SHARP

No.	LD -D2113804B
DATE	Nov. 8. 2013

TECHNICAL LITERATURE

For

TFT-LCD module

These parts have corresponded with the RoHS directive.

MODEL No. LQ156D1JX01

The technical literature is subject to change without notice. So, please contact SHARP or its representative before designing your product based on this literature.

DEVELOPMENT DEPARTMENT I
DISPLAY DEVICE UNIT Ⅱ
DISPLAY DEVICE BUSINESS DIVISION
SHARP CORPORATION

RECORDS OF REVISION

LQ156D1JX01

SPEC No.	DATE	REVISED No.	PAGE	SUMMARY	NOTE
LD-D2113804A	Aug.28.2013	-	-	-	1st Issue
LD-D2113804B	Nov.8.2013	△1	3	Mass SPEC. TBD → (320)	2nd Issue
			5	Corresponding connector 20525-040T-01 → 20524-040T-01	
			8	Current dissipation(Typ) TBD → (440)	
			8	Current dissipation(Max) TBD → (950)	
			8	Power dissipation(Typ) TBD → (1.45)	
			8	Power dissipation(Max) TBD → (3.14)	
			10	Typical current condition 16-gray-bar pattern →256-gray-bar pattern	
			10	Maximum current condition Max pattern add. TBD → The pattern below	
			11	Current dissipation(Typ) TBD → (322)	
			11	Current dissipation Remark VBL=12V(TYP), VBL=(7V)(MAX) → VBL=12V	
			11	Vmin (TBD) → (7.0V)	
			11	Vth (TBD) → (0.9VBL)	
			11	td max （TBD） → (20ms)	
			19	Viewing angle range (Min) 70 → 80	
			19	Contrast ratio (Typ) (900) → （1000）	
			19	Luminance of White (Min) (TBD) → （280）	

NOTICE

The application circuit examples in this technical literature are provided to explain the representative applications of SHARP's devices and are not intended to guarantee any circuit design or permit any industrial property right or other rights to be executed. SHARP takes no responsibility for any problems related to any industrial property right or a third party resulting from the use of SHARP's devices, except for those resulting directly from device manufacturing processes.

In the absence of confirmation by device specification sheets, SHARP takes no responsibility for any defects that occur in equipment using any of SHARP's devices, shown in catalogs, data books, etc. Contact SHARP in order to obtain the latest device specification sheets before using any SHARP's device.

SHARP reserves the right to make changes in the specifications, characteristics, data, materials, structures and other contents described herein at any time without notice in order to improve design or reliability. Contact SHARP in order to obtain the latest specification sheets before using any SHARP's device. Manufacturing locations are also subject to change without notice.

Observe the following points when using any device in this technical literature. SHARP takes no responsibility for damage caused by improper use of the devices.

The devices in this technical literature are designed for general electronic equipment use.

The appropriate design measures should be taken to ensure reliability and safety when SHARP's devices are used for equipment such as:

・Transportation control and safety equipment(i.e., aircraft, trains, automobiles, etc.)
・Traffic signals・Gas leakage sensor breakers ・Alarm equipment・Various safety devices etc.

SHARP's devices shall not be used for equipment that requires extremely high level of reliability, such as:

・Military and space applications ・Nuclear power control equipment
・Medical equipment for life support

Contact a SHARP representative, in advance, when intending to use SHARP’s devices for any “specific” applications other than those recommended by SHARP.

Contact and consult with a SHARP representative if there are any questions about the contents of this technical literature.

Table of contents

1. Application

This specification applies to a color TFT-LCD module, LQ156D1JX01.

2. Overview

This module is a color active matrix LCD module incorporating Oxide TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, a control circuit and power supply circuit, and a backlight unit. Graphics and texts can be displayed on a 3840×3×2160 dots panel with 16,777,216 colors by using eDP (Embedded Display Port) Ver1.3 interface and supplying +3.3V DC supply voltage for TFT-LCD panel driving and applying DC supply voltage for LED backlight-driving DC/DC converter.

In this TFT-LCD panel, color filters for excellent color performance and backlights for high brightness are incorporated to realize brighter and clearer pictures, making this model optimum for use in multi-media applications.

Optimum viewings are in all directions.

Backlight-driving LED controller is built in this module.

eDP Transfer rate Specification : 5.4Gbps / 4 lane

3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	39.652 (15.6") Diagonal	cm
Active area	345.60(H)×194.40 (V)	mm
Pixel format	3840 (H)×2160 (V)	pixel
	(1 pixel = R+G+B dots)	
Pixel pitch	0.090 (H) × 0.090 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally black	
Surface treatment	Glare,Hard coating (3H)	

Outline dimensions

Parameter		Min.	Typ.	Max.	Unit	Remark
Unit outline dimensions [Note 3-1]	Width	357.62	358.12	358.62	mm	w/o bracket
	Height	217.31	218.31	219.31	mm	w/o bracket
	Depth	(2.802)	(3.102)	(3.402)	mm	w/ Fix tape
Mass		—	(320)	—	g	△ 1

[Note 3-1] Outline dimensions is shown in Fig.2

4. Input Terminals

4 - 1. Symbol

CN1 (eDP signals, +3.3V DC power supply, and B/L power supply)

Pin No.	Symbol	I/O	Function	Remark
1	NC	-	Reserved for LCD manufacturer's use	[Note4-1-1]
2	H_GND	P	High Speed Ground	
3	Lane3_N	I	Complement Signal Link Lane 3	
4	Lane3_P	I	True Signal Link Lane 3	
5	H_GND	P	High Speed Ground	
6	Lane2_N	I	Complement Signal Link Lane 2	
7	Lane2_P	I	True Signal Link Lane 2	
8	H_GND	P	High Speed Ground	
9	Lane1_N	I	Complement Signal Link Lane 1	
10	Lane1_P	I	True Signal Link Lane 1	
11	H_GND	P	High Speed Ground	
12	Lane0_N	I	Complement Signal Link Lane 0	
13	Lane0_P	I	True Signal Link Lane 0	
14	H_GND	P	High Speed Ground	
15	AUX_CH_P	I	True Signal Auxiliary Channel	
16	AUX_CH_N	I	Complement Signal Auxiliary Channel	
17	H_GND	P	High Speed Ground	
18	VDD	P	LCD logic and driver power(3.3V)	
19	VDD	P	LCD logic and driver power(3.3V)	
20	VDD	P	LCD logic and driver power(3.3V)	
21	VDD	P	LCD logic and driver power(3.3V)	
22	NC	-	Reserved for LCD manufacturer's use	[Note4-1-1]
23	LCD_GND	P	LCD logic and driver ground	
24	LCD_GND	P	LCD logic and driver ground	
25	LCD_GND	P	LCD logic and driver ground	
26	LCD_GND	P	LCD logic and driver ground	
27	HPD	O	HPD signal pin	
28	BL_GND	P	Backlight ground	
29	BL_GND	P	Backlight ground	
30	BL_GND	P	Backlight ground	
31	BL_GND	P	Backlight ground	
32	BL_ENABLE	I	Backlight On/Off	
33	BL_PWM_DIM	I	System PWM	
34	NC	-	Reserved for LCD manufacturer's use	[Note4-1-1]
35	NC	-	Reserved for LCD manufacturer's use	[Note4-1-1]
36	VBL	P	Backlight power	
37	VBL	P	Backlight power	
38	VBL	P	Backlight power	
39	VBL	P	Backlight power	
40	NC	-	Reserved for LCD manufacturer's use	[Note4-1-1]

