TO :

DATE : July 6. 2010

*SAMSUNG TFT-LCD*
# MODEL NO : LTN156AT14-F01

NOTE : Extension code [ F ]
→ LTN156AT14-**F**
Surface type [ **Glare** ]

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

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**SAMSUNG ELECTRONICS CO., LTD.**

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## CONTENTS

# REVISION HISTORY

| Date | Revision No. | Page | Summary |
|---|---|---|---|
| Apr. 23. 2010 | P00 | All | .The preliminary specification of LTN156AT14-F01 was issued first. |
| Apr. 26. 2010 | P01 | p.30 – p.32 | .The EDID was updated. |
| May 20. 2010 | P02 | p. 6<br>p. 10<br>p. 12 | .The Max. voltage of logic input was changed from +2.45V to +0.3.<br>.The Min. & Max. value of Main frequency were updated.<br>.The Min. of PWM frequency was updated as 0.1KHz. |
| July, 6. 2010 | A00 | All<br>p. 6<br>p. 7<br><br>p. 9<br>p. 10<br><br>p. 12<br><br><br><br>p. 14<br><br><br>p. 15<br><br>p.22~23<br>p.26~27<br><br>p.30~32 | .The approval specification of LTN156AT14-F01 was updated.<br>.The absolute rating of VLED was updated as Fujitsu's request.<br>.Typ. and Min. value of viewing angle was updated.<br>.fDCLX was changed from 72.33MHz to 75.55MHz.<br>.SEC changed definition of 13points positions as HD resolution.<br>.SEC updated Power based on real value.<br>.fDCLX was changed from 72.33MHz to 75.55MHz.<br>.LED driver was changed from Richtek(RT8561) to Intersil (ISL97670) as Fujitsu's request.<br>.Due to changing LED driver, Max. of PWM low level, Min. of PWM high level and Max. of LED enable were changed.<br>.The name of LVDS connector was changed from IPEX 20455-040E-12 to IPEX 20455-040E-02R.<br>.LED enable off range was changed from 0~0.1V to 0~0.8V.<br>.The name of LVDS connector was changed from IPEX 20455-040E-02S to IPEX 20455-040E-02R.<br>.Outline dimension was updated.<br>.Fujitsu's CP No was updated.<br>[CP496542-01 01A]<br>.EDID was changed as correcting Gx. (0.335 to 0.330)<br>[Checksum 68] → [Checksum 6D] |
|  |  |  |  |

# GENERAL DESCRIPTION

DESCRIPTION

LTN156AT14 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
- RoHS comply 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 (Reflection ratio 4~5%) | | 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 | 210.0 | mm | |
| | Depth (D) | - | - | 5.65 | mm | (1) |
| Weight | | - | 458 | 490 | g | |

Note  (1) Measurement condition of outline dimension
. Equipment : Vernier Calipers
. Push Force : 750g·f (minimum)

# 1. ABSOLUTE  MAXIMUM  RATINGS

## 1.1 ENVIRONMENTAL  ABSOLUTE  RATINGS

| Item | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Storage temperate | $T_{STG}$ | -20 | 60 | °C | (1) |
| Operating temperate (Temperature of glass surface) | $T_{OPR}$ | 0 | 50 | °C | (1) |
| Shock ( non-operating ) | Snop | - | 210 | G | (2),(5) |
| | | | 50 | | (3),(5) |
| Vibration (non-operating) | Vnop | - | 2.41 | G | (4),(5) |
| Altitude ( operation ) | - | - | 10,000 | feet | |
| Altitude ( storage ) | - | - | 40,000 | feet | |

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 $\geq$ 40 °C)  No condensation.
(2)  2ms,  half  sine wave, one time for  $\pm$X,$\pm$Y,$\pm$Z.
(3)  11ms, Trapezoidal wave, one time for  $\pm$X,$\pm$Y,$\pm$Z.
(4)  5~500 Hz,  Random vibration,   30  min for X,Y,Z.
(5)  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.

**Relative Humidity ( %RH)**

100
95
80
60   **Operating Range**
40
20
8
5   **Storage Range**
0

-40      -20       0       20      40       60      80

**Temperature (°C)**
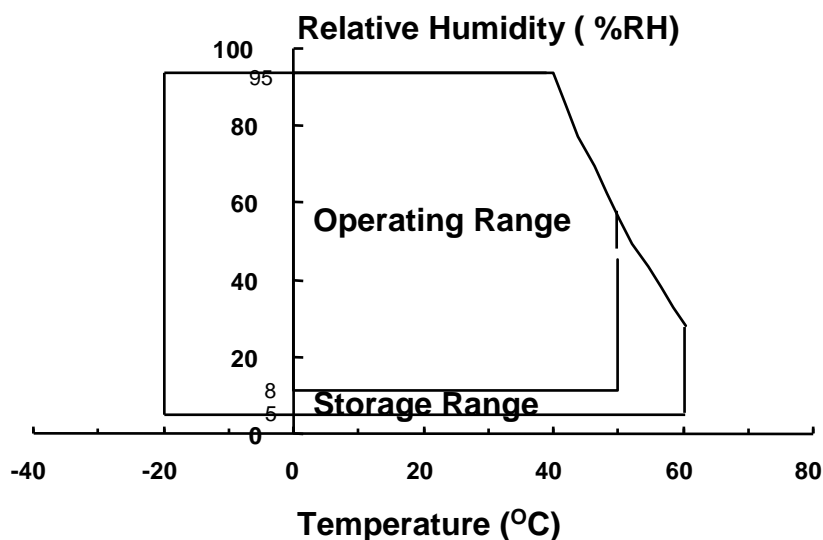
## 1.2 ELECTRICAL ABSOLUTE RATINGS

### (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) |
| Absolute rating of VLED | $V_{LED}$ | 4.5 | 26 | V | (1) |

Note (1) Within Ta (25 $\pm$ 2 ℃ )

## 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, fDCLK = **75.55** MHz, PWM duty = 100%

| Item | | Symbol | Condition | Min. | Typ. | Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | 1center point | 400 | 500 | - | - | (1), (2), (5) |
| Response Time at Ta ( Rising + Falling ) | | $T_R + T_F$ | | - | 16 (6+10) | 25 | msec | (1), (3) |
| Average Luminance of White | | $Y_{L,AVE}$ | 1center point | 340 | 400 | - | cd/m$^2$ | PWM duty = 100% (4) |
| Color Chromaticity ( CIE 1931 ) | Red | $R_X$ | Normal Viewing Angle $\phi = 0$ $\theta = 0$ | 0.585 | 0.615 | 0.645 | - | (1), (5) SR-3 |
| | | $R_Y$ | | 0.325 | 0.355 | 0.385 | | |
| | Green | $G_X$ | | 0.300 | 0.330 | 0.360 | | |
| | | $G_Y$ | | 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 | 45 | - | Degrees | (1), (5) |
| | | $\theta_R$ | | 40 | 45 | - | | |
| | Ver. | $\phi_H$ | | 10 | 15 | - | | |
| | | $\phi_L$ | | 30 | 35 | - | | |
| Color Gamut | | | | - | 60 | - | % | |
| 13 Points White Variation | | $\delta_L$ | | - | - | 1.7 | - | (6) |

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

Normal Line
$\phi = 0°, \theta = 0°$

$\theta_L$

$\theta_R$

$\phi_L$  $\phi_H$

$\theta_L = 90°$  x

12 O'clock direction
$\phi_H = 90°$

y

6 O'clock y'
direction
$\phi_L = 90°$

x'

$\theta_R = 90°$
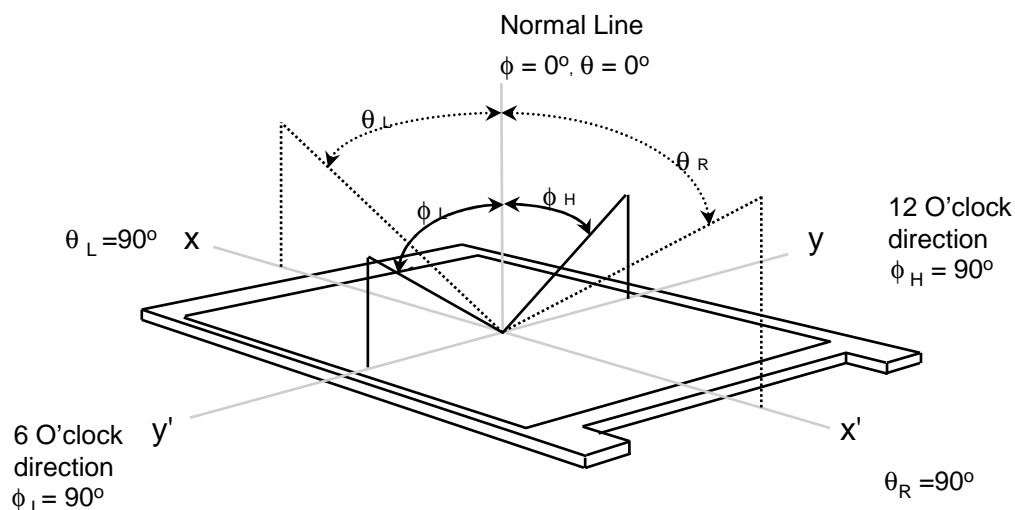
Note 2)  Definition of Contrast Ratio (CR) :  Ratio of  gray max (Gmax) ,gray min (Gmin)
at  center 1point

CR   =  CR (7)

Points    :  (7)  at the figure of Note (6).

