SHARP

No.	LD –S12707A
DATE	Jul. 31. 2012

TECHNICAL LITERATURE

FOR

TFT - LCD module

These parts have corresponded with the RoHS directive.

MODEL No. LQ235D1LW03

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DEVELOPMENT DEPARTMENT 5
DISPLAY DEVICE DIVISION 2
DISPLAY DEVICE BUSINESS GROUP
SHARP CORPORATION

RECORDS OF REVISION

LQ235D1LW03

SPEC No.	DATE	REVISED No.	PAGE	SUMMARY	NOTE
LD－S12707A	Jul. 31. 2012	-	-	-	1st Issue

1. Application

This technical literature applies to the color 23.5” TFT-LCD module LQ235D1LW03.

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2. Overview

This module is a color active matrix LCD panel incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, control circuit and edge-lite LED backlight system etc. Graphics and texts can be displayed on a 1920×RGB×1080 dots panel with about one billion colors (8bit+2FRC) by using LVDS RGB 10bit(Low Voltage Differential Signaling) interface, +12V of DC supply voltages.
And in order to improve the response time of LCD, this module applies the Over Shoot driving (O/S driving) technology for the control circuit. In the O/S driving technology, signals are being applied to the Liquid Crystal according to a pre-fixed process as an image signal of the present frame when a difference is found between image signal of the previous frame and that of the current frame after comparing them.
With this technology, image signals can be set so that liquid crystal response completes within one frame. As a result, motion blur reduces and clearer display performance can be realized
This LCD module also adopts Frame Rate Enhanced Driving method.
With combination of these technologies, motion blur can be reduced and clearer display performance can be realized.

3. Mechanical Specifications

Parameter	Specifications	Unit
Display size	59.809 (Diagonal)	cm
	23.547 (Diagonal)	inch
Active area	521.28(H) x 293.22 (V)	mm
Pixel Format	1920(H) x 1080 (V)	pixel
	(1pixel = R + G + B dot)	
Pixel pitch	0.0905(H) x 0.2715 (V)	mm
Pixel configuration	R,G,B vertical stripe	
Display mode	Normally Black	
Outline Dimensions *1	554.8(W)×319(H)×10.3(D) (*1) Excluded Control PWB	mm
Mass	(T.B.D)	
Surface treatment	Anti Glair Hard Coat 3H Haze 2.0%	

(*1)Outline dimensions are shown in Fig.3

4. Input Terminals

4-1. TFT Panel Driving

CN1 (Interface signals and +12V DC power supply)

Using connector : FI-RNE51SZ-HF (Japan Aviation Electronics Ind., Ltd.)

Mating connector : FI-RE51HL, FI-RE51CL (Japan Aviation Electronics Ind., Ltd.)

Mating LVDS transmitter : THC63LVD1023 or equivalent device

No	Signal	Note	Remark
1	GND	GND	
2	SDA	[Note 1]	Slave address : B4 / Pull up (3.3[V])
3	SCL	[Note 1]	Slave address : B4 / Pull up (3.3[V])
4	(GSP_out)	(Frame sync signal output)	High pulse output / frame [Note 4]
5	(R/W)	(Read/write enable for TCON ROM) (Low : Disenable, High : Enable)	
6	Reserved	Non-connection (default : OPEN)	OPEN
7	SELLVDS	Select LVDS data order [Note2]	Pull down (GND) [Note 3]
8	Reserved	Non-connection (default : OPEN)	OPEN
9	2D/3D	2D/3D mode selection (Low：2D, High：3D (I2C supported))	Pull down (GND) [Note 3]
10	Reserved	Non-connection (default : OPEN)	Pull down (GND) [Note 3]
11	GND	GND	
12	AIN0-	Aport (-)LVDS CH0 differential data input	
13	AIN0+	Aport (+)LVDS CH0 differential data input	
14	AIN1-	Aport (-)LVDS CH1 differential data input	
15	AIN1+	Aport (+)LVDS CH1 differential data input	
16	AIN2-	Aport (-)LVDS CH2 differential data input	
17	AIN2+	Aport (+)LVDS CH2 differential data input	
18	GND		
19	ACK-	Aport LVDS Clock signal(-)	
20	ACK+	Aport LVDS Clock signal(+)	
21	GND		
22	AIN3-	Aport (-)LVDS CH3 differential data input	
23	AIN3+	Aport (+)LVDS CH3 differential data input	
24	AIN4-	Aport (-)LVDS CH4 differential data input	
25	AIN4+	Aport (+)LVDS CH4 differential data input	
26	GND		
27	GND		
28	BIN0-	Bport (-)LVDS CH0 differential data input	
29	BIN0+	Bport (+)LVDS CH0 differential data input	
30	BIN1-	Bport (-)LVDS CH1 differential data input	
31	BIN1+	Bport (+)LVDS CH1 differential data input	
32	BIN2-	Bport (-)LVDS CH2 differential data input	
33	BIN2+	Bport (+)LVDS CH2 differential data input	
34	GND		
35	BCK-	Bport LVDS Clock signal(-)	
36	BCK+	Bport LVDS Clock signal(+)	
37	GND		
38	BIN3-	Bport (-)LVDS CH3 differential data input	
39	BIN3+	Bport (+)LVDS CH3 differential data input	
40	BIN4-	Bport (-)LVDS CH4 differential data input	
41	BIN4+	Bport (+)LVDS CH4 differential data input	
42	GND		
43	GND		
44	GND		
45	GND		
46	GND		
47	Reserved(VCC)	Connected to VCC(+12V) on CPWB	
48	VCC	+12V Power Supply	
49	VCC	+12V Power Supply	

50	VCC	+12V Power Supply	
51	VCC	+12V Power Supply	

CN2 (Interface signals)

Using connector : FI-RNE41SZ-HF (Japan Aviation Electronics Ind., Ltd.)

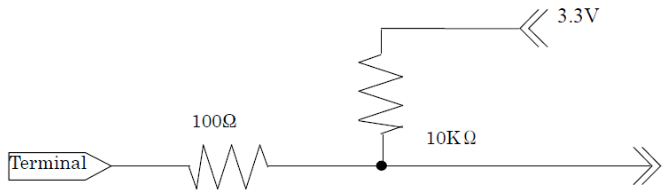
Mating connector : FI-RE41HL, FI-RE41CL (Japan Aviation Electronics Ind., Ltd.)

