Product Specification

SPECIFICATION
FOR
APPROVAL

( ) Preliminary Specification
(●) Final Specification

Title	12.3”FHD (1920 X RGB X 720) TFT- LCD

BUYER	
MODEL	

SUPPLIER	LG Display Co.,Ltd.
MODEL	LA123WF1
SUFFIX	SL01

SIGNATURE	DATE
/	
/	
/	

APPROVED BY	DATE
J. B. Kim / Chief Engineer	
REVIEWED BY	
K.K.Lee / Senior Engineer	
PREPARED BY	
J.H.Lee / Engineer	

Product Engineering Dept.
LG Display Co., Ltd

Product Specification

Record of Revisions

Revision No.	Revision Date	Page	Description	Note
0.1	Jul. 18.2013	-	First Draft (Preliminary)	
0.2	Sep. 25.2013	9	Electrical Characteristics update	
0.3	Oct. 28.2013	14	Changed Typo error (RSDS → LVDS)	
		22,23	Changed Mechanical drawing	
0.4	Nov.27.2013	2	Changed Typo error (RSDS → LVDS)	
		10	Changed Gate Modulation time Spec.	
		11	Changed Flicker pattern	
		19	Changed Electro-optical Characteristics	
		27	Changed Packing Form	
		Appendix	Added Thermistor Characteristics	
1.0	DEC.09.2013	9	Changed Electrical Characteristics - VCC Max. Current (240mA → 260mA)	
		19	Changed Electro-optical Characteristics - Luminance Typical value 750nit → 720nit - Added Response time max	
		22,23	Changed Mechanical drawing	
1.1	DEC.26.2013	9	Changed I_VCC and I_VDD current spec	
1.2	Apr.03.2014	16	Changed AC Specification - CLK Min. Frequency	
			Timing Characteristics	

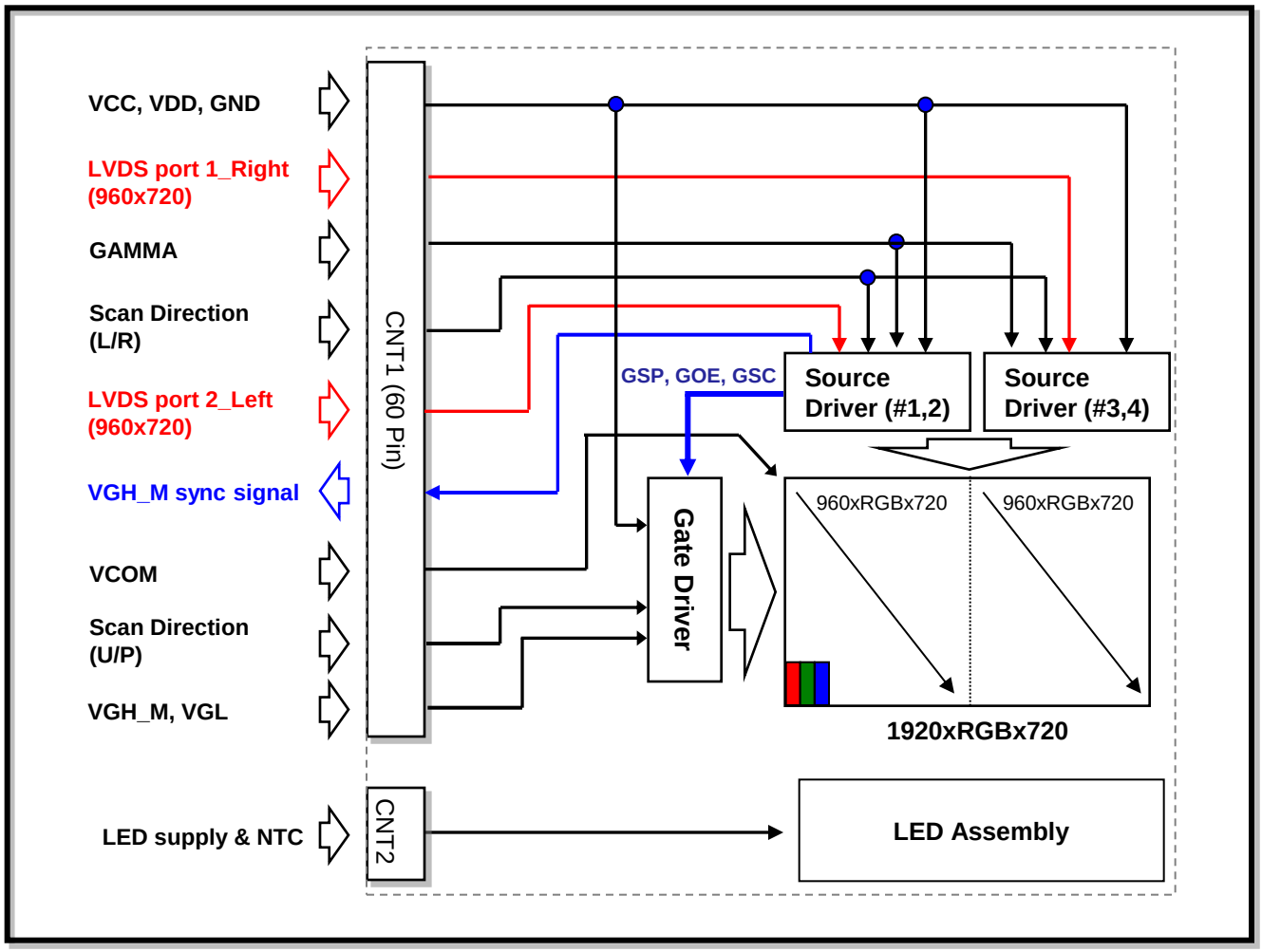
Contents

1. Summary

This module utilizes amorphous silicon thin film transistors and a 8:3 aspect ratio. A 12.3” active matrix liquid crystal display allows 16,777,216 colors to be displayed.
The applications are Cluster/CID (Center Information Display) and others AV system.

2. Features

- Utilizes a panel with a 8:3 aspect ratio, which makes the module suitable for use in wide-screen systems.
- The ” screen produces a high resolution image that is composed of 4,147,200 pixel elements in a stripe arrangement.
- Wide viewing angle technology is employed.
- 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 8bit gray scale signal.



3. General Specification

Characteristic Item	Specification
Interface	LVDS 2port
Display Mode	Normally Black, Transmitting Type
Screen Size (Diagonal)	12.3”(312.42mm)
Aspect Ratio	8:3
Outline Dimension (W x H x D)	310.0mm (H) X 128.0mm (V) X 8.2mm (T)
Active Area	292.032(H) [mm] X 109.512 (V) [mm]
Display Area	292.032(H) [mm] X 109.512 (V) [mm]
Number Of dots	1920(H) X 3(R, G, B) X 720(V)
Color Depth	8 Bit, 16.7M Colors
Pixel Pitch	0.1521mm(H) × 0.1521mm(V)
Color Filter Array	RGB vertical stripes
Weight	395g (Typ.) 405g (Max.)
Backlight	White LED
Surface Treatment	Hard Coating treatment of the front polarizer

