

**SAMSUNG DISPLAY****Samsung Secret****Product Information****DATE : 23. July. 2012****SAMSUNG TFT-LCD****MODEL : LTA400HM23**

The information described in this specification is preliminary and can be changed without prior notice

Samsung Display Co . , LTD.

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**Samsung Secret***** Revision History**

| Date | Rev. No | Page | Summary |
|-------------------|---------|------|--------------|
| 23. July. 2012 | 000 | All | First Issued |

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General Description

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Description

LTA400HM23 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT (Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit.

The resolution of a 40.0" is 1920 x 1080 and this model can display up to 16.7 million colors with wide viewing angle of 178° or higher in all directions. This panel is intended to support applications to provide an excellent performance for Flat Panel Display such as Home-alone multimedia TFT-LCD TV and high definition TV

Features

- RoHS compliance (Pb-free)
- High contrast ratio & aperture ratio with wide color gamut
- SPVA (Super Patterned Vertical Align) mode
- Wide viewing angle (typ. 178°)
- High speed response
- HD resolution (16:9)
- Low Power consumption
- Direct Type LED (Light Emitted Diode) BLU
- DE (Data Enable) mode
- 2ch LVDS (Low Voltage Differential Signaling) interface (2pixel/clock)

General Information

| Items | Specification | Unit | Note |
|---------------------|---|-------------------|--------|
| Module Size | 914.4 (H _{Typ}) x 530.6 (V _{Typ}) | mm | ±1.0mm |
| | 37 (D _{Max}) | | |
| Weight | 6200 (Typ.) | g | |
| Pixel Pitch | 0.46125(H) x 0.15375(W) | mm | |
| Active Display Area | 885.6 (H) x 498.15 (V) | mm | |
| Surface Treatment | Anti-Glare Haze 5.5%, Hard coating (2H) | - | |
| Display Colors | 8 bit – 16.7 M | color | |
| Number of Pixels | 1920 x 1080 | pixel | |
| Pixel Arrangement | RGB Horizontal stripe | | |
| Display Mode | Normally Black | | |
| Luminance of White | 300 (Typ.) | cd/m ² | |

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1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

| Item | Symbol | Min. | Max. | Unit | Note |
|-------------------------------|-----------|---------|------|------|------|
| Power Supply Voltage | V_{DD} | GND-0.3 | 13.2 | V | (1) |
| Dimming Control | Max. Lum | - | 5 | V | |
| Storage temperature | T_{STG} | -20 | 60 | °C | (2) |
| Operating temperature | T_{OPR} | 0 | 50 | °C | |
| Shock (non - operating) | X,Y,Z | - | 50 | G | (3) |
| Vibration (non - operating) | V_{NOP} | - | 1.5 | G | (4) |

Note (1) $T_a = 25 \pm 2 \text{ }^\circ\text{C}$

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

- $T_a \leq 39 \text{ }^\circ\text{C}$, Relative Humidity is max 90 %
- $T_a > 39 \text{ }^\circ\text{C}$, Relative Humidity is less than 90%
- No condensation

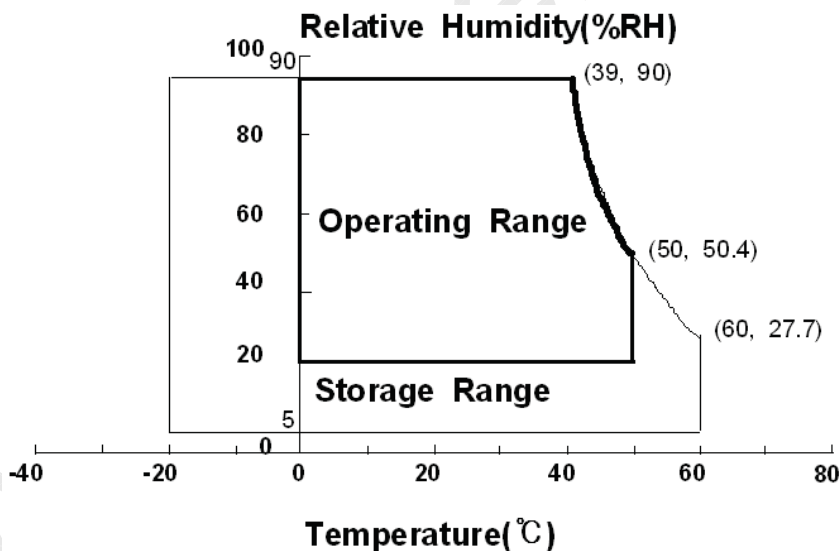


Fig. Temperature and Relative humidity range

(3) 11ms, sine wave, one time for $\pm X$, $\pm Y$, $\pm Z$ axis

(4) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

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2. Optical Characteristics

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The optical characteristics should be measured in a dark room or equivalent condition.

Measuring equipment () : equipment maker

: BM-7(TOPCON), PR-650(Photo Research), SR3(TOP CON)

(Ta = 25 ± 2°C, VDD=12V, fv= 60Hz, f_{DCLK} = 148.5 MHz, If = 400mA, Dim.duty 100%)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Note | |
|---|------------------|----------------|---|--------|---------------|-------------------|---|--------------------|
| Contrast Ratio (Center of screen) | C/R | | - | 5000 | - | | (1) SR-3 | |
| Response Time | G-to-G (2D) | Tg | - | 8 | 20 | msec | (3) BM-7, RD-80S | |
| Luminance of White (Center of screen) | Y _L | | 260 | 300 | - | cd/m ² | (4) SR-3 | |
| Color Chromaticity (CIE 1931) | Red | Rx | Normal θ _{L,R} = 0 θ _{U,D} = 0 Viewing Angle | 0.640 | TYP. -0.03 | TYP. -0.03 | (5),(6) PR650, SR-3 Center Point | |
| | | Ry | | 0.338 | | | | |
| | Green | Gx | | 0.312 | | | | |
| | | Gy | | 0.616 | | | | |
| | Blue | Bx | | 0.150 | | | | |
| | | By | | 0.054 | | | | |
| | White | Wx | | 0.275 | | | | |
| | | Wy | | 0.285 | | | | |
| Color Gamut | - | | - | 70 | - | % | (5) SR-3 | |
| Color Temperature | - | | - | 11,000 | - | K | | |
| Typ. Viewing Angle | Hor. | θ _L | C/R≥10 | 75 | 89 | - | Degree | (6) EZ-Contrast |
| | | θ _R | | 75 | 89 | - | | |
| | Ver. | θ _U | | 75 | 89 | - | | |
| | | θ _D | | 75 | 89 | - | | |
| White Brightness Uniformity (9 Points) | B _{uni} | | - | - | 30 | % | (2) SR-3 | |

