



深圳锐朗光电有限公司

SAMSUNG

LTN154U1_L03

TEL: 0755-29555810 0755-36926300

FAX: 0755-29555810

E-mail: fpd31@163.com zhoufeng.419@163.com

Website: <http://www.rlofpd.com>

ADD: 深圳市龙华街道梅龙路梅龙苑1单元1201



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ELECTRONICS

Preliminary

TO : Dell / Compal

DATE : Mar. 29, 2004.

SAMSUNG TFT-LCD

MODEL NO. : LTN154U1-L03

NOTE :

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

APPROVED BY :



PREPARED BY : LCD Application Engineering Group 1, TCS Team

SAMSUNG ELECTRONICS CO., LTD.



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REVISION HISTORY

Preliminary

Date	Revision No.	Page	Summary
Mar. 29. 2004	P00	All	LTN154U1-L03 Model spec was issue first.

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GENERAL DESCRIPTION

DESCRIPTION

LTN154U1-L03 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight unit. The resolution of a 15.4" contains 1920 x 1200 pixels and can display up to 262,144 colors. 6 O'clock direction is the Optimum viewing angle.

FEATURES

- High contrast ratio, high aperture structure
- 1920 x 1200 pixels resolution
- Low power consumption
- Fast Response
- Single CCFL
- DE(Data enable) only mode
- 3.3V LVDS Interface
- Onboard EEDID chip
- Attached Burst mode Inverter

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	331.38(H) x 207.1125(V) (15.4" diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	262,144		
Number of pixel	1920 x RGB(3) x 1200	pixel	16 : 10
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.1725(H) x 0.1725(V) (TYP.)	mm	
Display Mode	Normally white		
Surface treatment	Haze 25, Hard-Coating 3H		

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Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	343.5	344.0	344.5	mm	w/o inverter ass'y
	Vertical (V)	221.5	222.0	222.5	mm	
	Depth (D)	-	-	6.5	mm	
Weight		-	620	635	g	LCD module only
		-	640	655	g	w/ Inverter assembly

1. ABSOLUTE MAXIMUM RATINGS

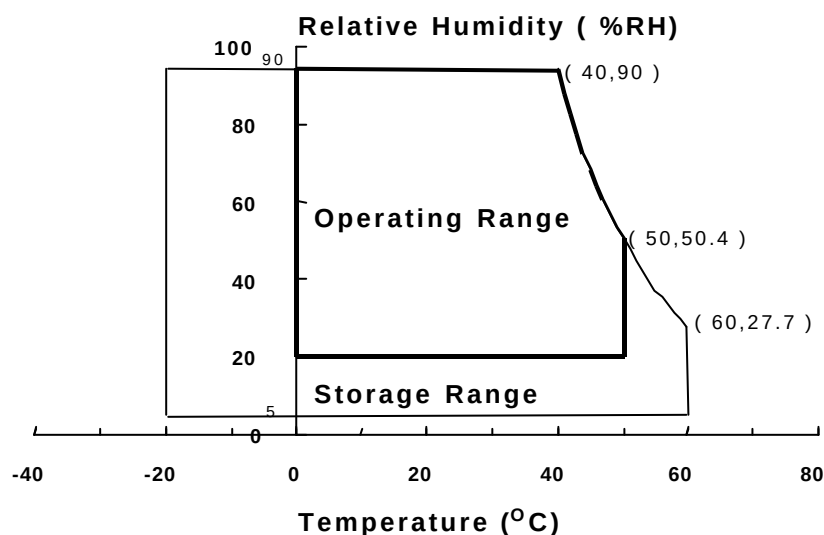
1.1 ENVIRONMENTAL ABSOLUTE RATINGS

Item	Symbol	Min.	Max.	Unit	Note
Storage temperate	TSTG	-20	60	°C	(1),(5)
Operating temperate (Temperature of glass surface)	TOPR	0	50	°C	(1),(5)
Shock (non-operating)	Snop	-	240	G	(2),(4)
Vibration (non-operating)	Vnop	-	2.41	G	(3),(4)

Note (1) Temperature and relative humidity range are shown in the figure below.

95 % RH Max. ($40^{\circ}\text{C} \geq T_a$)

Maximum wet - bulb temperature at 39°C or less. ($T_a > 40^{\circ}\text{C}$) 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.

(5) If product is used for extended time excessively or exposed to high temperatures for extended time, there is a possibility of wide viewing angle film damage which could affect visual characteristics.

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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}	$V_{SS} - 0.3$	3.6	V	(1)

Note (1) Within T_a ($25 \pm 2^\circ C$)

(2) BACK-LIGHT UNIT

 $T_a = 25 \pm 2^\circ C$

Item	Symbol	Min.	Max.	Unit	Note
Lamp Current	I_L	2.0	7.0	mArms	(1)
Lamp frequency	F_L	40	80	kHz	(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

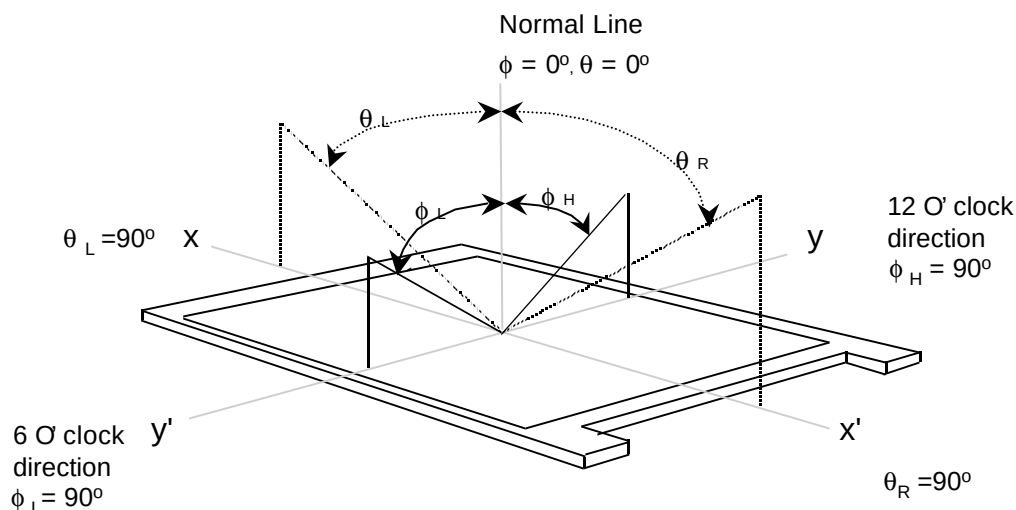
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).
Measuring equipment : TOPCON BM-5A and PR-650

* Ta = 25 ± 2 °C, V_{DD}=3.3V, f_V= 60Hz, f_{DCLK} = 48.15MHz, I_L = 6.5 mA

Item		Symbol	Condition	Min.	Typ.	Max	Unit	Note
Contrast Ratio (5 Points)		CR	Normal Viewing Angle ϕ = 0 θ = 0	300	-	-	-	(1), (2), (5)
Response Time at Ta (Rising + Falling)		T _{RT}		-	25	35	msec	(1), (3)
Average Luminance of White (5 Points)		Y _{L,AVE}		150	175	-	cd/m ²	I _L =6.5mA (1), (4)
Color Chromaticity (CIE)	Red	R _X		(0.560)	(0.580)	(0.600)	-	(1), (5) PR-650
		R _Y		(0.320)	(0.340)	(0.360)		
	Green	G _X		(0.290)	(0.310)	(0.330)		
		G _Y		(0.530)	(0.550)	(0.570)		
	Blue	B _X		(0.135)	(0.155)	(0.175)		
		B _Y		(0.135)	(0.155)	(0.175)		
	White	W _X		0.293	0.313	0.333		
		W _Y	0.309	0.329	0.349			
Viewing Angle	Hor.	θ _L	CR ≥ 10	60	65		Degrees	(1), (5) BM-5A
		θ _H		60	65			
	Ver.	ϕ _H		40	45			
		ϕ _L		50	55			
	Hor.	θ _L	CR ≥ 100	(40)	TBD		Degrees	
		θ _H		(40)	TBD			
	Ver.	ϕ _H		(20)	TBD			
		ϕ _L		(20)	TBD			
13 Points White Variation		δ _L		-	-	1.5	-	(6)

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

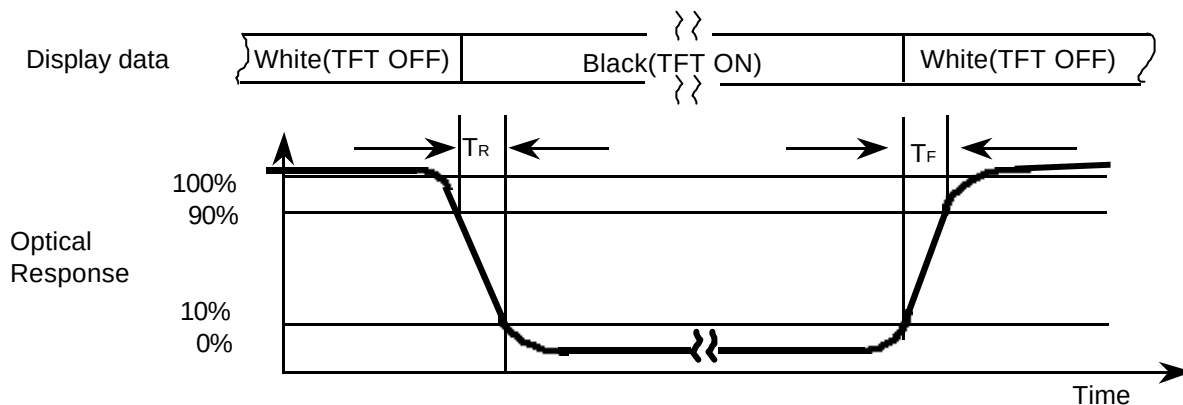


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

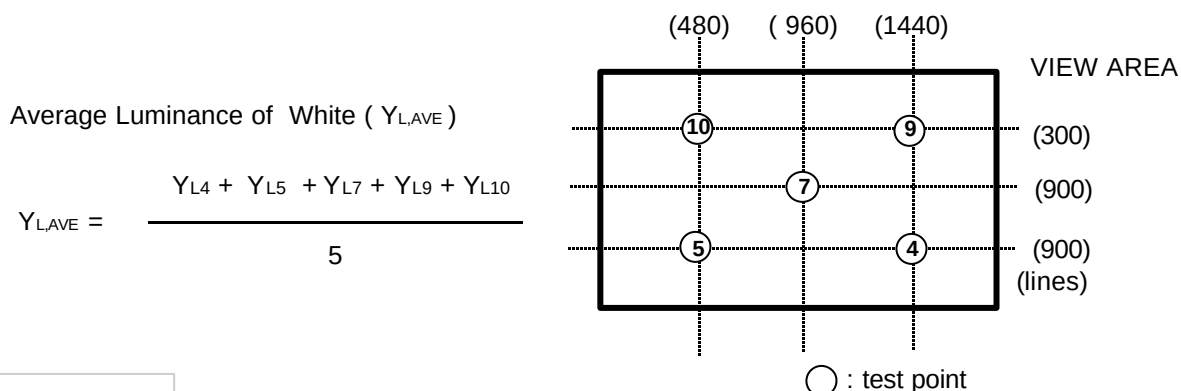
$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