Note 3)  Definition of Response time :

Display data  White(TFT OFF)  Black(TFT ON)  White(TFT OFF)

$T_R$  $T_F$

100%
90%

Optical
Response

10%
0%

Time
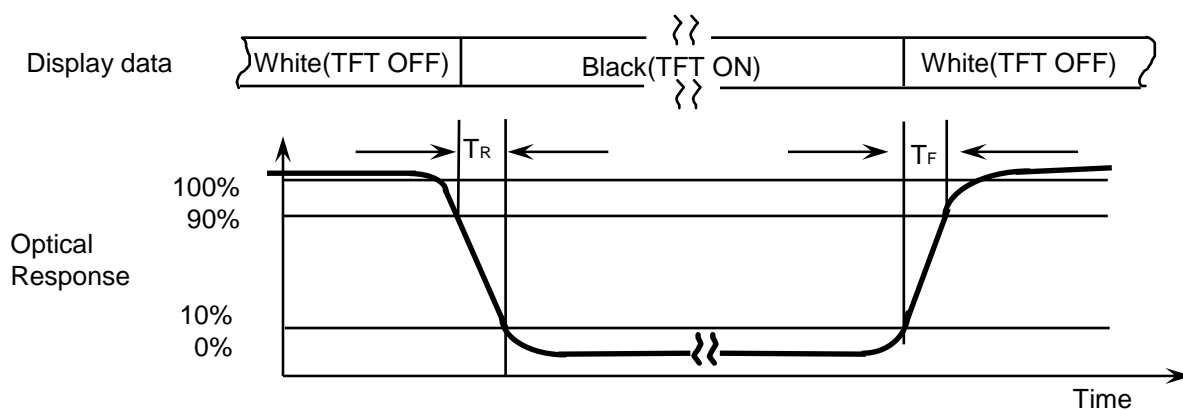
Note 4) Definition of Average Luminance of  White : measure the luminance of white at center 1 point.

. Center 1 point of White ( $Y_{L,AVE}$ )

$Y_{CENTER} = Y_{L7}$

(342)  ( 683)  (1024)

VIEW AREA

(192)

(7)  (384)

(576)
(lines)

○ : test point

**Samsung Secret**

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|---------|----------------|--------|-----------------|------|--------|
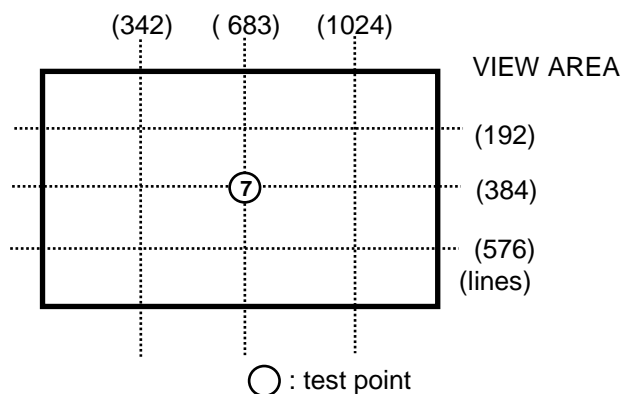
Note 5) After stabilizing and leaVBLg the panel alone at a given temperature for 30 min , the measurement should be executed.  Measurement should be executed in a stable, windless,and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.
LED current :  24.0 mA
Environment condition : Ta  = 25 $\pm$ 2 $^\circ$C

Photo-detector
(TOPCON SR-3)

Field = 2$^\circ$

50cm

TFT-LCD module

LCD panel

Center of the screen

[ Optical characteristics measurement setup ]
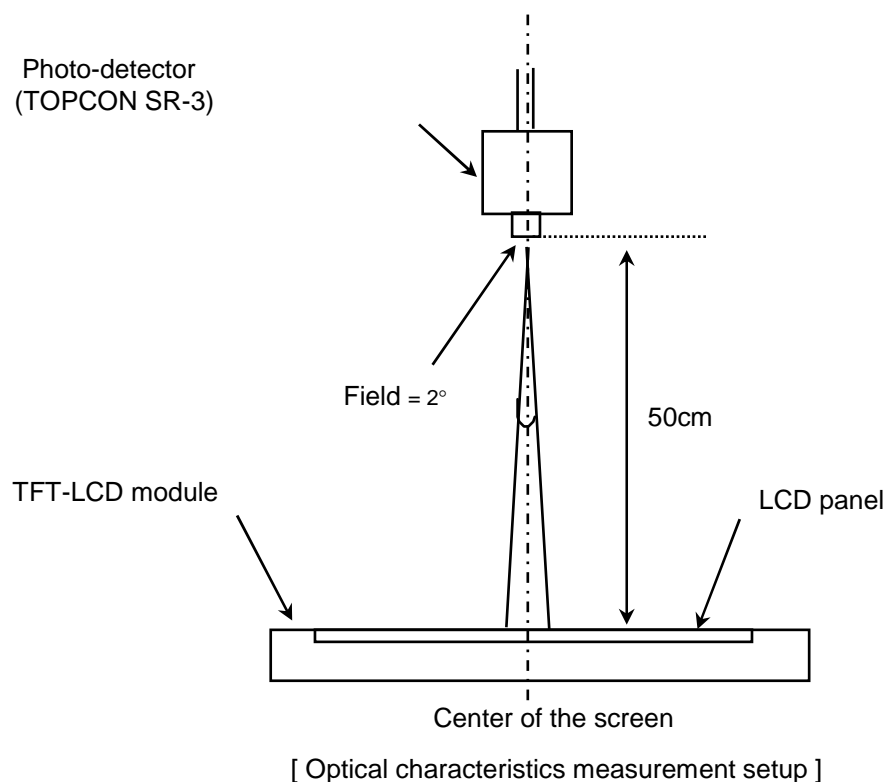
Note 6)  Definition of 13 points white variation ($\delta$ L ), [ ① ~ ⑬ ]

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

10mm

10mm

342       683       1024

10mm

13       12       11

10       9       192

8       7       6       384       ◯ : test point

5       4       576
(lines)

3       2       1

10mm
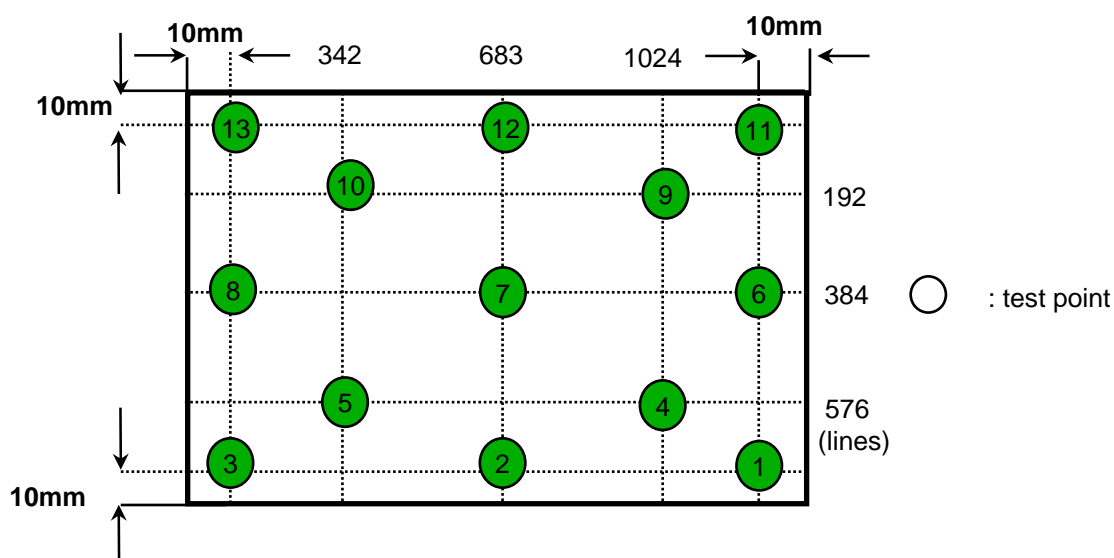
# 3. ELECTRICAL CHARACTERISTICS

## 3.1 TFT LCD MODULE

Ta= $25 \pm 2°C$

| 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 ( +/- 10% ) |
| | Low | $V_{IL}$ | -100 | - | - | mV | |
| Vsync Frequency | | fv | - | 60 | - | Hz | |
| Main Frequency | | $f_{DCLK}$ | 67.5 | 75.55 | 80 | MHz | |
| EDID Input Voltage | | $V_{EDID}$ | 1.8 | 3.3 | 5.5 | V | |
| EDID Input Current | | $I_{EDID}$ | - | 0.8 | 1.0 | mA | $V_{EDID}$=1.8V, $f_c$=400kHZ |
| Skew | | RSKM | -400 | - | +400 | ps | $f_{DCLK}$ =75.55Mhz |
| Rush Current | | $I_{RUSH}$ | - | - | 1.5 | A | (5) |
| Current of Power Supply | White | $I_{DD}$ | - | 250 | - | mA | (2),(4)*a |
| | Mosaic | | - | 350 | - | mA | (2),(4)*b |
| | V. Stripe | | - | 380 | - | mA | (2),(4)*c |
| | Black | | - | 400 | 450 | mA | (2),(3),(4)*d |

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

(2) fv = 60Hz, $f_{DCLK}$ = 75.55 MHZ, $V_{DD}$ = 3.3V , DC Current.

