

ZETTLER DISPLAYS

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

| CUSTOMER APPROVAL | | | |
|---|--|-----------------|--|
| ※ PART NO. : <u>ATM1010M40 (ZETTLER DISPLAYS) SPEC VER1.0</u> | | | |
| APPROVAL | | COMPANY CHOP | |
| CUSTOMER COMMENTS | | | |

| ZETTLER DISPLAYS ENGINEERING APPROVAL | | |
|---------------------------------------|------------|-------------|
| DESIGNED BY | CHECKED BY | APPROVED BY |
| XW | GZC | GZH |

※ **CONTENTS**

1. GENERAL SPECIFICATIONS
2. PIN ASSIGNMENT
3. ABSOLUTE MAXIMUM RATINGS
4. ELECTRICAL SPECIFICATIONS AND INPUT TIMING TABLE
5. LED BACKLIGHT SPECIFICATION
6. POWER SEQUENCE
7. OPTICAL CHARACTERISTICS
8. RELIABILITY TEST
9. PRECAUTION FOR USING LCM
10. MECHANICAL DRAWING
11. PACKAGE DRAWING
12. INSPECTION SPECIFICATION

1. General Specifications

ATM1010M40 is a TFT-LCD module. It is composed of a TFT-LCD panel, driver IC, FPC, a back light unit. The 10.1" display area contains 1200(RGB)x1920 pixels and can display up to 16.7M colors. This product accords with RoHS environmental criterion.

| Item | Specification | Remark |
|---------------------------------|------------------------------------|---------------|
| 1. LCD size | 10.1 inch(Diagonal) | |
| 2. Driver element | a-Si TFT active matrix | |
| 3. Resolution | 1200x(RGB)x1920 | |
| 4. Display mode | Normally black ,IPS, Transmissive | |
| 5. Dot Pitch (W*H) | 0.0376mm(W) x 0.1128mm(H) | |
| 6. Pixel pitch(W*H) | 0.1128mm(W) x 0.1128mm(H) | |
| 7. Active Area(W*H) | 135.36mm(W) x 216.576mm(H) | |
| 8. Module size (W*H) | 142.9mm(W) x 228.6mm(H) x 2.4mm(D) | Note 1 |
| 9. Surface treatment | HC+Clear | |
| 10. Color arrangement | RGB-stripe | |
| 11. Color | 16.7M | |
| 12. Viewing angle (L/R/T/B) | 85/85/85/85 | |
| 13. Interface | 4 Lane MIPI | |
| 14. LCD controller | 2* HX8279-D*2 | |
| 15. LCM brightness | 380 cd/m2 Typ. | |
| 16. Backlight driving condition | 240mA @9.0V | |
| 17. Touch panel | N.A. | |
| 18. Touch controller | N.A. | |
| 19. Operation temperature | 0~50 °C | |
| 20. Weight | T.B.D(Typ.) | |
| 21. RoHS | ROHS compliant | |

Note 1: Please refer to mechanical drawing.

2. PIN ASSIGNMENT

TFT LCD Panel Driving Section

FPC Connector is used for the module electronics interface.

| Pin No. | Symbol | Function |
|---------|--------|--|
| 1 | NC | NC |
| 2 | VDD | Power Supply(3.3V) |
| 3 | VDD | Power Supply(3.3V) |
| 4 | NC | NC |
| 5 | NC | NC |
| 6 | ID(0V) | ID |
| 7 | GND | Ground |
| 8 | D0N | MIPI Data lane0 input (negative) |
| 9 | D0P | MIPI Data lane0 input (positive) |
| 10 | GND | Ground |
| 11 | D1N | MIPI Data lane1 input(negative) |
| 12 | D1P | MIPI Data lane1 input(positive) |
| 13 | GND | Ground |
| 14 | CLKN | MIPI CLK input (negative) |
| 15 | CLKP | MIPI CLK input (positive) |
| 16 | GND | Ground |
| 17 | D2N | MIPI Data lane2 input (negative) |
| 18 | D2P | MIPI Data lane2 input(positive) |
| 19 | GND | Ground |
| 20 | D3N | MIPI Data lane3 input (negative) |
| 21 | D3P | MIPI Data lane3 input(positive) |
| 22 | GND | Ground |
| 23 | NC | NC |
| 24 | NC | NC |
| 25 | GND | Ground |
| 26 | SDA | SPI data input, suggest reserving test pad for debug, default pull high |
| 27 | PWMO | PWM signal input for DIMO, default pull high |
| 28 | GND | Ground |
| 29 | NC | NC |
| 30 | GND | Ground |
| 31 | LED- | LED cathode |
| 32 | LED- | LED cathode |
| 33 | SCL | SPI clock input, suggest reserving test pad for debug, default pull high |
| 34~38 | NC | NC |
| 39 | LED+ | LED anode |
| 40 | LED+ | LED anode |

3. Absolute Maximum Ratings(Ta=25°C)

3.1 Electrical Absolute Maximum Ratings

The followings are maximum values which, if exceed, may cause faulty operation or damage the unit. The operational and non-operational maximum voltage and current values are listed in the following table .

| Parameter | Symbol | Condition | Min | Typ | Max | Unit | Note |
|----------------------------|---------|-----------|------|-----|-----|------|------|
| Logic Power Supply Voltage | VDD/VCI | Ta=25°C | -0.3 | - | 6.6 | V | |

3.2 Environmental Absolute Maximum Ratings

| Item | Storage | | Operating | | Note |
|---------------------|---------|------|-----------|------|------|
| | MIN. | MAX. | MIN. | MAX. | |
| Ambient Temperature | -25°C | 60°C | 0°C | 50°C | 1,2 |

1. The response time will become lower when operated at low temperature.
2. Background color changes slightly depending on ambient temperature.
The phenomenon is reversible.

