



ELECTRONICS

Product Information

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MODEL : LTM170E6-L04

Note : This Product information is subject to change after 3 months of issuing date

Prepared by AMLCD Application Engineering Group

Samsung Electronics Co . , LTD.

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General Description

* Description

LTM170E6-L04 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFTs as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a back-light system. The resolution of a 17.0" contains 1280 x 1024 pixels and can display up to 16.7 million colors with wide viewing angles of 89° or higher in all directions. (Vertical viewing angle : 178° , Horizontal viewing angle : 178°)

* Features

- High contrast ratio, high aperture structure
- PVA(Patterned Vertical Alignment) mode
- Wide viewing angle
- High speed response
- SXGA(1280 x 1024 pixels) resolution
- Low power consumption
- 2 dual CCFTs(Cold Cathode Fluorescent Tube)
- DE only mode
- LVDS(Low Voltage Differential Signaling) interface (2pixels/clock)
- COMPACT SIZE DESIGN

* Applications

Workstation & desktop monitors

Display terminals for AV application products

Monitors for industrial machine

* General information

| Items | Specification | Unit | Note |
|-------------------|-----------------------------|--------|------|
| Display area | 337.92(H) x 270.336(V) | mm | |
| Driver element | a-Si TFT active matrix | | |
| Display colors | 16.7M | colors | |
| Number of pixels | 1280 x 1024 | pixel | |
| Pixel arrangement | RGB vertical stripe | | |
| Pixel pitch | 0.264(H) x 0.264(W) | mm | |
| Display mode | Normally Black | | |
| Surface treatment | Haze 44%, Hard-coating (3H) | | |

*** Mechanical information**

| Item | | Min. | Typ. | Max. | Note |
|-------------|---------------|------|-------|-------|------|
| Module size | Horizontal(H) | - | 358.5 | - | mm |
| | Vertical(V) | - | 296.5 | - | mm |
| | Depth(D) | - | - | 17.5 | mm |
| Weight | | - | - | 2,100 | g |

1. Absolute Maximum Ratings

1.1 Absolute ratings of environment

| Item | Symbol | Min. | Max. | Unit | Note |
|--|------------------|------|------|------|--------|
| Storage temperature | T _{STG} | -20 | 65 | °C | (1) |
| Operating temperature (Glass surface temperature) | T _{OPR} | 0 | 50 | °C | (1) |
| Shock (non - operating) | Snop | - | 50 | G | (2)(4) |
| Vibration (non - operating) | Vnop | - | 1.5 | G | (3)(4) |

Note (1) Temperature and relative humidity range are shown in the figure below.

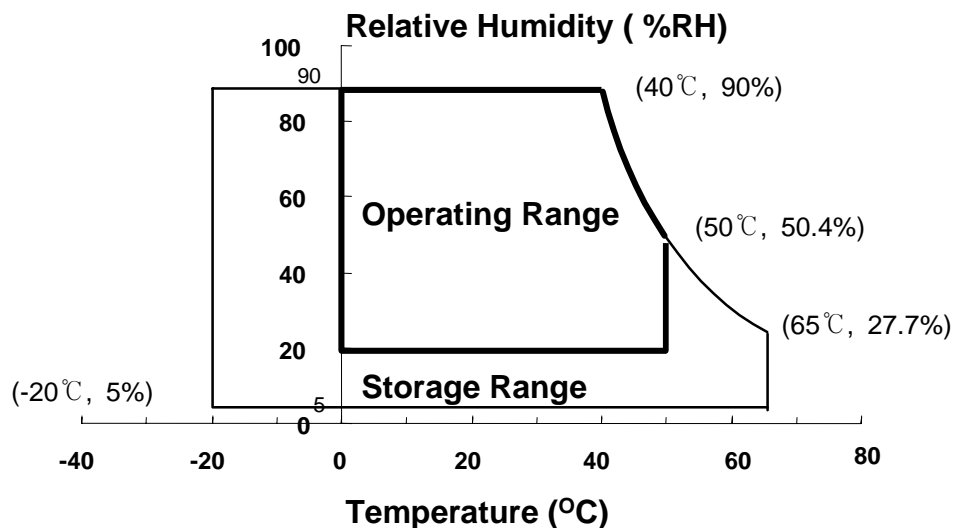
90 % RH Max. (40 °C ≥ Ta)

Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.

(2) 11ms, sine wave, one time for ±X, ±Y, ±Z axis

(3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

(4) At vibration and shock test, the fixture which holds the module to be tested has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD Module

(V_{SS} = GND = 0 V)

| Item | Symbol | Min. | Max. | Unit | Note |
|----------------------|--------|----------------------|------|------|------|
| Power Supply Voltage | VDD | V _{SS} -0.5 | 6.5 | V | (1) |

NOTE (1) Within Ta (25 ± 2 °C)

(2) BACK-LIGHT UNIT

(Ta = 25 ± 2°C)

| Item | Symbol | Min. | Max. | Unit. | Note |
|----------------|--------|------|------|-------|--------|
| Lamp Current | IL | 2.0 | 7.0 | mArms | (1)(2) |
| Lamp Frequency | fL | 40 | 80 | kHz | (1) |

NOTE

- (1) Permanent damage to the device may occur if the maximum values are exceeded. Functional operation should be restricted to the conditions described under normal operating conditions.
- (2) Specified values are for a single lamp.
(Refer to the Note (1) in the page 11 for further information).

2. Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (1).

Measuring equipment : TOPCON BM-5A, BM-7, PHOTO RESEARCH PR650
Eldim EZ-Contrast

(Inverter Freq. : 50kHz) * Ta = 25 ± 2°C, VDD=5V, fv= 60Hz, fdCLK=54MHz, IL = 6.5mA_{rms}