(3) Max. 700mA is fixed by the average of Max. current in the SEC's test. ( So, almost panels are under 700mA, but please also allow some Max. currents that are over 700mA by peaks. )

(4) Power dissipation pattern



*a) White Pattern

VIEW AREA
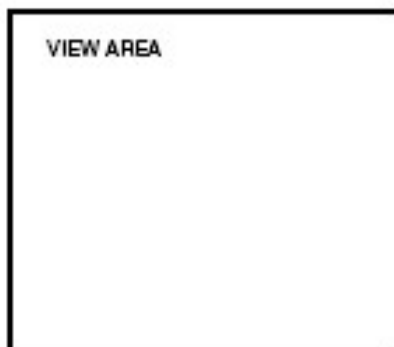
*b) Mosaic Pattern

Display Brightest Gray Level

Display Darkest Gray Level

\*c) 1dot Vertical stripe pattern



\*d) Black Pattern



5) Rush current measurement condition



V_DD rising time is 470us
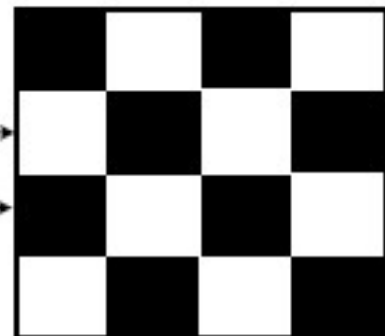
## 3.2  BACK-LIGHT UNIT

Ta= 25 ± 2 °C

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|------|--------|------|------|------|------|------|
| Operating Life Time | Hr | 12,000 | - | - | Hr | (1) |

Note (1) Life time (Hr) of LEDs can be defined as the time in which it continues to operate under the condition Ta= 25 ± 2 °C and PWM duty = 100% until one of the following event occurs.
- When the brightness becomes 50% or lower than the original.

## 3.3  LED Driver

- LED Driver Manufacturer : Intersil (ISL97670)

Ta= 25 ± 2 °C

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|------|--------|------|------|------|------|------|
| Input Voltage | $V_{BL}$ | 7 | 12 | 21 | V | |
| $V_{LED}$ on level voltage | $V_{LED\_on}$ | 7 | - | 21 | V | |
| $V_{LED}$ off level voltage | $V_{LED\_off}$ | 0 | - | 4 | V | |
| Input Current | I | - | - | 550 | mA | Duty=100%, $V_{BLU}$=12V |
| Input Power | Pin | - | - | 6.5 | W | Pin = $V_{BL}$ x I, $V_{BLU}$ = 12V |
| PWM duty ratio | - | 6 | - | 100 | % | (1) |
| PWM Frequency | $F_{PWM}$ | 0.1 | 1 | 10 | KHz | (1) |
| PWM Impedance | $Z_{PWM}$ | 2.4 | - | - | Mohm | |
| PWM high level vol. | $V_{PWM\_H}$ | 1.5 | 3.3 | 5.0 | V | |
| PWM low level vol. | $V_{PWM\_L}$ | 0 | 0 | 0.5 | V | |
| LED_EN Impedance | $Z_{PWM}$ | 50 | - | - | Mohm | |
| LED_EN high vol. | $V_{LED\_EN\_H}$ | 1.5 | - | 5.0 | V | |
| LED_EN low vol. | $V_{LED\_EN\_L}$ | 0 | - | 0.8 | V | |
| LED rush current | $I_{LED\ RUSH}$ | - | - | 1.5 | A | |

Note - (1) PWM can be guaranteed under the same condition as operation temperate $T_{OPR}$ 0 ~ 50 ℃.

# 4. BLOCK DIAGRAM

## 4.1 TFT LCD Module



TFT on Glass

Input ConFujitsutor
I-PEX 20455-040E-12

*LVDS*

LVDS Input/LCDS Output
Timing Controller

*mLVDS*

DC-DC
Converter

DC-DC
Converter
VCOM
Generator

Gamma
Generator

Source
Driver
IC

15.6" HD
TFT-LCD Panel

→ Video Signal
→ Control Signal
→ VCOM
→ Gamma
→ DVDD
→ AVDD
→ Von/Voff

*SOURCE PCB*
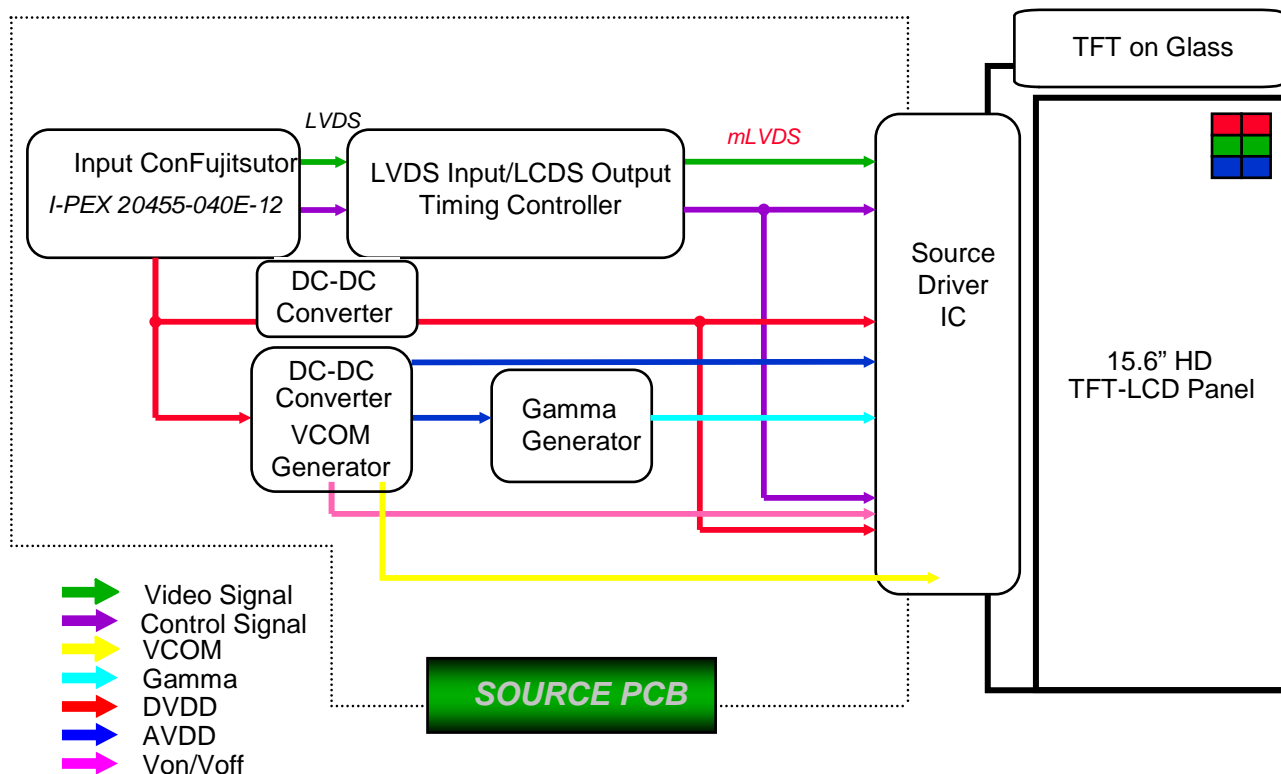
## 4.2 LED conFujitsution and placement



**8 LEDs x 8 channels = Total 64 LEDs**

LED Wiring

LED Placement

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|---|---|---|---|---|---|
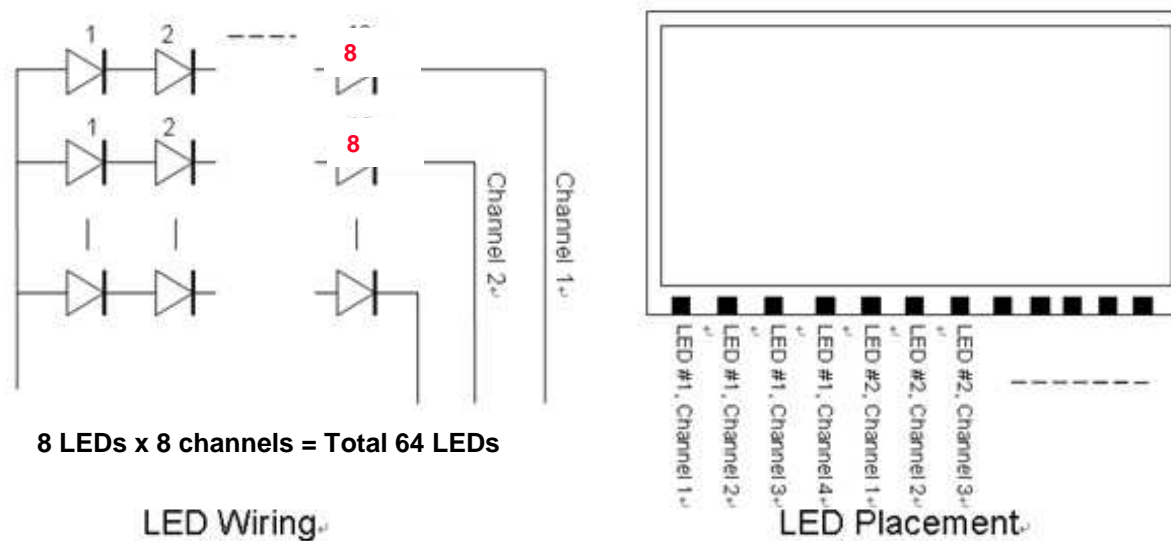
# 5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power   LVDS, ConFujitsutor : IPEX 20455-040E-02R
Mating ConFujitsutor:  IPEX 20454-040T-01