- Test Equipment Setup

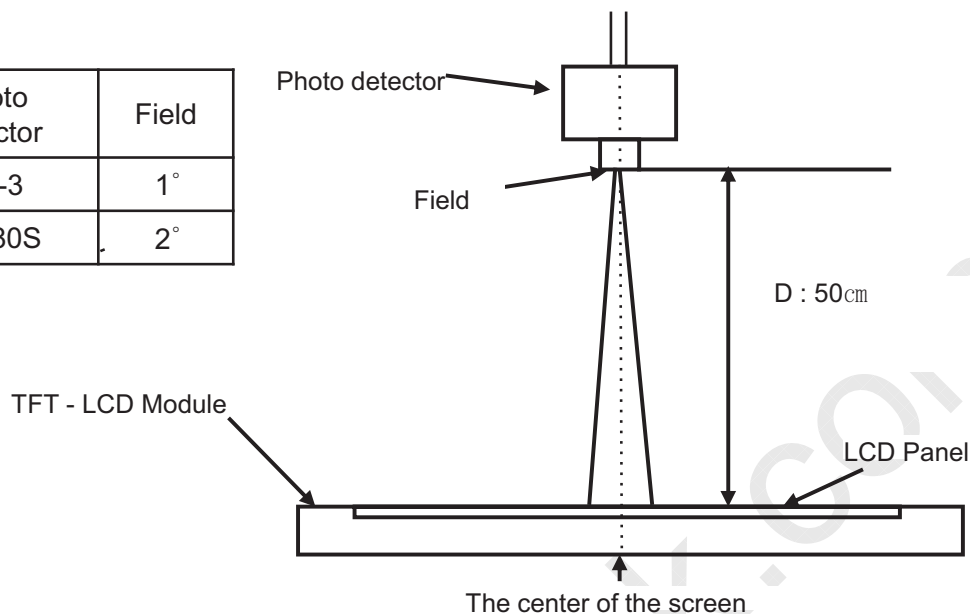
The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

Environment condition : Ta = 25 ± 2 °C

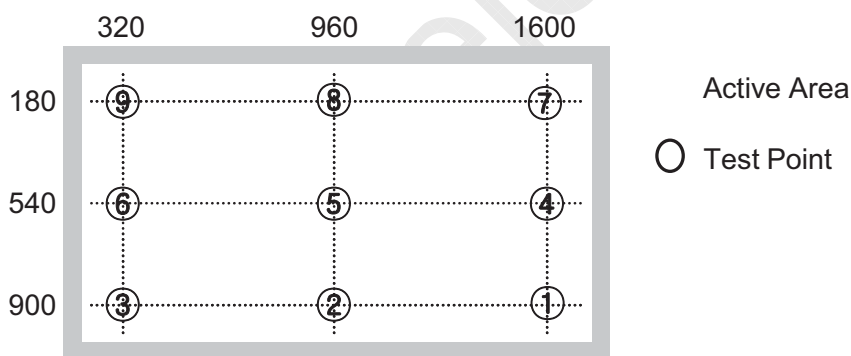
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| Photo detector | Field |
|----------------|-------|
| SR-3 | 1° |
| RD-80S | 2° |



- Definition of test point



Note (1) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

$$C/R = \frac{G_{\max}}{G_{\min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

| | | | | | |
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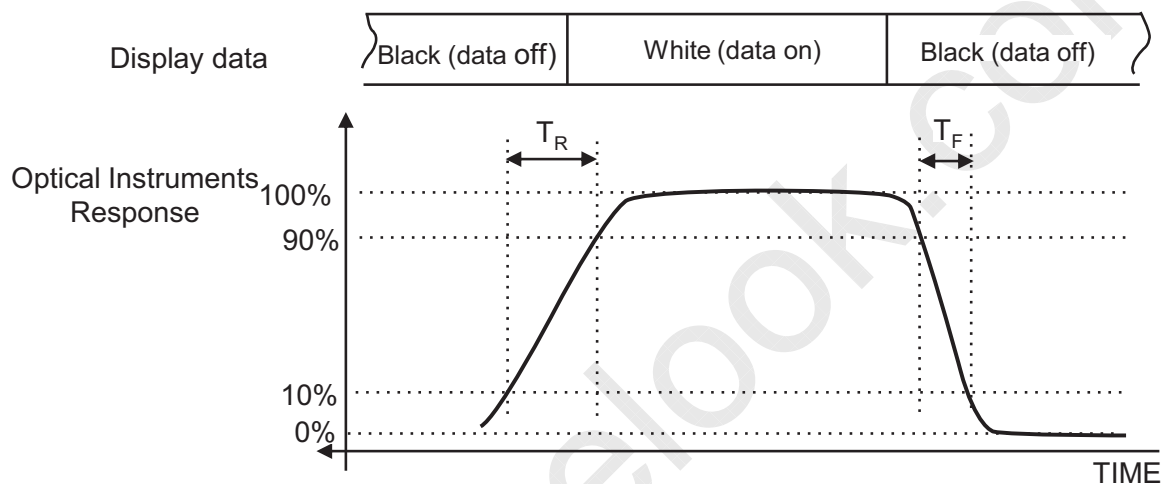
Note (2) Definition of 9 points brightness uniformity (Test pattern : Full White)

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

Bmax : Maximum brightness

Bmin : Minimum brightness

Note (3) Definition of Response time : Average of T_R , T_F
(data is 8 x 8 Gray table, excluding 0 to 255Gray)



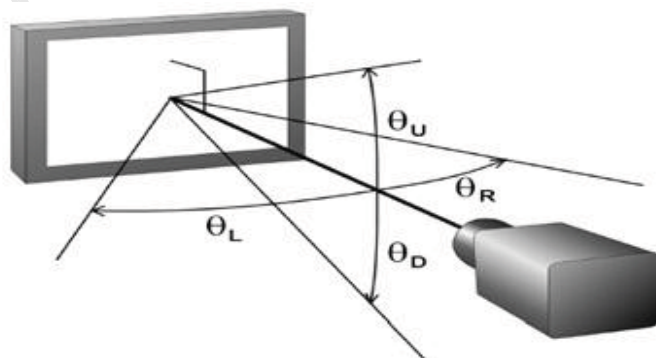
Note (4) Definition of Luminance of White : Luminance of white at center point ⑤

Note (5) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red, Green, Blue & White at center point ⑤

Note (6) Definition of Viewing Angle at center point

: Viewing angle range ($C/R \geq 10$)



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3. Electrical Characteristics

3.1 TFT LCD Module

The connector for display data & timing signal should be connected.