No	Signal	Note	Remark
1	Reserved (VCC)	+12V Power Supply	
2	Reserved (VCC)	+12V Power Supply	
3	Reserved (VCC)	+12V Power Supply	
4	Reserved (VCC)	+12V Power Supply	
5	Reserved	Non-connection (default : OPEN)	
6	OS	Over Shoot driving (Low : OFF, High or open : ON) (default : High)	Pull up (3.3[V])
7	Reserved	Non-connection (default : OPEN)	
8	Reserved	Non-connection (default : OPEN)	
9	GND		
10	CIN0-	Cport (-)LVDS CH0 differential data input	
11	CIN0+	Cport (+)LVDS CH0 differential data input	
12	CIN1-	Cport (-)LVDS CH1 differential data input	
13	CIN1+	Cport (+)LVDS CH1 differential data input	
14	CIN2-	Cport (-)LVDS CH2 differential data input	
15	CIN2+	Cport (+)LVDS CH2 differential data input	
16	GND		
17	CCK-	Cport LVDS Clock signal(-)	
18	CCK+	Cport LVDS Clock signal(+)	
19	GND		
20	CIN3-	Cport (-)LVDS CH3 differential data input	
21	CIN3+	Cport (+)LVDS CH3 differential data input	
22	CIN4-	Cport (-)LVDS CH4 differential data input	
23	CIN4+	Cport (+)LVDS CH4 differential data input	
24	GND		
25	GND		
26	DIN0-	Dport (-)LVDS CH0 differential data input	
27	DIN0+	Dport (+)LVDS CH0 differential data input	
28	DIN1-	Dport (-)LVDS CH1 differential data input	
29	DIN1+	Dport (+)LVDS CH1 differential data input	
30	DIN2-	Dport (-)LVDS CH2 differential data input	
31	DIN2+	Dport (+)LVDS CH2 differential data input	
32	GND		
33	DCK-	Dport LVDS Clock signal(-)	
34	DCK+	Dport LVDS Clock signal(+)	
35	GND		
36	DIN3-	Dport (-)LVDS CH3 differential data input	
37	DIN3+	Dport (+)LVDS CH3 differential data input	
38	DIN4-	Dport (-)LVDS CH4 differential data input	
39	DIN4+	Dport (+)LVDS CH4 differential data input	
40	GND		
41	GND		

[Note] GND of a liquid crystal panel drive part has connected with a module chassis.

[Note 1] Slave address “B4” is allocated for internal use for TCON board.

The equivalent circuit figure of the terminal



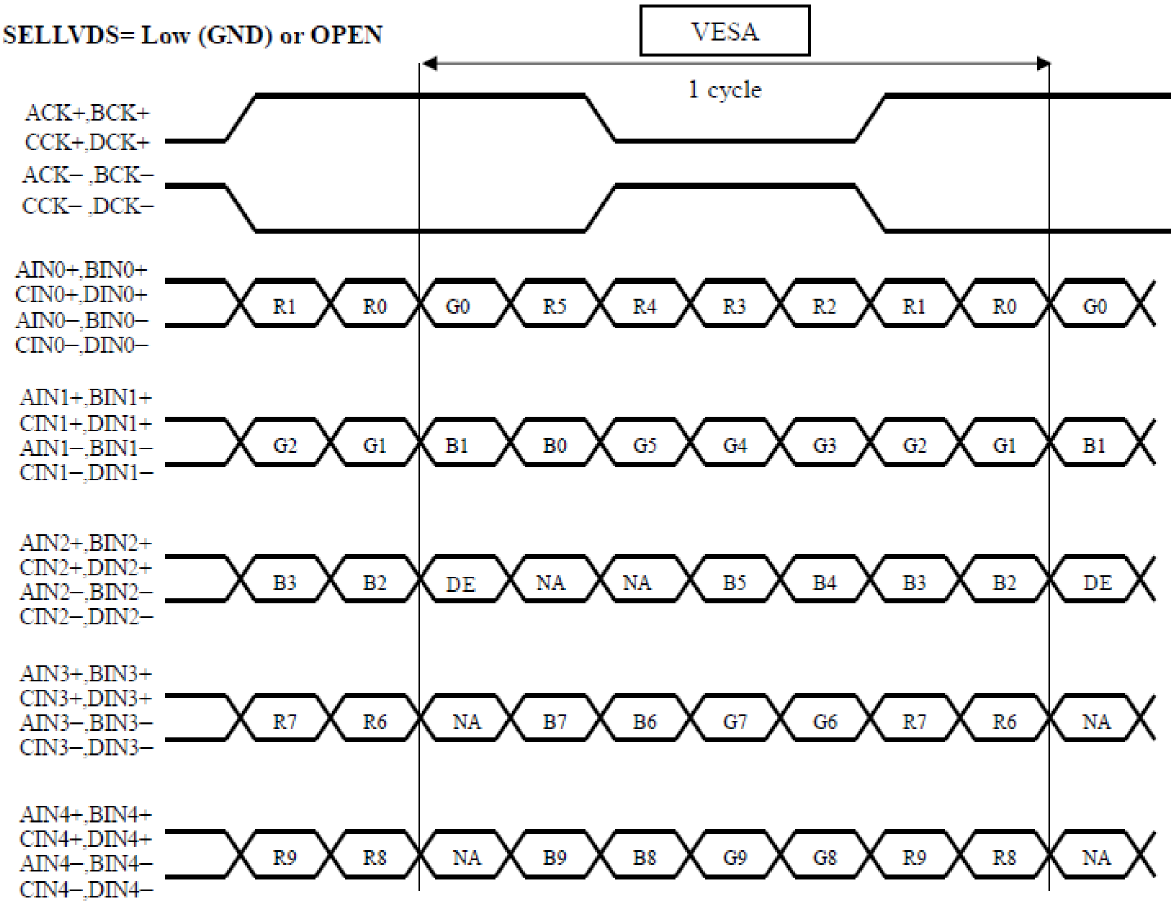
[Note 2] SELLVDS ORDER

SELLVDS		
DATA	L(GND) or Open [VESA，NS]	H(3.3V) [JEIDA]
TA0	R0(LSB)	R4
TA1	R1	R5
TA2	R2	R6
TA3	R3	R7
TA4	R4	R8
TA5	R5	R9(MSB)
TA6	G0(LSB)	G4
TB0	G1	G5
TB1	G2	G6
TB2	G3	G7
TB3	G4	G8
TB4	G5	G9(MSB)
TB5	B0(LSB)	B4
TB6	B1	B5
TC0	B2	B6
TC1	B3	B7
TC2	B4	B8
TC3	B5	B9(MSB)
TC4	N/A	N/A
TC5	N/A	N/A
TC6	DE(*)	DE(*)
TD0	R6	R2
TD1	R7	R3
TD2	G6	G2
TD3	G7	G3
TD4	B6	B2
TD5	B7	B3
TD6	N/A	N/A
TE0	R8	R0(LSB)
TE1	R9(MSB)	R1
TE2	G8	G0(LSB)
TE3	G9(MSB)	G1
TE4	B8	B0(LSB)
TE5	B9(MSB)	B1
TE6	N/A	N/A

