# *Displaytech Ltd.*

**Website: www.displaytech.com.hk**

# LCD Module
# Product Specification

## Product: 2.8'' TFT Display Module (240RGBx320DOTS)

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**6 November 2008.**

# REVISION RECORD

| VERSION | CHANGES | DATE |
|---|---|---|
| 1.0 | Initial revision | 3 August 2007 |
| 2.0 | Whole data sheet was amended | 12 Nov 2007 |
| 3.0 | Complete new module | 9 January 2008 |
| 4.0 | IC was changed. Data updated on: Introduction, General specifications, Mechanical drawing, Interface description, Absolute maximum ratings, Electrical characteristics, and Optical characteristics | 11 April 2008 |
| 5.0 | Corrected the lifetime info on page 4. Added DT028TFT-TS mechanical drawing (P.6) and touch screen pinout connection (P.7) | 6 November 2008 |
| | | |

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## 1. Introduction

***DT028TFT*** or ***DT028TFT-TS*** is a display module that contains a TFT display with a 320 * 240 RGB resolution. The driver used for this project is the Ilitek **ILI9320 or compatible** and can display 262K colors. The driver is mounted on the glass and the interconnection via FPC including components to drive the display module.

## 2. General Specifications

| Item | Specification | Unit |
|---|---|---|
| LCD mode | Transmissive | --- |
| Resolution | 240(RGB) | Line |
| | 320 | Line |
| Viewing area | 47.00 | mm |
| | 60.10 | mm |
| Active area | 43.20 | mm |
| | 67.60 | mm |
| Driver IC | ILI9320 | --- |
| Interface type | System parallel / RGB (1) | --- |
| Colours | 262K | --- |
| Operation temperature range | -20~70 | °C |
| Storage temperature range | -30~80 | °C |

**Remarks:**

(1) Serial interface is available, but not recommendable, as the speed of it is very slow.

(2) Recommended mating connector: Hirose FH19SC-45S-0.5SH, FH12S-45S-0.5SH; or
Molex 0512964593, 0512964594; or equivalent

(3) Orientation: both Portrait and Landscape mode are available (controlled by software, refer to IC spec)

**Component Life Cycle**

1) Storage Life: min. 1 Year

2) Operation Life (*1): min. 43 x $10^3$ h (24h per day x 7 days per week x 52 weeks / year x 5 years)
(Not include backlight)

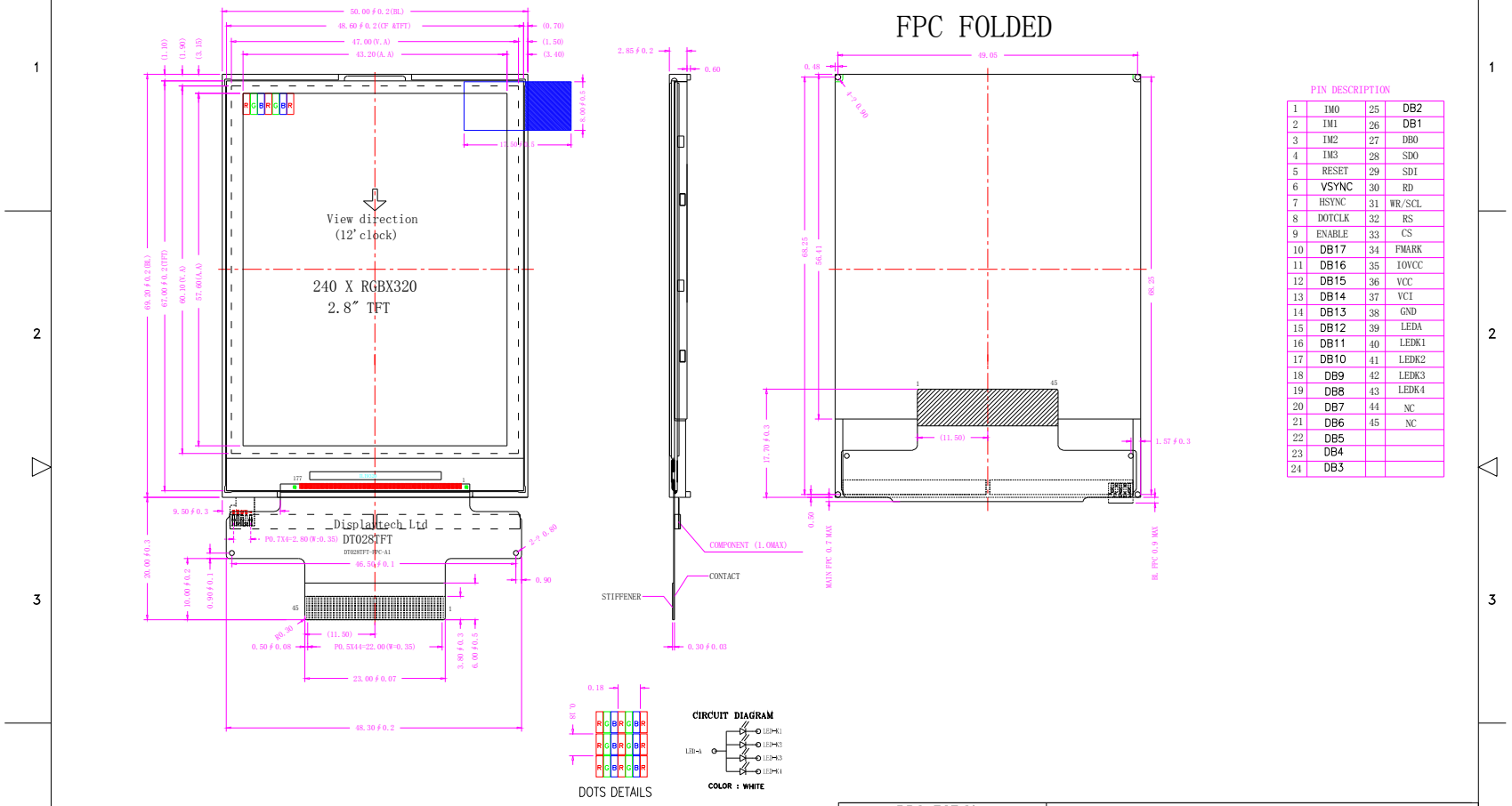
3) Storage and Operation Life Times are defined for a temperature of +25°C