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

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|-------------------------|-------------|------|-------|------|------|---------|
| Voltage of Power Supply | V_{DD} | 10.8 | 12.0 | 13.2 | V | (1) |
| | (a) Black | - | 725 | 850 | mA | (2),(3) |
| | (b) White | - | 730 | 850 | mA | |
| | (c) Checker | - | 1060 | 1200 | mA | |
| Vsync Frequency | f_V | 48 | 60 | 62 | Hz | |
| Hsync Frequency | f_H | 50 | 67.5 | 73 | kHz | |
| Main Frequency | f_{DCLK} | 130 | 148.5 | 155 | MHz | |
| Rush Current | I_{RUSH} | - | - | 3 | A | (4) |

- Note (1) The ripple voltage should be controlled under 10% of V_{DD} .
 (2) $f_V=60\text{Hz}$, $f_{DCLK}=148.5\text{MHz}$, $V_{DD}=12.0\text{V}$, DC Current.
 (3) Power dissipation check pattern (LCD Module only)

a) Black Pattern



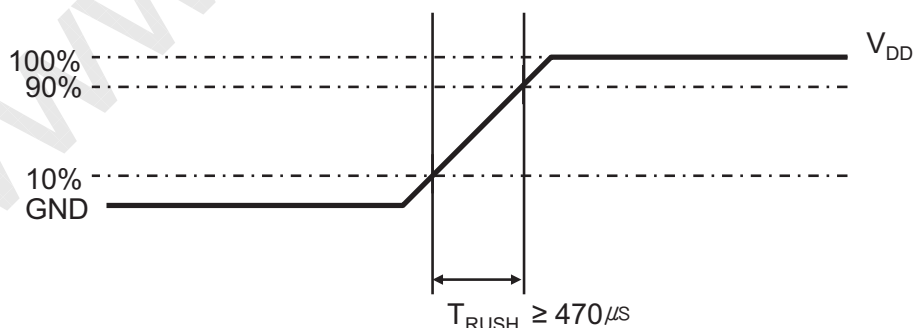
b) White Pattern



c) Checker



(4) Measurement Conditions



Rush Current I_{RUSH} can be measured when T_{RUSH} is bigger than $470\mu\text{s}$.

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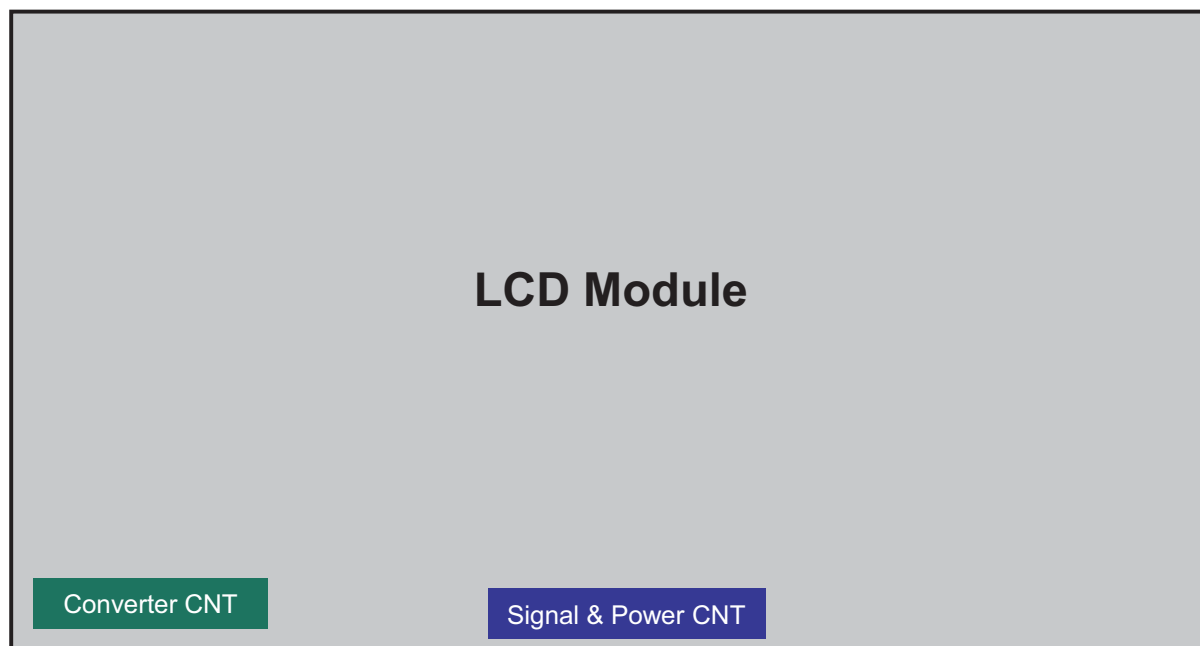
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3.2 Back Light Unit

The back light unit contains Direct type White LEDs (Light Emitting Diode)

Ta=25 ± 2°C



| Item | Min. | Typ. | Max. | Unit | Note |
|---------------------|-------|------|------|------|------|
| Operating Life Time | 30000 | - | - | Hour | |

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.
 [Operating condition : Ta = 25±2°C]

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3.3 Converter Input Condition & Specification

| Items | Symbol | Conditions | Specifications | | | Unit | Note |
|-------------------------------------|---------------------|---|----------------|------|------|------|---------------------------------|
| | | | Min. | Typ. | Max. | | |
| Input Voltage | V _{in} | - | 22 | 24 | 26 | V | Ta=25±2 °C |
| Input Rush Current | I _{RUSH} | V _{in} =24.0V V _{dim} =3.3V | - | - | 3.66 | A | |
| Output Current | I _{LED, N} | V _{in} =21.6 ~ 26.4V V _{dim} =3.3V | 380 | 400 | 420 | mA | |
| Backlight On/Off | ON | V _{in} =24.0 V | 3 | - | 5.25 | V | Pin(#12) |
| | OFF | V _{in} =24.0 V | 0 | - | 0.4 | | |
| Dimming Range | V _{DIM} | V _{in} :22~26V | 0 | - | 3.3 | V | |
| Dimming Duty Output | D max | V _{in} =24V Dim:3.3V | - | - | 100 | % | (2) |
| | D min | V _{in} =24V Dim:0V | 10 | - | - | | |
| External Dimming Duty Range | EX_Dim | Min | 10 | - | 100 | % | |
| External Dimming Frequency Range | F _{EX_PWM} | V _{in} =22.0~26.0 V | 95 | 120 | 185 | Hz | Dim Pin(#14) : Floating, (4) |
| External Dimming Signal Level | V _{PWM} | High (ON) | 3 | - | 5.25 | V | |
| | | Low (Off) | 0 | - | 0.4 | | |

Note) Power Consumption is measured when 300 [cd/m] of luminance which is the typical luminance.

