------|--------|------|---------------|-------------|
| Clock | Frequency | - | 138.5 | - | MHz | [Note7-1-1] |
| Data enable signal | Horizontal period | - | 2080 | - | clock | |
| | Horizontal period (High) | - | 15.02 | - | μs | |
| | Vertical period | - | 1920 | - | clock | |
| | Vertical period (High) | - | 1111 | - | line | |
| | | - | 16.685 | - | ms | |
| | | - | 1080 | - | line | |

[Note 7-1-1] In case of using the long vertical period, the deterioration of display quality, flicker, etc., may occur.



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7.0 Reliability test items

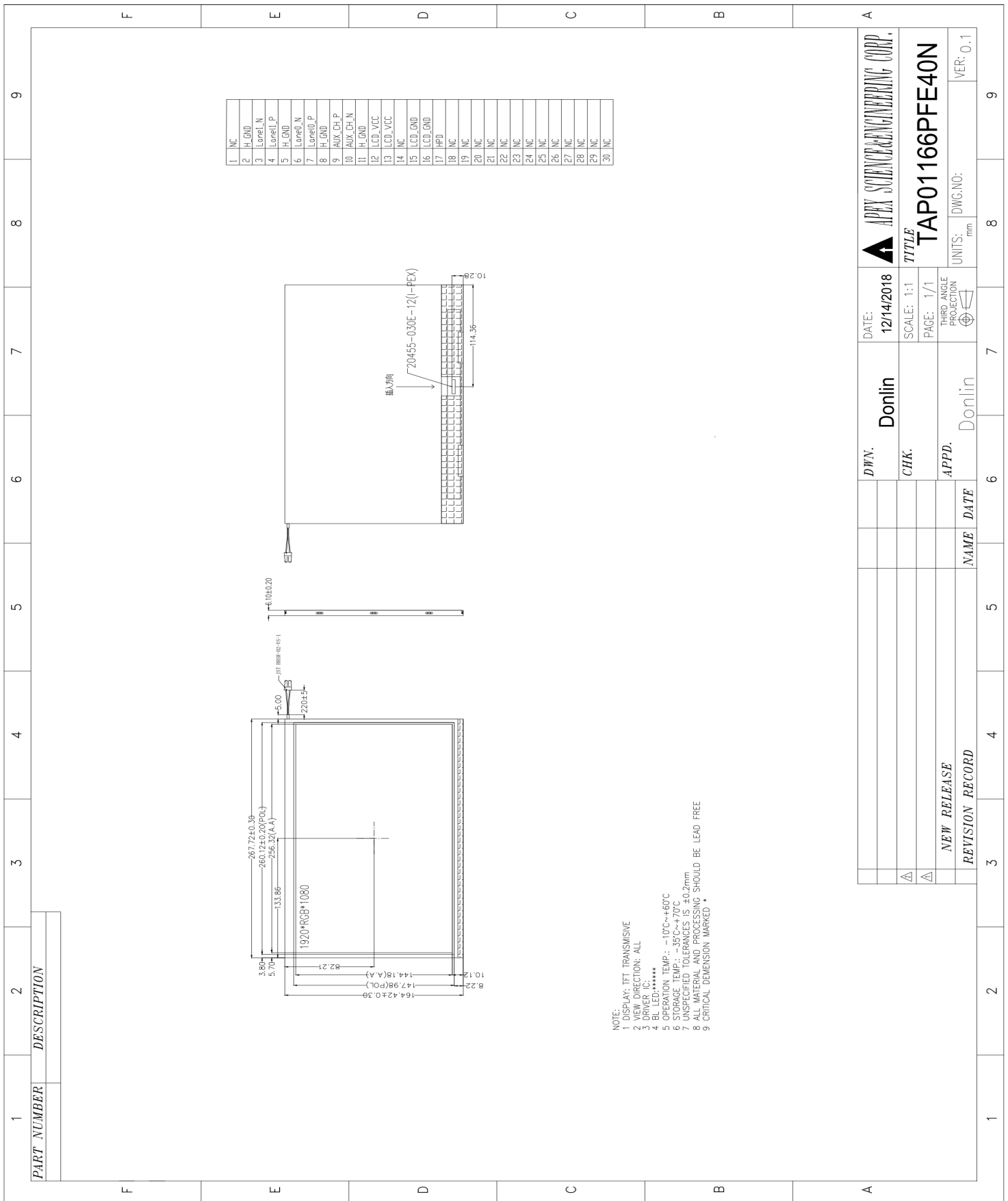
| NO. | Item | Conditions | Remark |
|-----|---|---|---|
| 1 | High Temperature Storage | Ta= +70℃,240hrs | Inspection after 2~4 hours storage at room temperature, the sample shall be free from defects 1. Air bubble in the LCD 2. Sealleak 3. non-display 4. missing segments 5. glass crack 6. current idd is twice higher than initial value. |
| 2 | Low Temperature Storage | Ta= -20℃,240hrs | |
| 3 | High Temperature Operation | Ta= +60℃,240hrs | |
| 4 | Low Temperature Operation | Ta= -10℃,240hrs | |
| 5 | High Temperature and High Humidity(Operation) | Ta= +60℃, 90%RH, 240hrs | |
| 6 | Thermal cycling Test (non operation) | -30℃(30min)→+80℃(30min),200cycles | |
| 7 | Electrostatic discharge | 200V 200pf(0ohm) 1time/each terminal | |
| 8 | Vibration | 1. Random: 1.04 Grms,5~500HZ, X/Y/Z,30min/each direction 2. Sine: Freq. Range:8~33.3hz Stoke:1.3mm Sweep:2.9G,33.3~400HZ X/Z:2hr,Y:4hr,cyc:15min | |
| 9 | Shock | 100G,6ms,±X, ±Y, ±Z 3 times for each direction | |
| 10 | Vibration(with carton) | Random:0.015G ^ 2/HZ, 5~200HZ -6dB/octave,200~400HZ XYZ each dirction:2hr | |
| 11 | Drop (with carton) | Height:60cm 1corner,3edges,6surfaces | |

