SAMSUNG

ELECTRONICS

Approval

LEAD-FREE

TO　　　　:

DATE　　　: Mar. 12 , 2012

SAMSUNG TFT-LCD

MODEL NO. : LTN156AT19-8

NOTE : Extension code [- 8xx　　]
　　　　　→ LTN156AT19-8xx
　　　　Surface type [A/G]

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

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Application engineering part, Mobile Division
Samsung Electronics Co., Ltd.

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REVISION HISTORY

Date	Revision No.	Page	Summary
Mar. 12, 2012	A00	All	The approval specification of LTN156AT19-8 was issued first.

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GENERAL DESCRIPTION

DESCRIPTION

LTN156AT19 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices.
This model is composed of a TFT LCD panel, a driver circuit and a backlight unit.
The resolution of a 15.6" contains 1366 x 768 pixels and can display up to 16.2M colors.
6 O'clock direction is the optimum viewing angle.

FEATURES

- High contrast ratio
- HD(1366 x 768 pixels) resolution
- Fast Response
- LED Back Light with embedded LED Driver
- DE (Data enable) only mode
- 3.3V LVDS Interface
- Onboard EEDID chip
- 6Bit FRC.

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	16.2M		
Number of pixel	1366 * 768	pixel	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.252 (H) x 0.252 (V) (TYP.)	mm	
Display Mode	Normally white		
Surface treatment	Haze 25%, Hardness 2H		A/G

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Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	358.8	359.3	359.8	mm	
	Vertical (V)	208.95	209.45	209.95	mm	
	Depth (D)	-	-	3.8	mm	PCB Area 4.0mm (1)
Weight		-	-	430	g	

Note (1) Measurement condition of outline dimension
. Equipment : Bernier 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)
Operating temperate (Temperature of glass surface)	TOPR	0	50	°C	(1)
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 $\geq$ Ta)
Maximum wet - bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation

Relative Humidity (%RH)
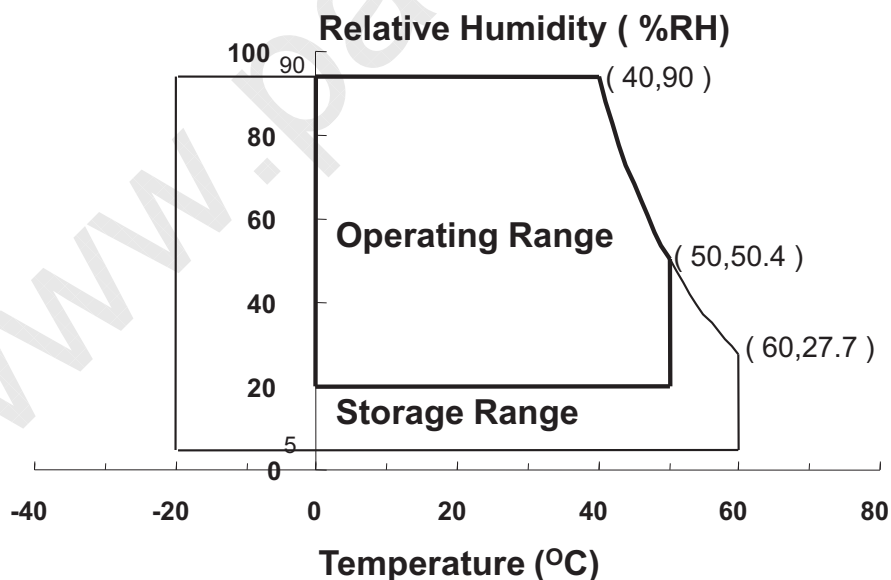
(2) 2ms, half sine wave, one time for ±X, ±Y, ± Z.
(3) 5 - 500 Hz, random vibration, 30min for X, Y, Z.
(4) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.

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1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

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

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

Note (1) Within Ta (25 ± 2 °C)

(2) BACK-LIGHT UNIT

Ta = 25 ± 2 °C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Current	I_L	-	27.5	-	mArms	(1)
LED Voltage	V_L	-	3.2	-	V	(1)

Note 1) Permanent damage to the device may occur if maximum values are exceeded
         Functional operation should be restricted to the conditions described under normal operating conditions.

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2. OPTICAL CHARACTERISTICS

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5). Measuring equipment ： TOPCON SR-3
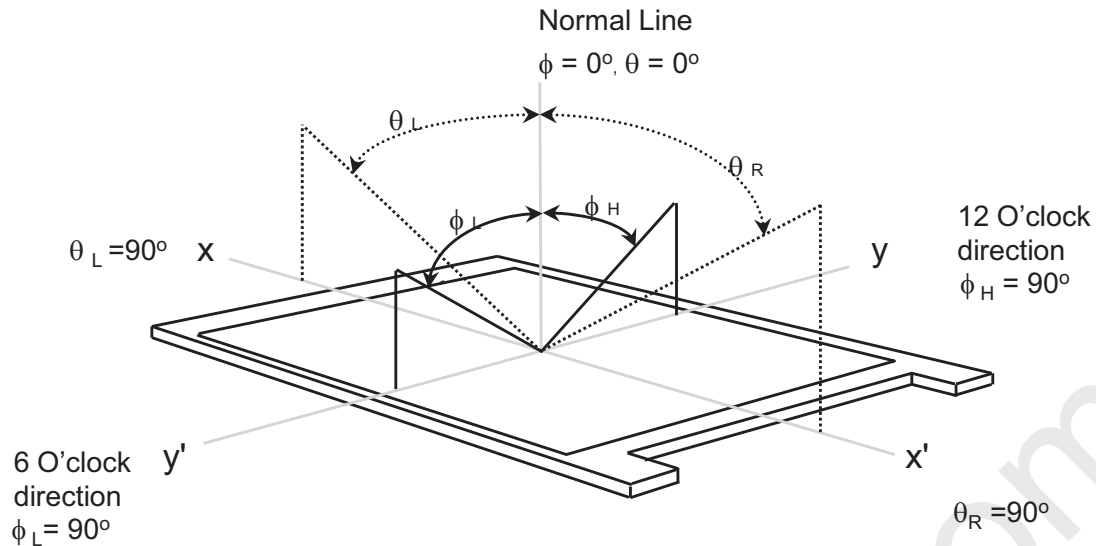
* Ta = 25 ± 2 °C, V_{DD}=3.3V, fv= 60Hz, f_{DCLK} = 70.7MHz, IF = 100% duty

Item		Symbol	Condition	Min.	Typ.	Max	Unit	Note
Contrast Ratio (5 Points)		CR		300	500	-	-	(1), (2), (5)
Response Time at Ta (Rising + Falling)		T_{RT}		-	16	25	msec	(1), (3)
Average Luminance of White (5 Points)		$Y_{L,AVE}$		255	300	-	cd/m^2	IF=100% duty (1), (4)
Color Chromaticity (CIE)	Red	R_X	Normal Viewing Angle $\phi = 0$ $\theta = 0$	Typ- 0.03	0.570	Typ +0.03	-	(1), (5) SR-3
		R_Y			0.340			
	Green	G_X			0.330			
		G_Y			0.560			
	Blue	B_X			0.160			
		B_Y			0.135			
	White	W_X			0.313			
		W_Y			0.329			
Viewing Angle	Hor.	θ_L	CR ≥ 10 At center	40	45	-	Degrees	
		θ_H		40	45	-		
	Ver.	ϕ_H		15	15	-		
		ϕ_L		30	30-	-		
Color Gamut		CG		-	45	-	%	
13 Points White Variation		δ_L		-	1.7	2.0	-	(6)

