# MODEL NO. :   TM020HBH01

# ISSUED DATE:   2009-8-14

# VERSION   :   Ver 1.0

## ■Preliminary Specification
## □Final Product Specification

Customer :_____

| Approved by | Notes |
|---|---|
|  |  |

**SHANGHAI TIANMA Confirmed :**

| Prepared by | Checked by | Approved by |
|---|---|---|
| 2009.8.14 | 2009.8.25 | 8/26 |

This technical specification is subjected to change without notice

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# Record of Revision

| Rev | Issued Date | Description | Editor |
|---|---|---|---|
| 1.0 | 2009-8-14 | Preliminary Specification Release | Bencan Yang |
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## 1 General Specifications

| Feature | | Spec |
|---|---|---|
| **Display Spec.** | Size | 2.0 inch |
| | Resolution | 240(RGB) x 320 |
| | Interface | CPU 16bits |
| | Color Depth | 262K/65k |
| | Technology Type | a-Si |
| | Pixel Pitch (mm) | 0.126 x 0.126 |
| | Pixel Configuration | R.G.B. Vertical Stripe |
| | Display Mode | TM with Normally White |
| | Surface Treatment(Up Polarizer) | Clear Type(3H) |
| | Surface Treatment(TSP) | Clear Type(3H) |
| | Viewing Direction | 9 o'clock |
| | Gray Scale Inversion Direction | 3 o'clock |
| **Mechanical Characteristics** | LCM (W x H x D) (mm) | 44.04 x 49.75 x 3.60 |
| | Active Area(mm) | 30.24 x 40.32 |
| | With /Without TSP | With TSP |
| | Weight (g) | TBD |
| | LED Numbers | 3 LEDs |
| **Electronic** | Driver IC | ILI9335 |

Note 1: Viewing direction for best image quality is different from TFT definition, there is a 180 degree shift.

Note 2: Requirements on Environmental Protection: Q/S0002

Note 3: LCM weight tolerance : +/- 5%

## 2  Input/Output Terminals

### 2.1  TFT LCD Panel

| No | Symbol | I/O | Description | Remark |
|----|--------|-----|-------------|--------|
| 1 | GND | P | Ground | |
| 2 | LED-K3 | P | LED Cathode | |
| 3 | LED-K2 | P | LED Cathode | |
| 4 | LED-K1 | P | LED Cathode | |
| 5 | LED-A | P | LED Anode | |
| 6 | GND | P | Ground | |
| 7 | NC | - | Not Connected | |
| 8 | RS | I | Register select signal | |
| 9 | CS | I | Chip Select | |
| 10 | RESET | I | Reset Signal | |
| 11 | RD | I | Read Signal | |
| 12 | WR | I | Write Signal | |
| 13 | DB15 | I | Data Bus | |
| 14 | DB14 | I | Data Bus | |
| 15 | DB13 | I | Data Bus | |
| 16 | DB12 | I | Data Bus | |
| 17 | DB11 | I | Data Bus | |
| 18 | DB10 | I | Data Bus | |
| 19 | DB9 | I | Data Bus | |
| 20 | DB8 | I | Data Bus | |
| 21 | DB7 | I | Data Bus | |
| 22 | DB6 | I | Data Bus | |
| 23 | DB5 | I | Data Bus | |
| 24 | DB4 | I | Data Bus | |
| 25 | DB3 | I | Data Bus | |
| 26 | DB2 | I | Data Bus | |
| 27 | DB1 | I | Data Bus | |
| 28 | DB0 | I | Data Bus | |
| 29 | NC | - | Not Connected | |
| 30 | VDD | P | Power Supply | |
| 31 | VDD | P | Power Supply | |
| 32 | GND | P | Ground | |
| 33 | XR | P | Touch Panel Signal: XR | |
| 34 | YU | P | Touch Panel Signal: YU | |
| 35 | XL | P | Touch Panel Signal: XL | |
| 36 | YD | P | Touch Panel Signal: YD | |
| 37 | GND | P | Ground | |

Note 1:   I/O definition：  I-----Input   O---Output  P----Power(Ground)   NC---No connection

## 3  Absolute Maximum Ratings

### 3.1  Driving TFT LCD Panel

Ta = 25$^{o}$C

| Item | Symbol | Min | Max | Unit | Remark |
|---|---|---|---|---|---|
| Supply Voltage | VDD | -0.3 | 4.6 | V | |
| Input voltage | CS,RD,WR,RS,RESET, DB0~15 | -0.3 | VDD+0.3 | V | |
| Back Light Forward Current | $I_{LED}$ | - | 25 | mA | For each LED |
| Touch Panel Operating Voltage | YU, XL,YD,XR | - | 7 | V | |
| Operating Temperature | $T_{OPR}$ | -20 | 60 | ℃ | |
| Storage Temperature | $T_{STG}$ | -30 | 70 | ℃ | |

## 4  Electrical Characteristics

### 4.1  Driving TFT LCD Panel

GND=0V,  Ta=25℃

| Item | | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Logic & Analog Power Supply | | VDD | 2.5 | 2.8 | 3.3 | V | |
| Input Signal Voltage | Low Level | $V_{IL}$ | 0 | -- | 0.2xVDD | V | DB0~DB15,RS,WR,CS,RD, RESET |
| | High Level | $V_{IH}$ | 0.8xVDD | -- | VDD | V | |
| Output Signal Voltage | Low Level | $V_{OL}$ | -- | -- | 0.2xVDD | V | |
| | High Level | $V_{OH}$ | 0.8xVDD | -- | VDD | V | |
| (Panel+ LSI) Power Consumption | Black Mode (60Hz) | | -- | TBD | -- | mA | |
| | Sleeping Mode | | -- | TBD | -- | mA | |
| | Standby Mode | | -- | TBD | -- | uA | |