- (1) All data is measured after 60min warm-up.
- (2) only use #Pin 13
- (3) only use #Pin14
- (4) External PWM frequency should be synchronized with SET frequency

- Additional Appendix for Supply Current & Power consumption

| ITEM | SYMBOL | CONDITION | SPECIFICATION | | | UNIT | NOTE |
|---------------|-----------------|-------------------------------|---------------|------|------|------|------------------------------------|
| | | | MIN | TYP | MAX | | |
| Input Current | overshoot, 2D | V _{in} =24V, dim=max | - | 2.91 | 3.00 | Adc | Maximum current after turn-on |
| | Isaturation, 2D | | - | 2.90 | 2.98 | Adc | Saturation current after 1hr aging |

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4. Input Terminal Pin Assignment

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4.1. Input Signal & Power

Connector : FI-RE51S-HF (JAE)

| Pin | Symbol | Description | Pin | Symbol | Description |
|-----|--------|--------------------|-----|----------|--------------------|
| 1 | 12V | DC power supply | 26 | RE[0]P | Even LVDS Signal + |
| 2 | 12V | DC power supply | 27 | RE[1]N | Even LVDS Signal - |
| 3 | 12V | DC power supply | 28 | RE[1]P | Even LVDS Signal + |
| 4 | 12V | DC power supply | 29 | RE[2]N | Even LVDS Signal - |
| 5 | 12V | DC power supply | 30 | RE[2]P | Even LVDS Signal + |
| 6 | NC | NOTE1 | 31 | GND | Ground |
| 7 | GND | Ground | 32 | ROCLK- | Even LVDS Clock - |
| 8 | GND | Ground | 33 | ROCLK+ | Even LVDS Clock + |
| 9 | GND | Ground | 34 | GND | Ground |
| 10 | RO[0]N | Odd LVDS Signal - | 35 | RE[3]N | Even LVDS Signal - |
| 11 | RO[0]P | Odd LVDS Signal + | 36 | RE[3]P | Even LVDS Signal + |
| 12 | RO[1]N | Odd LVDS Signal - | 37 | NC | NOTE1 |
| 13 | RO[1]P | Odd LVDS Signal + | 38 | NC | |
| 14 | RO[2]N | Odd LVDS Signal - | 39 | GND | Ground |
| 15 | RO[2]P | Odd LVDS Signal + | 40 | NC | NOTE1 |
| 16 | GND | Ground | 41 | NC | |
| 17 | ROCLK- | Odd LVDS Clock - | 42 | NC | |
| 18 | ROCLK+ | Odd LVDS Clock + | 43 | NC | |
| 19 | GND | Ground | 44 | NC | |
| 20 | RO[3]N | Odd LVDS Signal - | 45 | LVDS_SEL | NOTE2 |
| 21 | RO[3]P | Odd LVDS Signal + | 46 | NC | |
| 22 | NC | NOTE1 | 47 | NC | |
| 23 | NC | | 48 | NC | |
| 24 | GND | Ground | 49 | NC | |
| 25 | RE[0]N | Even LVDS Signal - | 50 | NC | |
| | | | 51 | NC | NOTE1 |

Note1) No Connection: These PINS are used only for SAMSUNG. (DO NOT CONNECT)

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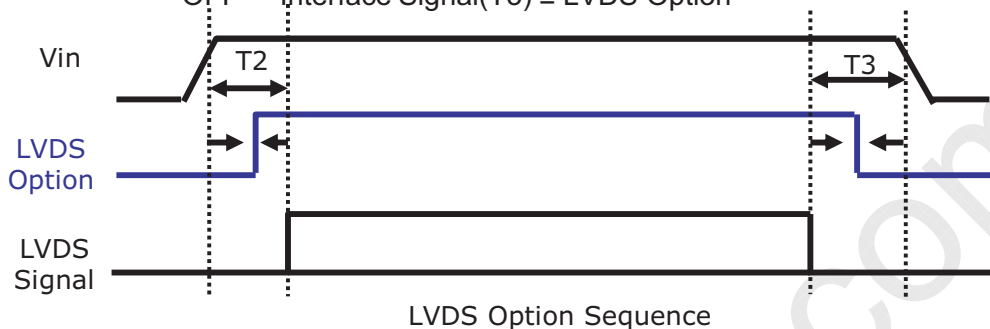
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Note(2) LVDS OPTION : If this PIN is HIGH (3.3 V) → Normal LVDS format
 LOW (GND) → JEIDA LVDS format

Pull down resistor : 47Kohm

SEQUENCE : On = V_{DD}(T1) ≥ LVDS Option ≥ Interface Signal(T2)
 OFF = Interface Signal(T3) ≥ LVDS Option



Note (3) Signal level of LVDS selection

| | Min | Typ | Max |
|------|------|-----|-------|
| High | 2.8V | - | 3.6 V |
| Low | 0 V | - | 0.4V |

Note(4) Pin number starts from Left side

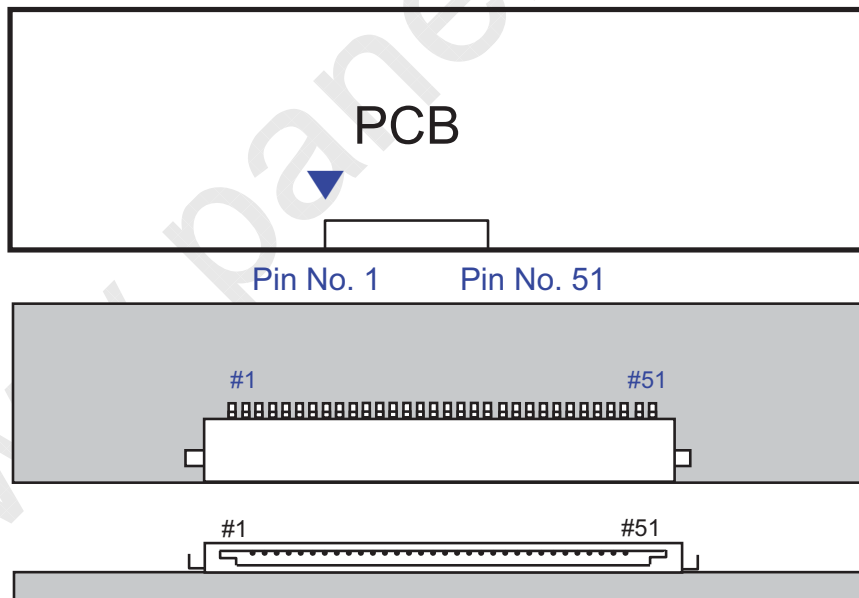


Fig. Connector diagram

- a. Power GND pins should be connected to the LCD's metal chassis.
- b. All power input pins should be connected together.
- c. All NC pin should be separated from other signal or power.

