



MODEL NO. : TM022HDHT1-00

ISSUED DATE: 2009-11-3

VERSION : Ver 0.0

- Provisional Specification
- Final Product Specification

Customer : _____

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

SHANGHAI TIANMA Confirmed :

| prepared by | Checked by | Approved by |
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| | | |

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1 General specifications

| Feature | | Spec |
|-----------------------------------|---------------------------------|------------------------|
| Display Spec. | Size | 2.2 inch |
| | Resolution | 240(RGB) X 320 |
| | Interface | RGB 18 bits+4 SPI |
| | Color Depth | 262K |
| | Technology type | a-si TFT |
| | Pixel pitch (mm) | 0.141x0.141 |
| | Pixel Configuration | R.G.B. Vertical Stripe |
| | Display Mode | ECB Transflective |
| | Surface Treatment(Up Polarizer) | Clear type (3H) |
| | Surface Treatment(TSP) | Clear type (3H) |
| | Viewing Direction | 12 o'clock |
| | Gray Scale Inversion Direction | 6 o'clock |
| Mechanical Characteristics | DIM. LCM (W x H x D) (mm) | 40.6x56.6x2.70 |
| | Active Area(mm) | 33.84 x45.12 |
| | With /Without TSP | Without TSP |
| | Weight (gram) | TBD |
| | LED Numbers | 4 LEDs (serial) |

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: RoHS



2 Input/Output terminals

2.1 TFT LCD Panel

Recommended connector: FH23-39S-0.3SHW (HIROSE)

| No | Symbol | I/O | Description | Remarks |
|----|------------|-----|---|---------|
| 1 | VL1 (LED+) | I | Power supply for LED(High voltage) | |
| 2 | VL2 (LED-) | I | Power supply for LED(Low voltage) | |
| 3 | GND | P | Ground | |
| 4 | VDD | P | Power supply of gate driver(high level) | |
| 5 | GND | P | Ground | |
| 6 | VSYNC | I | Vertical sync. signal | |
| 7 | RESET | I | Reset Enable | |
| 8 | GND | P | Ground | |
| 9 | CS | I | SPI Chip select | |
| 10 | SDO | O | SPI serial Data output | |
| 11 | SDI | I | SPI serial Data input | |
| 12 | GND | P | Ground | |
| 13 | SCL | I | SPI serial interface clock | |
| 14 | GND | P | Ground | |
| 15 | B5 | I | Blue data signal | |
| 16 | B4 | I | Blue data signal | |
| 17 | B3 | I | Blue data signal | |
| 18 | B2 | I | Blue data signal | |
| 19 | B1 | I | Blue data signal | |
| 20 | B0 | I | Blue data signal | |
| 21 | ENABLE | I | Data enable signal | |
| 22 | HSYNC | I | Horizontal sync signal | |
| 23 | GND | P | Ground | |
| 24 | DCLK | I | Data sampling clock signal | |
| 25 | GND | P | Ground | |
| 26 | G5 | I | Green data signal | |
| 27 | G4 | I | Green data signal | |
| 28 | G3 | I | Green data signal | |
| 29 | G2 | I | Green data signal | |
| 30 | G1 | I | Green data signal | |
| 31 | G0 | I | Green data signal | |
| 32 | GND | P | Ground | |
| 33 | R5 | I | Red data signal | |
| 34 | R4 | I | Red data signal | |
| 35 | R3 | I | Red data signal | |
| 36 | R2 | I | Red data signal | |
| 37 | R1 | I | Red data signal | |
| 38 | R0 | I | Red data signal | |
| 39 | GND | P | Ground | |

Note2-1: I/O definition:

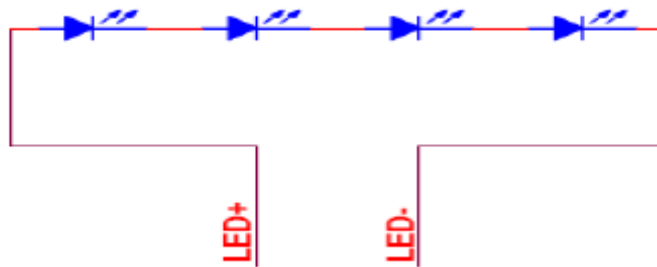
I-----Input



O---Output

P----Power

Note 2-2: The figure below shows the connection of backlight LED.





3 Absolute maximum ratings

3.1 Driving TFT LCD Panel

(VSS=0, Ta = 25°C)

| Item | Symbol | MIN | MAX | Unit | Remark |
|----------------------------|---|------|--------------|------|--------|
| Logic Supply Voltage | VDD | -0.3 | 3.3 | V | |
| Input Signal Voltage | R0~R5,G0~G5,B0~B5, ENABLE,DCLK,HSYNC, VSYNC,/CS,SCL,SDI,SDO/RESET | -0.3 | VDD3 +0.5 | V | |
| Back Light Forward Current | I _{LED} | -- | 20 | mA | |
| Operating Temperature | T _{OPR} | -20 | 70 | °C | |
| Storage Temperature | T _{STG} | -30 | 80 | °C | |

Note 1: Symbol VDD3 rate is -0.3 to 5.0 and The parameter is for S6D04H0X02-B0C1 only.



4 Electrical characteristics

4.1 Driving TFT LCD Panel

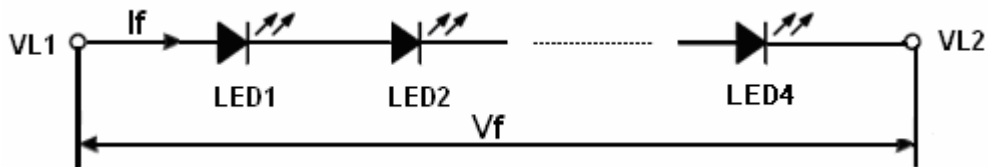
(VSS=0, Ta=25°C)

| Parameter | Symbol | MIN | TYP | MAX | Unit | Remark |
|-----------------------------|------------|----------|-----------------|------|-----------------|--------|
| Digital supply Voltage | VDD | 2.52 | 2.8 | 3.08 | V | |
| Gate on voltage | VGH | 13.5 | 15.0 | 16.5 | V | |
| Gate off voltage | VGL | -11.0 | -10.0 | -9.0 | V | |
| Input Signal Voltage | Low Level | V_{IL} | 0 | - | $0.3 \cdot VDD$ | V |
| | High Level | V_{IH} | $0.7 \cdot VDD$ | - | VDD | V |
| Output Signal Voltage | Low Level | VOL | 0.0 | - | $0.2 \cdot VDD$ | V |
| | High Level | VOH | $0.8 \cdot VDD$ | - | VDD | V |
| Current of VDD Power supply | I_{CC} | - | TBD | - | mA | Note 1 |

Note1: To test the current dissipation, use "all Black Pattern".