4. Pin Configuration

4-1. 60 Pin Connector Pin Configuration

Pin No.	Pin name	Function	Reference voltage
1	VGL	Low level power supply for gate	
2	NC	Not connected	
3	VGH_M	Modulated High level power supply for gate	
4	VGH_M	Modulated High level power supply for gate	
5	GM_CLK	Gate Modulation sync signal	
6	GM_Enable	Gate Modulation sync signal	
7	VCC	Power supply for logic	
8	GND	Ground	
9	RD1-	LVDS input data_Left	
10	RD1+	LVDS input data_Left	
11	RC1-	LVDS input data_Left	
12	RC1+	LVDS input data_Left	
13	RB1-	LVDS input data_Left	
14	RB1+	LVDS input data_Left	
15	RA1-	LVDS input data_Left	
16	RA1+	LVDS input data_Left	
17	GND	Ground	
18	CLK1-	LVDS input clock_Left	
19	CLK1+	LVDS input clock_Left	
20	GND	Ground	
21	SCAN_L/R	Scan direction Left/Right	
22	SCAN_U/P	Scan direction Up/Down	
23	VCOM	Common voltage	
24	VDD	Power supply for Analog	
25	GMA0	Gamma reference voltage (highest voltage)	
26	GMA1	Gamma reference voltage	
27	GMA2	Gamma reference voltage	
28	GMA3	Gamma reference voltage	
29	GMA4	Gamma reference voltage	
30	GMA5	Gamma reference voltage	
31	GMA6	Gamma reference voltage	
32	GMA7	Gamma reference voltage	
33	GMA8	Gamma reference voltage	
34	GMA9	Gamma reference voltage	
35	GMA10	Gamma reference voltage	
36	GMA11	Gamma reference voltage	
37	GMA12	Gamma reference voltage	
38	GMA13	Gamma reference voltage	
39	GMA14	Gamma reference voltage	
40	GMA15	Gamma reference voltage	

4-1. 60 Pin Connector Pin Configuration

Pin No.	Pin name	Function	Notes
41	GMA16	Gamma reference voltage	
42	GMA17	Gamma reference voltage (Lowest voltage)	
43	VDD	Power supply for Analog	
44	RD2-	LVDS input data_Right	
45	RD2+	LVDS input data_Right	
46	RC2-	LVDS input data_Right	
47	RC2+	LVDS input data_Right	
48	RB2-	LVDS input data_Right	
49	RB2+	LVDS input data_Right	
50	RA2-	LVDS input data_Right	
51	RA2+	LVDS input data_Right	
52	GND	Ground	
53	CLK2-	LVDS input clock_Right	
54	CLK2+	LVDS input clock_Right	
55	GND	Ground	
56	NC	Not connected	
57	VCOM	Common voltage	
58	NC	Not connected	
59	VCC	Power supply for logic	
60	GND	Ground	

4-2. Backlight LED FPC Pin Configuration

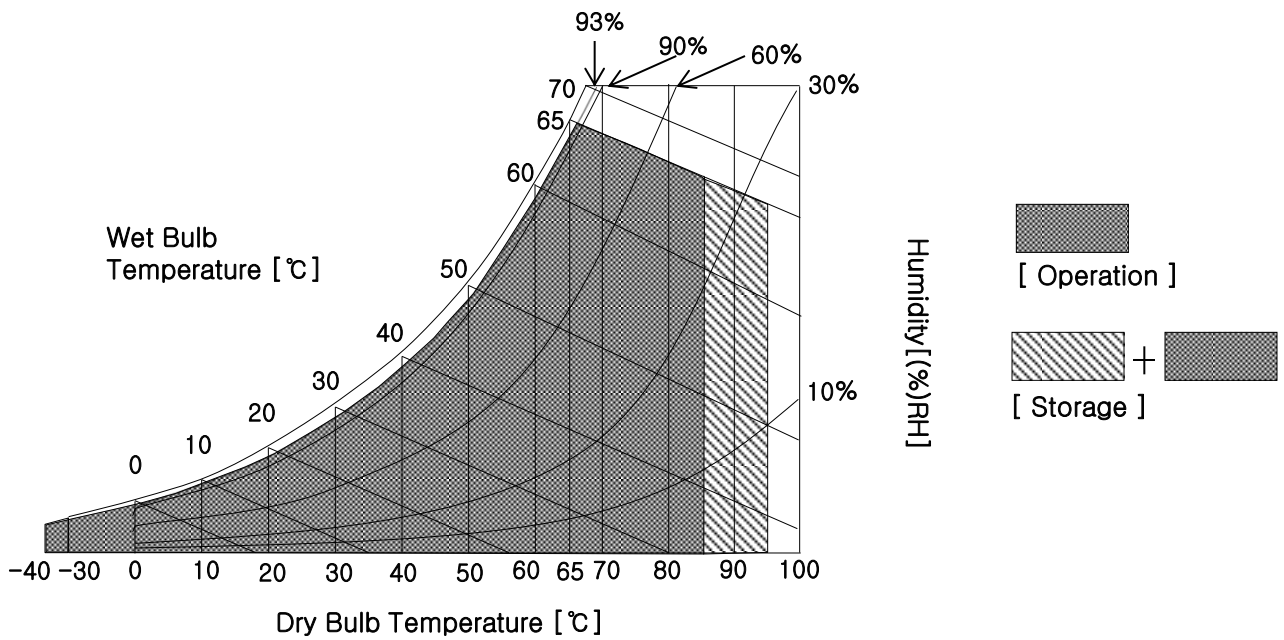
Pin No.	Pin name	Function	Notes
1	ANODE 1	LED Anode Terminal 1	
2	ANODE 2	LED Anode Terminal 2	
3	-	-	
4	ANODE 3	LED Anode Terminal 3	
5	ANODE 4	LED Anode Terminal 4	
6	-	-	
7	-	-	
8	-	-	
9	-	-	
10	CATHODE 1	LED Cathode Terminal 1	
11	CATHODE 2	LED Cathode Terminal 2	
12	-	-	
13	CATHODE 3	LED Cathode Terminal 3	
14	CATHODE 4	LED Cathode Terminal 4	
15	-	-	
16	-	-	
17	-	-	
18	-	-	
19	THERMISTOR+	Thermal Sensor	
20	THERMISTOR-	Thermal Sensor	

[Connector] 04 6288 020 000 846+ Kyocera

5. Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit	Notes
Digital Supply Voltage	VCC	-0.5	4	V	
Gamma Reference Voltage	V_{GMA} (GMA 0~17)	GND+0.2	VDD-0.2	V	
Source Driver Analog Voltage	VDD	-0.5	14	V	
Gate Driver Voltage	VGH-VGL	-0.3	39.0	V	
	VGL	-12.0	0.3	V	
Storage Temperature	Ta	-40	95	℃	5-1,2
Operating Temperature	Ta	-40	85	℃	5-1,2,3

[Note 5-1] This rating applies to all parts of the module and should not be exceeded.
[Note 5-2] 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 5-3] 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
Source Driver	Digital Supply Voltage		VCC	3.0	3.3	3.6	V	
	Supply Voltage		VDD	12.6	13	13.5	V	
	Gamma Reference Voltage		VGMA (GMA0~17)	GND+0.2	-	VDD-0.2	V	6-1.1
Gate Driver	TFT	Hi	VGH	17	20	23	V	6-1.2
		Low	VGL	-9	-7.5	-6	V	
		Modulation Voltage	VDD_M	5	13	17	V	6-1.2
		Voltage Difference	VGH-VGL	17	-	32	V	
	Logic Supply Voltage		VCC	3.0	3.3	3.6	V	
Common Voltage			VCOM	5.0	5.7	7.0	V	6-1.3
Digital Supply Voltage Current			I_{VCC}	-	220	340	mA	6-1.4
Source Driver Analog Voltage Current			I_{VDD}	-	170	220	mA	6-1.4
Gate High Voltage Current			I_{VGH}	-	0.6	3	mA	6-1.5
Gate Low Voltage Current			I_{VGL}	-	0.68	3	mA	6-1.5
Common Voltage Current			I_{VCOM}	-	0.1	1	mA	6-1.5