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

Normal Line
$\phi = 0°, \theta = 0°$

θ_L

θ_R

ϕ_I ϕ_H

$\theta_L = 90°$ x

12 O'clock direction
$\phi_H = 90°$

y

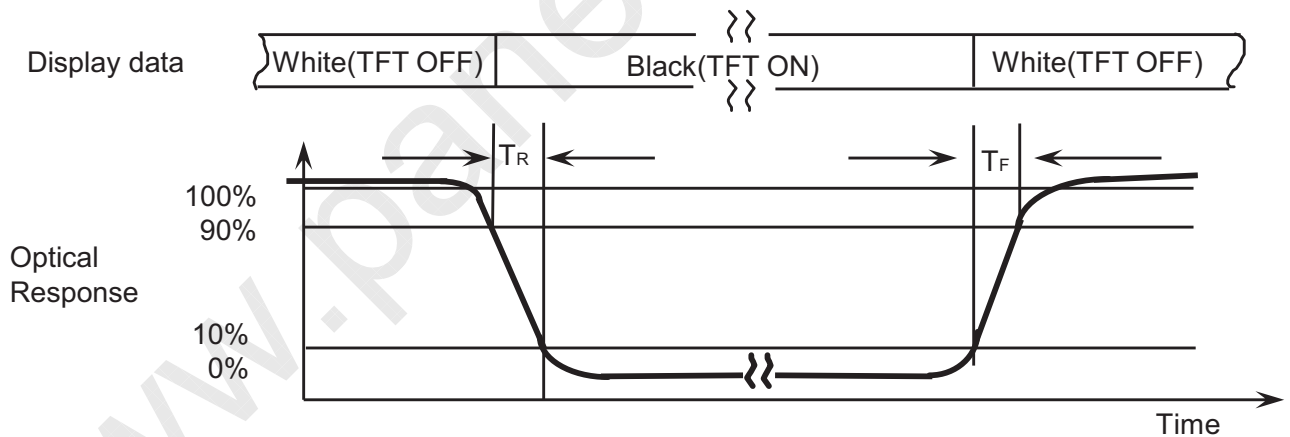6 O'clock direction
$\phi_L = 90°$ y'

x'

$\theta_R = 90°$

Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)
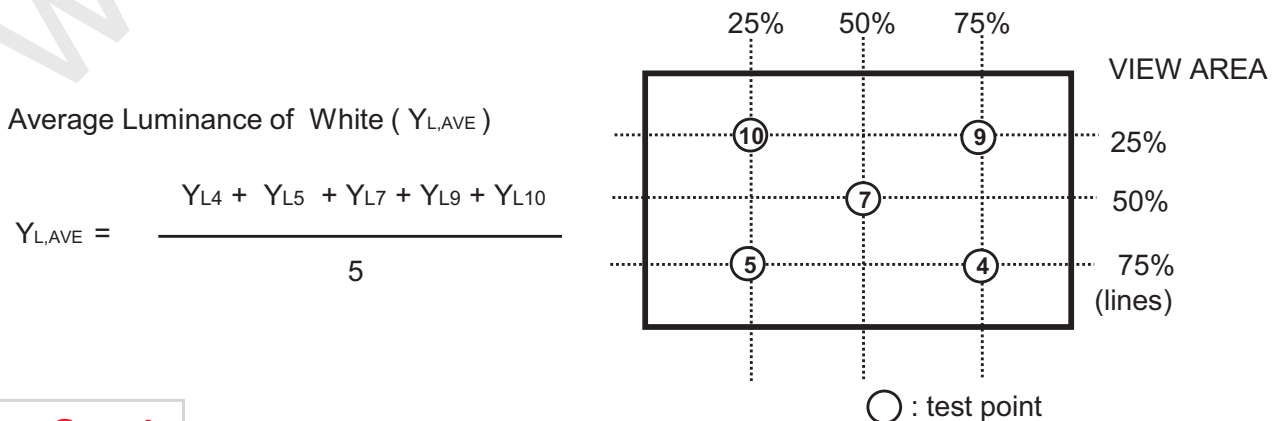
$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

Points : ④ , ⑤ , ⑦ , ⑨ , ⑩ at the figure of Note (6).
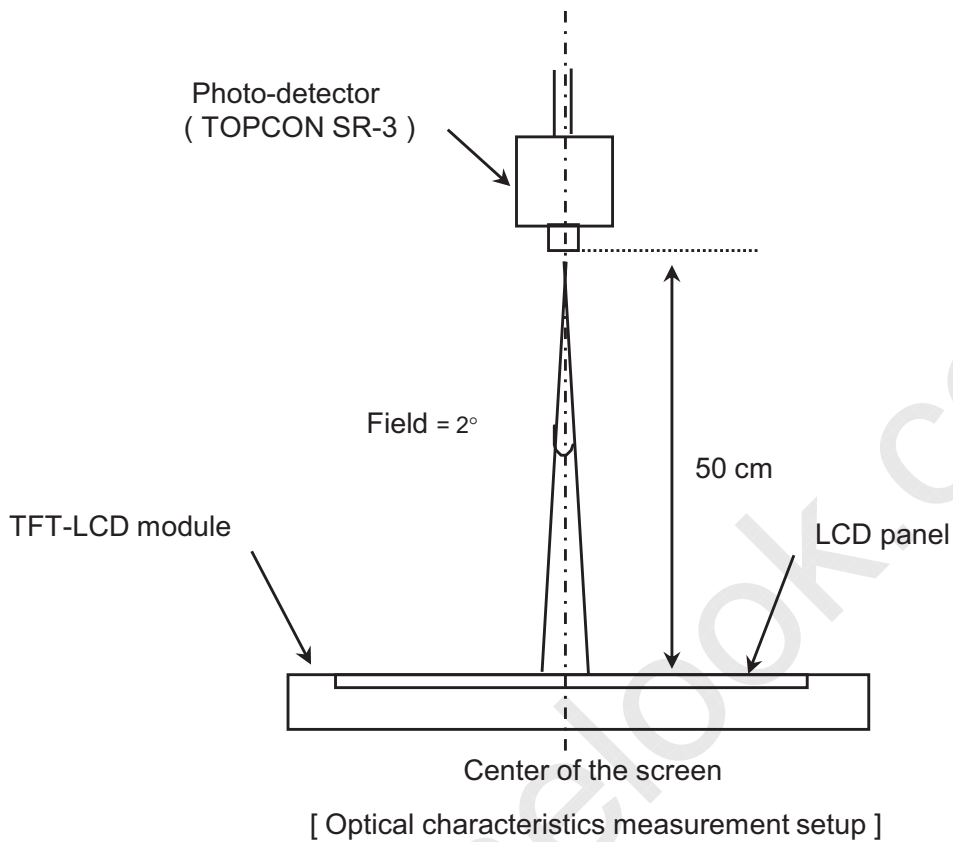
Note 3) Definition of Response time :

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

T_R T_F

Optical Response

100%
90%

10%
0%

Time

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

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

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

25%   50%   75%

VIEW AREA

⑩   ⑨   25%

⑦   50%

⑤   ④   75% (lines)

