# Specification

### Tianma Part Number: **TM042NDZP90**

### Description: **4.2'WQVGA Normally Black**

| | Department | Name | Signature |
|---|---|---|---|
| Tianma | Integrate Project Manager | 万 江 Jon Miller | |
| | Project Management | 温映辉 Ray Wen | |
| Customer | | | |
| | | | |

# Revision History

| Version | Page | Revision Items | Name | Date |
| :---: | :---: | :--- | :---: | :---: |
| 0.0 | All | First release | Jon Miller | 2016.03.11 |
| 0.1 | 6 | Change pin assignment define | Liu Wang | 2016.03.15 |
| | 16 | Update Mechanical Drawing | Han Chun | 2016.03.15 |

# Table of Contents

# 1. Features

   This is a 4.2 inch Amorphous-TFT-LCD (Thin Film Transistor Liquid Crystal Display) Normally Black technology module, which is composed of a TFT-LCD panel, LCD Driver IC, FPC and a LED backlight unit. It is designed for Automotive and other high reliability electronic products and complies with the *RoHS* environmental protection directive.

# 2. General Specification

| Feature | Specification | Remark |
|---|---|---|
| Diagonal Size | 4.2 inch | |
| Resolution | 480(RGB) x 272 | |
| Active Area(mm) | 92.88 x 52.632 | |
| Pixel Pitch (mm) | 0.1935 x 0.1935 | |
| Pixel Configuration | R.G.B. Vertical Stripe | |
| Technology Type | a-Si | |
| Display Mode | Normally Black SFT technology | |
| Landscape or Portrait | Landscape (Compatible with Polarizer Sunglass) | Not for portrait |
| Surface Treatment (Top Polarizer) | AG | |
| Gray Scale Inversion Direction | No gray inversion. | |
| Interface | RGB 18/24 bits +SPI | |
| Color Depth | 262k or 16.7M | |
| Dimension (W x H x D) (mm) | 102.5 x 67.0 x 7.8 | Note1 |
| With /Without Touch Panel | Without Touch Panel | |
| Weight (g) | (105) | Note2 |

Table 2.1 General TFT Specifications

Note1: The dimensions do not include the length of FPC, and location boss. For more detail, please refer to the drawing in this specification.

Note2: LCM weight tolerance: ± 5%.

# 3. Input/Output Terminals

## 3.1 CN1 Pin assignment (TFT Interface)

Mating connector type: FH28D-50S-0.5SH (Hirose)

| PIN NO. | Symbol | P/I/O | Description |
|---|---|---|---|
| 1 | VPP | NC | Power pins for OTP programming.<br>Leave this pin open in normal mode. |
| 2 | GND | P | 0V pins connected to system GND |
| 3 | VCC | P | Power supply for module. |
| 4 | VCC | P | Power supply for module. |
| 5 | XRES | I | Hardware reset pin. When XRES= "L ", this IC is initialized. |
| 6 | ERR | OD | Output pin for error detection signal by noise.<br>"Hi-Z" : no error detected    "L" : error detected<br>Must be left open when not using this pin. |
| 7 | ENAB | I | Input pin for data enable signal of display data interface. |
| 8 | VSYNC | I | Vertical synchronization signal input pin. |
| 9 | HSYNC | I | Horizontal synchronization signal input pin. |
| 10 | GND | P | 0V pins connected to system GND. |
| 11 | PCLK | I | Data input Clock. |
| 12 | GND | P | 0V pins connected to system GND. |
| 13 | XCS | I | Serial Interface chip enable signal. |
| 14 | SDI | I | Data input pin for serial interface. |
| 15 | SCL | I | Serial interface clock input. |
| 16 | GND | P | 0V pins connected to system GND. |
| 17 | R0 | I | Red Data(LSB) |
| 18 | R1 | I | Red Data |
| 19 | R2 | I | Red Data |
| 20 | R3 | I | Red Data |
| 21 | R4 | I | Red Data |
| 22 | R5 | I | Red Data |
| 23 | R6 | I | Red Data |
| 24 | R7 | I | Red Data(MSB) |
| 25 | GND | P | 0V pins connected to system GND |
| 26 | G0 | I | Green Data(LSB) |
| 27 | G1 | I | Green Data |
| 28 | G2 | I | Green Data |
| 29 | G3 | I | Green Data |
| 30 | G4 | I | Green Data |
| 31 | G5 | I | Green Data |
| 32 | G6 | I | Green Data |
| 33 | G7 | I | Green Data(MSB) |
| 34 | GND | P | 0V pins connected to system GND. |
| 35 | B0 | I | Blue Data(LSB) |
| 36 | B1 | I | Blue Data |
| 37 | B2 | I | Blue Data |
| 38 | B3 | I | Blue Data |
| 39 | B4 | I | Blue Data |
| 40 | B5 | I | Blue Data |
| 41 | B6 | I | Blue Data |
| 42 | B7 | I | Blue Data(MSB) |
| 43 | NVSEL2 | I | Refresh select for test mode. Connect this Pin with a 10K |