※ 1 I : Input , O : Output , P : Power:

[Note 4-1-1] Don’t input any signals or any powers into a NC pin. Keep the NC pin open.

[Note 4-1-2] The shielding case is connected with signal GND.

- Connector used : 20525-040E-02 (IPEX)
- Corresponding connector : 20524-040T-01(IPEX) △1

  (Sharp is not responsible to its product quality, if the user applies a connector not corresponding to the above model.)

4 - 2. eDP interface

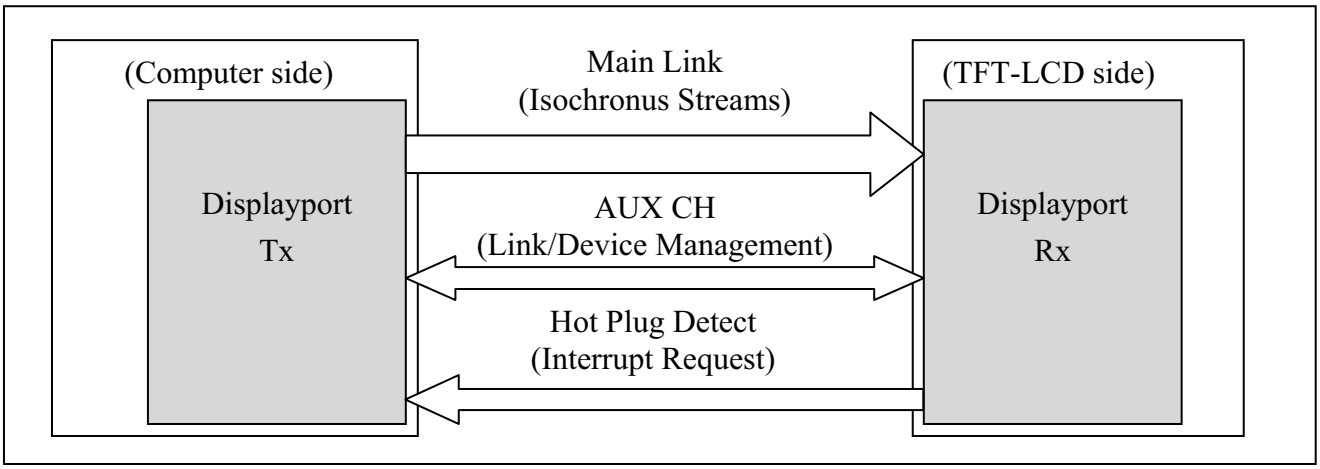


Fig.4-2-1 DP architecture.

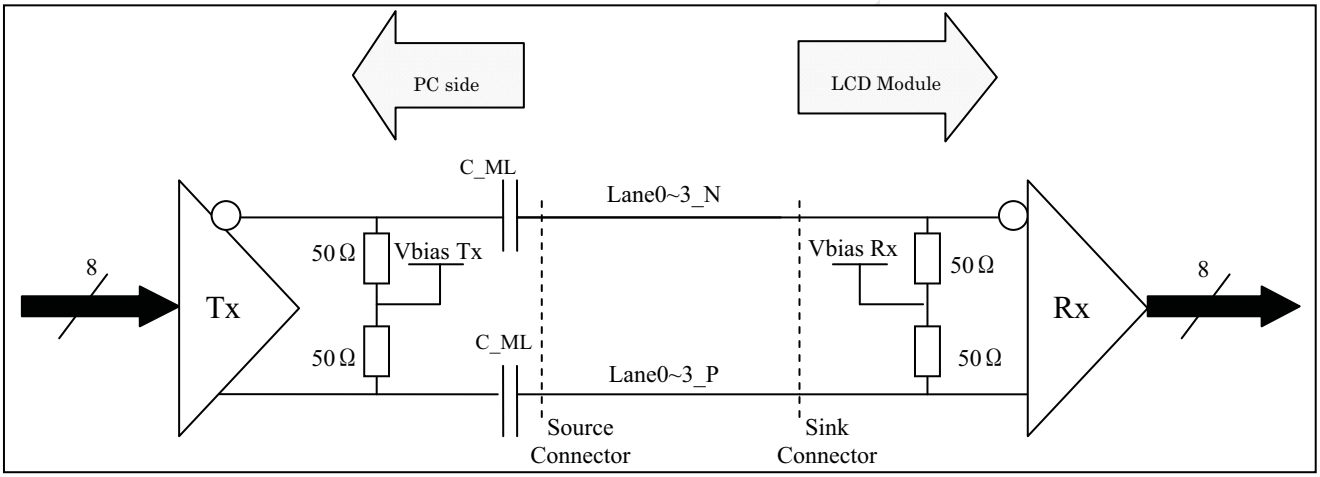


Fig.4-2-2 Main Link differential pair.

