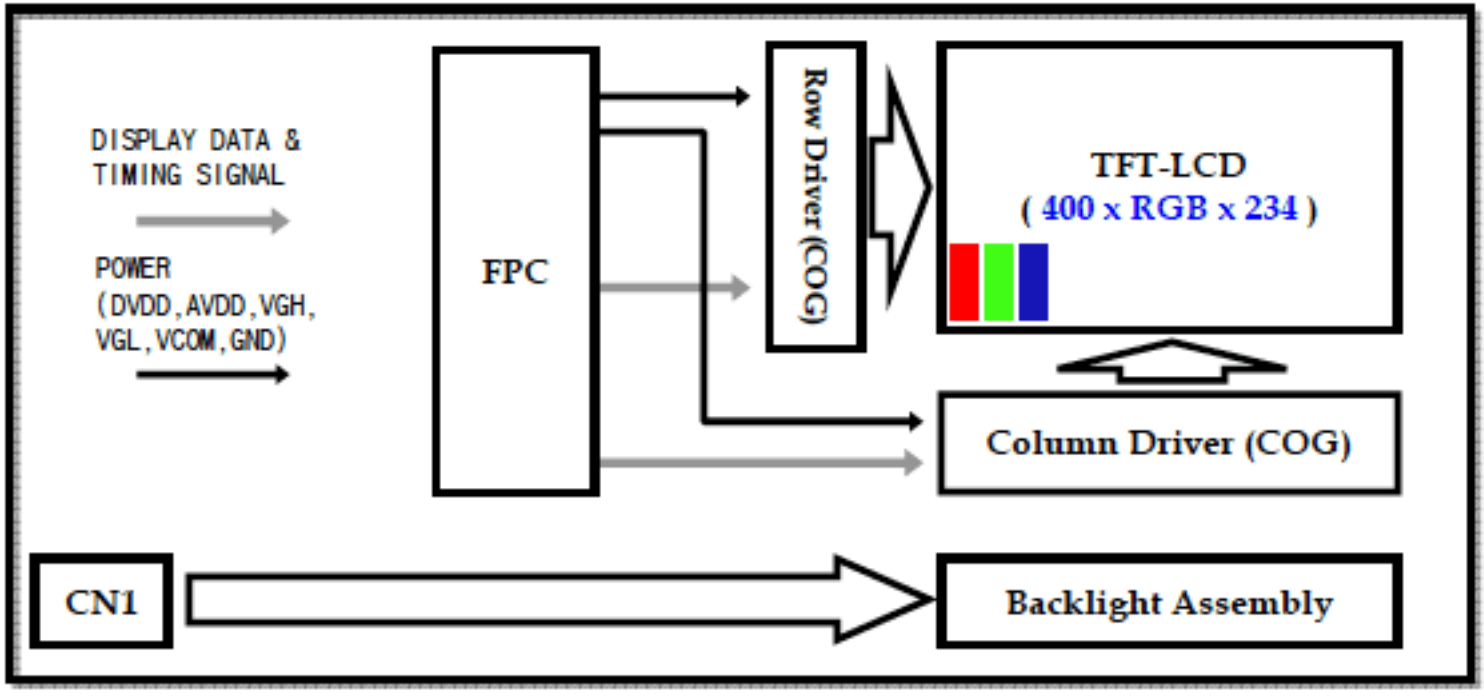
1. Summary

This module utilizes amorphous silicon thin film transistors and a 16.97:9 aspect ratio. A 6.95" active matrix liquid crystal display allows 262,144 colors to be displayed.
The applications are Car Navigation System, Amusement and others AV system.

2. Features

- Utilizes a panel with a 16.97:9 aspect ratio, which makes the module suitable for use in wide-screen systems.
- The 6.95" screen produces a high resolution image that is composed of 93,600 pixel elements in a stripe arrangement.
- Wide viewing angle technology is employed.
  [The most suitable viewing direction is in the 6 o'clock direction.]
- By adopting an active matrix drive, a picture with high contrast is realized.
- A thin, light and compact module is accomplished through the use of COG mounting technology.
- By adopting a high aperture panel, high transmittance color filter and high transmission polarizing plates, transmittance ratio is realized.
- Gray scale or the brightness of the sub-pixel color is determined with a 6-bit gray scale signal.



3. General Specification

Characteristic Item	Specification
Input Signal Type	Digital, RGB (6bit)
Display Mode	Normally White, Transmitting Type
Screen Size (Diagonal)	6.95"(176.574mm)
Aspect Ratio	16.97:9
Outline Dimension (W x H x D)	167.5mm (H) X 93.2mm (V) X 6.9mm (D)
Active Area	156.0(H) [mm] X 82.719(V) [mm] (Typ.)
Number Of dots	400(H) X 3(R, G, B) X 234(V)
Dot Pitch	0.1300(W) [mm] X 0.3535(H) [mm]
Color Depth	6 Bit, 262,144 Colors
Pixel Pitch	0.3900mm(H) × 0.3535mm(V)
Color Filter Array	RGB vertical stripes
Weight	170g (Typ.)
Backlight	CCFL
Surface Treatment	Anti-Glare Treatment