Note:

1. There is no display function NG issue occurred, all the cosmetic specification is judged before the reliability stress.
2. the test samples should be applied to only one test item
3. for damp proof test, Pure water(resistance>10M ohm)should be used
4. 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
5. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Charateristic, Optical Characteristic

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8.0 OUTLINE DIMENSION



| | | | |
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9.0 GENERAL PRECAUTION

9.1 Use Restriction

This product is not authorized for use in life supporting systems, aircraft navigation control systems, military systems and any other application where performance failure could be life threatening or otherwise catastrophic.

9.2 Disassembling or Modification

Do not disassemble or modify the module. It may damage sensitive parts inside LCD module, and may cause scratches or dust on the display. HannStar does not warrant the module, if customers disassemble or modify the module.

9.3 Breakage of LCD Panel

9.3.1. If LCD panel is broken and liquid crystal spills out, do not ingest or inhale liquid crystal, and do not contact liquid crystal with skin.

9.3.2. If liquid crystal contacts mouth or eyes, rinse out with water immediately.

9.3.3. If liquid crystal contacts skin or cloths, wash it off immediately with alcohol and rinse thoroughly with water.

9.3.4. Handle carefully with chips of glass that may cause injury, when the glass is broken.

9.4 Electric Shock

9.4.1. Disconnect power supply before handling LCD module.

9.4.2. Do not pull or fold the LED cable.

9.4.3. Do not touch the parts inside LCD modules and the fluorescent LED's connector or cables in order to prevent electric shock.

9.5 Absolute Maximum Ratings and Power Protection Circuit

9.5.1. Do not exceed the absolute maximum rating values, such as the supply voltage variation, input voltage variation, variation in parts' parameters, environmental temperature, etc., otherwise LCD module may be damaged. 9.5.2. Please do not leave LCD module in the environment of high humidity and high temperature for a long time. 11.5.3. It's recommended to employ protection circuit for power supply.

9.6 Operation

9.6.1 Do not touch, push or rub the polarizer with anything harder than HB pencil lead.

9.6.2 Use fingerstalls of soft gloves in order to keep clean display quality, when persons handle the LCD module for incoming inspection or assembly.

9.6.3 When the surface is dusty, please wipe gently with absorbent cotton or other soft

| | | | | |
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material.

9.6.4 Wipe off saliva or water drops as soon as possible. If saliva or water drops contact with polarizer for a long time, they may causes deformation or color fading.

9.6.5 When cleaning the adhesives, please use absorbent cotton wetted with a little petroleum benzine or other adequate solvent.

9.7 Mechanism

Please mount LCD module by using mouting holes arranged in four corners tightly.

9.8 Static Electricity

9.8.1 Protection film must remove very slowly from the surface of LCD module to prevent from electrostatic occurrence.

9.8.2. Because LCD module use CMOS-IC on circuit board and TFT-LCD panel, it is very weak to electrostatic discharge. Please be careful with electrostatic discharge. Persons who handle the module should be grounded through adequate methods.

9.9 Strong Light Exposure

The module shall not be exposed under strong light such as direct sunlight. Otherwise, display characteristics may be changed.

