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ELECTRONICS

Preliminary



TO : General

DATE : Feb. 10, 2009

SAMSUNG TFT-LCD

MODEL NO. : LTN101NT02-C01

NOTE : Extension code [[xxx]]
→ LTN101NT02[xxx]
Surface type [**Glare**]

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

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



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Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	1 / 29
----------------	------------	---------------	-----------------	-------------	--------

CONTENTS

Preliminary

Revision History	----- (3)
General Description	----- (4)
1. Absolute Maximum Ratings	----- (5)
1.1 Absolute Ratings of environment	
1.2 Electrical Absolute Ratings	
2. Optical Characteristics	----- (7)
3. Electrical Characteristics	----- (10)
3.1 TFT LCD Module	
3.2 Backlight Unit	
3.3 LED Driver	
4. Block Diagram	----- (13)
4.1 TFT LCD Module	
4.2 LED Placement Structure	
5. Input Terminal Pin Assignment	----- (14)
5.1 Input Signal & Power	
5.2 LVDS Interface	
5.3 Timing Diagrams of LVDS For Transmitting	
5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color.	
5.5 Pixel format	
6. Interface Timing	----- (20)
6.1 Timing Parameters	
6.2 Timing Diagrams of interface Signal	
6.3 Power ON/OFF Sequence	
7. Outline Dimension	----- (22)
8. Packing	----- (24)
9. Markings & Others	----- (25)
10. General Precautions	----- (27)

Samsung Secret

Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	2 / 29
----------------	------------	---------------	-----------------	-------------	--------

REVISION HISTORY

Preliminary

Date	Revision No.	Page	Summary
Jan. 22, 2009	P00	All	The preliminary specification of LTN101NT02-C01 was issued first.
Feb.10.2009	A00	12	LED Driver PWM control ration value was changed.

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Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	3 / 29
----------------	------------	---------------	-----------------	-------------	--------

GENERAL DESCRIPTION

DESCRIPTION

LTN101NT02 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 10.1" contains 1024 x 600 pixels and can display up to 262,144 colors. 6 O'clock direction is the optimum viewing angle.

FEATURES

- High contrast ratio
- WSVGA (1024 x 600 pixels) resolution
- Low power consumption
- Fast Response
- LED Back Light with embedded LED Driver
- DE (Data enable) only mode
- 3.3V LVDS Interface
- Onboard EEDID chip
- Green product (RoHS compliant)

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	222.72(H) x 125.28(V) (10.1" wide diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	262,144		
Number of pixel	1024 x 600	pixel	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.2175(H) x 0.2088(V) (TYP.)	mm	
Display Mode	Normally white		
Surface treatment	Haze 0, Hard-Coating 3H		

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Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	4 / 29
----------------	------------	---------------	-----------------	-------------	--------

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	234.5	235.0	235.5	mm	
	Vertical (V)	142.5	143.0	143.5	mm	
	Depth (D)	-	5.0	5.2	mm	(1)
Weight		-	190	200	g	

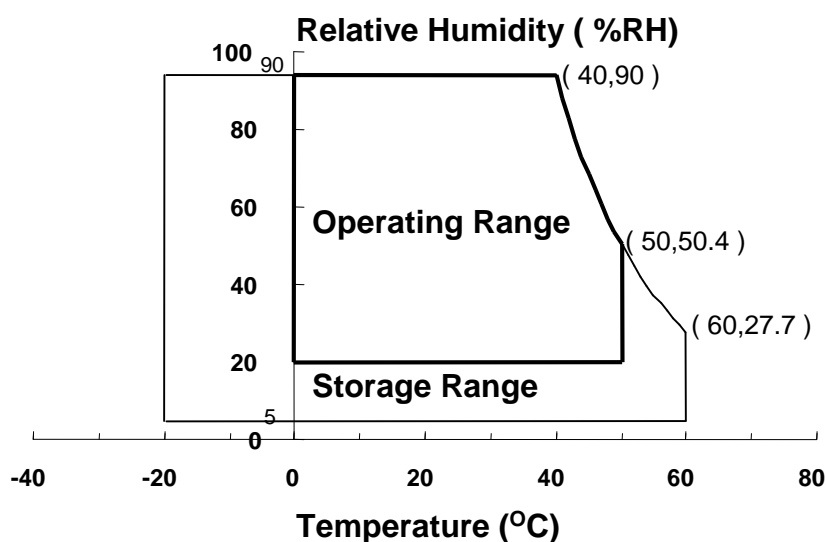
Note (1) Measurement condition of outline dimension
 . Equipment : Bernier Calipers
 . Push Force : 500g · f (minimum)

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



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

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1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

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

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

Note (1) Within T_a (25 ± 2 °C)

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2. OPTICAL CHARACTERISTICS

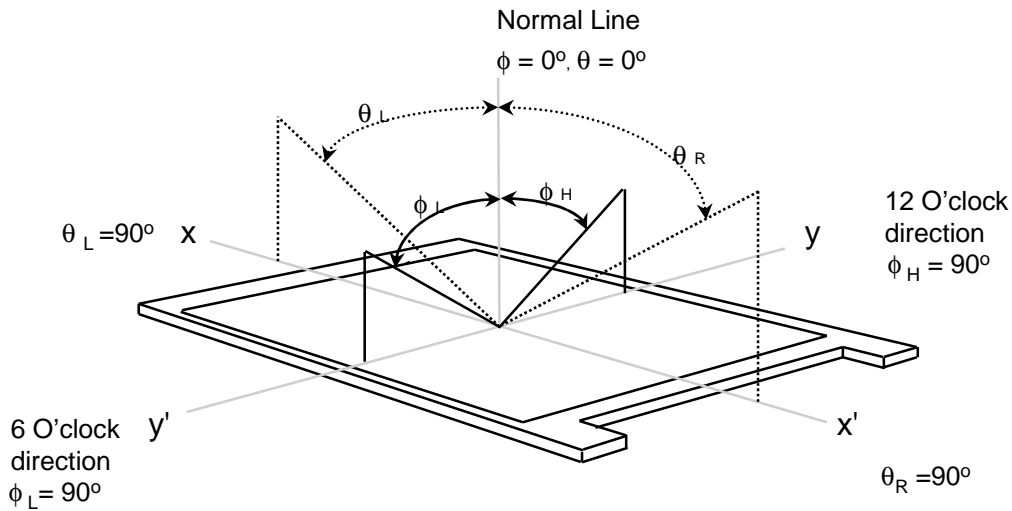
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).
Measuring equipment : TOPCON SR-3

* Ta = 25 ± 2 °C, V_{DD}=3.3V, fv= 60Hz, fd_{CLK} = 54.2MHz, IF = 100% duty

Item		Symbol	Condition	Min.	Typ.	Max	Unit	Note
Contrast Ratio (5 Points)		CR	Normal Viewing Angle $\phi = 0$ $\theta = 0$	-	400	-	-	(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}		170	200	-	cd/m ²	IF= 100% duty (1), (4)
Color Chromaticity (CIE)	Red	R _X		0.523	0.553	0.583	-	(1), (5) SR-3
		R _Y		0.288	0.318	0.348		
	Green	G _X		0.322	0.352	0.382		
		G _Y		0.556	0.586	0.616		
	Blue	B _X	0.135	0.165	0.195			
		B _Y	0.080	0.110	0.140			
	White	W _X	0.283	0.313	0.343			
		W _Y	0.299	0.329	0.359			
Viewing Angle	Hor.	θ_L	40	45	-	Degrees	(1), (5) SR-3	
		θ_H	40	45	-			
	Ver.	ϕ_H	15	20	-			
		ϕ_L	35	40	-			
Color Gamut		CG	42	45	-	%		
13 Points White Variation		δ_L	-	-	1.7	-	(6)	