| | | | | | |
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4.2. converter Input Pin Configuration

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Connector : Yeon-ho, 20022WS-H145J

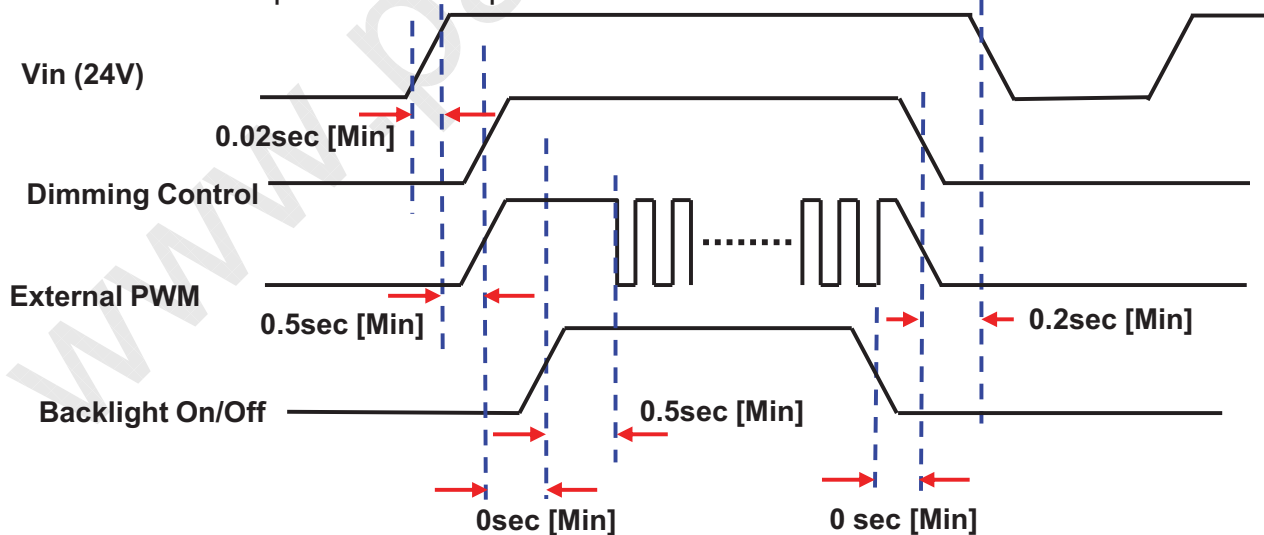
| Pin No. | Pin Configuration(FUNCTION) |
|---------|--|
| | Master |
| 1 | 24 V |
| 2 | 24 V |
| 3 | 24 V |
| 4 | 24 V |
| 5 | 24 V |
| 6 | GND |
| 7 | GND |
| 8 | GND |
| 9 | GND |
| 10 | GND |
| 11 | No connection |
| 12 | ENA [converter on/off control signal] *Note(2) |
| 13 | Analog Dimming Control [0V:Min, 3.3V:Max] *Note(1) |
| 14 | External PWM [10~100%] *Note(1), Note(2) |

Note(1) If use Dimming Control, Pin 14 Must be N.C

If use External PWM, Pin 13 Must be N.C

Note(2) Pin 12 has Pull down register 100Kohm, Pin 13/14 has Pull up register 100Kohm

4.3. converter Input Power Sequence



Note) SEQUENCE : ON = Vin(24V) > Dimming Control ≥ Backlight On/Off

OFF = Backlight On/Off ≥ Dimming Control > Vin(24V)

| | | | | | |
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4.4 LVDS Interface

- LVDS Receiver : Tcon (merged)
- Data Format

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| | LVDS pin | JEIDA -DATA | VESA -DATA |
|-------------|--------------|-------------|------------|
| TxOUT/RxIN0 | TxIN/RxOUT0 | R2 | R0 |
| | TxIN/RxOUT1 | R3 | R1 |
| | TxIN/RxOUT2 | R4 | R2 |
| | TxIN/RxOUT3 | R5 | R3 |
| | TxIN/RxOUT4 | R6 | R4 |
| | TxIN/RxOUT6 | R7 | R5 |
| | TxIN/RxOUT7 | G2 | G0 |
| TxOUT/RxIN1 | TxIN/RxOUT8 | G3 | G1 |
| | TxIN/RxOUT9 | G4 | G2 |
| | TxIN/RxOUT12 | G5 | G3 |
| | TxIN/RxOUT13 | G6 | G4 |
| | TxIN/RxOUT14 | G7 | G5 |
| | TxIN/RxOUT15 | B2 | B0 |
| | TxIN/RxOUT18 | B3 | B1 |
| TxOUT/RxIN2 | TxIN/RxOUT19 | B4 | B2 |
| | TxIN/RxOUT20 | B5 | B3 |
| | TxIN/RxOUT21 | B6 | B4 |
| | TxIN/RxOUT22 | B7 | B5 |
| | TxIN/RxOUT24 | HSYNC | HSYNC |
| | TxIN/RxOUT25 | VSYNC | VSYNC |
| | TxIN/RxOUT26 | DEN | DEN |
| TxOUT/RxIN3 | TxIN/RxOUT27 | R0 | R6 |
| | TxIN/RxOUT5 | R1 | R7 |
| | TxIN/RxOUT10 | G0 | G6 |
| | TxIN/RxOUT11 | G1 | G7 |
| | TxIN/RxOUT16 | B0 | B6 |
| | TxIN/RxOUT17 | B1 | B7 |
| | TxIN/RxOUT23 | RESERVED | RESERVED |