**Notes:**

*1. Operation life ends when one of the listed faults occurs:

- The on/off response-times reach 1.5 times of the max. value specified for a new display
- The contrast is reduced to 0.5 of the original contrast value
- Loss of function
- The number of cosmetic defects exceeds the maximum defined

# 3. Mechanical Drawing – DT028TFT




| REV. | DESCRIPTIONS | DWN. | APPD. | DATE |
|---|---|---|---|---|

PIN DESCRIPTION

| | | | |
|---|---|---|---|
| 1 | IM0 | 25 | DB2 |
| 2 | IM1 | 26 | DB1 |
| 3 | IM2 | 27 | DB0 |
| 4 | IM3 | 28 | SDO |
| 5 | RESET | 29 | SDI |
| 6 | VSYNC | 30 | RD |
| 7 | HSYNC | 31 | WR/SCL |
| 8 | DOTCLK | 32 | RS |
| 9 | ENABLE | 33 | CS |
| 10 | DB17 | 34 | FMARK |
| 11 | DB16 | 35 | IOVCC |
| 12 | DB15 | 36 | VCC |
| 13 | DB14 | 37 | VCI |
| 14 | DB13 | 38 | GND |
| 15 | DB12 | 39 | LEDA |
| 16 | DB11 | 40 | LEDK1 |
| 17 | DB10 | 41 | LEDK2 |
| 18 | DB9 | 42 | LEDK3 |
| 19 | DB8 | 43 | LEDK4 |
| 20 | DB7 | 44 | NC |
| 21 | DB6 | 45 | NC |
| 22 | DB5 | | |
| 23 | DB4 | | |
| 24 | DB3 | | |

NOTES:

1. OPERATING TEMPERATURE: -20 C TO 70 C
2. STORAGE TEMPERATURE: -30 C TO 80 C
3. DRIVE IC : ILI9320
4. VIEWING DIRECTION 12:00
5. ROHS COMPLIANT
6. GENERAL TOLERANCE ∮0.2

PROJECTION

ALL ARE PRODUCT DIMENSIONS, UNLESS OTHERWISE SPECIFIED. ALL DIMENSIONS ARE IN mm (INCHES) AND TOLERANCES
.XXX ± .XX ± 0.20 ANGULAR ±
DO NOT SCALE DRAWING