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

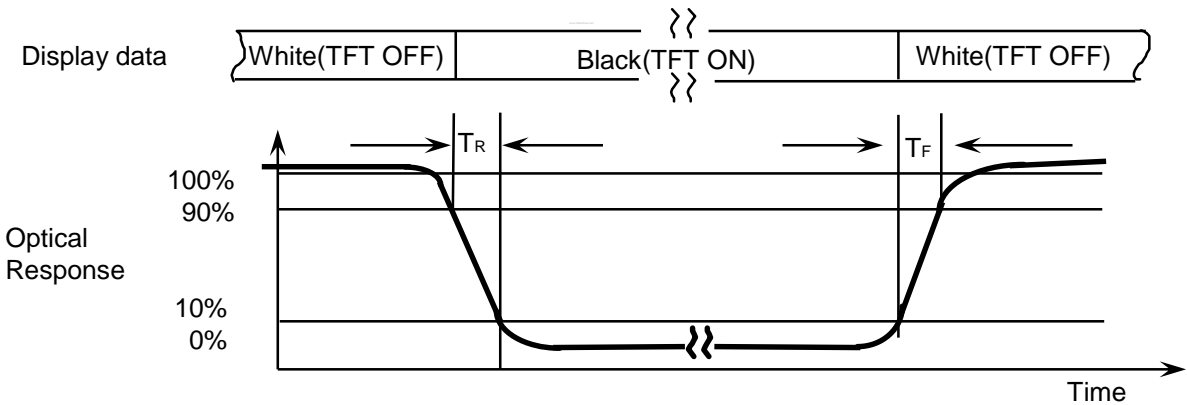


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

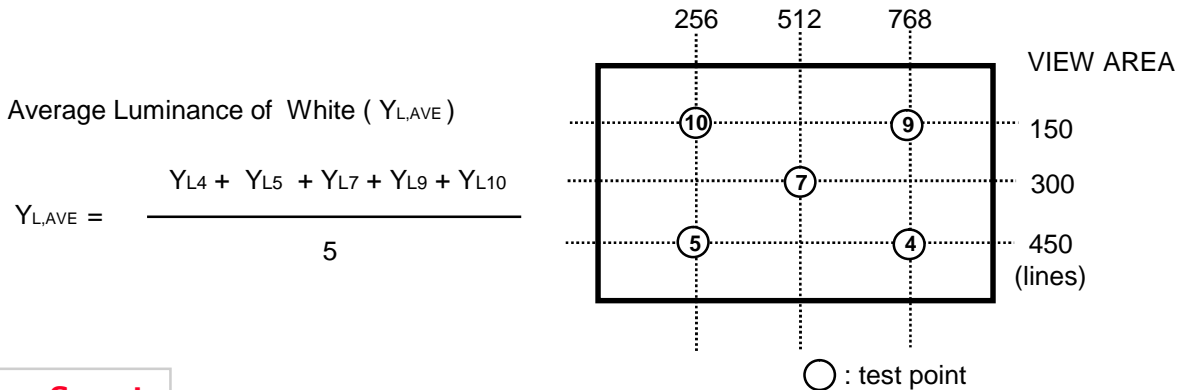
$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

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

Note 3) Definition of Response time :



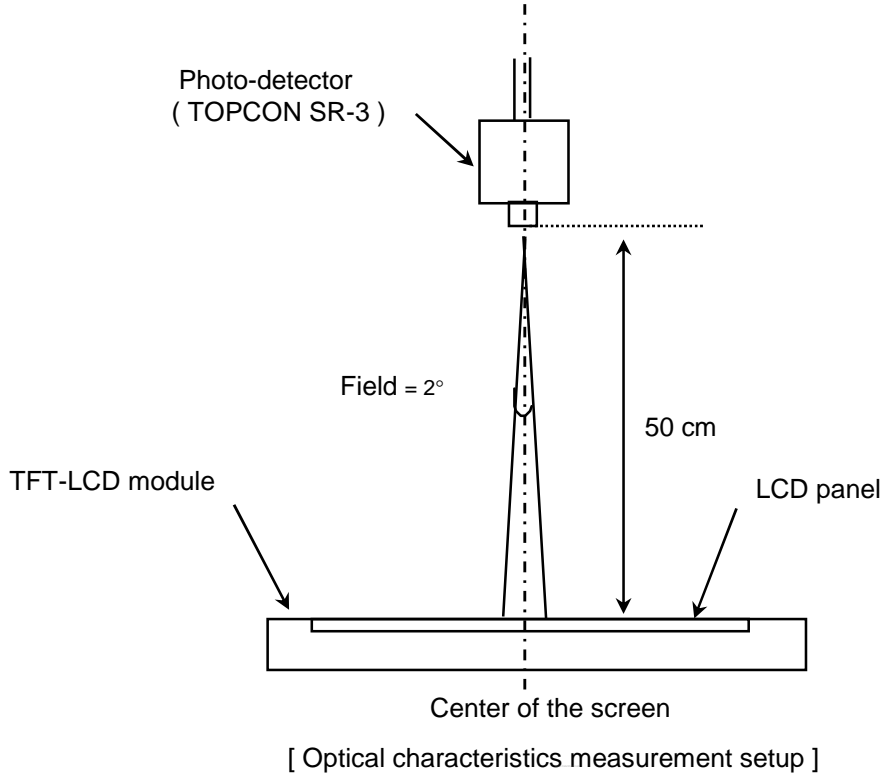
Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.



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

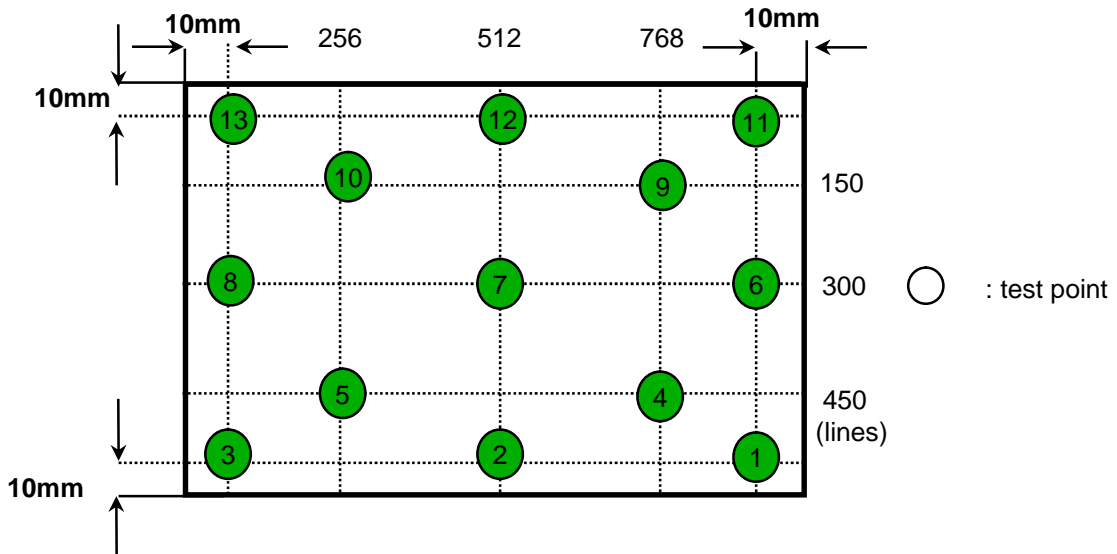
$$Y_{L,AVE} = \frac{Y_{L4} + Y_{L5} + Y_{L7} + Y_{L9} + Y_{L10}}{5}$$