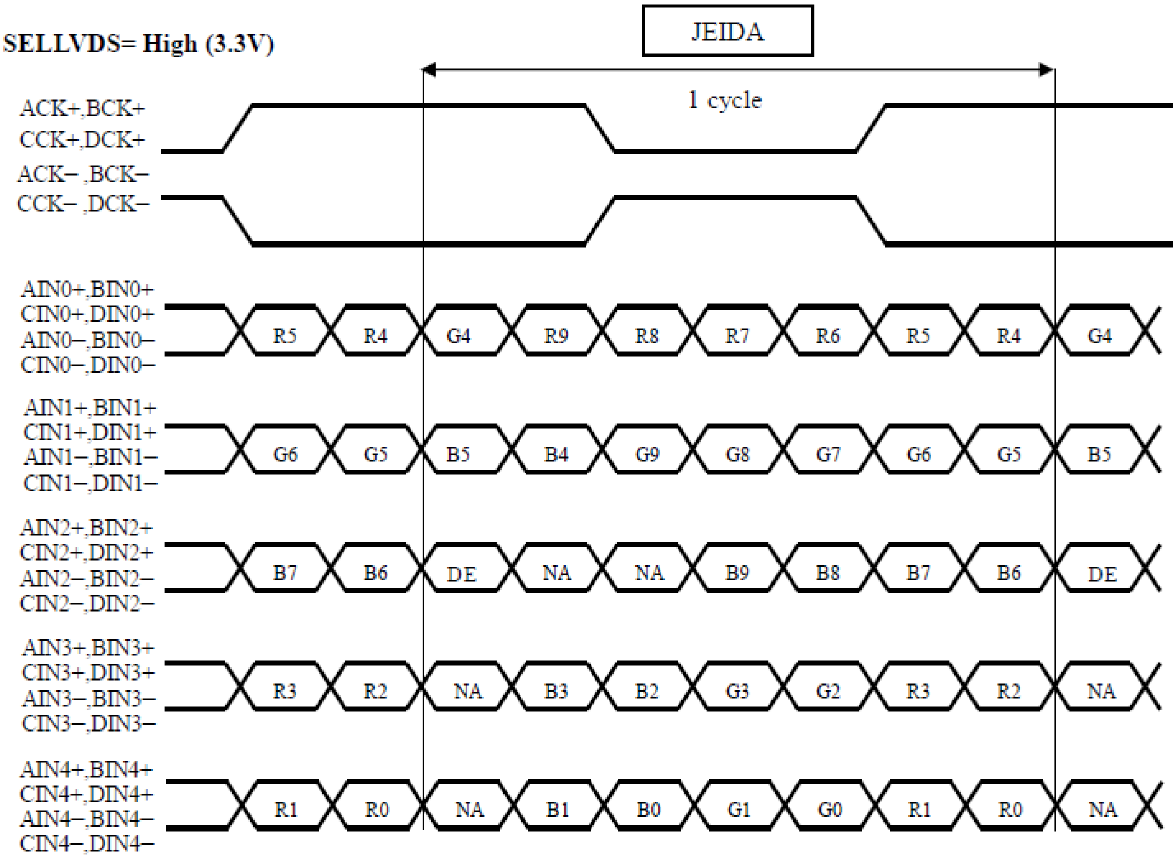
N/A: Not Available

(*)Since the display position is prescribed by the rise of DE(Display Enable)signal, please do not fix DE signal during operation at ”High”.

SELLVDS= Low (GND) or OPEN

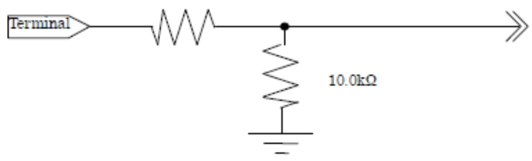


SELLVDS= High (3.3V)



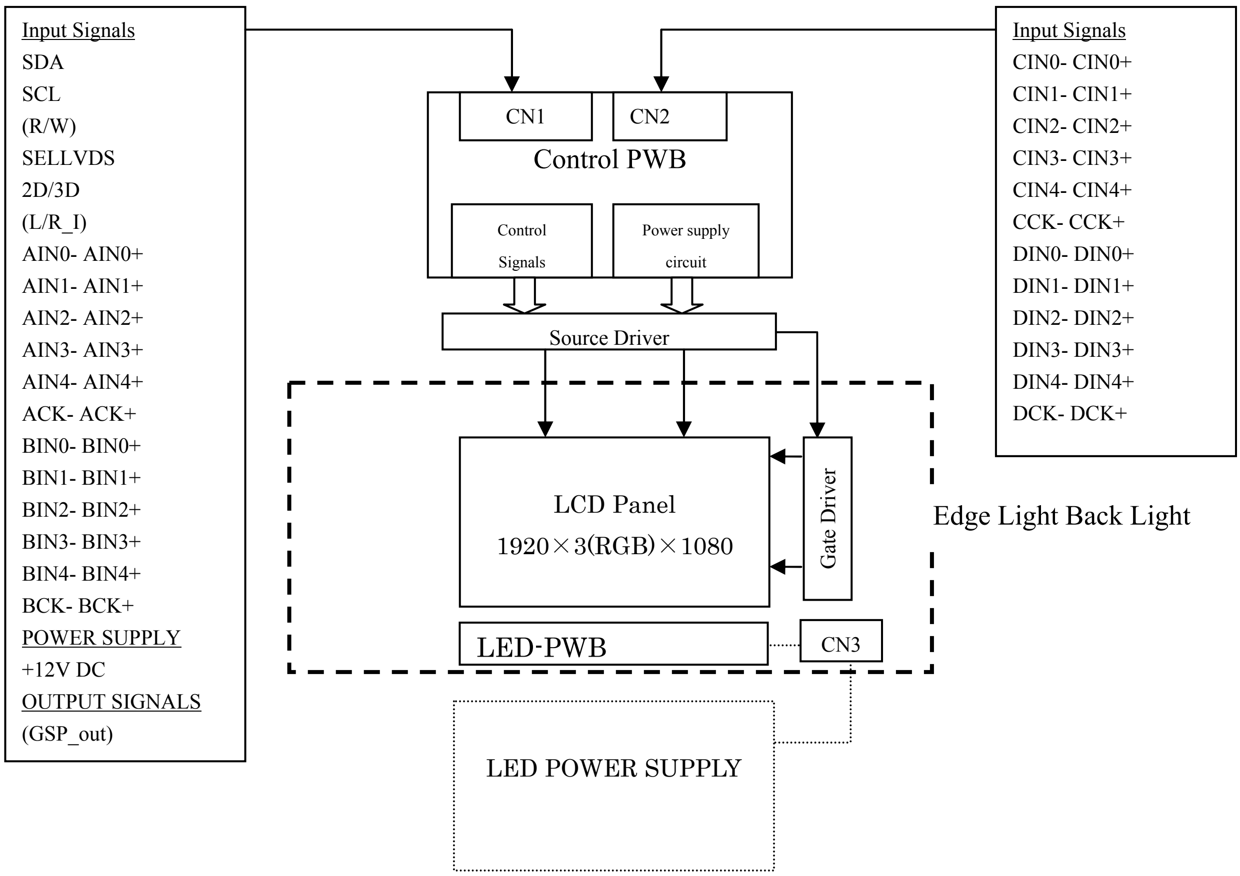
DE: Display Enable, N/A: Not Available (Fixed Low)

[Note 3] The equivalent circuit figure of the terminal



[Note 4] Optional output signal for goggle / backlight control.