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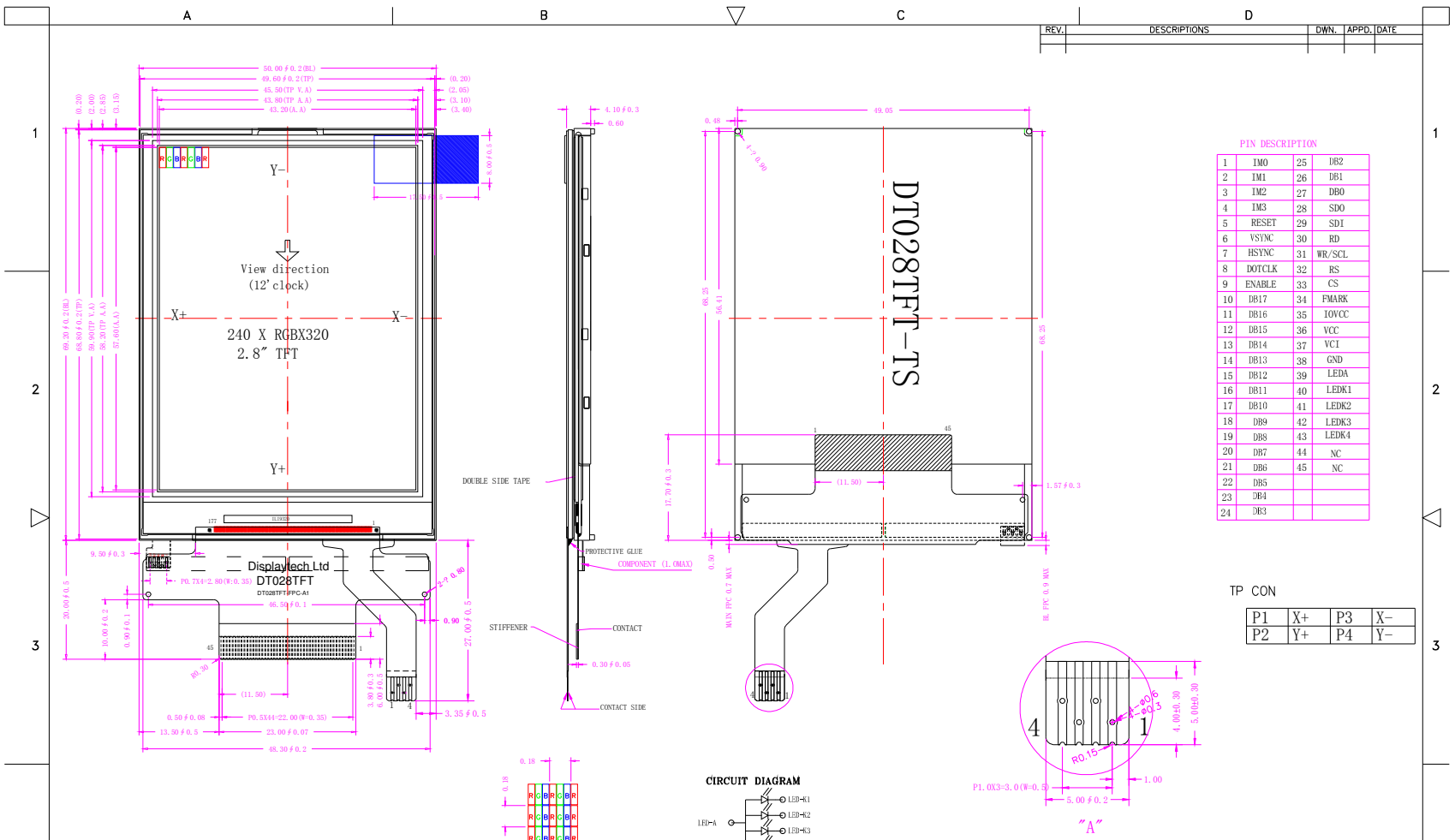
| | | | |
|---|---|---|---|
| SCALE | DRAWN BY | DATE | 20MAR08 |
| SHT# | APP. BY | DATE | |
| DWG. | DT028TFT | | |
| PROJ# | | DWG# | |
| MODEL# | | REV. E | DATE |
| RELEASE TO: | | | |

