SAMSUNG ELECTRONICS

Approval

TO : Acer

DATE : Oct. 06. 2009

*SAMSUNG TFT-LCD*

# MODEL NO : LTN156AT02-A04

NOTE : Extension code [ -A ]

→ LTN156AT02-**A**04

Surface type [ Glare ]

***The information described in this SPEC is preliminary and can be changed without prior notice.***

**Application engineering part, DS Solution**
**Samsung Electronics Co., Ltd.**

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## CONTENTS

# REVISION HISTORY

Approval

| Date | Revision No. | Page | Summary |
|---|---|---|---|
| Oct. 6, 2009 | A00 | All | The preliminary specification of LTN156AT02-A04 was issued first. New revision code ‘A04’ was applied for FAB Line was changed to ‘L6’ from ‘A5’ |
| | | | |

# GENERAL DESCRIPTION

## DESCRIPTION

LTN156AT02-A04 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 system. The resolution of a 15.6" contains 1366 x 768 pixels and can display up to 262,144 colors. 6 O'clock direction is the Optimum viewing angle.

## FEATURES

- Thin and light weight
- High contrast ratio, high aperture structure
- 1366 x 768 pixels resolution (16:9)
- Fast Response Time
- Low power consumption
- LED BLU Structure
- DE (Data enable) only mode
- 3.3V LVDS Interface
- On board EDID chip
- Pb-free product

## 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 | 344.232 (H) x 193.536 (V) (15.6”diagonal) | mm | |
| Driver element | a-Si TFT active matrix | | |
| Display colors | 262,144 | | |
| Number of pixel | 1366 x 768 | pixel | 16 : 9 |
| Pixel arrangement | RGB vertical stripe | | |
| Pixel pitch | 0.252 (H) x 0.252 (V) (TYP.) | mm | |
| Display Mode | Normally white | | |
| Surface treatment | Haze 0, Hardness 3H | | Glare |

Mechanical Information

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Module size | Horizontal (H) | 358.8 | 359.3 | 359.8 | mm | |
| | Vertical (V) | 209.0 | 209.5 | 210 | mm | |
| | Depth (D) | - | 5.1 | 5.5 | mm | (1) |
| Weight | | - | 430 | 450 | g | |

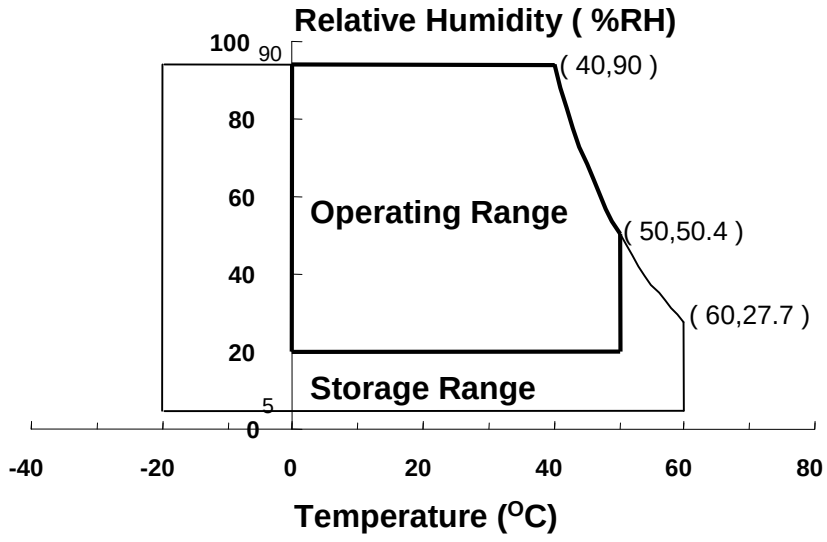
Note (1) Measurement condition of outline dimension
. Equipment : Vernier Calipers
. Push Force : 500g ·f (minimum)

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




(2) 2ms, half sine wave, one time for ±X, ±Y, ± 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.

## 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 | $V_{DD}$ | $V_{DD}$ – 0.3 | $V_{DD}$ + 0.3 | V | (1) |

Note (1) Within Ta (25 ± 2 °C )

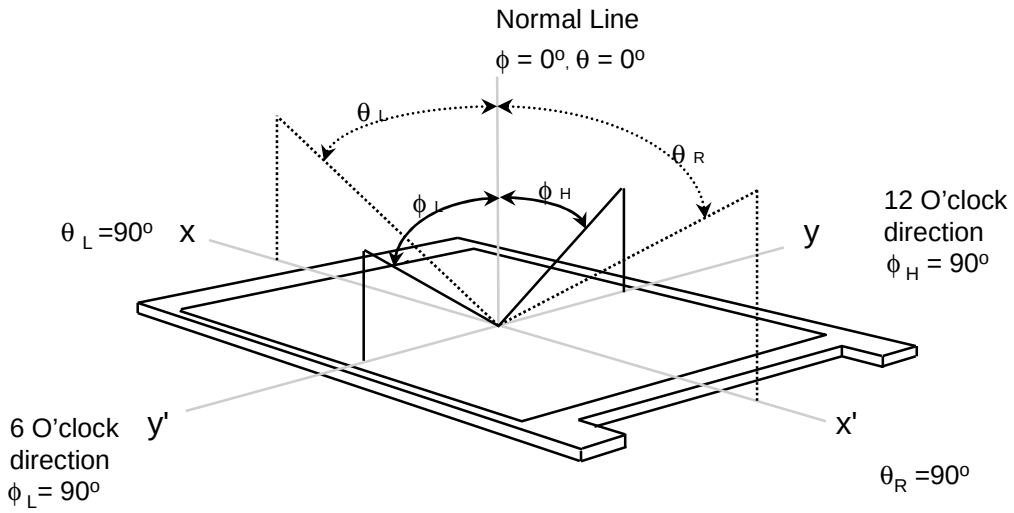
## 2. OPTICAL CHARACTERISTICS

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 SR-3

* Ta = 25 ± 2 °C, $V_{DD}$=3.3V, fv= 60Hz, $f_{DCLK}$ = 72.33MHz, $I_L$ = 20mA

| Item | | Symbol | Condition | Min. | Typ. | Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio (5 Points) | | CR | Normal Viewing Angle $\phi = 0$ $\theta = 0$ | 400 | 500 | - | - | (1), (2), (5) |
| Response Time at Ta ( Rising + Falling ) | | $T_{RT}$ | | - | 8 | 16 | msec | (1), (3) |
| Average Luminance of White (5 Points) | | $Y_{L,AVE}$ | | 190 | 220 | - | cd/m$^2$ | $I_L$=20mA (1), (4) |
| Color Chromaticity ( CIE ) | Red | $R_X$ | | 0.585 | 0.615 | 0.645 | - | |
| | | $R_Y$ | | 0.325 | 0.355 | 0.385 | | |
| | Green | $G_X$ | | 0.305 | 0.335 | 0.365 | | |
| | | $G_Y$ | | 0.580 | 0.610 | 0.640 | | |
| | Blue | $B_X$ | | 0.120 | 0.150 | 0.180 | | |
| | | $B_Y$ | | 0.070 | 0.100 | 0.130 | | |
| | White | $W_X$ | | 0.283 | 0.313 | 0.343 | | |
| | | $W_Y$ | | 0.299 | 0.329 | 0.359 | | |
| Viewing Angle | Hor. | $\theta_L$ | CR ≥ 10 | 40 | - | - | Degrees | (1), (5) SR-3 |
| | | $\theta_R$ | | 40 | - | - | | |
| | Ver. | $\phi_H$ | | 15 | - | - | | |
| | | $\phi_L$ | | 30 | - | - | | |
| Color Gamut | | | | - | 60 | - | % | |
| 13 Points White Variation | | $\delta_L$ | | - | - | 1.7 | - | (6) |

Note 1) Definition of Viewing Angle : Viewing angle range(10 ≤ C/R)