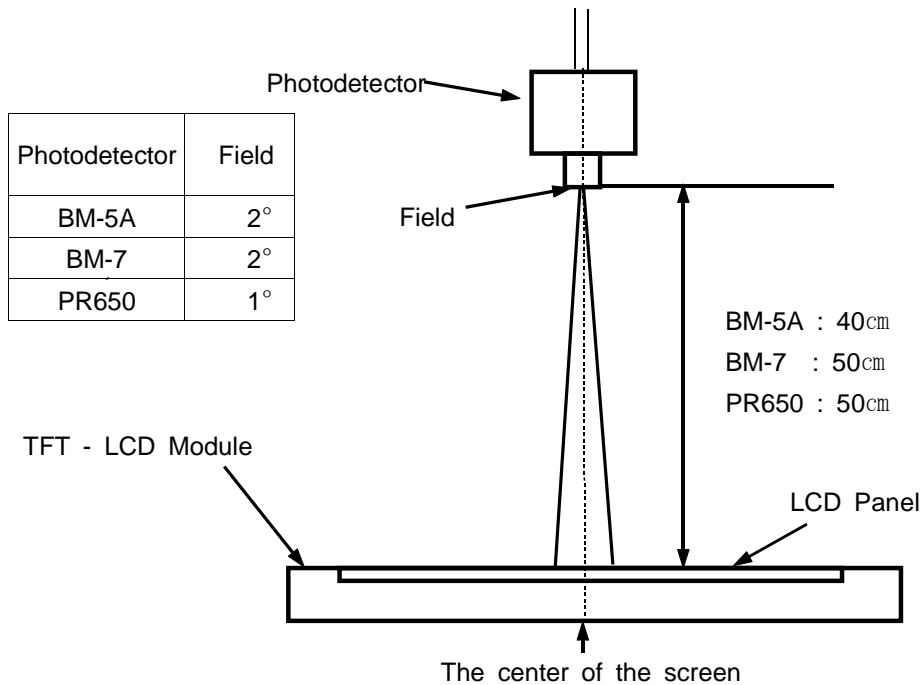
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Note | |
|--|---------|--------------------------------------|------------------|-------|------|------|-------------------|------------------|
| Contrast Ratio (Center of screen) | C/R | Normal $\phi = 0$ $\theta = 0$ | - | 600 | - | | (3) BM-5A | |
| Response Time | Rising | | Tr | - | 15 | - | msec | (5) |
| | Falling | | Tf | - | 10 | - | | BM-7 |
| Luminance of White (Center of screen) | YL | | | - | 250 | - | cd/m ² | (6) BM-5A |
| Color Chromaticity (CIE 1931) | Red | Rx | Viewing Angle | 0.640 | - | - | (7) PR650 | |
| | | Ry | | 0.330 | | | | |
| | Green | Gx | | 0.300 | | | | |
| | | Gy | | 0.600 | | | | |
| | Blue | Bx | | 0.150 | | | | |
| | | By | | 0.060 | | | | |
| | White | Wx | | 0.313 | | | | |
| | | Wy | | 0.329 | | | | |
| Viewing Angle | Hor. | θ L | CR \geq 10 | - | 89 | - | Degrees | (1),(8) BM-5A |
| | | θ R | | - | 89 | - | | |
| | Ver. | ϕ H | | - | 89 | - | | |
| | | ϕ L | | - | 89 | - | | |
| Brightness Uniformity (9 points) | Buni | | - | - | 25 | % | (4) BM-5A | |

Note 1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 30min and 40min after lighting the back-light at the given temperature for stabilization of the back-light. This should be measured in the center of screen.

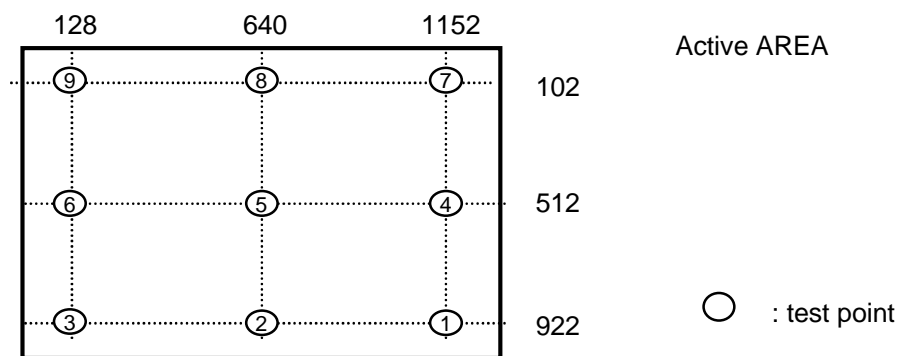
Single lamp current : 6.5mA (Refer to the note(1) in the page 11 for more information.)

Environment condition : $T_a = 25 \pm 2 \text{ }^\circ\text{C}$



Optical Measuring Equipment Setup

Note 2) Definition of test point



Note 3) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point⑤ of the panel

$$CR = \frac{G \text{ max}}{G \text{ min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

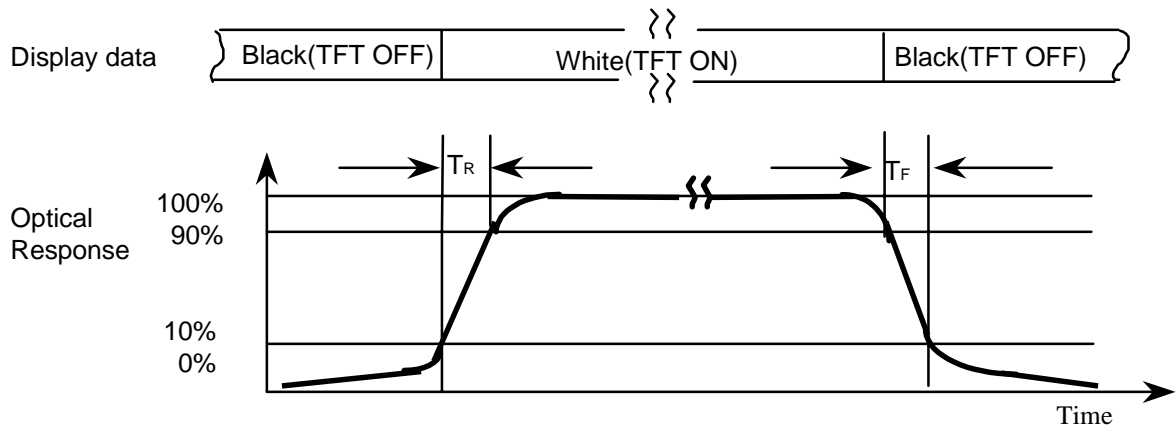
Note 4) Definition of 9 points brightness uniformity

$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

Bmax : Maximum brightness

Bmin : Minimum brightness

Note 5) Definition of Response time : Sum of T_r , T_f

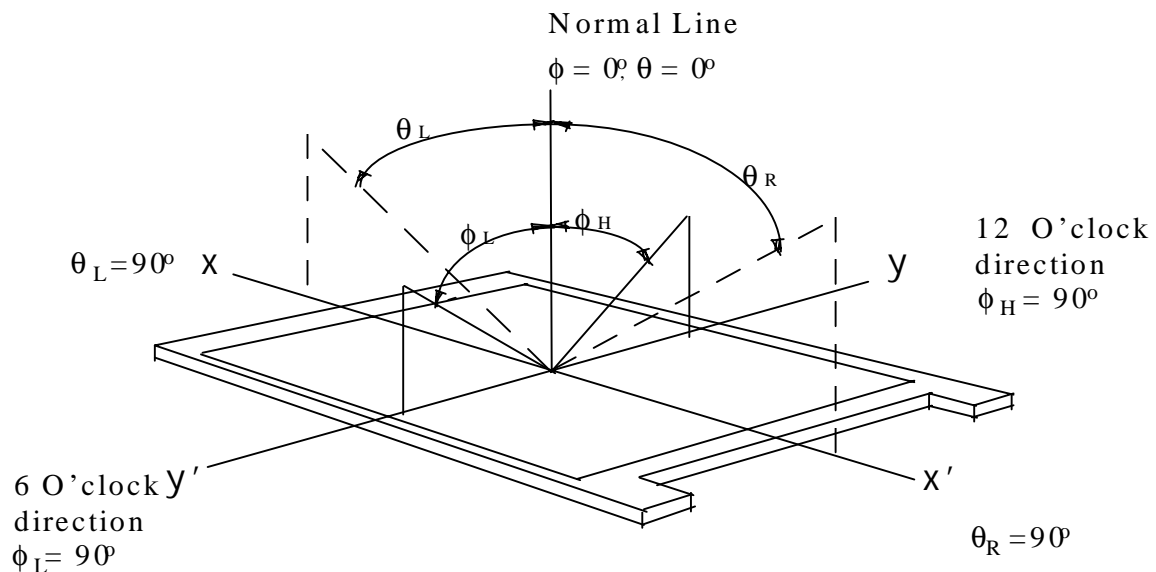


Note 6) Definition of Luminance of White : Luminance of white at center point⑤.