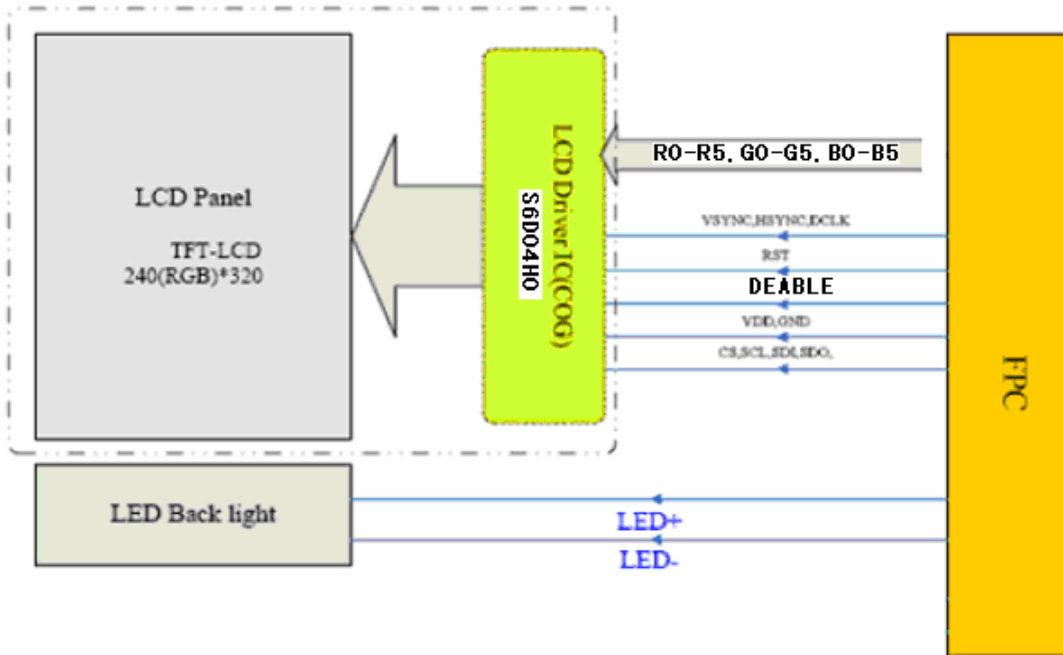
4.2 Driving Backlight Ta=25°C

| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|-------------------|----------|-----|------|-----|------|---------------|
| Forward Current | I_F | | 20 | -- | mA | 4 LEDs serial |
| Forward Voltage | V_F | -- | 12.8 | | V | |
| Power Consumption | W_{BL} | -- | 256 | -- | mW | |





4.3 Block Diagram





5 Timing chart

5.1 RGB INTERFACE CHARACTERISTICS

5.2.1 RGB Interface Timing

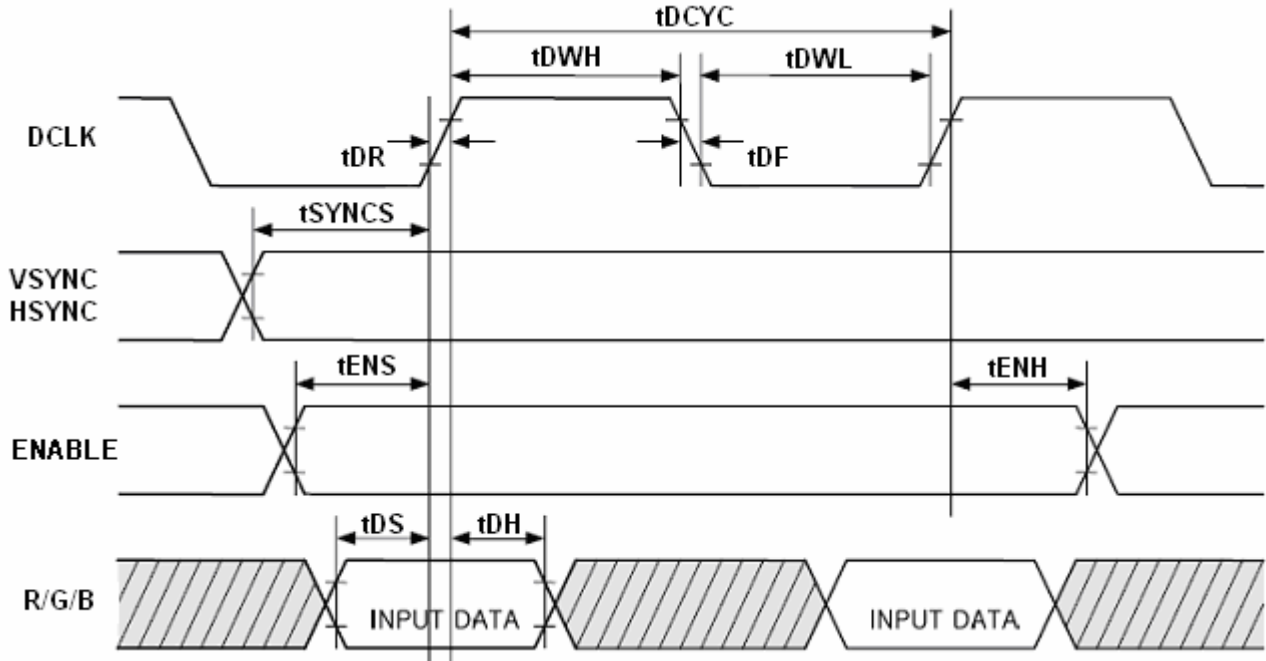


Fig.5-1 RGB Interface Timing

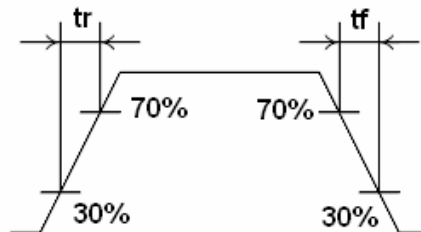


Fig.5-2 Input signal's rise and fall times

Tab.5-1 RGB Interface AC Characteristics

(VSHD=2.4~3.3V, Ta=-40~+85°C)