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.
 IF current : 100% duty
 Environment condition : $T_a = 25 \pm 2 \text{ }^\circ\text{C}$



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

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



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3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta= 25 ± 2°C

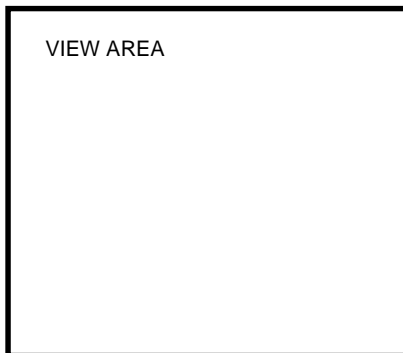
Item	Symbol	Min.	Typ.	Max.	Unit	Note	
Voltage of Power Supply	V _{DD}	3.0	3.3	3.6	V		
Differential Input Voltage for LVDS Receiver Threshold	High	V _{IH}	-	-	+100	mV	V _{CM} = +1.2V
	Low	V _{IL}	-100	-	-	mV	
Vsync Frequency	f _v	-	60	-	Hz		
Hsync Frequency	f _H	-	40.38	-	KHz		
Main Frequency	f _{DCLK}	-	54.2	-	MHz	-	
Rush Current	I _{RUSH}	-	-	1.5	A	(4)	
Current of Power Supply	White	I _{DD}	-	250	-	mA	(2),(3)*a
	Mosaic		-	280	-	mA	(2),(3)*b
	V. stripe		-	320	350	mA	(2),(3)*c

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

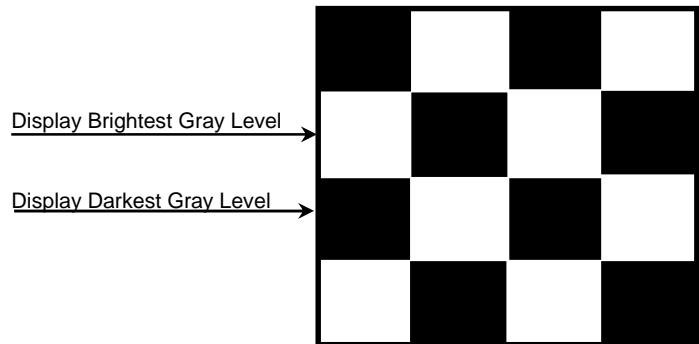
(2) f_v = 60Hz, f_{DCLK} = 54.2MHz, V_{DD} = 3.3V , DC Current.

(3) Power dissipation pattern

*a) White Pattern

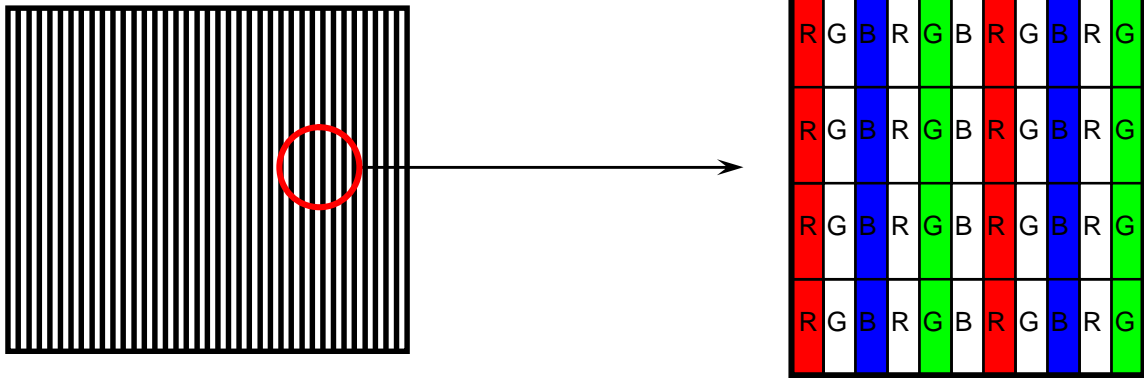


*b) Mosaic Pattern

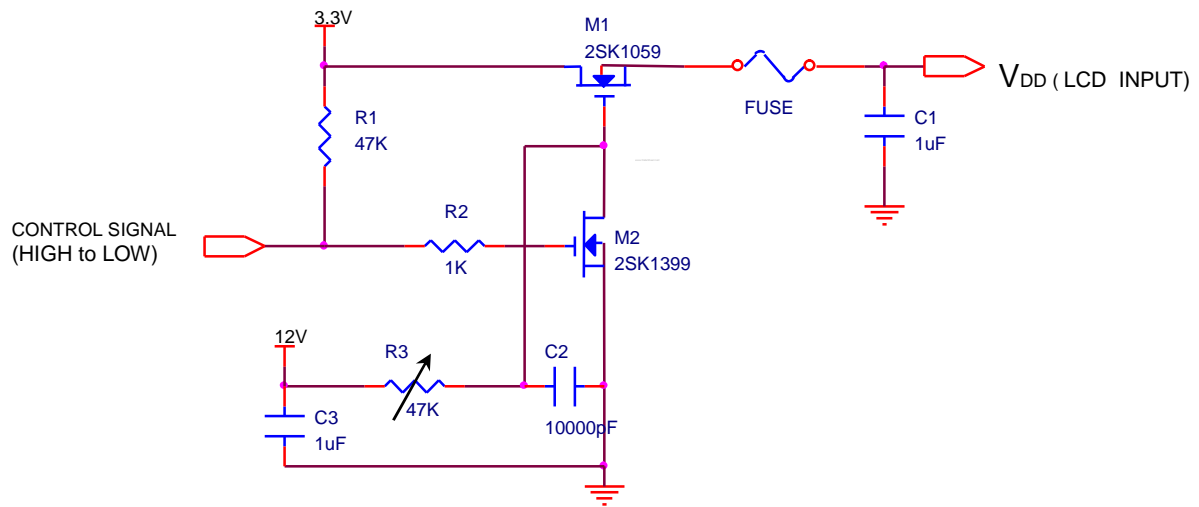


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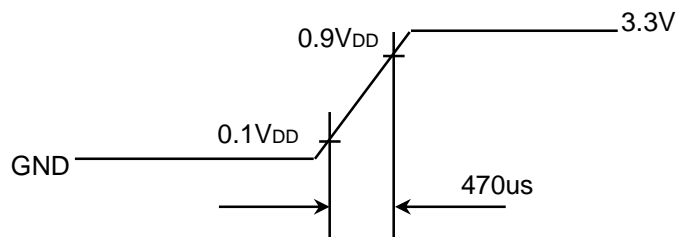
*c) 1dot Vertical stripe pattern



