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ELECTRONICS

Approval



TO : Acer/Inventec

DATE : Mar. 12, 2008

SAMSUNG TFT-LCD

MODEL NO. : LTN160HT01-A02

NOTE : Extension code [-A]
→ LTN160HT01-**A02**
Surface type [**Glare**]

Any modification of spec is not allowed without SEC's permission

APPROVED BY :

K. H. Shin

PREPARED BY :

Kevin Kim

LCD DEVELOPMENT G1. MOBILE DIVISION
SAMSUNG ELECTRONICS CO., LTD.

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GENERAL DESCRIPTION

DESCRIPTION

LTN160HT01-A02 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight unit. The resolution of a 16.0" contains 1920 x 1080 pixels and can display up to 262,144 colors. 6 O'clock direction is the optimum viewing angle.

FEATURES

- High contrast ratio, high aperture structure
- 1920 x 1080 pixels resolution (16:9)
- High color Gamut (Typical 60%)
- Low power consumption
- Fast Response Time
- Single CCFL
- DE(Data enable) only mode
- 3.3V LVDS Interface
- Onboard EEDID chip
- RoHS Compliance

APPLICATIONS

- Notebook PC
- If the usage of this product is not for PC application, but for others, please contact SEC

GENERAL INFORMATION

| Item | Specification | Unit | Note |
|-------------------|--|-------|--------|
| Display area | 353.28 (H) x 198.72 (V) (16.0" diagonal) | mm | |
| Driver element | a-Si TFT active matrix | | |
| Display colors | 262,144 | | |
| Number of pixel | 1920 x 1080 | pixel | 16 : 9 |
| Pixel arrangement | RGB vertical stripe | | |
| Pixel pitch | 0.184 (H) x 0.184 (V) (TYP.) | mm | |
| Display Mode | Normally white | | |
| Surface treatment | Haze 0, Hardness 3H | | |

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Mechanical Information

| Item | | Min. | Typ. | Max. | Unit | Note |
|-------------|----------------|-------|------|-------|------|------|
| Module size | Horizontal (H) | 364.5 | 365 | 365.5 | mm | (1) |
| | Vertical (V) | 213.5 | 214 | 214.5 | mm | |
| | Depth (D) | - | 6.2 | 6.5 | mm | |
| Weight | | - | 580 | 600 | g | |

Note (1) Measurement condition of outline dimension

- . Equipment : Vernier Calipers
- . Push Force : 500g · f (minimum)

1. ABSOLUTE MAXIMUM RATINGS

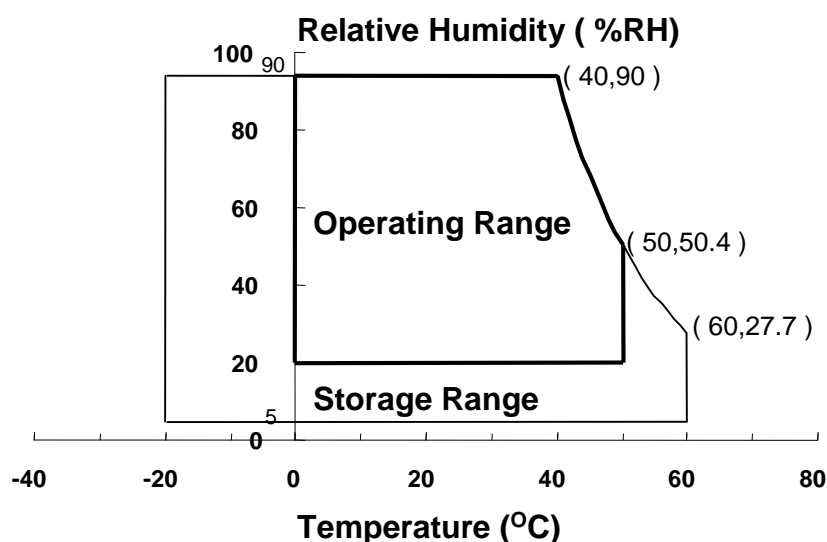
1.1 ENVIRONMENTAL ABSOLUTE RATINGS

| Item | Symbol | Min. | Max. | Unit | Note |
|---|--------|------|------|------|---------|
| Storage temperate | TSTG | -20 | 60 | °C | (1),(5) |
| Operating temperate (Temperature of glass surface) | TOPR | 0 | 50 | °C | (1),(5) |
| Shock (non-operating) | Snop | - | 240 | G | (2),(4) |
| Vibration (non-operating) | Vnop | - | 2.41 | G | (3),(4) |

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

95 % RH Max. ($40^{\circ}\text{C} \geq T_a$)

Maximum wet - bulb temperature at 39°C or less. ($T_a > 40^{\circ}\text{C}$) No condensation



(2) 2ms, half sine wave, one time for $\pm X, \pm Y, \pm Z$.

(3) 5 - 500 Hz, random vibration, 30min for X, Y, Z.

(4) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.

(5) If product is used for extended time excessively or exposed to high temperatures for extended time, there is a possibility of wide viewing angle film damage which could affect visual characteristics.

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1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

 $V_{DD} = 3.3V, V_{SS} = GND = 0V$

| Item | Symbol | Min. | Max. | Unit | Note |
|----------------------|----------|----------------|----------------|------|------|
| Power Supply Voltage | V_{DD} | $V_{DD} - 0.3$ | $V_{DD} + 0.3$ | V | (1) |
| Logic Input Voltage | V_{IN} | $V_{DD} - 0.3$ | $V_{DD} + 0.3$ | V | (1) |

Note (1) Within T_a ($25 \pm 2^\circ C$)

(2) BACK-LIGHT UNIT

 $T_a = 25 \pm 2^\circ C$

| Item | Symbol | Min. | Max. | Unit | Note |
|----------------|--------|------|------|------|------|
| Lamp Current | I_L | 3.0 | 7.0 | mA | (1) |
| Lamp frequency | F_L | 50 | 80 | kHz | (1) |

Note 1) Permanent damage to the device may occur if maximum values are exceeded

Functional operation should be restricted to the conditions described under normal operating conditions.

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2. OPTICAL CHARACTERISTICS

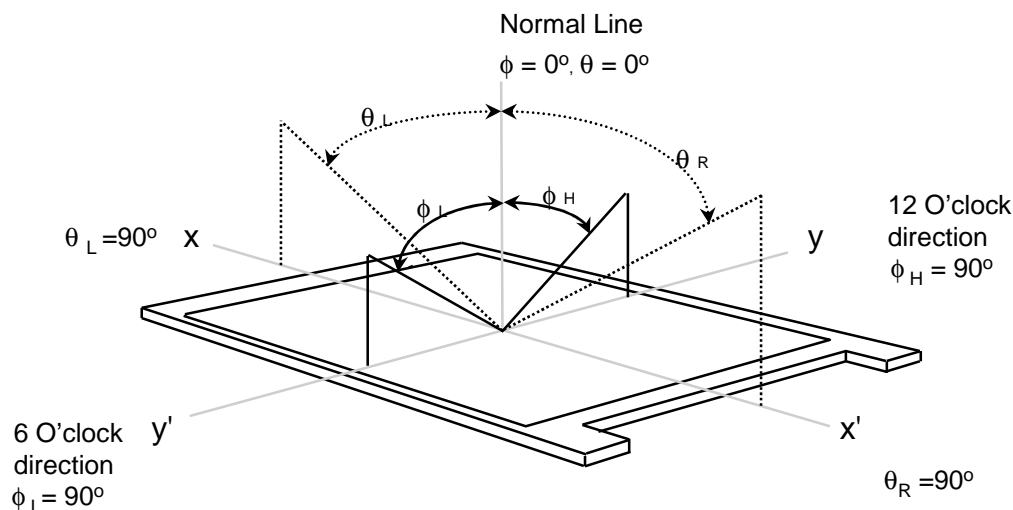
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).
Measuring equipment : TOPCON BM-5A and PR-650

* Ta = 25 ± 2 °C, V_{DD}=3.3V, f_V= 60Hz, f_{DCLK} = (TBD)MHz, I_L = 6.5 mA

| Item | | Symbol | Condition | Min. | Typ. | Max | Unit | Note |
|---|-------|--------------------|--|-------|-------|-------|---------|-----------------------------------|
| Contrast Ratio (5 Points) | | CR | Normal Viewing Angle ϕ = 0 θ = 0 | 300 | 600 | - | - | (1), (2), (5) |
| Response Time at Ta (Rising + Falling) | | T _{RT} | | - | 8 | 16 | msec | (1), (3) |
| Average Luminance of White (5 Points) | | Y _{L,AVE} | | 210 | 250 | - | cd/m² | I _L =6.5mA (1), (4) |
| Color Chromaticity (CIE) | Red | R _X | | 0.580 | 0.610 | 0.640 | - | (1), (5) PR-650 |
| | | R _Y | | 0.295 | 0.325 | 0.355 | | |
| | Green | G _X | | 0.270 | 0.300 | 0.330 | | |
| | | G _Y | | 0.540 | 0.570 | 0.600 | | |
| | Blue | B _X | | 0.115 | 0.145 | 0.175 | | |
| | | B _Y | | 0.055 | 0.085 | 0.115 | | |
| | White | W _X | | 0.283 | 0.313 | 0.343 | | |
| | | W _Y | 0.299 | 0.329 | 0.359 | | | |
| Viewing Angle | Hor. | θ _L | CR ≥ 10 | 65 | 75 | - | Degrees | (1), (5) BM-5A |
| | | θ _H | | 65 | 75 | - | | |
| | Ver. | ϕ _H | | 50 | 60 | - | | |
| | | ϕ _L | | 45 | 55 | - | | |
| | Hor. | θ _L | CR ≥ 100 | 30 | 40 | | Degrees | (1), (5) BM-5A |
| | | θ _H | | 30 | 40 | | | |
| | Ver. | ϕ _H | | 10 | 20 | | | |
| | | ϕ _L | | 10 | 20 | | | |
| 13 Points White Variation | | δ _L | | - | - | 2.2 | - | (6) |