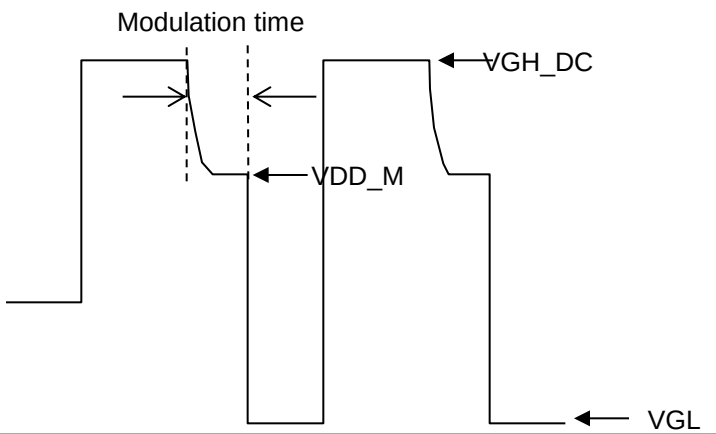
Product Specification

[Note 6-1.1] Recommended Gamma Correction Voltage [Reference Only, GMA0 to GMA17]

Symbol	Min.	Typ.	Max.	Unit
GMA0	12.42	12.47	12.52	V
GMA1	12.35	12.38	12.43	V
GMA2	10.90	11.00	11.10	V
GMA3	10.29	10.39	10.49	V
GMA4	9.62	9.72	9.82	V
GMA5	8.97	9.07	9.17	V
GMA6	8.34	8.44	8.54	V
GMA7	7.20	7.30	7.40	V
GMA8	6.68	6.78	6.88	V
GMA9	6.28	6.38	6.48	V
GMA10	5.72	5.82	5.92	V
GMA11	4.59	4.69	4.79	V
GMA12	3.99	4.04	4.09	V
GMA13	3.38	3.43	3.48	V
GMA14	2.68	2.73	2.78	V
GMA15	2.09	2.14	2.19	V
GMA16	0.73	0.78	0.83	V
GMA17	0.61	0.66	0.71	V

[Note 6-1.2] VGH Modulation Method

Parameter	Min.	Typ.	Max.	Unit	Notes
VGH_DC	16	20 (Reference)	22	V	
VDD_M	12.6		16	V	
Modulation time	1.5	3	4	us	Slew rate : 1.1 V/us (Typ.)

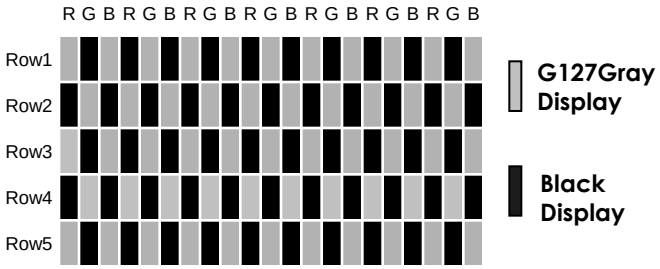


[Note 6-1.3] VCOM adjustment method.

* Pattern : Flicker pattern (Horizontal 1dot)

* Method : Adjust the VCOM Voltage to the minimum flicker phenomenon.

(adjustment must be finished within 30 sec)



Horizontal 1 Dot Flicker Pattern

[Note 6-1.4] f_{CLK} = 44.7MHz, VCC = 3.3V, VDD = 12.9V, GMA0 = 12.75V / GMA17 = 0.67V, with Probe Load.

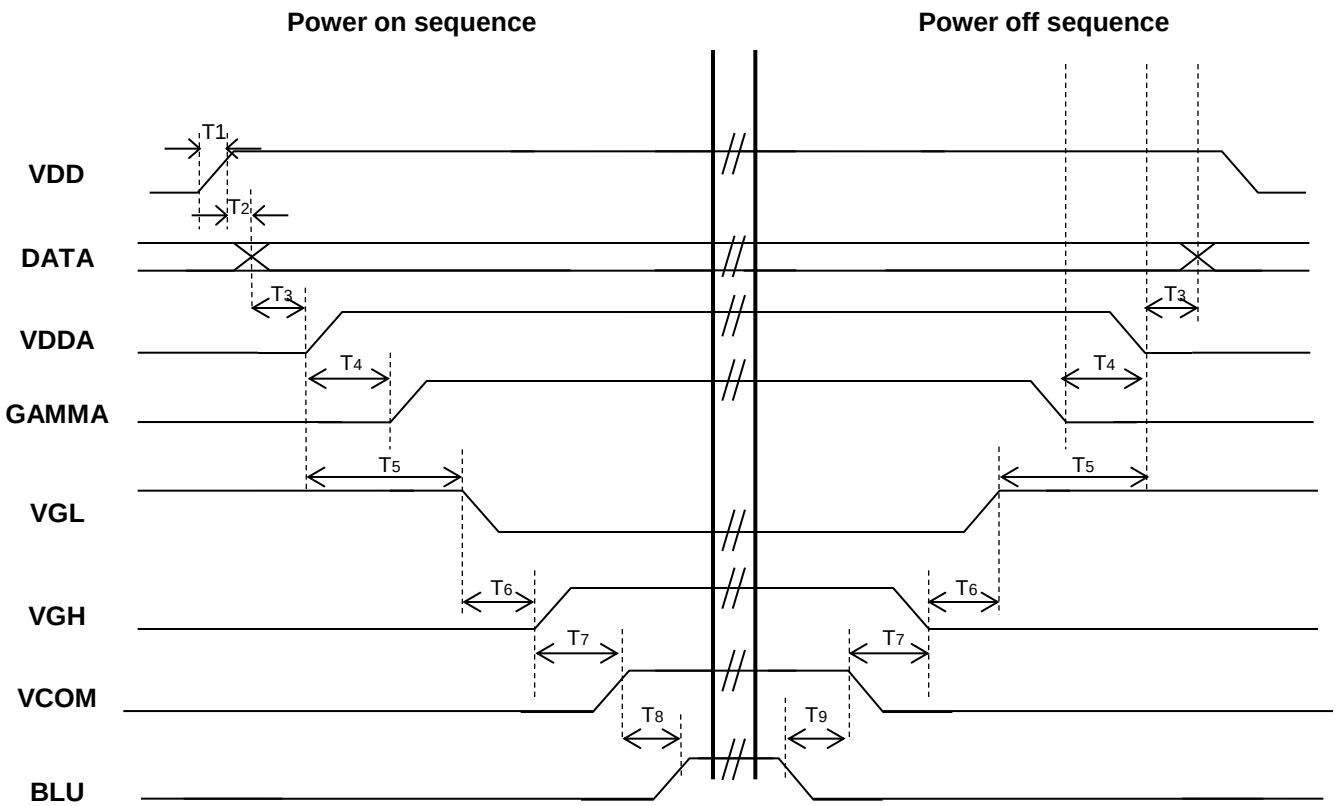
* Test pattern : White (256 Gray)

[Note 6-1.5] f_{CLK} = 44.7MHz, VGH = 21V, VGL = -8V, with Probe Load.

* Test pattern : White (256 Gray)

6-2. Power On/Off Sequence

Parameter		Timing				Notes
		Min.	Typ.	Max.	Unit	
Power On/off	t1	0	-	20	ms	
	t2	20	-	-		
	t3	5	-	-		
	t4	0.2	-	-		
	t5	5	-	-		
	t6	5	-	-		
	t7	5	-	-		
	T8	200				
	T9	500				