○ : test point

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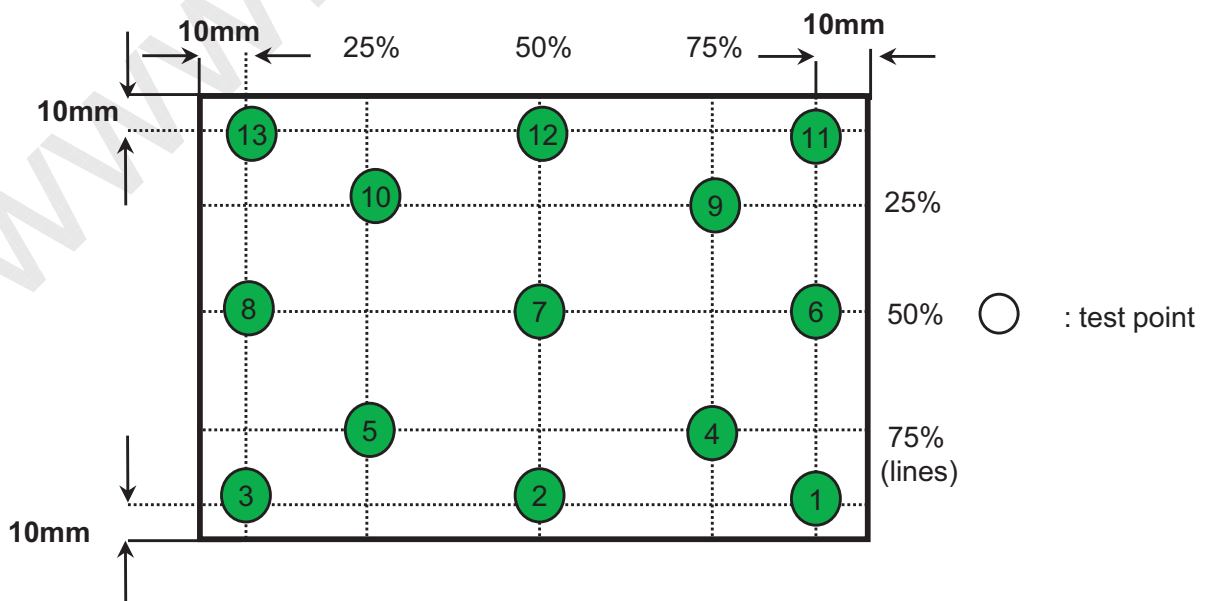| Doc.No.	LTN156AT19-8	Rev.No	04-A00-G-120312	Page	8 / 29

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Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement
should be executed. Measurement should be executed in a stable, windless,and dark room.
30 min after lighting the backlight. This should be measured in the center of screen.
IF current : 27.5mA
Environment condition : Ta = 25 ± 2 °C

Photo-detector
(TOPCON SR-3)

Field = 2°

50 cm

TFT-LCD module

LCD panel

Center of the screen

[Optical characteristics measurement setup]

Note 6) Definition of 13 points white variation (δ L), CR variation(C$_{VER}$) [① ~ ⑬]

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

10mm   25%   50%   75%   10mm

10mm

13   12   11

10   9   25%

8   7   6   50%   ◯ : test point

5   4   75%
(lines)

3   2   1

10mm

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3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta= 25 ± 2°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V_{DD}	3.0	3.3	3.6	V	
Differential Input Voltage for LVDS Receiver Threshold	High	V_{IH}	-	-	+100	mV	V_{CM} = +1.2V
	Low	V_{IL}	-100	-	-	mV	
Vsync Frequency		fv	-	60	-	Hz	
Main Frequency		f_{DCLK}	-	70.7	-	MHz	-
Rush Current		I_{RUSH}	-	-	1.5	A	(4)
Current of Power Supply	White	IDD	-	230	-	mA	*a),b),c)
	Mosaic		-	230	-	mA	
	V.stripe		-	350	-	mA	

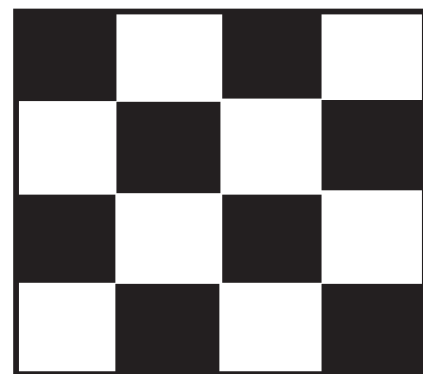Note (1) Display data pins and timing signal pins should be connected.(GND = 0V)

(2) fv = 60Hz, f_{DCLK} = 70.7MHZ, V_{DD} = 3.3V , DC Current.

(3) Power dissipation pattern

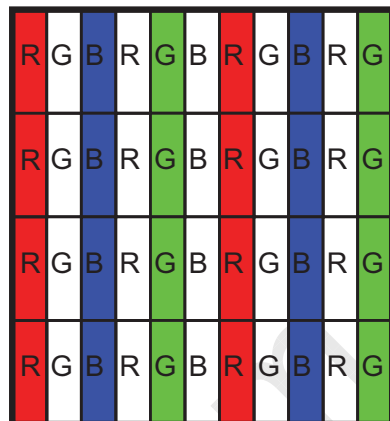*a) White Pattern

VIEW AREA

*b) Mosaic Pattern

Display Brightest Gray Level →

Display Darkest Gray Level →

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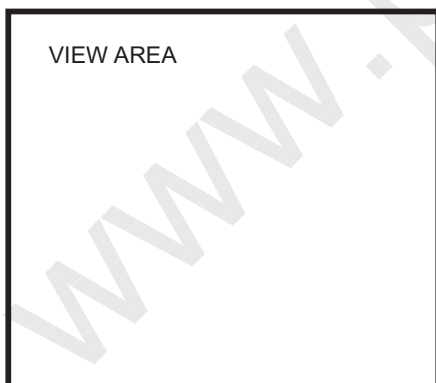
*c) 1dot Vertical stripe pattern
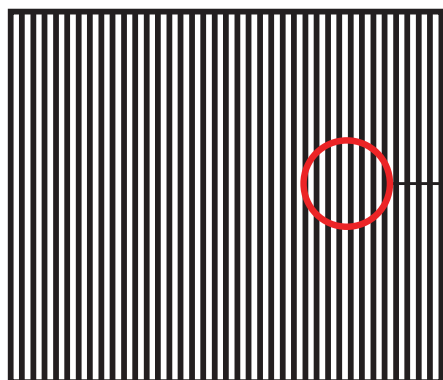
4) Rush current measurement condition