4. Electrical Specifications and Input Timing Table

4.1 DC Electrical characteristics(Vss=0V ,Ta=25°C)

| Parameter | Symbol | Min | Typ | Max | Unit | Condition |
|--|---------------------|-----|-----|-----|------|-----------|
| MIPI Characteristics for High Speed Receiver | | | | | | |
| Differential input low voltage | V _{IDTL} | -70 | - | - | mV | |
| Differential input high voltage | V _{IDTH} | - | - | 70 | mV | |
| Single-ended input low voltage | V _{ILHS} | -40 | - | - | mV | |
| Single-ended input high voltage | V _{IHHS} | - | - | 460 | mV | |
| Common-mode voltage | V _{CMRXDC} | 70 | - | 330 | mV | |
| Differential input impedance | Z _{ID} | 80 | 100 | 125 | Ω | |
| HS transmit differential voltage (V _{OD} =V _{DP} -V _{DN}) | V _{OD} | 140 | 200 | 270 | mV | |
| MIPI Characteristics for Low Power Receiver | | | | | | |
| Input low level | V _{IH} | 880 | - | - | mV | |
| Input high level | V _{IL} | 0 | - | 550 | mV | |
| Output low level | V _{OL} | -50 | - | 50 | mV | |
| Output high level | V _{OH} | 1.1 | 1.2 | 1.3 | V | |

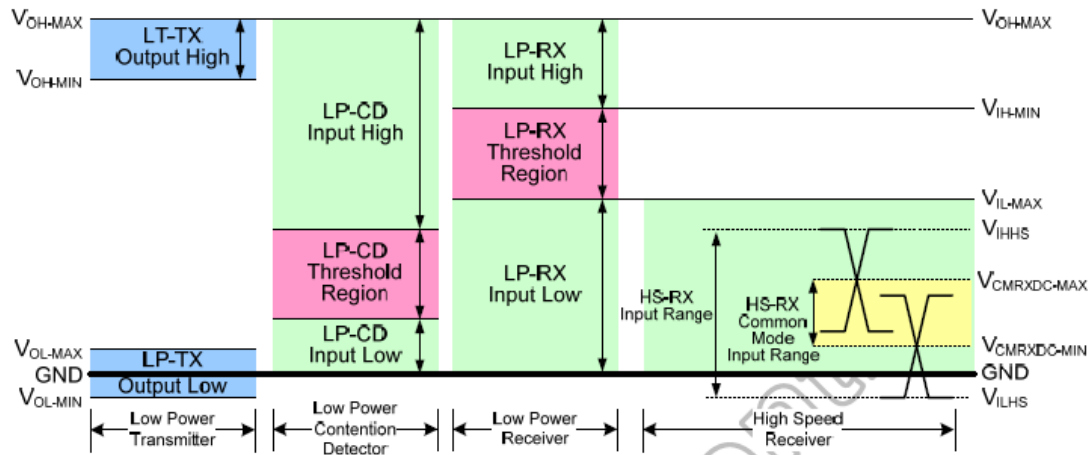
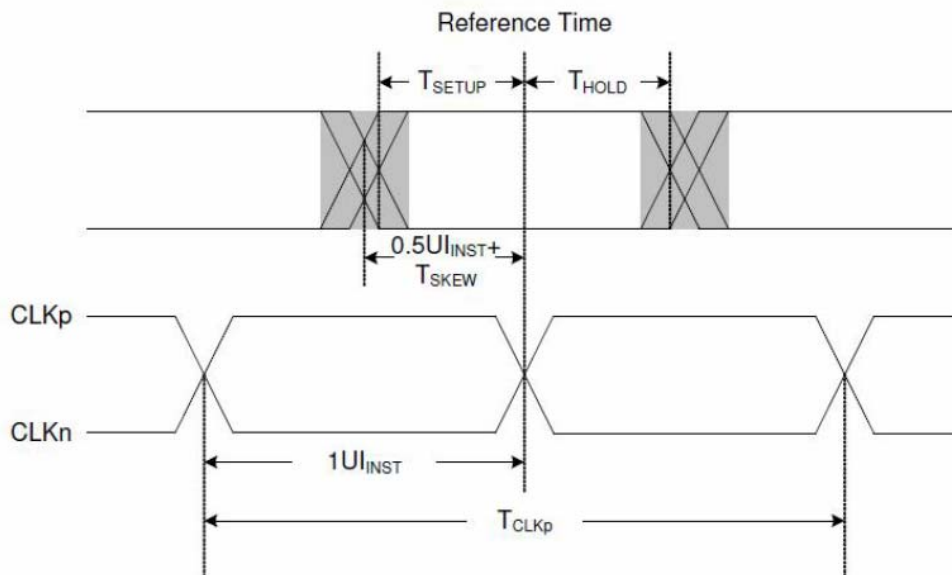