4-2. Interface block diagram



4-3. Backlight driving

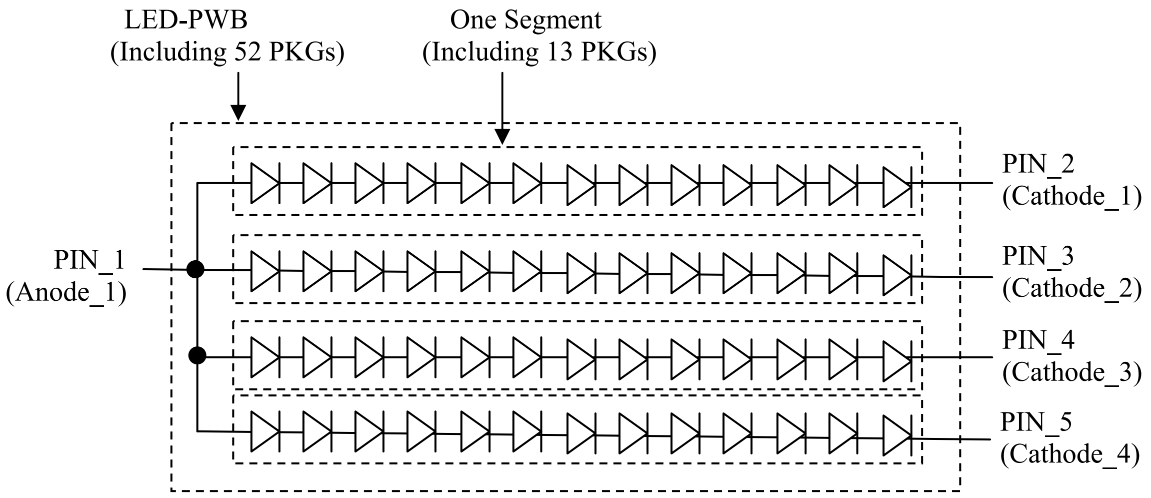
CN3 (DC power supply)

Using connector : CI1405M1HRL-NH (CviLux Corp.)

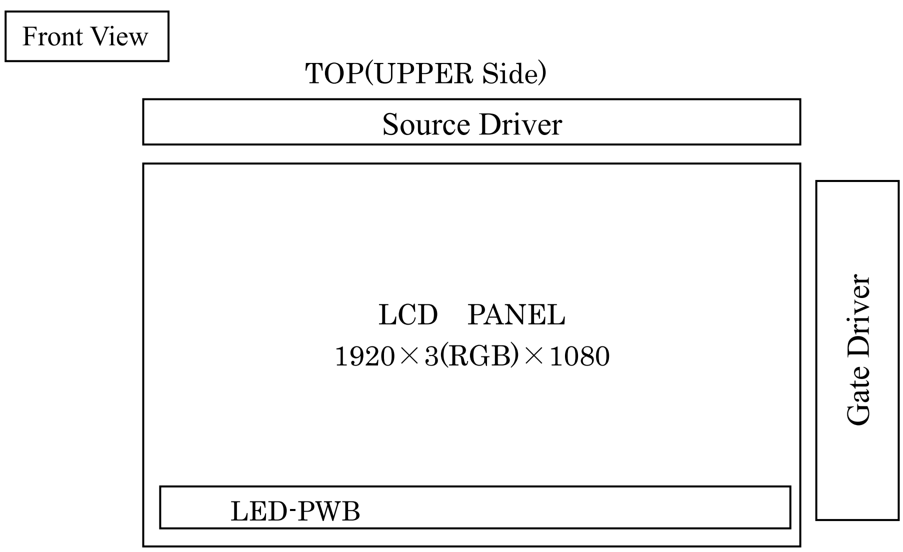
Mating connector : CI1405S(CviLux Corp.)

Pin No.	Symbol	Function	Remark
1	PIN_1	LED Anode 1 terminal	
2	PIN_2	LED Cathode 1 terminal	
3	PIN_3	LED Cathode 2 terminal	
4	PIN_4	LED Cathode 3 terminal	
5	PIN_5	LED Cathode 4 terminal	

Equivalent Circuit of LED PWB



Layout of LED-PWB



4.4 The back light system characteristics

The back light system is side-edge type with LED.

The characteristics of LCD are shown in the following table. The value mentioned below is at the case of one LED.

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Life time	T_{LED}	-	(30000)	-	Hour	

【Note】

LED life time is defined as the time when brightness becomes 50% of the original value in the continuous operation under the Ta=25℃.

5. Absolute Maximum Ratings

Parameter	Symbol	Condition	Ratings	Unit	Remark
Input Voltage (for Control PWB)	V1	Ta=25℃	-0.3～+3.6	V	【Note 1】
12V supply voltage (for Control PWB)	VCC	Ta=25℃	0～+14.0	V	
Reverse voltage for LED-PWB	V_{LED}	Ta=25℃	(T.B.D)	V	【Note 3】
Forward Current for LED-PWB	I_{LED}	Ta=25℃	(T.B.D)	mA	【Note 4】
Storage temperature	Tstg	-	(-25～+60)	℃	【Note 2】
Operational Temperature (Ambient)	Tsf		(0~+50)	℃	

[Note 1] SDA, SCL, R/W, SELLVDS, 2D/3D, L/R_I

[Note 2] Humidity 95%RH Max.(Ta≦40°C)

Maximum wet-bulb temperature at 39 °C or less. (Ta>40°C)

No condensation.