| | | | resistor to GND in normal mode. |
|---|---|---|---|
| 44 | NC | NC | Leave open |
| 45 | A1 | P | Blacklight anode1 |
| 46 | A2 | P | Blacklight anode2 |
| 47 | A3 | P | Blacklight anode3 |
| 48 | C1 | P | Blacklight cathode1 |
| 49 | C2 | P | Blacklight cathode2 |
| 50 | C3 | P | Blacklight cathode3 |

Table 3.1.1 Pin assignment for TFT interface

Note1:  P: power pin, I: input pin, O: output pin, NC: No connection.

Note2:  Relation between input data signal and perceived color
RGB Data=0, 0, 0 ⟶ 0 gray scale level ⟶ Black
RGB Data=255, 255, 255 ⟶ 255 gray scale level ⟶ White
RGB Date=255, 0, 0 ⟶ Red; 0, 255, 0 ⟶ Green; 0, 0, 255 ⟶ Blue.

# 4. Absolute Maximum Ratings

| Item | Symbol | Min | Max | Unit | Remark |
| --- | --- | --- | --- | --- | --- |
| Power Voltage | VCC | -0.3 | 5.0 | V | - |
| Input signal | VI | -0.3 | 5.0 | V | Note |
| Operating Temperature | Top | -30 | 85 | ℃ | - |
| Storage Temperature | Tst | -40 | 95 | ℃ | - |

**Table 4 absolute maximum rating**

Note:
　　VI includes signals: serial peripheral signals, R/G/B signals, Sync signals, PCLK signal.

# 5.　Electrical Characteristics

## 5.1 Driving TFT LCD Panel

GND=0V, T = 25℃

| Item | | Symbol | Condition | Min | Typ | Max | Unit | Remark |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Power Supply Voltage | | VCC | | 3.0 | 3.3 | 3.6 | V | |
| Input Signal Voltage | High Level | VIH | VCC=3.3+/-0.3V | 0.80xVCC | - | VCC | V | |
| | Low Level | VIL | | 0 | - | 0.20xVCC | V | |
| Output Signal Voltage | High Level | VOH | VCC=3.3+/-0.3V | 0.80xVCC | - | VCC | V | |
| | Low Level | VOL | | 0 | - | 0.20xVCC | V | |

**Table 5.1 Driving characteristics**

## 5.2 DC Characteristics for Backlight Driving

| Item | Symbol | Min | Typ | Max | Unit | Remark |
| --- | --- | --- | --- | --- | --- | --- |
| Forward Current | $I_{BL}$ | - | (90) | 100 | mA | Note1 |
| Forward Voltage | $V_{BL}$ | 5.4 | 6 | 6.8 | V | |
| LED Life Time | - | 10000 | | - | Hrs | Note2 |
| Backlight Power Consumption | | | (1.62) | | W | |

Table 5.2.1 LED backlight characteristics
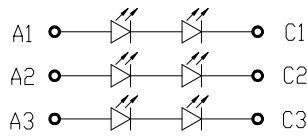
CIRCUIT DIAGRAM

Figure 5.2.1 LED connection of backlight

Note1: $I_{BL}$ is defined for one channel LEDs. There are total 3 LED channels in backlight unit. While the LCM is operating a stable forward current should be input.

Note2: Optical performance should be evaluated at Ta=25℃ only. If the LEDs are driven at high current or at high ambient temperature & humidity condition the lifetime of the LEDs will be reduced. Operating lifetime means the brightness decrease to 50% of the original brightness.