4) Rush current measurement condition



V_{DD} rising time is 470us



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3.2 LED Driver

- On board LED Driver (Manufacturer : Richtek)

Ta= 25 ± 2 °C

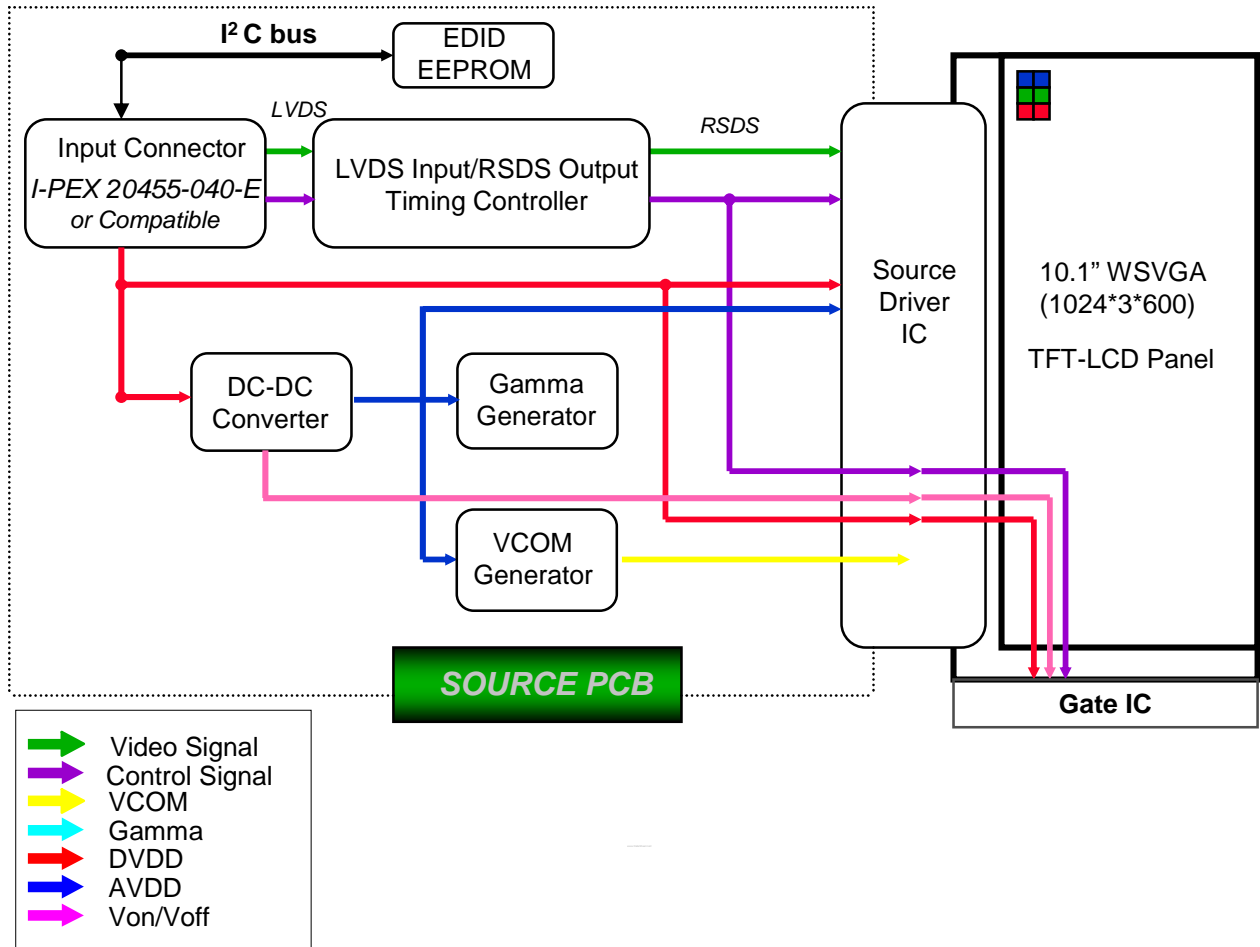
Item-	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	V _{in}	7.0	12.0	21	V	-
Input Current	I	-	160	-	mA	-
Input Power	P _{in}	-	1.9	2.2	W	-
Operating Frequency	F _o	-	1	-	MHz	-
Burst Ratio	D	10	-	100	%	PWM freq: 1KHz~100KHz
External PWM Dimming Control Frequency (BLIM)	F _{BLIM}	190	210	230	Hz	
Output Power	P _{out}	1.0	1.4	1.8	W	BLIM=100%
Efficiency	η	82	88	94	%	(Generally, Efficiency can be defined depends on Duty cycle, V _{in} and Dimming Freq.)
Operating Life Time	Hr	10,000	-	-	Hour	Note 1

Note 1. When the brightness becomes 50% or lower than the original.

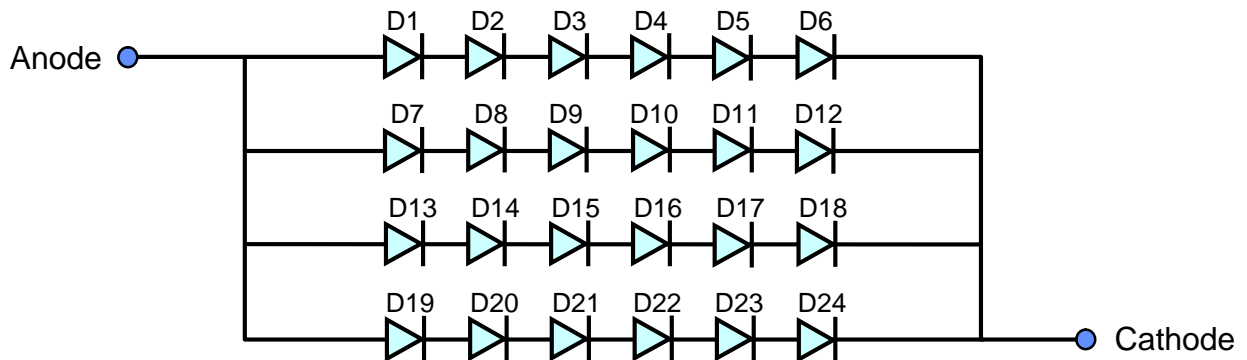
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4. BLOCK DIAGRAM