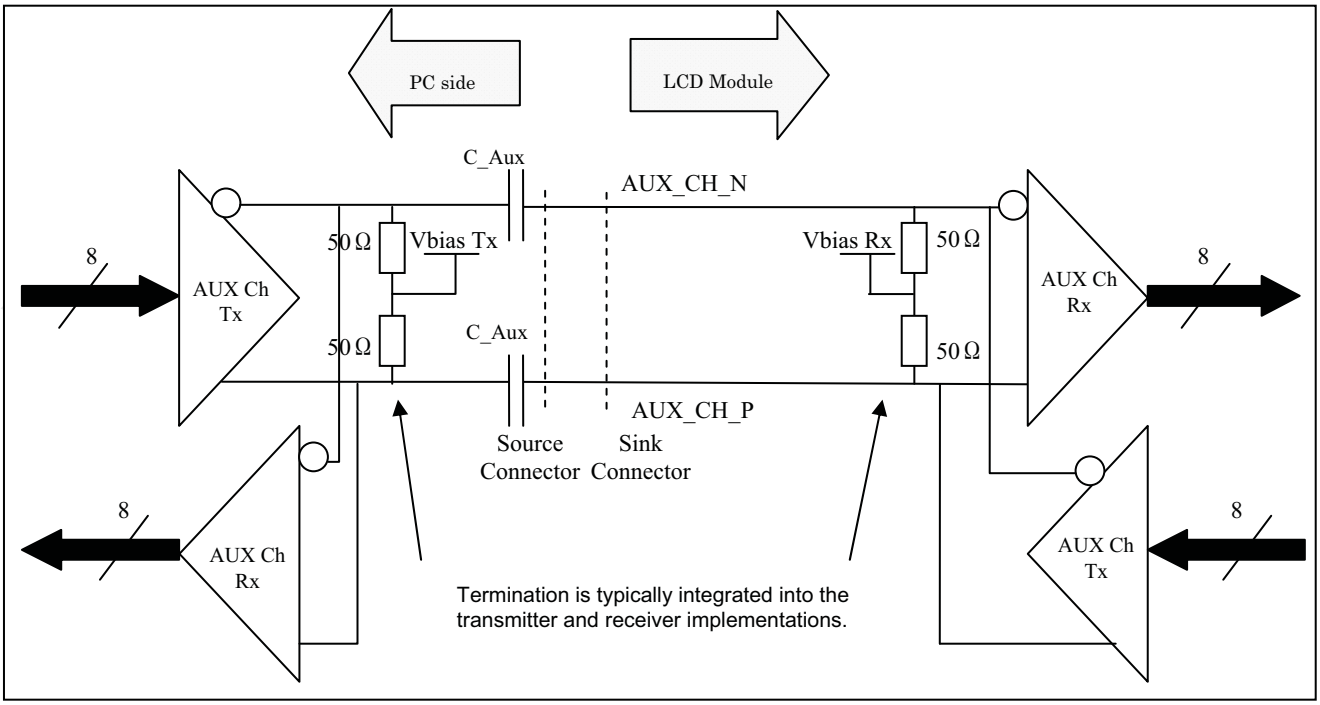


Fig.4-2-3 AUX Link differential pair.

Lane0	Lane1	Lane2	Lane3
R0-7:0	R1-7:0	R2-7:0	R3-7:0
G0-7:0	G1-7:0	G2-7:0	G3-7:0
B0-7:0	B1-7:0	B2-7:0	B3-7:0
R4-7:0	R5-7:0	R6-7:0	R7-7:0
G4-7:0	G5-7:0	G6-7:0	G7-7:0
B4-7:0	B5-7:0	B6-7:0	B7-7:0
R8-7:0	R9-7:0	R10-7:0	R11-7:0
G8-7:0	G9-7:0	G10-7:0	G11-7:0
B8-7:0	B9-7:0	B10-7:0	B11-7:0

Fig.4-2-5 eDP 4 lane 8 bit input data mapping.

5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings		Unit	Remark
			Min.	Max.		
+3.3V supply voltage	VDD	Ta=25℃	-0.3	+4.0	V	
Back Light supply voltage	VBL	Ta=25℃	-0.3	+26.5	V	
Input voltage(eDP)	VI	Ta=25℃	-0.3	+1.8	V	[Note 5-1]
Input voltage(BL)	BL_I	Ta=25℃	-0.3	(VDD+0.3)	V	[Note 5-2]
Storage temperature (ambient)	Tstg	—	-20	+60	℃	[Note 5-4]
Operating temperature(ambient)	Topa	—	0	+50	℃	

[Note 5-1] eDP signals

[Note 5-2] Back light control signals (BL_ENABLE, BL_PWM_IN)

[Note 5-3] Humidity：90%RH Max. at Ta≦+40℃.

Maximum wet-bulb temperature at +39℃ or less at Ta>+40℃.

No condensation.