4-1. FPC Pin Configuration

Pin	Symbol	Description	Notes
1	VCOM	Voltage Applied To Color Filter Substrate	
2	VCOM	Voltage Applied To Color Filter Substrate	
3	GND	Ground	
4	VREF9	Voltage For Gamma Correction	
5	VREF7	Voltage For Gamma Correction	
6	VREF5	Voltage For Gamma Correction	
7	VREF3	Voltage For Gamma Correction	
8	VREF1	Voltage For Gamma Correction	
9	GND	Ground	
10	R5	Red Data 5 [MSB]	
11	R4	Red Data 4	
12	R3	Red Data 3	
13	R2	Red Data 2	
14	R1	Red Data 1	
15	R0	Red Data 0 [LSB]	
16	G5	Green Data 5 [MSB]	
17	G4	Green Data 4	
18	G3	Green Data 3	
19	G2	Green Data 2	
20	G1	Green Data 1	
21	G0	Green Data 0 [LSB]	
22	B5	Blue Data 5 [MSB]	
23	B4	Blue Data 4	
24	B3	Blue Data 3	
25	B2	Blue Data 2	
26	B1	Blue Data 1	
27	B0	Blue Data 0 [LSB]	
28	AVDD	Power Line For Source Driver IC	
29	AVDD	Power Line For Source Driver IC	
30	SSPL	Source Scanning Left Start Signal	4-1.1

Pin	Symbol	Description	Notes
31	REV	Pixel Data Inversion Signal	
32	GND	Ground	
33	GND	Ground	
34	SSC	Source Driver Clock Input	
35	DVDD	Power Voltage For Logic	
36	DVDD	Power Voltage For Logic	
37	SSPR	Source Scanning Right Start Signal	4-1.1
38	SOE	Source Driver Output Enable Control	
39	L_R	Control Signal For Source Driver (Fixed 3.3v)	4-1.1
40	VREF0	Voltage For Gamma Correction	
41	VREF2	Voltage For Gamma Correction	
42	VREF4	Voltage For Gamma Correction	
43	VREF6	Voltage For Gamma Correction	
44	VREF8	Voltage For Gamma Correction	
45	VREF10	Voltage For Gamma Correction	
46	AVDD	Power Line For Source Driver IC	
47	AVDD	Power Line For Source Driver IC	
48	GSPD	Gate Scanning Down Start Signal	4-1.1
49	VGL	Gate Driver Negative Voltage	
50	VGL	Gate Driver Negative Voltage	
51	GSPU	Gate Scanning Up Start Signal	4-1.1
52	VCOM	Voltage Applied To Color Filter Substrate	
53	VCOM	Voltage Applied To Color Filter Substrate	
54	GND	Ground	
55	U_D	Control Signal For Gate Driver (Fixed 3.3v)	4-1.1
56	GSC	Gate Driver Scanning Clock Pulse	
57	GOE	Gate Driver Output Enable Control	
58	DVDD	Power Voltage For Logic	
59	VGH	Gate Driver Positive Voltage	
60	GND	Ground	

[Note 4-1.1] Detail Description of Pin Functions

1. U_D is used as input pin for the vertical scanning direction. If U_D is 'H', GSPU is the Input Pin for the Gate Start Pulse(GSP). U_D 'H' is only available for LB070WQ6-TD01.

U_D	Output Shift	GSP Input Pin
H	From Up to Down	GSPU

2. L_R is used as input pin for the horizontal scanning direction. If L_R is 'H', SSPL is the Input Pin for the Source Start Pulse(SSP). L_R 'H' is only available for LB070WQ6-TD01.

L_R	Scanning Direction	SSP Input Pin
H	From Left to Right	SSPL

4-2. Backlight Pin Configuration

Terminal	Pin	Symbol	Function	Notes
CN1	1	LV	Power Supply For Lamp [Low Voltage Side]	4-2.1
	2	HV	Power Supply For Lamp [High Voltage Side]	4-2.2

The backlight interface connector is a model **BHSR-02VS-1** manufactured by JST.
The mating connector is **SM02B-BHSS-1-TB** or equivalent.

[Note 4-2.1] The wire color of low voltage side is white. Connect the low voltage side of the DC/AC inverter used to drive the fluorescent tube to GND of the inverter circuit.
[Note 4-2.2] The wire color of high voltage side is blue.

5. Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Notes
Logic Voltage	DVDD	-0.3	6.5	V	
Logic Input Voltage	V_{Logic} (Logic Input)	-0.3	DVDD+0.3	V	5-1
Gamma Reference Voltage	V_{GMA} (Vref 0~10)	-0.3	AVDD+0.3	V	5-2
Source Driver Voltage	AVDD	-0.3	6.5	V	
Gate Driver Voltage	VGH-VGL	-0.3	40	V	
	VGL	-20	0.3	V	
Storage Temperature	Ta	-40	85	℃	5-3,4,5
Operating Temperature	Tp	-30	85	℃	5-3,4,5,6

[Note 5-1] GSC, GSPU, GSPD, U/D, GOE, SSC, SSPL, SSPR, REV, L/R, SOE
[Note 5-2] Vref0 ~ Vref10
[Note 5-3] This rating applies to all parts of the module and should not be exceeded.
[Note 5-4] Maximum wet-bulb temperature is 58℃. Condensation of dew must be avoided as electrical current leaks will occur, causing a degradation of performance specifications.
[Note 5-5] Ambient Temperature when the backlight is on(reference value).
[Note 5-6] The operating temperature only guarantees operation of the LCM and doesn't guarantee all the contents of Electro-optical specification.