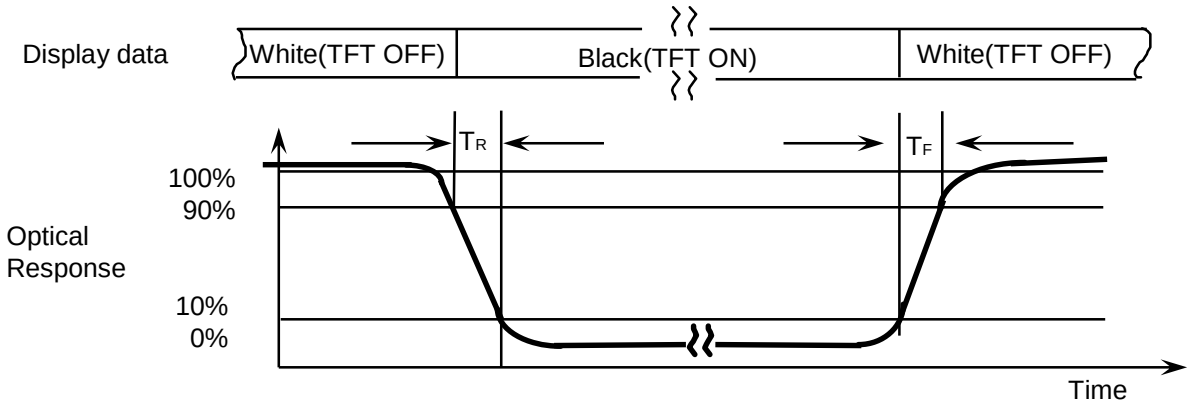



Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

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

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

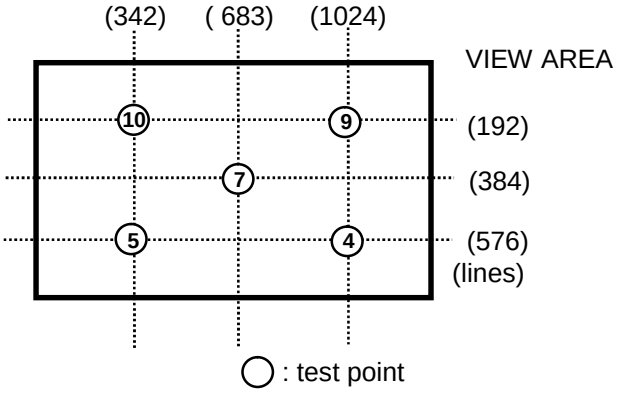
Note 3) Definition of Response time :



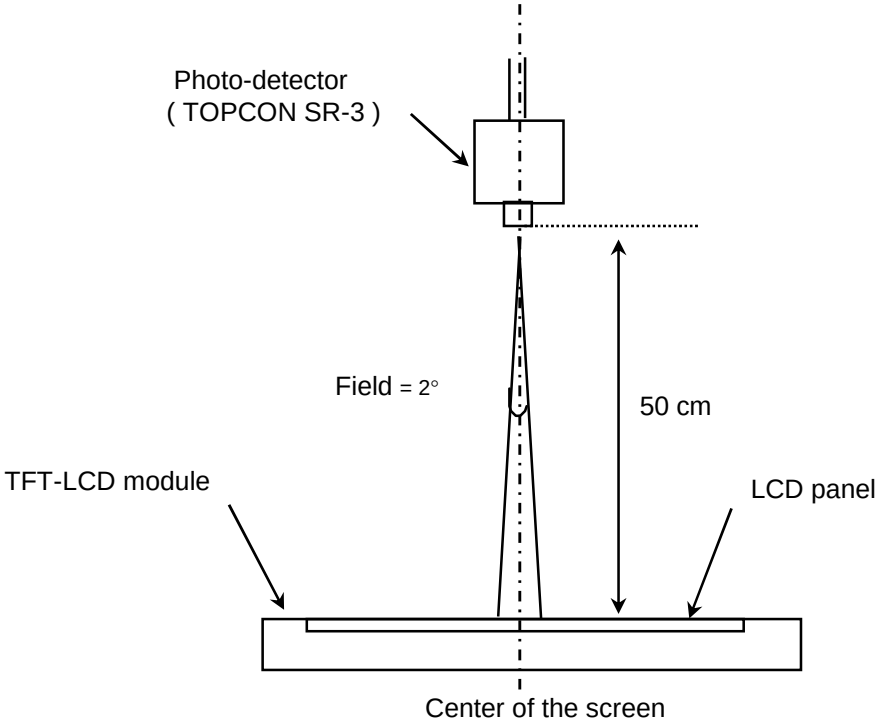

Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.

Average Luminance of White ( $Y_{L,AVE}$ )

$$Y_{L,AVE} = \frac{Y_{L4} + Y_{L5} + Y_{L7} + Y_{L9} + Y_{L10}}{5}$$



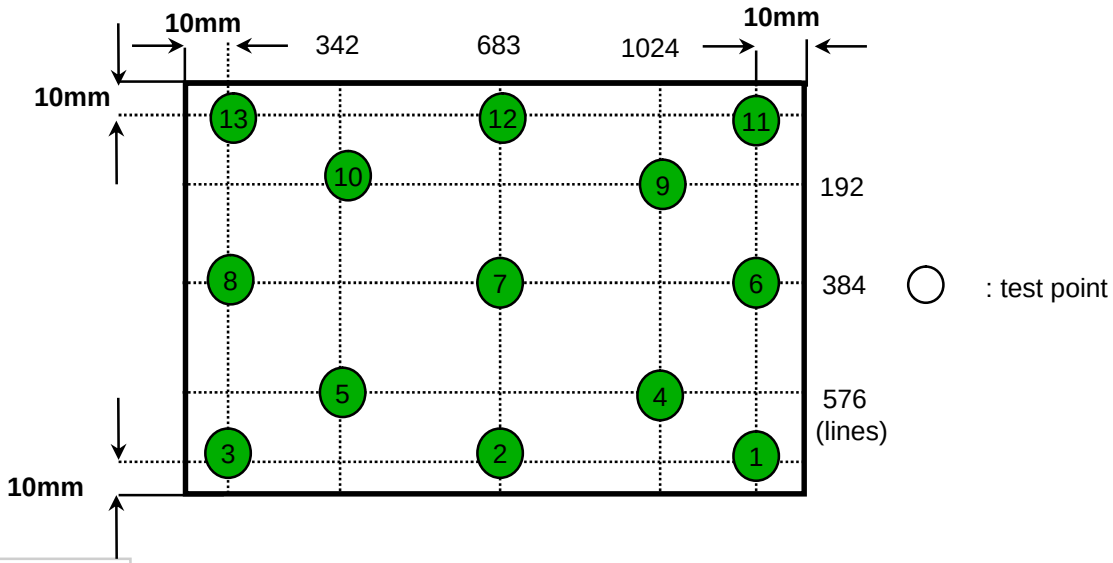
Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless,and dark room.
30 min after lighting the backlight. This should be measured in the center of screen.
LED current : 20 mA
Environment condition : Ta = 25 ± 2 °C




[ Optical characteristics measurement setup ]

Note 6) Definition of 13 points white variation ($\delta_L$), [ 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

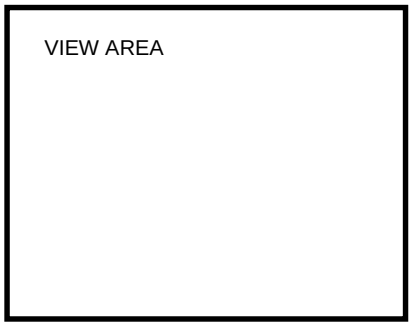
| Item | | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Voltage of Power Supply | | $V_{CC}$ | 3.0 | 3.3 | 3.6 | V | |
| Differential Input Voltage for LVDS Receiver Threshold | High | $V_{IH}$ | - | - | +100 | mV | $V_{CM}$ = +1.2V |
| | Low | $V_{IL}$ | -100 | - | - | mV | |
| Vsync Frequency | | fv | - | 60 | - | Hz | |
| Hsync Frequency | | $f_H$ | - | 47.4 | - | KHz | |
| Main Frequency | | $f_{DCLK}$ | - | 72.33 | 80 | MHz | |
| Rush Current | | $I_{RUSH}$ | - | - | 1.5 | A | (4) |
| Current of Power Supply | White | $I_{DD}$ | - | 330 | - | mA | (2),(3)*a |
| | Mosaic | | - | 470 | - | mA | (2),(3)*b |
| | Black | | - | 650 | 700 | mA | (2),(3)*c |
| | V-strip | | - | 500 | - | mA | (2),(3)*c |

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

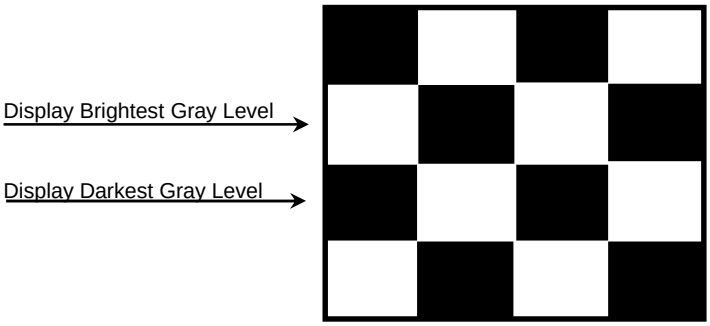
(2) $f_V$ = 60Hz, $f_{DCLK}$ = 72.33 MHZ, $V_{DD}$ = 3.3V , DC Current.