6-3. LED Backlight Characteristics

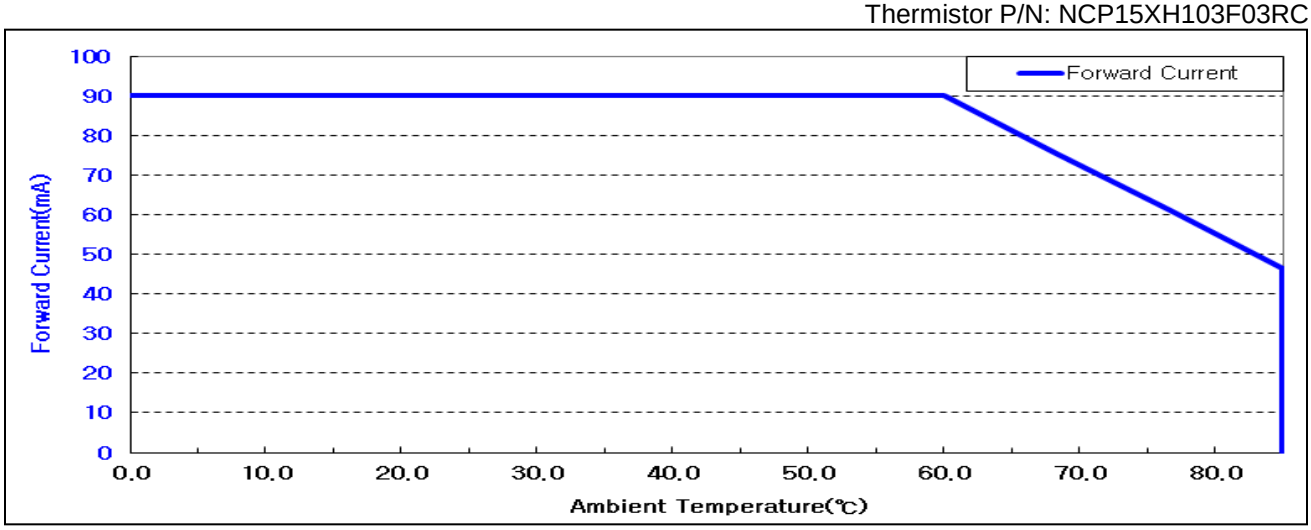
6-3-1. LED Backlight Characteristics

Ta=25℃

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
LED Current	ILED	-	90	95	mA	Per LED
LED Voltage	VLED	-	33	-	V	Per chain
LED Power	PLED	-	11.88	12.54	W	
LED chain		-	4	-	EA	6-3.1

[Note 6-3.1] LED PCB chain

Thermistor P/N: NCP15XH103F03RC



6-4. Timing Characteristics

6-4-1. Input Signals Timing

This is the signal timing required at the input of the LVDS Transmitter. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

Ta=25℃

Parameter	Symbol	Min.	Typ.	Max.	Unit
CLK frequency	Fclk	37	44.7	52	MHz
Horizontal display area	THD		960		CLK
HS period time	TH	1020	1024	1120	CLK
HS blanking	THBW + THBP	60	64	160	CLK
Vertical display area	TVD		720		H
VS period time	TV	726	728	810	H
VS blanking	TVBW + TVBP	6	8	90	H

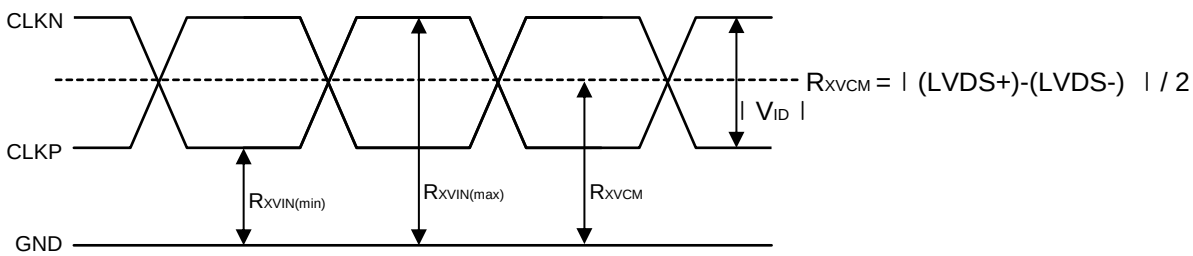
6-5. LVDS Input characteristics

6-5-1. DC Specification

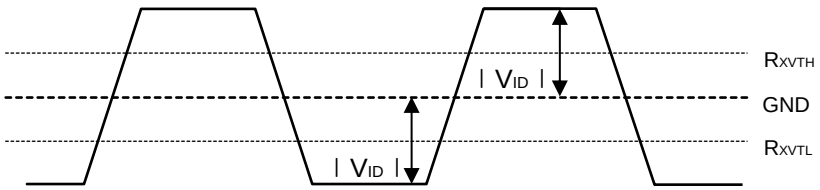
(VDD_IF=VDD=3.0V to 3.6V, VDDA = 8V to 13.5V, GND_IF=GND=GNDA=0V, TA=-40℃ to 85℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Differential input high Threshold voltage	R_{XVTH}	+0.1	+0.2	+0.3	V	R_{XVCM} = 1.2V
Differential input low Threshold voltage	R_{XVTL}	-0.3	-0.2	-0.1	V	
Input voltage range (singled-end)	R_{XVIN}	1	-	1.7	V	
Differential input common Mode voltage	R_{XVCM}	1	1.2	1.4	V	
Differential input voltage	$\lvert V_{ID} \rvert$	0.2	-	0.6	V	
Differential input leakage current	I_{LLVDS}	-10	-	+10	uA	
LVDS Digital operating current	$I_{VDDLVDS}$	-	42	-	mA	F_{CLK} = 50 MHz, VDD=3.3V
LVDS Digital Stand-by current	I_{STLVDS}	-	40	-	uA	Clock & all Functions Are stopped, VDD=3.3V

Single-end Signal



Differential Signal

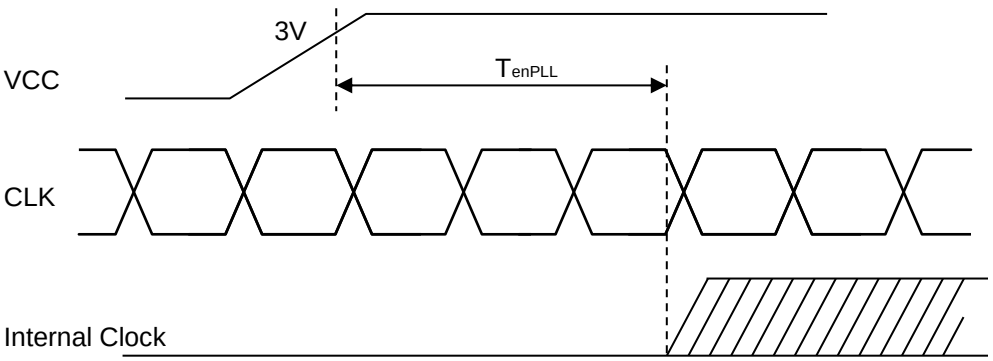


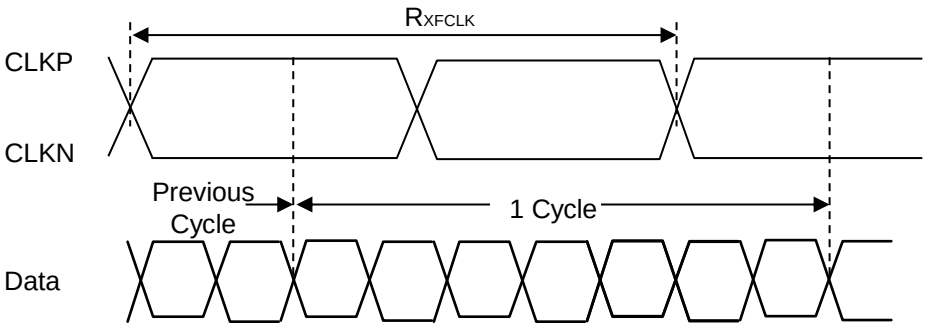
※ Differential input voltage swing = V_{ID}
※ | (LVDS+)-(LVDS-) | = | V_{ID} |
※ | (LVDS+)-(LVDS-) | = | V_{ID} | > R_{XVTH} = " H "
※ | (LVDS+)-(LVDS-) | = | V_{ID} | < R_{XVTL} = " L "