Note3: The exact de-rating curve will test and update when sample phase. The following chart is based on only LCD module level without customer system.
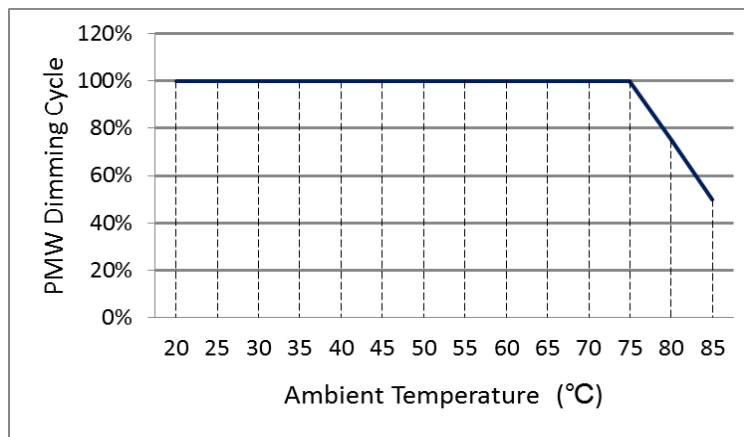


## 5.3 Block Diagram

# 6. Timing Chart

**To be updated when design fix**

## 6.1 TFT LCD Input Timing 3-Wire Command Format

## 6.2 RGB Interface

## 6.4 Reset Timing

## 6.5 Power ON/OFF Sequence

## 6.6 Power Interval Sequence(VCC)

## 7. Optical Characteristics

| Item | | Symbol | Condition | Min | Typ | Max | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Viewing Angle | | θU | CR≧10 | 80 | 88 | -- | Degree | -- |
| | | θD | | 80 | 88 | -- | | |
| | | θL | | 80 | 88 | -- | | |
| | | θR | | 80 | 88 | -- | | |
| Contrast Ratio | | CR | Vertical,25℃ | (600) | -- | -- | -- | Note3 |
| Response Time | | $T_{ON}$ / $T_{OFF}$ | 25℃ | -- | (25) | 50 | ms | Note4 |
| | | $T_{ON}$ / $T_{OFF}$ | -20℃ | -- | (250) | 400 | | |
| | | $T_{ON}$ / $T_{OFF}$ | -30℃ | -- | (450) | 700 | | |
| Chromaticity | White | x | CIE1931-XYZ | (0.27) | (0.31) | (0.35) | -- | Note5 |
| | | y | | (0.29) | (0.33) | (0.37) | | |
| | Red | x | | (0.56) | (0.60) | (0.64) | | |
| | | y | | (0.32) | (0.36) | (0.40) | | |
| | Green | x | | (0.29) | (0.33) | (0.37) | | |
| | | y | | (0.54) | (0.58) | (0.62) | | |
| | Blue | x | | (0.11) | (0.15) | (0.19) | | |
| | | y | | (0.03) | (0.07) | (0.11) | | |
| NTSC | | | CIE1931-XYZ | -- | (55) | -- | % | Note5 |
| Uniformity W | | U | 25℃ | 75 | 85 | -- | % | Note6 |
| Luminance | | L | 25℃ | 600 | (750) | -- | cd/m$^2$ | Note7 |
| Gamma | | γ | VESA | 1.9 | 2.2 | 2.5 | -- | VESA standard Perpendicular |

Test Conditions:

1. $I_F$= 90mA(one channel), the ambient temperature is 25℃.
2. The test systems refer to Note 1 and Note 2.