6. Electrical Specification

6-1. Electrical Characteristics

Ta=25℃

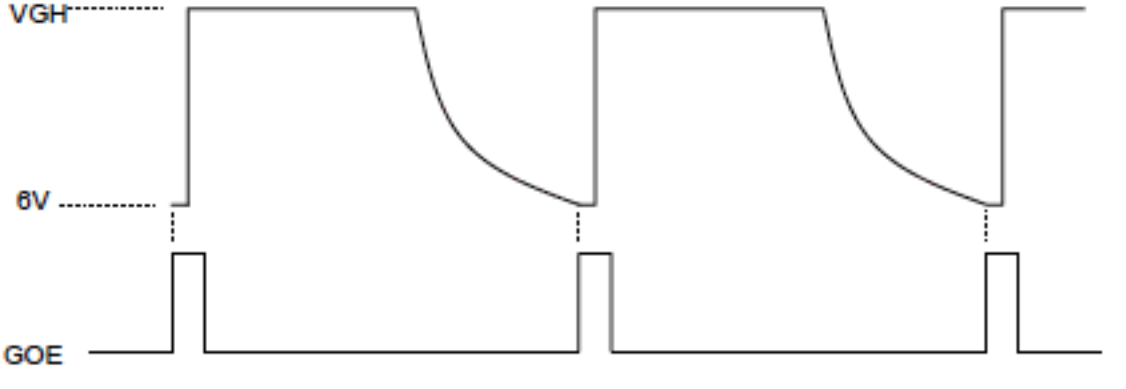
Parameter			Symbol		Min.	Typ.	Max.	Unit	Notes
Logic Supply Voltage			DVDD		3.0	3.3	3.6	V	
Digital Input Signal	High Level		V_{IH}		0.7DVDD	-	DVDD	V	
	Low Level		V_{IL}		0	-	0.3DVDD	V	
Source Driver	Supply Voltage		AVDD		4.5	5.0	5.5	V	
	Gamma Correction Voltage		VREF		GND+0.1	-	AVDD-0.1	V	6-1.1
Gate Driver	TFT	Hi	VGH		5	15.8	20	V	6-1.2
		Lo	VGL	DC	-15	-9.5	-2	V	
				AC	4.5	5	5.5	V_{p-p}	
		Voltage Difference	DVDD-VGL		5	-	20	V	
			VGH-VGL		10	-	38	V	6-1.2
	Logic Supply Voltage		DVDD		3.0	3.3	3.6	V	
Color Filter Substrate Voltage			VCOM	DC	1.7	1.89	2	V	
				AC	4.5	5.0	5.5	V_{p-p}	
Source Driver	Supply Current		I_{AVDD}		-	-	35	mA	6-1.3
	Logic Voltage Supply Current		I_{DVDD-S}		-	-	7.5	mA	6-1.3
Gate Driver	High Voltage Current Consumption		I_{VGH}		-	-	1	mA	6-1.4
	Logic Current		I_{DVDD-G}		-	-	0.1	mA	6-1.4

[Note 6-1.1] Recommended Gamma Correction Voltage [VREF0 to VREF10]
Recommended Gamma Correction Voltage is adapted to Gamma 2.2 curve

Symbol	Typ.		Unit
	VCOM Low Period	VCOM High Period	
VREF0	4.395	0.435	V
VREF1	3.83	0.8	V
VREF2	2.88	1.65	V
VREF3	2.355	2.25	V
VREF4	2.24	2.475	V
VREF5	2.0	2.65	V
VREF6	1.8	2.758	V
VREF7	1.61	2.96	V
VREF8	1.54	3.235	V
VREF9	1.37	3.595	V
VREF10	0.83	4.23	V

[Note 6-1.2]

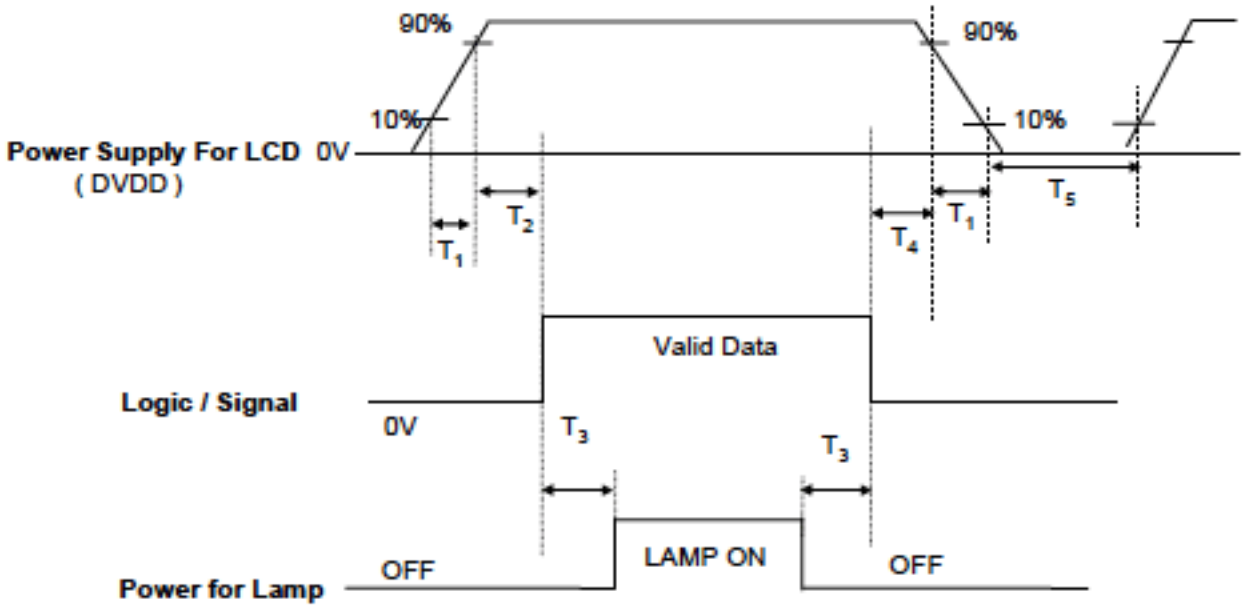
This is VGH timing diagram when adopt gate modulation. You can use VGH(DC) or modulated VGH(AC) for TFT Hi voltage. Then you should design VCOM_DC level properly.



[Note 6-1.3] V_{IH} = DVDD, V_{IL} = GND, SOE Pulse Width = 2.87us, fclk = 8.005MHz, AVDD = 5V, Recommended Gamma Correction Voltage, with Probe Load.