| Pin | Symbol | Function |
|---|---|---|
| 1 | NC | No ConFujitsution (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 proction |
| 6 | CLK_EDID | DDC clock |
| 7 | DATA_EDID | DDC data |
| 8 | RXin0- | LVDS Oth Signal Negative (Odd) |
| 9 | RXin0+ | LVDS Oth Signal Positive (Odd) |
| 10 | GND | Ground |
| 11 | RXin1- | LVDS 1st Signal Negative (Odd) |
| 12 | RXn1+ | LVDS 1st Signal Positive (Odd) |
| 13 | GND | Ground |
| 14 | RXin2- | LVDS 2nd Signal Negative (Odd) |
| 15 | RXn2+ | LVDS 2nd Signal Positive (Odd) |
| 16 | GND | Ground |
| 17 | ClkIN- | LVDS Clock Signal Negative (Odd) |
| 18 | ClkIN+ | LVDS Clock Signal Positive (Odd) |
| 19 | GND | Ground |
| 20~21 | NC | No ConFujitsution |
| 22 | GND | Ground |
| 23~24 | NC | No ConFujitsution |
| 25 | GND | Ground |
| 26~27 | NC | No ConFujitsution |
| 28 | GND | Ground |
| 29~30 | NC | No ConFujitsution |
| 31~33 | GND | Ground |
| 34 | NC | No ConFujitsution |
| 35 | PWM | PWM for luminance control |
| 36 | LED_EN | BL On/Off ( On : 1.5 ~ 5.0, Off : 0 ~ 0.8V ) |
| 37 | NC | No ConFujitsution |
| 38~40 | $V_{BL}$(7~21) | LED power supply 7V ~ 21V |

### 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
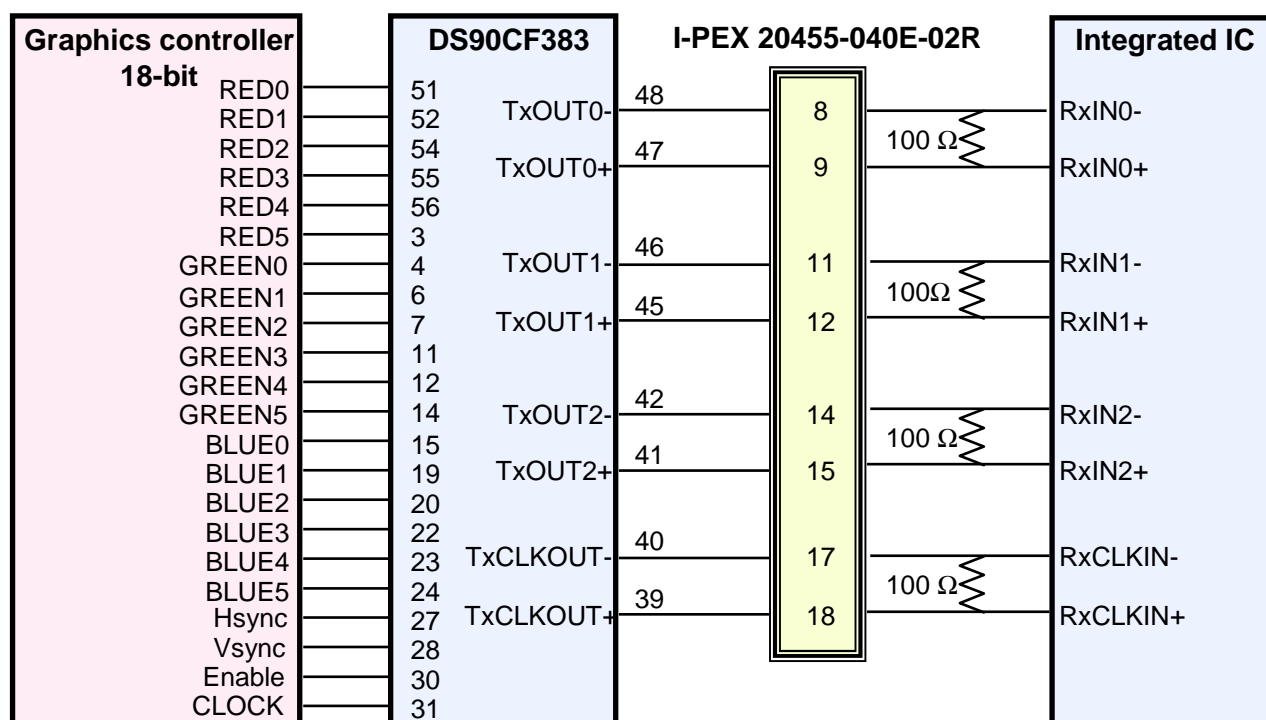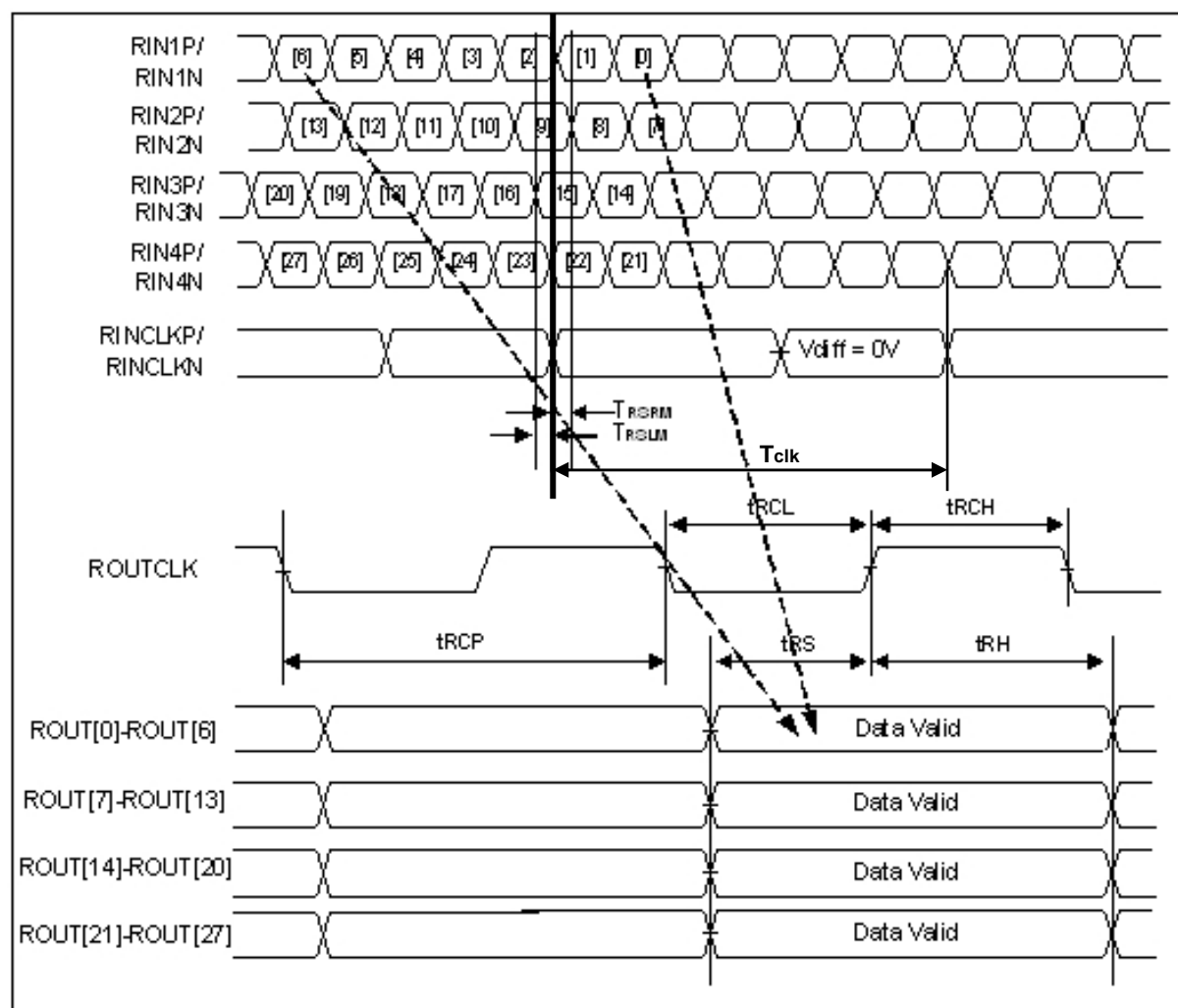


Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

## 5.3 LVDS characteristics



< Definition of LVDS AC characteristics >

### 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) 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

5.5 Pixel Format in the display

Pixel 1                                                                                                          Pixel 1366