Note1: Definition of viewing angle range and measurement system.
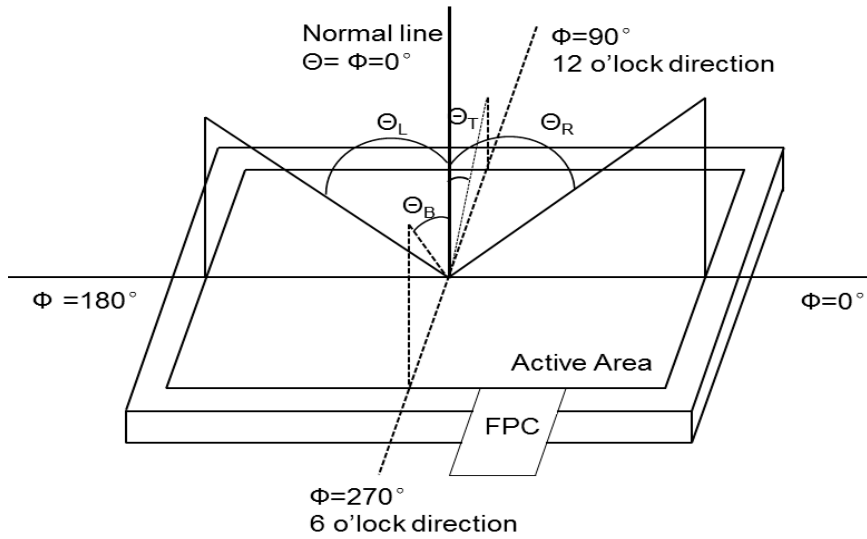
Note2: Definition of optical measurement system
Measured at the center of the panel by SR-3.
Measuring condition:
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=+25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.
- Measured value at the center point of LCD panel after more than 10 minutes while backlight is turned on.
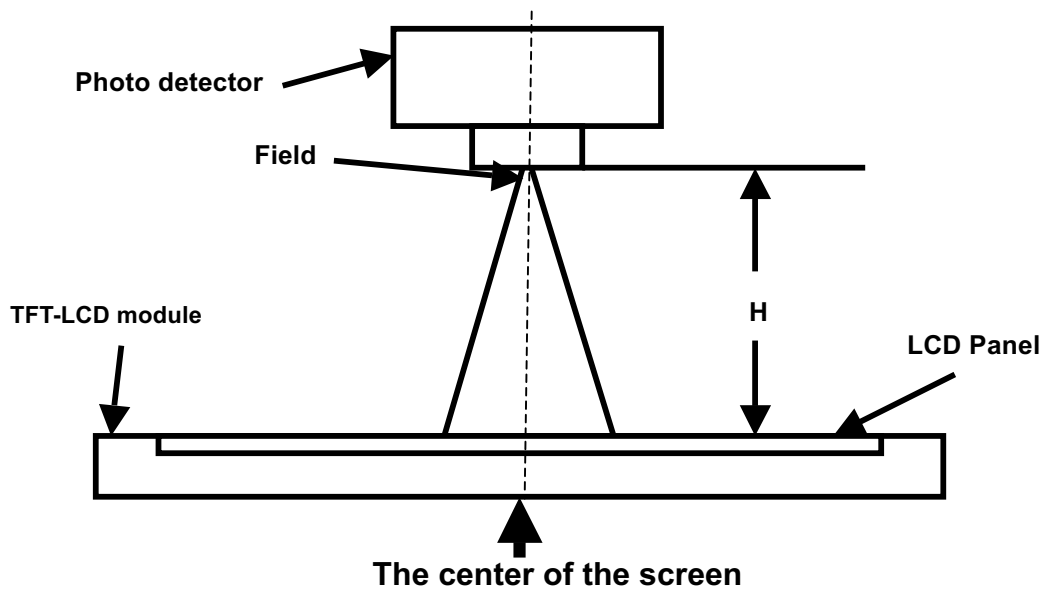
| Item | Photo detector | Field | Height |
| --- | --- | --- | --- |
| Contrast Ratio | SR-3 | 1° | H=500mm |
| Luminance | | | |
| Chromaticity | | | |
| Lum Uniformity | | | |
| Contrast Plot | EZ-Contrast/ DMS | 6mm/3mm | H=1mm/H≈80mm |
| Response Time | LCD5200 | 3mm | H=200mm |
| Reflectivity | CM3600A | 8mm/25.4mm | H=0mm |

Note3: Definition of contrast ratio:

$$\text{Contrast Ratio(CR)}= \frac{\text{Luminance When LCD is White}}{\text{Luminance When LCD is Black}}$$