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

Note 3) Definition of Response time :

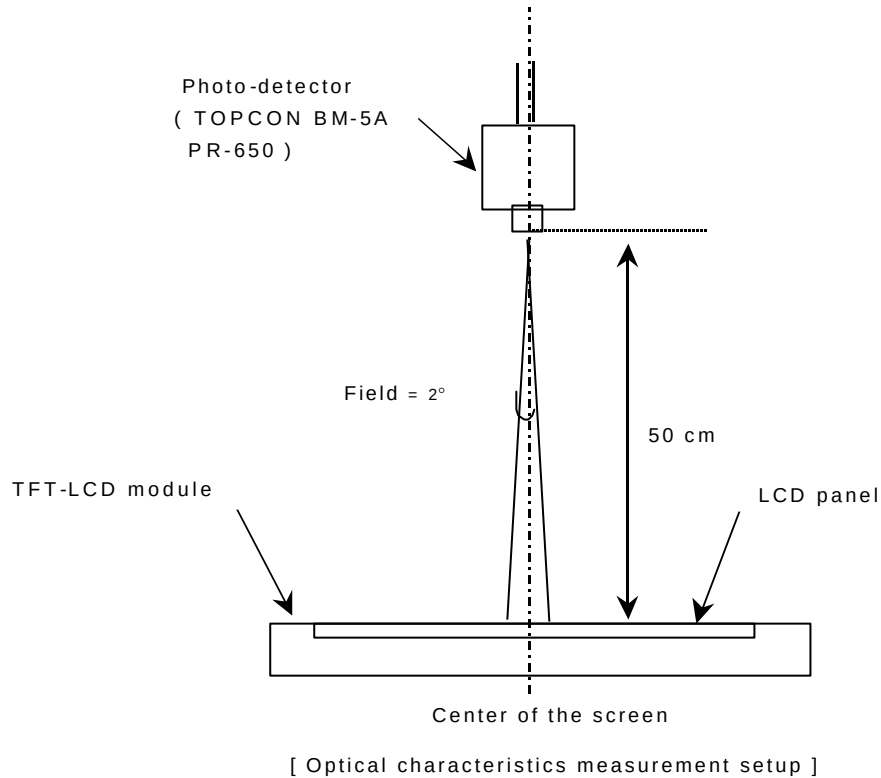


Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.



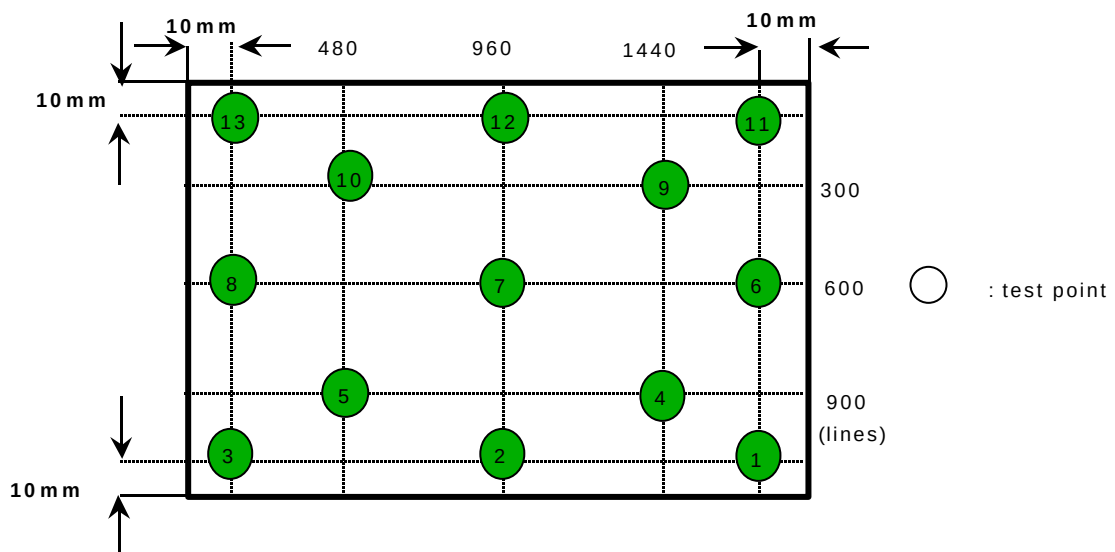
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Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.
Lamp current : 6.5mA (Inverter : SIC-130T)
Environment condition : $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$



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

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



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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	-	75	-	KHz	
Main Frequency		f _{DCLK}	-	81	-	MHz	
Rush Current		I _{RUSH}	-	-	1.5	A	(4)
Current of Power Supply	White	I _{DD}	-	TBD	-	mA	(2),(3)*a
	Mosaic		-	TBD	-	mA	(2),(3)*b
	V. stripe		-	TBD	TBD	mA	(2),(3)*c

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

(2) f_v = 60Hz, f_{DCLK} = 60.7MHz, V_{DD} = 3.3V , DC Current.

(3) Power dissipation pattern

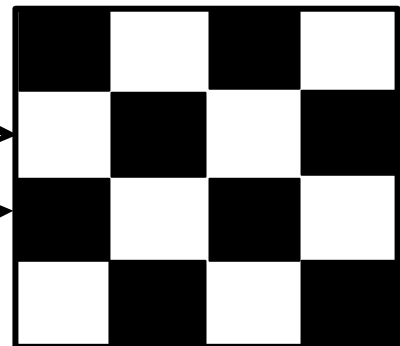
*a) White Pattern



*b) Mosaic Pattern

Display Brightest Gray Level →

Display Darkest Gray Level →



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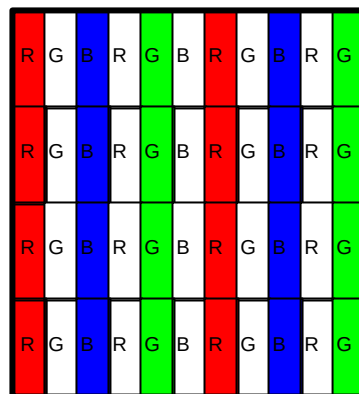
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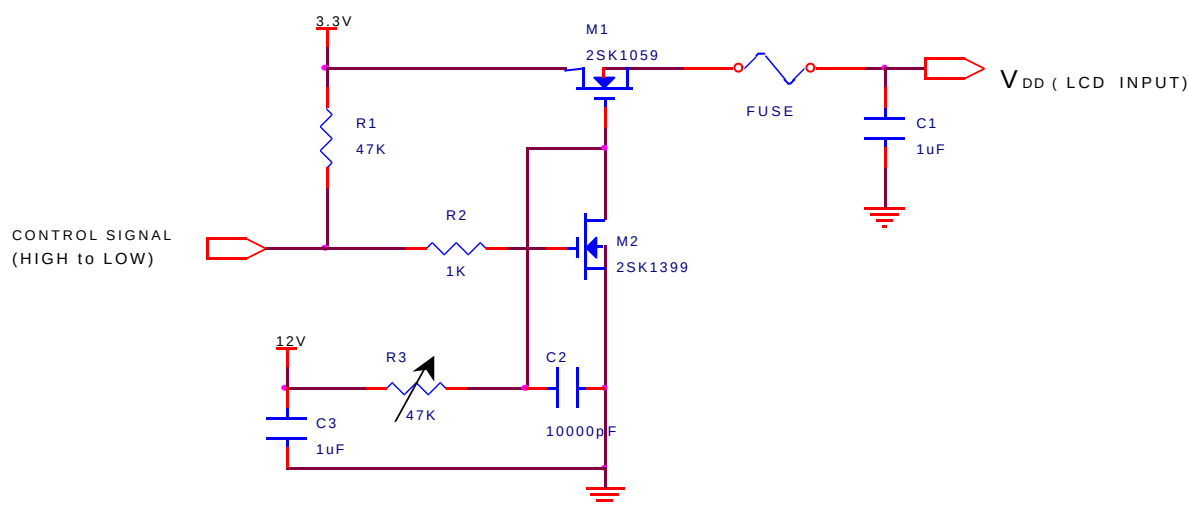
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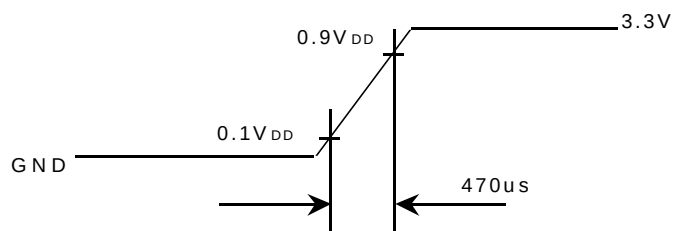
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4) Rush current measurement condition



V_{DD} rising time is 470us



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3.2 BACK-LIGHT UNIT

The backlight system is an edge-lighting type with a single CCFT (Cold Cathode Fluorescent Tube).
The characteristics of a single lamp are shown in the following table.

- INVERTER : TBD

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

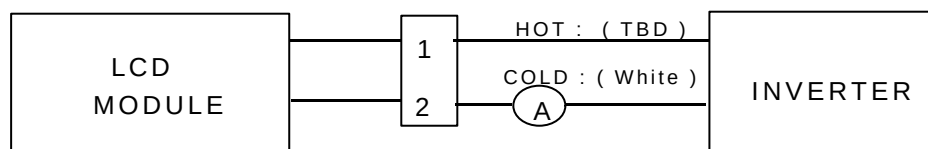
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current	I_L	3.0	6.5	7.0	mArms	(1)
Lamp Voltage	V_L	-	TBD	-	Vrms	$I_L = 6.5\text{mA}$
Frequency	f_L	40	-	60	KHz	(2)
Power Consumption	P_L		TBD		W	(3) $I_L = 6.5\text{mA}$
Operating Life Time	Hr				Hour	(4)
Startup Voltage	V_s			TBD	Vrms	25°C, (5)
				TBD	Vrms	0°C, (5)

Note) The waveform of the inverter output voltage must be area symmetric and the design of the inverter must have specifications for the modularized lamp.