Figure 12.1: MIPI signaling and contention voltage levels

4.2 MIPI AC Specification

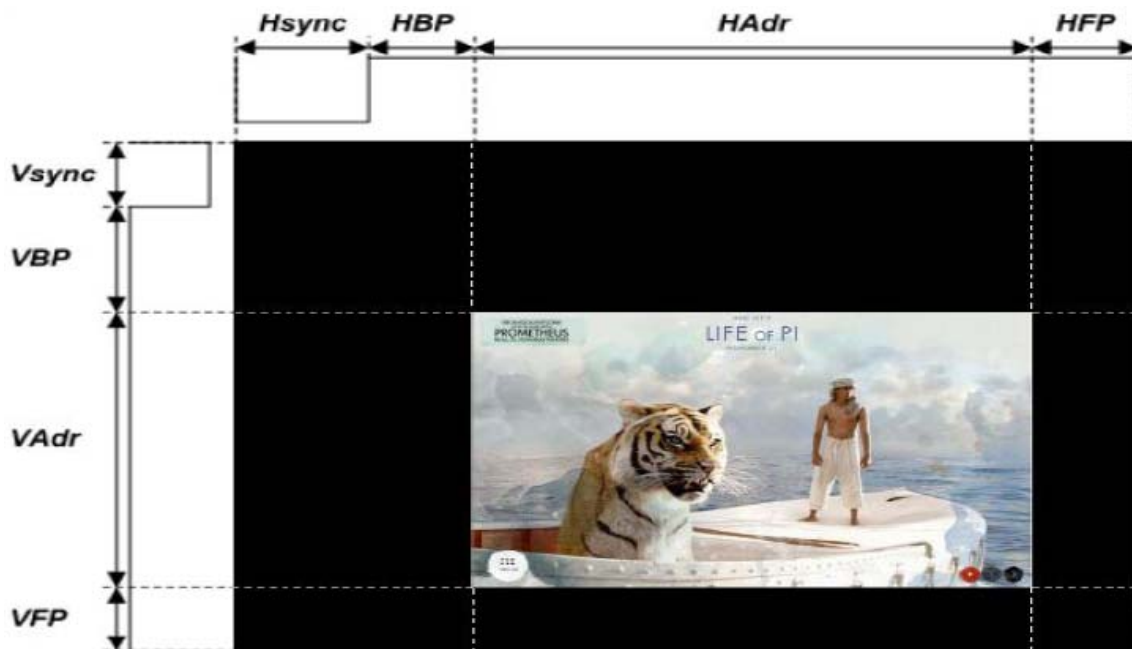


| Description | Symbol | Condition | Min | Typ | Max | Unit |
|--------------------------|--------|-----------|-----|-----|---------|--------|
| UI instantaneous | UIINST | - | 1.0 | - | 12.5(1) | ns |
| Data to Clock Setup Time | TSETUP | - | 0.3 | - | - | UIINST |
| Clock to Data Hold Time | THOLD | - | 0.3 | - | - | UIINST |

Note: (1) This value corresponds to a minimum 80 Mbps data rate.

4.3 Input Timing Table

| ITEM | | SYMBOL | min | typ | max | UNIT | |
|----------------------|-------------|------------------------|--------|------|------|----------------|------------------|
| LCD | Frame Rate | - | - | 60 | - | Hz | |
| | Pixels Rate | - | - | 156 | - | MHz | |
| Timing | Mipi CLK | Frequency | fCLK | - | 468 | - | MHz |
| | | Period | Tclk | - | 2.14 | - | ns |
| | Horizontal | Horizontal total time | tHP | - | 1340 | 2047 | t _{CLK} |
| | | Horizontal Active time | tHadr | 1200 | | | t _{CLK} |
| | | Horizontal Pulse Width | tHsync | - | 24 | - | t _{CLK} |
| | | Horizontal Back Porch | tHBP | - | 80 | - | t _{CLK} |
| | | Horizontal Front Porch | tHFP | - | 60 | - | t _{CLK} |
| | Vertical | Vertical total time | tvp | - | 1944 | 2047 | t _H |
| | | Vertical Active time | tVadr | 1920 | | | t _H |
| | | Vertical Pulse Width | tVsync | - | 2 | - | t _H |
| | | Vertical Back Porch | tVBP | - | 12 | - | t _H |
| Vertical Front Porch | | tVFP | - | 17 | - | t _H | |
| Bit Rate | | TX SPD (MBPS) | 980 | 980 | 995 | Mbps | |
| Lane | | | - | 4 | - | Lane | |