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 Connect		
2	VDD	Power Supply +3.3V		
3	VDD	Power Supply +3.3V		
4	VEDID	EDID +3.3V Power		
5	NC	No Connect		
6	CLK_EDID	EDID Clock Input		
7	DATA_EDID	EDID Data Input		
8	RxOIN0-	-LVDS Differential Data (Odd R0-R5, G0)	Negative	
9	RxOIN0+	+LVDS Differential Data (Odd R0-R5, G0)	Positive	
10	VSS	Ground		
11	RxOIN1-	-LVDS Differential Data (Odd G1-G5,B0-B1)	Negative	
12	RxOIN1+	+LVDS Differential Data (Odd G1-G5,B0-B1)	Positive	
13	VSS	Ground		
14	RxOIN2-	-LVDS Differential Data (Odd B2-B5,HS,VS,DE)	Negative	
15	RxOIN2+	+LVDS Differential Data (Odd B2-B5,HS,VS,DE)	Positive	
16	VSS	Ground		
17	RxOCKIN-	-LVDS Odd Differential CLK	Negative	
18	RxOCKIN+	+LVDS Odd Differential CLK	Positive	
19	VSS	Ground		
20	NC	No Connect		
21	NC	No Connect		
22	NC	No Connect		
23	NC	No Connect		
24	NC	No Connect		
25	NC	No Connect		
26	NC	No Connect		
27	NC	No Connect		
28	NC	No Connect		
29	NC	No Connect		
30	NC	No Connect		

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No.	Symbol	Function	Polarity	Remarks
31	VLED_GND	LED Ground		
32	VLED_GND	LED Ground		
33	VLED_GND	LED Ground		
34	NC	No Connect		
35	S_PWMIN	System PWM signal Input		
36	BL_ON	LED enable pin (+3V input, +5V tolerance)		
37	NC	No Connect		
38	VLED	LED Power Supply 7V-20V		
39	VLED	LED Power Supply 7V-20V		
40	VLED	LED Power Supply 7V-20V		

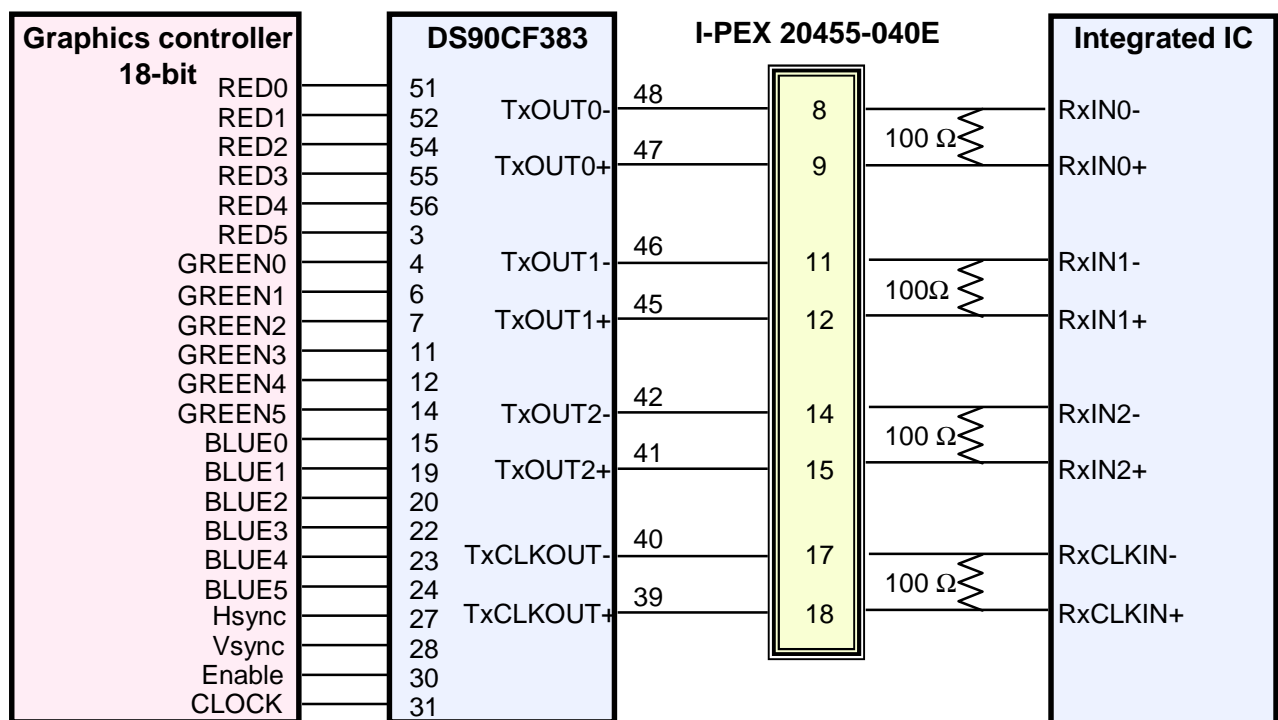
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Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	15 / 29
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5.2 LVDS Interface : Transmitter DS90CF363 or Compatible

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

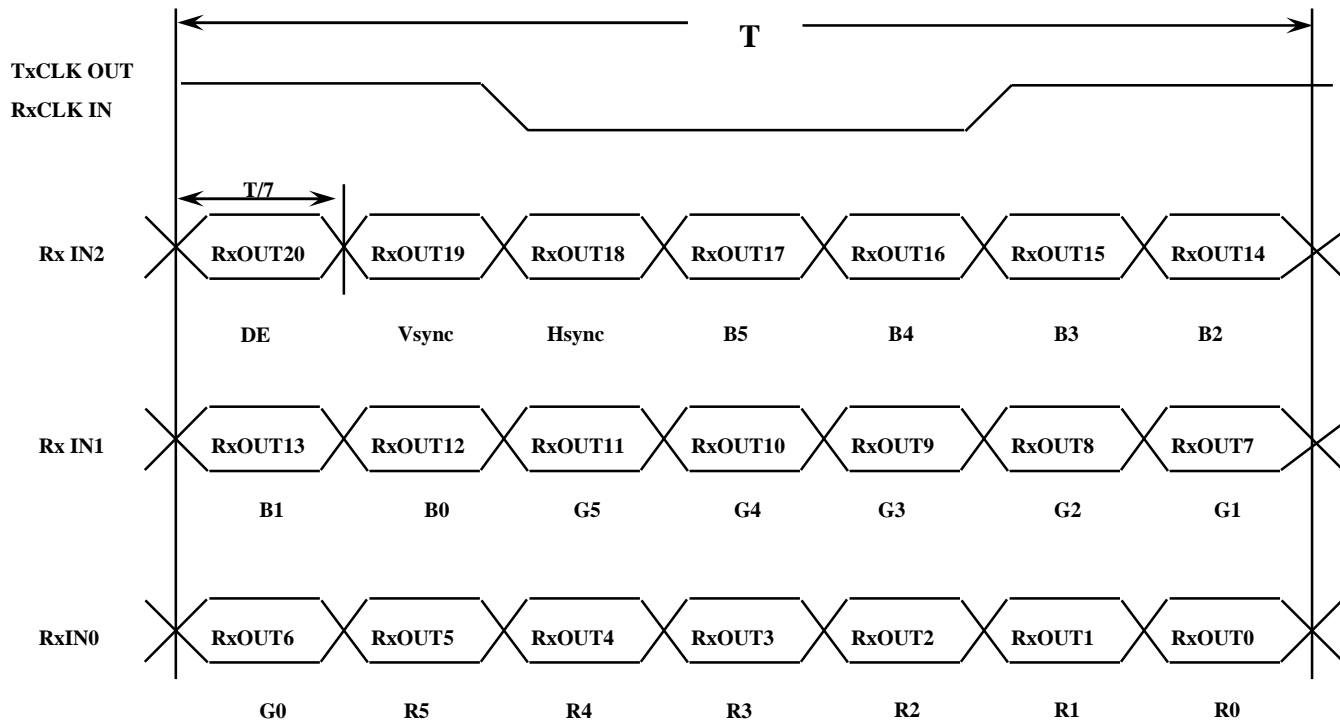


Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

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5.3 Timing Diagrams of LVDS For Transmission