Note 7) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red , Green , Blue & White at center point⑤.

Note 8) Definition of Viewing Angle : Viewing angle range ($CR \geq 10$)



3. Electrical Characteristics

3.1 TFT LCD MODULE

Ta = 25°C

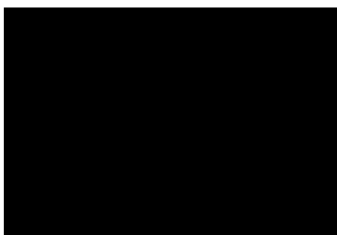
| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|-------------------------|-------------------|------------------|------|---------------|------|---------|
| Voltage of Power Supply | V _{DD} | 4.5 | 5.0 | 5.5 | V | (1) |
| Interface type | LVDS | DS90C383/385/387 | | DS90C386 Pair | | |
| Current of Power Supply | (a)Black | - | 700 | - | mA | (2),(3) |
| | (b)White | - | 800 | - | mA | |
| | (c)2 Line Stripe | - | 800 | 1050 | mA | |
| Vsync Frequency | f _V | - | 60 | - | Hz | |
| Hsync Frequency | f _H | - | 64 | - | kHz | |
| Main Frequency | f _{DCLK} | - | 54 | - | MHz | |
| Rush Current | I _{RUSH} | - | - | 4.0 | A | (4) |

Note (1) The connector for display data & timing signal should be connected.(V_{SS}=0V)

(2) f_V=60Hz, f_{DCLK} = 54MHz, V_{DD} = 5.0V, DC Current.

(3) Power dissipation check pattern(LCD Module only)

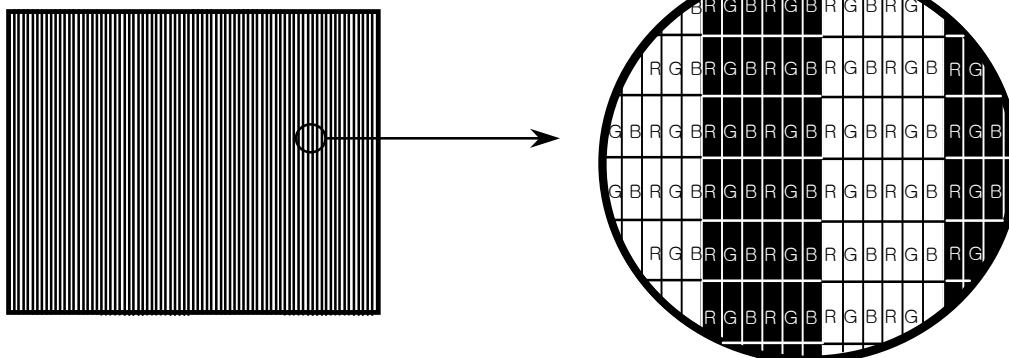
a) Black Pattern



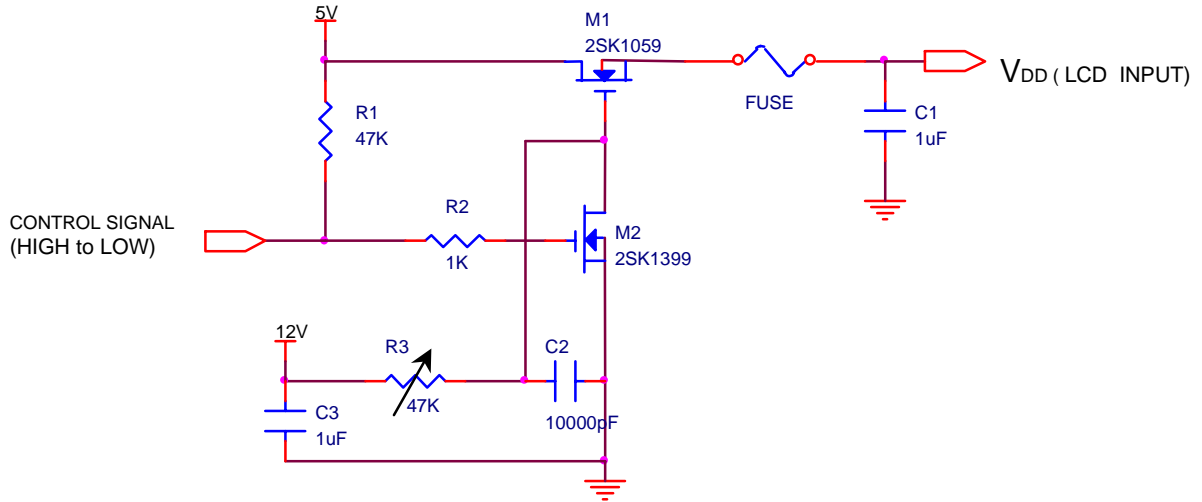
b) White Pattern



c) 2line vertical stripe pattern



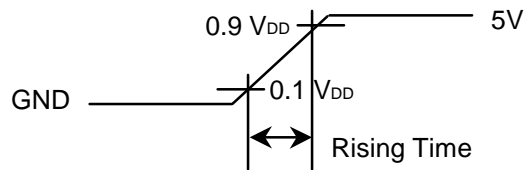
(4) Measurement Conditions



Note : Control Signal : High(+5V) -->Low(Ground)

All signal lines to panel except for power 5V : Ground

The rising time of supplied voltage is controlled to 470us by R3 and C2 value.



3.2 BACK-LIGHT UNIT

The back-light system is an edge - lighting type with 2 dual CCFTs (Cold Cathode Fluorescent Tube). The characteristics of two dual lamps are shown in the following tables.

Ta=25 ± 2°C

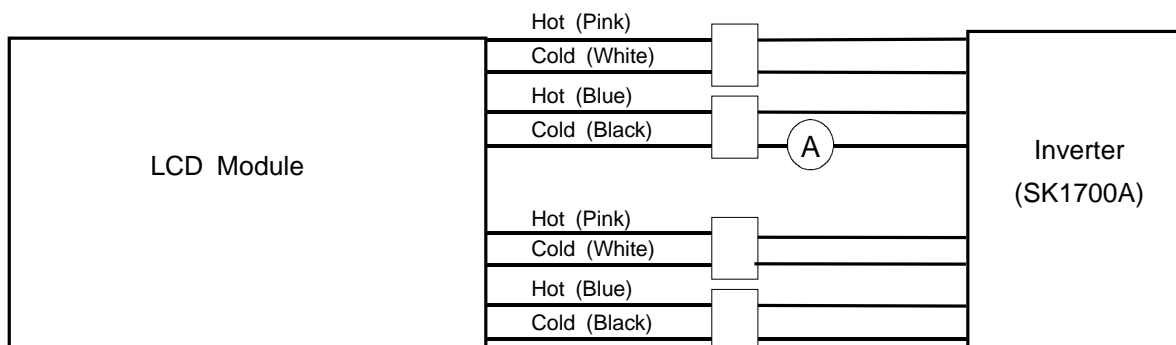
| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|-----------------|--------|------|------|------------|-------|------|
| Lamp Current | IL | 3.0 | 6.5 | 7.0 | mArms | (1) |
| Lamp Voltage | VL | - | 650 | - | Vrms | |
| Lamp Frequency | fL | 50 | - | 60 | kHz | (2) |
| Startup Voltage | Vs | - | - | 0°C:1,800 | Vrms | (3) |
| | | | | 25°C:1,500 | | |

Note) The waveform of the inverter output voltage must be area symmetric and the design of the inverter must have specifications for the modularized lamp.