| Parameter | Description | Min | Max | Unit | Remark |
|-----------------|--------------------------|-----|-----|------|--------|
| t_{DCYC} | DCLK period | 100 | - | ns | |
| t_{DWL} | DCLK pulse width low | 50 | - | ns | |
| t_{DWH} | DCLK pulse width high | 50 | - | ns | |
| t_{DR}/t_{DF} | DCLK rising/falling time | - | 20 | ns | |
| t_{SYNCS} | VSYNC, HSYNC setup | 30 | - | ns | Note |
| t_{ENS} | ENABLE setup | 50 | - | ns | |
| t_{ENH} | ENABLE hold | 50 | - | ns | |
| t_{DS} | Input Data setup | 50 | - | ns | |
| t_{DH} | Input Data hold | 50 | - | ns | |

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| | | | | | |
|----|--------------------|---|----|----|--|
| tf | signal's rise time | - | 15 | ns | |
| tr | signal's fall time | - | 15 | ns | |

Note:

1. VSYNC Low Pulse Width $\geq 1H$;
2. HSYNC Low Pluse Width $\geq 1DCLK$

5.2.2 Recommend RGB Interface Timing

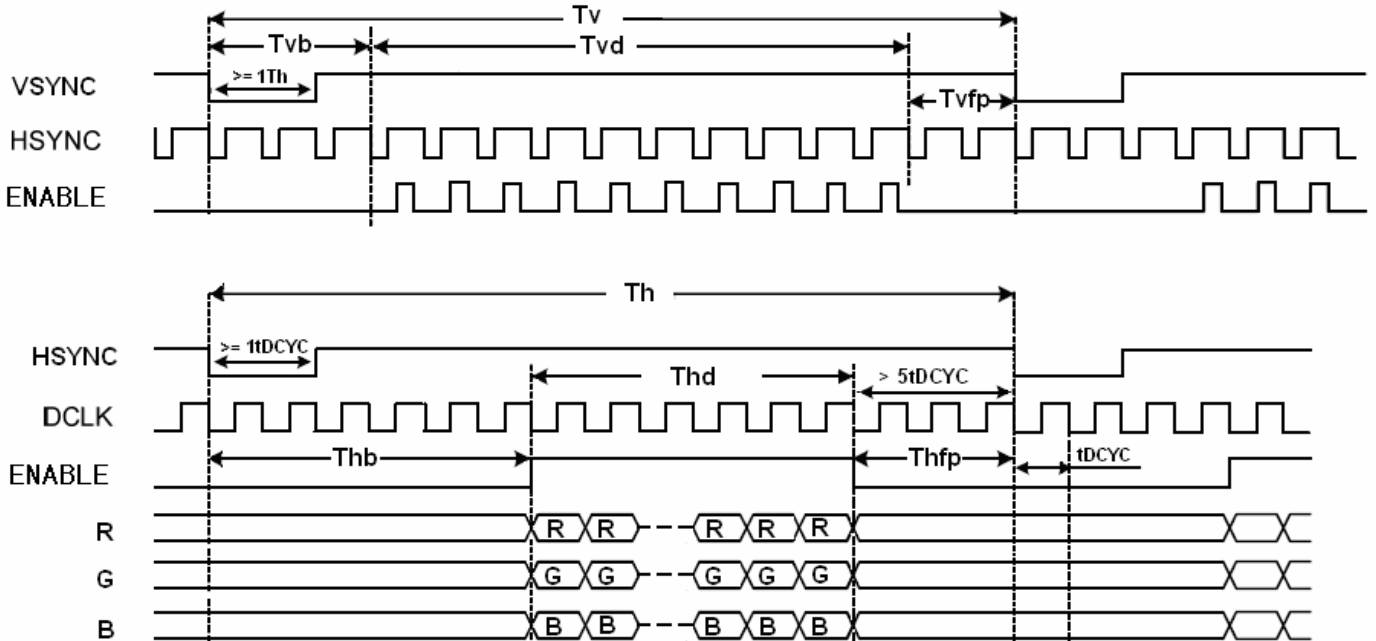


Fig.5-3 Recommend RGB Interface Timing

Tab.5-2 Recommend Input Timing (DCLK, HSYNC, VSYNC, ENABLE)
(VSHD=2.4~3.3V, Ta=-40~+85°C)

| Parameter | Symbol | Symbol | Min. | Typ. | Max. | Unit | Remark |
|-----------|------------------------|--------|------|--------|------|------|--------|
| DCLK | DCLK frequency | fDCYC | - | 5.64 | 10 | MHz | |
| | DCLK period | tDCYC | 100 | 177.15 | - | ns | |
| HSYNC | Horizontal | Thd | 240 | | | Tclk | |
| | 1horizontalline | Th | 259 | 280 | - | | |
| | Horizontal blank | Thb | 3 | 20 | - | | |
| | Horizontal front porch | Thfp | 15 | 20 | - | | |
| VSYNC | Vertical display area | Tvd | 320 | | | Th | |
| | Vsync period time | Tv | 325 | 336 | - | | |
| | Vsync blank | Tvb | 2 | 8 | - | | |
| | Vsync Front porch | Tvfp | 2 | 8 | - | | |

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5.2 3-WIRE 9-BIT SERIAL INTERFACE