(3) Power dissipation pattern

*a) White Pattern

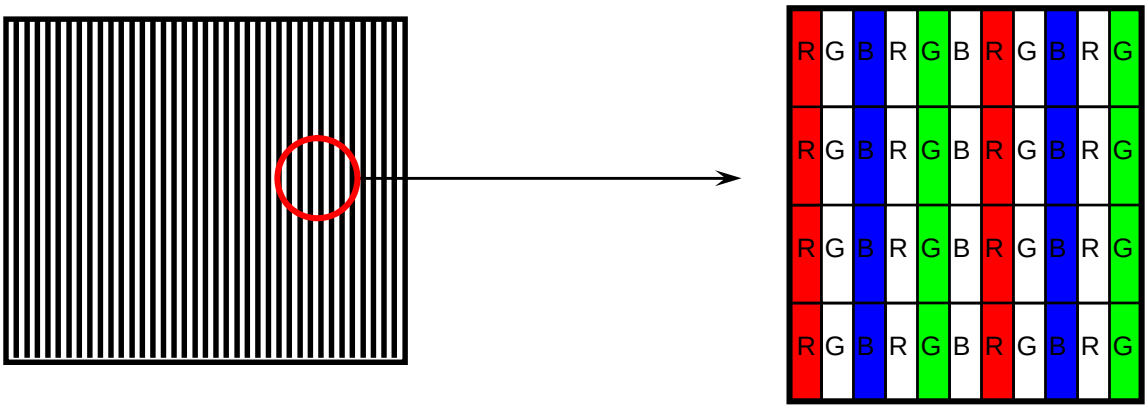



*b) Mosaic Pattern

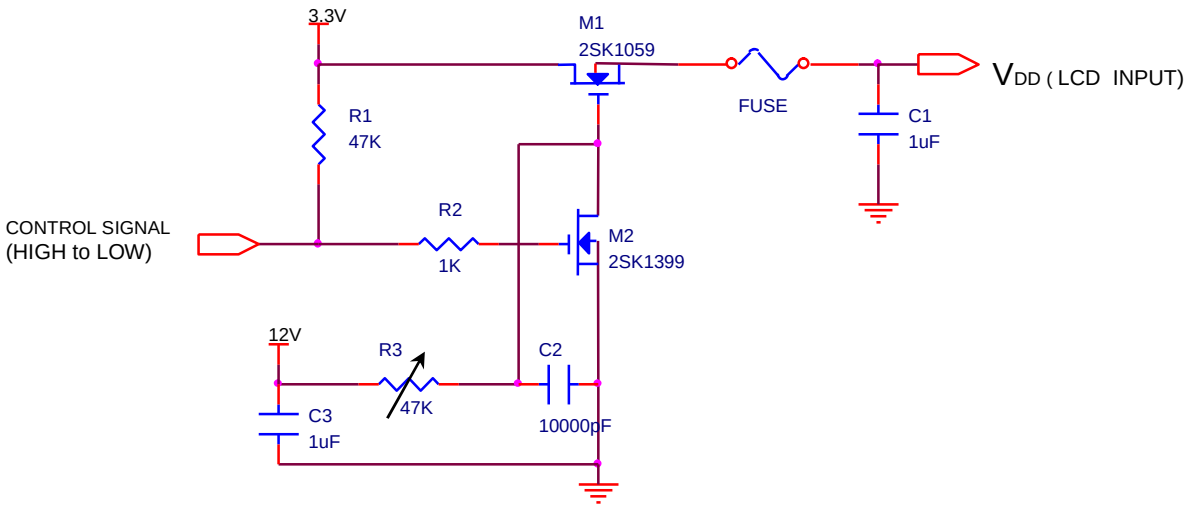



*C) Black Pattern

*d) 1dot Vertical stripe pattern




4) Rush current measurement condition ($V_{CC}$ rising time is 470us)



## 3.2 BACK-LIGHT UNIT

Ta= 25 ± 2 °C

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| LED Forward Current | IF | - | 20 | 30 | mA | |
| LED Forward Voltage | VF | - | 3.2 | - | V | |
| LED Array Voltage | VP | - | 35.2 | - | V | VF X 11 LEDs |
| Power Consumption | P | - | 2.816 | - | W | IF X VF X 44 LEDs (w/o Converter) |

## 3.3 LED Driver

- On board LED Driver (Manufacturer : Richtek)

Ta= 25 ± 2 °C

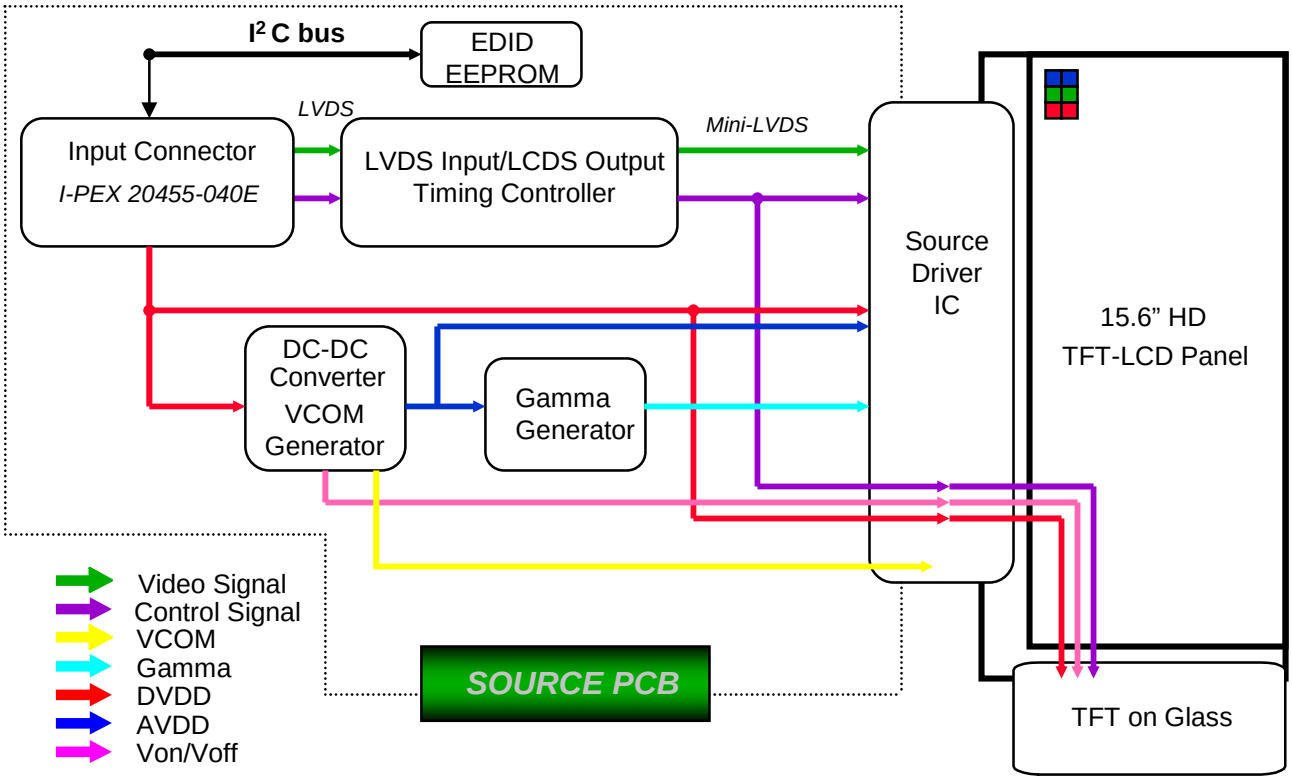
| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Input Voltage | $V_{in}$ | 7 | 12 | 30 | V | |
| Operating Frequency | $F_o$ | 840 | 1000 | 1160 | KHz | 600KHz possible |
| Duty ratio | D | 10 | - | 100 | % | PWM Freq. : 1kHz~10KHz |
| | | 5 | | 100 | | 200Hz~1KHz |
| PWM frequency | $P_{PWM}$ | - | 1 | 10 | KHz | |