The performance of the backlight, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the backlight and the inverter(miss lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

Note (1) Lamp current is measured with a high frequency current meter as shown below.



(2) Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) Refer to $I_L \times V_L$ to calculate.

(4) Life time (Hr) of a lamp can be defined as the time in which it continues to operate under the condition $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$ and $I_L = 6.0 \text{ mArms}$ until one of the following event occurs.

1. When the brightness becomes 50% or lower than the original.
2. When the Effective ignition length becomes 80% or lower than the original value.
(Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

(5) The inverter open voltage - this voltage should be measured after ballast capacitor- have to be larger than the lamp startup voltage, otherwise backlight may has blinking for a moment after turns on or not be turned on.

If an inverter has shutdown function it should keep its open voltage for longer than 1 second even if lamp connector open.

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3.3 Inverter

Inverter Manufacturer : TBD

Ta = 25 ± 2°C

Item		Min.	Typ.	Max	Unit	Note
Input Voltage (Vin)		7.5	14.4	21.0	V	
Open Circuit Voltage		TBD(L/K:1400)	-	2000	Vrms	
Lamp Current (Duty Cycle)		TBD @SMB_DAT FFH	-	100 @SMB_DAT 00H IL=6.5mArms	%	Vin=14.4V
Efficiency	Optical	20	-	-	nit / W	After 30min turn on at the center of LCD Vin=14.4V @6.5mA
	Electrical	-	80	-	%	
Operating Frequency		45	55	65	kHz	SMB_DAT=00H
Input Power Consumption		-	-	(6.5)	W	Vin=14.4V Iout = 6.5mArms
PWM Frequency		200	210	220	Hz	
Shutdown time		0.6	1.0	1.4	sec	
Start-up time		-	-	0.1	sec	(1)

Note)

(1) Inverter start-up time

(2) Efficiency should be calculated as below formulation.

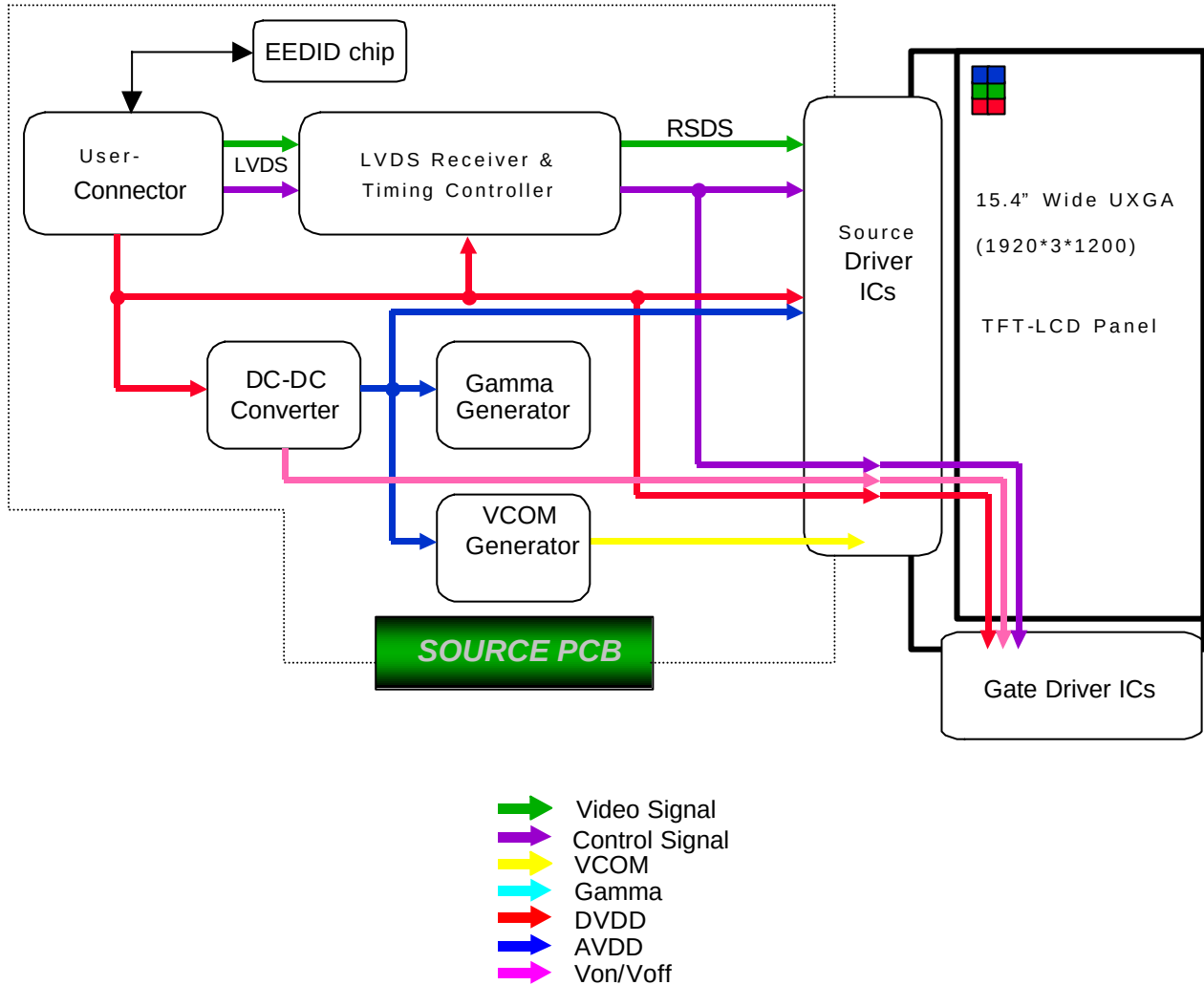
Optical efficiency = output Brightness(nits) / Input power(watt)

Electrical efficiency = output power / input power

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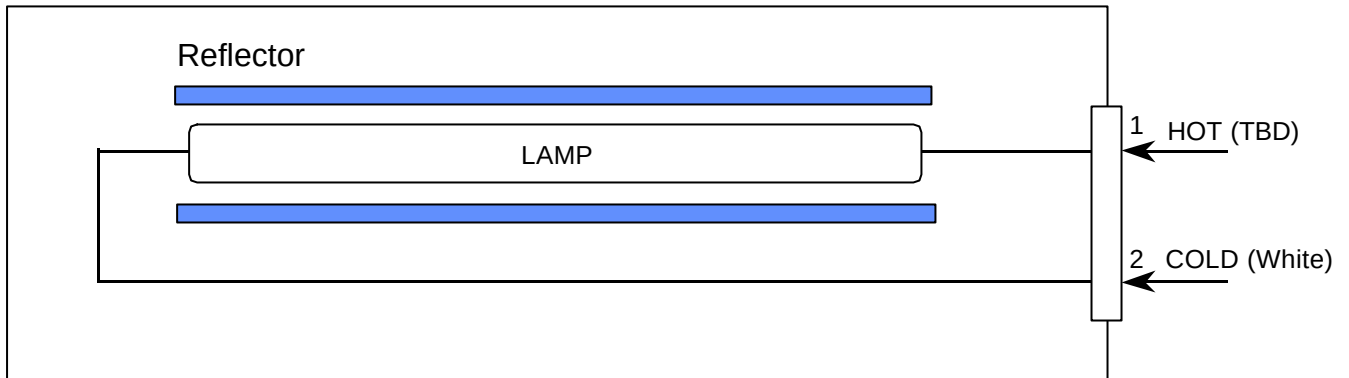
4. BLOCK DIAGRAM

4.1 TFT LCD Module



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4.2 BACKLIGHT UNIT

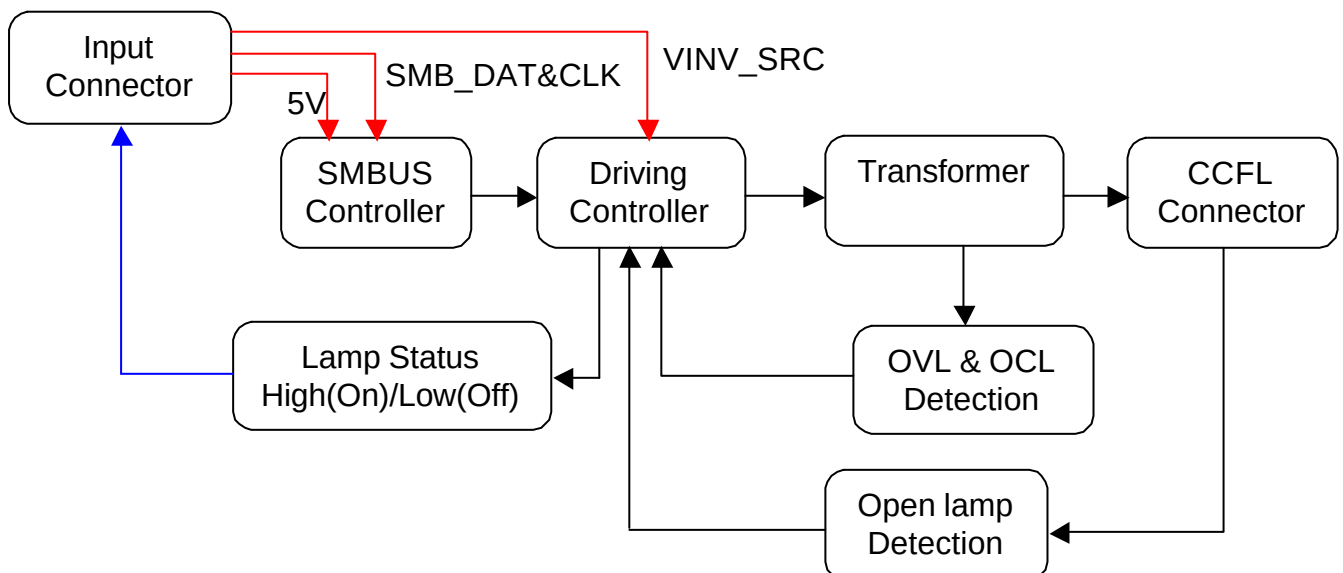


Note) The output of the inverter may change according to the material of the reflector.