5.2.1 3-Wire 9-Bit data serial interface write mode

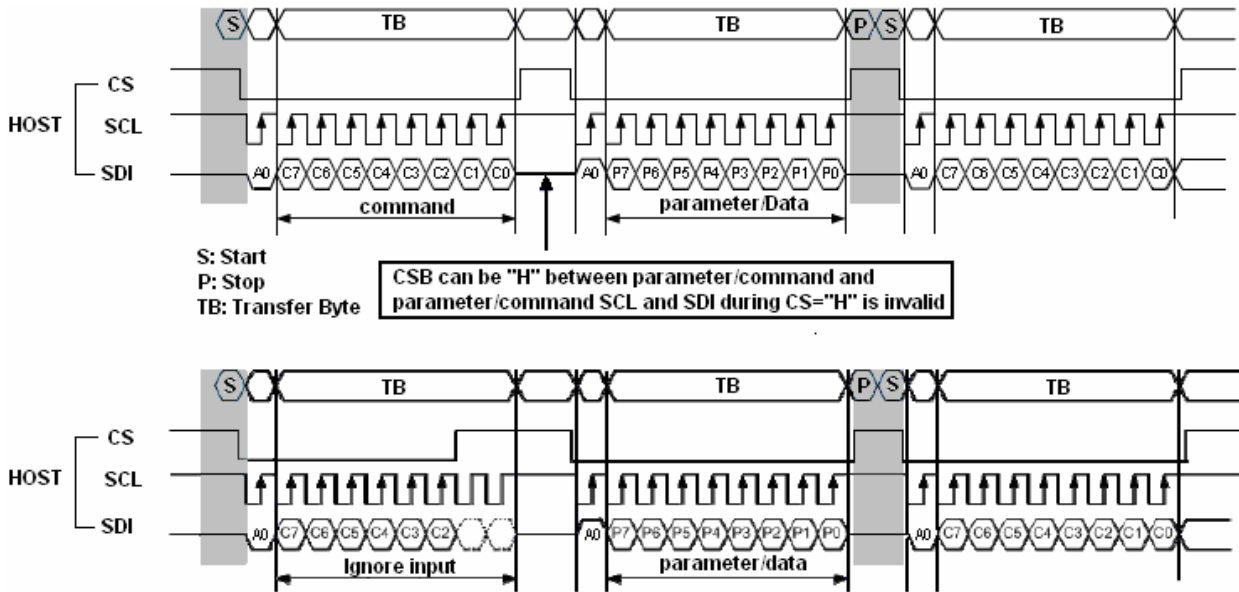


Figure. 5-4 3-Wire 9-Bit Serial Interface I Bus Protocol, Write to Register or Display RAM
Note: A0=0, Transfer Command; A0=1, Transfer Data.

5.2.2 3-Wire 9-Bit data serial interface read 1-byte mode

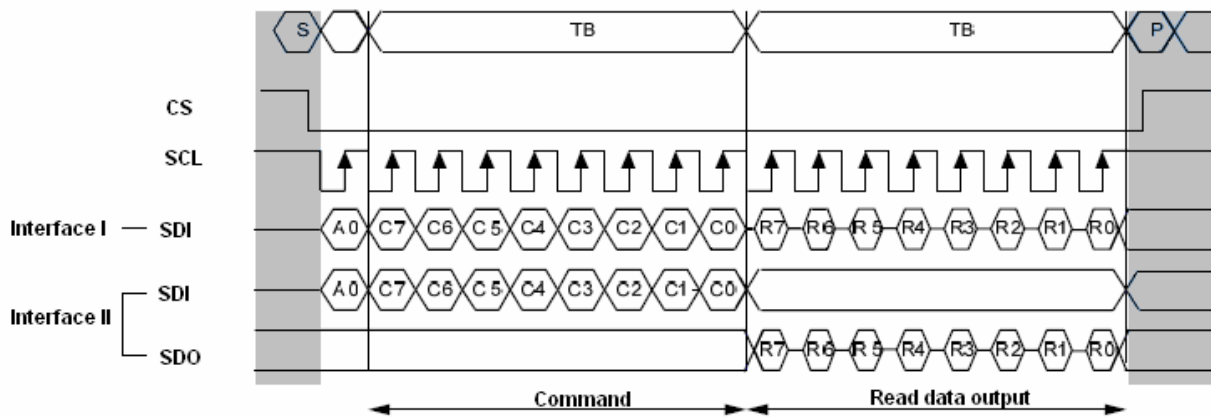


Figure. 5-5 3-Wire 9-Bit Serial Interface I/II Bus Protocol, Read 1-Byte From Register
Note: A0=0, Transfer Command; A0=1, Transfer Data.



5.2.2 3-Wire 9-Bit data serial interface read multi-byte mode

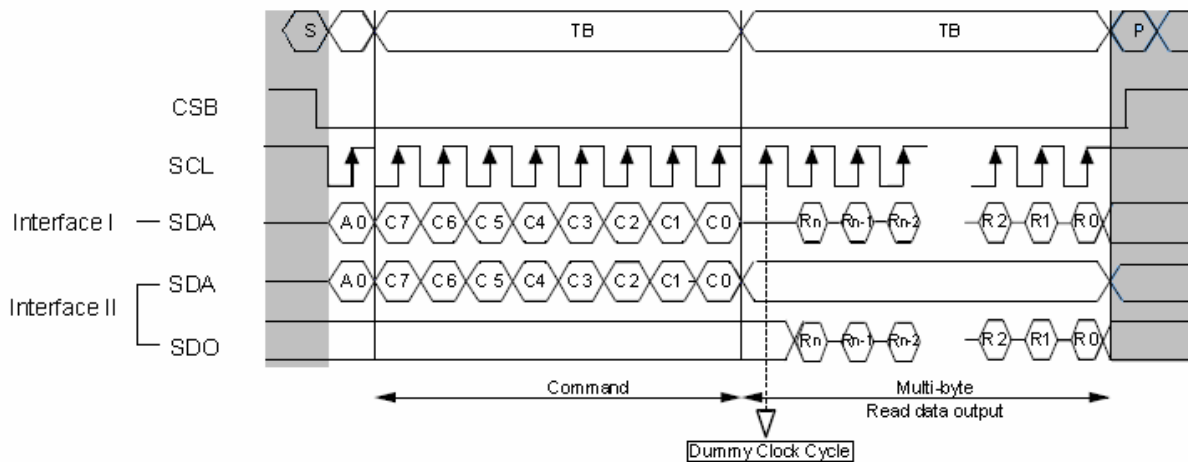


Figure. 5-6 3-Wire 9-Bit Serial Interface I/II Bus Protocol, Read Multi-Byte From Register
Note: A0=0, Transfer Command; A0=1, Transfer Data.