### 4.2  Driving Backlight

Ta=25℃

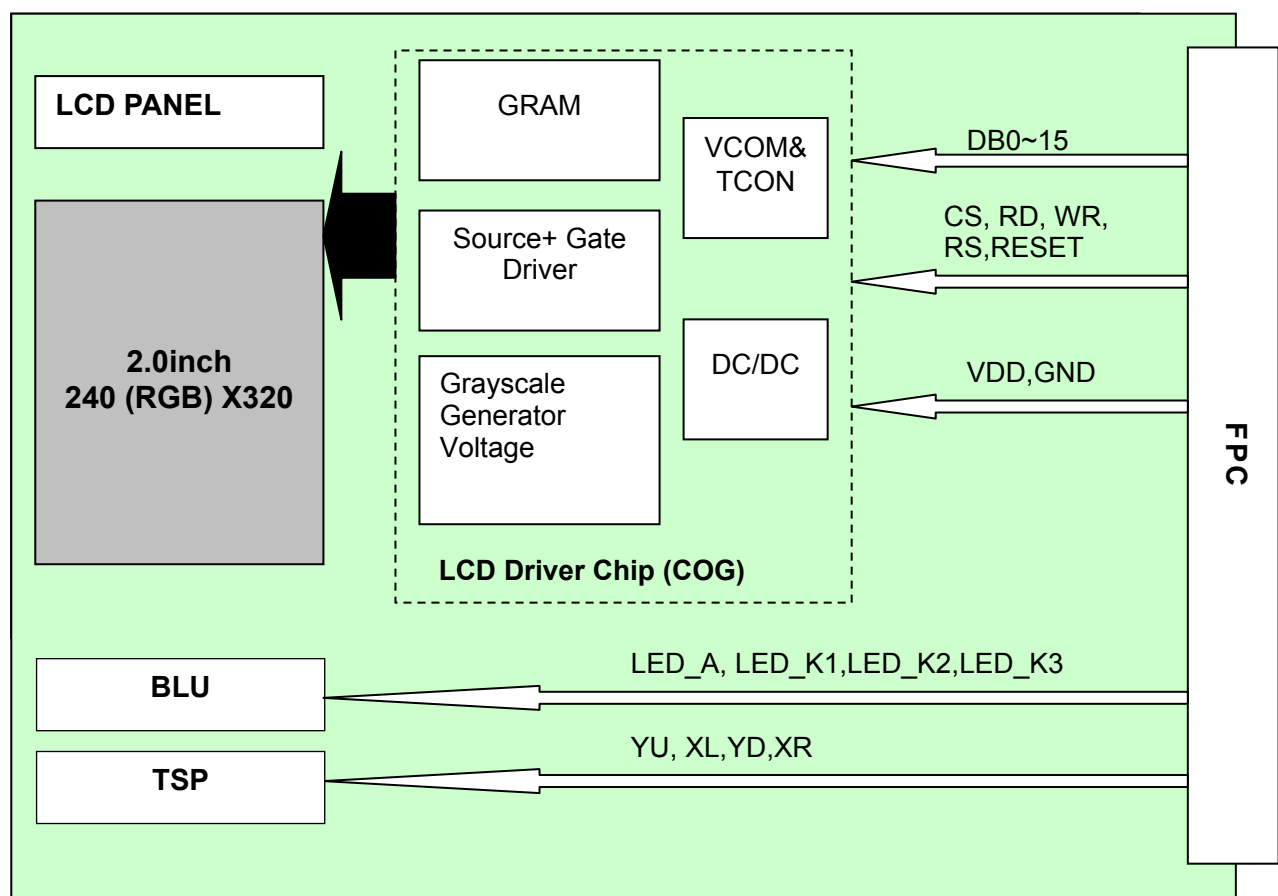| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| Forward Current | $I_F$ | -- | 45 | -- | mA | 3LEDs ( in parallel) |
| Forward Voltage | $V_F$ | -- | 3.2 | -- | V | |
| Power Consumption | $W_{BL}$ | -- | 144 | -- | mW | |

Note1: Figure below shows the connection of backlight LED.
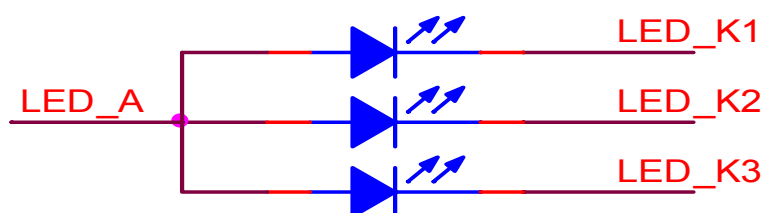


Note 2: One LED : (1/3)*$I_F$ =15mA, $V_F$ =3.2V
Note 3: The life of LED : 20,000 hours