4.3 Inverter UNIT

Input Connector : Honda, LVC-D20SFYG

Lamp Connector : JST, SM02B-BHSS-1-TB



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5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (LVDS, Connector : JAE FI-XB30SL-HF10 or compatible)
Mating Connector : JAE FI-X30M or compatible)

No.	Symbol	Function	Polarity	Remarks
1	VSS	Ground		
2	VDD	POWER SUPPLY +3.3V		
3	VDD	POWER SUPPLY +3.3V		
4	VEEDID	DDC 3.3V Power		
5	BIST	Panel BIST enable		
6	CLKEDID	DDC Clock		
7	DATAEDID	DDC data		
8	O_RxIN0-	LVDS Differential Data INPUT (Odd R0-R5,G0)	Negative	
9	O_RxIN0+	LVDS Differential Data INPUT (Odd R0-R5,G0)	Positive	
10	GND	Ground		
11	O_RxIN1-	LVDS Differential Data INPUT (Odd G1-G5,B0-B1)	Negative	
12	O_RxIN1+	LVDS Differential Data INPUT (Odd G1-G5,B0-B1)	Positive	
13	GND	Ground		
14	O_RxIN2-	LVDS Differential Data INPUT (Odd B2-B5,Sync,DE)	Negative	
15	O_RxIN2+	LVDS Differential Data INPUT (Odd B2-B5,Sync,DE)	Positive	
16	GND	Ground		
17	O_RxCLK-	LVDS Differential Data INPUT (Odd Clock)	Negative	
18	O_RxCLK+	LVDS Differential Data INPUT (Odd Clock)	Positive	
19	GND	Ground		
20	E_RxIN0-	LVDS Differential Data INPUT (Even R0-R5,G0)	Negative	
21	E_RxIN0+	LVDS Differential Data INPUT (Even R0-R5,G0)	Positive	
22	GND	Ground		
23	E_RxIN1-	LVDS Differential Data INPUT (Even G1-G5,B0-B1)	Negative	
24	E_RxIN1+	LVDS Differential Data INPUT (Even G1-G5,B0-B1)	Positive	
25	GND	Ground		
26	E_RxIN2-	LVDS Differential Data INPUT (Even B2-B5,Sync,DE)	Negative	
27	E_RxIN2+	LVDS Differential Data INPUT (Even B2-B5,Sync,DE)	Positive	
28	GND	Ground		
29	E_RxCLK-	LVDS Differential Data INPUT (Even Clock)	Negative	
30	E_RxCLK+	LVDS Differential Data INPUT (Even Clock)	Positive	

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5.2 LVDS Interface : Transmitter DS90CF365 or Compatible

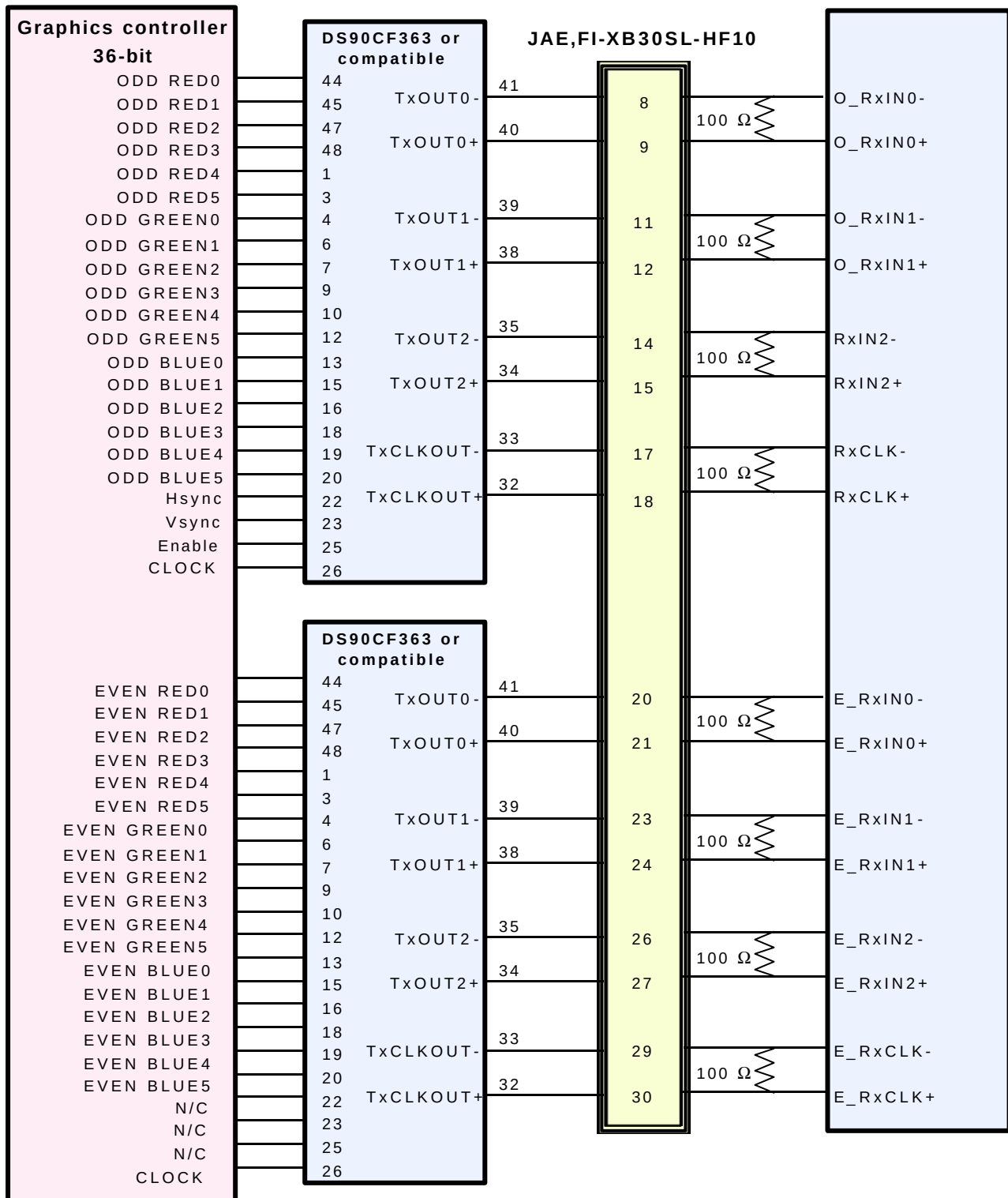
LVDS for Odd pixel

Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
44	TxIN0	RO0	12	TxIN11	GO5
45	TxIN1	RO1	13	TxIN12	BO0
47	TxIN2	RO2	15	TxIN13	BO1
48	TxIN3	RO3	16	TxIN14	BO2
1	TxIN4	RO4	18	TxIN15	BO3
3	TxIN5	RO5	19	TxIN16	BO4
4	TxIN6	GO0	20	TxIN17	BO5
6	TxIN7	GO1	22	TxIN18	Hsync
7	TxIN8	GO2	23	TxIN19	Vsync
9	TxIN9	GO3	25	TxIN20	DE
10	TxIN10	GO4	26	TxCLK IN	Clock

LVDS for Even pixel

Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
44	TxIN0	RE0	12	TxIN11	GE5
45	TxIN1	RE1	13	TxIN12	BE0
47	TxIN2	RE2	15	TxIN13	BE1
48	TxIN3	RE3	16	TxIN14	BE2
1	TxIN4	RE4	18	TxIN15	BE3
3	TxIN5	RE5	19	TxIN16	BE4
4	TxIN6	GE0	20	TxIN17	BE5
6	TxIN7	GE1	22	TxIN18	N/C
7	TxIN8	GE2	23	TxIN19	N/C
9	TxIN9	GE3	25	TxIN20	N/C
10	TxIN10	GE4	26	TxCLK IN	Clock

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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 BACK LIGHT UNIT