5.2.4 3-Wire 9-Bit serial interface Timing

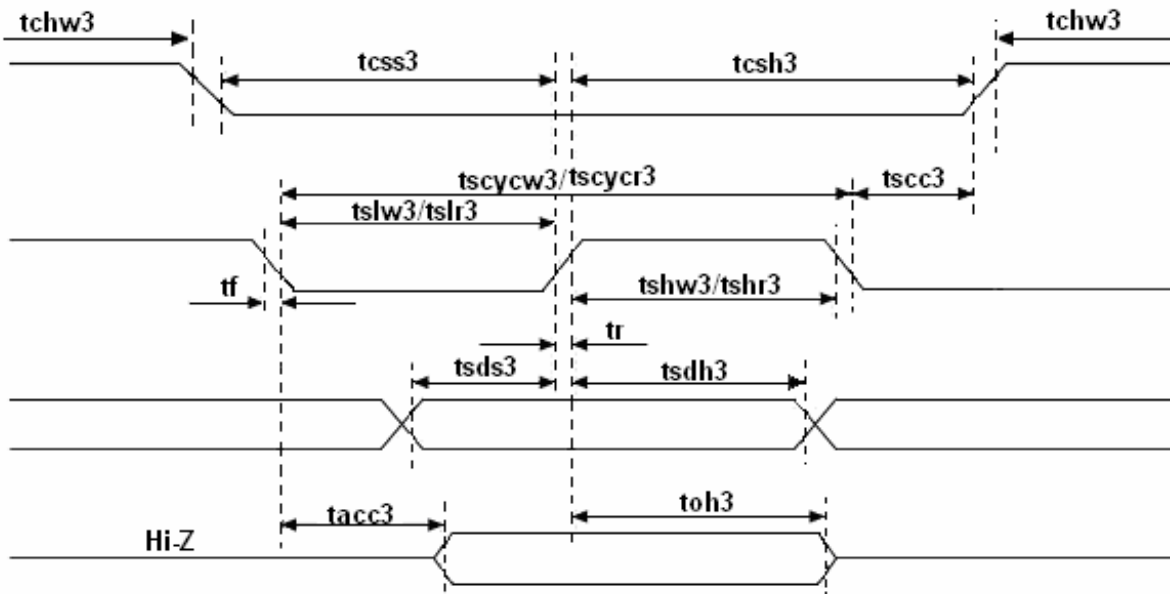


Fig.5-7 AC Characteristics of 3-Wire 9-Bit Serial Interface timing



Tab.5-3 AC Characteristics of 3-Wire 9-Bit Serial Interface
(VSHD=2.4~3.3V, Ta=-40~+85°C)

| Parameter | Symbol | Conditions | Min | Max | Unit | Remark |
|----------------------------|---------|------------|-----|-----|------|--------|
| Serial Clock Cycle(Write) | tscycw3 | SCL | 100 | - | ns | |
| SCL "H" pluse width(Write) | tshw3 | SCL | 35 | - | ns | |
| SCL "L" pluse width(Write) | tslw3 | SCL | 35 | - | ns | |
| Data setup time(Write) | tsds3 | SDA | 30 | - | ns | |
| Data hold time(Write) | tsdh3 | SDA | 30 | - | ns | |
| Serial Clock Cycle(Read) | tscycr3 | SCL | 150 | - | ns | |
| SCL "H" pluse width(Read) | tshr3 | SCL | 60 | - | ns | |
| SCL "L" pluse width(Read) | tslr3 | SCL | 60 | - | ns | |
| Access time | tacc3 | SDO(Note2) | 10 | 50 | ns | |
| Output disable time | toh3 | SDO(Note2) | 15 | 50 | ns | |
| CS "H" pluse width | tchw3 | CS | 40 | - | ns | |
| CS-SCL time | tcsw3 | CS (Write) | 60 | - | ns | |
| | tcshw3 | CS (Write) | 65 | - | ns | |

Note: For maximum CL=30pF, for minimum CL=8pF

5.3 Reset Timing

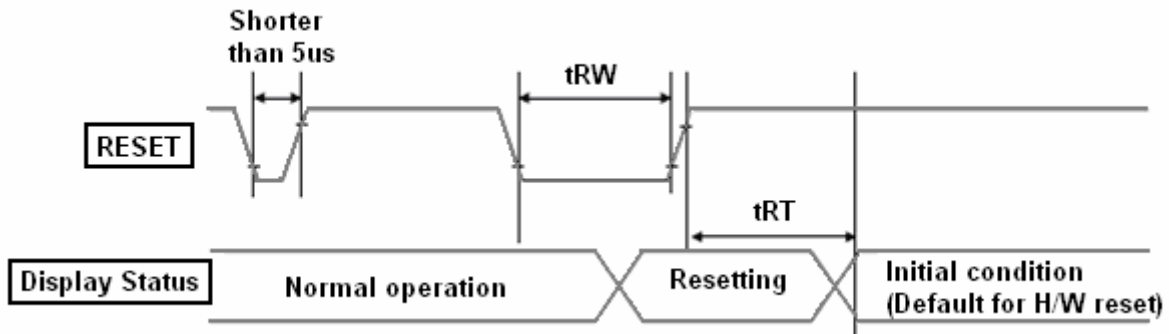


Fig.5-8 Reset timing

Tab.5-4 Reset input timing

| Parameter | Symbol | MIN | TYP | MAX | Unit | Remark |
|-----------|--------|-----|-----|-----|------|--------|
| RESET | tRW | 10 | - | - | us | - |
| | tRT | - | - | 5 | ms | note 1 |
| | | - | - | 120 | ms | note 2 |

Note1: When Reset applied during Sleep In Mode.