[Note 6-1.4] V_{IH} = DVDD, V_{IL} = GND, GOE Pulse Width = 2.75us, f_{GSC} = 15.75kHz, f_{GSPU} = 15.91Hz, with Probe Load.

6-2. Power Sequence

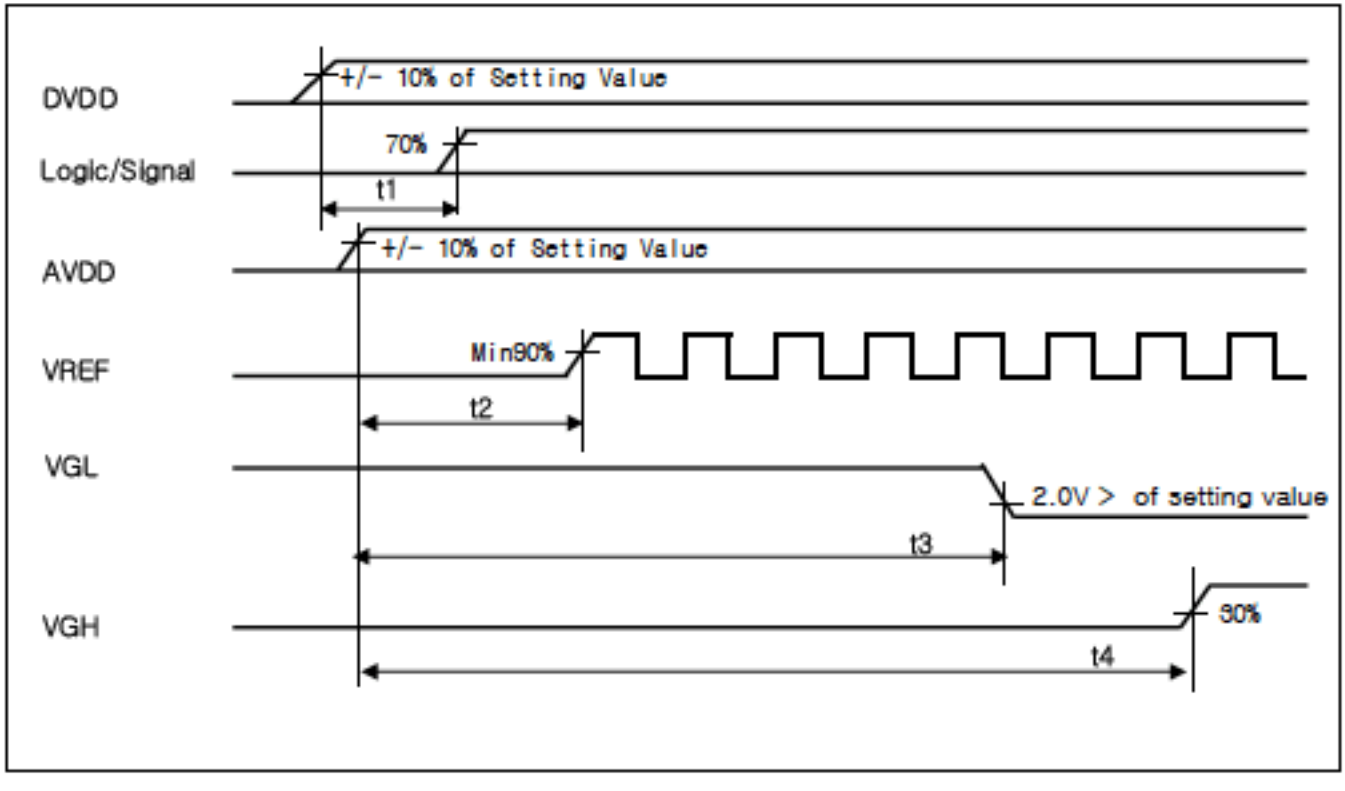


Parameter	Value			Unit
	Min.	Typ.	Max.	
T_1	0	-	10m	Sec
T_2	100u	-	-	
T_3	200m	-	-	
T_4	0	-	50m	
T_5	400m	-	-	

* Please avoid floating state of interface signal at invalid period.
* When the interface signal is invalid, be sure to pull down the power supply for LCD VCC to 0V.
* Lamp power must be turned on after power supply for LCD and interface signal are valid.

6-3. Power On Sequence

		Timing				Notes
		Min.	Typ.	Max.	Unit	
Power On	t1	100u	10m	-	Sec	6-3.1
	t2	100n	10m	-		
	t3	1m	-	-		
	t4	t3+1m	130m	-		



[Note 6-3.1] AVDD must be supplied later than DVDD.

6-4. Lamp Characteristics

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Operating Voltage	V_{BL}	565 ($6.5mA_{RMS}$)	580 ($6.0mA_{RMS}$)	730 ($3.0mA_{RMS}$)	V_{RMS}	6-4.1
Operating Current	I_{BL}	3.0	6.0	6.5	mA_{RMS}	6-4.2
Power Consumption	P_{BL}	-	3.48	3.83	W	6-4.3
Operating Frequency	f_{BL}	40	-	60	kHz	6-4.4
		40	-	80		6-4.5
Discharge Stabilization Time	Ts	-	-	3	Min	6-4.6
Life Time		12,000	15,000	-	Hrs	6-4.7
Established Starting Voltage at 25℃ at -30 ℃	Vs	 - -	 - -	 1,480 1,780	 V_{RMS} V_{RMS}	6-4.8