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Note 1) Definition of Viewing Angle : Viewing angle range($10 \leq C/R$)

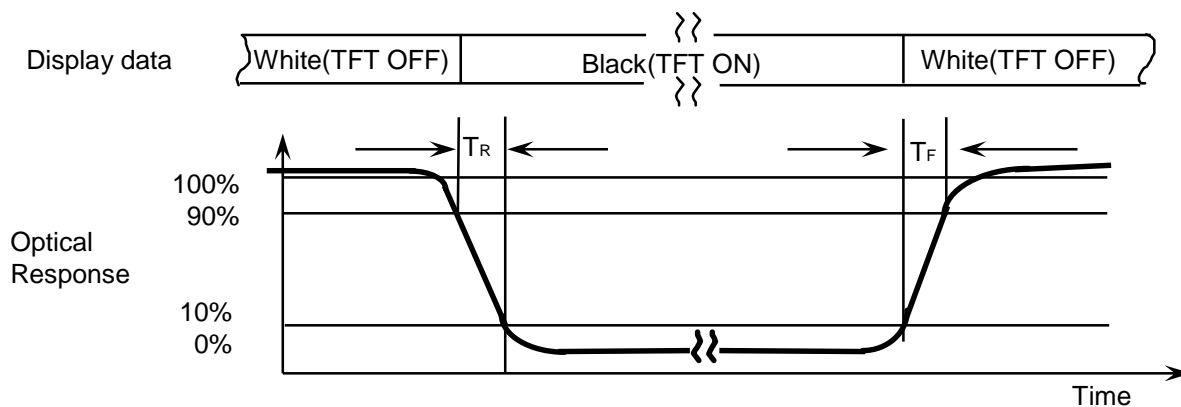


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax), gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

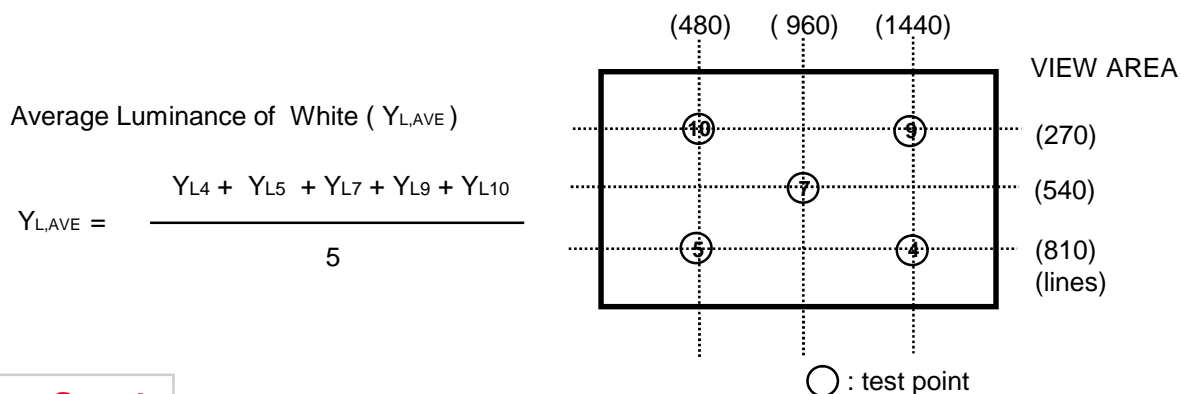
$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

Points : (4), (5), (7), (9), (10) at the figure of Note (6).

Note 3) Definition of Response time :

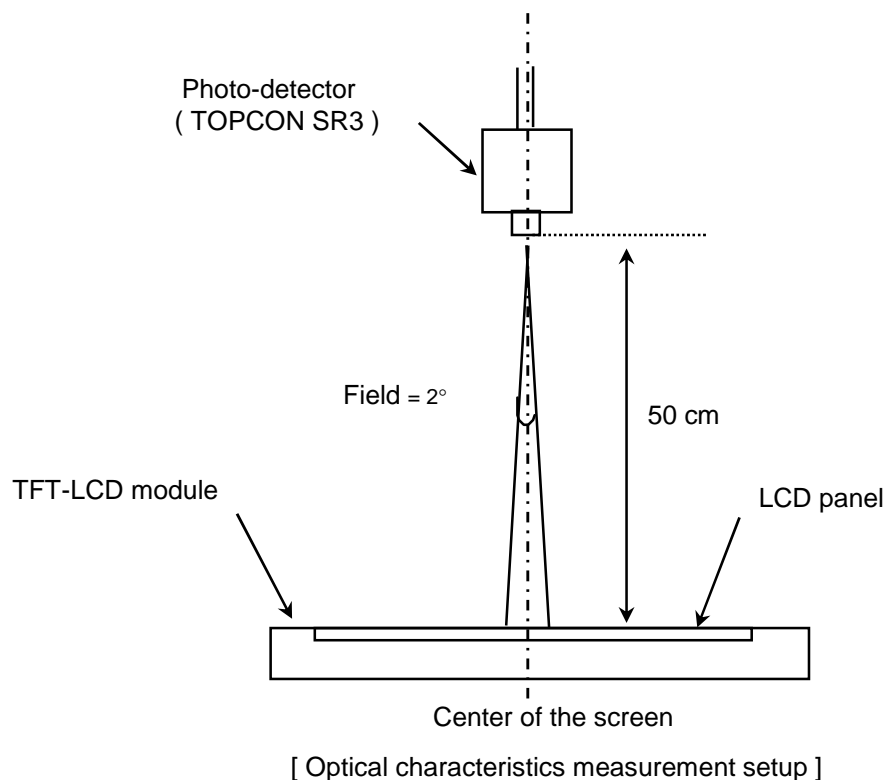


Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.



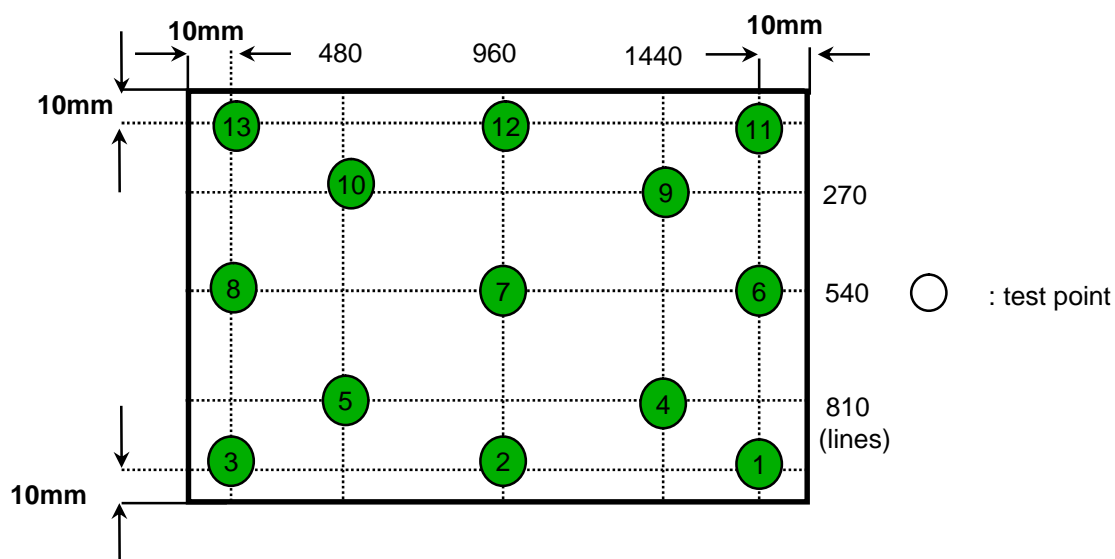
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Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.
 Lamp current : 6.5mA (Inverter : SIC-130T)
 Environment condition : $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$



Note 6) Definition of 13 points white variation (δL), CR variation(C_{VER}) [① ~ ⑬]

$$\delta L = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$



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3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta= 25 ± 2°C

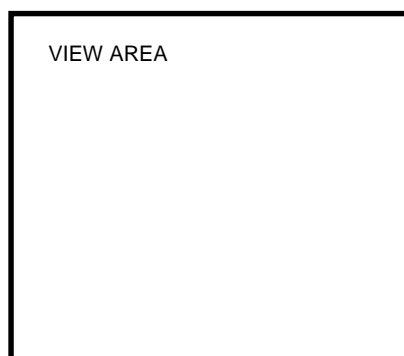
| Item | | Symbol | Min. | Typ. | Max. | Unit | Note |
|--|-----------|-------------------|------|-------|------|------|-------------------------|
| Voltage of Power Supply | | V _{DD} | 3.0 | 3.3 | 3.6 | V | |
| Differential Input Voltage for LVDS Receiver Threshold | High | V _{IH} | - | - | +100 | mV | V _{CM} = +1.2V |
| | Low | V _{IL} | -100 | - | - | mV | |
| Vsync Frequency | | f _v | - | 60 | - | Hz | |
| Hsync Frequency | | f _H | - | 63.40 | - | KHz | |
| Main Frequency | | f _{DCLK} | - | 69.33 | - | MHz | 2CH |
| Rush Current | | I _{RUSH} | - | - | 2.5 | A | (4) |
| Current of Power Supply | White | I _{DD} | - | 600 | - | mA | (2),(3)*a |
| | Mosaic | | - | 750 | - | mA | (2),(3)*b |
| | V. stripe | | - | 800 | 900 | mA | (2),(3)*c |

Note (1) Display data pins and timing signal pins should be connected.(GND = 0V)

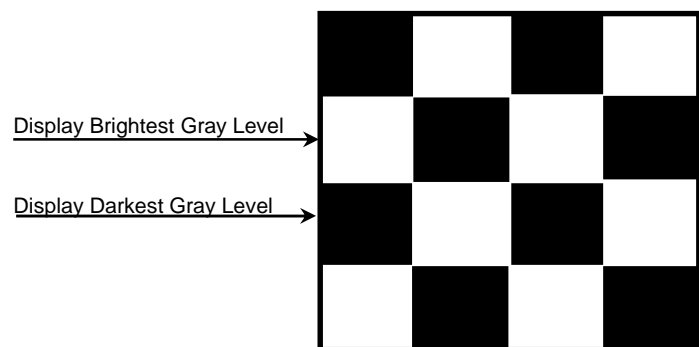
(2) f_v = 60Hz, f_{DCLK} = 69.33 MHz, V_{DD} = 3.3V , DC Current.