V_{DD} rising time is 470us

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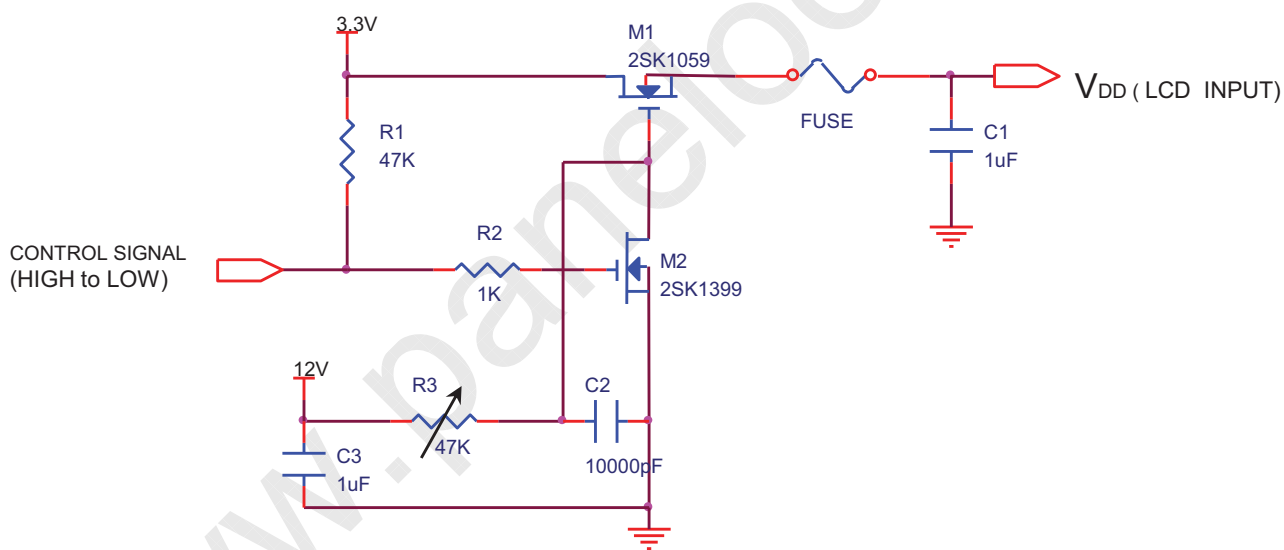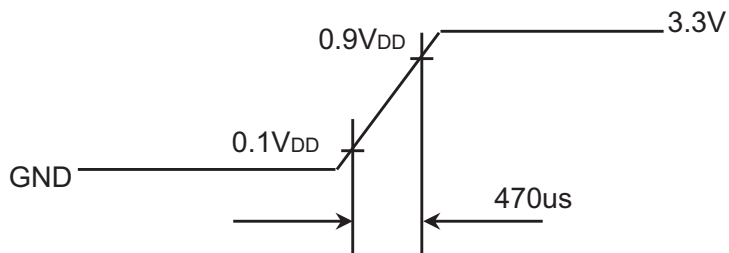
3.2 LED Driver

- On board LED Driver (Intersil)　　　　　　　　　　　　　　　　Ta= 25 ± 2 °C

Item-	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	V_{in}	6	12	24	V	-
Input Current	I	-	325	-	mA	-
EN control level	ON	1.5	3.3	5.0	V	
	OFF	0	0	0.5	V	
PWM control level	ON	1.5	3.3	5.0	V	
	OFF	0	0	0.1	V	
PWM Control Duty Ratio	D	10	-	100	%	
External PWM Dimming Control Frequency (BLIM)	F_{BLIM}	-	1	10	kHz	
Operating Life Time	Hr	10,000	-	-	Hour	

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 IF = 27.5 mArms until one of the following event occurs.
When the brightness becomes 50% or lower than the original.

3.3 BACK-LIGHT UNIT

Ta= 25 ± 2 °C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Forward Current	IF	-	27.5	-	mA	
LED Forward Voltage	VF	3.0	3.2	3.4	V	
LED Array Voltage	VP	-	36	-	V	
BL consumption	P	-	-	1.1	W	@ 60 nit