The performance of the back-light, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the back-light and the inverter(miss lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

Note (1) Lamp current is measured with a current meter for high frequency as shown below.

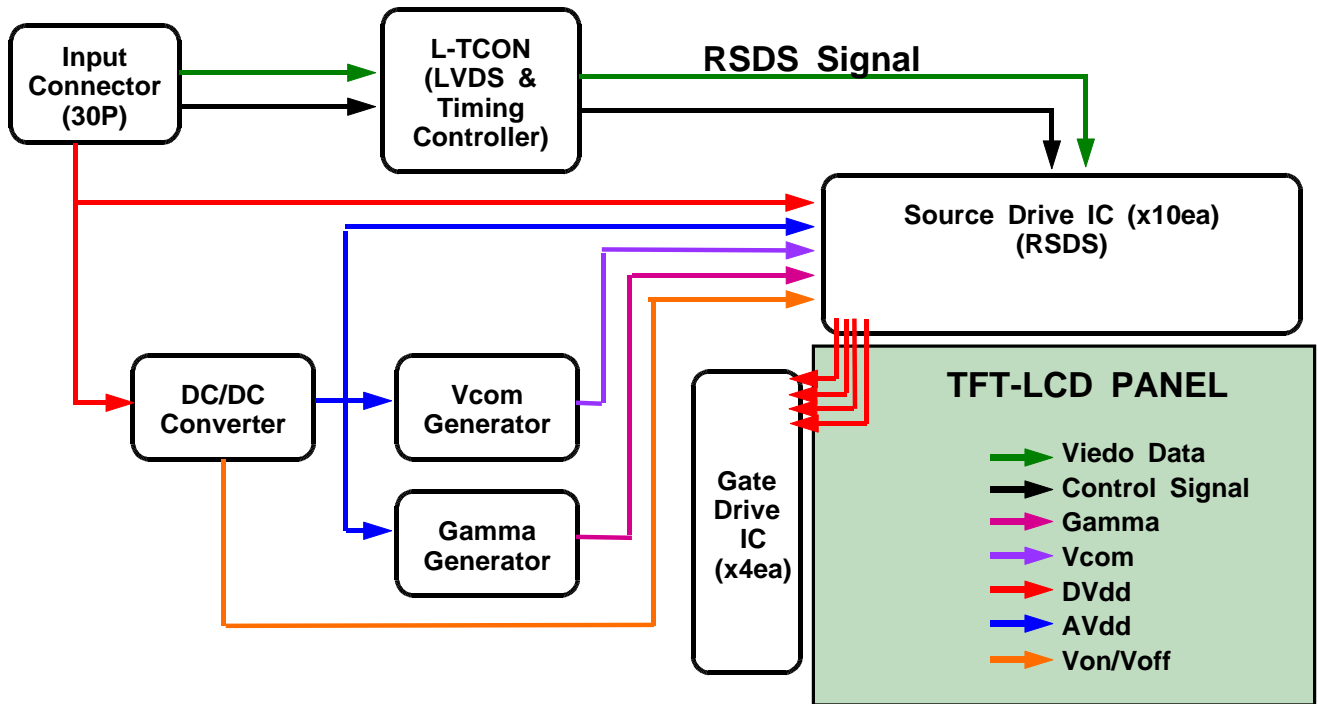
Refer to the block diagram of the back-light unit in the next page for more information. Specified values are for a single lamp.



- (2) Lamp frequency, which may produce interference with horizontal synchronous frequency which may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.
- (3) If an inverter has shutdown function, it should keep its output for over 1 second even if the lamp connector is open. Otherwise the lamps may not be turned on.
- (4) Because the inverter uses high voltage, please disconnect it from the power before assembling or disassembling.