Note2: When Reset applied during Sleep Out Mode.



5.4. POWER ON/OFF SEQUENCE

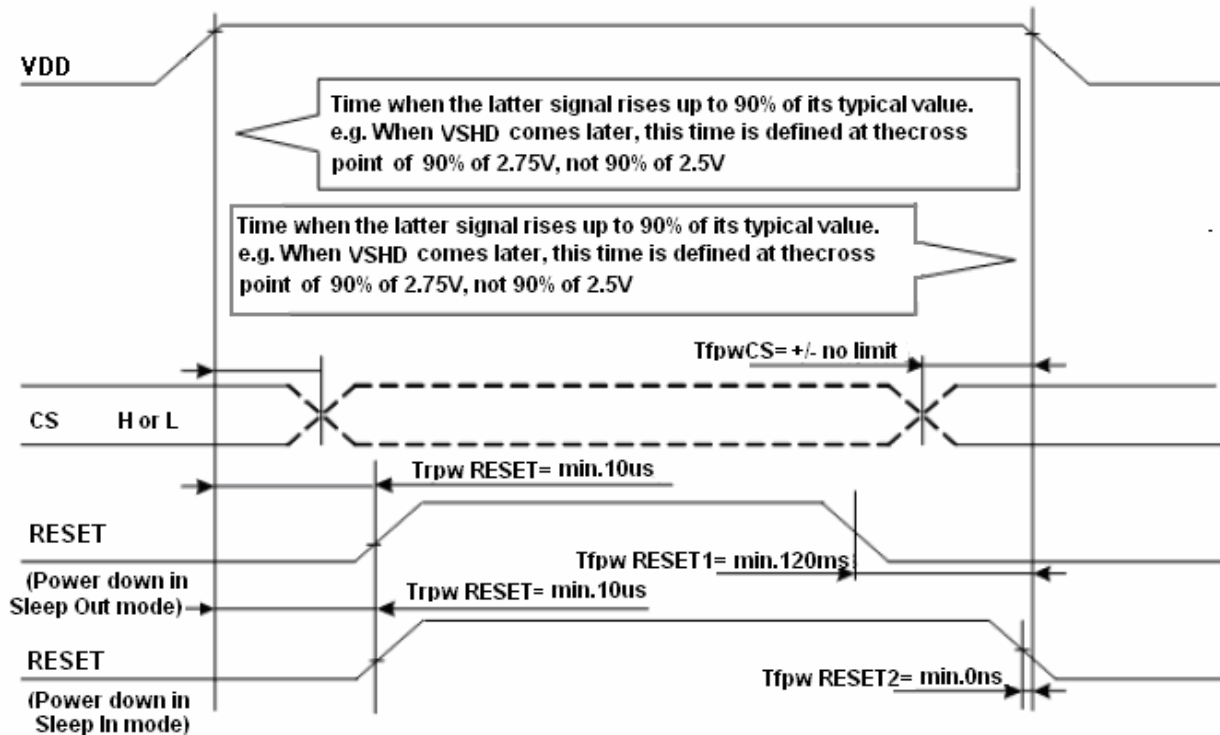


Fig.6-1 Power On/Off Sequence

Note 1. $T_{fpw RESET1}$ is applied to RESET falling in the sleep out mode.

Note 2. $T_{fpw RESET2}$ is applied to RESET falling in the sleep in mode.



6 Optical characteristics

6.1 Optical Specification

Ta=25°C

| Item | Symbol | Condition | Min | Typ. | Max. | Unit | Remark |
|----------------|------------|--------------------|------------------|------|------|-------------------|-----------------|
| View Angles | θT | $CR \geq 10$ | 40 | 45 | - | Degree | Note 2 |
| | θB | | 40 | 45 | - | | |
| | θL | | 40 | 45 | - | | |
| | θR | | 40 | 45 | - | | |
| Contrast Ratio | CR | $\theta = 0^\circ$ | 200 | 350 | - | | Note1 Note3 |
| Response Time | Ton | 25°C | - | 35 | | ms | Note1 |
| | Toff | | | | | | Note4 |
| Chromaticity | White | x | Brightness is on | TBD | | | Note5, Note1 |
| | | y | | TBD | | | |
| Uniformity | U | | | 80 | - | % | Note1 Note6 |
| NTSC | | | - | 30 | - | % | Note 5 |
| Luminance | L | | 145 | 195 | - | cd/m ² | Note1 Note7 |
| Reflectance | | | | 6 | | % | Note8 |

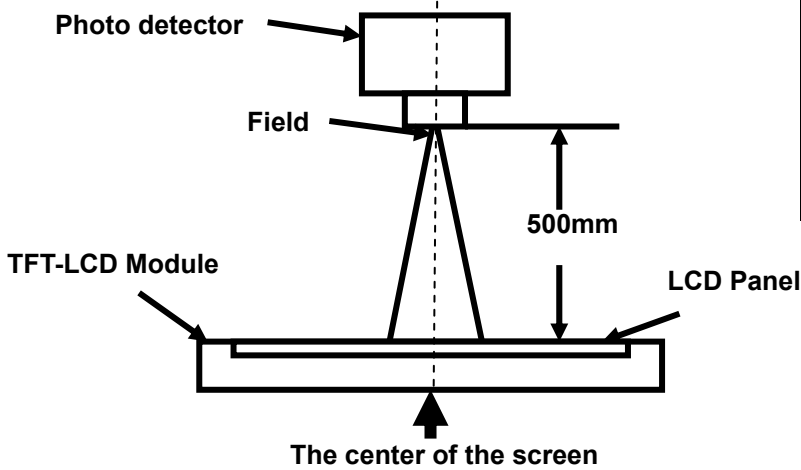
Test Conditions:

- VDD=2.8V, I_L=20mA(LED current), the ambient temperature is 25°C.
- The test systems refer to Note 1 , Note 2 and Note 8.



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 | BM-7A | 2° |
| Response Time | | |

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).