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4.5 Input Signals, basic display colors and gray scale of each color

| COLOR | DISPLAY (8bit) | 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 | R1 | |
| | | 0 | 1 | 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 | R253 | |
| | | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 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 | 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 | G1 | |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 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 | G253 | |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 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 | 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 | B1 | |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 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 | B253 | |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 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 | 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

| | | | | | |
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5. Interface Timing

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5.1 Timing Parameters (DE mode)

| SIGNAL | ITEM | SYMBOL | MIN. | TYP. | MAX. | Unit | NOTE |
|-------------------------|-----------------------|----------|------|-------|------|--------|------|
| Clock | Frequency | $1/T_C$ | 130 | 148.5 | 155 | MHz | - |
| Hsync | | F_H | 50 | 67.5 | 73 | KHz | - |
| Vsync | | F_V | 48 | 60.0 | 62 | Hz | - |
| Vertical Display Term | Active Display Period | T_{VD} | - | 1080 | - | Lines | - |
| | Vertical Total | T_V | 1092 | 1125 | 1380 | Lines | - |
| Horizontal Display Term | Active Display Period | T_{HD} | - | 1920 | - | Clocks | - |
| | Horizontal Total | T_H | 2090 | 2200 | 2350 | clocks | - |

Note) This product is DE mode. But the Hsync & Vsync signal must be inputted

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

(2) Internal VDD = 3.3V

(3) Spread spectrum

- Modulation rate (max) : $\pm 1.5\%$, Modulation Frequency : Min 30KHz

5.2 LVDS Input Data Characteristics

| ITEM | | SYMBOL | Min. | Typ. | Max. | UNIT | NOTE |
|----------------------------|-----------------------|------------|---------------|------|---------------|------|------|
| Input Data Position | $F_{IN}=85\text{MHz}$ | t_{RSRM} | - | - | 400 | ps | |
| | | t_{RSLM} | -400 | - | - | ps | |
| Input common mode voltage | | V_{CM} | $V_{SSL}+0.6$ | 1.2 | $V_{DDL}-0.6$ | V | - |
| Differential Input Voltage | | $ V_{ID} $ | 100 | - | 600 | mV | - |

Note) When the skew is measured the Spread Spectrum should be 0%

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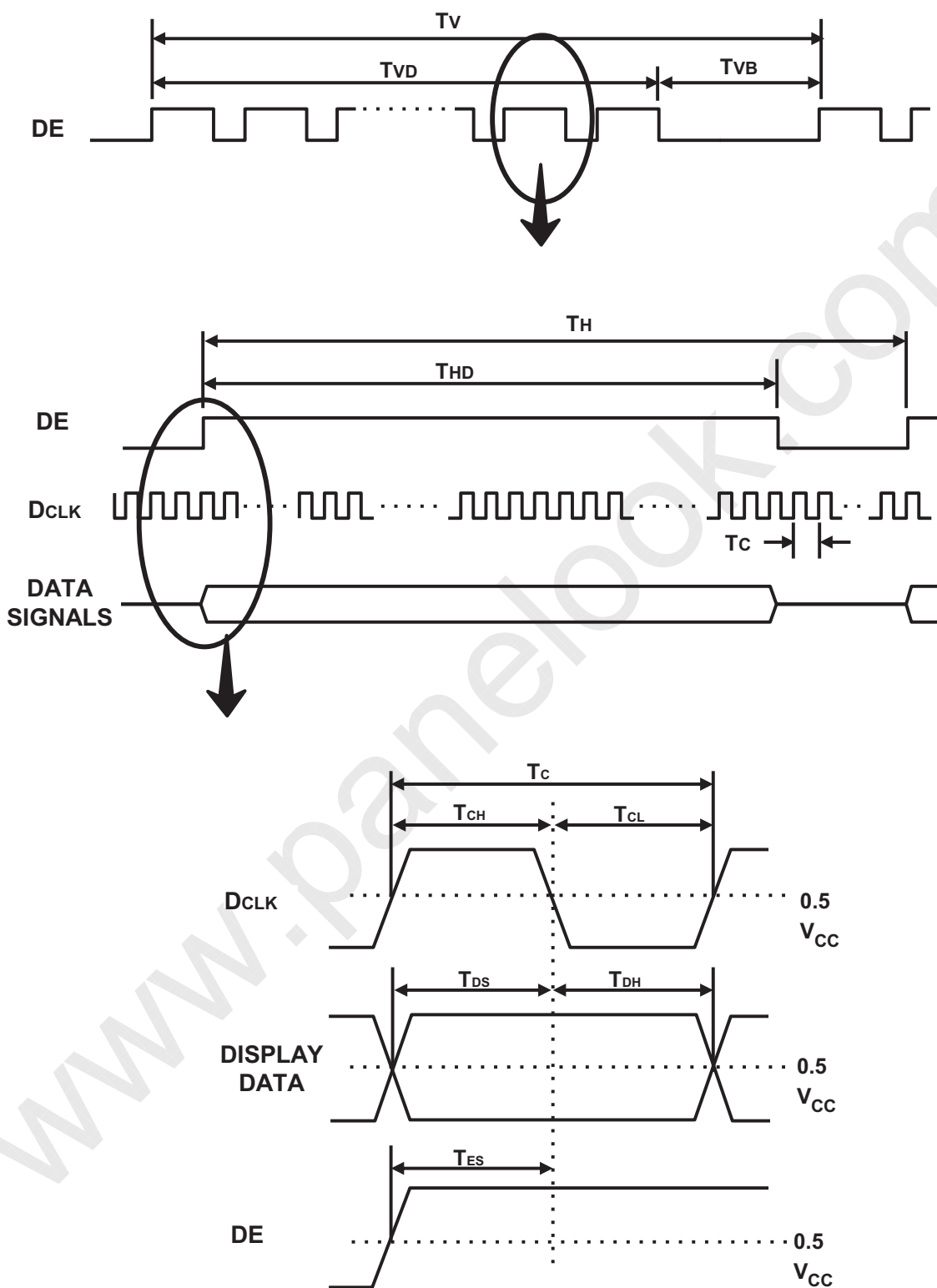
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5.3 Timing diagrams of interface signal (DE mode)