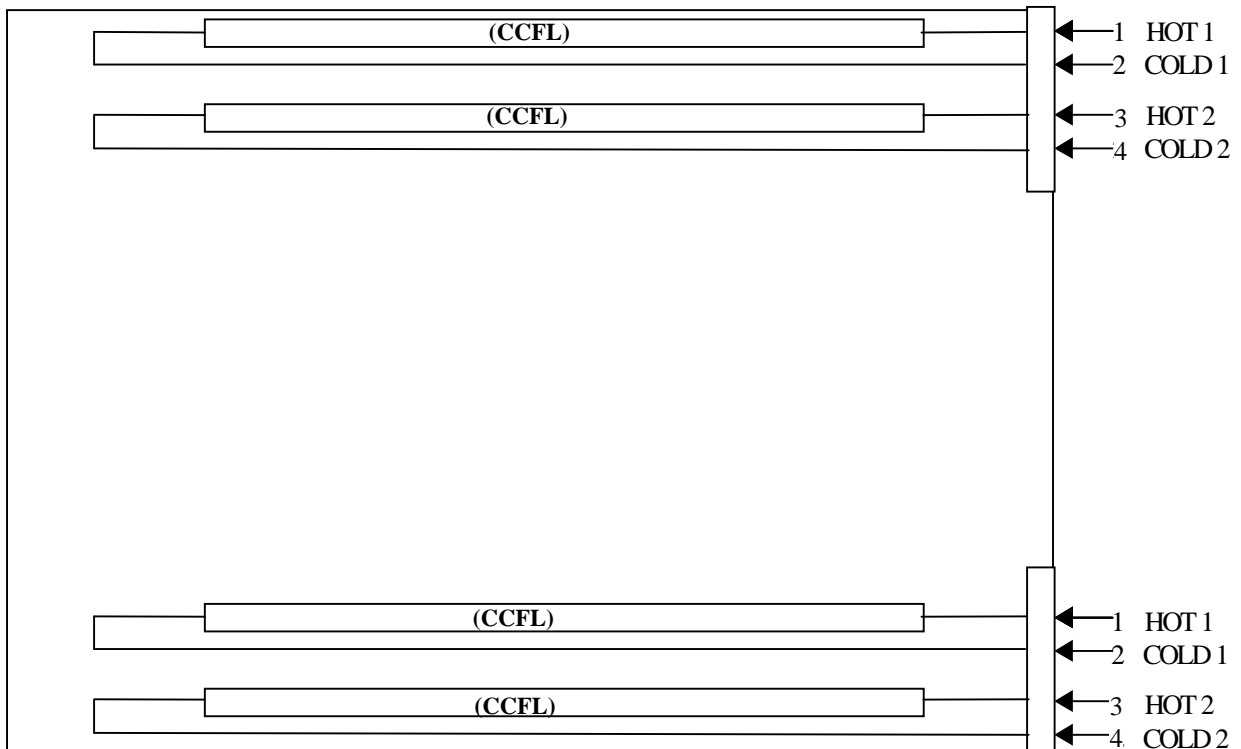
4. Block Diagram

4.1 TFT LCD MODULE



4.2 BACK-LIGHT UNIT

Connector : JST BHSR-02VS-1 or equivalent



5. Input Terminal Pin Assignment

5.1. Input Signal & Power (Connector : Uju IN-30-BB100 or equivalent)

| PIN NO | SYMBOL | FUNCTION |
|--------|-----------------|---|
| 1 | RXO0- | Negative Transmission Data of Pixel 0 (ODD data) |
| 2 | RXO0+ | Positive Transmission Data of Pixel 0 (ODD data) |
| 3 | RXO1- | Negative Transmission Data of Pixel 1 (ODD data) |
| 4 | RXO1+ | Positive Transmission Data of Pixel 1 (ODD data) |
| 5 | RXO2- | Negative Transmission Data of Pixel 2 (ODD data) |
| 6 | RXO2+ | Positive Transmission Data of Pixel 2 (ODD data) |
| 7 | GND | Power Ground |
| 8 | RXOC- | Negative Sampling Clock (ODD data) |
| 9 | RXOC+ | Positive Sampling Clock (ODD data) |
| 10 | RXO3- | Negative Transmission Data of Pixel 3 (ODD data) |
| 11 | RXO3+ | Positive Transmission Data of Pixel 3 (ODD data) |
| 12 | RXE0- | Negative Transmission Data of Pixel 0 (EVEN data) |
| 13 | RXE0+ | Positive Transmission Data of Pixel 0 (EVEN data) |
| 14 | GND | Power Ground |
| 15 | RXE1- | Negative Transmission Data of Pixel 1 (EVEN data) |
| 16 | RXE1+ | Positive Transmission Data of Pixel 1 (EVEN data) |
| 17 | GND | Power Ground |
| 18 | RXE2- | Negative Transmission Data of Pixel 2 (EVEN data) |
| 19 | RXE2+ | Positive Transmission Data of Pixel 2 (EVEN data) |
| 20 | RXEC- | Negative Sampling Clock (EVEN data) |
| 21 | RXEC+ | Positive Sampling Clock (EVEN data) |
| 22 | RXE3- | Negative Transmission Data of Pixel 3 (EVEN data) |
| 23 | RXE3+ | Positive Transmission Data of Pixel 3 (EVEN data) |
| 24 | GND | Power Ground |
| 25 | NC | No Connection |
| 26 | NC | No Connection |
| 27 | NC | No Connection |
| 28 | V _{DD} | Power Supply : +5V |
| 29 | | |
| 30 | | |

5.2 LVDS Interface(1)

5.2.1 Odd pixel data (1st pixel data)

| 1st LVDS Transmitter (<i>DS90C383</i> , <i>DS90C385</i>) Signal Interface | | | | | | |
|---|--------|---------------------|----------------------------|--------------------|---------------------------------|----------------|
| Device Input Pin | | Device Input Signal | | Output Signal | To LTM170E6 Interface (CN101) | |
| No | Symbol | Symbol | Function | | Terminal | Symbol |
| 51 | TXIN0 | RO0 | Red Odd Pixel Data (LSB) | TXOUT0- TXOUT0+ | No. 1 | RXO0- RXO0+ |
| 52 | TXIN1 | RO1 | Red Odd Pixel Data | | | |
| 54 | TXIN2 | RO2 | Red Odd Pixel Data | | | |
| 55 | TXIN3 | RO3 | Red Odd Pixel Data | | | |
| 56 | TXIN4 | RO4 | Red Odd Pixel Data | | | |
| 2 | TXIN5 | RO7 | Red Odd Pixel Data (MSB) | TXOUT3- TXOUT3+ | No. 10 No. 11 | RXO3- RXO3+ |
| 3 | TXIN6 | RO5 | Red Odd Pixel Data | TXOUT0- TXOUT0+ | No. 1 | RXO0- |
| 4 | TXIN7 | GO0 | Green Odd Pixel Data (LSB) | | No. 2 | RXO0+ |
| 6 | TXIN8 | GO1 | Green Odd Pixel Data | TXOUT1- TXOUT1+ | No. 3 | RXO1- |
| 7 | TXIN9 | GO2 | Green Odd Pixel Data | | No. 4 | RXO1+ |
| 8 | TXIN10 | GO6 | Green Odd Pixel Data | TXOUT3- TXOUT3+ | No. 10 | RXO3- |
| 10 | TXIN11 | GO7 | Green Odd Pixel Data (MSB) | | No. 11 | RXO3+ |
| 11 | TXIN12 | GO3 | Green Odd Pixel Data | TXOUT1- TXOUT1+ | No. 3 | RXO1- RXO1+ |
| 12 | TXIN13 | GO4 | Green Odd Pixel Data | | | |
| 14 | TXIN14 | GO5 | Green Odd Pixel Data | | | |
| 15 | TXIN15 | BO0 | Blue Odd Pixel Data (LSB) | TXOUT3- TXOUT3+ | No. 10 | RXO3- |
| 16 | TXIN16 | BO6 | Blue Odd Pixel Data | | No. 11 | RXO3+ |
| 18 | TXIN17 | BO7 | Blue Odd Pixel Data (MSB) | TXOUT1- TXOUT1+ | No. 3 | RXO1- |
| 19 | TXIN18 | BO1 | Blue Odd Pixel Data | | No. 4 | RXO1+ |
| 20 | TXIN19 | BO2 | Blue Odd Pixel Data | TXOUT2- TXOUT2+ | No. 5 | RXO2- |
| 22 | TXIN20 | BO3 | Blue Odd Pixel Data | | No. 6 | RXO2+ |
| 23 | TXIN21 | BO4 | Blue Odd Pixel Data | | | |
| 24 | TXIN22 | BO5 | Blue Odd Pixel Data | TXOUT3- TXOUT3+ | No. 10 | RXO3- |
| 50 | TXIN27 | RO6 | Red Odd Pixel Data | | No. 11 | RXO3+ |