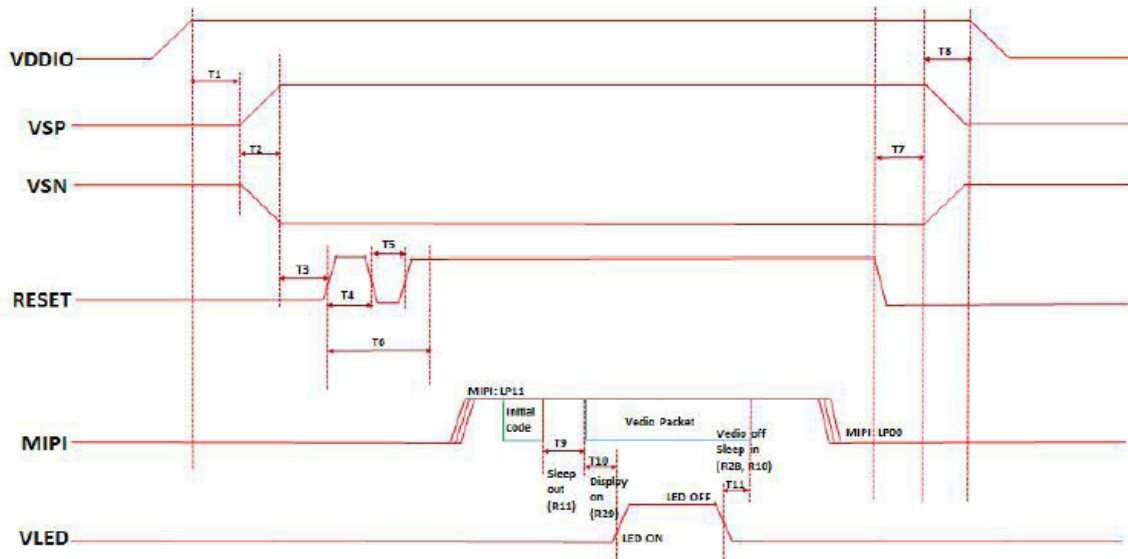


5.0 LED backlight specification(VSS=0V ,Ta=25°C)

| Item | Symbol | Min | Typ | Max | Unit | Note |
|----------------|--------|-------|-----|-----|-------|------|
| Supply voltage | VLED | 8.6 | 9 | 9.6 | V | 1 |
| Supply current | ILED | -- | 240 | -- | mA | |
| LED life time | Life | 30000 | | | hours | |

6.0 Power Sequence

6.1 Power on timing sequence, VDD=3.3V



| Item | Time | Unit | Remark |
|------|------|------|--------|
| T1 | >0 | ms | |
| T2 | 1 | ms | |
| T3 | >5 | ms | |
| T4 | >=0 | ms | |
| T5 | >=0 | ms | |
| T6 | >6 | ms | |
| T7 | >0 | ms | |
| T8 | >0 | ms | |
| T9 | >0 | ms | |
| T10 | >120 | ms | |
| T11 | >120 | ms | |
| T12 | | | |
| T13 | | | |
| T14 | | | |

6.2 Timing Characteristics

Please Reference IC Specifications

7. Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|-------------------------|----------------|------------------------------------|------|------|------|-------------------|------|
| Brightness | Bp | $\theta=0^\circ$ | 330 | 380 | - | Cd/m ² | 1 |
| Uniformity | ΔBp | $\Phi=0^\circ$ | 75 | 80 | - | % | 1,2 |
| Viewing Angle | 3:00 | Cr \geq 10 | - | 85 | - | Deg | 3 |
| | 6:00 | | - | 85 | - | | |
| | 9:00 | | - | 85 | - | | |
| | 12:00 | | - | 85 | - | | |
| Contrast Ratio | Cr | $\theta=0^\circ$ $\Phi=0^\circ$ | 800 | 1000 | - | - | 4 |
| Response Time | T _r | | - | 10 | 20 | ms | 5 |
| | T _f | | - | 15 | 30 | ms | |
| Color of CIE Coordinate | W | x | - | 0.30 | - | - | 1,6 |
| | | y | - | 0.34 | - | - | |

Note: The parameter is slightly changed by temperature, driving voltage and material

Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white.

The brightness is the average value of 9 measured spots. Measurement equipment BM-7 (Φ 7.5mm)

Measuring condition:

--Measuring surroundings: Dark room.

--Measuring temperature: Ta=25°C.

--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 5 minutes while backlight turning on.

Note 1: Definition of viewing angle range

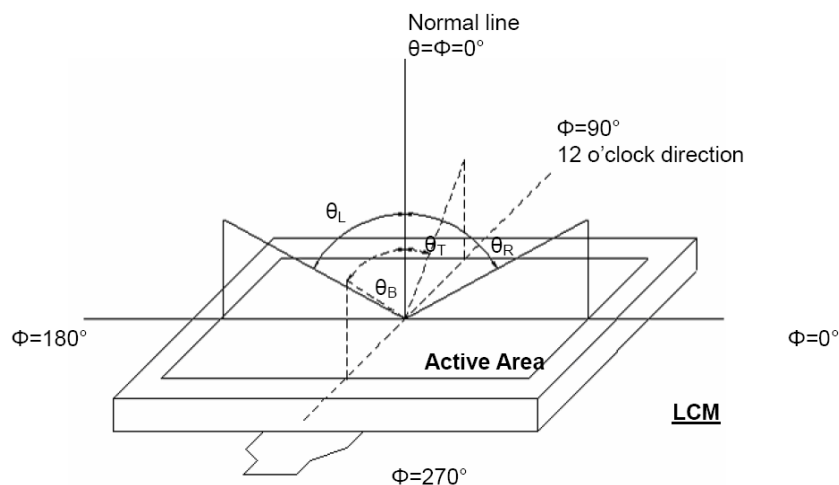


Figure 4.1 Definition of viewing angle.