[Note 3] PIN2-5 (CN3)

[Note 4] (T.B.D)

6. Electrical Characteristics

6-1. Control circuit driving GND=0V

Parameter			Symbol	Min.	Typ.	Max.	Unit	Remark
+12V Supply Voltage	Supply Voltage		VCC	11.4	12.0	12.6	V	【Note1】
	Current dissipation		ICC1		(0.8)	(1.9)	A	120Hz【Note2】
			ICC2		(0.9)	(2.0)	A	240Hz【Note2】
Permissible input ripple voltage			VRP		-	100	mVp-p	VCC=+12V
Differential input threshold voltage		High	VTH			100	mV	V_{CM} = +1.2V
		Low	VTL	100			mV	
Input Low Voltage			VIL	0		0.8	V	【Note3】
Input High Voltage			VIH	2.0		3.3	V	
Terminal Register			RT		100		Ω	Differential Input

[Note]V_{CM}: Common mode voltage of LVDS driver.

[Note]About the relation between data input and back light lighting, please base on the above-mentioned input

[Note 1]

Input voltage sequences

50us < t1 ≦ 20ms

30ms < t2

30ms < t3

0 < t4

t5 ≧ 1s

t6 > 0

t7 ≧ 1s

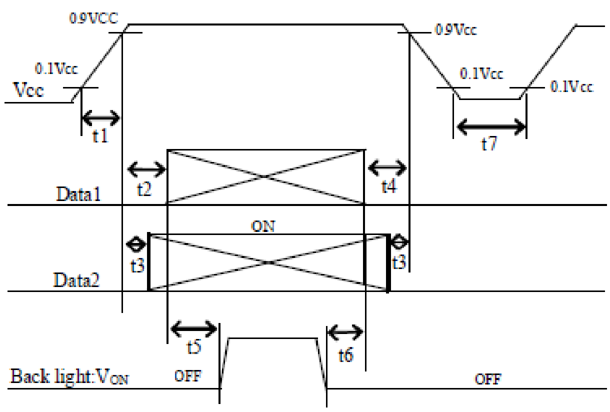
Dip conditions for supply voltage

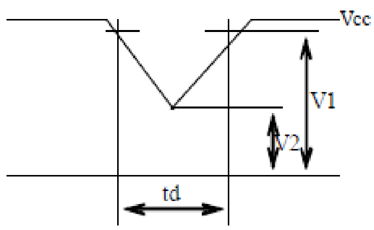
a) 9.1V ≦ Vcc < 10.8V

td ≦ 10ms

b) Vcc < 9.1V

Dip conditions for supply voltage is based on input voltage sequence.





V1:10.8V
V2:9.1V

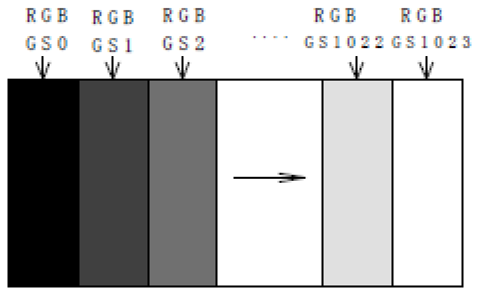
※ Data1: ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±, BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4±, CCK±, CIN0±, CIN1±, CIN2±, CIN3±, CIN4±, DCK±, DIN0±, DIN1±, DIN2±, DIN3±, DIN4±

*V_{CM} voltage pursues the sequence mentioned above

※ Data2: SDA, SCL, R/W, SELLVDS, 2D/3D, L/R_I

sequence. When back light is switched on before panel operation or after a panel operation stop, it may not display normally. But this phenomenon is not based on change of an incoming signal, and does not give damage to a liquid crystal display.

[Note 2] Typical current situation: 1024 gray-bar patterns. (Vcc = +12.0V)
The explanation of RGB gray scale is seen in section 8.



Vcc＝+12.0V
CK＝74.25MHz
Th＝7.41μs

【Note 3】 : SCL, SDA.

6-2. **LED driving for back light**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED Current	I_{LED}		(480)	(T.B.D)	mA	[Note 1]
LED Voltage	V_{LED}		(42.9)	(49.4)	V	[Note 2]

[Note1] PIN1-PIN5 (CN3)

LED current (I_{LED}) is the value of each bar

*Please decrease LED heat enough when the LED current is increased more than TYP value.

[Note2] Ta = 25℃, Measurement after 1h has passed since power supply was turned on.

*The products are sensitive to the static electricity and care shall be fully taken when handling the products. Particularly in case that an over-voltage which exceeds the Absolute Maximum Rating of the products shall be applied, the overflowed energy may cause damages to, or possibly result in destruction of the products. Please take absolutely secured countermeasures against static electricity and surge when handling the products.

7. Timing characteristics of input signalsTiming characteristics

Timing diagrams of input signal are shown in Fig.2.

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
Clock	Frequency	1/Tc	(T.B.D)	74.25	(T.B.D)	MHz	
Data enable signal	Horizontal period	TH	(T.B.D)	550	(T.B.D)	CLK	
			(T.B.D)	7.41	(T.B.D)	μ s	
	Horizontal period (High)	THd	480	480	480	CLK	
	Vertical period	TV	(T.B.D)	1125	(T.B.D)	Line	
			(T.B.D)	120	(T.B.D)	Hz	
	Vertical period (High)	TVd	1080	1080	1080	V	

[Note]-When vertical period is very long, flicker and etc. may occur.

-Please turn off the module after it shows the black screen.

-Please make sure that length of vertical period should become of an integral multiple of horizontal length of period. Otherwise, the screen may not display properly.

-As for your final setting of driving timing, we will conduct operation check test at our side, please inform your final setting.