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4. BLOCK DIAGRAM

4.1 TFT LCD Module
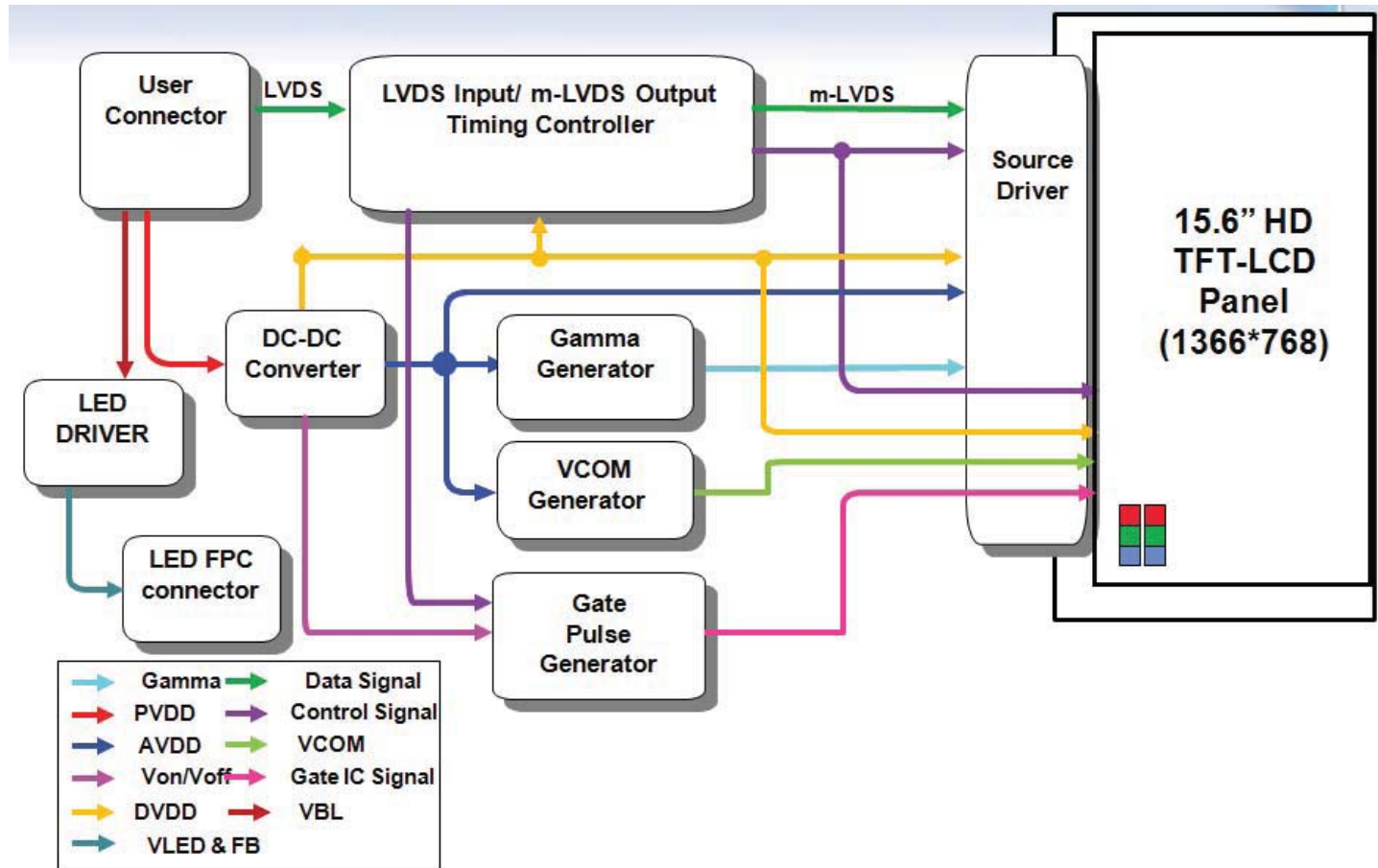
4.2 LED placement structure

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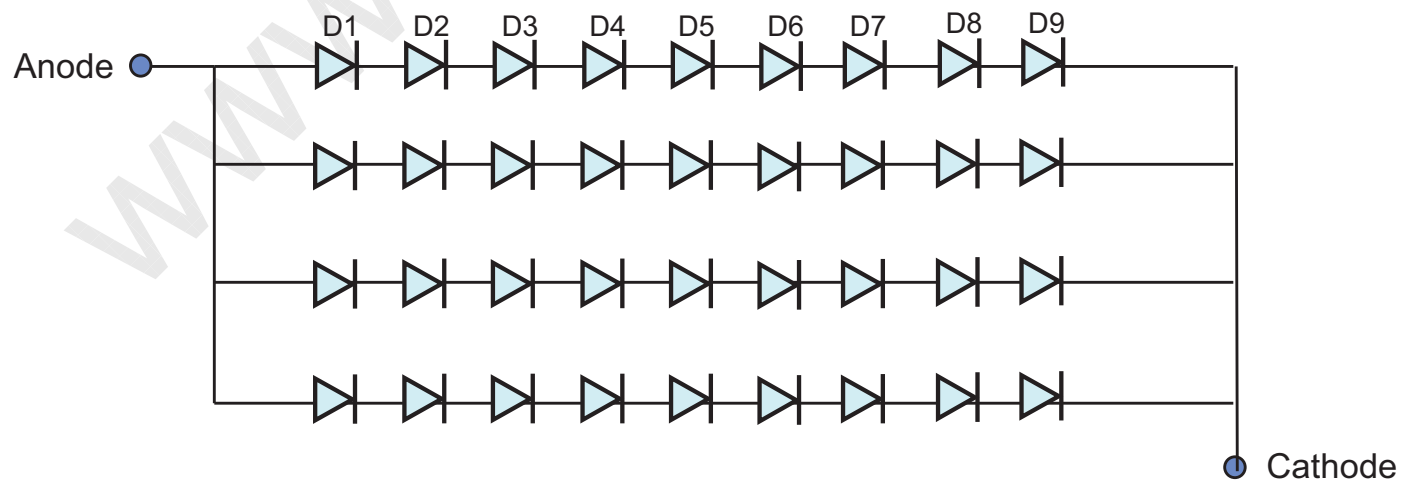
5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (LVDS, Connector : I-PEX 20455-040E-## or equivalent)

No.	Symbol	Function	Polarity	Remarks
1	NC	No Connection (Reserved for supplier)		
2	AVDD	Power Supply 3.3V (typical)		
3	AVDD	Power Supply 3.3V (typical)		
4	DVDD	DDC 3.3V power		
5	NC	No Connection		
6	SCL	DDC Clock		
7	SDA	DDC data		
8	RIN0-	-LVDS differential data input (R0-R5, G0)	Negative	
9	RIN0+	+LVDS differential data input (R0-R5, G0)	Positive	
10	GND	Ground		
11	RIN1-	-LVDS differential data input (G1-G5, B0-B1)	Negative	
12	RIN1+	+LVDS differential data input (G1-G5, B0-B1)	Positive	
13	GND	Ground		
14	RIN2-	-LVDS differential data input (B2-B5, HS, VS, DE)	Negative	
15	RIN2+	+LVDS differential data input (B2-B5, HS, VS, DE)	Positive	
16	GND	Ground		
17	CLK-	-LVDS differential clock input	Negative	
18	CLK+	+LVDS differential clock input	Positive	
19	GND	Ground		
20	RIN2-	-LVDS differential data input (R/G/B 6-7)	Negative	
21	RIN2+	+LVDS differential data input (R/G/B 6-7)	Positive	
22	GND	Ground		
23	NC	No connection		
24	NC	No connection		
25	GND	Ground		
26	NC	No connection		
27	NC	No connection		
28	GND	Ground		
29	NC	No Connect		
30	NC	No Connect		

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No.	Symbol	Function	Polarity	Remarks
31	VSSLED	Ground – LED		
32	VSSLED	Ground – LED		
33	VSSLED	Ground – LED		
34	NC	No Connect		
35	PWM	System PWM Signal Input (+3.3V Swing)		
36	LED_EN	LED enable pin (+3.3V Input)		
37	APS	APS Enable. (On +3.3V)		
38	VDDLED	6.0V – 24V LED power		
39	VDDLED	6.0V – 24V LED power		
40	VDDLED	6.0V – 24V LED power		

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5.2 LVDS Interface

5.2.1 LVDS DC Input

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LVDS Differential Voltage	$\lvert VID \rvert$	100	200	400	mV	
Input Common Mode Voltage	V_{CM}	0.4	1.2	1.6	V	
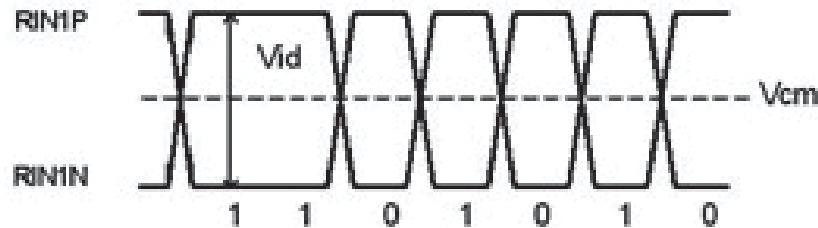
5.2.1 LVDS AC Input

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LVDS input Clock Frequency		F_{CLK_LVDS}	30		100	Mhz	
LVDS RX skew Right margin	100MHz	T_{RSRM}	–	–	270	ps	(1),(2)
	50MHz		–	–	700	ps	(1),(2)
LVDS RX skew Left margin	85MHz		−270	–	–	ps	(1),(2)
	50MHz		−700	–	–	ps	(1),(2)
Maximum deviation of LVDS input clock during SSCG		F_{CLK_DEV}	–	–	(± 3)	%	(3)
Modulating frequency of LVDS input clock during SSCG		F_{CLK_MOD}	(30)	–	(300)	KHz	(3)

Note (1) : LVDS Receiver Skew (Strobe) Margin

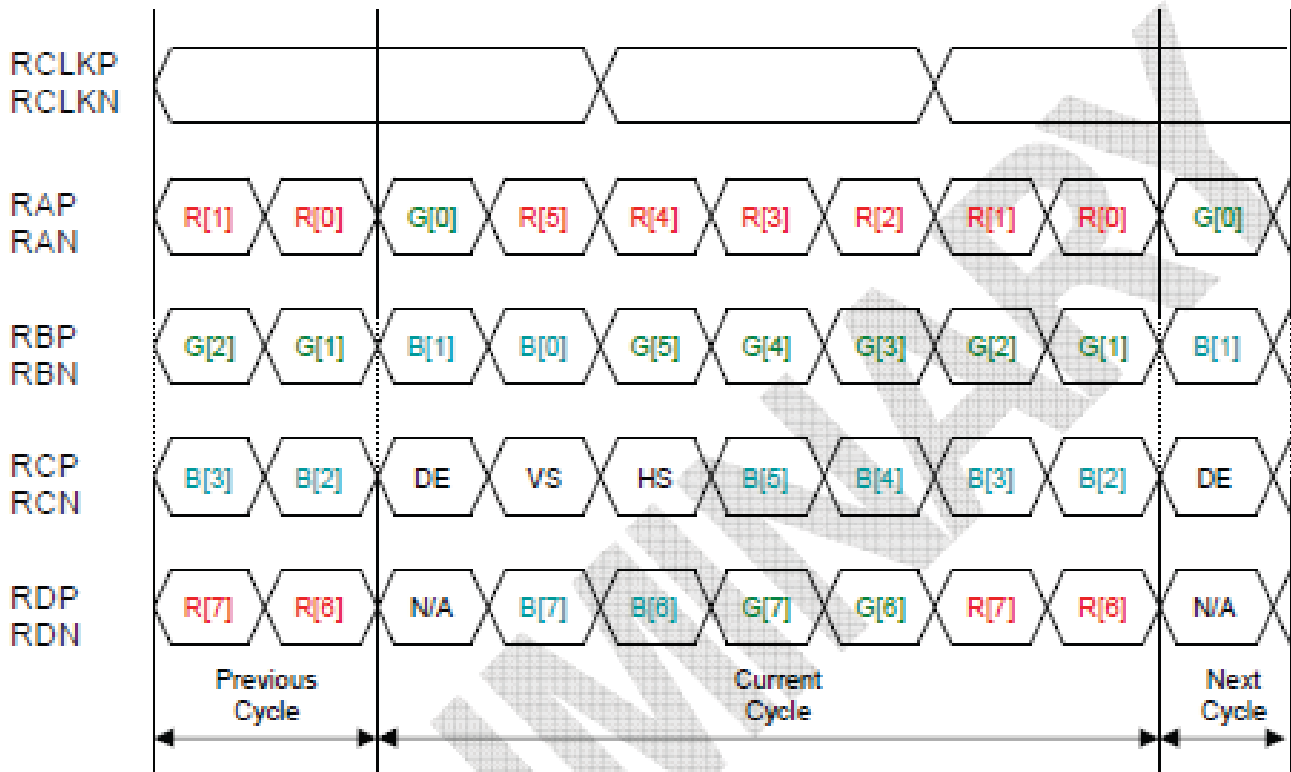| Doc.No.	LTN156AT19-8	Rev.No	04-A00-G-120312	Page	16 / 29