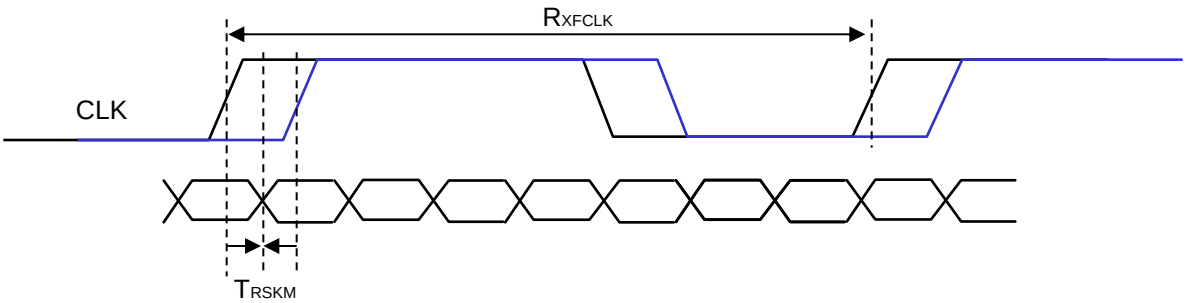
6-5-2. AC Specification

(VDD_IF=VDD=3.0V to 3.6V, VDDA = 8V to 13.5V, GND_IF=GND=GNDA=0V, TA=-40℃ to 85℃)

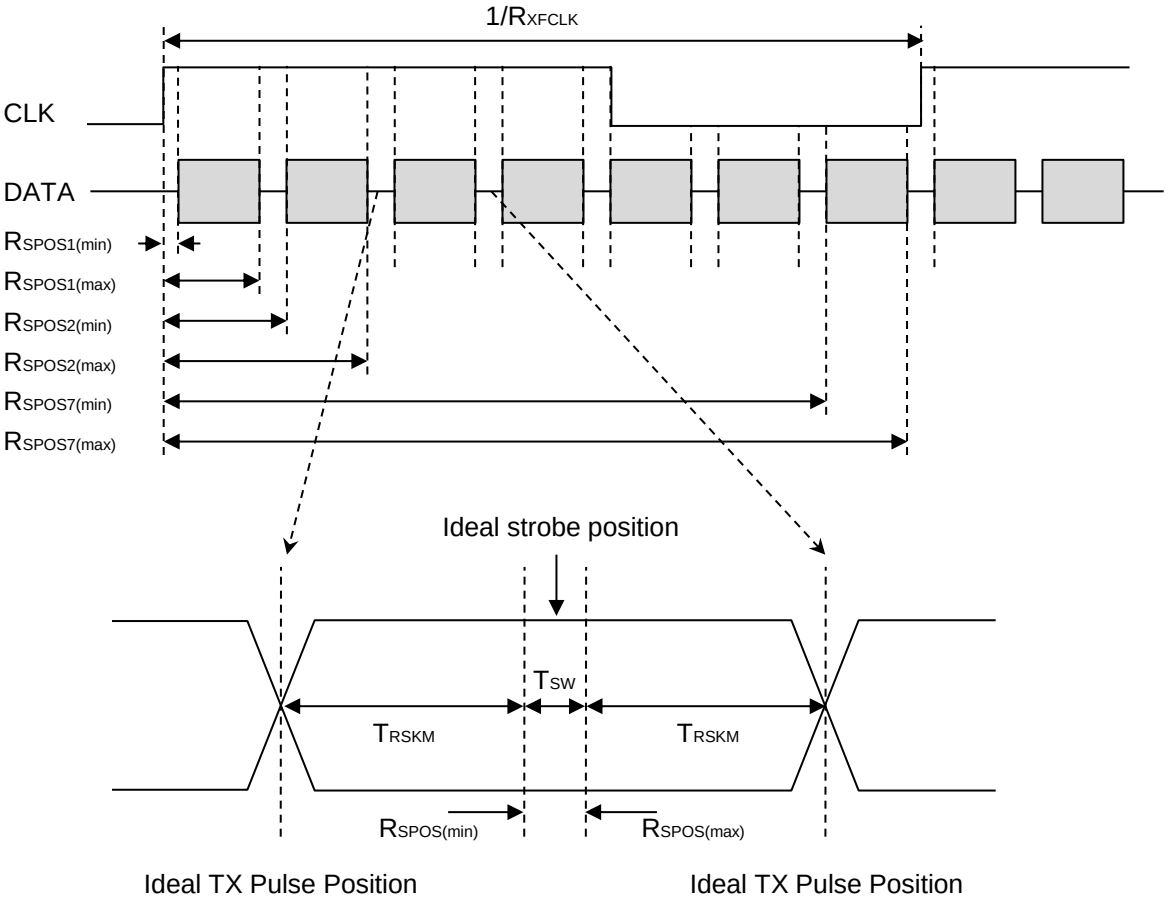
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK Frequency	R_{XFCLK}	37	44.7	56	MHz	
Input data skew margin	T_{RSKM}	400	-	-	ps	$\lvert V_{ID} \rvert$ = 400mV R_{XVCM} = 1.2V R_{XFCLK} = 80MHz
CLK high time	T_{LVCH}	-	4/(7*R_{XFCLK})	-	ns	
CLK low time	T_{LVCL}	-	3/(7*R_{XFCLK})	-	ns	
PLL wake-up time	T_{enPLL}	-	-	150	us	
LVDS 2port delay (Left/Right)	T_{PD}	-	-	40	ns	







6-5-2. AC Specification

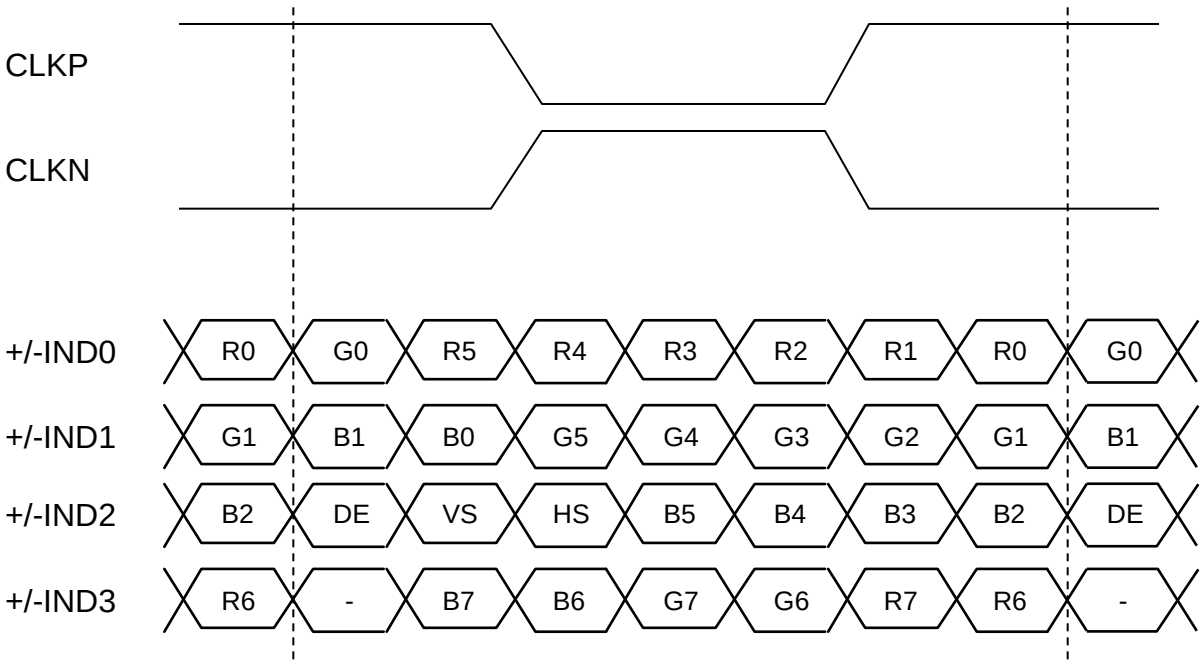


T_{RSKM} :Receiver strobe margin

R_{SPOS} :Receiver strobe position

T_{SW} :Strobe width (Internal data sampling window)