Note 2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen. (Response time is measured by Photo detector TOPCON)

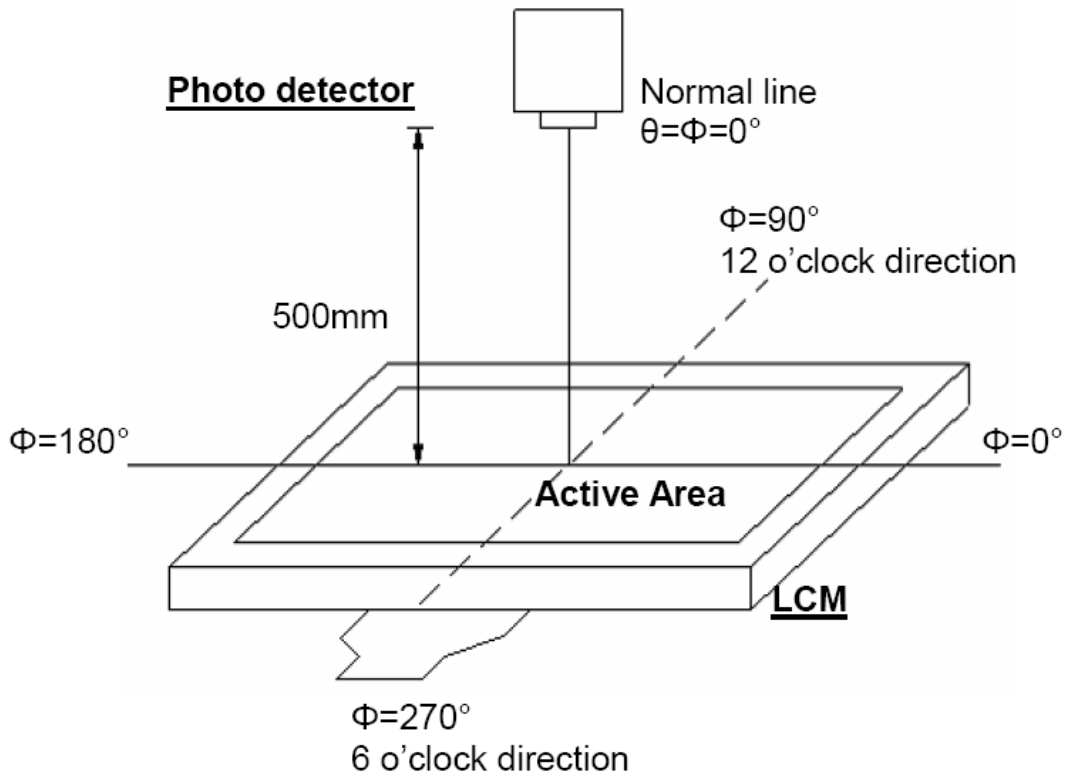


Figure 4.2 Optical measurement system setup

Note 3: Definition of Response time

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

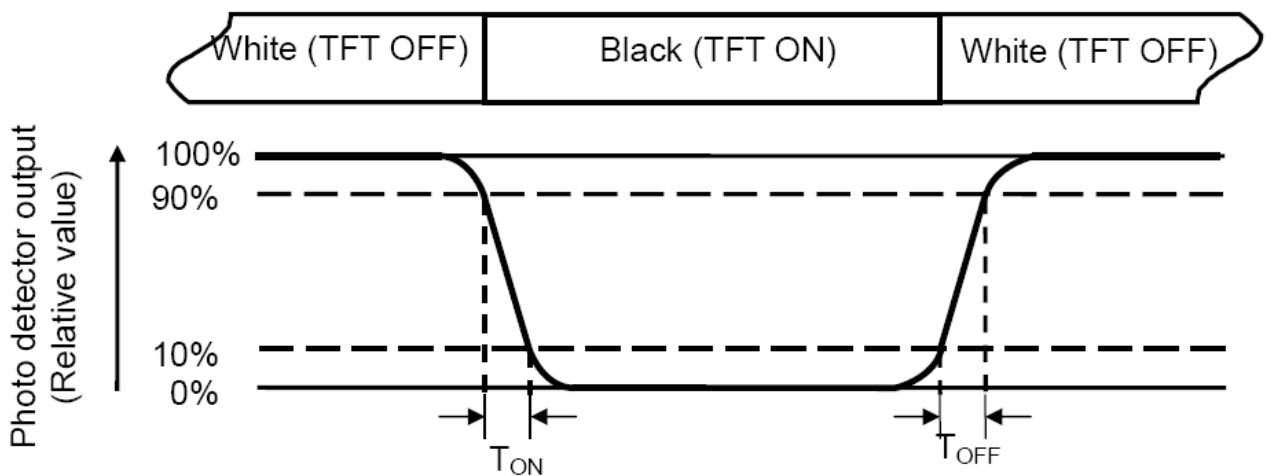


Figure 4.3 Definition of response.

Note 4: Definition of contrast ratio

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

Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: All input terminals LCD panel must be ground while measuring the center area of the panel.