Line 1    R G B  R G B  ————————————————  R G B  R G B

LTN156AT14-N

Line 768  R G B  R G B  ————————————————  R G B  R G B

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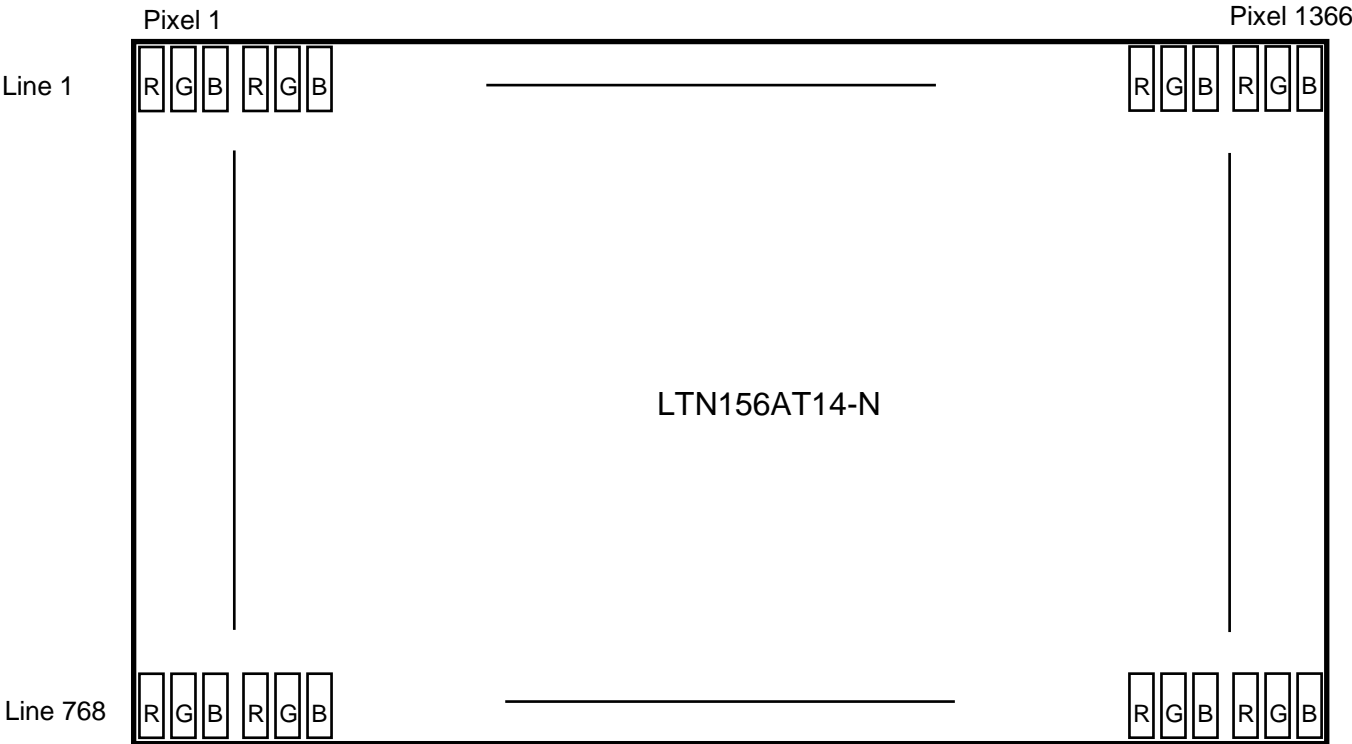
# 6. INTERFACE TIMING

## 6.1 Timing Parameters

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|--------|------|--------|------|------|------|------|------|
| Frame Frequency | Cycle | TV | 780 | 790 | 807 | Lines | - |
| Vertical Active Display Term | Display Period | TVD | - | 768 | - | Lines | |
| One Line Scanning Time | Cycle | TH | 1430 | 1526 | 1620 | Clocks | 2pixel /clock (1) |
| Horizontal Active Display Term | Display Period | THD | - | 1366 | - | Pixels | - |

Note 1) DE signal always should have the same cycle during operation.

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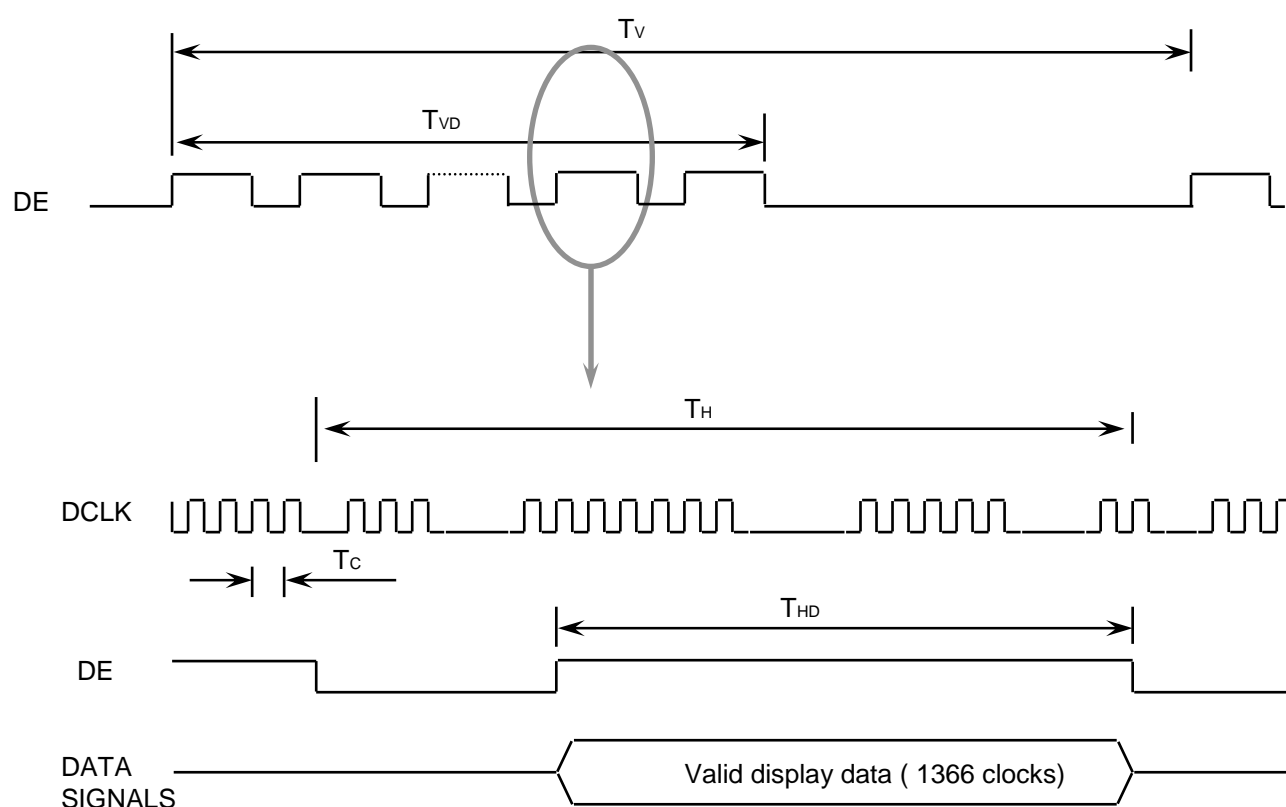
: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.

## Power ON/OFF Sequence



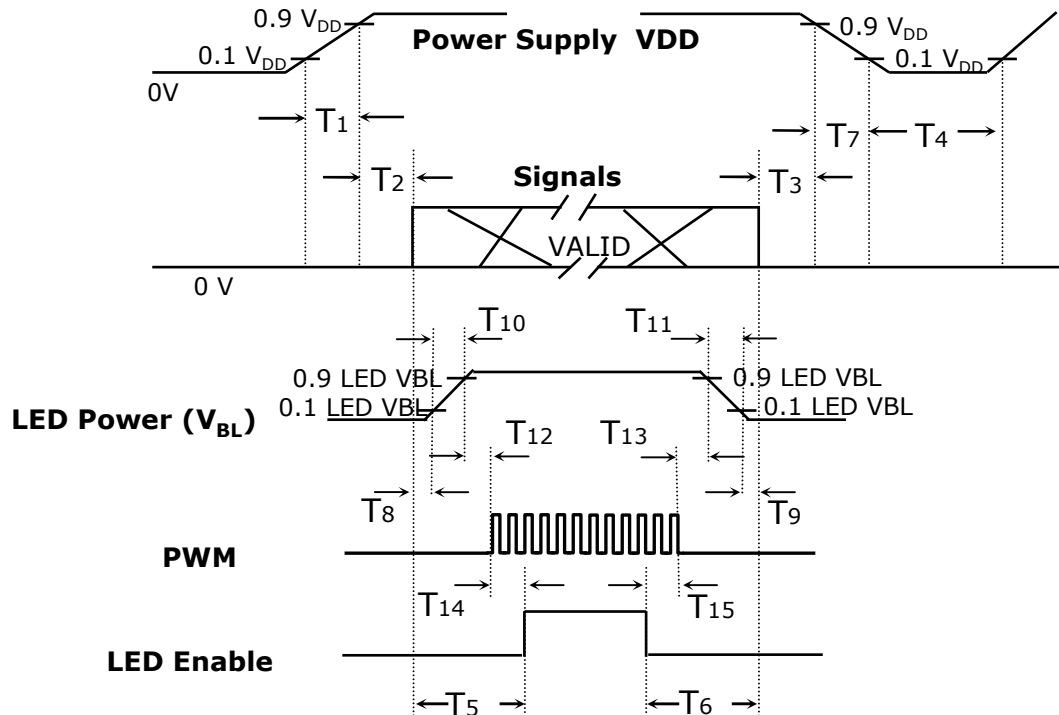| Timing (ms) | Remarks |
|---|---|
| $0 < T_1 \leq 10$ | $V_{DD}$ rising time from 10% to 90% |
| $0 < T_2 \leq 50$ | Delay from $V_{DD}$ to valid data at power ON |
| $0 < T_3 \leq 50$ | Delay from valid data OFF to $V_{DD}$ OFF at power Off |
| $400 \leq T_4$ | $V_{DD}$ OFF time for Windows restart |
| $200 \leq T_5$ | Delay from valid data to LED enable at power ON |
| $200 \leq T_6$ | Delay from valid data off to LED disable at power Off |
| $0 < T_7 \leq 10$ | $V_{DD}$ falling time from 90% to 10% |
| $0 < T_{10} < 10$ | LED VBL rising time from 10% to 90% |
| $0 < T_{11} < 10$ | LED VBL falling time from 90% to 10% |
| $10 < T_{12}$ | Delay from LED driver VBL rising time 90% to PWM ON |
| $10 < T_{13}$ | Delay from PWM Off to LED driver VBL falling time 10% |
| $0 < T_{14}$ | Delay from PWM ON to LED Enable ON |
| $0 < T_{15}$ | Delay from B/L Enable Off to PWM Off |