Contrast Ratio is measured in optimum common electrode voltage

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%. Refer to the figure below:
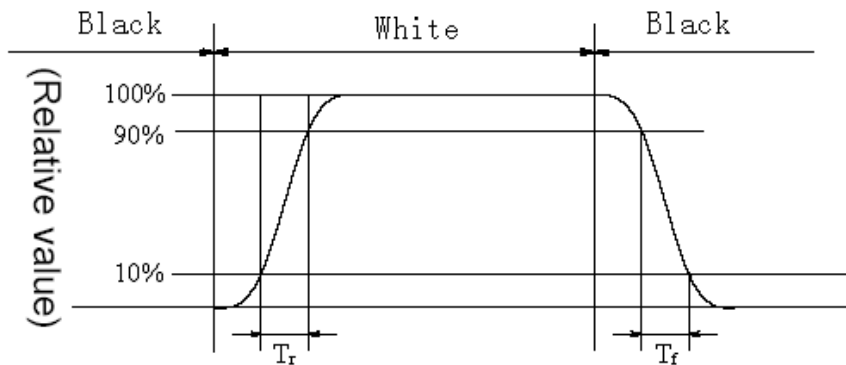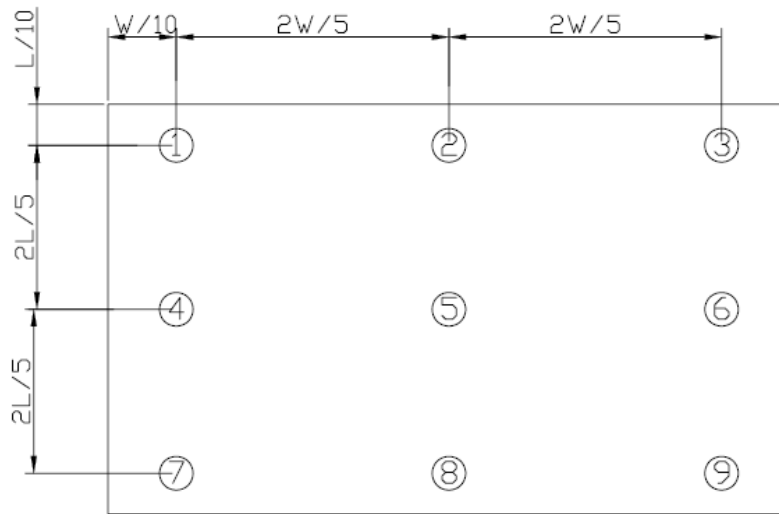


Note5: Definition of color chromaticity (CIE1931)

Color coordinates measured at the center point of the LCD.

Note6: Definition of Luminance Uniformity

The luminance uniformity is calculated by using following formula.

$$\text{Luminance uniformity (Lu)}= \frac{\text{Minimum luminance from ① to ⑨}}{\text{Maximum luminance from ① to ⑨}}$$

The luminance is measured at the 9 points shown below.

Note7: Definition of Luminance
      Measure the luminance of white state at the center point.