Note 7: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer to Fig. 4.3).Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (Yu)} = \frac{B_{min}}{B_{max}}$$

L-----Active area length W----- Active area width

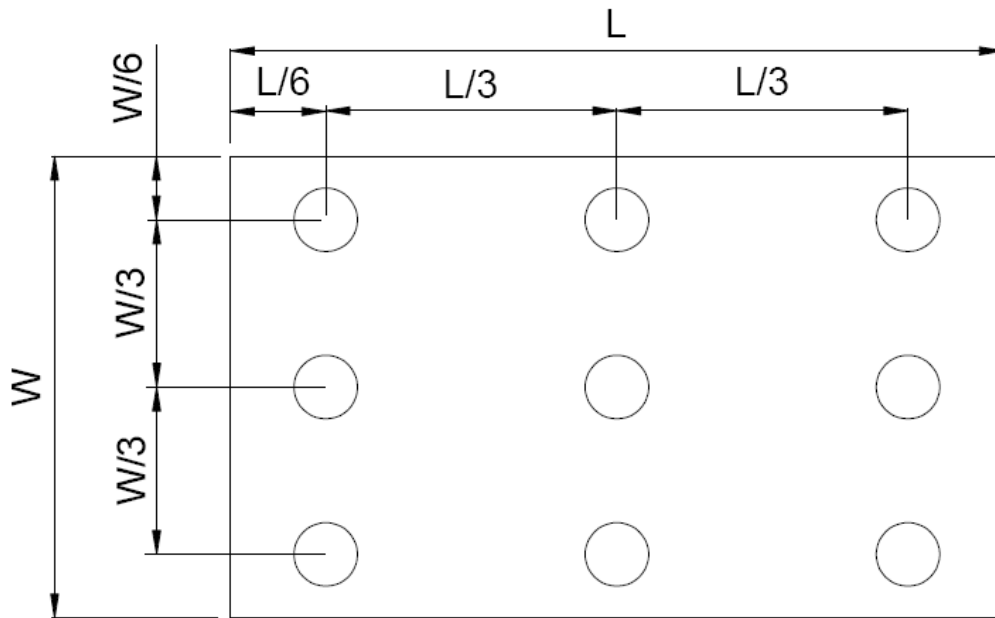


Figure 4.3 Definition of measuring points.

Bmax: The measured maximum luminance of all measurement position.

Bmin: The measured minimum luminance of all measurement position.

8. Reliability Test Items and Criteria

| No | Test Item | Test condition | Criterion |
|----|-------------------------------------|---|--|
| 1 | High Temperature Storage | 60°C 96H Restore 2H at 25°C Power off | 1. After testing, cosmetic and electrical defects should not happen. 2. Total current consumption should not be more than twice of initial value. |
| 2 | Low Temperature Storage | -25°C 96H Restore 2H at 25°C Power off | |
| 3 | High Temperature Operation | 50°C 96H Restore 2H at 25°C Power on | |
| 4 | Low Temperature Operation | 0°C 96H Restore 4H at 25°C Power on | |
| 5 | High Temperature/Humidity Operation | 60°C 90%RH 96H Power on | |
| 6 | Temperature Cycle | -25 °C ←————→ 60 °C 30min 5min 30min After 20 cycle, Restore 2H at 25°C Power off | |
| 7 | Package Vibration Test | Random Vibration : 0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total) | Not allowed cosmetic and electrical defects. |
| 8 | Mechanical Shock | 100G, 6ms,±X, ±Y, ±Z 3 times for each direction | |
| 9 | Electro Static Discharge | Air :±8KV,(150PF,330Ω) Contact:±4KV(150PF,330Ω) Class B(EN 61000-4-2) | |

Note: Operation: Supply 3.3V for logic system.

The inspection terms after reliability test, as below

| ITEM | Inspection |
|------------|-------------------|
| Contrast | CR>50% |
| IDD | IDD<200% |
| Brightness | Brightness>60% |
| Color Tone | Color Tone+/-0,05 |

9. PRECAUTION FOR USING LCM

1. When design the product with this LCD Module, make sure the viewing angle matches to its purpose of usage.
2. As LCD panel is made of glass substrate, Dropping the LCD module or banging it against hard objects may cause cracking or fragmentation. Especially at corners and edges.
3. Although the polarizer of this LCD Module has the anti-glare coating, always be careful not to scratch its surface. Use of a plastic cover is recommended to protect the surface of polarizer.
4. If the LCD module is stored at below specified temperature, the LC material may freeze and be deteriorated. If it is stored at above specified temperature, the molecular orientation of the LC material may change to Liquid state and it may not revert to its original state. Excessive temperature and humidity could cause polarizer peel off or bubble. Therefore, the LCD module should always be stored within specified temperature range.
5. Saliva or water droplets must be wiped off immediately as those may leave stains or cause color changes if remained for a long time. Water vapor will cause corrosion of ITO electrodes.
6. If the surface of LCD panel needs to be cleaned, wipe it swiftly with cotton or other soft cloth. If it is not still clean enough, blow a breath on the surface and wipe again.
7. The module should be driven according to the specified ratings to avoid malfunction and permanent damage. Applying DC voltage cause a rapid deterioration of LC material. Make sure to apply alternating waveform by continuous application of the M signal. Especially the power ON/OFF sequence should be kept to avoid latch-up of driver LSIs and DC charge up to LCD panel.
8. Mechanical Considerations
 - a) LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.
 - b) Do not tamper in any way with the tabs on the metal frame.
 - c) Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.

9. Static Electricity

a) Operator

Wear the electrostatics shielded clothes because human body may be statically charged if not ware shielded clothes. Never touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.

b) Equipment

There is a possibility that the static electricity is charged to the equipment, which has a function of peeling or friction action (ex: conveyer, soldering iron, working table). Earth the equipment through proper resistance (electrostatic earth: 1×10^8 ohm).

Only properly grounded soldering irons should be used.

If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.