Note (1) Test Equipment : Fluke 45

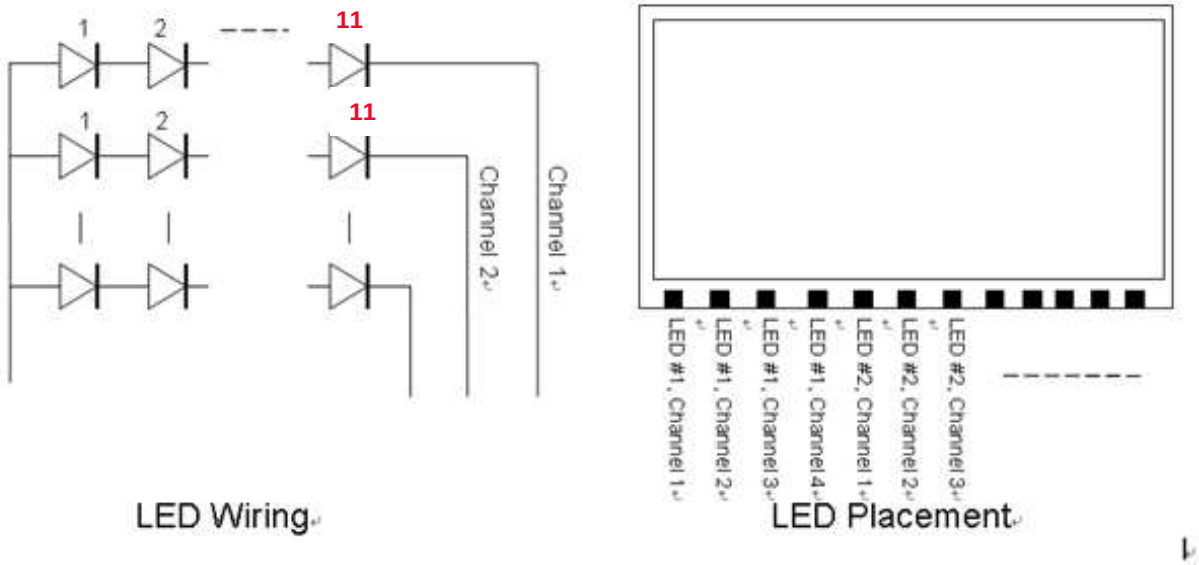
(2) SEC guarantee PWM frequency from 0.2kHz to 10KHz

# 4. BLOCK DIAGRAM

## 4.1 TFT LCD Module




## 4.2 LED connection and placement




LED Wiring

LED Placement

## 5. INPUT TERMINAL PIN ASSIGNMENT

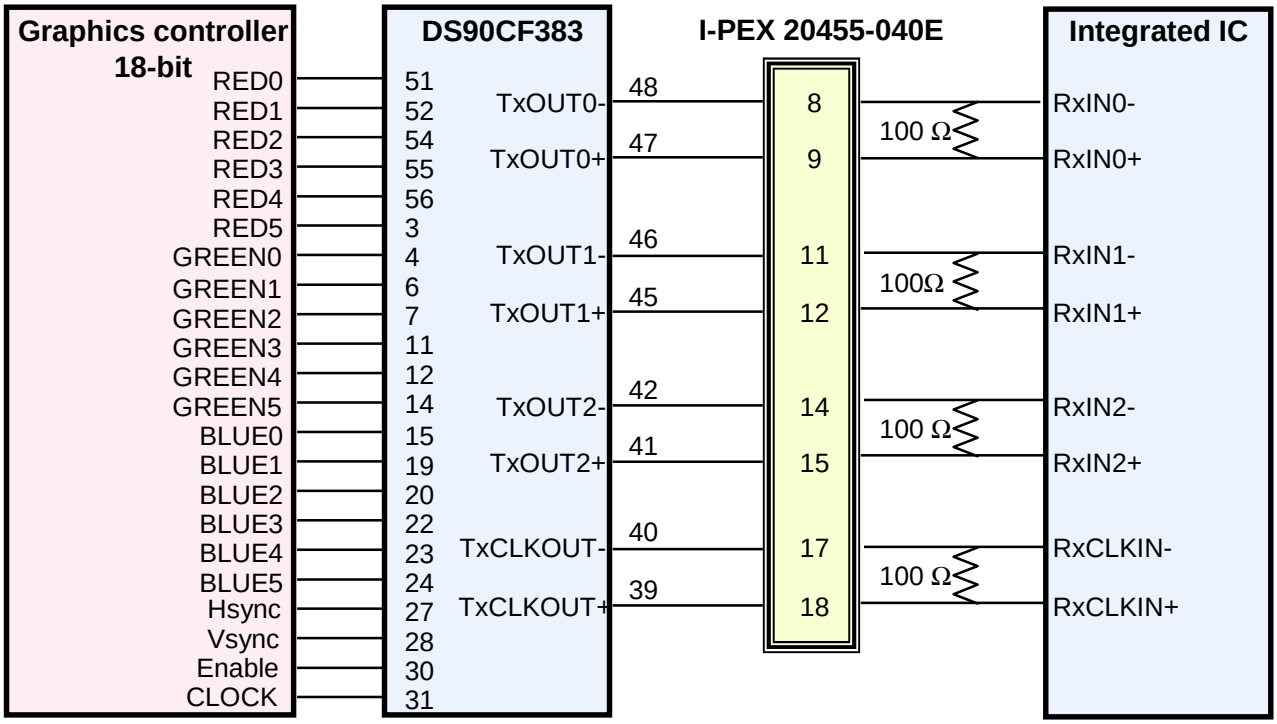
5.1. Input Signal & Power (LVDS, Connector : I-PEX 20455-040E-02S or Compatible )

| Pin | Symbol | Function |
|---|---|---|
| 1 | NC | No Connection (Reserved for supplier) |
| 2 | VCC | Power Supply, 3.3V (typical) |
| 3 | VCC | Power Supply, 3.3V (typical) |
| 4 | VCC_EDID | DDC 3.3V power |
| 5 | WPN | EDID writing protection |
| 6 | CLK_EDID | DDC Clock |
| 7 | DATA_EDID | DDC Data |
| 8 | RXin0- | - LVDS differential data (R0-R5, G0) |
| 9 | RXin0+ | + LVDS differential data (R0-R5, G0) |
| 10 | GND | Ground |
| 11 | RXin1- | - LVDS differential data (G1-G5, B0-B1) |
| 12 | RXn1+ | + LVDS differential data (G1-G5, B0-B1) |
| 13 | GND | Ground |
| 14 | RXin2- | - LVDS differential data (B2-B5,HS,VS, DE) |
| 15 | RXn2+ | + LVDS differential data (B2-B5,HS,VS, DE) |
| 16 | GND | Ground |
| 17 | ClkIN- | - LVDS differential clock input |
| 18 | ClkIN+ | + LVDS differential clock input |
| 19 | GND | Ground |
| 20~21 | NC | No Connection |
| 22 | GND | Ground |
| 23~24 | NC | No Connection |
| 25 | GND | Ground |
| 26~27 | NC | No Connection |
| 28 | GND | Ground |
| 29~30 | NC | No Connection |
| 31~33 | GND | LED Ground |
| 34 | NC | No Connection |
| 35 | PWM | PWM for luminance control |
| 36 | LED_EN | BL On/Off (On: 2.0~3.3V, Off: 0~0.5V) |
| 37 | NC | No Connection |
| 38~40 | VBL(7~20) | *LED Power Supply 7V-20V |