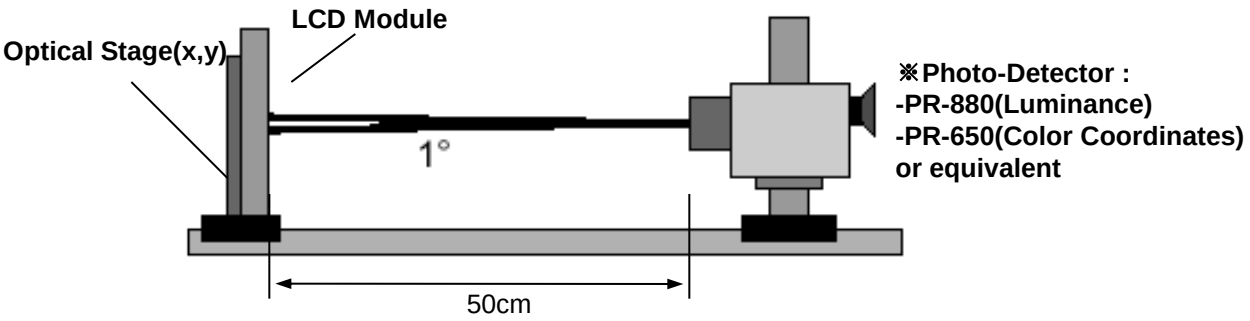
6-5-3. LVDS Data input format (8bit)



7. Electro-optical Characteristics

7-1. Electro-optical Characteristics

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.
VCC=3.3V, VDD=12.9V, fv=60Hz, fclk= 44.7MHz, I_{LED} = 80mA

Parameter		Symbol	Condition	Values			Unit	Remark
				Min.	Typ.	Max.		
Contrast Ratio		CR	Perpendicular	800	900	-	-	7-1.1
Response Time		$Tr_R + Tr_D$	+25℃	-	25	30	ms	7-1.2
			-20℃	-	175	250		
			-30℃	-	350	600		
Luminance		L	Perpendicular	600	720	-	cd/m²	
White Uniformity		δ_{WHITE}	9 Point	80	-	-	%	7-1.3
Black Uniformity		δ_{BLACK}	9 Point	50	-	-	%	7-1.3
Color Coordinates [CIE1931]	RED	Rx		Typ -0.025	0.661	Typ +0.025		
		Ry			0.306			
	GREEN	Gx			0.298			
		Gy			0.662			
	BLUE	Bx			0.137			
		By			0.067			
	WHITE	Wx			0.313			
		Wy			0.329			
LED Life Time		Hrs		10,000	-	-	-	7-1.4
Viewing Angle	x axis, right(Φ=0°)	Θr	CR≥10	89		-	degree	
	x axis, left (Φ=180°)	Θl		89		-		
	y axis, up (Φ=90°)	Θu		89		-		
	y axis, down (Φ=270°)	Θd		89		-		

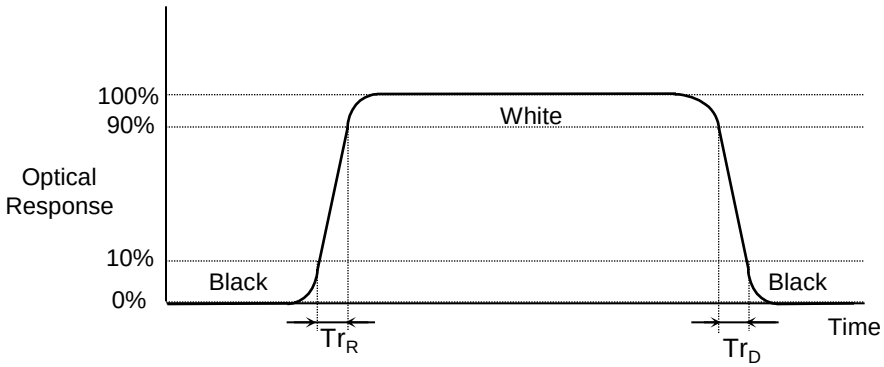
[Note 7-1.1]

Contrast Ratio

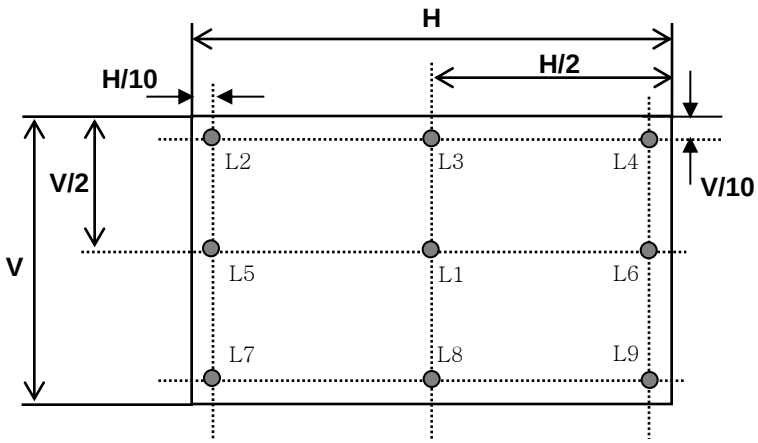
$$CR = \frac{\text{Gray 255 [White]}}{\text{Gray 0 [Black]}}$$

[Note 7-1.2]

Definition of Response time



[Note 7-1.3]



***H,V : ACTIVE AREA**

[Note 7-1.4]

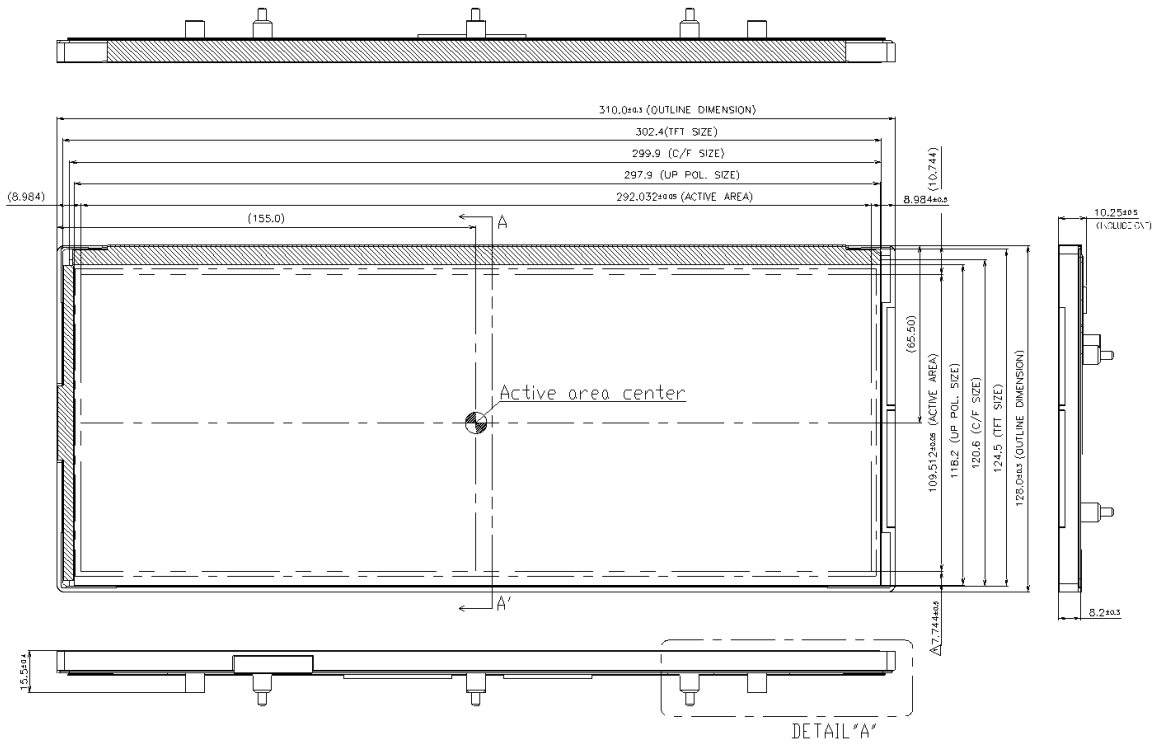
The life time is determined as the time at which brightness of LED is 80% compare to that of initial value at the typical LED current.