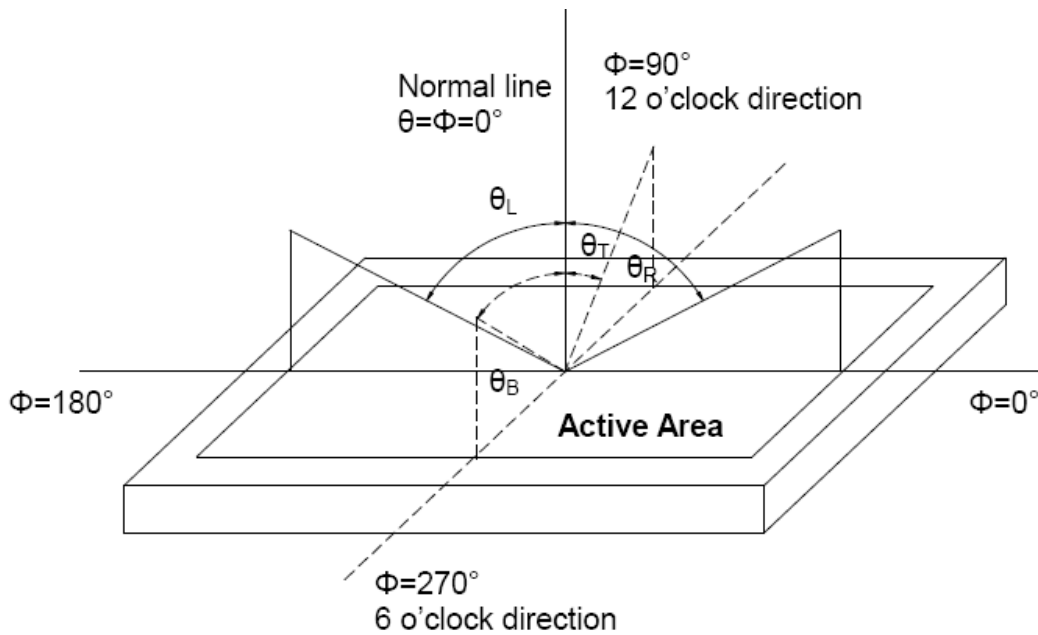


Fig. 1 Definition of viewing angle



Note 3: Definition of contrast ratio

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

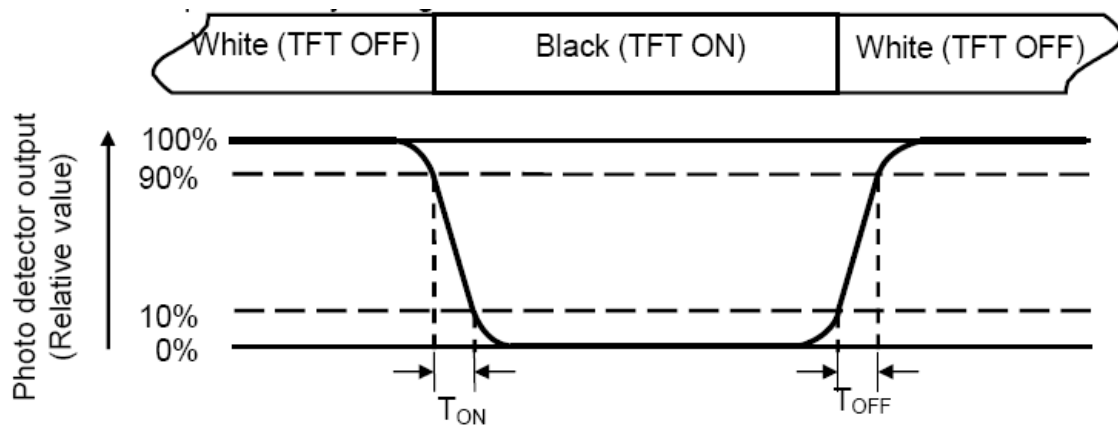
“White state “:The state is that the LCD should driven by V_{white} .

“Black state”: The state is that the LCD should driven by V_{black} .

V_{white} : To be determined V_{black} : 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) = L_{min} / L_{max}

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

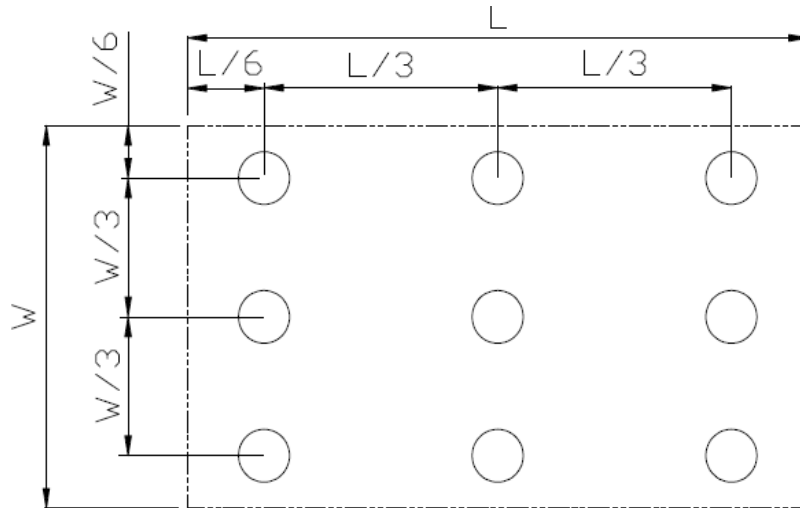


Fig. 2 Definition of uniformity

Lmax: The measured maximum luminance of all measurement position.

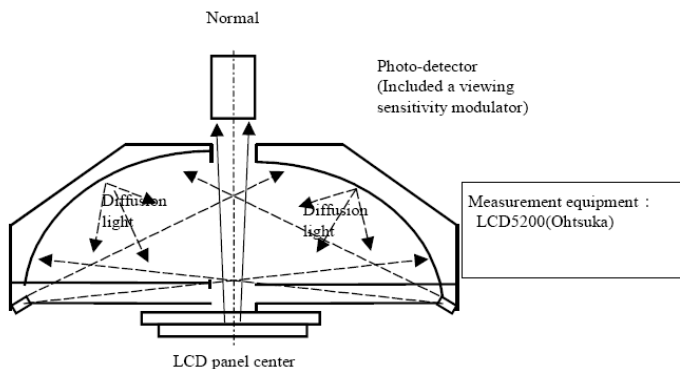
Lmin: The measured minimum luminance of all measurement position.