# Mechanical Drawing – DT028TFT-TS



## 4. Interface Description

<table>
<tr><th>Pin no</th><th>Symbol</th><th>Level</th><th>Description</th></tr>
<tr><td>1~4</td><td>IM0~IM3</td><td>H/L</td><td>
<table>
<tr><th>IM3</th><th>IM2</th><th>IM1</th><th>IM0</th><th>MPU interface</th><th>DB Pin</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>80-system, 16 bit</td><td>DB[10:17], DB[1:8]</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>80-system, 8 bit</td><td>DB[10:17]</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>80-system, 18 bit</td><td>DB[0:17]</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>80-system, 9 bit</td><td>DB[9:17]</td></tr>
</table>
</td></tr>
<tr><td>5</td><td>RESET</td><td>H/L</td><td>Reset signal pin</td></tr>
<tr><td>6</td><td>VSYNC</td><td>---</td><td>Frame synchronous signal for RGB interface operation. Low active.</td></tr>
<tr><td>7</td><td>HSYNC</td><td>---</td><td>Line synchronous signal for RGB interface operation. Low active.</td></tr>
<tr><td>8</td><td>DOTCLK</td><td>---</td><td>Dot clock signal for RGB interface operation. The data input timing is on the rising edge of DOTCLK.</td></tr>
<tr><td>9</td><td>ENABLE</td><td>---</td><td>Data enable signal for RGB interface operation.</td></tr>
<tr><td>10~27</td><td>DB17~DB0</td><td>H/L</td><td>Data bus</td></tr>
<tr><td>28</td><td>SDO</td><td>H/L</td><td>Serial data output (SDO) pin in serial interface operation. The data is outputted on the falling edge of the SCL signal.</td></tr>
<tr><td>29</td><td>SDI</td><td>H/L</td><td>Serial data input (SDI) pin in serial interface operation. The data is inputted on the rising edge of the SCL signal.</td></tr>
<tr><td>30</td><td>RD</td><td>H/L</td><td>Read strobe signal in 80-system bus interface operation and enables read operation when RD* is low.</td></tr>
<tr><td>31</td><td>WR/SCL</td><td>H/L</td><td>Write strobe signal in 80-system bus interface operation and enables write operation when WR* is low. Synchronous clock signal (SCL) in serial interface operation.</td></tr>
<tr><td>32</td><td>RS</td><td>H/L</td><td>Register select signal</td></tr>
<tr><td>33</td><td>CS</td><td>H/L</td><td>Chip select signal</td></tr>
<tr><td>34</td><td>FMARK</td><td>---</td><td>Frame head pulse signal, which is used when writing data to the internal RAM.</td></tr>
<tr><td>35</td><td>IOVCC</td><td>2.8V</td><td>Logic power supply</td></tr>
<tr><td>36</td><td>VCC</td><td>2.8V</td><td>Power supply</td></tr>
<tr><td>37</td><td>VC1</td><td>2.8V</td><td>Liquid crystal analog circuit power supply</td></tr>
<tr><td>38</td><td>GND</td><td>0V</td><td>Ground</td></tr>
<tr><td>39</td><td>LEDA</td><td>---</td><td>Backlight anode</td></tr>
<tr><td>40</td><td>LEDK1</td><td>---</td><td>Backlight cathode</td></tr>
<tr><td>41</td><td>LEDK2</td><td>---</td><td>Backlight cathode</td></tr>
<tr><td>42</td><td>LEDK3</td><td>---</td><td>Backlight cathode</td></tr>
<tr><td>43</td><td>LEDK4</td><td>---</td><td>Backlight cathode</td></tr>
<tr><td>44~45</td><td>NC</td><td>---</td><td>No connection</td></tr>
</table>

### Touch Screen FPC (only for DT028TFT-TS)

| Pin no | Symbol |
|---|---|
| 1 | X+ |
| 2 | Y+ |
| 3 | X- |
| 4 | Y- |

## 5. Absolute Maximum Ratings

| Item | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage range | VCC / IOVCC | -0.3 to + 4.6 | V |
| Input voltage range | Vin | -0.3 to Vcc + 0.3 | V |
| Operating Ambient Temperature | TOP | -20 ~ +70 | °C |
| Operating Ambient Humidity | HOP | 10 ~ 90 (Max 60°C) | % RH |
| Storage Temperature | TSTG | -30 ~ +80 | °C |
| Storage Humidity | HSTG | 10 ~ 90 (Max 60°C) | % RH |

## 6. Electrical Characteristics

DC Characteristics

| Item | Symbol | Rating | Unit |
|---|---|---|---|
| Power supply | VCC | 2.7 to 2.9 | V |
| Input current | IDD | 18.58 max | mA |
| Input voltage “H” | VIH | 0.8 IOVCC to IOVCC | V |
| Input voltage “L” | VIL | -0.3 to 0.2 IOVCC | V |
| Output voltage “H” | VOH | 0.8 IOVCC to IOVCC | V |
| Output voltage “L” | VOL | 0 to 0.2 IOVCC | V |

## 7. Display Controller /Power Supply Timing

See Display Controller Specification: **ILITEK ILI9320**

## 8. Operational EMC Requirements

The operational EMC immunity requirements and emission limits for DISPLAYTECH modules are provided in table 1: EMC specification for operational modules.