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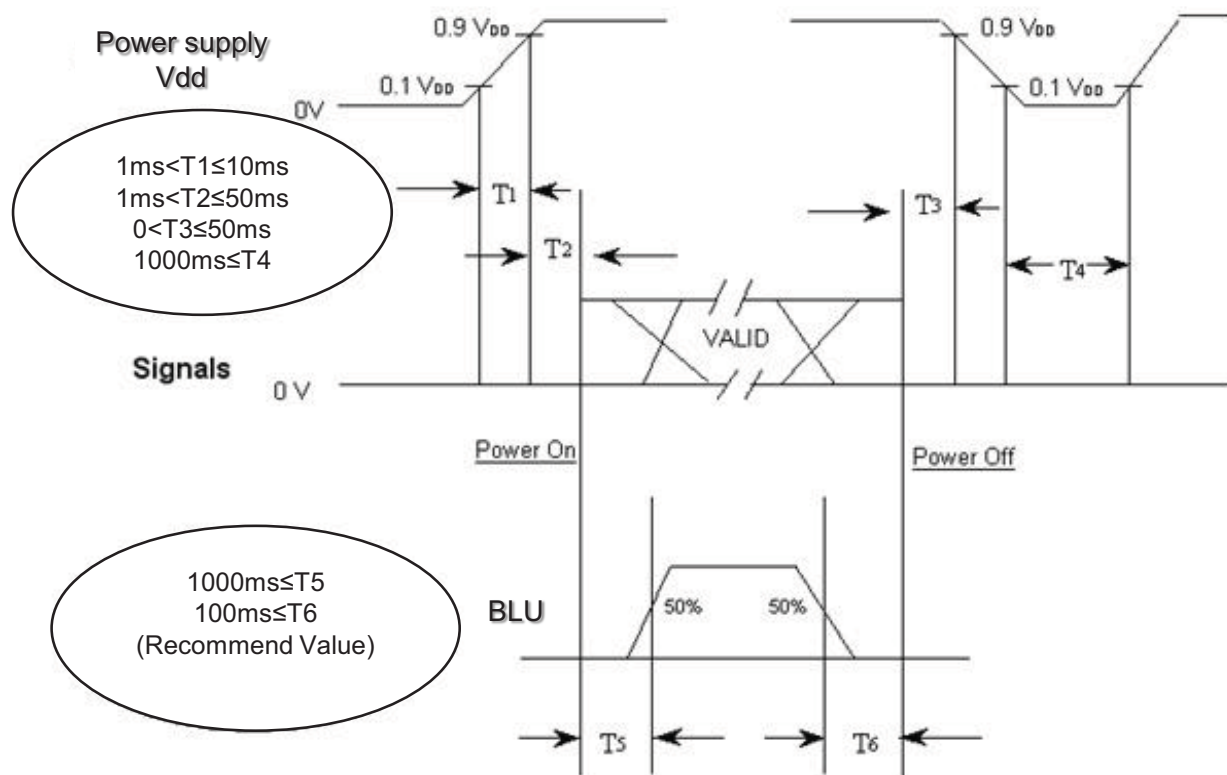
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5.4 Power ON/OFF Sequence

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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.



T₁ : V_{DD} rising time from 10% to 90%

T₂ : The time from V_{DD} to valid data at power ON.

T₃ : The time from valid data off to V_{DD} off at power Off.

T₄ : V_{DD} 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.

- The supply voltage of the external system for the module input should be the same as the definition of V_{DD}.
- Apply the LED 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 show abnormal screen.
- In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- T₄ should be measured after the module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.
- In Case T₅ is less than 1000msec and T₆ is less than 100msec, garbage display can be seen. (It is not related to electrical function issue, just for recommendation to prevent garbage display)

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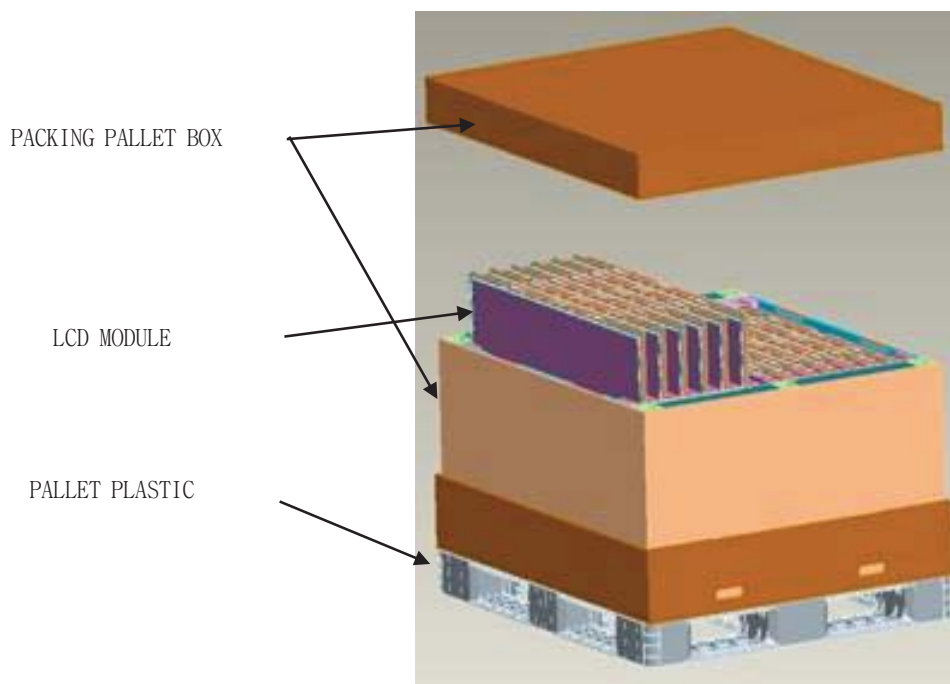
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7. PACKING

7.1 Carton (Internal Package)



7.2 Packing Specification

| Item | Specification | Remark |
|---------------------|------------------------------------|---|
| LCD Packing | 13ea / Box (Packing-Pallet Box) | 1. 6.2 Kg / LCD (24ea) 2. 18.5 Kg / Packing Box (1set) > Packing Box Material : Paper 3. 10 g/EA, 4 EA/Module, Cobalt-dichloride-free |
| Pallet | 1 Box / Pallet | 1. Pallet weight = 4.9 kg > Pallet Material : HDPE |
| Packing Direction | Vertical | |
| Total Pallet Size | L x W x height | 1150mm(L) x 850mm(W) x 1071mm(height) |
| Total Pallet Weight | 114.12 kg | Module(80.6kg) + Desiccant(0.52kg) Pallet(14.5kg) + Packing SET(18.5kg) |