### 4.3 Block Diagram

# 5  Timing Chart

## 5.1  Timing Parameter

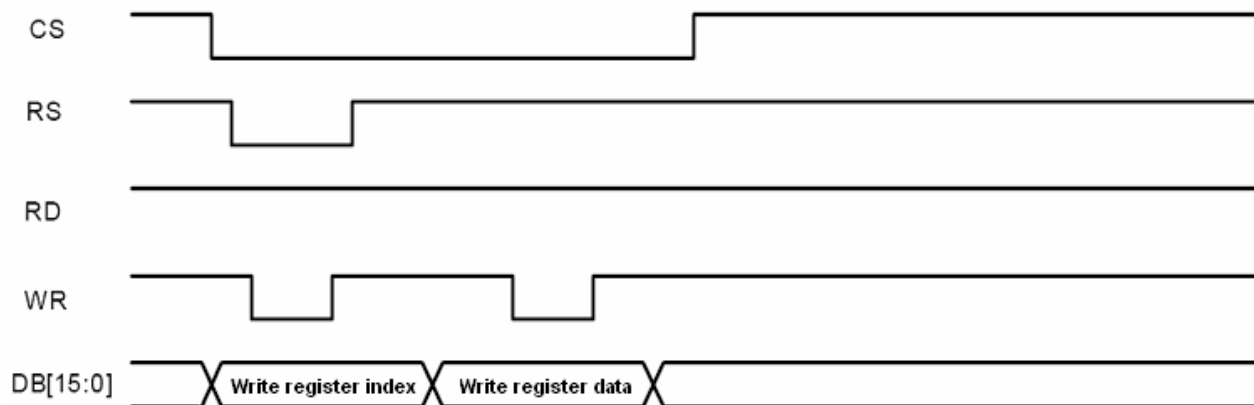| Item | | Symbol | Unit | Min | Typ | Max |
|---|---|---|---|---|---|---|
| Bus cycle time | Write | tCYCW | ns | (75) | - | - |
| | Read | tCYCR | ns | 300 | - | - |
| Write low-level pulse width | | PWLW | ns | (40) | - | 500 |
| Write high-level pulse width | | PWHW | ns | (30) | - | - |
| Read low-level pulse width | | PWLR | ns | 150 | - | - |
| Read high-level pulse width | | PWHR | ns | 150 | - | - |
| Write / Read rise / fall time | | tWRr / tWRf | ns | - | - | 25 |
| Setup time | Write ( RS to CS, WR ) | tAS | ns | 10 | - | - |
| | Read ( RS to CS, RD ) | | | 5 | - | - |
| Address hold time | | tAH | ns | 5 | - | - |
| Write data set up time | | tDSW | ns | 10 | - | - |
| Write data hold time | | tH | ns | 15 | - | - |
| Read data delay time | | tDDR | ns | - | - | 100 |
| Read data hold time | | tDHR | ns | 5 | - | - |
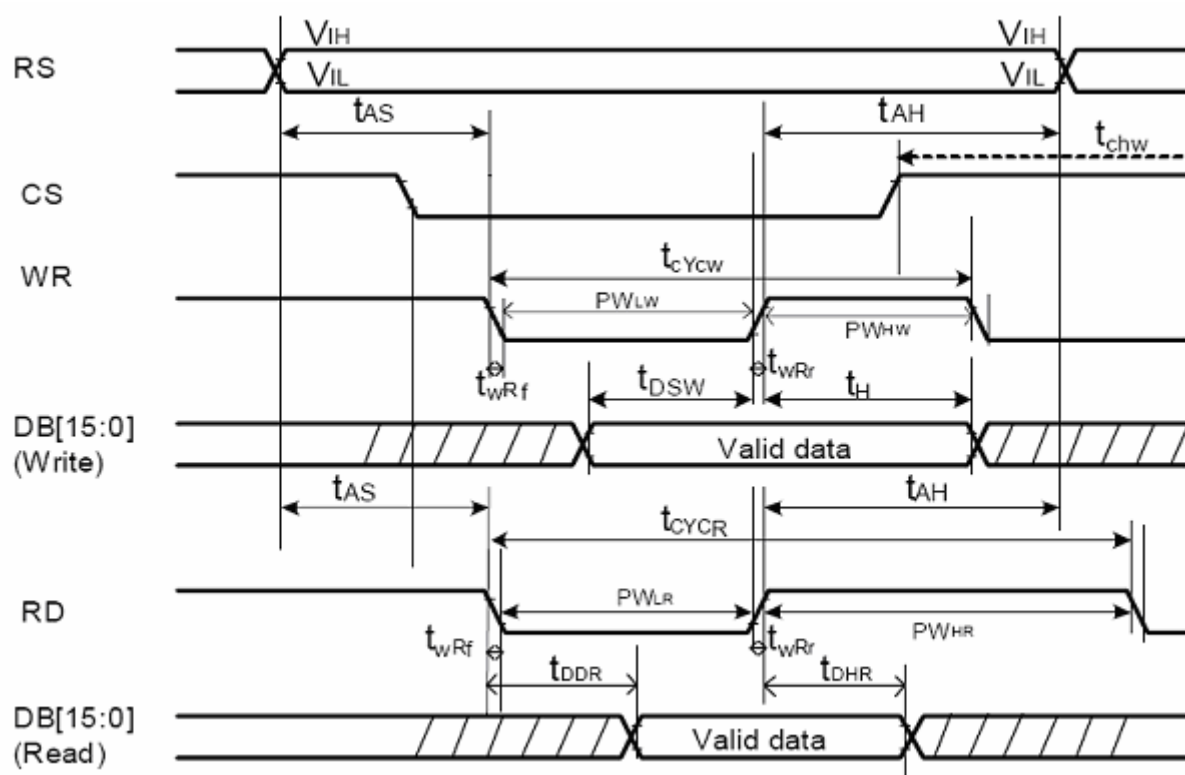