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5.3 Timing Diagrams of LVDS For Transmission

LVDS Receiver : Integrated T-con

* 8Bit   NS Format

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5.4 Pixel Format in the display
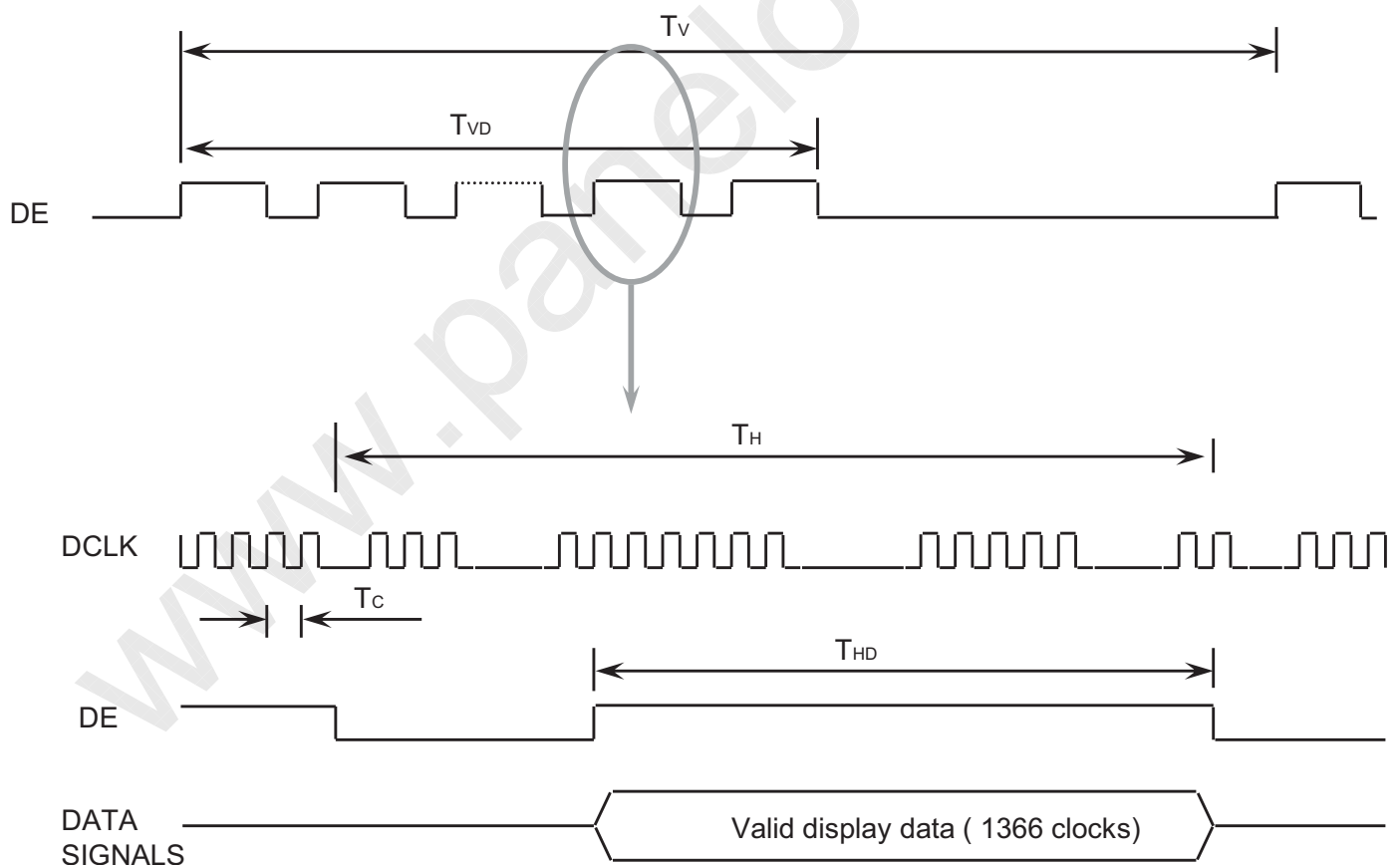
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6. INTERFACE TIMING

6.1 Timing Parameters

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	Cycle	TV	773	790	810	Lines	
Vertical Active Display Term	Display Period	TVD	-	768	-	Lines	
One Line Scanning Time	Cycle	TH	1426	1526	1726	Clocks	
Horizontal Active Display Term	Display Period	THD	-	1366	-	Clocks	

6.2 Timing diagrams of interface signal

DE

T_V

T_{VD}

T_H

DCLK

T_C

T_{HD}

DE

DATA SIGNALS　Valid display data (1366 clocks)

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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

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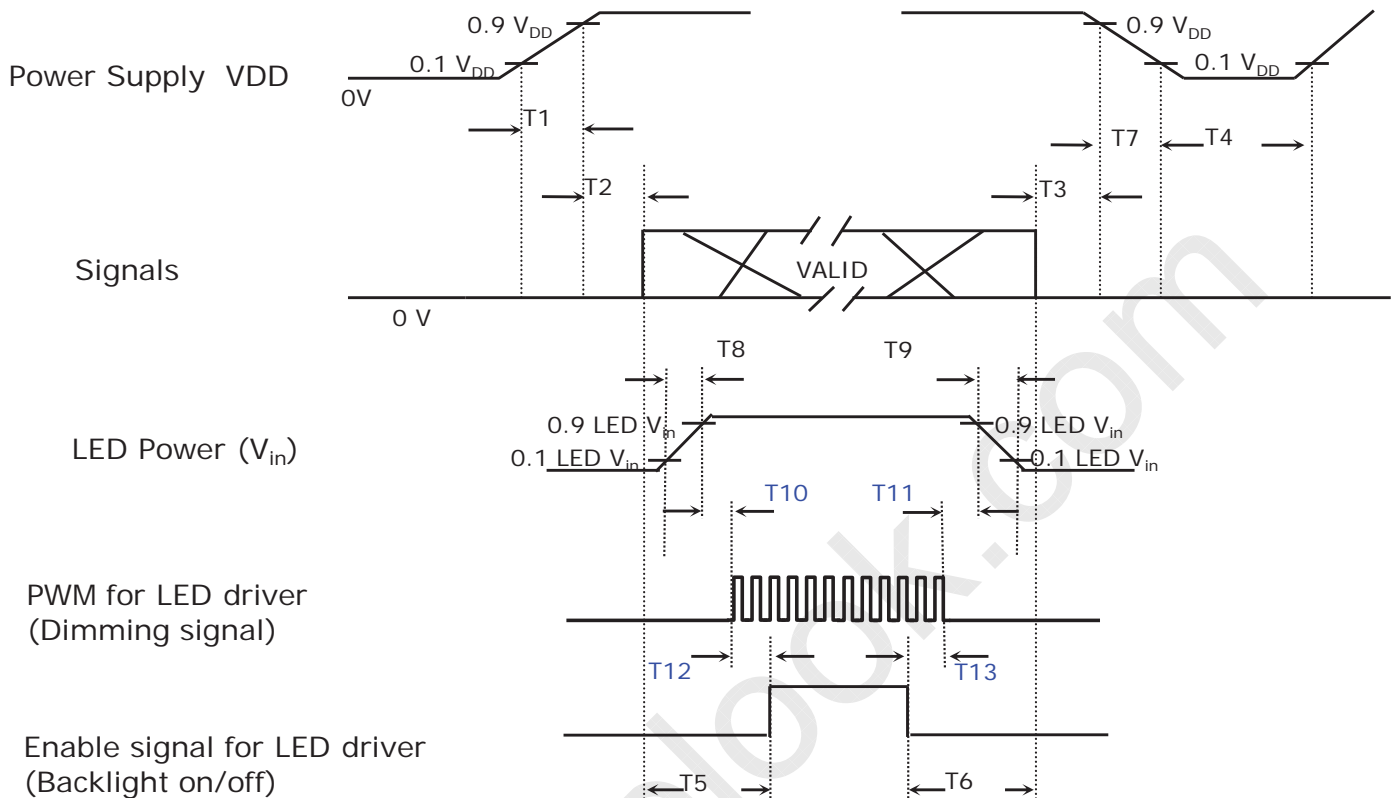
Timing (ms)	Remarks
$0.5 < T1 \le 10$	V_{DD} rising time from 10% to 90%
$0 < T2 \le 50$	Delay from V_{DD} to valid data at power ON
$0 < T3 \le 50$	Delay from valid data OFF to V_{DD} OFF at power Off
$500 \le T4$	V_{DD} OFF time for Windows restart
$200 \le T5$	Delay from valid data to B/L enable at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