## Timing Parameters and definition

Note  (1)   Regarding the timing of T8 and T9,  the following one are recommended

10 < T8 : Delay from valid data on to LED driver VBL rising time 10%

10 < T9 : Delay from LED driver VBL falling time 10% to valid data Off
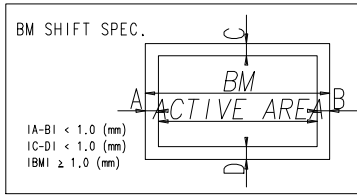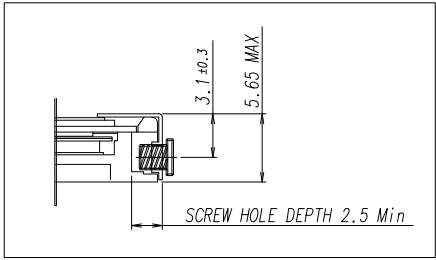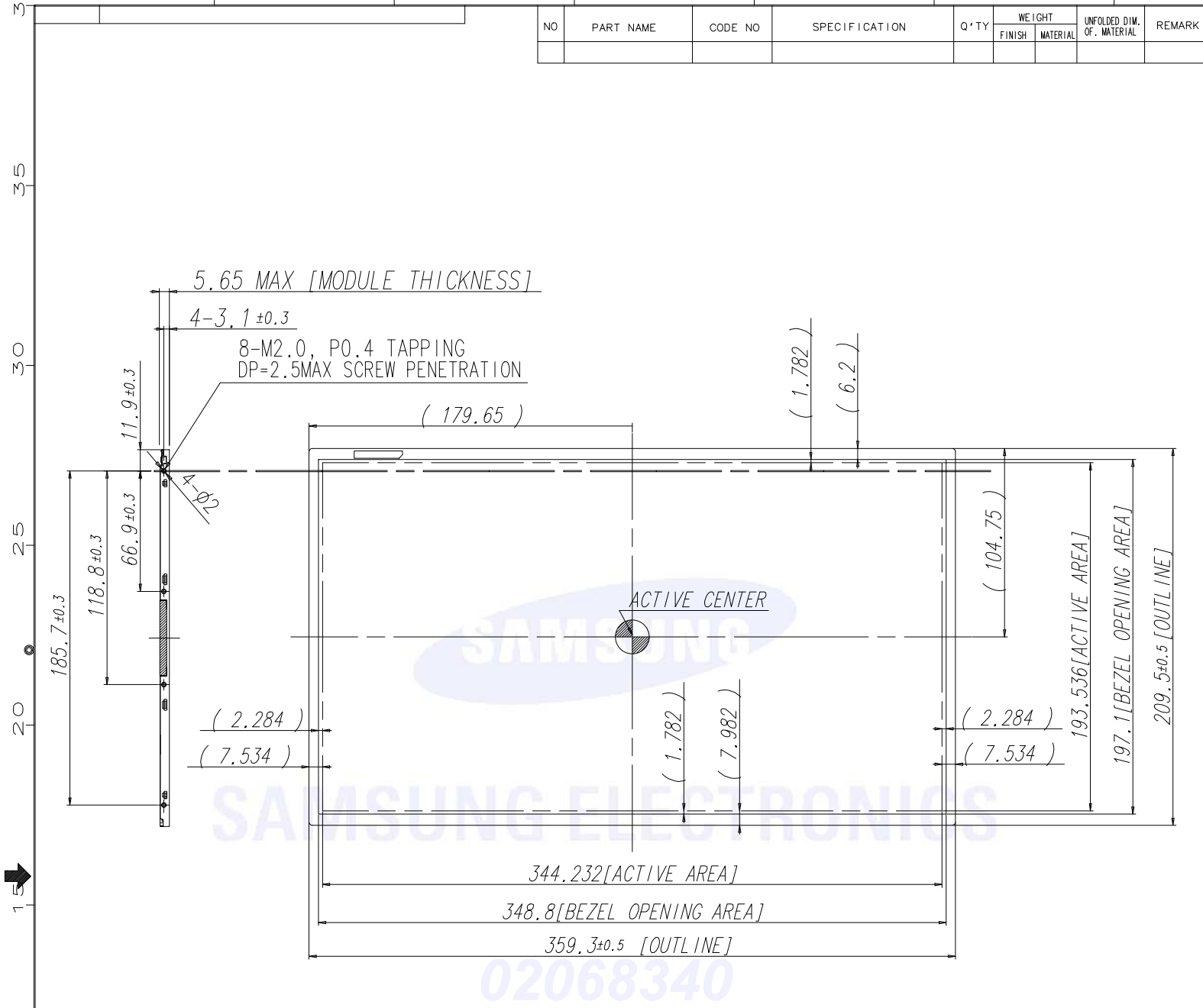
## 7. MECHANICAL OUTLINE DIMENSION

[ Refer to the next page ]

| NO | PART NAME | CODE NO | SPECIFICATION | Q'TY | WEIGHT | | UNFOLDED DIM. OF. MATERIAL | REMARK |
|----|-----------|---------|---------------|------|--------|--------|----------------------------|--------|
| | | | | | FINISH | MATERIAL | | |
| | | | | | | | | |

5.65 MAX [MODULE THICKNESS]

4-3.1 ±0.3

8-M2.0, P0.4 TAPPING
DP=2.5MAX SCREW PENETRATION

11.9 ±0.3

4-φ2

66.9 ±0.3

118.8 ±0.3

185.7 ±0.3

( 179.65 )

( 1.782 )

( 6.2 )

( 104.75 )

193.536[ACTIVE AREA]

197.1[BEZEL OPENING AREA]

209.5 ±0.5 [OUTLINE]

ACTIVE CENTER

( 2.284 )

( 7.534 )

( 1.782 )

( 7.982 )

( 2.284 )

( 7.534 )

344.232[ACTIVE AREA]

348.8[BEZEL OPENING AREA]

359.3 ±0.5 [OUTLINE]

3.1 ±0.3

5.65 MAX

SCREW HOLE DEPTH 2.5 Min

BM SHIFT SPEC.

C

BM
ACTIVE AREA

A          B

D

IA-BI < 1.0 (mm)
IC-DI < 1.0 (mm)
IBMI ≥ 1.0 (mm)

* NOTE
1. SIGNAL INTERFACE CONNECTOR TO BE SPECIFIED AS BELOW.
 -. MAKER :I-PEX(Not accecpt compotable connector basically)
 -. INPUT CONNECTOR : I-PEX 20455-040E-02R
2. LED CONNECTOR FOR BACKLIGHT TO BE SPECIFIED AS BELOW.
 -. MAKER : UJU Electronics
 -. PART NO : 51441-1041
3. MAXIMUM SCREW TORQUE : MAX 2.5 Kgf-cm
4. WEIGHT : 490 g MAX
5. In order to avoid IC damage, it is not allow that overlapping
 of cables or antennas, camera , WLAN , WWAN over these COF locations.
6. Chassis Gap : Max 0.7mm

| 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 | LTN156AT14-N01 | |
| SCALE | 0.3 | | H.H.KIM | | J.S.OK | | | |
| TOLERANCE | | | | | | PART/SHEET NAME | OUTLINE DIMENSION | SHEET 1/1 |
| ±0.5 | . . | 2010.04.15 | . . | 2010.04.15 | | | | |
| | | | | | | SPEC. NO | | |
| SAMSUNG ELECTRONICS | | | | | | CODE NO. | | VER. 000 |

02068340

007051277274708

359.3 ±0.5

209.5 ±0.5

I-PEX ,20455-040E-02R

PIN #1

LTN156AT14-N01

****

MADE IN *****

35 ±1

128 ±1

| REVISION | 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 | LTN156AT14-N01 | | |
| | SCALE | 0.3 | | H.H.KIM | | J.S.OK | | | | |
| | TOLERANCE | | | | | | PART/SHEET NAME | OUTLINE DIMENSION | SHEET | 1/1 |
| | ±0.5 | | . . | 2010.04.15 | . . | 2010.04.15 | | | | |
| | | | | | | SPEC. NO | | | | |
| | SAMSUNG ELECTRONICS | | | | | | CODE NO. | | VER. | |