(3) Power dissipation pattern

*a) White Pattern

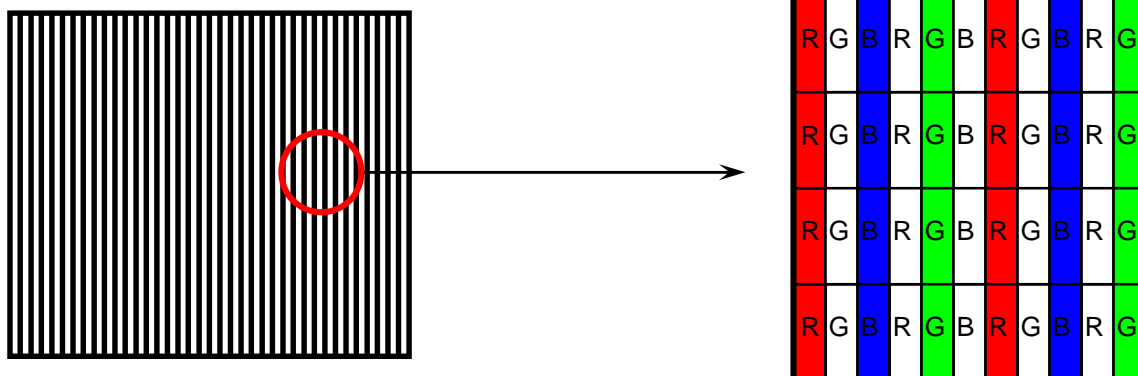


*b) Mosaic Pattern

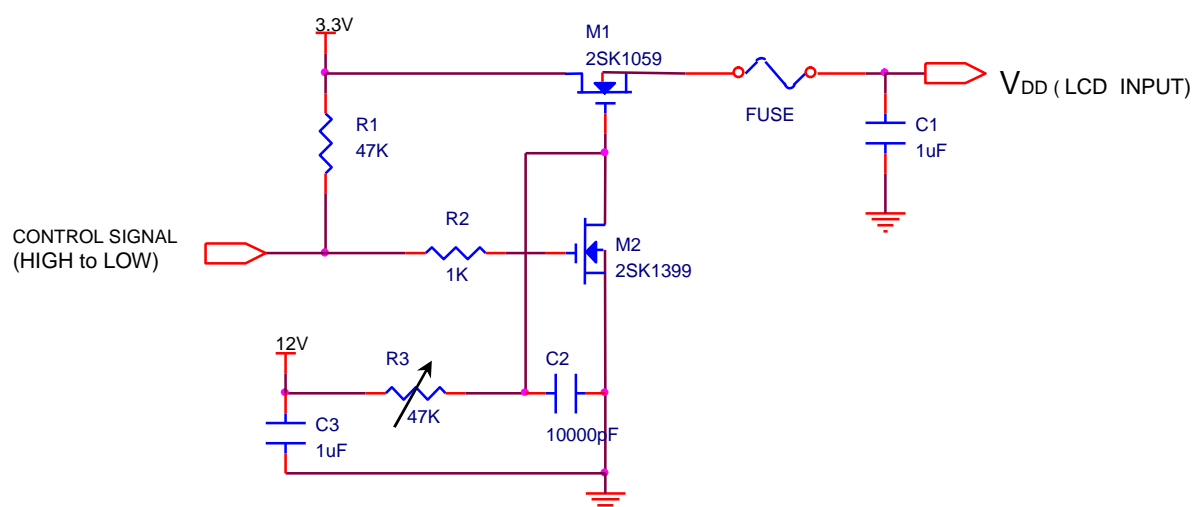


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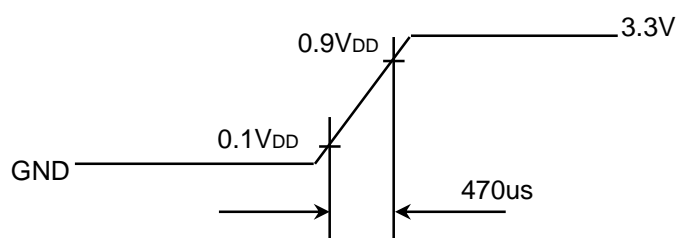
*c) 1dot Vertical stripe pattern



4) Rush current measurement condition



V_{DD} rising time is 470us



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3.2 BACK-LIGHT UNIT

The backlight system is an edge-lighting type with a single CCFL (Cold Cathode Fluorescent Lamp).
The characteristics of a single lamp are shown in the following tables.

- INVERTER : (SEM SIC 130T)

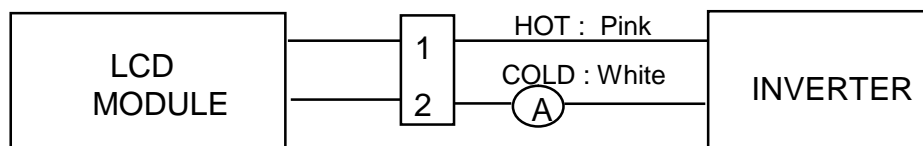
Ta= 25 ± 2 °C

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---------------------|----------------|--------|------|-------|-------|------------------------------|
| Lamp Current | I _L | 3.0 | 6.5 | 7.0 | mArms | (1) |
| Lamp Voltage | V _L | - | 685 | - | Vrms | I _L =6.5mA |
| Frequency | f _L | 45 | 60 | 70 | KHz | (2) |
| Power Consumption | P _L | | 4.5 | | W | (3) I _L =6.5mA |
| Operating Life Time | Hr | 12,000 | | | Hour | (4) |
| Startup Voltage | V _s | - | - | 1,230 | Vrms | 25°C, (5) |
| | | | | 1,480 | Vrms | 0°C, (5) |
| Lamp startup time | | - | - | 1.0 | sec | (5) |

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 backlight, 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 backlight 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 high frequency current meter as shown below.



(2) Lamp frequency may produce interference with horizontal synchronous frequency and this 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) Refer to I_L × V_L to calculate.

(4) Life time (Hr) of a lamp can be defined as the time in which it continues to operate under the condition Ta= 25 ± 2 °C and I_L = 6.5 mArms until one of the following event occurs.

1. When the brightness becomes 50% or lower than the original.
2. When the Effective ignition length becomes 80% or lower than the original value.
(Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

(5) The inverter open voltage - this voltage should be measured after ballast capacitor- have to be larger than the lamp startup voltage, otherwise backlight may has blinking for a moment after turns on or not be turned on.

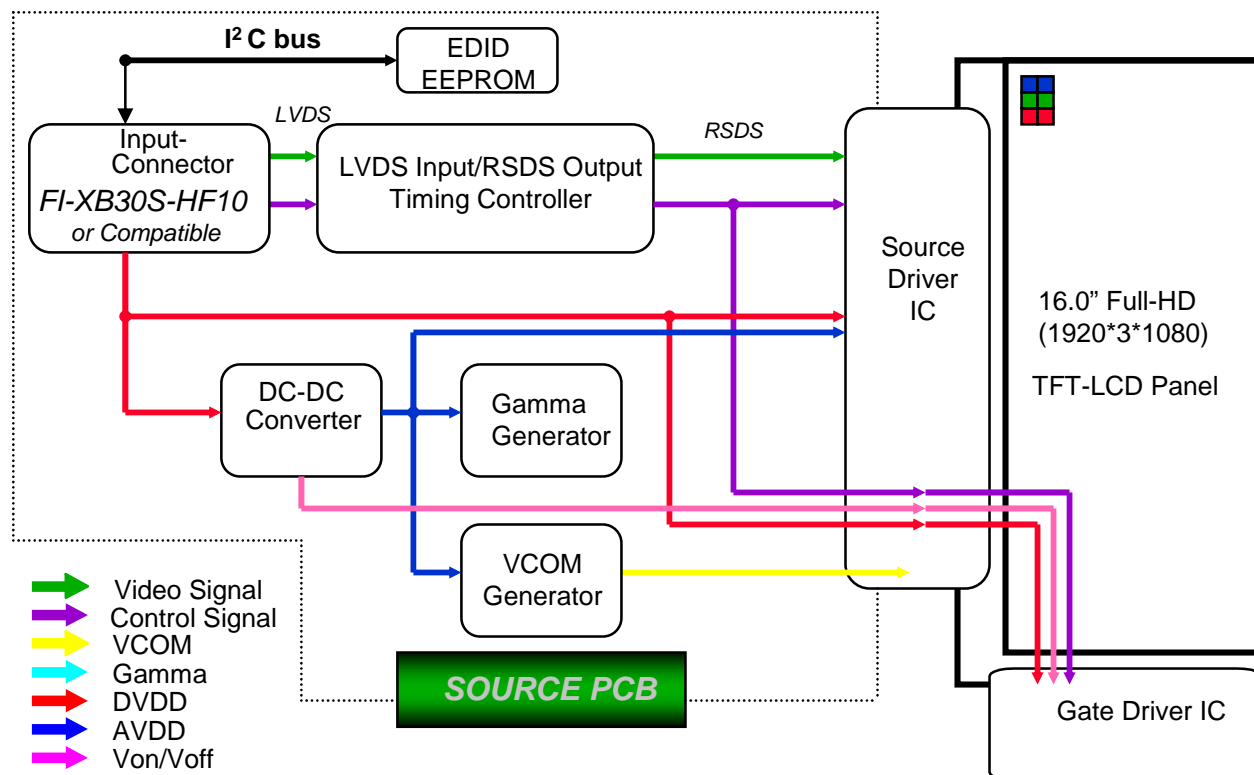
If an inverter has shutdown function it should keep its open voltage for longer than 1 second even if lamp connector open.