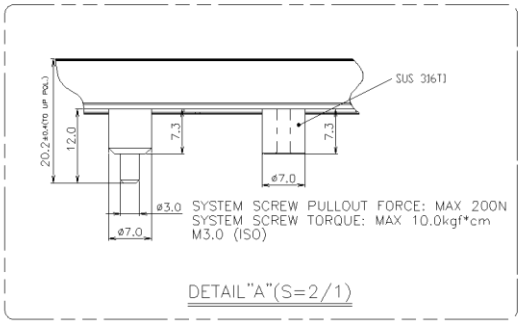
8. Mechanical Characteristics

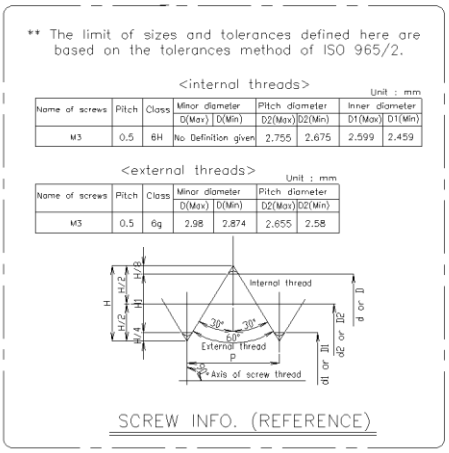
Parameter	Specification		Unit
Outline Dimension	Width	310.0 ±0.3	mm
	Height	128.0 ±0.3	mm
	Depth	8.2 ±0.3	mm
Active Display Area	Width	292.032	mm
	Height	109.512	mm
Weight	395(Typ), 405 (Max)		G

<FRONT VIEW>

Unit:[mm], General tolerance: ± 0.3mm

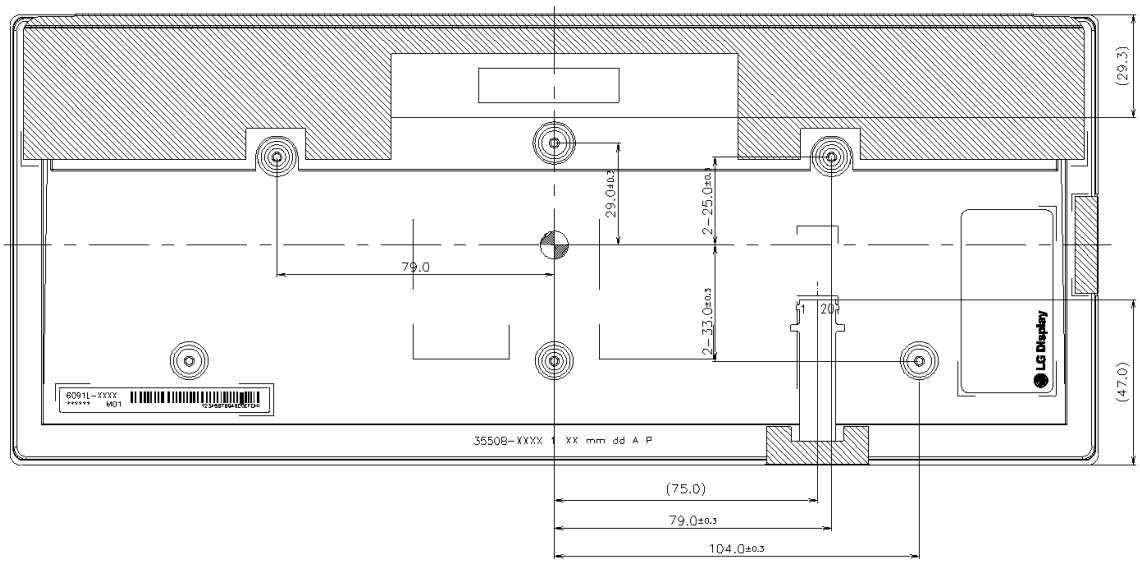


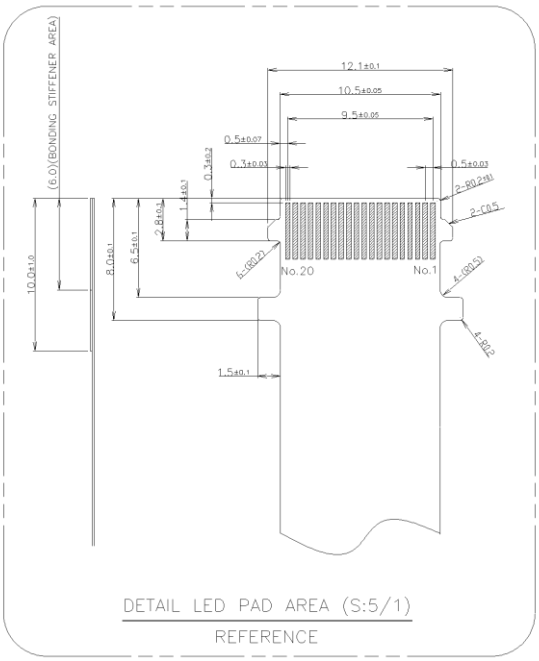




<REAR VIEW>

Unit:[mm], General tolerance: ± 0.3mm





9. Reliability Test

No.	Test Items	Test Condition	Notes
1	High Temperature Storage Test	T_a =95℃ 500h	9-1,2,3
2	High Temperature Operation Test	T_P =85℃ 240h	9-1,2,3
3	Low Temperature Storage Test	T_a =-40℃ 100h	9-1,3
4	High Temperature and High Humidity Operation Test	T_a =65℃ 93%RH 500h	9-1,2,3
5	Light-proof	UV exposure 42℃, 750W/m^2, 300hrs	9-1,2,3
6	Thermal Shock Test (non-operating)	T_a=-40℃ to T_P=+95℃ 10cycles 2h duration	9-1,2,3
7	Electro Static Discharge Test	Panel Surface : 150pF ±15kV 330Ω (Direct Discharge, Five Times) FPC Input Terminal : 200pF ±200V 0Ω	9-3
8	Shock Test (non-operating)	3 shocks in each direction Peak acceleration: 981 m/s² Duration of nominal shock: 6 ms Waveform: saw-tooth with slow rise (2,94 m/s) or half-sine	9-3
9	Vibration Test (non-operating)	10 - 30 Hz: ± 0,75mm 30 - 500 Hz: 3g 1 Oct./min Random 3Grms 3 x (16 h sinusoidal and 8 h random) in X, Y, and Z direction	9-3

[Note 9-1] T_a = Ambient Temperature, T_P = Panel Surface Temperature

[Note 9-2] After this test has been done, a display is rejected when one of the following defects occurs:

- optical and electrical defects as specified in the test specification
- exceeding the specified “on” and “off” switching times
- reduction of the original contrast ratio perpendicular of more than 30%
- doubling of specified max. total consumption
- reduction of the original min. brightness from LED more than 50%
- TFT-LCD panels should take place at room temperature for 24 hours after the reliability tests finish.

[Note 9-3] After this test has been done, the specimen should function normally without any fatal defect.
(no picture, line defect, out of synchronization)

10. International Standards

10-1. Safety

a) UL 60950-1, Second Edition, Underwriters Laboratories Inc.
Information Technology Equipment - Safety - Part 1 : General Requirements.
b) CAN/CSA C22.2 No.60950-1-07, Second Edition, Canadian Standards Association.
Information Technology Equipment - Safety - Part 1 : General Requirements.
c) EN 60950-1:2006 + A11:2009, European Committee for Electro technical Standardization (CENELEC).
Information Technology Equipment - Safety - Part 1 : General Requirements.