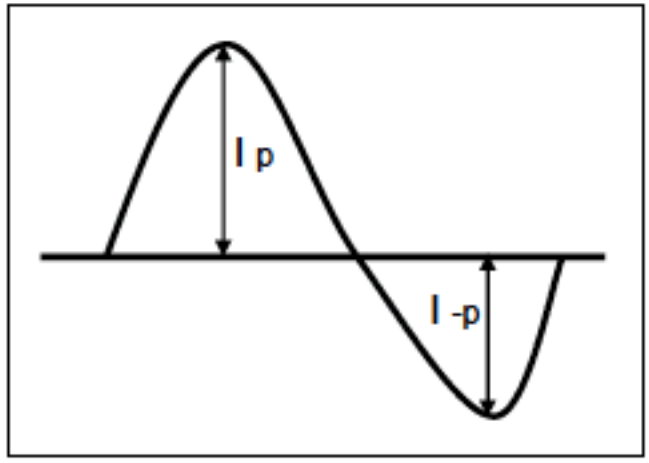
[Note 6-4.1] The variance of the voltage is ±10%.
[Note 6-4.2] The typical operating current is for the typical surface luminance (L_{WH}) in optical characteristics.
[Note 6-4.3] The lamp power consumption shown above does not include loss of external inverter. The applied lamp current is a typical one.
[Note 6-4.4] This frequency range means the range to keep within • •10% change of electrical and optical characteristics.
[Note 6-4.5] This frequency range means not affecting to lamp life and reliability characteristics. (The lamp frequency should be selected as different as possible from display horizontal synchronous signal (Including harmonic frequency of this scanning frequency) to avoid "Beat" interference which may be observed on the screen as horizontal stripes like moving wave. This phenomenon is caused by interference between lamp (CCFL) lighting frequency and LCD horizontal synchronous signal.)
[Note 6-4.6] The time needed to achieve not less than 95%brightness of the center part of lamp. The brightness of the lamp after lighted for 5 minutes is defined as 100%.
[Note 6-4.7] "Life time" is defined as the lamp brightness decrease to 50% original brightness at I_{BL}=Typ., continuous lighting, T_a=25℃.
[Note 6-4.8] The "Established Starting Voltage" means the minimum voltage for inverter to turn on the CCFL normally in the LCD module. However this isn't the values that we can assure stability of starting lamp on condition that the module is installed in your set.
It should be careful that "Established Starting Voltage" is changed by an increase of stray capacitance in your set, inverter method, value of ballast capacitor in your inverter and so on. Especially, the value of "Established Starting Voltage" is higher in low temperature condition than in normal temperature condition, because impedance of CCFL is increased.
"The voltage above Vs should be applied to the lamps for more than 1 second for start-up. Otherwise, the lamps may not be turned on. The used lamp current is the lamp typical current."

Note) Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp, are following. It shall help increase the lamp lifetime and reduce leakage current. Inverter should be designed to be subject to the conditions below

A. The asymmetry rate of the inverter waveform should be less than 10%.

B. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$.

* Inverter output waveform had better be more similar to ideal sine wave.



* Asymmetry rate:

$$(I_p - I_{-p}) / I_{RMS} * 100\%$$

•Distortion rate:

$$I_p \text{ (or } I_{-p}) / I_{RMS}$$

C. There should not be any spikes in the waveform.

D. Lamp current should not exceed the "Max." value under the "Operating Temperature" (it is prohibited to exceed the "Max." value even if it is operated in the guaranteed temperature). When lamp current exceed the maximum value for a long time, it may cause a smoking and ignition.
Therefore, it is recommended that the inverter have the current limited circuit that is used as a protection circuit and/or the lamp current-controlled inverter.

※ Do not attach a conducting tape to lamp connecting wire.
If the lamp wire attach to a conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action. Because leakage current is occurred between lamp wire and conducting tape.

6-5. Timing Characteristics of Input Signals

Ta=25℃

	Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
SOURCE	SSC Cycle Time	fclk	7.2	8.005	8.8	MHz	Fig. 1
	SSC High-Level Period	twh	4	-	-	ns	
	SSC Low-Level Period	twl	4	-	-	ns	
	DATA/REV Setup Time	ts1	2	-	-	ns	
	DATA/REV Hold Time	th1	2	-	-	ns	
	Start Pulse Setup Time	ts2	2	-	-	ns	
	Start Pulse Hold Time	th2	2	-	-	ns	
	Start Pulse Signal Delay Time	td1	-	-	10	ns	
	SOE Setup Time from SSC	tstp1	2	-	-	ns	
	SOE Hold Time from SSC	thtp1	2	-	-	ns	
	SOE Signal Setup Time from SSPL	ts3	3	-	-	CLK	
	SOE Hold Time from final data SSC	th3	0	-	-	CLK	
	SOE High-Level Pulse Width	twtp1	2.6	2.89	5.3	us	
GATE	GSC Frequency	fGSC	14.17	15.75	17.3	kHz	Fig. 2
	GSC,GOE,GSPU/GSPD Rising Time	tr_in	-	-	150	ns	
	GSC,GOE,GSPU/GSPD Falling Time	tf_in	-	-	150	ns	
	GSC Pulse Width	tGSCH, tGSCL	3	-	-	us	
	GSPU / GSPD Setup Time	tsu	700	-	-	ns	
	GSPU / GSPD Hold Time	thd	700	-	-	ns	
	GOE Pulse Width	twCL	2.47	2.75	5.8	us	
	Output Delay Time	trpd, tfpd	-	-	500	ns	