LVDS Receiver : Integrated T-CON



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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
Basic Colors	Black	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	-
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	-
	Cyan	0	0	0	0	0	0	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	-
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	-
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	-
	White	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	R0
	Dark	1	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	R3~R60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	1	0	1	1	1	1	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	R62
	Red	1	1	1	1	1	1	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	G0
	Dark	0	0	0	0	0	0	1	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	G3~G60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	G61
	Light	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	G62
	Green	0	0	0	0	0	0	1	1	1	1	1	1	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	B0
	Dark	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B1
	↑	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	B2
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	
	Light	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	B62
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B63

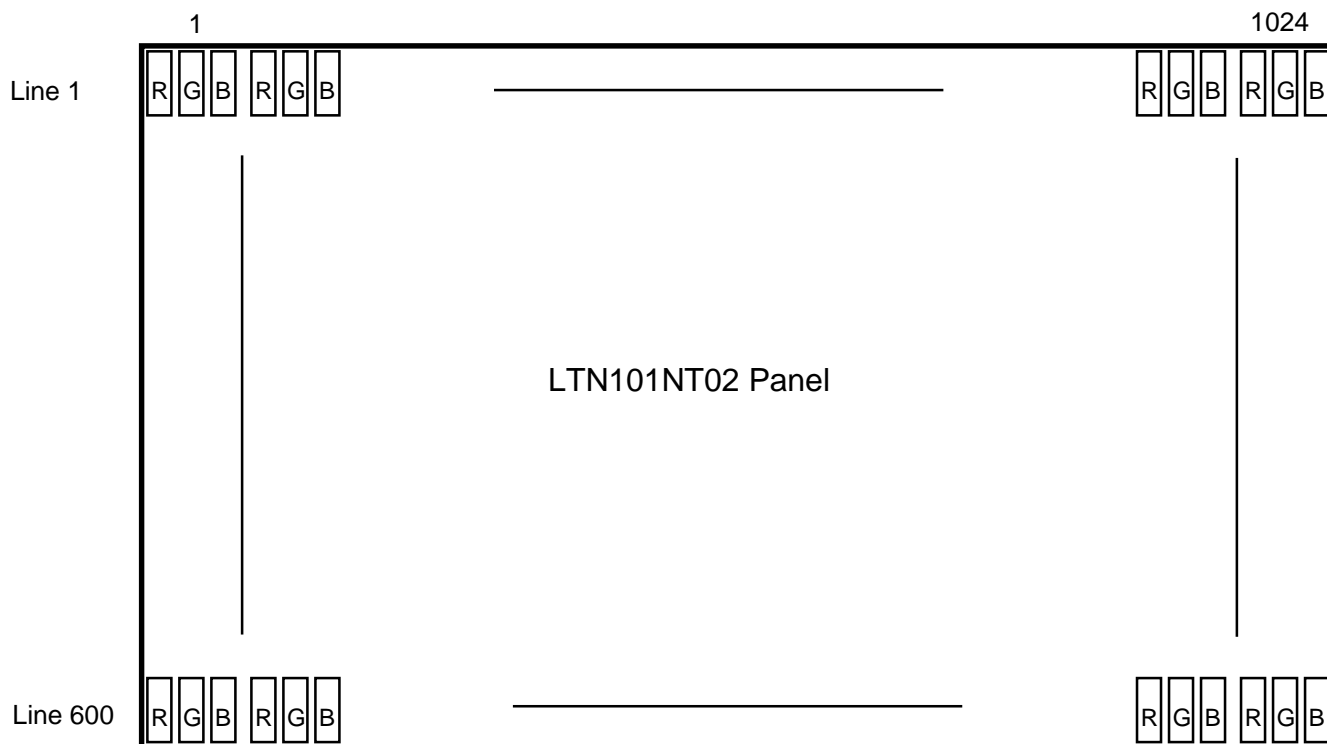
Note 1) Definition of gray :

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

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

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5.5 Pixel Format in the display



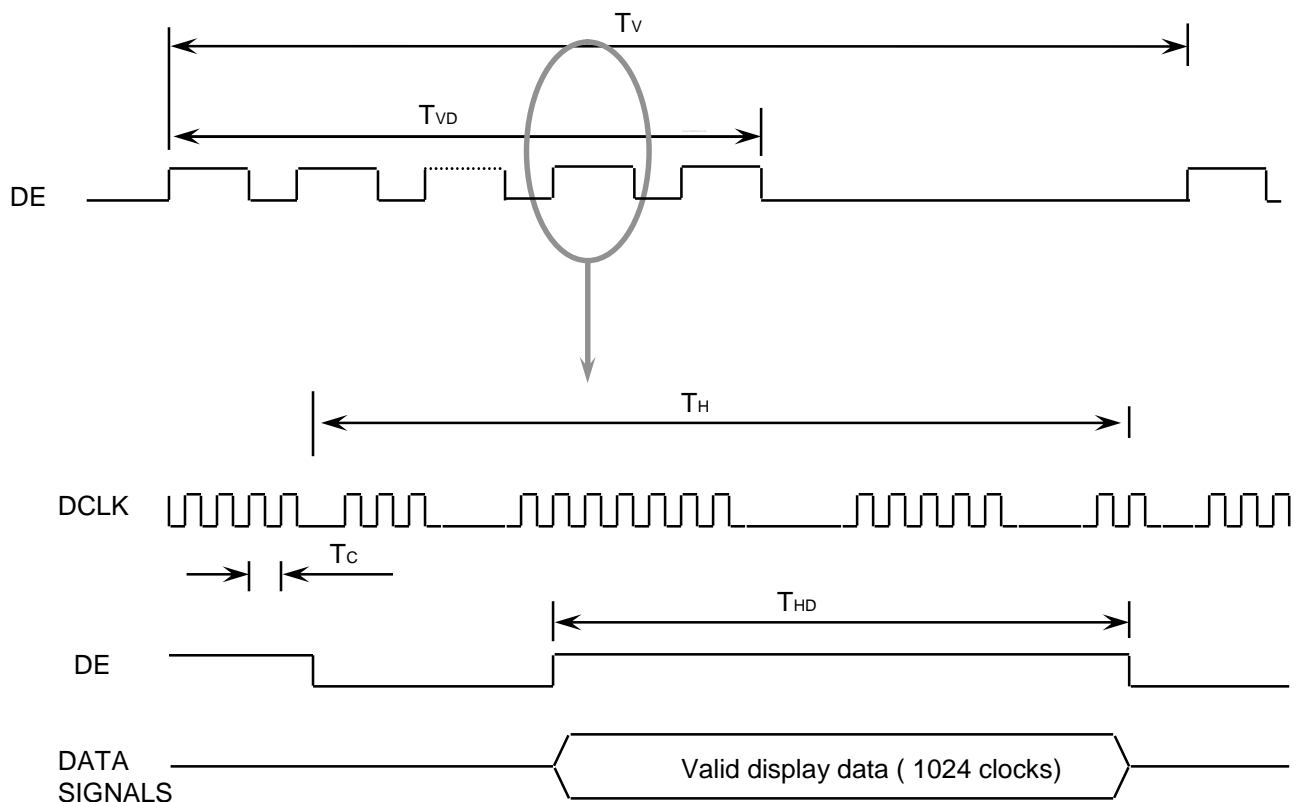
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6. INTERFACE TIMING