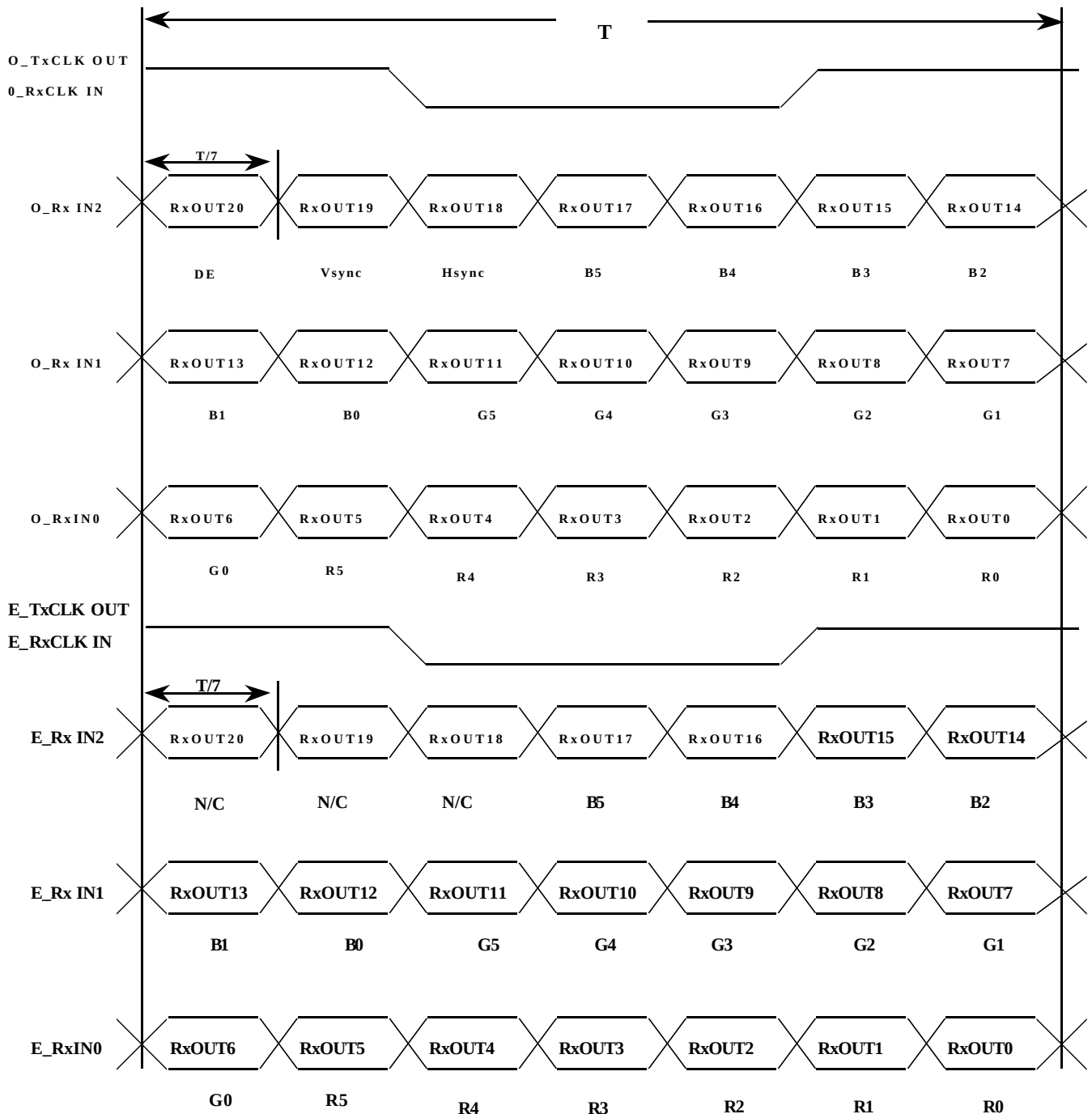
Preliminary

Connector : JST BHSR - 02VS -1
Mating Connector : JST SM02B-BHSS-1

Pin NO.	Symbol	Color	Function
1	HOT	TBD	High Voltage
2	COLD	White	Low Voltage

5.4 Timing Diagrams of LVDS For Transmission

LVDS Receiver : Integrated T-CON



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5.5 Input Signals, Basic Display Colors and Gray Scale of Each Colors

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

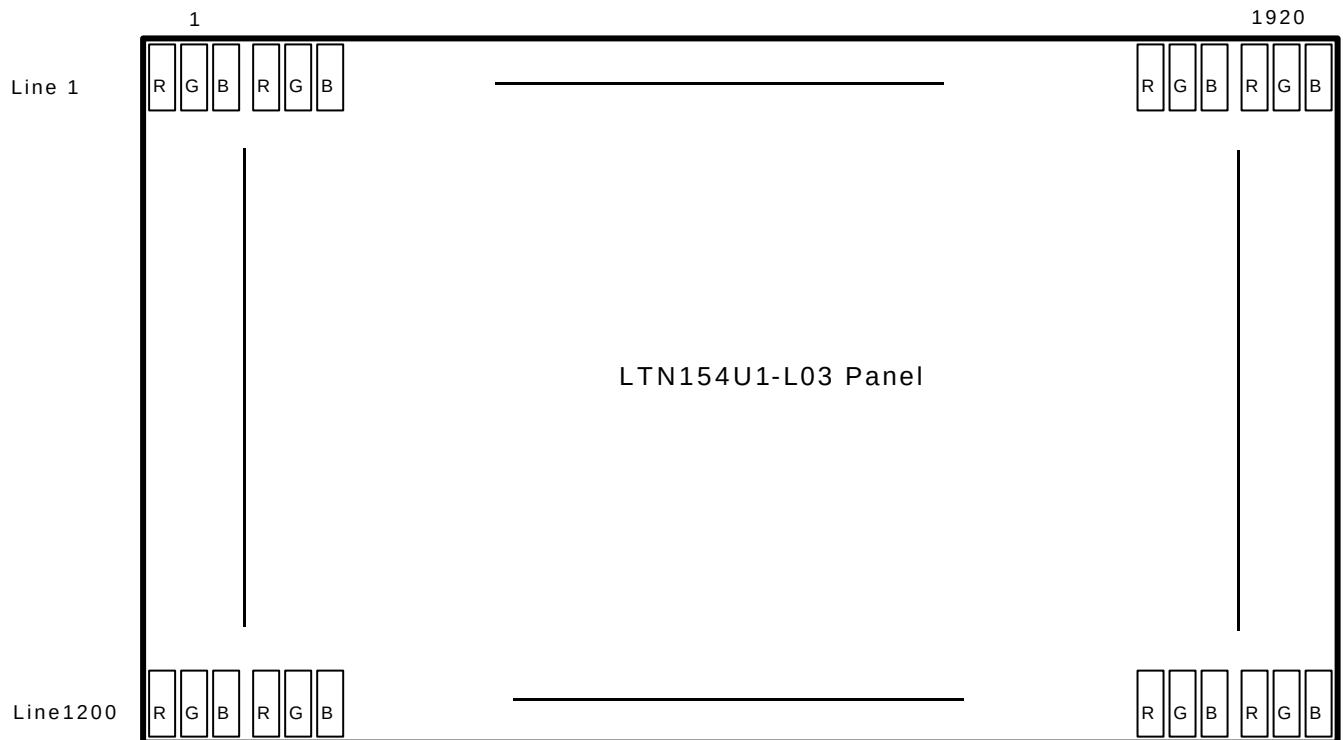
Note 1) Definition of gray :

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

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

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5.6 Pixel Format in the display



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5.7 Inverter signals & power

Inverter Connector : Honda, LVC-D20SFYG

Pin No.	Symbol	Voltage	Comments
1	INV_SRC	7.5V to 21V	This power rail should be used as a power rail to drive the back-light DC-AC converter.
2	INV_SRC	7.5V to 21V	This power rail should be used as a power rail to drive the back-light DC-AC converter.
3	INV_SRC	7.5V to 21V	This power rail should be used as a power rail to drive the back-light DC-AC converter.
4	NC	-	No Connection
5	GND	0V	Ground
6	5VSUS	5V	This should be used as power source for the control circuitry on the inverter.
7	5VALW	5V	This should be used as power source that stores the brightness/contrast values & the circuit that interfaces with SMB_CLK & SMB_DAT.
8	GND	0V	Ground
9	SMB_DAT	-	SMBUS interface for sending brightness & contrast information to the inverter/panel
10	SMB_CLK	-	SMBUS interface for sending brightness & contrast information to the inverter/panel
11	GND	0V	Ground
12	FPBACK	-	Control signal input into the inverter to turn ON or OFF Lamp. (1 - ON, 0 - OFF)
13	GND	0V	Ground
14	LAMP_STAT	-	Lamp Status Output On (High) / Off (Low) from control chip.
15	NC	-	No Connection
16	NC	-	No Connection
17	NC	-	No Connection
18	NC	-	No Connection
19	NC	-	No Connection
20	NC	-	No Connection

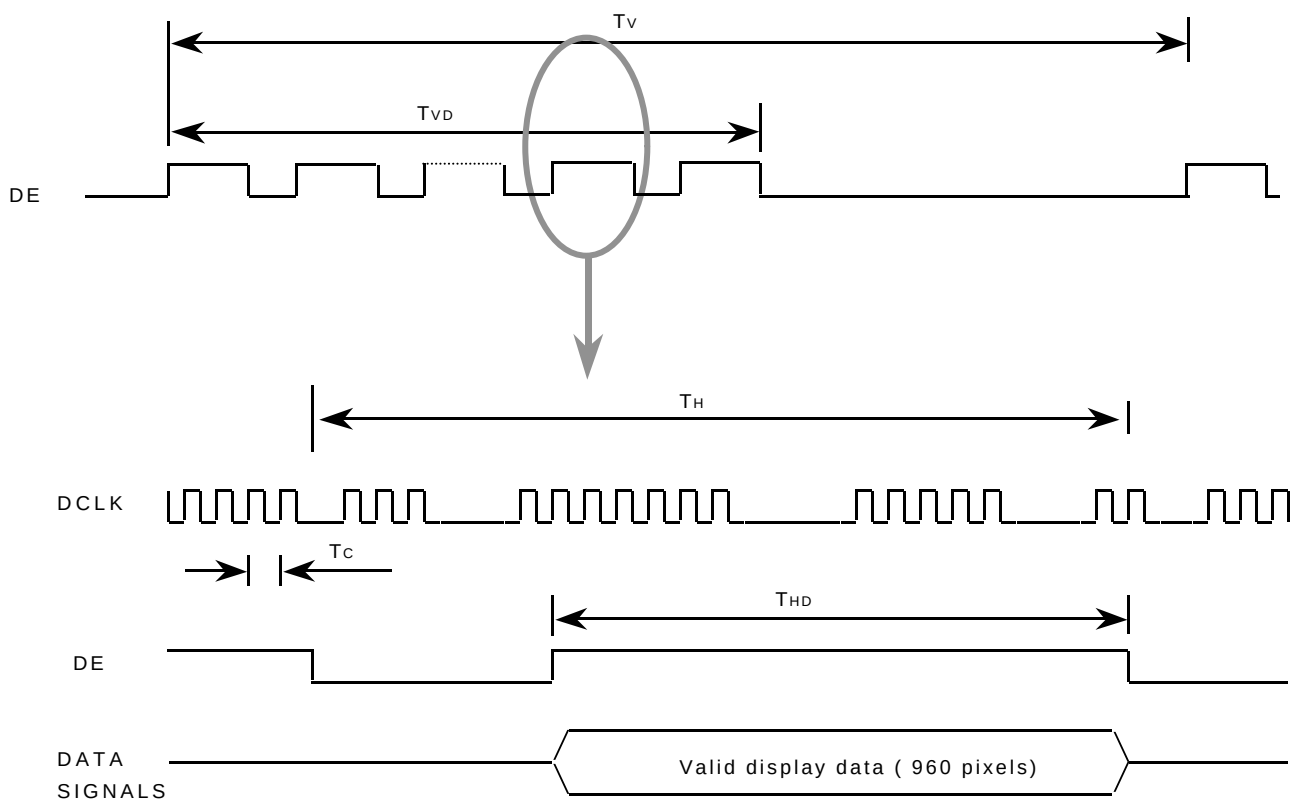
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6. INTERFACE TIMING

6.1 Timing Parameters

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	Cycle	TV	1204	1250	1400	Lines	
Vertical Active Display Term	Display Period	TVD	-	1200	-	Lines	
One Line Scanning Time	Cycle	TH	1030	1080	1170	Clocks	
Horizontal Active Display Term	Display Period	THD	-	960	-	Clocks	