Fig. 1 Source D-IC Timing Diagram

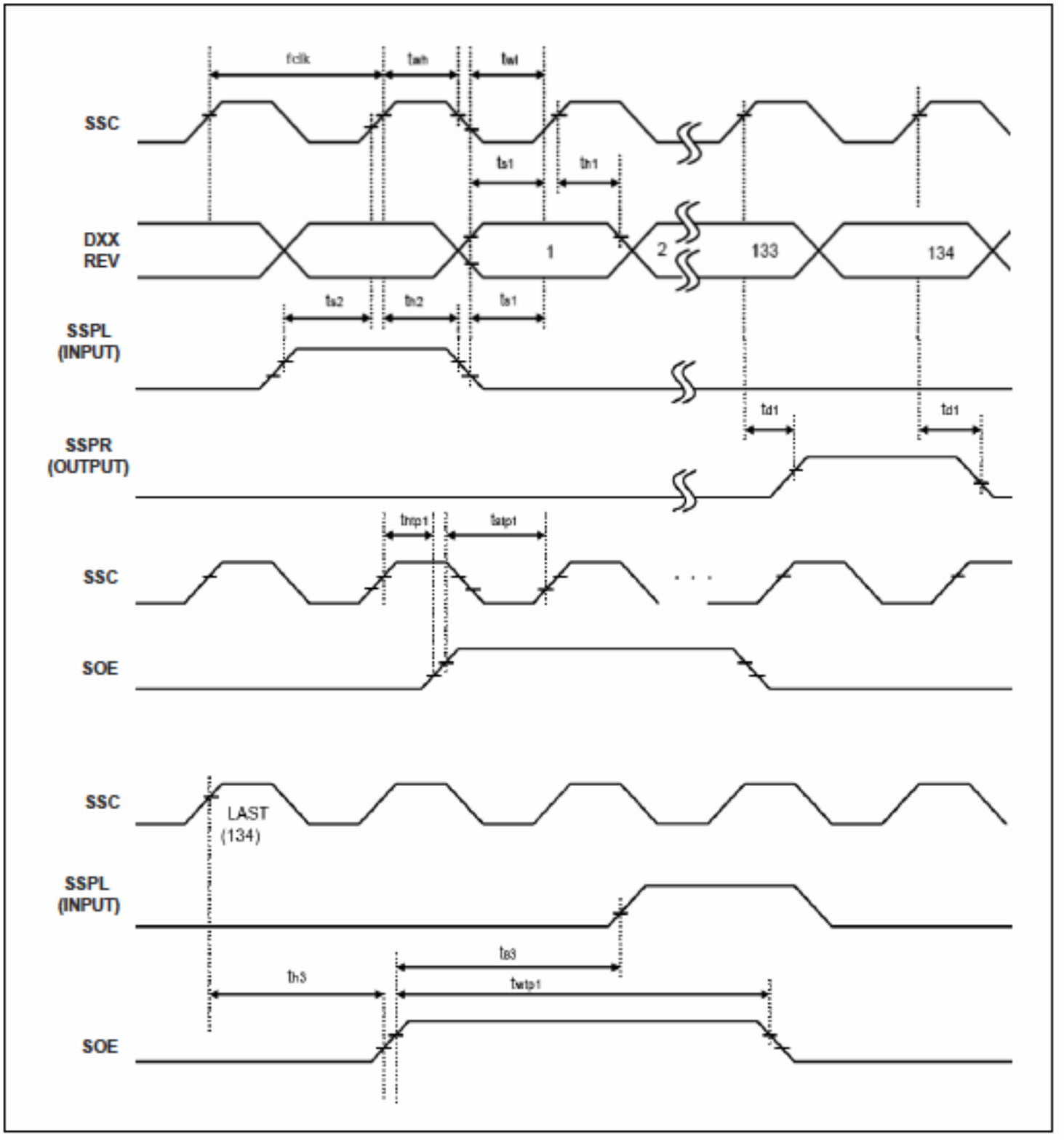
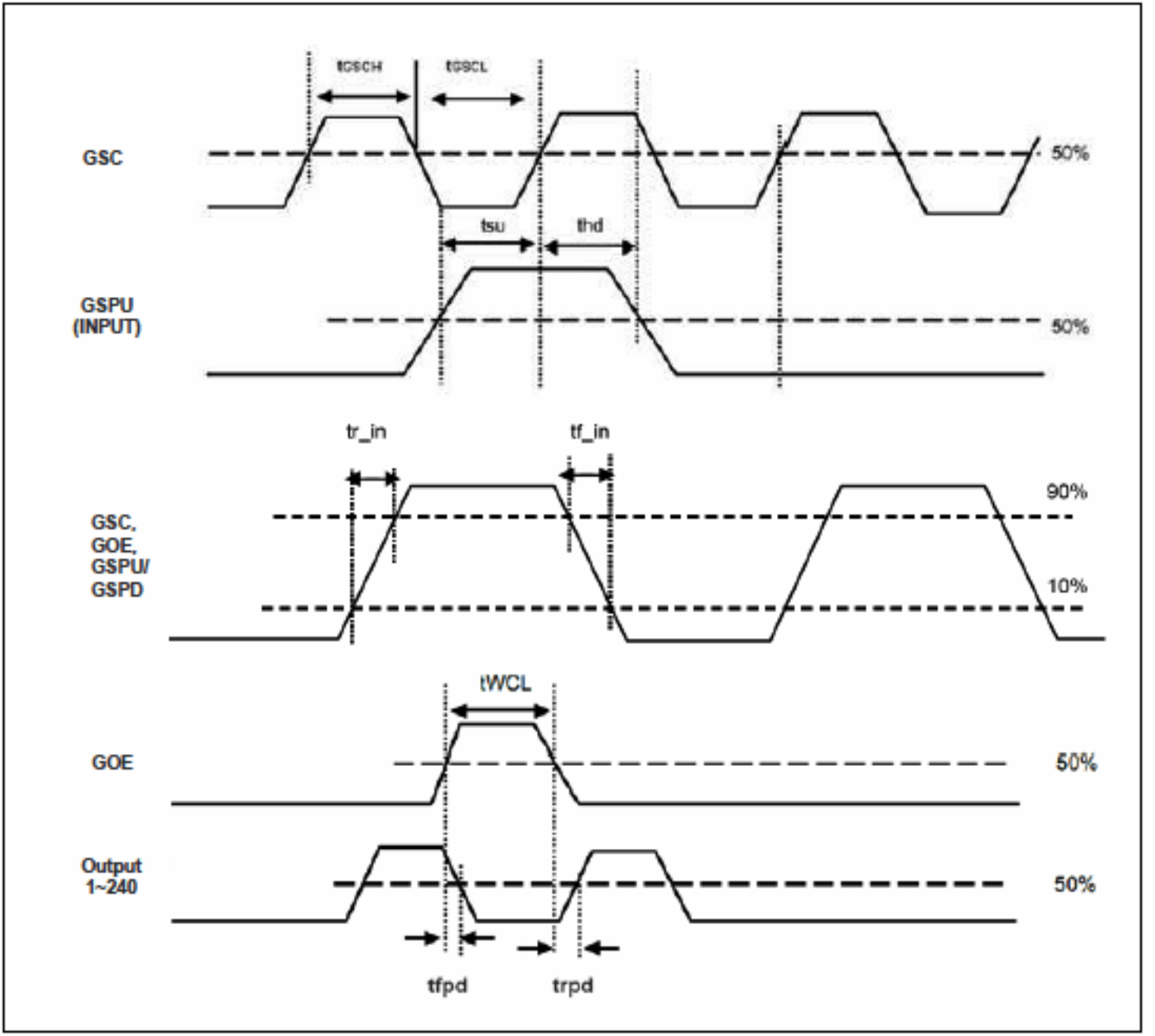