5.2.2 Even pixel data (2nd pixel data)

| 2nd LVDS Transmitter (<i>DS90C383</i> , <i>DS90C385</i>) Signal Interface | | | | | | |
|---|--------|---------------------|-----------------------------|--------------------|---------------------------------|----------------|
| Device Input Pin | | Device Input Signal | | Output Signal | To LTM170E6 Interface (CN101) | |
| No | Symbol | Symbol | Function | | Terminal | Symbol |
| 51 | TXIN0 | RE0 | Red Even Pixel Data (LSB) | TXOUT0- TXOUT0+ | No. 12 No. 13 | RXE0- RXE0+ |
| 52 | TXIN1 | RE1 | Red Even Pixel Data | | | |
| 54 | TXIN2 | RE2 | Red Even Pixel Data | | | |
| 55 | TXIN3 | RE3 | Red Even Pixel Data | | | |
| 56 | TXIN4 | RE4 | Red Even Pixel Data | | | |
| 2 | TXIN5 | RE7 | Red Even Pixel Data (MSB) | TXOUT3- TXOUT3+ | No. 22 No. 23 | RXE3- RXE3+ |
| 3 | TXIN6 | RE5 | Red Even Pixel Data | TXOUT0- TXOUT0+ | No. 12 No. 13 | RXE0- RXE0+ |
| 4 | TXIN7 | GE0 | Green Even Pixel Data (LSB) | | | |
| 6 | TXIN8 | GE1 | Green Even Pixel Data | TXOUT1- TXOUT1+ | No. 15 No. 16 | RXE1- RXE1+ |
| 7 | TXIN9 | GE2 | Green Even Pixel Data | | | |
| 8 | TXIN10 | GE6 | Green Even Pixel Data | TXOUT3- TXOUT3+ | No. 22 No. 23 | RXE3- RXE3+ |
| 10 | TXIN11 | GE7 | Green Even Pixel Data (MSB) | | | |
| 11 | TXIN12 | GE3 | Green Even Pixel Data | TXOUT1- TXOUT1+ | No. 15 No. 16 | RXE1- RXE1+ |
| 12 | TXIN13 | GE4 | Green Even Pixel Data | | | |
| 14 | TXIN14 | GE5 | Green Even Pixel Data | | | |
| 15 | TXIN15 | BE0 | Blue Even Pixel Data (LSB) | | | |
| 16 | TXIN16 | BE6 | Blue Even Pixel Data | TXOUT3- TXOUT3+ | No. 22 No. 23 | RXE3- RXE3+ |
| 18 | TXIN17 | BE7 | Blue Even Pixel Data (MSB) | | | |
| 19 | TXIN18 | BE1 | Blue Even Pixel Data | TXOUT1- TXOUT1+ | No. 15 No. 16 | RXE1- RXE1+ |
| 20 | TXIN19 | BE2 | Blue Even Pixel Data | TXOUT2- TXOUT2+ | No. 18 No. 19 | RXE2- RXE2+ |
| 22 | TXIN20 | BE3 | Blue Even Pixel Data | | | |
| 23 | TXIN21 | BE4 | Blue Even Pixel Data | | | |
| 24 | TXIN22 | BE5 | Blue Even Pixel Data | | | |
| 50 | TXIN27 | RE6 | Red Even Pixel Data | TXOUT3- TXOUT3+ | No. 22 No. 23 | RXE3- RXE3+ |

5.3 LVDS Interface (2)

5.3.1 Odd pixel data (1st pixel data)

| LVDS Transmitter (<i>DS90C387</i>) Signal Interface | | | | | | |
|---|--------|---------------------|----------------------------|---------------|---------------------------------|----------------|
| Device Input Pin | | Device Input Signal | | Output Signal | To LTM170E6 Interface (CN101) | |
| No | Symbol | Symbol | Function | | Terminal | Symbol |
| 10 | R10 | RO0 | Red Odd Pixel Data (LSB) | A0M A0P | No. 1 No. 2 | RXO0- RXO0+ |
| 9 | R11 | RO1 | Red Odd Pixel Data | | | |
| 8 | R12 | RO2 | Red Odd Pixel Data | | | |
| 7 | R13 | RO3 | Red Odd Pixel Data | | | |
| 6 | R14 | RO4 | Red Odd Pixel Data | | | |
| 3 | R17 | RO7 | Red Odd Pixel Data (MSB) | A3M A3P | No. 10 No. 11 | RXO3- RXO3+ |
| 5 | R15 | RO5 | Red Odd Pixel Data | A0M | No. 1 | RXO0- |
| 2 | G10 | GO0 | Green Odd Pixel Data (LSB) | A0P | No. 2 | RXO0+ |
| 1 | G11 | GO1 | Green Odd Pixel Data | A1M | No. 3 | RXO1- |
| 100 | G12 | GO2 | Green Odd Pixel Data | A1P | No. 4 | RXO1+ |
| 94 | G16 | GO6 | Green Odd Pixel Data | A3M | No. 10 | RXO3- |
| 93 | G17 | GO7 | Green Odd Pixel Data (MSB) | A3P | No. 11 | RXO3+ |
| 99 | G13 | GO3 | Green Odd Pixel Data | A1M A1P | No. 3 No. 4 | RXO1- RXO1+ |
| 96 | G14 | GO4 | Green Odd Pixel Data | | | |
| 95 | G15 | GO5 | Green Odd Pixel Data | | | |
| 92 | B10 | BO0 | Blue Odd Pixel Data (LSB) | A3M A3P | No. 10 No. 11 | RXO3- RXO3+ |
| 86 | B16 | BO6 | Blue Odd Pixel Data | | | |
| 85 | B17 | BO7 | Blue Odd Pixel Data (MSB) | | | |
| 91 | B11 | BO1 | Blue Odd Pixel Data | A1M A1P | No. 3 No. 4 | RXO1- RXO1+ |
| 90 | B12 | BO2 | Blue Odd Pixel Data | A2M A2P | No. 5 No. 6 | RXO2- RXO2+ |
| 89 | B13 | BO3 | Blue Odd Pixel Data | | | |
| 88 | B14 | BO4 | Blue Odd Pixel Data | | | |
| 87 | B15 | BO5 | Blue Odd Pixel Data | | | |
| 4 | R16 | RO6 | Red Odd Pixel Data | A3M A3P | No. 10 No. 11 | RXO3- RXO3+ |

5.3.2 Even pixel data (2nd pixel data)

| LVDS Transmitter (<i>DS90C387</i>) Signal Interface | | | | | | |
|---|--------|---------------------|-----------------------------|---------------|---------------------------------|----------------|
| Device Input Pin | | Device Input Signal | | Output Signal | To LTM170E6 Interface (CN101) | |
| No | Symbol | Symbol | Function | | Terminal | Symbol |
| 84 | R20 | RE0 | Red Even Pixel Data (LSB) | A4M A4P | No. 12 No. 13 | RXE0- RXE0+ |
| 81 | R21 | RE1 | Red Even Pixel Data | | | |
| 80 | R22 | RE2 | Red Even Pixel Data | | | |
| 79 | R23 | RE3 | Red Even Pixel Data | | | |
| 78 | R24 | RE4 | Red Even Pixel Data | | | |
| 75 | R27 | RE7 | Red Even Pixel Data (MSB) | A7M A7P | No. 22 No. 23 | RXE3- RXE3+ |
| 77 | R25 | RE5 | Red Even Pixel Data | A4M A4P | No. 12 No. 13 | RXE0- RXE0+ |
| 74 | G20 | GE0 | Green Even Pixel Data (LSB) | | | |
| 73 | G21 | GE1 | Green Even Pixel Data | A5M A5P | No. 15 No. 16 | RXE1- RXE1+ |
| 72 | G22 | GE2 | Green Even Pixel Data | | | |
| 66 | G26 | GE6 | Green Even Pixel Data | A7M A7P | No. 22 No. 23 | RXE3- RXE3+ |
| 65 | G27 | GE7 | Green Even Pixel Data (MSB) | | | |
| 71 | G23 | GE3 | Green Even Pixel Data | A5M A5P | No. 15 No. 16 | RXE1- RXE1+ |
| 70 | G24 | GE4 | Green Even Pixel Data | | | |
| 69 | G25 | GE5 | Green Even Pixel Data | | | |
| 64 | B20 | BE0 | Blue Even Pixel Data (LSB) | | | |
| 58 | B26 | BE6 | Blue Even Pixel Data | A7M A7P | No. 22 No. 23 | RXE3- RXE3+ |
| 57 | B27 | BE7 | Blue Even Pixel Data (MSB) | | | |
| 63 | B21 | BE1 | Blue Even Pixel Data | A5M A5P | No. 15 No. 16 | RXE1- RXE1+ |
| 62 | B22 | BE2 | Blue Even Pixel Data | A6M A6P | No. 18 No. 19 | RXE2- RXE2+ |
| 61 | B23 | BE3 | Blue Even Pixel Data | | | |
| 60 | B24 | BE4 | Blue Even Pixel Data | | | |
| 59 | B25 | BE5 | Blue Even Pixel Data | | | |
| 76 | R26 | RE6 | Red Even Pixel Data | A7M A7P | No. 22 No. 23 | RXE3- RXE3+ |