6.2 Timing diagrams of interface signal

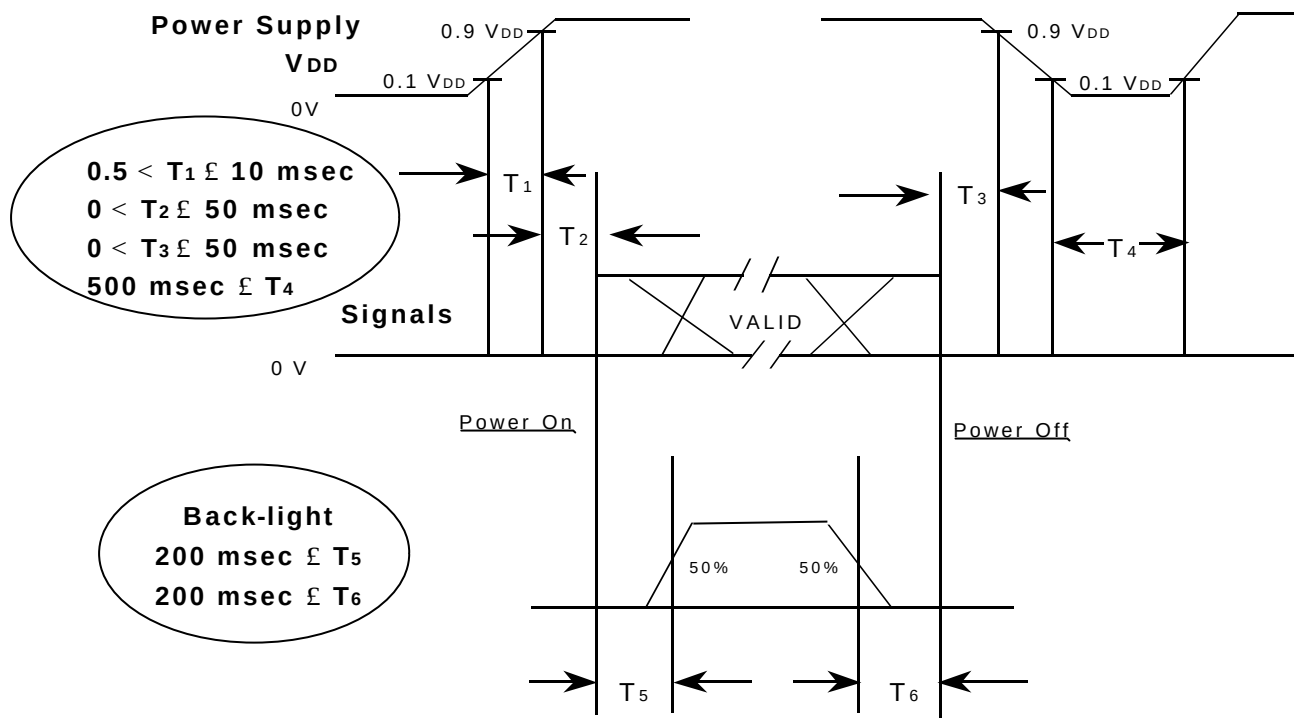


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6.3 Power ON/OFF Sequence

Preliminary

: 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

- T1 : V_{DD} rising time from 10% to 90%
- T2 : The time from V_{DD} to valid data at power ON.
- T3 : The time from valid data off to V_{DD} off at power Off.
- T4 : V_{DD} off time for Windows restart
- T5 : The time from valid data to B/L enable at power ON.
- T6 : The time from valid data off to B/L disable at power Off.

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) 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.

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PRELIMINARY

GENERAL TOLERANCE										REASON		CHK'D BY
STEP	LEVEL 1	LEVEL 2	LEVEL 3	REV. DATE	DESCRIPTION OF REVISION			MODEL NAME				
0 × 5 ± 4	+0.05	+0.1	+0.1	UNIT	DRAWN BY	DES'D BY	CHK'D BY	APP'D BY	LAGUNA (154MG)			
4 × 5 ± 16	+0.08	+0.15	+0.3	SCALE	1:1	J.Y. MON						
				TOLERANCE	2004.02.19				PART/SHEET NAME	OUTLINE DIMENSION	SHEET 1/1	
64 × 5 ± 64	+0.12	+0.25	+0.5	LEVEL 3								
16 × 5 ± 256	+0.25	+0.4	+0.8	SAMSUNG ELECTRONICS				SPEC. NO	CODE NO.	-	VER. 000	

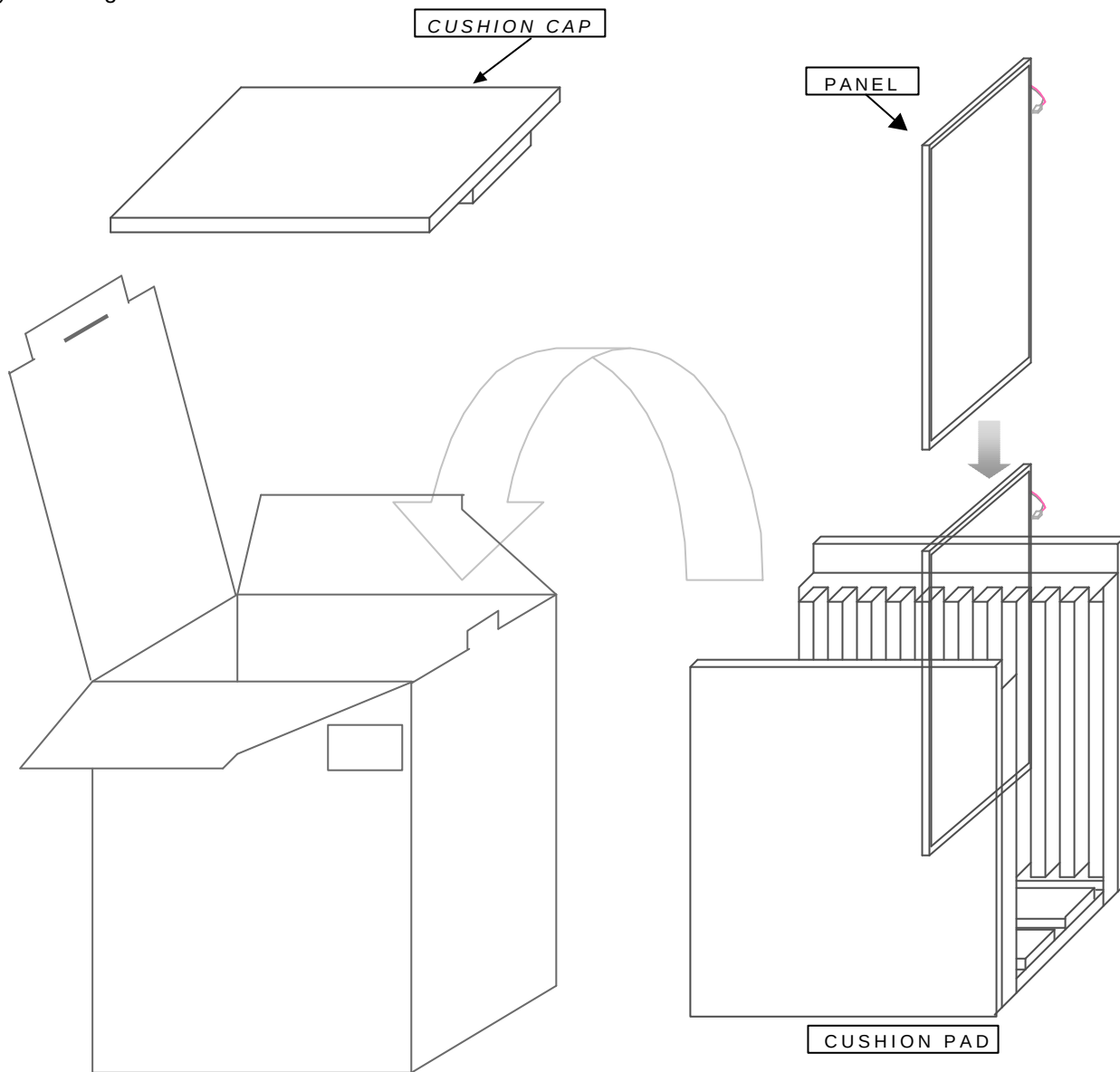
8. PACKING

1. CARTON(Internal Package)

(1) Packing Form

Corrugated Cardboard box and Corrupad form as shock absorber

(2) Packing Method



- Note 1) Total Weight : Approximately 10 kg
 2) Acceptance number of piling : 10 sets
 3) Carton size : 376(W)×326(D)×404(H)

PACKING CASE

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No	Part name	Quantity
1	Static electric protective sack	10
2	Packing case (Inner box) included shock absorber	1 set
3	Pictorial marking	2 pcs
4	Carton	1 set

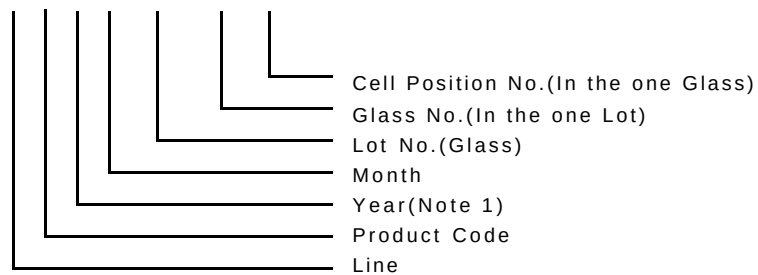
9. MARKINGS & OTHERS

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

(1) Parts number : LTN154U1-L03

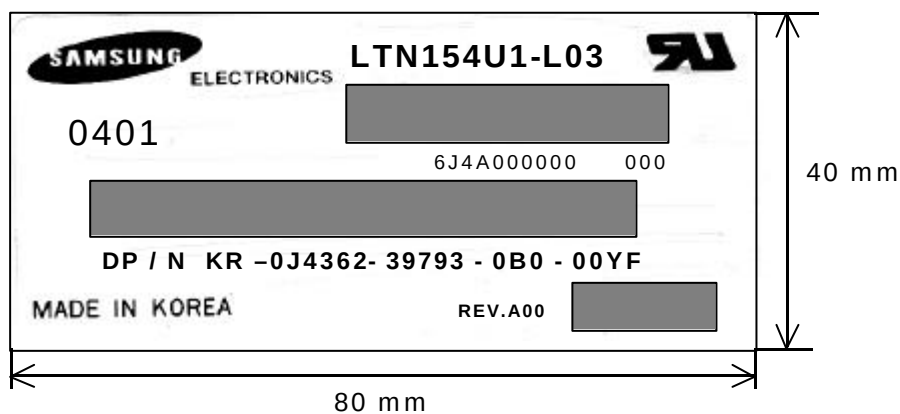
(2) Revision : Three letters

(3) Lot number : 4 J 4 A XXX XX X



NOTE 1). This code indicating year is omitted in the products of KIHENG site.