Note 7: Definition of Luminance :

Measure the luminance of white state at center point.

Note 8: Definition of Reflectance measurement system

Note 5) Reflectance is defined as follows:





7 Environmental / Reliability tests

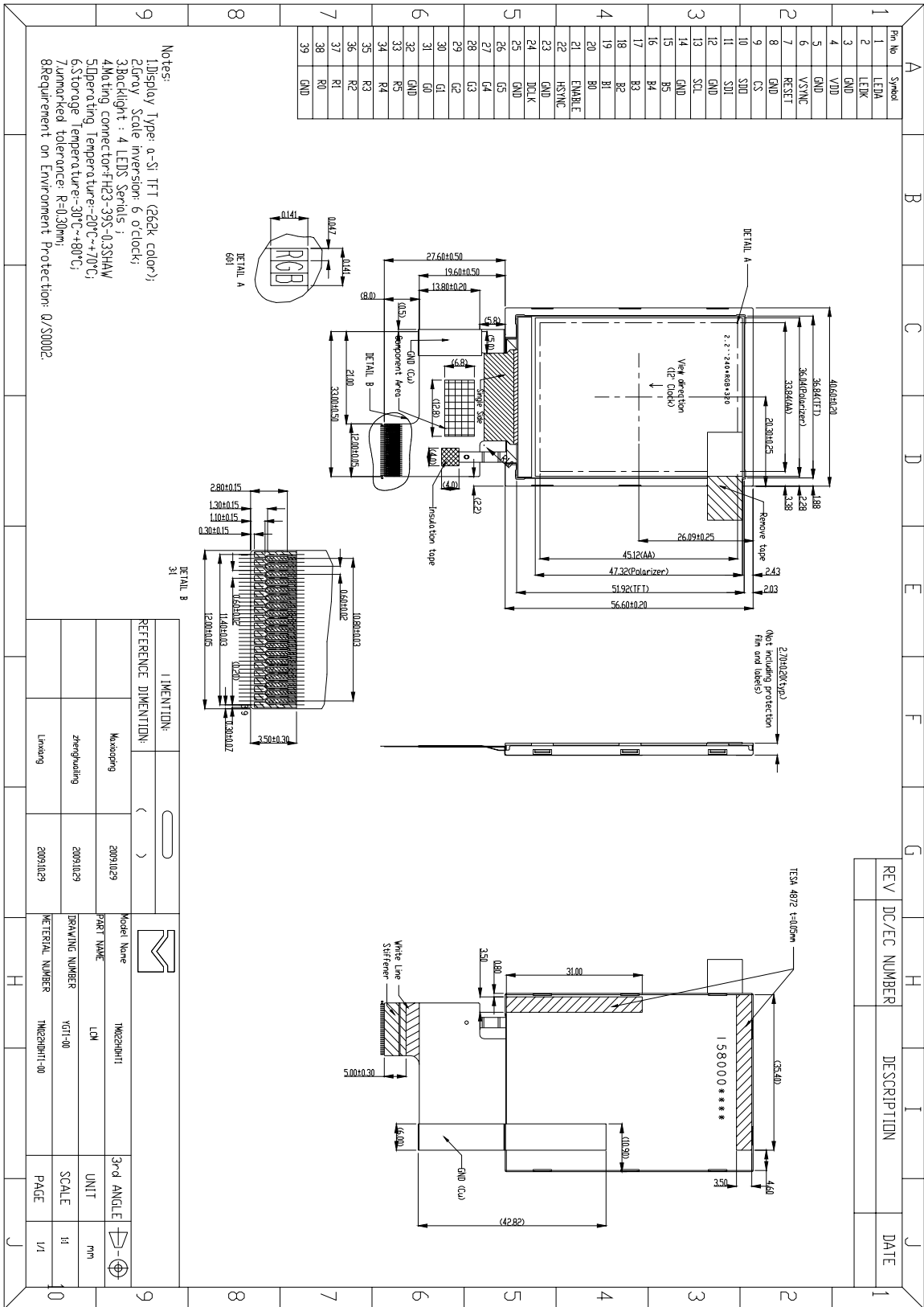
| No | Test Item | Condition | Remarks |
|----|--|---|--|
| 1 | High Temperature Operation | Ts=+70°C, 240hrs | Note1 IEC60068-2-2,GB2423.2—89 |
| 2 | Low Temperature Operation | Ta=-20°C, 240hrs | IEC60068-2-1 GB2423.1—89 |
| 3 | High Temperature Storage | Ta=+80°C, 240hrs | IEC60068-2-2, GB2423.2—89 |
| 4 | Low Temperature Storage | Ta=-30°C, 240hrs | IEC60068-2-1 GB2423.1—89 |
| 5 | High Temperature & High Humidity Storage | +60°C, 90% RH max,240 hours | Note2 IEC60068-2-3, GB/T2423.3—2006 |
| 6 | Thermal Shock (Non-operation) | -30°C 30 min~+80°C 30 min, Change time:5min, 20 Cycle | Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22—87 |
| 7 | Electro Static Discharge (Operation) | C=150pF, R=330Ω, 5points/panel Air:± 8KV, 5times; Contact:± 4KV, 5 times; (Environment: 15°C~35°C, 30%~60%, 86Kpa~106Kpa) | IEC61000-4-2 GB/T17626.2—1998 |
| 8 | Vibration (Non-operation) | Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 1 hours for each direction of X.Y.Z.(3 hours for total) | IEC60068-2-6 GB/T2423.10—1995 |
| 9 | Shock (Non-operation) | 60G 6ms, ± X,± Y,± Z 3times for each direction | IEC60068-2-27 GB/T2423.5—1995 |
| 10 | Package Drop Test | Height:80 cm, 1 corner, 3 edges, 6 surfaces | IEC60068-2-32 GB/T2423.8—1995 |

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

Note2: Ta is the ambient temperature of sample.



8 Mechanical drawing



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9 Packing drawing(TBD)



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 alcoholSolvents 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°C ~ 40°C 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.