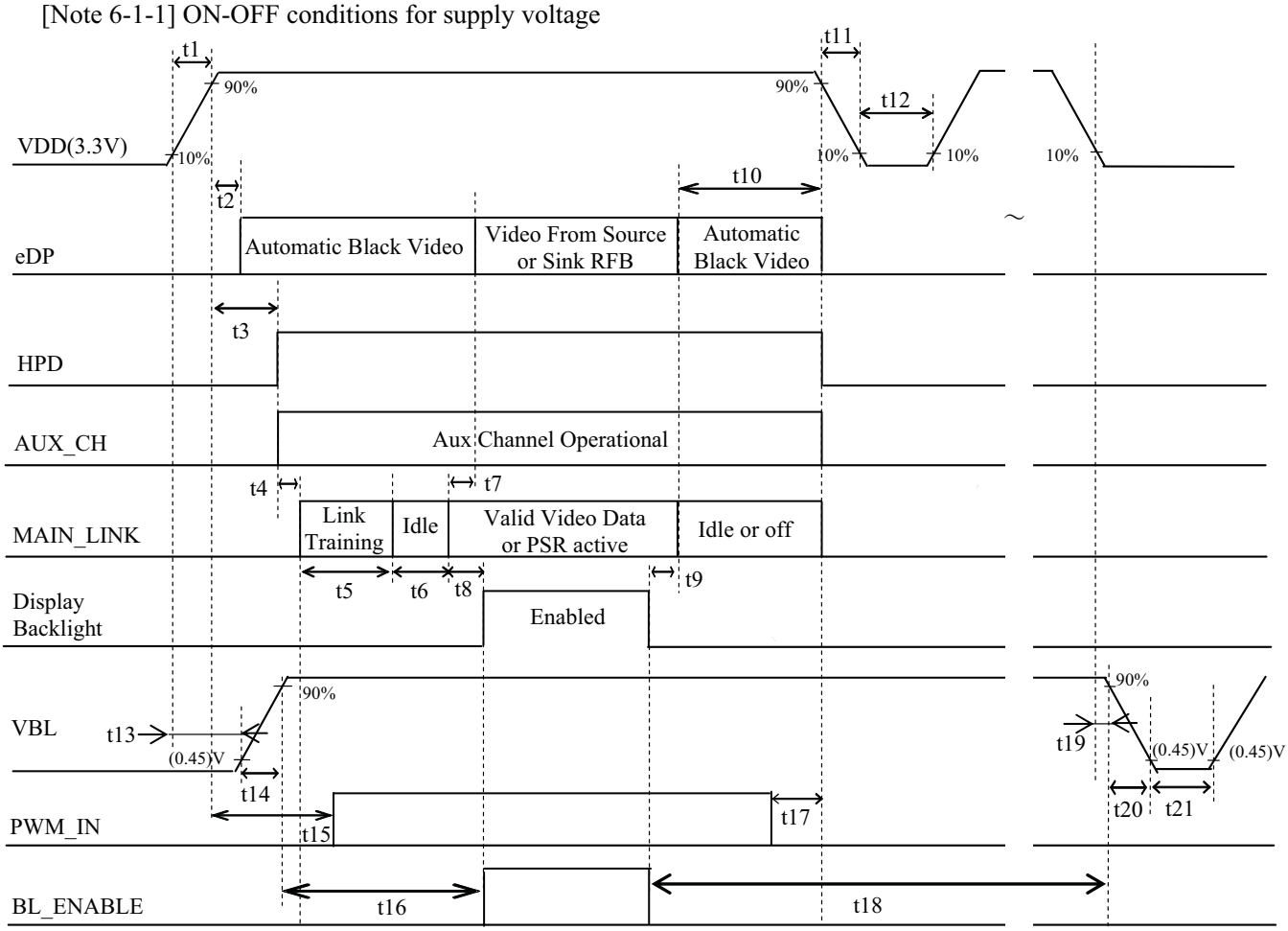
6. Electrical Characteristics

6 - 1. TFT-LCD panel driving

Ta＝+25℃

DC Electrical Characteristics						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Supply voltage	VDD	+3.0	+3.3	+3.6	V	[Note 6-1-1]
Current dissipation	IDD	—	(440)	(950)	mA	[Note 6-1-2] △1
Power dissipation	PDD	—	(1.45)	(3.14)	W	[Note 6-1-2] △1
Permissive input ripple voltage	V_{RP}	—	—	100	mV_{P-P}	VDD = +3.3V
eDP AUX Channel Characteristics						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Unit Interval for AUX channel	UI_{AUX}	(0.4)	(0.5)	(0.6)	μs	
peak-to-peak voltage at TP1	$V_{AUX-DIFF-p}$	(0.32)	-	(1.36)	V	
AUX DC Common Mode Voltage	$V_{AUX-DC-CM}$	-	(0.9)	-	V	
AUX Short Circuit Current Limit	I_{AUX_SHORT}	-	-	(90)	mA	
AUX CH termination DC resistance	R_{AUX-_TERM}	-	(100)	-	Ω	
AUX AC Coupling Capacitor	C_{AUX}	(75)	-	(200)	nF	
Number of pre-charge pulses	Pre-charge pulses	(10)	-	(16)	-	
eDP Main Link Receiver Characteristics						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Link clock down spreading	Down_Spread_ Amplitude	0	-	(0)	%	△1
Differential Peak-to-peak Input Voltage at RX package pins	$V_{RX-DIFFp-p}$	(90)	-	(1200)	mV	
Differential Return Loss at 1.35 GHz at RX package pins	$RL_{RX-DIFF}$	(9)	-	-	dB	
RX DC Common Mode Voltage	$V_{RX-DC-CM}$	(0)	-	(2.0)	V	
Differential termination resistance	$V_{RX-TERM}$	-	(100)	-	Ω	
RX Short Circuit Current Limit	$I_{RX-SHORT}$	-	-	(50)	mA	
Lane Intra-pair Skew at RX package pins	$L_{RX-SKEW-INTRA-PAIR-High-Bit-Rate}$	-	-	(50)	ps	

[Note 6-1-1] ON-OFF conditions for supply voltage



[Note] Do not keep the interface signal high-impedance or unusual signal when power is on.

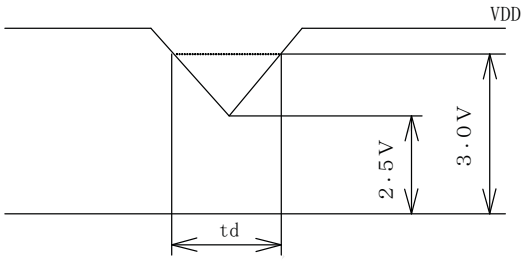
Symbol	Min	Max	Unit	Note
t1	(0.5)	(10)	ms	
t2	(0)	(200)	ms	
t3	0	100	ms	
t4	-	-	ms	
t5	-	-	ms	
t6	-	-	ms	
t7	0	50	ms	
t8	-	-	ms	
t9	-	-	ms	
t10	0	500	ms	
t11	(1)	(50)	ms	[Note 1]
t12	500	-	ms	
t13	-	-	ms	
t14	(0.1)	(10)	ms	
t15	(100)		ms	
t16	0	-	ms	
t17	0	-	ms	
t18		-		
t19	-	-	ms	
t20	(0.1)	-	ms	
t21	(100)		ms	

[Note 1] As for the power off sequence for VDD (t11), Be sure to keep above mentioned timing.
If the VDD power off sequence timing is other than shown above, LCD may cause permanent damage.
As for the power sequence for backlight, it is recommended to apply above mentioned input timing.
If the backlight is light on and off at a timing other than shown above, displaying image may get disturbed.

VDD-dip conditions

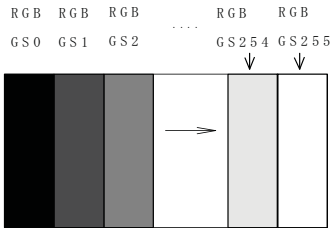
1) 2.5 V≦VDD＜3.0 V
td≦10 ms
Under above condition, the display image should return to an appropriate figure after VDD voltage recovers.

2) VDD＜2.5 V
VDD-dip conditions should also follow the ON-OFF conditions for supply voltage



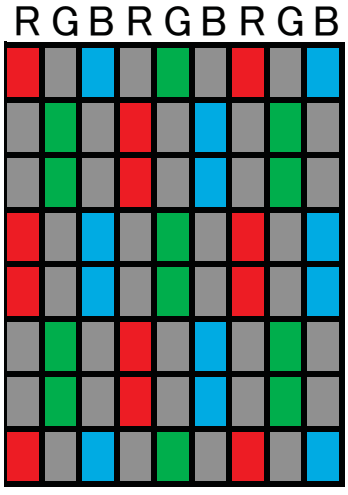
[Note 6-1-2] Typical current condition: 256-gray-bar pattern.
VDD=+3.3V

△1



Maximum current condition: The pattern below.
VDD=+3.3V

△1



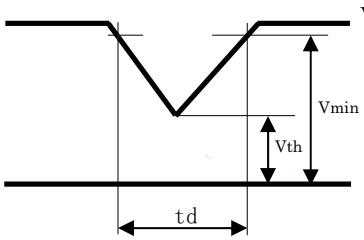
6 - 2. Backlight driving

The backlight system is an edge-lighting type with white-LED.
(It is usually required to measure under the following condition. : Ta=25℃±2℃)