Fig. 2 Gate D-IC Timing Diagram

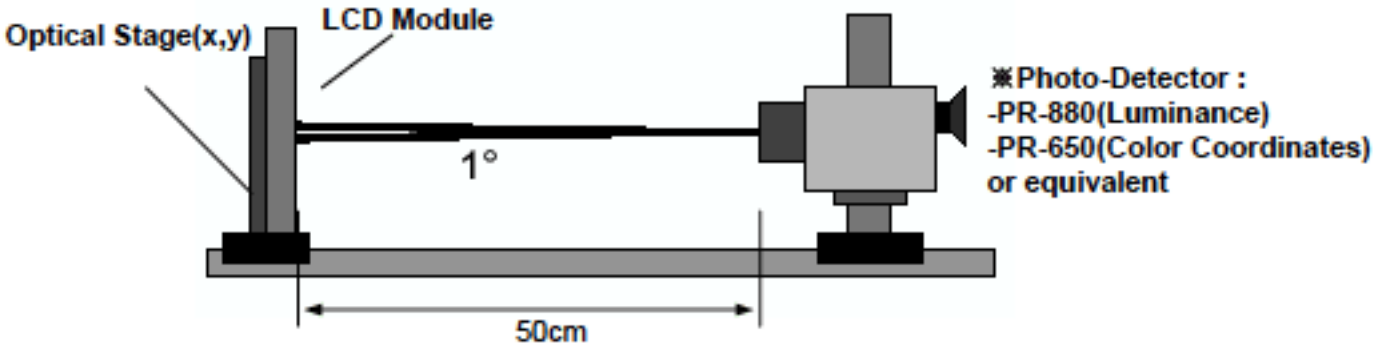


7. Electro-optical Characteristics

Ta=25°C, DVDD=3.3V, AVDD=5.0V, fv=60Hz, fclk= 8.005MHz, I_{BL} = 6.0mA$_{RMS}$

Parameter		Symbol	Condition	Values			Unit	Notes
				Min.	Typ.	Max.		
Contrast Ratio		CR	Optimal	300	500	-	-	7-1, Fig 3.
Viewing Angle	x axis, right(Φ=0°)	Θr	CR≥10	55	65	-	degree	7-2, Fig 3.
	x axis, left (Φ=180°)	Θl		55	65	-	degree	
	y axis, up (Φ=90°)	Θu		40	50	-	degree	
	y axis, down (Φ=270°)	Θd		50	60	-	degree	
Response Time	Rise Time	Tr_R	Θ=0°	-	-	25	ms	7-3, Fig 3.
	Decay Time	Tr_D		-	-	50	ms	
Luminance		L	Center	320	400	-	cd/m^2	Fig 3.
Color Coordinates		Wx	Center	0.251	0.281	0.311	-	Fig 3.
		Wy		0.256	0.286	0.316	-	
		Rx	Center	0.584	0.634	0.684	-	Fig 3.
		Ry		0.283	0.333	0.383	-	
		Gx		0.240	0.290	0.340	-	
		Gy		0.531	0.581	0.631	-	
		Bx		0.094	0.144	0.194	-	
		By		0.039	0.089	0.139	-	

Fig. 3 Optical Characteristic Measurement Equipment and Method



Measuring Condition ;
-Measuring surroundings : Dark Room
-Measuring temperature : T_a=25℃
-Adjust operating voltage to get optimum contrast at the center of the display.
-Measured value at the center point of LCD panel after more than 30 minutes while backlight turning on.