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6.3 Power ON/OFF Sequence

NOTE.

(1) The supply voltage of the external system for the module input should be the same as the definition of V_{DD}.

(2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become white.

(3) In case of V_{DD} = off level, please keep the level of input signals on the low or keep a high impedance.

(4) T4 should be measured after the module has been fully discharged between power off and on period.

(5) Interface signal shall not be kept at high impedance when the power is on.

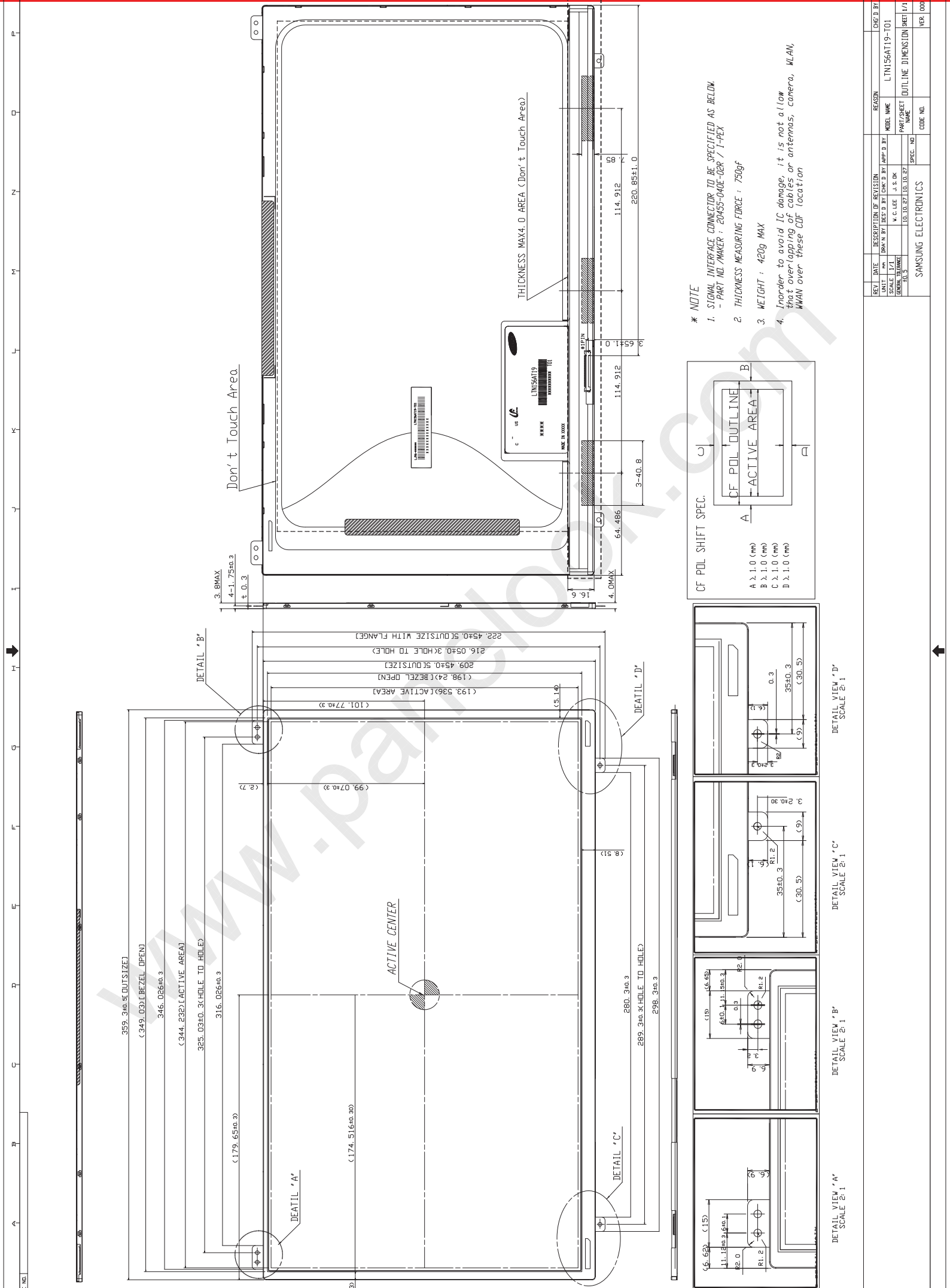**Samsung Secret**

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7. Mechanical Outline Dimension

Refer to the next page

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* NOTE

1. SIGNAL INTERFACE CONNECTOR TO BE SPECIFIED AS BELOW.
   - PART NO./MAKER : 20455-040E-02R / I-PEX

2. THICKNESS MEASURING FORCE : 750gf

3. WEIGHT : 420g MAX

4. Inorder to avoid IC damage, it is not allow that overlapping of cables or antennas, camera, WLAN, WWAN over these CDF location

THICKNESS MAX4.0 AREA (Don't Touch Area)

Don't Touch Area

LTN156AT19

CF POL SHIFT SPEC.