Parameter	Symbol	Min.	Typ.	Max	Unit	Remark
Supply voltage	VBL	(7.0)	12.0	(21.0)	V	
Current dissipation △1	I_{BL}	—	(322)	(TBD)	mA	VBL = 12.0V △1 Duty Ratio=100%
Modulated light signal voltage	VPWMH	0.6VDD	3.3	3.6	V	
	VPWML	0	—	0.7	V	
Brightness Control Duty Ratio	Duty	(1)	—	100	%	【Note6-2-1】
Brightness Control pulse width	T_{PWM}	(30)	—	—	us	【Note6-2-2】
Brightness Control frequency	f_{PWM}	(150)	200	(2000)	Hz	
LED-BL ON/OFF High voltage	VCNTH	1.8	3.3	3.6	V	【Note6-2-3】
LED-BL ON/OFF Low voltage	VCNTL	—	—	0.6	V	【Note6-2-3】
Input signal pin current	I_{IN}	—	—	(1.0)	μA	BL_ENABLE, BL_PWM_DIM
LED lifetime	-	—	(10,000)	—	h	LED

【Note6-2-1】 PWM_IN Input : 100%= Max luminance 1%= Min luminance
【Note6-2-2】 The minimum value of the dimming signal pulse width is assumed regulations of the width of high and the width of low.
【Note6-2-3】 BL_ENABLE Input : High = BL turn on, Low or OPEN =BL turn off

VBL-dip conditions



Vmin : (7.0V) △1
Vth : ($0.9V_{BL}$) △1

1) Vth ≦ V_{BL} ＜ Vmin : td ≦ (20ms) △1
2) V_{BL} ＜ Vth : The condition of instantaneous voltage drop is apply to input voltage sequences

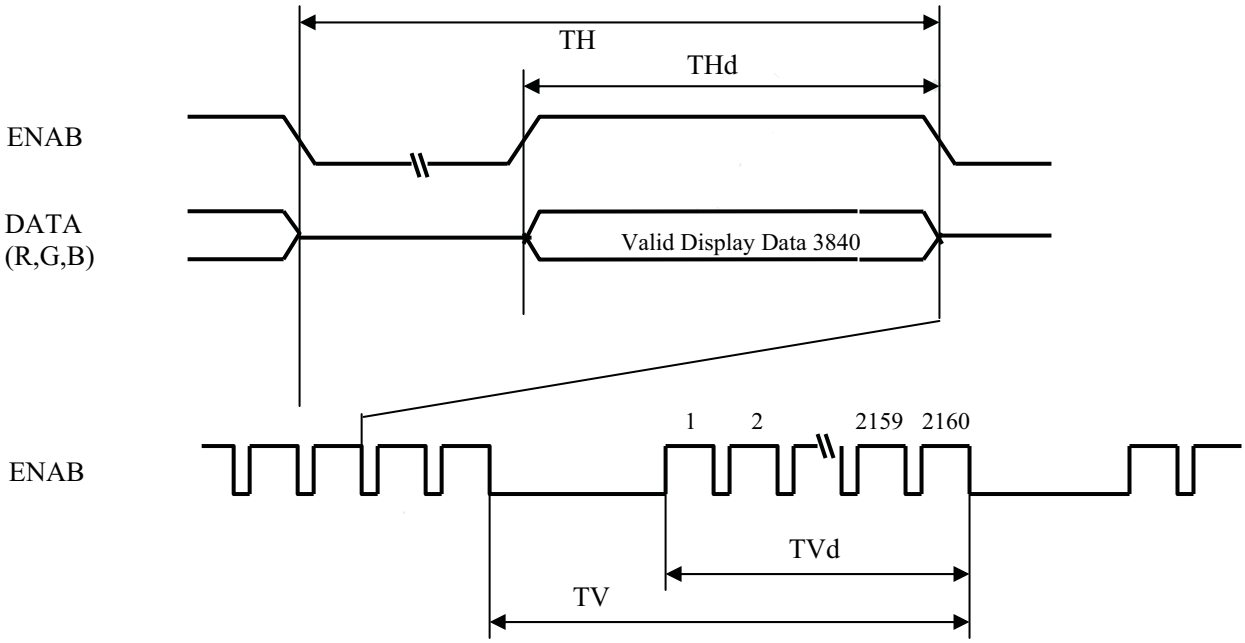
7. Timing Characteristics of Input Signals

7 - 1. Timing characteristics

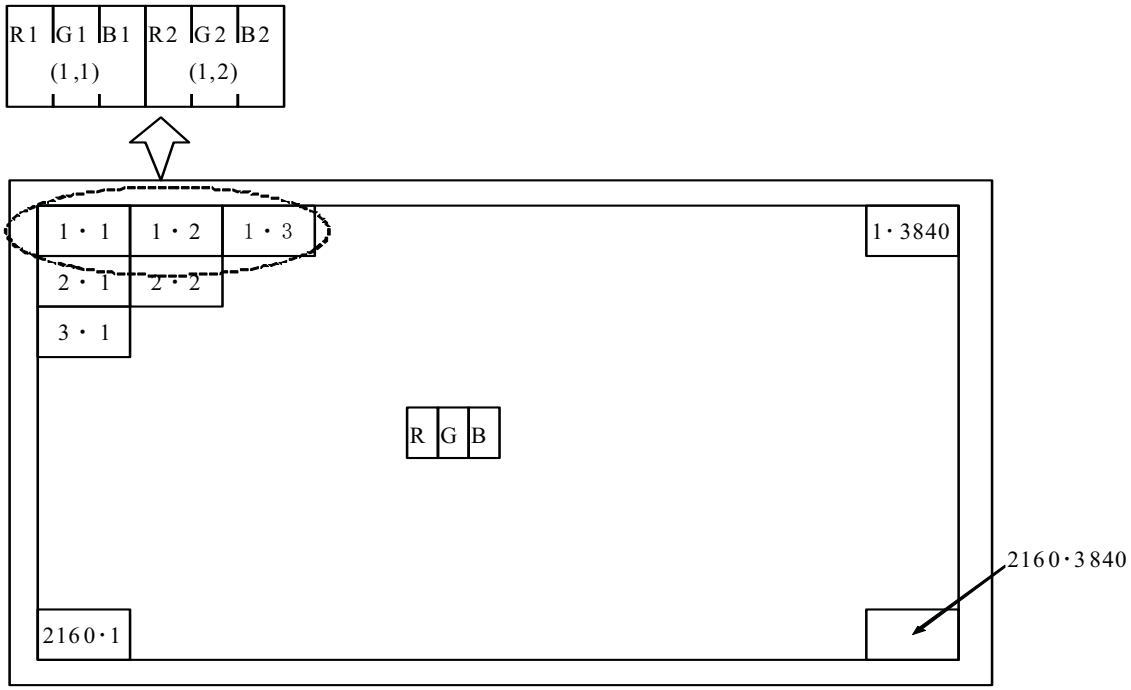
VDD=+3.0V～+3.6V, Ta＝0℃～+50℃

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
Clock	Frequency	1/Tc	—	(533.25)	—	MHz	[Note 7-1-1]
Data enable Signal	Horizontal period	TH	—	(4000)	—	clock	
				(7.501)		μs	
	Horizontal period (High)	THd	—	3840	—	clock	
	Vertical period	TV	—	(2222)	—	Line	
			—	(16.67)	—	ms	
	Vertical period (High)	TVd	—	2160	—	line	

[Note 7-1-1] In case of using the long vertical period, the deterioration of display quality, flicker, etc, may occur.