6.1 Timing Parameters

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	Cycle	TV	-	673	-	Lines	
Vertical Active Display Term	Display Period	TVD	-	600	-	Lines	
One Line Scanning Time	Cycle	TH	-	1344	-	Clocks	
Horizontal Active Display Term	Display Period	THD	-	1024	-	Clocks	

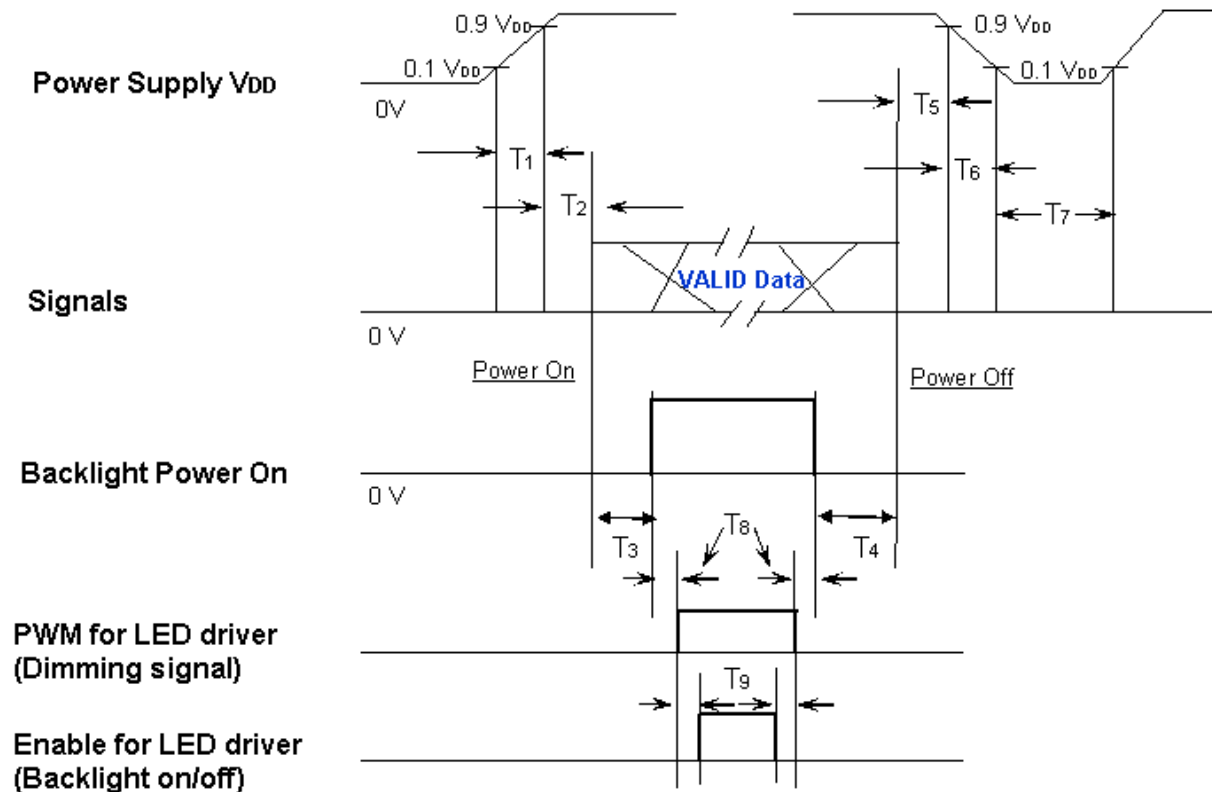
6.2 Timing diagrams of interface signal



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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

Parameter	Value			Unit	Remark
	Min.	Typ.	Max.		
T1	0.5	-	10	(ms)	V _{DD} rising time from 10% to 90%
T2	0	-	50	(ms)	The time from V _{DD} to valid data at power ON.
T3	200	-	-	(ms)	The time from valid data to B/L enable at power ON.
T4	200	-	-	(ms)	The time from valid data off to B/L disable at power Off.
T5	0	-	50	(ms)	The time from valid data off to V _{DD} off at power Off.
T6	0	-	10	(ms)	V _{DD} falling time from 10% to 90%
T7	500	-	-	(ms)	V _{DD} off time for Windows restart
T8	10	-	-	(ms)	PWM on time for LED driver
T9	10	-	-	(ms)	Enable on time for LED driver

Power Sequence Table

T8, T9 startup sequence is Backlight Power On → PWM for LED driver → Enable.

If the dimming signal is applied after the Enable pin, the device will not perform the soft start again, in fact it will start switching with the maximum current limit in order to recover the output voltage.

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6.3 Power ON/OFF Sequence

Preliminary

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 $V_{DD} = \text{off level}$, please keep the level of input signals on the low or keep a high impedance.
- (4) T_4 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

Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	22 / 29
----------------	------------	---------------	-----------------	-------------	---------

7. Mechanical Outline Dimension

Preliminary

Refer to the next page

Samsung Secret

Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	23 / 29
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This page will be replaced with the outline drawing after producing PDF file.

Samsung Secret

Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	24 / 29
----------------	------------	---------------	-----------------	-------------	---------