(5) Nameplate Indication



Parts name : LTN154U1-L03

Lot number : 6J4A000000

Inspected work week : 0401

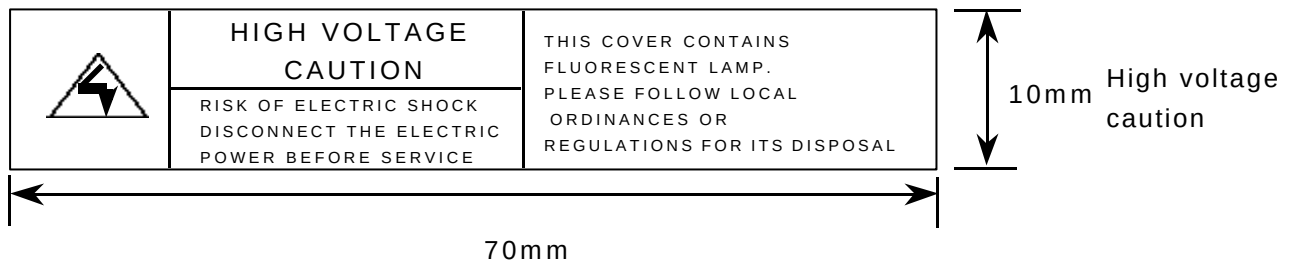
DP/N : Dell Part Number ("0J4362" is for 154U1-L03)

REV.A00 : Product Revision Code

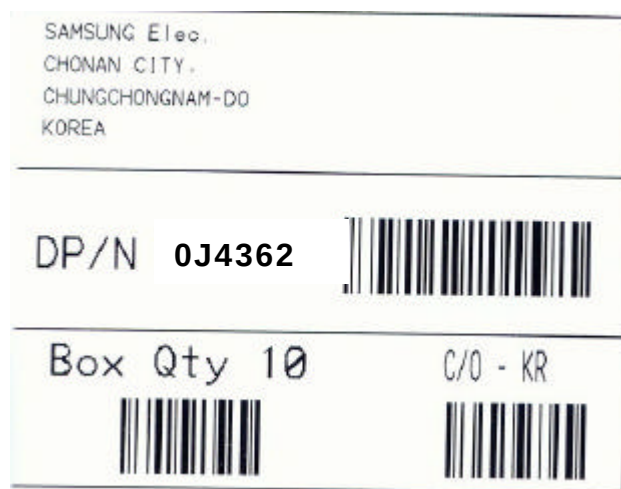
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This HIGH VOLTAGE CAUTION is carved in mold frame



(6) Packing box attach



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



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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.

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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.

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Preliminary Inverter Specification for [Laguna](#)

[SEC : LTN154X/154P/154U](#)

[2004. 02. 13](#)

REV. 0.0

- Inverter Input Voltage Range : [7.5 ~ 21V](#)

[2004. 02. 19](#)

REV. 0.1

- Lamp Current : [6.3mA\(typ.\)](#) → [6.5mA\(typ.\)](#)

1. General

This specification should be used as a guideline for designing the inverter used in [Laguna](#) Program.

Brightness control method of inverter should be PWM(Burst) mode control.

1.1 Model

Type	Samsung Part Number	Supplier Part Number	Remark
TFT_LCD	LTN154X* LTN154P* LTN154U*		

2. Specification

2.1 General electrical specification

Referenced Panels: Samsung TFT-LCD

Item	Minimum	Typical	Maximum	Remarks
Input voltage(Vin)	7.5 V	14.4V	21.0 V	Note 1)
Open Circuit Voltage	(1.4k)Vrms	-	1.8kVrms	Note 2) Refer Appendix B
Lamp voltage	-	(690)Vrms	-	Note 2) Refer Appendix B
Lamp Current	(2.0 ± 0.3) mAms @ SMB_DAT FFH	-	6.5 ± 0.3 mAms @SMB_DAT 00H	Vin = 7.5 ~ 21.0V Note 3)
Dimming Duty Cycle	10(± 2%)		100%	
Efficiency	Optical	20nits/W	-	After 30min turn on at the center of the LCD. Vin = 14.4V, Iout=6.5mAms
	Electrical	-	80%	
Operating Frequency	45 kHz	55kHz	65kHz	
PWM Frequency	210 ± 10Hz			Note 4)
Input Power Consumption	-	-	6.5W	Vin = 14.4V, Iout = 6.5mAms SMB_DAT=00H
Shutdown time	0.6sec	1.0sec	1.4sec	
Start-up time			0.1sec	

Note 1) When input is 7.5V to 21.0V, output current must be regulated within setting value.

Any pop-up, flickering, any other abnormal operation isn't acceptable with 7.5V to 21.0V input voltage.

Provide output waveforms for verification inverter operation in worst load(panel) condition by changing operation condition.

- Test Condition : Input Voltage(1V Step) & Burst Duty(10% Step) & Temperature(0C / 25C / 50C).

The ballast capacitor is recommended for preventing panel flickering issue.

Note 2) When the output is open circuit, it must not damage or burn any components in the inverter including the PWB. And, if the output is shorted together, it should not damage or burn any components in the inverter including the PWB.

No load current shall not exceed full load current.

Maximum open circuit voltage is less than 1800Vrms.

Inverter design must include a fuse on the assembly for over current protection at the input(V_{INV_SRC}) pin.

Please refer to attached inverter design feature (Appendix A)

Please refer to attached CCFL Specification (Appendix B)

Note 3) The lamp current must be controlled within tolerance of setting value.

The lamp current value should be measured by [YOKOGAWA RMS current meter](#).

Minimum current value correspond to minimum brightness(PWM Duty 10%) in LCD module.

Provide brightness output data(Dimming Curve) by burst dimming control.

- Test Condition : Dimming Range(10 ~ 100%), Each 10% Dimming Step

Note 4) The inverter should not emit [acoustic noise](#) in components like transformer.

The inverter should not cause [waterfall problem](#) by interfering with LCD module.

Note 5) Efficiency should be calculated as below formulation.

Optical efficiency = Output Brightness(nits) / Input power(watt)

Output brightness measurement DUT will be provided to SEC standard product.

2.2 Connectors

2.2.1 Backlight connector (CN1)

Backlight connector CN1 must be same as table.

Connector Maker	Connector Part No.	Remark
JST	SM02B-BHSS-1-TB	

Pin No	Symbol	Description	Remark
1	HV	Power supply for CCFL	

2	RTN	Return
---	-----	--------

2.2.2 Input connector(CN2)

It must be a **HONDA, LVC-D20SFYG** 20pin connector, and the pin assignment is ;

Input connector		Voltage	Comments
HONDA	LVC-D20SFYG		
Pin	Function		
1	INV_SRC	7.5V to 21V	This power rail should be used as a power rail to drive the backlight DC-AC converter
2	INV_SRC	7.5V to 21V	This power rail should be used as a power rail to drive the backlight DC-AC converter
3	INV_SRC	7.5V to 21V	This power rail should be used as a power rail to drive the backlight DC-AC converter
4	NC	-	No Connection
5	GND		Ground
6	5VSUS	5V	This should be used as power source for the control circuitry on the inverter
7	5VALW	5V	This should be used as power source that stores the brightness/contrast values & the circuit that interfaces with SMB_CLK & SMB_DAT
8	GND		Ground
9	SMB_DAT		SMBus interface for sending brightness & contrast information to the inverter/panel
10	SMB_CLK		SMBus interface for sending brightness & contrast information to the inverter/panel
11	GND		Ground
12	FPBACK		Control signal input into the inverter to turn the backlight ON & OFF (1 - ON, 0 – OFF)
13	GND		Ground
14	LAMP_STAT		Lamp Status, on(High)/off(Low), from control chip
15 ~ 20	NC		No Connection

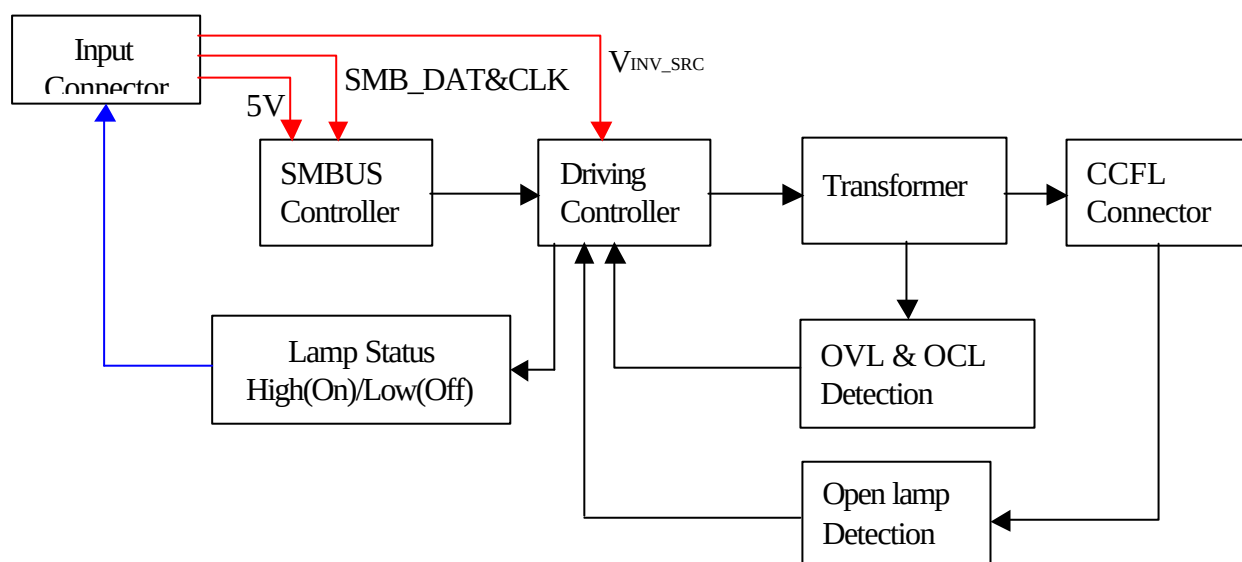
2.2.3 SMBUS Address Definition

SMBus Address Definition for Brightness Control

Device Identifier				Device Address			Read/Write Bit
0	1	0	1	A2	A1	A0	R/W=0

Inverter SMBUS Address	A2	A1	A0
Address = 58H	1	0	0
Recommend using DS1803/DS1805 or Equivalent Function IC(MPS/O2Micro/MAXIM, Etc.). Use wiper 1 for brightness (Backlight) control in case DS1803/DS1805.			