7 - 2. Input data signals and display position on the screen



Display position of input data(V・H)

8. Input Signals, Basic Display Colors and Gray Scale of Each Color

	Colors & Gray Scale	Gray Scale	Date signal																							
			R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7
			LSB							MSB	LSB							MSB	LSB							MSB
Basic Color	Black	–	0	0	0	0	0	0	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	0	0	0	0	1	1	1	1	1	1	1	1
	Green	–	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	–	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	–	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	–	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	–	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	1	1	1	1	1	1
Gray Scale of Red	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓					↓							↓								↓				
	⇩	↓					↓							↓								↓				
	Brighter	GS253	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇩	GS254	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓					↓							↓								↓				
	⇩	↓					↓							↓								↓				
	Brighter	GS253	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	⇩	GS254	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green	GS255	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of Blue	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	⇧	↓					↓							↓								↓				
	⇩	↓					↓							↓								↓				
	Brighter	GS253	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1
	⇩	GS254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Blue	GS255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

0 : Low level voltage, 1 : High level voltage

Each basic color can be displayed in 256 gray scales from 8 bit data signals.

According to the combination of 24 bit data signals, the 16.7M color display can be achieved on the screen.

9. EDID Specifications

9 - 1. EDID data structure

This is the EDID(Extended Display Identification Data) data formats to support displays as defined in the VESA Plug & Display

Byte (decimal)	Byte (hex)	Field Name and Comments	Value (hex)	Value (binary)
0	00			
1	01			
2	02			
3	03			
4	04			
5	05			
6	06			
7	07			
8	08			
9	09			
10	0A			
11	0B			
12	0C			
13	0D			
14	0E			
15	0F			
16	10			
17	11			
18	12			
19	13			
20	14			
21	15			
22	16			
23	17			
24	18			
25	19			
26	1A			
27	1B			
28	1C			
29	1D			
30	1E			

T.B.D

31	1F	
32	20	
33	21	
34	22	
35	23	
36	24	
37	25	
38	26	
39	27	
40	28	
41	29	
42	2A	
43	2B	
44	2C	
45	2D	
46	2E	
47	2F	
48	30	
49	31	
50	32	
51	33	
52	34	
53	35	
54	36	
55	37	
56	38	
57	39	
58	3A	
59	3B	
60	3C	
61	3D	
62	3E	
63	3F	
64	40	
65	41	
66	42	

T.B.D

67	43		
68	44		
69	45		
70	46		
71	47		
72	48		
73	49		
74	4A		
75	4B		
76	4C		
77	4D		
78	4E		
79	4F		
80	50		
81	51		
82	52		
83	53		
84	54		
85	55		
86	56		
87	57		
88	58		
89	59		
90	5A		
91	5B		
92	5C		
93	5D		
94	5E		
95	5F		
96	60		
97	61		

T.B.D

98	62	
99	63	
100	64	
101	65	
102	66	
103	67	
104	68	
105	69	
106	6A	
107	6B	
108	6C	
109	6D	
110	6E	
111	6F	T.B.D
112	70	
113	71	
114	72	
115	73	
116	74	
117	75	
118	76	
119	77	
120	78	
121	79	
122	7A	
123	7B	
124	7C	
125	7D	
126	7E	
127	7F	

10. Optical Characteristics

Ta=+25℃, VDD=+3.3V

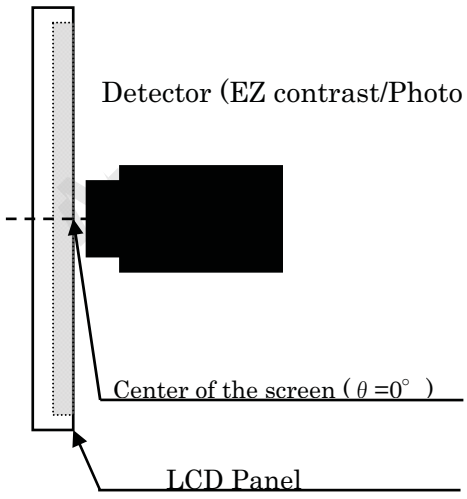
Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range △1	Horizontal	θ 21, θ 22	CR>10	80	88	—	deg.	[Note 10-1, 10-3, 10-4, 10-6]
	Vertical	θ 11		80	88	—	deg.	
		θ 12		80	88	—	deg	
Contrast ratio △1		CR	θ =0°	(700)	(1000)	—		[Note 10-1, 10-4, 10-6]
Response time		τ r+ τ d	θ =0°	—	25	—	ms	[Note 10-2, 10-5, 10-6]
Chromaticity of white		x		(0.283)	(0.313)	(0.343)		[Note 10-2, 10-6] Normal operation (PWM Duty=100%)
		y		(0.299)	(0.329)	(0.359)		
Chromaticity of red		x		—	(0.640)	—		
		y		—	(0.330)	—		
Chromaticity of green		x		—	(0.300)	—		
		y		—	(0.600)	—		
Chromaticity of blue		x		—	(0.150)	—		
		y		—	(0.060)	—		
NTSC ratio				(68)	(72)		%	
Luminance of white △1		Y_{LI}		(280)	(330)	—	cd/m^2	
White Uniformity		δ w	θ =0°	—	(1.25)	(1.40)		[Note 10-2, 10-7]

※ The measurement shall be taken (30) minutes after lighting the module at the following rating:

Condition: PWM Duty = 100%

The optical characteristics shall be measured in a dark room or equivalent.

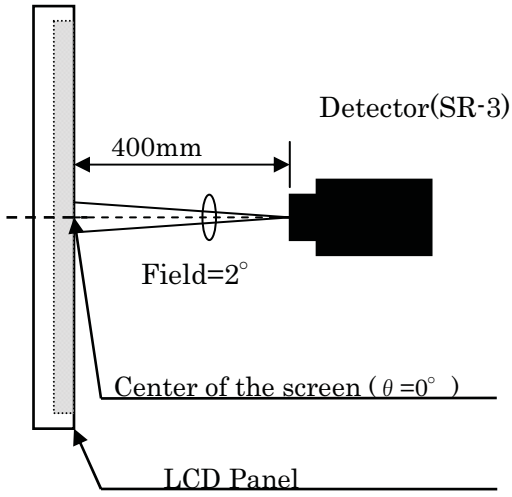
[Note 10-1] Measurement of viewing angle range and Response time.