CF POL OUTLINE
ACTIVE AREA

A ≥ 1.0 (mm)
B ≥ 1.0 (mm)
C ≥ 1.0 (mm)
D ≥ 1.0 (mm)

DETAIL 'B'
DETAIL 'D'
DETAIL 'C'
DETAIL 'A'

DETAIL VIEW 'D' SCALE 2:1
DETAIL VIEW 'C' SCALE 2:1
DETAIL VIEW 'B' SCALE 2:1
DETAIL VIEW 'A' SCALE 2:1

ACTIVE CENTER

222.45±0.5[OUTSIZE WITH FLANGE]
216.05±0.3[HOLE TO HOLE]
209.45±0.5[OUTSIZE]
(198.24)[BEZEL OPEN]
(193.536)[ACTIVE AREA]

359.3±0.5[OUTSIZE]
(349.03)[BEZEL OPEN]
346.026±0.3
(344.232)[ACTIVE AREA]
325.03±0.3[HOLE TO HOLE]
316.026±0.3
280.3±0.3
289.3±0.3[HOLE TO HOLE]
298.3±0.3

(179.65±0.3)
(174.516±0.30)

114.912
220.85±1.0
8.5
3.65±1.0
114.912
64.486
4-40.8

3.8MAX
4-1.75±0.3
± 0.3
16.6
4.0MAX

CHG'D BY
REASON
MODEL NAME   LTN156AT19-T01
PART/SHEET NAME   OUTLINE DIMENSION SHEET 1/1
CODE NO.   VER. 000

DESCRIPTION OF REVISION
DES'D BY   APP'D BY
DRA'N BY   CHK'D BY
W.C.LEE   J.S.OK
10.10.27   10.10.27

REV DATE
UNIT mm
SCALE 1/1
GENERAL TOLERANCE ±0.5

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8. PACKING

1. CARTON(Internal Package)

(1) Packing Form
Corrugated fiberboard box and corrupad form as shock absorber

(2) Packing Method

STEP 1. Putting into Zipper Bag

STEP 2. Putting on the paper tray

STEP 6. Putting the Top pad

STEP 5 .Inserting at the Box

STEP 4. Folding the Paper tray

Note 1)Total Weight : Approximately 18 kg
2) Acceptance number of piling : 36 sets
3) Carton size : 464(W) × 368(D) × 337(H)

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(3)Packing Material

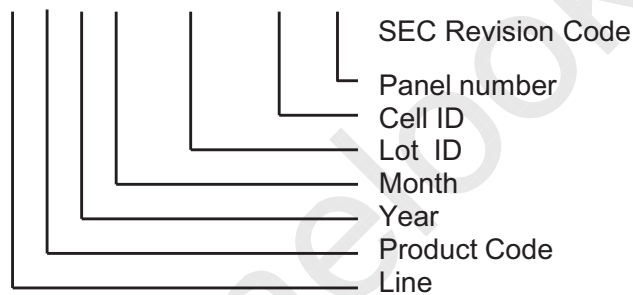| No	Part name	Quantity
1	Static electric protective sack	36
2	Packing case (Inner box) included shock absorber	1 set
3	Pictorial marking	2 pcs
4	Carton	1 set

9. MARKINGS & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.
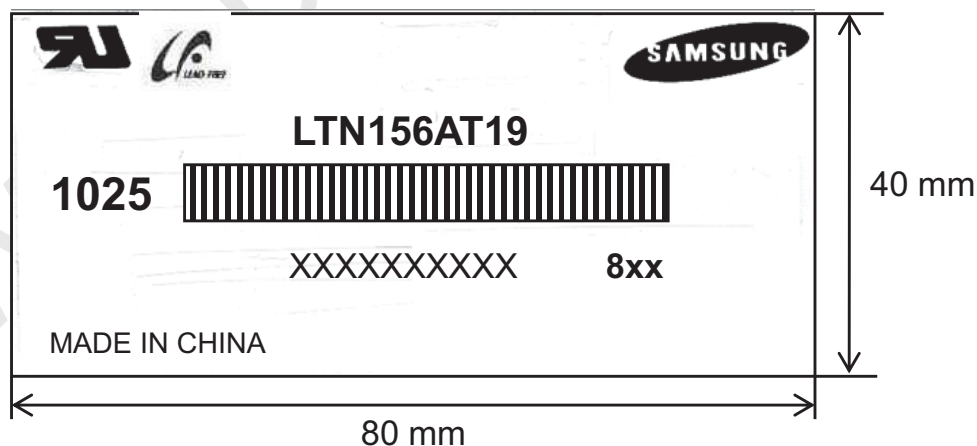
(1)Parts number : LTN156AT19
(2)Revision code : 3 letters
(3)Lot number   : X X X X **XXX** **XX** **X**   **8xx**
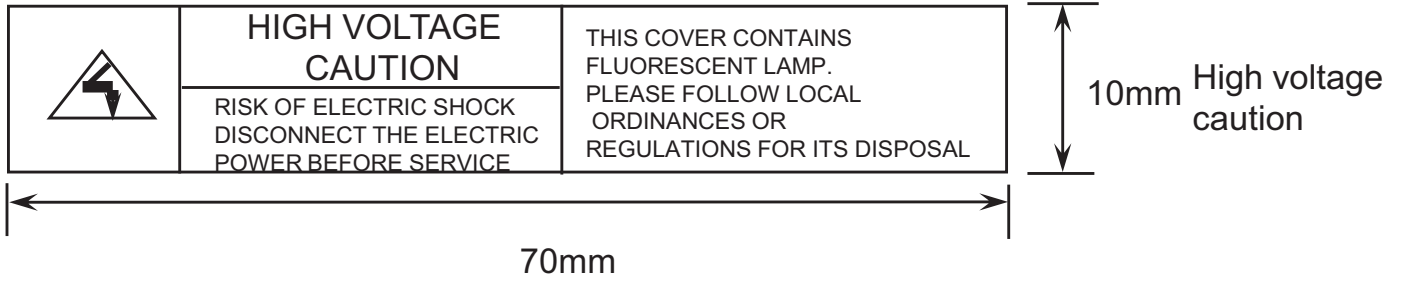
SEC Revision Code
Panel number
Cell ID
Lot ID
Month
Year
Product Code
Line

(5) Nameplate Indication

LTN156AT19

1025   XXXXXXXXXX   **8xx**

MADE IN CHINA

40 mm

80 mm

Parts name   : LTN156AT19
Lot number   : XXXXXXXXXX
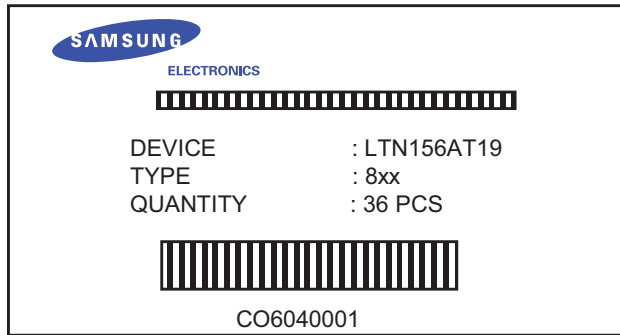Inspected work week   : 1025(2010 year, 25nd week)

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High voltage caution label

	HIGH VOLTAGE CAUTION	THIS COVER CONTAINS FLUORESCENT LAMP. PLEASE FOLLOW LOCAL ORDINANCES OR REGULATIONS FOR ITS DISPOSAL
	RISK OF ELECTRIC SHOCK DISCONNECT THE ELECTRIC POWER BEFORE SERVICE	

10mm High voltage caution

70mm

(6)　Packing small box attach

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DEVICE　　　　　: LTN156AT19
TYPE　　　　　　: 8xx
QUANTITY　　　　: 36 PCS

CO6040001

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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 connector shall not be touched directly with bare hands.

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2. STORAGE

ITEM	Unit	Min.	Max.
Storage Temperature	(℃)	5	40
Storage Humidity	(%rH)	35	75
Storage life	12 months		
Storage Condition	-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 3 months, the recommended temperature or humidity range. we recommend you leave the at a temperature of 20℃ and a humidity of 50% for 24 hours.		

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.

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4. OTHERS

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

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

(c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on) Otherwise the module may be damaged.

(d) If the module displays the same pattern continuously for a long period of time,it can be the situation when the image "sticks" to the screen.

(e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

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