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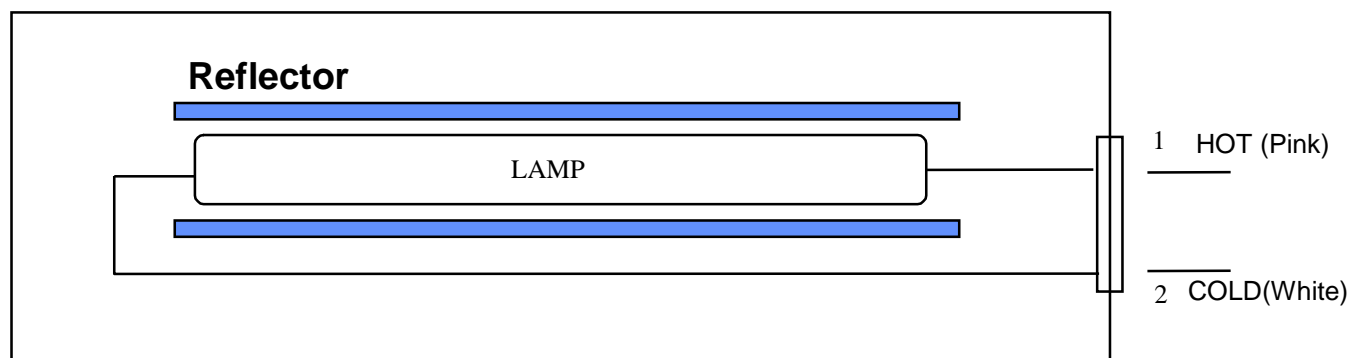
| | | | | | |
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4. BLOCK DIAGRAM

4.1 TFT LCD Module



4.2 BACK-LIGHT UNIT



Note) The output of the inverter may change according to the material of the reflector.

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5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (LVDS, Connector : JAE FI-XB30SL-HF10 or compatible)
Mating Connector : JAE FI-X30M or compatible)

| No. | Symbol | Function | Polarity | Remarks |
|-----|----------|---|----------|---------|
| 1 | VSS | Ground | | |
| 2 | VDD | POWER SUPPLY +3.3V | | |
| 3 | VDD | POWER SUPPLY +3.3V | | |
| 4 | VEEDID | DDC 3.3V Power | | |
| 5 | NC | No Connection | | |
| 6 | CLKEDID | DDC Clock | | |
| 7 | DATAEDID | DDC data | | |
| 8 | O_RxIN0- | LVDS Differential Data INPUT (Odd R0-R5,G0) | Negative | |
| 9 | O_RxIN0+ | LVDS Differential Data INPUT (Odd R0-R5,G0) | Positive | |
| 10 | GND | Ground | | |
| 11 | O_RxIN1- | LVDS Differential Data INPUT (Odd G1-G5,B0-B1) | Negative | |
| 12 | O_RxIN1+ | LVDS Differential Data INPUT (Odd G1-G5,B0-B1) | Positive | |
| 13 | GND | Ground | | |
| 14 | O_RxIN2- | LVDS Differential Data INPUT (Odd B2-B5,Sync,DE) | Negative | |
| 15 | O_RxIN2+ | LVDS Differential Data INPUT (Odd B2-B5,Sync,DE) | Positive | |
| 16 | GND | Ground | | |
| 17 | O_RxCLK- | LVDS Differential Data INPUT (Odd Clock) | Negative | |
| 18 | O_RxCLK+ | LVDS Differential Data INPUT (Odd Clock) | Positive | |
| 19 | GND | Ground | | |
| 20 | E_RxIN0- | LVDS Differential Data INPUT (Even R0-R5,G0) | Negative | |
| 21 | E_RxIN0+ | LVDS Differential Data INPUT (Even R0-R5,G0) | Positive | |
| 22 | GND | Ground | | |
| 23 | E_RxIN1- | LVDS Differential Data INPUT (Even G1-G5,B0-B1) | Negative | |
| 24 | E_RxIN1+ | LVDS Differential Data INPUT (Even G1-G5,B0-B1) | Positive | |
| 25 | GND | Ground | | |
| 26 | E_RxIN2- | LVDS Differential Data INPUT (Even B2-B5,Sync,DE) | Negative | |
| 27 | E_RxIN2+ | LVDS Differential Data INPUT (Even B2-B5,Sync,DE) | Positive | |
| 28 | GND | Ground | | |
| 29 | E_RxCLK- | LVDS Differential Data INPUT (Even Clock) | Negative | |
| 30 | E_RxCLK+ | LVDS Differential Data INPUT (Even Clock) | Positive | |

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5.2 LVDS Interface : Transmitter DS90CF365 or Compatible

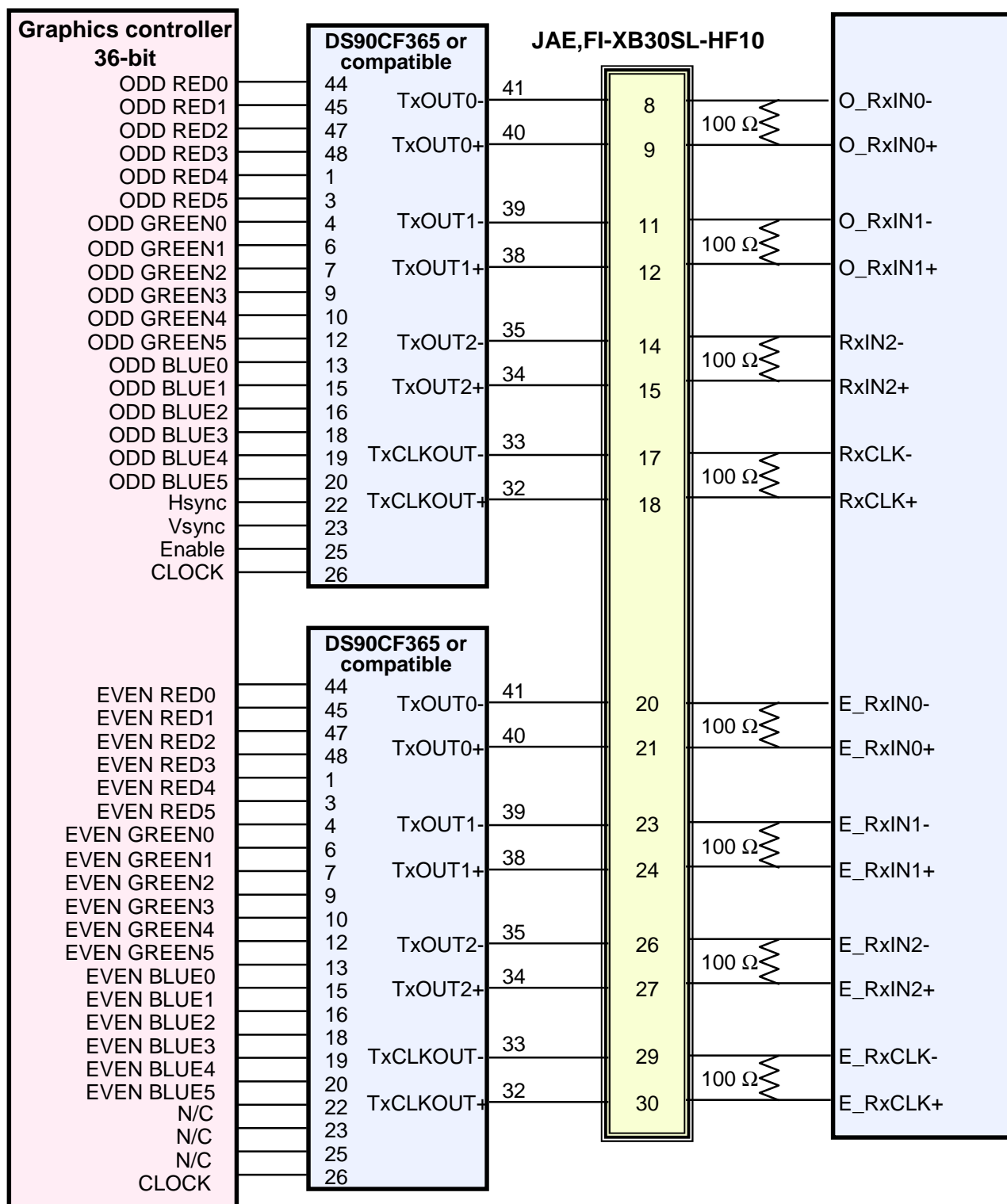
LVDS for Odd pixel

| Pin No. | Name | RGB Signal | Pin No. | Name | RGB Signal |
|---------|--------|------------|---------|----------|------------|
| 44 | TxIN0 | RO0 | 12 | TxIN11 | GO5 |
| 45 | TxIN1 | RO1 | 13 | TxIN12 | BO0 |
| 47 | TxIN2 | RO2 | 15 | TxIN13 | BO1 |
| 48 | TxIN3 | RO3 | 16 | TxIN14 | BO2 |
| 1 | TxIN4 | RO4 | 18 | TxIN15 | BO3 |
| 3 | TxIN5 | RO5 | 19 | TxIN16 | BO4 |
| 4 | TxIN6 | GO0 | 20 | TxIN17 | BO5 |
| 6 | TxIN7 | GO1 | 22 | TxIN18 | Hsync |
| 7 | TxIN8 | GO2 | 23 | TxIN19 | Vsync |
| 9 | TxIN9 | GO3 | 25 | TxIN20 | DE |
| 10 | TxIN10 | GO4 | 26 | TxCLK IN | Clock |