NOTE)

Must be connected 24th BAL pin with low and 23th DUAL pin with high in DS90C387 LVDS Transmitter

5.4 BACK-LIGHT UNIT

| | Pin No. | Input | Color | Function |
|-------|--------------------|-------------------------------|-------|--------------|
| Upper | 1 | Hot1 | Pink | High Voltage |
| | 2 | Cold1 | White | Ground |
| | 3 | Hot2 | Blue | High Voltage |
| | 4 | Cold2 | Black | Ground |
| Lower | 1 | Hot1 | Pink | High Voltage |
| | 2 | Cold1 | White | Ground |
| | 3 | Hot2 | Blue | High Voltage |
| | 4 | Cold2 | Black | Ground |
| | Connector Part No. | JST BHSR-02VS-1 or equivalent | | |

5.5 Input Signals, Basic Display Colors and Gray Scale of Each Colors

| COLOR | DISPLAY | DATA SIGNAL | | | | | | | | | | | | | | | | | | | | | GRAY SCALE LEVEL | | | |
|---------------------|---------|-------------|----|----|----|----|----|----|-------|----|----|----|----|----|----|------|----|----|----|----|----|----|------------------|----|----|------|
| | | RED | | | | | | | GREEN | | | | | | | BLUE | | | | | | | | | | |
| | | R0 | R1 | R2 | R3 | R4 | R5 | R6 | R7 | G0 | G1 | G2 | G3 | G4 | G5 | G6 | G7 | B0 | B1 | B2 | B3 | B4 | | B5 | B6 | B7 |
| BASIC COLOR | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | BLUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | GREEN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | CYAN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | RED | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | MAGENTA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | YELLOW | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | WHITE | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| GRAY SCALE OF RED | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R0 | |
| | DARK ↑ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R1 |
| | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R2 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | R3~ |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | R252 |
| | LIGHT ↓ | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R253 |
| | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R254 |
| | RED | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R255 |
| GRAY SCALE OF GREEN | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G0 | |
| | DARK ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G1 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G2 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | G3~ |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | G252 |
| | LIGHT ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G253 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G254 |
| | GREEN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G255 |
| GRAY SCALE OF BLUE | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | B0 | |
| | DARK ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | B1 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | B2 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | B3~ |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | B252 |
| | LIGHT ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | B253 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | B254 |
| | BLUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | B255 |

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

6. Interface Timing

6.1 Timing Parameters (DE only mode)

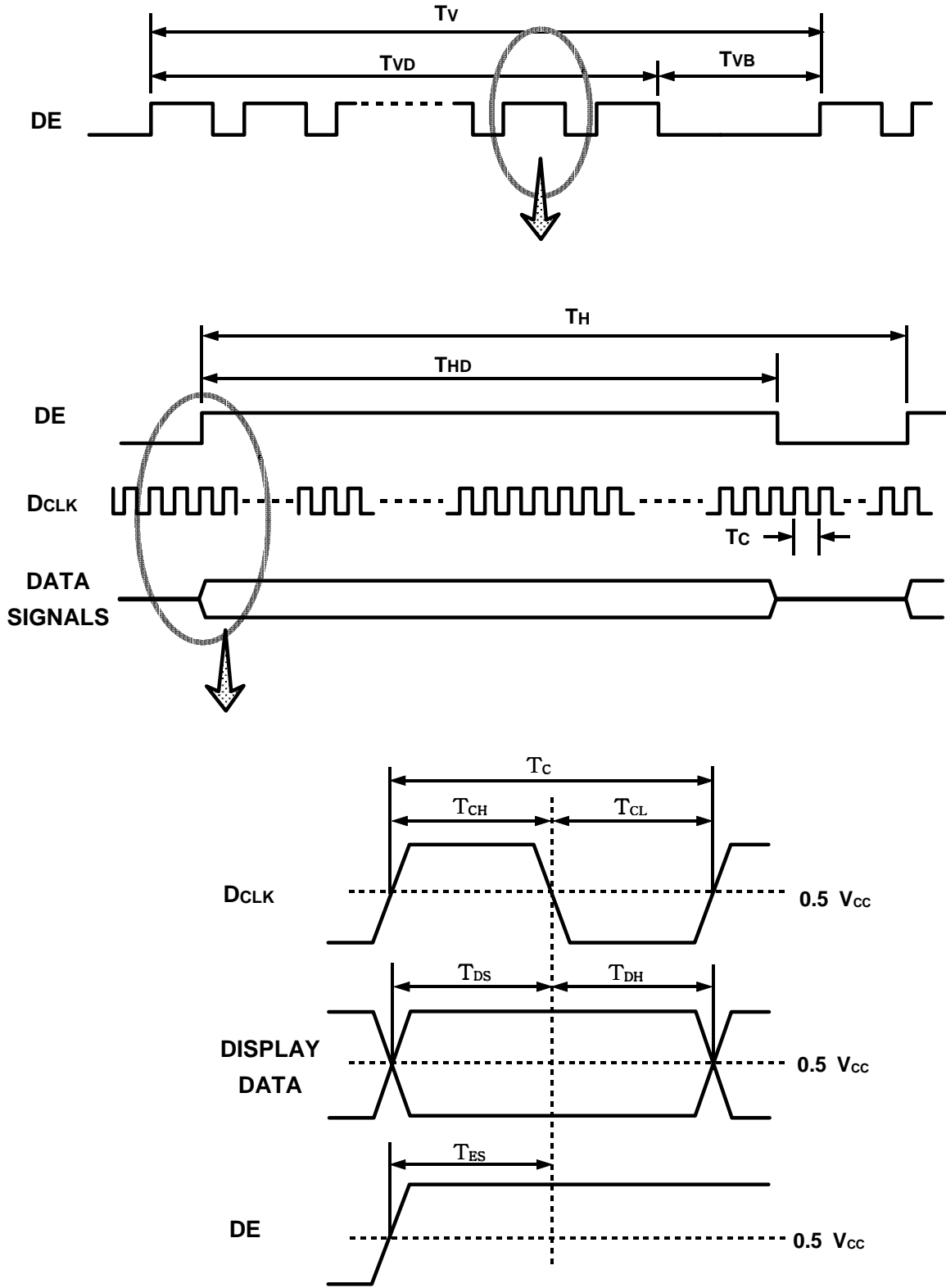
| SIGNAL | ITEM | SYMBOL | MIN. | TYP. | MAX. | UNIT | NOTE |
|--------------------------------|-----------------------|--------|------|------|------|--------|----------|
| Clock | Frequency | 1/TC | - | 54 | - | MHz | (1), (2) |
| | High Time | TCH | 4 | - | - | nsec | |
| | Low Time | TCL | 4 | - | - | nsec | |
| Data | Setup Time | TDS | 4 | - | - | nsec | |
| | Hold Time | TDH | 4 | - | - | nsec | |
| Data Enable | Setup Time | TES | 4 | - | - | nsec | |
| Frame Frequency | Cycle | Tv | 18.2 | 16.7 | 13.1 | msec | (3) |
| | | | 1032 | 1066 | 1066 | lines | |
| | Frequency | 1/Tv | 55 | 60 | 76 | Hz | |
| Vertical Active Display Term | Display Period | TVD | 1024 | 1024 | 1024 | lines | |
| | Vertical Blank Period | TVB | 8 | - | - | lines | |
| One Line Scanning Time | Cycle | TH | 672 | - | 844 | clocks | |
| Horizontal Active Display Term | Display Period | THD | 640 | 640 | 640 | clocks | |