2.2.4. Circuit Block Diagram



3.0 Safety Requirement

Inverter must comply with UL1950 3rd edition, CSA22.2 No. 950-95, EN60950-1992 + A1 & A2 and other applicable regulations.

The inverter has several safety critical components due to high voltage. See list and associated comments:

PWB : The PWB must be UL Recognized and have a 94V-0 rating.

Transformer : Bobbin and other plastic parts must be UL Recognized and have appropriate temperature ratings for the application. Plastic must have 94V-0 Flame Rating.

High Voltage Capacitors : Must have adequate ratings for the application.

Fuse : Must be UL Listed with appropriate ratings for application.

Output Connector(s) : Must be UL Recognized. Must provide adequate spacing from pin to pin for high voltage.

Insulator : The PWB must be UL Recognized and have a 94V-0 rating.

Note) It is preferable that the inverter be a UL Recognized assembly. If assembly is not UL Approved, then a CFM (Confirmation List of Material) must be provided with each shipment of inverters providing manufacturer identification and material/part identification for each critical part.

4.0 Emissions Requirements

Inverter design must be such that it does not prevent host product from complying with CFR47-Part 15 Class B Limits, CISPR-22 Class B Limits, and EN55022 Class B Limits. Consideration should be given to high frequency signals, ringing on signals, filtering of ground and voltage lines, and use of good high frequency grounding techniques.

5.0 Immunity Requirements

Inverter Design must be such that it does not prevent host product from complying with EN50082-1 Generic Immunity Requirements for European Union. This includes ESD, EFT, FRI, Surge, Harmonics, and Flicker.

6.0 Reliability

Minimum MTBF: 200,000 Hrs min @ 25C +/- 1C, 60% RH.

All reliability items refer to Appendix C.

7.0 Mechanical Spec.

7.1 Drawing - Refer to separate drawing.

Inverter Layout Drawing

Please see attached drawing

Appendix A. Inverter Design Features (Inverter design – checklist)

Following table outlines the desired features and design checklist of the inverter.

Item	Feature	Description
1	Soft-start	Lamp should soft start.
2	Short/Open detection	Lamp out (mechanical broken) detection should be provided.
3	Over current protection	Over current protection : Must be checked at all temperature/voltage extremes
4	Over voltage Protection	Over voltage protection : Must be checked at all temperature/voltage extremes And have a stable cut off point.
5	Start-up time Control	Good start-up transient response
6		If dual conversion stage is used both stages shall synchronize
7		There is no indication that the inverter design must be tuned to the bulb.
8		Verify that Strike time and Strike voltage meet the Panel specification
9		The inverter board is designed with test nodes and an ICT fixture is in place to Verify that all components are within the design tolerances.
10		Four corner testing (Voltage vs. Temperature) has been performed on several Inverters using a lamp with components (i.e. BJT & Zener Diodes from different build lots
11		Four corner testing (min. & max. Voltage vs. Temperature) has been performed on several Inverters not using a lamp with components (i.e. BJT & Zener Diodes) from different build lots.
12		Efficiency should be measured – in side the panel and outside of the panel. Results should be analyzed and circuit modified, if the difference between efficiencies is too great.
13		Test inverter over the operating temperature inside the panel. (Notebook operating temperature ambient of 0 to 50 °C
14		Check stress factors on critical components (i.e. voltage and power ratings).
15		Panel should be observed in all display modes to ensure that pattern interference is not present. Look for this in the area of the panel that is closest to the bulb. This is sometimes termed as beat frequencies problem.
16		Abnormal what if analysis must be performed. For e.g. what happens if a component opens, shorts? The goal here is to make sure that failures do not result in safety issues.
17		Obtain drawings of key components, Transformer, inductor, ballast cap, valves, resonant cap etc. Verify that none of the aforementioned is over stressed.
18		Check thermals, to ensure that hotspots are not present, such that the customer can feel heat through the plastics, or display discoloration results.
19		Ensure that the inverter can not be heard (humming or clicking noises) and that control loop is stable
20		EMI recommendation: 1.The GND on the inverter board should be connected to the display metal which should be connected to the notebook system GND. This should be achieved through a secure mechanism such as a screw, copper washer etc. and NOT using conducting foam or copper tape. 2.The ground of the inverter should also be positively connected to the GND on the source PCBs on the panel. The GND point should be physically close to the input connector of the inverter.

Appendix B. CCFL Specification

Our Backlight system is an edge-lighting type with single CCFT(Cold Cathode Fluorescent Tube)Lamp . The characteristics of single lamp are shown in following table.

1. LTN154X/154P/154U - TBD

Items	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp current	IL	2.0	6.0	7.0	mAms	Note1, 2
Lamp Voltage	VL	-	690	-	Vms	+/-5% @ IL=6.0mA
Lamp power	Pcfl	-	4.1	-	Watt	@ IL=6.0mA
Lamp frequency	Fcfl	45	60	80	kHz	Note 3
Kick-off Voltage	Vs	-	-	1090	Vms	Ta=25°C
		-	-	1305		Ta=0°C
Life time	Hlife				Hour	Note4, @ IL=6.0mA
CCFL turn on time	Ton	-	-	0.5	msec	

Note1. If CCFT lamp was flowed below minimum current, lamp become unstable for ignition.

And if the CCFT lamp was flowed over maximum current, lamp life time should be shorter than normal condition.

Note2. At the condition of luminance YL=TBD cd/m2 on TFT-LCD Panel output.

Note3. Lamp frequency may produce interference with Horizontal synchronous frequency and this may cause beat on the display. Therefore lamp driving frequency shall be detached as much as possible from the horizontal synchronous frequency and its harmonics to avoid interference.

Note4. Lamp life time is defined as the time when either A or B occur in the continuous operation under the condition of Ta=25°C and at maximum current.

A) Brightness becomes 50% of the original value.

B) Kick-off voltage at Ta=0°C exceeds maximum value.

Appendix C. P2 Inverter Test Plan.

1. Functional Test Items

Check Items	Split Condition	Sample Quantity	Test Condition	Remark
Output current (Min, Max) & Output deviation	Input voltage Vin=7.5V, 14.4V, 21V	5	SMB_DAT=00H SMB_DAT=FFH	
	Temperature Ta=0°C, Ta=25°C, Ta=50°C			
Output Voltage	Output current SMBUS_DAT=FFH and 00H	5	Input voltage Vin=7.5V, 14.4V, 21V	
	Temperature Ta=0°C, Ta=25°C, Ta=50°C			
Input Power	Output current SMBUS_DAT=FFH and 00H	5	Input voltage Vin=7.5V, 14.4V, 21V	
	Temperature Ta=0°C, Ta=25°C, Ta=50°C			
Kick-off Voltage & Operating freq.	Temperature Ta=0°C, Ta=25°C, Ta=50°C	5	Vin=14.4V, SMB_DAT=00H No load condition	
Shutdown time	Temperature Ta=0°C, Ta=25°C, Ta=50°C	5	Vin=14.4V, SMB_DAT=00H Open voltage detection & shutdown time check	
Turn-on time	Temperature Ta=0°C, Ta=25°C, Ta=50°C	5	Vin=14.4V, SMB_DAT=00H	
Electrical Efficiency	Output current 6mA(00H)	5	Vin=14.4V, SMB_DAT=00H	
	Temperature Ta=0°C, Ta=25°C, Ta=50°C			
Optical Performance (Nits/W)	Output current SMBUS_DAT= 00H	5	Vin=14.4V, SMB_DAT=00H	SEC test only
	Temperature Ta=0°C, Ta=25°C, Ta=50°C			
Stress Factor	Critical components	5	Voltage and power rating	
Display pattern check	SEC standard test pattern	5		SEC test only
Acoustic noise	Humming & clicking noise	5		
Temperature rise Measurement	Power on 2 hours under 25±5°C 60±5°C, measure key component's body temperature.	5	Vin=14.4V, SMB_DAT=00H	

All functional test will perform by inverter supplier and LCD manufacturer(SEC).
And both company should be correct test results.

2. Reliability Test Items

No	Items	Test Condition	Sample size	Check Point
1	High temp. operation	Power on at max. input with load. Operation at Ta=50°C, 500Hours SMB_DAT=00H, 95%RH	20	Function test
2	Low temp. operation	Power on at min. input with load. Operation at Ta=0°C, 500hours SMB_DAT=00H	20	Function test
3	High temp. storage	Power off High temperature 85°C, 500hours	10	Function test
4	Low temp. storage	Power off Low temperature -20°C, 500hours	10	Function test
5	Thermal Cycle	Power off storage Ta=-20°C(30min) ↔ Ta=60°C(30min) 100cycles	20	Function test
6	Power On/Off test	Max. input & min. input. Power on full load(SMB_DAT= 00H) 10sec On/10sec Off, 30,000cycle	10 each	Function test
7	Signal On/Off test	Signal HI(SMB_DAT=00H), 10sec Signal Low(SMB_DAT=FFH), 10sec Max. Vinut, Power on full load. 30,000cycle	10	Function test
8	Hot Start test	After storage at Ta=50°C for 2hour, Then power on at min. Vinut, max. Ioutput. 10times.	10	Function test
9	Cold Start test	After storage at Ta=0°C for 2hour, Then power on at min. Vinut, min. Ioutput. 10times	10	Function test
10	PCB bending test	PCB bending rate : 1mm max.	20	Cosmetic inspection
11	MTBF demo stress Test	Power on at Ta=60°C Max. input voltage, Full load operation	10	MTBF
12	Vibration test (Storage)	2G, 10~500Hz, 30min. 500Hz~10Hz, 30min .	10	Function test

3. TEST Schedule

ITEM	D+1W	D+2W	D+3W	D+4W	D+5W	D+6W	D+7W	D+8W	remark
Functional test	Test by SEC/Maker								
Reliability test		Test by Maker, 500hours							
Long life test			Test by Maker, 1,000hours						