LVDS for Even pixel

| Pin No. | Name | RGB Signal | Pin No. | Name | RGB Signal |
|---------|--------|------------|---------|----------|------------|
| 44 | TxIN0 | RE0 | 12 | TxIN11 | GE5 |
| 45 | TxIN1 | RE1 | 13 | TxIN12 | BE0 |
| 47 | TxIN2 | RE2 | 15 | TxIN13 | BE1 |
| 48 | TxIN3 | RE3 | 16 | TxIN14 | BE2 |
| 1 | TxIN4 | RE4 | 18 | TxIN15 | BE3 |
| 3 | TxIN5 | RE5 | 19 | TxIN16 | BE4 |
| 4 | TxIN6 | GE0 | 20 | TxIN17 | BE5 |
| 6 | TxIN7 | GE1 | 22 | TxIN18 | N/C |
| 7 | TxIN8 | GE2 | 23 | TxIN19 | N/C |
| 9 | TxIN9 | GE3 | 25 | TxIN20 | N/C |
| 10 | TxIN10 | GE4 | 26 | TxCLK IN | Clock |

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LVDS Interface

Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

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5.3 BACK LIGHT UNIT

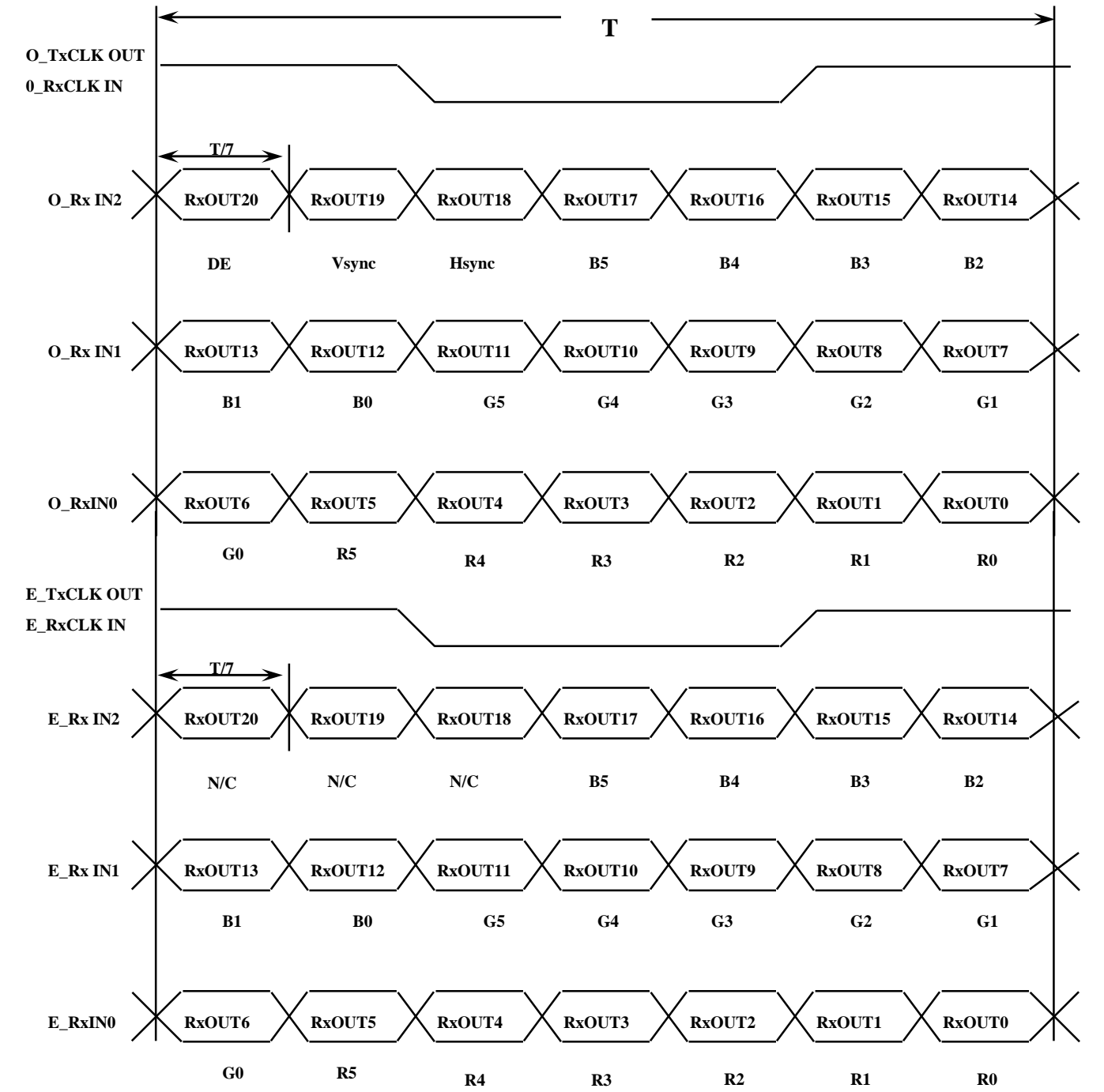
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Connector : JST BHSR - 02VS -1
Mating Connector : SM02B-BHSS-1

| Pin NO. | Symbol | Color | Function |
|---------|--------|-------|--------------|
| 1 | HOT | Pink | High Voltage |
| 2 | COLD | White | Low Voltage |

5.4 Timing Diagrams of LVDS For Transmission

LVDS Receiver : Integrated T-CON



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

| Color | Display | Data Signal | | | | | | | | | | | | | | | | | Gray Scale Level | |
|---------------------|---------|-------------|----|----|----|----|----|-------|----|----|----|----|----|------|----|----|----|----|------------------|--------|
| | | Red | | | | | | Green | | | | | | Blue | | | | | | |
| | | R0 | R1 | R2 | R3 | R4 | R5 | G0 | G1 | G2 | G3 | G4 | G5 | B0 | B1 | B2 | B3 | 45 | | B5 |
| Basic Colors | Black | 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 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 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 | - |
| Gray Scale Of Red | Black | 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 | R1 |
| | ↑ | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R2 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | R3~R60 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | ↓ | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R61 |
| | Light | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R62 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R63 |
| Gray Scale Of Green | Black | 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 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G1 |
| | ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G2 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | G3~G60 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G61 |
| | Light | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G62 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G63 |
| Gray Scale Of Blue | Black | 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 | 1 | 0 | 0 | 0 | 0 | 0 | B1 |
| | ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | B2 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | B3~B60 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | B61 |
| | Light | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | B62 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | B63 |

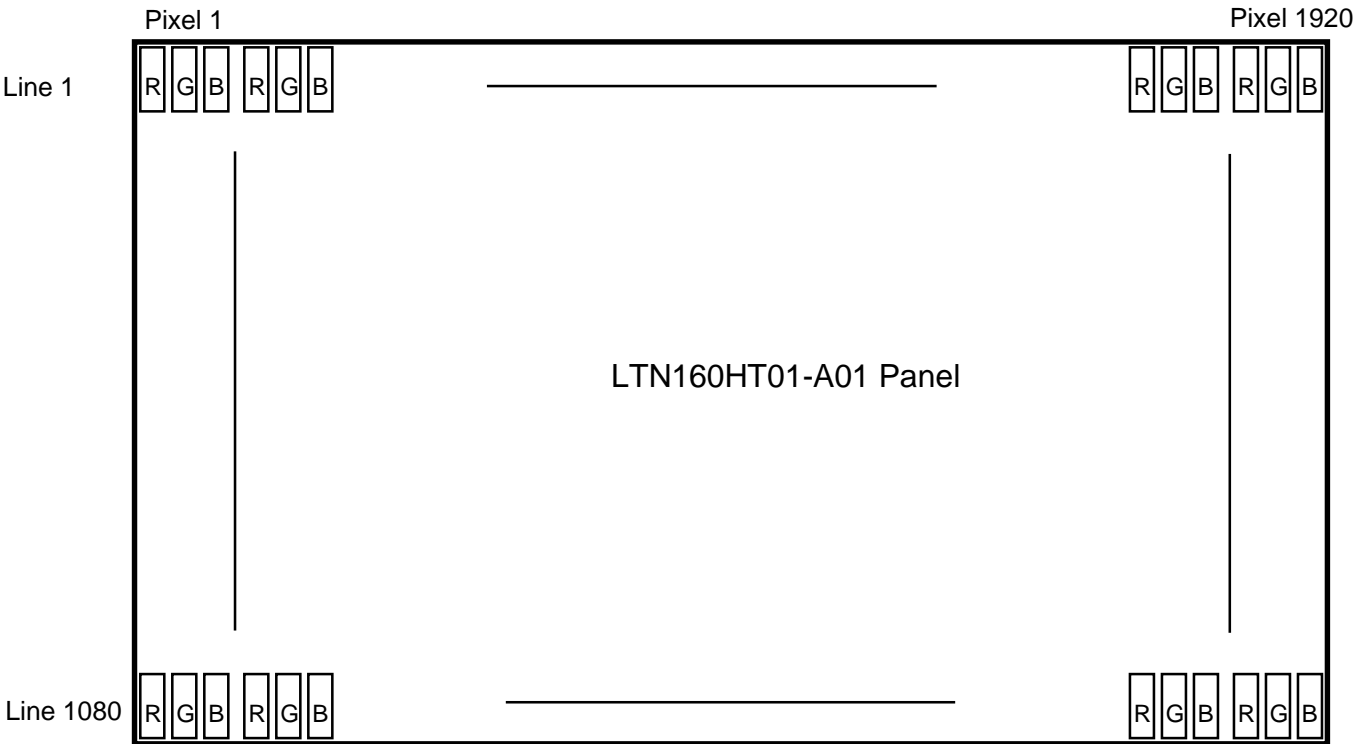
Note 1) Definition of gray :