## 5.2 LVDS Interface : Transmitter DS90CF363 or Compatible

| Pin No. | Name | RGB Signal | Pin No. | Name | RGB Signal |
|---|---|---|---|---|---|
| 51 | TxIN0 | R0 | 14 | TxIN14 | G5 |
| 52 | TxIN1 | R1 | 15 | TxIN15 | B0 |
| 54 | TxIN2 | R2 | 19 | TxIN18 | B1 |
| 55 | TxIN3 | R3 | 20 | TxIN19 | B2 |
| 56 | TxIN4 | R4 | 22 | TxIN20 | B3 |
| 3 | TxIN6 | R5 | 23 | TxIN21 | B4 |
| 4 | TxIN7 | G0 | 24 | TxIN22 | B5 |
| 6 | TxIN8 | G1 | 27 | TxIN24 | Hsync |
| 7 | TxIN9 | G2 | 28 | TxIN25 | Vsync |
| 11 | TxIN12 | G3 | 30 | TxIN26 | DE |
| 12 | TxIN13 | G4 | 31 | TxCLKIN | Clock |

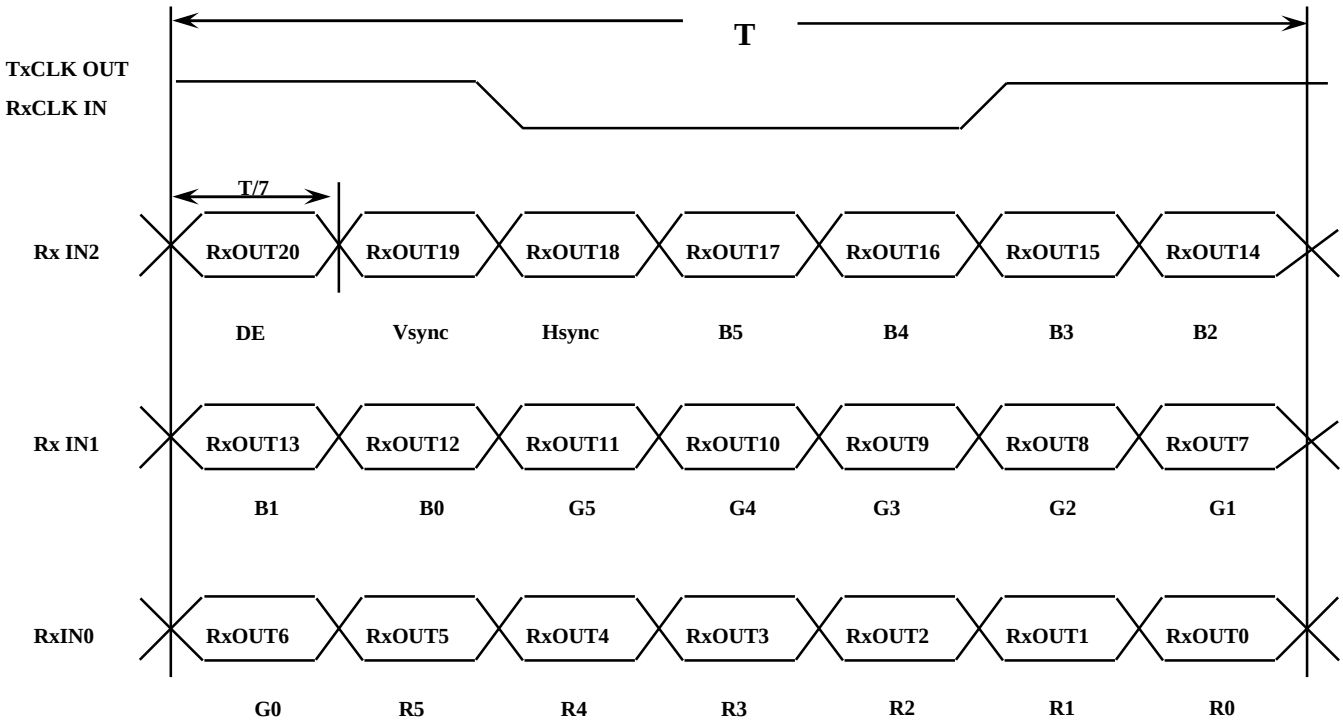
**LVDS INTERFACE**




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

## 5.3 Timing Diagrams of LVDS For Transmission

LVDS Receiver : Integrated T-CON

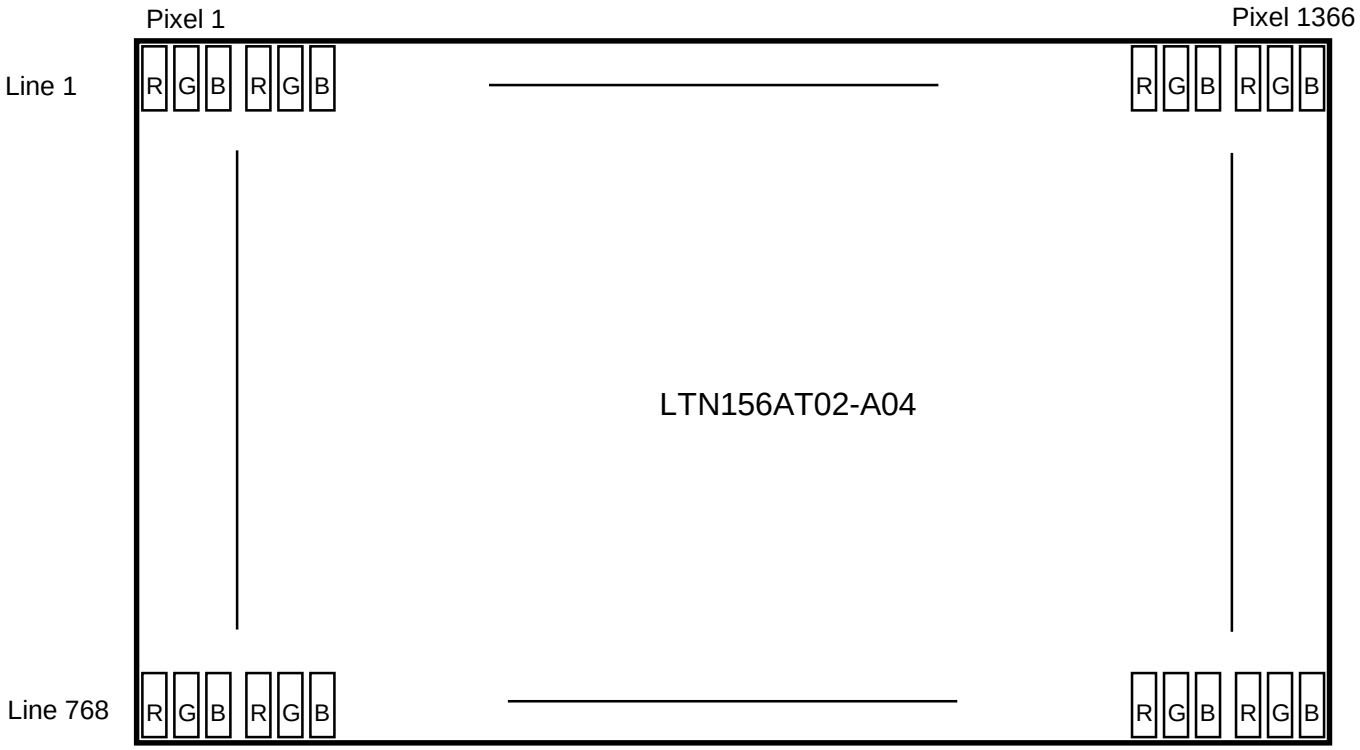


## 5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color

| 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) MSB = R5,G5,B5, LSB=R0,G0,B0
Note 2)Input signal: 0 =Low level voltage, 1=High level voltage