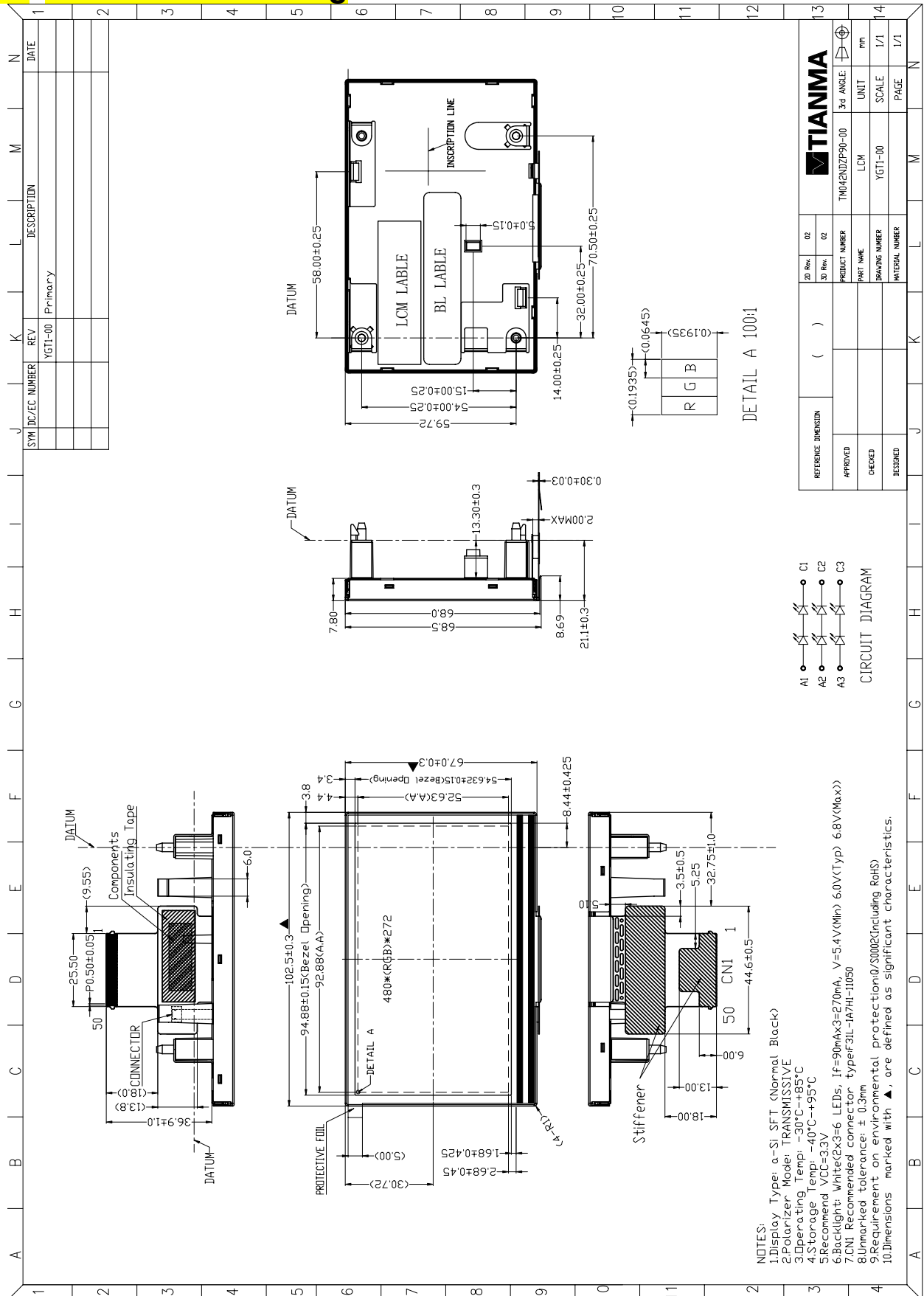## 8. Reliability Test

### 8.1 Content of Reliability Test

| No | Test Item | Test condition | Criterion |
|---|---|---|---|
| 1. | High Temperature Storage | 95℃  240H RH<=45%<br>Restore 2H at 25℃<br>non-operation | Note1, Note2 |
| 2. | Low Temperature Storage | -40℃±3℃  240H<br>Restore 2H at 25℃<br>non-operation | Note1, Note2 |
| 3. | High Temperature Operation | 85℃±2℃  240H RH<=45%<br>Restore 2H at 25℃<br>operation | Note1, Note2, , Note5 |
| 4. | Low Temperature Operation | -30℃±3℃  240H<br>Restore 2H at 25℃<br>operation | Note1, Note2 |
| 5. | High Temperature & Humidity Operation | 60℃±2℃, 90±2%RH 240H<br>operation | Note1, Note2, Note5 |
| 6. | Thermal Shock | -40℃→  change→+85℃<br>30min 30s 30min<br>100cycle<br>non-operation | Note1, Note2 |
| 7. | Vibration Test | Frequency: 8 - 33.3 Hz, Total amplitude: 1.3mm<br>Frequency: 33.3 - 400 Hz, Acceleration: 29.4 m/s$^2$<br>sweep time: 15 minutes<br>2 hours each for X and Z directions, 4 hours for Y direction (total 8 hours)<br>Non-operation | Note1, Note2 |
| 8. | Shock Test | 100 x 9.8m/s2, t=6ms, XYZ directions,<br>Half sin curve,<br>[non-operating],each directions<br>2 times | Note1, Note2 |
| 9. | ESD | Air discharge:<br>C=150pF±10%,R=330Ω±10%, 5 point/panel<br>Air: +/-15KV, 5times | Note1, Note2, Note4 |
| | | Contact discharge:<br>C=150pF±10%,R=330Ω±10%, 5 point/panel<br>Contact: +/-8KV,5times | Note1, Note2, Note4 |

Notes:

1. The test result shall be evaluated after the sample has been left at room temperature and humidity for 2 hours without load. No condensation shall be accepted. The sample will not be accepted if appear these defects:

1) Air bubble in the LCD

2) Seal leak

3) Non-display

4) Missing segments

5) Glass crack

2. Each test item applies for a test sample only once, The test sample can not be used again in any other test item.

3.For Damp Proof Test, Pure water(Resistance＞10MΩ) 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 judge as a good part.