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

Note 2) Input signal: 0 =Low level voltage, 1=High level voltage

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5.6 Pixel Format in the display



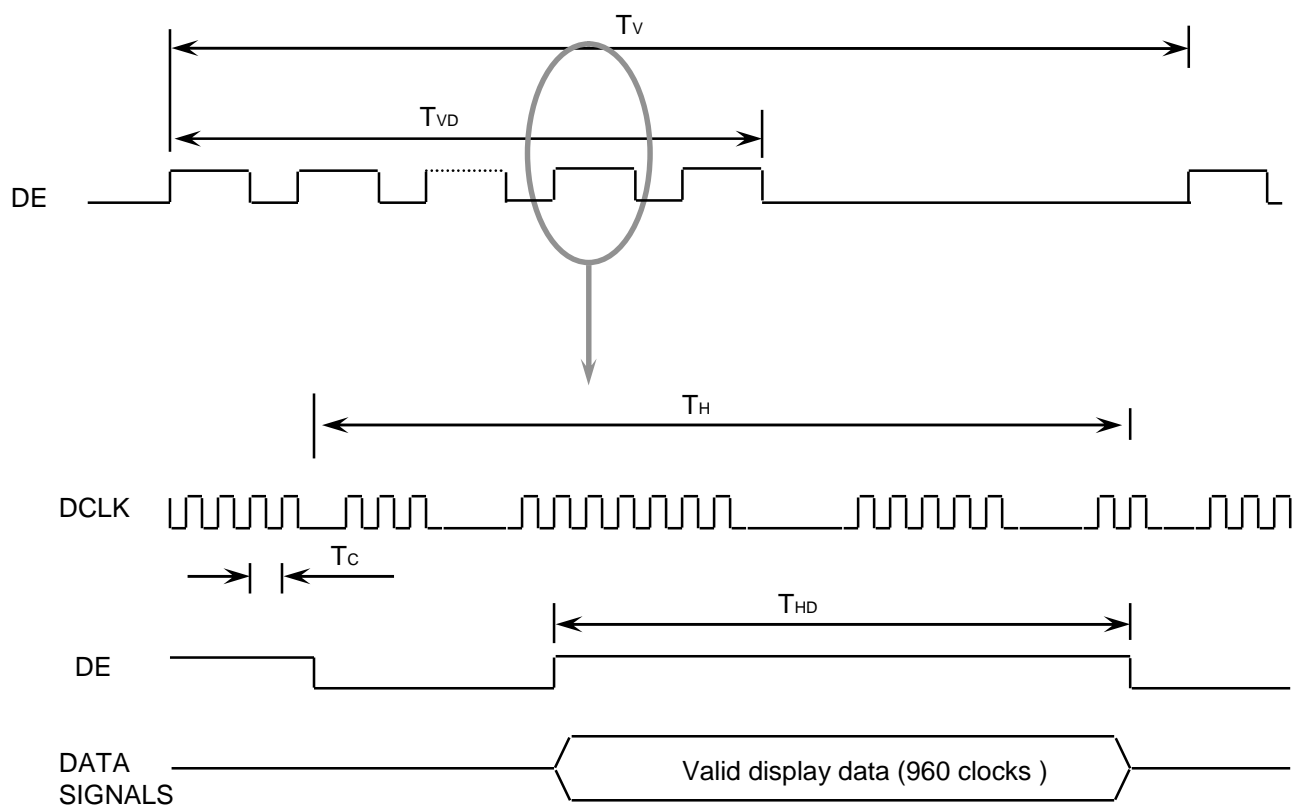
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6. INTERFACE TIMING

6.1 Timing Parameters

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|--------------------------------|----------------|--------|------|------|------|--------|------|
| Frame Frequency | Cycle | TV | | 1111 | | Lines | |
| Vertical Active Display Term | Display Period | TVD | | 1080 | | Lines | |
| One Line Scanning Time | Cycle | TH | | 1040 | | Clocks | |
| Horizontal Active Display Term | Display Period | THD | - | 960 | - | Clocks | |

6.2 Timing diagrams of interface signal

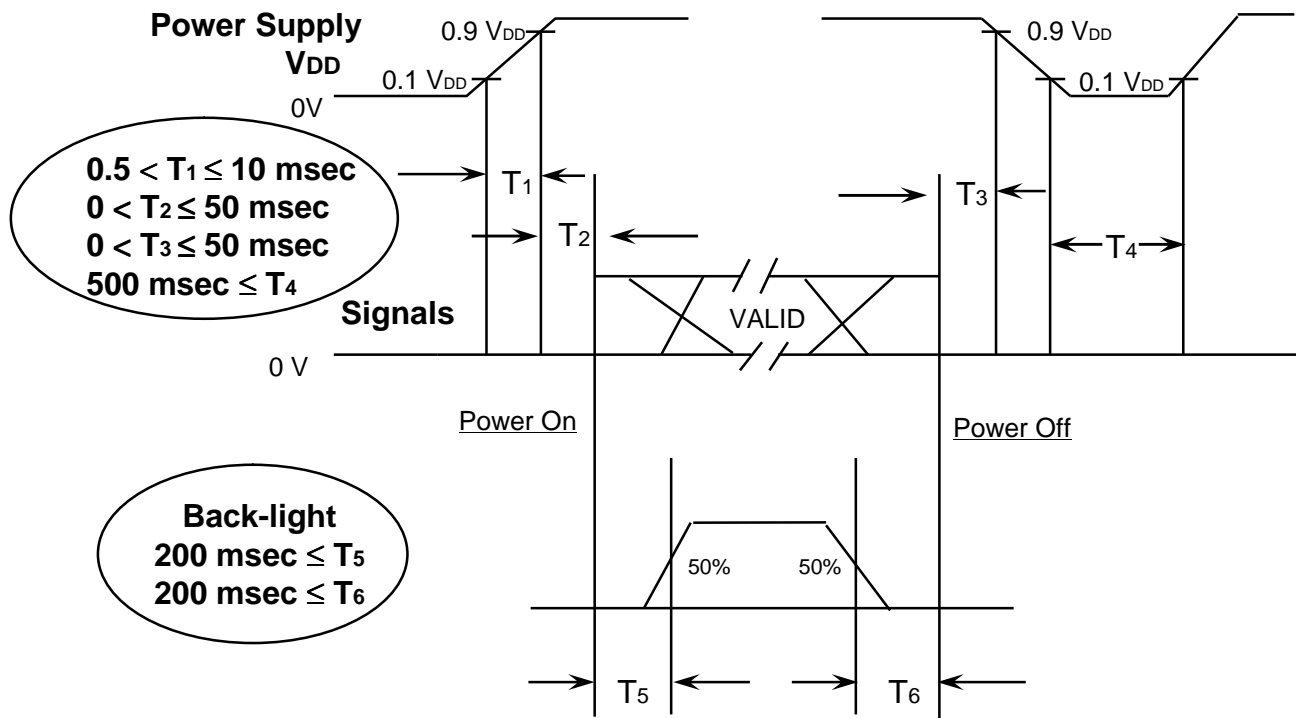


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6.3 Power ON/OFF Sequence

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



Power ON/OFF Sequence

- T1 : Vdd rising time from 10% to 90%
- T2 : The time from Vdd to valid data at power ON.
- T3 : The time from valid data off to Vdd off at power Off.
- T4 : Vdd off time for Windows restart
- T5 : The time from valid data to B/L enable at power ON.
- T6 : The time from valid data off to B/L disable at power Off.

NOTE.

- (1) The supply voltage of the external system for the module input should be the same as the definition of VDD.
- (2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become white.
- (3) In case of VDD = off level, please keep the level of input signals on the 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 shall not be kept at high impedance when the power is on.