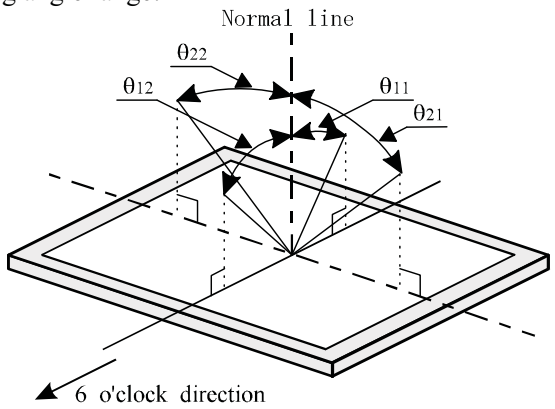
Viewing angle range:EZ-CONTRAST

/Response time: Photo diode)

[Note 10-2] Measurement of luminance and Chromaticity and Contrast.



[Note 10-3] Definitions of viewing angle range:



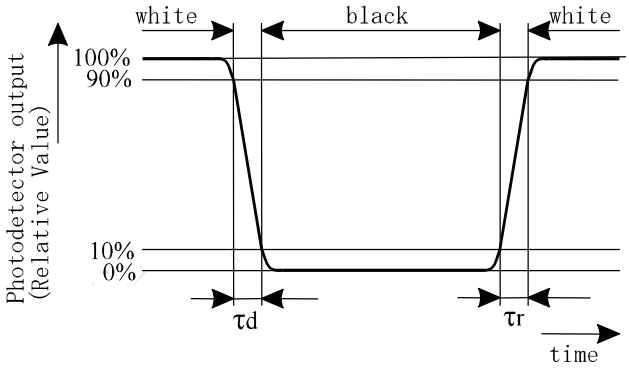
[Note 10-4] Definition of contrast ratio:

The contrast ratio is defined as the following.

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

[Note 10-5] Definition of response time:

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" .

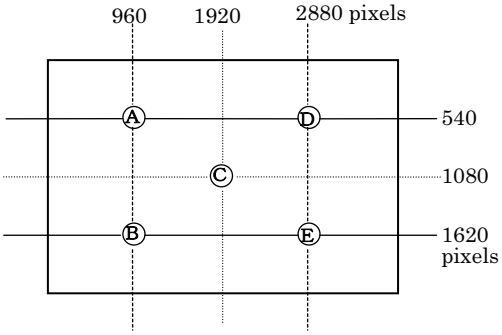


[Note 10-6] This shall be measured at center of the screen.

[Note 10-7] Definition of white uniformity:

White uniformity is defined as the following with five measurements (A～E).

$$\delta w = \frac{\text{Maximum Luminance of five points (brightness)}}{\text{Minimum Luminance of five points (brightness)}}$$



11. Display Quality

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

12. Handling Precautions

a) Be sure to turn off the power supply when inserting or disconnecting the cable.
Please insert for too much stress not to join a connector in the case of insertion of a connector.

b) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.

c) Since the front polarizer is easily damaged, pay attention not to scratch it.

d) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.

e) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

g) Since CMOS LSI is used in this module, take care of static electricity and injure the human earth when handling. Observe all other precautionary requirements in handling components.

h) This module has its circuitry PCBs on the side and should be handled carefully in order not to be stressed.

i) Protect sheet(Laminate film) is attached to the module surface to prevent it from being scratched. Peel the sheet off slowly just before the use with strict attention to electrostatic charges. Ionized air shall be blown over during the action. Blow off the 'dust' on the polarizer by using an ionized nitrogen gun, etc. Working under the following environments is desirable.
   - All workers wear conductive shoes, conductive clothes, conductive fingerstalls and grounding belts without fail.
   - Use Ionized blower for electrostatic removal, and peel of the protect sheet with a constant speed. (Peeling of it at over 2 seconds)

j) The polarizer surface on the panel is treated with Anti Glare . In case of attaching protective board over the LCD, be careful about the optical interface fringe etc. which degrades display quality.

k) Do not expose the LCD module to a direct sunlight, for a long period of time to protect the module from the ultra violet ray.

l) When handling LCD modules and assembling them into cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the LCD modules.

m) Liquid crystal contained in the panel may leak if the LCD is broken. Rinse it as soon as possible if it gets inside your eye or mouth by mistake.

n) Disassembling the module can cause permanent damage and should be strictly avoided.
Please don't remove the fixed tape, insulating tape etc that was pasted on the original module.
(Except for protection film of the panel.)

o) Be careful when using it for long time with fixed pattern display as it may cause afterimage.
(Please use a screen saver etc., in order to avoid an afterimage.)

p) If a minute particle enters in the module and adheres to an optical material, it may cause display non-uniformity issue, etc. Therefore, fine-pitch filters have to be installed to cooling and inhalation hole if you intend to install a fan.

q) Epoxy resin (amine series curing agent), silicone adhesive material (dealcoholization series and oxime series),
tray forming agent (azo compound) etc, in the cabinet or the packing materials may induce abnormal display with polarizer film deterioration regardless of contact or noncontact to polarizer film.
Be sure to confirm the component of them.

r) Do not use polychloroprene. If you use it, there is some possibility of generating Cl_2 gas that influences the reliability of the connection between LCD panel and driver IC.

t) Do not put a laminate film on LCD module, after peeling of the original one. If you put on it, it may cause discoloration or spots because of the occurrence of air gaps between the polarizer and the film.

u) Ground module bezel to stabilize against EMI and external noise.

13. Packaging Condition

Piling number of cartons	T.B.D.
Package quantity in one carton	T.B.D.
Carton size	T.B.D.
Total mass of one carton filled with full modules	T.B.D.
Packing form	Fig.1

14. Label

1) Module barcode label:

T.B.D

2) Packing bar code label

T.B.D

15. RoHS Directive

This LCD module is compliant with RoHS Directive.

16. Reliability Test Items

No.	Test item	Conditions
1	High temperature storage test	Ta = 60℃ 240h
2	Low temperature storage test	Ta = -20℃ 240h
3	High temperature & high humidity operation test	Ta = 40℃ ; 90%RH 240h (No condensation)
4	High temperature operation test	Ta = 50℃ 240h
5	Low temperature operation test	Ta = 0℃ 240h
6	Vibration test (non- operating)	T.B.D
7	Shock test (non- operating)	
8	ESD	

[Result Evaluation Criteria] Under the display quality test conditions with normal operation state. Do not change these conditions as such changes may affect practical display function.