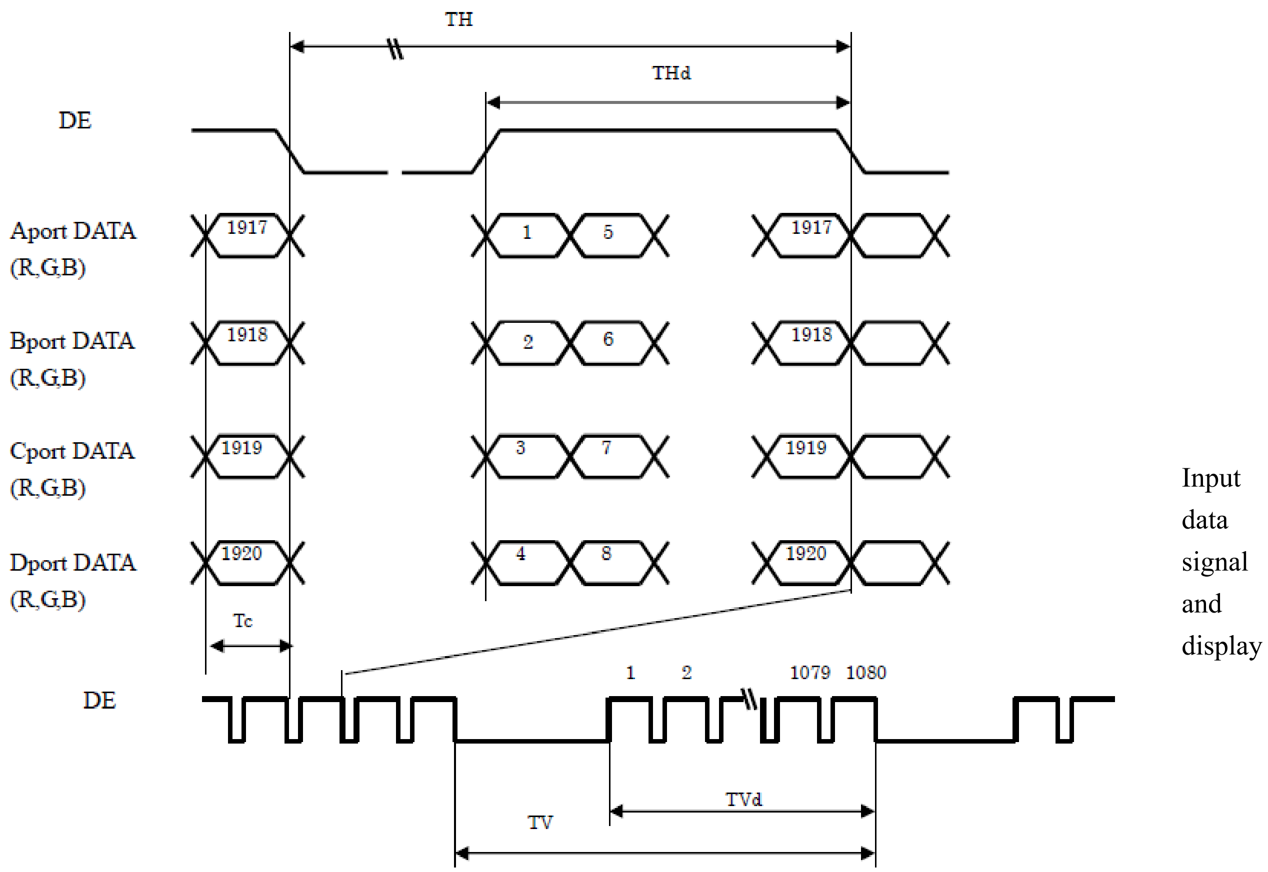
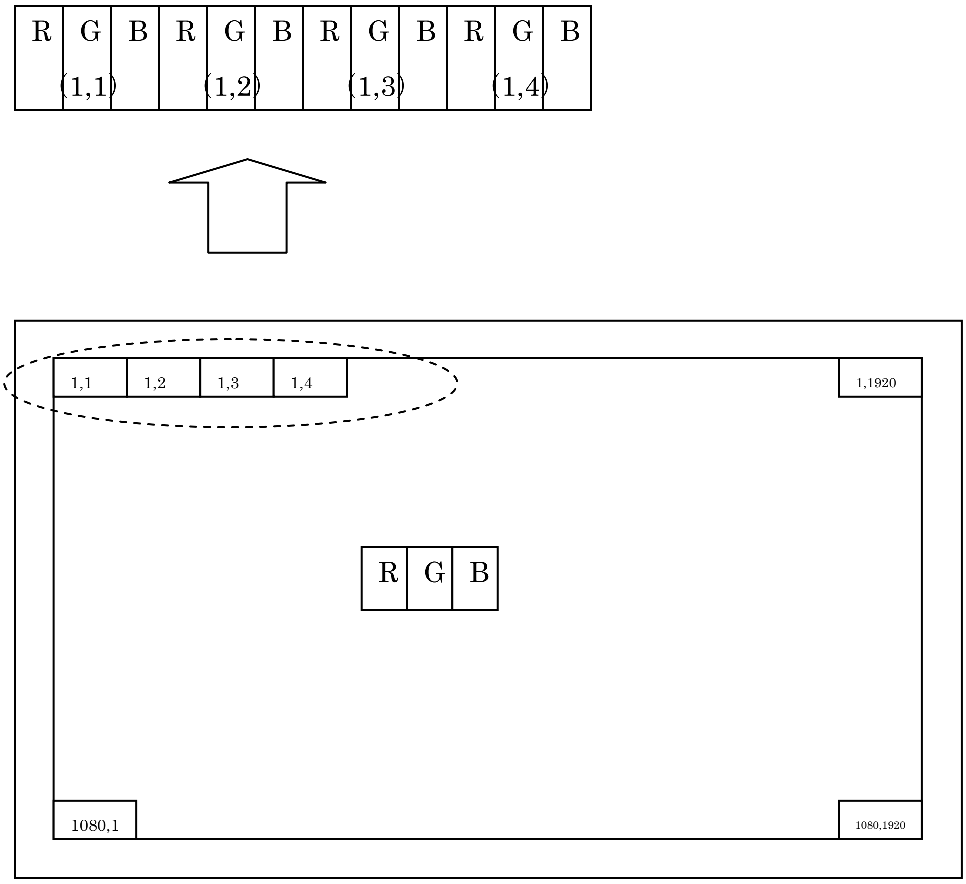


Fig.2 Timing characteristics of input signals

position on the screen



Display position of Dat (V,H)

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

	Colors & Gray scale	Gray Scale	R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9
			Data signal																													
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	0	0	0	0	0	0
	Blue	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Green	—	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Cyan	—	0	0	0	0	0	0	0	0	0	0	1	1	1	1	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	1	1	0	0	0	0	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	1	1	0	0	0	0	0	0	0	0	0	0	1	1	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	1	1	1	1	0	0	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	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	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓					↓										↓										↓					
	⇩	↓					↓										↓										↓					
	Brighter	1021	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇩	1022	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1023	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	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	0	0	0	0	0	0	0
	⇧	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓					↓										↓										↓					
	⇩	↓					↓										↓										↓					
	Brighter	1021	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	⇩	1022	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Green	1023	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Gray Scale of Blue	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	0	0	0	0	0	0	0
	⇧	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Darker	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	⇧	↓					↓										↓										↓					
	⇩	↓					↓										↓										↓					
	Brighter	1021	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1
	⇩	1022	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
	Blue	1023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

0 : Low level voltage,   1 : High level voltage.

Each basic color can be displayed in 1024 gray scales from 10 bits data signals. According to the combination of total 30 bits data signals, one billion-color display can be achieved on the screen.

9. Optical characteristics

The optical measurement at the time of driving on the following conditions is shown in the following table.