# 8. PACKING

 1.  CARTON(Internal Package)

  (1) Cushion Pad

     Corrugated fiberboard box and corrugated cardboard as shock absorber

  (2) Packing Method



CUSHION BOTTOM

PANEL : 2EA/SLIT

CUSHION TOP, BOTTOM
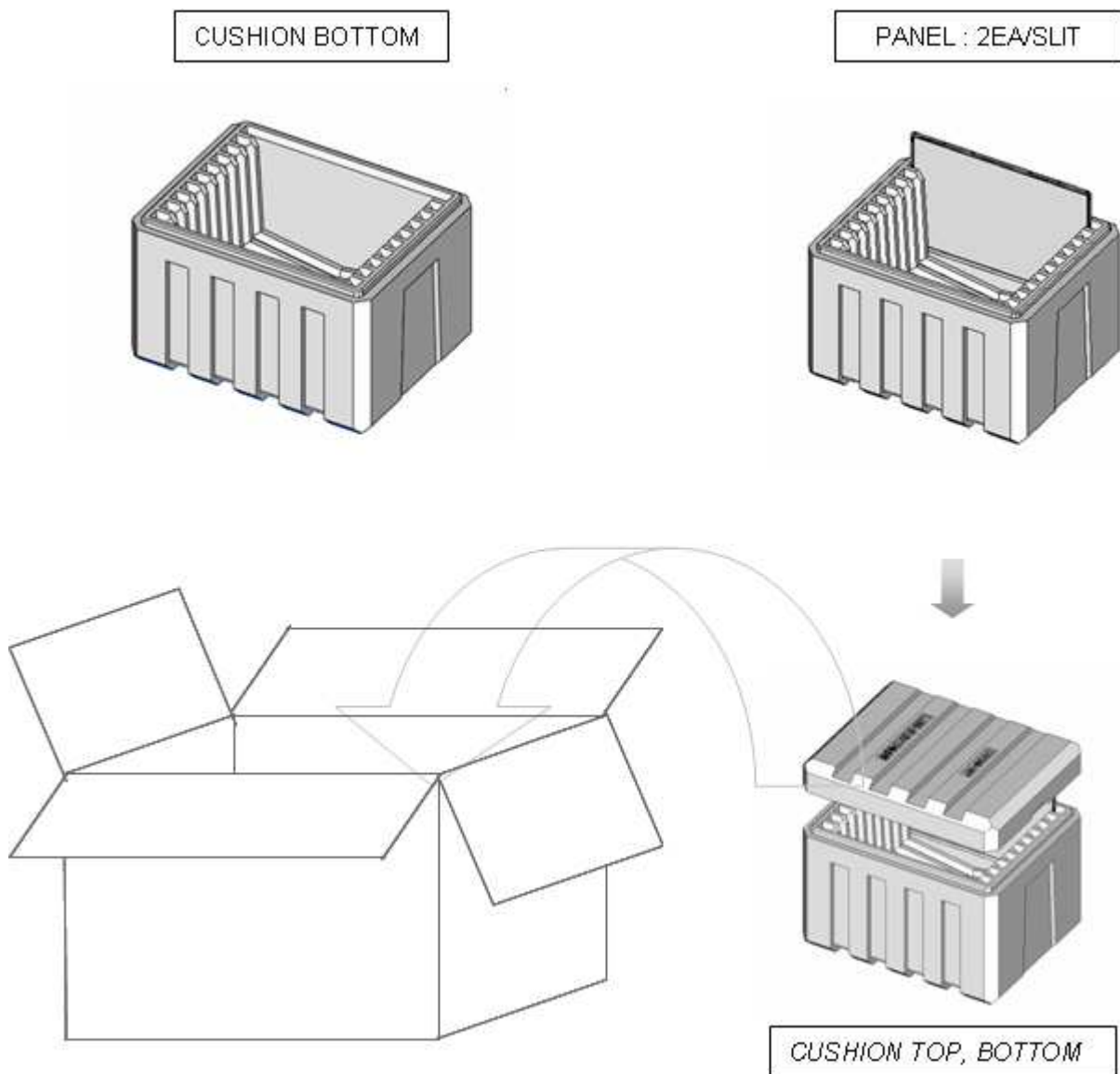
        Note 1) Total Weight : Approximately 15.0 kg
             2) Acceptance number of piling : 20 sets
             3) Carton size : 344(W) x 432(D) x 329 (H)
             4) MAX accumulation quantity : 5 cartons

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### (3)Packing Material

| No | Part name | Quantity |
|----|-----------|----------|
| 1 | Static electric protective sack | 20 |
| 2 | Cushion Top<br>Cushion Bottom | 1 set |
| 3 | Pictorial marking | 2 pcs |
| 4 | Carton | 1 set |