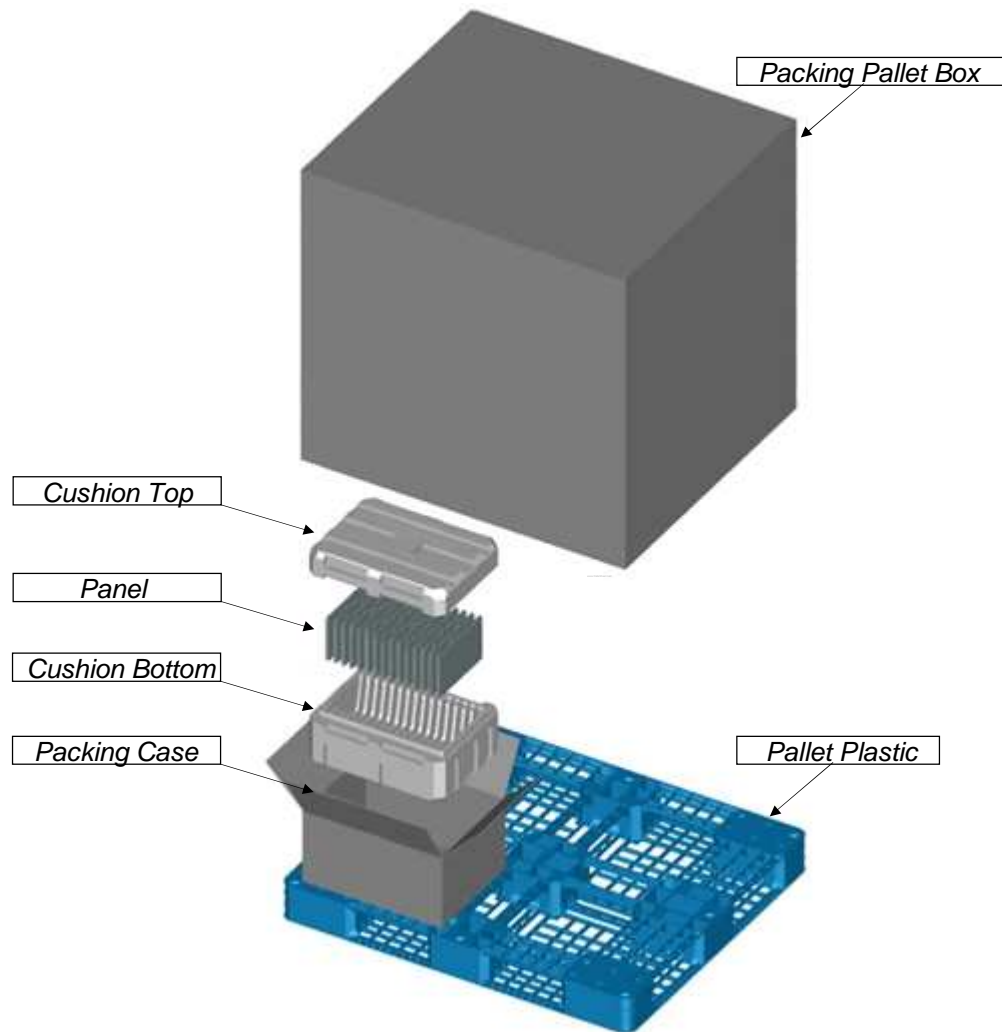
8. PACKING

1. CARTON(Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrupad form as shock absorber

(2) Packing Method



PACKING CASE

- Note 1) Total Weight : Approximately 7 kg
 2) Acceptance number of piling : 30 sets
 3) Carton size : 450(W) × 340(D) × 230(H)

Samsung Secret

Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	25 / 29
---------	------------	--------	-----------------	------	---------

(3)Packing Material

No	Part name	Quantity
1	Static electric protective sack	30
2	Packing case (Inner box) included shock absorber	1 set
3	Pictorial marking	2 pcs
4	Carton	1 set

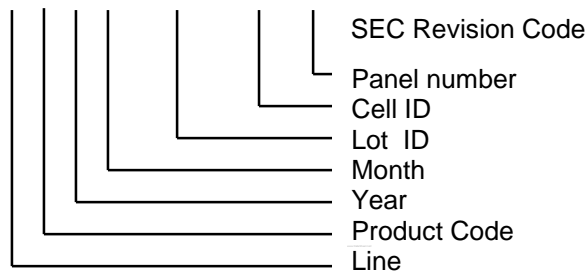
9. MARKINGS & OTHERS

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

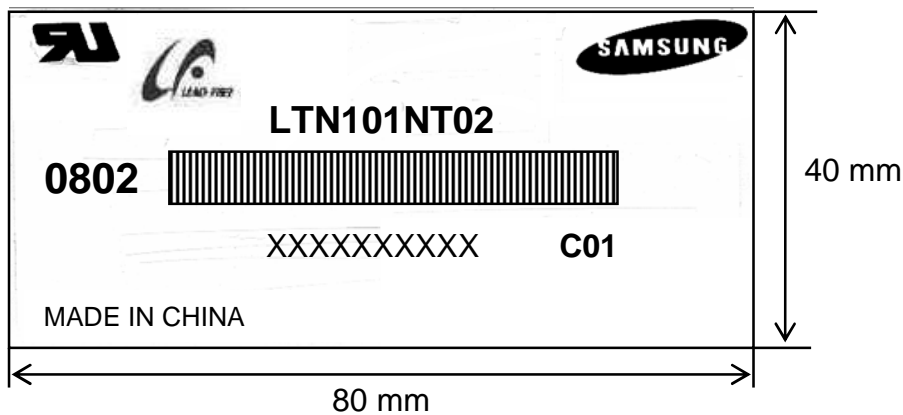
(1)Parts number : LTN101NT02

(2)Revision code : 3 letters

(3)Lot number : X X X X XXX XX X **C01**



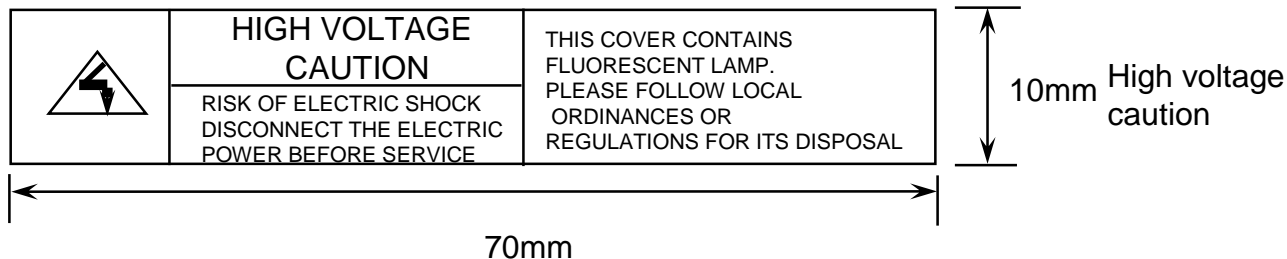
(5) Nameplate Indication



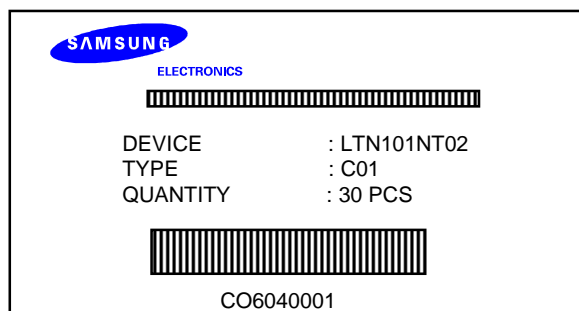
Parts name : LTN101NT02
Lot number : XXXXXXXXXX
Inspected work week : 0802(2008 year, 2nd week)

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High voltage caution label



(6) Packing small box attach



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



Samsung Secret

10. GENERAL PRECAUTIONS

Preliminary

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 (Isopropyl 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.

Samsung Secret

Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	28 / 29
----------------	------------	---------------	-----------------	-------------	---------

2. STORAGE

- (a) Do not leave the module in high temperature, and high humidity for a long time.
It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD module in direct sunlight.
- (c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

3. OPERATION

- (a) Do not connect, disconnect the module in the “ Power On” condition.
- (b) Power supply should always be turned on/off by following item 6.3
“ Power on/off sequence “.
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back-light connector and its inverter power supply shall be a minimized length and be connected 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.

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.

Samsung Secret

Doc.No.	LTN101NT02	Rev.No	04-A00-G-090210	Page	29 / 29
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