**CPU Interface Timing**

## 5.2 Register Write/Read Timing In i80 16bit System

### 5.2.1 Register Write Timing

```
CS

RS

RD

WR

DB[15:0]    ⟨ Write register index ⟩⟨ Write register data ⟩
```

### 5.2.2 Register Read Timing

```
CS

RS

RD

WR

DB[15:0]    ⟨ Write register index ⟩  ⟨ Read register data ⟩
```
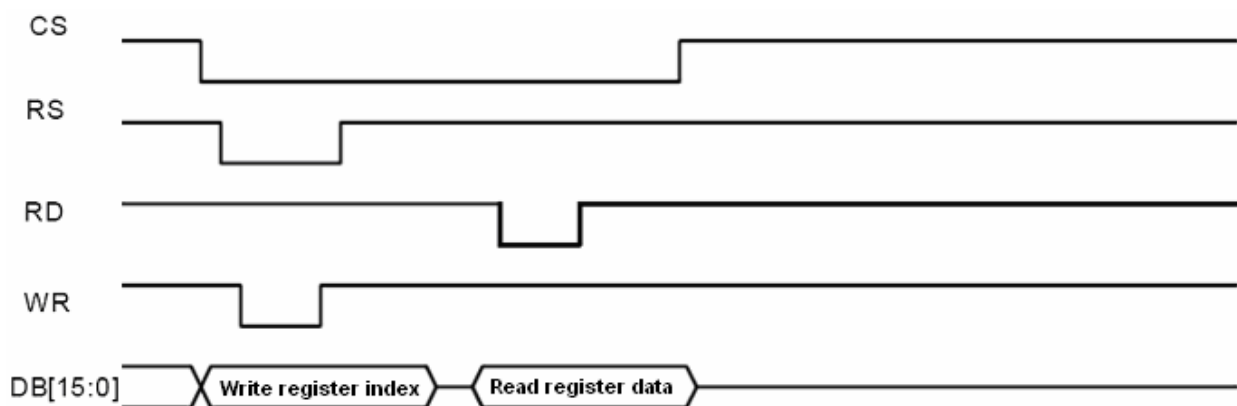
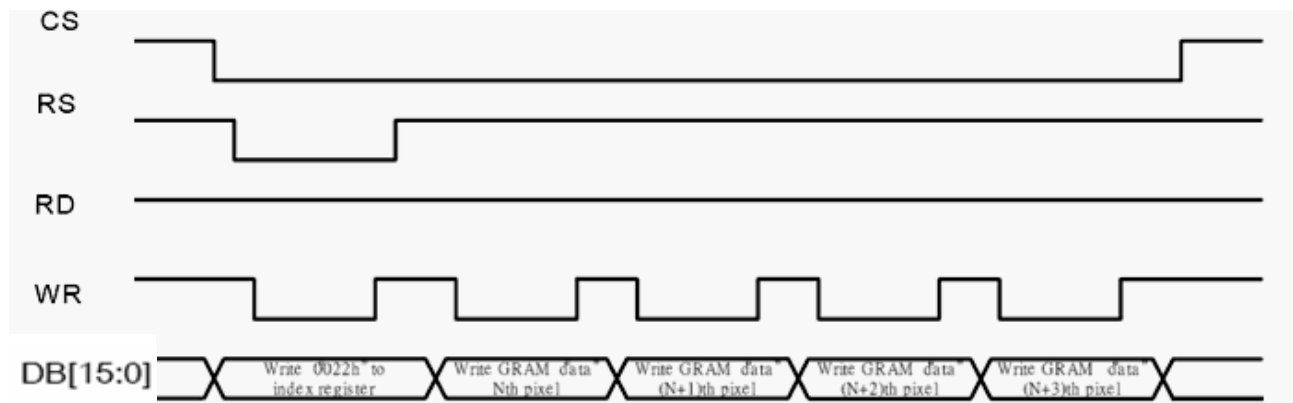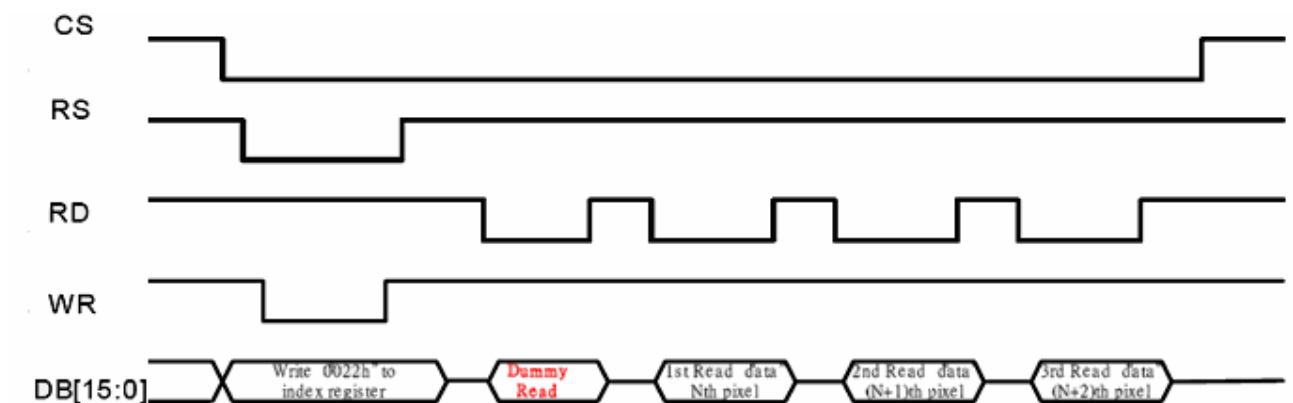## 5.3    GRAM Write/Read Timing In i80 16bit System

### 5.3.1    GRAM Write Timing



### 5.3.2    GRAM Read Timing



### 5.4    Reset Timing Characteristics

| Item | Symbol | Unit | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| RESET low-level width | tRES | ms | 1 | - | - |
| RESET rise time | trRES | µs | - | - | 10 |
| Reset high-level width | tRES_H | ms | 50 | | |



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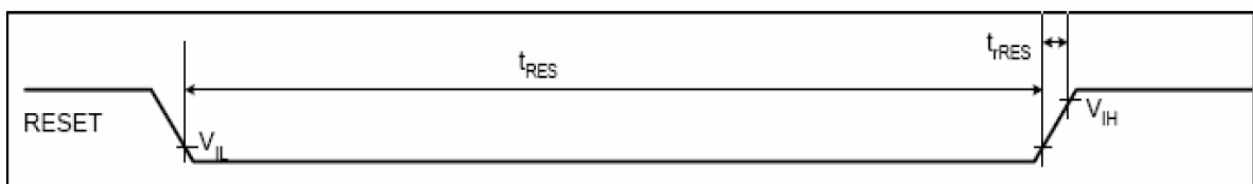
## 5.5   Power On/Off Sequence