### (4)Pallet Form



985mm

1150mm

120mm

Hoof
5mm

432mm  344mm

329mm
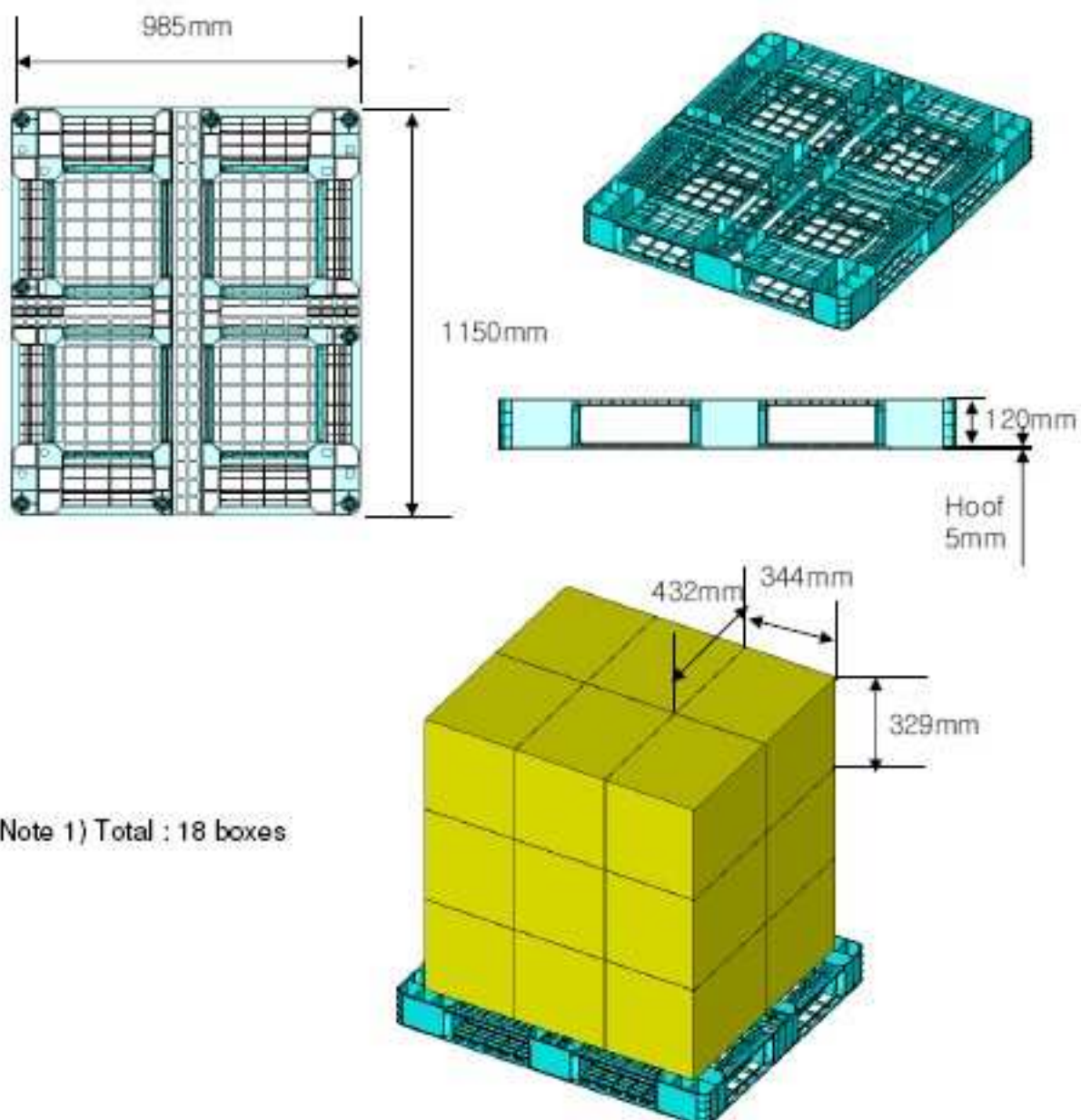
Note 1) Total : 18 boxes

## 9. MARKINGS & OTHERS

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

(1) Parts number : LTN156AT14-F01
(2) Revision code : 3 letters
(3) Lot number : X X X X  XX XX XX    F01

```
                                        SEC Revision Code
                                        Panel number
                                        Cell ID
                                        Lot  ID
                                        Month
                                        Year
                                        Product Code
                                        Line
```
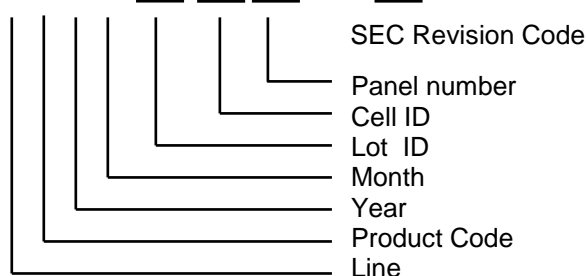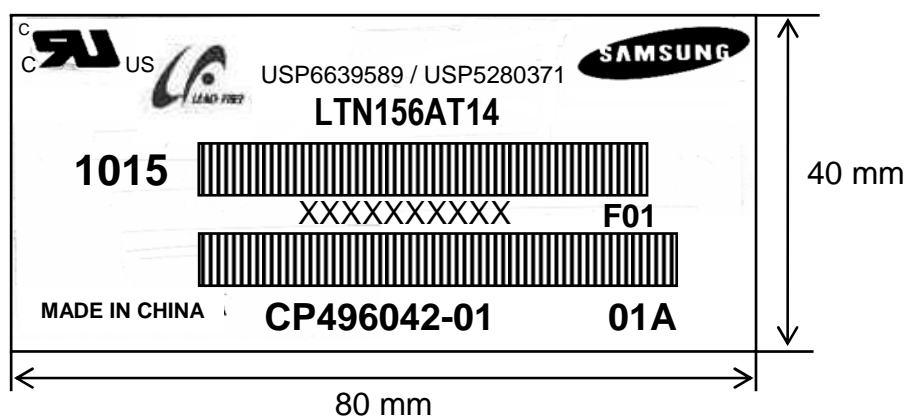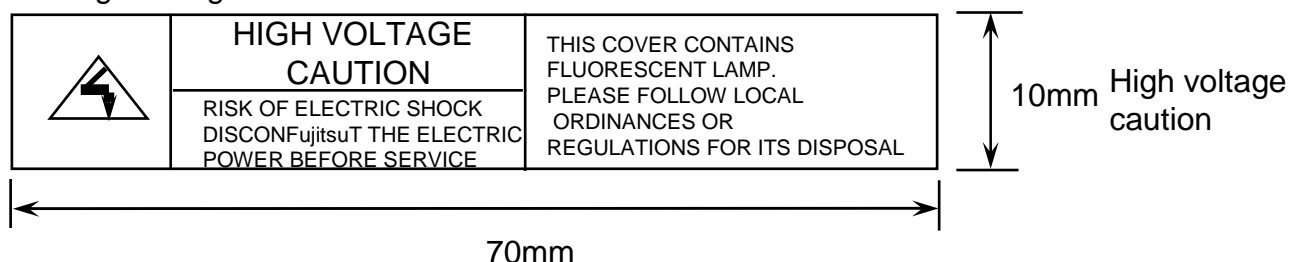
(4) Nameplate Indication

```
┌──────────────────────────────────────────────┐  ▲
│ C ℝℳ    LEAD FREE   USP6639589 / USP5280371  SAMSUNG │  │
│ C   US                                        │  │
│              LTN156AT14                       │  │
│                                               │  │
│  1015  ‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖         │ 40 mm
│                                               │  │
│         XXXXXXXXXX        F01                  │  │
│        ‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖‖           │  │
│  MADE IN CHINA   CP496042-01      01A          │  ▼
└──────────────────────────────────────────────┘
        ◄──────────── 80 mm ────────────►
```

Parts name            : LTN156AT14
Lot number            : XXXXXXXXXX
Inspected  work week  : 1015 (2010 year 15th week)
Product Revision Code : F01
US Patents No.        : USP6639589 / USP5280371
Fujitsu's part No.    : CP496042-01 01A

High voltage caution label

```
┌───────┬─────────────────────┬──────────────────────────┐  ▲
│  ⚡   │   HIGH VOLTAGE      │ THIS COVER CONTAINS       │  │
│       │      CAUTION        │ FLUORESCENT LAMP.         │ 10mm   High voltage
│       │ RISK OF ELECTRIC SHOCK │ PLEASE FOLLOW LOCAL    │  │     caution
│       │ DISCONFujitsuT THE ELECTRIC │ ORDINANCES OR      │  │
│       │ POWER BEFORE SERVICE │ REGULATIONS FOR ITS DISPOSAL │ ▼
└───────┴─────────────────────┴──────────────────────────┘
  ◄──────────────────── 70mm ────────────────────►
```

(5) Packing small box attach

**SAMSUNG**
ELECTRONICS

|||||||||||||||||||||||||||||||||||||||||||||||||||||||

DEVICE          : LTN156AT14
TYPE            :  F01
QUANTITY        : 20 PCS

||||||||||||||||||||||||||||||||||||||||

CO6040001
**CP496042-01          01A**

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|---------|----------------|--------|-----------------|------|---------|
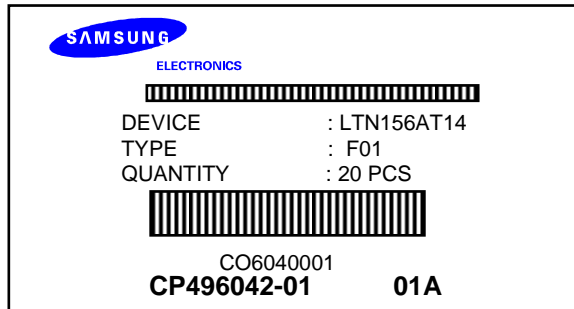
# 10. GENERAL PRECAUTIONS

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 back-light.

   (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 conFujitsutor shall not be touched directly with bare hands.

**Samsung Secret**

## 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 conFujitsut,disconFujitsut 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 back-light conFujitsutor and its inverter power supply shall be a minimized length and be conFujitsuted directly . The longer cable between the back-light 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.

( f ) When you conFujitsut a signal cable to LCD, remove an AC adapter by all means.
In addition, to conFujitsut with keep the correct sequence, not to occur the short by left voltage.

## 4. OTHERS

(a) Ultra-violet ray filter is Fujitsuessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconFujitsution 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.

Approval

# 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 E | 3 character ID |
| 09 | | A3 | 10100011 | 163 | C | "SEC" |
| 0A | ID Product Code | 34 | 00110100 | 52 | [4] | |
| 0B | | 46 | 01000110 | 70 | [F] | |
| 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 | 14 | 00010100 | 20 | 2010 | 2010 |
| 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 | 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 | 89 | 10001001 | 137 | | 10000111 |
| 1A | Blue/white low bits | A5 | 10100101 | 165 | | 11111110 |
| 1B | Red x/ high bits | 9D | 10011101 | 157 | 0.615 | Red x 0.615= 10011101 |
| 1C | Red y | 5B | 01011011 | 91 | 0.355 | Red y 0.355= 01011000 |
| 1D | Green x | 54 | 01010100 | 84 | 0.330 | Green x 0.330= 01010101 |
| 1E | Green y | 9C | 10011100 | 156 | 0.610 | Green y 0.610= 10011100 |
| 1F | Blue x | 26 | 00100110 | 38 | 0.150 | Blue x 0.150= 00100110 |
| 20 | Blue y | 19 | 00011001 | 25 | 0.100 | Blue y 0.100= 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 | | |

| Addr | Descriptor | Hex | Binary | Dec | Value | Description |
|---|---|---|---|---|---|---|
| 36 | | 83 | 10000011 | 131 | 75.55 | Main clock= 75.55 MHz |
| 37 | | 1D | 00011101 | 29 | | |
| 38 | | 56 | 01010110 | 86 | 1366 | Hor active=1366 pixels |
| 39 | | E8 | 11101000 | 232 | 232 | Hor blanking=232 pixels |
| 3A | | 50 | 01010000 | 80 | | 4bit : 4bit |
| 3B | | 00 | 00000000 | 0 | 768 | Vertcal active=768 lines |
| 3C | | 14 | 00010100 | 20 | 20 | Vertical blanking=20 lines |
| 3D | | 30 | 00110000 | 48 | | 4bit : 4bit |
| 3E | | 30 | 00110000 | 48 | 48 | |
| 3F | Detailed timing/monitor | 20 | 00100000 | 32 | 32 | H sync. Width=32 pixels |
| 40 | descriptor #1 | 25 | 00100101 | 37 | 2 / 5 | V sync. Offset=2 lines / V sync. Width=5 lines |
| 41 | | 00 | 00000000 | 0 | | 2bit : 2bit :2bit :2bit |
| 42 | | 58 | 01011000 | 88 | 344 | H image size= 344 mm(approx) |
| 43 | | C1 | 11000001 | 193 | 193 | V image size = 193 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 | | 00 | 00000000 | 0 | | |
| 49 | | 00 | 00000000 | 0 | | |
| 4A | | 00 | 00000000 | 0 | | Manufacturer Specified (Timing) |
| 4B | | 0F | 00001111 | 15 | | |
| 4C | | 00 | 00000000 | 0 | | |
| 4D | | 00 | 00000000 | 0 | | **Value**=HSPWmin / 2 |
| 4E | | 00 | 00000000 | 0 | | **Value**=HSPWmax / 2 |
| 4F | Detailed timing/monitor | 00 | 00000000 | 0 | | **Value**=Thbpmin /2 |
| 50 | descriptor #2 | 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 pixelclks |
| 56 | | B4 | 10110100 | 180 | | Thpmax=**value**\*2 + HA pixelclks |
| 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 | | |
| 5B | | 00 | 00000000 | 0 | | |
| 5C | | 00 | 00000000 | 0 | | ASCII Data String Tag |
| 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 | | |
| 6D | | 00 | 00000000 | 0 | | |
| 6E | | 00 | 00000000 | 0 | | Monitor Name Tag (ASCII) |
| 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 | | 31 | 00110001 | 49 | [1] | |
| 77 | | 34 | 00110100 | 52 | [4] | |
| 78 | | 2D | 00101101 | 45 | [-] | |
| 79 | | 46 | 01000110 | 70 | [F] | |
| 7A | | 30 | 00110000 | 48 | [0] | |
| 7B | | 31 | 00110001 | 49 | [1] | |
| 7C | | 0A | 00001010 | 10 | [^] | |
| 7D | | 20 | 00100000 | 32 | [ ] | |
| 7E | Extension Flag | 00 | 00000000 | 0 | | |
| 7F | Checksum | **6D** | 01101101 | **109** | | |