9.10 Disposal



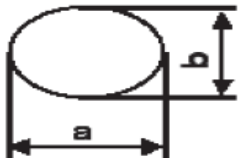
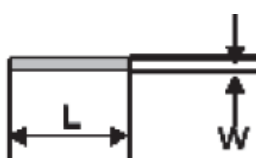
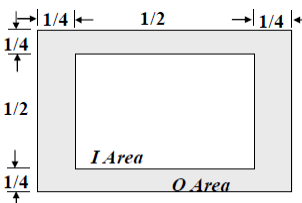
When disposing LCD module, obey the local environmental regulations.

10. Package Specification

10.1 Packing format

| | | | |
|-----------------------|--------|----------------|--------------|
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11. Visuals Specification: 1) Note

| | | | |
|-------------------------------|---|---|---|
| General | <p>1. Customer identified anomalies not defined within this inspection standard shall be reviewed by APEX, and an additional standard shall be determined by mutual consent.</p> <p>2. This inspection standard about the image quality shall be applied to any defect within the effective viewing area and shall not be applicable to outside of the area.</p> <p>3. Inspection conditions</p> <p>Luminance : 500 Lux min.</p> <p>Inspection distance : 300 mm.</p> <p>Temperature : 25±5°C</p> <p>Direction : Directly above</p> | | |
| Definition of inspection item | Dot defect | Bright dot defect | <p>The dot is constantly “on” when power applied to the LCD, even when all “Black” data sent to the screen. Inspection tool: 5% Transparency neutral density filter. Count dot: If the dot is visible through the filter. Don’t count dot: If the dot is not visible through the filter.</p>  <p>dot defect</p> |
| | | Black dot defect | <p>The dot is constantly “off” when power applied to the LCD, even when all “White” data sent to the screen.</p> |
| | | Adjacent dot | <p>Adjacent dot defect is defined as two or more bright dot defects or black dot defects.</p>  <p>dot defect</p> |
| External inspection | Bubble ,scratch(foreign Particle polarizer, Cell, Backlight) | | Visible operating (all pixels “Black” or “White”) and non operating. |
| | Appearance inspection | Does not satisfy the value at the spec. | |
| Others | LED wires | Damaged to the LED wires, connector, pin, functional failure or appearance failure. | |
| Definition of Size | <p>Definition of circle :</p>  <p>$d = (a + b) / 2$</p> | <p>definition of linear size</p>  | <p>definition Area I/O</p>  |

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2) Standard

| Classification | | Inspection item | | Judgment Standard | | |
|------------------------------|------------------------|--|---|--------------------------|--------------------------|--|
| Defect (in LCD glass) | Dot defect | Area | | I | O | |
| | | Bright dots(Note: Visible under:ND5%) 1:D≤0.15mm:No count); D>0.15mm acceptable: 2 | | N≤0 | N≤2 | |
| | | Dark dots (0.15mm<D≤0.3mm), D>0.3mm Not allowable | | N≤3 | | |
| | | Bright dot-2Adjacent | | N≤0 | | |
| | | Dark dot-2Adjacent | | N≤0 | | |
| | | Dark or bright dots-3 and more adjacent(note6) | | N≤0 | | |
| | | Total bright and dark dots | | N≤5 | | |
| | | Minimum distance between bright dots | | 5mm | | |
| | | Minimum distance between dark dots | | 5mm | | |
| | | Minimum distance between bright and bright dots | | 5mm | | |
| | Other | White dot ,dark dot (circle) | Size (mm) | | Acceptable number | |
| | | | d≤0.2 | | Neglected | |
| | | | 0.2mm<D≤0.3mm | | N≤4 | |
| 0.3mm<D≤0.4mm | | | N≤2 | | | |
| D>0.4mm | | | Not allowable | | | |
| Visual defect | Foreign partial | Circular foreign material: dark/bright sport | Visible under:ND5% 1:D≤0.2mm:No count 2:0.15mm<D≤0.3mm,N≤4 3:D>0.3mm:Not allowable | | | |
| | | Linear foreign material: bright or dark line | Invisible under ND5% 0.1mm<W≤0.3mm, 0.3mm<L≤1.5mm,N≤4 Visible under ND5% 0.05mm≤w≤0.1mm, 0.3mm≤L≤0.7mm,N≤4 | | | |
| | Polarizer | Linear scratch | 1:BM:No Count 2:Pixel area 0.05mm≤w≤0.2mm, 1.0mm≤L≤5.0mm,N≤4 | | | |
| | | Bubble peeling | 1:BM:No Count 2:Pixel area 0.15mm≤D<0.3mm,N≤4 | | | |
| | Mura & leak | | ND5% | | | |