The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.

c) Floor

Floor is the important part to drain static electricity, which is generated by operators or equipment. There is a possibility that charged static electricity is not properly drained in case of insulating floor. Set the electrostatic earth (electrostatic earth: 1×10^8 ohm).

d) Humidity

Proper humidity helps in reducing the chance of generating electrostatic charges. Humidity should be kept over 50%RH.

e) Transportation/storage

The storage materials also need to be anti-static treated because there is a possibility that the human body or storage materials such as containers may be statically charged by friction or peeling. The modules should be kept in antistatic bags or other containers resistant to static for storage.

f) Soldering

Soldering anything to this TFT display would void the warranty.

g) Others

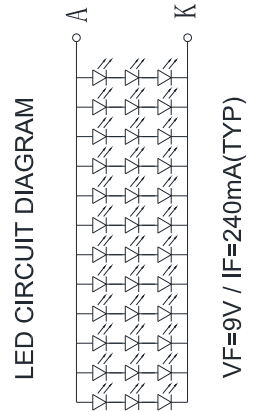
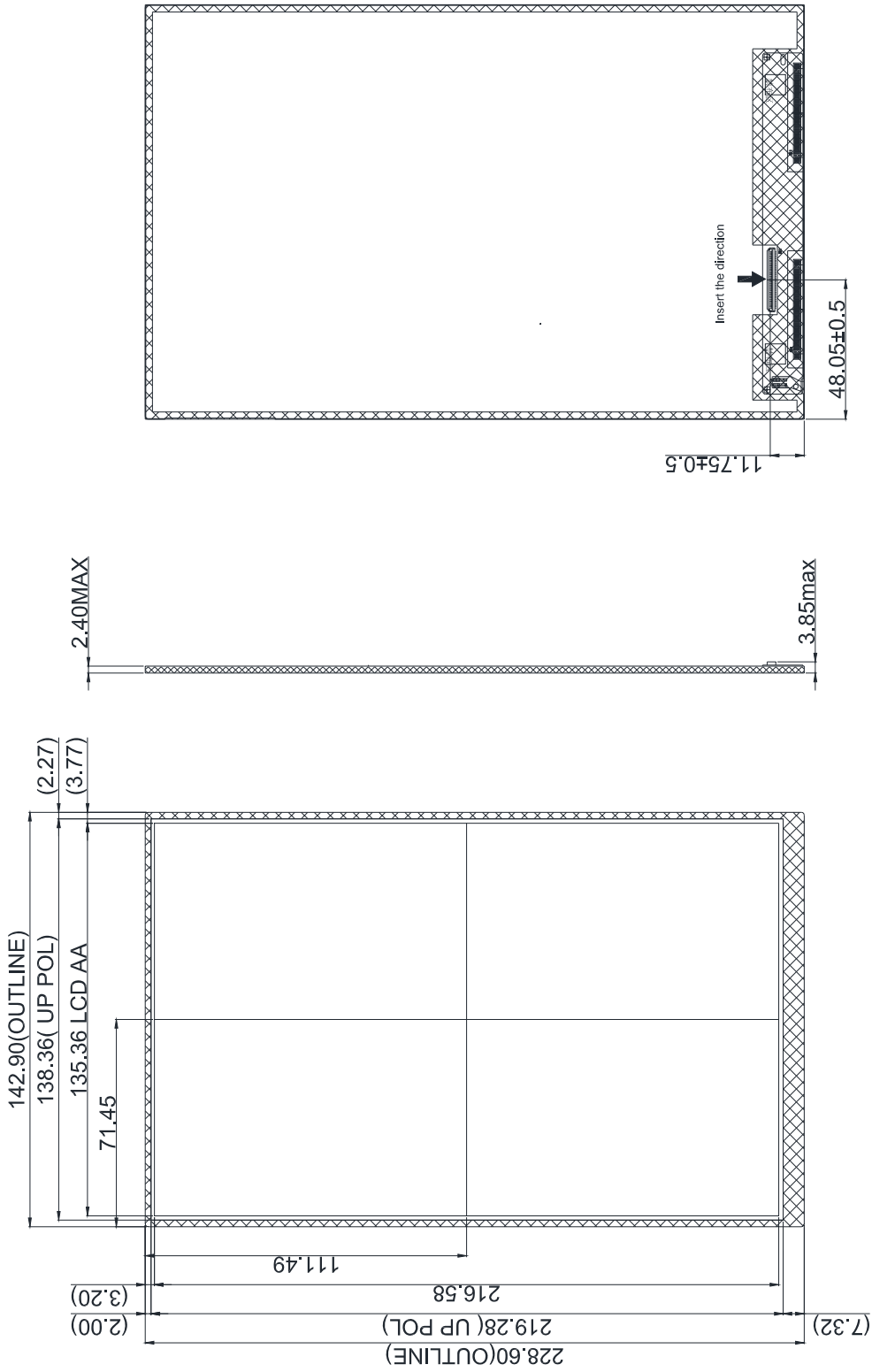
The laminator (protective film) is attached on the surface of LCD panel to prevent it from scratches or stains. It should be peeled off slowly using static eliminator.

Static eliminator should also be installed to the workbench to prevent LCD module from static charge.