## 5.5 Pixel Format in the display

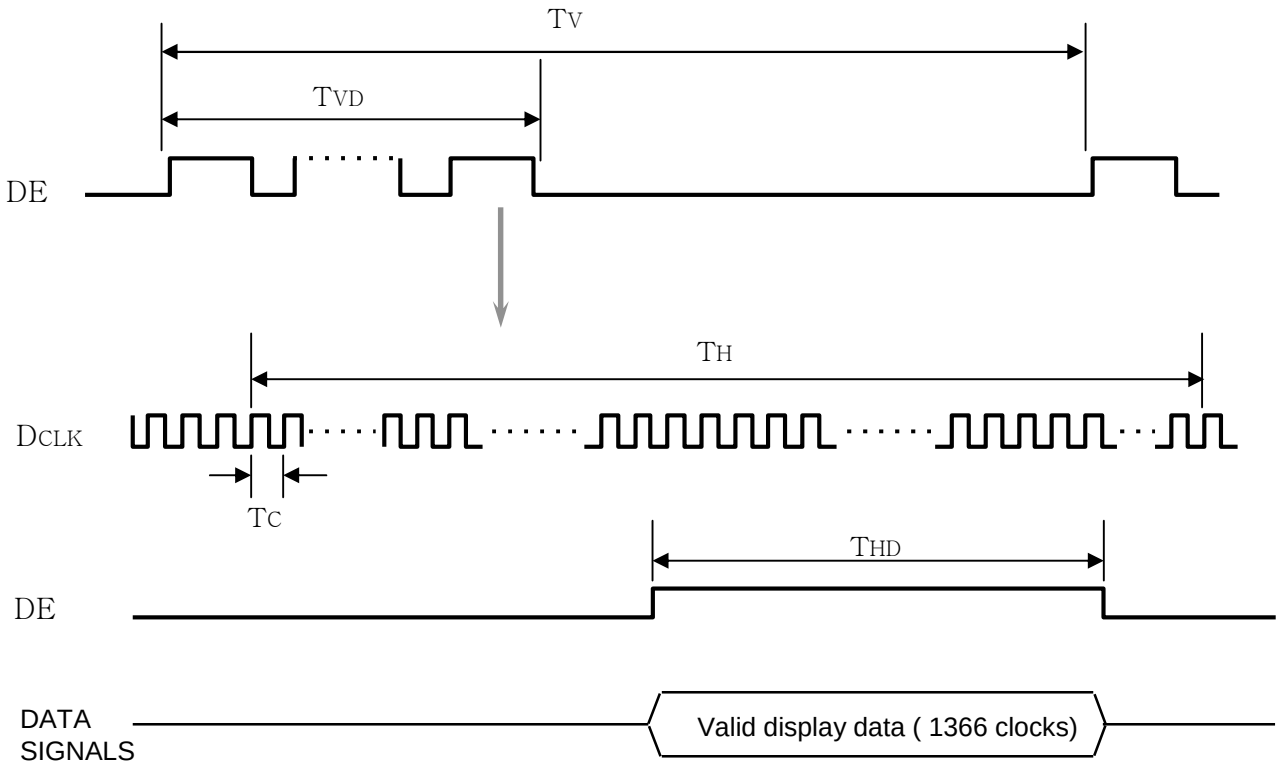


# 6. INTERFACE TIMING

## 6.1 Timing Parameters

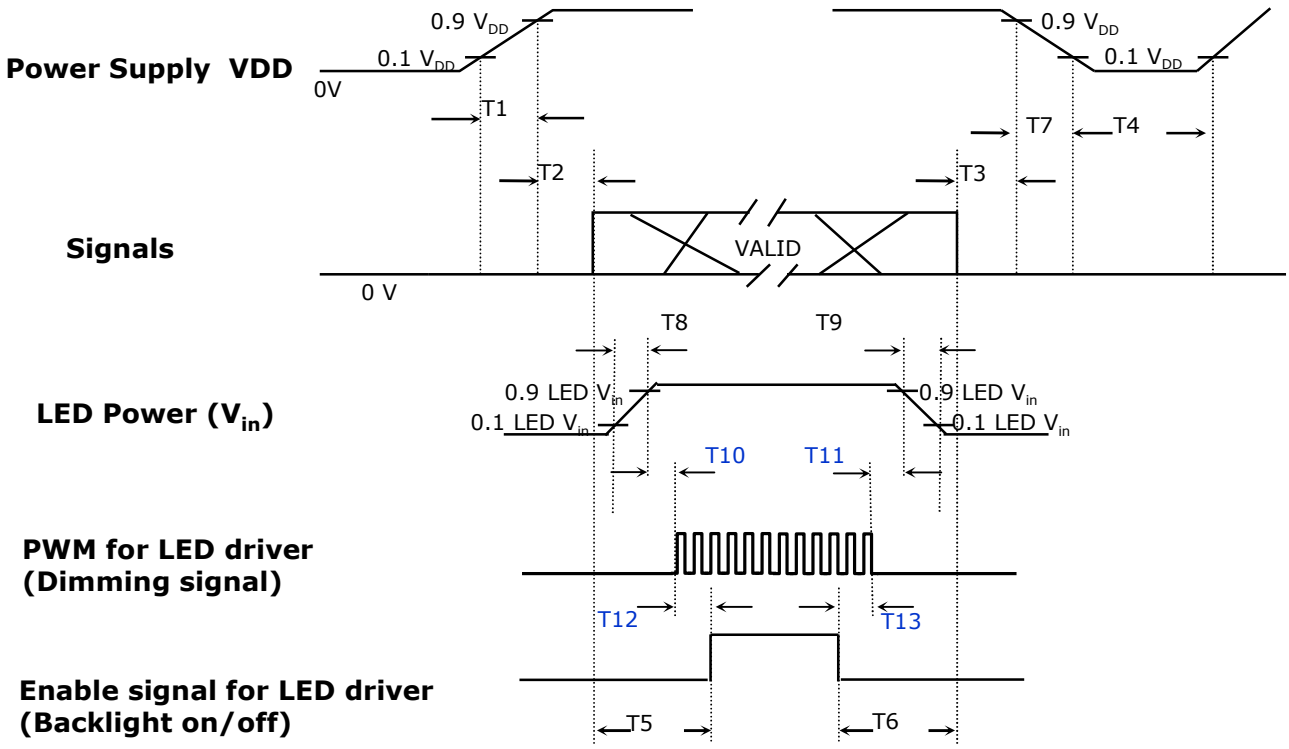
| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Main Clock | Frequency | 1/TC | - | 72.33 | - | MHz | - |
| Frame Frequency | Cycle | TV | 776 | 790 | 1000 | Lines | - |
| Vertical Active Display Term | Display Period | TVD | - | 768 | - | Lines | - |
| One Line Scanning Time | Cycle | TH | 1386 | 1526 | 2049 | Clocks | - |
| Horizontal Active Display Term | Display Period | THD | - | 1366 | - | Clocks | - |