### 5.5.1 Power on Sequence

Power Supply ON ( VDD)

Power On Reset and Display OFF

Display OFF Setting
DTE = 0
D[1:0] = 00
GON = 0
PON = 0

Registers setting before power supply startup

LCD Power Supply ON Sequence

Power supply initial setting
Set VC[2:0], VRH[3:0], VCM[5;0], VDV[5:0], PON=0,BT[2:0] = 000

50ms or more Stabilizing time

Registers setting for power supply startup

Power supply operation setting
Set BT[2:0],PON = 1,
Set AP[2:0],APE=1,
Set DC1[2:0], DC0[2:0]

80ms or more Step-up circuit stabilizing time

Set the other registers

Operational Amplifier stabilizing time

Display ON Sequence

Set SAP=1

Display ON

DTE=1
D[1:0]=11
GON=1

BLU ON

### 5.5.2 Power off Sequence

```
┌─────────────────────┐        Display ON Setting
│   Normal Display    │        DTE=1
└─────────────────────┘        D[1:0]=11
           │                   GON=1
           ▼
┌─────────────────────┐
│      BLU OFF        │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│    Display OFF      │
└─────────────────────┘
           │
           ▼
┌─────────────────────┐        SAP=0
│  Power Supply Halt  │        AP[2:0] = 000
│      Setting        │        PON = 0
└─────────────────────┘
           │
           ▼
┌─────────────────────┐
│ Power Supply OFF (VDD) │
└─────────────────────┘
```

# 6  Optical Characteristics

## 6.1      Optical Specification

Ta=25℃

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| View Angles | | θT | CR≧10 | 55 | 60 | - | Degree | Note 2 |
| | | θB | | 55 | 60 | - | | |
| | | θL | | 35 | 40 | - | | |
| | | θR | | 55 | 60 | - | | |
| Contrast Ratio | | CR | θ=0° | 300 | 350 | - | | Note1 Note3 |
| Response Time | | $T_{ON}$ | 25℃ | - | 25 | 40 | ms | Note1 Note4 |
| | | $T_{OFF}$ | | | | | | |
| Chromaticity | White | x | Backlight is on | 0.250 | 0.300 | 0.350 | | Note5, Note1 |
| | | y | | 0.270 | 0.320 | 0.370 | | |
| | Red | x | | 0.541 | 0.591 | 0.641 | | |
| | | y | | 0.297 | 0.347 | 0.397 | | |
| | Green | x | | 0.277 | 0.327 | 0.377 | | |
| | | y | | 0.511 | 0.561 | 0.611 | | |
| | Blue | x | | 0.110 | 0.160 | 0.210 | | |
| | | y | | 0.038 | 0.088 | 0.138 | | |
| Uniformity | | U | | - | 80 | - | % | Note1 Note6 |
| NTSC | | | | - | 50 | - | % | Note 5 |
| Luminance (TSP) | | L | | 160 | 180 | - | cd/m$^2$ | Note1 Note7 |

Test Conditions:

1.   $V_F$ =3.2V, $I_F$ =45mA(Backlight current), the ambient temperature is 25℃.

2.   The test systems refer to Note 1 and Note 2.

Note 1:  Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.
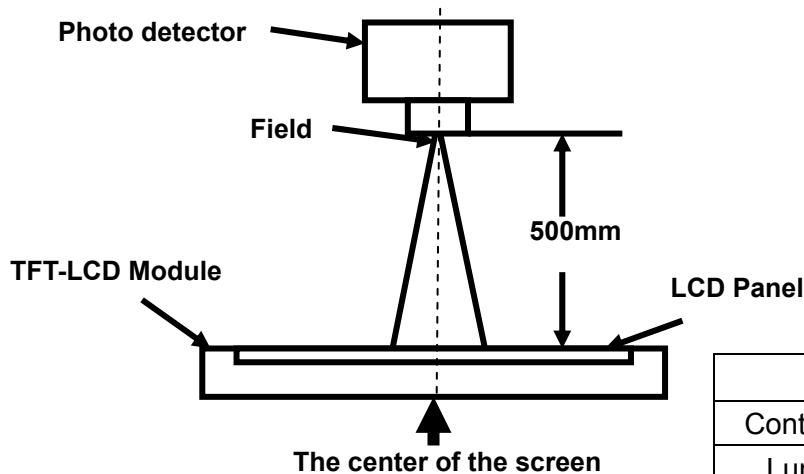


| Item | Photo detector | Field |
|---|---|---|
| Contrast Ratio | SR-3A | 1° |
| Luminance | | |
| Chromaticity | | |
| Lum Uniformity | | |
| Response Time | BM-7A | 2° |

Note 2: Definition of viewing angle range and measurement system.