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)

10-3. Environment

a) RoHS, Directive 2011/65/EU of the European Parliament and of the council of 8 June 2011

11. Packing

11-1. Designation of Lot Mark

a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M

A,B,C : SIZE(INCH)
D : YEAR
E : MONTH
F ~ M : SERIAL NO.

Note

1. YEAR

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mark	A	B	C	D	E	F	G	H	J	K

2. MONTH

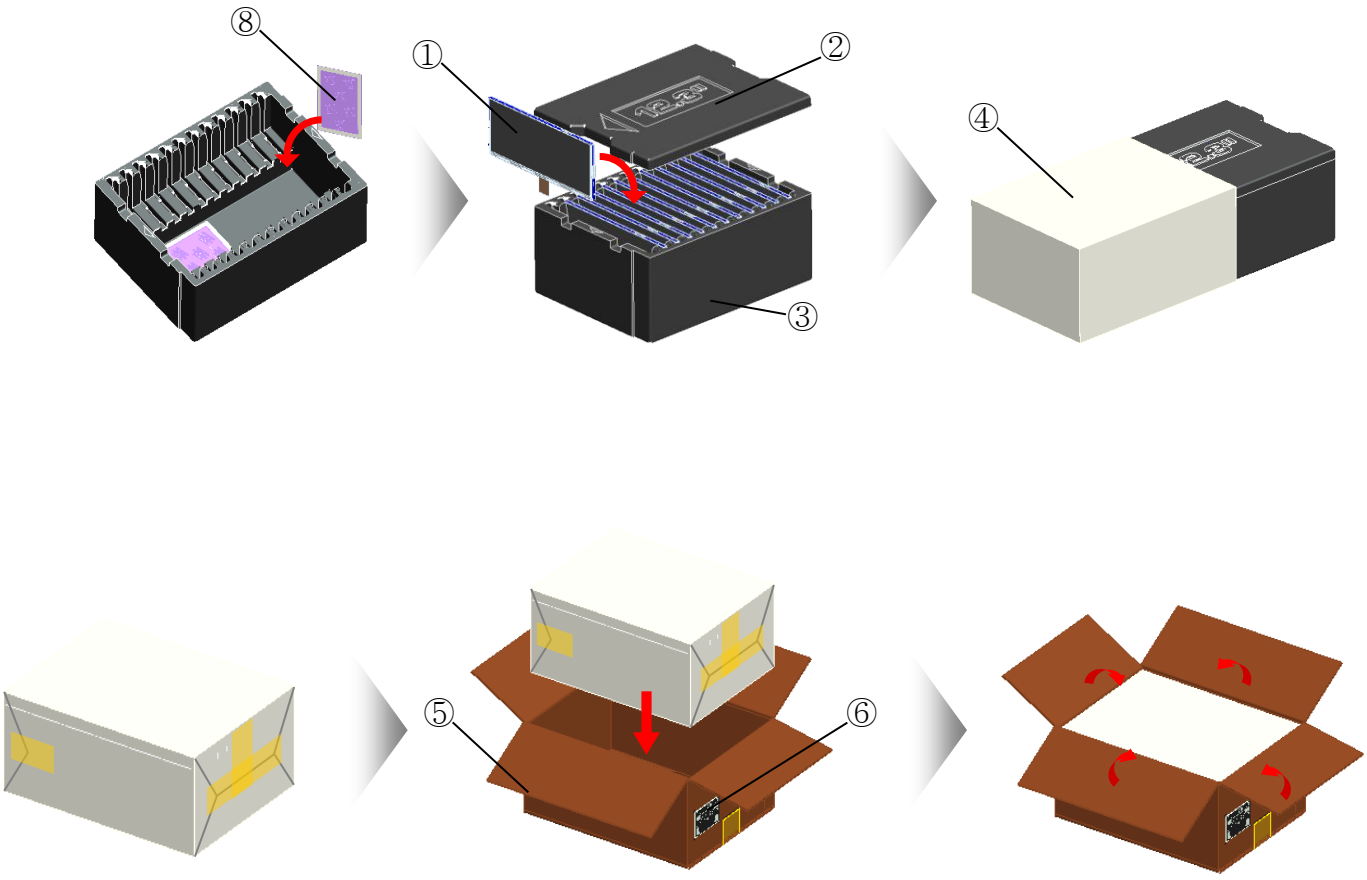
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

b) Location of Lot Mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

11-2. Packing Form

a) Package quantity in one box :12 pcs
b) Box Size : 478×365×244 (mm)



NO.	Description	Material
1	Module	
2	Packing, Top	EPP
3	Packing, Bottom	EPP
4	Bag	AL, 610*800
5	Box	SW
6	Label	YUPO 100x70
7	Tape	OPP 70MMx300M
8	Desiccant	POWER DRY, 60G, UX

12. PRECAUTIONS

Please pay attention to the following when you use this TFT LCD module.

12-1. MOUNTING PRECAUTIONS

(1) You must mount a module using holes arranged in bottom.
(2) You should consider the mounting structure so that uneven force(ex. Twisted stress) is not applied to the module.
And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
(3) Please attach a transparent protective plate to the surface in order to protect the polarizer.
Transparent protective plate should have sufficient strength in order to the resist external force.
(4) You should adopt radiation structure to satisfy the temperature specification.
(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
(6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
(9) Do not open the case because inside circuits do not have sufficient strength.
(10) The metal case of a module should be contacted to electrical ground of your system.

12-2. OPERATING PRECAUTIONS

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
V=±200mV(Over and under shoot voltage)
(2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
(3) Brightness depends on the temperature. (In higher temperature, it becomes lower.)
(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
(6) 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.

12-3. ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

12-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

12-5. STORAGE

When storing modules as spares for a long time, the following precautions are necessary.
(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

12-6. HANDLING PRECAUTIONS FOR PROTECTION FILM

(1) When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
(2) The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt to remain on the polarizer.
Please carefully peel off the protection film without rubbing it against the polarizer.
(3) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
(4) You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

APPENDIX- I

■ Thermistor Characteristics

Note 1. The display module shall incorporate a NTC thermistor surface mounted to the display circuit board.
The user of LCD module can utilize this thermistor for some special purpose.
For example, the user can measure display temperature from the thermistor and
then turn off backlight when LCD module temperature exceeds maximum rating.

2. $R_{thermistor}$ in the table is the feature of the thermistor by itself, and R_{THER} is measured value in the LCM. Customers should refer to the value of R_{THER} for LED derating.
3. $R_{thermistor}$ is typical value.

temp(℃)	RTHER	Rthermistor
-40	49.103 kΩ	195.652 kΩ
-35	38.709 kΩ	148.171 kΩ
-30	30.498 kΩ	113.347 kΩ
-25	24.134 kΩ	87.559 kΩ
-20	19.511 kΩ	68.237 kΩ
-15	15.630 kΩ	53.650 kΩ
-10	12.622 kΩ	42.506 kΩ
-5	10.713 kΩ	33.892 kΩ
0	8.833 kΩ	27.219 kΩ
5	7.356 kΩ	22.021 kΩ
10	6.184 kΩ	17.926 kΩ
15	5.191 kΩ	14.674 kΩ
20	4.368 kΩ	12.081 kΩ
25	3.731 kΩ	10.000 kΩ
30	3.162 kΩ	8.315 kΩ
35	2.695 kΩ	6.948 kΩ
40	2.382 kΩ	5.834 kΩ
45	2.059 kΩ	4.917 kΩ
50	1.792 kΩ	4.161 kΩ
55	1.570 kΩ	3.535 kΩ
60	1.373 kΩ	3.014 kΩ
65	1.203 kΩ	2.586 kΩ
70	1.065 kΩ	2.228 kΩ
75	0.937 kΩ	1.925 kΩ
80	0.828 kΩ	1.669 kΩ
85	0.752 kΩ	1.452 kΩ
90	0.671 kΩ	1.268 kΩ
95	0.602 kΩ	1.110 kΩ