Note (1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

(2) Internal Vcc = 3.3V

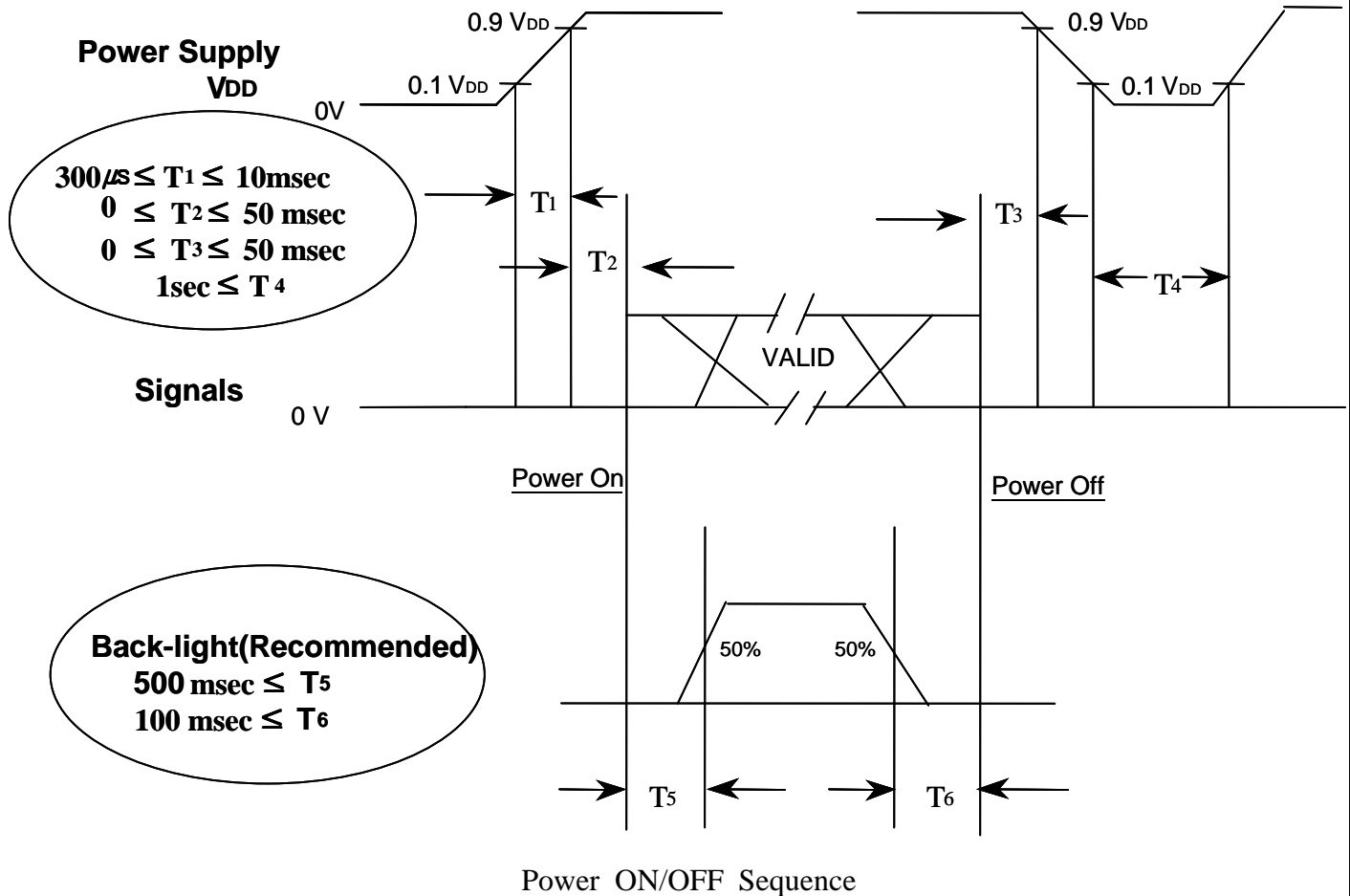
(3) At low Vsync frequency, under 60Hz, flicker level can increase at specific pattern.

6.2 Timing diagrams of interface signal (DE only mode)



6.3 Power ON/OFF Sequence

: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should follow the diagram shown below.



Power ON/OFF Sequence

NOTE.

- (1) The supply voltage from the external system to the module input should be the same as the definition of V_{DD}.
- (2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operates or the LCD turns off before the back-light does, the display may momentarily show abnormal images.
- (3) In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- (4) T₄ should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal should not be kept in the high impedance state when the power is on.

7. Outline Dimension

(Refer to the next page.)

8. General Precautions

8.1 Handling

- (a) When the module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist or bend the modules.
- (b) Because the inverter use high voltage, power should be disconnected before it is assembled or disassembled.
- (c) Refrain from strong mechanical shock and /or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT back-light.
- (d) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface using the harder than a HB pencil lead.
- (e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining and discoloration may occur.
- (f) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (g) The desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.
- (i) Protect the module from static which may cause damage to the CMOS Gate Array IC.
- (j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (k) Do not disassemble the module.
- (l) Do not pull or fold the lamp wire.
- (m) Do not adjust the variable resistor located on the module.
- (n) Protection film for polarizer on the module should be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (o) Pins of I/F connector should not be touched directly with bare hands.

8.2 Storage

- (a) Do not leave the module in high temperature, high humidity for a long time.
It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD module in direct sunlight.
- (c) The module should be stored in a dark place.
It is prohibited to apply sunlight or fluorescent light in storage.

8.3 Operation

- (a) Do not connect or disconnect the module in the "Power On" condition.
- (b) Power supply should always be turned on/off by 6.3 "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back-light connector and its inverter power supply should be connected directly with a minimized length. A longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

8.4 Others

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water which may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on)
Otherwise the module may be damaged.
- (d) If the module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen.
- (e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.