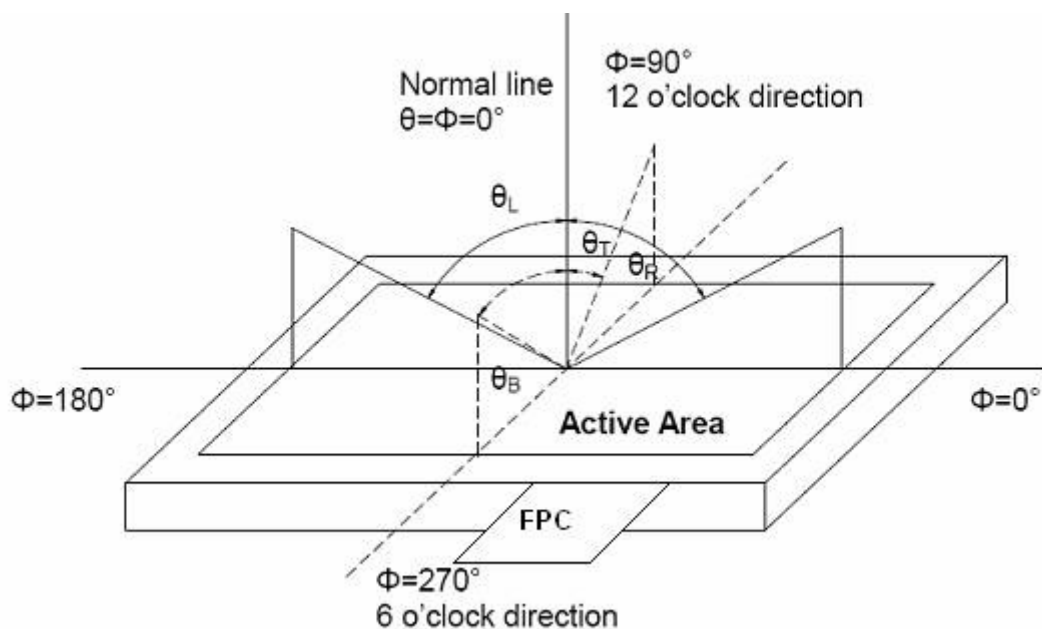viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80)。



Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

"White state ":The state is that the LCD should be driven by Vwhite.

"Black state": The state is that the LCD should be driven by Vblack.

Vwhite: To be determined     Vblack: To be determined.

Note 4: 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%.
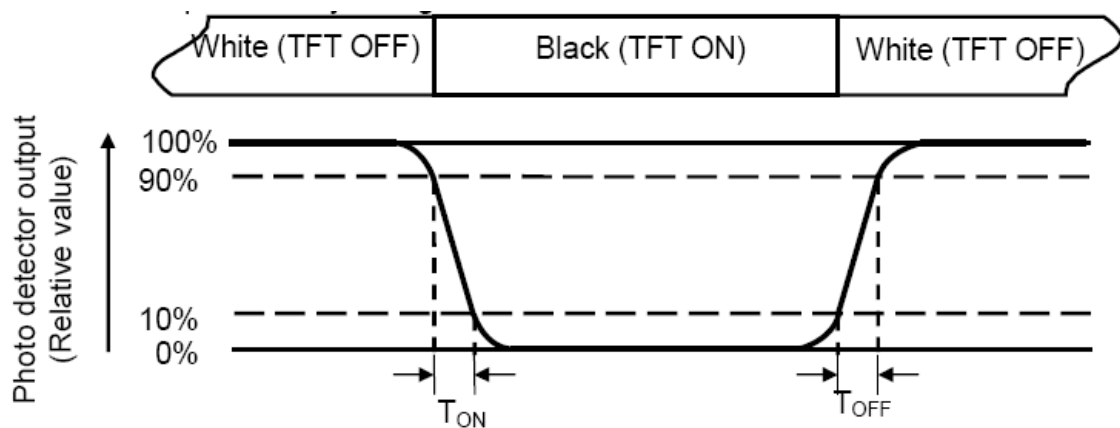
Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

## Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity(U) = Lmin/ Lmax
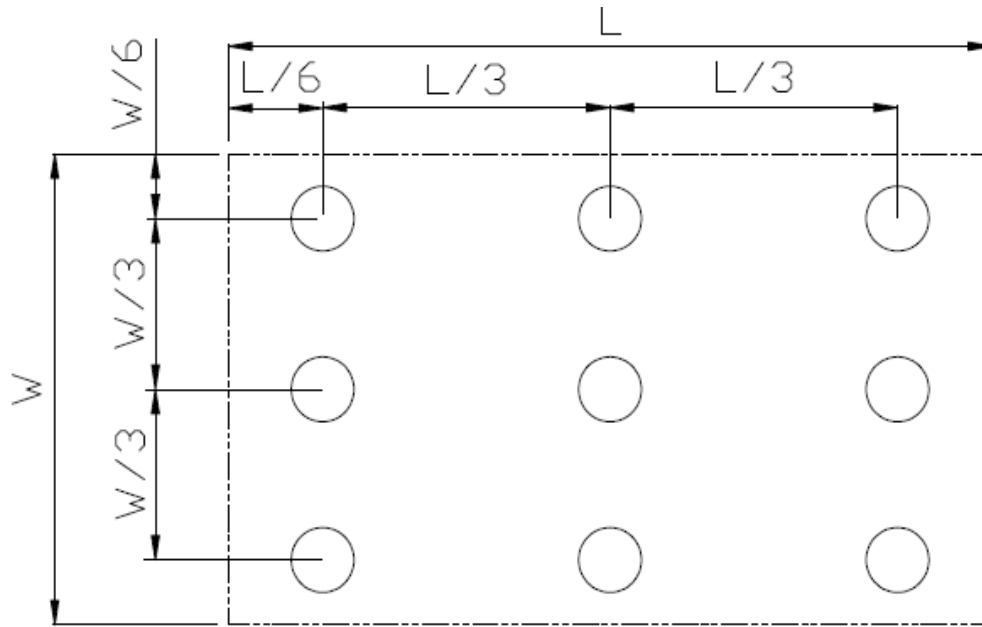
L-------Active area length W----- Active area width



Fig. 2 Definition of uniformity

Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.


## Note 7: Definition of Luminance:

Measure the luminance of white state at center point.