## 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 be as the diagram below.



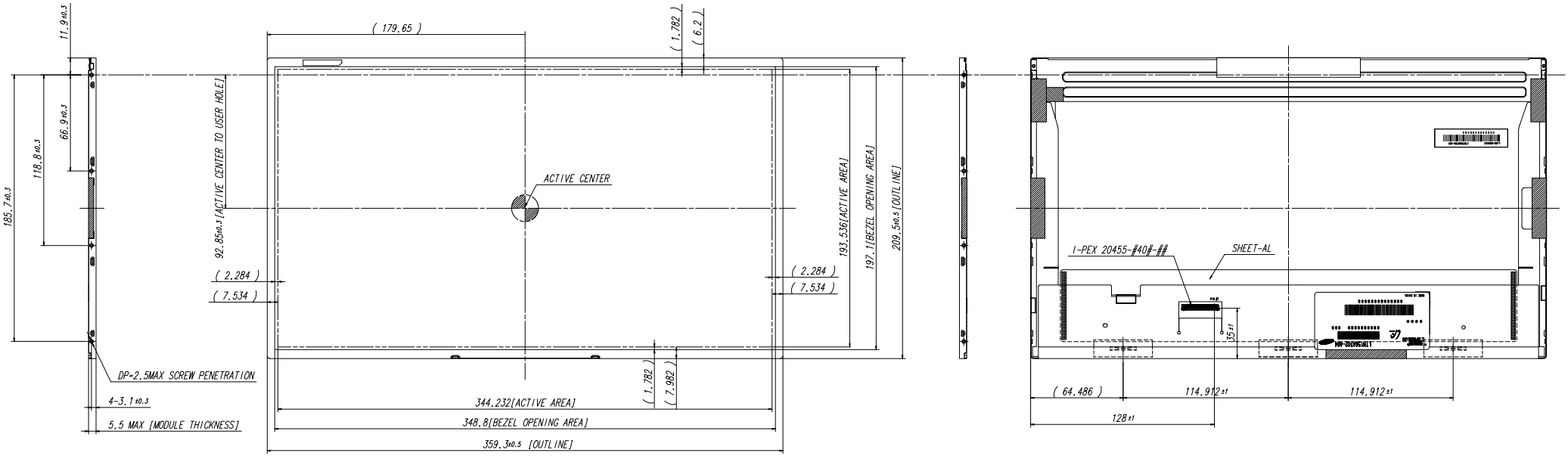

## Power ON/OFF Sequence

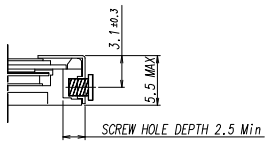
| Timing (ms) | Remarks |
|---|---|
| 0.5 < T1 ≤ 10 | $V_{DD}$ rising time from 10% to 90% |
| 0 < T2 ≤ 50 | Delay from $V_{DD}$ to valid data at power ON |
| 0 < T3 ≤ 50 | Delay from valid data OFF to $V_{DD}$ OFF at power Off |
| 500 ≤ T4 | $V_{DD}$ OFF time for Windows restart |
| 200 ≤ T5 | Delay from valid data to B/L enable at power ON |
| 200 ≤ T6 | Delay from valid data off to B/L disable at power Off |
| 0 < T7 ≤ 10 | $V_{DD}$ falling time from 90% to 10% |
| 0.5 < T8 ≤ 10 | LED $V_{in}$ rising time from 10% to 90% |
| 0.5 < T9 ≤ 10 | LED $V_{in}$ falling time from 90% to 10% |
| 0 ≤ T10 | Delay from LED driver Vin rising time 90% to PWM ON |
| 0 ≤ T11 | Delay from PWM Off to LED driver Vin falling time 10%, Must Keep rule |
| 0 ≤ T12 | Delay from PWM ON to B/L Enable ON, Must Keep rule |
| 0 ≤ T13 | Delay from B/L Enable Off to PWM Off |

## Power Sequence & Timing Parameters

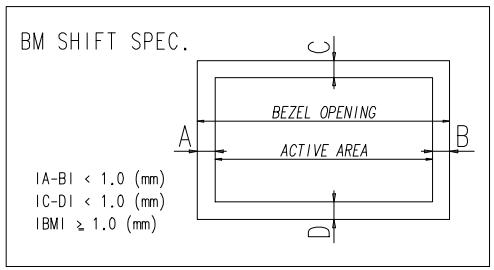
## 7. MECHANICAL OUTLINE DIMENSION

Please refer to the next page.




<USER HOLE SCREW HOLE DEPTH>




* NOTE
1. SIGNAL INTERFACE CONNECTOR TO BE SPECIFIED AS BELOW.
   -. MAKER : I-PEX OR COMPATIBLE
   -. INPUT CONNECTOR : I-PEX 20455-#40#-## OR EQUIVALENT
2. LED CONNECTOR FOR BACKLIGHT TO BE SPECIFIED AS BELOW.
   -. MAKER : UJU Electronics
   -. PART NO : 51441-1041
3. CALIFERS MEASURING FORCE : 750 ± 250 gfcm
4. MAXIMUM SCREW TORQUE : MAX 2.5 Kgf-cm(5TIMES)
5. WEIGHT : 465 g MAX
6. IN ORDER TO AVOID IC DAMAGE, IT IS NOT ALLOW THAT OVERLAPPING OF CABLES OR ANTENNAS, CAMERA, WLAN, WWAN, OVER THESE COF LOCATIONS.

| REV. | DATE | DESCRIPTION OF REVISION | REASON | CHG'D BY |
|---|---|---|---|---|
| UNIT | mm | DRA'N BY | DES'D BY | CHK'D BY | APP'D BY | MODEL NAME | LTN156AT02-A04 |
| SCALE | 1/1 | H.H.KIM | | | | | |
| GENERAL TOLERANCE | ± 0.5 | 2006.05.13 | | | | PART/SHEET NAME | OUTLINE DIMENSION | SHEET | 1/1 |
| SAMSUNG ELECTRONICS | | | SPEC. NO | BN50022X-A01 | | CODE NO. | - | VER. | 000 |

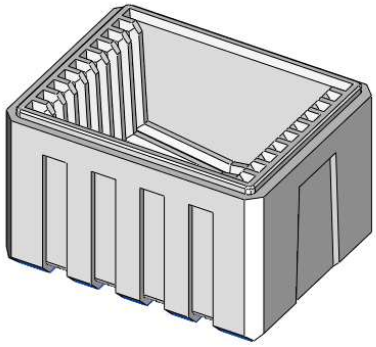
## 8. PACKING

1. CARTON(Internal Package)

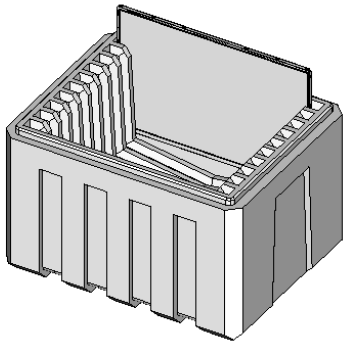
(1) Packing Form
Corrugated Cardboard box and Corrupad form as shock absorber

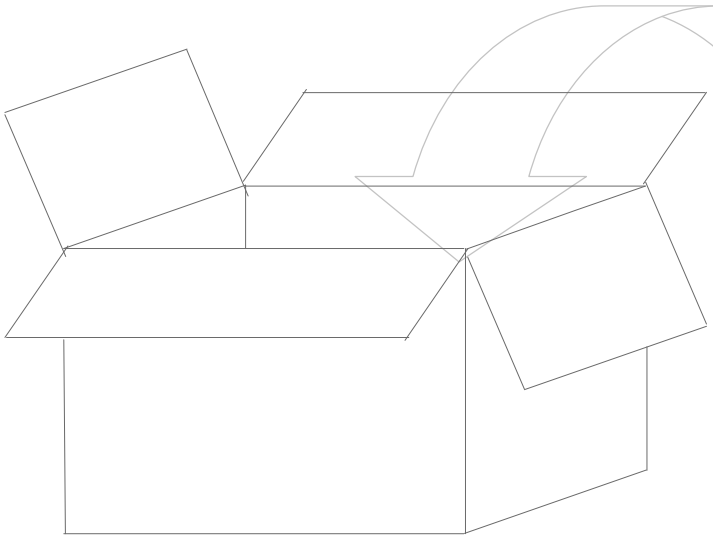
(2) Packing Method

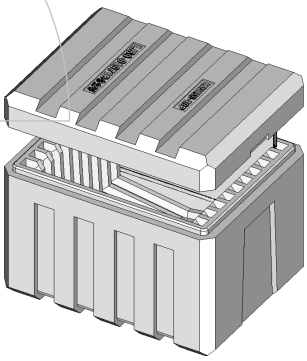
CUSHION BOTTOM



PANEL : 2EA/SLIT







*CUSHION TOP, BOTTOM*

*Note* (1) Total : Approx. 12.4kg

(2) Acceptance number of piling : 20 sets

(3) Carton size : 359(W) X 463(D) X 333(H)

(4) Max accumulation quantity : 5 cartons

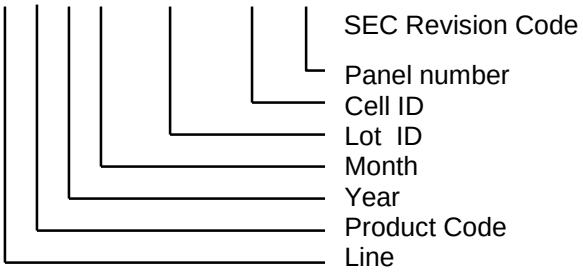
(3)Packing Material

| No | Part name | Quantity |
|---|---|---|
| 1 | Static electric protective sack | 20 |
| 2 | Packing case (Inner box)<br>included shock absorber | 1 set |
| 3 | Pictorial marking | 2 pcs |
| 4 | Carton | 1 set |