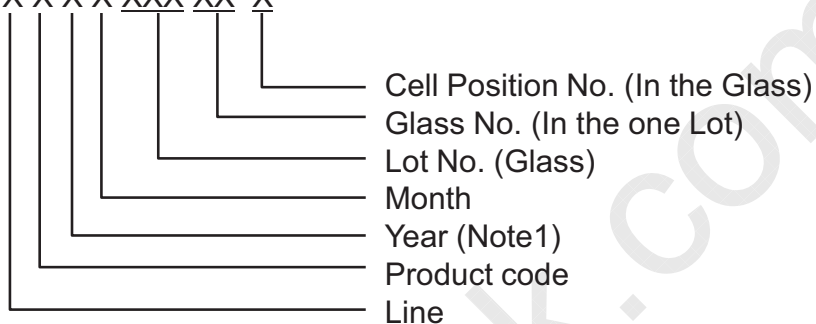
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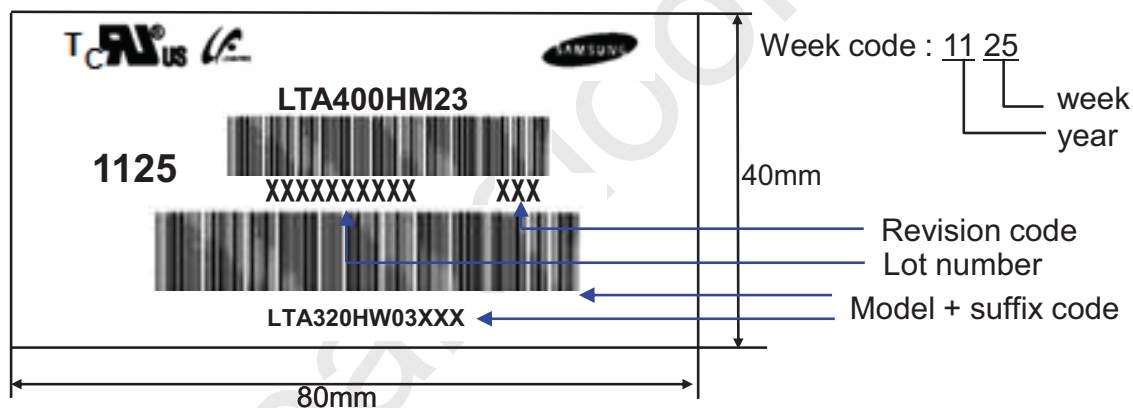
8. Marking & Others

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

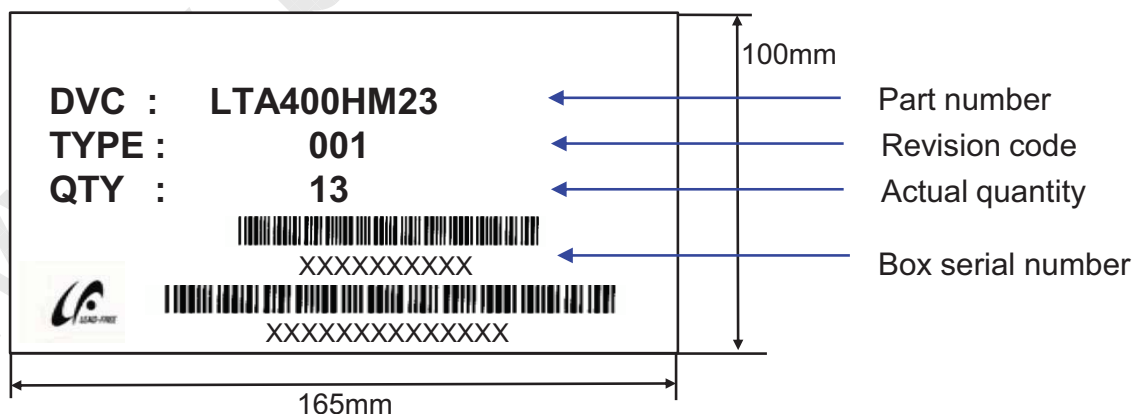
- (1) Part number : LTA400HM23
- (2) Revision: Three letters
- (3) Lot number : X X X X XXX XX X



(4) Nameplate Indication



(5) Packing box attach



(6) Others

- 1. After service part
 LED bar can not be replaced because of the narrow bezel structure.

| | | | | | |
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9. General Precautions

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9.1 Handling

- (a) When the module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend them.
- (b) Module should be disconnected from power 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 LED back light.
- (d) Note that polarizers are very fragile and could be damage easily. Do not press or scratch the surface harder than a HB pencil lead.
- (e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.
- (f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.
- (g) 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 do 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 with soap thoroughly.
- (i) Protect the module from ESD (Electro-Static Discharge). Otherwise the ASIC IC or semiconductor would be damaged.
- (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 disassemble shield case of LVDS board
- (m) Do not connect N.C pins. (Samsung internal use only)
- (n) Protection film for polarizer on the module should be slowly peeled off just before use so that the electrostatic charge can be minimized. Must put on antistatic glove while handling a module
- (o) Pins of Interface connector should not be touched directly with bare hands.

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9.2 Package storage

We highly recommend to comply with the criteria in the table below.

| ITEM | UNIT | Min. | Max. |
|---------------------|--|------|------|
| Storage Temperature | (°C) | 5 | 40 |
| Storage Humidity | (%rH) | 35 | 75 |
| Storage Life | 6 months | | |
| Storage Condition | <ul style="list-style-type: none"> - The storage room should provide good ventilation and temperature control. - Products should not be placed on the floor, but on the Pallet away from a wall. - Prevent products from direct sunlight, moisture nor water; Be cautious of a build up of condensation. - Avoid other hazardous environment while storing goods. - If products delivered or kept in conditions of over the storage period of 3months, the recommended temperature or humidity range, we recommend you leave them at a temperature of 20 °C and a humidity of 50% for 24 hours. | | |

9.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "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 Converter power supply should be connected directly with a minimized length. A longer cable between the back light and the Converter may cause lower luminance of lamp(LED) and may require higher startup voltage(Vs).

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9.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
- Temperature : $20 \pm 15^{\circ}\text{C}$
 - Humidity : $55 \pm 20\%$
 - Display pattern : continually changing pattern (not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, banks, stock market, and controlling systems.

9.5 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. (supply 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.
To avoid image sticking, it is recommended to use a screen saver.
- (e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.
- (f) Please contact SEC in advance when you display the same pattern for a long time.
- (g) Be cautious for detergents or water not to be permeated into the gap between the module and the panel when placing the module upside down.

| | | | | | |
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