## 7　Environmental / Reliability Tests

| No | Test Item | Condition | Remarks |
|---|---|---|---|
| 1 | High Temperature Operation | Ts=+60℃, 240hrs | Note1<br>IEC60068-2-1:2007,GB2423.2-2008 |
| 2 | Low Temperature Operation | Ta=-20℃, 240hrs | IEC60068-2-1:2007<br>GB2423.1-2008 |
| 3 | High Temperature Storage | Ta=+70℃, 240hrs | IEC60068-2-1:2007<br>GB2423.2-2008 |
| 4 | Low Temperature Storage | Ta=-30℃, 240hrs | IEC60068-2-1:2007<br>GB2423.1-2008 |
| 5 | High Temperature & High Humidity Storage | Ta=+60℃, 90% RH<br>240 hours | Note2<br>IEC60068-2-78 :2001<br>GB/T2423.3—2006 |
| 6 | Thermal Shock (Non-operation) | -30℃ 30 min~+70℃ 30 min,<br> Change time:5min, 20 Cycles | Start with cold temperature,<br>End with high temperature,<br>IEC60068-2-14:1984,GB2423.22-2002 |
| 7 | Electro Static Discharge (Operation) | C=150pF,　　　R=330Ω　，<br>5points/panel<br>Air:±8KV, 5times;<br>Contact:±4KV, 5 times;<br>（Environment: 15℃～35℃,<br>30%～60%, 86Kpa～106Kpa） | IEC61000-4-2:2001<br>GB/T17626.2-2006 |
| 8 | Vibration (Non-operation) | Frequency range:10~55Hz,<br>Stroke:1.5mm<br>Sweep:10Hz~55Hz~10Hz　2 hours<br>for each direction of X.Y.Z.<br>(6 hours for total)(Package condition) | IEC60068-2-6:1982<br>GB/T2423.10—1995 |
| 9 | Shock (Non-operation) | 60G 6ms, ±X,±Y,±Z 3times,<br>for each direction | IEC60068-2-27:1987<br>GB/T2423.5—1995 |
| 10 | Package Drop Test | Height:80 cm,<br>1 corner, 3 edges, 6 surfaces | IEC60068-2-32:1990<br>GB/T2423.8—1995 |

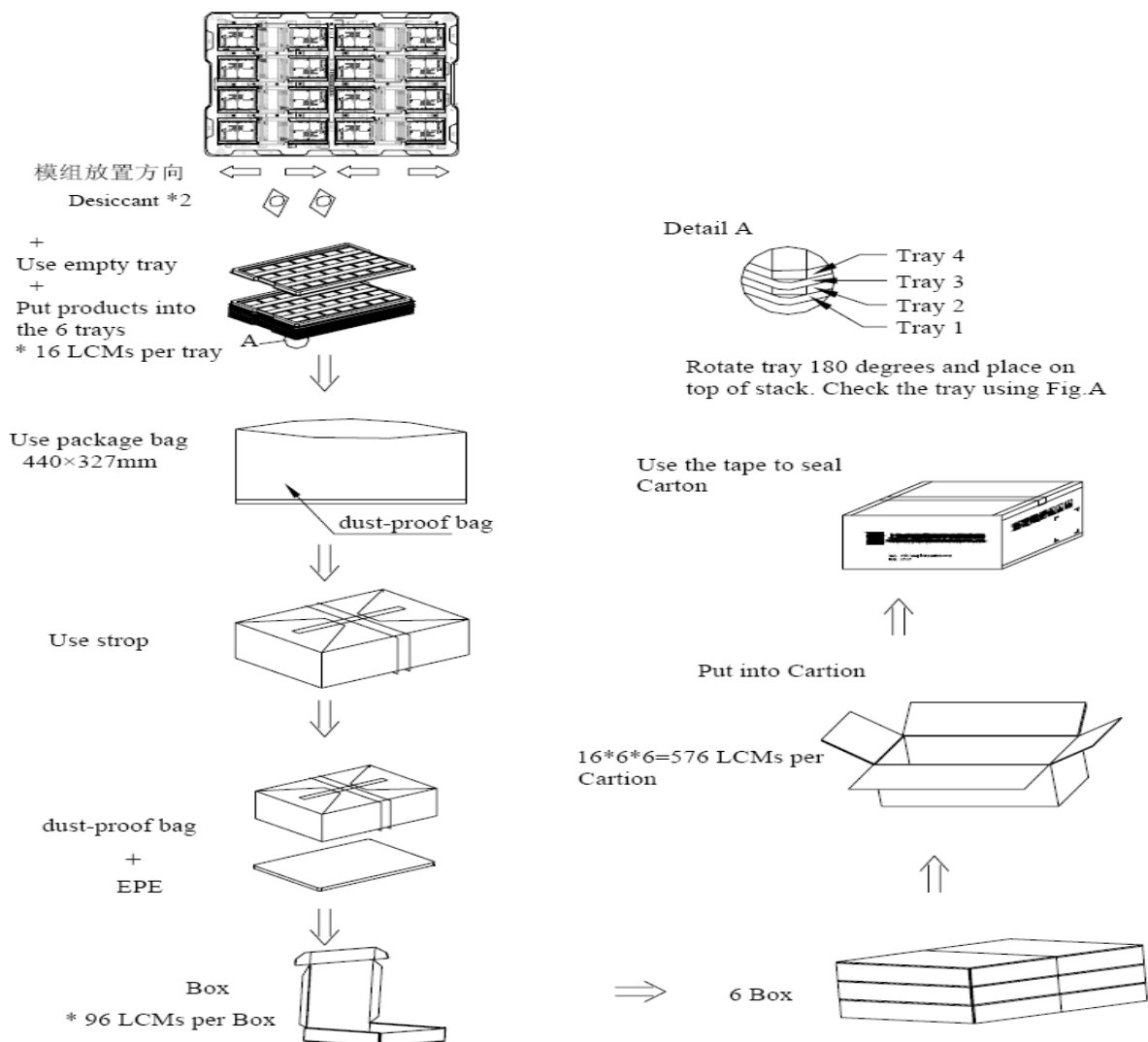Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of sample.