[Normal operation state] Temperature：+15～+35℃, Humidity：45～75%, Atmospheric pressure：86～106kPa

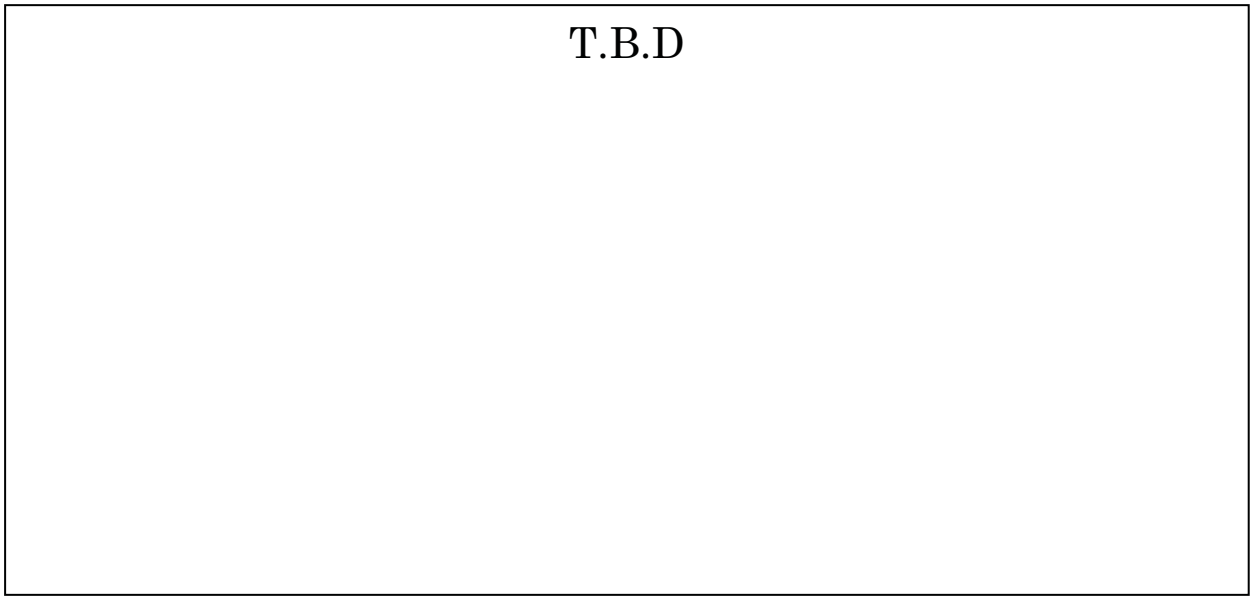


Fig. 1 Packaging Condition

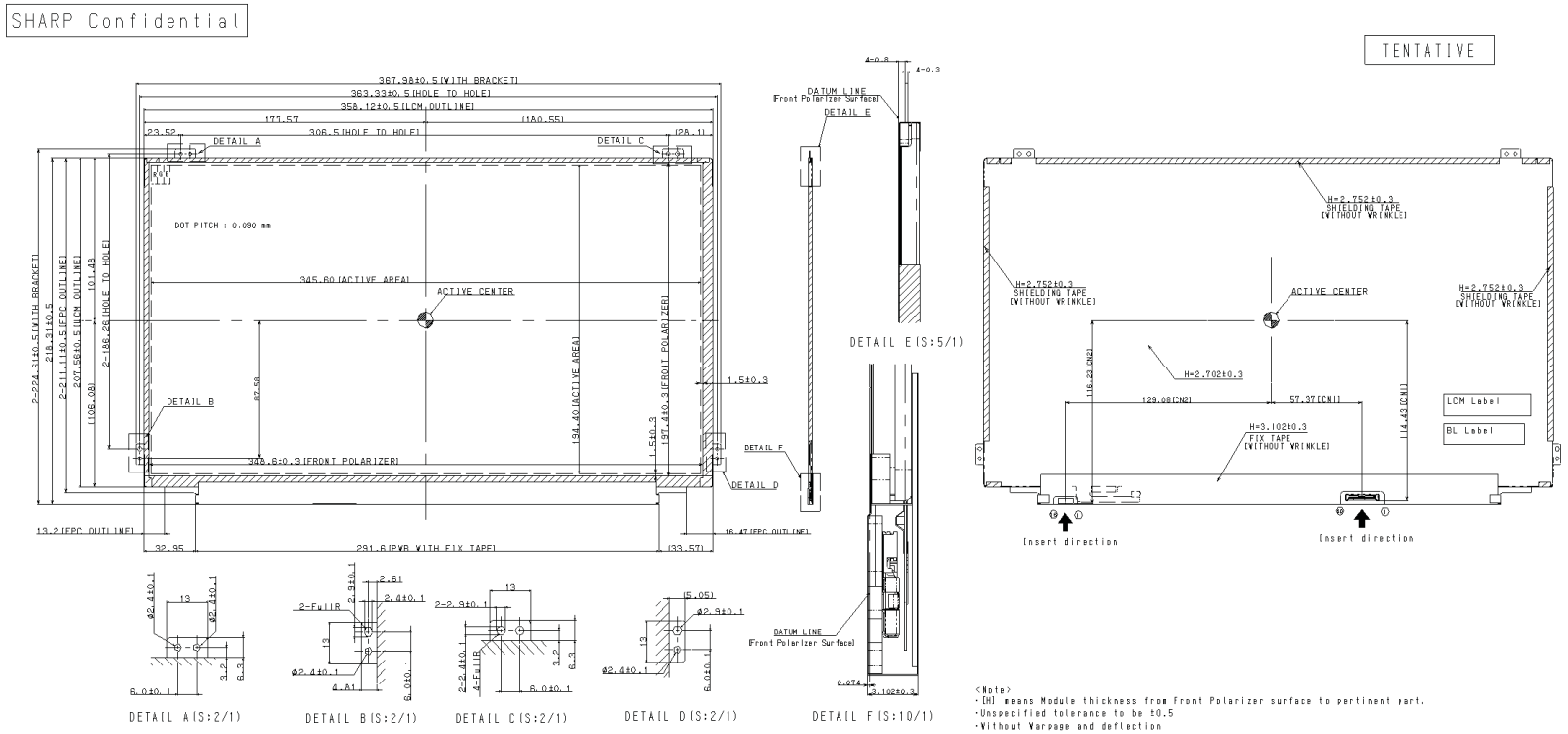


Fig. 2　Outline Dimension