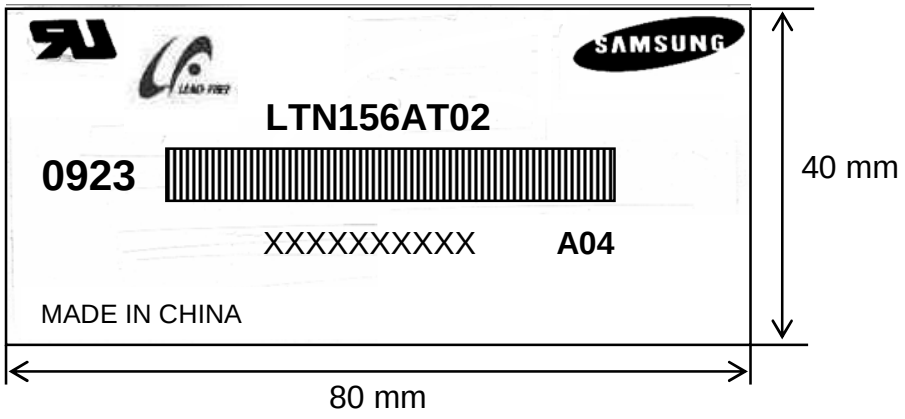
## 9. MARKINGS & OTHERS

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

(1)Parts number : LTN156AT02 –A04
(2)Revision code : 3 letters
(3)Lot number : X X X X XXX XX X **A04**

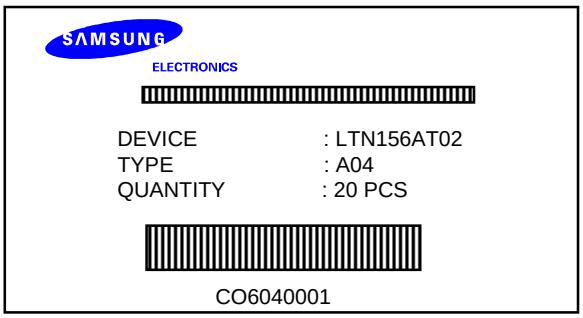



(4) Nameplate Indication




Parts name : LTN156AT02
Lot number : XXXXXXXXXX
Inspected work week : 0923(2009 year, 23th week)
Product revision Code : A04

(5) Packing small box attach




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

## 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.

(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.

## 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 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.

## 11. EDID

| 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 |
| | | | | | E | |
| 09 | | A3 | 10100011 | 163 | C | "SEC" |
| 0A | ID Product Code | 41 | 01000001 | 65 | [A] | |
| 0B | | 41 | 01000001 | 65 | [A] | |
| 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 | 13 | 00010011 | 19 | 2009 | 2009 |
| 12 | EDID Structure Ver. | 01 | 00000001 | 1 | 1 | EDID Ver. 1.0 |
| 13 | EDID revision # | 03 | 00000011 | 3 | 0 | EDID Rev. 0 |
| 14 | Video input definition | 80 | 10000000 | 128 | | |
| 15 | Max H image size | 22 | 00100010 | 34 | 34 | 34 cm(approx) |
| 16 | Max V image size | 13 | 00010011 | 19 | 19 | 19 cm(approx) |
| 17 | Display Gamma | 78 | 01111000 | 120 | 2.2 | Gamma 2.2 |
| 18 | Feature support | 0A | 00001010 | 10 | | |
| 19 | Red/green low bits | 8D | 10001101 | 141 | | 10000111 |
| 1A | Blue/white low bits | A5 | 10100101 | 165 | | 11111110 |
| 1B | Red x/ high bits | 9D | 10011101 | 157 | 0.615 | Red x 0.615= 100101001 |
| 1C | Red y | 5B | 01011011 | 91 | 0.355 | Red y 0.355= 01011011 |
| 1D | Green x | 55 | 01010101 | 85 | 0.335 | Green x 0.300= 01010101 |
| 1E | Green y | 9C | 10011100 | 156 | 0.610 | Green y 0.570= 10011100 |
| 1F | Blue x | 26 | 00100110 | 38 | 0.150 | Blue x 0.145= 00100110 |
| 20 | Blue y | 19 | 00011001 | 25 | 0.100 | Blue y 0.080= 00011001 |
| 21 | White x | 50 | 01010000 | 80 | 0.313 | White x 0.313= 01010000 |
| 22 | White y | 54 | 01010100 | 84 | 0.329 | White y 0.329= 01010100 |
| 23 | Established timing 1 | 00 | 00000000 | 0 | | |
| 24 | Established timing 2 | 00 | 00000000 | 0 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 25 | Established timing 3 | 00 | 00000000 | 0 | | |
| 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 | 41 | 01000001 | 65 | 72.33 | Main clock= 72.33 MHz |
| 37 | | 1C | 00011100 | 28 | | |
| 38 | | 56 | 01010110 | 86 | 1366 | Hor active=1366 pixels |
| 39 | | A0 | 10100000 | 160 | 160 | Hor blanking=160 pixels |
| 3A | | 50 | 01010000 | 80 | | 4bit : 4bit |
| 3B | | 00 | 00000000 | 0 | 768 | Vertcal active=768 lines |
| 3C | | 16 | 00010110 | 22 | 22 | Vertical blanking=22 lines |
| 3D | | 30 | 00110000 | 48 | | 4bit : 4bit |
| 3E | | 30 | 00110000 | 48 | 48 | |
| 3F | | 20 | 00100000 | 32 | 32 | H sync. Width=32 pixels |
| 40 | | 25 | 00100101 | 37 | 2<br>5 | V sync. Offset=2 lines<br>V sync. Width=5 lines |
| 41 | | 00 | 00000000 | 0 | | 2bit : 2bit :2bit :2bit |
| 42 | | 58 | 01011000 | 88 | 344 | H image size= 344 mm(app |
| 43 | | C1 | 11000001 | 193 | 193 | V image size = 193 mm(app |
| 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 (Tim |
| 49 | | 00 | 00000000 | 0 | | |
| 4A | | 00 | 00000000 | 0 | | |
| 4B | | 0F | 00001111 | 15 | | |
| 4C | | 00 | 00000000 | 0 | | |
| 4D | | 00 | 00000000 | 0 | | **Value**=HSPWmin / 2 |
| 4E | | 00 | 00000000 | 0 | | **Value**=HSPWmax / 2 |
| 4F | | 00 | 00000000 | 0 | | **Value**=Thbpmin /2 |
| 50 | | 00 | 00000000 | 0 | | **Value**=Thbpmax /2 |
| 51 | | 00 | 00000000 | 0 | | **Value**=VSPWmin /2 |
| 52 | | 00 | 00000000 | 0 | | **Value**=VSPWmax /2 |
| 53 | | 00 | 00000000 | 0 | | **Value**=Tvbpmin / 2 |
| 54 | | 00 | 00000000 | 0 | | **Value**=Tvbpmax / 2 |
| 55 | | 1E | 00011110 | 30 | | Thpmin=**value***2 + HA pixel |
| 56 | | B4 | 10110100 | 180 | | Thpmax=**value***2 + HA pixel |
| 57 | | 02 | 00000010 | 2 | | Tvpmin=**value***2 + VA lines |
| 58 | | 74 | 01110100 | 116 | | Tvpmax=**value***2 + VA lines |
| 59 | | 00 | 00000000 | 0 | | Module revision |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5A | | 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 | Detailed timing/monitor | 4D | 01001101 | 77 | [M] | |
| 62 | descriptor #3 | 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 | | 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 | | 35 | 00110101 | 53 | [5] | |
| 73 | Detailed timing/monitor | 36 | 00110110 | 54 | [6] | |
| 74 | descriptor #4 | 41 | 01000001 | 65 | [A] | |
| 75 | | 54 | 01010100 | 84 | [T] | |
| 76 | | 30 | 00110000 | 48 | [0] | |
| 77 | | 32 | 00110010 | 50 | [2] | |
| 78 | | 2D | 00101101 | 45 | [-] | |
| 79 | | 41 | 01000001 | 65 | [A] | |
| 7A | | 30 | 00110000 | 48 | [0] | |
| 7B | | 34 | 00110100 | 52 | [4] | |
| 7C | | 0A | 00001010 | 10 | [^] | |
| 7D | | 20 | 00100000 | 32 | [ ] | |
| 7E | Extension Flag | 00 | 00000000 | 0 | | |
| 7F | Checksum | **EF** | 11101111 | 239 | | |