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7. Mechanical Outline Dimension

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[Refer to the next page]

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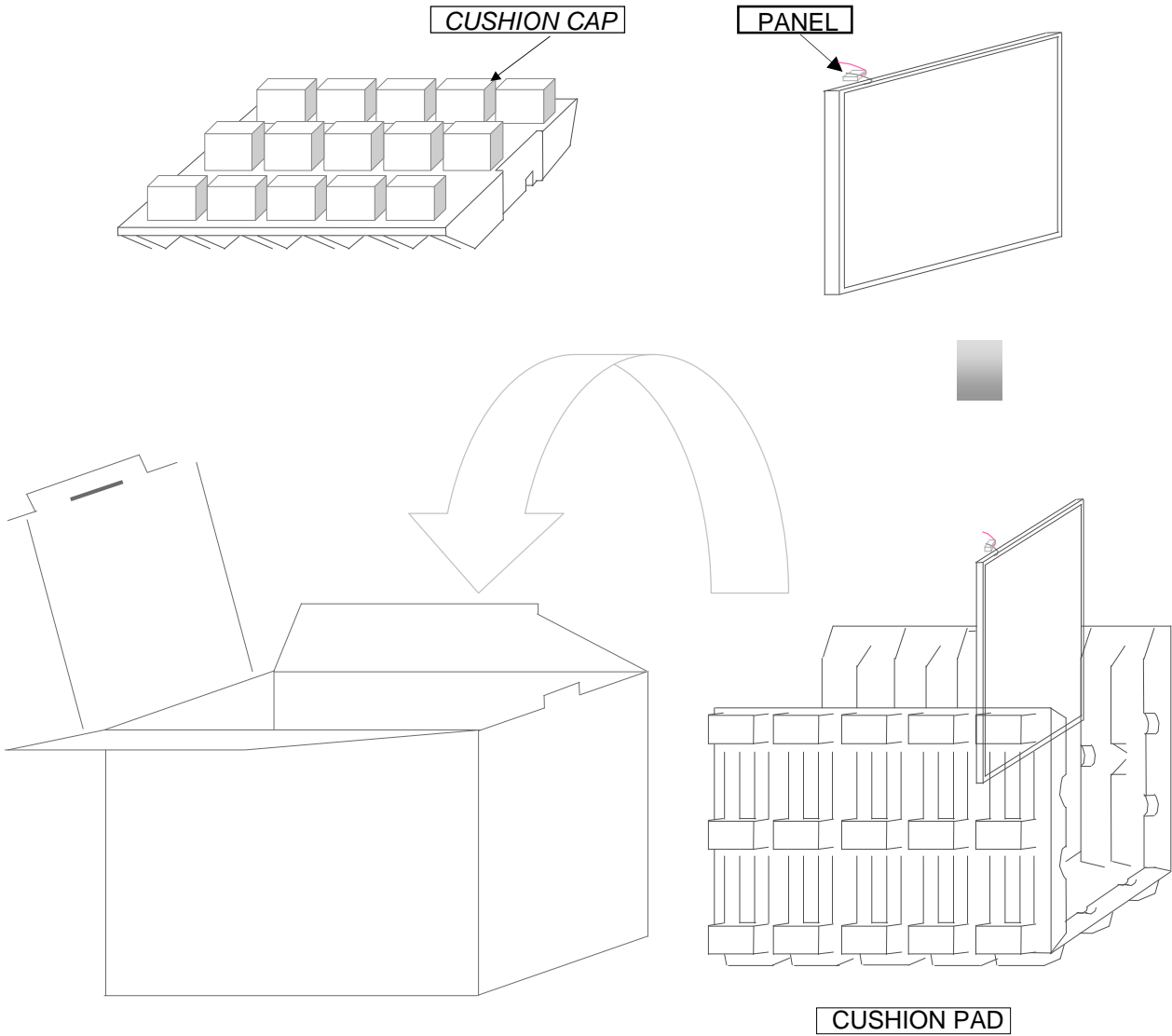
| | | | | | |
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8. PACKING

1. CARTON(Internal Package)

- (1) Packing Form
- Corrugated Cardboard box and Corrupad form as shock absorber

(2) Packing Method



Note 1)Total Weight : Approximately (TBD) kg

2) Acceptance number of piling : 10 sets

3) Carton size : 376(W) x 326(D) x 404 (H)

PACKING CASE

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(3)Packing Material

| No | Part name | Quantity |
|----|---|----------|
| 1 | Static electric protective sack | 10 pcs |
| 2 | Packing case (Inner box) included shock absorber | 1 set |
| 3 | Pictorial marking | 2 pcs |
| 4 | Carton | 1 set |

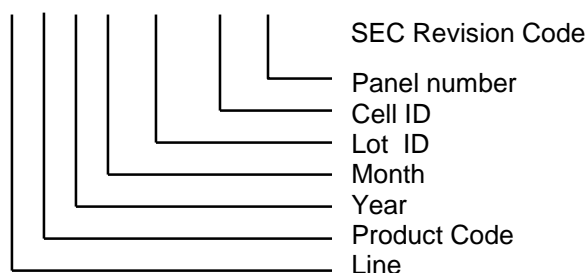
9. MARKINGS & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

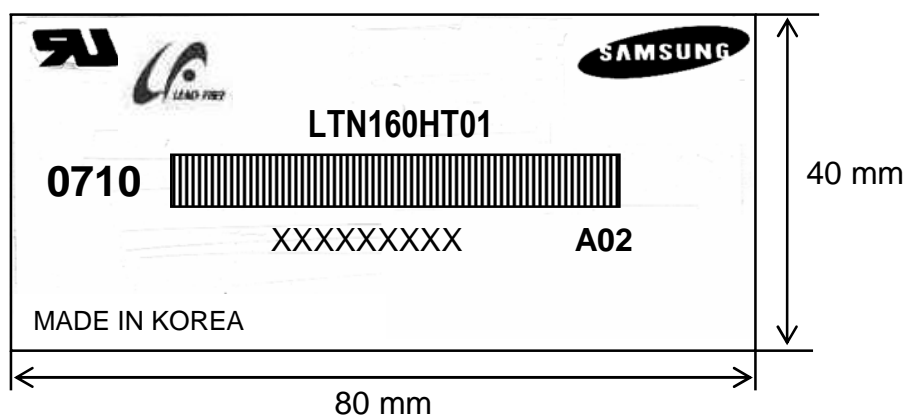
(1)Parts number : LTN160HT01

(2)Revision code : 3 letters

(3)Lot number : X X X X XX XX XX A02



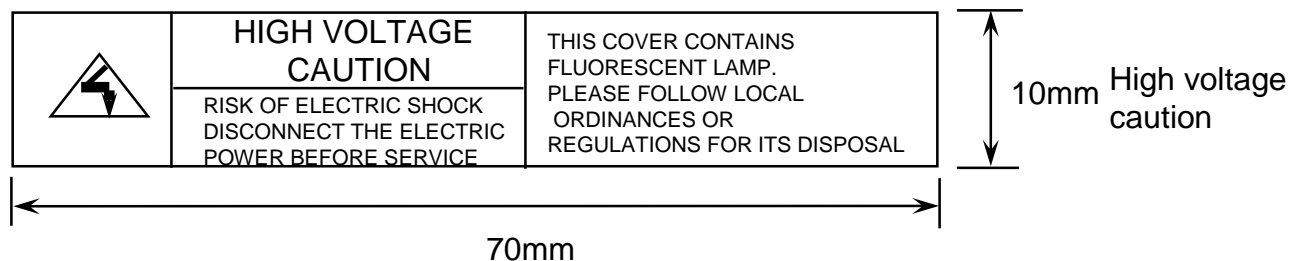
(4) Nameplate Indication



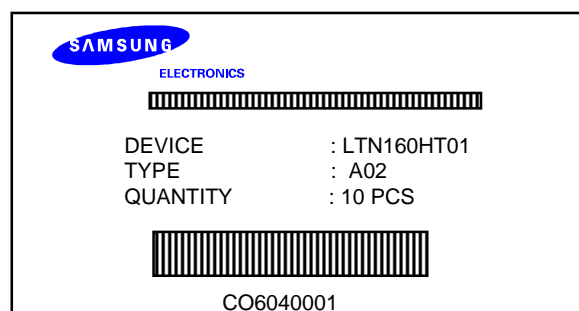
Parts name : LTN160HT01
 Lot number : XXXXXXXXXX
 Inspected work week : 0710(2007 year 10th week)
 Product Revision Code : A02

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(5) High voltage caution label



(6) Packing small box attach



(7) Packing box Marking : Samsung TFT-LCD Brand Name



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10. GENERAL PRECAUTIONS

1. Handling

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (b) 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 backlight.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA(Isoprophyl 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.
- (g) 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.
- (h) Protect the module from static, it may cause damage to the C-MOS Gate Array IC.
- (i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the back side.
- (m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector shall not be touched directly with bare hands.

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2. STORAGE

- (a) Do not leave the module in high temperature, and 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 shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

3. OPERATION

- (a) Do not connect, disconnect the module in the “ Power On” condition.
- (b) Power supply should always be turned on/off by following item 6.3
“ Power on/off sequence “.
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the backlight connector and its inverter power supply shall be a minimized length and be connected directly . The longer cable between the backlight and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).
- (e) The standard limited warranty is only applicable when the module is used for general notebook applications. If used for purposes other than as specified, SEC is not to be held reliable for the defective operations. It is strongly recommended to contact SEC to find out fitness for a particular purpose.

4. OTHERS

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on)
Otherwise the module may be damaged.
- (d) If the module displays the same pattern continuously for a long period of time, it can be the situation when the image “sticks” 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.