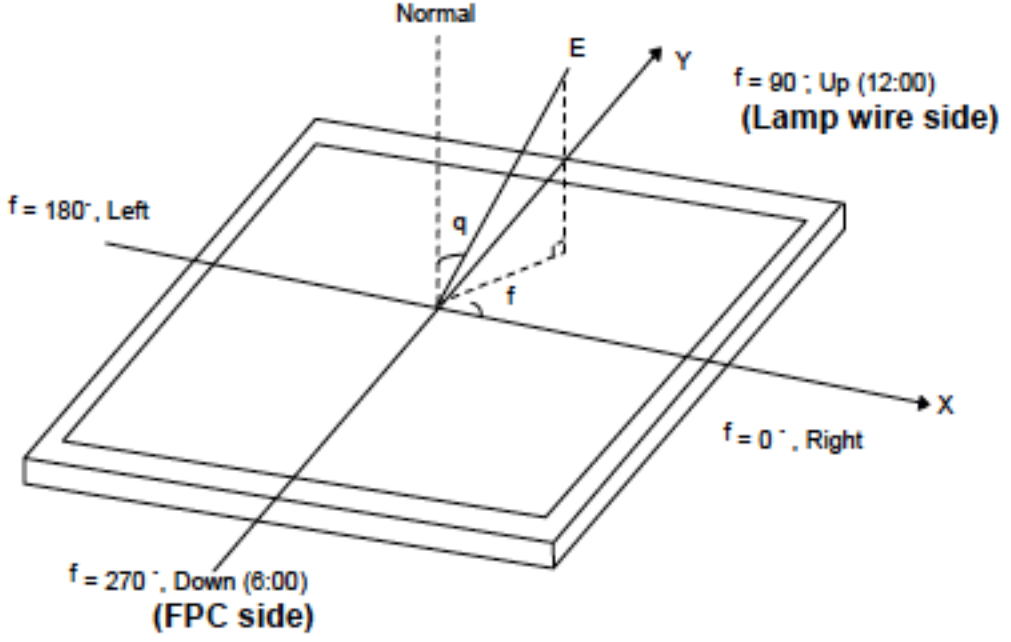
[Note 7-1]

Contrast ratio is defined as follows ;

$$\text{Contrast Ratio(CR)} = \frac{\text{Photo detector output with LCD being "white"}}{\text{Photo detector output with LCD being "black"}}$$

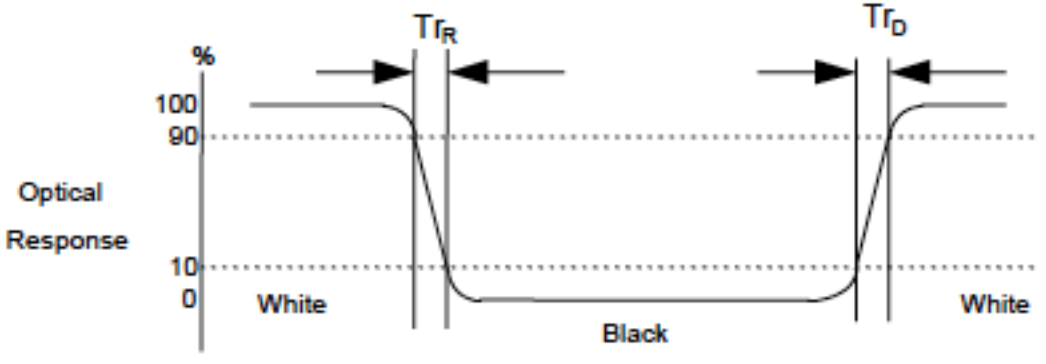
[Note 7-2]

Viewing angle range is defined as follows;



[Note 7-3]

Response time is obtained by measuring the transition time of photo detector output, when input signals are applied to make center point "black" and "white".



8. Mechanical Characteristics

Parameter	Specification		Unit
Outline Dimension	Width	167.5	mm
	Height	93.2	mm
	Depth	6.9(Typ.)	mm
Bezel Area	Width	158.0	mm
	Height	84.6	mm
Active Display Area	Width	156.0	mm
	Height	82.719	mm
Weight	170(Typ.), 185(Max.)		g

9. Reliability Test

No.	Test Items	Test Condition	Notes
1	High Temperature Storage Test	Ta=85℃ 240hr	9-1,2,3
2	Low Temperature Storage Test	Ta= -40℃ 240hr	9-1,2,3
3	High Temperature Operation Test	Tp=85℃ 240hr	9-1,2,3
4	Low Temperature Operation Test	Ta= -30℃ 240hr	9-1,2,3
5	High Temperature and High Humidity Operation Test	Ta=65℃ 90%RH 240hr	9-1,2,3
6	Electro Static Discharge Test (Non-operation)	- Panel Surface : 150pF + 150Ω, ±15kV (Non-direct Discharge, 5 Times) - Top_case : 150pF + 150Ω, ±8kV (Direct Discharge, 5 Times) - FPC Input Terminal : 200pF + 0Ω, ±200V (Direct Discharge, 3 Times)	
7	Shock Test (Non-operation)	Half Sine Wave, 100G, 6ms 2 Times Shock of X, Y, Z each Axis	
8	Vibration Test (Non-operation)	X, Y, Z : 96hrs for Each Axis 5 ~ 10 Hz Disp. 25 mm 10 ~ 30 Hz Accel. 3.7×9.8 m/s^2 30 ~ 50 Hz Accel. 1.6×9.8 m/s^2 50 ~ 80 Hz Accel. 0.7×9.8 m/s^2 80 ~200 Hz Accel. 0.3×9.8 m/s^2	
9	Thermal Shock Test(Non-operation)	-30℃(0.5hr) ~ 85℃(0.5hr) / 300 Cycles	

[Note 9-1] T_a = Ambient Temperature, T_p = Panel Surface Temperature
[Note 9-2] Evaluation should be tested after storage at room temperature for 24 hours.
[Note 9-3] In the standard condition, there shall be no practical problems that may affect the display function.

10. International Standards

10-1. Safety

a) UL 60950, Third Edition, Underwriters Laboratories, Inc., Dated Dec. 11, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
b) CAN/CSA C22.2, No. 60950, Third Edition, Canadian Standards Association, Dec. 1, 2000.
Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment.
c) EN 60950 : 2000, Third Edition
IEC 60950 : 1999, Third Edition
European Committee for Electro technical Standardization(CENELEC)
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

10-2. EMC

a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9KHz to 40GHz. "American National Standards Institute(ANSI), 1992
b) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference.
c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electro technical Standardization.(CENELEC), 1998
(Including A1: 2000)