# 8  Mechanical Drawing

Pin Assignment:

| No. | Symbol |
|-----|--------|
| 1 | GND |
| 2 | LED-K3 |
| 3 | LED-K2 |
| 4 | LED-K1 |
| 5 | LED-A |
| 6 | GND |
| 7 | NC |
| 8 | RS |
| 9 | CS |
| 10 | RESET |
| 11 | RD |
| 12 | WR |
| 13 | DB15 |
| 14 | DB14 |
| 15 | DB13 |
| 16 | DB12 |
| 17 | DB11 |
| 18 | DB10 |
| 19 | DB9 |
| 20 | DB8 |
| 21 | DB7 |
| 22 | DB6 |
| 23 | DB5 |
| 24 | DB4 |
| 25 | DB3 |
| 26 | DB2 |
| 27 | DB1 |
| 28 | DB0 |
| 29 | IM0(NC) |
| 30 | VDD |
| 31 | VDD |
| 32 | GND |
| 33 | XR |
| 34 | YU |
| 35 | XL |
| 36 | YD |
| 37 | GND |

NOTES:
1. Display Type: TFT
2. Backlight: 3-chips LED
3. Gray Scale Inversion 3 o'clock;
4. Driver IC: ILI9335
5. General Tolerance: ±0.2
6. Requirements on Environment Protection: Q/S0002

12 O'clock

BLU circuit

LED-A
LED-K1
LED-K2
LED-K3

Detail A
Scale 4/1

View Direction
9 O'clock
240(RGB)×320

SEE DETAIL A

39.10±0.20
31.80±0.10
P0.8×(37-1)=28.80±0.10
W=0.40
6.15
7.65
5.00
1.50
5.00±0.50
2.50±0.30
3.00±0.30
0.5,T=0.05mm
33.85±0.50
0.25±0.30
49.75±0.20(Module Outline)
49.00(CTP Outline)
42.32(CTP V.A)
41.32(TP AA)
40.32(LCD A.A)
(24.10)
(3.94) (3.44) (2.94) (0.20)
(21.50)
30.24(LCD A.A)
34.64(TP AA)
35.64(TP V.A)
43.64(TP Outline)
44.04±0.20(Module Outline)
(6.38) (5.88) (5.38) (0.20)
3-0.80±0.15
3.60±0.20(Exclude tape)
2.45±0.10
42.44±0.15
0.5,T=0.05mm
(8.21)
(1.50)
3-Ø0.90±0.15
2-0.80±0.15
(7.57)
(2.50)
0.80±0.15
(2.00)
(13.98)
(18.60)
导电布T=0.1mm
(42.50)
43.30±0.15
(31.45)
0.5,T=0.05mm
1.0 Max
1.2Max
0.126
0.042
0.126

| | | | |
|---|---|---|---|
| CONTROL DIMENTION: | | | |
| REFERENCE DIMENTION: | | | |
| APPROVED: Shu Wei | 2009-08-11 | MODEL NAME | TM020HBH01 |
| CHECKED: Fang Wei | 2009-08-11 | PART NAME | LCM |
| DESIGNED: Yang Qingju | 2009-08-11 | DRAWING NUMBER | YGT 1-00 |
| | | MATERIAL NUMBER | TM020HBH01-00 |

Shanghai Tianma Micro-Electronics Co.,Ltd.
No.889,Huiping Rd.,Pudong New District,Shanghai,China

3rd ANGLE
UNIT  mm
SCALE  1:1
PAGE  1/1

| REV | DC/EC NUMBER | DESCRIPTION | DATE |
|-----|--------------|-------------|------|

## 9  Packing Drawing

| No | Item | Model(Material) | Dimensions(mm) | Unit Weight(Kg) | Quantity | Remark |
|----|------|-----------------|----------------|-----------------|----------|--------|
| 1 | LCM module | TM020HBH01 | 44.04x49.75x3.60 | TBD | 576 | |
| 2 | Tray | PET（Transmit） | 315×247×11.8 | 0.079 | 42 | Anti-static |
| 3 | EPE | EPE | 315×247×5 | 0.009 | 6 | |
| 4 | Anti-static bag | PE | 327×440 | 0.021 | 6 | |
| 5 | BOX | CORRUGATED PAPER | 345×260×70 | 0.227 | 6 | |
| 6 | Desiccant | Desiccant | 45×50 | 0.0035 | 12 | |
| 7 | Carton | CORRUGATED PAPER | 544×365×250 | 1.01 | 1 | |
| 8 | Total Weight(Kg) | TBD | | | | |

模组放置方向 ⇐ ⇒ ⇐ ⇒
Desiccant *2

+
Use empty tray
+
Put products into
the 6 trays
* 16 LCMs per tray
A

Use package bag
440×327mm

dust-proof bag

Use strop

dust-proof bag
+
EPE

Box
* 96 LCMs per Box

Detail A

Tray 4
Tray 3
Tray 2
Tray 1

Rotate tray 180 degrees and place on
top of stack. Check the tray using Fig.A

Use the tape to seal
Carton

Put into Cartion

16*6*6=576 LCMs per
Cartion

6 Box

# 10 Precautions for Use of LCD Modules

**10.1** Handling Precautions

**10.1.1** The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

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

**10.1.3** Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

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

**10.1.5** If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

－ Isopropyl alcohol

－ Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

－ Water

－ Ketone

－ Aromatic solvents

**10.1.6** Do not attempt to disassemble the LCD Module.

**10.1.7** If the logic circuit power is off, do not apply the input signals.

**10.1.8** To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

**10.1.8.1** Be sure to ground the body when handling the LCD Modules.

**10.1.8.2** Tools required for assembly, such as soldering irons, must be properly ground.

**10.1.8.3** To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

**10.1.8.4** The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

**10.2** Storage precautions

**10.2.1** When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

**10.2.2** The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃        Relatively humidity: ≤80%

**10.2.3** The LCD modules should be stored in the room without acid, alkali and harmful gas.

**10.3** Transportation Precautions:

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.