Table 1. EMC specification for operational modules

| EMC phenomena | REFERENCE standard | Frequency range | Level/ Limit | Test specification | Performance criteria |
|---|---|---|---|---|---|
| Electromagnetic field | IEC 61000-4-3 | 30MHz-1000MHz | 3 V/m | 1kHz sine, 80% AM | C |
| EFT/Burst | IEC 61000-4-4 | n.a. | 10 V | -8us/50us<br>-10ns/100ns | C<br>C |
| Electrostatic Discharge* | IEC61000-4-2 | n.a. | 4 kV/ 8 kV | Contact/ Air | C |
| Conducted RF signals | IEC 61000-4-6 | 150kHz-30MHz | 1 V | 1kHz sine, 80% AM | C |
| Radiated emission | IEC 61000-6-4 | 30 MHz-1000MHz | 47 dBuV | d = 10 m | n.a. |

After a charge of 4kV, the display module is allowed to go down for 2 seconds and need to comeback again. With 8kV the display module is allowed to go down and has to comeback after a reset.

## 9. Optical Characteristics

| Item | | Symbol | Condition | Min | Typ | Max | Unit | Remark | Note |
|---|---|---|---|---|---|---|---|---|---|
| Response Time | | Tr + Tf | θ=0º Ø=0º Ta=25ºC | --- | 36.2 | 54.3 | ms | Fig 2 | 4 |
| Contrast ratio | | Cr | | 252 | 505 | --- | --- | | 1 |
| Luminance Uniformity | | δ White | | 38 | 93 | --- | % | | 3 |
| Surface Luminance | | Lv | | 179 | 224 | --- | cd/m² | | 2 |
| Viewing Angle range | | θ | Ø=90º | 70 | 80 | --- | deg | Fig 1 | 6 |
| | | | Ø=270º | 58 | 68 | --- | | | |
| | | | Ø=0º | 70 | 80 | --- | | | |
| | | | Ø=180º | 70 | 80 | --- | | | |
| CIE (x,y) Chromaticity | Red | x | θ=0º Ø=0º Ta=25ºC | 0.560 | 0.610 | 0.660 | | | 5 |
| | | y | | 0.292 | 0.342 | 0.392 | | | |
| | Green | x | | 0.278 | 0.328 | 0.378 | | | |
| | | y | | 0.525 | 0.575 | 0.625 | | | |
| | Blue | x | | 0.098 | 0.148 | 0.198 | | | |
| | | y | | 0.034 | 0.084 | 0.134 | | | |
| | White | x | | 0.241 | 0.301 | 0.361 | | | |
| | | y | | 0.245 | 0.305 | 0.365 | | | |

Note 1: Contrast Ratio = Average Surface Luminance with all white pixels ($P_1$,$P_2$, $P_3$,$P_4$, $P_5$) / Average Surface Luminance with all black pixels ($P_1$, $P_2$, $P_3$,$P_4$, $P_5$)

Note 2: Surface luminance is the LCD surface from the surface with all pixels displaying white.
Lv = Average Surface Luminance with all white pixels ($P_1$, $P_2$, $P_3$,$P_4$, $P_5$)

Note 3: The uniformity in surface luminance, δ WHITE is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance.
δ WHITE = Minimum Surface Luminance with all white pixels ($P_1$, $P_2$, $P_3$,$P_4$, $P_5$) / Maximum Surface Luminance with all white pixels ($P_1$, $P_2$, $P_3$,$P_4$, $P_5$)

Note 4: Response time is the time required for the display to transition from White to black (Rise Time, Tr) and from black to white (Decay Time, Tf). For additional information see FIG 2.

Note 5: CIE (x, y) chromaticity: The x,y value is determined by measuring luminance at each test position 1 through 5,and then taking average value

Note 6: Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For additional information see Fig 1.