Ta=25℃

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	θ 21 θ 22	CR≧10	70	88	—	Deg	【Note1,2】
	Vertical	θ 11 θ 12		70	88	—	Deg	Fig8-1,8-3
Contrast ratio		CR		—	(5000)	—		【Note2】Fig8-2
Response Time (G to G)		τdrv	θ =0°	—	(4)	—	ms	【Note3,4,5】 Fig8-1,8-2 Fig.8-5
Chromaticity of white		x		(0.263)	(0.313)	(0.363)	—	ILED=TBD mA The value of each bar. 【Note4】 Fig8-1,8-2
		y		(0.279)	(0.329)	(0.379)	—	
Chromaticity of red		x		(NTSC 72%, typ.)				
		y						
Chromaticity of green		x						
		y						
Chromaticity of blue		x						
		y						
Luminance uniformity		δ w		—	—	(1.43)	—	【Note6】Fig8-2
Luminance					(400)		cd/m²	【Note4】Fig8-2

*The measurement shall be executed 30 minutes after lighting at rating.

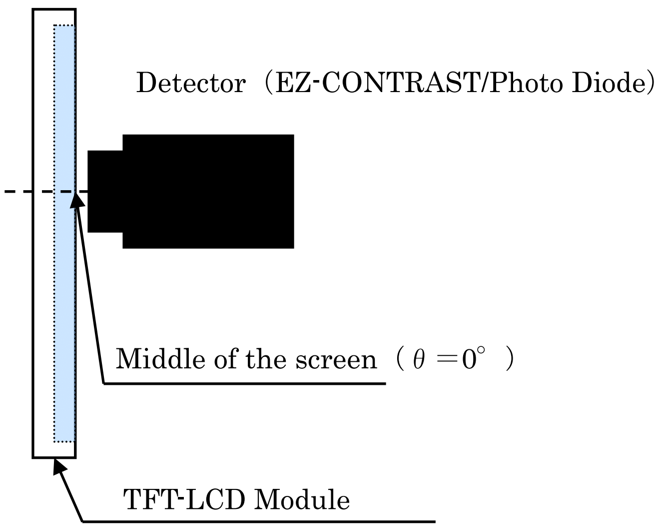


Fig.8-1 Measurement of viewing angle range and Response time.
Viewing angle range:EZ-CONTRAST
/Response time: Photo diode)

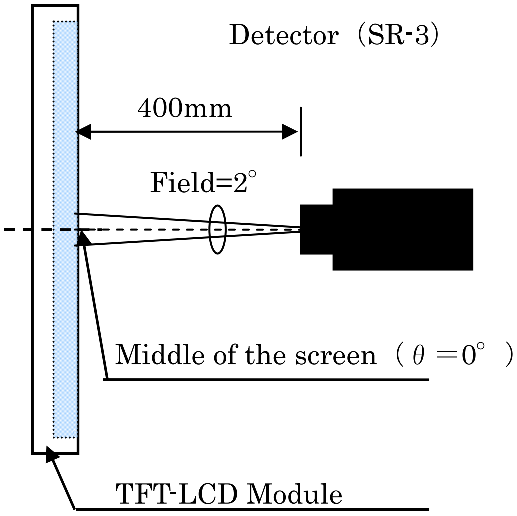


Fig.8-2 Measurement of luminance and chromaticity and Contrast.

【Note 1】Definitions of viewing angle range

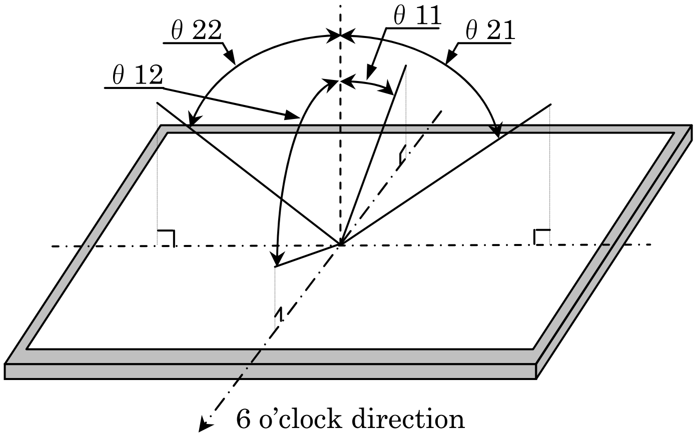


Fig. 8-3 Definitions of viewing angle range

【Note 2】Definition of contrast ratio :

The contrast ratio is defined as the following.

Contrast Ratio (CR) = Luminance(brightness) with all pixels white / Luminance(brightness) with all pixels black

【Note 3】Definition of response time

The response time of (τd and τr) is defined as the following figure.8-4 and shall be measured by switching the input signal for "any level of gray (0, 64, 128, 192, 255)" and "any level of (0, 64, 128, 192, 255)".

	0	64	128	192	255
0		τr0-64	τr0-128	τr0-192	τr0-255
64	τd64-0		τr64-128	τr64-192	τr64-255
128	τd128-0	τd128-64		τr128-192	τr128-255
192	τd192-0	τd192-64	τd192-128		τr192-255
255	τd255-0	τd255-64	τd255-128	τd255-192	

t*:x-y...response time from level of gray(x) to level of gray(y)

$\tau r = \Sigma(tr{:}x\text{-}y)/10$ $\tau d = \Sigma(td{:}x\text{-}y)/10$ $\tau drv = (\tau r + \tau d)/2$

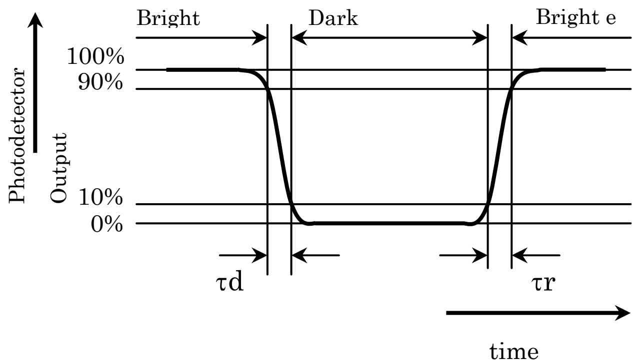


Fig. 8-4 Definitions of response time

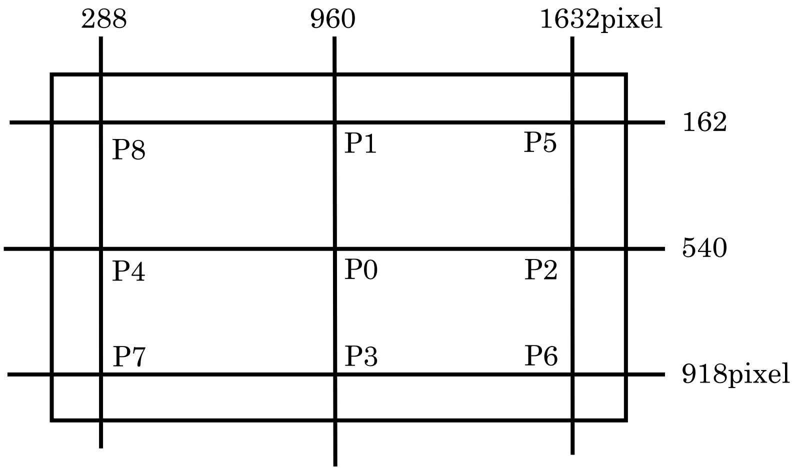
【Note 4】This shall be measured at center of the screen.