5. In the test of High Temperature Operation and High Temperature & Humidity Operation. The operation temperature is the surface temperature of module

# 9. Mechanical Drawing



NOTES:
1.Display Type: a-Si SFT (Normal Black)
2.Polarizer Mode: TRANSMISSIVE
3.Operating Temp: -30°C~+85°C
4.Storage Temp: -40°C~+95°C
5.Recommend VCC=3.3V
6.Backlight: White(2x3=6 LEDs, If=90mAX3=270mA, V=5.4V(Min) 6.0V(Typ) 6.8V(Max))
7.CN1 Recommended connector type:F31L-1A7H1-11050
8.Unmarked tolerance: ± 0.3mm
9.Requirement on environmental protection:0/S0002(Including RoHS)
10.Dimensions marked with ▲, are defined as significant characteristics.

CIRCUIT DIAGRAM

TIANMA

| REFERENCE DIMENSION | | | | 2D Rev. | 02 | | |
| | | | | 3D Rev. | 02 | 3rd ANGLE: | mm |
| APPROVED | | | PRODUCT NUMBER | | | UNIT | |
| CHECKED | | | PART NAME | LCM | | SCALE | 1/1 |
| DESIGNED | | | DRAWING NUMBER | YGT1-00 | | PAGE | 1/1 |
| | | | MATERIAL NUMBER | | | | |

TM042NDZP90-00

# 10.　　Product Inspection Criteria

## 10.1. Inspection Conditions

10.1.1 Ambient conditions:

    a. Temperature: Room temperature 25±5℃

    b. Humidity: (60±10) ％RH

    c. Circumstance Illumination（Light to the surface of LCD）

    Backlight-on 100-300Lux

    Backlight-off 800-1200lux

10.1.2 Viewing distance

    The distance between the LCD and the inspector's eyes shall be 35cm or more.
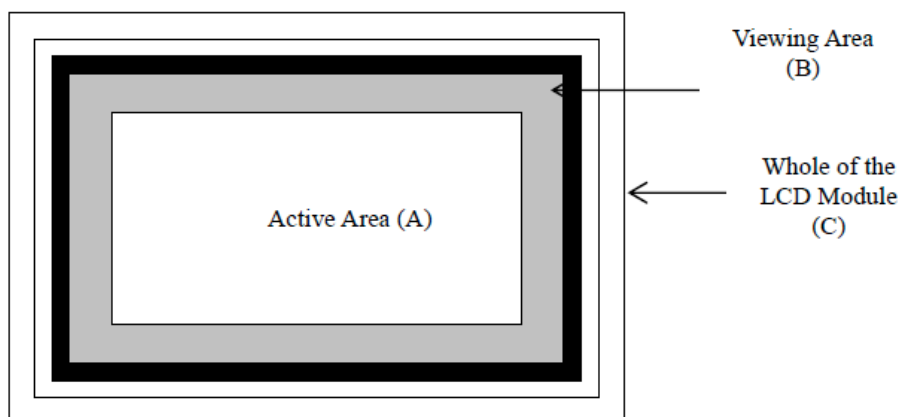
10.1.3 Viewing Angle

    U/D: 45º/45º, L/R: 45º/45º
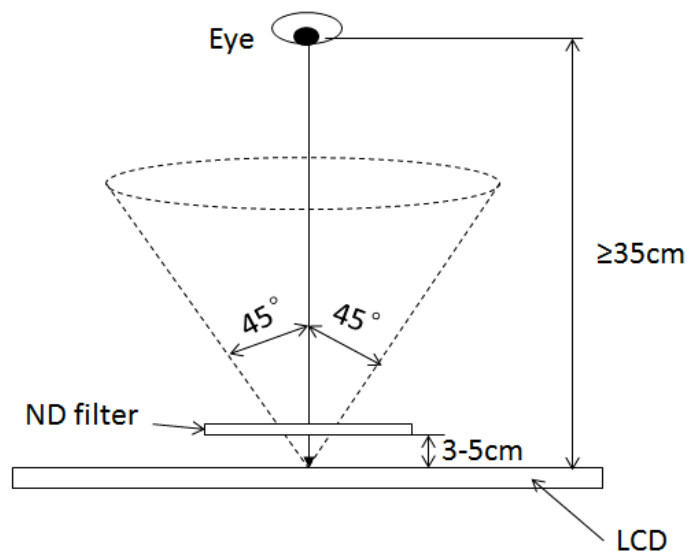


10.1.4 Light-on condition

    The current of the Backlight should refer to the recommended typical value in this specification.