Fig.1 (Definition of Viewing Angle)

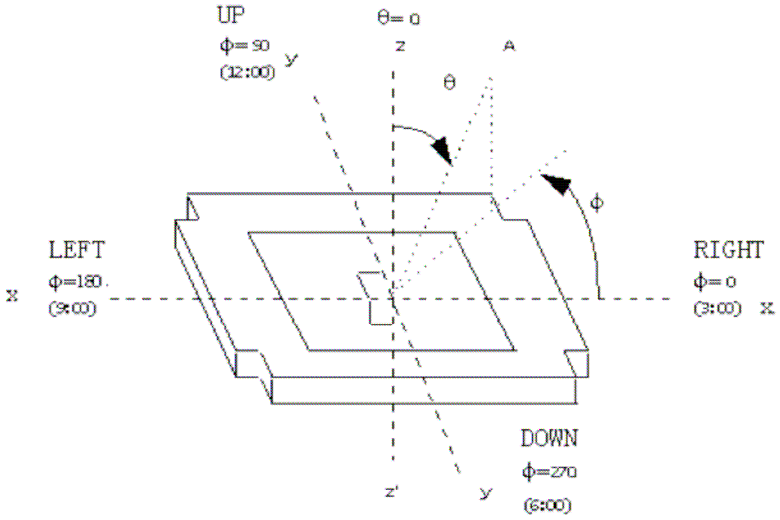
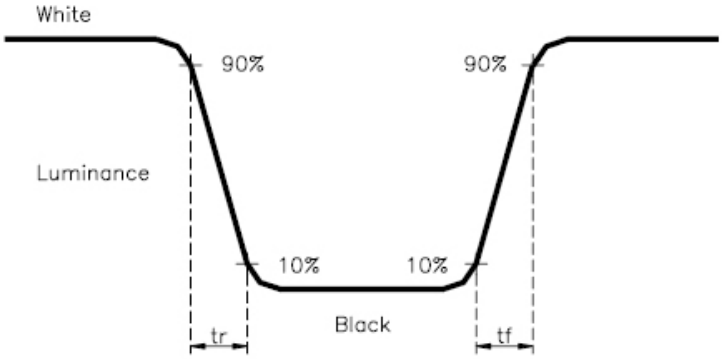



Fig. 2 (The response time is defined as the time interval between the 10% and 90% amplitudes. Refer to figure below.)



## 10.Backlight specification

| ITEM | PARAMETER | | UNIT |
|---|---|---|---|
| COLOR | WHITE | | |
| CHROMATICITY COORDINATE | X=0.283-0.330 | Y=0.276-0.339 | |
| AVERAGE LUMINOUS INTENSITY (LV) | 1800 to 2600 (IF 60mA) | | $cd/m^2$ |
| NO.OF LED SMT | 4 | | --- |
| FORWARD VOLTAGE (VF) | 3.0 to 3.4 (IF 60mA) | | V |

## 11.Safety Precaution

Handling precautions:

- This device is susceptible to Electro-Static Discharge (ESD) damage. Observe Anti-Static precautions.

Power supply precautions:

- Identify and, at all times, observe absolute maximum ratings for both logic and LC drivers. Note that there is some variance between models.
- Prevent the application of reverse polarity to VCC and GND, however briefly.
- Use a clean power source free from transients. Power up conditions are occasionally "jolting" and may exceed the maximum ratings of the modules.
- The VCC power of the module should also supply the power to all devices that may access the display. Don't allow the data bus to be driven when the logic supply to the module is turned off.

Operating precautions:

- DO NOT plug or unplug the module when the system is powered up.
- Minimize the cable length between the module and host MPU.
- Operate the module within the limits of the modules temperature specifications.

Mechanical/Environmental precautions:

- Improper soldering is the major cause of module difficulty. Use of flux cleaner is not recommended as they may seep under the elastomeric connection and cause display failure.
- Mount the module so that it is free from torque and mechanical stress.
- Surface of the LCD panel should not be touched or scratched. The display front surface is an easily scratched, plastic polarizer. Avoid contact and clean only when necessary with soft, absorbent cotton dampened with petroleum benzene.
- Always employ anti-static procedure while handling the module.
- Prevent moisture build-up upon the module and observe the environmental constraints for storage temperature and humidity.
- Do not store in direct sunlight
- If leakage of the liquid crystal material should occur, avoid contact with this material, particularly ingestion. If the body or clothing becomes contaminated by the liquid crystal material, wash thoroughly with water and soap