10. Operation

- a) Driving voltage should be kept within specified range; excess voltage shortens display life.
 - b) Response time increases with decrease in temperature.
 - c) Display may turn black or dark blue at temperatures above its operational range; this is (however not pressing on the viewing area) may cause the segments to appear "fractured".
 - d) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured".
11. If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. The toxicity is extremely low but caution should be exercised at all the time.
 12. Disassembling the LCD module can cause permanent damage and it should be strictly avoided.
 13. LCD retains the display pattern when it is applied for long time (Image retention). To prevent image retention, do not apply the fixed pattern for a long time. Image retention is not a deterioration of LCD. It will be removed after display pattern is changed.
 14. Do not use any materials, which emit gas from epoxy resin (hardener for amine) and silicone adhesive agent (dealcohol or deoxym) to prevent discoloration of polarizer due to gas.
 15. Avoid the exposure of the module to the direct sunlight or strong ultraviolet light for a long time.

10. MECHANICAL DRAWING



- NOTE:**
1. Unspecified tolerance: ±0.3mm
 2. "()" is reference dimension
 3. Must meet the requirement of ROHS and REACH

11. PACKAGE DRAWING

TBD

12. inspection specification

1. Scope Specifications contain

- 1.1 Display Quality Evaluation
- 1.2 Mechanics Specification

2. Sampling Plan

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

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

3. Panel Inspection Condition

- 3.1 Environment:
 - Room Temperature: 25±5°C.
 - Humidity: 65±5% RH.
 - Illumination: 300 ~ 700 Lux.
- 3.2 Inspection Distance:
 - 35±5 cm
- 3.3 Inspection Angle:
 - The vision of inspector should be perpendicular to the surface of the Module.
- 3.4 Inspection time:
 - Perceptibility Test Time: 20 seconds max.

4. Display Quality

4.1 FUNCTION RELATED:

THE FUNCTION DEFECTS OF LINE DEFECT, ABNORMAL DISPLAY, AND NO DISPLAY ARE CONSIDERED MAJOR DEFECTS.

4.2 BRIGHT/DARK DOTS:

| Defect Type | Specification | Major | Minor |
|----------------------------|---------------|-------|-------|
| Bright Dots | $N \leq 2$ | | • |
| Dark Dots | $N \leq 3$ | | • |
| Total Bright and Dark Dots | $N \leq 4$ | | • |

Note: 1:




The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot.

Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern.

The bright dot defect must be visible through 2% ND filter

Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.

4.3 Pixel Definition:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|--|---|---------------------|
| R | G | B | R | G | B | R | G | B | |  | Dot Defect |
| R | G | B | R | G | B | R | G | B | |  | Adjacent Dot Defect |
| R | G | B | R | G | B | R | G | B | |  | Cluster |

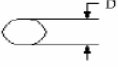
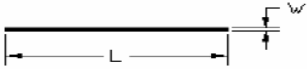
Note 1:

If pixel or partial sub-pixel defects exceed 50% of the affected pixel or sub-pixel area, it shall be considered as 1 defect.

Note 2:

There should be no distinct non-uniformity visible through 2% ND Filter within 2 sec inspection times.

4.4 Visual Inspection specifications:

| Defect Type | | Specification Size | Count(N) | Major | Minor |
|---|-------------------|---|-----------------|--------------|--------------|
| Dot Shape (Particle、Scratch and Bubbles in display area)  | | $D \leq 0.25 \text{ mm}$ | Ignored | | • |
| | | $0.25\text{mm} < D \leq 0.5\text{mm}$ | $N \leq 3$ | | |
| | | $D > 0.5\text{mm}$ | $N=0$ | | |
| Newton Ring (Only for Touch panel) | | $D \leq 70\text{mm}$ | $N \leq 4$ | | • |
| | | $D > 70\text{mm}$ | $N=0$ | | |
| TSP Fish Eyes (Only for Touch panel) (Bubble/Dent) | | $0.1\text{mm} < D \leq 0.2\text{mm}$ | $N \leq 4$ | | • |
| | | $0.2\text{mm} < D \leq 0.3\text{mm}$ | $N \leq 3$ | | |
| | | $0.3 < D \leq 0.4$ | $N \leq 2$ | | |
| Line Shape (Particles、Scratch、Lint and Bubbles in display area)  | | $W \leq 0.01 \text{ mm}$ | Ignored | | • |
| | | $0.01\text{mm} < W \leq 0.05\text{mm}$ and $L \leq 3\text{mm}$ | $N \leq 3$ | | |
| | | $W > 0.05\text{mm}$ or $L > 3 \text{ mm}$ | $N=0$ | | |
| Bubble in cell (active area) | | It should be found by eyes | | | • |
| Bezel | Scratch | No harm | | | • |
| | Dirt | | | | • |
| | Wrap | | | | • |
| | Sunken | | | | • |
| Label | No label | No | | | • |
| | Inverted label | | | | • |
| | Broken | | | | • |
| | Dirt | Word can be read. | | | • |
| | Not clear | No | | | • |
| | Word out of shape | | | | • |
| | Mistake | No | | | • |
| | Position | Be attached on right position | | | • |
| Screw | Not enough | No | | | • |
| | Limp | No | | | • |

| | | | | |
|-----------|-------------------|----------------------------|--|---|
| Connector | Connection status | No bend on pins and damage | | • |
| FPC/FFC | Broken | No | | • |

Note: Extraneous substance and scratch not affecting the display of image, for instance, extraneous substance under polarizer film but outside the display area, or scratch on metal bezel and backlight module or polarizer film outside the display area, shall not be considered as defective or non-conforming.