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11. EDID

Approval

| Address (HEX) | FUNCTION | Value HEX | BIN | DEC | ASCII or Data | Notes |
|------------------|------------------------|--------------|----------|-----|---------------------|-----------------------------|
| 00 | Header | 00 | 00000000 | 0 | | EDID Header |
| 01 | | FF | 11111111 | 255 | | |
| 02 | | FF | 11111111 | 255 | | |
| 03 | | FF | 11111111 | 255 | | |
| 04 | | FF | 11111111 | 255 | | |
| 05 | | FF | 11111111 | 255 | | |
| 06 | | FF | 11111111 | 255 | | |
| 07 | | 00 | 00000000 | 0 | | |
| 08 | ID Manufacturer Name | 4C | 01001100 | 76 | S | 3 character ID |
| 09 | | A3 | 10100011 | 163 | E C | "SEC" |
| 0A | ID Product Code | 4C | 01001100 | 76 | [L] | |
| 0B | | 30 | 00110000 | 48 | [0] | |
| 0C | 32-bit serial no. | 00 | 00000000 | 0 | | |
| 0D | | 00 | 00000000 | 0 | | |
| 0E | | 00 | 00000000 | 0 | | |
| 0F | | 00 | 00000000 | 0 | | |
| 10 | Week of manufacture | 00 | 00000000 | 0 | | |
| 11 | Year of manufacture | 12 | 00010010 | 18 | 2008 | 2008 |
| 12 | EDID Structure Ver. | 01 | 00000001 | 1 | 1 | EDID Ver. 1.0 |
| 13 | EDID revision # | 03 | 00000011 | 3 | 3 | EDID Rev. 3 |
| 14 | Video input definition | 80 | 10000000 | 128 | | |
| 15 | Max H image size | 23 | 00100011 | 35 | 35 | 35 cm(approx) |
| 16 | Max V image size | 14 | 00010100 | 20 | 20 | 20 cm(approx) |
| 17 | Display Gamma | 78 | 01111000 | 120 | 2.2 | Gamma 2.2 |
| 18 | Feature support | 0A | 00001010 | 10 | | |
| 19 | Red/green low bits | 87 | 10000111 | 135 | | 10000111 |
| 1A | Blue/white low bits | F5 | 11110101 | 245 | | 11111110 |
| 1B | Red x/ high bits | 94 | 10010100 | 148 | 0.580 | Red x0.580= 1001010010 |
| 1C | Red y | 57 | 01010111 | 87 | 0.340 | Red y0.340= 0101011100 |
| 1D | Green x | 4F | 01001111 | 79 | 0.310 | Green x0.310= 0100111101 |
| 1E | Green y | 8C | 10001100 | 140 | 0.550 | Green y0.550= 1000110011 |
| 1F | Blue x | 27 | 00100111 | 39 | 0.155 | Blue x0.155= 0010011111 |
| 20 | Blue y | 27 | 00100111 | 39 | 0.155 | Blue y0.155= 0010011111 |
| 21 | White x | 50 | 01010000 | 80 | 0.313 | White x0.313= 0101000001 |
| 22 | White y | 54 | 01010100 | 84 | 0.329 | White y0.329= 0101010001 |
| 23 | Established timing 1 | 00 | 00000000 | 0 | | |
| 24 | Established timing 2 | 00 | 00000000 | 0 | | |
| 25 | Established timing 3 | 00 | 00000000 | 0 | | |

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| | | | | | | |
|----|---------------------------------------|----|----------|-----|--------|---------------------------------|
| 26 | Standard timing #1 | 01 | 00000001 | 1 | | not used |
| 27 | | 01 | 00000001 | 1 | | |
| 28 | Standard timing #2 | 01 | 00000001 | 1 | | not used |
| 29 | | 01 | 00000001 | 1 | | |
| 2A | Standard timing #3 | 01 | 00000001 | 1 | | not used |
| 2B | | 01 | 00000001 | 1 | | |
| 2C | Standard timing #4 | 01 | 00000001 | 1 | | not used |
| 2D | | 01 | 00000001 | 1 | | |
| 2E | Standard timing #5 | 01 | 00000001 | 1 | | not used |
| 2F | | 01 | 00000001 | 1 | | |
| 30 | Standard timing #6 | 01 | 00000001 | 1 | | not used |
| 31 | | 01 | 00000001 | 1 | | |
| 32 | Standard timing #7 | 01 | 00000001 | 1 | | not used |
| 33 | | 01 | 00000001 | 1 | | |
| 34 | Standard timing #8 | 01 | 00000001 | 1 | | not used |
| 35 | | 01 | 00000001 | 1 | | |
| 36 | Detailed timing/monitor descriptor #1 | 29 | 00101001 | 41 | 138.65 | Main clock= 138.65 MHz |
| 37 | | 36 | 00110110 | 54 | | |
| 38 | | 80 | 10000000 | 128 | 1920 | Hor active=1920 pixels |
| 39 | | A0 | 10100000 | 160 | 160 | Hor blanking=160 pixels |
| 3A | | 70 | 01110000 | 112 | | 4bit : 4bit |
| 3B | | 38 | 00111000 | 56 | 1080 | Vertical active=1080 lines |
| 3C | | 1F | 00011111 | 31 | 31 | Vertical blanking=31 lines |
| 3D | | 40 | 01000000 | 64 | | 4bit : 4bit |
| 3E | | 30 | 00110000 | 48 | 48 | |
| 3F | | 20 | 00100000 | 32 | 32 | H sync. Width=32 pixels |
| 40 | | 25 | 00100101 | 37 | 2 | V sync. Offset=2 lines |
| | | | | | 5 | V sync. Width=5 lines |
| 41 | | 00 | 00000000 | 0 | | 2bit : 2bit :2bit :2bit |
| 42 | | 61 | 01100001 | 97 | 353 | H image size= 353 mm(approx) |
| 43 | | C6 | 11000110 | 198 | 198 | V image size = 198 mm(approx) |
| 44 | | 10 | 00010000 | 16 | | |
| 45 | | 00 | 00000000 | 0 | | No Horizontal Border |
| 46 | | 00 | 00000000 | 0 | | No Vertical Border |
| 47 | | 19 | 00011001 | 25 | | |
| 48 | Detailed timing/monitor descriptor #2 | 00 | 00000000 | 0 | | Manufacturer Specified (Timing) |
| 49 | | 00 | 00000000 | 0 | | |
| 4A | | 00 | 00000000 | 0 | | |
| 4B | | 0F | 00001111 | 15 | | |
| 4C | | 00 | 00000000 | 0 | | Value=HSPWmin / 2 |
| 4D | | 00 | 00000000 | 0 | | Value=HSPWmax / 2 |
| 4E | | 00 | 00000000 | 0 | | Value=Thbpmin / 2 |
| 4F | | 00 | 00000000 | 0 | | Value=Thbpmax / 2 |
| 50 | | 00 | 00000000 | 0 | | Value=VSPWmin / 2 |
| 51 | | 00 | 00000000 | 0 | | Value=VSPWmax / 2 |
| 52 | | 00 | 00000000 | 0 | | Value=Tvbpmin / 2 |
| 53 | | 00 | 00000000 | 0 | | Value=Tvbpmax / 2 |
| 54 | | 00 | 00000000 | 0 | | Thpmin=value*2 + HA pixelclks |
| 55 | | 20 | 00100000 | 32 | | Thpmax=value*2 + HA pixelclks |
| 56 | | 91 | 10010001 | 145 | | Tvpmin=value*2 + VA lines |
| 57 | | 02 | 00000010 | 2 | | Tvpmax=value*2 + VA lines |
| 58 | | 64 | 01100100 | 100 | | |
| 59 | | 00 | 00000000 | 0 | | Module revision |

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| | | | | | | |
|----|---------------------------------------|----|----------|-----|-----|--------------------------|
| 5A | Detailed timing/monitor descriptor #3 | 00 | 00000000 | 0 | | ASCII Data String Tag |
| 5B | | 00 | 00000000 | 0 | | |
| 5C | | 00 | 00000000 | 0 | | |
| 5D | | FE | 11111110 | 254 | | |
| 5E | | 00 | 00000000 | 0 | | |
| 5F | | 53 | 01010011 | 83 | [S] | |
| 60 | | 41 | 01000001 | 65 | [A] | |
| 61 | | 4D | 01001101 | 77 | [M] | |
| 62 | | 53 | 01010011 | 83 | [S] | |
| 63 | | 55 | 01010101 | 85 | [U] | |
| 64 | | 4E | 01001110 | 78 | [N] | |
| 65 | | 47 | 01000111 | 71 | [G] | |
| 66 | | 0A | 00001010 | 10 | [^] | |
| 67 | | 20 | 00100000 | 32 | [] | |
| 68 | | 20 | 00100000 | 32 | [] | |
| 69 | | 20 | 00100000 | 32 | [] | |
| 6A | | 20 | 00100000 | 32 | [] | |
| 6B | | 20 | 00100000 | 32 | [] | |
| 6C | Detailed timing/monitor descriptor #4 | 00 | 00000000 | 0 | | Monitor Name Tag (ASCII) |
| 6D | | 00 | 00000000 | 0 | | |
| 6E | | 00 | 00000000 | 0 | | |
| 6F | | FE | 11111110 | 254 | | |
| 70 | | 00 | 00000000 | 0 | | |
| 71 | | 31 | 00110001 | 49 | [1] | |
| 72 | | 36 | 00110110 | 54 | [6] | |
| 73 | | 30 | 00110000 | 48 | [0] | |
| 74 | | 48 | 01001000 | 72 | [H] | |
| 75 | | 54 | 01010100 | 84 | [T] | |
| 76 | | 30 | 00110000 | 48 | [0] | |
| 77 | | 31 | 00110001 | 49 | [1] | |
| 78 | | 2D | 00101101 | 45 | [-] | |
| 79 | | 41 | 01000001 | 65 | [A] | |
| 7A | | 30 | 00110000 | 48 | [0] | |
| 7B | | 32 | 00110010 | 50 | [2] | |
| 7C | | 0A | 00001010 | 10 | [^] | |
| 7D | | 20 | 00100000 | 32 | [] | |
| 7E | Extension Flag | 00 | 00000000 | 0 | | |
| 7F | Checksum | 45 | 01000101 | 69 | | |