【Note 5】This value is valid when O/S driving is used at typical input time value.

【Note 6】Definition of Luminance uniformity ;

Luminance uniformity is defined as the following with nine measurements.(P0～P8)

$$\delta_w = \frac{\text{maximum Luminance of nine points(brightness)}}{\text{minimum Luminace of nine points(brightness)}}$$



10. Handling Precautions of the module

a) Be sure to turn off the power supply when inserting or disconnecting the cable.

b) Voltage difference generated by this switching, ΔV_{LED}, may affect a sound output, etc. when the power supply is shared between the LED PWB and its surrounding circuit. So, separate the power supply of the LED PWB with the one of its surrounding circuit.

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

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

e) Since long contact with water may cause discoloration or spots, wipe off water drop immediately.

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

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

h) Since CMOS LSI is used in this module, take care of static electricity and take the human earth into consideration when handling.

i) The module has some printed circuit boards (PCBs) on the back side, take care to keep them from any stress or pressure when handling or installing the module; otherwise some of electronic parts on the PCBs may be damaged.

j) Observe all other precautionary requirements in handling components.

k) When some pressure is added onto the module from rear side constantly, it causes display non-uniformity issue, functional defect, etc... So, please avoid such design.

l) When giving a touch to the panel at power on supply, it may cause some kinds of degradation. In that case, once turn off the power supply, and turn on after several seconds again, and that is disappear.

m) 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.

n) This LCD module is designed to prevent dust from entering into it. However, there would be a possibility to have a bad effect on display performance in case of having dust inside of LCD module. Therefore, please ensure to design your product to keep dust away around LCD module.

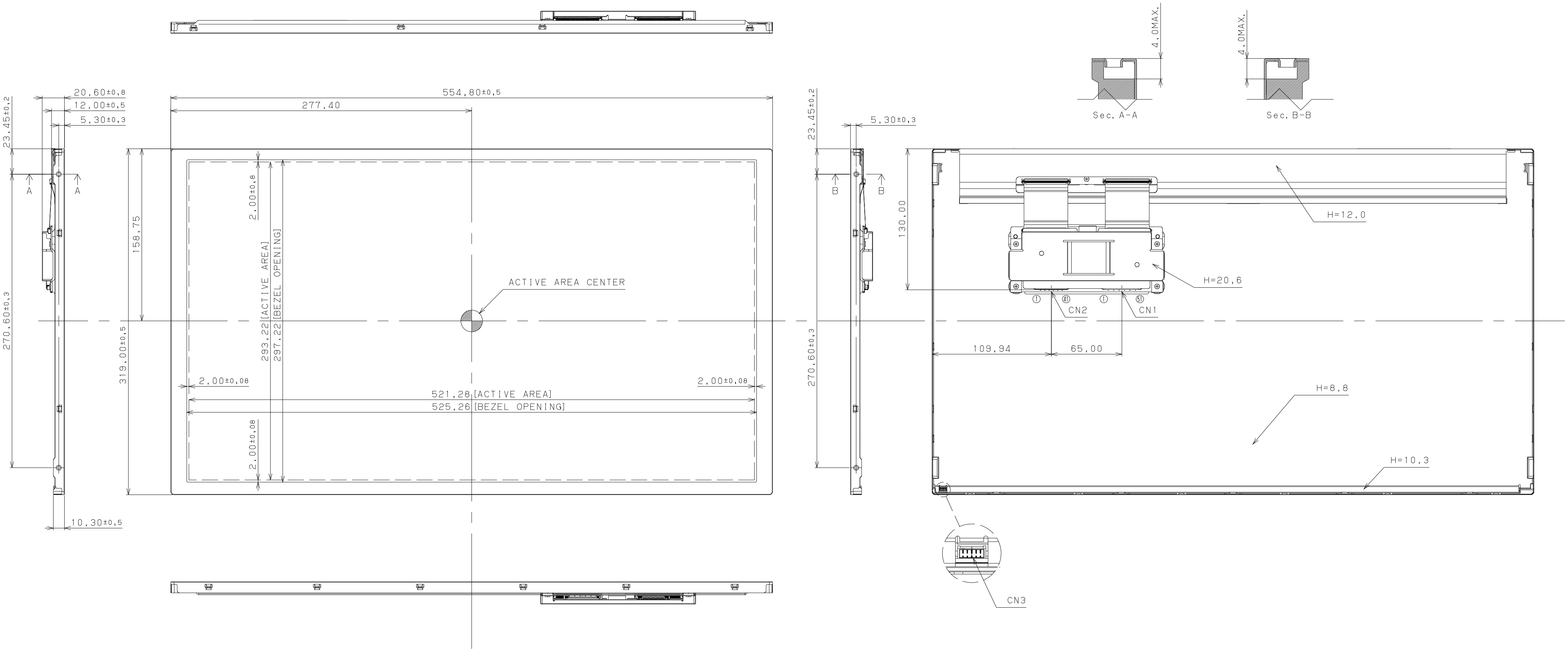
o) Make sure that the LCD module is operated within specified temperature and humidity.
Measures against dust, water, vibration, and heat dissipation structure, etc. are required at the cabinet or equipment side.
Avoid combination of background and image with large different luminance.
Please consider the design and operating environment.

p) Ultra-violet ray filter is necessary in outdoor environment.

q) Operation for 24 hours a day is NOT recommended.

r) When the module is turned on, you might hear cracking noises coming from the module until it warms up. Similarly, this phenomenon might occur when the module is turned off until it cools down.
This phenomenon occurs by a large amount of heat generation due to a big module.
Therefore, it is not a defect.

s) Image retention may occur if same fixed pattern is displayed for a long time.
In some cases, it may not disappear. It is recommended to use moving picture periodically.
After long-term static display, periodical power-off or screen saver is needed. For screen saver, moving picture or black pattern is strongly recommended.



<NOTES>
1. UNSPECIFIED TOLERANCE TO BE ±0.6

Fig.3 OUTLINE DIMENSIONS (LQ235D1LW03)