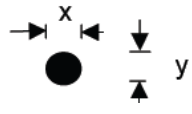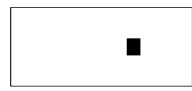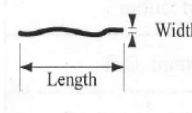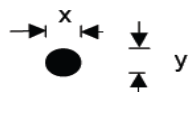10.1.5 Definition of LCD zone (with Bezel)



A-zone: The inside of the Active Area(as defined on the product drawing)

B-zone: The inside of the Viewing Area which is between A-zone and the metal frame (defined on the product drawing if no up metal frame).

C-zone: Whole of the LCD Module except the zone A and B. (Including FPC& Metal

Frame & backside of the LCD Module)

**10.2** Cosmetic Inspection Criteria

| Inspection Item | Inspection Standards | Acceptable Qty. | Applied Zone | Inspection Mode | Note |
|---|---|---|---|---|---|
| Dark /Bright spots (the bright spots should not visible through ND2%) | $\varphi \le 0.2$ | Ignore | A | Backlight-on | $\varphi = (x+y)/2$  |
| | $0.2 < \varphi \le 0.4$ | 3 | | | |
| | $0.40 < \varphi$ | None | | | |
| Bright pixel dot | 1 sub-pixel, Visible through ND2% | None | A | Backlight-on |  |
| Dark pixel dot | 1 sub-pixel | 3 (distance ≥ 10mm) | A | Backlight-on |  |
| Lints & Scratches | W≤ 0.03 and L≤ 3.0 | Ignore | A\B | Backlight-on Backlight-off |  |
| | $0.03 < W \le 0.05$ and L≤ 3.0 | 2 | | | |
| | $0.05 < W$ or L>3.0 | None | | | |
| Polarizer Dent/Bubble | $\varphi \le 0.2$ | Ignore | A\B | Backlight-on Backlight-off | $\varphi = (x+y)/2$  |
| | $0.2 < \varphi \le 0.4$ | 3 | | | |
| | $0.40 < \varphi$ | None | | | |
| Mura | Visible through ND2% at full black pattern | None | A | Backlight-on | Uniformity at black pattern |
| Dirty\Dust (The surface of Polarizer) | Those wiped out easily are acceptable | | A\B | Backlight-off | \ |

# 11. Packing Instruction (will update when sample phase)

# 12. Appendix

# 13. Precautions for Use of LCD Modules

## 13.1 Handling Precautions

13.1.1 The display panel is made of glass. Do not subject it to mechanical shock by dropping it, etc.

13.1.2 If the display panel is damaged and the liquid crystal fluid inside it leaks out be sure not to get any in your mouth. If the fluid comes into contact with your skin or clothes promptly wash it off using soap and water.

13.1.3 Do not apply excessive force to the display surface or the bezel since this may cause the color tone to vary.

13.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle the polarizer carefully.

13.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is still not completely clear use a moist cloth with one of the following solvents:
- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Specifically, do not use the following:
- Water
- Ketone
- Aromatic solvents

13.1.6 Do not attempt to disassemble the LCD Module.

13.1.7 If the logic circuitry is powered off, do not apply the input signals.

13.1.8 To prevent destruction of the module by static electricity, be careful to maintain an optimum work environment.

    13.1.8.1 Be sure to ground your body when handling the LCD Modules.

    13.1.8.2 Tools used for assembly, such as soldering irons, must be properly grounded.

    13.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly or other work under very low humidity conditions.

    13.1.8.4 The LCD Module is covered with a film to protect the display surface. Be careful when peeling off this protective film since static electricity may be generated.

## 13.2 Storage precautions

13.2.1 When storing the LCD modules avoid exposure to direct sunlight or to the light

of fluorescent lamps.

13.2.2 The LCD modules should be stored within the rated storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature: 15 ~ 35 degree C (or at least Temp. 10 ~ 40 degree C / Humidity 25% ~ 75%), for National Std. recommendation

13.2.3 The LCD modules should be stored in a room without acid, alkali or other harmful gases.

## 13.3 Transportation Precautions

The LCD modules should not be dropped or subject to violent mechanical shock during transportation. Also they should avoid excessive pressure, water, high humidity and direct sunlight.